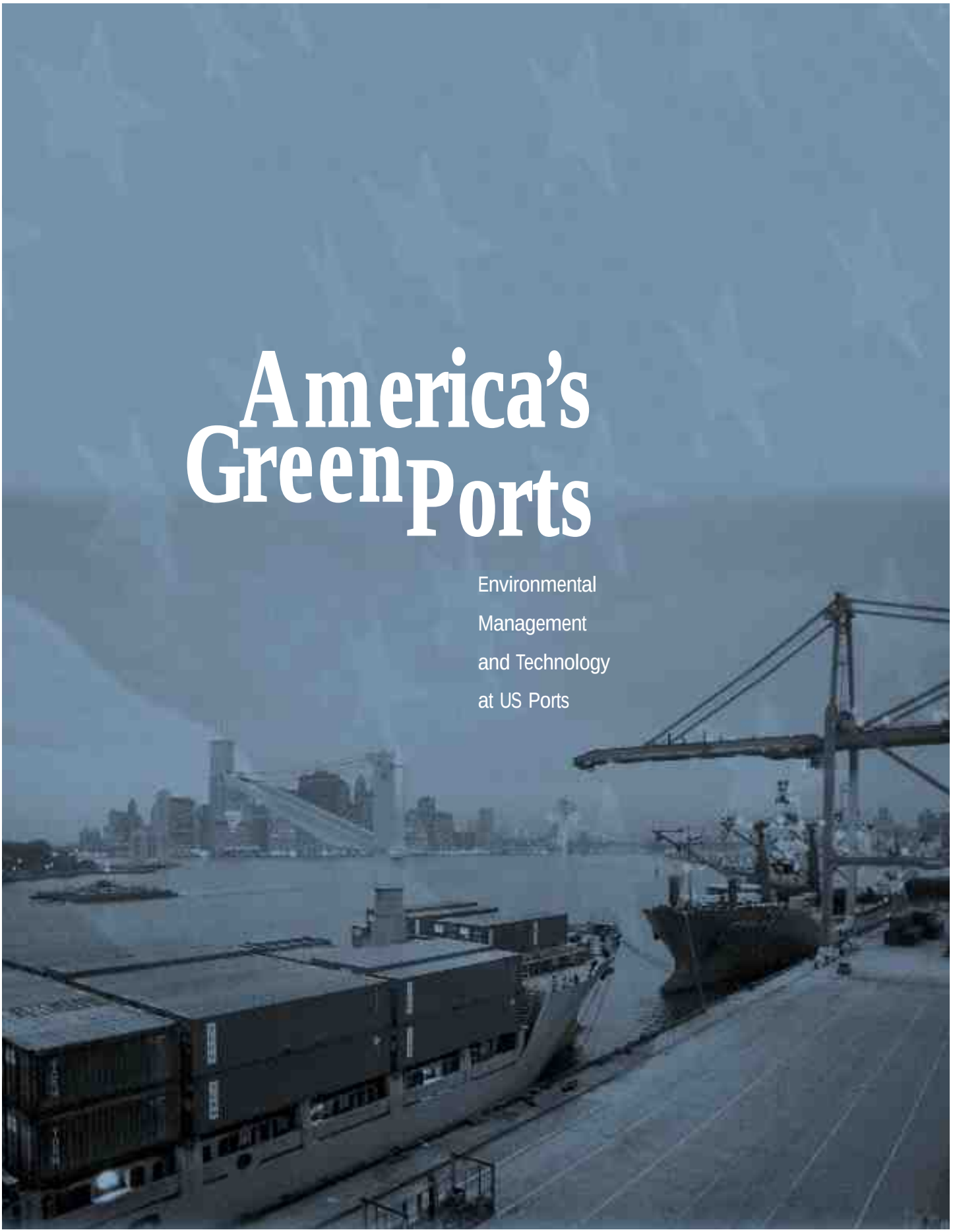

America's Green Ports

Environmental Management and Technology at US Ports

PHOTO

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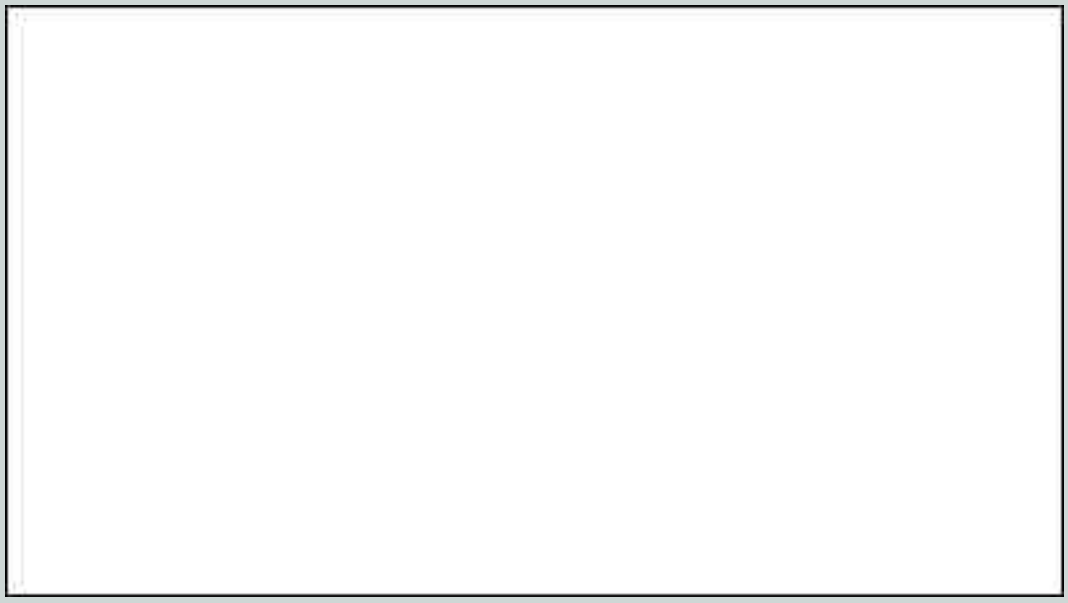

America's Green Ports

Environmental Management and Technology at US Ports

Urban Harbors Institute
University of Massachusetts Boston
March 2000

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ACKNOWLEDGMENTS

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INTRODUCTION

Historically, ports occupied the center of the nation's economic and urban life. Our regional and national economies were based on the trade and commerce carried out in and around the country's coastal and riverine ports. Over time, changes in national and global economies, technological advances, and greater awareness of the environment have greatly altered the nature of port activities and their relationship to the host community and region.

In the past, port development and operations often resulted in considerable alteration of and damage to the natural environment. Today, largely in response to the national mandate for environmental protection, ports are more conscious of and responsive to the need to minimize impacts on natural resources and the surrounding communities. In fact, the need to address environmental concerns is a top priority for US ports according to a recent poll of the membership of the Association of American Port Authorities.

The ports' locations at the interface of land and water—the fundamental characteristic of ports—is a heavily regulated environment due to the sensitivity of intertidal and marine resources, habitat value, and exposure to natural hazards. Port development and expansion often require significant alteration of the environment through dredging and filling and on-going port operations have the potential to impact the quality of air, soil, and water resources. The common challenge faced by all ports is the need to conduct all aspects of their operations in an environmentally sound yet economically productive and competitive manner.

Ports are facing-up to their responsibility to protect and clean up the environment. They are doing this for economic and ecological reasons, aesthetics and safety, and to improve integration and compatibility with the surrounding community. In some cases these acitivities are undertaken in response to environmental regulations but, increasingly, ports are initiating projects and programs voluntarily. Many port authorities and facility owners have begun taking aggressive steps to remediate contaminated areas and prevent future incidences of pollution by employing environmentally sound technologies and best management practices that allow for continued economic development of the port while minimizing the negative impacts to the environment and surrounding communities.

America's Green Ports: Environmental Management and Technology at US Ports is a compendium of case studies presenting a selection of innovative and cost-effective management practices and technologies employed by US ports to avoid, prevent, minimize, mitigate or remediate environmental impacts associated with port development and operations. This compendium of projects is one product of the US EPA, Office of Water's Green Ports Program. It follows the 1998 publication of the Environmental Management Handbook prepared by the American Association of Port Authorities, also funded by the US EPA's Office of Water. That report provides practical information on incorporating environmental stewardship into all aspects of port operations and development. The case studies presented here provide an illustration of the variety of approaches that actually have been utilized with proven results in US ports.

METHODOLOGY

The case studies included in this report were selected from projects identified through contacts with over 120 sea, river and inland ports in the US and a comprehensive review of the literature and trade publications related to commercial ports and their operations. Our focus was on projects that have been implemented by port authorities and port operators. This research and outreach process yielded an initial list of 87 candidate projects which were evaluated using a set of criteria designed to select projects that cumulatively would best illustrate a range of desired characteristics. These included: (1) degree of innovation of technology or operational procedure, (2) effectiveness and measurable results, (3) wide applicability and transferability, (4) respon-

siveness to US EPA or other government initiatives, (5) initiatives exceeding regulatory requirements, (6) degree of complexity, (7) importance or ubiquitousness of problem, (8) size of the port and its institutional capacity, (9) significance and breadth of benefits, (10) acknowledgement by others of project benefits, and (11) regulatory approvability.

Ultimately, the final selection was also influenced by the individual port's responsiveness in providing the necessary information. It is important to note also that we did not include projects developed or initiatives undertaken solely by a government agency, such as the US Army Corps of Engineers, or by an equipment manufacturer, though there exist many worthy innovations from these sources. Our interest was in highlighting the activities being undertaken at and by those operating and managing the commercial ports of the US.

The case studies in this report are organized by environmental issue/problem. During the final stages of the evaluation process it was determined that the selected projects could be catalogued under one of the number of environmental issues which accurately reflects the environmental concerns currently facing ports. These are: air quality, brownfields, community relations and environmental stewardship, dredged material disposal and contaminated sediments, endangered and threatened species, habitat restoration, land-based water pollution, oil pollution, and ship and port generated solid waste.

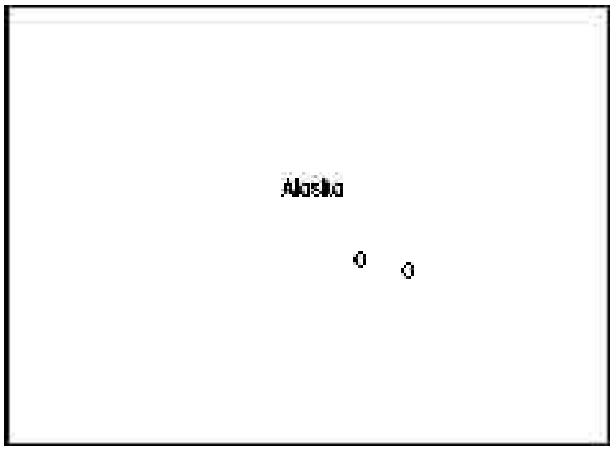
One issue, nonindigenous aquatic species, is quickly attracting the attention of government, shipping interests, and environmentalists. Nonindineous aquatic species (also called exotic or invasive species) are introduced into US port environments primarily through ballast water transported during overseas shipping. These species subsequently can be spread locally through coastal shipping, transfering these organisms from an infected area to an uninfected area. In response to the damage caused by the zebra mussel in the Great Lakes, in 1990 Congress enacted the Non- Indigenous Aquatic Nuisance Prevention and Control Act, which requires open ocean ballast water exchange for all ships entering into the Great Lakes system. In addition, in 1997, an executive order was drafted, requiring federal agencies to review exisiting authorities and activities to reduce the risk of nonindigenous species. The primary option to open ocean ballast water exchange is to treat the ballast water prior to discharge at port. Treatment options include filtration, ultraviolet radiation, and chlorine gas. Treatment facilities can be either landside, shipboard, or mobile facilities capable of traveling to more than one port. The problem with treatment facilities is the high costs.

Each section of the report begins with a brief description of the issue as it relates to port development and operations to provide a context for the project descriptions. The issue description is followed in most instances by a summary of the human and environmental impacts associated with the issue and a brief overview of the relevant legal and regulatory programs. The introductory section concludes with a discussion of the traditional management options for addressing the issue.

The final section of the report is a description of each of the ports for which a case study is presented. A knowledge of the port, its location, size, facilities, types of cargo handled, and its institutional capacity and resources are presented to aid the reader in understanding and evaluating a specific project and its potential transferability.

The *Green Ports* report is a testament that significant advances in environmental management are taking place in US ports. The challenge for the nation's ports is to find the most cost-effective and appropriate strategies for dealing with the environmental impacts of its operations. The material in this report is intended to provide and assist in the exchange of information on successful experiences at US ports. Contact information is provided for each port whose project(s) is featured.

MAP OF
Green Port Project Sites



AIR Quality

Issue/Problem

It is estimated that millions of tons of pollutants are emitted into the air we breathe each year (US EPA 1998). Polluting emissions may be accidental single-source events or they may be more routine. They may emanate from man-made sources such as industries and vehicles or be released from natural sources. Regardless of the source or duration of emission, it is certain that air pollutants have profound negative effects on human health and the environment.

In 1996, at least 12 million marine engines were operated in the United States (US EPA 1996). Emissions from motor vehicles and vessels account for 80 percent of air pollution and are in many regions among the highest contributors of hydrocarbons and nitrogen oxides to the atmosphere. Other major types and sources of air pollutants produced in a port environment include (US EPA 1998):

- xylene, toluene, and methylene bromide released during painting and cleaning at ship building and ship repair facilities;
- benzene, toluene, xylene and other toxic pollutants found in vapors released from fuel distribution facilities;
- benzene, toluene, xylene, and chromium released from petroleum refining industries;
- benzene, toluene, xylene, hexane, and ethyl benzene released during loading and unloading of marine tank vessels;
- sulfur dioxide emitted from power plants; and
- hydrocarbon-based diesel soot from marine engines.

Health and Environmental Impacts

Adverse health effects of prolonged and/or high exposure to air pollutants include headaches, dizziness, respiratory distress and disease, lung damage, cardiovascular disease, endocrine disruption, visual impairment, diminished manual dexterity, learning impairment, seizures, and death. Particulate matter that is 10 microns or less in diameter—referred to as PM10—is considered one of the most unhealthful components of air pollution because it cannot be filtered by the human respiratory system's natural defenses. Air pollutants also degrade the environment by depleting upper-atmosphere ozone, damaging vital agricultural resources, and producing acid rain, which in turn changes soil chemistry, and endangers forest and plant communities.

Applicable Federal Environmental Regulations

To control emissions from stationary and mobile sources of air pollution and to protect air quality, Congress passed the Federal Clean Air Act in 1970, with amendments in 1990. The Environmental Protection Agency administers the Act. The Clean Air Act currently lists six "Criteria Air Pollutants" (CAPs) as indicators of outdoor air quality. These are ozone, one-hour ozone, carbon monoxide, nitrogen oxides, sulfur dioxides, and particulate matter. To protect human health and the natural environment, primary and secondary maximum concentration thresholds were established for each CAP, referred to as the National Ambient Air Quality Standards (NAAQS), which are published in the Federal Register.

In addition to CAPs, the Clean Air Act identifies 188 chemicals that it classifies as "Hazardous Air Pollutants" (HAPs), also commonly referred to as air toxics or toxic air pollutants. HAPs are legally distinguished from CAPs in the Clean Air Act and include the most harmful air pollutants known or suspected to cause adverse environmental effects, cancer, birth defects, and death. Examples of HAPs include benzene, toluene and xylene (the light aromatics found in crude oil and its by-products); methylene chloride (used in solvents and paint strippers) and methylene bromide (used as a biocide); asbestos; cadmium; and mercury.

Asbestos, beryllium, mercury, vinyl chloride, radionuclides, arsenic, and benzene are regulated through the National Emissions Standards for Hazardous Air Pollutants Program (NESHAP), which establishes concentration thresholds not to be exceeded. However, due to technical difficulties in establishing NESHAPs for other air pollutants, the remaining 181 HAPs are regulated by Maximum Allowable Emission Threshold (MACT) Standards, which are based on the best available technology for reducing emissions or on the best performing facilities. Both NESHAP and MACT

standards are intended to limit pollution discharges sufficiently to achieve NAAQS.

To effectively tackle the air pollution problem, US EPA has identified Air Quality Control Regions (AQCR)—where air quality appears to be a significant environmental concern. State governments are responsible for ensuring that the air quality requirements in AQCRs are met through an US EPA-approved State Implementation Plan. These plans can go so far as to propose stricter standards than the federal law dictates, but cannot be less strict.

Class I, II, and III AQCRs have been designated throughout the US. The maximum allowable pollution thresholds increase incrementally as class number increases. Class I areas, for example, are the most restrictive and reflect the most pristine areas, while Class III designation is reserved for areas that must necessarily accommodate a large amount of human industrial activity and hence more pollution. Ports provide a good example of a typical Class III AQCR. It is important to note that most class designation thresholds are lower than NAAQS to prevent the degradation of all regions of the country down to the NAAQS, which—it should be emphasized—present only minimum air quality standards. An area where pollution thresholds are exceeded is called a "nonattainment" area.

As a final note, US EPA has an "offset" policy for new, large-scale, stationary sources of pollution. This policy enables polluters to trade any increase in pollution generated by a new facility in a region with reductions in emissions from either existing facilities that they own with past reductions in pollution, or with reductions from other sources. Particular aspects of an offset policy are outlined in each State Implementation Plan (SIP).

Management Options

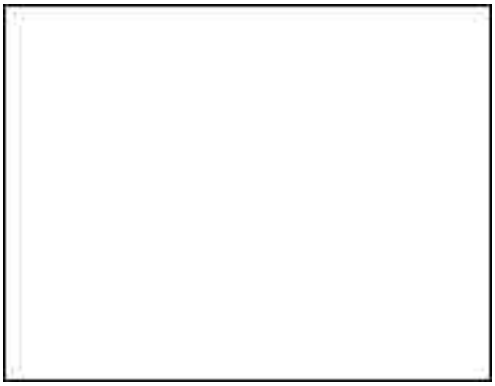
There are several technological approaches to reducing air polluting emissions: (1) use of non-polluting fuels (e.g., electricity, natural gas, photovoltaics); (2) control of emissions through filtration, chemical reaction, and reuse; (3) scrubbing after combustion, and (4) source reduction and energy conservation. Legislation, economic incentives, government-sponsored programs, (e.g., US EPA's Energy Star Program), and local planning initiatives also play an important role in controlling or eliminating emissions and reducing air pollution.

Emissions Reduction: Retrofitted Tug Boat Engines, Port of Los Angeles, California

Low-emission engines installed in tug boats are a success.

Emissions from diesel engines have come under increased scrutiny due to concerns about ozone forming pollutants, particulate matter and air toxins. While the use of alternatively fueled engines such as electric and natural gas have been demonstrated as viable options for land-based vehicles, their adoption in marine vessels has been slow due to a lack of experience and air quality data. This pilot program was undertaken in an effort to reduce emissions from existing marine vessel engines and to demonstrate how the overall environmental impact of vessels can be reduced.

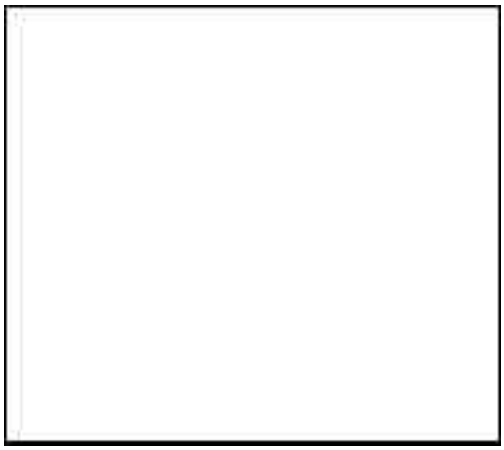
Two tug-boats were retrofitted by the Port of Los Angeles to incorporate state-of-the-art environmental equipment and design. These boats included features that reduce air emissions, reduce waste



Tugboat modified by the Port of Los Angeles

products generated during painting, and eliminate the discharge of waste and oil. Alternative energy sources were not considered because of concerns with reliability and safety at sea.

Modifications to the engines included (1) changing the injection timing sequence so as to enable



Retrofited engine inside tugboats.

injection of diesel fuel at lower peak combustion temperatures, and (2) supplying the lowest temperature water by the jacket water-sea water keel cooler to charge the air cooler. With earlier injection, combustion temperature is lower and the adiabatic temperature increase is less. In addition, passing the engine water through the ocean bathes the cylinders in a cooler solution and reduces the air temperature prior to compression, which further decreases the combustion temperature. Keeping the combustion temperature as low as possible optimizes engine efficiency, reducing nitrous oxide, overall emissions, and fuel consumption. The boats now achieve a 25 percent reduction in air emissions. The use of new electronically controlled diesel engines is expected to result in longer time between overhauls, reduced maintenance, better engine performance, and decreased fuel consumption because of increased combustion efficiency and decreased mechanical wear. It was determined that this new design could be retrofitted easily into all pilot boats to ensure that the air emission standards are met.

In addition to engine retrofitting, several modifications to the body of the boat were made. The hull of the boat was coated with a Teflon-based material that is easily cleaned, contains no toxic chemicals, and eliminates the need for periodic repainting. The deckhouse was constructed of aluminum, which also eliminated the need for paint. A holding tank for waste was installed to prevent any accidental or intentional discharge of waste from the boat, and a segregated bilge system with a holding tank was installed to collect engine waste oils. All of these features are cost effective and environmentally sound measures, particularly due to the reduced painting and maintenance requirements.

Voluntary Air Quality Study: Swan Island Air Quality Project, Port of Portland, Or egon

Task force measurably reduces air pollution emanating from Port.

Swan Island Industrial Park is a 580-acre inner-city “island” on the Willamette River. It is a major corporate center for approximately 170 distribution, warehousing, and manufacturing businesses. In 1995, four district neighborhood associations representing communities situated east and uphill of Swan Island expressed concern to the Port of Portland, the Oregon Department of Environmental Quality, and Freight-Liner Truck Manufacturing, a local industry, about air pollution and particulate emissions visible in their neighborhoods. In response, the Port organized a community effort to address pollution emanating from industrial activities on Swan Island. Since the neighborhood associations in Portland are very politically active, it was not difficult for the Port to bring the stakeholders together.

Given the nature of the activities on Swan Island, most of the pollutants were presumed to be toxic, but there was no information on how much or what kind of air toxins were present. The stakeholders agreed that an evaluation of air emissions was required. A task force comprised of Port officials and representatives and experts from the affected neighborhoods convened to determine the best course of action for such a study. The group agreed that pollution was a problem and that emissions from Swan Island had to be reduced regardless of whether the study revealed pollutant concentrations lower than State or Federal toxic emission requirements. They also agreed that they wanted to collect real facts—facts that they could use to effect change and not just anecdotal information. The neighborhood associations played a central role in all aspects of the air quality evaluation proj-

ect, from designing the scope and approach, to selecting a contractor, to reviewing the data and making recommendations for improvements.

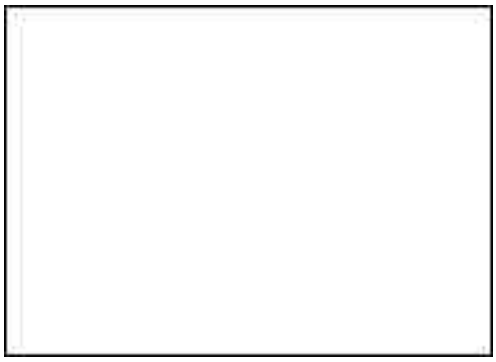
Toxic contaminants volatized during ship painting and particulates emitted during paint stripping were identified as the most problematic pollutants discharged from Swan Island. The air quality study also indicated that through the years, toxic air pollution from these sources had been decreasing. The decline in toxic emissions over time was attributed mostly to modifications in American-made anti-fouling paints, which no longer contain hexavalent chrome and other heavy metals considered highly toxic. The fact that toxins were still present despite the discontinued use of heavy metal paints was attributed to the use of non American-made paints by foreign flag ships while they were in port. Other sources of pollution included general ship repair operations such as sand-blasting, cutting, and welding—all activities that emit particulates.

The conclusions of this study resulted in a number of modifications to operations on Swan Island. First, the Port contracted with foreign vessels calling on the Port to prohibit the application of non-American-made anti-fouling paints that contain heavy metals. While Port officials were initially concerned they might lose business as a result of this provision, this was found not to be the case. In fact, other ports around the country are now adopting a similar requirement. Second, cruise ships that apply high quantities of hexavalent chrome paints are discouraged from calling on the Port. Third, sand-blasting, welding, and other equipment that propel particles have been retrofitted with covers, guards, and shields to prevent particulates from becoming airborne. Fourth, shifting naval vessel maintenance operations from one side of the shipyard to the other reduced particulate fallout on the affected neighborhoods. The Port is better equipped to arrange for cleanup of these toxic particles, while pre-existing Office of Safety and Health Administration (OSHA) safety measures protect Port workers from inhalation. Finally, to ensure the neighborhood associations that these protective measures will not disappear as facility ownership on Swan Island changes over time, the Port has voluntarily tightened its own Federal emission permit.

Since the air quality study was completed in 1997 and the above modifications have been in effect, the Port has produced annual reports based on routine sampling throughout the affected neighborhoods. The results of these reports indicate an overall reduction in visible air pollution and particulates. In addition, a Port-commissioned health risk assessment by experts from Harvard Medical School confirmed that the concentration of pollutants measured in the neighborhoods did not merit concern or further intervention.

The Port of Portland reports significant economic benefits from this project, namely in the form of avoided costs. The Portland area has a very active and organized environmental community. Had these air quality concerns not been addressed in an appropriate and concerted manner, it is likely the Port and other polluting industries on Swan Island would have been the subject of air permit and other environmental advocate challenges, which can slow-down production and reduce profits.

As with many environmental problems, public concern comes before the necessary programs and regulations to ratify the problem are established. When this group first convened, there were no air toxic programs in place that it could use as a model. Instead, because of its success, this project is now used by the Oregon Department of Environmental Quality as a model for technical and community feedback in its design of a state hazardous air pollution program. The Port of Portland received the 1997 Environmental Improvement Award from the American Association of Port Authorities.



Port of Portland, Oregon.

Brownfields

Issue/Problem

Brownfields are commonly defined as abandoned, idled, or under-used industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination. This contamination increases the costs and uncertainty of redevelopment. Lenders, investors and developers, fearing liability for prior contamination, tend to avoid involvement in redevelopment of these sites that results in some prime waterfront industrial properties being abandoned or underused.

Brownfields site contamination includes substances defined as hazardous or toxic under the Clean Water Act, the Clean Air Act, the Resource Conservation and Recovery Act, and the Toxic Substances Control Act. Contamination of properties is usually caused by past industrial, or commercial activities.

Health and Environmental Impacts

Property contaminated with hazardous or toxic substances has a number of potential deleterious human health and environmental impacts. Exposure to these substances can result in increased mortality rates or life-threatening and incapacitating illness in humans and wildlife. The effects can extend beyond property lines as contaminates may seep into the underlying groundwater system, spreading to other regions and adversely affecting drinking water supplies.

Cleaning up and reusing brownfield property has a multitude of community benefits beyond elimination of environmental and public health threats. These include utilization of existing transportation infrastructure and utilities, job generation, and elimination of blight and revitalization of neighborhoods. Further, brownfield reuse diminishes the pressures to develop outlying pristine properties.

Applicable Regulatory Framework

At the Federal level, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as the Superfund Act of 1980 that was amended by the Superfund Amendments and Reauthorization Act (SARA) in 1986, holds owners and operators of facilities which release hazardous wastes or substances liable and responsible for the costs of clean up. The Act also provides a mechanism for identifying all liable parties and holding them accountable. CERCLA establishes a fund to clean up accidental releases and prevent potential releases of hazardous substances.

CERCLA's cleanup standards first require that a contaminated site be cleaned-up to, at a minimum, an adequate level to protect human health and the environment and, second, that the most cost-effective means to achieve this adequate level of protection is selected. Whether an adequate level to protect human health and the environment means returning the property to its predevelopment condition has resulted in tremendous debate between environmental regulators and those performing the cleanups. Cleanup costs to predevelopment conditions can be prohibitively high, often exceeding the property value.

Most states have laws similar in purpose and intent to CERCLA, and many have programs similar to the Brownfield Initiative, discussed below, to promote clean up and reuse of contaminated property.

Management Options

In response to the reality that CERCLA (and similar state "Superfund laws") complications actually slow the cleanup process, US EPA established a community-based brownfield revitalization program known as the Brownfields Economic Redevelopment Initiative (BERI) and Action Agenda. This initiative addresses the issue that liability concerns remain a central factor in promoting the redevelopment of brownfields. Policies and guidance stemming from BERI and its pilot programs have resulted in increased flexibility in clean-up standards and practices, and in a host of new techniques to encourage investment in brownfield properties that include voluntary remediation programs, flexible standards and procedures, limited liability provisions, and financial and technical support.

Ports have been the recipients of a number of US EPA brownfields assessment pilot grants under

which they have negotiated prospective purchaser agreements, acquired and developed contaminated property, and taken title to "impaired" properties for leaseback to companies.

Brownfield properties are often minimally contaminated and in advantageous locations such as waterfront areas. Many already have buildings, docks, and transportation infrastructure and utilities that can be reused with simple modifications making brownfield redevelopment cost competitive in terms of redevelopment potential and future property value.

The proliferation of brownfield redevelopment is one component of the solution to the growing problem of urban sprawl. By targeting once-built land for new commercial and industrial activity, the need to develop agricultural lands and other open spaces—so called "greenfields"—is reduced.

Harborside International, Port of Chicago, Illinois

Port converts landfill into world-class golf course using local materials.

This innovative brownfields project involved the redevelopment of two former landfill sites along Lake Calumet on Chicago's southeast side. The most notable and innovative aspects of this project were the Port's use of locally available material to shape the terrain, clever soil mixing to optimize soil chemistry, inflatable dams to assist in the removal of fish while clay was excavated from the lakebed, and an irrigation system that uses lake water. The use of such materials reduced remediation costs tremendously and also minimized air pollution and truck traffic to and from the site. Land marred by decades of digging, dumping, and filling activities was transformed into a world-class golf course.

The southeast shore of Lake Calumet, owned by the Illinois International Port District, was used for over 20 years as Chicago's primary municipal solid waste landfill. Later, it was used by the city to dispose incinerator ash and by the Metropolitan Water Reclamation District to dispose treated wastewater sludge. When these contracts expired, the Port was left with the responsibility of capping and securing the landfill in accordance with Illinois Environmental Protection Agency (IEPA) closure requirements. Recognizing that securing the site over a long period of time would be costly, the Port agreed to convert this land into something more beneficial and aesthetic for neighboring communities. In-house engineering and production brought about a dramatic change in the landscape. This contaminated landfill, along with an adjacent construction debris landfill, was converted to the 458-acre Harborside International Golf Center, with two 18-hole champion golf courses, a 58-acre practice facility, and a Golf Academy. The entire project took three and a half years to complete.

Harborside International as it appeared during construction.

For construction of the golf courses, wastewater biosolids found on-site were blended with treated sludge brought in from off-site. Both have salinity contents too high to grow grass so other locally available materials were brought in to achieve a soil chemistry that could serve as a healthy substrate for sensitive golf course grasses. This soil was installed in a complex layering process to create the varied topography necessary for a golf course. Before layering, a two-foot blue clay cap was created to seal-off the underlying contaminated landfill (210 acres of the 458-acre site) and minimize leachate draining into the Lake, as required by IEPA. Clay was obtained locally by dredging a section of the adjacent Lake Calumet. No trees were planted on the course to avoid roots penetrating the underlying clay cap. Drainage and irrigation systems were carefully designed to accommodate the integrity of the clay cap, to allow for high

salinity sludges to be utilized, and to foster growth and fertility of the sensitive champion level golf course grasses.

Over 200,000 fish were removed from their habitat while clay was excavated and the lakebed deepened and improved. An inflatable dam was used to aid in the capture of the fish for removal.

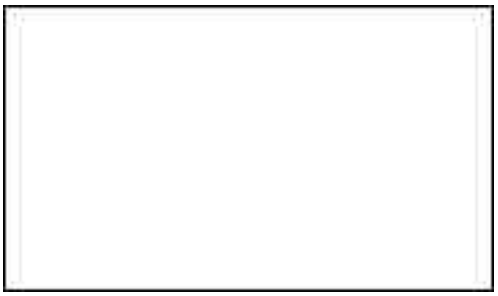
Water from Lake Calumet is used for direct irrigation of the golf course. The irrigation system was fitted with sensors and controls to manage stormwater runoff, and a pump with special design features to prevent Zebra Mussel infestation was installed. Six acres of new wetlands were created as mitigation for areas filled during construction of the course. A portion of the site (238 acres) has been previously operated by the Port as a clean landfill for construction materials and as a concrete recycling site. Much of the concrete slated for recycling was reused during construction of the course for roadways, golf car paths, and building foundations.

Prior to redevelopment, this site was a major eyesore and a great environmental concern in the Chicago area. This innovative reuse succeeded not only in visual enhancements and aesthetic improvements, but also in reduced air and water pollution—all at relatively low costs.

TCL Corporation Site Cleanup, Port of Long Beach, California

Contaminated site remediated with no off-site disposal.

In March 1994, the Port of Long Beach purchased 725 acres of land, previously operated mostly as an active oil and gas production field, from the Union Pacific Resources Company (UPRC). The Port purchased the property for long-term Port-related expansion, including a new 200 acre marine container terminal. This acquisition included a parcel of land that had, in the past, been leased from UPRC by TCL Corporation for the purpose of disposing off-site oil and gas drilling wastes in shallow impoundments (called “sumps”). Wastes permitted for disposal on the site included rotary mud, crude oil tank bottoms, and oil and water. However, in 1981, soil tests revealed that non-approved toxic substances were also disposed of on the site, and in



TCL site during remediation.

1983 the TCL Corporation site was placed on the National Priorities List (Superfund).

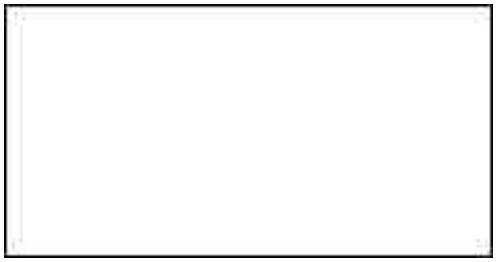
Between 1992 and 1994, a Remedial Action Plan was prepared for UPRC by the Port of Long Beach for 31-acres of the contaminated site. Development of the Plan was supervised by the California Department of Toxic Substances Control (DTSC). This test parcel was successfully remediated and is currently operated as an international vehicle distribution center. Between 1994 and 1995, a Remedial Investigation and a Feasibility Study were prepared by UPRC for the remainder of the site, again under the supervision of DTSC. To advance the development proposed for the remainder of the site, the Port implemented a phased remediation. The main goals of the remediation were to eliminate any human health risks from exposure to contamination and minimize the risk of future impacts to groundwater.

The plan to separate contaminated soil from groundwater was one of the more notable aspects of the cleanup. The contaminated soil in the waste disposal sumps was to be completely excavated to depths below the groundwater table, effectively eliminating any contact between contaminants and the shallow groundwater. The sumps were then filled with clean fill. The contaminated soil removed from below groundwater and a portion removed from above groundwater were dried and stabilized by mixing with cement and other materials. The remaining sump soil was treated and placed along with the stabilized soil. Stabilization took place in transient mixing areas on-site that were moved as the project progressed from one section of the site to another. No contaminants were carried off-site or required off-site disposal. The soil was then placed in a layer above the previously placed clean fill,

above the shallow groundwater level. Three feet of clean imported fill and an asphalt pavement section were placed over the sump material to bring the site to the desired grade. Groundwater monitoring will be conducted periodically to ensure satisfactory water quality standards are maintained.

Ohio Voluntary Action Program, Port of Toledo, Ohio

Port uses state program to mediate cleanup of non-Port property.



Improved roadways at the Port of Toledo.

In the late 1980s, in an effort to alleviate traffic congestion in the Toledo-Lucas County Port area, the Port and the City of Toledo developed a plan to widen roadways and construct overpasses. The Port and City obtained the necessary funding, engineering design work, and right-of-way only to discover seven acres of the right-of-way were contaminated. Consequently, the project stalled.

No resolution was realized until 1996, several years after the state of Ohio promulgated the Voluntary Action Program (VAP), a statute designed to promote voluntary reuse and cleanup of contaminated land. Serving as mediator, the Port Authority used VAP and the many advantages it affords to move the expansion project forward. Advantages of Ohio's VAP are that (1) it is a privatized program not requiring direct cleanup oversight by US EPA, (2) it provides grants, low-interest loans, and tax credits to brownfield redevelopment projects, (3) it sets new and reasonable cleanup standards based on the intended future use of the brownfield site; (4) it allows property owners and others to engage in redevelopment with liability assurance from the Federal government—in the form of covenants not to sue, "no further action" agreements, or consent decrees—that such clean-up activities will be final; and (5) it grants immunity from cleanup lawsuits.

Southwest Harbor Cleanup and Redevelopment Project, Port of Seattle, Washington

Rapid remediation exemplified using Superfund Accelerated Cleanup Model and other innovative environmental assessment processes.

"This project is an outstanding example of a port providing the impetus for redevelopment of vacant and underutilized contaminated industrial [lands]...to sustain economic development and improve environmental conditions," (1995 AAPA Environmental Awards).

Industrial property cleanup and marine terminal development of the Southwest Harbor by the Port of Seattle began in 1991. The main objective of the project was to rehabilitate, through cleanup and redevelopment, five large contaminated sites (a total of 180 acres), including a former shipbuilding and ship repair yard, a municipal landfill, and slag and scrap steel yards (State Superfund sites); a wood treatment plant (Federal Superfund site), as well as a series of smaller contaminated sites. Area-wide risk analysis revealed that it would not be technically or economically reasonable to return the lands to pristine condition. Instead, the proposed plan of action considered the feasibility of mitigating identifiable human health and environmental risks, and the recommended cleanup levels were set not at pristine levels, but at levels that would be non-threatening to humans and the environment.

The five sites were to be redeveloped into a modern container shipping terminal and intermodal rail yard to support increasing trade along the Pacific Rim. In addition to the infrastructure and long-term economic benefits befitting such a project, it also provided an opportunity for habitat restoration and

Southwest Harbor before redevelopment.

public access improvements at the Port.

The project required assessment of sediment quality prior to dredging and cleanup of sediments associated with submerged areas of the former shipyard. A Submerged Nearshore Facility was proposed to serve as a disposal and on-site containment site for all contaminated sediments. After capping with clean sediments, the facility would provide 19 acres of clean subtidal and intertidal habitat.

One important outcome of the project was that through the environmental impact assessment, the Port was able to establish guidelines for integrating environmental factors in all future decision-making and design consideration. The EIS process also ensured that project consensus among community groups and government agencies was achieved. As noted in a letter from the President's Council on Environmental Quality, the EIS for the Container Terminal Development Plan is a "national model for policy level environmental impact analysis."

Not without its share of difficulties, the challenges and most innovative aspects of the project included:

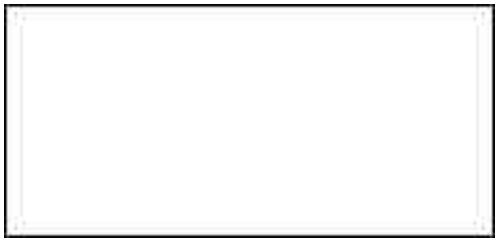
1. Establishing and implementing guidelines for integrating environmental factors into the development of Port infrastructure;
2. Developing cost-effective site cleanup approaches, sediment disposal and habitat mitigation;
3. Minimizing liability and financial issues associated with the acquisition of the contaminated sites; and
4. Integrating regulatory requirements for environmental impact assessment with contaminated site cleanup within a short time period.

The Port also employed a number of innovative approaches during land acquisition that allowed it to obtain the properties at fair market value, which enabled the Port to concentrate its financial resources on timely completion of the project.

- The Port negotiated a purchaser consent decree (a voluntary, unopposed agreement) with the Washington Department of Ecology and US EPA that specified limited liability.
- The property deed restricted the use of the site to industrial development, and a non-potable aquifer designation was obtained from the state. These designations shifted the focus of the project from cleanup to pristine conditions, including maintenance of a stringent drinking water standard in the underlying aquifer, to cleanup standards that were protective of the environment given its future land use.
- Previous property owners were made partners in the cleanup, which minimized litigation and enabled a reasonable agreement on liability and cleanup costs to be realized. The Partnership also allowed previous owners to review and approve all documents prior to submission to regulatory agencies and to participate in the selection of cleanup options.
- US EPA agreed to a prepurchasers agreement and a Covenant Not to Sue prior to the purchase of the Federal Superfund Site.
- The Port offered to pay market value for the federal Superfund site as if it were clean, and requested that site cleanup be performed by the Port rather than by Superfund contractors. This arrangement allowed cleanup to proceed without delay.

The Port of Seattle maximized the use of the Superfund Accelerated Cleanup Model (SCAM) and presumptive remedy approaches and removal actions previously developed by US EPA as part of SCAM. Use of these pre-approved techniques required minimal paperwork compared to a full scale US EPA remedial action decision. In addition, the Port integrated the procedural and substantive requirements of four major environmental laws through an innovative environmental assessment process and the preparation of a joint NEPA/SEEP EIS, which saved time and reduced the administrative and technical costs associated with preparing an EIS.

All these efforts have used cost-effective mechanisms and saved millions of dollars in project delays and litigation. Savings of $16 million were possible from on-site containment as opposed to removal of low toxicity soil from contaminated properties.



Cleanup of Port of Seattle's Southwest Harbor.

COMMUNITY RELATIONS AND Environmental Stewardship

Issue/Problem

Beginning with the host of environmental laws passed by the federal government in the 1970s, the federal and state governments have sought to reverse decades of environmental negligence and establish and implement policies leading to broad environmental responsibility, protection, and restoration. Over the past several decades, port authorities, like other public agencies and private industries, have incorporated environmental values into their organizations and decision-making apparatus and become more attentive to the environmental impacts of their plans, decisions and operations.

Pollution prevention and reduction was initially and largely pursued through a command and control regulatory approach. A reduction in pollution was to be achieved through direct regulation, requiring adherence to sets of objective environmental quality standards. Increasingly, greater emphasis is placed on economic incentives and innovative management. The US EPA is a leading proponent of this transformation in environmental management, advocating greater flexibility and intergovernmental cooperation through initiatives such as Project XL, Brownfields, and Community-based Environmental Protection.

Ports must confront the legacy of past practices while continually modernizing and expanding facilities. They are responding to problems of past contamination with innovation and putting in place programs and mechanisms to ensure on-going operations and new projects are in compliance with environmental regulations. Ports have adopted comprehensive environmental programs that feature environmental audits and performance reviews to evaluate where they and their tenants stand with regard to regulations, especially RCRA, CERCLA, Clean Air Act, and Clean Water Act as well as on-going educational programs.

Ports are recognizing that they are part of a larger urban community and that they need to be attentive to public processes and issues beyond their boundaries. Ports do not have a natural constituency and therefore must work to increase understanding of the importance of ports to the local, regional and national economies. It has become an imperative that a port be recognized as a good neighbor in the ways it develops its properties and in the way it operates.

Ports have responded to these issues with various initiatives to better manage their resources, facilities, and operations and to educate the general populace on the functional requirements and importance of ports. Port authorities are also participating in a broader public process and contributing their expertise to addressing environmental concerns within their regions. These efforts are not only yielding environmental improvement, they are helping to create a political climate for support of port development and operations within the community.

Compliance and Education, Port of Bellingham Bay, Washington

Environmental Compliance and Education a priority at Bellingham.

In 1991, the Port of Bellingham developed a Comprehensive Environmental Program (CEP) to help ensure that Port operations were conducted in compliance with federal, state, and local environmental laws. The program is based on education, compliance assessment, and prompt attention to environmental problems. One of the primary objectives of the program is to review over 300 tenant operations for potential environmental problems and liabilities that may impact the Port. Compliance reviews are performed by Port staff using established procedures that are designed to highlight either permit compliance issues or signs of contamination. Regular site inspections are performed at tenant operations with a significant potential for compliance problems. In the event an environmental concern is identified, the Port's assessment team leader works with the tenant to address the problem promptly in accordance with applicable regulations. The Port has developed a comprehensive database of tenant operations in order to track and manage its environmental compliance assessment program.

A key aspect of the Port's CEP is the Environmental Compliance Assessment Program (ECAP) designed to educate Port staff and tenants

about the complexities of emerging environmental regulations and to help develop appropriate responses to any identified problems. For example, the Port has provided educational workshops to help tenants understand the impact of new stormwater regulations on their commercial operations. It has also implemented a number of remedial actions to clean up contaminated property along the working waterfront. The program has been recognized in the Puget Sound region as a model for addressing environmental issues large and small.

In addition to the educational components of ECAP, the Port works to weave educational elements into each of its activities. The Port's "In the Schools" program, for example, utilizes a non-technical educational videotape on Port operations, conducts field trips to various Port properties and facilities (the airport, the intermodal terminals, the waterfront and marina), and provides in-classroom environmental, transportation, and trade development curriculum support. The Marine Life Center touch-tank, located at the Port's Squalicum Harbor Marina, is visited year-round by school groups and tourists.

The construction of the *Commercial Fleet Interpretive Center* transformed an underused parcel at the head of a commercial fishing loading dock into a useful public area. The Interpretive Center, part of the Port's growing parks system on the Bellingham and Blaine waterfronts, has a treated boardwalk constructed with handrail, built-in planter boxes, benches, and picnic tables. Interpretive signage provides historical information on the commercial fishing fleet, which has been a major industry in the Puget Sound area. The signs detail the fishing fleet's activities and include information about the various types of fishing vessels and the vast quantities of seafood once harvested throughout this area.

The Interpretive Center was built on a degraded parcel of land that had been contaminated from oil and garbage dumping. Cleanup and redevelopment enabled the Port to return the parcel to a useful and aesthetically pleasing state, and to prevent the spread of contaminants. The total cost of the project was $50,000, which more than offset the costs that would have been incurred had erosion of the property continued and personal liability become an issue. The Center and its surrounding grounds are heavily used by the general public, particularly boaters, and are demonstrative of the Port's continuing efforts to upgrade the aesthetics of the working Harbor and Marina area.

Among other of the Port's more ambitious projects is one covering a 50-acre section of the waterfront being conducted as a pilot project under US EPA's Brownfields Initiative. The project is designed to quickly clean up and redevelop a package of four individual properties that are listed as contaminated sites under the state's superfund legislation. The redevelopment goal includes significant improvements in environmental, economic and local public access to the working waterfront.

As the Port continued to bring additional environmental projects on line, the need for a comprehensive "baywide" strategy became evident. In the Puget Sound area, as in many urbanized coastal port areas, contaminated marine sediments have been recognized as a particularly difficult environmental problem. In 1996 Bellingham Bay was selected as the location for a demonstration pilot, sponsored by state and federal agencies, to explore new and innovative approaches for baywide cleanup and habitat restoration. The Port was identified as the local project manager and has recently completed a comprehensive plan that integrates multi-site cleanup, broad-scale habitat restoration, improved public access to the waterfront, and dredging of federal channels to support local navigation and commerce. Regulatory approval of the plan was anticipated in December of 1999.

Savannah Harbor Stakeholders Evaluation Group, Port of Savannah, Georgia

Stakeholder group advises Port authority on important decisions.

A 1996 Reconnaissance Study report produced by the Georgia Port Authority revealed that certain vessels were incurring significant transportation costs when calling on Savannah due to

insufficient channel depths, and that vessel operating schedules would continue to be constrained by the present 42-foot channel unless the Harbor were deepened. Further, the report concluded "As the average size of vessels in the world containership fleet increases, vessels calling on Savannah will experience increased transportation costs due to light loading and tidal delays." Over 50 percent of the containership calls in Savannah Harbor are delayed by the current depth of the channel.

The need to deepen the Harbor was obvious, and in 1997, the Port submitted a Feasibility Study and Tier I Environmental Impact Statement (EIS) to Congress for approval under the Water Resources Development Act (WRDA) of 1986. In the interest of saving time and state and federal money, the Port conducted the Feasibility Study itself as authorized in Section 203 of WRDA, which enables preparation by a non-federal sponsor. These reports evaluated the economic need and engineering feasibility of deepening Savannah Harbor to 50 feet.

Upon completion of these reports, concerns about the project emerged from resource agency representatives, environmental groups, and local businesses. The Stakeholders Evaluation Group (SEG) was a concept suggested during the agency review of the Tier I EIS by one of the natural resource agencies. The idea was to congregate all parties interested in this project in a collaborative forum through which they could actively participate in the remaining project phases.

The SEG group was established in 1998 with representatives from the Georgia Port Authority, the US Army Corps of Engineers (Corps), state and federal resource agencies, the cities of Savannah and Tybee Island, local and regional environmental organizations, members of the maritime community, and other interested parties. SEG acts as an advisor to the Georgia Ports Authority to ensure that the project's investigations, studies, and analyses are conducted adequately and provide the information needed by the natural resource agencies to evaluate the project.

SEG requires consensus (rather than a majority vote) among the participants in the development of the scientific studies and analysis necessary to identify impacts or specific environmental concerns that may result from the proposed deepening of the federal navigation channel. Consensus in this case is the mutual belief that all concerns have been addressed and does not require 100 percent agreement on all points.

While there are consensus decisions, SEG recognizes that the federal and state regulatory agencies must retain their independence to ensure that any proposed plans meet agency requirements. Nothing compromises or alters the legally defined responsibilities, authority, or operational procedures imposed on any organization. What SEG does provide is a comprehensive identification and discussion of concerns surrounding the project and an opportunity for public participation.

At the time this is written, the project is not yet complete, so the overall success and lessons learned from SEG cannot be fully evaluated. Nevertheless, this effort is an excellent example of an attempt to include interested parties in the EIS process beyond the standard public comment requirements.

Public Education and Outreach Programs, Port of San Diego, California

Port Authority educates San Diego Bay community.

The Port of San Diego has initiated a number of environmental education and outreach programs that contribute community service and result in positive Port/community relations. Collectively, these programs educate, inform, and involve individuals, interest groups, businesses, industry, and government in the cleanup, protection, monitoring and management of the San Diego Bay area. The breadth of involvement and leadership role the Port plays have become essential to these programs' successes.

Stormwater drainage education has proven to be one of their most successful endeavors. The Port, in cooperation with the Resource Conservation District (RCD), has established educational partnerships with one school in each of the Port's five member cities. RCD provides the training and the Port provides the necessary funding support. Each partnership is developed to meet the particular needs of both the school and

the Port. The school programs have included watershed/stormwater pollution prevention strategies, outdoor laboratories, landscaping and monitoring projects, and field trips. RCD also conducts stormwater management training outside the Port's member cities in schools located upstream in the San Diego Bay watershed. Together, RCD and the Port have educated 14,000 students and adults about stormwater management and San Diego County's stormwater permit program. They also have organized erosion control and streambank restoration workshops for Port engineers and other municipalities within the watershed, coordinated water quality conferences for high school students and teachers, and assisted and funded student water quality projects.

In 1998, the Port took a leadership role in the creation of the San Diego Bay Watershed Task Force. This group was established to address stormwater pollution and other nonpoint source pollution that affects San Diego Bay and to seek solutions to problems arising from nutrients, household hazardous wastes, pesticides, herbicides, fertilizers, organic carbon, bacteria and other pathogenic oils, and heavy metals. In particular, the Task Force seeks to identify concerns where collaborative efforts would be beneficial to all interested parties within the watershed. All Task Force members agreed that US EPA's watershed management approach would be incorporated in their efforts to reduce water pollution.

The Port of San Diego also is a partner in a comprehensive environmental education campaign—the largest environmental education project in San Diego history—called "Think Blue." Other partners include the City of San Diego, the County of San Diego, Caltran, and KGTV Channel 10. The campaign is designed to "generate awareness and action among San Diego residents in order to prevent the sources of storm drain pollution that have a severe impact on San Diego's environment, life-style and economy." Extending beyond the usual array of workshops, websites, and educational literature, "Think Blue" will use radio and television to provide tips and suggestions for preventing stormwater pollution. A survey conducted by the Center for Watershed Protection found that television is the preferred way to effectively reach target audiences with environmental messages.

DREDGED MATERIAL DISPOSAL AND Contaminated Sediments

Issue/Problem

Ocean, river, and lakebed sediments can be contaminated by heavy metals (e.g., lead, zinc, mercury, cadmium, copper), polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs), hydrophobic organics (e.g, dioxins), pesticides (e.g, DDT, chlordane), oils, greases, and organic matter that adsorb onto suspended particles, settle onto the underwater floor, and alter the sediment's composition. Sediment contamination is a major environmental problem in the United States with an estimated one-eighth to one-quarter of all Superfund sites being submerged sediment beds. Contaminated sediments threaten ecosystems, human health, and natural resources and also have serious economic impacts. They are considered a problem when concentrations are determined to pose significant adverse effects on the environment.

Several hundred million cubic yards of sediment must be dredged from waterways and ports each year to improve and maintain the nation's waterborne navigation. Port dredging is essential to creating and maintaining sufficient depth for safe operations. Disposal of the dredged material can be difficult and controversial, particularly if the sediments are contaminated by toxic pollutants. While ports are not responsible for all of the contamination in harbor sediments, they are responsible for disposing of sediments they dredge in an environmentally sound and economically effective manner. It has been estimated that almost 5 - 10 percent of all dredged sediments are contaminated. Alternatives for the management of dredged material from these projects must be carefully evaluated from the standpoint of environmental acceptability, technical feasibility, and economics.

Health and Environmental Impacts

Most present-day sediment contamination stems from past human activity, before environmental regulations restricted the type and quantity of industrial and domestic waste discharges and emissions. Even though many pollution sources have been removed today, problems persist because of the chemical nature of contaminants and because of physical and biological conditions of the affected underwater environments. For example, the overlying water or underlying "clean" sediments can be affected by contaminated sediment as biological and mechanical mixing of the top layer remobilizes contaminants and mixes them back into the water column or into deeper sediment layers. Once released into the water column, contaminants present a considerable threat to ecosystem health, particularly as they work their way up the food chain through the plants and animals that live in the effected environment.

Potential environmental impacts resulting from dredged material disposal may be physical, chemical, or biological in nature. The sediments in urban harbors and ports are often highly contaminated by industrial activities occurring in the ports and through the deposition of upstream sediments burdened with pollutants from point and nonpoint sources. Unless properly managed, dredging and disposal of contaminated sediments can adversely affect water quality and aquatic or terrestrial organisms. Sound planning, design, and management of projects are essential if dredged material disposal is to be accomplished with appropriate environmental protection in an economically efficient manner.

Applicable Federal Environmental Regulations

A number of federal environmental statutes and regulations apply to dredging and disposal operations. Section 10 of the Rivers and Harbors Act of 1899 requires an Army Corps of Engineers (Corps) permit for any work or structure, including fill material discharges, in navigable US waters.

Section 404 of the Clean Water Act (CWA), requires an authorization by the Corps for discharges of dredged or fill material in "waters of the United States," a term that includes wetlands and other aquatic areas. The goal of the Section 404 program is to ensure protection of the aquatic environment while allowing for necessary economic development. In evaluating permit applications the Corps is required by law to consider all factors involving the public interest including: economics, environmental concerns, historical values, fish and wildlife, aesthetics, flood damage prevention, land use classifications, navigation, recreation, water

supply, water quality, energy needs, food production and the general welfare of the public. The Section 404(b)(1) Guidelines are the substantive criteria by which proposed dredged material discharge actions are evaluated. US EPA also maintains general environmental oversight, including Section 404(c) permit veto authority if it is determined that the activity will result in an "unacceptable adverse effect."

Discharges are also reviewed by the applicable state, which must certify under Section 401 of CWA that the disposal operations comply with state water quality standards.

Material dredged from waters of the United States and disposed in the territorial sea is evaluated under the Marine Protection, Research, and Sanctuaries Act of 1972 (MPRSA). In general, dredged material discharged as fill (e.g., beach nourishment, island creation, or underwater berms) and placed within the territorial sea is evaluated under the CWA.

Under Section 103 of MPRSA, the Corps must evaluate proposed projects that require the transportation of dredged material for the purpose of disposal in the open ocean. The US Environmental Protection Agency (US EPA) has the primary responsibility for designating ocean-disposal sites within and beyond the three-mile limit, i.e., within and beyond the territorial sea. The evaluation of these activities is based on criteria promulgated by US EPA after consultation with the Corps and other federal agencies. Non-Corps Federal projects and private projects that are approved receive an ocean-dumping permit from the Corps. If a permit does not comply with established criteria, disposal of the material cannot proceed unless a waiver is obtained from US EPA.

The National Environmental Policy Act (NEPA (P. L. 91-190)) applies to major federal actions (e.g., proposals, permits, and legislation) that may significantly affect the environment. Corps activities in the areas of dredging and disposal, including regulatory actions, come under NEPA jurisdiction. It is through the NEPA process that the dredged material disposal alternatives including no action, open-water disposal, confined disposal of dredged material, or beneficial uses are evaluated, documented, and publicly disclosed. NEPA requires that government use all practicable means, consistent with the act and other essential considerations of national policy, to fulfill the requirements of the Act. This requirement specifically applies to federal agencies, their plans, regulations, programs, and facilities. NEPA requires the preparation of a report that provides complete information about the environmental impact of a proposed action. This document is either an Environmental Impact Statement (EIS) or an Environmental Assessment (EA)/ Finding of No Significant Impact (FONSI).

Management Options

Challenges surrounding the treatment and disposal of contaminated sediments are related to scientific uncertainty over the bioavailability of contaminants in both sediments and in the water column, uncertainty as to the mobility of contaminants within the sediments, and unpredictability of the total effects of contaminants in the top layer of sediments. Other problems include the high cost and technical challenges of sediment and site characterization, sediment removal, contaminant immobilization and isolation, biodegradation, and disposal. The problem of contaminated sediments is important for ports to overcome as it poses a threat to essential maintenance and development.

In general, there are three major disposal alternatives available: open-water disposal, confined disposal, and beneficial use. Selection of the disposal alternative is a function of environmental, engineering, and economic considerations.

Open-water disposal is the placement of dredged material in rivers, lakes, estuaries, or oceans. Such disposal may involve appropriate management actions or controls such as capping. Dredged material can be placed in open-water sites using direct pipeline discharge, direct mechanical placement, or release from hopper dredges or scows. The potential for environmental impacts is related to the type of dredging and disposal operation used, the nature of the material (physical characteristics), and the hydrodynamics of the disposal site.

Open-water disposal sites can be either predominantly nondispersive or predominantly dispersive. At predominantly nondispersive sites, most of the

material is intended to remain on the bottom following placement and may be placed to form mounds. At predominantly dispersive sites, material may be dispersed either during placement or eroded from the bottom over time and transported away from the disposal site by currents and/or wave action. Both types of disposal sites can be managed to achieve environmental objectives or reduce potential operational conflicts.

Capping is the controlled placement of contaminated material at an open-water site followed by a covering or cap of clean isolating material. The feasibility of capping is dependent on site bathymetry, water depth, currents, wave climate, physical characteristics of contaminated sediment and capping sediment, and placement equipment and techniques. Precise placement of material is necessary for effective capping, and use of other control measures increase the effectiveness of capping.

Confined disposal is placement of dredged material within diked nearshore or upland confined disposal facilities (CDFs). CDFs are designed to provide for adequate storage capacity, to maximize efficiency in retaining the solids and, if contaminants are present, control of contaminant releases.

Beneficial use includes a wide variety of options, which utilize the material for some productive purpose. Dredged material can be a manageable and valuable soil resource with beneficial uses of importance that should be incorporated into project plans and goals at the project's inception to the maximum extent.

Broad categories of beneficial uses, based on the functional use of the dredged material or site, are:

- Habitat restoration/enhancement (wetland, upland, island, and aquatic sites including use by waterfowl and other birds);
- Beach nourishment;
- Aquaculture;
- Parks and recreation (commercial and non-commercial);
- Agriculture, forestry, and horticulture;
- Strip mine reclamation and landfill cover for solid waste management;
- Shoreline stabilization and erosion control (fills, artificial reefs, submerged berms, etc.);
- Construction and industrial use (including port development, airports, urban, and residential); and
- Material transfer (fill, dikes, levees, parking lots, and roads).

Nearshore Disposal, Port Canaveral, Florida

Disposal of dredged sand from the channel renourished beaches south of the Port.

Port Canaveral was constructed in the early 1950s to facilitate trade in the relatively shallow waters of Canaveral Harbor. A federal navigation project created an ocean entrance channel with a depth of -46 feet mean low water (MLW), stabilized by two rock jetties. Not long thereafter it was recognized that the jetties interrupted the natural net southerly drift of sand causing significant erosion of the beach to the south of the Harbor. It is estimated that each year approximately 200,000 cubic yards of sand accrete along the shoreline north of the jetties and that another 200,000 cubic yards of sand accumulate in the channel.

The entrance and channel basins are dredged annually by the US Army Corps of Engineers (Corps). Traditionally, this maintenance dredging had been done with a hopper dredge and the total volume of dredged material disposed of at an offshore disposal site nine miles at sea. In 1991, the US Fish and Wildlife Service prohibited further use of hopper dredges due to potential impacts on endangered sea turtles that inhabit the area. The Canaveral Port Authority developed and funded an alternative plan, known as the Nearshore Berm

Disposal Project, the purpose of which is to offset the sediment deficit caused by the navigation project. Since a nearshore berm disposal project had never been implemented in the State of Florida, the Port's Engineers had to convince the Corps and various state agencies that their proposal was safe and operationally feasible. Once the agencies gave their support, the Port was able to fast-track dredge and fill permits for channel maintenance.

The Port's plan was to segregate the beach-compatible sand dredged from the channel and transport and dispose of it at a site south of the Harbor about one-half mile offshore of the City of Cocoa Beach. The sand was removed from the channel with a clamshell dredge that, unlike the hopper dredge, allows segregation of sand from silt and clay. After separation, the sandy material, which contains less than 10 percent silt and no contaminants, was transported by tug and scow to the disposal site. The sand was placed in a berm configuration with the expectation that it will migrate shoreward and become part of the active littoral zone, renourishing the eroding shore. The berm was designed to have a 100-300 foot crest with an elevation maximum at -10 feet MLW. Over 158,000 cubic yards of sandy material has been deposited at the berm site.

Through its Nearshore Berm Disposal Project, Port Canaveral has devised a solution for retaining much of the sand in the coastal system. Sand that is transported into the Harbor through natural physical processes is no longer shipped out of the littoral zone but reaches the shore south of the Port. Nourishment of the beaches in Brevard County enhances nesting habitat for endangered species like sea turtles and least terns and adds to the valuable storm protection that the beaches provide.

The Port has conducted monitoring of the project's effects on the littoral sand budget. One year after the project's implementation, monitoring indicated that the berm's sand, by moving landward, has already become an active part of the coastal system.

Boston Harbor Navigation Improvement Pr oject (BHNIP), Port of Boston, Massachusetts

Disposal Options Working Group collaborates to determine innovative disposal option for contaminated sediment.

The Boston Harbor Navigation Improvement and Berth Dredging Projects involves the deepening of two areas of the Main Ship and three tributary channels: Reserved Channel, Mystic River Channel and Chelsea Creek Channel as well as a number of berth areas. Channel depths will be increased to -40 feet MLW (except Chelsea Channel to -38 feet MLW). The project, when complete, will allow greater use of the previously underutilized -40 feet MLW Entrance Channel and Main Ship Channel in Boston Harbor, thereby improving navigation and safety, reducing the cost of transporting goods, and improving efficiency.

The project will remove approximately 2.7 million cubic yards (cy) of in-situ material. This includes 1.0 million cubic yards of silt, 1.7 million cy of parent material composed of clay and sand/gravel and 88,000 million cy of rock. An additional 1.3 million cy of parent material will be dredged to provide for in-channel disposal of the silt as is described below. The average depth of cell excavation will be approximately -50 to -80 feet MLW with some cells reaching a depth of -100 feet MLW.

The project was authorized by Congress in the Water Resources Development Act of 1990 (P.L. 101-640). The Massachusetts Port Authority is the non-federal sponsor and is providing the non-federal cost sharing portion. The total project cost is currently estimated at $60 million including deepening and maintenance dredging in the channels and berth areas. Phase I of the project involving dredging of two areas at Conley Terminal with disposal in the Inner Confluence, was completed in the summer of 1999. Phase II dredging operations began August, 1998 and are scheduled for completion by December 31, 1999.

As with most dredging projects, the key environmental issue was where and how to dispose of the dredged sediments. Generally, the level of difficulty in identifying and permitting a disposal site relates to the volume and quality of the sediment to be

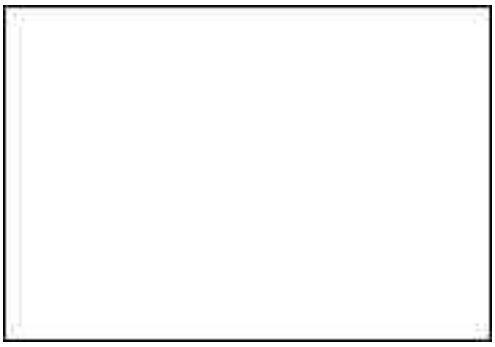
dredged.

An extensive sediment sampling and testing program was conducted to determine the quality of the material to be dredged. The assessment revealed that the surficial silt layer (or "maintenance" material) was found to contain varying concentrations of metals, polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and other organics. Under stricter new protocols imposed in 1990 by the Corps and US EPA the silt material was found to be generally unsuitable for unconfined open water disposal. The underlying sediment (parent material) is composed of clay and sand/gravel that is uncontaminated and suitable for unconfined open water disposal if no beneficial uses are identified.

A combined Massachusetts Environmental Impact Report (EIR) and federal Environmental Impact Statement (EIS) (June 1995) explored alternatives for disposal of the dredge material. One innovative and productive aspect of thie project was the formation of a Disposal Options Working Group. The technical expertise contributed by this group was reponsible for expanding the scope of sediment sampling and testing and broadening the consideration of disposal options and the diposal sites to be screened.

Ultimately, the use of in-channel disposal cells was selected as the least environmentally damaging practicable alternative (LEDPA). The original disposal plan entailed excavating approximately 54 disposal cells beneath the federal navigation channels in the Inner Confluence, Mystic River, and Chelsea River. The project as carried out created nine cells deeper (-20 to -65 MLW) and larger than the original configuration. It is important to note that the disposal cells will only be constructed in the Inner Harbor where channels will never be dredged deeper than -40 feet MLW due to existing navigational obstructions below this depth. No cells will be constructed in the Reserved Channel or outer harbor where there are no restrictions on future dredging depths.

The unsuitable material removed from the navigation channels and berths is placed on barges while the cells are dug deeper into the parent material of the channels. The silty material is then placed in the cells and capped with a 3-foot layer of clean sandy material. Construction of the in-channel disposal cells will generate an additional 1.3 million cubic yards of clean material that will be disposed of at the Massachusetts Bay Disposal Site (MBDS), a US EPA-designated disposal site located approximately 25 miles east of Boston in Massachusetts Bay.



Channel dredging in Boston Harbor.

The environmental resources impacted for this disposal alternative are the same as for dredging the site. Because this disposal practice does not involve impacting any additional area beyond the dredging footprint, and because the material will be capped with a three-foot layer of clean granular material, it results in no identified significant long-term impacts. The only environmental impacts that needed to be addressed by the project mitigation plan were short-term in nature, mostly related to turbidity increases during dredging and disposal activities.

Benefits from this alternative include keeping the unsuitable material near its point of origin within the area impacted by the channel dredging, thereby reducing the amount of material exposed to biological resources elsewhere. Transportation costs, vessel traffic disturbances and socio-economic impacts are kept to a minimum. Newly-exposed substrate and clean capping materials will provide better substrate conditions for benthic community development that is expected to recover rapidly.

As of the preparation of this report, all nine disposal cells have been constructed and filled with dredged material. Six have been capped and three await capping which is schedules to occur in summer 2000. The cells are regularly monitored as required by the project's water quality certification.

Monitoring revealed some problems with the capping as originally carried out and led to modifications of the process in later phases. Project managers learned that it is necessary to allow the unsuitable materials being disposed to consolidate within the cells for a period of time (several months or more) before the cap is placed on top. Allowing additional time for consolidation results in more effective sequestering of the unsuitable material.

In February 2000, the Massachusetts Port Authority, the Corps, and Great Lakes Dredge & Dock Company—the three partners in the project—received the "Hammer Award" for the another innovation. Sand tha needed to be dredged from the Cape Cod Canal is being used to cap the cells, providing a cost effective solution to the disposal of the sand and source of cap material that saved taxpayers $1.5 million.

The Orion Project, Port of New York & New Jersey

Beneficial use found for contaminated harbor sediments.

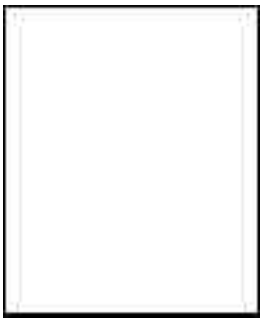
The Port of New York & New Jersey is a naturally shallow harbor with heavy annual sediment deposits. Sediments entering the system from the watershed settle into a network of artificially deepened public and private channels and berths. To deepen these berths and maintain safe navigation channels, the Port dredges approximately three to five million cubic yards of sediment each year.

Appropriate disposal sites for these sediments are determined according to the levels of toxicity and bioavailability in the sediments. Historically, all dredged material from the Port has been disposed of in the ocean. However, under current federal regulations, not all of the dredged sediments from the Port of New York and New Jersey meet the standards for the Remediation Material at the Historic Area Remediation Site (HARS). In fact, less than one-third of the dredged sediment meets standards for the Remediation Material at the HARS. Stricter standards for the Remediation Material have required the Port to look for alternative dredge disposal sites.

With a restriction on the placement requirement at the HARS and fewer existing adequate upland disposal sites in the region, the Port initiated a search for new ways to dispose of dredged materials. As a result of this search, the Port identified an upland site where they could convert dredged materials into beneficial use products. This upland site, named the Orion Project, has the technology to transform 1.5 million cubic yards of dredged sediment into foundation fill for a parking lot.

To create the foundation fill from the sediments, the Port first transports sediment material dredged from various Port locations to an on-water processing site. There the dredged material is screened to separate debris from sediment. The sediment is then pumped to an on-shore site in New Jersey where it is mixed with cement kiln dust to enhance its compressive strength. After this mixing process, the sediment mixture is used as fill for a 60-acre parking lot foundation. Asphalt is applied over the treated material as a final cover.

The Orion Project has provided the Port with a disposal option for sediment that must be dredged for safe navigation in the harbor. Without the Orion disposal option, dredging could be halted and many ships could be redirected. In addition to allowing for dredging and disposal of contaminated sediments, the Orion Project provided a beneficial use for the dredged material. As a result, no virgin fill material will be required to construct the parking lot foundation.



Heavy Metal Treatment Alternative for Marine Sediments, Port of San Diego, Californ ia

Copper contaminated sediment treated and placed on-site.

From 1970 to 1988, copper ore concentrate was shipped on bulk carriers from San Diego to Japan. The loading of copper onto the ships released substantial quantities of copper to San Diego Bay and to the marine terminal storm drain system, contaminating sediments adjacent to the marine terminal.

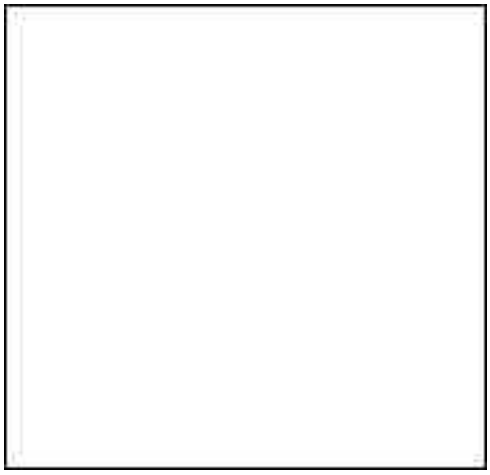
In small quantities, copper is essential to marine life as a key component of enzymes and normal metabolism functions; however, high concentrations can damage gills, adversely affect the liver and kidneys and cause neurological damage in fish. High concentrations of copper are also hazardous to humans if ingested.

In response to a 1987 Cleanup and Abatement order by the California Regional Water Quality Control Board, the Port of San Diego was required to remove and dispose of 21,000 cubic yards of copper contaminated sediment. Various cleanup and disposal alternatives were considered, including (1) shipping the dredged sediment to the copper mines in Arizona where the copper ore could be extracted from the sediment and recycled, (2) placing the sediment in offsite landfills, and (3) fixing it in situ. Initial studies showed that disposal of the sediment in an offsite landfill carried too much liability. In situ fixation would prevent future deepening of the shipping channel. Of the alternatives, the Port found the best option to be recycling the sediment. However, rather than pay to have the sediment shipped to the Arizona facility, the Port adapted the copper extraction system used at the mines to perform remediation on site. Most of the sediment could then be used safely onsite.

Prior to remediation of the entire site, the Port initiated a pilot study to test the system. A small scale processing plant was built to process one hundred tons of highly contaminated (greater than 4,000 ppm copper, the California land-based hazardous waste designation) sediment. The sediment underwent a two-stage process. In the first stage the sediment was physically separated into different size fractions. After the sediment was passed through a feed hopper to remove any of the large material, like rocks and ship parts, it was passed through a +20 mesh size screen to remove the shell fraction. At this point, the sediment proceeded through a series of screens and hydrocyclones that separated the solids into three size fractions. The sand fraction, in compliance with California land-based hazardous waste standard for copper, required no further processing. The sediment was reused onsite as fill. The fraction less than 200 mesh was dewatered and removed for direct smelter recycling.

The intermediate fraction (-140 to +200) exceeded the 4,000 ppm standard, but was not concentrated enough for direct smelter recycling. Instead, this material was subjected to a second stage of remediation in which it was treated chemically, the first time that this technique had been used on marine sediments. The sediment was treated with nitric acid in a heated reactor vessel. The solid from the reaction was settled out, washed with water, and neutralized with sodium hydroxide. The solid material was then shipped offsite for smelter recycling. The remaining material from the chemical extraction was placed onsite.

Following successful completion of the pilot study, the Port proceeded with dredging and remediation of 21,000 cubic yards of sediment. Due to a low volume of high copper content sediments and refinements in the physical separation process, the chemical extraction process was not necessary during full-scale remediation. At the end of the physical separation process, cement was added to the low level and washed sediment and the material was placed onsite. The innovative sediment treatment system implemented at the San Diego Unified Port District not only remediated the sediment contamination, it also saved the Port approximately $1.5 million in cleanup costs over other, more conventional methods.



San Diego Bay.

ENDANGERED AND Threatened Species

Issue/Problem

Extinction of a species is an irreversible ecological tragedy attributable to habitat loss from pollution and urbanization, unrestrained hunting and fishing that depletes stocks to unsustainable levels, poaching and consumer demand for exotic animals and plants, and fish and other wildlife. There are more than 1,000 species in the US listed as threatened or endangered, and there is a backlog of species waiting to be listed. Under the protection of the Endangered Species Act (ESA), 36 percent of all threatened and endangered species listed are in stable or improving condition. Examples of recovered species include the American alligator, brown pelicans, and the bald eagle.

Species provide a wide array of benefits; they are essential to the natural function of ecosystems, provide recreational and aesthetic benefits, and serve as a potential source of important medical drugs. They can also afford many economic benefits. For example, pacific salmon in the Northwest once supported a lucrative $1 billion industry that employed over 60,000 people. The salmon is currently listed as threatened due to overfishing and pollution, and the salmon industry is lagging as a consequence.

Many animals find particular aspects of a port environment appealing. Others are frequent visitors to the highly industrial and heavily trafficked land and waters surrounding a port.

Environmental Impacts

A high level of biodiversity is essential to the long-term stability of an ecosystem. Species interactions provide essential ecological services such as the production of oxygen, removal of carbon dioxide from air, cleaning and regulating of fresh water, and production of organic matter and soil. To make an ecosystem work, all organisms establish a number of interactions and mutually beneficial links with other organisms that they, in turn, depend upon for survival. All of these mutual-dependent links establish a network between species that has important implications in both small-scale and large-scale ecosystems. The network is such that each organism has some small influence on the rest—the activities of one group will benefit others and the ecosystem as a whole.

It can be argued that some organisms could be lost without any immediately noticeable effect on an ecosystem. But not enough is understood about species-species and species-ecosystem interactions to argue that species extinction is tolerable or that ecosystem impacts are always minimal. Moreover, there is a lack of understanding of the impacts that these losses could have as environmental conditions, such as global temperature, change over time. Until we better understand how a species is essential to the functioning of that ecosystem, it cannot be argued that biodiversity is unimportant.

Applicable Federal Environmental Regulations

ESA, the Fish and Wildlife Coordination Act (FWCA), the Marine Mammal Protection Act, and the Migratory Bird Treaty Act are the major federal statutes designed to protect plant and animal resources from adverse effects, such as population endangerment, resulting from human activity. These laws require consultation with wildlife authorities before committing resources to certain types of projects.

ESA was enacted by Congress in 1973 with amendments in 1984. It is the principal legislation used to slow the process of species extinction in the United States. The goals of ESA are to institute a regulatory system to conserve simultaneously endangered and threatened species and the ecosystems upon which they depend. Endangered species are those in danger of extinction throughout all or a portion of its habitat range. Threatened species are those likely to become endangered in the foreseeable future. Recognized insect pests are excluded from these definitions.

ESA is administered by the Department of Interior's (DOI) US Fish and Wildlife Service, the Department of Commerce's National Marine Fisheries Service, and the US Department of Agriculture. The Act details prohibited acts (Section 9) and provides for both civil and criminal penalties for violators, and the Secretaries of Interior, Treasury, and Transportation are given powers of inspection and seizure. Private citizens may bring civil suit to preclude other citizens or government agencies from engaging in activities that violate the Act or to oblige the Secretary of the Interior to take

certain actions.

Several mechanisms exist to prevent a species from becoming extinct once placed on the endangered list. First, ESA requires the development of Recovery Plans for all listed species, which provide specific guidance on how to return the species population to a level that is not threatened or endangered. Approximately half the threatened and endangered species have Recovery Plans at this time. Second, under the auspices of the US Fish and Wildlife Service, habitat is required to be designated as Critical Habitat if it is considered essential for the survival of an endangered or threatened species. Exceptions are made only if the costs of doing so exceed the benefits and only if species extinction can be avoided by some other mechanism. Third, importing, exporting, as well as harassing, harming, capturing, or killing—collectively called "taking"—of endangered species is strictly prohibited by ESA regulations.

ESA directs all federal agencies to ensure that their activities will not jeopardize a threatened or endangered species and requires inter-agency coordination to facilitate this objective.

The goals associated with water-related projects (e.g., navigation, flood control) often conflict with the goals associated with conserving fish and wildlife resources. The Fish and Wildlife Coordination Act (FWCA), as amended, provides for equal consideration for fish and wildlife resources with economic benefits during the planning of water resources development projects.

There are several key provisions of FWCA. Among these are: authorizing DOI to provide assistance to and cooperate with federal, state, and public and private organizations in the development and protection of wildlife resources and habitat; to make surveys and investigations of wildlife; and to accept donations of land and funds that further the purposes of the Act. The Act requires consultation with the state agency that administers wildlife resources in the affected state to promote conservation of wildlife resources by preventing loss of and damage to such resources, and to provide for the development and improvement of wildlife resources in connection with the agency action. These activities should be conducted in accordance with plans approved by the federal agency, the Secretary of the Interior, and the head of the applicable state agency.

The Marine Mammal Protection Act (MMPA) was enacted in 1972 and amended in 1984. The purpose of this Act is to protect and manage marine mammals and their products (e.g., the use of hides and meat).

The primary authority for implementing MMPA belongs to the Department of Interior's US Fish and Wildlife Service (FWS) and the Department of Commerce's National Marine Fisheries Service (NMFS). FWS manages walruses; polar bears; sea otters; dugongs; marine otters; and West Indian, Amazonian, and West African manatees. NMFS manages whales, porpoises, seals, and sea lions.

The Migratory Bird Treaty Act provides protection for migratory birds by prohibiting the taking, importing, exporting, possession, purchase, or sale of any migratory bird or its parts, including feathers, nests or eggs.

Management Options

Recognizing the different species that inhabit, use, or approach a port environment is a first step towards protecting both listed and non-listed endangered species. Other efforts include modifications to certain port structures so that they are not harmful in any way, regulation of boat speeds to reduce collisions with protected mammals, and education and outreach concerning the types of species at risk in a region and what can be done to prevent further harm.

Manatee Protection Programs, Port Canaveral, Florida

Infrastructure improvements and awareness campaign protect Florida manatee.

The manatee is one of many mammals protected under ESA and is found all along Florida's coastline. These animals have a strong presence in Port Canaveral, using the Port's waters for playing, resting, feeding, mating, freshwater drinking and as a corridor between the Indian River Lagoon and the Atlantic Ocean. The Port Canaveral Authority Manatee Protection Program was developed and is

implemented voluntarily by the Port to increase awareness of these animals. The main goal of the program is to minimize manatee injury and mortality resulting from commercial and recreational uses. Highlights of the program include improvements in the Port's fendering system, grating of storm water outfalls to prevent manatees from entry, and the implementation of an education and awareness effort for Port users.

Many existing fendering systems were retrofitted with a three to four foot clearance space between the vessels and bulkheads. All new piers were required to have manatee safe fenders with at least three feet of standoff space providing sufficient escape room for manatees. Port tenants were encouraged to use these three foot fenders as well. Existing outfalls were grated while new ones were redesigned and strategically placed to minimize the potential for small and mid-sized manatees to get caught in the various pipes around the Port. Many of the outfalls are under water at high tide and pose a danger to unsuspecting manatees as the tide goes out.

The voluntary effort expended by the Canaveral Port Authority to protect the Florida manatee and to educate Port users about their presence has been worthwhile and successful. All areas or activities in the Port that pose a potential threat to the safety of the manatee have been modified, resulting in the minimization of adverse impacts to these species. As awareness about the manatees' movement within the Port increases, so too will the number of Port users who watch for them and take action to avoid them. The program has been successful in that many Port tenants and users have implemented the manatee safety suggestions outlined in the brochure and video produced by the Port. Awareness about manatees in Port Canaveral has increased dramatically and mortalities attributable to shipping impacts have been minimized.

The Port Authority continues to develop the Manatee Protection and Education Program in coordination with the Florida Department of Environmental Protection and to educate lock operators about manatees in coordination with the US Army Corps of Engineers.

Manatee Protection Program, Port Ever glades, Florida

Lagoon modifications improve manatee habitat.

To accommodate migrating manatees attracted to the heated effluent of the Florida Power and Light's Discharge Canal, Port Everglades modified a mangrove area within its boundaries. Before the Port made modifications, manatees used the lagoon in the mangrove forest only during the highest portion of the tidal cycle. Because of shallow depths and mid to lower tides, the manatees could get stranded or trapped in the lagoon when the water level dropped.

To allow manatees to safely utilize the lagoon at all stages of the tide, the Port restored the depth to -5.0 MLW by dredging. No dredging was done within 20 feet of the mangroves to minimize impact to the forest. The Port also ensured that entrances to the lagoon were closed to all boat traffic by installing floating barricades and pilings.

An observation platform was built in the center of the lagoon. Scientific agencies and accredited researchers use the platform to observe manatees mating and nursing. These observations resulted in the designation of a protected manatee nursing area.

In addition to improving habitat for the manatees, the Port, in coordination with various environmental agencies, developed a Manatee Protection Plan to be utilized during dredging and blasting projects. The plan involved educating the contractor about manatee habits, habitat, and migrations. The education program included a slide presentation depicting manatees within the port area as well as field observations in the waters of the proposed project. Based on a review of scientific data, a 300-foot zone was designated.

The Manatee Protection Plan calls for observers to be placed in various areas around a proposed dredging or blasting project. Observers will be placed on all contractor work vessels, at locations 500 feet from the center of activity, and on boats within 300 feet of activity. If manatees are spotted within the 500 foot zone, the intensity of the watch is increased. If manatees are found within the 300 foot zone, all operations are curtailed until the animal is sighted outside of the zone. Sightings of

manatees are recorded in a log.

Manatee protection measures implemented by Port Everglades have led to benefits for both the manatee and the Port. Improvements to the lagoon have resulted in more manatees frequenting the area. In fact, once the modifications were completed, researchers noticed that more manatees utilized the lagoon in one season than in the previous five years combined. In addition, implementation of a Port Protection Plan has allowed the Port to dredge during the designated manatee season without harming any manatees.

Right Whale Protection, Port of Boston, Massachusetts

Effective information tools disseminated as part of a comprehensive whale protection program.

The Massachusetts Port Authority (MassPort) has played an important role in the protection of the Northern right whale, whose population continues to dwindle despite increased regulatory protection. Essentially, the Port serves as a coordinating agency for the various right whale interest groups, including mariners, scientists, and regulators. The Port uses its established relationships with the shipping industry to transfer whale-related information from scientists and regulators. Through financial and technical support, the Port is ensuring that mariners will be better equipped to handle encounters with these endangered creatures.

At the request of the National Marine Fisheries Service, the Port joined with others such as the Massachusetts Division of Fish and Wildlife, US Coast Guard, and New England Aquarium who were already actively engaged in reducing injuries to the right whale from fishing gear entanglements and ship strikes. As part of the Northeast Right Whale Take Reduction Implementation Team, the Port focused its efforts on educating the mariners that pass through the Northeast whale feeding grounds on their way to the Port. MassPort plays an active role in producing the educational materials and disseminating the information to the mariners.

MassPort's Guidelines for Mariners

The Port has paid particular attention to the presentation of the information. They ensured that the materials would be useful to the mariners by reducing scientific jargon and creating an attractive design. One of the educational materials is a four page color brochure. Not only does the brochure describe the whale's behavior, threats to whales, and on-going research in the area, it also provides over a dozen photographs of the right whale that can be used in identification. Another educational tool is a one-page guide for mariners. The color, laminated guide lists precautionary measures for mariners to take to avoid northern right whales. It includes a list of ways to identify right whales, recommendations for how to handle a whale sighting, and several photos with text describing unique right whale markings. The Port has also been involved in the production of a fifteen minute training video for mariners that includes interviews with ship's masters and on-vessel footage.

In addition to assisting with the production of informative brochures, guides, and videos, the Port serves as the main distributor for these items. The Port distributes the materials to the shipping agents at both public and private berths. The materials are also included in paperwork packets for all of the Port-owned berths. Additionally, the pilots at MassPort bring the guides and brochures on-board ships and personally inform the crew of the right whale presence in New England waters. The pilots have found an increasing awareness among the ships' crews since the materials were first disseminated.

Another way that the Port helps in the transfer of information from scientists to mariners is through a sighting alert network. Vessels search the waters of the Massachusetts coast for right whales and, once spotted, send the location to MassPort. In turn, the sighting location is communicated elec-

tronically to incoming vessels upon entry to Massachusetts Bay. NMFS air crafts also search the waters and fax any whale sightings to area agencies like MassPort. For the following 48 hours, MassPort passes this information along to vessels entering the area.

MassPort has recognized its unique role in the marine community as a point of coordination for scientists, mariners and regulators. The Port has used its resources to effectively communicate to mariners the steps they can take to avoid colliding with northern right whales. The Port itself stays updated on the latest right whale information by participating in local conferences focused on right whale protection and by hosting whale-related presentations at its internal meetings. By continuing to coordinate with scientists, shippers, fishers, and regulators, the Port aims to minimize and eventually eliminate whale mortalities due to ship strikes off the Massachusetts coast.

Note: Port Canaveral initiated a similar Right Whale Protection Program that received a 1994 AAPA Environmental Improvement Award. In its program, Port Canaveral coordinated with other Southeastern US ports to ensure consistency in Port plans and requirements. For more information, contact Port Canaveral.

Protection of the California least tern, Port of Los Angeles, California

Collaboration with federal agencies results in least tern habitat protection.

The California least tern is a small black and white migratory sea bird that nests along the southern California coast from the middle of April to the end of August. Sightings of the least tern at the Port of Los Angeles were first recorded in 1973, the same year that the tern was listed as endangered by the US Fish and Wildlife Service. Through the years, the Port has played an active role in protecting the least tern nesting and feeding areas within the Port.

To protect the least tern nesting areas, particularly the bare, sandy beach areas, the Port entered into a Memorandum of Agreement with the US Fish and Wildlife Service, the US Army Corps of Engineers and the California Department of Fish and Game. This renewable Cooperative Agreement, first signed in 1984, recognizes the importance of protecting the least tern while facilitating maritime commerce. The agreement specifies conditions for locating a fifteen acre nesting area in the Harbor. With the cooperation of all parties involved, the nesting area is prepared and protected from 1 April to 1 September. Conditions listed in the agreement state that the site must be reasonably level, within 0.5 miles of shallow water, and devoid of structures. The agreement also establishes guidelines for the necessary relocation and monitoring of the nesting site as required by Port developments.

Responsibilities of each participating agency are defined in the agreement. The California Department of Fish and Game and the US Fish and Wildlife Service are responsible for recommending actions for successful nesting. They also monitor the nesting activities in the Harbor area. The Los Angeles Harbor Department is charged with designating, creating, and maintaining the least tern nesting site. The US Army Corps of Engineers, who handles various conservation, development, and management issues in the harbor area, will assure compliance with the conditions in the agreement. Contacts for each of these agencies are designated in the agreement to ease communication among the parties.

The Port also protects important shallow water least tern feeding areas in Outer Los Angeles Harbor. These shallow water areas appear to be favorite feeding sites for terns, especially after their young hatch. In 1984 as well as in 1996, the Port constructed a 190-acre shallow habitat region to mitigate certain infrastructural expansions. These feeding areas served as replacement habitat for shallow water lost as a result of construction and dredging of a deep berth. The construction of the shallow region covered nonhazardous contaminated sediments present in the Harbor; thus this project serves the dual purpose of creating a least tern feeding site and a Confined Aquatic Disposal site.

Protection of nesting and feeding areas in the Port has allowed least terns to coexist with one of the largest industrial harbors in the nation. The cooperative interagency coordination has led to unprecedented success with 105 nests in 1997 and 218 nests in 1998.

HABITAT Restoration

Issue/Problem

Port development inevitably consumes a large amount of property and resources, requiring periodic expansion and reshaping of the coastline to keep pace with technology and demand. In addition to filling, dredging, and in- and over-water construction, ports frequently install devices to control flooding, stabilize shorelines, reduce wave energy, and improve water quality. The latter activities are designed to protect and enhance the port environment, but sometimes at a cost to local habitats. As a result, ports are often required to restore adversely impacted habitats or create additional habitat as compensation.

There are differing points of view as to how effective habitat restoration can be, and many habitat restoration and creation projects stimulate controversy. Although the functions of a wetland are understood, for example, there is no consensus as to what constitutes a fully functional wetland. There also are disagreements over whether restored habitats can function as productively as natural habitats, or if these habitats will serve the same ecosystem function as before. The controversy surrounding restoration projects often results in lawsuits and legal injunctions that delay projects for many years. The debate will likely continue until the distribution and abundance of species is understood well enough to address these management questions and learn how to protect and provide habitats while preserving their natural attributes.

Difficulties in obtaining the necessary permits also result in significant project delays. The permit process can be both frustrating and expensive, and relationships between the regulators and project proponents can be strained as a result. For these reasons, in restoration projects, the permitting process becomes the focal point of both the port industry and the regulating authorities.

Environmental Impacts

Sensitive and ecologically important coastal habitats such as wetlands, estuaries, mangrove forests and reefs are easily damaged by port activities through the pollution of waters by toxic substances or with excessive nutrients, and through the physical destruction of the seafloor. Some obvious examples of habitat degradation include coral reef damage and wetland sedimentation.

Wetlands comprise the largest portion of habitat restoration projects in the US. The reason for this concentration of effort is clear: wetlands are vital to the reproduction and migration of millions of species, they control greenhouse gases, reduce flooding, filter pollutants, and provide a natural storm buffer, but they are disappearing more rapidly than any other habitat. One study indicates that 22 states have lost 50 percent or more of their original wetlands (Dahl 1990).

Many ports are located in estuaries which provide food, shelter, and spawning grounds for 75 percent of the commercial fish landed in the US. The primary threat to these habitats is water pollution from land-based sources, water contamination through the resuspension of toxic sediments during dredging, chronic oil pollution from ports, and episodic oil spills. Symptoms of estuarine habitat degradation include the destruction of seagrass or decline in seagrass production, an increase in numbers of diseased fish, a decline in marine mammals, eutrophication of the water column, and large fish kills.

Applicable Federal Environmental Regulations

The US Army Corps of Engineers, US Environmental Protection Agency, US Fish and Wildlife Service, Forest Service, Natural Resources Conservation Service, and Federal Emergency Management Agency have jurisdiction over habitat restoration programs. Relevant federal laws include the National Environmental Policy Act, Section 404 of the Clean Water Act, Rivers and Harbors Act of 1899, Executive Order 11990, Coastal Zone Management Act, National Fishing Enhancement Act of 1984, Endangered Species Act, Marine Mammal Protection Act, and the Fish and Wildlife Coordination Act.

Section 404 of Clean Water Act regulates the discharge of dredged or fill material into waters of the US, including wetlands. Section 10 of the River and Harbors Act of 1899 requires a permit be obtained for any obstruction or alteration to

navigable waters, including structures in or over the water. The US Army Corps of Engineers has the permitting authority under each of these statutes. The regulatory discussion under the Dredging and Contaminated Sediments issues section provides more detail on these programs.

Executive Order No. 11990, the Protection of Wetlands, directs each federal agency to provide early public review of plans and proposals for construction in wetlands. The main purpose of this order is to ensure that proposed federal wetland activities are adequately justified.

The federal consistency provision of the Coastal Zone Management Act requires all federal activities (projects, permits, plans) be carried out in a manner consistent with approved state coastal zone management programs. State coastal zone management programs are designed to balance protection of the environment with needed economic development.

The National Fishing Enhancement Act of 1984 establishes national standards for the development of artificial reefs and encourages the development of reefs that will enhance fishery resources. It also encourages state involvement in these activities.

Habitat restoration projects also must comply with the Endangered Species Act, Marine Mammal Protection Act, and the Fish and Wildlife Coordination Act. These laws are described in more detail in the discussion under the *Endangered and Threatened Species* issue description.

Management Options

As compensation for the loss or reduction in value of natural habitat resulting from development activities, environmental laws require project proponents to restore degraded or create new habitat. If properly designed, new or restored habitat can provide equivalent environmental benefits such as cleaner water and biodiversity, reduced siltation, accretional-erosional stability, and increased dissolved oxygen content. There are several common types of habitat restoration and creation projects.

Wetland restoration and creation requires a thorough understanding of the existing or damaged system so that the functional processes of the wetland that are/were important to fish and wildlife can be maintained. When restoring a wetland, it is important to identify problems related to erosion or sedimentation, channel or stream obstructions, unsuitable or lacking vegetation, and water quality. A substrate favorable to plant growth must be available along with the right mix of sediments and organic materials. Small creeks and channels are often constructed to maintain flushing, provide nutrients, and prevent sedimentation of the wetland.

The use of dredge material has become a widely applied practice for restoring and creating habitat. Specialized dredges and equipment have been developed for the careful placement of dredge material to form berms, wetlands, reefs, and beaches. Floating and tracked equipment have been designed to minimize impacts during construction. Artificial habitats created with dredge material have provided excellent environments for sea birds and other animals.

The construction of artificial aquatic habitats using habitat enhancement structures, fish aggregating devices, and artificial reefs is another widely used restoration technique. These structures can provide cover, shelter, and a stable environment for feeding, resting, nursing, and evading predators. Examples of habitat enhancement structures include in-water structures such as carefully placed large rocks and rock aggregates, digger logs, deflectors and brush fences. Concrete, old ships, and rubble are materials most commonly used to create artificial reef habitats.

Erosion Control and Beach Restoration, Port Canaveral, Florida

Eroding dunes restored by massive beach grass planting.

Since the early 1990s, Port Canaveral has undertaken several large scale beach restoration projects to counteract erosion resulting from Port development and from the dual rock jetties that protect the entrance channel to the Port. Studies as far back as 1962 reveal a clear correlation between construction at the Port and significant erosion of sand from beaches on the south side of the jetties in Brevard County. In some areas the beaches have eroded as much as 15 feet per year.

In 1991, the Port conducted a voluntary study to determine the cause and effect of the impacts of erosion and to determine the feasibility and cost of restoring the beaches of Brevard County. The results of this study were used to frame the Port Canaveral Inlet Management Plan in 1994. Recommendations in this plan included renourishing the eroded beaches south of Port Canaveral and restoring the natural sand drift. The plan has been implemented through a number of different projects (see, for example, the Nearshore Berm Disposal Project under *Dredging and Contaminated Sediments*), all of which were joint efforts between the Canaveral Port Authority and federal, state, and local governments.

In order to generate continued legislative support for its beach restoration efforts, the Port Authority has created and produced a comprehensive briefing notebook and informational video outlining its Shore Protection Project. Several presentations explaining the project and encouraging public support have been distributed to local citizens, restaurants, chambers of commerce, and hotel and condominium associations.

From 1992 to 1998, a series of jetty-tightening projects using sand-filled geotextile tubes have reduced shoaling effects and beach erosion from these structures. Longshore drifting sand no longer filters through the jetties and instead is available to replenish the beaches. The Port also sponsored several beach renourishment projects—Nearshore Berm Disposal Project, the Cape Canaveral Truck Haul, Sand By-pass Phase I, Cocoa Beach Truck Haul, and the Sand By-pass Phase II.

One of the Port's more celebrated erosion control efforts—and winner of a 1995 AAPA Environmental Award—was a massive dune restoration project. This effort provided an opportunity for homeowners and local residents to directly participate in an environmental restoration project, generating positive publicity for the Port and its historical commitment to beach restoration.

In 1995, the Army Corps of Engineers asked the Port Authority if it would be interested in purchasing any amount of 65,000 beach plant seedlings (35,000 sea oats and 30,000 bitter panicum) intended for a project that had been delayed. Unless they were planted soon, the seedlings were going to die. Recognizing that dune grass is a natural buffer against erosion, the Port agreed to purchase the entire reserve of seedlings and plant them along the 72 miles of continuous beach dunes in Brevard County. The Port offered the seedlings for free to anyone willing to plant them.

The challenge of distributing the plants was resolved by recruiting local governments and residents. Cape Canaveral, Cocoa Beach, and Indialantic planted 11,400 seedlings adjacent to public access crossovers where vegetation had been disrupted by pedestrians. The Brevard County Commission used 8,500 seedlings to enhance the dune systems of several beachfront public parks, and the US Fish & Wildlife Service planted 5,600 seedlings on the dunes of a wildlife refuge. The Port Authority placed an advertisement in the local newspaper announcing that the seedlings were available to local residents free-of-charge. Hundreds of beachfront residents responded and the giveaway lasted only two hours.

During the planting phase, the Port ensured that existing turtle nests on the beaches were not disrupted and that seedlings were planted on the landward side of the dune crest where they would be most beneficial. As the seedlings grow, their roots, stems and leaves will stabilize the dunes and provide enhanced habitat for several endangered species, including the nesting turtles.

Coal Combustion Byproduct Oyster Reef Construction, Port of Houston, Texas

Habitat for reef climax community provided by innovative artificial substrate.

In 1995, the Port of Houston Authority (PHA) proposed widening and deepening the Houston Ship Channel. One obvious impact was that approximately 118 acres of primary oyster reef habitat that bisect the channel would be destroyed by the proposed project. Any potential indirect impacts to neighboring reefs were ruled out by the coupling of a hydrodynamic model designed by the US Army Corps of Engineers Waterways Experiment Station and a population dynamics model developed by Texas A&M and Old Dominion universities that permitted full-scale simulations of oyster populations in the area.

Port of Houston, Texas, Turning Basin Terminal.

Mitigation required the construction of six separate 20-acre oyster reefs in Galveston Bay. In conjunction with the Houston Authority, the Houston Lighting and Power Company, the National Marine Fisheries Service, and the Galveston Bay National Estuary Program, the Port embarked on a 5-acre demonstration project to determine the biological feasibility and cost-effectiveness of using coal combustion by-products (CCBs) to construct artificial oyster reefs. Fly ash, bottom ash, boiler slag, and flue gas desulfurization material are examples of CCBs. In this project, 12,100 cubic yards of ash obtained from the Houston Lighting and Power Company's coal and lignite power plants were combined with cement to form golf ball sized pellets. These pellets were designed to simulate suitable cultch material upon which oyster spat can settle, attach, and eventually grow to market size.

Deployment of the entire reef was scheduled for May, just prior to the peak oyster spawning period, but because of permit delays the reef had to be deployed in two separate sections and at separate times—one in May and one in August. Each section was deployed to an average depth of 18 feet. Combined, both parts of the reef formed a rectangle approximately 300 x 700 feet, positioned with the long side aligned with the prevailing tidal movement.

The test reefs were monitored for oyster attachment and within six months the pellets were encrusted with oysters, demonstrating the heaviest recorded natural oyster set on a Galveston Bay reef substrate in at least 40 years. Oysters grew to three inches or larger (market size) in less than 18 months. Typically, it takes oysters four to seven years to reach market size. In addition, they found that finfish such as spadefish and snappers inhabited the reef in a short time and that after two years, the habitat was representative of a reef climax community equitably shared among species.

The highly favorable results of this project indicate that CCBs constitute environmentally safe and biologically sound artificial reef material. And there are additional benefits. First, using CCBs is a cost effective alternative to using natural oyster shells, the traditional artificial reef substrate (note: the dredging of derelict oyster beds to obtain the necessary shells has been banned in Galveston Bay since 1970 because of environmental impacts). Second, the disposal of CCBs presents a growing environmental problem in light of the amount of landfill space required for disposal. Developing a new market for CCBs for reef construction frees-up much needed landfill space. Third, the transportation costs of the reef materials to the site was economically more favorable than placing the ash in a landfill, demonstrating advantages for both producers and consumers in diverting CCBs from landfills.

Note: While the demonstration project was suc-

cessful, the reefs were never built due to unsurmountable permitting hurdles.

Relocation Plan for the black-crowned night heron nesting colony, Port of Long Beach, California

Regionally significant species protected by relocation of heron habitat.

In 1994, the Long Beach Naval Station adjacent to the Port of Long Beach, declared previously as military surplus, was closed. The property was subsequently transferred to the City of Long Beach for non-military commercial use. The City's approved plan for reuse permitted the Port to redevelop the property as a marine container terminal.

Container handling is an intense activity involving large cranes, expansive storage area, numerous tractors and trucks, and 24-hour lighting. Redevelopment of the site required the demolition and removal of all existing structures, utilities, and vegetation, resulting in the destruction of the existing nesting habitat of a black-crowned night heron rookery (*Nycticorax nycticorax*). This particular colony is considered to be a regionally significant species since, at its peak in 1996, it was the largest known nesting colony in southern California. The bird is protected under the federal Migratory Bird Treaty Act, and any demolition of the nesting habitat during the nesting season would be considered a "takings" of the species. While the regulations do not protect the habitat outside of nesting season, as an act of good faith, the Port agreed to prepare a long-term mitigation plan for the heron for the US Fish & Wildlife Service (FWS).

The Port considered four alternatives for mitigating the loss of this habitat. First, it considered cancelling its redevelopment plans altogether, but the waterfront property was considered too valuable to relinquish to a less economically productive commercial use. Second, the Port considered ignoring the colony under the assumption that the herons would recolonize elsewhere during construction. This option was undesirable because there was no proof that recolonization would take place and that the colony would not be lost entirely as a breeding resource. Third, it considered leaving the colony in its current location and building the new terminal around the nesting trees, an idea dismissed because it seemed unlikely that the herons could survive, let alone nest, in a noisy and busy environment. The final and most plausible option was to move the herons to a remote location. During deliberation over the potential for relocation, a spontaneous recolonization of half of the heron colony to a different location in the harbor area was observed, affirming the workability of this option. Absent a plan of their own, FWS agreed that relocation of the colony was the best alternative.

The new nesting site was chosen after careful consideration of (1) suitability for long term survival of the trees, (2) proximity to the water to support heron feeding, and (3) remoteness from human and industrial activities that could harass or harm the herons. The 8.5 acre Gull Park, located 1.5 miles from the present site, met all these qualifications.

The site was first prepared by removing all existing park structures, planting windbreak trees, installing windbreak walls, upgrading the irrigation system, and amending the soil. Only twelve trees similar to those at the old nesting site existed at the new one so, following the 1998 nesting season, 50 of the largest trees from the old site were moved to the new one and 20 additional trees were purchased to ensure that there were enough trees to support nesting activity. Some of the nests used in the 1998 season were salvaged, stored and later placed in the relocated trees to help make the trees more attractive to the herons. Black-crowned night heron decoys also were installed and recordings of heron vocalizations were broadcast twice daily to encourage nesting.

Under agreement with FWS, the recolonized herons will be monitored by the Port of Long Beach for the next five years, at which point US Fish & Wildlife will conclude whether the project was a success or not. Monitoring began in early 1999. The first survey on 22-23 March 1999 found approximately 18 active nests producing 47 eggs. By the second survey on 4-5 May 1999 the colony had grown to 37 chicks and 200 eggs

in 96 nests. By the third survey on 16-17 June, the population was 138 chicks and 227 eggs in 147 nests. The 1999 numbers are the highest observed since the peak in 1996, and the surveys revealed that the birds are nesting in both the relocated and existing trees. If this trend continues, the Port will have succeeded in relocating and maintaining the black-crowned night heron.

Restoration of Batiquitos Lagoon, Port of Los Angeles, California

Marine resources reestablished in wetland restoration project.

Batiquitos Lagoon is a 600-acre coastal wetland located in northern San Diego County in the City of Carlsbad. Less than 150 years ago, Batiquitos was fully tidal and supported an array of marine shellfish. Over time, development in the region has restricted water flows to and from the lagoon and sediment from development has filled significant portions of the lagoon. Until restoration began, the lagoon had ceased being tidal altogether. It would fill with fresh water in the winter, and was subsequently drained in the spring to stop flooding and provide nesting sites for endangered birds, becoming completely dry or hypersaline in the summer and fall.

Despite the obvious functional degradation of the lagoon, migratory birds still visited in large numbers each year. It was home to several threatened or endangered species including the California least tern, Western snowy plover, and Beldings savannah sparrow. But development pressures continued to persist for both the lagoon and its surrounding land. A land transaction in the early 1980s deeded over most of the lagoon to the State of California, which recognized that without restoration the lagoon would continue to fill with sediment and lose its remaining wetland values.

In 1985, the California Coastal Conservancy prepared an Enhancement Plan for Batiquitos Lagoon. The plan was completed in 1987, at which time California resource agencies approached the Port of Los Angeles to restore the lagoon, in accordance with the Enhancement Plan, as mitigation for the loss of deepwater fish habitat following a proposed cargo terminal development and channel improvements in the Outer Los Angeles Harbor of San Pedro, now known as Pier 400. An interagency mitigation agreement between the Port of Los Angeles and various municipal, state, and federal agencies required the Port to fund all restoration activities, including preliminary design, environmental review, final design, construction, monitoring, and maintenance in perpetuity.

The goals of the restoration project were to reestablish marine resources in the lagoon through the restoration of tidal flushing, while preserving important habitat and protecting sensitive species in the lagoon. Construction began in March 1994 and was concluded in December 1996.

The restored lagoon has since become typical of other healthy California coastal habitats. Reestablishing the lagoon-ocean interface provides natural flood and sediment control. Improved water quality prohibits eutrophication and eliminates previous odor problems.The lagoon now supports over 40 marine species and functions as an important nursery area for fish. The number of birds inhabiting the lagoon has remained high, and the endangered tern and plover have demonstrated a population increase since restoration began. In addition, the black skimmer, a species not previously nesting in all of San Diego County, now inhabits the lagoon.

Two features of this project are particularly innovative. First, dredges used to remove the sediment from the lagoon were modified to allow precision dredging to achieve specified acreage of very flat slopes within specific elevation bands. Second, this contouring generated nearly one million cubic yards of silts, clays and organic material that needed to be disposed of. As an alternative to upland or offshore disposal, sandy material was dredged from another area in the Batiquitos lagoon area and used to construct nesting sites and nourish local beaches. The large pit created by the dredging was then used for disposal of the finer grained and organic material removed from the lagoon and capped with sand. The total cost of the Batiquitos Lagoon restoration was $55.3

million, with substantial cost savings realized by these innovative, cost-effective and time saving practices.

The lagoon is leased to the California Department of Fish and Game and used as an Ecological Reserve with the use of maintenance funds provided by the Port of Los Angeles.

Berth Expansion Fish Enhancement Structures, South Jersey Port Corporation, New Jersey

Steel pilings modified to serve as freshwater tidal migratory fish habitat.

In response to increased productivity and larger vessels, the South Jersey Port Corporation needed to expand its facilities. To do so required that a portion of the Delaware River be filled, destroying intertidal and subtidal shallow habitats. A traditional wetlands mitigation program was designed and approved by the federal and state regulatory agencies. In addition, a pilot program was designed consisting of fish enhancement structures to be placed in this tidal fresh water environment. The goal was to find a suitable, cost effective alternative to the typical high cost, wetland mitigation creation in high cost real estate areas.

Part of the Port renovation involved the expansion of berthing facilities and a high deck expansion of the pier, requiring the placement of steel pipe piles for support. Used automobile tires were attached to these steel pilings to create artificial fish habitat to enhance spawning. The tires were first radially mounted to steel collars in a vertical position—eight tires per collar. The tire collars were then slipped over the steel pipe piles and down into the water prior to installing the top deck. Plumb lines were used to install the tires at varying depths.

This artificial habitat proved to be very successful. Over time, the interior of these tires were silted with suspended river sediments and became home to many organisms. The surface of the tires were inhabited by numerous other species, and the tires provided a shelter and feeding habitat for nursery fish which feed on these organisms. The smaller fish, in turn, are grazed by larger anadromous fish. Aside from the success of the habitat, this project demonstrates additional benefits. The total cost of these structures was less than 10 percent of what it would have cost to create a traditional wetland. In exchange for installing these tires, the permitting agencies agreed to reduce the size of the mitigation area by one quarter of an acre. The use of tires not only saved time but also saved money over other traditional methods of mitigation and diverted a product destined to be landfilled. This design is simple and easily transferrable to other ports. It was the first pilot program conducted in freshwater tidal migratory fish habitat.

LAND-BASED Water Pollution

Issue/Problem

Water pollution can result from either episodic events, e.g., catastrophic oil spills, or from more low-level and chronic point and non-point sources. The impacts of episodic events such as oil spills are readily observable and often sensationalized in the media. The presence of chronic pollutants are often less obvious but their cumulative impacts in the marine environment can be equally or more detrimental over time. Chronic pollution stems mainly from non-point sources, generating a diffuse problem that is difficult to mitigate. Most land-based pollution is classified as chronic.

An estimated 80 percent of pollutants identified in the marine environment are generated as a result of land-based activity. The byproducts of these activities—nutrients, persistent organic compounds, heavy metals, and pathogens—can be introduced directly into the ocean from point source discharges, such as controlled sewer outfalls and wastewater pipes, or through non-point sources, such as surface runoff. These pollutants also can be introduced indirectly via rivers and streams that eventually discharge into the ocean. Symptoms of water pollution include: foul odors, water discoloration, excessive algal growth, high fecal coliform counts, low dissolved oxygen levels, wetland loss, increased fish mortality, contaminated sediments and marine life, and erosion.

Inorganic nutrients from land-based activities enter the marine environment from wastewater treatment plants, agricultural fertilizers, and atmospheric deposition. Toxic pollutants such as persistent organic compounds (particularly pesticides, dioxins, furans, and PCBs) enter the environment primarily though various commercial and industrial sources. Heavy metals reach the marine environment through atmospheric deposition, having formerly been released into the air from automobiles or during mining, metal-plating, jewelry-making, textile milling, and other manufacturing operations. Large agricultural operations and the cumulative impacts of residential application are a significant source of pesticides to the marine environment—more than two billion pounds of pesticides are used in the United States each year (Hall-Arber 1991). Dioxins and furans originate from industrial sources such as pulp and paper mills, dry cleaners, municipal waste incinerators, and automobile exhaust.

Health and Environmental Impacts

Once transported to coastal waters, land-based pollutants can seriously affect marine biodiversity, resonate throughout the food chain, and interfere with active and passive recreational use of the marine environment. Commercial and recreational fishing and shellfishing opportunities, for example, can suffer from diminished or damaged stocks, aquatic vegetation can be destroyed, and human health can be affected by contact with polluted water.

Perhaps one of the most serious impacts of land-based marine pollution—and the most serious pollution problem of the coastal zone—is eutrophication of the water column. Eutrophication is a condition where unusually high levels of nutrients, presumably from land-based sources, stimulates excessive biological production of microalgae. One effect of eutrophication is a depletion of the oxygen supply in the water column and its underlying sediments. The depletion of oxygen can result in significant habitat loss over time, especially the loss of valuable spawning and nursing grounds. Another affect is an increase in the presence of certain nuisance and toxic species, also called harmful algal blooms (HABs). HABs can cause water quality deterioration and toxin bioaccumulation. The consumption of contaminated fish that feed on toxic algae can cause illness and death. HABs can also produce economic losses when beaches and shellfish beds have to be closed (Taylor et al. 1994), or through heightened consumer fears concerning the safety of eating seafood (Brooks 1992).

Heavy metals are also a significant problem in a marine environment. Because of their basic elemental form, heavy metals are very long-lived in the environment, resistant to degradation, they tend to accumulate in sediments and marine life, and can be acutely toxic. In marine animals, long-term or intense exposure to heavy metals can result in impaired growth and deformities,

reduced reproductive rates, and death. Human impacts include metabolic disruption, neurological damage, and increased incidents of cancer.

Applicable Federal Environmental Regulations

The Clean Water Act (1977 amendments to the Federal Water Pollution Control Act of 1972) regulates the discharge of pollutants, seeking eventual elimination of all discharges of pollutants into navigable waters—the "Zero Discharge" goal—with an intermediate goal being water that is both "swimmable" and "fishable." The Act classifies water bodies, sets water quality standards, enables US EPA to establish technology-based effluent limitations that are industry-specific, and mandates certain technologies for controlling conventional and toxic pollutants.

All waters have been classified in terms of levels of certain pollutants. Every navigable body of water is assigned a Water Quality Classification and a corresponding Water Quality Standard. The Act's nondegradation policy is designed to ensure that the most pristine water bodies are not allowed to degrade below the minimum Water Quality Standards.

To supplement the Water Quality Standards, US EPA has established maximum concentration levels for pollutants discharged from certain industrial point sources. These "Effluent Limitations" are established based on the best technology available to control the pollutant. For conventional pollutants, this technology is referred to as the "Best Conventional Pollution Control Technology," and for toxic and non-conventional pollutants, it is refereed to as the "Best Available Technology Economically Achievable."

A permit is needed for point source discharge to waters of the US or its adjacent wetlands under the National Pollution Discharge Elimination System (NPDES). An NPDES permit requires the use of technology to meet Effluent Limitations. No permit can be issued without water quality certification, i.e., the state water pollution agency must certify that the activity will have no adverse impacts on water quality. A facility with a point source discharge must treat the wastewater to within the limits defined in the NPDES permit.

The 1987 reauthorization of the Clean Water Act established the section 319 Nonpoint Source Management Program. Under section 319, States and other jurisdictions receive funds to support a variety of activities including technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to address nonpoint sources of water pollution. The Coastal Zone Act Reauthorization Amendments of 1990 included provisions (section 6217) requiring states with approved coastal zone management programs to develop coastal nonpoint pollution control programs. These programs will be implemented through changes to the state nonpoint source programs under section 319 of the CWA and through changes to the state coastal zone management program.

Additional public laws relevant to the issue of land-based water pollution include the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA); the Pollution Prevention Act (PPA) of 1990; the Resource Conservation and Recovery Act (RCRA) of 1976; and the Toxic Substances Control Act (TSCA) of 1976.

Management Options

Strategies for understanding and managing water quality problems include: (1) designing a comprehensive program for water quality management that includes an evaluation of pollution sources, a review of hydrogeographical factors that affect pollution distribution, an assessment of water quality, prioritization of water pollution problems, and identification of the best available control measures and management practices; (2) the use of less chemically-dependent methods for controlling pests (e.g., pest traps, natural predators, and companion planting); (3) proper maintenance of stormwater collection systems and combined sewer overflows to improve their water carrying capacity and reduce the volume of untreated water released during overflow periods; (4) careful planning and controlling of Port development; (5) use of foliage buffer zones near water bodies to serve as natural water treatment for run-off; (6) diversion of stormwater into leaching basins, which also nat-

urally treat polluted run-off; (7) use of porous pipes to reduce the overall volume of point-source discharge; and (8) redesigning of drainage systems to accommodate pollutant removal.

Port Area Petroleum Users Group Risk Assessment, Port of Anchorage, Alaska

Nontraditional approach featuring MOA results in community-wide support for regional cleanup.

Faced with prohibitive costs to manage contaminated soils associated with a Port transportation improvement project, the Port of Anchorage spearheaded the creation of the Port Area Petroleum Users Group (PUG) for the purpose of encouraging and enabling all Port area land owners and users to work cooperatively in identifying and resolving environmental concerns related to contaminated soil and water. It was believed that a cooperative approach would be more successful and cost effective than each responsible party attempting to remediate pollution on its own.

PUG entered into a Memorandum of Agreement with the Alaska Department of Environmental Conservation to provide for the assessment and cleanup of petroleum-contaminated soils and water within a 300-acre area of the Port. PUG is comprised of the Port of Anchorage, the Alaska Railroad, US Defense Fuels Supply, and several domiciled Alaska oil companies. Participation in the PUG does not indicate any assumption of liability nor does it relieve any responsible party of any liability for hydrocarbon contamination. Members can withdraw from the process at any time.

This collaborative approach has resulted in more resources being directed at cleaning up contaminated areas. Members of the collaborative jointly fund site assessments and related work and share administrative and management responsibilities for the projects. The Port staff has taken an active role by serving as chairs for both the Executive and Public Relations Committee and by hosting the meetings at the Port's facilities.

By combining technical and financial resources, the PUG members have developed a nontraditional approach to remediation that has resulted in considerable cost and time savings. In this case, cost effectiveness is measured as avoided costs.

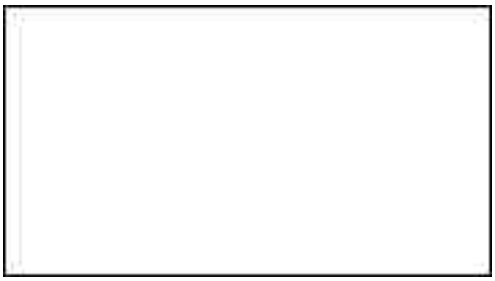
Another noteworthy aspect of the PUG program is the support from state regulatory agencies which have supported the effort from the beginning. The agencies' support included providing verbal assurances that compliance orders would not be sought while the PUG functioned. The Alaska Department of Environmental Conservation has expressed interest in the approach as a potential model for other large contaminated sites in the state.

Stormwater Collection System, Port of Corpus Christi, Texas

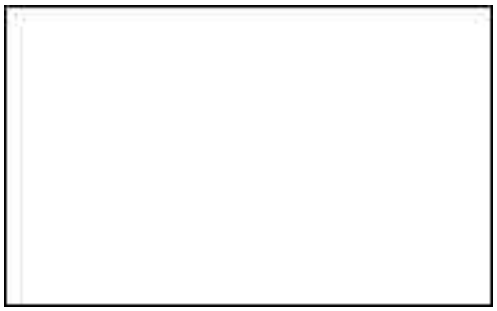
Successful storm water program includes infrastructure and management improvements.

With increasing dry bulk materials traffic, the Port of Corpus Christi Authority (PCCA) has developed a Bulk Dock expansion master plan that will reconfigure existing operations, relocate facilities, and build a third bulk dock. Increased bulk materials handling resulting from this expansion will add significant amounts of dust to the terminal. To handle increased dust dispersal and minimize its discharge into the ship channel with stormwater runoff, the PCCA Engineering and Environmental staff collectively formulated a stormwater pollution prevention plan. The plan includes added operational controls and upgraded stormwater drainage infrastructure that will improve the environmental quality of the stormwater runoff from the PCCA facilities.

Traditional pollution control measures, such as water-sprays at transfer drop and direction-change points, covered conveyor belts, and a solid waste recycling program, are currently in place at the Port. The PCCA is supplementing these measures by sweeping and vacuuming the roadways, fitting vehicles carrying dust generating product with tarps, enforcing slower vehicle speeds (10 mph) and improving truck washing. These PCCA's pollution control measures have been further enhanced by the stormwater pollution prevention plan.



Stormwater filtration system and shiploader.



Stormwater ditches.

The stormwater pollution prevention plan has been designed to exceed the minimum requirements mandated by the US EPA's NPDES Industrial Stormwater Program. The plan's design includes stormwater infrastructure improvements such as construction of concrete-lined storm drains and ditches, stilling basins for runoff water, and filtration before stormwater is released into the channel or before pumping into storage ponds.

Specifically, storm ditches have been cleared and then lined with concrete to control, direct, and contain storm water flows. Runoff water is directed through the ditches to a filtration unit before release into the ship channel. This filtration box consists of three different beds - limestone, geosynthetic fabric membranes and anthracite coal. These filters remove sediments, hydrocarbons, insoluble heavy metals and aeration improves the Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD). The filtered effluents can be reused by coke and coal pad operators for air pollution dust control. Waste sediments accumulated in the basins and filter traps are periodically removed. Since they do not need any additional disposal management, the sediments are recycled as base material for pet-coke pads.

Monitoring of the stormwater runoff, a requirement of the NPDES permit program, has shown that water quality has improved since the design's implementation. In addition to enhancing environmental quality, the plan's infrastructure improvements have contributed to the aesthetic image of the Port. The Port has also found the improvements to be cost-effective. Through a comprehensive approach to multimedia pollution control, the PCCA has improved the quality of discharge water, improved the aesthetics of the Bulk terminal, separated and reclaimed solid wastes, captured and reused filtered stormwater, suppressed dust emissions and saved money.

Stormwater Program, Port of Long Beach, California

Several Port departments work together to implement comprehensive management program.

In order to comply with requirements of NPDES permits for stormwater discharges, the Port of Long Beach developed a Stormwater Pollution Prevention Program. The goal of the program is to reduce the pollutants entering the Port's storm drain system from runoff at Port, tenant, and privately-owned facilities. The Port administers the program and facilitates the federal permit compliance of the fifty-five participating facilities. Through the Stormwater Program, the Port strives to minimize redundancy and waste, reduce pollutant loading, and lessen the burden on tenants.

The Port serves as the single facilitator for the program. Several Port departments are involved in implementing different components of the Program. The day-to-day administration of the Program is handled by the Port of Long Beach Planning Division. In addition, the Planning Division assists the participating facilities with stormwater pollution issues. The Maintenance Division assists the Planning Division in implementing the Stormwater Program by maintaining the storm drain system, conducting periodic

cleaning, stenciling inlets, and sweeping the streets. The Engineering Division designs and constructs structures for tenants using Best Management Practices and obtaining NPDES permits when necessary. The Security Division reports on spills and tenant activities that may impact stormwater quality. The Information Management Division manages a Geographic Information System database.

A Master Stormwater Program document has been prepared to serve as a comprehensive reference manual for the Program. The document includes history and documentation of the Port's efforts to comply with federal requirements. It has been organized into sections which describe the evolution and implementation of the various elements of the Port's Stormwater Program. In addition, it contains supplementary materials with detailed information to assist participating facilities in understanding the Program. For instance, a Stormwater Pollution Prevention Employee Training Manual is included in the document appendix.

The Port initiated its efforts in 1991 by educating each of the facility operators about their need to comply with the General Permit and inviting facilities to participate in the Stormwater Program. Concurrently, the Port distributed a Stormwater Runoff Facility Questionnaire to gather information on each facility's operations, activities, potential pollutants, and control measures. In addition to these surveys, the Port now requests that facilities fill out a washing practices survey. Files of completed questionnaires and surveys and records of meetings with participating facilities have been maintained by the Port's Planning Division.

Once a baseline of the Port's stormwater activities had been established, the Port submitted a Notice of Intent to the State Water Resources Control Board, on behalf of itself and participating facilities, in order to comply with federal requirements. The Port's next step involved development of a state-of-the-art GIS database. The database integrates information on the Port's storm drain infrastructure with facility-specific information from the questionnaires and surveys. Layers such as base map, basins, streets, land uses, pipes, storm drain nodes, and parcels are included in the GIS maps. The associated database tables contain information on the facility names, records of previously known spills, best management practices, materials handled, as well as other facility specific details. The Port uses the database to identify areas or facilities where improvements to stormwater pollution prevention measures may be necessary.

The Port has also been actively engaged in ensuring that tenants comply with federal regulations. For example, the Port assists the tenants in preparing and revising Stormwater Pollution Prevention Plans (SWPPPs) so that they meet requirements of the General Permit. A copy of a model SWPPP is included as an appendix in the Port's master document. In conjunction with these efforts, the Port provides participating facilities with a compendium of Best Management Practices from the "California Storm Water Best Management Handbook". To further assist tenants, the Port distributes a video produced by the American Society of Civil Engineers entitled "Storm Water Regulations Employee Training: A Clear Solution."

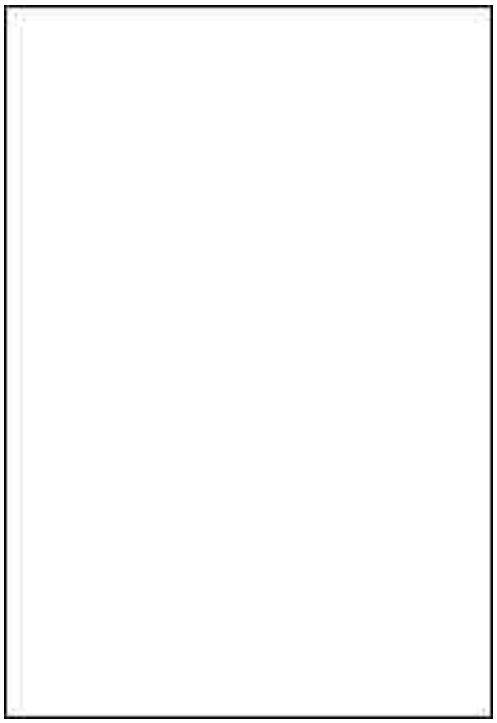
The Port's comprehensive program also includes a water quality monitoring program. In 1992, the Port modified its voluntary water quality monitoring program to comply with federal requirements. The monitoring program consists of water sampling and analysis, wet and dry season visual observations, annual site inspections, record keeping and preparation of annual reports for submittal to the Regional Board.

The Port has found that having a single facilitator implement and maintain its comprehensive program is far more effective than requiring each facility to develop and implement its own program. Implementation of the program has created a collaborative team environment between the Port and its tenants. This coordinated approach provides cost savings to Port tenants, reduced pollutant load in the storm water runoff to meet federal requirements, and enhances the overall quality of the marine environment within the Harbor District.

Integrated Wastewater Management System, Port Manatee, Florida

Local groups participate in integrated wastewater treatment project.

The Manatee County Port Authority assisted the Florida Department of Environmental Protection (DEP) with implementation of an innovative integrated management system for wastewater discharged from the agency's Stock Enhancement Research Facility (fish hatchery) which is located on Port property. The Port's assistance was sought because of its experience in engineering design and construction and because the Port Authority is a "certified governmental entity" which DEP could contract with at considerable cost savings.



Volunteers harvest saltmarsh grass at Port Manatee.

The system provides two levels of treatment prior to discharge of hatchery seawater to Tampa Bay. The Port created a 1.5 acre salt marsh pond by constructing earth berms and grading the interior to the proper elevation. Planting of saltmarsh grasses (*Spartina alterniflora*) in the pond has been done by volunteers from several groups from the community including middle school teachers (who were participating in a training workshop for the Florida School of Environmental Studies), Youth Environmental Services, and the Manatee County Chapter of the Florida Conservation Association. Discharge water from the hatchery first enters a retention pond for aerobic treatment. The hatchery wastewater typically has a low dissolved oxygen content. This condition is improved in the retention pond with the use of two submerged aerators. Each night the water in the detention pond is pumped into the saltmarsh pond where the saltmarsh plants remove nutrients from the wastewater before it is discharged to the bay over the course of the day.

The regular flooding and draining of the saltmarsh pond simulates a tidal cycle to keep the plants healthy and thriving. This produces an additional benefit of the project. Once the saltmarsh grasses achieve maximum density and the efficiency curve in nutrient removal is optimized, some of the plants can be harvested for use in Tampa Bay saltmarsh restoration projects without damaging the pond's wastewater treatment performance. Harvests of even one-tenth of the saltmarsh plants would provide more Spartina than currently planted by both programs in a given year.

Wando Terminal Storm Water Detention Project, Port of Charleston, South Car olina

Stormwater collection system design maximizes available Port space while providing useful wildlife habitat.

In 1991, the South Carolina State Ports Authority approved a design to expand one of its terminals to include a 70-acre container yard and a 1,373 foot wharf extension. This terminal, however, is adjacent to sensitive wetland areas that would be inundated with significant stormwater flow generated on the newly paved surface. Consequently, it became necessary for Port engineers to give increased consideration to the design of the new wharf and to stormwater deten-

tion and release.

In the terminal's new stormwater control and collection system, the first one inch of stormwater that falls onto the expanded container area is gathered, treated and gradually released into the surrounding ecosystem, in a manner mimicking natural processes. Stormwater is collected by an extensive underground network of concrete pipes and then directed through filter cloth into a 17-acre L-shaped detention pond. Sand filters in the pond naturally remove contaminants from the water. Drains installed in the sand filtration bed around the perimeter of the pond were made with geosynthetic materials designed to filter particulates from water and enhance soil reinforcement. During low tide conditions, hydraulic pressure pushes collected storm water through the filtration system and into the Wando river. A tide gate prevents salt water intrusion into the pond during high tides.

One of the noteworthy features of the project is the use of geogrid reinforcement soil walls. Port analysts determined that geogrid walls would cost $385,000 less than wall systems made from sheet pile or concrete. The Wando Terminal is located in a seismic zone and it became necessary to design a wall that can accommodate Zone 2 seismic loadings. A geogrid reinforced modular block can withstand high live loads and seismic loading conditions in areas with low soil loading and settlement conditions. In addition to providing significant cost savings, the use of geogrid reinforced modular walls allowed the pond to abut the container facility without a sloped landscape, thus maximizing available acreage.

Over the past 15 years, monthly water testing directly in front of the Wando Terminal by a mobile monitoring station indicate that Port activities have not negatively impacted water quality. In fact, the river's status has been upgraded and shellfish can be harvested in the Wando River today. Wildlife in the area also benefit from this new detention system. Osprey nest on the terminal, ducks frequent the pond and alligators swim in the retention pond and sun bathe on the grassy embankment.

OIL Pollution

Issue/Problem

Oil pollution is one of the most serious environmental problems in the marine environment. Episodic pollution events, such as catastrophic oil spills, in particular, threaten water quality and habitat with a suddenness and severity rarely matched by other pollutants. Catastrophic spills typically result from transportation accidents such as collisions or groundings of oil tankers.

Most oil pollution stems from non-catastrophic events, however, and occurs most frequently during cargo transfer operations. In fact, of the 3.5 million tons of oil that end up in the ocean every year worldwide, only a small percent is a consequence of tanker spills. About 70 percent of oil pollution is due to chronic pollution from municipal and industrial wastes or runoff, dumping of waste oil, release of oily bilge water, and from other-than-tanker transportation.

Most chronic oil pollution occurs in ports, where tank vessels spend extended periods of time during routine operations, including loading, off-loading, tank washing, and waste-water discharging. Oily discharges emanate from bilge tanks, grease and oils used to maintain engines and shipboard machinery, engine drippings, and devices used to clean oil-carrying cargo tanks. Some of this oily waste is illegally mixed into ships' ballast water and transferred to ballast treatment plants, which are not designed to handle oily residue. Disposal of these wastes has become an overwhelming problem even for facilities equipped to cope with them. Most ports lack adequate facilities altogether. These discharges contain hydrocarbons, including BTX compounds (benzene, toluene, and xylene), and toxic metals (zinc, chromium, copper, and cadmium), which are hazardous to both humans and the environment.

Health and Environmental Impacts

Impacts from oil pollution vary, depending on the amount (catastrophic v. chronic) and type (refined v. crude) of discharged oil. While overall concentrations of oil toxins from chronic sources might be lower compared to concentrations following a catastrophic spill in the marine environment, chronic pollution can be equally toxic to marine life if sustained over extended periods of time.

Lighter and more refined oil typically disappears quickly from the water column because of the volatility, biodegradability, and immiscibility of hydrocarbons. Although refined oil may be short-lived in a marine environment, this grade of oil is more toxic than the heavier crude oils so its immediate impacts can be severe. While less toxic, heavier oil that sinks can persist for years in sediments and beach sand. Asphalt pavements can form when heavy accumulations of emulsified oil fills the voids between sediments, effectively changing the biological function of the substrate. Further, oily residues can repeatedly appear and disappear on marsh grass, shellfish, worms, invertebrates, and algae many years after a spill as a result of persistence and resuspension.

Oil pollution reduces, fragments, and degrades coastal habitats and causes local and regional extinction of species and reduction in plant and wildlife population. The immediate impacts of oil can smother tidal pools and the intertidal zone, killing marsh grass, shellfish, benthic worms, and invertebrates. The contaminants can bioaccumulate in organisms unaffected by the toxicity and be transferred to higher and more sensitive organisms in the food chain. Sea and shore animals can be impaired and killed when their feathers or fur are coated with oil. If the original impact is large enough, a permanent ecosystem imbalance may result.

The chemical contaminants in oil can poison marine life, disrupt feeding, or cause chronic disease, reproductive failure and deformities—ultimately impacting the survival rates of the affected species. Contaminants concentrate in the sea surface microlayer which is an important area for the early development of many fish and other marine species with planktonic life stages. Effects of contaminants on eggs and larvae found at the sea surface in sites along US coasts include mortality, malformation and chromosome abnormalities.

Applicable Federal Environmental Regulations

The Clean Water Act (1977 amendment to the Federal Water Pollution Control Act of 1972), and the Oil Pollution Act (OPA) of 1990 are the primary federal laws that govern oil discharges affecting or threatening navigable waters of the United States. The US Coast Guard and US EPA share responsibilities under the Clean Water Act, OPA, and the Comprehensive Environmental Response Compensation and Liability Act (CERCLA). The US Coast Guard also has responsibility for spills from foreign flag ships under the Intervention on the High Seas Act.

OPA, which is the primary act dealing with oil spills and spill response, was enacted in 1990 shortly after the Exxon Valdez oil spill. OPA provides guidance on oil spill prevention, mitigation, cleanup, and liability. OPA established many new requirements for pollution prevention and extensively amended the Federal Water Pollution Control Act to provide enhanced capabilities for oil response and natural resource damage assessment. The major provisions of OPA are to

1. Require foreign flag ships to demonstrate that they have sufficient resources to respond to a spill;
2. Restrict the entry into a port of those vessels with a history of accidents, pollution incidents or serious repair problems;
3. Require US Coast Guard and US EPA approved oil spill emergency response plans to be developed by any vessel or facility owner who handles oil as cargo;
4. Require double hull tank barges and tank ships in US waters, and the phasing-out of existing tankers by 2015;
5. Establish the responsible party or vessel as liable for the removal costs and damages;
6. Establish unlimited liability for gross negligence, willful misconduct, violation of any federal operating or safety standard, failure to report a spill, or failure to participate in cleanup;
7. Establish a $1 billion Oil Spill Liability Trust Fund—funded by a tax on the petroleum industry—to ensure legal and monetary issues do not impede cleanup measures or reimbursement for damages;
8. Enable states to enact oil pollution regulations more restrictive than those of OPA;
9. Allow for third party claims for personal property and environmental damages caused by pollution incidents; and
10. Increase penalties for violations of OPA.

Management Options

Established under OPA, the National Response System ensures that both state and federal resources are available for adequate and timely cleanup of oil pollution. Under this system, ports can participate in the development of a required Area Contingency Plan, and vessels and facilities within ports are required to develop Vessel Response Plans and Facility Response Plans. A research plan should be developed that assesses the current status of knowledge, identifies research gaps, and estimates the resources necessary to carrying out the plan.

A contaminated sites strategy should be developed that addresses:

1. Implementation of regulatory guidelines;
2. Need for and nature of a contaminated sites register;
3. Issue of financial liability for remediation of contaminated sites; and
4. Need for planning controls that take actual or potential contamination into account during transfer of title and /or the rezoning of the land.

On June 5, 1996, The National Response Team and US EPA published new guidance designed to assist facilities in creating a single emergency planning and response plan to be used to demonstrate compliance with emergency planning requirements set forth under the federal programs. The integrated Contingency Planning Guidance known informally as the "One Plan" is intended to provide a format for organizing emergency response information required under several laws into a single functional plan.

While contingency planning for large oil spills is important and mandated by OPA, planning for the small and recurrent contributions to water quality problems from chronic sources is equally

important. In this regard, preventing oil from entering the waste stream should be the first priority.

Ports should provide facilities for oil collection and recycling, which are easily, accessible and inexpensive. Precautions must be taken to ensure oil is not contaminated with other port waste. It should not be assumed that mariners are aware of the negative impacts of releasing oil into the marine environment. All port users should be educated so that they understand the potential damage of improper disposal of waste oil and the benefits of recycling oil. Facilities in the port that dispense oil to individual mariners might want to consider requiring deposits on oil to encourage return of used oil. Fuel intake devices to prevent overflows should be encouraged.

Run-off from parking areas and roads that pick-up oil and other wastes from land should be directed into vegetation to naturally filter petroleum products and recharge groundwater. Useful infiltration devices include porous pavement, soak-away pits or dry wells, seepage or infiltration trenches, recharge or percolation basins and grass swales. Catch basins should be appropriately placed and maintained.

Used Oil Collection and Recycling, Port of Cordova, Alaska

Used oil from harbor users and members of the community is recovered for secondary use by a local utility.

The Port of Cordova collects used oil from its harbor users and from the surrounding community, which it then transfers to a local utility company which burns the oil for heat recovery. The Port provides convenient dockside oil disposal tanks where boaters can empty their used oil. A bilge water vacuum pump is available for small boat users who want to empty and clean their bilge of oily water. This oily water is pumped into a holding tank where the water and oil are separated. For ocean going ships over 400 gross tons, including cruise ships, tank ships, ferries, and tugs, a mobile facility is used for the collection of oily bilge water and used oil. The oil and water are separated in a holding tank.

All of the oil collected from harbor users is transferred approximately once per week to a 12,000 gallon tank. When this tank approaches capacity, an oil sample is sent to a laboratory in Anchorage which tests for contaminants such as arsenic, chromium, PCBs, antifreeze, and unleaded gasoline. The Port receives the results of these tests within two weeks, and the oil is then transferred to the local utility. The industrial boiler at this facility is US EPA-certified to burn both on-spec and off-spec oil, so even if some of the contaminants listed above are identified in a sample the oil can still be burned.

In an effort to reduce the illicit disposal of oil in the harbor, on streets, and down storm drains, the Port allows the surrounding community to use its oil collection facility. The large storage tank is not fenced or locked and the Port does not charge a user fee unless the load exceeds 100 gallons of oil. An estimated 15 percent of contributors are non-harbor users such as local garages, contractors, and home owners use the facility. The Port director has noticed a significant reduction in the amount of pollution attributable to oil in the harbor area with this program in place.

"One pint of spilled oil can cause a sheen over an acre of water, and kill the marine organisms that live on the surface....Do the right thing!" The Port educates both harbor and non-harbor users about the oil collection facility through signage posted around the Port area and through a local newsletter. These also provide harbor users with information on how they can prevent oily spills through regular maintenance, by properly draining oil filters, and using absorbent pads when necessary.

This program is extremely cost effective for the Port. The only costs include the oil test, transportation of oil to the utility plant, and approximately 16 man-hours per week. These costs are recovered in moorage fees and fees collected by non-harbor users depositing over 100 gallons of oil. Most importantly, this program ensures a second life for a vital non-renewable resource.

Oil and Oil Filter Recycling Program, Port of Newport, Oregon

New facilities offer oil filter recycling and collection tanks designed to minimize hazards.

The Port of Newport's motor oil and oil filter recycling program has been fully operational since July 1999. While oil recycling previously was offered at the Port, the new program—which includes oil filters—will increase and improve opportunities for recycling oily waste generated by commercial fishermen and recreational boaters.

The new facilities feature more environmentally sound systems for reception. Three 250 gallon double-walled steel tanks have been placed in both the commercial and recreational marinas. The tanks have been placed upland away from the water to avoid accidental spills into the estuary. Special features of these tanks include double-wall construction, a liquid level indicator to prevent overflows, a fire suppression system, and ventilation. The tanks are kept within a three-wall covered shelter to prevent water from entering and to protect the tanks from weathering. Two 5,000 gallon tanks are used for the gravitational separation of oil and water from vessel bilge water. The oil is periodically pumped off the top of these tanks and recycled with the other waste oil. The Port accepts only waste oil in its collection tanks. Other types of hazardous waste, including paints, thinners, and unleaded gasoline are discouraged.

A unique component of this program is the availability of an industrial oil filter press, which crushes the filters and squeezes out the excess oil. Both the oil recovered from the filters and the filters themselves are recycled by the Port. Previously, used oil filters were drained only as well as boat owner's were willing to drain them and disposed of in the Port's garbage dumpsters.

The initial start-up costs for this program was $31,000—money that was obtained through an oil settlement grant from the Oregon Department of Justice. Installation required little labor, and the cost of continued maintenance and operation of the facilities is minimal, involving occasional repairs and operation of the oil filter press. Costs for providing this service are factored into established Port user fees. Both the waste oil and the filters are collected by a local environmental recycling company at no cost to the Port.

SHIP AND PORT Generated Solid Waste

Issue/Problem

Marine debris is generated by commercial fishing and merchant vessels, passenger cruise lines, recreational boats, and military and research vessels as well as from sources on land. Types of marine debris include: glass, plastic, metal, paper, fishing gear, cloth, food waste, wood, rubber, and packing materials. With the exception of plastics, all these materials may be discharged overboard at prescribed distances from shore under MARPOL Annex V.

Studies characterizing debris generated by vessels in the US reveal that cargo ships alone generate 111,700 million tons of garbage each year (NRC 1995) and that US ports can receive up to 368,000 tons of waste per year from foreign vessels (Brillat & Liffman 1991). A key section of the laws pertaining to disposal of ship generated solid waste requires ports and terminals to provide adequate facilities to receive garbage from vessels.

A survey conducted by the National Research Council (1995) found the ship-to-shore waste management interface in the US to be "clumsy, inadequate, and at times non-existent. Each individual port or terminal has to devise its own means to comply, and each has to pay for any related expansion." Only a minority of vessels appear to be off-loading garbage at US port facilities. Moreover, according to US Coast Guard (USCG) boarding officers, there is often "no trace of garbage, separated plastics, or incinerated ash on ships that doubtlessly generate large quantities of garbage" (Federal Register, 1994, Vol. 59, p.18).

The apparent low usage of solid waste disposal facilities at ports are related to whether or not: (1) off-loading garbage is allowed at a port; (2) vessel operators are aware that reception facilities exist; and (3) facilities are convenient and affordable. Additional issues related to the Animal and Plant Health Inspection Service (APHIS) program for foreign vessels include high disposal costs, confusion over the types of garbage that are subject to quarantine, a lack of integration of APHIS and Annex V regimes, and the lack of a requirement for off-loading of APHIS waste at US ports. Disposal also can be burdensome for commercial vessels that call on many different ports due to variations in garbage handling, garbage restrictions, and fee structures.

Port operator problems associated with implementation of Annex V include difficulty in predicting future levels of demand for waste disposal and the uncertainty surrounding the local solid waste disposal site's long-term capability to accommodate increased waste over time (US Senate-Leach 1987). An increase in volume of waste requiring handling could lead to an increase in user fees that, in turn, may direct larger ships to the least expensive off-loading facilities. As a consequence, waste disposal facility availability and fees could become a significant competitive force among ports.

Environmental Impacts

Hundreds of thousands of marine mammals, sea turtles, seabirds and fish die each year from exposure to marine debris, either through entanglement or ingestion. Animals may become entangled in loops or openings of submerged, floating debris and consequently drown or lose their ability to catch food or avoid predators. Some animals also can ingest plastic material resulting in choking, damage to stomach lining, intestinal blockage, reduced capacity to forage efficiently, inability to digest food, reduced rate of absorption of nutrients, and other physiological effects from the absorption of toxics. Although accounting for less than one percent of the total amount of garbage disposed at sea (Brillat & Liffman 1991), plastics comprise the most harmful elements of marine debris and have been extensively researched. Less is known about the behavior and effects of pulped garbage, paper, or cardboard in the marine environment.

The raw materials from which plastic products are formed—called resin pellets—are the most common plastic materials in the marine environment (US EPA 1989). Resin pellets enter the marine environment through the careless handling of cargo and spilling of pellets onto loading docks, ships' decks, and cargo holds, which are eventually washed overboard into waterways (US EPA 1992). Because plastic pellets are small, light-

weight, buoyant, persistent, and ubiquitous in the aquatic environment, they are a potential hazard to aquatic organisms who ingest the pellets mistaking them for prey. Pellets are the most common form of plastic debris ingested by seabirds (US EPA 1990). Because the elements that cause plastic to deteriorate on land—heat, wind, and ultra violet radiation—are less intense in the ocean, plastic is essentially non-degradable there. Even plastics considered "degradable" only disintegrate into smaller fragments of plastic and eventually into plastic dust. The impacts of plastic dust are not known.

Another impact of solid waste debris in the marine environment is aesthetic degradation, which in turn can produce economic impacts when recreation areas are affected. Sewage-related and medical-related debris are particularly displeasing.

Marine debris impacts and the environmental damage incurred also can be measured in terms of economic costs to industry. Marine debris can damage or disable vessel propellers and block water intake valves, causing engines to overheat or burn-out.

Applicable Federal Environmental Regulations

The United States is a signatory (along with 78 other nations) to Annex V of the International Convention for the Prevention of Pollution from Ships (MARPOL Protocol of 1973/78, hereafter referred to as MARPOL Annex V). Annex V applies to solid waste generated during normal vessel operations at sea and in port, as well as the solid waste generated by economic activities such as fishing conducted aboard vessels. Annex V imposes restrictions on the locations and materials discharged, but does not specify how compliance is to be achieved. Port reception facilities for garbage also must be available.

The Marine Plastics Pollution Research and Control Act (MPPRCA), promulgated in 1988, is the US federal law implementing Annex V in all US waters. MPPRCA prohibits the disposal of any plastic from any vessel in the US Exclusive Economic Zone (waters up to 200 miles offshore) and other types of garbage within three miles of shore. MPPRCA applies to merchant ships, recreational and commercial fishing vessels, offshore oil rigs, and military vessels. All ports, marinas, fuel docks, fish plants, and other revenue-generating docking facilities are required to provide garbage facilities to accept refuse. MPPRCA gives the US Coast Guard primary enforcement authority for Annex V. Regulations regarding port reception facilities were promulgated by the US Coast Guard and are contained in 33 CFR 158.

To certify that a US port or terminal meets the requirements for reception facilities, the US Coast Guard issues a Certificate of Adequacy (COA). If a port which is subject to the COA requirement does not have adequate reception facilities, the US Coast Guard may deny ships from entering the port. Though the regulations provide general guidance on adequacy, they do not include technical standards upon which to base the determination of adequacy (NRC 1995).

Another federal law that may apply to the disposal of solid waste into the marine environment is the Marine Protection, Research, and Sanctuaries Act (MPRSA) of 1972 which is commonly referred to as the Ocean Dumping Act. MPRSA does not apply to waste generated from the normal operation of vessels but rather only to wastes taken to sea for the express purpose of dumping. Under MPRSA, no US vessel may transport any material for the purpose of dumping the material into the ocean unless the vessel has a permit to dump from US EPA.

In addition to federal laws and international treaties to which the United States is a signatory, states and local governments may regulate the disposal of wastes from vessels in waters under their jurisdiction.

Management Options

Regarding solid waste generated by vessels, management options include source reduction, on-board garbage handling techniques and treatment technologies, disposal at sea within the law, and offloading at ports where it is handled by the landside solid waste management system.

On-board technologies include compactors, pulpers, shredders, and incinerators. The technolo-

gy is well developed for certain types of ships and applications (cruise ships and navy vessels), but is not readily transferable to other types and sizes of vessels.

Source reduction, particularly relevant to ships can be achieved by targeting plastic packaging and disposable flatware. Recycling is one of the best ways for a port to lower costs, increase efficiency and remain competitive. Many items brought to shore could have additional uses and economic benefits. Assuming that adequate on-board storage is available for restricted waste under Annex V, port waste disposal volumes can be reduced if recyclable materials are separated using coded containers. Easily recycled materials include aluminum and steal cans, glass bottles, plastic bottles, paper, and cardboard packaging. Other materials that can be recycled include metal parts, fishing nets, ropes, and other gear.

Incineration is an available option that reduces the volume of waste intended for a landfill by 80-90 percent. However, incineration raises concerns about toxic pollutants. The International Maritime Organization's guidelines for Annex V recognize these concerns and discourage the use of incinerators in ports in or near urban areas. All bottom and fly ash produced during incineration is considered to be hazardous, requiring costly hazardous waste handling methods and disposal sites. Also, many items burned are made from non-renewable resources. Reliance on incineration as a disposal option discourages proactive source reduction, reuse and recycling systems (NRC 1995).

To help with compliance, ports need to provide facilities that have sufficient capacity and are likely located close to docks. To be successful, port operators must identify the types of refuse materials that are likely to be disposed of at the port and select appropriate vessel refuse handling and contaminant methods. Coordination of ship waste handling with shoreside waste management practices is essential for effective and efficient operation.

Recognizing that they are in a leadership position to mitigate a visible marine pollution problem, ports can establish outreach programs to educate port users about shoreside waste management practices and increase awareness of the problems of marine debris.

Marine Refuse Disposal Project, Port of Newport, Oregon

Construction of marine refuse reception facilities improve refuse system efficiency.

In 1987-88, the Port of Newport coordinated efforts with the National Marine Fishery Service (NMFS), West Coast Trawl fisherman, and the Oregon State University Extension/Sea Grant Program to conduct a pilot program to address the problem of ship generated waste becoming marine debris. The Marine Refuse Disposal Project was initiated to improve refuse system efficiency and to encourage use of these systems by mariners. The Port of Newport was selected as a demonstration port because its diversity of activities simulate an environment found at both small and large ports. Ports nationwide would benefit from the experiences of this pilot project to develop similar marine refuse disposal projects.

As part of the Marine Refuse Disposal Project, the Port of Newport was to establish convenient refuse reception facilities. Ten refuse facilities were constructed and strategically placed near the boat berths to encourage use by fishers and boaters; refuse bins that had been located in areas easily accessible to the surrounding community were removed. Three galvanized dumpsters, each with a 1.5 cubic yard capacity, were housed in each facility, replacing small, overflowing garbage cans. Each facility has a concrete pad flooring that provides a stable, easily cleanable surface. Three recycling bins were also placed in each facility. Many of these recycling bins are reused products themselves, having been donated or bought at a low price from local fish processing companies. These bins have been successful in recovering metal, wood, nets, and cardboard from the waste stream. Many of the nets collected have even been picked up and reused by fishermen and members of the local community. The new refuse collection facilities have decreased disposal costs while increasing

the aesthetic appeal of the Port.

As part of the project, fishermen, Port workers and Port management staff were consulted to determine existing refuse problems at the Port and devise the most convenient methods of disposal. Through these discussions, the Port identified the options that would improve service, maximize efficiency, minimize costs, and benefit the community. Consequently, a water level barge was adapted to help fishermen off-load heavy items such as net, metal, cables, and wood. A main refuse and recycling area was established near the Port's service dock where a hoist was available. The high level of organization and efficiency of this area has increased the Port's refuse reception capacity.

An education program tailored for recreational boaters and fishers was successful at reducing the amount of waste thrown overboard by many mariners. An advisory group, composed of Port users, Port management, fish and wildlife agencies, boating safety groups, and other community interest groups was established to inform mariners and the community members about the debris issue and to generate peer pressure. The formation of the knowledgeable advisory group, the use of local media and the distribution of promotional items, such as posters,brochures, letters, and resource lists, resulted in enthusiastic support for the recycling program and improved mariner-Port communications.

This pilot project has been valuable in providing a framework for other ports to use in developing their own marine refuse programs. The Port of Newport's experiences, documented in a report as part of the project, have been used by a number of ports along the west coast to streamline refuse systems and to educate mariners.

Solid Waste Management Program, Port of Portland, Oregon

Innovative engineering projects recover and reuse available materials.

The goal for solid waste management at the Port of Portland is to minimize the amount of waste directed to landfills and to continuously search for new opportunities to recycle and reuse different materials. Recycling and reuse of materials is always the first alternative to disposal at the Port.

In response to the City of Portland's mandatory recycling program, and as part of its own commitment to waste reduction, the Port has implemented a recycling program that collects over twenty-seven different materials. These materials include mixed paper, glass, plastics, dry-cell batteries, mercury and mercury vapor lamps, sodium lamps, used oil, and solvents. With the implementation of this program, the types of materials recycled and reused and the tonnage of materials recycled has increased steadily.

In addition to maintaining its recycling program, the Port has initiated several innovative projects that recover used materials for alternative uses. In one project, old growth timbers were recovered from an old warehouse. In preparation for redevelopment of a terminal area, the oldest warehouse in the Port was carefully dismantled. The recovered timbers were remilled and then incorporated into other construction projects, such as Port building lobbies and meeting rooms and nearby houses.

Old growth timbers reused at the Port of Portland.

Another innovative project involved the recovery of a 600 foot long container freight station at one of the Port's terminals. Rather than demolish the steel structure to make room for a new container stacking facility, the Port chose to relocate the entire building. Port engineers, in an effort to avoid paying money to lose an asset, investigated alternative Port locations for the structure.

However, due to its damaged appearance, the building was not suitable for either of the two available sites at the Port. The engineers then looked outside the Port for interested buyers who would dismantle and remove the structure. The Port received several responses to their request for proposals and eventually sold the structure to Erickson Air-Crane Company of Central Point, Oregon. The building now functions as a helicopter hangar and manufacturing warehouse.

A further example of Portland's innovation involves the reuse of World War II Liberty Ships as floating docks. Port engineers modified the ships to serve as docks that would move with the yearly 20-foot river fluctuations that result from snowmelt along the Columbia River. The wing walls and bows were removed from the ships. The decks were then paved and the modified structures attached to pilings with rings. Ramps connecting these floating docks to cargo vessels increase the efficiency of transfer operations. For instance, automobiles are now driven off the ships rather than being individually slung on palettes. The Port has also acquired a dry dock decomissioned by the Navy to accommodate the increasing size of cargo ships. Two sections of this dock, each 240 feet long by 101 feet wide, were put end to end to create a floating wharf that will support a full size car carrier.

The Port's commitment to recycling, reclamation, and reuse have resulted in increased efficiency and reduced costs throughout the Port.

Solid Waste Management Program, Port of Los Angeles, California

Variety of recycling and reduction projects move Port toward waste reduction goal.

In 1989, California municipalities were mandated to have fifty percent of their total waste diverted from landfills by the year 2000. To assure compliance with the mandate, the Port of Los Angeles, a branch of the Los Angeles municipal government, has developed a comprehensive solid waste management program. The program consists of projects to reduce waste generation and increase recycling at Port facilities, on-site educational programs, and initiatives to buy recycled products.

After performing a full waste audit in 1993, the City of Los Angeles determined that only 15 percent of the Port's 25,000 tons of waste was being diverted from landfills. As part of its comprehensive program to increase this diversion rate to 50 percent, the Port implemented several waste reduction and recycling projects. One project includes the implementation of a tracking system to monitor the Port's material recovery and reduction efforts.

Recycling projects have been implemented in many different areas of the Port. Organic waste, for example, is recovered and reused on site. Trees and shrubs are chipped and then reused as mulch on Port property. A collection area has been established for wood from used pallets and crates and Port users are encouraged to reuse the material from this site. Office products, like white and colored ledger paper, computer paper, junk mail, magazines, and newspaper, are recovered. In addition, toner cartridges are returned to their manufacturers for reconditioning and reuse.

The program also includes ferrous metals recovery and oil and tire collection. To further develop the Port waste minimization program, a recycling committee has been established. Representatives from various Port divisions,: Environmental Management , Purchasing, Property Management, Construction and Maintenance, Public Affairs, as well as Port tenants comprise the committee.

The Port has also implemented education programs as part of its waste reduction initiative. By distributing updates and publishing articles in the employee newsletter about the office recycling program, the Port keeps employees informed of current recycling efforts. In addition, an educational program was developed specifically for Port tenants. Prior to the development of the educational program, Tenant Recycling Surveys were distributed to the tenants to collect information on their operations and waste diversion practices. Within the next few years, the Port intends to improve tenant recycling practices by serving as the waste reduction facilitator.

In addition to recovering used materials from

the waste stream, the Port initiated a program that encourages the procurement of recycled materials. The Purchasing Division purchases recycled-content products whenever feasible. Recycled materials have been used for a number of development projects. For example, in 1991, the Port installed plastic pilings. Since then, 100 percent recycled plastic has been used for breasting camels, fender piles, bull rails, walers, chocks and wheel stops. Recycled materials have also been purchased for Port office areas. These products include photocopy paper, continuous computer paper, paper towels, and toilet paper.

The Port's recycling efforts are not confined to Port boundaries. The Port has collaborated with the city Environmental Affairs Department and the Recreation and Parks Department to sponsor a program that collects glass, aluminum, and plastic beverage containers in the surrounding marinas and beach areas. The Port of Los Angeles has developed and implemented a truly comprehensive program in an effort to reach its goal of a fifty percent reduction of waste by the year 2000.

Port DESCRIPTIONS

Port of Anchorage, Alaska
www.ci.anchorage.ak.us/Services/Departments/Port
Roger K. Graves
Government/Environmental Affairs
Tel (907) 343-6200
Fax (907) 277-5636

The Port of Anchorage, the northernmost deep draft port in the United States, is located in the upper Cook Inlet of Alaska. Although Anchorage has been a port city since the early 1900s, it began its operation as a major marine center in the 1960s. Within the past few decades, the Port has expanded from a single-berth facility to a five-berth terminal handling three million short tons per year. As a flexible, general cargo port, the Port provides facilities for the movement of containerized freight, iron and steel products, wood products, bulk petroleum and cement.

Alaska's only active foreign trade zone exists at the Port of Anchorage. Available foreign trade services include public warehousing, contract warehousing, and bulk petroleum product storage. The Port's remaining facilities include three multi-use terminals and two petroleum berths that handle standard cargo vessels such as container, Roll On-Roll Off, bulk petroleum and dry bulk, and specialized carriers for automobiles, newsprint, and cement. An industrial park, for cargo staging and storage, occupies 150 acres of Port property. In 1998, the Port handled approximately three million short tons of cargo. Imports—everything from aluminum to zinc—comprise 90% of the cargo handled. Currently, the Port mainly exports petroleum products, although exports of timber, fish, and coal are increasing.

Amidst all of the shipping activity and economic expansion, the Port is committed to protecting its surrounding environment. In conjunction with the Alaska Department of Environmental Conservation, the Port is involved in an on-going program of environmental assessment. The Port also has initiated an effort to enhance environmental attributes of the Port of Anchorage area, to mitigate past damage in a voluntary manner, and to involve the local community. The Port continues its commitment to environmental preservation through the efforts of its Government/Environmental Affairs Office.

Port of Bellingham Bay, Washington
www.portofbellingham.com
Mike Stoner
Environmental Manager
Tel (360) 676-2500
Fax (360) 671-6411

The Port of Bellingham, located near the Canadian border, was established in 1920 as a timber and fishing port. Today, the Port serves as a marine cargo facility, specializing in break bulk and bulk cargoes such as aluminum, pulp, logs, lumber, wood chips, and cotton seed. The Port has expanded to include the Fairhaven Transportation Center, an intermodal facility that connects road, rail, sea, and air transportation. The Port offers waterborne passenger transportation facilities and owns two full-service commercial fishing and pleasure boat marinas, an international airport, industrial sites and other leased properties. Annually, about 375,000 travelers, visitors, and community members pass through the Port's terminals. The Port of Bellingham is directed by an elected three-member commission.

Total tonnage handled by the Port in 1998 was 281,576 short tons. Major imports include salt and wood chips; exports include lumber, pulp, aluminum, and liquid chemicals.

The Port of Bellingham strives to improve economic development while maintaining a commitment to environmental stewardship. To counteract any adverse impacts from its commercial and industrial activities, the Port is developing new ways to address environmental concerns while balancing habitat restoration and aquatic land use. For instance, the Port is working with government, industry, residents, and local businesses on the Bellingham Bay Demonstration Pilot to clean up Bellingham Bay. The Port is involved in the creation of 10 to 15 acres of sub-tidal mud flats and smaller areas for macro algae production. In addition, as a result of Port efforts, the Squalicum Harbor/Central Waterfront area— once an industri-

al landscape—is now an attractive working waterfront with public parks, scenic ocean views, promenades, and concert venues.

Port of Boston, Massachusetts
www.massport.com/portbos
Brad Wellock
Tel (617) 946-4413
Fax (617) 946-4422

The Port of Boston is the oldest continually active major port in the Western Hemisphere. The Port is owned and operated by the Massachusetts Port Authority (MassPort), an independent public authority created by the Massachusetts legislature in 1959. In addition to managing the seaport, Massport also develops and manages Logan Airport and city transportation infrastructure. MassPort is an independent bond authority, and does not typically receive any state tax money. MassPort facilities and operations contribute more than $5 billion to the state's economy annually. Twelve thousand people work directly for MassPort, another 20,000 jobs are generated by its operations and activities.

Major features of the Port of Boston include a container terminal, auto terminal, cruise ship terminal, two shipyards, numerous pubic and private ferry operations, marine research institutions, marinas, and a major Coast Guard facility. The Port also serves as a high-valued fishing port. MassPort's Maritime Department operates Conley Terminal for containerized cargo shipments. Moran Terminal, currently leased to Boston Autoport, is used for the import and distribution of automobiles. In 1998, the Port processed nearly 75,000 vehicles. The Maritime Department also owns and operates the Black Falcon Cruise Terminal, located in the Boston Marine Industrial Park, which served 62 cruise ships and over 105,000 cruise passengers in 1998.

Over 16 million short tons of cargo were handled by the Port in 1998. Imports include petroleum products, liquefied natural gas, salt, gypsum, cement, and autos. Exports include scrap metal and petroleum products.

Port of Camden, New Jersey
www.southjerseyport.com
Joseph Balzano
Executive Director
Tel (856) 757-4969
Fax (856) 757-4903

The Port of Camden is located in southern New Jersey on the Delaware River. The Port is owned by the South Jersey Port Corporation and directed by a seven-member board of commissioners appointed by the Governor.

The Port maintains two terminals, Beckett Street and Broadway. The main features of these terminals include 5,884 feet combined berthing space, berthside rail service, warehousing, temperature-controlled warehousing, and Roll-On Roll-Off capabilities. Major imports at the Port include steel, fresh fruit, wood products, and cocoa; exports include scrap metal and petroleum coke. Total tonnage handled in 1998 measured 2.2 million short tons. The Port of Camden, in combination with the Port of Philadelphia, is currently holding top cargo handling, growth, and market share positions among all North Atlantic ports.

Port Canaveral, Florida
www.portcanaveral.org
Lorraine Guise
Assistant Director of Environmental Programs
Tel (407) 783-7831
Fax (407) 784-6223

Port Canaveral is located in the northern half of Brevard County in Southern Florida. Since its foundation in 1953, Port Canaveral has grown from a newsprint and petroleum-based maritime industry into a major deep water port capable of accommodating a variety of bulk tank and dry bulk cargoes, including orange juice, scrap steel, deciduous concentrates, solar salt, sugar, fertilizers lumber, and cement. The Port is directed by the Canaveral Port Authority Board of

Commissioners, a quasi-government entity consisting of five elected officials from each of the Port districts. The Port's jurisdiction extends over 3300 acres of land, with approximately 780 acres of uplands devoted solely to Port activities.

Port Canaveral features two liquid bulk facilities, eight dry cargo berths and two Roll-On/Roll-Off ramps. Dock space is available for frozen and perishable food shipments and general cargo; dry freight storage is also available. Warehouses, all covered by Foreign Trade Zone 136, offer vessel-side freezer/chill space as well as dry vessel-side cargo space. Cargo tonnage handled by the Port for 1998 measured 3.9 million short tons. The primary commodities imported through the Port include cement clinkers, newsprint, slate granite, and fresh fruit. Exports are citrus fruits, concentrate, frozen products, and fresh water. The Port also supports an extensive cruise industry with over 1.4 million cruise passengers passing through the Port each year.

The Canaveral Port Authority strives to be pro-active when it comes to the environment. Some of their recent environmental efforts include the development of manatee and right whale protection programs, a massive dune grass distribution program, water quality monitoring, and an ongoing beach nourishment program. Port Canaveral also has developed more recreational areas than all the other ports in Florida combined, including four parks with beaches, campsites, harbor walks, public boat launches, parking lots and picnic areas—all for the benefit of its local residents and its many visitors.

Port of Charleston, South Carolina
www.port-of-charleston.com
Joe Bryant
Vice President Terminal Development
Tel (803) 577-8611
Fax (803) 577-8626

The Port of Charleston, located at the geographic center of the Atlantic Coast, is the fourth largest container port in the United States. All four of the shipping terminals at the Port of Charleston are owned, operated, and managed by the South Carolina State Port Authority. In 1998, the Port moved more than 12 million short tons of cargo valued at $29 billion. The largest imports were paper and paperboard, fabrics, natural rubber, and furniture. The largest exports were paper and paperboard, wood pulp, poultry, and Benezoid chemicals.

The terminal closest to the open sea, the Union Pier terminal, is Charleston's breakbulk and Roll-On/Roll-Off cargo facility, offering 2,470 continuous feet of berth space. The Columbus Street Terminal handles a variety of cargo such as containers, common breakbulk, bulk, rolling stock, heavy lift and project cargo. There is also container storage space at this terminal. The North Charleston Terminal is a container handling facility with an on-terminal container freight station, an on-terminal intermodal rail yard, and a Foreign Trade Zone. The Port's largest terminal in terms of volume and physical size is the Wando Welch Terminal. This terminal is recognized worldwide for its overall productivity and provides 3,800 continuous feet of berth space.

As the Port continues to expand its facilities, it uses designs that minimize adverse environmental impacts. For instance, during the redevelopment of the Wando Welch Terminal, the Port designed a stormwater collection system to protect sensitive wetland areas. In addition to preserving environmental integrity, this effort to minimize adverse impacts from development has saved the Port money.

Port of Chicago, Illinois
Frank Kudrna
Chief Engineer
Tel (773) 646-4400
Fax (773) 221-7678

The Port of Chicago historically has been a major port for shipping and commerce. The modern Port facilities were constructed between 1955 and 1958. At that time, facilities included a turning basin, docks, grain elevators and public terminals at Lake Calumet. Today, the Port features two cargo handling areas and leases termi-

nals, docks, and properties to private owners. The Port is owned and operated by the Illinois International Port District, a self-supporting municipal corporation.

One of the Port's cargo-handling areas, Iroquois Landing Lakefront Terminus, is located at the mouth of the Calumet River at Lake Michigan, 13 miles from Chicago. It is a 100 acre, open-paved terminal with 3,000 linear feet of ship and barge berthing space. The terminal features two transit sheds that have direct truck and rail access.

Another cargo handling area is on Lake Calumet, located at the junction of the Grand Calumet and Little Calumet Rivers about 6 miles inland from Lake Michigan. The southwest part of Lake Calumet offers 3,000 linear feet of ship and barge berthing space, three transit sheds, a warehouse, and two grain elevators. The northeast area has a liquid bulk terminal and two general cargo handling terminals. The northwest quadrant has two dry-bulk and steel slag processing terminals.

Major commodities handled by the Port of Chicago include steel, zinc, and aluminum. In 1998, 558,000 short tons of cargo were handled by Port tenants. Note that this figure does not reflect total tonnage of cargo handled by the Port. They do not report total tonnage.

Port of Cordova, Alaska
Dave Muma
Harbormaster
Tel (907) 424-6400
Fax (907) 424-6000

The Port of Cordova is located at

the southeastern edge of Prince William Sound and is the center for commercial fishing vessels within the Sound. The Port houses a small boat harbor with 845 slips for boats ranging from 20 feet to 160 feet, and three large docks—Municipal Dock, City Dock, and North Fill Dock—that provide moorage for large vessels, the Coast Guard, and the State of Alaska marine ferries. With container Roll-On/Roll-Off facilities, staging areas, and storage and industrial space, these docks also serve as terminals for the transfer of freight and fuel. The principal cargoes handled at the Port include salmon and general cargo.

The Port has a demonstrated commitment to the environment, doing what it can to reduce the environmental impacts of harbor and Port operations. Currently, the Port has in place a used oil collection facility, bilge water vacuum pump, mobile bilge water collection system, and a regulated garbage collection program for ships arriving from outside of the US. The Port produces a small newsletter available to all interested persons in the City of Cordova, which often highlights its environmental programs.

Port of Corpus Christi, Texas
www.cctexas.org/port
Dipak Desai
Environmental Manager
Tel (512) 882-5633
Fax (512) 882-3079

The Port of Corpus Christi is the fourth largest port in the US. It is located along the southwestern coast of Texas on the Gulf of Mexico approximately 150 miles north of the US-Mexico border. The Port is comprised of four divisions: Harbor Island, Port Ingleside, La Quinta, and Inner Harbor. The Port of Corpus Christi is directed by a commission of seven members. They are responsible for guiding the Port in accordance with provisions of the Texas state constitution under which the Port district was created.

The Port of Corpus Christi Authority (PCCA) is a grantee-operator of Foreign Trade Zone No. 122. All of the Port's 7,275 acres are located within this zone. PCCA provides a full service public warehouse with covered floor space located directly across Harbor Drive. The South side terminal also offers warehouse storage space. PCCA has a grain elevator with a storage capacity of 5 million bushels. Dry bulk com-

modities are handled at the Port's bulk terminal, which features one dock for unloading and another for loading. The Port also operates 11 oil docks, all located in the Inner Harbor. In 1998, 89.5 million short tons of cargo was handled by the Port. The primary imports are steel, machinery, and ferro alloys; exports are steel, machinery, and heavy lift cargo.

In the design of its projects, the Port includes environmental controls whenever possible. Facilities are designed to minimize the potential for spillage, optimize product recovery, and lend to a workable concept of zero waste disposal. Immediate collection and recycling of all waste from the work areas is accomplished with the use of pollution control measures such as a baghouse, cyclone, scrubbers, water-sprays, and covered conveyor belts. In addition, the Port has installed a stormwater system that holds, directs, decants, and mechanically filters captured runoff prior to discharge. These environmental considerations allow the Port to expand while maintaining the quality of the surrounding environment. According to the Port, "on one particular occasion the US Coast Guard referred to the Port of Corpus Christi as one of the cleanest and most environmentally sound ports in the United States."

Port Everglades, Florida
www.co.broward.fl.us/port.htm
Allan D. Sosnow
Environmental Projects Manager
Tel (954) 523-3404
Fax (954) 468-3506

Port Everglades, located in Broward County 23 miles north of Miami and 48 miles south of West Palm Beach, is the deepest commercial harbor in Florida. Since its development in the 1920s, the Port has become well established in three maritime industry segments: cruise, cargo, and military. More than 2 million passengers a year pass through the Port, making it the second-busiest cruise port in the world. The Port handles over 20 million tons of cargo a year and commodities such as cement, scrap metal, gypsum, steel and steel coils, lumber, and secondary fiber. It is considered the second largest US petroleum storage and distribution port among nonrefinery sites. In addition, the Port offers a Foreign Trade Zone allowing duty-related advantages for importers and exporters.

Port Everglades' harbor facilities consist of 48 berths. Six container cranes, two rail-mounted dockside bulk cement unloaders, and 207 petroleum tanks are available for service. In addition, the facility offers warehouse space, Roll-On/Roll-Off ramp facilities, and reefer/cold storage. Port Everglades continues to expand, having recently added an additional parking garage, a convention center, and cargo-related developments. Future developments include a near-dock container transfer facility to enhance intermodal connections. Total cargo tonnage handled by the Port in 1998 was 23 million tons. The major imports at the Port were gasoline and aviation fuel, cement and clinkers, petro and fuel oil, and fruit and vegetables. Major exports include general cargo, grocery products, container cargo, and gypsum.

Over the past seven decades, Port Everglades has grown into one of the world's premier cargo and cruise ports, and also earned a reputation as a leader in environmental responsibility. The Port's programs have earned it several national awards from the American Association of Port Authorities. In the 1970s, Port commissioners and local officials initiated protection efforts for the manatee. The Port also formed an environmental guidance advisory committee to assist in Port development projects. In the 1980s, the Port continued its environmental efforts by establishing healthy mangrove wetlands, a tidal lagoon, and an educational facility. Other projects at the Port involve reef monitoring and water testing and programs to help sea turtles and least terns. The Port continues to serve the environment through its Environmental Programs Office in the Construction Management/ Planning Division.

Port of Houston, Texas
www.portofhouston.com
Customer Service
Tel (713) 670-2400
Fax (713) 670-2614

The 25-mile long Port of Houston is a complex of both public and private facilities. The Port area includes the Houston Ship Channel and its tributary channels and basins extending from Morgan's Point, at the Head of Galveston Bay, to and including a turning basin within the city limits of Houston; the Buffalo Bayou extending from the turning basin to the Main Street Bridge; and the Port facilities at Bayport on the west side of upper Galveston Bay. The public facilities—43 general cargo wharves, six container wharves, five liquid bulk wharves, and five dry bulk wharves—are located on the Houston Ship Channel. They are owned and operated by the Port of Houston Authority, an autonomous political subdivision of Texas governed by a board of seven appointed commissioners.

Over 5,000 vessels call at the Port's public and private terminals each year, and it ranks as America's number one port in foreign tonnage and second in total tonnage, with an estimated 170 million short tons handled in 1998. The Port earns $5.5 billion in annual business revenues, and an estimated 196,000 direct and indirect jobs are generated from cargo moving through the Port. The top imports are petroleum and petroleum products, crude fertilizers and minerals, iron and steel, organic chemicals, and sugars. The top exports are petroleum and petroleum products, organic chemicals, cereals and cereal products, plastics, and animal or vegetable fat and oils.

In recent years, the Port has expanded and added another wharf, extended its rail capacities, added cranes, and opened a cruise ship terminal. Current development plans include widening and deepening of the Houston Ship Channel. Throughout its development projects and operational activities, the Port Authority strives to preserve the integrity of Galveston Bay. The Port of Houston's Environmental Affairs Department, working with representatives from both federal and state resource protection agencies, has developed programs for using dredged material in beneficial ways and for better managing its dredge material disposal sites, resulting in an increased capacity of their existing confined disposal sites. A 220 acre salt marsh constructed by the Port serves as an outdoor laboratory, and an environmental compliance program for port tenants has been established. The Port also has been involved in a number of restoration projects in Galveston Bay, including construction of 4,250 acres of salt marsh, construction of recreational boater access channels and anchorages, construction and restoration of island habitats, and restoration of oyster reefs.

Port of Long Beach, California
www.polb.com
Robert Kanter
Manager of Environmental Planning
Tel (562) 590-4154
Fax (562) 495-4925

Located in San Pedro Bay at the mouth of the Los Angeles River,

the Port of Long Beach is the nation's leading container port and the sixth busiest port in the world. The majority of the Port's trade passes through the Port on its way to or from Asia. The Port has eight container handling terminals, five of which have on-dock rail facilities. The largest container terminal in the Port was opened in 1997. In addition to containerized cargo, the Port also has specialized facilities for handling liquid bulk, breakbulk, dry bulk, and autos.

The Port of Long Beach is officially recognized as the City of Long Beach Harbor Department, and is directed by the Long Beach Harbor Commissioners whose members are appointed. The Port receives no money from the city;

all revenue is generated from terminal leases and Port fees.

In 1998, 67 million short tons of cargo were handled by the Port with a total value exceeding $80 billion. The Port handles traditional breakbulk, neobulk, dry bulk, liquid bulk, and general cargoes. The Port's leading imports include bulk petroleum, electronics and electrical machinery, plastics products, clothing, furniture, and machinery parts. The leading exports include petroleum coke, bulk petroleum, chemicals, wastepaper, foods such as meat, fruits, and nuts, and machinery. Trade through the Port generates an estimated 260,000 trade-related direct and indirect jobs—one in 30 regional jobs—in a five-county region consisting of LA, Orange, San Bernardino, Riverside and Ventura counties. The Port of Long Beach is the grantee for Foreign Trade Zone No. 50.

Throughout its development projects, the Port strives to maintain compliance with state and federal environmental regulations, foster cooperation among participating groups, and enhance the marine environment within the Harbor District. The Port's Environmental Planning section is responsible for protecting the natural resources of the harbor area, ensuring that Port operations comply with environmental laws and regulations, and supporting other Port divisions in permitting, environmental contamination characterization, and cleanup, and other areas. Environmental Planning is involved in several on-going programs, including the restoration of Southern California coastal wetlands as part of its habitat mitigation program, stormwater management and monitoring, water quality monitoring for dredging and fill projects, sediment evaluation and protective disposal options for contaminated sediment, evaluation of control measures for air particulate emissions associated with dry bulk cargo operations, an alternative fuels demonstration project, and a brownfields project constructing a container terminal on a former state superfund site.

Port of Los Angeles, California
www.pola.com
Ralph Appy
Assistant Director of Environmental Management
Tel (310) 732-3497
Fax (310) 831-0439

The Port of Los Angeles was established in 1907 and has since

grown into one of the largest ports in North America. Located in Southern California, the Port of Los Angeles extends for 35 miles along the waterfront. Over 2,500 vessels call on the Port annually. The Port of Los Angeles is a department of the City of Los Angeles, often referred to as the Los Angeles Harbor Department. The Los Angeles Board of Harbor Commissioners oversees the management and operations of the Port of Los Angeles. Commissioners are appointed by the Mayor and serve a five-year term. The Port is not supported by municipal taxes, rather revenue is derived from rent and Port fees.

Los Angeles handles the West Coast's second largest cargo tonnage and is the eight busiest container port in the world. The Port has eleven liquid bulk facilities, six container facilities, four dry bulk facilities, three automobile centers, two omni facilities, and two breakbulk/neobulk facilities. The Port has direct links to two trans-continental rail routes, a growing number of on-dock rail facilities, a common user intermodal yard, and high-tech information systems. A total value of $79.3 billion in cargo was handled by the Port in 1998. The top five imports at that time included crude petroleum, petroleum oils, iron and steel shapes, ethers, bananas, and plantains. The top five exports were coal, petroleum coke, petroleum oils, iron and steel scrap, and waste paper. In addition, nearly one million people passed through the Port's World Cruise Center.

In all of its development projects, the Port's Environmental Management department takes steps to minimize impacts to air, water, and land. Examples of the Port's environmental efforts include use of a water-spray to suppress coal dust during cargo transfer to maintain air quality standards, transportation of cargo in enclosed conveyors to minimize escape of the products, use of dredged material from the channel

to restore shallow water habitat and wetlands, participation in recycling programs; and use of reduced emission diesel engines and zero-emission electric and compressed natural gas vehicles in its transportation fleet. The Port also recently fully funded the $55 million restoration of Batiquitos Lagoon in San Diego County as mitigation for the construction of Pier 400.

Port Manatee, Florida
www.portmanatee.com
Bill Tiffany
Director of Environmental Affairs
Tel (941) 722-6621
Fax (941) 729-1463

Port Manatee is located on Florida's West Coast at the entrance of Tampa Bay and is the nearest US deep water port to the Panama Canal. It is situated on 775 acres of waterfront property. The Port has more than 5,400 linear feet of deep water berthing, general and dry bulk cargo covered storage, cold storage, and liquid bulk storage. Support services include pilotage, tugboats, stevedores, US Customs Service, custom house brokerage, dockside fuel bunkering, and USDA services—to name a few.

Port Manatee is one of Florida's largest and busiest deep seaports, and is Del Monte's largest US port facility. As a result, the Port has become a national leader in the importation of frozen concentrated orange juice and is rising in the importation of tropical fruits and vegetables. Other imports include vegetables, steel, and petroleum products. Major exports from the Port include phosphate, general cargo, and container cargo. Port Manatee also exports up to 24,000 used cars and trucks to Central America each year. In 1998, 4.9 million short tons of cargo was handled by the Port.

The Port has a number of expansion and enhancement projects proposed, all which exhibit the Port's commitment to environmental protection. They are currently proposing a mitigation and management plan to transplant sea grasses—prior to dredging—and to enhance 420-acres of sea floor in the bay, as well as a state-owned island and uplands currently not cared for by anyone. The Port has a comprehensive team of staff that patrols and examines every aspect of the Port's activities and the businesses to make sure that the current US EPA standards are met and exceeded. The environmental commitment of the Port has earned them recognition from such organizations as the American Association of Port Authorities, the Florida Department of Environmental Protection, and the Florida Division of Marine Resources.

Port of Newport, Oregon
www.portofnewport.com
Maureen Keeler
Tel (541) 261-7758
Fax (541) 265-4235

Located in Yaquina Bay on the central Oregon Coast, the Port of Newport provides shipping services to local, regional, and international vessels, moorage for commercial and recreational boats, and support services. It is a deepwater port featuring a shipping terminal, commercial fishing moorage, and a recreational marina and science center.

Newport International Terminal, the Port's shipping terminal, consists of 17 acres of property. Facilities at the terminal include a Roll-On/Roll-Off concrete pad, a 265 foot wooden barge berth, a nine-acre log yard, and a storage/transit shed. Commercial fishing is one of the major industries that the Port supports. Moorage and support services are housed at the Port's Bay Boulevard facility. Four-hundred and fifty fishing vessels can be accommodated at the Port at any one time.

The Port of Newport handles a variety of activities, including shipping, research, and recreational services. Because of these diverse functions, the Port was chosen as the site for a pilot project to end marine debris problems at ports. The project has resulted in improved disposal efficiency and better-informed mariners. Other environmental projects at the Port include an oil collection program and a program to press oil filters on-site.

Port of New York/New Jersey
www.panynj.gov
Thomas H. Wakeman
Dredging Program Manager
Tel (212) 435-6618
Fax (212) 435-6030

The Port of New York and New Jersey is the largest port complex on the East Coast of North America. The Port consists of both public and privately operated marine terminals that handle a wide variety of cargo and passenger ships. The Port is operated and maintained by the New York/New Jersey Port Authority, a bi-state agency created in 1921. The Authority is directed by six commissioners from each state who are appointed to the agency's Board of Commissioners

Nearly 5,000 ships called on the Port in 1998, at which time it handled about 63 million short tons of general and bulk cargo. Imports at the Port of New York/New Jersey include alcoholic beverages, organic chemicals, auto vehicles and parts, cocoa beans, and bananas. Exports include waste paper, lumber, plastic materials, and paper and paperboard.

The "Working Port" of New York and New Jersey is composed of five regional terminals. The Auto Marine Terminal is one of the leading facilities in the US for automobile imports and exports, handling over 400,000 vehicles each year. The Brooklyn-Port Authority Marine Terminal complex piers are used for warehousing, bulk cargo handling and storage, and transient ship berthing. The Howland Hook facility consists of 2,500 linear feet of berth space and has the capacity to handle 425,000 containers annually. The Newark/Elizabeth complex offers a full-range of other maritime services including major container handling terminals, automobile processing and storage facilities, liquid and solid bulk terminals, breakbulk facilities, warehousing and distribution buildings, trucking firms, and an on-dock rail terminal. It is also the site of Foreign Trade Zone No. 49. The Red Hook Container Terminal, located on the Brooklyn waterfront, provides barge service to and from the Elizabeth-Port Authority Marine Terminal and has the capacity to handle deep draft vessels.

The Port has a recognized reputation for environmental programming, which according to US EPA Region 2 represents "the most extensive commitment by any transportation agency in the country to US EPA's voluntary pollution prevention efforts." In 1998, it was recognized by US EPA for its voluntary conservation efforts, which include promotion of clean air, alternative fuel vehicles, mass transit and energy conservation efforts, as well as support for the US EPA's National Estuary Program. The Port also has developed an innovative way to dispose of contaminated sediments by converting them to beneficial reuse products.

Port of Portland, Oregon
www.portofportland.org
Aaron Ellis
Public Relations
Tel (503) 944-7054
Fax (503) 731-7080

The Port of Portland is located at the confluence of the Columbia and Willamette rivers in the Pacific Northwest. Portland is the third largest port and second largest volume auto handling port on the West Coast. The Port of Portland is a regional department of government formed by three separate Oregon counties. It is directed by a nine member commission appointed by the Governor. The Port of Portland Marine Department is responsible for channel dredging, building public docks, acquiring waterfront property, and promoting world trade.

The Port owns five marine terminals, four airports, the Portland Ship Yard, six business parks, and the dredge OREGON. The marine terminals offer industrial and warehousing operations, modern cargo terminals, the largest grain elevator

on tide water west of the Mississippi River, mineral bulk loading and storage facilities, auto processing centers, and an intermodal rail yard. Marine activities at the Port generate more than $700 million in revenues for regional businesses. In 1998, 984 ships called on the Port and it handled over 11 million short tons of cargo. Imports include wheat, soda ash, barley, and potash; exports include alumina, limestone, cement, and salt.

The Port is very proactive in environmental and natural resource programs, and is involved with many environmental enhancement projects that include reducing air emissions; recycling landscape debris, asphalt, and buildings; recycling non-potable water to rinse ships; improving water quality in local lakes and streams; creating wetlands; and using dredged sediment for beneficial uses. The Port's Environmental Affairs Department is constantly looking to implement innovative environmental projects. Projects planned for the near future include replacing petroleum-based hydraulic fluids with non-toxic equipment lubricating fluid, using non-potable well-water for irrigating common-area landscaping, and constructing new wetlands for cooling ship engines. In addition to benefiting the environment, these projects have benefited the economic activities of the Port by saving thousands of dollars in water expenses, preventing property damage from floods, and increasing revenue from the sale of recycled dredged sediment.

Port of San Diego, California
www.portofsandiego.org
Ruth Kolb
Tel (619) 686-6534
Fax (619) 686-6467

The San Diego Unified Port District was formed in 1963. The Port district is comprised of Chula Vista, Coronado, Imperial Beach, National City, and San Diego. The Port, directed by a seven-member appointed Board of Commissioners, oversees San Diego International Airport, tidelands real estate activity, and maritime commerce.

The Port's maritime commerce is served by two major ocean cargo terminals, Tenth Avenue Marine Terminal and National City Marine Terminal. Tenth Avenue Marine Terminal handles most of the bulk and breakbulk cargo including soda ash, cement, fertilizers, cottonseed and newsprint. This facility has warehouses and transit sheds, paved open space for laydown of steel and project cargo, 8 berths, three liquid bulk storage tanks, an on-site bunker fuel concession, and an on-dock cold/freeze storage facility. The National City Marine Terminal houses an automobile transfer facility capable of handling more than 300,000 vehicles a year and a major lumber import facility.

Foreign vehicle imports remain the strongest revenue source in the Port's maritime division. Other imports include lumber, cement, newsprint, and palm oil. Major exports are soda ash, potash, and sodium sulfate. Total tonnage handled by the Port in 1998 was 1.7 million short tons.

Environmental stewardship is an important part of Port of San Diego operations. The Port participates in a number of real estate transactions intended to enhance and revitalize the environment. For example, the Port plans to lease newly acquired land to the US Fish and Wildlife Service to create the largest wildlife and wetland habitat preserve on the Bay. The Port also has been involved with several environmental projects including a massive stormwater education and outreach program, management of urban runoff into San Diego Bay, installation of oil-water separators at the airport, and the use of alternative fuel vehicles. The Port has collaborated with local, state, and federal agencies to produce several studies to protect the Bay's ecosystem and to adopt a formal Integrated Pest Management Policy. Such environmental projects allow the Port to balance economic development with environmental preservation.

Port of Savannah, Georgia
www.gaports.com
Jamie McCurry
Legislative Affairs
Tel (912) 964-3806
Fax (912) 964-3615

The Georgia Ports Authority (GPA) operates deepwater port facilities in Savannah and Brunswick, Georgia, and provides value added services to facilitate international trade. Inland barge terminals operated under the auspices of GPA are located in Bainbridge and Columbus. GPA is governed by a nine-member board appointed by the Governor.

GPA operates two deep water terminals in Savannah. Everyday, up to 30,000 containers arrive via ship, truck or train at GPA facilities in Savannah. The Garden City Terminal is located seven miles west of downtown Savannah on the Savannah River. The terminal occupies 838-acres and houses a container-handling facility featuring seven continuous berths, 13 container cranes, and Roll-On/Roll-Off ramps. Garden City terminal also is equipped with a cold storage facility and a paved container yard. The terminal handles liquid bulk cargoes, conventional general cargoes, and project cargoes. A liquid facility offers 2.2 million barrel storage capacity. Ocean Terminal is a 208-acre general and container cargo terminal located in downtown Savannah. It features 10 berths, open storage, covered storage, one container crane, five gantry cranes, and 32 reefer outlets.

Primary imported cargoes include iron and steel, woodpulp, foodstuff, and machinery; exports include kaolin clay, linerboard, woodpulp, and machinery. In 1998, 11.4 million short tons of cargo were handled by the Port in two-way trade.

GPA strives to be 100 percent environmentally compliant, maintains an environmental staff, and has been involved in a number of environmental projects. For example, the Port has made a commitment to cleanup four of its sites that are on the Georgia Hazardous Sites Inventory (HSI) List. All four are in active remediation and two are in construction for major Port expansion. The Port is also in the process of purchasing two brownfield sites for future Port expansion—both sites are on the State HSI List. Other projects include construction and maintenance of least tern nesting sites; beneficial resuse of dredge soils for beach erosion, dikes, and roadways; and extensive wetland mitigation.

Port of Seattle, Washington
www.portseattle.org
David Aggerholm
Health, Safety, & Environmental Manager
Tel (206) 728-3000
Fax (206) 728-3252

The Port of Seattle is the fifth largest container port in the US in terms of tonnage and revenue, making Washington the fifth largest exporting state in the United States. The Port is a municipal corporation directed by a five-member elected commission. The Port owns 20 commercial marine terminals, including six container terminals with 22 container cranes and 16 berths, an on-dock intermodal rail facility, and a 150 acre breakbulk/neobulk complex with cold-storage. The Port also operates Fisherman's Terminal, a working commercial fishing port and an important public access site.

In 1998, over 14 million short tons valued at approximately $33 billion passed through the Port in total two-way trade. The top exports from the Port included beef, poultry, and pork, industrial equipment, paper, and motor vehicle parts. The top imports were clothing, office and DP machine parts, motor vehicle parts, and video games.

The Port is participating in several projects that combine economic development with environmental restoration. For instance, the Port is developing industrial land in the Southwest Harbor by capping contaminated soil and by adding fish and wildlife habitat and public access areas. This development will increase the container cargo capacity of the Port and ensure the integrity of the natural resources of the harbor. Other environmentally conscious projects led by Port environmental specialists include a newly created intertidal slough and a redesigned pier that retains existing fish habitat.

Port of Toledo, Ohio
www.toledoportauthority.org
John Loftus
Seaport Director
Tel (419) 243-8251
Fax (419) 243-1835

The Port of Toledo is located at the Mouth of the Maumee River on Lake Erie. It is a full-service port and the most diversified cargo handling port on the Great Lakes. It was the first port to establish a Foreign Trade Zone on the Great Lakes and the first approved cargo delivery warehouse for London Metal Exchange. In addition, in 1996, the Port revitalized cruise ship activity for the Great Lakes.

Vessels of up to 800 feet can be dry-docked at the Toledo Shipyard. The Port has an overseas cargo center that is located along one mile of wharf. Ships calling on the Port use the center to discharge and load a variety of general, dry, and liquid bulk cargoes. Warehouse and storage space is available, and the entire Port is designated as an approved Foreign Trade Zone. Three grain terminals at the Port have 22 million bushel capacity for storing corn, soybeans, and wheat prior to exportation. Coal and iron are the largest imported commodity, making Toledo one of the largest coal and iron ore ports in the world. In 1997, the Port handled 13.5 million short tons of cargo.

The Port's environmental commitment includes the formation of a long-term dredge management program and a soil conservation management program. The Port also has actively participated in brownfields restoration. In 1996, the Toledo-Lucas Port Authority formed a partnership with the City of Toledo and a property owner to address environmental contamination problems on a parcel outside of the Port's jurisdiction and to build an overpass to improve traffic conditions around the Port. The cleanup and overpass were completed in 1998.

Port of Vancouver, Washington
www.portvanusa.com
Heidi Rosenberg
Environmental Affairs Manager
Tel (360) 992-1118
Fax (360) 735-1565

The Port of Vancouver is located 106 miles from the Pacific Ocean along the north shore of the Columbia River. Since its establishment as a state port in 1912, the Port has grown from a center for shipbuilding into the transportation center of the Pacific Northwest. The Port has 600 acres of developed industrial and marine property and 1080 acres of additional land. The Port is governed by three elected commissioners who serve six year terms.

The Port maintains berthing space for thirteen vessels, dockside warehousing, a bulk storage warehouse, open storage, and marshalling yards. The Port offers facilities for public use, such as a hotel and restaurant and a public dock with moorings and an amphitheater. In 1998, about 5.4 million short tons of total cargo were handled at the Port. Imports include automobiles, steel products, dry bulk, liquid bulk, aluminum, and cement. Exports include grain, woods products, aluminum, steel products, and paper products.

The Port's mission statement speaks to its environmental commitment in that it continues to participate in projects that will create economic development and maximize environmental protection. Currently, the Port is improving its storm drainage systems at its operating facilities. Working with the City of Vancouver, the Washington Department of Health, the Washington Department of Ecology, and Port tenants, the Port wants to ensure that the storm drain upgrades meet or exceed regulatory requirements. The Port also recently received approval to use formerly contaminated soil as embankment fill in the Port's main entrance. Up to 14,000 cubic yards of soil contaminated with trichloroethylene—a toxic chemical used as an industrial solvent by a former Port tenant—was treated and cleaned with soil vapor extraction technology. Cleaning and reusing this soil is an important part of an ongoing remediation project at the Port.

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