II.

The Marine Transportation System

This chapter describes the marine transportation system — its principal components, functions, and the support systems that it requires — and its service providers.

PRINCIPAL COMPONENTS

The MTS contains physical elements, including the waterways, ports, and the network of railroads, roadways, and pipelines that connect the waterborne portions of the system to the rest of the Nation. The physical elements also include the vessels and vehicles that move goods and people within the system. The physical network is supported by a series of systems that facilitate the movement of goods and people, and provide access for recreation and to natural resources.

The principal components of the U.S. marine transportation system are:

- ***Waterways*** include the navigable waters of the United States and associated infrastructure (for example, locks, bridges, aids to navigation) that vessel traffic uses;
- ***Ports*** contain marine transportation facilities where vessels transfer cargo and passengers, and include recreational access facilities and shipyards;

- ***Intermodal connections*** are linkages at the land-water boundary that allow the transfer of cargo and passengers between transportation modes. Intermodal connections include pipelines, road, and rail access routes;
- ***Vessels and vehicles*** are the transportation equipment that moves goods and people within the system and include oceangoing, coastal, and inland vessels, trains and trucks;
- ***MTS users*** are the people who depend on the system for their livelihood and recreational access.

Waterways

The waterways portion of the U.S. MTS consists of:

- Harbor channels;
- Inland and intracoastal waterways; and
- Locks and dams.

Harbor Channels: There are 926 Federal harbor channel projects (including both deep draft and shallow draft) that support the U.S. port system. In addition, non-Federal interests maintain and improve a network of channels, connecting channels and berths.

The U.S. deep-water port system includes more than 300 Federal harbor channel projects. There are 51 ports with depths greater than or equal to 40 feet. The 25 ports most active in foreign trade have depths of at least 40 feet.

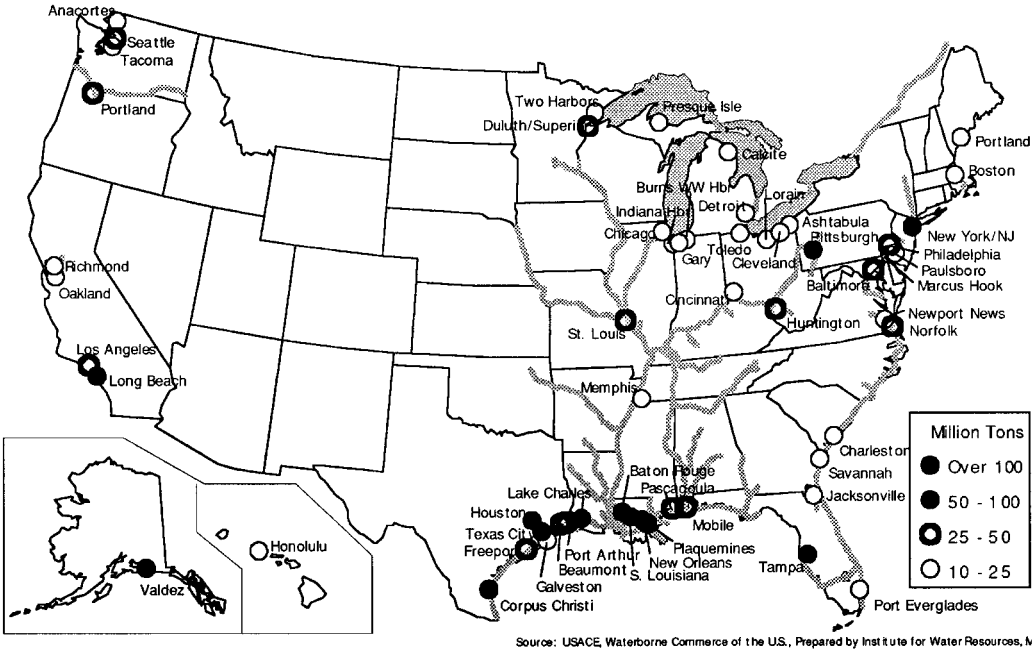
Although some ports have natural deep water, most Federal harbor channels are deepened channels. Deepening projects may include breakwaters, seawalls, channel control structures, dredged material disposal sites, drift removal components, and other related features. There is no one-to-one relationship between ports and Federal channels. Some U.S. ports contain several Federal harbor channel projects with varying depths, while a few ports have no Federal channels. In addition, a single Federal harbor channel may provide access to more than one port.[7]

Inland and Intracoastal Waterways: There are about 25,000 miles of inland, intracoastal, and coastal waterways and channels in the United States. Of this total, nearly 12,000 miles of network constitute the commercially active inland and intracoastal waterway system. This network includes 10,867 miles of fuel-taxed inland waterway system. Fuel-taxed waterways comprise nearly all of the commercially significant inland and intracoastal waterways in the U.S.

The Mississippi River and its tributaries and the Gulf Intracoastal Waterway (GIWW) connect Gulf Coast ports with major inland ports. The controlling depth of 45 feet in the section of the Mississippi River from Baton Rouge to the Gulf of Mexico allows ocean shipping to connect with the barge traffic, thereby making this segment vital to both the domestic and foreign trade of the United States. On the Great Lakes, seven key waterways must be kept navigable during portions of average or severe winters when ice formation would otherwise restrict or prohibit ship movements. The U.S. Coast Guard (USCG) is tasked by Executive Order to conduct icebreaking operations in order to meet the reasonable demands of commerce to keep harbors and channels open for navigation during the winter months. During average or severe winters, domestic icebreaking allows shipping to continue for an additional 6 to 8 weeks — enabling 10 to 12 million tons to be shipped over ice-covered waters.

The Atlantic Intracoastal Waterway (AIWW) is a combination of protected coastal waterways and connecting canal segments that parallel the Atlantic Coast between Norfolk, Virginia, and

Figure II-1: *Location of Major U.S. Seaport Facilities.*



Jacksonville, Florida. Another section known as the Intracoastal Waterway continues from Jacksonville southward to Miami. A shallower, partially protected stretch of the Intracoastal Waterway that is not fuel taxed also extends along the Atlantic Ocean side of the Virginia portion of the Delmarva Peninsula and along the coast of New Jersey and Long Island, NY. The shallow-draft, fuel-taxed inland waterways of the Pacific Coast include the Columbia-Snake Waterway and the Willamette River above Portland, Oregon.

Locks and Dams: Lock and dam structures allow vessels to move up or down one level when traveling navigable waterways with different water levels. There are 192 commercially active lock sites, with 238 chambers in the Federal navigation system. Of these, 171 lock sites with 215 chambers are in segments designated as fuel-taxed waterways.

Lock and tow sizes are critical factors in the amount of cargo that can pass through a lock in a given period of time. Locks may vary in width and length based on their location (for example, in a major river or tributary) and their age (for example, by 2000, 44 percent of the chambers will be more than 50 years old).

Despite a number of relatively new lock chambers, there are significant signs of age within the system. Locks on any given waterway tend to be from the same era. Therefore, problems associated with aging locks on the waterways tend to affect many locks within the same segment at the same time.[8]

The Ports

In 1997, the U.S. port system handled more than 2 billion metric tons of foreign and domestic waterborne cargo. This cargo moved through 326 coastal, Great Lakes, and shallow-draft ports. Within the individual ports, cargo is transferred between water and landside transportation modes at publicly and privately owned marine terminals. Private ownership of inland waterway facilities is more pronounced than that of the coastal and Great Lakes facilities, with 87 percent privately owned, compared to 66 percent at the deep-water ports. The movement of waterborne commerce

Table II-1: *U.S. Ports Handling More Than 10 Million Tons in 1997.*

Coastal Region	Number of Terminals[1]	Percent of Total	Number of Berths	Percent of Total
North Atlantic	421	22.0	761	24.1
South Atlantic[2]	197	10.3	349	11.0
Gulf	484	25.3	786	24.9
South Pacific[3]	223	11.6	414	13.1
North Pacific[4]	249	13.0	365	11.6
Great Lakes	340	17.8	483	15.3
Total	1,914	100.0	3,158	100.0

Source: U.S. Department of Transportation, Maritime Administration, adapted from U.S. Army Corps of Engineers, Navigation Data Center.

Notes:

1 *Includes those commercial cargo handling facilities with a minimum depth alongside of 25 feet for coastal ports and 18 feet for Great Lakes ports.*
2 *Includes Puerto Rico and the U.S. Virgin Islands*
3 *Includes Hawaii*
4 *Includes Alaska*

through the U.S. port system is concentrated. For 1997, the top 50 ports — coastal and inland — handled 82 percent of the total waterborne trade. Even with this high degree of concentration, 148 ports — or 45 percent of all U.S. ports handling waterborne commerce — each handled more than 1 million metric tons of cargo. These figures reflect the broad base on which the U.S. port system is built, the large volume of waterborne trade, and the adaptability of ports to market forces. Figure II-1 (page 7) shows the U.S. ports handling more than 10 million tons in 1997. Major ports on the Atlantic and Pacific Coasts service container trades, while the major Gulf Coast ports are involved primarily in tanker and dry bulk trades. For cruise ships, Miami and San Juan were by far the largest U.S. ports of call.

Shipyards and repair facilities form an important part of the MTS infrastructure in which ships, barges, and vessels are designed, built, and repaired. The U.S. shipbuilding and repair industry is an aggregate of more than 280 privately owned facilities throughout the Nation's waterways and ports.

Passenger vessels are a growing consideration for ports. For example, the Port of Miami is the world's largest cruise port. In 1997, cruise lines called on over 30 ports in the U.S. More than 6,000 vessel calls were recorded at these ports.(9)

The two major types of port facilities are:

- Deep-draft seaport and Great Lakes port facilities; and
- Inland river and intracoastal waterways port facilities.

Deep-Draft Seaport and Great Lakes Port Facilities

Table II-1 shows the location of the major U.S. seaport facilities by coastal region. Twenty-eight States contain coastal or Great Lakes ports.

As shown in Table II-1, 1,914 terminals contain 3,158 berths. Berths are the locations where vessels dock. These figures include both privately and publicly owned facilities.

Table II-2: *Top 25 U.S. Ports and Their Number of Cargo Vessel Calls.*

	TANKER		DRY BULK		CONTAINER		OTHER		TOTAL	
PORT	CALLS	000 DWT	CALLS	000 DWT	CALLS	000 DWT	CALLS	000 DWT	CALLS	000 DWT
Houston	3,450	132,185	807	33,273	515	16,558	2,031	25,798	6,803	207,814
New Orleans	1,660	94,621	3,337	150,999	399	10,071	1,366	20,802	6,762	276,493
Los Angeles	806	57,563	952	49,602	2,462	102,174	1,365	19,695	5,585	229,034
New York	1,219	62,216	485	21,148	2,150	77,153	1,270	21,848	5,124	182,365
San Francisco	773	55,922	361	12,497	1,643	67,874	382	7,575	3,159	143,868
Hampton Roads	198	8,398	841	66,802	1,488	53,026	571	11,249	3,098	139,475
Philadelphia	1,076	92,577	476	20,069	522	8,567	922	10,591	2,996	131,804
Port Everglades	338	13,820	83	2,734	734	11,981	1,807	12,706	2,962	41,241
San Juan(PRI)	155	4,980	83	2,620	671	12,266	1,993	13,762	2,902	33,628
Miami	10	321	26	1,073	607	15,193	1,946	12,673	2,589	29,260
Columbia River	203	10,022	1,303	46,872	259	9,634	456	10,133	2,221	76,661
Charleston	151	5,521	103	3,241	1,289	50,793	614	13,032	2,157	72,587
Baltimore	146	4,116	499	26,989	579	17,887	809	14,250	2,033	63,242
Jacksonville	195	7,632	217	6,504	497	11,426	680	8,761	1,589	34,323
St. Thomas	8	117	21	126	4	56	1,442	8,966	1,475	9,265
Corpus Christi	1,106	64,487	330	16,997	0	0	29	405	1,465	81,889
Texas City	1,209	63,088	122	5,669	1	18	23	242	1,355	69,017
Savannah	123	4,069	222	7,122	414	15,236	526	11,386	1,285	37,813
Seattle	32	1,611	203	9,824	755	33,856	276	5,898	1,266	51,189
Tacoma	82	3,168	307	13,441	526	17,943	338	5,616	1,253	40,168
Tampa	267	7,032	492	17,613	5	62	457	3,843	1,221	28,550
Mobile	137	7,059	465	25,468	0	0	560	10,193	1,162	42,720
Beaumont	816	53,279	151	7,019	1	41	46	990	1,014	61,329
Honolulu	165	9,180	93	4,504	448	12,002	201	2,815	907	28,501
Lake Charles	538	34,817	135	5,729	0	0	177	1,963	850	42,509
Top 25	14,863	797,801	12,114	557,935	15,969	543,817	20,287	255,192	63,233	2,154,74
All Ports	20,584	1,270,89	14,481	645,945	16,930	568,868	25,858	315,205	77,853	2,800,91
Top 25 Percent	72.2	62.8	83.7	86.4	94.3	95.6	78.5	81	81.2	76.9

**Excludes calls by non-self-propelled vessels under 1,000 Gross Tons.*

Source: Lloyd's Maritime Information Services, Vessel Movements, London: Lloyd's of London Press, February 1998.

Note: The Lloyd's port scheme often combines several ports. For example, Long Beach is included in the Los Angeles figures, and Oakland is considered in the San Francisco data.

Berths can be specialized to serve specific types of freight and passenger movements. For example, berths may be designed to handle containerized cargo, dry and liquid bulk cargo, automobiles and other cargo that can roll-on/roll-off vessels, and general cargo. Passenger berths may handle ferries or large cruise vessels.

Table II-2 shows the top 25 deep-draft U.S. ports and their number of cargo vessel calls.

Table II-3: *U.S. Shallow-Draft Terminal Facilities by State.*

STATE	NUMBER OF TERMINALS	NUMBER AND TYPE OF FACILITIES									
		GENERAL CARGO	DRY BULK CARGO				LIQUID BULK CARGO			MULTI-PURPOSE
			GRAIN	COAL	ORE	OTHER	PETROL	LPG	OTHER	
Alabama	137	8	16	21	-	41	21	-	15	15
Arkansas	84	2	26	-	-	24	7	-	6	19
Illinois	267	6	64	18	1	70	37	-	42	29
Indiana	60	2	8	14	1	16	9	-	2	8
Iowa	75	-	16	9	-	17	8	-	11	14
Kansas	8	-	4	-	-	1	-	-	2	1
Kentucky	175	3	13	48	-	49	32	1	15	14
Louisiana	66	1	8	2	-	12	19	1	14	9
Minnesota	55	1	10	-	-	20	8	-	7	9
Mississippi	69	1	16	-	-	13	16	1	6	16
Missouri	133	2	22	6	-	59	14	-	18	12
Nebraska	17	1	7	-	-	4	-	-	4	1
Ohio	132	6	7	21	2	43	23	-	19	11
Oklahoma	27	3	5	-	-	9	4	-	2	4
Pennsylvania	145	9	-	41	2	49	18	-	18	8
Tennessee	129	6	21	7	1	47	23	-	12	12
West Virginia	149	9	-	47	1	52	21	1	15	3
Wisconsin	20	1	1	4	-	7	3	-	2	2
Mississippi System Subtotal	1,748	61	244	238	8	533	263	4	210	187
Idaho	4	1	2	-	-	1	-	-	--	-
Oregon	24	3	7	-	-	12	-	-	1	1
Washington	36	5	18	-	-	5	2	-	4	2
Columbia/Snake Subtotal	64	9	27	-	-	18	2	-	5	3
Total	1,812	70	271	238	8	551	265	4	215	190

Source: U.S. Department of Transportation, Maritime Administration, adapted from U.S. Army Corps of Engineers, Navigation Data Center.

Inland River and Intracoastal Waterways Port Facilities

There are more than 1,800 river terminals located in 21 States. The U.S. inland waterway ports and terminals have unique characteristics that distinguish them from the deep-water ports on the Nation's coasts and Great Lakes seaports. Aside from shallow water depths of 14 feet or less, the inland system is less concentrated geographically and provides almost limitless access points to the waterways.

Overall, there are more inland facilities located outside traditional port boundaries than within. Terminal siting on the inland waterways is less constrained than coastal ports, which provides greater flexibility to the users in determining the location of plants requiring water access.

Table II-3 (page 10) profiles by State the terminal facilities located on the U.S. inland waterway system.

Dry bulk facilities account for 59 percent of inland terminals. Grain and coal terminals are the leading types within dry bulk. Liquid bulk terminals are the second largest category comprising 27 percent. Within this category, petroleum facilities account for more than half. Multipurpose and general cargo terminals account for the balance of the terminals.

Intermodal Connections

Waterways, ports, and terminals are only part of the MTS. The system also includes inland rail, roadway, and pipeline connections that permit cargo and passengers to reach the marine facilities. In general, these intermodal connectors are almost exclusively built and maintained by the private sector, for example, by Class I railroads and pipelines, or by States through State-funded local roads or user fee-supported Federal highways. The importance of intermodal connections was recognized in the National Highway System (NHS) Designation Act of 1995. This Act directed the Secretary of Transportation, not later than 180 days after the date of the enactment, to submit for approval to Congress modifications to the National Highway System that consist of connectors to major ports, airports, international border crossings, public transportation and transit facilities, interstate bus terminals, and rail and other intermodal transportation facilities. These modifications were in addition to connectors approved in the Designation Act of 1995.

In May 1996, the Secretary submitted to Congress for approval the modifications to the NHS in the report titled *Pulling Together: The National Highway System and Its Connections to Major Intermodal Terminals.* As a result, connections to 1,407 terminals have been identified. The report cites connections to 519 freight terminals, including 247 ports and terminals, 211 rail terminals, and 61 pipelines. Of the identified 907 passenger terminals, there are connections to 59 ferry terminals and 42 multimodal (more than one nonhighway mode) facilities. Approval of the connections by Congress is still pending, however, on an interim basis, improvements to connectors are eligible for NHS funds.

The Transportation Equity Act for the 21st Century (TEA-21), enacted June 1998, directed the Federal Highway Administration (FHWA) to conduct a freight study to evaluate NHS connections to terminals and their related investments. The purpose of the NHS Connector Condition and Investment Study is to characterize the nature and extent of physical and operational problems on freight connectors and investments made on them. This effort will result in a Report to Congress, scheduled to be submitted by September 30, 1999.

The Nation's public port authorities have recognized the need to improve the intermodal movement of cargo. Several ports, often with their local Metropolitan Planning Organizations (MPOs), have built or are planning intermodal projects. In most cases, these projects are outside the port's boundary and require extensive coordination and partnering. The largest such project, the Alameda Corridor (serving the Ports of Los Angeles and Long Beach), will cost more than $2 billion.

Vessels and Vehicles

Vessels and vehicles move goods and people throughout the U.S. MTS. The U.S. domestic fleet includes more than 30,000 vessels that transport goods and people between U.S. ports.

As of January 1, 1999, the domestic fleet includes:[10]

- Domestic coastal and oceangoing vessels including 55 container ships, 104 tankers, 982 dry cargo barges, and 456 tank barges;
- An inland-barge fleet consisting of 22,279 dry cargo barges and 2,791 tank barges;
- 5,424 tugs and towing vessels that move coastal and inland barges and provide shipdocking, vessel escort, lightering, and other services;
- The Great Lakes system consisting of a fleet of 56 dry bulk carriers, 8 cement carriers, 3 tankers, and an additional 101 dry cargo barges and 41 tank barges; and
- Hundreds of passenger vessels that serve as ferries, excursion vessels, and gaming vessels.

In addition, the MTS is served by an international fleet that transports goods and people among U.S. and foreign ports. The international fleet consists of a wide variety of vessel types such as tankers, dry bulk carriers, containerships, roll-on/roll-off ships, and cruise ships. In 1997, 7,520 vessels (27 percent of the world merchant fleet) called at U.S. ports. In terms of capacity, these ships represented 44 percent of the world's merchant fleet.

The intermodal component of the MTS also relies on an inland freight rail system, which consists of nearly 1.3 million freight cars, 20,000 locomotives, 152,000 miles of railroad, and 200,000 employees. From double-stack trains, which transport containers stacked two high, to hopper or tank cars carrying bulk cargo, U.S. railroads provide a full range of equipment to accommodate inland movement of waterborne cargo.

In addition to the railroads, nearly 5 million trucks operate in the U.S. While many of these vehicles move domestic cargo, a significant number are involved in a variety of port-related activities, including moving cargo between the port and rail yards and transporting international cargo both long and short distances to customers.

MTS Users

The MTS transports people to work, provides them with recreation and vacation opportunities, puts food on their tables, and brings them many of the items they need in their professional and personal lives. The MTS also provides American businesses with access to suppliers and markets around the world. Within the U.S., the MTS provides a cost-effective means for moving major commodities. Further, the MTS is an essential element in maintaining national security.

The MTS serves an extensive range of users, including commercial, recreational, and defense-related activities. For example, in the movement of freight alone, the MTS users include:

- Companies that need to ship or receive freight by water, including manufacturers, retailers, agricultural concerns, petroleum companies, utilities, and mining operations;
- Companies that arrange and physically move the freight to, from, and across the water, including ship operators, trucking firms, railroads, third-party logistics operations, freight forwarders, consolidators, customshouse brokers, and others;

The U.S. Marine Transportation System users include:

- Carriers and cargo owners of the more than 2 billion tons of domestic and international freight pass through the system annually.
- 134 million passengers who travel each year by ferry.
- 78 million Americans who use the system for recreational boating annually.
- Annually more than 5 million cruise ship passengers.
- Commercial fishers operate 110,000 boats that contribute $111 billion to the U.S. economy.
- Shipyards and repair facilities.

- Public and private organizations that support the movement of the waterborne cargo, including terminal operators, shipyards, pilots, and tugboat operators;
- Governmental agencies that inspect waterborne cargo and vessels, along with supporting maritime operations and commerce;
- Firms that provide the information, telecommunications, financial, and insurance services needed to facilitate the movement of waterborne cargo; and
- Governmental agencies that protect U.S. citizens, critical infrastructure, national interests, and environmental quality.

MTS FUNCTIONS

The marine transportation system serves five functions:

- Provides a global gateway to world markets and for military mobilization;
- Provides domestic transportation of goods and passengers;
- Supports recreational uses;
- Supports other commercial uses; and
- Supports local economic development and creates jobs.

Global Gateway

Three sets of users rely on the MTS as a global gateway:

- Cargo operations;
- Passenger operations; and
- National defense and mobilization.

Each user places different demands on the U.S. marine transportation system.

Cargo Operations: The U.S. annually imports and exports more than 1 billion tons of freight through its ports and waterways. The billion tons of cargo move in a wide range of vessel types, extending from barges to *mega-ships* capable of carrying more than 6,000 20-foot containers (projected to reach 15,000). The increase in vessel size in maritime transportation is, in general, a direct result of the significant increase in the trade volumes, current and projected. Additionally, economic and competitive forces will decrease transportation costs per unit volume, as well as increase reliability for shippers.

- Container vessels account for 121 million metric tons.[11]
- Roll-on/roll-off vessels are used for military mobilization, as well as to carry vehicles.
- Bulk vessels, which carry commodities such as petroleum, coal, and grain, account for 532 million metric tons.
- Breakbulk vessels (for such commodities as steel and lumber) account for 414 million metric tons.
    - *Container vessels* represent a growing portion of the vessels calling on U.S. ports. These vessels generally carry higher value cargo and serve a range of users. Container ships

carry 66 percent of the value of U.S. waterborne overseas trade and represent 11 percent of the annual tonnage. Container operations require large acreage facilities and specialized cranes.[12]

Carriers have also deployed increasingly larger container vessels. These larger vessels provide significant economies of scale and are consolidating their activities at designated hub ports on primary trade lanes. The new class of container vessels, called mega-ships, is included in the "Post Panamax" category of vessels, which means that they exceed the size of the locks in the Panama Canal. The mega-ships are deployed on the longest trade routes of Europe-to-Asia and U.S. West Coast-to-U.S. East Coast via the Suez Canal. The growth in the containership industry and vessel size is driving many of the harbor improvement projects in the United States. To accommodate these ships, ports need to provide channel depths of at least 50 feet, cranes that can fully extend over their width, highly efficient terminals, and superior inland connections.

- *Bulk vessels* carry commodities such as petroleum, chemicals, minerals, and grain. Bulk facilities can be quite diverse and are designed to meet the requirements of specific commodity movements. Bulk vessel movements account for a considerable portion of trade at U.S. ports. The largest vessels in the world (with a draft more than 85 feet) are crude oil tankers that generally do not call at U.S. ports.
- *Breakbulk vessels* transport a wide variety of general merchandise cargo. This cargo is carried in a variety of ways, including palletized, baled, or boxed. These vessels are capable of serving a broad range of ports and terminals because they often have equipment onboard for the loading and unloading of cargo.

Passenger Operations: In addition to freight operations, the U.S. MTS acts as a global gateway for business and leisure travelers. According to the Cruise Lines International Association, nearly 5.5 million North American vacationers took a cruise in 1998. Passenger terminals, similar to airports, require more detailed security measures and streamlined processing. These vessels range in capacity to more than 5,000 passengers and crew. The vast majority of the passenger vessels serving U.S. markets are built in foreign shipyards, registered under foreign flags, and crewed with foreign nationals.

National Defense and Mobilization: The United States remains committed to a policy of engagement abroad to promote peace, prosperity, and democracy. Because the overwhelming majority of material to sustain overseas operations needs to move by sea, the logistical backbone for the all-season rapid loading and transport of American forces and material relies ultimately upon the marine transportation system.

The Department of Defense (DOD) spends more than $2 billion annually on commercial freight services, increasingly emphasizing the use of intermodal freight movement.[13] DOD relies on commercial transportation providers for 90 percent of its peacetime freight and personnel movements and an estimated 95 percent of its wartime movements. The availability of U.S.-flagged vessels is essential to this effort. One key element of maintaining this capability is the U.S. cabotage laws. Commercial shipyards provide critical infrastructure needed to build new military and commercial sealift vessels, as well as maintain and repair the U.S. fleet of vessels needed to support national defense and mobilization efforts.

National defense and mobilization also increasingly depend upon domestically based operations, especially with the closure of so many overseas bases during the last decade. More than 3 million tons of military equipment and supplies were loaded at U.S. commercial ports for shipment to the Persian Gulf during Operation Desert Shield/Storm. Concurrent with the greater

dependence on commercial ports is the use of larger, deeper draft vessels designed for specific cargo types. These vessels rely on technically sophisticated, highly specialized shoreside facilities and their intermodal connections, as well as shipyard repair facilities.

The National Port Readiness Network promotes the readiness of three continental U.S. military and 13 commercial strategic seaports to support deployment of military surge and sustainment cargo. These ports and waterways must continue to provide the critical infrastructure and services needed to ensure rapid, secure, and effective military mobilization. These strategic resources include deep-draft harbor channels, modern port facilities, and an extensive network of intermodal links. Under its Railroads and Highways for National Defense program, DOD, with the support of the Department of Transportation (DOT), ensures the Nation's rail and highway infrastructure can support defense emergencies. The Strategic Rail Corridor Network (STRACNET) consists of 38,800 miles of rail lines important to national defense and provides service to 193 defense installations whose mission requires rail service. The Strategic Highway Network (STRAHNET) consists of 61,000 miles of highways defining DOD's public highway needs. An additional 2,000 miles of STRAHNET connectors link important military installations and ports to STRAHNET. These highways define the total minimum public highway network required to support defense emergencies.

Domestic Movement

The MTS also moves a substantial amount of cargo within the U.S., and is becoming an increasingly popular method of commuting to work. More than 1 billion metric tons of domestic freight moves through the marine transportation system, which is equal to the amount of cargo imported and exported by the MTS.

Domestic Freight Movement: In 1997, carriers serving this market segment moved:

- 239 million tons of freight between U.S. ports on the deep seas;
- 572 million tons on the inland waterways; and
- 111 million tons on the Great Lakes.

The 1997 tonnage was 70 percent greater than the level of traffic in 1965, and 18 percent greater than the level of traffic recorded in 1980. Most of the 1997 traffic was composed of liquid and dry bulk commodities such as petroleum and petroleum products, coal, grain and other farm products, sand, gravel and other nonmetallic minerals, industrial and agricultural chemicals, forest products, and metallic ores and products. The number of ton-miles increased by 67 billion (29 percent) to 294 billion ton-miles over the 1980-97 period.

The domestic deep-sea (coastwise) traffic in 1997 was 239 million metric tons, 20 percent below the record total in 1980. The main commodities shipped were:

- Petroleum (72 percent); and
- Coal (9 percent).

Barges carried 86 percent of cargoes moved less than 500 miles, while self-propelled vessels carried 91 percent of the metric tons moved in trades greater than 2,000 miles. The capacity of the dry cargo vessel fleet is expected to remain at its 1997 level through 2002, reflecting limited growth in U.S. noncontiguous trades.

In 1997, barges moved 96 percent of the 572 million metric tons that moved on the inland waterways. Waterway traffic grew by 18 percent from 1980 to 1997. Total inland barge capacity

increased by 6.2 percent in 1995-1996 — the largest annual increase in capacity since 1980-1981. The primary commodities moved by barge were: coal (28 percent), petroleum (25 percent), crude materials (19 percent), and farm products (13 percent).

In 1997, 111 million metric tons of domestic cargo moved on the Great Lakes, 7 percent above 1980 traffic.[14] More than 90 percent of the overall trade is moved in dry bulk ships, and this traffic is expected to remain at the 111 million ton level annually over the next 5 years. The major commodities moved via the Great Lakes were: iron ore (49 percent), limestone (24 percent), and coal and coke (19 percent).

Passenger Movement: Ferries in the United States provide critical links in the U.S. highway, transit, and freight network, as well as the national intermodal network. As highway links, transit providers, and floating high-occupancy-vehicle lanes, ferries transport commuters, recreational travelers, and vehicles of all sizes, from bicycles to freight trains. According to a national ferry database, 35 States have ferry systems. Service is provided by 168 entities (72 public/96 private) on 264 routes. Of the 264 individual ferry routes, approximately 112 are lifeline routes, linking mainland ports with island communities. Annually, ferries carry an estimated 134 million Americans and tens of millions of vehicles, thereby relieving congestion on other surface transportation modes. For example, the Washington State Ferry System carries more people annually than Amtrak. A number of ferries are designated as part of the NHS. Congress has recognized this trend in ferry growth and that transportation planners need more accurate and complete data about this growing sector of the MTS. Section 1207(c) of TEA-21 required the compilation of information on existing ferry operations and forecasts about new routes and technologies for ferry vessels.

Hundreds of American companies operate passenger vessels that provide sightseeing, excursion, dining, gaming, windjamming, whale watching, and nature cruises.

Recreation

Boating is a major source of outdoor recreation for millions of Americans. The National Marine Manufacturers Association estimates that more than 78 million Americans participated in recreational boating in 1997. That same year, Americans:

- Used 16 million boats of all types.
- Spent $19 billion for boats, accessories, and memberships in 8,000 associations.

Reasonably easy access to the waters is essential for their full enjoyment. The majority of recreational boats are transported to the water by trailer. Access from the roadways to boat launching ramps and marinas is an important consideration for boaters. The MTS also provides recreational opportunities to a vast array of others, including swimmers, bird watchers, and fishermen. Sufficient access for those uses is necessary. However, recreational boating safety is a critical issue.

Other Commercial Use

Commercial users of the MTS include the fishing industry and shipbuilding and repair.

Fishing: Americans operate 110,000 commercial fishing vessels, which contribute $20 billion in product value to the U.S. economy and provide an important food source for the American population.

Table II-4: *Major U.S. Shipbuilding and Repair Base as of October 1998.*

	EAST COAST	GULF COAST	WEST COAST	GREAT LAKES	NON-CONTIGUOUS*	TOTAL BY TYPE
Shipbuilding	5	8	3	3	0	19
Repair w/ Drydock	13	8	7	2	3	33
Topside Repair	10	19	8	2	1	40
Total (By Coast)	28	35	18	7	4	92

**Alaska, Hawaii, Puerto Rico, and the Virgin Islands*

Source: U.S. Department of Transportation, Maritime Administration, Office of Ship Construction.

Shipbuilding and Repair: Shipbuilding is an important industry in the United States and around the world. Table II-4 shows the coastal location of major U.S. shipbuilding and repair yards. U.S. shipbuilding and repair, a key element for national security, is dominated by two main components:

- Military market and
- Commercial market for deep- and shallow-draft vessels, including recreational vessels.

The United States shipbuilding industry has made progress in its reemergence as an active participant in the commercial shipbuilding market. The National Shipbuilding and Conversion Act of 1993 and the expanded Title XI Federal Ship Financing Program provide one of the primary stimuli for this evolution of the U.S. shipbuilding industry and its ability to aggressively enter and compete in the market. As of May 1999, the U.S. Maritime Administration (MARAD) had applications for 17 projects pending, including three shipyard modernization projects — as well as projects for tankers, ferries, various offshore vessels, barges, and tug/supply vessels — for an estimated cost of $1.3 billion, with Title XI guarantees totaling $1.1 billion. These pending applications may not all be approved and may not be approved in the short term. Those with a longer lead time do not reflect near-term demand.

The U.S. orderbook, as of May 1, 1999, consisted of one tanker, three crude carriers, and two cruise ships. During 1998 and the first quarter of 1999, U.S. shipyards delivered six commercial oceangoing ships, two nonoceangoing ferries, one oceangoing ferry, and scores of smaller vessels.

The U.S. Navy's (USN's) proposed Fiscal Year 1999-2004 shipbuilding program will average 7.5 new ships a year, compared to 5.8 new ships per year in the FY 1998-2003 shipbuilding program, and 10 new ships per year in the 1992 to 1997 shipbuilding program.

The U.S. government and the shipbuilding industry have made great strides in their efforts toward industry revitalization and market transformation. The small or mid-sized shipyards continue to build an assortment of vessels for use on the inland and coastal waterways, as well as for foreign markets. The major change has been the surge in activity relating to the offshore exploration, drilling, and servicing sectors. These shipyards are expected to continue to prosper for the next decade.

The benchmark used to track the U.S. shipbuilding industry is the U.S. Major Shipbuilding Base (MSB). The MSB is defined as those privately owned shipyards that are open and have at least one shipbuilding position consisting of an inclined way, a launching platform, or a building basin capable of accommodating a vessel 400 feet or more in length. With few exceptions, these

shipbuilding facilities are also major repair facilities with drydocking capability. As of January 1, 1999, there were 19 major shipbuilding facilities in the United States.

Employment in the U.S. shipbuilding and repair industry, as of December 1998, was 100,300, up 1,700 from 1997. The MSB shipyards employ about 60 percent of the total work force of the shipbuilding and ship repair industry. The remaining 40 percent were in the 550 smaller establishments with 10 or more employees. In addition, as of October 1998, 14,473 people were employed in the four USN and one USCG shipyards.

Offshore Oil and Gas Exploration: There are more than 4,000 offshore facilities in place to support mineral development under Federal jurisdiction. These facilities have a critical impact on MTS safety and waterway navigation. Almost $3.5 billion per year, on average, is collected and distributed by the Federal government from bonuses, rents, and royalties from offshore (outer continental shelf) mineral leases. This effort provides about $2.5 billion annually to Federal and State treasuries, $900 million per year to the Land and Water Conservation Fund, and $150 million to the National Historic Preservation fund.

SUPPORT SYSTEMS

Two systems support the U.S. MTS:

- ***Information systems*** are communication and information systems that collect, store, retrieve, analyze, and disseminate information required by all MTS stakeholders and users; and
- ***Management systems*** are the multiple and diverse systems that currently exist to direct and manage the MTS.

Information Systems

Information technology is transforming the MTS and the intermodal freight industry by enabling it to integrate operations across the supply chain. In addition, navigational aids are crucial to the safe and efficient operation of the marine transportation system.

Intelligent Transportation Systems

Advanced communication and information systems and intelligent transportation systems (ITS) provide real-time information on intermodal freight operations and congestion on the physical transportation system. Sharing information about congestion and operations across intermodal freight systems is critical to increasing capacity and improving reliability. Some examples of the existing private and public sector information systems with ITS applications include:

- Shipment Information Systems that manage the flow of materials and products from source to user include shipping, booking, and gate clearance systems.
- Security Systems monitor the condition of vehicles, containers, and goods during shipment or in storage at terminals.
- Customs Clearance Systems automate filing, processing, review, and issuance of documents for import and export of goods.
- Ship Stowage Management Systems plan and track the location of containers aboard ships.
- Asset Location and Management Systems locate and track vehicles or containers.

Navigation Systems

Navigation systems are key to safe operations within the MTS. Vessels, both large and small, rely upon existing public and private navigation systems to transit the Nation's waterways and ports. These vessels, possibly carrying large numbers of passengers or environmentally harmful cargoes, have the potential to cause significant accidental injury and damage.

The National Oceanic and Atmospheric Administration (NOAA), USCG, U.S. Army Corps of Engineers (USACE), and the National Imagery and Mapping Agency (NIMA) cooperate to provide navigation warnings information to mariners. These are used to update nautical charts and publications issued by NOAA and NIMA. The USCG issues the Local Notices to Mariners, the USACE issues Notices to Navigation Interests, and NIMA issues worldwide Notices to Mariners, including U.S. notices of interest to international shipping. U.S. notices must be coordinated with the national charting authority, NOAA, and with other information providers such as the port authorities. Notices to Mariners are currently issued in paper form and communicated through broadcasts. However, NOAA, USCG, USACE, and NIMA are considering or are using Internet-based systems for both Notices and nautical chart updates.

Short-range aids to navigation help mariners operate safely and efficiently. Used in conjunction with nautical charts, these aids to navigation provide mariners with visual directions that guide them away from dangers by marking channels, shoals, and hazards, and help them to avoid groundings, obstructions to navigation, and collisions with other vessels.

Among the many factors considered when establishing aids to navigation are depth of water, bottom composition, tides and currents, width of the waterway, and size and types of vessels (naval, commercial, recreational) using a waterway. Additionally, the requirements of all mariners using a waterway are considered when establishing aids to navigation. The USCG maintains approximately 50,000 Federal aids to navigation and oversees an additional 50,000 private aids to navigation. Many of the 50,000 Federal aids mark channels to and from commercial or military ports used by deep-draft vessels. However, the largest percentage of aids is located in shallow waters frequented primarily by shallow-draft commercial operators and recreational boaters.

Navigation methods and techniques vary with the type of vessel, the conditions of the waterway, and the navigator's experience. Navigating a pleasure craft, for example, differs from navigating a container ship or supertanker; and both differ from navigating a naval vessel. As such, these mariners have different requirements for navigation information and use the available aids in different ways. To determine the optimal mix of aids to navigation, the USCG conducts a study that includes evaluating the characteristics of the waterway user and the expressed user needs for aids to navigation. To minimize duplication, the needs of the entire spectrum of users are simultaneously analyzed. This analysis considers the varying needs of the international shipping community, coast-wise trade, inland waterway trade, intra-harbor traffic (tugs, ferries, small commercial craft, etc.), fishing vessels, recreational boats, special operations craft (survey, oceanographic, search and rescue, etc.), vessels of very large size, and high-speed vessels (hydrofoils, air cushion vehicles, etc.). Also considered are the number of vessels, tonnage of vessels, value of the cargo, and the nature of the cargo visiting the area, along with the benefits (economic, safety, and convenience) to the mariner.

Mariners require real-time access to integrated hydrographic services, including bathymetry, shoreline, detailed large-scale digital vector charts, precise positioning information, and real-time and predicted oceanographic and meteorological data. This integrated information data suite is essential to providing the mariner with a three-dimensional view of the significant hazards to navigation. Accurate bathymetric information implies recent acquisition of full bottom surveys. Accurate shoreline information implies recent data from aerial surveys or satellite remote sensing.

Detailed large-scale digital vector charts, coupled with precise positioning, enable precision docking and undocking and waterway transit.

Real-time and predicted information provide the reliable safety margins and competitive advantage necessary to conduct modern just-in-time (JIT) intermodal commerce. In the event of hazardous materials accidents, they facilitate accurate containment, cleanup, and restoration response. The nautical chart, whether paper or electronic, is the background on which this information suite is integrated and displayed. A chart update service will refresh this most fundamental tool of safe navigation on a weekly basis. These navigational system components and their integration are offered through various programs supported by the Hydrographic Services Act of 1998. One such element is NOAA's Physical Oceanographic Real-Time System (PORTS), which provides real-time tide and current information. Positioning technologies are centered on the Differential Global Positioning System (DGPS).

A Vessel Traffic Service (VTS) promotes the safe and orderly flow of traffic through a port or waterway. The USCG operates nine VTSs. In the Port of Los Angeles-Long Beach, a tenth VTS is operated jointly by the USCG and the local Marine Exchange. The USACE operates a VTS in the Cape Cod Canal. Port authorities and pilots' associations operate VTS advisory services in Tampa Bay and Delaware River. VTSs increase safety and efficiency by providing navigational information, traffic organization, and navigation assistance services. Ninety-nine percent of all communication between the VTS and participating vessels is information in nature.

Management Systems

These systems involve managing the marine transportation system, as well as funding the operations, maintenance, research, and new investment in the MTS.

MTS Management

A variety of public and private sector organizations at the national, regional, and local levels currently manage the MTS. These organizations serve users, operators, managers, and regulators, as well as plan, conduct research, invest, operate, and maintain the Nation's waterways, ports, and intermodal connections.

Different organizations may be responsible for different geographic areas, users, or parts of the MTS. They may have different priorities, requirements, and procedures. Coordinating the MTS, along with the role of the MTS in the total transportation system, is complex and not always clear. For example, there is little coordination of the few MTS research efforts.

Funding

Funding in the MTS is a difficult subject to break down. Local, State, and Federal government agencies and the private sector concerns all share fiscal responsibilities within the system. The Standing Committee on Water Transportation of the American Association of State Highway and Transportation Officials (AASHTO) compiled and published *Marine Transportation Funding and Responsibilities* (December 1998). This report provides an overview of MTS funding issues and mechanisms. The introduction to this report captures the essence of the complexity of MTS funding:

> "Waterborne transportation historically has influenced development patterns in the United States, and continues to be extremely important to our present and future economic vitality. The marine system is very complex and includes an extensive infrastructure of waterways and harbors, port facilities, and connections to the nation's highways, railroads, and pipelines.

> "There is great diversity among the various water transport systems in terms of their size, geographical service areas, and type of governance. While most of the actual transportation of marine cargo and passengers is conducted by private sector companies and vessels, many public agencies and organizations at the international, Federal, State, and local levels are involved in developing, operating, promoting, and regulating the marine system. Governmental involvement becomes increasingly complex as the size of the governing entity increases. Indeed, at the federal level there are numerous agencies with responsibility, oversight, and powers of funding for marine projects."

As this quote illustrates, the U.S. MTS is highly decentralized and investment decisions are made by many users and service providers, both public and private, often in partnerships that are intended to take advantage of competitive opportunities in the marketplace. However, overlying this complex investment environment is a general framework, established in the U.S. Constitution and through long-standing practice, that rests responsibility for the development and operation of landside infrastructure with State and local governments and the private sector. Responsibility for construction and maintenance of common waterways rests with the Federal government while responsibility for private channels, approaches, and berths rest with non-Federal stakeholders.

The Maritime Administration's U.S. Port Development Expenditure Reports include past and projected capital expenditures by inland and deep-draft ports and discussion of their funding sources. These reports provide a more detailed discussion of the funding mechanisms within the MTS. Other public agencies, private terminal operators, and vessel owners in the MTS infrastructure make additional significant, but unquantified, investments. Highlights of MTS-related funding are:

Waterside

- **Federal Channels and Harbors** — Since 1986, Federal funding has been provided on a cost-share basis with other stakeholders for harbor improvements (channel deepening). The amount of cost-share is a function of channel depths and dredged material disposal costs. The Harbor Maintenance Trust Fund (HMTF) is used to provide Federal funding for maintenance dredging. A fee on passengers and cargo loaded or unloaded in U.S. ports supports the HMTF. In March 1998, the Supreme Court ruled that the fee on exports was unconstitutional. The Administration has proposed a replacement fee called the Harbor Services User Fee. In May 1999, the Administration introduced legislation, the Harbor Services Fund Act of 1999 (H.R. 1947), that would replace the existing fee and address the issues raised in the court decision. The new fee, which is based on the vessel's volumetric carrying capacity, is intended to pay for the USACE annual cost of developing, operating, and maintaining the Nation's harbor channels. The proposed fee would be assessed on ship owners and be based on the type of ship (general cargo, tanker, bulk, and cruise ships) and the level of services required by that type of ship. Estimates are that the fee would generate approximately $1 billion annually for Federal channels. While many non-Federal MTS stakeholders recognize the benefits they receive from Federal harbor improvements, they feel that the benefits accrue to a wide spectrum of MTS users and to broader national concerns such as national defense and our overall economic well-being. For these reasons, they believe that general revenues are the appropriate funding source. However, the highway and aviation systems, which share these characteristics, are supported by user fees. The Administration believes that waterways improvements should — much like highway, transit, and airport improvements — be financed by the users who benefit from those improvements.
- **Federal Inland Waterways System** — The Federal government uses general revenues to fund maintenance costs for the inland waterways. Two sources fund most new construction costs: 50 percent from Federal general revenues and 50 percent from the Inland Waterways Trust Fund, which is supported via a fuel tax levied on system users. Continuing construction projects initiated prior to fiscal year 1986 are funded from Federal general revenues.

- **Non-Federal Navigation Channels** — These channels are generally approaches to marine terminals, berths, marinas, and private moorings that connect to deep-draft channels. They are constructed and maintained by non-Federal organizations but require similar permits and approvals as required for Federal dredging projects.
- **Navigational Aids** — Federal public funds provide a broad range of navigation-related support including buoys, lights, vessel traffic services, fog signals, and publications such as the *Coast Pilot*, *Light Lists*, and *Notice to Mariners.* Historically, these activities have been funded from general revenues. Private and local public organizations also maintain local navigational aids. Recently, the Administration proposed two fees to fund some MTS navigational aids:
  - A *Navigational Services Fee* would recover a portion of the USCG aids-to-navigation costs from commercial cargo and cruise vessels, which rely on these services to operate safely and efficiently. It is estimated that the fee would raise $41 million in FY 2000 (part-year collection) and $165 million on an annual basis. USCG aids-to-navigation costs exceed $500 million per year.
  - The *NOAA Navigational Assistance Fee* is a proposal to levy a fee on commercial cargo carriers to recover the cost of NOAA navigational services, such as navigational charting. The fee would raise $14 million annually.

For similar reasons discussed in the previous section on *Federal Channels and Harbors*, many non-Federal MTS stakeholders feel general revenues is the appropriate funding source for these navigation services. The Administration disagrees. It should be noted that Congress has also required the USCG and NOAA to seek specific authorization for new fees before developing implementing regulations for those new fees.

Landside

- **Terminals** — Marine terminals are generally funded by private sector investment based on economic issues. There is also public funding via local or State agencies such as port authorities. In 1997 alone, the Nation's deep-draft public ports invested $1.5 billion in terminal improvements, dredging, and intermodal projects; over the next 5 years, these ports estimate they will spend $7.7 billion on these and other capital investments. Revenues generated through fees, services, leases, etc., by the public agency may be used for this purpose. Public funding is generally raised via bonds (general obligation or revenue) or by taxing authority. There are some avenues of Federal public funding via grant programs, such as Economic Development Agency programs.
- **Intermodal Connections** — There are three major types of intermodal connections to the MTS: rail, pipeline, and highway. Rail and pipeline development is almost exclusively funded by private sector investment. Highway connections are either by private access roads or public roadways. Funding for public roadways is available through State and local road funding processes and possibly from the Federal Highway Trust Fund, which is funded from a Federal gasoline tax.

Services and Programs

- **Services** — In addition to infrastructure, the MTS funding mechanisms support a number of services provided by Federal, State, and local governments and the private sector. These include services such as search and rescue, vessel and facility inspection, VTS, pilotage, towing, icebreaking, and navigation information.

- **Programs** — In conjunction with services, the stakeholders in the MTS, public funding, and private investment also support a number of related programs including recreational boating safety, research and development, bridge administration, shipbuilding and repair, and port marketing, and promotional activities.

MTS SERVICE PROVIDERS

The Federal government plays an integral role in the function and management of the Nation's marine transportation system, based on statutory authority and responsibility to provide core services. This authority and responsibility is spread across numerous Federal agencies that provide leadership, expertise, technical assistance, advice, resources, information, and promote system mobility, safety, environmental protection, and security. Many of the marine services promote system mobility through activities such as aids to navigation, channel design and construction, icebreaking, and traffic management. Other services protect human health and safeguard the natural environment through programs aimed at prevention, preparedness, response, and restoration. They also protect U.S. citizens and national security interests by activities such as law enforcement, defense operations, port safety, and security.

State and local agencies also provide services and support to the MTS. State and local governments play key roles in planning, investing, and operating the intermodal system so essential to maritime operations. These agencies are also involved in land use decisions and economic development initiatives that affect ports and waterways. State and local governments additionally interface and reflect the needs of communities in the vicinity of the MTS.

State governmental entities have a significant impact on vessel navigation in their State waters. Examples include California's Office of Oil Spill Prevention and Response, Washington State's Department of Ecology, and the Florida and New Jersey Marine Patrols. State agencies also service the MTS in other areas including pilotage regulation, environmental protection, emergency response, infrastructure maintenance and investment, economic development, law enforcement, safety patrols, port facilities security, removal of wrecks and obstructions, permits for dams and dikes, non-Federal aids-to-navigation, maintenance of bridges, fire protection, and reviewing ocean-dumping permits.

The private sector owns the majority of the infrastructure — ports, terminals, piers, vessels, trucks, trains, and cranes — critical to the effectiveness of the MTS. To a large degree, the private sector also handles the movement of people and goods in the system. Transportation providers develop, invest in, and operate the vehicles, vessels, and equipment that make the movement of goods and people possible.