

Figure 2. Extract from barge-use report.

Barge Type	B	C	I	J	M	R	S	T	Z	Total
Pool										
MI25	#	#	#							#
	%	%	%							%
MI26	#	#	#							#
	%	%	%							%
.										
.										
.										
	#	#	#							#
	%	%	%							%

Note: # = average number of operational barges;  
% = percentage use of operational barges.

Figure 3. Extract from tow-use report.

Horsepower Range	1-600	601-1200	1201-1600	. . .	9000-*****	Total
Pool						
MI25	#	#	#			#
	%	%	%	. . .		%
MI26	#	#				#
	%	%		. . .		%
.				. . .		
.				. . .		
.				. . .		
Total	#	#		. . .		#
	%	%		. . .		%

Note: # = average number of operational towboats;  
% = percentage use of active towboats.

not leave during the study period traveled to the midpoint of the pool and then became idle. Conversely, it assumes that a flotilla that left the pool was formerly sitting idle at the midpoint of the pool and traveled the distance from the midpoint

to the lock by which it exited. (In a pool at a confluence, the hypothetical midpoint is established by averaging.) The time requirements for traveling between the midpoint of a pool and each adjoining lock are included in the transit-time report.

#### TOWBOAT USE AND FLEET SIZE

Since every towboat is individually identified in the PMS records, establishing the size of the active fleet of towboats should be straightforward, with one exception: A lone towboat may be locked through as a light boat together with other light boats or with a flotilla, and in that case its identification number will not be in the PMS records. The VESUSE program treats light boats much like a tenth barge category. Observe, however, that a towboat may enter a pool as part of a flotilla and leave as a light boat, or vice versa, and that the program takes this into account.

The statistics on tow-use days are compiled in much the same way as those on barge-use days, but of course a flotilla may drop off or pick up a barge, but not a towboat, on its way through a pool. Furthermore, a towboat may enter a pool, refleet, and then turn around and go back out the same way; we assume that a barge does not do this without stopping to be loaded or unloaded. When a tow does this, we assume that it travels to the pool's hypothetical midpoint, drops off all its barges and picks up new ones, spends zero or more time idle, and travels back to the lock, where it exits.

Tow-use statistics are recorded in the tow-use report (see Figure 3).

#### SUMMARY

The VESUSE program provides us with very useful information on the use of towboats, barges, and flotillas. It serves our need for some insight into how towing equipment is used. A more sophisticated program is planned for the future as demand arises.

The Navigation Analysis Center will supply the program and the user's manual on request.

#### REFERENCE

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## State Water-Port Master Planning

MARTIN L. MILLER AND JOSEPH M. GILROY

Existing state roles in transportation and water-port planning and their relationship to other planning activities are explored. A rationale for expanding states' water-port planning responsibility is discussed, and alternative approaches to developing a state water-port master plan and a description of the components of such a plan are presented. It is concluded that cooperation between state governments and local port agencies provides an effective political and operating mechanism for bridging the gap between national and local objectives.

A recently completed report by the General Accounting Office (1) raised serious questions about the ability of local port agencies to continue financing much-needed capital improvements. Without recommending a specific course of action, the report questioned the efficacy of the "go-it-alone" competitive environment in which ports currently operate. It recognized the national importance of ports and

said that if Congress decides to act in this area it should consider, in addition to maintaining the status quo, various options of a national port plan and federal funding.

Port development is a complex process. Federal, state, regional, and local agencies interact with one another and with the private sector. Federal interests alone may be represented by as many as a dozen agencies. Federal agencies that have varying degrees of water-port involvement include the U.S. Army Corps of Engineers, the Maritime Administration and the Economic Development Administration of the U.S. Department of Commerce, the Office of Coastal Zone Management, the Office of the Secretary of Transportation, the U.S. Coast Guard, river basin commissions (on the inland waterways), the U.S. Environmental Protection Agency, the Federal Maritime Commission, the Interstate Commerce Commission, and the Tennessee Valley Authority.

Within the states, responsibility for water-port development may be lodged with state agencies, autonomous port authorities, or local municipalities. Ports are located in 41 states--on the Atlantic, Pacific, and Gulf Coast; on the Great Lakes; and on the inland waterways. In a survey of 33 of these states (2, p. 59), it was found that 12 had state port authorities, 12 had a ports agency within a state department of transportation (DOT), and 9 had no particular state port agency. The recently completed Mid-America Ports Study, which addresses the inland port needs of 17 states, draws the following conclusion (3, p. 19):

State governments make significant contributions to port development. . .by providing firm legislative authority for exercise of local incentives. Twelve Mid-America states have general enabling statutes that authorize local governments to create port authorities. In three states riverport development is a responsibility of agencies (state) closely integrated with the structure of general government.

The creation of state departments of transportation (DOTs) has reinforced the role that states can perform in water-port development. As of 1979, 38 states had DOTs. The creation of state DOTs resulted in part from a desire to coordinate transportation development in a multimodal framework. Most states have the statutory authority to undertake multimodal planning. For example, the New York State DOT is given the responsibility to develop a balanced transportation policy. As the New York State Transportation Law, which established the state DOT in 1967, states, "The DOT shall. . .formulate a statewide Master Plan. . .including highways, rapid transit, railroad, omnibus, marine and aviation facilities. . ."

Largely in response to federal requirements, statewide planning has been geared to highway, mass transit, and aviation planning. The intermodal characteristics of water ports have been largely ignored by the majority of the states, although the results have been excellent in those instances in which states have taken a role. This apparent lack of substantive involvement in port development is inconsistent with the multimodal nature of waterborne transshipments: Waterborne commerce moves to and from the port area by truck, trailer, pipeline, rail car, or container, and the port's efficiency and competitive standing depend on the service provided by one or more of these surface modes. The state's relative lack of involvement is understandable. There are no federal grants and, because a port moves freight and not people, it has low public visibility in the political sense. Moreover, states

have provided local authorities with the enabling legislation necessary to pursue water-port development, a course of action local governments have supported.

As data given in Table 1 indicate, 13 states have completed or have under way either a statewide plan or a regional state plan; in the latter category is New York State, which conducted a study of upstate New York ports (4), and California, which, under the sponsorship of the Northern California Ports and Terminals Bureau, undertook a study of San Francisco Bay ports. According to data of the Office of Ports and Intermodal Development of the Maritime Administration, more than 30 states have been, are currently, or are planning to be participating in regional port plans partially funded by the Maritime Administration.

#### FEDERAL ROLE

The only federal agency that provides direct grants for construction of port facilities is the Economic Development Administration (EDA), and even EDA participation is limited to project areas that qualify

Table 1. State water-port functions in 1979

State	State DOT	Waterway or Port Function <sup>a</sup>	Status of State or Regional Water-Port Plans
Alabama	No	— <sup>b</sup>	A
Alaska	Yes	X	B
Arkansas	Yes	P	A
California	Yes	—	B
Connecticut	Yes	X <sup>c</sup>	Yes, statewide
Delaware	Yes	—	No
Florida	Yes	P	Yes
Georgia	Yes	X	No
Hawaii	Yes	X	Under way
Illinois	Yes	P, T <sup>d</sup>	A, C
Indiana	No	—	No
Iowa	Yes	P, T	A, yes
Kansas	Yes	P	A
Kentucky	Yes	P	A
Louisiana	Yes	—	A
Maine	Yes	X, P	No
Maryland	Yes	X, P	Under way
Massachusetts	No	—	No
Michigan	Yes	X, P, T	C
Minnesota	Yes	X	A, C
Mississippi	No	—	A
Missouri	Yes	X	A, yes
Nebraska	No	—	A
New Hampshire	No	— <sup>e</sup>	—
New Jersey	Yes	—	No
New York	Yes	X, T	B, C
North Carolina	Yes	— <sup>e</sup>	Planned
Ohio	Yes	T	A
Oklahoma	Yes	P	A
Oregon	Yes	P	Under way by another agency
Pennsylvania	Yes	X	A, C
Rhode Island	Yes	—	No
South Carolina	No	— <sup>e</sup>	Planned
Tennessee	Yes	X	A
Texas	Yes	P	Under way
Vermont	Yes	X	No
Virginia	Yes	— <sup>e</sup>	Under way
Washington	Yes	— <sup>f</sup>	Yes, update under way
West Virginia	No	—	A
Wisconsin	Yes	P	A, C

Note: A = state included in Mid-America Ports Study; B = regional port study or studies performed within the state; C = state included in Great Lakes Ports Study; P = planning; T = technical assistance; X = financial control or responsibility.

<sup>a</sup>Based in part on findings of the National Transportation Policy Study Commission (2).

<sup>b</sup>State Docks Department.

<sup>c</sup>Connecticut Department of Commerce.

<sup>d</sup>Department of Business and Economic Development.

<sup>e</sup>State port(s) authority.

<sup>f</sup>Washington Public Ports Association engages in statewide planning but is not a government agency.

as economically depressed. The Maritime Administration provides funds for statewide and regional port planning on a basis of cost sharing with the participants. Section 8 of the Merchant Marine Act of 1920 directs the Maritime Administration to promote, encourage, and develop ports and transportation facilities for water commerce. The act requires the agency to study water terminals, including docks, warehouses, and related equipment; to provide advice to communities; and to investigate the practicality of harbor, river, and port improvements. Currently, a total of 13 such state or regional studies have been performed or are under way. The Maritime Administration has been successful in bringing together a relatively diverse group of agencies to perform the studies. The study participants, however, are not obligated to carry out the study findings and have no financial incentive to implement the recommendations since the agency does not provide the development funds available from federal highway, aviation, and rail programs.

Of the dozen or so federal agencies involved in some aspect of port development, the more significant contributions are made by the U.S. Army Corps of Engineers, the Office of Coastal Zone Management, and the U.S. Coast Guard. The harbor, channel, and waterways navigation programs of the Corps of Engineers, including dredging and flood control, have an impact on port development. Of major importance are projects in channel maintenance, channel widening and deepening, and new-channel construction. The depth of a harbor or channel limits the size of the vessels that can use it for navigation and this, in turn, can affect the economic viability of port operations. Although the Corps of Engineers does not get involved in port development, it is obvious that its actions, or lack thereof, significantly influence the competitive balance among ports.

Coastal zone management (CZM) plans have a port and industrial component. The CZM program is administered at the federal level by the U.S. Department of Commerce, and planning grants are given directly to eligible states to carry out the study work. Ports are generally viewed as a secondary issue within the larger framework of developing a balanced plan that encompasses environmental, recreational, conservation, and industrial uses of the coastal zone.

Regulatory functions in the area of waterway safety, including the movement and handling of dangerous cargoes, are performed by the U.S. Coast Guard. The Coast Guard is also involved in the maintenance of aids to navigation and in the licensing of offshore deepwater ports.

An Office of Marine Affairs was created last year in the Office of the Secretary of Transportation. It is still too early to judge whether this office will play a role in port development.

#### STATE AND LOCAL ROLE

Water-port development is largely a local responsibility, whereas channel and harbor improvements are a federal responsibility of the Corps of Engineers. This creates a dichotomy in national policy, aggravated, at least in a conceptual sense, by the absence of a national port plan.

Proponents of the present system of port development argue that the combination of local initiative and private-sector investment is highly flexible and more cost effective than a centralized port program. The method of operation, both on the inland waterways and at coastal ports, is for local port authorities--many of which are operating under state enabling legislation--to finance and/or control the course of port development.

At the coastal ports, the public sector is largely involved in the development of general cargo facilities, such as container-handling terminals; bulk cargo-handling facilities, such as coal and oil terminals, have been built primarily by the private sector. On the inland waterways and the Great Lakes, bulk cargoes, such as grains, coal, and non-metallic minerals, predominate. The end industrial users of bulk commodities on the lakes and waterways are usually located adjacent to the channel and construct the wharves and other cargo-handling facilities. Many private waterfront facilities for handling bulk commodities are located in haphazard fashion along the nation's navigable inland waterways. American Waterways Operators, Inc., reports that since 1952 more than 10 000 water-oriented industrial plants have been built on these waterways.

Without national or significant regional support or direction, the nation's ports have been able to adapt to changing technologies while continuing to accommodate growing volumes of cargo. The system has been largely self-financed with minimal use made of public funds. The absence of significant federal involvement permits local port authorities to act with greater flexibility than would otherwise be the case.

Nevertheless, local port agencies increasingly find themselves in situations that are beyond their control. Multinational maritime shipping companies can play one port off against another to the detriment of both shipper and consignee. The number of railroads serving the ports continues to decline, and the result is noncompetitive overland hauling rates. Minibridge and landbridge operations have pitted East Coast against West Coast and Gulf Coast ports, and the railroads and marine carriers set the rates that make this service so successful.

Port activities generate economic benefits that extend well beyond the area of influence of the local port authority. This is partly explained by the fact that waterborne commodity flows through a port do not necessarily originate within the immediate geographic area of the port, let alone within the same state. More than 66 percent of the total annual inland waterway tonnage moving through the 17 states included in the Mid-America Ports Study originates in another state.

The state level of government provides a convenient mechanism for bridging the gap between regional and local interests. Most states are already organized, or have the statutory authority, to perform multimodal planning; presumably this includes water ports. State-level port planning makes it easier to consider a larger public interest than could normally be considered at the local level. Moreover, state planning and financial resources can be more effective than comparable local resources in addressing regional issues.

The following reasons can be cited in support of pursuing state-level water-port planning:

1. State DOTs are engaged in multimodal planning, and state water-port planning efforts--in consultation with local interests--would be a logical extension of this role.

2. State energy plans are being promulgated. Waterborne transportation of energy materials is a principal concern. As utilities convert to coal-fired plants, the use of waterways to transport coal takes on greater importance. In addition, water transportation is one of the more cost-effective forms of freight transport.

3. The economic benefits generated by port activities are significant and have regional and statewide impacts. State and regional agencies involved in economic development and promotion can

maximize these benefits by working with state and local agencies to ensure closer integration of port and overland transportation programs and economic development activities.

4. CZM planning is being coordinated at the state level. An evaluation of the trade-offs between environmental, conservation, recreational, and industrial development issues in CZM requires a thorough analysis of the water-port role.

5. Many ports, although certainly not all, are faced with financial constraints. State governments have access to a larger tax base than do local agencies.

6. Many local port authorities are operating through state enabling legislation. In certain states, prior approval by the state is required for local debt financing.

#### ESTABLISHING A STATE WATER-PORT MASTER PLAN

Each state water-port master plan would be unique. Differences will be caused by study organization, financing, local-state relations, study objectives, and study content. Inasmuch as state involvement in water-port planning should be viewed as complementary to, and not a substitute for, local action, formative efforts in establishing a state water-port master plan should be directed to ensuring a substantive role for local agencies. States should not preempt local options, and statewide planning should build on the efforts of local port authorities. Kester, in evaluating Missouri's statewide water-borne commerce and port development plan (5, p. 8), concludes the following:

Aggressive local interest and financial commitment stand behind nearly all successful river ports. Without local support most port development efforts have failed. In addition, the presence of a skilled port director during early stages of planning and development has been crucial to fledgling port authorities.

#### Objectives

Among the problems that confront the states are port congestion; obsolescence of facilities; availability of waterfront property suitable for marine terminal use; low levels of shipping service; land use conflicts; inadequate waterway, terminal, and/or hinterland transportation capacity; and economic underdevelopment. Since the nature of the problems and commodity flows and trading patterns differ from state to state, the objectives of a state water-port master plan will likewise vary. Nevertheless, some objectives that would apply to any state water-port plan can be defined:

1. The role of waterborne transportation in the state economy should be defined. Data would be compiled to describe water transportation in the state as it exists, the economic benefits derived from it (such as employment and transportation savings in relation to other modes), and the economic sectors that depend on its availability.

2. The provision of basic and economically viable levels of water transportation service to all regions of the state that depend on it should be ensured. Distribution of energy materials and grain export, for example, might be considered basic services.

3. A mechanism should be provided by which state and local interests can allocate waterfront lands in a manner consistent with future water transportation needs as well as environmental, recreational, industrial, fishing, flood control, and surface transpor-

tation needs. Trade-offs among these concerns may be necessary, and the consequences of future actions should be described to the concerned parties.

4. Unnecessary duplication of terminal facilities and uneconomical overlapping of port hinterlands should be discouraged. A corollary objective is to make the state and its ports more competitive with other states.

5. Coordination of marine transportation development with other actions such as rail-line abandonment or upgrading, economic development, highway construction, and location of utilities and industrial plants should be facilitated.

6. A framework should be provided for coordinating the planning efforts of local and regional port authorities and port agencies in adjoining states. Lines of communication should be established and consistent procedures and formats for data collection defined.

#### Statewide Versus Regional Port Planning

State port planning can proceed in one of several ways depending on the geographic interrelationships among ports. A multistate regional effort might be desirable before a state plan is initiated; this was the approach taken in the Mid-America Ports Study (MAPS), in which port needs in each of 17 states were related to such external factors as lock and dam constraints and regional energy programs. The MAPS findings can now be refined independently by each participating state.

In contrast to MAPS, a regional port study at the substate level may be desirable. New York State undertook such a study of its upstate ports in addition to its participation in the Great Lakes Ports Study. When a group of ports in one general location have complementary interests--or competing interests--a resolution of such substate regional needs precedes the formulation of a comprehensive state plan. A similar rationale applies to the preparation of a bi-state regional plan, such as the study of the Port of Metropolitan St. Louis.

#### Components of a State Water-Port Master Plan

A four-phase approach to water-port master planning is suggested. These phases are described below.

##### Definition

The definition phase entails establishing the detailed study methodology and inventorying marine facilities, waterway characteristics, and the related transportation facilities and land uses in and around ports (including potential sites for marine activities). In addition, historical commerce statistics by commodity, volume, mode of hinterland transportation, and origin and destination should be collected. Study regions and subregions should be defined for purposes of analysis and the economics and demographics of these areas tabulated. Inter-agency coordination should be formalized. The policies and programs of federal, state, and local agencies that have an impact on and/or relate to port development should be identified. Since the economic benefits attributable to port operations will play an important role in preparing recommendations, agreement among study participants in the approach to this aspect of the study should be reached during the early study phases.

##### Analysis and Forecast

In the analysis and forecast phase, projections of waterborne commerce should be performed in conjunc-



tion with the econometric and demographic forecasts. An analysis of the potential impact of other transportation systems on projected commerce flows will reveal the extent to which external factors may constrain projected growth; these may include characteristics of locks and dams, channels, railroads, highways, and vessels. Estimates of cargo-handling capacity by commodity (e.g., bulk and general cargo) for the study areas should be completed. Study area benefits should be estimated based on commodity and econometric projections.

#### Requirements

The requirements phase includes estimates of cargo-handling requirements; these are translated into terminal types, land areas, waterfront development costs, and hinterland transportation needs. The impact of projected water-port development actions on recreational, conservation, and other adjacent land uses should be assessed. Based on projected needs, and on the assessment of impacts and estimated economic benefits, alternative institutional mechanisms for carrying out waterfront development programs (including the status quo) should be postulated and evaluated.

#### Formulation

The formulation of the state water-port master plan requires the following elements:

1. A schedule for port development, including equipment acquisition, land development, facility construction, renovation, or abandonment;
2. A definition of the primary hinterland by cargo type for each port in the study area (for example, general cargo handling may be encouraged at a single port to increase frequency of service, or it may be dispersed to serve local markets, and bulk cargo terminals might be encouraged to locate along a particular river reach and at a particular rail

line or highway to facilitate efficient use of transportation facilities);

3. An allocation of waters and waterfront lands for port development, fleeting, conservation, recreational, and other uses, to be undertaken in concert with the CZM plan, if appropriate; and

4. A definition of responsibilities of various agencies for implementing the plan and identification of means of implementation (e.g., development rights and zoning laws, eminent domain, permitting requirements, tax incentives, and funding mechanisms).

#### CONCLUSIONS

An enlarged state role in water-port development is practical and should be undertaken in coordination with local interests. There is ample precedent for this working partnership, a relationship that can effectively address the financial problems facing the nation's ports.

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## Statistically Based Methods for Efficient Sampling of Inland Waterway Freight Charges

DONALD E. MATZIE, M. CAMINO, AND D. SYSKOWSKI

Preliminary results of work on the estimation of freight charges for commodity movements in the Ohio River Basin are presented. The U.S. Army Corps of Engineers had rate quotations on 875 of the approximately 12 000 movements in the basin and funds to obtain an additional 325. Consad Research Corporation was engaged to apply statistically based analysis to specify the sample that would give the most accurate estimate of freight rates for the given sample size. The traffic universe and original rate quotations were stratified by commodities and annual tonnage. There were 18 commodity strata, each of which was broken down into 3 volume substrata. The original rate quotations were used to calculate the sample size required for each of the 54 cells at several levels of sampling error and confidence intervals. This indicated the additional points needed. These points were also apportioned among the strata on the basis of freight charges to achieve efficiency in estimating total system charges. Points were also allocated among the three cells of each stratum for purposes of statistical reliability. The resulting sampling plan had a projected error of 5-39 percent for each stratum and an error of 12.9 percent for the system as a whole. Mathematical relations were also derived and applied to estimate freight rates for water and alternative overland movements. The methods used should result in greater reliability in the estimation of freight charges.

One aspect of the evaluation of navigation improvements on the inland waterways system by the U.S. Army Corps of Engineers is benefit-cost analysis. A major component of the benefit side of any such calculation is the difference between the freight charges borne by shippers and receivers who use the waterway mode and freight charges for alternative transportation modes. Such calculations involve estimating freight rates by the waterway mode and by alternative modes of freight transportation. Corps of Engineers planners have developed estimates for many studies, but most of these studies have dealt with a single navigation project. In order to evaluate projects within the context of the systems of which they are a part, there is a need to apply system-analysis methods.

This need has been clearly recognized by the