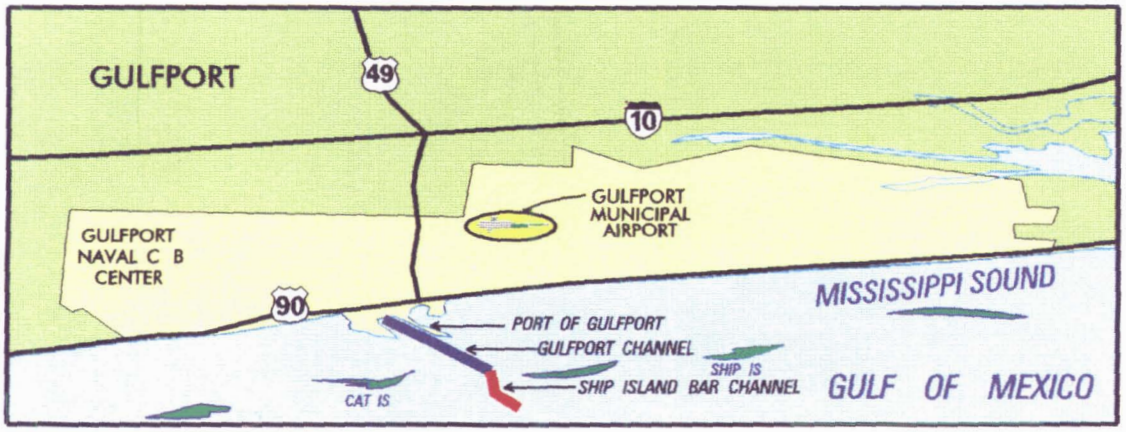
DCN 66

I. GENERAL DATA

TRANSPORTATION ACCESS

WATER

The Port of Gulfport, Mississippi, is on the Mississippi Sound, in the southeast portion of the State. The port is between Mobile, Alabama, and New Orleans, Louisiana. It is about 19 miles from the deepwater of the Gulf of Mexico.



Water Access

A series of barrier islands separate the Mississippi Sound from the Gulf of Mexico. The two main islands south of Gulfport are Ship and Cat.

Gulfport Harbor consists of a manmade, rectangular-shaped basin. Two parallel piers (west and east), spaced about one-quarter mile apart and extending three-quarters mile into the Mississippi Sound, form the basin.

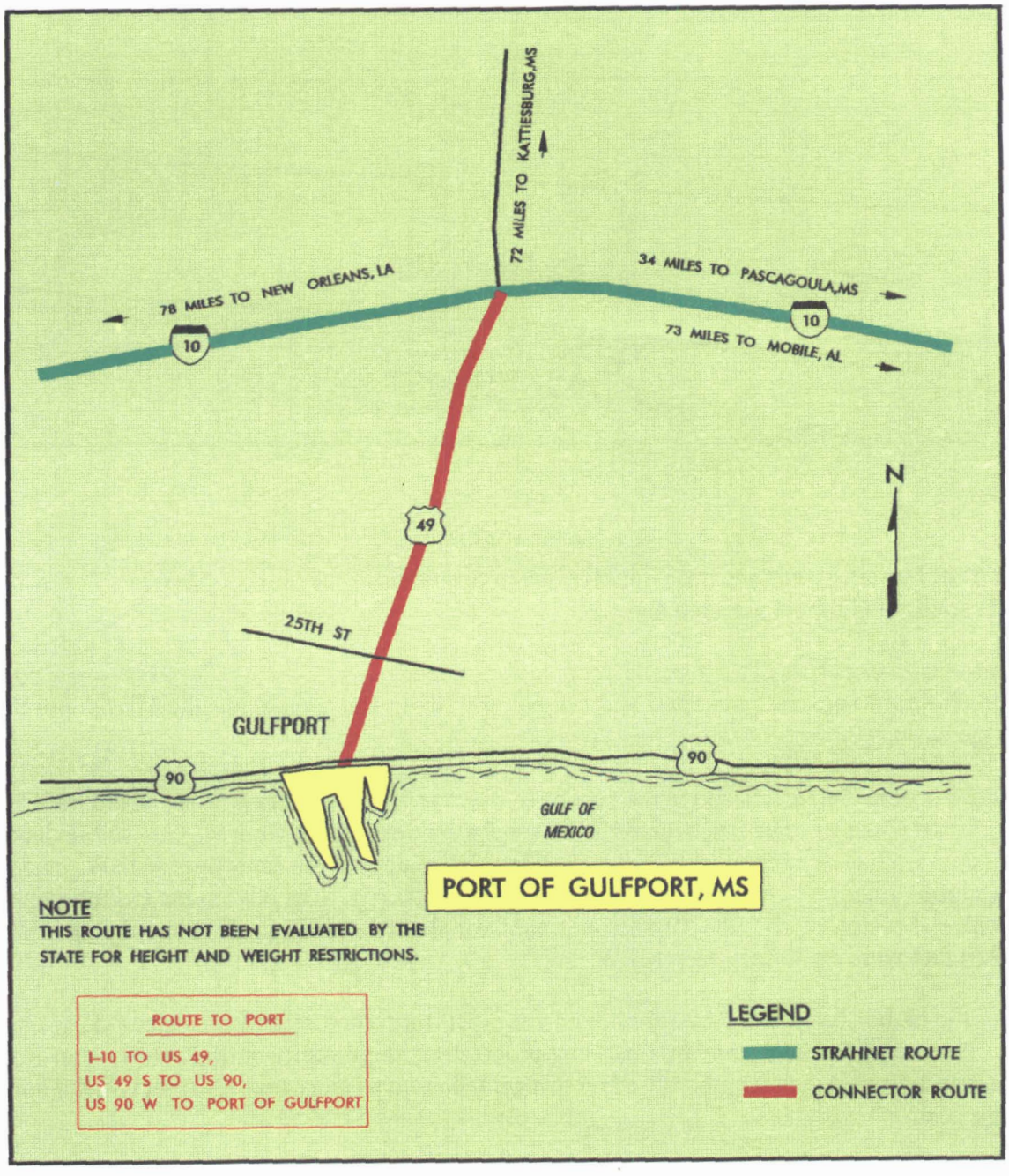
Passage from the Gulf of Mexico to the Port of Gulfport is via two channels: Ship Island Bar Channel and Gulfport Channel. The Ship Island Bar Channel provides passage from the Gulf of Mexico to the Mississippi Sound. The channel is 300 feet wide, 32 feet deep mean low water (MLW), and about 7 miles long. Access to the harbor basin through the Mississippi Sound is via the Gulfport Channel. This channel extends across the Mississippi Sound for about 10 miles, leading into the harbor basin. It is 220 feet wide by 30 feet deep MLW.

Within the harbor basin is a 1,320-foot diameter by 30-foot-deep mean low water (MLW) turning basin. According to Navy standard operating procedures, ships do not normally turn in an area that is less than 1.5 times their length. Based on this guideline, ships more than 880 feet will not normally use this basin.

No bridges cross any of the ship channels leading to the Gulfport harbor basin. Also, no other overhead clearance restrictions are along these ship channels.

HIGHWAY

Two main gates provide access to the port. From US Route 90, the 30th Avenue (to West Pier Gate) and 27th Avenue (to East Pier Gate) extensions provide direct access to the port. Two additional private gates (Chiquita and Dole Gates) are off the 30th Avenue and 27th Avenue extensions, respectively. These gates are used for the import of bananas and other fruit. Although not normally available to the military, the Army may be able to arrange for use of these gates to support military operations in emergency situations. One block west of the port, US Route 49 intersects US 90. US 49 provides access to Interstate Routes 10, 20, and 59 and US Routes 98 and 84.



Highway Access

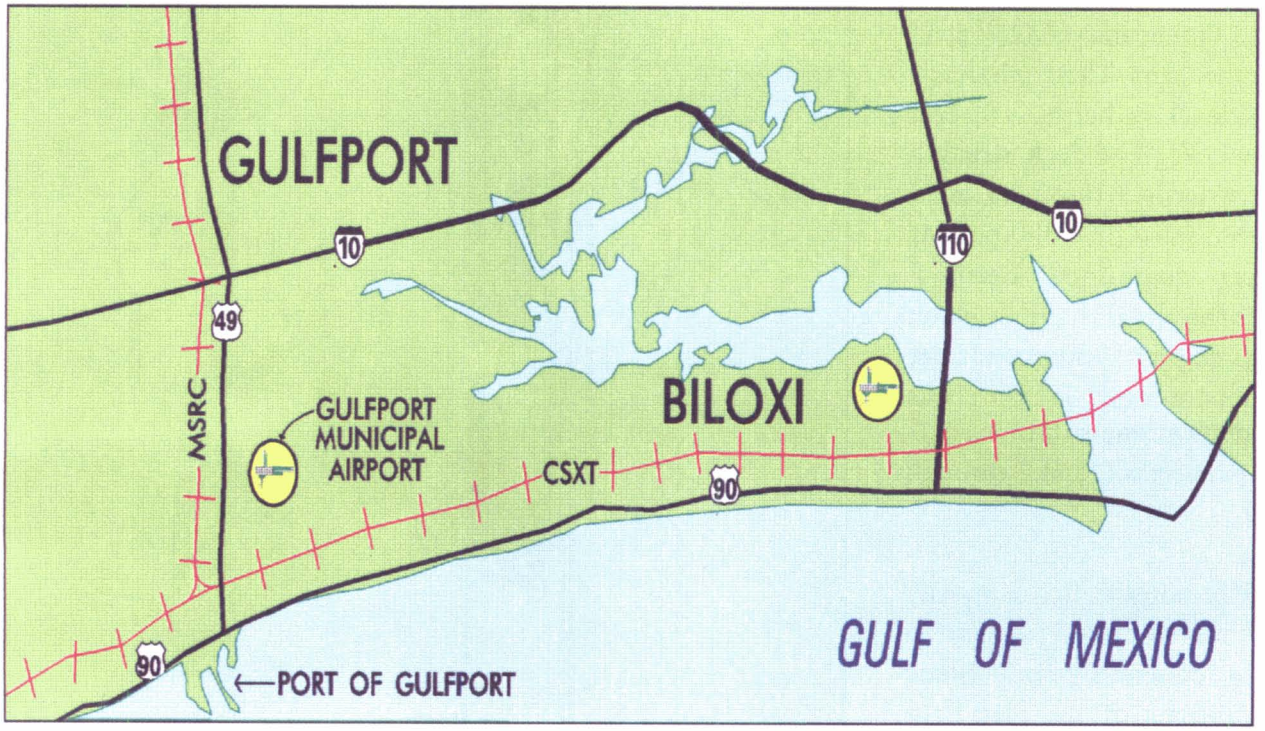
RAIL

Mid-South Rail Corporation provides one track to each of the two piers at the Port of Gulfport. The port has no rail switching yards. About 1.25 miles from the port is a Mid-South Rail Corporation railyard with an 800-railcar capacity. The port owns and operates a trackmobile for railcar placement within port areas.

AIR

Two airports, one commercial and one military, are within service range of the Port of Gulfport. The Gulfport-Biloxi Regional Airport is about 3.8 miles northeast of the port. It has two asphalt runways. One runway is 9,000 feet long by 150 feet wide. The other runway is 5,000 feet long by 150 feet wide.

Keesler Air Force Base is about 13 miles east of the port. It has one asphalt runway, which is 5,030 feet long by 150 feet wide.



Rail and Air Access

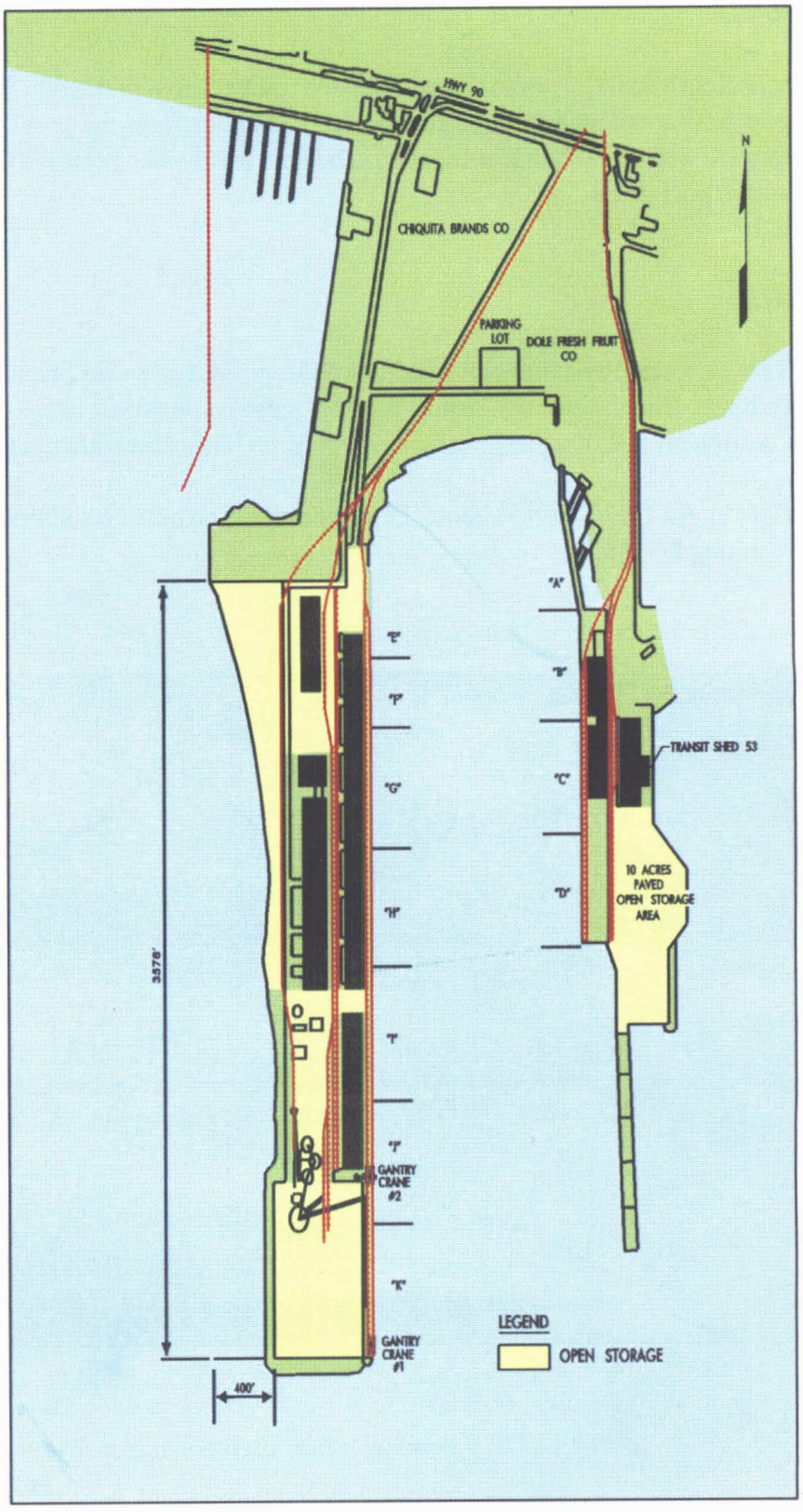
PORT FACILITIES

BERTHING

Two piers, east and west, provide 11 berths. The east pier (berths A through D) has 2,060 feet of continuous berthing space. The west pier (berths E through K) has 3,740 feet of continuous berthing space. Individual berths range in length from 330 to 600 feet. Apron width varies from 30 feet to open. Apron height ranges from 10 feet above MLW at berths A through C on the east pier to 11 feet above MLW at all other piers. The depth alongside all the berths is 30 feet MLW. The deck strength for berths A through E and I through K is 1,000 pounds per square foot. Berths F through H have a deck strength of 750 pounds per square foot. Transit sheds support one-half of berth B and berths C and E through J.

Pier construction is mostly concrete decking supported by concrete piles. Some portions of the pier have concrete decking supported by steel sheet piles with earth backfill. All berths have a timber fendering system.

Lighting is very good for night operations.



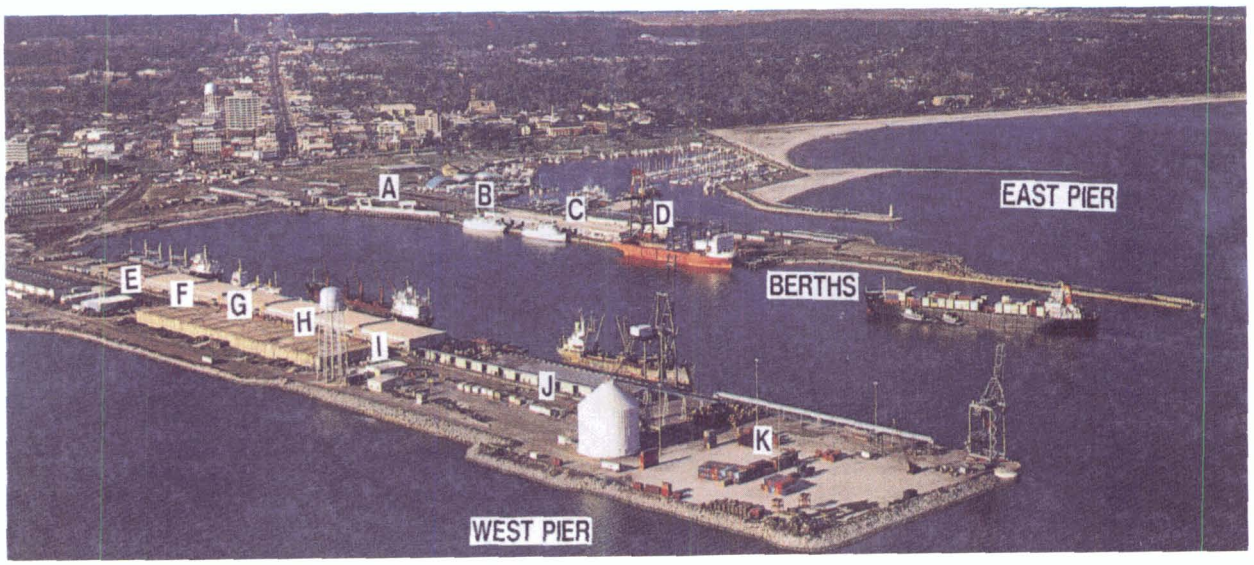
Site Map

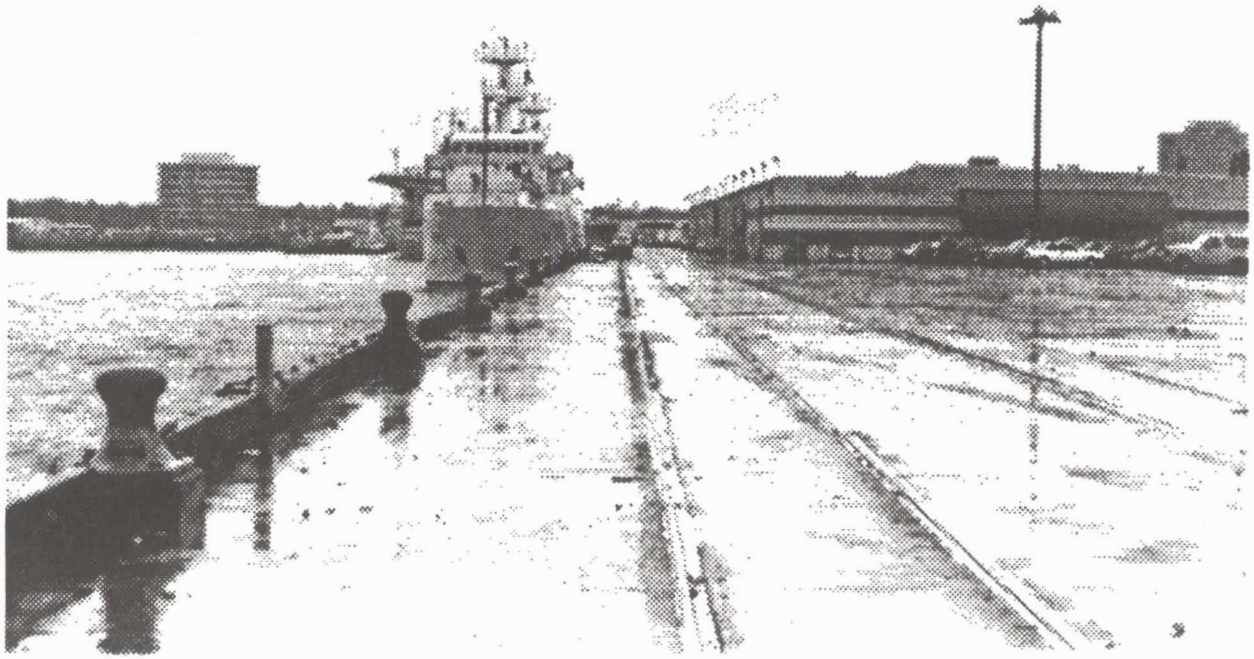
BERTH CHARACTERISTICS

CHARACTERISTICS	BERTHS						
	A	B - C	D	E	F - H	I - J	K
Length (ft)	530	1,020	510	520	1,430	1,190	600
Depth alongside at MLW (ft)	30	30	30	30	30	30	30
Deck strength (psf)	1,000	1,000	1,000	1,000	750	1,000	1,000
Apron width (ft)	30	40	Open	Open	44	63	Open
Apron height above MLW (ft)	10	10	11	11	11	11	11
Number of container cranes	0	0	0	0	0	0	2
Number of wharf cranes	0	0	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stem RORO facilities	No	No	No	No	No	No	No
Apron length served by rail (ft)	0	1,020	510	520	1,430	1,190	600

NOTES:

1. Terminal open storage area is 30 acres.
2. Terminal covered storage area is 336,960 square feet.





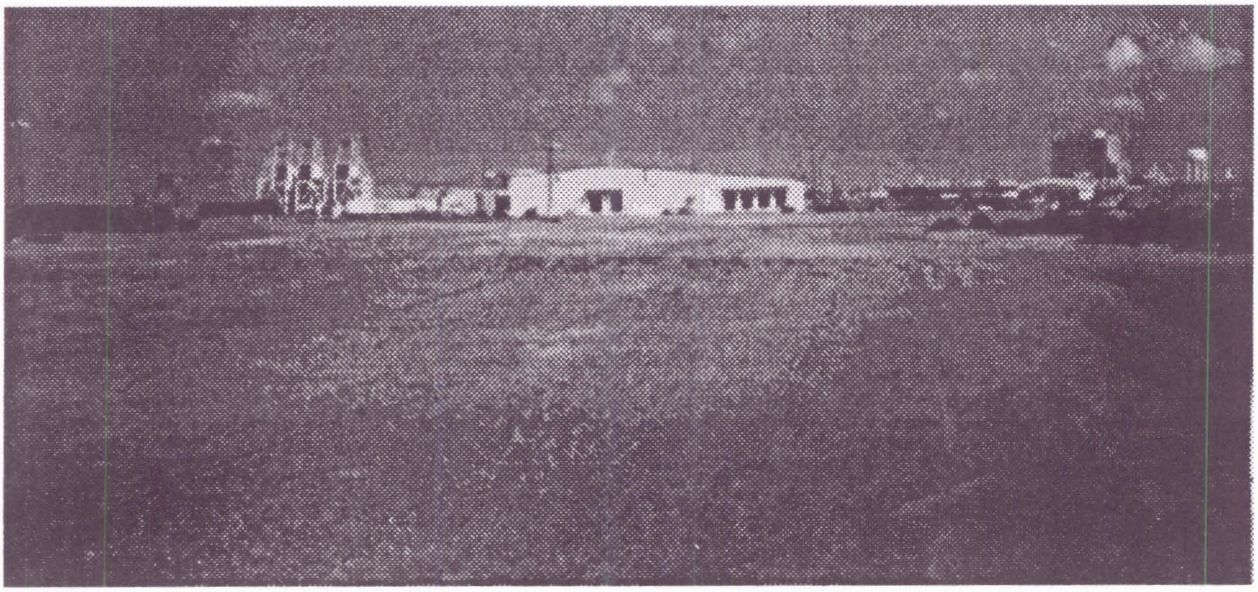
East Pier, Berths A - D

West Pier, Berths E - K

STAGING

Open Storage

The Port of Gulfport has about 41 acres of open storage. About 31 of these acres are paved or shell. Ten acres of paved open storage is behind berth D and part of berth C. The remaining 21 acres of paved open storage is on the west pier. The 10 acres of undeveloped land is north of the port.



Open Storage Behind Berth D

Open Storage Area on West Pier

The open storage is mainly used for containers, lumber, forest products, rolling stock, and general cargo. United Brands Company has an additional 15 acres of paved open storage under lease.

The open storage areas at the end of the west and east piers are the only possible locations for helicopter operations within the port.

Covered Storage

The Port of Gulfport has 11 transit or backup sheds. Nine and one-half transit/backup sheds provide 336,960 square feet of covered storage for general cargo. The other 1.5 transit sheds provide 103,160 square feet of refrigerated covered storage. In general, the refrigerated covered storage and associated truck and rail docks are not available for military use. However, if needed, the Army can arrange for use of these facilities provided they are available.

COVERED STORAGE

STORAGE FACILITY DESIGNATION	*FLOOR AREA (sq ft)*	*NUMBER OF UNLOADING POSITIONS (nonconcurrent use)*			*CURRENT USE*
		TRUCKS		*RAILCARS*	
Shed 1	0	10	or	3	Torn Down
Shed 2	12,100	20	or	3	General Cargo
Shed 3	24,200	20	or	3	General Cargo
Shed 4	24,200	20	or	3	General Cargo
Shed 5	24,200	0		3	General Cargo
Shed 6	24,200	0		3	General Cargo
Shed 7	24,200	0		3	General Cargo
Shed 8	24,200	0		3	General Cargo
Shed 14	96,320	80	or	12	50% Refrigerated 50% General Cargo
Shed 15	55,000	40	or	6	Refrigerated Cargo
Shed 52	71,500	8	or	10	General Cargo
Shed 53	60,000	12	or	12	Backup

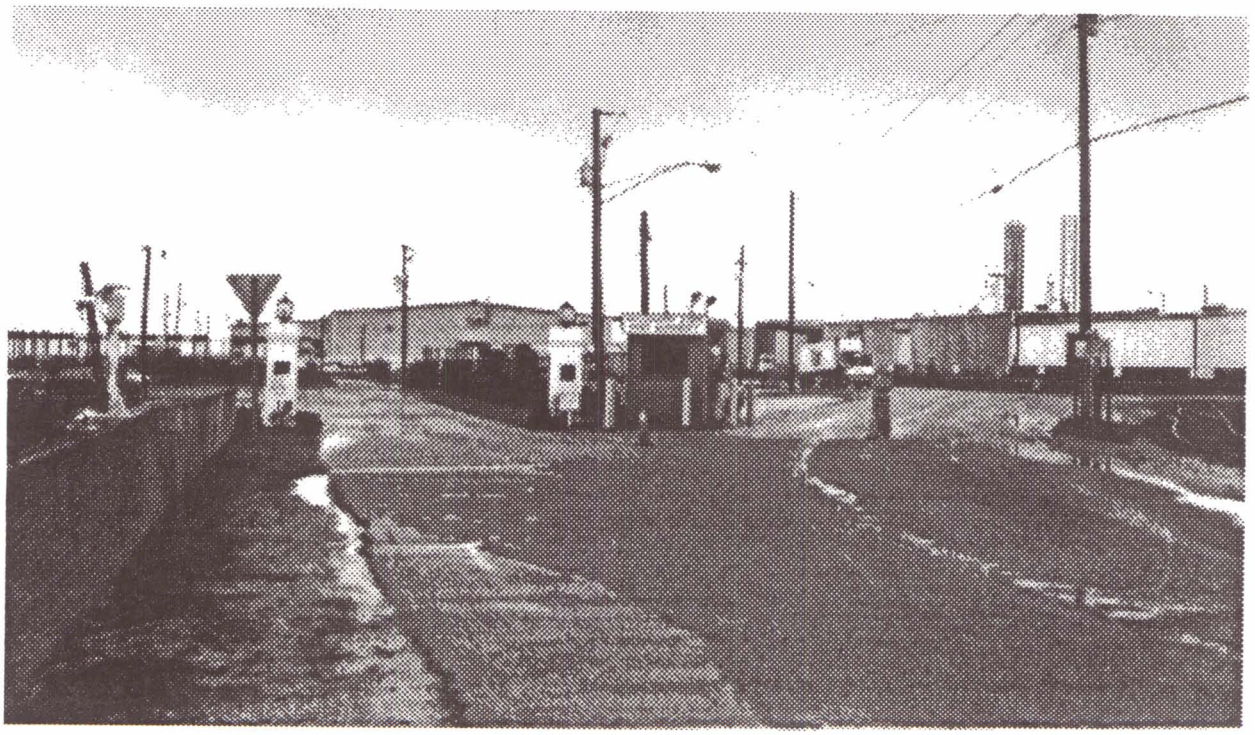
RAIL

Mid-South Rail Corporation provides two apron tracks on both the west and east piers. There are rail spurs behind all of the transit and backup sheds. All of the transit and backup sheds have railcar-level platforms. These platforms provide 64 railcar handling positions. Rail trackage links the apron tracks and rail spurs to the two rail lines coming into the port. Container-on-flatcar (COFC) and trailer-on-flatcar (TOFC) operations are conducted at the west pier open storage areas. The Mid-South Rail Corporation railyard located 1.25 miles from the port can store 800 railcars.

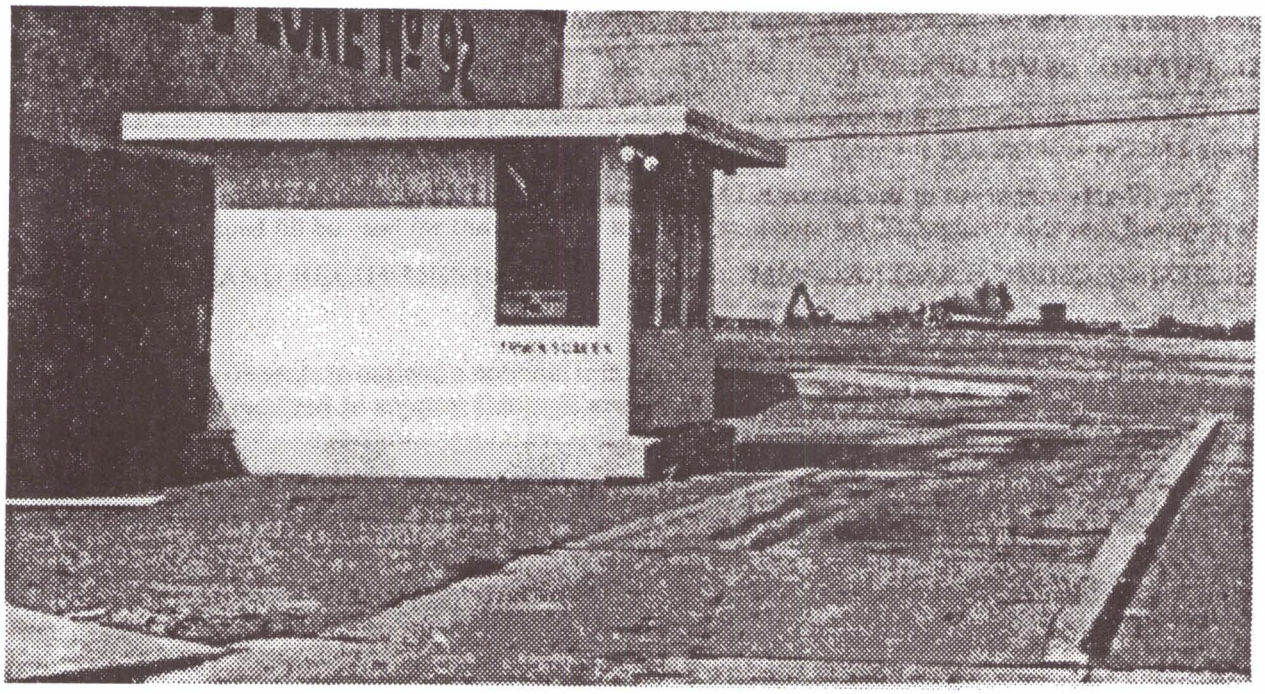
HIGHWAY

Access to the west pier by commercial truck traffic is by way of the 30th Avenue Extension. Access to the east pier is via the 27th Avenue Extension. Berth roads are two lanes and asphalt paved. Entry to the piers is by way of two-lane manned gates. The west pier has a 52-ton truck scale. This scale is on the main roadway leading to the container marshaling areas and backup sheds.

Thirtieth Avenue Extension Gate



Twenty-Seventh Avenue Extension Gate



Truck Scales (West Pier)

UNLOADING/LOADING POSITIONS

Ramps

The east pier has a concrete truck end ramp at berth D. This ramp can serve 10 trucks at one time. A wood/concrete rail end ramp is on the west pier, at the south end of transit shed 14. It has a 12-railcar loading capacity.

Docks

The transit sheds have eight truck docks. These truck-level docks provide more than 210 truck handling positions. A concrete rail side dock is on the east pier, behind the apron at berth D. This dock has a nine-railcar loading capacity. Because the truck and rail docks share some of the handling positions, not all of the truck or rail handling positions are available at the same time. Also, 80 of the truck handling positions and 12 of the railcar positions are used in conjunction with the refrigerated storage.

MARSHALING AREAS

The undeveloped tracts of land north of the piers and the United Brands Company leased area are potential marshaling areas. A Naval Construction Battalion Center that could provide a substantial and secure marshaling area is about 2 miles north of the port.

MATERIALS HANDLING EQUIPMENT (MHE)

Two 30-ton Paceco container cranes (33.6 STON listed capacity) serve berths I through K at the south end of the west pier. One of these cranes is dual purpose and is capable of container, heavy-lift, or bulk operations. The time required to convert this crane to a particular operation is 30 minutes. No portable RORO or fixed stern ramps serve the port.

Heavy-lift equipment, as well as any mobile assets, is readily available from stevedoring firms within 24 hours' notice. Mobile land and floating cranes range in capacity from 100 to 200 tons.

MATERIALS HANDLING EQUIPMENT
(Port of Gulfport)

TYPE OF EQUIPMENT	*CAPACITY (STON)*	*QUANTITY*
Mobile crane	65	1
Mobile crane	40	1
Mobile wharf crane	25	1
Forklift	10	2
Forklift	6	8
Forklift	4	41
Forklift	3.5	8
Forklift	2.5	5
Forklift, electric	3.5	12
Forklift, electric	3	7
Front end loader	NA	8
Container tractor	NA	12

Port of Gulfport Container Crane

INTERMODAL FACILITIES

The Port of Gulfport has a limited intermodal capability. The closest dedicated intermodal railyards to the Port of Gulfport are in New Orleans, Louisiana, and Mobile, Alabama. The companies providing intermodal service in the New Orleans area are the CSX, Illinois Central, Kansas City Southern, Norfolk Southern, Southern Pacific, and Union Pacific Railroads. The companies providing intermodal service in Mobile are Illinois Central Gulf, CSX, Burlington Northern, and Norfolk Southern.

FUTURE DEVELOPMENT

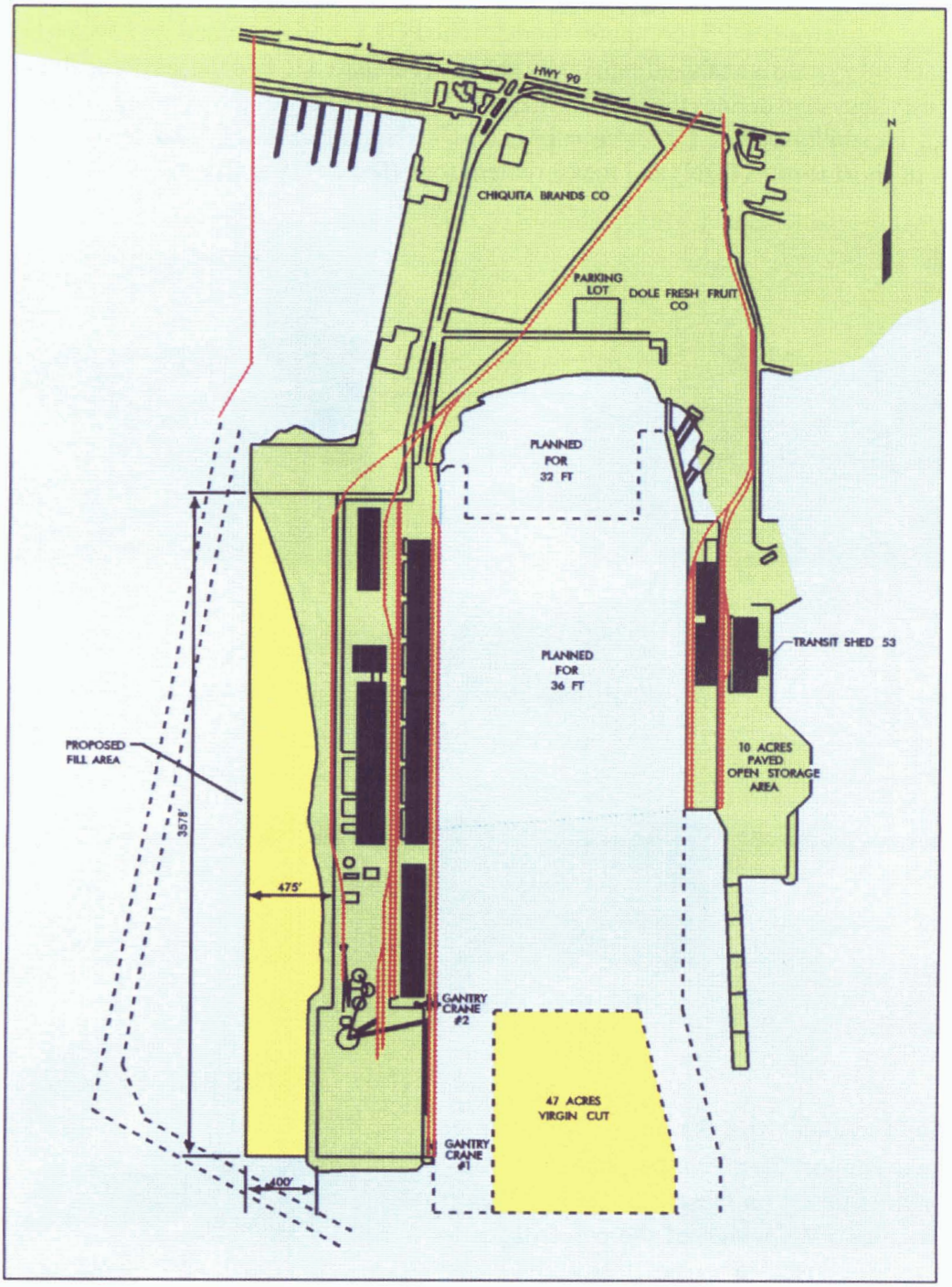
Several maintenance projects such as rail rehabilitation, roof repairs, and dock resurfacing are underway or have been completed.

The most significant improvements are the proposed dredging of the channel and entrance to the harbor basin and the expansion of the west pier. The scheduled completion date is 1 December 1993.

During dredging operations, 47 acres of virgin cut in the harbor basin will provide about 1.47 million cubic yards of fill material. This dredged material will be used as fill for the 29-acre expansion project of the west pier container area.

The Ship Island Bar Channel will be dredged to 38 feet and the Gulfport Channel and Gulfport Harbor will be dredged to 36 feet.

Sheds 1, 2, 9, 10, 11, and 12 and half of shed 3 were torn down. The port authority plans to convert these areas into open storage for containers.

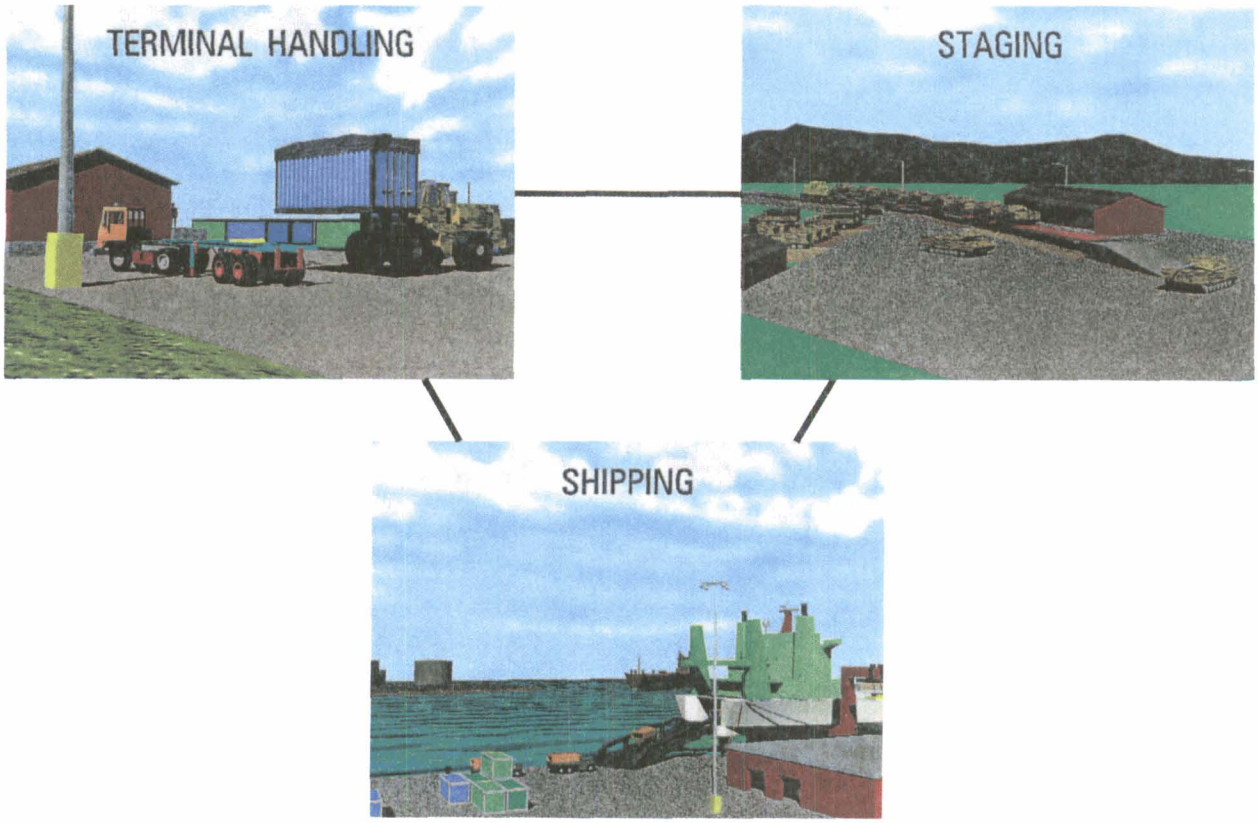


Dredging and Expansion of Port of Gulfport

II. THROUGHPUT ANALYSIS

GENERAL

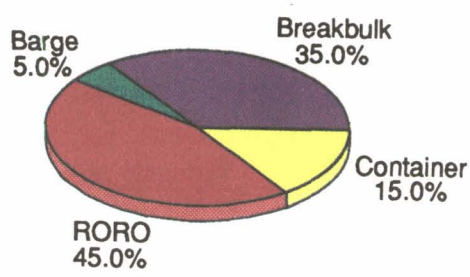
We evaluated the theoretical throughput capability of the Port of Gulfport using the port operational performance simulator (POPS) computer model. The POPS model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least-capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/ handling - in short tons (STON) and measurement tons (MTON) per day.



Terminal Throughput Subsystems

The analysis assumes that 80 percent of the port facilities will support the military deployment. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.

SHIP MIX PERCENTAGES



TERMINAL RECEPTION/HANDLING

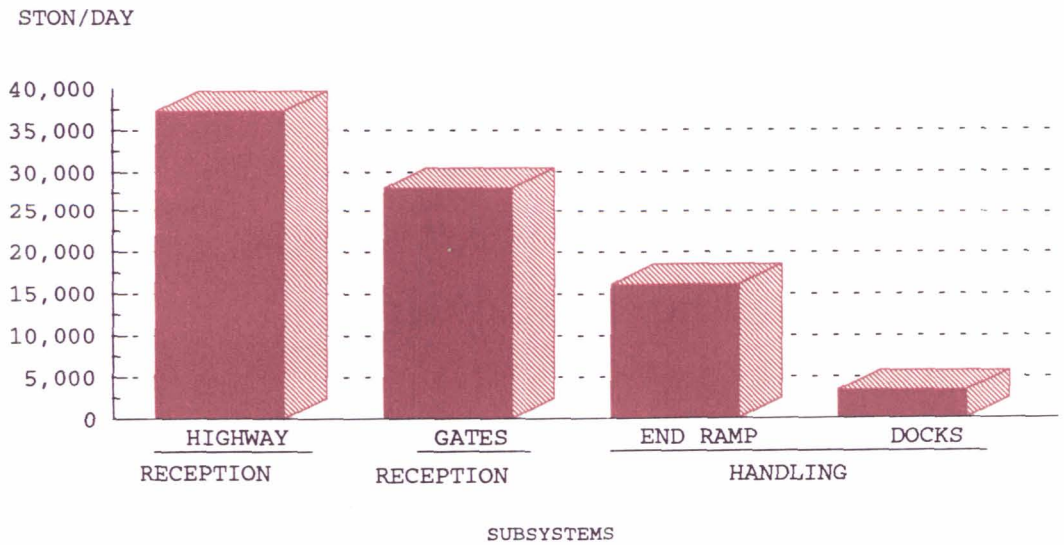
HIGHWAY

From US Route 90, the 30th and 27th Avenue extensions provide direct access to the port. These two port roadways provide access to staging and pier areas. The gate reception capability of these two roadways could handle almost 28,000 STON of equipment and supplies per day.

Roadable vehicles in convoys will process directly to staging areas. Vehicles on commercial or military flatbed trailers not equipped with a means for unloading vehicles can offload at the truck end ramp on the east pier. This ramp could offload about 16,000 STON per day. Van semitrailers carrying supplies will proceed to transit shed docks not occupied by railcars for offloading.

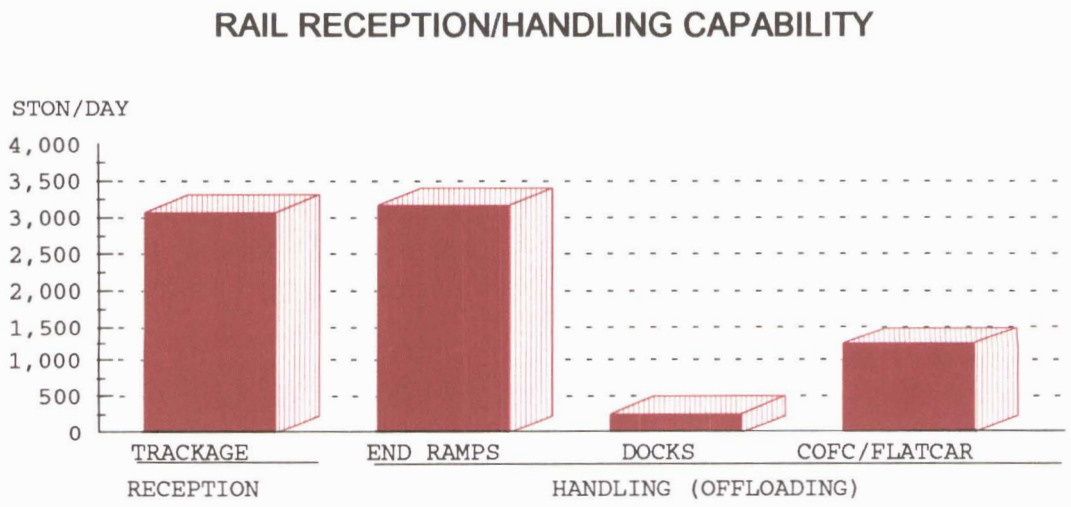
For this study, we assumed that railcars would occupy the truck/railcar docks on the west pier because the railcar end ramp is on that pier. Therefore, we analyzed van semitrailers offloading on the east pier because the truck end ramp is on the east pier. The 20 truck dock handling positions on the east pier could handle almost 3,300 STON of cargo per day. Although the Port of Gulfport has a limited container handling capability, it does not have a dedicated intermodal railyard.

HIGHWAY RECEPTION/HANDLING CAPABILITY



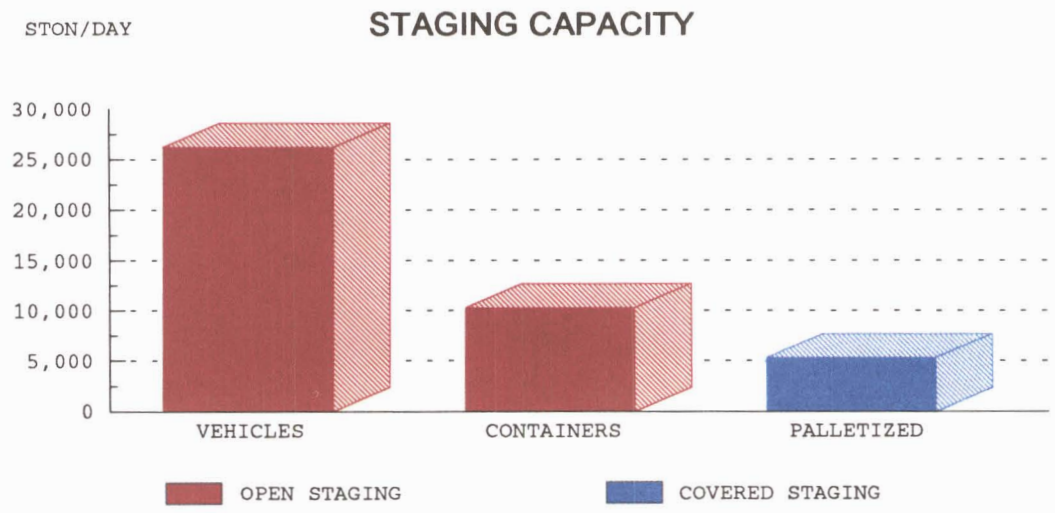
RAIL

The Port of Gulfport has two railroad tracks running along the wharf, allowing direct transfer of cargo from railcar to ship. Also, rail spurs are behind all the transit and backup sheds. All the sheds have railcar-level platforms, allowing offloading of boxcars. These platforms provide 64 railcar handling positions. The Port of Gulfport has a railcar end ramp on the west pier that serves 12 railcars at one time. This allows vehicles to offload circus style. Because of this ramp, we assumed that rail traffic could be routed to the west pier, allowing offloading of vans and semitrailers on the docks and at the truck end ramp on the east pier. Current rail service to the port is two trains a day.



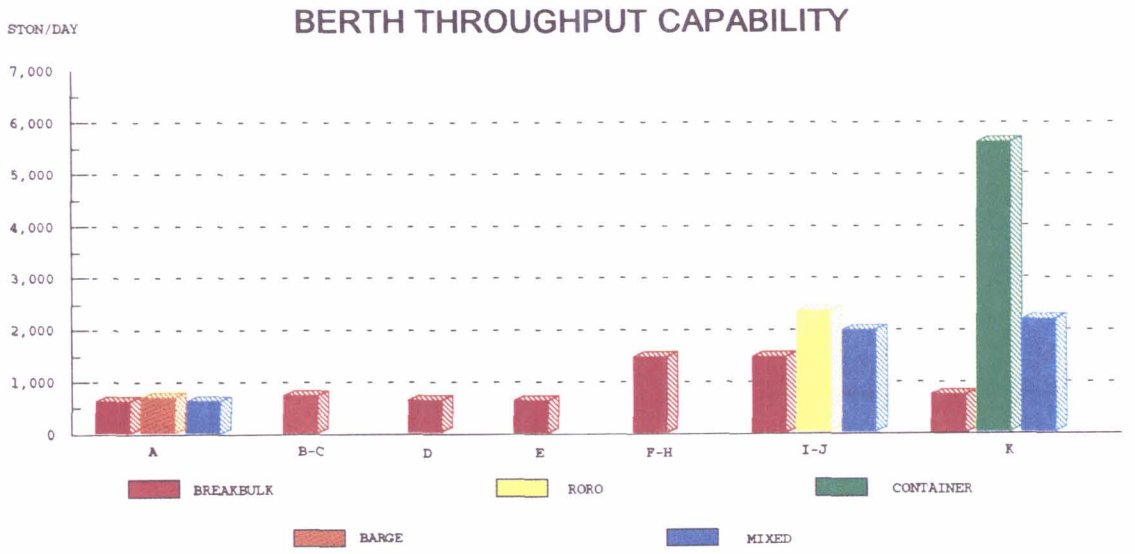
STAGING

The Port of Gulfport has about 31 acres of paved open storage for vehicles and/or containers. This staging area can store about 23,230 STON of breakbulk cargo and 3,000 STON of rolling stock (26,230 STON total), and 10,350 STON of containers. Also, about 336,960 square feet of covered storage provides protection for about 5,400 STON of palletized cargo.



SHIPPING

The figure shows the throughput capability per berth in STON per day for breakbulk, RORO, container, and mixed vessels. These results were based on various factors, including MHE used, loading, operational, and berth utilization rates, as well as berth/ship compatibility.



The berth/ship compatibility for various vessel types is shown in the table 1. This appendix shows for each type of ship, the number of vessels that can be accommodated at each berth. The table also provides the limitations that can hinder shipping operations.

The type of ship preferred at each berth is based on methodology that compares the characteristics of the ship berth to a list of ideal factors required to support the different ship mixes. The evaluation takes into consideration the current physical characteristics and MHE available for a berth. This evaluation gives no considerations for enhancements, such as equipment.

Berth K provides the largest throughput capability for container vessels. Berth I-J provides the largest throughput capability for RORO and breakbulk operations.

PREFERENCE BERTH SELECTION

LOADING TYPE	*BERTHS*						
	A	**B - C**	**D**	**E**	**F - H**	**I - J**	**K**
Breakbulk	6	2	6	2	4	1	5
RORO	-	-	-	-	-	1	-
Container	-	-	-	-	-	-	1
Barge	1	-	-	-	-	-	-
NOTE: Berths marked "-" are not recommended for these operations.							

TABLE 1
SUMMARY OF GULFPORT BERTHING CAPABILITIES

VESSEL	BERTHS						
	A	B - C	D	E	F - H	I - J	K
Breakbulk							
C3-S-33a	a,g	a,g	a,g	a,g	a,g	a,g	a,g
C3-S-37c	a,g	a,g	a,g	a,g	a,g	a,g	a,g
C3-S-37d	1	1	1	1	2	2	1
C3-S-37a	1	1	1	1	2	2	1
C4-S-1a	c	1	c	c	2	2	1
C4-S-1qb and 1u	a,c,g	a,g	a,c,g	a,c,g	a,g	a,g	a,g
C4-S-58a	a,c,g	a,g	a,c,g	a,c,g	a,g	a,g	a,g
C4-S-65a	c	1	c	c	2	2	1
C4-S-66a	a,c,g	a,g	a,c,g	a,c,g	a,g	a,g	a,g
C4-S-69b	a,c,g	a,g	a,c,g	a,c,g	a,g	a,g	a,g
Seatrain							
GA and PR-class	c	1	c	c	2	2	1
Barge							
LASH C8-S-81b	a,c,g	a,g	a,c,g	a,c,g	a,g	a,g	a,c,g
LASH C9-S-81d	a,c,g	a,g	a,c,g	a,c,g	a,g	a,g	a,c,g
LASH lighter	3	7	3	3	10	8	4
SEABEE C8-S-82a	a,c,g	a,g	a,c,g	a,c,g	a,g	a,g	a,c,g
SEABEE barge	2	5	2	2	7	5	3
RORO							
Comet	d,o	d,o	d,i,j	d,i,j	d,o	d,o	d,i,j
C7-S-95a/Maine-class	a,b,c,g	a,b,g	a,c,g	a,c,g	a,b,g	a,g	a,c,g
Ponce-class	b,c,h	b,h	c,h	c,h	b,h	b,h	c,h
Great Land-class	b,c,h	b,h	c,h	c,h	b,h	b,h	c,h
Cygnus/Pilot-class	b,c	b	c	c	b	1	c
Meteor	c,d,o	d,o	c,d	c,d	d,o	d,o	d,i,j
AmEagle/Condor	b,c	b	c	c	b	i,j	c
MV Ambassador	c,d,o	d	c,d	c,d	d	d	d
FSS-class	a,b,c,g	a,b,g	a,c,g	a,c,g	a,b,g	a,g	a,c,g
Cape D-class	a,b,c,g	a,b,g	a,c,g	a,c,g	a,b,g	a,g	a,c,g
Cape H-class	a,b,c,g	a,b,g	a,c,g	a,c,g	a,b,g	a,g	a,c,g
Container							
C6-S-1w	c,e	1,e	c,e	c,e	2,e	1,e	c
C7-S-68e	a,c,e,g	a,e,g	a,c,e,g	a,c,e,g	a,e,g	a,e,g	a,c,g
C8-S-85c	a,c,e,g	a,e,g	a,c,e,g	a,c,e,g	a,e,g	a,e,g	a,c,g
Combination							
C5-S-78a	a,c,e,g	a,e,g	a,c,e,g	a,c,e,g	a,e,g	a,e,g	a,c,g
C5-S-37e	c.e	1,e	c,e	c,e	2,e	1,e	1

a = maximum vessel draft limited to berth depth
b = inadequate apron width
c = inadequate berth length
d = no straight stern-ramp facilities
e = no container-handling equipment
f = inadequate berth depth, adequate anchorage depth
g = inadequate channel depth
h = no shore-based ramps available
i = insufficient ramp clearance at low tide
j = insufficient ramp clearance at high tide
k = excessive ramp angle at low tide
m = excessive ramp angle at high tide
n = parallel ramp operation only
o = insufficient apron width for side-ramp operation

Note: Ramp clearance and ramp angle based on maximum bessel draft.

( ) indicates vessels assigned by analyst

Note: Although a particular berth may show an inadequate berth length, the vessel may extend into an adjacent berth to allow bar usage.

III. APPLICATION

GENERAL

This section of the report will evaluate the port's throughput capability for deploying a notional mechanized infantry brigade using primarily FSS vessels.

The analysis will use only those facilities designated in the *Planning Orders Digest*, issued by MARAD. These orders call for the Port of Gulfport to grant exclusive use of certain facilities before and during national emergencies. These facilities include the "West Pier Dry Bulk and Container Wharf and 10 acres of paved open storage; West Pier Cold Storage Wharf and truck marshaling yard; and West Pier North Wharf, open storage west of North Wharf, and transit shed."

FACILITIES PLANNED FOR MILITARY USE

(SEE FIGS)

BERTH	*STAGING AREA*
E	Open storage west of North Wharf west pier (about 6 acres)
I - J	Truck marshalling yard (about 1 acre)
K	10 acres paved open storage
	Common area north of the port (about 10 acres) for marshalling

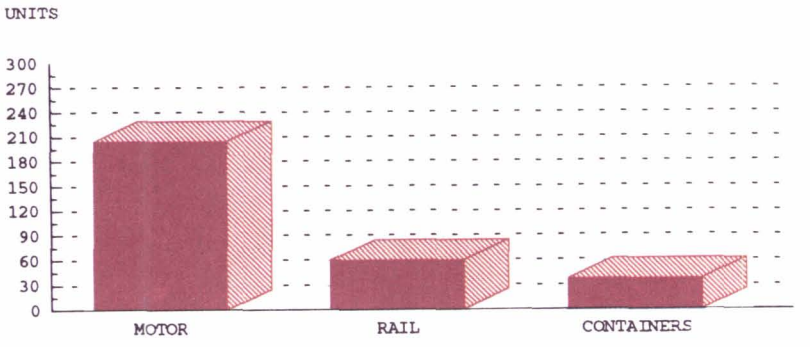
REQUIREMENTS

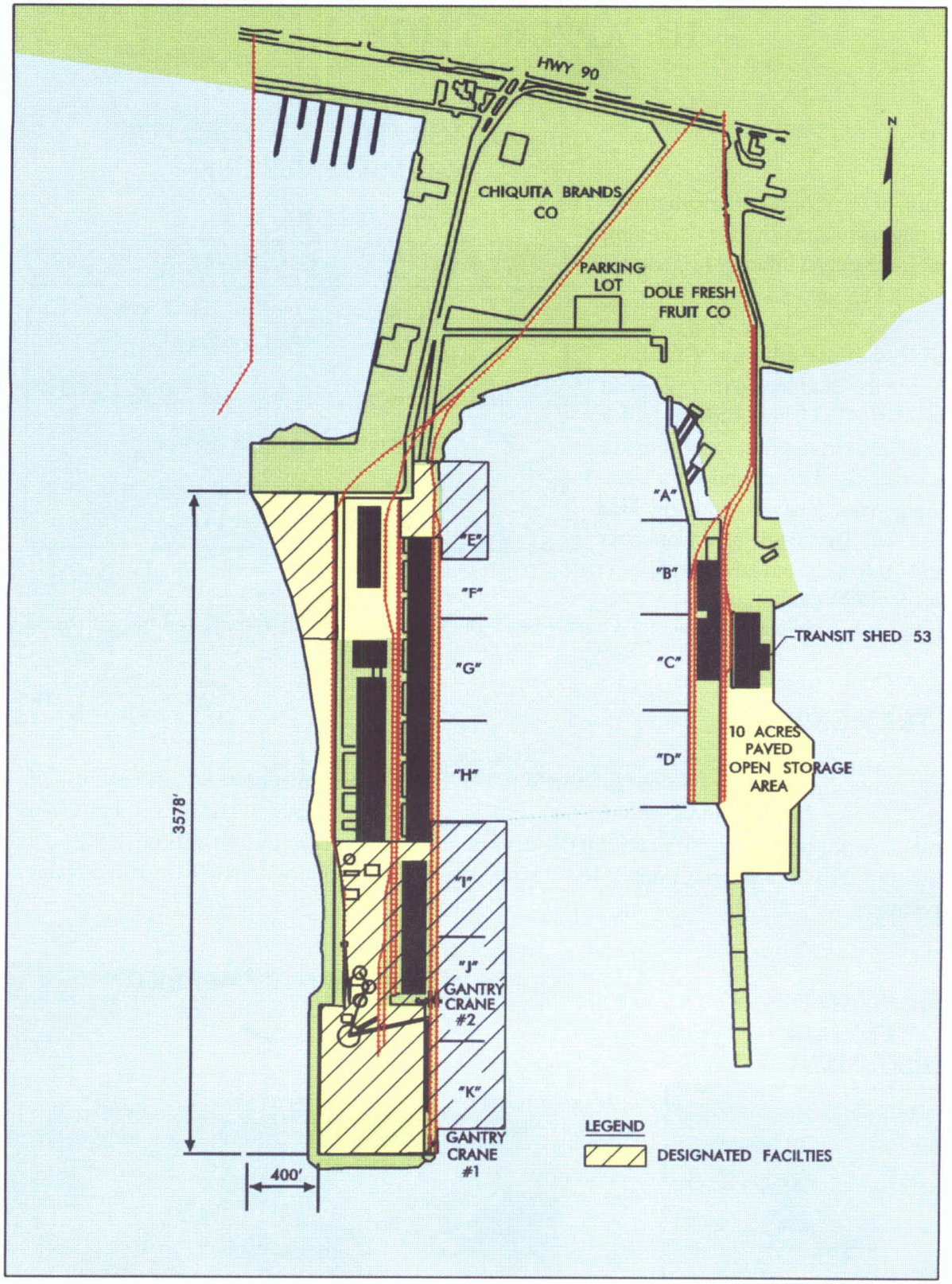
The likely requirement for the Port of Gulfport is to deploy a notional mechanized infantry brigade in 6 days. The brigade has to move about 2,600 vehicles and 220 containers. The movement of this requirement to the port will require 360 (60 per day) railcars using a convoy/rail option. Under this option, about 1,220 (205 per day) roadable vehicles would be driven and about 775 (130 per day) would be towed.

MECHANIZED INFANTRY BRIGADE DEPLOYMENT DATA

Total Equipment	
Volume	91,506 MTON
Weight	31,670 STON
Area	474,300 SQ FT
Vehicles	2,600
Containers (20 ft)	220

DAILY REQUIREMENTS CAPABILITY



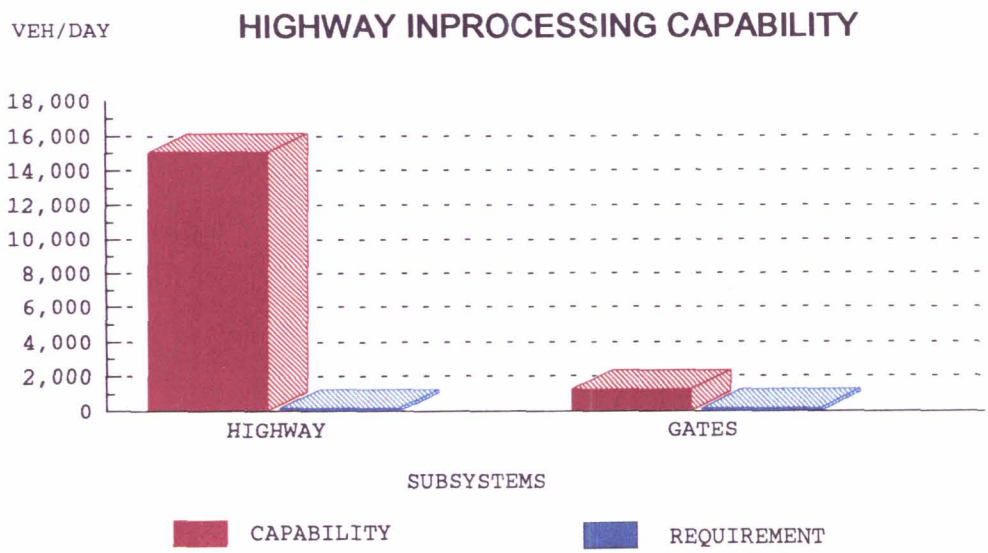


Facilities Designated for Military Use

TERMINAL HANDLING

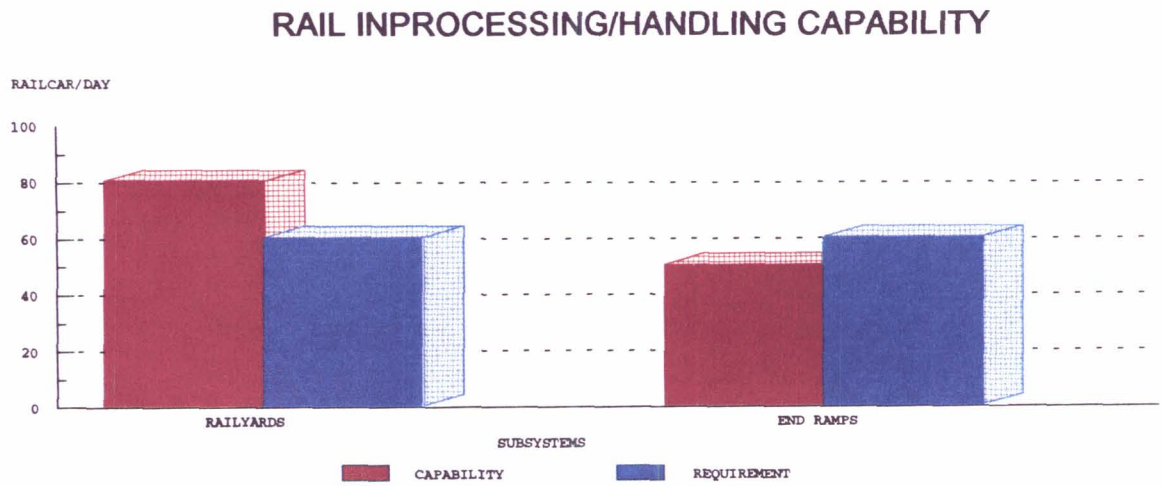
HIGHWAY

Vehicles would access the west pier through West Pier Gate on the 30th Avenue extension. Both the access road and West Pier Gate can handle at least 1,200 vehicles per day.



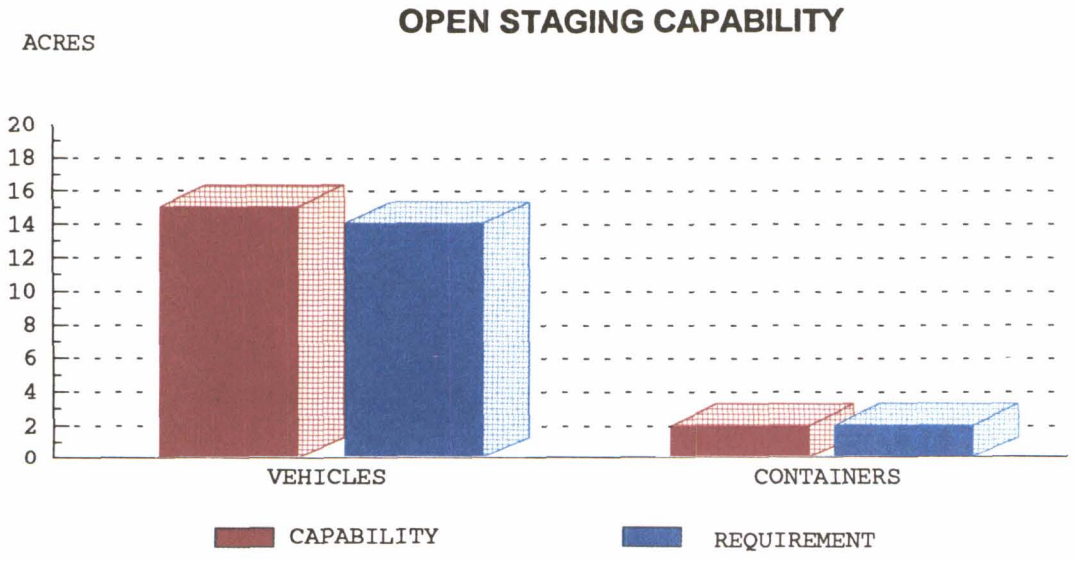
RAIL

No classification yards (classyards) are within the port. However, the port authority indicates that the port area can store about 40 railcars at one time. Current service to the port is 2 trains per day (potentially 80 railcars per day). Also, Mid-South Rail Corporation has an 800-railcar capacity rail classyard 1.25 miles from the port. At times of peak port operation, the Army may need more than the current two trains per day coming into the port from the local railyard. On the west pier is one wood/concrete railcar end ramp that can serve 12 railcars at one time. This end ramp could offload about 50 railcars per day. Since the capability does not meet the requirement, a mechanized infantry brigade may need to use the railcar side dock on the east pier, or request the port authority to obtain portable end ramps from local stevedores.



STAGING

Based on the *Planning Orders Digest* issued by MARAD, about 17 acres of paved open storage are assigned for military operations. We estimate that the Port of Gulfport needs at least 16 acres (14 acres for vehicles and 2 acres for containers) of open staging to support the sustained loading of a one FSS vessel berth system.



UNIT MOVEMENT REQUIREMENTS
MECHANIZED BRIGADE

LOADING CONDITION/ SAMPLE SHIP MIX	*VESSEL TYPES*			
	FSS (RORO/COMB)	CAPE H (RORO/COMB)	C3/C4 (BREAKBULK)	C6/C7/C8 (CONTAINER)
Minimum Containerization				
All FSS*	2.67	0.64		
FSS and Cape H	2.22	1.00		
All Breakbulk			12.57	
Maximum Containerization				
FSS and Container	2.64			0.67
FSS, Cape H, and Container	1.54	1.00		0.67
Breakbulk and Container			9.86	0.87

*Only 8 FSSs are available. Unit shipping requirements exceed the capacity of these 8 vessels. Other vessel types are required to make up the FSS shortfall (Cape H).

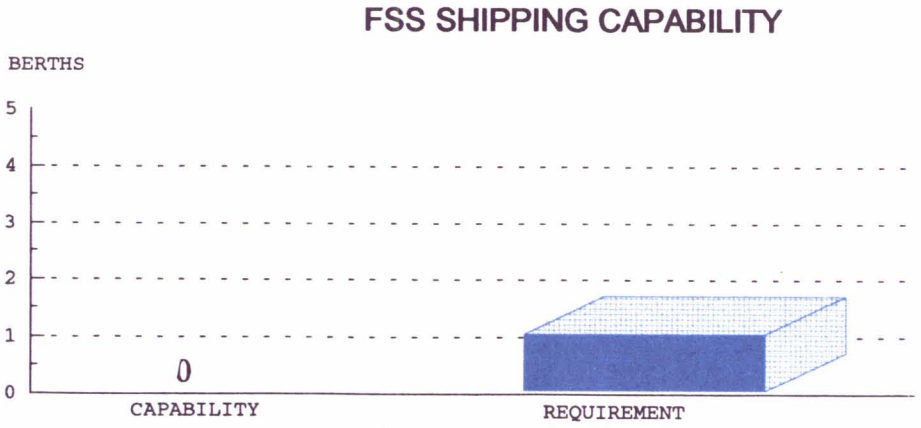
Legend:

RORO - roll on/roll off

FSS - fast sealift ship

Source: MTMCTEA Report OA 90-4f-22, Deployment Planning Guide, 91.

SHIPPING



The number of ships needed to load this requirement depends on the shipping mix selected. The best ship mix would require three FSS vessels and one Cape H RORO ship. However, the ship channel is too shallow to allow passage of a fully loaded FSS or Cape H RORO ship. Considering this, a brigade cannot outload in 6 days using FSS and RORO vessels. However, deploying units could outload using selected breakbulk and containership vessels. (See above table for number of breakbulk and containership vessels needed to deploy a brigade.)

SUMMARY

The ship channel and harbor shallow draft (30 feet MLW) limits the Port of Gulfport to selected breakbulk, containership, and RORO vessels unless the Army deploys partial FSS and Cape H shiploads.

Because of the lack of railcar storage space at the port, the flow of incoming equipment via the rail transport mode depends on the number of trains coming in per day from the local railyard. The current support is two trains per day.

The port's capability to meet rail inprocessing/handling capability requirements depends on the availability of a second railcar end ramp.

The shipping subsystem is the constraining factor in the throughput capability for the Port of Gulfport.

RECOMMENDATIONS

We do not recommend deploying a mechanized infantry brigade through the Port of Gulfport unless select ships are available for deployment. The shallow ship channel and harbor limit deployments to selected breakbulk, RORO, and containership vessels.

We recommend a reevaluation of the Port of Gulfport in the future after completion of the channel and harbor basin dredging project. This project is scheduled for completion on 1 December 1993.

PORT OF HOUSTON

HOUSTON, TEXAS

I. GENERAL DATA

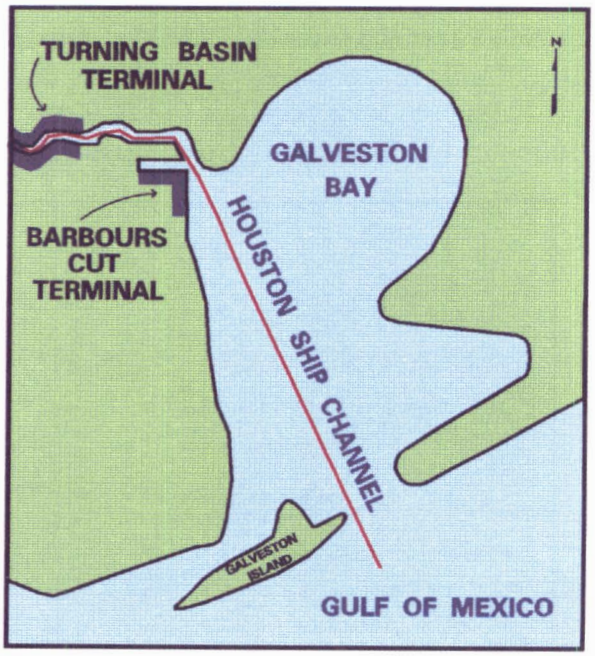
TRANSPORTATION ACCESS

WATER

The Port of Houston consists of two terminals: Turning Basin and Barbours Cut. The Turning Basin Terminal is on the east side of Houston, with berths on both sides of the Houston Ship Channel (HSC).

Barbours Cut Terminal is about 20 miles east, in Morgan's Point. All berths are in a row along an industrial canal off HSC.

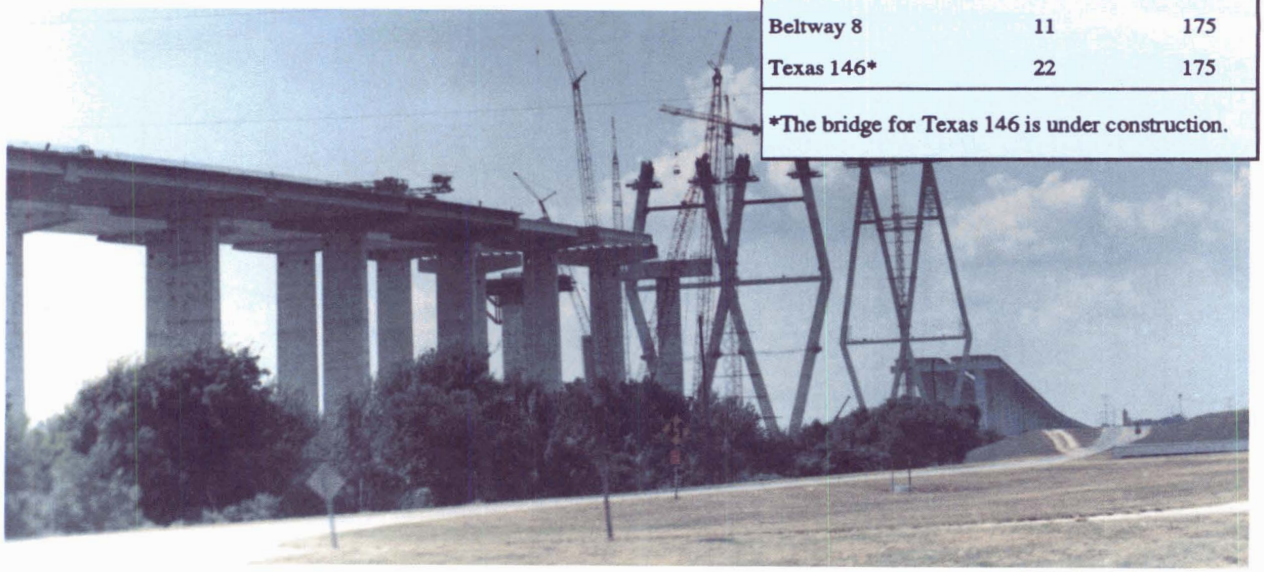
Entrance to the port is via HSC. This channel varies from 36 to 42 feet deep at mean low water (MLW) and 300 to 800 feet wide. Ships pass the Barbours Cut Terminal enroute to the Turning Basin Terminal. Three overhead restrictions cross the channel between the two terminals. No other overhead restrictions exist below the Barbours Cut Terminal.



Water Access

OVERHEAD RESTRICTION	*MILES BELOW TURNING BASIN*	*FEET ABOVE MHW*
I-610	2	135
Beltway 8	11	175
Texas 146*	22	175

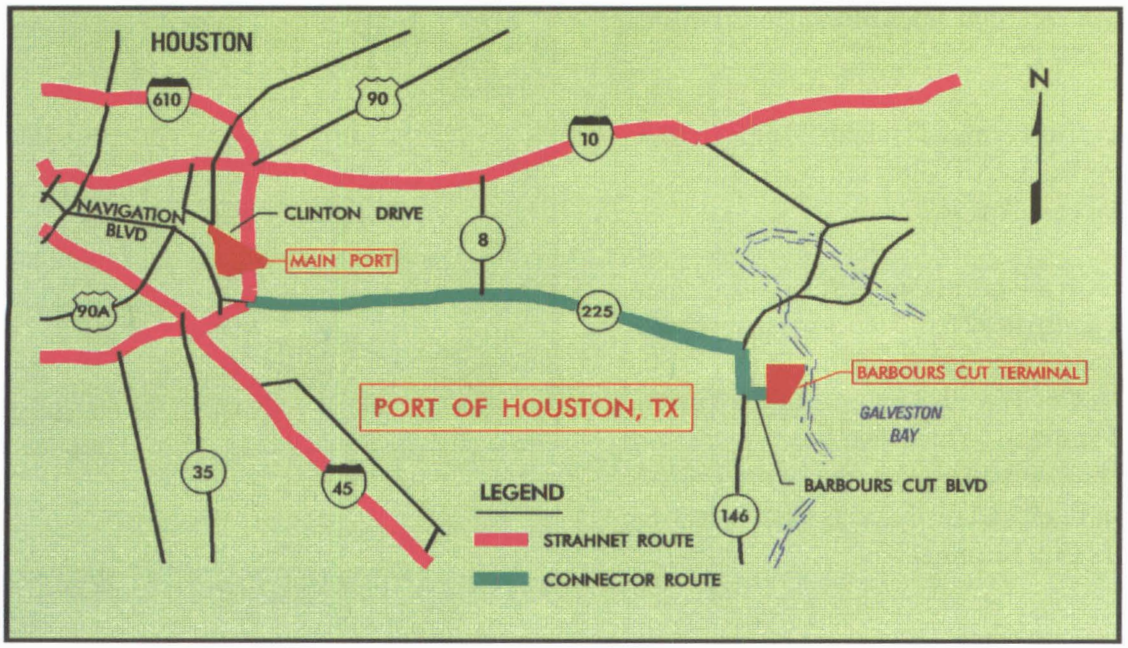
*The bridge for Texas 146 is under construction.



Texas Route 146 Bridge Construction

HIGHWAY

An extensive network of highways serves the Port of Houston. The port area has access to Interstate Routes 610, 10, and 45. Access to the north side of the Turning Basin Terminal is directly off I-610 (east loop), via exit 29 or Clinton Drive. These routes lead to Gates A, 8, 1, and AA. Access to the south side of the Turning Basin Terminal is via Navigation Boulevard to either 75th Street and Gate 15 or 76th Street and Gate 18. Gate 15 is normally closed and unmanned. Gate 18 is manned during the day. Traffic congestion is chronic around the terminal. Access to the Barbours Cut Terminal from Texas 225 or 146 is via Barbours Cut Boulevard (Route 410). The terminal has four gates directly off Barbours Cut Boulevard. No congestion prevails in this rural area.



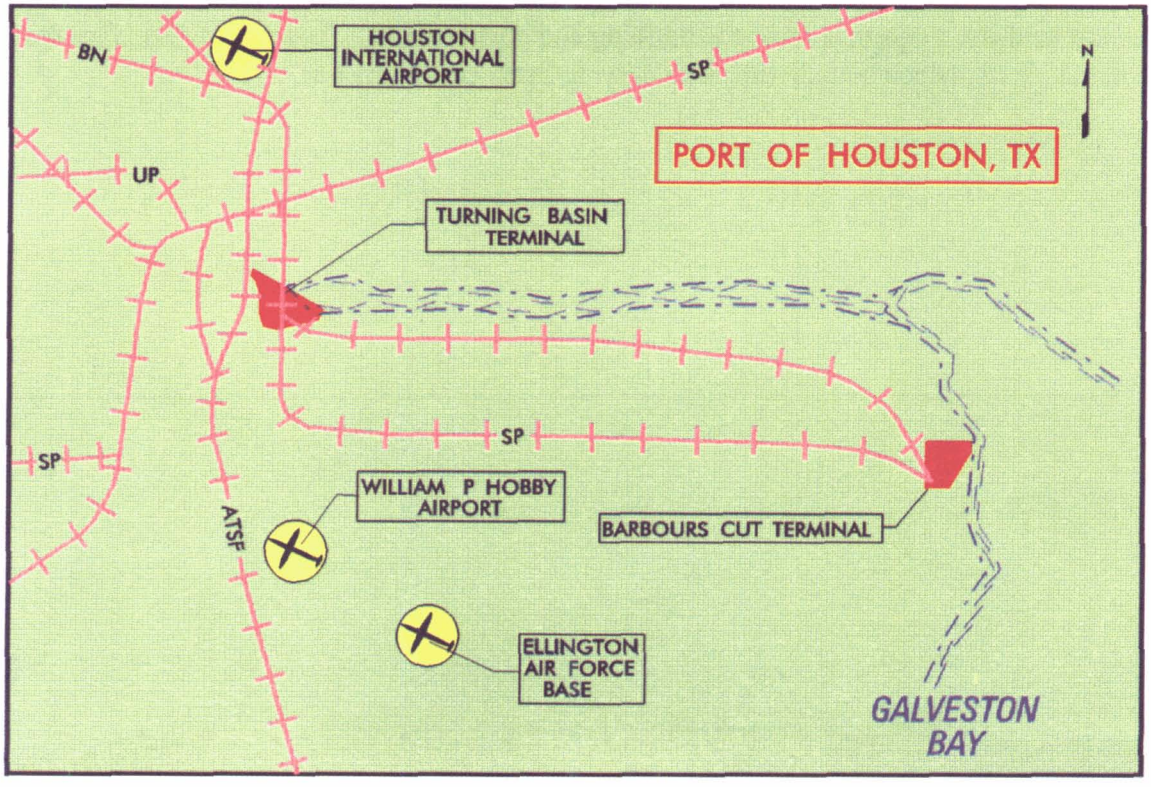
Highway Access

Barbours Cut Gate at Berth 3

RAIL

The four major railroad companies that serve the Port of Houston are the Atchison, Topeka, and Santa Fe (ATSF), Burlington Northern (BN), Southern Pacific (SP), and Union Pacific (UP). Within the port, the Port Terminal Railroad Association (PTRA) provides switching for freight cars entering and within the port.

Four regional railyards - PTRA, Houston Belt and Terminal (HB&T), UP, and SP - serve the Port of Houston. These railyards range in capacity from 2,000 to 4,400 cars. Rail clearances are sufficient for bilevel and trilevel railcars to access the port.



Rail and Air Access

AIRPORTS

The three largest airports that serve the Port of Houston are Houston Intercontinental Airport, William P. Hobby Airport, and Ellington Air Force Base. All of these are within 12 miles of the Turning Basin Terminal.

AIRPORTS NEAR THE PORT OF HOUSTON

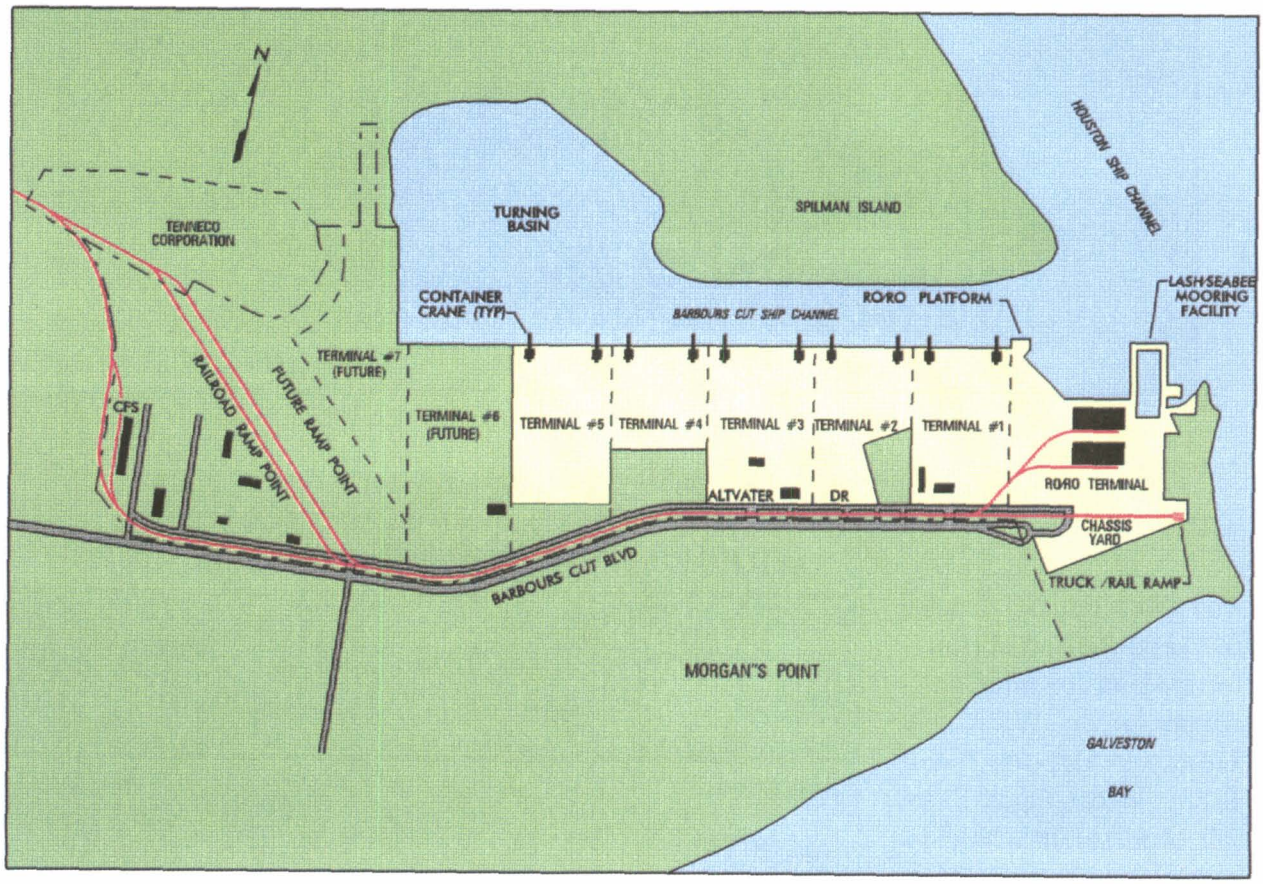
	HOUSTON INT AIRPORT	*WILLIAM P. HOBBY AIRPORT*	*ELLINGTON AIR FORCE BASE*
Main Runway:			
Length (ft)	12,000	7,600	9,000
Width (ft)	150	150	150

BERTH FACILITIES

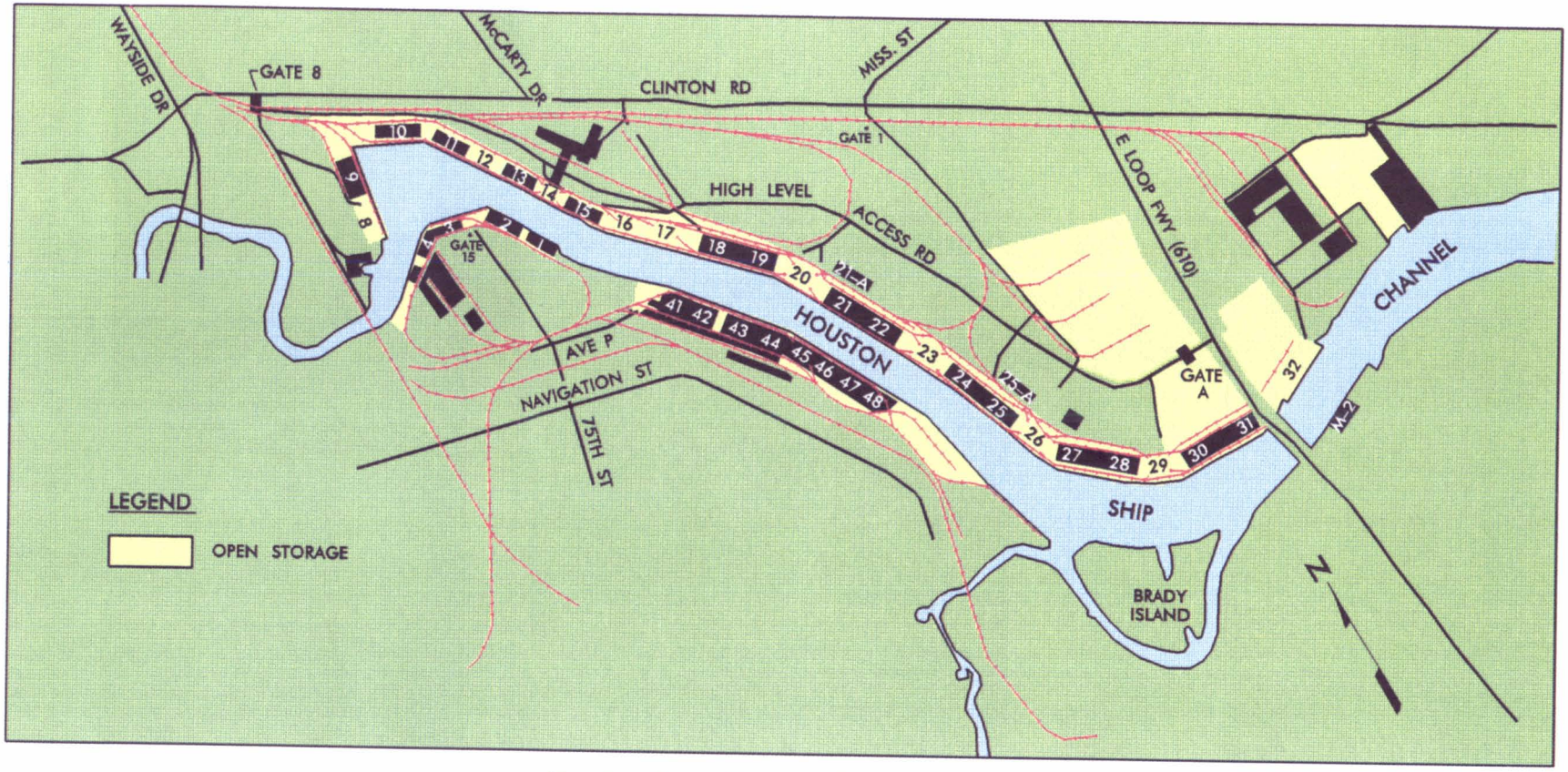
BERTHING

The Turning Basin Terminal handles predominantly breakbulk cargo, while the Barbours Cut Terminal handles predominantly containerized cargo. Both terminals consist of marginal wharves. Most of the wharves at the Turning Basin Terminal and all the wharves at the Barbours Cut Terminal consist of concrete piles with steel sheet bulkheads. Fendering at the Turning Basin Terminal is timber, except for berth 15, which has rubber fendering on a timber bulkhead. Fendering at the Barbours Cut Terminal is rubber-cushioned steel and timber. Both terminals have adequate lighting for night operations.

Below are land-use maps that show the berthing and port facilities of both terminals. Figures 1 and 2 are aerial views, which include tables identifying berth characteristics.



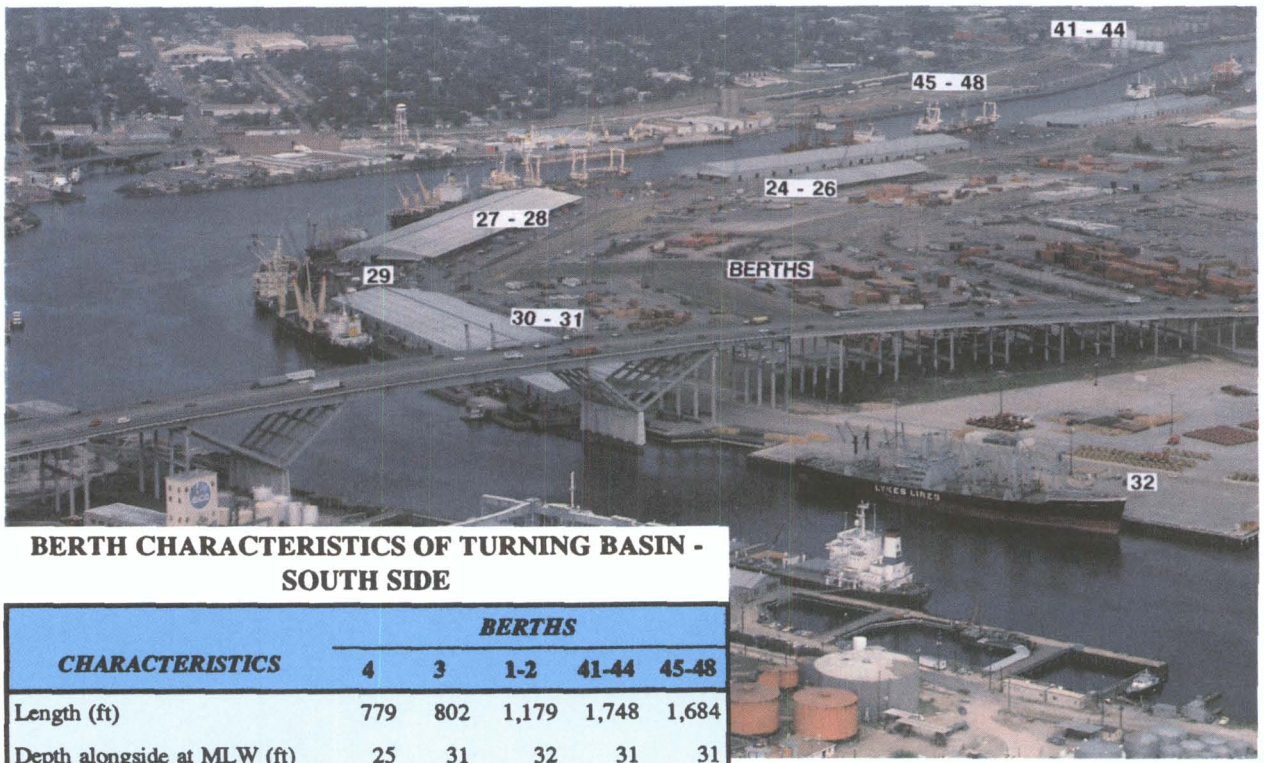
Barbours Cut Terminal Land-Use Map



Turning Basin Terminal Land-Use Map

BERTH CHARACTERISTICS OF TURNING BASIN - NORTH SIDE

CHARACTERISTICS	BERTHS											
	8-9	10	11-13	14-15	16-17	18-19	20-21	22-23	24-26	27-28	29	30-31
Length (ft)	1,205	600	1,520	960	1,154	1,177	1,193	1,200	1,800	1,200	600	1,176
Depth alongside at MLW (ft)	33	31	31	33	37	37	37	37	37	37	37	37
Deck strength (psf)	500	600	500	500	500	500	600	600	750	750	750	750
Apron width (ft)	Open	46	30	30	Open	52	52	52	56	60	Open	60
Apron height above MLW (ft)	19	16	16	16	16	16	16	16	16	16	16	16
Number of container cranes	0	0	0	0	0	0	0	0	0	0	0	1
Number of wharf cranes	0	0	0	0	0	0	0	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Straight-stem RORO facilities	Yes	No	No	No	No	No	No	No	No	No	No	No
Apron length served by rail (ft)	1,205	600	1,520	960	1,154	1,177	1,193	1,200	1,800	1,200	600	1,176



BERTH CHARACTERISTICS OF TURNING BASIN - SOUTH SIDE

CHARACTERISTICS	BERTHS				
	4	3	1-2	41-44	45-48
Length (ft)	779	802	1,179	1,748	1,684
Depth alongside at MLW (ft)	25	31	32	31	31
Deck strength (ft)	500	500	500	500	500
Apron width (ft)	25	30	30	40	25
Apron height above MLW (ft)	9	9	13	16	16
Number of container cranes	0	0	0	0	0
Number of wharf cranes	0	0	0	1	0
Apron lighting	Yes	Yes	Yes	Yes	Yes
Straight-stem RORO facilities	No	No	No	No	No
Apron length served by rail (ft)	0	802	0	1,748	1,684

Figure 2. Turning Basin Terminal (northwest view).

BERTH CHARACTERISTICS OF BARBOURS CUT TERMINAL

CHARACTERISTICS	BERTHS				
	1	2	3	4	5
Length (ft)	1,000	1,000	1,000	1,000	1,000
Depth alongside at MLW (ft)	42	42	42	42	42
Deck strength (ft)	1,000	1,000	1,000	1,000	1,000
Apron width (ft)	Open	Open	Open	Open	Open
Apron height above MLW (ft)	12	12	12	12	12
Number of container cranes	2	2	2	2	2
Number of wharf cranes	0	0	0	0	0
Apron lighting	Yes	Yes	Yes	Yes	Yes
Straight-stern RORO facilities	Yes	No	No	No	No
Apron length served by rail (ft)	0	0	0	0	0

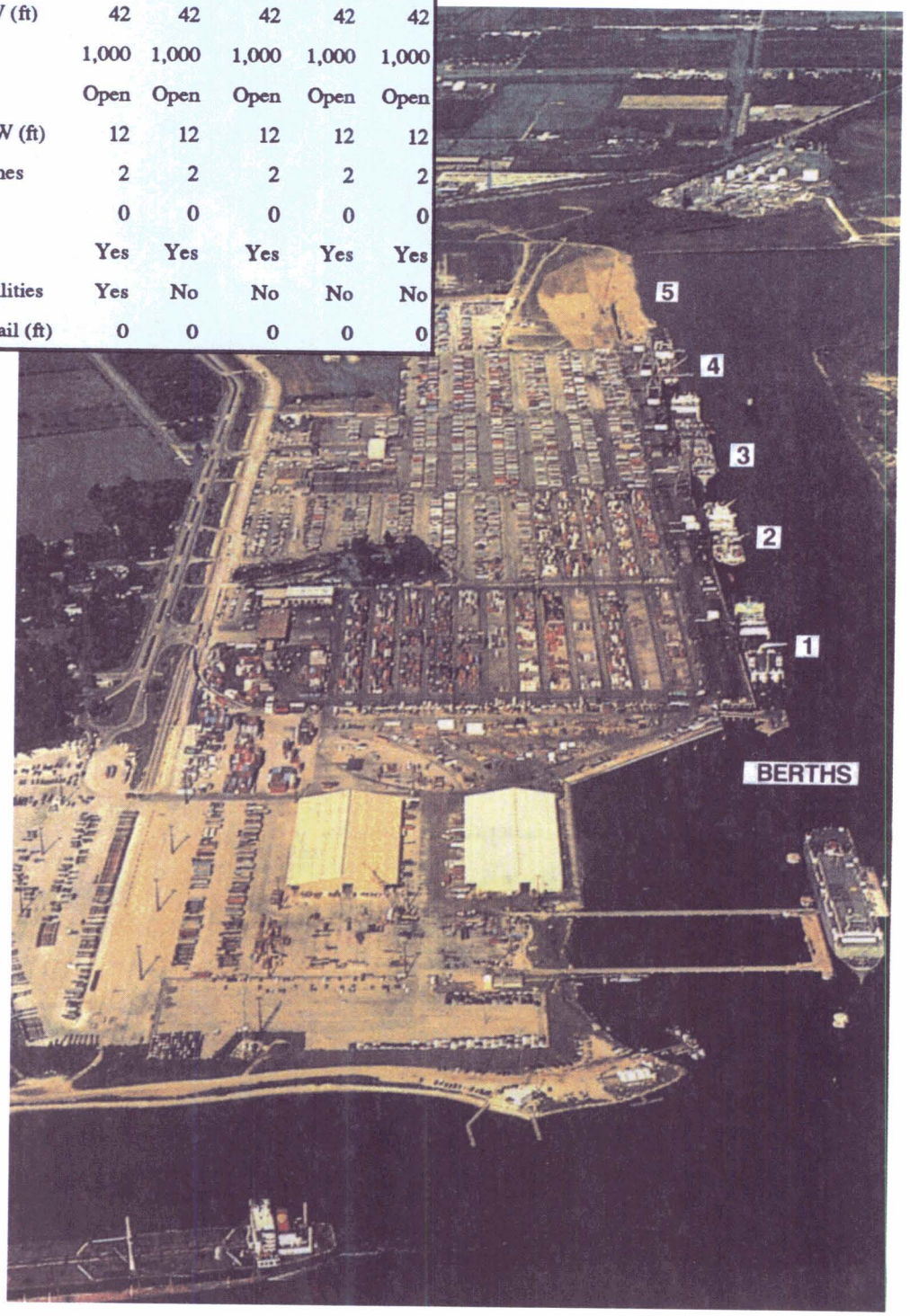


Figure 3. Barbours Cut Terminal (westward view).

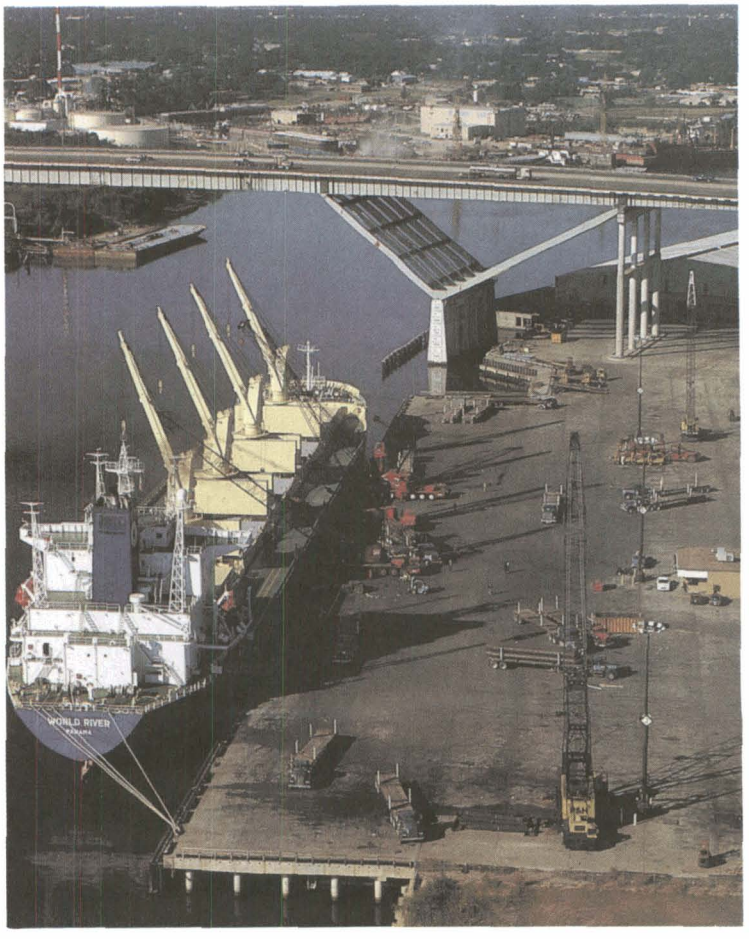
STAGING

Open Staging

The two terminals at the Port of Houston have about 200 acres of open staging available. Of this, 180 acres are paved. The remaining area is slag covered or unimproved. Of the 180 paved acres, 130 are at the Barbours Cut Terminal. Most of the paved open areas at the Turning Basin Terminal are near berths 30-32.

The best location for helicopter operations at the Turning Basin Terminal is the cargo staging area of berth 32. Good locations for helicopter operations at the Barbours Cut Terminal is the inland end of berth 5.

Temporary shelters and portable lighting are required to support reduction and shrink-wrapping operations at either terminal.



Open Staging Area at Turning Basin Berth 32

Covered Staging

Thirty-three sheds and warehouses provide about 3,000,000 square feet of covered storage.

RAIL

Rail trackage links the railyards to aprons on the port and to boxcar-handling tracks at the Turning Basin Terminal and the Barbours Cut Terminal. All the Turning Basin Terminal aprons have one or more tracks, except berths 1, 2, 4, and 32. None of the Barbours Cut Terminal aprons have tracks.

Railyards on the port can store about 2,500 89-foot railcars. Railyards within 8 miles of the Turning Basin Terminal can store about 12,000 89-foot railcars.

HIGHWAY

The port roads are generally two laned and concrete. The High Level Access Road provides express transit between berths along the north side of the Turning Basin Terminal. The port has no clearance restrictions.

Barbours Cut Terminal has nine 60-ton scales. The Turning Basin Terminal has no truck scales.

UNLOADING/LOADING POSITIONS

Ramps

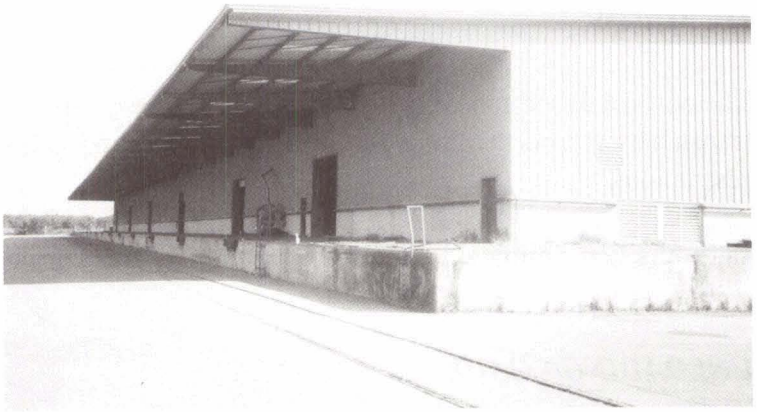
The Turning Basin Terminal has no permanent rail or truck end ramps. However, the port maintains one permanent rail end ramp at the east end of the Barbours Cut Terminal. Also, next to the track is space for a flatbed trailer to offload. Just west of the terminal, off L Street, are two temporary gravel and timber rail end ramps.

Truck-Train End Ramp at Barbours Cut Terminal

Two-Track Railhead at Barbours Cut Terminal Near L Street

Docks

All the transit sheds have docks that are suitable for boxcar or van handling. A few sheds also have docks on their sides for trucks only. All together, the port has about 240 truck docks and 280 boxcar handling positions.



Rail-Truck Docks at Barbours Cut CFS

MARSHALING AREAS

Within Port

The port has no marshaling areas. All open area within the port is required for staging.

Offsite

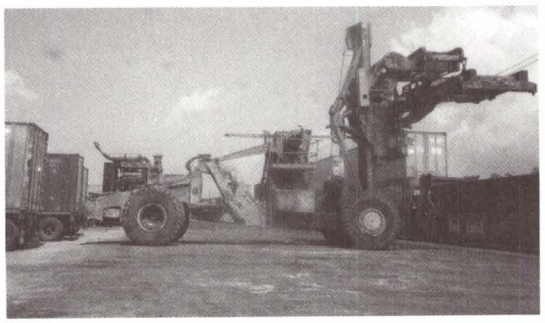
The Houston area is highly developed. It has no areas larger than 5 acres within 5 miles of the Turning Basin Terminal. All the open area at the Barbours Cut Terminal is required for staging commercial or military cargo.

MATERIALS HANDLING EQUIPMENT

The Port of Houston Authority owns several cranes, MHE, and CHE. The container crane at the Turning Basin Terminal can access berths 23-31. Local stevedore companies can provide mobile cranes with capacities ranging from 50 to 300 tons.

PORT-OWNED MHE AND CHE

TYPE OF EQUIPMENT	*CAPACITY (STON)*	*QUANTITY*	*LOCATION*
Container Cranes	40	1	TB
	50	2	BC
	40	6	BC
	30	2	BC
Mobile Crane	82	1	BC
Transtainers	30	8	BC
	40	3	BC
Container Handlers	15	3	BC



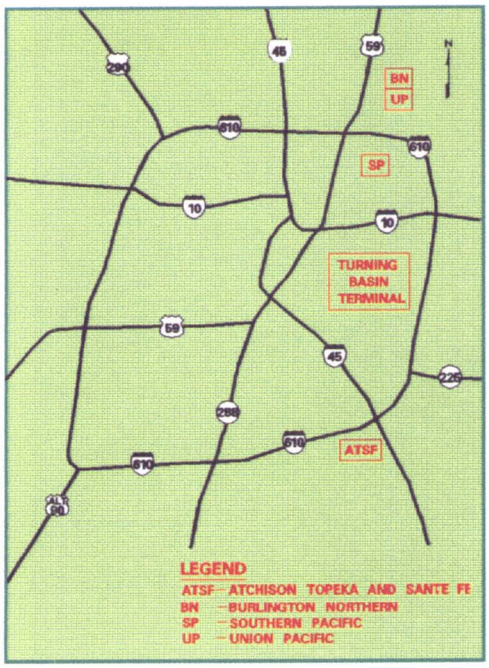
Container Handler

Barbours Cut Container Cranes

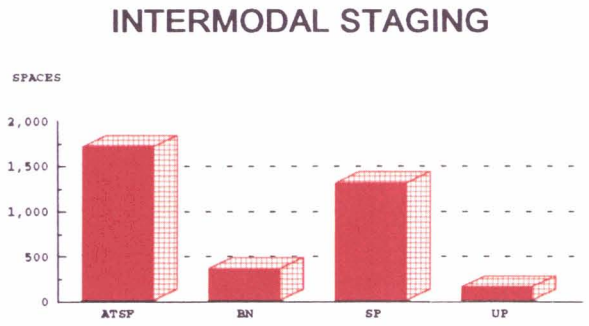
INTERMODAL FACILITIES

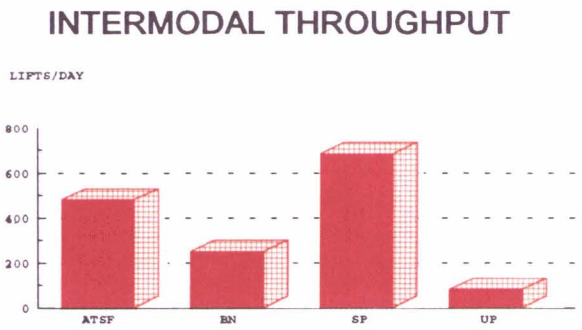
GENERAL

Four railroad companies operate intermodal railyards in the Houston area.



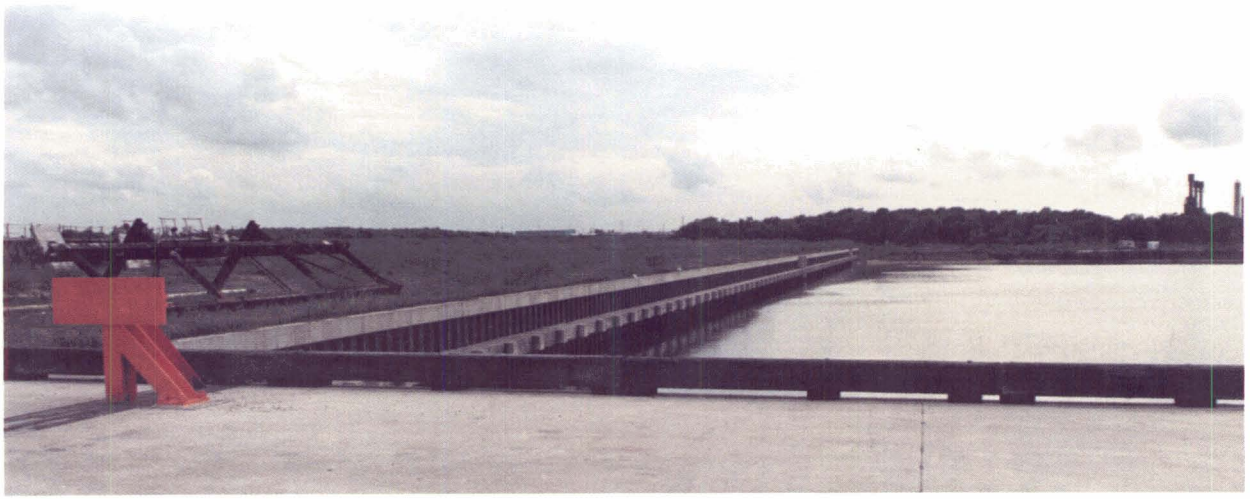
Intermodal Facilities





FUTURE DEVELOPMENT

The Port of Houston Authority expects to demolish the Turning Basin Terminal sheds 45 to 48 to build a berth for scrap metal operations. The Barbours Cut Terminal will continue to expand westward until berth 7 is complete. Plans call for berth 6 to be operational by early 1995.



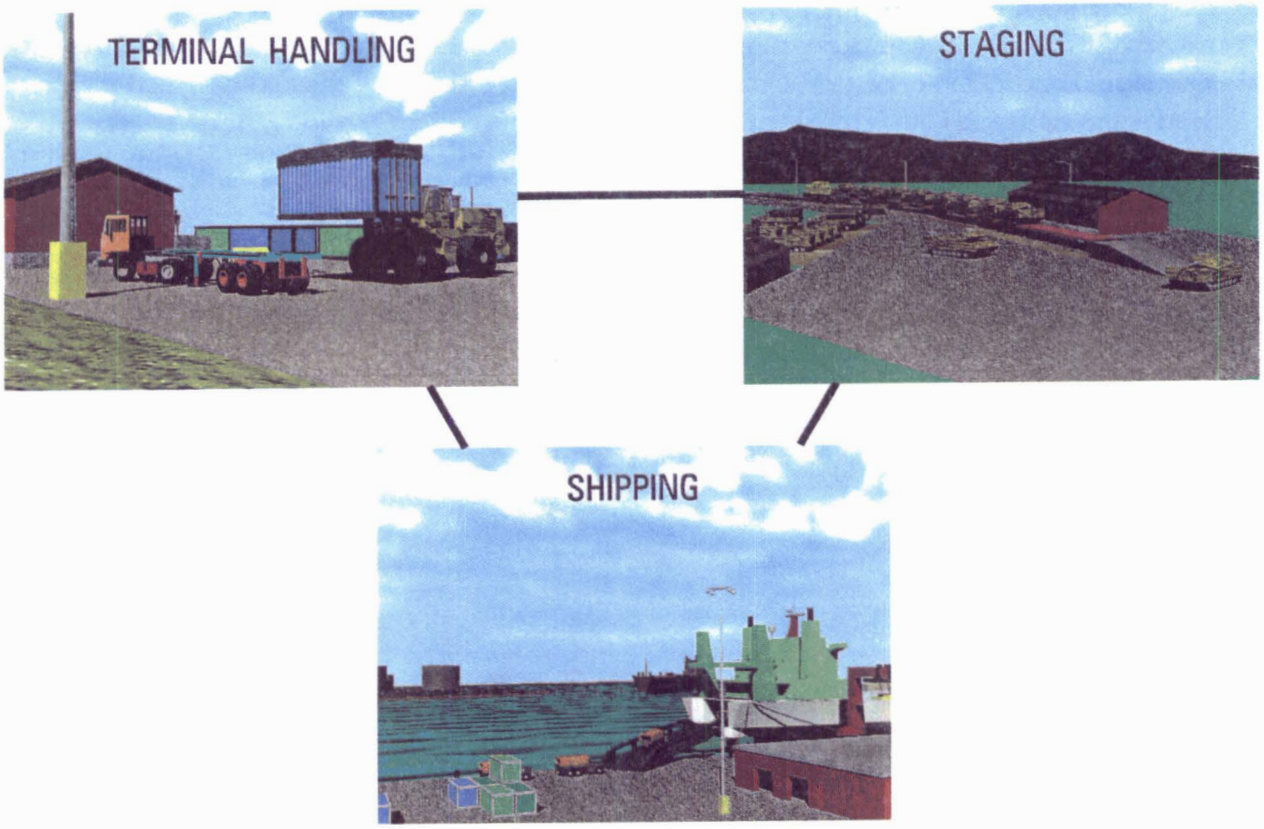
Barbours Cut Berth Expansion

Highway access will improve as new beltways around the city develop. Beltway 8 is about one-third complete. Construction has begun for the Grand Parkway Loop, which will provide direct access to the Barbours Cut Terminal. Part of the Grand Parkway Loop, the I-146 bridge, is under construction. To provide access to Barbours Cut for tall loads, this bridge will have an overhead clearance of 22 feet.

II. THROUGHPUT ANALYSIS

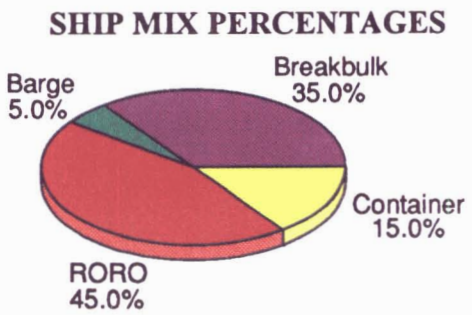
GENERAL

We evaluated the throughput capability of the Port of Houston using the port operational performance simulator (POPS) computer model. The POPS model is based on a weak-link analysis in which each subsystem is analyzed separately and then compared to find the least capable subsystem. The weakest subsystem defines the maximum throughput capability of the terminal. The model yields throughput capability values for three subsystems - shipping, staging, and terminal processing/handling - in short tons (STON) per day.



Terminal Throughput Subsystems

The analysis assumes that 80 percent of the port facilities will support military deployments. Also, the ship mix is based on Desert Shield and Desert Storm statistics. We weighted the percentages to adjust for differences in cargo deadweights and expectations for future deployments.



RECEPTION/HANDLING

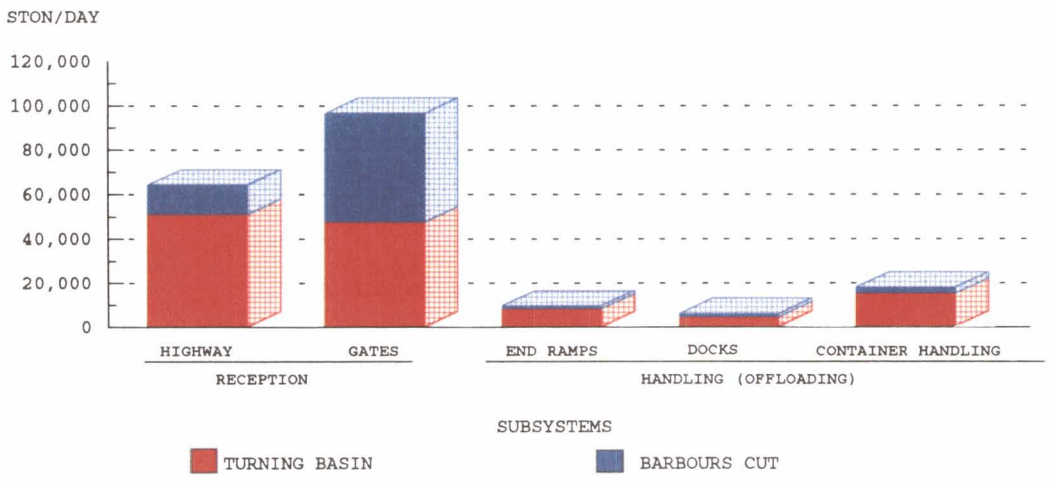
HIGHWAY

Interstate Routes 610, 10, and 45 provide access to the Turning Basin Terminal. Clinton Drive, Navigational Boulevard, and 75th and 76th Streets provide direct access to the six Turning Basin Terminal gates. Texas 225 or 146 provides access to the Barbours Cut Terminal via Barbours Cut Boulevard (Route 410). Four gates allow entrance into the Barbours Cut Terminal. The road network in and out of the port, including the gate processing of vehicles, could handle more than 60,000 STON of equipment and supplies per day.

Roadable vehicles in convoys will process directly to staging areas. Vehicles on commercial or military flatbed trailers without integral ramps will offload at portable ramps. However, the Turning Basin Terminal has no permanent truck end ramps. Our analysis assumes four portable ramps inland of berths 18 and 19 and one inland of berth 1-2 at the Turning Basin Terminal. Vehicles on flatbed trailers can offload at the Barbours Cut Terminal at the ramp built alongside the rail end ramp at the far east end of the terminal. These six ramps could offload more than 9,600 STON from flatbed trailers per day.

Supplies in van semitrailers will proceed to the 144 handling positions. These truck docks can offload about 5,900 STON of van semitrailer-shipped material per day. Containers on chassis will move to the staging areas to be offloaded. One container handler at the container marshaling yard of the Turning Basin Terminal and two container handlers at the open staging areas at the Barbours Cut Terminal could each offload 1,500 STON in containers from their chassis per day.

HIGHWAY RECEPTION HANDLING CAPABILITY



RAIL

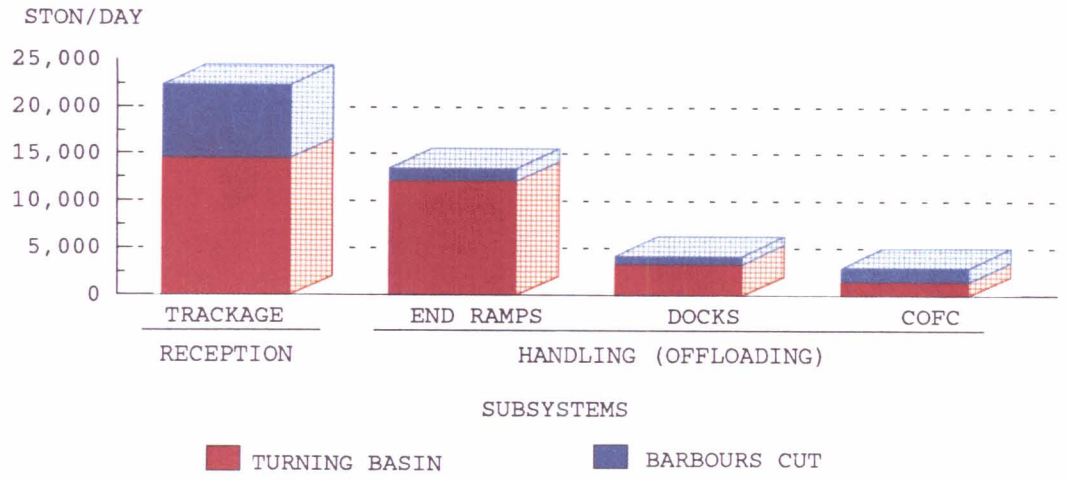
Rail reception at the Turning Basin Terminal is very good, with four major railroad companies serving the Houston area. Railyards within the port could store more than 3,500 railcars. Also, commercial railyards within 12 miles of the Turning Basin Terminal could store more than 18,000 additional railcars. The service is limited to the Barbours Cut Terminal because of commercial traffic and a lack of storage yards in the Morgans Point area. It is possible that six 100-railcar trains per day can access the port's terminals.

Vehicles on flatcars could be offloaded at the permanent end ramp at the east end of the Barbours Cut Terminal, or the two temporary end ramps near L Street west of the Barbours Cut Terminal. Boxcars could be offloaded at the transit sheds, where about 275 boxcar handling positions are available. Containers could be offloaded at the container marshaling yard of the Turning Basin Terminal, or on the tracks adjacent to the sheds at Barbours Cut Terminal. A container handler at each terminal could each offload 1,500 STON per day.

POTENTIAL PORTABLE END RAMP LOCATIONS AND LENGTHS

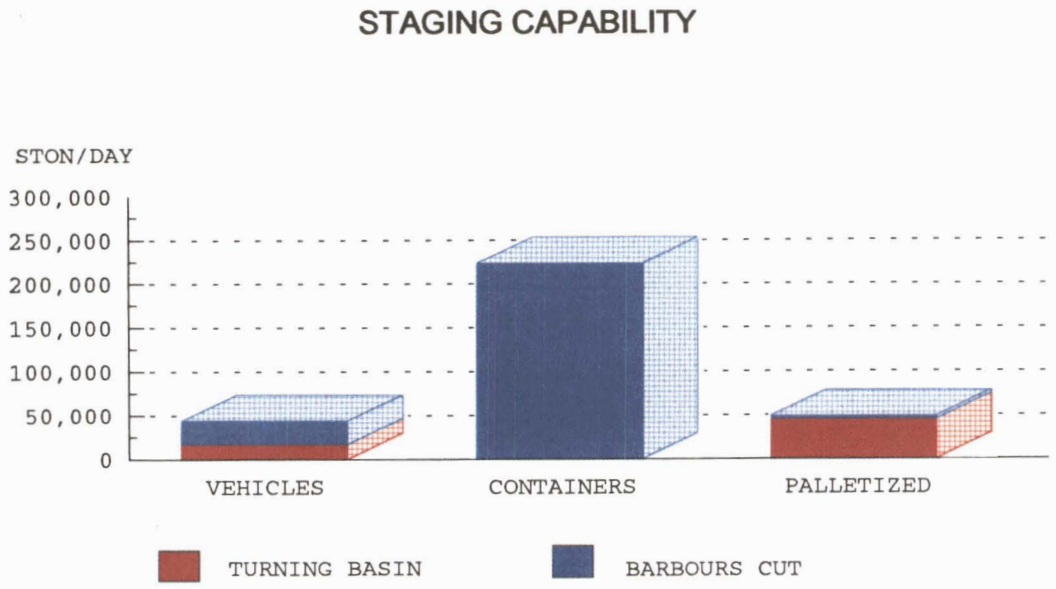
LOCATION	*NUMBER OF 89-FOOT RAILCARS*
Turning Basin (North Side)	
Inland of shed 18-19	10
Inland of shed 21-22	10
Container marshaling yard	8
Turning Basin (South Side)	
HB&T Booth Railyard	20
Barbours Cut	
Storage tracks west of berth 7 (2 tracks)	32 each
CFS	12
RORO sheds (2 tracks)	7 each

RAIL RECEPTION/HANDLING CAPABILITY



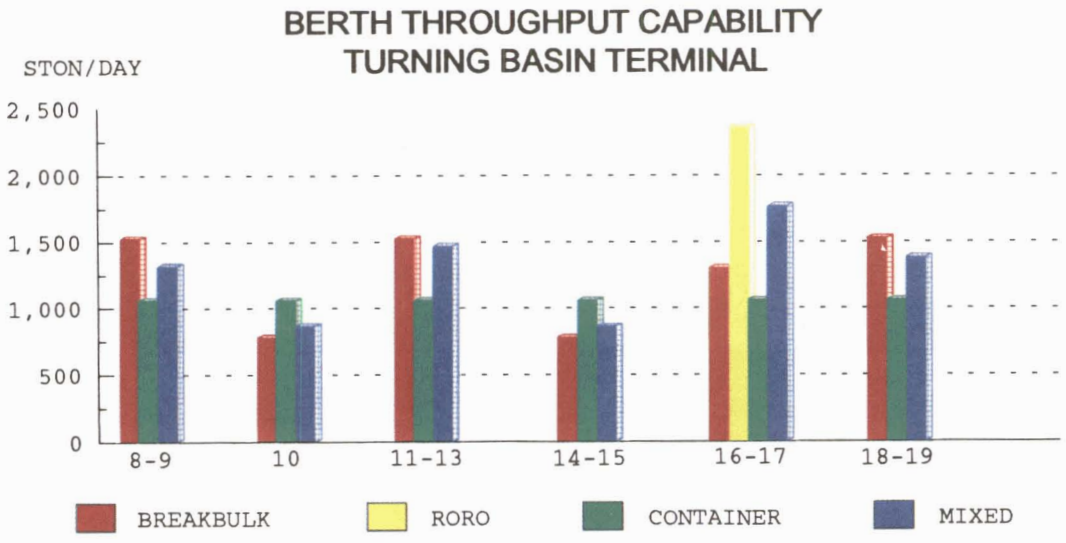
STAGING

The port has about 200 acres of open storage for vehicles and/or containers. It also has about 3,000,000 square feet of covered storage.

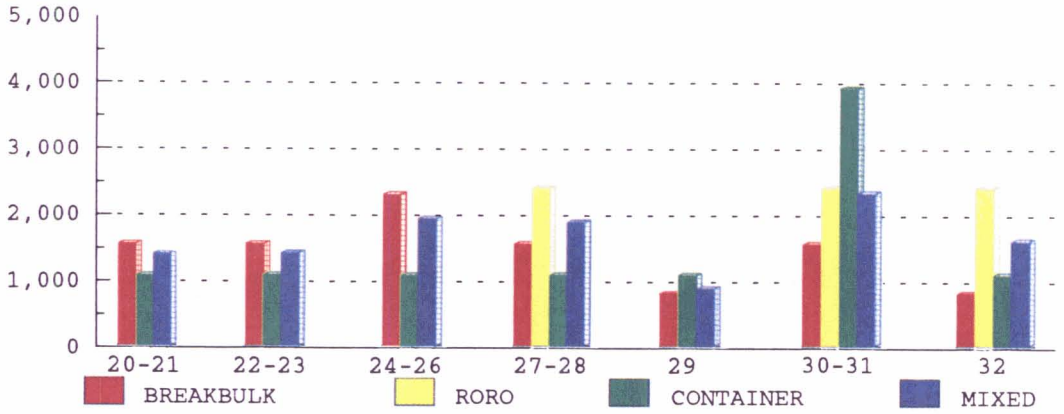


SHIPPING

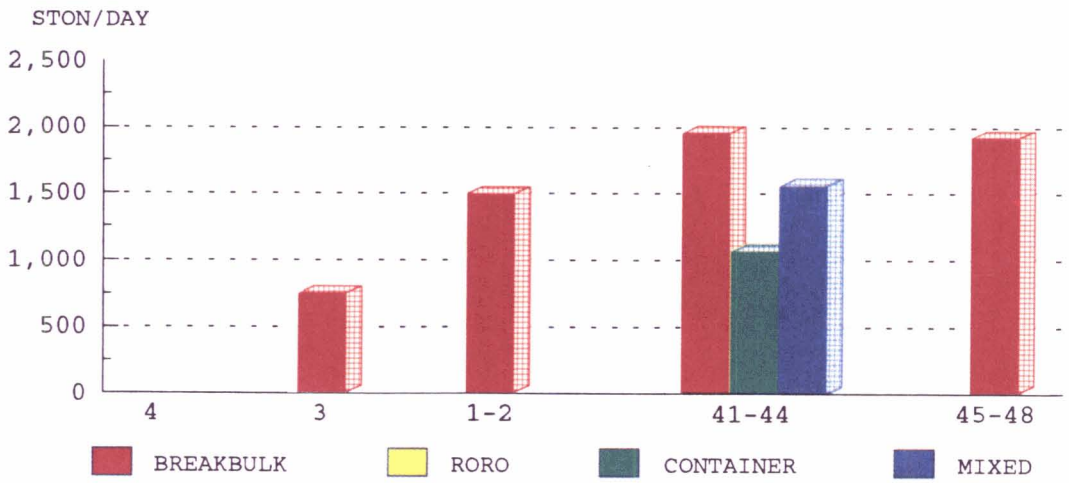
The bar graphs below show the throughput capability per berth in STON per day for breakbulk, RORO, container, and mixed vessels. These results were based on various factors, including MHE used, loading, operational, and berth usage rates as well as berth/ship compatibility.



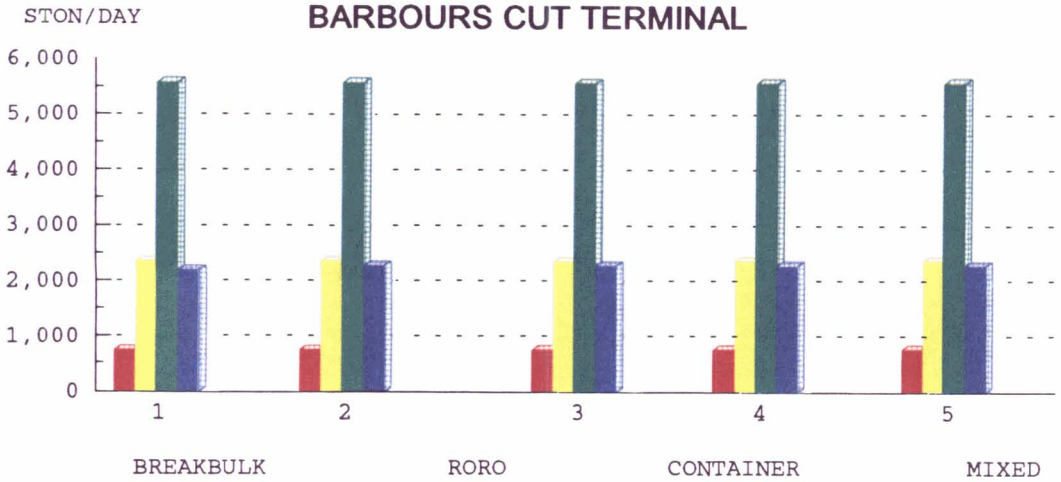
BERTH THROUGHPUT CAPABILITY
TURNING BASIN TERMINAL



BERTH THROUGHPUT CAPABILITY
TURNING BASIN TERMINAL



BERTH THROUGHPUT CAPABILITY
BARBOURS CUT TERMINAL



The berth/ship compatibility for various vessel types is shown in tables 1 through 3. The tables also provides the limitations that can hinder shipping operations.

The type of ship preferred at each berth is based on the methodology described in the appendix. The evaluation is based on a snapshot view of the current physical characteristics of the berths and the MHE available. The evaluation gives no considerations for enhancements, such as equipment.

The berths at the Barbours Cut Terminal provide the largest throughput capacity for container and RORO vessels. Berth 1 is the best berth because of its RORO ramp and nearby transit sheds.

PREFERENCE BERTH SELECTION

BERTH	*BB*	*RORO*	*CNTNR*
Turning Basin			
8-9	7	-	-
10	9	-	-
11-13	9	-	-
14-15	7	-	-
16-17	21	6	-
18-19	6	-	-
20-21	5	-	-
22-23	1	-	-
24-26	1	-	-
27-28	1	7	6
29	20	-	-
30-31	14	-	6
32	22	7	-
4	23	-	-
3	9	-	-
1-2	19	-	-
41-44	9	-	-
45-48	9	-	-
Barbours Cut			
1	1	1	1
2	14	1	1
3	14	2	1
4	14	2	1
5	14	2	1

TABLE 1
SUMMARY OF HOUSTON BERTHING CAPABILITIES - NORTH

VESSEL	BERTHS												
	8-9	10	11-13	14-15	16-17	18-19	20-21	22-23	24-26	27-28	29	30-31	32
Breakbulk													
C3-S-33a	2	1	2	1	2	2	2	2	3	2	1	2	1
C3-S-37c	2	a	a	1	2	2	2	2	3	2	1	2	1
C3-S-37d	2	1	2	1	2	2	2	2	3	2	1	2	1
C3-S-37a	2	1	2	1	2	2	2	2	3	2	1	2	1
C4-S-1a	2	1	2	1	1	1	2	2	3	2	1	1	1
C4-S-1qb and 1u	2	a	a	1	1	1	2	2	3	2	1	1	1
C4-S-58a	2	1	2	1	1	1	1	2	3	2	1	1	1
C4-S-65a	2	1	2	1	1	2	2	2	3	2	1	2	1
C4-S-66a	2	a	a	1	2	2	2	2	3	2	1	2	1
C4-S-69b	1	a	a	1	1	1	1	1	2	1	1	1	1
Seatrain													
GA and PR-class	2	1	2	1	1	2	2	2	3	2	1	2	1
Barge													
LASH C8-S-81b	a,f	a,c,f	a,f	a,f	1	1	1	1	2	1	c	1	c
LASH C9-S-81d	a	a,c	a	a	a	a	a	a	a	a	a,c	a	a,c
LASH lighter	8	4	10	6	8	8	8	8	12	8	4	8	5
SEABEE C8-S-82a	a	a,c	a	a	a	a	a	a	a	a	a,c	a	a,c
SEABEE barge	6	3	7	4	5	5	5	6	9	6	3	5	4
RORO													
Comet	i,j	d,o	d,o	d,o	d,i,j	d,o	d,o	d,o	d,o	d,o	d,i,j	d,o	d,i,j
C7-S-95a/Maine-class	a	a,b,c	a,b	a,b	1,i	b	b	b	b	1,i	c	1,i	1,i
Ponce-class	h	b,c,h	b,h	b,h	h	b,h	b,h	b,h	b,h	b,h	c,h	b,h	h
Great Land-class	h	b,c,h	b,h	b,h	h	b,h	b,h	b,h	b,h	b,h	c,h	b,h	h
Cygnus/Pilot-class	i,j	b,c	b	b	1,i	b	b	b	b	1,i	c	1,i	1,i
Meteor	i,j	d,o	d,o	d,o	d,i,j	d,o	d,o	d,o	d,o	d,o	d,i,j	d,o	d,i,j
AmEagle/Condor	i,j	b,c	b	b	i,j	b	b	b	b	i,j	c	i,j	i,j
MV Ambassador	i,j	d	d	d	d	d	d	d	d	d	d	d	d
FSS-class	a	a,b,c	a,b	a,b	i,j	b	b	b	b	i,j,n	c	i,j,n	c
Cape D-class	i,j	a,b,c	a,b	b	i,j	b	b	b	b	i,j	c	i,j	i,j
Cape H-class	a	a,b,c	a,b	a,b	i,j	b	b	b	b	i,j	c	i,j	i,j
Container													
C6-S-1w	1,e	c,e	2,e	1,e	1,e	1,e	1,e	1,e	2,e	1,e	c,e	1	1,e
C7-S-68e	1,e	a,c,e	a,e	1,e	1,e	1,e	1,e	1,e	2,e	1,e	c,e	1	1,e
C8-S-85c	1,e	a,c,e	a,e	1,e	1,e	1,e	1,e	1,e	2,e	1,e	c,e	1	c,e
Combination													
C5-S-78a	a,e	a,c,e	a,e	a,e	1,e	1,e	1,e	1,e	2,e	1,e	c,e	1	1,e
C5-S-37e	1,e	1,e	2,e	1,e	1,e	1,e	1,e	1,e	2,e	1,e	1,e	1	1,e

a = maximum vessel draft limited to berth depth
b = inadequate apron width
c = inadequate berth length
d = no straight stern-ramp facilities
e = no container-handling equipment
f = inadequate berth depth, adequate anchorage depth
g = inadequate channel depth
h = no-shored based ramps available
i = insufficient ramp clearance at low tide
j = insufficient ramp clearance at high tide
k = excessive ramp angle at low tide
m = excessive ramp angle at high tide
n = parallel ramp operation only
o = insufficient apron width for side-ramp operation

Note: Ramp clearance and ramp angle based on maximum vessel draft.

TABLE 2
SUMMARY OF HOUSTON BERTHING CAPABILITIES - SOUTH

VESSEL	BERTHS				
	4	3	1-2	41-44	45-48
Breakbulk					
C3-S-33a	a	1	2	3	3
C3-S-37c	a	a	2	a	a
C3-S-37d	a	1	2	3	3
C3-S-37a	a	1	2	3	3
C4-S-1a	a	1	2	2	2
C4-S-1qb and 1u	a	a	1	a	a
C4-S-58a	a	1	1	2	2
C4-S-65a	a	1	2	2	2
C4-S-66a	a	a	a	a	a
C4-S-69b	a	a	1	a	a
Seatrain					
GA and PR-class	a	1	2	2	2
Barge					
LASH C8-S-81b	a,c,f	a,c,f	a,f	a,f	a,f
LASH C9-S-81d	a,c	a,c	a	a	a
LASH lighter	5	5	8	12	12
SEABEE C8-S-82a	a,c	a,c	a	a	a
SEABEE barge	3	4	5	8	8
RORO					
Comet	a,d,o	d,o	d,o	d,o	d,o
C7-S-95a/Maine-class	a,b	a,b	a,b	a,b	a,b
Ponce-class	a,b,h	b,h	b,h	b,h	b,h
Great Land-class	a,b,c,h	b,h	b,h	b,h	b,h
Cygnus/Pilot-class	a,b	b	b	b	b
Meteor	a,d,o	d,o	d,o	d,o	d,o
AmEagle/Condor	a,b	b	b	b	b
MV Ambassador	d	d	d	d	d
FSS-class	a,b,c	a,b,c	a,b	a,b	a,b
Cape D-class	a,b	a,b	a,b	a,b	a,b
Cape H-class	a,b	a,b	a,b	a,b	a,b
Container					
C6-S-1w	a,e	1,e	1,e	2,e	2,e
C7-S-68e	a,e	a,e	1,e	a,e	a,e
C8-S-85c	a,c,e	a,c,e	a,e	a,e	a,e
Combination					
C5-S-78a	a,e	a,e	a,e	a,e	a,e
C5-S-37e	a,e	1,e	1,e	2,e	2,e

a = maximum vessel draft limited to berth depth
b = inadequate apron width
c = inadequate berth length
d = no straight stern-ramp facilities
e = no container-handling equipment
f = inadequate berth depth, adequate anchorage depth
g = inadequate channel depth
h = no shore-based ramps available
i = insufficient ramp clearance at low tide
j = insufficient ramp clearance at high tide
k = excessive ramp angle at low tide
m = excessive ramp angle at high tide
n = parallel ramp operation only
o = insufficient apron width for side-ramp operation

Note: Ramp clearance and ramp angle based on maximum vessel draft.

TABLE 3
SUMMARY OF HOUSTON BERTHING CAPABILITIES BARBOURS CUT TERMINAL

VESSEL	BERTHS				
	1	2	3	4	5
Breakbulk					
C3-S-33a	1	1	1	1	1
C3-S-37c	1	1	1	1	1
C3-S-37d	1	1	1	1	1
C3-S-37a	1	1	1	1	1
C4-S-1a	1	1	1	1	1
C4-S-1qb and 1u	1	1	1	1	1
C4-S-58a	1	1	1	1	1
C4-S-65a	1	1	1	1	1
C4-S-66a	1	1	1	1	1
C4-S-69b	1	1	1	1	1
Seatrain					
GA and PR-class	1	1	1	1	1
Barge					
LASH C8-S-81b	1	1	1	1	1
LASH C9-S-81d	1	1	1	1	1
LASH lighter	7	7	7	7	7
SEABEE C8-S-82a	1	1	1	1	1
SEABEE barge	5	5	5	5	5
RORO					
Comet	i,j	d,i,j	d,i,j	d,i,j	d,i,j
C7-S-95a/Maine-class	1	1	1	1	1
Ponce-class	h	h	h	h	h
Great Land-class	h	h	h	h	h
Cygnus/Pilot-class	1	1	1	1	1
Meteor	i,j	d,i,j	d,i,j	d,i,j	d,i,j
AmEagle/Condor	i,j	i,j	i,j	i,j	i,j
MV Ambassador	1	d	d	d	d
FSS-class	1	1	1	1	1
Cape D-class	i,j	i,j	i,j	i,j	i,j
Cape H-class	1	1	1	1	1
Container					
C6-S-1w	1	1	1	1	1
C7-S-68e	1	1	1	1	1
C8-S-85c	1	1	1	1	1
Combination					
C5-S-78a	1	1	1	1	1
C5-S-37e	1	1	1	1	1

a = maximum vessel draft limited to berth depth
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m = excessive ramp angle at high tide
n = parallel ramp operation only
o = insufficient apron width for side-ramp operation

Note: Ramp clearance and ramp angle based on maximum vessel draft.

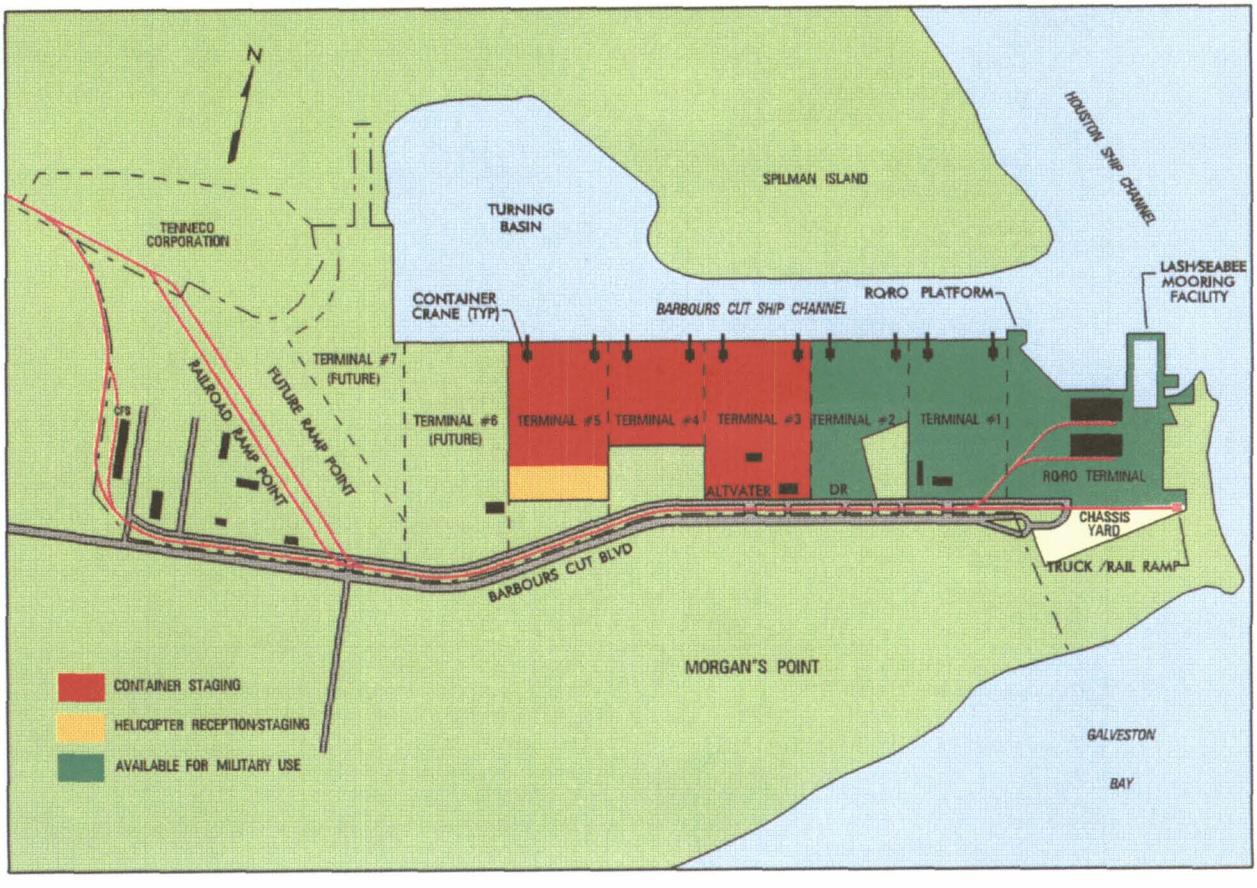
III. APPLICATION

GENERAL

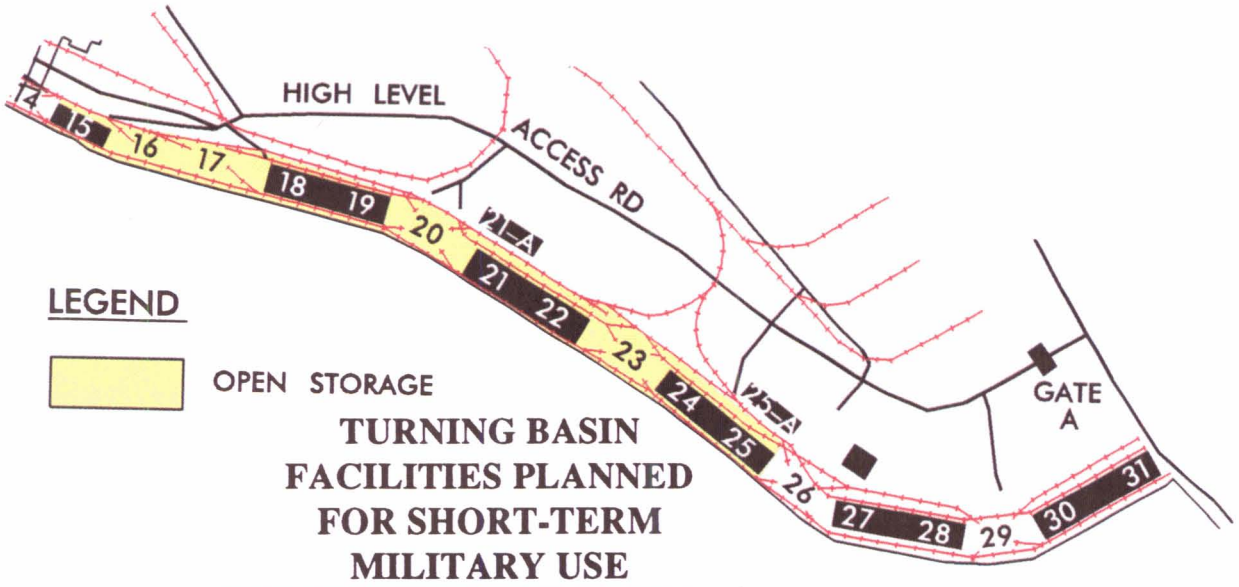
In this section, we evaluate the port's throughput capability for deploying a notional armored division using mainly FSS vessels. The analysis will use those facilities designated in the *Planning Orders Digest,* issued by MARAD. These orders call for the port to provide facilities prior to and during national defense mobilization. The port agrees to provide facilities for short-term usage and different facilities for long-term usage.

BARBOURS CUT FACILITIES PLANNED FOR SHORT-TERM MILITARY USE

BERTH	*STAGING AREA*
1	23 Acres
2	22 Acres
RORO Platform	
LASH Facility	
RORO Staging	19.1 Acres and sheds



Designated MARAD Facilities (Barbours Cut)



BERTH	*STAGING AREA*
16-17	4.6 Acres
18-19	
20-21	2.3 Acres
22-23	2.3 Acres
24-25	

Designated MARAD Facilities (Turning Basin)

FSS operations at the Turning Basin facilities provided by the Planning Orders are very limited for the following reasons:

The total open area (about 10 acres scattered) is insufficient to support sustained FSS operations.

The I-610 bridge height (135 feet above MHW) restricts a light FSS from passing.

The turning basin at the terminal is too small to safely turn an FSS.

The apron height (16 feet above MLW) limits FSS RORO operations.

Except for berth 32, the Turning Basin Terminal should only support military operations involving breakbulk ships. Since berth 32 is not in the Planning Orders for short-term or long-term military usage, this analysis will only consider the Planning Orders facilities at Barbours Cut. Long-term usage of these facilities for sustained FSS loading operations is assumed, despite the fact the planning orders only account for short-term usage.

REQUIREMENTS

The likely requirement for the Port of Houston is to deploy a notional armored division in 6 days of ship loading. The division has to move about 7,800 vehicles and 651 containers. The movement of this equipment to the port will require 1,060 (180 per day) railcars using the convoy/rail option. Under this option, about 3,700 (620 per day) roadable vehicles would be driven and about 2,300 (380 per day) would be towed.

ARMORED DIVISION DEPLOYMENT DATA

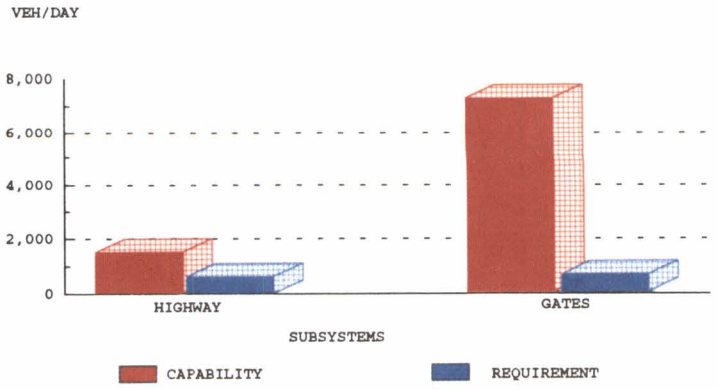
Total Equipment	
Volume	275,000 MTON
Weight	97,000 STON
Area	1,428,000 SQ FT
Vehicles	7,800
Containers	651

TERMINAL HANDLING

HIGHWAY

Vehicles and containers on chassis would access the Barbours Cut Terminal through the gate at berth 1, off Barbours Cut Boulevard. Both the access road and the gate could handle more than 1,500 vehicles per day.

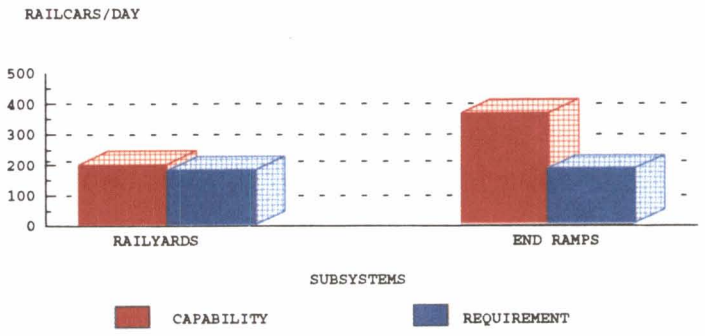
HIGHWAY INPROCESSING CAPABILITY



RAIL

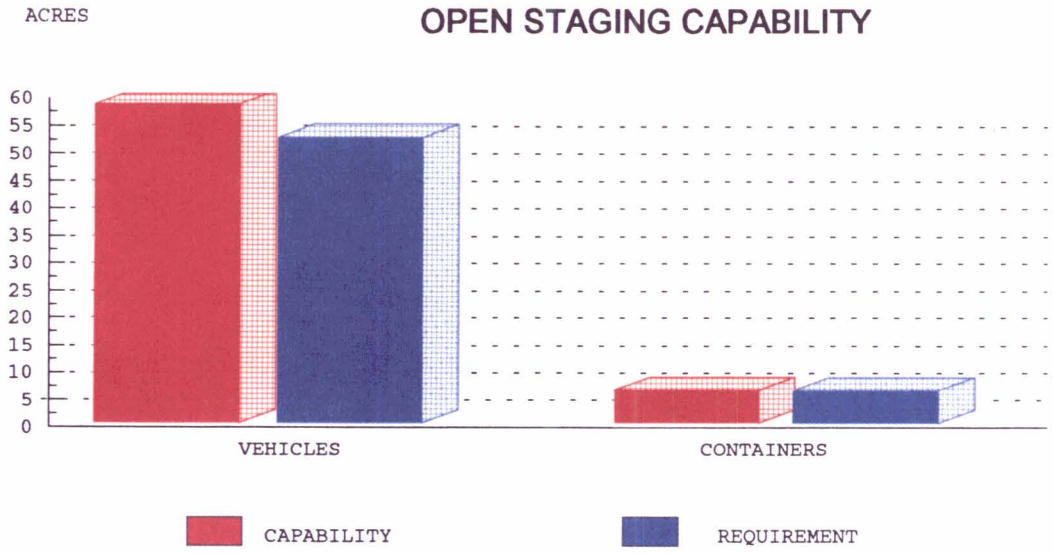
The classification yards near the Barbours Cut Terminal could receive about 200 railcars per day. Also, the 1 fixed and 3 portable rail end ramps could offload 90 flatcars every 5 hours, or 360 per day.

RAIL INPROCESSING/HANDLING CAPABILITY



STAGING

This analysis assumes that current downsizing continues and that nine FSS-sized ships will deploy an entire notional armored division. Three ships will depart every 2 days. Because of this, the staging requirement is to support three sustained loading operations. Although an FSS-load of cargo can be staged on 10 acres, 16 acres are required for sustained loading operations. Of these 16 acres, about 2 acres are required for the staging of the containers for each FSS. The three simultaneous ship loading operations will require 48 acres of open staging, of which about 6 acres are dedicated to containers.



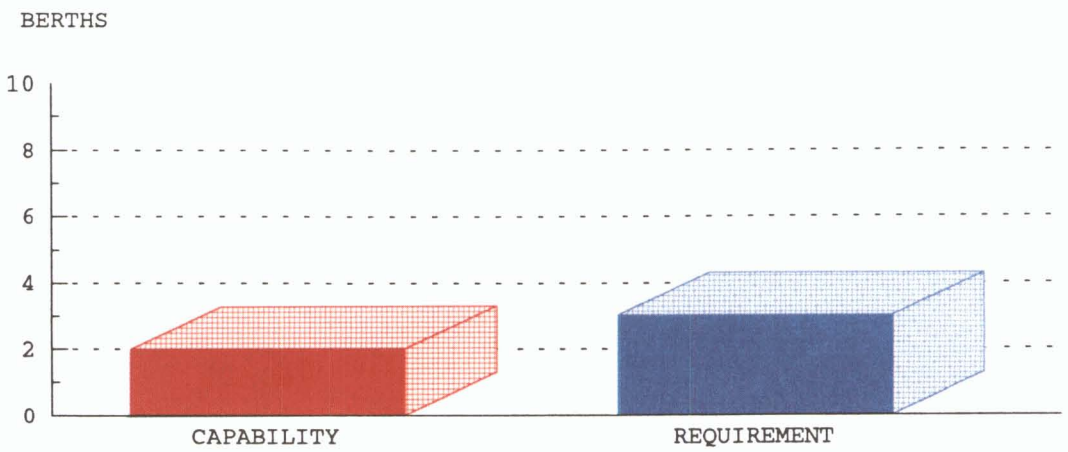
There are 64.1 acres of open staging that could support military operations. The Barbours Cut Terminal has enough staging area for the deployment.

SHIPPING

Although this analysis assumes that only nine FSS-sized ships can deploy the notional armored division, the table below provides ship quantities for the current division size. The number of ships required depends on the shipping mix selected. The best ship mix would consist of all eight FSS ships, plus two Cape H RORO ships.

However, the facilities called for in the *Planning Orders Digest* for the Barbours Cut Terminal can only support the loading of two ships at a time. Each FSS can be loaded in 2 days. To deploy the division in 6 days of shiploading, a third FSS-capable berth is required.

FSS SHIPPING CAPABILITY



UNIT MOVEMENT REQUIREMENTS
ARMORED DIVISION

LOADING CONDITION/ SAMPLE SHIP MIX	*VESSEL TYPES*			
	FSS (RORO/COMB)	**CAPE H (RORO/COMB)**	**C3/C4 (BREAKBULK)**	**C6/C7/C8 (CONTAINER)**
Minimum Containerization				
All FSS*	8.00	1.93		
FSS and Cape H	6.69	3.00		
All Breakbulk			37.88	
Maximum Containerization				
FSS and Container	7.95			2.00
FSS, Cape H, and Container	4.67	3.00		2.00
Breakbulk and Container			29.61	2.00

*Only 8 FSSs are available. Unit shipping requirements exceed the capacity of these 8 vessels. Other vessel types are required to make up the FSS shortfall (Cape H).

Legend:

RORO - roll on/roll off

FSS - fast sealift ship

Source: MTMCTEA Report OA 90-4f-22, Deployment Planning Guide, 91.

SUMMARY

The Port of Houston receiving capabilities and staging area can support the deployment; however, the berthing restrictions of the FSS vessels limit the port to two FSS support systems. Additional berthing space is required. The armored division cannot deploy in the 6-day shiploading period, using the Planning Orders facilities.

RECOMMENDATIONS

1. Designate only two brigades to deploy through the Port of Houston because of berth limitations of the current Planning Orders.

2. Designate Barbours Cut Terminal berths 1, 2, and 3 and 48 open acres of staging area for long-term use to support three FSS vessel systems. Designate the loading area and berthing space of berth 4 for short-term use to provide the additional berthing space required.

PORT OF LAKE CHARLES

LAKE CHARLES, LOUISIANA