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LETTER

FROM

THE SECRETARY OF THE ARMY

TRANSMITTING

A LETTER FROM THE CHIEF OF ENGINEERS, DEPARTMENT OF THE ARMY, DATED JULY 6, 1962, SUBMITTING A REPORT, TOGETHER WITH ACCOMPANYING PAPERS AND AN ILLUSTRATION, ON A REVIEW OF THE REPORTS ON THE SABINE-NECHES WATERWAY, TEXAS, REQUESTED BY A RESOLUTION OF THE COMMITTEE ON PUBLIC WORKS, HOUSE OF REPRESENTATIVES, ADOPTED JUNE 3, 1959



SEPTEMBER 12, 1962.—Referred to the Committee on Public Works
and ordered to be printed with one illustration

U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON : 1962

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LETTER OF TRANSMITTAL



DEPARTMENT OF THE ARMY
WASHINGTON 25, D.C.

IN REPLY REFER TO:

August 31, 1962

Honorable John W. McCormack
Speaker of the House of Representatives

Dear Mr. Speaker:

I am transmitting herewith a favorable report dated 6 July 1962, from the Chief of Engineers, Department of the Army, together with accompanying papers and an illustration, on a review of the reports on the Sabine-Neches Waterway, Texas, requested by a resolution of the Committee on Public Works, House of Representatives, adopted 3 June 1959.

In accordance with Section 1 of Public Law 14, 79th Congress, and Public Law 85-624, the views of the Governor of Texas and the Department of Interior are set forth in the inclosed communications. The views of the Department of Commerce are inclosed also.

The Bureau of the Budget advises that there is no objection to the submission of the proposed report to the Congress; however, it states that no commitment can be made at this time as to when any estimate of appropriation would be submitted for construction of the project modification, if authorized by the Congress, since this would be governed by the President's budgetary objectives as determined by the then prevailing fiscal situation. A copy of the letter from the Bureau of the Budget is inclosed.

Sincerely yours,

A handwritten signature in cursive script that reads "Cyrus Vance".

Cyrus R. Vance
Secretary of the Army

1 Incl
Rept w/accomp
papers & illus

COMMENTS OF THE BUREAU OF THE BUDGET

EXECUTIVE OFFICE OF THE PRESIDENT

BUREAU OF THE BUDGET

WASHINGTON 25, D. C.

August 21, 1962

Honorable Cyrus R. Vance
Secretary of the Army
Washington 25, D.C.

Dear Mr. Secretary:

Assistant Secretary Schaub's letter of July 16, 1962, submitted the proposed report of the Chief of Engineers on Sabine-Neches Waterway, Texas, requested by resolution of the Committee on Public Works, House of Representatives, adopted June 3, 1959.

The Chief of Engineers recommends modification of the existing project for Sabine-Neches Waterway to provide for deepening the entrance from the Gulf to a depth of 42 feet and a depth of 40 feet in part of the jetty channel and all inland channels to Port Arthur and Beaumont, the Sabine Pass anchorage basin, the Port Arthur turning basins, approaches thereto and connecting channels; widening the Port Arthur Canal and the Neches River channel; construction of three turning points in the Neches River channel; replacing an obstructive highway bridge at Port Arthur; and providing a channel 12 feet deep in the Sabine River from Orange to Echo. The Federal cost of the work is estimated at \$20,830,000 for construction dredging and bridge replacement and \$620,000 annually for maintenance in addition to that now required. The benefit-cost ratio is stated to be 1.7. The work would be subject to several conditions of cooperation including the requirement that local interests contribute in cash a share of the construction cost of the bridge relocation computed in accordance with the principles of Section 6 of the Bridge Alteration Act of June 21, 1940, as amended by the Act of July 16, 1952, a sum now estimated at \$220,000. The Chief of Engineers also recommends deauthorization of certain uncompleted portions of the existing project for improvement of Sabine-Neches Waterway.

The Corps of Engineers, in projecting the volume of petroleum products which would be transported through the improved waterway, considered the effect, over both 50 and 100-year periods of analysis, of commerce lost by supertanker transport to contemplated pipelines. We note that, despite substantial possible diversion, the project remains economically feasible.

I am authorized by the Director of the Bureau of the Budget to advise you that there would be no objection to the submission of the proposed report to the Congress. No commitment, however, can be made at this time as to when any estimate of appropriation would be submitted for construction of the project modification if authorized by the Congress, since this would be governed by the President's budgetary objectives as determined by the then prevailing fiscal situation.

Sincerely yours,

E. Fenton Shepard

E. Fenton Shepard
Acting Chief, Resources and
Civil Works Division

COMMENTS OF THE GOVERNOR OF TEXAS



EXECUTIVE DEPARTMENT
AUSTIN 11, TEXAS

PRICE DANIEL
GOVERNOR

June 12, 1962

Lt. General W. K. Wilson, Jr.
Chief of Engineers
U. S. Army Corps of Engineers
Washington 25, D. C.

Dear General Wilson:

This has further reference to your letter of May 21, 1962, transmitting copy of the proposed report on the Sabine-Neches Waterway, Texas.

At my request, the Texas Water Commission reviewed this report and approved its feasibility, as evidenced by the attached copy of a Commission Order. I concur in the findings and conclusions of the Commission.

Sincerely yours,

A handwritten signature in cursive script that reads "Price Daniel".

PD:gs

Enclosure

cc: Hon. Joe D. Carter, Chairman
Texas Water Commission
Capitol Station, Box 2311
Austin 11, Texas

TEXAS WATER COMMISSION



AN ORDER approving the feasibility of the proposed Federal Project to modify the existing Sabine-Neches Waterway Project, to provide for widening and deepening of the channels and basins along the waterway, as proposed in the "Review of Reports on Sabine-Neches Waterway, Texas" by the Corps of Engineers, United States Army.

BE IT ORDERED BY THE TEXAS WATER COMMISSION:

Section 1. Statement of Authority. Article 7472e, Vernon's Annotated Civil Statutes, provides that upon receipt of any engineering report submitted by a Federal Agency seeking the Governor's approval of a Federal Project, the Texas Water Commission shall study and make recommendations to the Governor as to the feasibility of the Federal Project. The Commission shall cause a public hearing to be held to receive the views of persons or groups who might be affected should the Federal Project be initiated and completed.

Section 2. Statement of Jurisdiction. (a) By letter dated May 23, 1962, the Honorable Price Daniel, Governor of Texas, requested the Texas Water Commission to study and make recommendations concerning the proposed Federal Project to modify the existing Sabine-Neches Waterway Project to provide for widening and deepening of the channels and basins along the waterway, as described in the report of Corps of Engineers, United States Army, entitled "Review of Reports on Sabine-Neches Waterway, Texas", dated March 1, 1962, and to enter its order finding said project to be feasible or not feasible. (b) In accordance with Article 7472e, the Commission caused a public hearing after due notice by publication and mail, to be held on June 11, 1962, at 2:00 o'clock P. M., in the offices of the Texas Water Commission, 201 East Fourteenth Street, Austin, Texas, on said project, and at which time all those interested or who may be affected should the project recommended in said Report be initiated and completed were requested to come forward and give testimony.

Section 3. After fully considering all the evidence and exhibits presented by persons and groups who may be affected should the project be initiated and completed, including the matters set forth in Section 4 of Article 7472e, the Commission finds that said project is feasible and that the public interest will be served thereby.

Section 4. It is further ordered that a certified copy of this Order be transmitted to the Governor.


Section 5. This Order shall take effect on the 11th day of June, 1982, the date of its passage, and it is so ordered.

SIGNED IN THE PRESENCE OF THE
TEXAS WATER COMMISSION




Joe D. Carter, Chairman

ATTEST:



Ben F. Looney, Jr., Secretary

I certify that the foregoing order was adopted by the Texas Water Commission at a meeting held on the 11th day of June, 1982, upon motion of Commissioner Dent, seconded by Commissioner Beckwith, Commissioner Beckwith voting "aye", Commissioner Dent voting "aye", and Chairman Carter voting "aye".



Ben F. Looney, Jr., Secretary

STATE OF TEXAS
COUNTY OF TRAVIS

I, Ben F. Looney, Jr., Secretary of the Texas Water Commission do hereby certify that the foregoing is a true and correct copy of an order of said Commission, the original of which is filed in the permanent records of said Commission.

Given under my hand and the seal of the Texas Water Commission, this the 17th day of June, A.D., 1962.

Ben F. Looney, Jr.
Ben F. Looney, Jr., Secretary

COMMENTS OF THE DEPARTMENT OF THE INTERIOR



UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF THE SECRETARY
WASHINGTON 25, D. C.

6 July 1962

Dear General Wilson:

This is in reply to your letter of May 21, 1962, requesting our comments on Sabine-Neches Waterway, Texas.

The Regional Office of the Bureau of Sport Fisheries and Wildlife in Albuquerque, New Mexico, has reported that it received from the Galveston District Engineer by letter of May 28, 1962, revised pages for insertion in the Review of Reports on Sabine-Neches Waterway, Texas, dated March 1, 1962. The revised pages include the Bureau of Sport Fisheries and Wildlife report of May 8, 1962, and the District Engineer's comments relative to that report. The comments of the Bureau of Sport Fisheries and Wildlife, therefore, are based upon this revision of the Review of Reports which it is assumed will be a part of your report when it is submitted to the Congress.

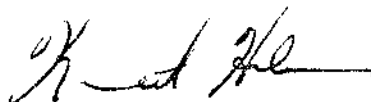
The Bureau of Sport Fisheries and Wildlife advises that the proposed developments will not benefit fish and wildlife and will result in substantial long-range losses to waterfowl and other migratory birds, fur animals, and marine fishes and shellfishes through industrial expansion along the channels. Pollution in the channels, marshes, and Sabine Lake is expected to increase as a result of the industrial expansion, causing decline in productivity of the estuarine waters in the project area and in reduced sport and commercial catch of marine fishes and shellfishes from Sabine Lake and the Gulf of Mexico.

The proposed deepening, widening, and extension of the project channels and basins and the placement of spoil on existing disposal areas will not cause significant losses to fish and wildlife. The extension of existing spoil areas and the creation of new ones, however, will eliminate about 3,740 acres of marsh and swamp-forest habitat important to fish and wildlife.

Fish and wildlife losses can be minimized partially by the adoption of the recommendations contained in the Bureau of Sport Fisheries and Wildlife report of May 8, 1962. These recommendations relate to the selection of spoil areas and to the method of disposal of excavated material. In his comments on that report, the District Engineer stated that these recommendations will be coordinated fully with the Texas Game and Fish Commission and the U. S. Fish and Wildlife Service during preconstruction phases of the proposed plan of improvement.

This Department appreciates the opportunity of presenting its views.

Sincerely yours,

A handwritten signature in dark ink, appearing to read "K. H. ...", with a long horizontal flourish extending to the right.

Assistant Secretary of the Interior

Lt. General W. K. Wilson, Jr.
Chief of Engineers
Department of the Army
Washington 25, D. C.

COMMENTS OF THE DEPARTMENT OF COMMERCE



THE UNDER SECRETARY OF COMMERCE
FOR TRANSPORTATION
WASHINGTON 25, D. C.

28 June 1962

Lieutenant General W. K. Wilson, Jr.
Chief of Engineers
Department of the Army
Washington 25, D. C.

Dear General Wilson:

As requested in your letter of May 21, 1962, I am transmitting herein the comments of the interested Department of Commerce agencies on your proposed report on the improvement of the "Sabine-Neches Waterway, Texas" for navigation purposes.

The Coast and Geodetic Survey advises that the construction of the project will necessitate the revision of the nautical charts of the area and estimates the cost at \$8,000. The Coast and Geodetic Survey also advises that extensive horizontal geodetic control exists in the immediate vicinity of the project and that vertical geodetic control has been established along the Texas and New Orleans Railroad and State Highway 87. If additional control should be required for the project, the Coast and Geodetic Survey would appreciate being advised in advance so that cost estimates can be furnished.

The Bureau of Public Roads notes that the construction of the project will require the reconstruction of the Pleasure Island bridge at Port Arthur and that the cost of replacing this bridge will be apportioned between Federal and local interests in accordance with the principles set forth in Section 6 of the Bridge Alteration Act of June 21, 1940.

Your courtesy in providing a copy of this report for our review is appreciated.

Sincerely yours,

A handwritten signature in cursive script that reads "Frank L. Barton".

Frank L. Barton
Deputy Under Secretary
for Transportation

SABINE-NECHES WATERWAY, TEXAS

REPORT OF THE CHIEF OF ENGINEERS, DEPARTMENT OF THE ARMY



HEADQUARTERS
DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON 25, D.C.

IN REPLY REFER TO

ENGOW-PD

6 July 1962

SUBJECT: Sabine-Neches Waterway, Texas


TO: THE SECRETARY OF THE ARMY

1. I submit for transmission to Congress the report of the Board of Engineers for Rivers and Harbors on Sabine-Neches Waterway, Texas, accompanied by reports of the District and Division Engineers, in response to a resolution of the Committee on Public Works of the House of Representatives, United States, adopted 3 June 1959, with a view to determining if the existing project should be modified in any way at this time.

2. The District and Division Engineers recommend modification of the existing project for Sabine-Neches Waterway, Texas, to provide for deepening the entrance from the Gulf to a depth of 43 feet and a depth of 40 feet in part of the jetty channel and all inland channels to Port Arthur and Beaumont, including the Sabine Pass anchorage basin, the Port Arthur turning basins, approaches thereto and connecting channels; widening the Port Arthur Canal to 500 feet and the Neches River channel to 400 feet; construction of three turning points in the Neches River channel; replacing an obstructive highway bridge at Port Arthur; and providing a channel 12 by 125 feet in the Sabine River from Orange to Echo, Texas, at an estimated Federal cost of \$21,251,000 for construction works and \$620,000 annually for maintenance. The benefit-cost ratio is 1.7.

3. The Board of Engineers for Rivers and Harbors agrees with the reporting officers that deeper channels are necessary. However, it believes that for the entrance channel, from the Gulf to a point within the jetties, a depth of 42 feet is sufficient in view of the fact that 42 feet has been found suitable at other Gulf harbors having a depth of 40 feet in the interior channels. With this change, the Board estimates the Federal cost at \$20,830,000 for construction and \$620,000 annually for additional maintenance, with no appreciable change in the benefit-cost ratio. The Board recommends the improvement subject to certain items of local cooperation.

4. I concur in the views and recommendations of the Board.


W. K. WILSON, JR.
Lieutenant General, USA
Chief of Engineers

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS



CORPS OF ENGINEERS, U.S. ARMY
BOARD OF ENGINEERS FOR RIVERS AND HARBORS
WASHINGTON 25, D.C.

ENGBR

4 May 1962

SUBJECT: Sabine-Neches Waterway, Texas

TO: Chief of Engineers
Department of the Army

1. Authority and scope. --This report is in response to the following resolution adopted 3 June 1959:

Resolved by the Committee on Public Works of the House of Representatives, United States, That the Board of Engineers for Rivers and Harbors be, and is hereby, requested to review the report of the Chief of Engineers on the Sabine-Neches Waterway published as Senate Document Numbered 80, Eighty-third Congress, Second Session, and other reports, to determine if the recommendations contained therein should be modified in any way at this time.

It favorably considers the provision of a channel through Sabine Bank, a deeper and wider ship channel to Beaumont, and a shallow-draft channel on the Sabine River from Orange upstream to Echo, Texas.

2. Description. --The Sabine-Neches Waterway, located in southeastern Texas about 225 miles west of New Orleans, Louisiana, and 65 miles east of Galveston, Texas, provides deepwater navigation to Port Arthur, Beaumont, and Orange. The waterway extends from deepwater in the Gulf of Mexico northward through a jettied entrance channel, Sabine Pass channel, and the Port Arthur Canal to Port Arthur, thence through the Sabine-Neches Canal to Beaumont and in the Sabine River to Orange. The authorized dimensions for the existing Federal project for various channels and basins comprising the waterway are shown in table 2 of the report of the District Engineer. The existing project also provides for:

Two stone jetties at the Sabine Pass entrance from the Gulf of Mexico, the west jetty being 21,905 feet long and the east jetty, 25,270 feet long;

Construction of suitable permanent protective works along the Sabine Lake frontage, owned by the city of Port Arthur, to prevent dredged material deposited on the lake side of the Sabine-Neches Canal from entering Sabine Lake and to prevent erosion of the material so deposited;

Modification of the Port Arthur bridge by reconstructing and extending the east approach to span the widened channel of the Sabine-Neches Canal; and

Removal of a guard lock structure in the Sabine-Neches Canal.

The project is 81 percent complete. Work remaining consists of realinement of the Neches River channel at miles 34.2, 37.4, and 39.6; widening the curve at the junction of the Port Arthur Canal and Sabine-Neches Canal; easing all curves to a minimum radius of 5,000 feet where possible; completing the widening of the entrance channel to the Port Arthur turning basin; relocating and enlarging the Sabine Pass anchorage basin; completing the enlargement of the channel connecting Port Arthur west turning basin with Taylors Bayou turning basin; and dredging the upper 0.6 mile of Cow Bayou channel.

3. Tributary area and commerce.--The area contributing commerce to the Sabine-Neches Waterway comprises large portions of eastern Texas, western Louisiana, and southern Oklahoma and Arkansas. The immediate tributary area in Texas and Louisiana is a timber and agricultural region. Timber growing, logging, and milling constitute important enterprises, and farming is carried on to some extent. The principal crops are rice, cotton, hay, potatoes, tomatoes, and miscellaneous truck crops. Livestock and poultry raising are also important agricultural pursuits. Waterborne commerce on the Sabine-Neches Waterway for the year 1951 through 1960 averaged about 59,278,000 tons annually, of which 87 percent or about 51,708,000 tons were petroleum and petroleum products. An average of 73 percent or about 37,718,000 tons of petroleum and petroleum products moved in seagoing vessels during this 10-year period. Commerce in 1960 amounted to 68,693,211 tons of which 41,130,656 tons were petroleum and petroleum products moved in seagoing vessels. The total annual commerce of the waterway has shown an average gain of about 1,600,000 tons annually during the period 1951-1960. The largest gains were at Port Arthur and Beaumont, where tonnage increased at an annual rate of 600,000 and 530,000 tons, respectively. Commerce on the channel to Orange remained relatively constant over

this same period. It is estimated that the petroleum commerce for the Sabine-Neches Waterway will increase to about 90,000,000 tons in 2015 of which 2,500,000 tons will move in the foreign trade; 61,000,000 tons will move in the coastwise trade; and 26,500,000 tons will move by barges. Further projection is increasingly unreliable; however, for purposes of this report, it is assumed that petroleum commerce in 2065 would total about 99,000,000 tons, or an increase of about 10 percent over the prospective 2015 commerce. The commerce of the Orange area, related primarily to the chemical and shipbuilding industries, is estimated to increase to about 3,000,000 tons in 2015 and to about 4,000,000 tons in 2065. The shallow-draft commerce above Orange to Echo, Texas, totaling 314,000 tons in 1961, is expected to average about 564,000 tons. In 1960, vessels with drafts of 19 feet or more made 4,354 passages in and out of the harbor of which 2,278 were by vessels having drafts of 28 feet or more.

4. Improvements desired.--The improvements requested by local interests are summarized as follows:

a. Deepening and widening of the channels and basins from deepwater in the Gulf of Mexico to Port Arthur and Beaumont to provide a project depth of 40 feet and width of 500 feet in the main channels with further widening in Sabine Pass and additional deepening and widening in the Gulf. One individual also requested relocation of the deep-draft channel from Sabine Pass through Sabine Lake to the mouth of the Neches River.

b. Deepening and widening the deep-draft channel from the mouth of the Neches River to the Interstate Highway 10 crossing above Orange to a depth of 40 feet and width of 400 feet, and deepening and widening the channel in Cow Bayou to a depth of 30 feet and width of 225 feet.

c. Construction of a shallow-draft channel with a depth of 12 feet and width of 125 feet in the Sabine River from the Interstate Highway 10 crossing upstream to Echo near the crossing of the Southern Pacific Railroad Company.

The requested modified dimensions of the channels and basin comprising the waterway are shown in table 2 of the report of the District Engineer. In addition, they requested the following items which are not possible of accomplishment under the existing authorizations:

Alteration of the existing bascule bridge across the Sabine-Neches Canal at Port Arthur to provide 500-foot horizontal and 135-foot vertical clearances.

Bank stabilization for Pleasure Island along the Sabine-Neches Canal and the Port Arthur Canal.

Between the mouth of the Neches River and Beaumont, widen the channel to 700 feet for a distance of 1,000 feet above and below the five terminals owned by the Atlantic Refining Company; Texaco, Incorporated; Socony Mobil Oil, Incorporated; Sun Oil Company; and the Pure Oil Company.

Reauthorization of the lower 2,200 feet of the abandoned Neches River channel at Clarks Island to provide access to the existing slip and terminal facilities of the Texas Gulf Sulphur Company terminal located on the channel prior to abandonment.

5. Proposed improvements. --The District Engineer reports that:

a. The authorized dimensions of the Sabine-Neches Waterway from the Gulf of Mexico to Port Arthur and Beaumont are not adequate to accommodate with reasonable safety and convenience the large tankers of over 27,000 deadweight tons that are now in existence and under construction, and which, within a few years, will carry up to 40 percent of the prospective seagoing petroleum commerce on the waterway;

b. The authorized dimensions of 30 by 200 feet in the channel from the mouth of the Neches River to Orange and the authorized dimensions of 13 by 100 feet in Cow Bayou are adequate to accommodate the existing and prospective commerce that would move over these sections of the waterway and no additional improvement is warranted at this time;

c. The existing and prospective commerce in the Sabine River above Orange cannot be accommodated with reasonable safety and convenience in the natural river channel. Extension of the Sabine-Neches Waterway project and construction of the improvements necessary to provide a 12- by 125-foot channel from the foot of Green Avenue in Orange to a point near the Southern Pacific Railroad bridge at Echo, a total distance of about 4.6 miles, is fully justified;

d. The existing double-leaf, bascule highway bridge crossing the Sabine-Neches Canal at Port Arthur would be endangered by the channel enlargement and would be a serious hazard to navigation. The bridge should be removed and replaced by one with horizontal clearance at least equal to the channel width and vertical clearance of at least 138 feet above mean low tide;

e. The rerouting of the waterway by construction of a deep-draft channel from Sabine Pass through Sabine Lake to the mouth of the Neches River would produce negligible benefits to navigation. Even if the rerouting were economically justified by the claimed benefits, speculative in nature, present policies would apportion most of the cost of channel relocation to local interests. No financially responsible agency offered cooperation. The total annual charges would be increased since continued maintenance on the present channels would be required to provide the necessary depths to existing industries;

f. Bank protection along the Port Arthur and Sabine-Neches Canals on Pleasure Island is not economically justified at this time; and

g. Construction of five 2,000-foot reaches of 700-foot width channel in the Neches River opposite each of five major oil shipping terminals, as desired by local interests, is not warranted at this time. Three additional turning points, with turning diameter of about 1,000 feet, should be provided at strategic locations in the Neches River channel. These can be constructed economically by slight enlargement of the junction areas between abandoned bends of the natural river and cutoffs in the navigation channel at about channel miles 31.3, 37.2, and 41.0. An additional reach of about 1,200 feet of former project channel in the natural channel of the Neches River upstream from the turning point at mile 41 should be maintained to a depth of 36 feet and a width of 350 feet to provide access to existing terminals.

The District Engineer states that the most feasible plan of improvement to accommodate fully loaded tankers up to 40,000 deadweight tons and provide for limited use of larger tankers is to deepen and extend the outer bar channel to a depth of 43 feet in the Gulf of Mexico; deepen the inland channels to 40 feet to Port Arthur and Beaumont, including the Sabine Pass anchorage basin, the Port Arthur turning basins, approaches thereto and connecting channels; widen the Port Arthur Canal to 500 feet and the Neches River channel to 400 feet; construct three turning points in the

Neches River channel; and relocate the existing highway bridge crossing the Sabine-Neches Canal at Port Arthur to provide adequate horizontal and vertical clearances for navigation and providing for accommodation of vehicular and pedestrian traffic in a manner equivalent to that provided by the existing bridge. He states that to accommodate existing and prospective commerce to industries located along the Sabine River above Orange, the waterway project should be extended to provide a 12- by 125-foot channel in the Sabine River from the foot of Green Avenue in Orange to a point near the Southern Pacific Railroad bridge near Echo, a distance of about 4.6 miles. Spoil from off-shore channels would be dumped in deep water in the Gulf. Spoil from the dredging of other channels and the basins would be placed in existing disposal areas and in additional areas to be acquired.

6. Costs and justification.--The District Engineer estimates the costs, annual charges, and benefits of the proposed modifications, based on March 1962 prices, as follows:

Item	Channel to Beaumont Widening and deepening to 40' x 400' (a)	Channel, Orange to Echo, Texas 12' x 125'	Total
First cost:			
Federal	\$21,326,000(b)	\$298,000(c)	\$21,624,000
Non-Federal	1,378,000	170,000	1,548,000
Total	\$22,704,000	\$468,000	\$23,172,000
Annual charges:			
Federal	\$ 1,268,000(d)	\$ 9,000(e)	\$ 1,277,000
Non-Federal	100,000	6,000	106,000
Total	\$ 1,368,000	\$ 15,000	\$ 1,383,000
Annual benefits:			
Savings in cost of tanker operation	\$ 2,186,000	--	\$ 2,186,000
Savings in time and re- duction in hazards	160,000	--	160,000
Savings in cost of barge operation	--	\$ 28,000	28,000
Total	\$ 2,346,000	\$ 28,000	\$ 2,374,000
Ratio of benefits to charges based on a 100-year period of analysis	1.7	1.9	1.7+

(a) Includes 43- to 40-foot depth from Gulf to Port Arthur and Beaumont, widening Port Arthur Canal to 500 feet, widening Neches River channel to 400 feet, three turning points in Neches River channel and alteration of Port Arthur bridge.

(b) Includes \$28,000 for preauthorization studies and \$336,000 for aids to navigation.

(c) Includes \$2,000 for preauthorization studies and \$7,000 for aids to navigation.

(d) Includes \$620,000 for maintenance dredging in addition to that now required and about \$19,000 for maintenance of navigation aids.

(e) Includes \$900 for maintenance of navigation aids.

The District Engineer recommends modification of the existing project for the Sabine-Neches Waterway to provide for further improvement in accordance with his plan subject to certain local cooperation. The Division Engineer concurs.

7. Public notice.--The Division Engineer issued a public notice stating the recommendations of the reporting officers and affording interested parties an opportunity to present additional information to the Board. Careful consideration has been given to the communications received.

Views and Recommendations of the Board of Engineers for Rivers and Harbors.

8. Views.--The Board of Engineers for Rivers and Harbors agrees that the channels should be deepened to facilitate the movement of deep-draft tankers used in the coastwise movements of refined petroleum products. It believes, however, that a depth of 42 feet is adequate for the Sabine Pass outer bar channel extending from Sabine Bank in the Gulf of Mexico to within the jetties. This is the same depth as authorized for the outer channels at other major Gulf coast petroleum-handling ports. With this modification of the plan, the Board reduces the estimated cost for construction dredging by \$421,000. It notes that the District Engineer finds uneconomic at this time the relocation of the deep-draft channel from Sabine Pass channel via Sabine Lake to the mouth of the Neches River and the revetment of the canal bank of Pleasure Island. The improvements proposed are economically justified by the prospective benefits.

9. Recommendations.--The Board accordingly recommends modification of the existing project for the Sabine-Neches Waterway, Texas, to provide for:

A depth of 42 feet and width of 800 feet in the Sabine Pass outer bar channel extending from Sabine Bank in the Gulf of Mexico to a point in the jetty channel about 1,000 feet inshore from the outer end of the jetties, and a depth of 40 feet in the remainder of the jetty channel and all inland channels to Port Arthur and Beaumont, including the Sabine Pass anchorage basin, Port Arthur turning basins, approach channel thereto and connecting channels, and including the turning area immediately downstream from the Beaumont turning basin;

A width of 500 feet in the Port Arthur Canal and a width of 400 feet in the Neches River channel from its junction with the Sabine-Neches Canal to the turning area at Beaumont;

Three turning points with a depth of 40 feet over an area providing a minimum turning diameter of 1,000 feet at the junctions of natural river bends and navigation channel cutoff near channel miles 31.3, 37.2, and 41.0;

Maintenance of a reach of former project channel, 36 feet deep and 350 feet wide, in the natural channel of the Neches River and extending upstream about 1,200 feet from the turning point at mile 41; and

A channel, 12 feet deep and 125 feet wide, extending in the Sabine River from the foot of Green Avenue in Orange to a point near the Southern Pacific Railroad bridge at Echo, a distance of about 4.6 miles;

generally in accordance with the plan of the District Engineer as modified herein and with such other modifications as in the discretion of the Chief of Engineers may be advisable, at an estimated cost to the United States of \$20,830,000 for construction dredging and replacement of an obstructive bridge at Port Arthur, and \$620,000 annually for maintenance in addition to that now required: Provided that prior to construction local interests agree to:

a. Provide without cost to the United States all lands, easements, and rights-of-way required for construction and subsequent maintenance of the project and for aids to navigation upon the request of the Chief of Engineer, including suitable areas determined by the Chief of Engineers to be required in the general public interest for initial and subsequent disposal of spoil, and also necessary retaining dikes, bulkheads and embankments therefor or the costs of such retaining works;

b. Hold and save the United States free from damages that may result from construction of the project;

c. Accomplish, without cost to the United States, all alterations of pipelines, powerlines, utility lines, cables, and highway facilities, excepting the bridge at Port Arthur, when and as required for construction of the project;

d. Furnish without cost to the United States all necessary rights-of-way and easements required for relocating the highway bridge at Port Arthur and contribute, in cash, a share of the construction costs of the relocation computed in accordance with the principles of section 6 of the Bridge Alteration Act of 21 June 1940, as amended by the Act of 16 July 1952, a sum presently estimated at \$220,000 for the expired service life of the existing bridge. This estimate, however, does not include the costs for special benefits and betterments attributable to highway use, which depend upon final design, and are not known at this time;

e. Assume all obligations of ownership, operation, and maintenance of the replacement highway bridge at Port Arthur upon its completion; and

f. Provide and maintain at local expense depths in berthing areas and local access channels serving the terminals commensurate with the depths provided in related project areas.

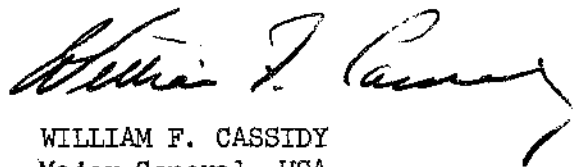
10. The Board further recommends that:

a. No dredging be done within 50 feet of any established pierhead line, wharf, or structure;

b. The authority for the unconstructed enlargement of the channel connecting Port Arthur west turning basin with Taylors Bayou turning basin, authorized by the River and Harbor Acts of 20 June 1938 and 24 July 1946, and the authority for unconstructed enlargement of the entrance channel to the Port Arthur turning basins, authorized by the River and Harbor Act of 3 September 1954, be rescinded; and

c. When the necessary conditions of local cooperation for either the deep-draft channel to Beaumont or the extension above Orange for shallow-draft vessels have been fulfilled, construction may be initiated on that part, irrespective of the status of local cooperation for the other parts, of the project.

FOR THE BOARD:



WILLIAM F. CASSIDY
Major General, USA
Chairman

REPORT OF THE DISTRICT ENGINEER

REVIEW OF REPORTS ON SABINE-NECHES WATERWAY, TEXAS

SYLLABUS

This report comprises the results of an investigation to determine the advisability of modifying the navigation project for Sabine-Neches Waterway, Texas. It was found that:

a. The enlargement of the deepwater channels of the project as provided under the proposed plan of improvement would be required to permit use of fully loaded tankers of 27,000 to 40,000 d.w.t. with reasonable safety and convenience. The trend in the construction and use of large tankers indicates that about 40 percent of the prospective commerce in petroleum would be carried in the large tankers. The annual benefits of the deep-draft plan of improvement would exceed annual charges with a benefits to cost ratio of 1.7.

b. The existing project dimensions of the channel in the Sabine River to Orange and in Cow Bayou are adequate to accommodate the existing and prospective commerce that would move over these sections of the waterway.

c. The existing and prospective commerce in the Sabine River above Orange cannot be accommodated with reasonable safety and convenience in the natural river channel. The shallow-draft channel described in the plan of improvement is fully justified with a benefits to cost ratio of 1.9.

d. The existing double-leaf, bascule bridge crossing the Sabine-Neches Canal at Port Arthur would become an unreasonable obstruction to navigation on the improved channel and relocation of this bridge must be provided to realize full benefits of the improvement.

e. Construction of five 2,000-foot reaches of 700-foot width channel in the Neches River opposite each of five major oil shipping terminals, as desired by local interests, is not warranted at this time.

f. The one authorized turning point in the Neches River channel is not sufficient for reasonable convenience of large supertankers using the waterway. Three additional turning points should be provided at strategic downstream locations.

g. Bank protection along the Port Arthur and Sabine-Neches Canals on Pleasure Island would have a benefits to cost ratio of 0.5 and is not economically justified.

Accordingly, it is recommended that the existing project for the Sabine-Neches Waterway be modified to provide for the following improvements, generally as described in this report:

a. A depth of 43 feet in the Sabine Bank channel and the outer bar channel and a 40-foot depth in all inland channels to Beaumont and in the Port Arthur turning basins; a width of 500 feet in the Port Arthur Canal and a width of 400 feet in the Neches River channel; and three turning points on the Neches River at miles 31.3, 37.2 and 41.0.

b. A channel 12 feet deep by 125 feet wide in the Sabine River from Orange to the Southern Pacific Railroad bridge near Echo, Texas.

The estimated first cost to the United States for all recommended new work is \$21,251,000, excluding \$30,000 which has been expended for pre-authorization study costs. The estimated increase in annual maintenance cost is \$620,000. The recommendation is subject to certain provisions of local cooperation.

U. S. ARMY ENGINEER DISTRICT, GALVESTON
CORPS OF ENGINEERS
GALVESTON, TEXAS

March 1, 1962

SUBJECT: Review of Reports on Sabine-Neches Waterway, Texas

TO: Chief of Engineers, Department of the Army
Washington, D. C., through
Division Engineer, U. S. Army Engineer Division, Southwestern
Dallas, Texas

AUTHORITY

1. This review of reports on the Sabine-Neches Waterway, Texas, is submitted pursuant to the following resolution adopted June 3, 1959 by the committee on Public Works of the House of Representatives, United States:

"Resolved by the Committee on Public Works of the House of Representatives, United States, That the Board of Engineers for Rivers and Harbors be, and is hereby, requested to review the report of the Chief of Engineers on the Sabine-Neches Waterway published as Senate Document Numbered 80, Eighty-third Congress, Second Session, and other reports, to determine if the recommendations contained therein should be modified in any way at this time."

PURPOSE AND EXTENT OF STUDY

2. This report comprises an investigation of survey scope and considers the advisability of modifying the existing Sabine-Neches Waterway project to provide for widening and deepening of the channels and basins of the entire waterway from deep water in the Gulf of Mexico to Port Arthur, Beaumont and Orange, Texas, for channel widening in the vicinity of certain wharves along the Neches River, for three turning points between the mouth of the Neches River and Beaumont, for relocating the Sabine Pass anchorage basin, for resumption of maintenance in the old Neches River Channel at Clarks Island, for extending the waterway upstream in the Sabine River to near Echo, Texas, for altering the Port Arthur bridge, and for stabilizing the banks of the waterway at and in the vicinity of Port Arthur. This report also considers the advisability of relocating the deep-draft channel from Sabine Pass Channel via Sabine Lake to the mouth of the Neches River. The improvements have been investigated to

determine the extent such improvements are needed for existing and prospective traffic, and the effect any improvements found to be economically justified at this time would have on improvements ultimately required for maximum development of the tributary area.

3. Investigations and studies for comprehensive river basin survey reports on the Neches and Sabine Rivers for navigation, flood control, water supply, and other related purposes are in progress. These reports will consider salt water barrier structures and navigation improvements for the Neches River above Beaumont, and for the Sabine River above Echo.

4. The views of local interests regarding the proposed improvements were obtained at a public hearing held in Port Arthur on December 6, 1960 and through subsequent conferences and correspondence. The improvements desired by the local interests are discussed in paragraphs 31 through 35. The views of Federal, State and other agencies are presented in paragraphs 89 and 90.

DESCRIPTION

5. The Federal project known as the Sabine-Neches Waterway, Texas, is located in the southeastern part of Texas about 225 miles west of New Orleans, Louisiana and 65 miles east of Galveston, Texas. It provides for deepwater navigation to the ports of Port Arthur, Beaumont and Orange, Texas. The waterway extends from deepwater in the Gulf of Mexico northward through a jettied entrance channel, Sabine Pass Channel, and the Port Arthur Canal to Port Arthur, thence through the Sabine-Neches Canal to the mouths of the Neches and Sabine Rivers, thence in the Neches River to Beaumont, and in the Sabine River to Orange. Table 2 lists authorized project dimensions for the various channels and basins. Plate 1 of this report and U.S. Coast and Geodetic Survey charts Nos. 517, 533, 884, 885 and 1279, show the Sabine-Neches Waterway and the adjacent area. Exhibits 1 through 6 of appendix III show details of the existing waterway and proposed improvements thereto. Paragraphs 2 through 5 of appendix III contain a detailed description of the area.

TRIBUTARY AREA

6. The area contributing commerce to the Sabine-Neches Waterway comprises large portions of eastern Texas, western Louisiana, and southern Oklahoma and Arkansas. The immediate tributary area in Texas and Louisiana is a timber and agricultural region. Timber growing, logging, and milling constitute important enterprises, and farming is carried on to some extent. The principal crops are rice, cotton, hay, potatoes, tomatoes, and miscellaneous truck crops. Livestock and poultry raising are also important agricultural pursuits.

7. The largest contribution of commerce on the waterway is made by the petroleum industry. Beaumont, Orange, Port Arthur, and the intervening region constitute an important industrial section containing six large oil refineries having a combined daily refining capacity of over 950,000 barrels of crude oil. One of the largest butadiene and synthetic rubber plants in the world is located on the Neches River near Port Neches. Several large petrochemical plants are located along the Sabine River. The refineries and chemical plants receive their supplies of manufacturing stock through an extensive system of pipelines extending from the various refining centers and oil fields in Texas, Oklahoma, Arkansas, and Louisiana and by barges and seagoing vessels on the improved waterways.

8. In addition to the petroleum, chemical, and petrochemical industries there are rice mills, shipbuilding and repair yards, steel fabricating plants, food packing and canning plants, a paper mill, brass and iron foundries, and large wholesale businesses. The processing of locally produced crops and the ordinary service trades required at established population centers are also important industries. Trapping and muskrat farming in marsh areas is of considerable importance and the streams and marshes afford excellent opportunities for fresh and salt water fishing, wild fowl and upland hunting, swimming, boating, and other aquatic sports.

9. The tributary area is adequately served by railroads, a network of improved State and Federal highways, and a serviceable system of all-weather county roads. Oil and gas pipelines extend throughout the area. Airports and landing fields are available at the larger communities.

10. The principal centers of population along the Sabine-Neches Waterway and their 1930, 1940, 1950, and 1960 populations are as follows:

City or town	Population			
	1930	1940	1950	1960
Beaumont	57,732	59,062	93,875	119,175
Port Arthur	50,902	46,140	57,374	66,676
Orange	7,913	7,472	21,000	25,605
Port Neches	2,327	2,487	5,447	8,696

BRIDGES

11. There are six bridges crossing sections of the waterway considered herein. Table 1 gives for each bridge the location, owner, type and clearances of channel span, and the date plans were approved by the Department of the Army. The city of Port Arthur bridge across the Sabine-Neches Canal is the only bridge that would be affected by proposed improvements considered in this report. Alteration of this bridge is discussed in paragraph 99 and in paragraphs 11 through 18 of appendix III.

TABLE 1

BRIDGES

Location (waterway mileage)(1)	Owner	Type	Clearance (feet)			Date of approval of plans
			Hori- zontal	Vertical above MLT	Closed:Open	
Sabine-Neches Canal (Mi. 19.2)	City of Port Arthur	Double leaf bascule	200	12	Unlim- ited	Feb 9, 1929
Neches River (Mi. 28.8)	Texas Highway Department	Fixed	600	140.9	(2)	Dec 31, 1935
Neches River (Mi. 45.9)	Kansas City Southern Ry	Vertical lift	200	19.5	153	Aug 15, 1938 (3)
Neches River (Mi. 46.2)	Texas & New Orleans RR	Single leaf bascule	200	17	Unlim- ited	Dec 21, 1938 (3)
Sabine River (Mi. 43.9)	Texas Highway Department	Fixed	190	51.5	-	Sept 30, 1947
Cow Bayou (Mi. 4.8)(4)	Orange County	Swing	50	9.5	Unlim- ited	Apr 14, 1939

- (1) Referred to outer end of Sabine Pass jetty channel, along recommended route.
(2) Also provides for a vertical clearance of 176.9 feet over a horizontal width of 400 feet.
(3) Reconstructed in 1940-41 by order of the Secretary of Army.
(4) Mileage above mouth of Cow Bayou.

PRIOR REPORTS

12. Information regarding prior reports that authorize the existing Federal navigation project for the Sabine-Neches Waterway, Texas, is listed in appendix I. A complete list of prior reports was printed as exhibit 1 to Senate Document No. 80, 83rd Congress, Second Session. There have been no reports submitted subsequent to the report under review.

EXISTING CORPS OF ENGINEERS' PROJECT

13. Previous project.- The original project for the improvement of Sabine Pass, the first portion of the Sabine-Neches Waterway to be improved, was adopted by the River and Harbor Act of March 3, 1875, and subsequent projects and modifications were adopted by the River and Harbor Acts of August 2, 1882; June 3, 1896; June 13, 1902; and June 19, 1906. The Port Arthur Canal was conveyed to the United States at no cost in 1906, and was incorporated in the project by the River and Harbor Act of July 25, 1912. The Sabine and Neches Rivers were first improved under the River and Harbor Acts of June 18, 1878 and March 3, 1899. The Sabine-Neches Canal was first improved under the River and Harbor Acts of March 3, 1905 and March 2, 1907, and was enlarged by the River and Harbor Acts of February 27, 1911, July 25, 1912, March 2, 1919, and September 22, 1922. The costs and expenditures prior to adoption of the existing project were \$7,560,508.29, exclusive of contributed funds, of which \$5,180,831.51 was for new work and \$2,379,676.78 was for maintenance.

14. Existing project.- The existing project for the Sabine-Neches Waterway was authorized by the River and Harbor Acts of July 25, 1912; September 22, 1922; March 3, 1925; January 21, 1927; August 30, 1935; August 26, 1937; June 20, 1938; the National Defense River and Harbor Act of October 17, 1940; March 2, 1945; July 24, 1946; May 17, 1950; and of September 3, 1954. The authorized project dimensions for the various channels and basins comprising the waterway are shown in table 2.

15. The existing project also provides for two stone jetties at the Sabine Pass entrance from the Gulf of Mexico, the west jetty being 21,905 feet long and the east jetty being 25,270 feet long. The project further provides for: The construction of suitable permanent protective works along the Sabine Lake frontage owned by the city of Port Arthur to prevent dredged material deposited on the lake side of the Sabine-Neches Canal from entering Sabine Lake and to prevent erosion of the material so deposited; modification of the Port Arthur bridge by reconstructing and extending the east approach to span the widened channel of the Sabine-Neches Canal; and the removal of a guard lock structure in the Sabine-Neches Canal.

16. The existing project on June 30, 1961, was 81 percent completed. Work remaining consisted of realignment of the Neches River Channel between miles 34.2 and 37.4 and 39.6; widening the curve at the junction of the Port Arthur Canal and Sabine-Neches Canal; easing all curves to a minimum radius of 5,000 feet where possible; complete the widening of the entrance channel to the Port Arthur Turning Basin; relocation and enlargement of the Sabine Pass anchorage basin; complete the enlargement of the channel connecting Port Arthur west turning basin with Taylors Bayou turning basin; and dredging the upper 0.6 miles of Cow Bayou channel.

17. The total cost of the existing project to June 30, 1961, was \$43,369,980 as follows:

Source of funds	New work	Maintenance	Total
Federal funds	\$20,889,321	\$22,095,159	\$42,984,480
Contributed funds	353,500	-	353,500
Value of useful work performed	<u>32,000</u>	<u>-</u>	<u>32,000</u>
Total	\$21,274,821	\$22,095,159	\$43,369,980

18. The current estimated total construction cost for the existing project is \$26,523,500, of which \$26,138,000 is Federal cost and \$385,500 is non-Federal cost. Average annual maintenance cost during the 5-year period ending June 30, 1961, was about \$1,690,000. The current estimate of annual maintenance cost after completion of the existing project is \$1,720,000.

LOCAL COOPERATION ON EXISTING AND PRIOR PROJECTS

19. Local interests have contributed, under prescribed conditions of local cooperation, a total of \$931,006.78 toward the cost of new work on the Sabine-Neches Waterway, of which \$577,506.78 was for previous projects and \$353,500 was for the existing project. The Beaumont Navigation District contributed \$613,428.35 of these funds and the Orange County Navigation District contributed the balance of \$317,578.43. In addition, the local interests contributed \$169,835.21 for maintenance of previous projects, of which the Beaumont Navigation District contributed \$77,440.51 and the Orange County Navigation District contributed \$92,394.70. In lieu of contributing \$32,000 in cash for the existing project, the Gulf Refining Co. widened the cutoff channel between the Port Arthur west turning basin and the Taylors Bayou turning basin at Port Arthur.

20. In addition to the cash contributions the local interests have fully complied with all requirements of local cooperation. On the completed portions of the project and on the portions now under construction local interests have provided the following items in accordance with the terms of the authorization legislation: (a) furnished without cost to the United States all necessary rights-of-way and spoil-disposal areas for construction and maintenance of the channels and basins; (b) furnished releases from damage claims and assurances that they will hold and save the United States free from damage claims due to the work, when and as such assurances were required by the authorizing legislation; (c) made bridge alterations on Cow Bayou; and (d) agreed to maintain the Port Arthur bridge extension and the Cow Bayou channel above the turning basin after completion.

21. Local cooperation remaining to be furnished consists of furnishing rights-of-way and spoil disposal areas for (a) remaining uncompleted items of work authorized by the River and Harbor Act of September 3, 1954, (b) uncompleted widening of Taylors Bayou connecting channel and in the entrance channel to the Port Arthur turning basins, and (c) for the channel in Cow Bayou above the turning basin at Orangefield. Local interests have furnished the cooperation required for the work authorized by the 1954 River and Harbor Act, when and as required. The widening remaining at Taylors Bayou connecting channel and at the entrance to Port Arthur turning basins cannot be accomplished because of existing structures that cannot be relocated without excessive costs. Deauthorization of these two uncompleted portions of authorized work is recommended in this report. Extension of the channel in Cow Bayou is currently obstructed by oil wells located in the rights-of-way area. The existing channel in Cow Bayou is serving the current needs of navigation and effectively providing flood control for the presently improved condition of the watershed. Request for the rights-of-way and spoil disposal areas needed for the Cow Bayou channel extension has been withheld pending either abandonment and removal of the oil wells from the rights-of-way, or urgent need for additional flood protection.

OTHER IMPROVEMENTS

22. In addition to the local cooperation required by congressional acts, local interests have reportedly performed additional improvements to the waterway at a cost of \$6,360,593.90. These improvements include widening and deepening of channels, enlargement of turning basins, construction of bridges across the waterway, and construction of a concrete pile seawall. These improvements are further discussed in paragraph 6 of appendix III.

TERMINAL AND TRANSFER FACILITIES

23. There are 125 commercially important installations of wharves, docks, and piers along the Sabine-Neches Waterway, excluding those on the shallow-draft tributary channels. These installations have a total of about 72,000 feet of berthing space and 882,000 square feet of transit shed area.

24. The terminal facilities at Sabine Pass consist of thirteen wharves. All installations, with the exception of the United States Coast Guard wharf and the quarantine wharf, are privately owned and operated in connection with private business. These facilities are of small size and are used for barge traffic and fishing vessels. An improved highway serves the area.

25. There are 36 terminal facilities located at Port Arthur on the east and west turning basins, Taylors Bayou turning basin and the Sabine-Neches Canal. Four wharves owned by the Port Arthur Canal and Dock Co. and operated by the Kansas City Southern Railway are open to public use. These wharves having about 3,000 linear feet of berthing space and about 135,000 square feet of transit shed area are used for the handling of general cargo and are served by railroads. A wharf and elevator with a capacity of 500,000 bushels is available for grain shipment. Six wharves at the port handle bulk petroleum and petroleum products, and five are equipped to handle packaged petroleum products. Four wharves are used in connection with shipbuilding, marine repair, and tie-up purposes. Twelve wharves, having a total berthing space of 4,073 linear feet, are used by barges and shallow-draft vessels. Facilities for handling lifts of five tons or more are available at various wharves. Highway, rail and pipeline connections to the terminal areas are adequate.

26. The Port of Beaumont public terminal has seven wharves with a total of 3,500 linear feet of berthing space, 220,000 square feet of transit shed area, 163,000 square feet of cotton warehouses, and 156,000 square feet of open storage. The wharves are equipped with adequate handling facilities and are served by rail and highway. A large amount of general cargo is handled at the port. The Port Commission also operates a public barge terminal having 60 linear feet of berthing space and 20,000 square feet of transit shed area. Within the city of Beaumont there are six wharves used in connection with shipbuilding and marine repairs, five for the receipt and shipment of petroleum products and oil bunkering, and seven, having 1,260 linear feet of berthing space, for the use of shallow-draft vessels and barges. The public and private terminal facilities within the city area are adequate for the present commerce and there is ample unused water frontage available for future development.

27. Along the Neches River below Beaumont there are ten privately owned terminals, with a total of 10,709 feet of berthing space, for handling bulk and packaged petroleum and petroleum products. These terminals consist of 23 wharves, of which 16 are used by seagoing vessels and seven are used for the receipt and handling of petroleum products by barge. Bunker oil is available at six wharves. These docks are served by extensive pipeline systems. In addition to the wharves at the oil terminals, there are fourteen wharves used by barge operators for other purposes. There is considerable unused water frontage available for future development.

28. The Orange County Navigation and Port District owns a terminal adjacent to a dredged slip about two miles downstream from the city, which handles practically all of the foreign and domestic cargo of the port. The facilities are available for use for use by all shippers on equal terms. The Port District wharf has 1,340 linear feet of berthing

space and two transit sheds with a total area of 78,000 square feet, and a 10-acre area of open bulk storage space. The terminal is served by two railroads and by an improved highway. A \$1,000,000 expansion of the existing port facilities at Orange was approved by a special election on February 24, 1962. The planned expansion includes two new transit sheds with a total of 110,000 square feet of floor space and one new vessel berth. The existing and proposed terminal facilities are adequate for present and immediately prospective needs, and additional frontage is available for further development.

29. Private facilities at Orange have a total berthing space of 8,268 linear feet, and consist of: eighteen wharves for shipbuilding and repair work; two barge wharves used for receipt and shipment of petroleum and petroleum products; two barge wharves for receipt of general cargo; one barge wharf for receipt of fuel oil; and two barge wharves for tie-up of shallow-draft floating plant. The United States Navy owns a tie-up dock 1,250 feet long at the upper end of the existing waterway on Sabine River. Immediately upstream from the existing project, the United States Navy owns twelve piers, having a total berthing space of about 7,000 linear feet, and a small-craft mooring dock 515 feet long.

30. The existing and proposed terminal facilities on the Sabine-Neches Waterway are considered adequate for present and prospective commerce. More details of the facilities on this waterway will be found in the Port Series No. 19, 1957, "Ports on the Gulf Coast of the United States," Volume 2, prepared by the Corps of Engineers and Maritime Administration.

IMPROVEMENTS DESIRED

31. A public hearing was held in Port Arthur, Texas, on December 6, 1960, to determine the nature and extent of the improvements desired by local interests and to afford all interested persons an opportunity to express their views regarding the requested improvements. The hearing was attended by 106 persons representing local interests including: Federal, State, county, municipal, and local officials; representatives of civic organizations, businesses, industries, shipping and navigation interests; and other interested parties.

32. The principal improvements requested by local interests include a seaward extension of the outer bar channel to Sabine Bank, widening and deepening of the waterway (except Adams Bayou channel), an upstream extension of the Sabine River channel, bank stabilization along the Port Arthur and Sabine-Neches Canals, and alteration of the Port Arthur bridge. Local interests supporting these requests included the American Merchant Marine Institute, Inc., Beaumont Navigation District, Port of Beaumont Navigation District, Beaumont Chamber of Commerce, Orange County Navigation and Port District, Orange Chamber of Commerce, Port Arthur Chamber of Commerce, the city of Port Arthur and various oil companies, associations and firms connected with water transportation. The authorized project dimensions and the modified dimensions requested by local interests are shown in table 2.

TABLE 2
EXISTING AND REQUESTED PROJECT DIMENSIONS

Section of waterway	Adopted project dimensions		Modified dimensions requested by local interests		Length of channel (miles)
	Depth (feet)	Bottom width (feet)	Depth (feet)	Bottom width (feet)	
	(1)	(feet)	(1)	(feet)	
Sabine Bank channel	None	None	43	1,000	15.3
Sabine Pass outer bar channel	37	800	43	1,000	3.4
Sabine Pass jetty channel (outer end)	37	800	40	1,000	4.1
Sabine Pass jetty channel (inner end)	36	500	40	600	
Sabine Pass channel	36	500	40	600	5.6
Sabine Pass anchorage basin	34	1,500	40(2)	1,000(2)	3,000 feet
Port Arthur Canal	36	400	40	500	6.2
Entrance to Port Arthur turning basins	36	350-540	40	None	0.3
Port Arthur east turning basin	36	420	40	None	1,800 feet
Port Arthur west turning basin	36	600-325	40	None	1,700 feet
Channel from Port Arthur west turning basin to Taylors Bayou turning basin	36	250	40	None	0.6
Taylors Bayou turning basin	36	1,000-150	40	None	2,900 feet
Sabine-Neches Canal:					
Port Arthur Canal to mouth of Neches River	36	400	40	500	11.2
Mouth of Neches River to mouth of Sabine River	30	200	40	400	4.5
Neches River, mouth to Beaumont turning basin	36	350	40	500-700	18.3
Beaumont turning basin	34	500	None	None	1,500 feet
Beaumont turning basin extension	34	350	None	None	2,300 feet
Neches River from Beaumont turning basin extension to vicinity of Bethlehem Shipyard	30	200	None	None	0.7
Sabine River, mouth to Orange municipal slip	30	200	40	400	7.2
Sabine River, Orange municipal slip	30	200	40	400	3,000 feet
Orange turning basin	30	200-1,340	40	None	2,800-3,300 feet
Sabine River, cutoff near Orange municipal slip to foot of Green Ave.	30	200	40	400	2.1
Sabine River, old channel around Harbor Island at Orange	25	150-200	40	400	2.4
Sabine River, foot of Green Ave. to Interstate Highway 10 bridge	None	None	40	400	3.5(3)
Sabine River, new Interstate Highway 10 bridge to S.P. R.R. bridge at Echo	None	None	12	125	4.5(3)
Adams Bayou	12	100	None	None	1.6
Cow Bayou, mouth to Highway 87 bridge	13	100	30	225	4.6
Cow Bayou, Highway 87 bridge to Orangefield turning basin	13	100	None	None	3.1
Cow Bayou, Orangefield turning basin	13	300	None	None	500 feet

- (1) Below mean low tide.
(2) Relocation to a section of former channel in Sabine Pass also requested.
(3) River miles.

33. In addition to the enlargement of channels and basins listed in table 2, local interests requested the following:

a. Alteration of the existing bascule bridge across the Sabine-Neches Canal at Port Arthur to provide 500-foot horizontal and 135-foot vertical clearances.

b. Bank stabilization for Pleasure Island along the Sabine-Neches Canal and the Port Arthur Canal.

c. Between the mouth of the Neches River and Beaumont, widen the channel to 700 feet for a distance of 1,000 feet above and below the five terminals owned by the Atlantic Refining Company, Texaco, Inc., Socony Mobil Oil, Inc., Sun Oil Company, and Pure Oil Company.

d. Reauthorization of the lower 2,200 feet of the abandoned Neches River Channel at Clarks Island to provide access to the existing slip and terminal facilities of the Texas Gulf Sulphur Company terminal located on the channel prior to abandonment.

e. Relocation of the authorized Sabine Pass Anchorage basin to the section of former Sabine Pass channel in front of the town of Sabine Pass, which was abandoned when the realignment of the upper Sabine Pass channel authorized by the River and Harbor Act of September 3, 1954, was constructed. A recent examination shows that rapid and extensive shoaling of the former channel occurred during a 15-month period following completion of the new cutoff. This indicates that maintenance costs of an anchorage basin in the old channel might be prohibitively expensive. An anchorage basin of adequate size, except for depth, is authorized for construction along the east side of the Sabine Pass channel under the existing project. It is believed that the Chief of Engineers has sufficient authority to relocate the presently authorized basin to the old channel along the west side of Sabine Pass if this proves to be a more feasible location. Accordingly, it is proposed to study the question of location as a matter pertaining to the existing project and it will not be considered further in this report.

f. Local interests also requested that the reach of recently realigned channel in Sabine Pass, which extends eastward across the mouth of Sabine Lake, be widened to provide additional maneuvering room, particularly for outbound loaded vessels. Subsequent to the public hearing, the Chief of Engineers considered this problem and authorized widening and easing of the bends under existing legislative authority. Since this will accomplish essentially the improvement requested by local interests for this location, the request is not considered further in this report.

34. In addition to the requested improvements in paragraphs 32 and 33, local interests requested expedited construction on the items listed below which were authorized by the River and Harbor Act of 1954, but which have not been constructed. Since construction of the items is a programming and budgeting matter and not pertinent to the investigations and studies authorized for this report, these requests have not been considered in this report.

a. Ease the reverse curve at the junction of the Port Arthur and Sabine-Neches Canals;

b. Ease the sharp channel curve in the Neches River around Smiths Bluff; and

c. Ease the sharp channel curve in the Neches River south of Clarks Island.

35. In support of the requested improvements, local interests furnished data and information which indicated the following:

a. The requested modifications to the waterway are necessary because the increased volume of traffic, the character of the commerce, and the trend toward greater increase in commerce have made the present and the authorized channels inadequate in both width and depth.

b. The depths of 40 feet in interior sections of the waterway and 43 feet in the outer bar channel and Sabine Bank channel are necessary to permit safe and efficient navigation of larger tankers at normal operating speeds.

c. The bottom widths of 500-1000 feet are necessary to permit two larger tankers to pass alongside, and thus eliminate the possibility of out-bound supertankers being delayed while waiting for inbound supertankers to clear the channel.

d. The horizontal clearance of 500 feet for the new Pleasure Island bridge at Port Arthur is necessary to permit two large tankers to pass alongside through the navigation opening.

e. Bank protection on Pleasure Island is necessary to prevent valuable land from being eroded away by wave wash from passing vessels, and to reduce Federal maintenance dredging costs.

f. Construction of passing-places at five oil terminals on the Neches River is necessary to provide a greater channel cross-section at these locations to reduce the surge action by passing vessels on vessels moored at the oil terminals.

g. Enlargement of the lower portion of the Cow Bayou Channel to deep-draft dimensions is necessary to stimulate industrial development of the area.

h. Enlargement of the Sabine River channel to 40 feet by 400 feet and extension of the channel upstream to the Interstate Highway 10 bridge, is necessary to encourage oil companies to locate major refineries along the river.

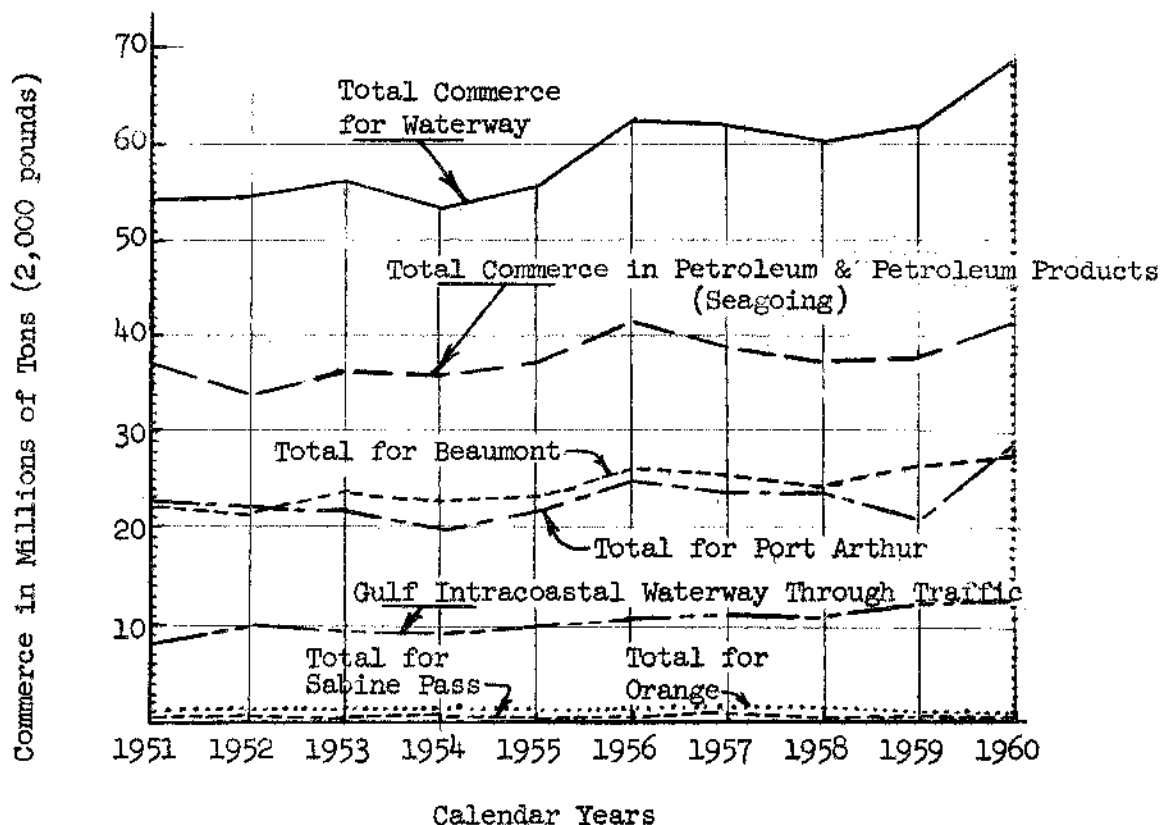
i. Improvement of the Sabine River from the Interstate Highway 10 bridge to the Southern Pacific Railroad bridge at Echo is necessary to better accommodate the present and prospective barge traffic to and from the two plants already located near Echo.

j. The authorized Sabine Pass anchorage basin should be relocated to the old channel at the town of Sabine Pass, since normal tidal action probably would keep the channel scoured out and maintenance dredging costs would be low.

EXISTING AND PROSPECTIVE COMMERCE

36. Existing commerce.- The annual commerce at each of the four ports on the Sabine-Neches Waterway, for the 10-year period 1951 to 1960, is indicated on the following chart. The total tonnages moved on the waterway during this period ranged from 53,523,810 tons in 1954 to 68,693,211 tons in 1960. A tabulation of tonnages for each year of the period is shown as table A of appendix II. The volume of petroleum and petroleum products in seagoing vessels and the through traffic movements on the Gulf Intracoastal Waterway are also indicated on the chart.

ANNUAL COMMERCE
SABINE-NECHES WATERWAY

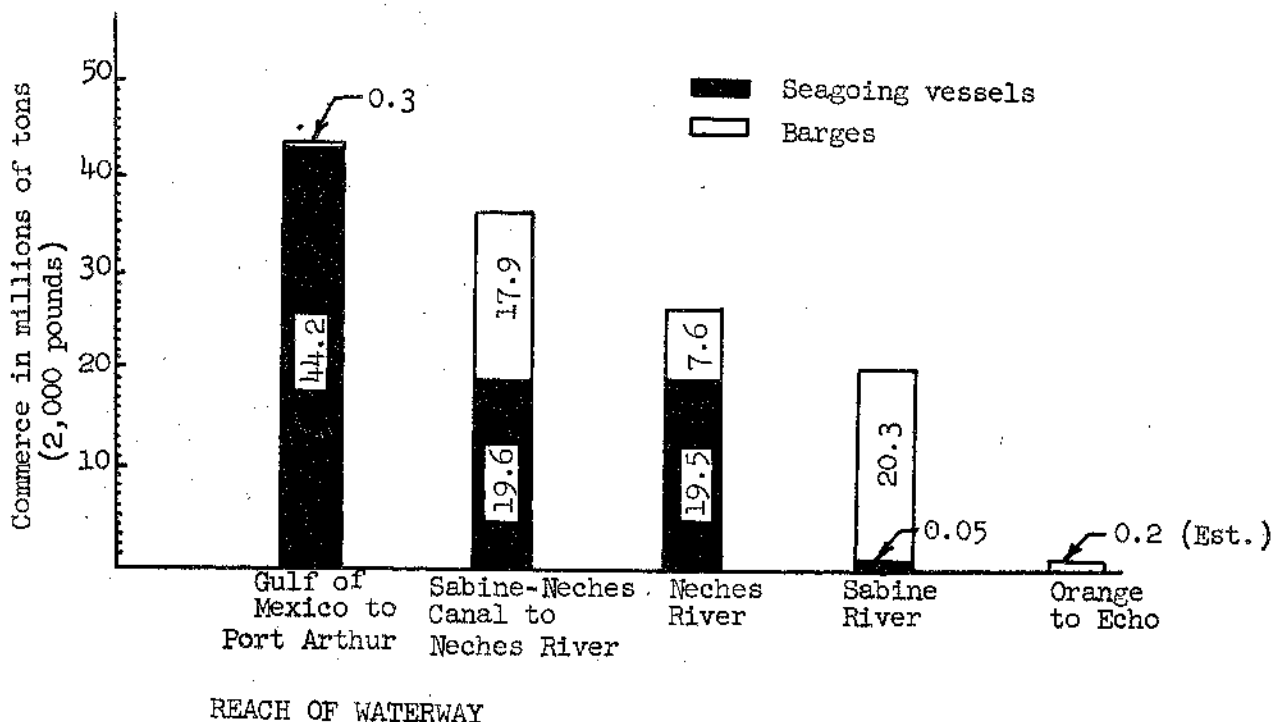


37. The total annual commerce of the waterway has shown an average gain of about 1,600,000 tons annually during the period 1951-1960. The largest gains were at Port Arthur and Beaumont, whose tonnage increased at an annual rate of 600,000 tons and 530,000 tons, respectively. Commerce on the channel to Orange has remained relatively constant over the past ten years. A tabulation of the commodities moved over the Sabine-Neches Waterway during the calendar year 1960 is shown as exhibit 1 of appendix II.

38. The principal products moved on the waterway are petroleum and petroleum products. The preceding chart indicates that the annual petroleum commerce over the waterway carried in seagoing vessels has varied from about 33,700,000 tons in 1952 to over 41,100,000 tons in 1960. Petroleum moving in the coastwise trade in 1960 showed an increase of 10 percent over the 1951 tonnage; however, since 1958, refining capacities in the area served by the waterway have increased by about 50 percent. As shown on plate 2 of the economic base study in appendix II, the 1960 capacities of the refineries at Beaumont and Port Arthur represent about 10 percent of the total refining capacity of the United States. The recent increase in refining capacity is reflected in the coastwise movement of petroleum in 1960 which exceeded by over 3 million tons the commerce moved in 1959.

39. The following chart indicates the volume of commerce moved by seagoing vessels and by barges over the various reaches of the waterway during 1960. This commerce includes the through traffic on the Gulf Intracoastal Waterway.

SABINE-NECHES WATERWAY
TOTAL COMMERCE MOVED OVER
VARIOUS REACHES OF THE WATERWAY
CALENDAR YEAR 1960



40. Prospective commerce - enlarged deepwater channels.- The economic base of the industrial area comprising Beaumont, Port Arthur, and Orange, Texas, is petroleum refining and shipping, and its subordinate industries. The refining capacity in this immediate area is about ten percent of the petroleum refinery capacity of the United States. The accessibility of large supplies of crude oil from Texas, Louisiana and offshore areas, as well as from foreign sources, together with an excellent transportation network of steamship, barge, pipeline, rail and highway facilities, assures the Sabine-Neches area a leading position in the processing and transfer of petroleum products. This condition can be expected to continue for at least as long as petroleum is an important energy and raw material source in the nation's economy.

41. To afford a basis for projections into the future of commerce on the Sabine-Neches Waterway, relations were developed of the present commerce in petroleum and petroleum products through the per capita consumption of petroleum to the population. Projections of the population indices then afforded a basis for projection of the petroleum traffic. Based on a straight line projection at a rate so developed, it is estimated that the prospective petroleum commerce for the Sabine-Neches Waterway in 2015 will be about 90,000,000 tons, of which 2,500,000 tons will move in the foreign trade; 61,000,000 tons will move in the coastwise trade; and 26,500,000 tons will move by barge.

42. Further projection becomes increasingly unreliable. However, for the purposes of this report it is assumed that the petroleum commerce in 2065 would total 99,000,000 tons, or an increase of about 10 percent over the prospective 2015 commerce. Of the 99,000,000 tons of petroleum commerce in 2065, about 70,000,000 tons would be moved in seagoing vessels and 29,000,000 tons would be moved in barges.

43. Prospective commerce - channel to Orange, Texas.- The commerce of the Orange area is related primarily to the chemical and shipbuilding industries, with some shipment of agricultural products. Projections of this traffic is subject to wide sporadic gains induced by new and expanding petrochemical plants. The next 50 years will undoubtedly see a considerable increase in traffic, which is estimated to more than double by 2015 to about 3,000,000 tons annually. Further increase to 2065 is indefinite, but is estimated to amount to 4,000,000 tons. These estimates do not include the prospective through Intracoastal Waterway traffic which will traverse this channel. The future traffic would include about 500,000 tons of seagoing traffic in 2015 and 600,000 tons in 2065.

44. Shallow-draft channel above Orange to Echo, Texas.- The existing commerce moved on the channel to Echo, Texas totaled 314,000 tons in 1961, including 250,000 tons of shell, and 64,000 tons of crude petroleum. Plant officials of the cement plant which uses the shell, state that they have plans to double the plant capacity within the next few years and, if financing can be arranged, will triple the present capacity several years later. The crude oil movement is to a chemical plant at Echo and, while

increased requirements of crude oil will probably develop, the company has not revealed plans for plant expansion. Based upon these proposals, it is conservatively estimated that the prospective commerce for the shallow-draft channel would amount to 564,000 tons of which 500,000 tons would be shell.

VESSEL TRAFFIC

45. Present vessel traffic.- The present vessel traffic for the various reaches of the Sabine-Neches Waterway is given in detail in exhibit 4 of appendix II. The exhibit shows the trips and drafts of vessels, and the direction of the movement, for the calendar year 1960. A summary of the trips and drafts of vessels for the waterway is given in table 3. The draft classification is based on the actual draft at the time the vessel cleared or arrived at port.

TABLE 3

SABINE-NECHES WATERWAY, TEXAS
TRIPS AND DRAFTS OF VESSELS
CALENDAR YEAR 1960

Draft (in feet)	Number of trips of vessels						
	Inbound			Outbound			Total
	Tankers	Others	Total	Tankers	Others	Total	
36	3	-	3	17	-	17	
35	62	-	62	187	-	187	
34	28	-	28	169	-	169	
33	4	1	5	50	-	50	
32	16	-	16	410	5	415	
31	64	7	71	586	8	594	
30	9	7	16	85	58	143	
29	18	16	34	197	79	276	
28	38	35	73	42	77	119	
27 to 19	1,085	479	1,564	233	279	512	
18 & less	789	26,463	27,252	64	26,067	26,131	
Total	2,116	27,008	29,124	2,040	26,573	28,613	

46. The data presented in table 3 is for all types of commercial vessels operating on the Sabine-Neches Waterway and includes: seagoing tankers and cargo vessels, seagoing tugs, inland waterway tugs, barges, and commercial fishing boats. The table does not distinguish between seagoing and inland waterway traffic; however, the seagoing vessels are largely deep-draft vessels and comprise all of the traffic of 19-foot draft and greater.

Practically all of the vessels with drafts of 30 feet and more were tankers. However, the tanker traffic on the waterway cannot be precisely established by analysis of the available statistics since small tankers and large tankers running light would have drafts in the same range as those for the dry cargo vessels.

47. The data in table 3 shows that in 1960 there was a total of 952 trips by vessels with drafts of 32 feet or greater. These vessels were mostly large supertankers of 27,000 d.w.t. and above. These drafts are the maximum draft, fore and aft and are not average or midship draft, which would be about a foot less.

48. For analysis of the prospective use of supertankers on the Sabine-Neches Waterway, a study was made to determine the present proportion of supertankers in the United States tanker fleet and the probable change in composition of the fleet within the next few years. The study, which is presented in detail in appendix II indicates that the rapid trend in the last few years towards use of the large supertankers will continue, and that these tankers in excess of 27,000 d.w.t. will constitute at least 40 percent of the United States tanker fleet during the life of the proposed improvements.

49. Prospective traffic.- The prospective seagoing vessel traffic is not expected to increase greatly from the actual number of vessel transits of the waterway during the year 1960. There will be a large increase in shallow-draft traffic, particularly in the barge movement of petroleum products. The current trend to larger tank vessels of over 27,000 d.w.t. will permit movement of a larger volume of petroleum and petroleum products with the same number or less vessel trips than now is transported with smaller tankers of from 16,000 to 25,000 d.w.t. In general, the principal change in prospective seagoing vessel traffic would be a decline in the number of seagoing tank vessels with loaded drafts of from 29 to 32 feet, and an increase in the number of seagoing vessels with loaded drafts of from 32 to 36 feet.

50. Channel depths necessary to accommodate vessels are determined from a consideration of the factors of trim, squat and clearance in addition to the draft of the vessel. As discussed in detail in paragraph 23 of appendix II, at least 1 foot is needed for trim, 1 foot for "squat" or sinkage of a vessel underway, and at least 2 feet for clearance between the keel of the vessel and bottom of channel. Based on these considerations, the authorized project depth of 36 feet is adequate for fully loaded vessels up to 27,000 d.w.t. with drafts of 32 feet. A channel depth of 43 feet in the Sabine Bank and outer bar channels and of 40 feet in inside channels would accommodate fully loaded vessels of up to 40,000 d.w.t. with loaded drafts of 36 feet.

51. Determination of the channel width required for safe and economical operation of vessels is not as definite as the depth requirements. As discussed in paragraph 25 of appendix II, the authorized channel dimensions of 36 feet by 400 feet from the Gulf to Port Arthur, thence 36 feet by

350 feet to Beaumont, are considered to be adequate for two-way operation of tankers up to 27,000 d.w.t. For large tankers up to 40,000 d.w.t. a channel width of 400 feet is required and for passage of two of the very large tankers with beams in excess of 100 feet a width of 500 feet is required.

52. Sabine River:

a. Below Orange, Texas.- Table F in appendix II shows the trips and drafts of vessels on the Sabine River during 1960. Most of the deep-draft vessels on the river carry dry cargo. All but one of the deep-draft vessels using the channel in 1960 had drafts of 26 feet or less, and that one had a draft of 28 feet. Although the loaded drafts of dry cargo vessels in the U. S. private fleet range upward to about 33 feet, it is not expected that such larger vessels will call at Orange fully loaded, since Orange is normally an intermediate port-of-call. The existing depth and width of 30 feet by 200 feet are considered to be adequate for present and reasonably prospective traffic to Orange.

b. Shallow-draft channel to Echo, Texas.- No published data are available on trips and drafts of vessels currently using the Sabine River channel above Orange to Echo, Texas. Such traffic was estimated based on the reported commerce transported to the terminals at Echo by one barge tows during calendar year 1961. With an assumed average load of 1,500 tons for the barges, a total of about 420 barge trips and a like number of trips by the towing vessels are made annually. The number of barge trips on the proposed new alignment of the channel would not materially increase over the number of trips made on the existing channel. However, the new cutoffs would permit the use of 3-barge tows in lieu of the 1-barge tows moved over the present channel. The future use of 2 or 3-barge tows over the improved channel would reduce appreciably the number of towboat trips.

DIFFICULTIES ATTENDING NAVIGATION

53. Navigation on the channels of the Sabine-Neches Waterway is made difficult during short periods of time by strong currents in the river channels during floods, strong cross channel winds, and fogs. The authorized 36-foot depth in the channels to Port Arthur and Beaumont is adequate for vessels of 27,000 d.w.t. with fully loaded drafts of 32 feet. Large tankers and supertankers of from 27,000 to 40,000 d.w.t. with fully loaded drafts of 36 feet are now in use on the waterway. Such vessels must operate at reduced speeds with loss in efficiency of operations, and with increased hazards from loss of steerage and possible bottom or bank scrapings. The open roadstead approach to the Sabine Pass outer bar channel has depths ranging from 32 feet to 38 feet. The newer tank vessels must traverse this area at less than normal operating speeds to avoid hitting bottom, even under normal weather conditions.

54. The bascule span of the Port Arthur Bridge is located on the west half of the 400-foot wide channel, and has a horizontal clearance of 200 feet between fenders. Ships approaching the bridge must deviate from a course on the centerline of the channel to pass through the navigation opening. The vessels are then subject to bank suction forces tending to divert their courses directly toward the bridge pier. This condition is further

aggravated by adjacent channel curves which require a reversal of course at slow navigating speeds. Clear vision of approaching vessels is obstructed by the open bascule leaf in the center of the channel, and by the low fixed spans in the east half of the channel.

55. Prior to the widening and rectification of the 30-foot Sabine River channel, completed in 1960, numerous reports of grounding and bank striking were received. No such reports have been received since completion of the work and the authorized channel is considered adequate for existing and reasonably prospective traffic in this reach of the river. About 9 miles of natural Sabine River channel above the head of the authorized project is used by barge traffic. In this reach of unimproved channel are snags, obstructions, and sharp curves which not only restrict tows to one-barge size but make navigation of the channel difficult.

WATER POWER AND OTHER SPECIAL SUBJECTS

56. The proposed improvements under consideration in this report would have no bearing on water power, flood control, abatement of pollution, irrigation or land reclamation. Increasing the authorized dimensions of the waterway would not alter the existing malaria control problems of the Sabine-Neches area. Increasing the dimensions of the Neches River channel would increase the possibility of movement of the salt water wedge upstream during periods of low flow in the river. Such movement of the salt water wedge might endanger municipal and industrial water supply intakes located on the Neches River and its tributary, Pine Island Bayou. The need for construction of a salt water barrier in the Neches River is being investigated under a comprehensive survey of the Neches River basin now in progress. Otherwise, the proposed improvements would not involve the control or conservation of water resources. The comments of the U. S. Fish and Wildlife Service concerning the effects of the improvements on the fish and waterfowl habitat of the area are contained in appendix V and discussed in paragraphs 88 through 89.

PLAN OF IMPROVEMENT

57. Project formulation.- Development of improvements to the existing project for the Sabine-Neches Waterway lends itself to consideration of several portions of the project separately. The separate studies would consider: (a) improvements to the deep-draft channels and basins that are used by supertankers in transportation of petroleum and petroleum products; (b) improvements to the deep-draft channels and basins that are used by dry cargo vessels but not by supertankers; (c) improvements to the shallow-draft channels and basins used by barge traffic; (d) miscellaneous improvements to the project features.

58. The improvements to the project requested by the local interests are summarized as follows:

a. Deepening and widening of the channels and basins from deep-water in the Gulf of Mexico to Port Arthur and Beaumont to provide a project depth of 40 feet and width of 500 feet in the main channels with further widening in Sabine Pass and additional deepening and widening in the Gulf. One individual also requested relocation of the deep-draft channel from Sabine Pass through Sabine Lake to the mouth of the Neches River.

b. Deepening and widening the deep-draft channel from the mouth of the Neches River to the Interstate Highway 10 crossing above Orange to a depth of 40 feet and width of 400 feet, and deepening and widening the channel in Cow Bayou to a depth of 30 feet and width of 225 feet.

c. Construction of a shallow-draft channel with a depth of 12 feet and width of 125 feet in the Sabine River from the Interstate Highway 10 crossing upstream to Echo near the crossing of the Southern Pacific Railroad Co.

d. Miscellaneous improvements consisting of bank revetment to prevent erosion of the spoilbank known as "Pleasure Island" along the Sabine Lake side of the Port Arthur and Sabine-Neches Canals.

59. In order to determine the advisability of improving the channel, estimates of cost were made of the improvements requested by the local interests and of a lesser and greater degree of improvements that would meet the requirements of prospective vessel traffic. Analyses were made of the channel dimensions required for reasonably safe navigation by various sizes of vessels and a determination of the extent of use of various sizes of vessels in transporting the prospective deep-draft commerce of the waterway.

60. The existing dimensions of the channels from the Gulf to Port Arthur and Beaumont are adequate to accommodate the largest dry cargo vessel that is likely to call at one of the ports; however, the depth and width are not adequate to accommodate fully loaded the largest tank vessel that is likely to call at one of the ports. The analysis of channel

dimensions required for various sizes of tank vessels is given in appendix II. This analysis shows that the existing project dimensions are adequate to accommodate fully loaded tank vessels up to 27,000 d.w.t. in size but that larger vessels must operate partly loaded and at considerable hazard. Increasing the project channel depth to 40 feet at mean low tide and widening the channel to 500 feet in the Port Arthur Canal and to 400 feet in the Neches River channel, would provide a project that would accommodate fully loaded tank vessels up to 40,000 d.w.t. A further increase in project depth to 43 feet at mean low tide would provide for accommodation of fully loaded tank vessels up to 53,000 d.w.t. These larger vessels would encounter some difficulty in passing in the 400-foot channels above Port Arthur, but the infrequency of their transits of this reach would greatly mitigate the probability of two large vessels passing. On rare instances of such occurrences, a delay of several hours for one ship would be required. The benefits from additional widening to prevent saving this occasional delay would not warrant the cost of the improvement. The further widening requested by the local interests would increase the ease of navigation with some reduction in hazards of passing of two vessels of 53,000 d.w.t. or larger.

61. The proposed widening to 400 feet in the Neches River would afford an increase in channel cross section that should reduce the surge caused by large vessels moving in the channel and should reduce the effect of the surge on vessels moored at wharves. The widening opposite the wharves, which was requested by the local interests to reduce the surge, is therefore not included in the proposed improvements. Experience after completion of the widening would indicate the need for further widening in local reaches.

62. The turning of vessels that are too long to turn in the wharf areas is accomplished at present at the junctions of natural river bends and several channel cutoffs that were made in improving the channel. These turning areas have been generally satisfactory; however, as the abandoned channels fill with sediment and as the vessels increase in size, turning the vessels will become more difficult. It is believed that three of the present turning areas should be designated as project turning points to be improved and maintained as features of the project. The areas are proposed to be designated as turning points, namely at channel miles 31.3, 37.2 and 41.0. These turning points are strategically located with respect to the wharves on the channel. The turning points should provide an effective turning diameter of about 1,000 feet at project depth. The improvement of these areas at the present time would involve comparatively small quantities of excavation and their maintenance would be small. These costs are included in the proposed improvement of the waterway.

63. The benefits from savings in transportation costs from operating the larger vessels fully loaded, from increased speed, and from reduction in hazards to navigation, as estimated in appendix II and the estimated annual costs of the several improvements considered are compared as follows:

<u>Improvement</u>	<u>Average annual costs</u>	<u>Average annual benefits</u>	<u>B/C</u>
a. Deepen to 40 ft. and widen to 500 ft. in Port Arthur Canal and 400 ft. in Neches River	\$1,368,000	\$2,346,000	1.7
b. Deepen to 40 ft. and widen Sabine Pass channel to 600 ft., and 500 ft. in other inner channels	2,097,000	2,396,000	1.1
Increment a to b	729,000	50,000	0.1
c. Deepen to 43 ft. and widen to 500 ft. in Port Arthur Canal and 400 ft. in Neches River	1,723,000	2,586,000	1.5
Increment a to c	355,000	240,000	0.7

64. The economic analysis indicated by the ratios of benefits to costs shown above indicated the most feasible improvement to the channels used by large tank vessels would provide for deepening the interior channels to 40 feet and widening the Port Arthur Canal to 500 feet and the Neches River to 400 feet. The improvement would include deepening the outer channel in the Gulf of Mexico to 43 feet and extending the channel seaward for a distance of about 15.3 miles through the Sabine bank opening known as the "Hole-in-the-wall."

65. The deep-draft channel from the mouth of the Neches River to Orange, Texas, serves the port of Orange and also, for most of its length, serves as a portion of the Gulf Intracoastal Waterway. The depth of this channel should be adequate to accommodate the seagoing traffic of the port of Orange. As discussed in appendix II, the present seagoing commerce is carried in dry cargo vessels. Analysis of the industrial development in the Orange tributary area and projection of this development into the future indicates extensive expansion in the chemical and petrochemical production. The products will move to a large extent on barges on the inland waterway, but appreciable volumes will move in seagoing dry cargo vessels for coastwise and foreign trade. The trend in dry cargo vessels is to larger vessels with deeper draft; however, the percentage of larger vessels is small, and the portion of the prospective commerce that would be carried in the larger vessels is also small. Furthermore, dry cargo vessels, unlike tank vessels, usually call at a number of ports for partial cargoes and are fully loaded only at the last port of call on the Gulf. Orange is an intermediate port and cargo vessels are not often fully loaded when using the channel to Orange. There is no apparent prospective commerce in petroleum or in petroleum products that would justify greater channel dimensions. The annual cost of deepening the channel to Orange to 34 feet is estimated \$50,000. The annual benefits from saving in transportation cost, through use of the larger dry cargo vessels fully loaded, would be negligible. Accordingly, deepening of the channel to Orange is not justified at this time.

66. In addition to seagoing traffic, the lower 10 miles of the channel carries the through barge traffic of the Gulf Intracoastal Waterway. At times the congestion of barge tows and seagoing vessels presents hazardous navigating conditions which results in a reduction in speed of vessels. Because of the short length of channel, the loss in time is not material and the hazards to navigation have not resulted in a greater incidence of collisions and damage to vessels than in the wider channels. The annual benefits from an increase in operating speed of the seagoing dry cargo vessels and from the reduction in navigation hazards are not of significant magnitude and would not justify the estimated annual cost of \$616,000 for providing the enlargement to a depth of 40 feet and widths of 400 feet requested by local interests, nor would any lesser degree of widening be justified.

67. The question of enlargement of a portion of Cow Bayou to provide for seagoing vessel traffic as requested is dependent entirely on the future development of commerce on the bayou channel by the location of a commerce producing industry along the channel. Any such development is speculative and would not justify enlargement of the channel by the United States at this time.

68. There is existing barge traffic in the Sabine River above Orange that carries the commerce of two industrial plants at Echo, about 9.4 miles above the Orange municipal slip. This barge traffic utilizes the existing river channel with considerable difficulty and hazards from snags and shoals in the river. The proposed improvement of the river channel and construction of two cutoffs to rectify the channel alinement to provide a channel 12 feet deep by 125 feet wide with a length of 7.5 miles above the Orange municipal slip would have an annual cost estimated at \$15,000. The benefits to existing and prospective commerce from reduction in travel time and hazards and use of large barges are estimated at \$27,500 annually. No alternate improvements have been considered for this reach of the river, since the prospective traffic would be readily accommodated on the proposed channel. The improvement proposed is considered to be justified and is included in the plan of improvement in this report.

69. A plan for the construction of a deep-draft channel across Sabine Lake from the inner end of Sabine Pass to the mouth of the Neches River was proposed by an individual at the public hearing and subsequently proposed by an association of individuals in Port Arthur. The proposal involves a new deep-draft channel across the lake for seagoing traffic to Beaumont and Orange with a branch for Intracoastal Waterway traffic extending to the junction with that waterway just below Port Arthur. Included is continued maintenance of the existing Port Arthur channels from the head of Sabine Lake to the mouth of the Neches River except for a short reach in Port Arthur which would be filled to provide access to the spoil bank.

70. The persons proposing this improvement claim that the very large benefits of the channel would justify its cost many times. The benefits claimed, however, are from alleged enhancement in land values, from development of harbors in the reaches of the Sabine-Neches Canal, from tourist

trade attracted by the recreation aspects of the spoil bank, from expenditures of vessel crews on the greatly increased number of vessels that would call at Port Arthur, and from similar speculative aspects of development.

71. A preliminary estimate of cost of the channel, including a highway bridge, is about \$25,000,000, with annual charges estimated at \$1,470,000. If the spoil must be placed on land or carried to the Gulf, this estimated first cost might double. The benefits from the standpoint of navigation would be negligible. There would be no saving in first cost over the existing project, and the annual charges would be increased, since the existing channels would still be maintained. On the basis of a realistic appraisal of benefits from savings in transportation costs and reduction in hazards to navigation, it is considered that there is practically no justification for Federal construction of a channel in Sabine Lake, at the present time. Furthermore, the responsible agencies that are able to provide the local cooperation on such an improvement have evidenced no interest therein and have made no offers of local cooperation. The construction of a channel in Sabine Lake is, therefore, not included in the plan of improvement in this report.

72. Plan of improvement.- The plan of improvement provides for deepening the outer bar channel to 43 feet and extending the channel seaward through Sabine Bank for a distance of about 15.3 miles to the natural 43-foot depth in the Gulf; deepening the waterway to 40 feet between the Sabine Pass jetty channel and Beaumont, including the turning area just below the Beaumont turning basin, Port Arthur turning basins, approaches thereto and connecting channels and the authorized Sabine Pass anchorage basin; widening the Port Arthur Canal to 500 feet; widening the Neches River Channel to 400 feet; constructing three turning points, with turning diameters of about 1,000 feet, at approximate miles 31.3, 37.2, and 41.0 on the Neches River Channel; reauthorization of a portion of the abandoned Neches River Channel below Clarks Island; removing the existing obstructive bascule bridge crossing the Sabine-Neches Canal at Port Arthur and constructing a new fixed bridge with a navigation span providing minimum horizontal clearance of 400 feet and minimum vertical clearance of 138 feet above mean low tide; and constructing a shallow-draft channel extension in the Sabine River upstream from the foot of Green Avenue in Orange to a point near the Southern Pacific Railroad Bridge at Echo, an overall distance of about 4.6 miles.

73. The materials to be encountered in dredging the improvements considered in this report are of the following general classifications. Hard sand and seashells for a distance of about 3 miles through and in the immediate vicinity of the Sabine Bank and chiefly a soft gray mud with some seashells for the remaining 12.3 miles of the requested Sabine Bank channel. Dredging through the hard sand and shell in the Sabine Bank area may entail some difficulty for hopper dredges; however, dredging the remaining channel in the Gulf should be comparatively easy. Enlargement of the Sabine Pass outer bar and jetty channels would involve removal of silt, clays and sands by hopper dredging. The materials to be encountered

in enlarging the inner channels to Port Arthur and Beaumont and extending the shallow-draft channel in the Sabine River above Orange consist chiefly of soft clays, soft sandy clays, stiff clays, hard sandy clays, and some deposits of sand, including previously dredged materials placed in spoil banks adjacent to the various channels. These materials offer no unusual difficulties for pipeline dredging. Dredging the cutoffs on the Sabine River would involve the removal of soft and stiff clays and the clearing of brush and small trees from the channel rights-of-ways.

74. The Commander, Eighth Coast Guard District, New Orleans, Louisiana, furnished estimates of the number and type of aids to navigation and the cost of their construction and maintenance required for the improvements considered in this report. These data are included in the estimates of first cost for the plan of improvement.

SHORELINE CHANGES

75. The improvements considered herein would have no appreciable effect on the configuration of existing natural shorelines.

ESTIMATES OF FIRST COST

76. Detailed estimates of first cost for constructing the proposed plan of improvement of the authorized channels and basins of the Sabine-Neches Waterway are shown in tables A through C of appendix IV and are summarized in the following table 4. The estimates are based on March 1962 price levels. The division of first costs between the Federal and non-Federal interests is based on the requirements of local cooperation set forth in paragraph 84.

TABLE 4

ESTIMATES OF FIRST COST
FOR
PROPOSED PLAN OF IMPROVEMENT

Item	: Widening & : deepening to : 40'x400' : project to : Beaumont(1)	: : : Shallow-draft : channel above : Orange to : Echo, Texas
<u>Federal first cost</u>		
Corps of Engineers		
Construction	\$19,471,000	\$257,000
Engineering and design	238,000	6,000
Supervision and administration	<u>1,253,000</u>	<u>26,000</u>
Subtotal	20,962,000	289,000
Preauthorization studies	<u>28,000</u>	<u>2,000</u>
Subtotal, Corps of Engineers	20,990,000	291,000
U. S. Coast Guard, aids to navigation	<u>336,000</u>	<u>7,000</u>
Total Federal first cost	21,326,000	298,000
<u>Non-Federal first cost</u>		
Non-Federal public, levees rights-of-way and spoil disposal areas	833,000	170,000
Non-Federal private, relocations	<u>545,000</u>	<u>-</u>
Total Non-Federal first cost	<u>1,378,000</u>	<u>170,000</u>
Total first cost	22,704,000	468,000

(1) Includes fixed high level bridge at Port Arthur, 500' widening on Port Arthur Canal and 3 turning points on Neches River.

ESTIMATES OF ANNUAL CHARGES

77. Estimates of the investment and annual charges for the proposed plan of improvement are given in tables E through G of appendix IV, and are summarized in table 5. The estimates of annual maintenance costs of the additional and enlarged channels are based on shoaling experience of existing channels of the waterway and costs prevailing in the area during March 1962.

TABLE 5
ESTIMATES OF ANNUAL CHARGES
FOR
PROPOSED PLAN OF IMPROVEMENT

Item	:40' x 400' project : to :Beaumont, Texas(1)	: Shallow-draft : channel above : Orange to Echo
<u>Investment</u>		
Federal	\$22,166,000	\$298,000
Non-Federal	<u>993,000</u>	<u>170,000</u>
Total Investment	23,159,000	468,000
<u>Annual charges</u>		
Federal:		
Corps of Engineers	1,239,000	8,000
U. S. Coast Guard	<u>29,000</u>	<u>1,000</u>
Total Federal annual charges	1,268,000	9,000
Non-Federal	<u>100,000</u>	<u>6,000</u>
Total annual charges	1,368,000	15,000

(1) Includes widening Port Arthur Canal to 500', construction of fixed bridge to Pleasure Island, and three turning points on the Neches River.

ESTIMATES OF BENEFITS

78. Benefits - enlargement of authorized project.- The benefits from the plan of improvement would be to the deepwater channels to Port Arthur and Beaumont derived primarily from the use of larger tankers, from a savings in travel time on the waterway and from reduction in the hazards to navigation. It is considered that tankers from 27,000 to 40,000 d.w.t. that can be operated only partly loaded on the authorized channel, could be operated fully loaded on a 40' channel, and that tankers larger than 40,000 d.w.t. could operate with larger loads on the improved channel than on the existing channel. The analysis of the operation costs of large tankers, presented in detail in paragraphs 28 and 29 of appendix II, shows that an average saving of about 20 cents per ton would be realized on the movement of petroleum from the Sabine-Neches Waterway if improved as proposed in the plan of improvement. It is assumed that commerce of petroleum and its products that would be moved in the larger tankers would be in proportion to the percentage of such tankers in the American tanker fleet. This is estimated at 40 percent in paragraph 48. Thus, it is estimated that 40 percent of the 70,000,000 tons of prospective commerce, or 28,000,000 tons, would move in the tankers of 27,000 d.w.t. to 63,000 d.w.t. The total saving on the estimated 28,000,000 tons of petroleum commerce is estimated at \$4,372,000. It is considered that this saving should be equally divided between the local project and the ports at the other end of the movement. The arbitrary assignment of one-half the benefits to the local project is made, since data for a precise determination of the actual proportions are not available for ports on the eastern seaboard. Accordingly, the benefits in saving of transportation cost from the plan of improvement is estimated at \$2,186,000 annually.

79. Additional benefits would be realized by the proposed enlargement of the channel and relocation of the Port Arthur bridge, comprised of a saving in vessel time of travel through increased speed and elimination of delays at the bridge and a reduction in hazards to navigation. These benefits, as evaluated in appendix II, amount to a total \$160,000 annually.

80. Benefits - Sabine River, Orange to Echo.- Improvement of the Sabine River between Orange and the S.P. RR bridge at Echo by cutoffs, by curve easement, deepening and removal of logs and snags, would allow the barge traffic to operate at increased speeds and suffer less damage. This saving in cost of barge operation as estimated in detail in paragraph 38 through 40 of appendix II, amounts to \$28,000 annually.

81. Summary of estimated benefits.- The benefits from the proposed improvements under the plan of improvement are estimated as follows:

	<u>Estimated benefits</u>
Saving in cost of tanker operations	\$2,186,000
Saving time and reduction in hazards to navigation	160,000
Saving in cost of barge operations	28,000
Total estimated benefits	\$2,374,000

COMPARISON OF BENEFITS AND COSTS

82. The estimated first costs, annual charges, annual benefits and the ratios of annual benefits to annual charges for the two separate features in the plan of improvement are as follows:

	<u>Plan of Improvement</u>	
	<u>43'-40' project from Gulf to Port Arthur and Beaumont, widening Port Arthur Canal to 500', widening Neches River channel to 400', 3 turning points in Neches River channel, and alteration of Port Arthur bridge</u>	<u>12' x 125' channel in Sabine River from Orange to Echo, Texas</u>
Estimated first cost	\$22,704,000	\$468,000
Annual charges	1,368,000	15,000
Annual benefits	2,346,000	28,000
Ratio of benefits to charges	1.7	1.9

83. The estimates of annual charges for the proposed improvements include interest on and amortization of the estimated initial investment. Also, the annual charges include the estimated increase in annual maintenance costs that would result from construction of the improvements.

PROPOSED LOCAL COOPERATION

84. The requirements of local cooperation proposed for modification of the existing project for Sabine-Neches Waterway considered herein are based on the apportionment of cost discussed in paragraphs 86 through 88. In accordance with present Federal policies, it is proposed that the local interests shall be required to:

a. Furnish without cost to the United States all necessary lands, easements and rights-of-way required for construction and subsequent maintenance of the project and of aids to navigation upon the request of the Chief of Engineers, including suitable areas determined by the Chief of Engineers to be required in the general public interest for initial and subsequent disposal of spoil and necessary retaining dikes, bulkheads and embankments therefor or the costs of such retaining works;

b. Accomplish, without cost to the United States, all alterations of pipelines, powerlines, utility lines, cables, and highway facilities, except the highway bridge to be relocated at Port Arthur, when and as required for construction of the project;

c. Hold and save the United States free from damages due to the construction works; and

d. Furnish without cost to the United States all necessary rights-of-way and easements required for relocating the highway bridge at Port Arthur and contribute, in cash, a share of the construction costs of the relocation computed in accordance with the principles of section 6 of the Bridge Alteration Act of June 21, 1940, as amended by the Act of July 16, 1952, which share shall include but not be limited to the following: (1) direct and special benefits to the bridge owner, (2) expectable savings in repair or maintenance costs, (3) costs attributable to requirements of highway traffic, (4) expenditure for increased carrying capacity and (5) expired service life of old bridge.

e. Assume all obligations of ownership, operation and maintenance of the replacement bridge upon its completion.

85. The improvements proposed herein and the proposed local cooperation have been discussed with officials of the Beaumont Navigation District, Orange County Navigation and Port District and the city of Port Arthur. A statement by officials of these agencies that the proposed improvements are satisfactory and that they would provide required local cooperation is attached as exhibit 2, appendix V.

APPORTIONMENT OF COST AMONG INTERESTS

86. The apportionment between the Federal and non-Federal interests of the estimated first cost and the annual cost of maintenance of the recommended modifications is based on present Federal policy on navigation projects for multi-use channels. This policy requires local interests to provide lands and rights-of-way and hold the Government free from damages

for channel improvement. Construction and maintenance cost for the new channel improvements would be apportioned to the United States. The local interest cost for the channel improvements include the cost of rights-of-way, spoil disposal areas and relocations. The proposed apportionment of the estimated first cost and annual maintenance cost of the recommended improvements to the Sabine-Neches Waterway is given in table 6.

87. The apportionment of cost for the high level bridge is in accordance with section 6 of the Act of June 21, 1940 (Truman-Hobbs), as amended by the Act of July 16, 1952. The apportionment of cost for the bridge is shown in detail in table B of appendix IV. The Federal share of the bridge relocation costs is presently estimated at \$4,843,000.

88. The existing bascule highway bridge at Port Arthur, which is to be replaced, is a double-lane bridge with a roadway width of 20 feet. The bridge was constructed in 1931 and was designed for H-15 live loading, in accordance with standard specifications for highway bridges of the American Association of State Highway Officials. The cost estimates used in this report for the replacement bridge are based on a designed roadway width of 20 feet and H-15 live loading and the estimated amounts to be apportioned to Federal and local interests have been computed accordingly. It is pointed out that the design standards of the existing bridge are probably deficient in meeting the requirements of prospective highway traffic on the replacement bridge. The requirements for additional width of roadway, capacity for heavier live loads, and similar betterments for improved service to vehicular and pedestrian traffic in the final design of the replacement bridge would be determined by local interests and the entire cost of such improvements would be apportioned to them. Since these requirements have not been determined, no estimate has been made at this time of the additional cost to be apportioned to local interests for betterments to serve the land traffic.

TABLE 6

APPORTIONMENT OF COSTS FOR
RECOMMENDED IMPROVEMENTS

Item	:40 'X400' project: : to Beaumont, : Texas	Shallow-draft : : channel above : : Orange to Echo:	Total
<u>First cost</u>			
Federal:			
Corps of Engineers	\$20,990,000(1)	\$291,000(2)	\$21,281,000(3)
U. S. Coast Guard	<u>336,000</u>	<u>7,000</u>	<u>343,000</u>
Total Federal first cost	21,326,000	298,000	21,624,000
Non-Federal			
Non-Federal public	833,000	170,000	1,003,000
Non-Federal private	<u>545,000</u>	<u>None</u>	<u>545,000</u>
Total non-Federal first cost	1,378,000	170,000	1,548,000
Total first cost	22,704,000	468,000	23,172,000
<u>Additional annual maintenance</u>			
Federal:			
Corps of Engineers	620,000	None	620,000
U. S. Coast Guard	<u>19,000</u>	<u>1,000</u>	<u>20,000</u>
Total Federal additional annual maint. cost	639,000	1,000	640,000
Non-Federal	<u>49,000</u>	<u>None</u>	<u>49,000</u>
Total additional annual maintenance cost	688,000	1,000	689,000

- (1) Includes \$28,000 for preauthorization studies.
(2) Includes \$2,000 for preauthorization studies.
(3) Includes \$30,000 for preauthorization studies.

COORDINATION WITH OTHER AGENCIES.

89. Copies of the notice of public hearing held in Port Arthur, Texas, on December 6, 1960, were sent to all known Federal, State, and local agencies that might be interested in the proposed improvements. Written comments concerning the improvements were received from the U. S. Soil Conservation Service, the Texas Game and Fish Commission, the U. S. Bureau of Mines, and the U. S. Fish and Wildlife Service. Copies of the letters are included in this report as exhibits in appendix V.

90. None of the letters from other agencies expressed opposition to the plan of improvement. The Texas Game and Fish Commission and the U. S. Fish and Wildlife Service recommended that dredging operations for channel improvements be subject to the following conditions: (a) that spoil placed on the marshlands be confined to the smallest areas possible and be diked off to prevent unnecessary spillage and siltation of adjoining marsh habitat; (b) that the natural drainages connecting the project channels to the surrounding marshlands be maintained; and (c) that spoil areas used for this project be reserved for the sole purpose of future spoil disposal. The selection of spoil areas and method of disposal of excavated material would be fully coordinated with these two agencies during preconstruction planning of any improvements which might be authorized for construction. At that time any recommended locations and methods found practicable and economically justified would be adopted.

DISCUSSION

91. Local interests request that extensive improvements be made to the Sabine-Neches Waterway in order to provide channel dimensions adequate for the requirements of present and prospective vessel traffic and commerce. The improvements requested would provide for a depth of 43 feet in the Gulf of Mexico, including an extension of the outer bar channel seaward for a distance of about 15.3 miles through Sabine Bank, and a depth of 40 feet in the inland channels to Port Arthur, Beaumont and Orange. The requested channel widths would vary from a maximum of 1,000 feet in the outer channel through the open Gulf to minimum of 500 feet in the inland channels to Beaumont and 400 feet in the Sabine River to Orange. Various other improvements requested by local interests would provide for: (1) extension of the project in the Sabine River upstream from Orange to provide a 40 by 400-foot channel to the Interstate Highway 10 bridge and a shallow-draft channel 125 feet wide from that point to the Southern Pacific Railroad bridge at Echo; (2) enlargement of the existing shallow-draft channel in Cow Bayou to provide a channel 30 feet deep and 225 feet wide from the Sabine River to State Highway 87 bridge; (3) widening of the Neches River Channel to 700 feet bottom width for distances of 1,000 feet upstream and 1,000 feet downstream from each of the 5 major petroleum terminals on the Neches River; (4) maintenance, to a depth of 36 feet and a width of 350 feet, of a 2,200-foot reach of former project channel extending northwestward in the natural channel of the Neches River from the southerly end of a recently constructed cutoff near mile 41; (5) relocation of the authorized anchorage basin from the east side to the west side of Sabine Pass, deepening the basin to 40 feet and changing its length, width and shape; (6) replacement of the existing bridge crossing the Sabine-Neches Canal at Port Arthur by a new bridge with 500 feet horizontal clearance and 135 feet vertical clearance, or, alternatively, by a high level bridge or tunnel; (7) stabilization of the east bank of Pleasure Island from Sabine Pass to the Neches River, with consideration of immediate improvement in the reach from Pleasure Pier to a point opposite Ninth Avenue in the city of Port Arthur; and (8) relocation of the entire waterway from Sabine Pass to the mouth of the Neches River from its present route along the west side of Sabine Lake to a new route near the center of Sabine Lake.

92. The Sabine-Neches Waterway is one of the major waterways of the nation in waterborne commerce of petroleum and petroleum products. Total commerce on the waterway in 1960 was 68,693,211 tons, of which 41,130,656 tons were petroleum carried in seagoing vessels. Practically all deep-draft petroleum commerce on the waterway moves through shipping terminals located either at Port Arthur or along the Neches River from its mouth to Beaumont. Little or no such commerce moves over the leg of the waterway extending in the Sabine River to Orange. Substantial quantities of dry cargo move in deep-draft vessels from each of the three major ports, Port Arthur, Beaumont and Orange. Large quantities of shallow-draft barge commerce move over all parts of the main waterway above Port Arthur and a very

large amount of Gulf Intracoastal Waterway barge traffic moves as through traffic in the Sabine-Neches Canal and Sabine River sections of the Sabine-Neches Waterway. The authorized channel dimensions of the existing waterway are fully adequate for movement of all existing and prospective dry cargo commerce and of all petroleum commerce moving in tankers of 27,000 d.w.t. or less. At the present time, a number of larger supertankers are using the waterway to Port Arthur and Beaumont; however, these vessels load only partial cargoes and operate at less than fully loaded drafts.

93. In recent years the many new supertankers added to the United States tanker fleet to replace older, smaller tankers have caused a steady and rapid increase in the average vessel size of the fleet. While the total number of tankers has dropped, the total deadweight tonnage for the entire fleet has risen sharply. It is expected that this trend will continue for a number of years until most of the smaller vessels have been replaced. Analyses were made to determine the numbers and sizes of tankers comprising the existing United States tanker fleet and the composition of the prospective fleet, taking into account the trend toward larger vessels.

94. It was assumed that, if adequate channel dimensions were available, seagoing petroleum commerce on the Sabine-Neches Waterway would move in the various sizes of tankers approximately in the same proportions that the total deadweight tons of all vessels in each of several size groupings would have to the total deadweight tons of all vessels in the fleet. Based on this assumption and analyses of the prospective petroleum commerce and the prospective tanker fleet, it was determined that most of the prospective commerce would move in tankers of 40,000 d.w.t. or less, although small amounts would move in larger tankers. Criteria for determining channel depths required for various sizes of vessels indicates that the 40-foot depth requested by local interests would be adequate for fully loaded movements of all but a small fraction of the prospective vessel traffic. A depth of 43 feet would permit the use of fully loaded tankers of up to 53,000 d.w.t.; however, estimates of incremental benefits and costs indicated that the additional 3 feet of depth could not be economically justified at this time, because of the very limited prospective use of the waterway by the vessels larger than 40,000 d.w.t.

95. Criteria used to determine channel widths indicate that a minimum width of 400 feet would be required for the portions of the waterway carrying deep-draft petroleum commerce in the larger tankers and that a minimum width of 500 feet should be provided in the reach of waterway below the point of separation of the Port Arthur and Beaumont commerce. Accordingly, a 100-foot increase in width, or a total width of 500 feet, is proposed for the Port Arthur Canal from Sabine Pass to the entrance of the Port Arthur turning basin and a 50-foot increase in width, or a total of 400 feet, is proposed for the Neches River Channel from the mouth of the river to Beaumont. With these increased channel widths and a depth of 40 feet, tankers of up to 40,000 d.w.t. would be able to navigate the channel fully loaded with reasonable convenience and safety. Vessels larger than 40,000 d.w.t. would be able to use the waterway by some degree of light loading,

although the 400-foot channel width is not adequate for safe passing of two of the larger vessels. Because of the small number of such larger vessels that can be considered as prospective traffic at this time, it is considered unlikely that two of the vessels would be required to pass in the 400-foot width channels. It is believed that if reasonable precautions were used in scheduling and handling the large tankers on their occasional trips on the waterway, no particular difficulties would be encountered. The small delays resulting from scheduling would not be sufficient to warrant further improvement to prevent the delay.

96. The request of local interests for widened reaches of about 2,000 feet length in the Neches River Channel opposite each of 5 major oil terminals was carefully considered. The benefits from these improvements would result from reduction of damages caused by the surge effect of passing vessels on vessels moored at the wharves and from a savings in turnaround time of vessels which would be able to turn near the terminals. The magnitude of the surge effect is a function of several factors, including relation of vessel size to cross sectional area of the channel, speed of the passing vessel, distance from the passing vessel to the wharf area, and others. It is believed that widening and deepening of the Neches River channel will have much the same effect in reducing the surge effect of passing vessels at wharves as would the widened channel reaches desired by local interests. It is believed, also, that provision of facilities for turning vessels at each adjacent terminal is beyond the scope of improvements for general navigation ordinarily provided by the Federal Government. Further, if the objectionable surge effects persist after completion of the general enlargement of the channel, it is believed that the Chief of Engineers has sufficient authority to effect remedial measures under existing laws. Accordingly, the widened reaches of channel requested by local interests have not been included in the plan of improvement.

97. The only authorized turning basin for the Neches River channel is at Beaumont, about 18 miles above the river mouth. Under previous authorizations several major cutoffs have been constructed to bypass reaches of sharp curvature in bends of the natural river channel. Several of the junction areas formed by the excavated cutoff channels and the abandoned river bends have been used as turning points for vessels calling at terminals in the lower and middle reaches of the river. As the size of vessels has increased in recent years, turning of the vessels has become more of a problem. In order that the larger vessels calling at the down-river terminals will not be forced to travel the entire distance to the Beaumont turning basin, three turning points, each to provide a turning diameter of about 1,000 feet, including the 400-foot wide channel, have been included in the plan of improvement. These turning points can be economically constructed by slight enlargement of the junction areas of cutoffs and abandoned natural river bends at about miles 31.3, 37.2 and 41.0.

98. Maintenance of a 1,200-foot reach of former project channel near mile 41 would provide for continued access to an existing sulphur shipping

terminal and to other industrial sites below the sulphur company. The sulphur shipping terminal was located on this reach of channel several years ago and the company constructed an off-channel slip and modern wharf facilities to accommodate both deep-draft tanker and barge shipments of molten sulphur. Substantial amounts of commerce move to and from the terminal. A cutoff channel, authorized by the River and Harbor Act of September 3, 1954, has been recently constructed and, in accordance with established policy, no further maintenance would be performed in the natural river bend. Since the sulphur company located along an established waterway to utilize water transportation and has invested heavily in modern terminal facilities, it is believed that access to the company's facilities should be maintained. One of the turning points discussed in paragraph 96 would also be located at the junction of the natural river channel and the recently constructed cutoff and maintenance of only an additional reach of about 1,200 feet in the natural river channel would be required to reach the sulphur company.

99. With the increased use of larger vessels and the increasing volume of traffic on both the Sabine-Neches and Gulf Intracoastal Waterways, the existing highway bridge crossing the Sabine-Neches Canal at Port Arthur each year has become increasingly hazardous to navigation. The double-leaf bascule span provides a clear navigation opening of 200 feet along the westerly side of a channel, which has a full bottom width of 400 feet on both sides of the bridge. The main pier supporting the east bascule leaf is located approximately on the centerline of the 400-foot channel. Waterway traffic through the bridge is very heavy, since all of the Sabine-Neches Waterway traffic to points above Port Arthur and the entire Gulf Intracoastal Waterway traffic to points west of Beaumont passes through the bridge. Vessel pilots and operators are very reluctant to attempt passing other vessels in the narrow bridge opening. Numerous short delays result from the stopping or slowing of one vessel to await passage through the bridge of another vessel. This practice frequently creates a hazardous condition because of the loss of steerageway by the waiting vessel. It has become virtually impossible to maintain an adequate fender system through the bridge opening because of the frequency of damages resulting from the impact of passing vessels. Numerous vessels have collided with the bridge structure proper and, on several occasions, have rendered the movable spans inoperative for periods of several days. Fortunately, no catastrophic accidents have occurred, although this possibility always exists, both because of the highly volatile and explosive cargoes carried by a large percent of the vessels using the Sabine-Neches Waterway and because the bridge is located very close to the central business district of Port Arthur. The bridge would be further endangered by the proposed channel deepening and would become a definite hazard to navigation. Reconstruction of the bridge would be required under the proposed improvement. The new bridge would provide horizontal clearance equal to the full dimensions of the waterway channel. In view of the improvements that have been constructed on Pleasure Island and the insistence of local interests that no additional dredging spoil be deposited on Pleasure Island or in the adjacent shallow waters of Sabine

Lake, the probability of future widening of the Sabine-Neches Canal is considered remote. Accordingly, it is not considered necessary to provide additional width in the new bridge to allow for future widening of the channel. The bridge would provide a vertical clearance of 138 feet above mean low tide. The clearance conforms to clearance of 135 feet above the water surface elevation not exceeded 99 percent of the time, which is accepted for bridges over channels carrying seagoing traffic. The costs of replacing the existing bridge would be apportioned between Federal and local interests in accordance with the principles set forth in section 6 of the Bridge Alteration Act of June 21, 1940, as amended by the Act of July 16, 1952 (Truman-Hobbs Act). The proposed apportionment is described in paragraphs 86 and 87.

100. The plan of improvement proposed herein would provide generally for a 40-foot waterway from the Gulf to Port Arthur and Beaumont with channels adequate for fully loaded tankers as large as 40,000 d.w.t. and for limited use of larger tankers. The existing highway bridge crossing the Sabine-Neches Canal at Port Arthur would be unreasonably obstructive for prospective traffic and would be replaced with a new bridge with adequate navigation clearances. The Sabine River portion of the project would be improved by providing a 12 by 125-foot extension in the Sabine River from Orange to the Southern Pacific Railroad bridge at Echo. The total estimated first cost of the plan of improvement is \$23,172,000 with annual charges of \$1,383,000 and a benefits to costs ratio of 1.7. The proposed improvements would require a Federal first cost of \$21,624,000 including \$30,000 which has been expended for preauthorization survey and study costs, and \$343,000 for aids to navigation. The increased annual maintenance costs to the Federal Government are estimated at \$620,000 for maintenance dredging and \$20,000 for aids to navigation. The total first cost to local interests for channel improvements is estimated at \$1,548,000. The present estimate of first cost to local interests for relocation of the highway bridge at Port Arthur is \$398,000 for lands and damages and expired service life of the existing bridge. This estimate, however, does not include the costs for special benefits and betterments attributable to highway use, which depend upon the final design, and are not known at this time.

101. Benefits from stabilizing the westerly bank of Pleasure Island, as desired by local interests, would accrue from: (1) prevention of damages to existing improvements on the island, (2) enhancement in value of existing undeveloped land that would otherwise be affected by the continuing erosion, and (3) reduction in maintenance dredging costs of the adjacent waterway. Under existing Federal policies only the latter can be considered to have a degree of Federal interest. The erosion results largely from dissipation of energy in the trailing wake and waves of passing vessels and, thus, is a consequential damage resulting from use of the waterway. Generally, in law, each vessel owner is responsible for damages caused by negligent or careless operation of his vessel. Further, the terms of local cooperation for Federal navigation projects provide that local interests shall furnish all rights-of-way and shall hold and save the Federal Government free from damages due to construction of the project. Thus, it is clear that any liability for damages resulting from use of the project would not lie with the Federal Government. In view of the large cost of providing adequate protection for the 16-mile reach of the westerly bank of Pleasure Island, the small benefits to be derived

clearly would not justify the cost; furthermore, existing policies would require that most of the costs be apportioned to local interests. Accordingly, bank stabilization is not recommended.

102. The proposed re-routing of the waterway through Sabine Lake was carefully considered. The Federal interest in the relocated channel would be small, since there would be few navigation benefits. Most of the benefits claimed by the advocates of the proposal are based on speculative development of activities not related to navigation. Even if the proposed re-routing were economically justified by the claimed benefits, present policies would apportion most of the cost of the improvement to local interests. Furthermore no financially responsible agency offered local cooperation. Accordingly the proposal has not been favorably considered. Additional information on recommended and alternative projects called for by Senate Resolution 148, 85th Congress, adopted January 28, 1958, is contained in an attachment to this report.

103. Recent news has announced the formation of the Colonial Pipeline Co., for the purpose of constructing a 36-inch pipeline from the Gulf Coast to Linden, New Jersey. The pipeline would be supplied by the refineries between Houston, Texas and Baton Rouge, Louisiana, and would have a capacity reported at 600,000 to 900,000 barrels of petroleum a day. Four of the companies with refineries on the Sabine-Neches Waterway are participating in the pipeline project. The effect that this pipeline would have on the shipment of petroleum products in supertankers from the Sabine-Neches Waterway has been carefully considered. The question is discussed in paragraphs 43, et seq., of appendix II. It is concluded that the pipeline, if constructed, might reduce the prospective deep-draft shipment of petroleum products from the Sabine-Neches Waterway by as much as 20 percent. If the movement in supertankers, on which benefits from the improvements recommended in this report are realized, were proportionately reduced the ratio of benefits to costs of the proposed deep-draft improvements, estimated on a 100-year project life, would be reduced to 1.5. The pipeline project is considered to be still in the planning stage and it is not considered desirable to include its effect in the economic analysis presented in this report.

104. The River and Harbor Acts of June 20, 1938 and July 24, 1946 authorized a 50-foot widening for the channel between the Port Arthur West turning basin and the Taylors Bayou turning basin. It has not been possible to obtain right-of-way for the authorized widening for one-third the length of the channel. The River and Harbor Act of September 3, 1954 authorized widening the entrance to the Port Arthur turning basins to a width of 350 feet. Subsequent to preparation of the survey report (Senate Doc. 80, 83d Cong., 2d sess.) and prior to authorization of the improvement, an industry was located on the adjacent land and right-of-way cannot be obtained for the authorized navigation improvement. To obviate necessity for scheduling and programming construction of these authorized improvements, which cannot be constructed within the foreseeable future, it is proposed to change the authorized width dimensions of the entrance to the Port Arthur turning basins and of the channel connecting the Port Arthur West turning basin with Taylors Bayou turning basin to correspond with the actual constructed dimensions of the channels.

CONCLUSIONS

105. Based on the findings of this investigation, it is concluded that:

a. The authorized dimensions of the Sabine-Neches Waterway from the Gulf of Mexico to Port Arthur and Beaumont are not adequate to accommodate with reasonable safety and convenience the large tankers of over 27,000 d.w.t. that are now in existence and under construction, and which, within a few years, will carry up to 40 percent of the prospective seagoing petroleum commerce on the waterway;

b. The authorized dimensions of 30 by 200 feet in the channel from the mouth of the Neches River to Orange and the authorized dimensions of 13 by 100 feet in Cow Bayou are adequate to accommodate the existing and prospective commerce that would move over these sections of the waterway and no additional improvement is warranted at this time;

c. The existing and prospective commerce in the Sabine River above Orange cannot be accommodated with reasonable safety and convenience in the natural river channel. Extension of the Sabine-Neches Waterway project and construction of the improvements necessary to provide a 12 by 125-foot channel from the foot of Green Avenue in Orange to a point near the Southern Pacific Railroad bridge at Echo, a total distance of about 4.6 miles, is fully justified;

d. The existing double-leaf, bascule highway bridge crossing the Sabine-Neches Canal at Port Arthur would be endangered by the channel enlargement and would be a serious hazard to navigation. The bridge should be removed and replaced by one with horizontal clearance at least equal to the channel width and vertical clearance of at least 138 feet above mean low tide;

e. Construction of five 2,000-foot reaches of 700-foot width channel in the Neches River opposite each of five major oil shipping terminals, as desired by local interests, is not warranted at this time. Three additional turning points, with turning diameter of about 1,000 feet, should be provided at strategic locations in the Neches River Channel. These can be constructed economically by slight enlargement of the junction areas between abandoned bends of the natural river and cutoffs in the navigation channel at about channel miles 31.3, 37.2 and 41.0. An additional reach of about 1,200 feet of former project channel in the natural channel of the Neches River should be maintained to a depth of 36 feet and a width of 350 feet upstream from the turning point at mile 41 to provide access to existing terminals.

g. The most feasible plan of improvement for enlarging the authorized waterway to accommodate fully loaded tankers up to 40,000 d.w.t. and provide for limited use of larger tankers was found to be deepening and extending the outer bar channel to a depth of 43 feet in the Gulf of Mexico; deepening the inland channels to 40 feet to Port Arthur and Beaumont, including the Sabine Pass Anchorage basin, the Port Arthur turning basins, approaches

thereto and connecting channels; widening the Port Arthur canal to 500 feet and the Neches River Channel to 400 feet; constructing 3 turning points in the Neches River Channel; and relocating the existing highway bridge crossing the Sabine-Neches Canal at Port Arthur to provide adequate horizontal and vertical clearances for navigation and providing for accommodation of vehicular and pedestrian traffic in a manner equivalent to that provided by the existing bridge. The total first cost of the proposed deep-draft channel improvements, including relocation of the bridge, is estimated at \$22,704,000. The improvements would have annual charges of \$1,368,000, annual benefits of \$2,346,000 and a benefits to cost ratio of 1.7.

h. To accommodate existing and prospective commerce to industries located along the Sabine River above Orange, the waterway project should be extended to provide a 12 by 125-foot channel in the Sabine River from the foot of Green Avenue in Orange to a point near the Southern Pacific Railroad bridge near Echo, a distance of about 4.6 miles. The estimated total first cost of the proposed shallow-draft improvement is \$468,000 with annual charges of \$15,000, annual benefits of \$28,000 and a benefits to costs ratio of 1.9.

i. The total first costs of the proposed improvements described above is estimated at \$23,172,000, of which \$21,624,000 would be apportioned to the Federal Government and \$1,548,000 would be apportioned to local interests. The Federal first cost of \$21,624,000 would be allocated in the amounts of \$21,281,000 to the Corps of Engineers for channel improvements and replacement of the obstructive bridge at Port Arthur and \$343,000 to the U. S. Coast Guard for aids to navigation. The allocated amount of \$21,281,000 to the Corps of Engineers includes \$30,000 which has been expended for preauthorization survey and study costs. The estimated first cost of \$5,241,000 for relocation of the bridge would be apportioned in accordance with principles of the Truman-Hobbs Act, referred to in paragraphs 86 and 87, with shares presently estimated at \$4,843,000 for the Federal Government and \$398,000 for local interests, exclusive of the cost of any features incorporated into the replacement bridge at the request of local interests and which are betterments solely for the benefit of vehicular and pedestrian traffic, when compared to the existing bridge. The increased cost of annual maintenance to the Federal Government for the improvements described above is estimated at \$640,000 including \$620,000 for maintenance dredging and \$20,000 for aids to navigation.

j. Local interests should be required to:

- (1) Furnish all rights-of-way and spoil disposal areas.
- (2) Accomplish all necessary relocations except the obstructive highway bridge at Port Arthur.
- (3) Hold and save the United States free from any damages that may result from construction of the improvements.

(4) Contribute in cash, a share of the costs for relocating the highway bridge at Port Arthur, in accordance with the principles of section 6 of the Bridge Alteration Act of June 21, 1940, as amended by the Act of July 16, 1952. The local share is presently estimated at \$398,000, for lands and damages and expired service life of the existing bridge. This estimate, however, does not include the costs for special benefits and betterments attributable to highway use, which depend upon final design, and are not known at this time.

106. It is further concluded that the authority for construction of the unconstructed portions of two small portions of elements of improvement at the entrance to the Port Arthur turning basins and in the channel connecting the Port Arthur West turning basin, which were authorized, respectively, by the River and Harbor Act of September 3, 1954 and by the Rivers and Harbors Acts of July 24, 1946 and June 20, 1938, should be rescinded.

RECOMMENDATIONS

107. Accordingly, it is recommended that the existing project for Sabine-Neches Waterway, Texas, be modified to provide for the following improvements generally as described in this report:

a. A depth of 43 feet in the Sabine Pass outer bar channel extending from Sabine Bank in the Gulf of Mexico to a point in the jetty channel about 1,000 feet inshore from the outer end of the jetties, and a depth of 40 feet in the remainder of the jetty channel and all inland channels to Port Arthur and Beaumont, including the Sabine Pass anchorage basin, Port Arthur turning basins, approach channel thereto and connecting channels, and including the turning area immediately downstream from the Beaumont turning basin.

b. A width of 500 feet in the Port Arthur Canal and a width of 400 feet in the Neches River channel from its junction with the Sabine-Neches Canal to the turning area at Beaumont.

c. Three turning points with a depth of 40 feet over an area providing a minimum turning diameter of 1,000 feet at the junctions of natural river bends and navigation channel cutoffs near channel miles 31.3, 37.2 and 41.0.

d. Maintenance of a reach of former project channel, 36 feet deep and 350 feet wide, in the natural channel of the Neches River and extending upstream about 1,200 feet from the turning point at mile 41.

e. A channel, 12 feet deep and 125 feet wide, extending in the Sabine River from the foot of Green Avenue in Orange to a point near the Southern Pacific Railroad bridge at Echo, a distance of about 4.6 miles.

All of the above to be constructed at an estimated first cost to the United States of \$21,251,000 for new work and an increase of \$620,000 in the cost of annual maintenance.

108. The foregoing recommendation shall be subject to the condition that the local interests shall agree to:

a. Provide without cost to the United States all lands, easements and right-of-way required for construction and subsequent maintenance of the project and of aids to navigation upon request of the Chief of Engineers including suitable areas determined by the Chief of Engineers to be required in the general public interest for initial and subsequent disposal of spoil and necessary retaining dikes, bulkheads and embankments therefor or the costs of such retaining works.

b. Hold and save the United States free from damages that may result from construction of the project.

c. Accomplish, without cost to the United States, all alterations of pipelines, powerlines, utility lines, cables, and highway facilities, excepting the bridge at Port Arthur, when and as required for construction of the project.

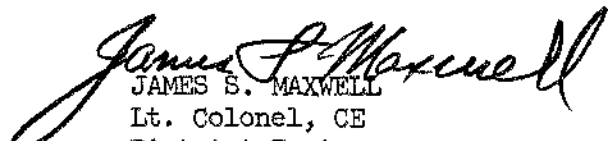
d. Furnish without cost to the United States all necessary rights-of-way and easements required for relocating the highway bridge at Port Arthur and contribute, in cash, a share of the construction costs of the relocation computed in accordance with the principles of section 6 of the Bridge Alteration Act of June 21, 1940, as amended by the Act of July 16, 1952.

e. Assume all obligations of ownership, operation, and maintenance of the replacement bridge upon its completion.

109. The foregoing shall be subject to the condition that no dredging shall be done within 50 feet of any established pierhead line, wharf or structure.

110. It is further recommended that the authority for the unconstructed enlargement of the channel connecting Port Arthur West turning basin with Taylors Bayou turning basin, authorized by the River and Harbor Acts of June 20, 1938 and July 24, 1946 and the authority for unconstructed enlargement of the entrance channel to the Port Arthur turning basins, authorized by the River and Harbor Act of September 3, 1954, be rescinded.

- 3 Incl
1. Plate 1
2. Appendixes I thru V
3. Attachment


JAMES S. MAXWELL
Lt. Colonel, CE
District Engineer

[First endorsement]

SWDGW-4

SUBJECT: Review of Reports on Sabine-Neches Waterway, Texas

United States Army Engineer Division, Southwestern, Dallas, Texas

March 19, 1962

TO: Chief of Engineers, Department of the Army, Washington, D.C.

I concur in the conclusions and recommendations of the District
Engineer.



C. H. DUNN
Colonel, CE
Division Engineer

REVIEW OF REPORTS
ON
SABINE-NECHES WATERWAY, TEXAS

APPENDIX II

ECONOMICS

1. General.- Economics herein covers the requested enlargement of the authorized channels and basins of the Sabine-Neches Waterway and the improvement of the Sabine River from the present head of navigation at the foot of Green Ave. in Orange, to the S.P. RR bridge near Echo, Texas. The improvements discussed in this appendix are considered separately under four categories: (a) improvements to the deep-draft channels and basins that are used by tank vessels; (b) improvements to deep-draft channels and basins that are used by dry cargo vessels, but not by tank vessels; (c) improvements to shallow-draft channels and basins used by barge traffic; and (d) miscellaneous improvements. The studies cover not only the improvements requested by local interests but alternate improvements considered adequate to accommodate prospective traffic on the several reaches of the waterway.

2. This appendix contains three sections, (a) commerce, (b) vessel traffic, and (c) benefits. The section pertaining to commerce contains data on existing and prospective commerce as furnished by the shippers along the canal and verified by supporting data on commercial statistics compiled annually by the Corps of Engineers. The section on vessel traffic presents information on trips and drafts of vessels, as pertains to existing commerce and supporting data for the analysis of estimated future vessel traffic to determine future channel requirements. The section pertaining to benefits gives the analysis and computations, with pertinent supporting data, that are used in deriving the estimated benefits that would be derived from proposed improvements of this waterway.

3. The analyses and computations are based on data and statistics computed from a survey of the waterway, records, and from statistical data furnished by maritime and industry representatives, and interviews with local interests. Specialized information, such as the commercial statistics compiled annually by the Corps of Engineers, the Panama Canal investigations conducted by the Corps of Engineers, and the David W. Taylor model studies of the United States Navy, was consulted for information pertinent to the project.

COMMERCE

4. Existing commerce.- A detailed tabulation of the reported commerce on this waterway for calendar years 1951 through 1960 is shown in detail in exhibit 1 of this appendix.

5. The total annual commerce at each of the four ports on the Sabine-Neches Waterway, Texas, for the 10-year period 1951 to 1960, inclusive, is given in table A.

TABLE A
SABINE-NECHES WATERWAY, TEXAS
ANNUAL COMMERCE - 1951 THROUGH 1960

Commerce in tons (2,000 pounds)						
Year:	Sabine Pass Harbor	Port Arthur	Beaumont	Orange	Through traffic(3)	Total(1)
1951	3,755(2)	22,801,523	22,334,665	1,056,207	8,284,107	54,365,948
1952	1,021	22,027,427	21,442,034	1,094,876	10,119,988	54,622,754
1953	785	22,309,765	23,422,652	1,221,374	9,875,789	56,763,206
1954	187,395	19,925,081	22,684,282	1,192,008	9,599,427	53,523,810
1955	165,659	21,577,553	22,862,971	1,130,729	10,571,135	56,233,895
1956	329,593	24,832,926	25,731,843	936,234	11,075,150	62,790,305
1957	681,121	23,532,813	25,680,572	1,125,995	11,702,323	62,638,250
1958	207,111	23,530,210	24,529,907	1,358,697	11,103,442	60,674,062
1959	216,509	23,095,561	26,125,522	944,281	12,365,816	62,474,378
1960	365,282	28,207,396	27,113,480	1,022,784	12,412,921	68,693,211

- (1) Excluding duplications
- (2) Seashells dredged from Lower Sabine Lake excluded beginning calendar year 1951
- (3) Intracoastal Waterway barge traffic

6. The total annual commerce of the waterway has shown an average gain of about 1,600,000 tons annually during the period. Table A also shows that each of the four ports on the waterway has shared in this growth.

7. The principal products moved on the waterway are petroleum and petroleum products. Table B shows a summary of the total annual tonnage of these commodities moving on the waterway in seagoing vessels and barges for the 10-year period 1951 through 1960.

TABLE B
SUMMARY OF COMMERCE IN PETROLEUM AND PETROLEUM PRODUCTS
SABINE-NECHES WATERWAY, TEXAS
(1951 through 1960)

Year	Commerce (in tons of 2,000 pounds)				
	Seagoing		Total		
	Foreign	Coastwise	seagoing	Barge	Total
1951	1,292,049	35,862,710	37,154,759	12,635,872	49,790,631
1952	1,194,993	32,478,653	33,673,646	15,791,222	49,464,868
1953	1,460,165	35,105,112	36,565,277	13,423,484	49,988,761
1954	1,248,476	34,732,227	35,980,703	11,249,674	47,230,377
1955	1,162,569	36,267,939	37,430,508	11,219,320	48,649,828
1956	2,117,758	38,959,324	41,077,082	13,334,989	54,412,071
1957	2,716,442	36,143,937	38,860,379	14,961,980	53,822,359
1958	1,535,067	36,111,521	37,646,588	14,420,867	52,067,455
1959	1,324,848	36,334,075	37,658,923	15,585,565	53,244,488
1960	1,653,560	39,477,096	41,130,656	17,279,546	58,410,202

8. Comparative statistics in table A and table B illustrate that petroleum and its products have been the principal commodities moved over the waterway for the 10-year period. Table B also shows that petroleum moving in the coastwise trade represents the major portion of the total petroleum commerce moving on the waterway. Since improvement of the channels of the waterway would be required only to accommodate larger tank vessels carrying petroleum and petroleum products, and since the major part of the petroleum commerce is the coastwise movement of these commodities, further discussion of the existing commerce is limited to the coastwise movement of petroleum.

9. Petroleum moving in the coastwise trade has increased about 10 percent over 1951 tonnages; however, since 1958, refining capacities in the area served by the waterway have been increased. As shown on plate 2 of the economic base study, 1960 refining capacities of the refineries at Beaumont and Port Arthur represent about 10 percent of the total refining capacity of the United States. The recent increase in refining capacity is reflected in the coastwise movement of petroleum in 1960 which, as shown in table B, exceeded by over 3 million tons the commerce moved in 1959.

10. Studies were made of factors affecting future trends of waterborne commerce, including production of plant installations along the waterway; changes in vessel sizes contemplated by the owners of the transport vessels, and any material changes that could be expected in the future development

of the area. No material change in the future production and quantity of petroleum and petroleum products is expected at this time. Analysis of the existing commerce and prospective future development indicates that no rapid changes will occur in the seagoing petroleum movement on the waterway, and that this commerce will continue to be the principal commodity moved on the waterway during the life of the project. It is also estimated that an increase in total cargo will amount to less than 1 percent annually over the life of the project.

11. Prospective commerce in petroleum and petroleum products.- Petroleum and petroleum products moved on the waterway increased from 49,790,631 in 1951 to 58,410,202 tons in 1960 or approximately 1.9 percent a year. The projected petroleum tonnage on the Sabine-Neches Waterway in the year 2015 is estimated at 90,000,000 tons, as shown in paragraph 18 of exhibit 5, and is distributed as shown in table C.

TABLE C

PROJECTED ANNUAL COMMERCE IN PETROLEUM AND PETROLEUM
PRODUCTS ON THE SABINE-NECHES WATERWAY
IN THE YEAR 2015

Trade	Commerce in tons (2,000 pounds)		
	Seagoing	Internal	Total
Foreign trade	2,500,000	-	2,500,000
Coastwise trade	61,000,000	-	61,000,000
Barge shipments	-	26,500,000	26,500,000
Total	63,500,000	26,500,000	90,000,000

12. The petroleum industry is responsive to numerous variable factors. Some of these factors include state production allowables; Federal import and export regulations; rapid fluctuations in the world and domestic petroleum markets; depletion of existing reserves; development of new resources; and rapid technological advances in discovery, production and recovery techniques. Because of these factors the long-range future position of the petroleum industry in the overall economic complex is difficult to evaluate; however, it is conservatively estimated that petroleum commerce over a project life of 100 years will sustain an overall increase of about 10 percent during the second 50 years to an annual commerce in the year 2065 of about 99,000,000 tons, of which 70,000,000 tons will be seagoing commerce.

13. The industrial structure of the Orange complex is based primarily on the chemical and petro-chemical industry. The products of this industry are both final consumptive articles and intermediary chemicals

used in further manufacturing. This industry develops a diversity of high value products of comparatively small volume. The transportation of the products is by rail, pipeline and barge, with only small movements by seagoing vessels. The raw materials supplying these plants are primarily petroleum and petroleum products moved by barge and pipeline from the vast resources of the Gulf coast to the plants. This movement does not use seagoing vessel traffic. As shown in table D, the seagoing commerce of Orange has averaged about 50,000 tons annually during recent years. The trend in the traffic does not appear to be markedly upward, nor are developments in the area conducive to large seagoing commerce. An increase to 500,000 tons annually over the next 50 years would represent a considerable increase in industrial development. The three major sources of seagoing traffic, namely crude petroleum, refined petroleum products, and an extensive market area for trade are not evidenced in Orange.

14. Channel from Neches River to Orange municipal slip.- The water-borne statistics for this channel show that the tonnage for 1960 was 1,022,784 short tons, a decrease of 33,423 short tons from the 1951 tonnage. Between the years of 1951 and 1960 the lowest tonnage was 936,234 in 1956, and the highest tonnage was 1,358,697 tons in 1958. In 1960, 247,851 tons of shell were moved as internal domestic receipts and shipments. Details of the seagoing commerce of the port of Orange are shown in table D by trade distribution for the 10-year period 1951 through 1960.

TABLE D
ANNUAL SEAGOING COMMERCE OF ORANGE, TEXAS
PERIOD 1951-1960

Year	Seagoing commerce in tons (2,000 pounds)					Total
	Foreign		Coastwise			
	Imports	Exports	Receipts	Shipments		
1951	7,379	53,224	0	162,688		223,291
1952	2,276	40,759	0	134,252		177,287
1953	11,662	13,199	9,377	134,628		168,866
1954	2,016	9,325	0	82,489		93,830
1955	0	24,748	0	106,101		130,849
1956	562	83,584	0	19,775		103,921
1957	0	86,950	0	0		86,950
1958	2	31,732	0	46,900		78,634
1959	1,102	31,228	0	4,962		37,292
1960	16	53,728	0	0		53,744

15. Cow Bayou Channel.- Existing commerce of Cow Bayou consists principally of shell from Sabine Lake, moved by barge to unloading terminals, on Cow Bayou. Occasional shipments of oilfield supplies are brought into

the bayou. The Orange County Navigation and Port District stated in its brief, "It is felt that the area served by the Cow Bayou channel affords splendid locations for industry and to neglect to develop this part of our waterways would result in a great loss to economic growth of the entire community." There was no classification of the commerce nor were any definite commitments of prospective commerce given. The Orange Chamber of Commerce stated in its brief that there is a need for studying a deep-draft channel in Cow Bayou because of the anticipated future needs. Until more industries are established or firm commitments are made to locate on this channel, an improvement at this time would have to be justified on anticipated and speculative commerce and business.

16. Sabine River - Orange to Echo.- According to local interests and substantiated by information published in the Department of the Army, Corps of Engineers "Waterborne Commerce of the United States," for calendar year 1960, the present commerce moving over the Sabine River above Orange, Texas, consists of approximately 250,000 tons of seashell and approximately 64,000 tons of crude oil. The shell is moved to a plant near Echo for use in manufacture of portland cement. The crude oil is moved to a chemical plant at Echo. Within the next two years local interests claim that planned expansion of the cement plant capacity will increase the movement of seashell to approximately 750,000 tons a year. There is no expansion proposed which would affect the movement of crude oil over this portion of the waterway.

VESSEL TRAFFIC

17. Detailed tabulations of the trips, drafts, and number of vessels using each portion of the existing Sabine-Neches Waterway during calendar year 1960 are given in exhibits 3 and 4. The trips and drafts of seagoing vessels in the two categories of "tankers" and "others" consolidated for the entire waterway are summarized and shown in table E. Similar statistics for the vessel traffic to the port of Orange are summarized and shown in table F.

TABLE E

TRIPS AND DRAFTS OF SEAGOING VESSELS ON
SABINE-NECHES WATERWAY (Consolidated)

Draft (in feet)	Calendar year 1960					
	Number of trips of vessels					
	Inbound			Outbound		
	Tankers	Others	Total	Tankers	Others	Total
36	3	-	3	17	-	17
35	62	-	62	187	-	187
34	28	-	28	169	-	169
33	4	1	5	50	-	50
32	16	-	16	410	5	415
31	64	7	71	586	8	594
30	9	7	16	85	58	143
29	18	16	34	197	79	276
28	38	35	73	42	77	119
27	32	36	68	33	54	87
26	18	42	60	31	76	107
25	24	54	78	17	62	79
24	37	47	84	22	64	86
23	44	61	105	10	71	81
22	81	69	150	16	71	87
21	82	40	122	9	50	59
20	380	60	440	77	67	144
19	387	69	456	18	61	79
18 & less	789	477	1266	64	259	323
Total	2116	1021	3137	2040	1062	3102

TABLE F

TRIPS AND DRAFTS OF VESSELS ON
ORANGE, TEXAS (SABINE RIVER) PART OF WATERWAY
CALENDAR YEAR 1960

Draft (in feet)	Number of trips of vessels					
	Inbound			Outbound		
	Seagoing	Others	Total	Seagoing	Others	Total
28	-	-	-	1	-	1
26	3	-	3	2	-	2
25	1	-	1	1	-	1
24	1	-	1	3	-	3
23	2	-	2	2	-	2
22	5	-	5	5	-	5
21	-	-	-	1	-	1
20	2	-	2	3	-	3
19	1	-	1	2	-	2
18 & less	19	2939	2958	16	2946	2962
Total	34	2939	2973	36	2946	2982

18. Cow Bayou channel.- No commercial statistics are available on the trips and drafts of vessels on the channel in Cow Bayou. The traffic comprises barge tows moving shell and oil field supplies.

19. Barge traffic to SP RR bridge - Sabine River.- Present vessel traffic consists of two types of tows, that is open barges for moving shell, and tank barges for moving crude oil. The snags, logs and short bends in the 2.5 miles below Echo limit tows to one barge at a time. Other vessel traffic consists of small fishing boats and pleasure craft.

20. Tank vessels.- Since the dimensions of the channels to Port Arthur and Beaumont should be designed to accommodate the prospective traffic in tank vessels, a survey of current trends in the building of tankers in the United States and world shipyards was made to determine the size changes that could be expected in the tanker fleet during the 100-year life of the project. A marked increase in size is apparent, particularly in those vessels engaged in the Near East trade where operation of the huge vessels is not restricted to the same degree that coastal vessels are limited by harbor dimensions. The vessels in the Near East trade apparently have no established limit on size since one vessel of 106,000 d.w.t. is in operation, at least two oil tankers of 130,000 d.w.t. are under construction in Japan, and one oil tanker of 106,500 d.w.t. has been launched in the United States. Vessels under American registry are extending into the 50,000 to 100,000 d.w.t. class; however, the greatest number of tankers completed and under construction are in the 27,000-50,000 d.w.t. class. A summary of data obtained by the survey referred to above is given in exhibit 2, which shows that individual tankers are being built longer,

wider and capable of carrying greater tonnage. This table shows that there will be at least 982 tank vessels of greater than 20,000 d.w.t. in the world tank fleet in the near future, and that 690 of these vessels will exceed 27,000 d.w.t. Of the 660 completed vessels exceeding 27,000 d.w.t., 88 are under American registry and 572 are under foreign registry. Of the 30 tankers larger than 27,000 d.w.t. now under construction, 13 are being built in the United States. On the basis of past experience 4 of these vessels will be registered under the United States flag when completed which will give a total of 92 tankers greater than 27,000 d.w.t. registered in the United States and of which 87 will fall between 27,000 d.w.t. and 63,000 d.w.t.

21. A review of the detailed vessel traffic for 1960 over the waterway, given in exhibit 4, with particular attention to loaded drafts, shows that tanker operators are already crowding the draft tolerances on the waterway to the limit. An examination of records of actual transits of tankers was made and a summary was prepared of the vessels using the channels, that moved in loaded drafts of 32 feet or greater in 1960. Such tankers transited the waterway 833 times in 1960. These vessels had loaded drafts to 36 feet. Oil company representatives and ship operators have stated that larger ships would be put into service if adequate channel and harbor dimensions were provided for safe operation of the larger vessels. These vessels would not depend on additional petroleum commerce, but would supplant the smaller tankers in the existing service because of the lower ton-mile cost that would be available in the larger tankers. The use of foreign vessels in the coastwise trade is not legally possible under normal conditions. However, the general trend in tanker construction is toward larger vessels because of the economy of operation, and use of the larger vessels in coastwise trade in petroleum and petroleum products is rapidly increasing. It was found that tankers of greater than 27,000 d.w.t. comprised about 3.5 percent of the privately-owned American tanker tonnage in 1951, about 12 percent in 1956, and about 26 percent in 1959. Since many of the T-2 type vessels built during World War II are approaching the useful life of about 20 years and because of the apparent trend toward larger vessels, it is estimated that tankers in excess of 27,000 d.w.t. will constitute at least 40 percent of the United States tanker fleet during the life of the proposed improvement, and that tankers in excess of 40,000 d.w.t. will constitute at least 12 percent of the future United States tanker fleet.

22. Channel depths necessary to accommodate vessels are determined from a consideration of the factors of trim, squat, and clearance in addition to the draft of the vessel. Shipping interests state that the uneven loading of a vessel by the stern, or trim, of 2 to 3 feet frequently is advisable, and an allowance of at least 1 foot to this factor is considered warranted.

23. The "squat" or sinkage of a vessel, when underway, is determined by numerous factors, including the width and depth of the channel related to the hull size and shape, and the speed of a vessel. Consequently, no definite allowance can be fixed that would be applicable to all vessels

on a particular waterway. However, based on available information, it is considered that an allowance of 1 foot, generally, is adequate for the larger tankers up to 40,000 d.w.t. moving at speeds up to 6 knots in channels 400 feet wide and 40 feet deep. An allowance of 2 feet for clearance between the keel of the vessel and the bottom of channel is considered adequate in channels such as the Sabine-Neches Waterway which have soft bottoms and where no particular damage is caused if a vessel should scrape bottom. These factors give a total required channel depth 4 feet greater than the mean draft of the larger vessels using the channel. From the foregoing considerations, it is considered that the authorized channel depth of 36 feet is adequate for vessels up to 27,000 d.w.t. with drafts of 32 feet. A channel depth of 40 feet would accommodate fully loaded vessels up to 40,000 d.w.t. and a depth of 43 feet would accommodate fully loaded vessels up to 53,000 d.w.t.

24. The channel width required for safe and economical operation of vessels is not as definite as the depth requirements. The navigation district states that a width of 500 feet is required for the large tankers. The American Merchant Marine Institute states that the requested channel widths of 500 to 600 feet are necessary for two-direction traffic for two large tankers of 90-foot beam passing each other. A Panama Canal report on an investigation of channel dimensions, and a United States Navy report on the David W. Taylor model studies on ship maneuvers in restricted channels were reviewed in order to determine the applicability of the method derived therein to a determination of channel dimensions for the Sabine-Neches Waterway. Based on these criteria, the indicated channel widths are: 350 feet for passing of two tankers of 27,000 d.w.t. with beams of 80 feet; 400 feet for the passing of two vessels of 38,000 d.w.t. with beams of 90 feet; 450 feet for passing of two tankers of 40,000 d.w.t. with beams of 95 feet, and 500 feet for passing of two larger tankers with beams of 105 feet.

25. Consideration was given to the depth and width requirements for reasonably safe navigation and the density and size of prospective vessel traffic on the several reaches of the Sabine-Neches Waterway. It is concluded that the authorized channel depth and width of 36 feet by 400 feet are adequate for tankers up to 26,000 d.w.t. For the larger tankers from 27,000 to 40,000 d.w.t., however, the authorized channel dimensions should be increased to 40 feet in depth and to 400 feet in width. Tank vessels of 40,000 to 53,000 d.w.t. would require a channel depth of 43 feet and a channel width of 500 feet in reaches with a traffic density sufficient to invoke passing of two such tankers.

BENEFITS

26. The benefits that would accrue to the various improvements considered in this report would be derived from a savings in cost of transportation of petroleum commerce from the use of larger tankers with greater loads than are now carried on the deep-draft channels of the waterway, a savings in travel time of tankers, a reduction in hazards to navigation on the deep-draft portion of the waterway and a reduction in travel time on the shallow-draft channel to the S.P. RR bridge near Echo on the Sabine River. Detailed studies, made to determine the respective estimated savings in transportation cost for each of the improvements considered in this report, are presented in the following paragraphs.

27. Tanker fleet.- As discussed in paragraph 25 of this appendix, the existing project depths and widths of 36 feet and 400 feet, respectively, are ample to accommodate with reasonable safety and convenience fully loaded tankers up to 27,000 deadweight tons and larger tankers partly loaded. The increased dimensions considered in this report would permit fully loaded tankers up to 40,000 d.w.t. on a 40-foot channel and up to 53,000 d.w.t. on a 43-foot channel. It is further considered that vessels up to 63,000 d.w.t. would operate partly loaded on the improved channels. The data on tankers in the United States registry, shown on exhibit 2 of this appendix, and data in the Sun Oil Company's "Analysis of World Tank Ship Fleet," dated December 1960, were analyzed to establish a straight line correlation between vessel loaded draft and deadweight tonnage. A curve was plotted of draft against deadweight tonnage. A similar curve is given in a study of tanker characteristics prepared by the Board of Engineers for Rivers and Harbors, Corps of Engineers. From these data an average curve with a 3,600 ton increment in deadweight tonnage for each foot increase in load draft was adopted. The formula for this curve is: $\text{Draft} = 24.5 + (.000278 \text{ d.w.t.})$. The deadweight tonnages of vessels were placed in the given group as shown in table G, then the number of vessels from exhibit 2 in each group was shown and used to compute the deadweight tonnage of vessels drawing an even number of feet of water in each group beginning with the first group that the computed d.w.t. vessels fell in above 27,000 d.w.t. In this referenced table the total tonnage of ships in the group 27,000 to 63,000 d.w.t. is 2,652,000. The percentage of the vessel deadweight tonnage in each group was computed and shown in the table. Similarly the percentages in each tonnage group from 40,000 d.w.t. to 63,000 d.w.t. were computed.

TABLE G

COMPUTATION OF PERCENTAGE OF VESSEL IN
EACH DEADWEIGHT TONNAGE GROUP IN
PORTION OF U. S. TANKER FLEET

Draft: feet :	DWT	:Number : of : tankers :	: Percent		
			: Total : (27,000 d.w.t. : tonnage: to 63,000 d.w.t.) :	: (40,000 d.w.t. : to 63,000 d.w.t.) :	
32	27,000	13	-	-	
33	30,600	40	1,232,000	46.5	
34	34,200	5	173,500	6.5	
35	37,800	8	298,000	11.2	
36	41,400(40,000)	6	245,000	9.2	
37	45,000	12	558,000	21.1	79.4
38	48,600	3	145,500	5.5	20.6
39	52,200(53,000)	0	0	-	-
40	55,800	0	0	-	-
41	59,400	0	0	-	-
42	63,000	0	0	-	-
Total		87	2,652,000	100.0	100.0

28. Cost of operation of tankers.- Estimated hourly operating cost of tank vessels at 17 knots average round trip speed was taken from a graph plotted from the statistics taken from "Average Construction and Operating Cost of Ocean-going Tankers - U. S. Fleet," dated 1 May 1961, prepared by the staff of the Board of Engineers for Rivers and Harbors, Corps of Engineers. The costs cover a 345-day annual operating year, allowing 20 days lay-up for repairs, special inspections, surveys, etc., which is considered to be standard operating practice. The costs shown are for operation under United States shipyards. The costs take into account items for interest, depreciation, overhead, and vessel charges. Table H shows for average vessels in each tonnage group principal characteristics of tankers which were used in estimating benefits for vessels operating between the Beaumont-Port Arthur area and the east coast ports, an average round trip distance of 3,600 nautical miles.

TABLE H

DATA ON SUPERTANKERS OPERATING AT 17 KNOTS SPEED

Size d.w.t.	Draft	Hourly operating cost at sea	Immersion factor (tons 2,240 lbs. per inch of draft)
27,000	32'	\$235	98
30,600	33'	255	108
34,200	34'	275	118
37,800	35'	297	127
41,400(40,000)	36'	312	134
45,000	37'	326	141
48,600	38'	339	148
52,200(53,000)	39'	353	153
55,800	40'	367	158
59,400	41'	380	161
63,000	42'	392	164

29. Cost per ton.- The data in table H were used in computing the differential in operating cost per ton of the tankers fully loaded and light loaded, on a round trip from Beaumont-Port Arthur area to the east coast ports, an average distance of about 3,600 nautical miles. A speed of 17 knots was used for all vessels. The cost of time in port was estimated to be equal for all vessels and is not included in the costs shown in table H, since it would not affect the differential cost. The cargo carrying capacity in short tons is estimated to be the same as the deadweight tonnage of a given vessel. It is assumed that the hourly cost of operating the vessels from one to ten feet light is the same as fully loaded. The following computation for a 30,600 d.w.t. tanker illustrates the method used for computing the cost per ton of moving petroleum:

Cargo capacity = 30,600 short tons
 Cost per hour taken from table H = \$255
 Time at sea = 3,600 ÷ 17 = 212 hours
 Total cost at sea per trip = 212 × 255 = \$54,060
 Cost per short ton fully loaded = 54,060 ÷ 30,600 = \$1.77
 Immersion factor for this vessel taken from table H
 = 108 long tons per inch of draft

Cost per short ton loaded one foot light =
 $\$54,060 \div (30,600 - (12 \times 108 \times 1.12)) = \1.85

30. Table I shows the estimated cost per ton of moving petroleum and its products in tankers from 27,000 to 63,000 d.w.t. with draft increments of one foot, fully loaded, and light loaded by 1 through 10 feet.

TABLE I

COST OF MOVING PETROLEUM IN SUPERTANKERS IN COASTWISE TRADE (17 KNOTS)

Size d.w.t.	Draft in feet	Cost per short ton cargo										
		Fully loaded	Light loaded									
		1-ft.	2-ft.	3-ft.	4-ft.	5-ft.	6-ft.	7-ft.	8-ft.	9-ft.	10-ft.	
27,000	32	1.85										
30,600	33	1.77	1.85									
34,200	34	1.70	1.79	1.88								
37,800	35	1.67	1.74	1.83	1.92							
41,400	36	1.60	1.67	1.75	1.84	1.93						
45,000	37	1.54	1.60	1.68	1.76	1.85	1.95					
48,600	38	1.48	1.54	1.61	1.69	1.77	1.86	1.96				
52,200	39	1.43	1.49	1.56	1.63	1.70	1.79	1.88	1.98			
55,800	40	1.39	1.45	1.51	1.57	1.64	1.72	1.81	1.90	2.00		
59,400	41	1.36	1.41	1.46	1.52	1.59	1.66	1.74	1.82	1.91	2.02	
63,000	42	1.32	1.37	1.42	1.47	1.53	1.60	1.67	1.75	1.83	1.93	2.03

31. Separate estimates were not prepared on foreign commerce, since it represents less than 5 percent of the total petroleum commerce, and moves to a number of ports. The saving by shipping in supertankers would be greater than for the estimated coastwise shipment; however, for the purpose of this report the unit saving on foreign commerce is considered to be the same as the estimated saving in transportation cost of moving coastwise commerce.

32. Average saving per ton.- From the data shown in paragraph 24, it is considered that supertankers of 32-foot draft, or 27,000 d.w.t., can operate fully loaded on the authorized channel; and that vessels up to about 36-foot draft, or 40,000 d.w.t. could operate fully loaded on the enlarged channel. Vessels between 27,000 and 63,000 d.w.t. can operate on the existing channel at light-loading varying from 1 to 10 feet. The estimated costs of operating fully loaded and lightly loaded in the several sizes of tankers obtained from table I are shown in table J for the proposed 40-foot channel depth and in table K for the proposed 43-foot channel depth. The savings were weighted in accordance with the proportion of the dead weight tonnage of each dead weight tons group to the combined dead weight tonnage of all tankers in the 27,000 and 63,000 d.w.t. portion of the U. S. fleet. The composition of this portion of the present fleet is considered to be representative of the prospective U. S. Fleet and was used in determining the weights. All tankers known to be in operation in, or under construction for, United States registry were included. Tables J and K shows the weighed average saving per ton of commerce for the supertankers between 27,000 and 63,000 d.w.t., operating on a 40-foot or 43-foot channel.

33. Table J shows a saving of \$0.20 a short ton, which is computed on the basis that tankers of 27,000 to 40,000 d.w.t. can operate partly loaded on the authorized channel, but could operate fully loaded on the channel deepened to 40 feet, and that tankers larger than 40,000 d.w.t. that could operate more heavily loaded on the 40-foot channel. The estimated 40 percent of the prospective commerce in petroleum and petroleum products that will be carried in tankers of over 27,000 d.w.t. capacity amounts to 25,400,000 tons annually in the year 2015 and 28,000,000 tons annually in the year 2065. The annual savings amounts to \$5,080,000 and \$5,600,000 during the two years. Allowing one-half of the savings to accrue to the ports on the other end of the movement the average annual benefits of the deepening from 36 feet to 40 feet amount to \$2,540,000 and \$2,800,000 for the two years. The equivalent average annual benefit for the 100-year period is estimated at \$2,186,000.

34. Table K shows a savings of \$0.08 per short ton over the 40-foot project, which is computed on the basis that tankers of 40,000 d.w.t. to 53,000 d.w.t. could operate partly loaded on the proposed 40-foot channel, and could operate fully loaded on the channel deepened to 43 feet, and that tankers larger than 53,000 d.w.t., when such tankers are constructed, could operate with larger loads on the 43-foot channel. Using the same procedures as given in paragraph 33, the incremental average annual benefits of deepening the Sabine-Neches Waterway from 40 feet to 43 feet amount to \$ 280,000 and \$308,000 during the 50th and 100th year of the project life. The equivalent average annual benefit for the 100 year life of the project is estimated at \$240,000.

35. The benefits to be realized from the projected commerce in petroleum and petroleum products that will be carried in super-tankers were reduced to average annual equivalent benefits with computations based on a project life of 100 years and a compound interest rate of 2.625 percent. For example, the initial annual benefit on the deepening to 40 feet in the year 1965 is estimated at \$1,720,000, the benefit in 2015 is estimated at \$2,540,000 and the benefit in 2065 is estimated at \$2,800,000. Based on the economic analysis the benefits would increase uniformly over the two 50 year periods. The reduction factors for computing the average annual amount of the present worth of the increasing benefits are taken from table 1 - supplement of appendix II, FM 1120-2-118. For the increase over the first 50 years the factor is 0.533 and for the second 50 years the factor is 0.111. The sum of these equivalents is added to the initial benefits giving \$1,720,000 + (\$820,000 x 0.533) + (\$260,000 x 0.111) = \$2,186,000 as the average annual equivalent benefits over the 100 year life of the project. The average annual equivalent benefits for the other items of prospective commerce were computed in a similar manner.

TABLE J

WEIGHTED SAVINGS PER TON FOR DEEPENING
FROM 36 Ft. to 40 Ft.

DWT	Cost per ton		Savings	Weight for cost comparison (percent)	Total weighted saving
	36'	40'			
30,600	\$1.85	\$1.77	\$.08	46.5	\$.04
34,200	1.88	1.70	.18	6.5	.01
37,800	1.92	1.67	.25	11.2	.03
41,400	1.93	1.60	.33	9.2	.03
45,000	1.95	1.60	.35	21.1	.07
48,600	1.96	1.61	.35	5.5	.02
52,200	1.98	1.63	.35	0	0
55,800	2.00	1.64	.36	0	0
59,400	2.02	1.66	.36	0	0
63,000	2.03	1.67	.36	0	0
		Total			.20

TABLE K

WEIGHTED SAVINGS PER TON FOR DEEPENING
FROM 40 FT. TO 43 FT. DEPTH

DWT	Cost per ton		Savings	Weight for cost comparison (percent)	Total weighted saving
	40'	43'			
45,000	\$1.60	\$1.54	\$.06	79.4	\$.05
48,600	1.61	1.48	.13	20.6	.03
52,200	1.63	1.43	.20	0	0
55,800	1.64	1.45	.19	0	0
59,400	1.66	1.46	.20	0	0
63,000	1.67	1.47	.20	0	0
		Total			.08

36. Benefits from reduction of damages.- The American Merchant Marine Institute, Inc. in its brief stated, "Based on experience during the years 1958 and 1959 and the increase in shipping estimated for the year 1970, an annual savings of \$190,000 has been allocated to reduction in navigation hazards as the result of the improvements." The Socony Mobil Oil Inc., submitted with its brief a tabulation of the damages to its ships for the years of 1958 and 1959 which covered 54 accidents. The total amount of damages is \$90,119 which covers only 27 of the 54 reported damages. Several of the accidents are still in litigation and therefore the amounts of damages have not been revealed. Accurate data and information on collisions and groundings on the waterway are very hard to obtain; however, it is the considered opinion of the District Engineer that a conservative estimate of the damages sustained on the existing waterway would amount to approximately \$200,000 a year, which includes damages and lost time costs. To date no extensive disastrous accident has occurred, a collision on the waterway involving a tank vessel loaded with highly volatile petroleum products could conceivably incur damages to shipping, personnel, and industrial facilities that could amount to millions of dollars. It is estimated that about 50 percent of these damages, or about \$100,000, will be prevented when the channel is dredged to 40 feet below mean low water. Widening to the requested width would reduce the damages another 25 percent, or about \$150,000 annually. Some of the users of the waterway reported in their briefs that their company ships had been damaged by grounding and dragging on the bottoms, which has required additional repairs and more often repainting. Since there are no records available on the number of cases to determine the additional costs of such repairs and repaintings, the costs of such have not been estimated.

37. Saving in time of travel through bridge at Port Arthur.- Local interests claim the present bascule bridge restricts large tankers to one-way traffic through the channel for a considerable distance above and below the bridge. When open, the bascule bridge hinders vision of the pilots of loaded ships and tugs and makes it difficult to see small boats and tows approaching from the opposite direction. These situations constitute serious hazards to safe navigation. Construction of a bridge, with a horizontal clearance of 400 feet to conform to the full channel width, would permit increased vessel speeds and reduce the hazards to navigation resulting from passing of shallow- and deep-draft traffic in the narrow channel. Accurate data on collisions and groundings on the waterway are not available, since local interests are reluctant to divulge such information. It is the considered opinion of the District Engineer that a conservative estimate of losses in time sustained along this portion of the waterway would amount to approximately \$60,000 annually. This loss would be eliminated by replacement of the bridge and would represent a benefit to the improvement.

38. Sabine River-Orange to Echo.- The savings in travel time and transportation cost would be derived from the movement of 500,000 tons of seashells annually from Orange to Echo, using a 450-HP tug and two 1500-ton open barges, via the proposed 12'x125' barge canal. Tows now using

the existing channel use a 450-HP tug and push two 1500-ton barges 5.3 miles up the Sabine River to the eddies immediately below the confluence of Big Bayou with the Sabine River. The tug then pushes one barge for 2.5 miles to the plant at Echo, and then returns for the second barge. Barge tows using the proposed improvement could operate at greater speed and could handle two barges to a tow for the entire trip. The saving in barge operating cost is computed as follows:

1. Existing channel - loaded tow:

(a)	Length of channel	=	7.8 miles
(b)	Speed of loaded tow	=	2 mph
(c)	2 barge tow from Orange to the eddies 5.3 mi. @ 2 mph	=	2.65 hrs.
(d)	Tie up #2 barge below the eddies	=	0.08 hrs.
(e)	Tow #1 barge from eddies to plant $2\frac{1}{2}$ mi. @ 2 mph	=	1.25 hrs.
(f)	Tug returns for #2 barge @ 5 mph	=	0.50 hrs.
(g)	Tie up to #2 barge	=	0.08 hrs.
(h)	Tow #2 barge from eddies to plant	=	1.25 hrs.
(i)	Total travel time w/loaded barge	=	5.81 hrs.

2. Existing channel - empty tow

(a)	Length of channel	=	7.8 miles
(b)	Speed of empty tow	=	4 mph
(c)	Tow #1 barge from plant to below eddies $2\frac{1}{2}$ mi. @ 4 mph	=	0.63 hrs.
(d)	Tie up #1 barge	=	0.08 hrs.
(e)	Tug returns for #2 barge - $2\frac{1}{2}$ mi. @ 5 mph	=	0.50 hrs.
(f)	Tie up to #2 barge	=	0.08 hrs.
(g)	Tow #2 barge from plant to eddies $2\frac{1}{2}$ mi. @ 4 mph	=	0.63 hrs.

2. Existing channel - empty tow (Cont'd)
- (h) Tie up to #1 barge = 0.08 hrs.
- (i) Continue downstream - 5.3 mi. @ 4 mph = 1.32 hrs.
- (j) Total travel time w/empty barges = 3.32 hrs.
3. Existing channel - loaded & empty tows
- (a) Total round-trip travel time
5.81 + 3.32 = 9.13 hrs.
- (b) One 450-HP tug and 2 open barges
hourly operating cost = \$22.50
- (c) Total cost per round trip
9.13 × \$22.50 = \$205.42
- (d) Cost per ton = \$205.42 ÷ 3000 tons = \$0.0685
4. Improved channel - loaded & empty 2 barge tow
- (a) Length of channel = 4.8 miles
- (b) Speed of loaded tow = 3 mph
- (c) Speed of empty tow = 5 mph
- (d) Average round trip speed = 4 mph
- (e) Tow cost per hour = \$22.50
- (f) Travel time for round trip 9.6 mi.
@ 4 mph = 2.40 hrs.
- (g) Total cost per round trip
2.40 × \$22.50 = \$54.00
- (h) Cost per ton \$54.00 ÷ 3000 tons = \$0.0180
5. Savings by using improved channel
- (a) Saving per ton = \$0.0685 - \$0.0180 = \$0.051
- (b) Annual savings = \$0.051 × 500,000 ton = \$25,500

39. The savings in travel time that would be derived from the movement of 64,000 tons of crude oil over the requested 12' x 125' channel, 4.7 miles in length, based on one 450-HP tug with one 220' x 40' barge carrying 2,000 tons at \$23.20 per hour are estimated as follows:

1. Existing 7.8 mile channel:

(a) Speed of loaded tow	=	2 mph
(b) Speed of empty tow	=	4 mph
(c) Average round trip speed	=	3 mph
(d) Travel time for round trip = 15.6 mi. @ 3 mph	=	5.2 hrs.
(e) Total cost per round trip = 5.2 hrs x \$23.20	=	\$120.64
(f) Cost per ton = \$120.64 ÷ 2,000	=	\$0.060

2. Proposed 4.8 mile channel:

(a) Speed of loaded tow	=	3 mph
(b) Speed of empty tow	=	5 mph
(c) Average round trip speed	=	4 mph
(d) Travel time for round trip = 9.6 min. @ 4 mph	=	2.40 hrs.
(e) Total cost per round trip = 2.40 hrs x \$23.20	=	\$55.68
(f) Cost per ton = \$55.68 ÷ 2000	=	\$0.028

3. Savings by using improved channel:

(a) Saving per ton = \$0.060 - \$0.028	=	\$0.032
(b) Annual savings = 0.032 x 64,000 tons = \$2048	=	\$2,000

40. The total saving from the proposed improvement of the channel between Orange and Echo would amount to \$27,500 annually.

41. Bank protection.- It is considered that the benefits creditable to the proposed bank protection of Pleasure Island along the lake side of the Port Arthur Canal and the Sabine-Neches Canal to the mouth of the Neches River would be from a reduction in maintenance dredging required by reducing the amount of accretion in the channel from the sloughing of the bank along the waterway. It is estimated that the proposed bank stabilization would reduce the accretion in the channel in the amount of about 165,000 cubic yards. Based on experienced cost of \$0.30 per cubic yard for maintenance dredging, the estimated annual benefits from the reduction in maintenance dredging are estimated at about \$49,500 or say \$50,000.

42. Summary of benefits.- The benefits for the plans of improvement considered in this report have been estimated on the basis of March 1962 prices. The total average annual equivalent benefits for the following: deepen to 40 feet and widen to 500 feet in the Port Arthur Canal and 400 feet in the Neches River; deepen to 40 feet and widen the channels to 600 feet in Sabine Pass and 500 feet in other inland channels; deepen to 43 feet and widen to 500 feet in the Port Arthur Canal and 400 feet in the Neches River; dredge shallow draft channel above Orange, Texas, to Echo, Texas; and provide bank protection along the lake side of the Port Arthur Canal and the Sabine-Neches Canal between Sabine Pass and the mouth of the Neches River are tabulated in table L.

TABLE L

SUMMARY OF ESTIMATED AVERAGE ANNUAL EQUIVALENT BENEFITS
IMPROVEMENTS CONSIDERED

Type of Benefit	Improvement of existing projects				
	Enlargement of existing project channels		Shallow-draft channel		
	Deepening to 40'	Deepening to 40'	Deepening to 40'	Deepening to 43'	Bank protection - Pt. Arthur Canal and Sabine-Neches River interests
Saving in transportation cost	\$2,186,000	\$2,186,000	\$50,000	-	-
Reduction in hazards to navigation	100,000	150,000	-	-	-
Saving in travel time	60,000	60,000	-	\$27,500	-
Bank protection	-	-	-	-	\$50,000
Total benefits	\$2,346,000	\$2,396,000	\$240,000	\$27,500	\$50,000

EFFECT OF PROPOSED COLONIAL PIPELINE

43. Recent news releases have announced the formation of a pipeline company to construct a petroleum products pipeline from the Gulf Coast refineries to the North Atlantic Coast. The reports indicate that a 36-inch pipeline with an initial capacity of 600,000 barrels a day, increasing to 900,000 barrels a day in about 30 years, is proposed. Since this capacity is equal to about 50 percent of the refinery capacity in the supply area, it could have a major effect on the volume of products moved by tanker from the Gulf Coast to the North Atlantic Coast, and consideration must be given to the effect the pipeline would have on economics of proposed improvements in the Sabine-Neches Waterway to accommodate supertankers. The proposed Colonial pipeline, projected for completion in late 1963, would carry refined petroleum products from the Houston, Beaumont and Port Arthur, Texas areas, and the Lake Charles, Louisiana area to Baton Rouge, Louisiana, thence generally paralleling the existing Plantation pipeline to Greensboro, North Carolina, thence northeastward to Washington, D. C., Baltimore, Md. and the metropolitan area of New York City. The pipeline would pick up products at various points along the Gulf Coast for distribution to various markets, ranging from Charleston, S. C. northeastward to its terminus at Linden, N. J., with branch lines extending inland to serve such points as Montgomery, Ala., August and Bainbridge, Ga., Nashville and Knoxville, Tenn., Charlotte, N. C., and Norfolk, Va. The line would be competitive with tanker movements of petroleum products from the Houston Ship Channel, Sabine-Neches Waterway and Calcasieu channel to ports on the northeastern coast of the conterminous United States.

44. It is assumed that the marketing area would extend for some distance from the announced terminal points; and, for the purpose of this study, it is assumed that the main economic effect would be felt initially by the smaller tankers of T-1 and T-2 types, existing smaller pipelines, barge traffic, railroads, and motor trucks, all of which have larger costs of transportation than supertankers. The probable effect on the tankers would be on commerce bound for points north of Charleston, S. C. with existing traffic patterns remaining much the same to such southerly ports as Savannah, Ga. and Jacksonville and Miami, Fla.

45. Barge line traffic would probably be affected on the Mobile-Warrior Rivers to points in the vicinity of Montgomery and Birmingham, Alabama. The barge traffic in petroleum products from the Gulf ports to the Ohio River above Louisville, Kentucky would be affected to the extent that this traffic serves markets south and east of the Ohio River above Louisville. Barge traffic from the Gulf to the Tennessee River above Florence, Alabama would also be affected, since the proposed pipeline could probably deliver petroleum products to that area cheaper than present barge movements of these commodities.

46. Existing smaller pipelines moving petroleum products may lose a portion of their present business when the Colonial pipeline begins operation because of prospectively lower costs for pipeline handling of the large volumes. Whether these affected lines would, in turn, be able to lower their rates to compete successfully over long hauls is not definitely known at this time but it is not considered likely that they could be fully competitive with the larger line.

47. While the volume of traffic presently being moved by rail and motor carrier is not known, it is believed that this traffic is mostly local in nature; and the competitive effect of the Colonial pipeline would be felt only to a minor degree.

48. As discussed above, available information on prospective sources of supply for petroleum products to be moved through the Colonial pipeline and the existing means of transportation of these products is not sufficient to fully analyze the probable effects on other means of transportation at this time. However, for the purpose of this study it has been assumed that the products to be moved would originate entirely in the Houston-Texas City and Beaumont-Port Arthur areas in Texas and the Lake Charles area in Louisiana. The nine reported owning companies of the line have one or more refineries in these areas. The route of the line will pass Baton Rouge, La., where other large refineries are located; however, the existing Plantation pipeline moves products from this area and no product supply to the Colonial line has been assumed from the Baton Rouge area. Since the line will be competitive with other forms of transportation as well as seagoing tanker traffic, it has been assumed that 10 percent of the capacity of the line would be occupied by products presently moved by the other forms of transportation.

49. The stated initial capacity of the line would be 600,000 bbls. daily, which would be increased to 900,000 bbls. daily at some time in the future. Because of the complexities of supply, storage, and delivery from several originating sources to a great many terminal areas, it has been assumed that the line, over a long period of time, would operate at about 10 percent less than full efficiency and that the actual movements would range from about 540,000 bbls. (65,854 tons) per day to 810,000 bbls. (98,780 tons) per day. The time sequence of this proposed increase is not known; however, it has been assumed that the initial capacity would begin in 1965 and increase uniformly for a period of 50 years, reaching the 98,780 tons per day in 2015 and continuing at that rate until 2065.

50. Since the line is planned for common-carrier operation, it has been assumed that each of the 3 supplying refinery areas named above would supply products in proportion to the existing refinery capacities in those areas. The present refining capacities of all plants in each of the area are shown in table M. This would allot 44 percent of the line input to refineries located along the Sabine-Neches Waterway. Deducting 10 percent of the line capacity for allocation to other means of transportation, as described above, and computing 44 percent of the remainder for supply

from the Sabine-Neches refineries, based on the capacities shown in table M, would indicate that about 9,518,000 tons annually in 1965 and 14,278,000 tons annually in 2015 would be moved in the pipeline that otherwise would be moved in seagoing coastwise tankers.

51. If the supply were withdrawn uniformly from all categories of tank vessels it would require that 40% be taken from the prospective commerce that it is estimated would be moved on supertankers. However, the T-2 tankers and somewhat larger to about 28,000 deadweight tons in size, which comprise the larger portions of the U. S. tanker fleet, also have the highest cost of seagoing transportation. Wherever possible, in the scheduling of tanker movements within the company capabilities, the smaller tankers would be laid up first. It is likely that the supply for the Colonial pipeline would be drawn to a large extent from the supply of the T-2 tankers. This factor cannot be determined at present but it is believed that at most not over 20 percent of the pipeline supply from seagoing tankers would come from the volume moved in supertankers. Using this estimate the commerce that would be carried in supertankers as estimated without the pipeline would be reduced by 1,904,000 tons annually in 1965, and 2,857,000 tons annually in 2015 and thereafter through 2065. The prospective commerce that would be moved in supertankers, adjusted for loss to the proposed pipeline is as follows:

<u>Item</u>	<u>Prospective annual commerce in supertankers (tons)</u>		
	<u>1965</u>	<u>2015</u>	<u>2065</u>
Without pipeline	17,200,000	25,400,000	28,000,000
Pipeline taking	<u>1,904,000</u>	<u>2,857,000</u>	<u>2,857,000</u>
Balance	15,296,000	22,543,000	25,143,000

52. The average annual equivalent benefits, based on moving these quantities of prospective commerce in supertankers on the enlarged waterway, on a 100-year economic life and using the factors and procedures used in paragraphs 32 through 35 of this appendix, and including the benefits from reduction in navigation hazards and saving in vessel time, are computed to be \$2,104,000 annually. The benefit cost ratio is 1.5.

53. As a matter of interest, several additional economic ratios were computed. One is on a 50 year economic life for the project, with the pipeline in place, which would realize an economic ratio of 1.2. Also, assuming that the supply for the pipeline is taken proportionately from all tank vessels, or that 40 percent would be withdrawn from prospective commerce, in supertankers, the economic ratios based on project lives of 50 years and 100 years would be 1.03 and 1.4, respectively. It is therefore considered that, under reasonable assumptions as to the effect of the pipeline, it would have only a small effect on the economic analysis of the improvements recommended in the report. Under most pessimistic assumptions, the improvements would still have a favorable economic ratio.

TABLE M

REFINERY CAPACITY AT THREE GULF COAST PORTS

Refinery	: Houston, : Texas : (bbls.)	: Sabine-Neches : Texas : (bbls.)	: Calcasieu : Louisiana : (bbls.)
American Oil Co. Texas City	148,000		
Atlantic Refining Co. Port Arthur, Tex.		62,000	
Cities Service Co. Lake Charles, La.			185,000
Continental Oil Co. Lake Charles, La.			53,000
Crown Central Pet. Corp., Pasadena, Tex.	40,000		
Eddy Refining Co. Houston, Texas	2,000		
Gulf Oil Corp. Port Arthur, Tex.		269,000	
Humble Oil & Ref. Co. Baytown, Texas	292,300		
Phillips Pet. Co. Sweeny, Tex.	95,000		
Plymouth Oil Co. (Ohio) Texas City	42,750		
The Pure Oil Co. (Nederland, Tex.)		80,000	
Shell Oil Co. Deer Park, Tex.	128,000		
Signal Oil & Gas Co. Houston, Tex.	63,000		
Sinclair Ref. Co. Houston, Tex.	159,000		
Socony-Mobil Co., Inc. (Beaumont, Tex)		220,000	
South Hampton Co. (Silsbee)		2,000	
Texaco, Inc. Port Neches & Port Arthur		320,000	
Texas City Ref., Inc. Texas City	34,000		
Texas Gas Corp. Winnie, Tex.		7,600	
Total	1,009,050	960,640	238,000
Percent	45.71	43.51	10.78

REVIEW OF REPORTS ON

SABINE-NECHES WATERWAY, TEXAS

Section included: Gulf of Mexico to turning basins at West Port Arthur, Beaumont, and Orange, Tex., about 80.5 miles; Adams Bay about 2 miles; and Cow Bayou Channel, about 8 miles. Controlling depth: December 1960, Sabine Pass Harbor, Tex., 37 feet; Ft. Tex., 35 feet; Beaumont, Tex., 33 feet except extension to Pennsylvania Shipyard, 30 feet; Orange, Tex., 29 feet except channel around Harbor Island, 24 feet; Adams Bayou Channel, 13 feet; and Cow Bayou Channel, 11 feet. Project depth: Sabine Pass Harbor, Tex., 37 to 36 feet; Port Arthur, Tex., 35 feet; Beaumont, Tex., 36 feet except turning basin, 34 feet and extension to Pennsylvania Shipyard, 30 feet; Orange, Tex., 30 feet except channel around Harbor Island, 25 feet, Adams Bayou, 12 feet, and Cow Bayou, 13 feet, mean low tide.

Comparative statement of traffic

Year	Vessel traffic (tons)	Rafted (tons)	Total (excluding duplications) (tons)	Passengers	Year	Vessel traffic (tons)	Rafted (tons)	Total (excluding duplications) (tons)	Passengers
1951	54,334,133	31,815	54,365,948	238	1956	62,790,305	-----	62,790,305	151
1952	54,599,609	23,145	54,622,754	208	1957	62,638,250	-----	62,638,250	289
1953	56,739,601	23,605	56,763,206	211	1958	60,574,062	-----	60,574,062	360
1954	53,504,920	18,890	53,523,810	212	1959	62,474,378	-----	62,474,378	316
1955	56,218,285	15,610	56,233,895	231	1960	68,693,211	-----	68,693,211	343

Consolidated statement of waterborne commerce of the Sabine-Neches Waterway, Tex. (Beaumont, Orange, Port Arthur, and Sabine Pass Harbor, Tex.)

Freight traffic, 1960 (Short tons)

Commodity	Total	Foreign		Domestic					
		Imports	Exports	Coastwise		Internal		Local	Through traffic
				Receipts	Shipments	Receipts	Shipments		
Total	68,693,211	429,259	3,552,983	4,616,004	35,567,698	6,853,991	4,660,369	599,986	12,412,921
010 Meat and products, fresh	36	-----	36	-----	-----	-----	-----	-----	-----
035 Dried milk	7,988	-----	7,988	-----	-----	-----	-----	-----	-----
094 Shells, unmanufactured	1,266,632	-----	-----	-----	-----	1,057,148	-----	-----	209,484
095 Animal products, inedible, nec	1,200	-----	-----	-----	-----	-----	1,200	-----	-----
100 Corn	19,285	-----	19,285	-----	-----	-----	-----	-----	-----
101 Rice	73,759	-----	73,759	-----	-----	-----	-----	-----	-----
102 Barley and rye	47,118	-----	34,403	-----	-----	-----	-----	-----	12,715
103 Wheat	1,248,899	-----	1,122,980	-----	30,425	9,756	-----	-----	85,738
107 Wheat flour	43,556	-----	43,556	-----	-----	-----	-----	-----	-----
108 Grain sorghums	491,434	-----	472,864	-----	-----	17,359	-----	-----	1,211
109 Flour, flour-grain prep, nec	772	-----	756	-----	-----	-----	-----	-----	16
110 Animal feeds, nec	4,044	-----	977	-----	-----	-----	-----	-----	3,067
125 Veg and prep incl. canned nec	452	452	-----	-----	-----	-----	-----	-----	-----
140 Nuts and prep	43	-----	-----	-----	-----	-----	-----	-----	43
160 Coffee, raw or green	2,767	1,955	-----	-----	-----	207	-----	-----	605
165 Tea	9	3	-----	-----	-----	-----	-----	-----	6
180 Sugar	3,246	-----	-----	-----	-----	80	-----	-----	3,766
185 Molasses, sugar prod, edible	2,198	-----	-----	-----	-----	2,188	-----	-----	10
190 Liquors and wines	12,356	37	-----	-----	-----	-----	-----	-----	12,319
195 Beverages and sirups, nec	8	-----	-----	-----	-----	-----	-----	-----	8
201 Synthetic rubbers	78,855	-----	38,855	-----	-----	-----	-----	-----	40,000
203 Reclaimed rubber and scrap	82	-----	82	-----	-----	-----	-----	-----	-----
207 Rubber manufactures, nec	1,481	1	1,449	-----	-----	-----	-----	-----	31
210 Naval stores, gums, and resins	6,965	-----	4,588	-----	-----	-----	-----	-----	2,377
240 Oils, fats, waxes, veg, crude	145	-----	-----	-----	-----	-----	-----	-----	145
290 Molasses, inedible	11,207	11,207	-----	-----	-----	-----	-----	-----	-----
300 Cotton, unmanufactured	26,835	-----	26,835	-----	-----	-----	-----	-----	-----
331 Burlap and jute bagging	419	-----	-----	-----	-----	-----	-----	-----	419
335 Vegetable fiber mfrs, nec	625	598	-----	-----	-----	-----	-----	-----	27
390 Textile products, nec	2	-----	2	-----	-----	-----	-----	-----	-----
405 Posts, poles, and piling	441	-----	-----	-----	-----	-----	195	-----	246
413 Lumber and shingles	6,195	5	6,044	-----	-----	-----	10	-----	136
416 Plywood, veneers, cont. mat.	1,276	-----	955	-----	321	-----	-----	-----	-----
417 Railroad ties	9,682	-----	9,682	-----	-----	-----	-----	-----	-----
421 Wood manufactures, nec	585	16	-----	-----	-----	190	-----	-----	379
441 Wood pulp	3,231	-----	93	-----	-----	-----	-----	-----	3,138
450 Standard newsprint paper	19,111	6,151	-----	-----	-----	-----	-----	-----	12,960
457 Paper and mfrs, nec	58,172	-----	1,092	-----	-----	-----	-----	-----	57,080
501 Anthracite coal	1,069	-----	1,069	-----	-----	-----	-----	-----	-----
502 Bituminous coal and lignite	218,226	-----	-----	-----	-----	-----	-----	-----	218,226
504 Coke, including petroleum coke	338,338	-----	338,338	-----	-----	-----	-----	-----	-----
507 Gasoline	14,614,660	-----	137,952	82,722	11,103,129	139,838	1,537,599	-----	1,613,420
510 Gas oil, distillate fuel oil	11,189,482	-----	83,722	11,638	10,145,490	92,624	457,158	-----	398,890
511 Petroleum, crude	19,484,268	290,769	67,498	4,280,112	4,372,641	4,806,863	964,539	258,123	4,443,723
512 Jet fuel, all types	1,233,693	-----	-----	-----	1,195,494	-----	9,873	-----	28,326
513 Kerosene	1,759,248	-----	9,759	-----	1,543,968	-----	70,445	-----	135,076
514 Residual fuel oil	6,138,007	110,613	53,125	75,469	4,936,655	46,027	321,226	861	594,031
516 Petroleum asphalt	564,453	-----	31,330	-----	410,723	-----	109,009	-----	13,391

EXHIBIT 1

**REVIEW OF REPORTS ON
SABINE-NECHES WATERWAY, TEXAS**

Freight traffic, 1960--Continued

(Short tons)

Commodity	Total	Foreign		Domestic					
		Imports	Exports	Coastwise		Internal		Local	Through traffic
				Receipts	Shipments	Receipts	Shipments		
518 Aliphatic naphtha-----	440,922	-----	679	-----	215,828	-----	69,664	-----	127,774
519 Lubricating oils and greases-----	2,028,760	-----	519,651	37,516	727,354	73,032	303,624	15,403	351,180
520 Petroleum products, nec-----	591,488	-----	10,124	77,691	260,621	11,442	39,788	4,125	187,697
522 Natural gasoline-----	26,838	-----	-----	-----	-----	25,679	1,159	-----	203,239
523 Building cement-----	203,239	-----	-----	-----	-----	-----	-----	-----	520
526 Stone and mfrs, nec-----	877	207	-----	-----	-----	150	-----	-----	173
530 Glass and glass products-----	497	324	-----	-----	-----	-----	-----	-----	18,502
540 Clays and earths-----	19,677	-----	-----	-----	-----	1,175	-----	-----	593
543 Brick and tile-----	593	-----	-----	-----	-----	-----	-----	-----	-----
547 Clay products, nec-----	267	-----	-----	-----	-----	267	-----	-----	-----
549 Sulphur, liquid-----	546,814	-----	-----	-----	209,222	199,522	138,070	-----	-----
550 Sulphur, dry-----	930,736	-----	215,656	-----	258,130	-----	199,582	-----	257,368
554 Sand, gravel, crushed rock-----	99,766	-----	-----	-----	-----	-----	3,600	96,166	-----
555 *Nonmetallic minerals, mfrs nec-----	136,174	-----	116	-----	-----	90	-----	-----	135,968
556 Slag, metal refuse-----	10,271	-----	-----	-----	-----	-----	-----	-----	10,271
601 Pig iron-----	2,215	-----	-----	-----	-----	-----	-----	-----	2,215
602 Iron and steel scrap-----	98,231	-----	87,109	-----	-----	-----	-----	-----	11,172
603 Iron, steel semifinished prod-----	34,761	-----	-----	-----	-----	-----	-----	-----	32,440
605 Ferrous castings and forgings-----	13,356	-----	-----	-----	-----	2,321	-----	-----	13,356
606 Tools and basic hardware-----	1,008	617	9	-----	-----	-----	-----	-----	382
608 Iron and steel pipe-----	421,322	221	291	-----	-----	9,265	34,675	-----	376,870
609 Rolled, finished stl mill prod-----	718,228	3,972	23	-----	-----	232,095	10,815	-----	471,323
611 Metal mfrs, parts nec exc SCI-----	13	-----	13	-----	-----	-----	-----	-----	-----
612 Metal mfrs and parts, nec-----	23,923	-----	-----	-----	-----	-----	-----	-----	16,270
613 Manganese-----	3,736	-----	-----	-----	-----	7,012	641	-----	3,736
615 Ferroalloys, ores, metals, nec-----	5,686	-----	-----	-----	-----	-----	-----	-----	5,686
617 Aluminum ores, concentr., scrap-----	382	-----	382	-----	-----	-----	-----	-----	6,084
618 Aluminum metal and alloys-----	6,084	-----	-----	-----	-----	-----	-----	-----	-----
620 Copper ore, concentr., scrap-----	511	-----	511	-----	-----	-----	-----	-----	6,084
632 Copper alloy forms and scrap-----	1,062	-----	1,062	-----	-----	-----	-----	-----	-----
640 Lead ores, concentr., and scrap-----	1,062	-----	-----	-----	-----	-----	-----	-----	102
642 Lead and alloys-----	1,444	-----	-----	-----	-----	-----	-----	-----	1,444
662 Nickel ore, concentr., scrap, fms-----	418	-----	418	-----	-----	-----	-----	-----	-----
662 Tin ore, concentr., scrap forms-----	2,595	-----	-----	-----	-----	-----	-----	-----	2,595
670 Zinc ore, concentr., and scrap-----	17,300	-----	-----	-----	-----	-----	-----	-----	17,300
672 Zinc forms-----	47,949	-----	1,119	-----	-----	-----	-----	-----	46,830
682 Nonferrous ores, metals, scrap, nec-----	1,160	-----	25	-----	-----	-----	-----	-----	1,135
700 Electrical machinery-----	156	65	-----	-----	-----	-----	-----	-----	91
701 Electrical machinery exc SCI-----	32	-----	32	-----	-----	-----	-----	-----	-----
710 Engines, turbines, parts, nec-----	409	-----	109	-----	-----	-----	-----	-----	300
722 Const., mining mach., parts-----	7,669	-----	2,288	-----	-----	-----	-----	-----	2,780
730 Metalworking machinery, parts-----	22	-----	-----	-----	978	586	1,037	-----	22
731 Metalworking mach, pts exc SCI-----	25	-----	25	-----	-----	-----	-----	-----	-----
740 Textile, shoe mach., parts-----	3	-----	-----	-----	-----	-----	-----	-----	-----
742 Industrial mach., parts, nec-----	12,065	3	351	-----	-----	-----	-----	-----	8,345
745 Machinery, parts nec exc agri-----	303	303	-----	-----	-----	275	3,094	-----	-----
770 Agricultural mach., parts-----	45	23	22	-----	-----	-----	-----	-----	-----
780 Motor vehicles-----	13	-----	-----	-----	-----	-----	-----	-----	-----
781 Motor vehicles exc SCI-----	15	-----	-----	-----	-----	-----	13	-----	-----
782 Motor vehicle parts-----	6	-----	15	-----	-----	-----	-----	-----	-----
783 Watercraft and parts-----	2,193	-----	-----	-----	-----	-----	-----	-----	6
785 Watercraft and parts exc SCI-----	7	-----	7	-----	-----	-----	-----	-----	2,193
801 Crude and refined coal tar-----	42,959	-----	-----	-----	-----	-----	-----	-----	42,959
802 Benzol or benzene-----	224,185	-----	10,729	1,480	1,231	31,667	69,463	4,737	104,878
805 Other coal tar products-----	447,289	-----	-----	-----	10,558	28,230	31,308	-----	377,193
806 Other coal tar prod exc SCI-----	5,091	-----	5,091	-----	-----	-----	-----	-----	-----
810 Medicines and preparations-----	504	-----	-----	-----	-----	-----	-----	-----	504
825 Sulphuric acid-----	59,348	-----	-----	-----	-----	-----	-----	-----	59,348
826 Alcohols-----	764,494	-----	57,248	-----	92,461	2,073	137,999	151,720	323,993
827 Sodium hydroxide, caustic soda-----	262,327	-----	29	-----	-----	11,880	34,658	-----	215,760
828 Other ind chem, exc SCI-----	19,519	-----	19,519	-----	-----	-----	-----	-----	-----
829 Industrial chemicals, nec-----	934,775	-----	-----	1,092	42,509	14,547	43,942	-----	832,685
846 Chemical specialties, nec-----	125,532	-----	7,830	47,390	10,960	-----	8,756	-----	50,596
848 Pigments, paints, varnishes-----	10,306	-----	1,355	-----	-----	-----	531	-----	8,420
849 Ammonium sulphate (fert mat.)-----	38,034	-----	-----	-----	-----	-----	-----	-----	38,034
851 Other nitrogenous fert, mat-----	33,797	-----	-----	-----	-----	-----	-----	-----	33,797
852 Phosphate rock-----	4,015	-----	-----	-----	-----	-----	-----	-----	4,015
854 Superphosphate-----	2,013	-----	-----	-----	-----	-----	-----	-----	2,013
859 Fertilizer and materials, nec-----	100,732	15	176	-----	-----	-----	-----	-----	100,541
860 Miscellaneous chemical prod-----	691	-----	-----	-----	-----	-----	-----	-----	691
900 Commodities, nec-----	70,517	23	-----	894	-----	3,426	56,196	25	10,353
901 Commodities, nec, exc SCI-----	145	-----	145	-----	-----	-----	-----	-----	-----
920 U. S. articles returned-----	1,679	1,679	-----	-----	-----	-----	-----	-----	-----

* See footnote at end of table.

**REVIEW OF REPORTS ON
SABINE-NECHES WATERWAY, TEXAS**

Freight traffic, 1960--Continued

(Short tons)

Commodity	Total	Foreign		Domestic				Local	Through traffic
		Imports	Exports	Coastwise		Internal			
				Receipts	Shipments	Receipts	Shipments		
925 Water-----	210	-----	-----	-----	-----	-----	-----	-----	210
970 Waterway improvement mat.-----	68,326	-----	-----	-----	-----	-----	500	67,826	-----
980 Low-valued shipments-----	4,361	-----	4,361	-----	-----	-----	-----	-----	-----
999 Department of Defense and Sci-----	17,389	-----	17,389	-----	-----	-----	-----	-----	-----
Total ton-miles, 1,554,055,645.									

* Includes salt; the combination is made to avoid disclosure of individual company operations.
† The error due to sampling is between 11 and 20 percent.

REVIEW OF REPORTS
SABINE-NECHES WATERWAY, TEXAS

PORT ARTHUR, TEX. (PART OF WATERWAY)

Section included: Sabine Pass Harbor, Tex., to Neches River, about 20 miles.
36 feet, mean low tide.

Freight traffic, 1960
(Short tons)

Commodity	Total	Foreign		Domestic			
		Imports	Exports	Coastwise		Internal	
				Receipts	Shipments	Receipts	Shipments
Total.....	28,207,396	110,940	2,626,660	3,289,699	18,457,870	1,750,879	1,971,388
094 Shells, unmanufactured.....	224,058					224,058	
095 Animal products, inedible, nec.....	1,200						1,200
100 Corn.....	19,285		19,285				
101 Rice.....	1,662		1,662				
102 Barley and rye.....	34,403		34,403				
103 Wheat.....	1,111,905		1,111,724		30,425	9,756	
107 Wheat flour.....	30		30				
108 Grain sorghums.....	490,223		472,864			17,359	
110 Animal feeds, nec.....	20		20				
185 Molasses, sugar prod, edible.....	61					61	
201 Synthetic rubbers.....	33		33				
207 Rubber manufactures, nec.....	19		19				
300 Cotton, unmanufactured.....	20		20				
390 Textile products, nec.....	2		2				
421 Wood manufactures, nec.....	190					190	
457 Paper and mfrs, nec.....	32		32				
501 Anthracite coal.....	1,069		1,069				
504 Coke, including petroleum coke.....	338,338		338,338				
507 Gasoline.....	7,783,139		40,960	82,722	6,543,458	132,367	983,632
510 Gas oil, distillate fuel oil.....	6,130,373		16,449		5,784,576	23,282	306,066
511 Petroleum, crude.....	4,415,562			3,090,382	321,233	988,462	15,485
512 Jet fuel, all types.....	941,378				931,505		9,873
513 Kerosene.....	723,412		9,759		703,219		10,434
514 Residual fuel oil.....	3,492,112	110,613	53,125	21,905	3,106,474	29,135	170,860
516 Petroleum asphalt.....	20,278		20,278				
518 Aliphatic naphtha.....	102,535		579		75,848	24,564	1,444
519 Lubricating oils and greases.....	1,324,454		399,070	16,999	636,263	82,691	189,471
520 Petroleum products, nec.....	362,202		10,002		233,159	11,118	30,232
522 Natural gasoline.....	26,838					25,679	1,159
526 Stone and mfrs, nec.....	150					150	
540 Clays and earths.....	1,150					1,150	
554 Sand, gravel, crushed rock.....	1,138					1,138	
608 Iron and steel pipe.....	2,593					2,316	277
609 Rolled, finished stl mill prod.....	72,336					72,072	264
612 Metal mfrs and parts, nec.....	3,796					3,796	
722 Const., mining mach., parts.....	20		20				
742 Industrial mach., parts, nec.....	150						150
770 Agricultural mach., parts.....	2		2				
785 Watercraft and parts exc. SCI.....	7		7				
802 Benzol or benzene.....	75,322		10,729		1,231	3,841	59,521
805 Other coal tar products.....	26,031						26,031
806 Other coal tar prod exc. SCI.....	5,066		5,066				
826 Alcohols.....	192,051		49,538		61,818	74,857	5,838
827 Sodium hydroxide, caustic soda.....	11,909		29			11,880	
828 Other ind chem, exc. SCI.....	14,873		14,873				
829 Industrial chemicals, nec.....	70,116				27,114	10,513	32,489
846 Chemical specialties, nec.....	9,282		2,399		1,547		5,336
848 Pigments, paints, varnishes.....	1,250		1,250				
900 Commodities, nec.....	53,744					444	53,300
920 U. S. articles returned.....	327	327					
970 Waterway improvement mat.....	68,326						68,326
980 Low-valued shipments.....	4,101		4,101				
999 Department of Defense and SCI.....	8,823		8,823				

* The error due to sampling is between 11 and 20 percent.

REVIEW OF REPORTS

SABINE-NECHES WATERWAY, TEXAS

BEAUMONT, TEX. (NECHES RIVER) (PART OF WATERWAY)

Section included: Mouth to Pennsylvania Shipyards, about 20 miles.

Freight traffic, 1960

(Short tons)

Commodity	Total	Foreign		Domestic				Local
		Imports	Exports	Coastwise		Internal		
				Receipts	Shipments	Receipts	Shipments	
Total	27,113,480	318,303	872,595	1,324,865	17,012,670	4,925,259	2,504,882	154,906
010 Meat and products, fresh	36		36					
035 Dried milk	7,988		7,988					
094 Shells, unmanufactured	585,239					585,239		
101 Rice	45,112		45,112					
103 Wheat	11,256		11,256					
107 Wheat flour	34,302		34,302					
109 Flour, flour-grain prep, nec	756		756					
110 Animal feeds, nec	957		957					
125 Veg and prep incl. canned nec	452		452					
160 Coffee, raw or green	2,162	1,955				207		
165 Tea	3		3					
180 Sugar	80					80		
185 Molasses, sugar prod, edible	2,127					2,127		
190 Liqueurs and wines	37	37						
201 Synthetic rubbers	38,822		38,822					
203 Reclaimed rubber and scrap	82		82					
207 Rubber manufactures, nec	1,431	1	1,430					
210 Naval stores, gums, and resins	4,588		4,588					
290 Molasses, inedible	11,207	11,207						
300 Cotton, unmanufactured	26,815		26,815					
335 Vegetable fiber mfrs, nec	598		598					
413 Lumber and shingles	4,475		4,470					
416 Plywood veneers, cont. mat.	1,276		955		321			
417 Railroad ties	1,719		1,719					
441 Wood pulp	93		93					
450 Standard newsprint paper	6,151	6,151						
457 Paper and mfrs, nec	1,060		1,060					
507 Gasoline	5,212,774		96,992		4,524,344	7,471	553,967	
510 Gas oil, distillate fuel oil	4,656,243		67,273	11,638	4,360,914	66,226	190,192	
511 Petroleum, crude	10,424,715	290,769	67,498	1,189,730	3,986,937	3,976,300	853,603	59,878
512 Jet fuel, all types	263,989				263,989			
513 Kerosene	900,760				840,749		60,011	
514 Residual fuel oil	2,045,953			53,564	1,830,181	16,745	145,463	
516 Petroleum asphalt	530,784		11,052		419,723		109,009	
518 Aliphatic naphtha	208,200				139,980		68,220	
519 Lubricating oils and greases	369,245		120,581	20,557	91,091	6,744	130,272	
520 Petroleum products, nec	42,727		122		27,462	1,462	13,681	
526 Stone and mfrs, nec	207	207						
530 Glass and glass products	324	324						
540 Clays and earths	25					25		
547 Clay products, nec	267					267		
549 Sulphur, liquid	546,814				209,222	199,582	138,070	
550 Sulphur, dry	673,368		215,656		258,130		199,582	
554 Sand, gravel, crushed rock	99,766						4,738	95,028
555 Nonmetallic minerals, mfrs nec	206		116				90	
602 Iron and steel scrap	87,109		87,109					
603 Iron, steel semifinished prod	2,321					2,321		
606 Tools and basic hardware	626	617	9					
608 Iron and steel pipe	9,895	221	291			6,899	2,484	
609 Rolled, finished stl mill prod	41,310	3,972	23			31,789	5,526	
611 Metal mfrs, parts nec exc SCI	13		13					
612 Metal mfrs and parts, nec	3,106					3,106		
617 Aluminum ores, concentr., scrap	382		382					
620 Copper ore, concentr., scrap	511		511					
632 Copper alloy forms and scrap	1,062		1,062					
652 Nickel ore, concentr., scrap, fms	418		418					
672 Zinc forms	1,119		1,119					
682 Nonfer ores, metals, scrap, nec	25		25					
700 Electrical machinery	65	65						
701 Electrical machinery exc SCI	32		32					
710 Engines, turbines, parts, nec	109		109					
722 Const., mining mach., parts	4,038		2,190		978		870	

REVIEW OF REPORTS
SABINE-NECHES WATERWAY, TEXAS

BEAUMONT, TEX. (NECHES RIVER) (PART OF WATERWAY)--Continued

Freight traffic, 1960--Continued

(Short tons)

Commodity	Total	Foreign		Domestic				
		Imports	Exports	Coastwise		Internal		Local
				Receipts	Shipments	Receipts	Shipments	
731 Metalworking mach, pts exc SCI-----	5		5					
740 Textile, shoe mach., parts-----	3	3						
742 Industrial mach., parts, nec-----	277		277					
745 Machinery, parts nec exc agri-----	303	303						
770 Agricultural mach., parts-----	43	23	20					
781 Motor vehicles exc. SCI-----	15		15					
802 Benzol or benzene-----	14,679						14,679	
805 Other coal tar products-----	18,374				10,558	3,837	3,979	
806 Other coal tar prod exc. SCI-----	25		25					
826 Alcohols-----	15,606		28		2,283	9,951	3,344	
827 Sodium hydroxide, caustic soda-----	34,658						34,658	
828 Other ind chem, exc. SCI-----	4,646		4,646					
829 Industrial chemicals, nec-----	27,361				1,092	15,395	2,853	8,021
846 Chemical specialties, nec-----	65,526		5,303	47,350		9,413		3,420
848 Pigments, paints, varnishes-----	636		105					531
859 Fertilizer and materials, nec-----	191	15	176					
900 Commodities, nec-----	3,477	23						
901 Commodities, nec, exc. SCI-----	145		145			1,998		562
920 U. S. articles returned-----	1,352	1,352						
980 Low-valued shipments-----	260		*260					
999 Department of Defense and SCI-----	8,566		8,566					

* The error due to sampling is between 61 and 75 percent.

REVIEW OF REPORTS
SABINE-NECHES WATERWAY, TEXAS

SABINE PASS HARBOR, TEX. (PART OF WATERWAY)

Section included: Gulf of Mexico to upper end of Sabine Pass, about 13 miles.

Freight traffic, 1960

Domestic

(Short tons)

Commodity	Total	Coastwise		Internal	
		Receipts	Shipments	Receipts	Shipments
Total-----	365,222	1,480	97,158	151,716	114,928
405 Posts, poles, and piling-----	50				50
507 Gasolins-----	5,327	5,327			
510 Gas oil, distillate fuel oil-----	684			684	
511 Petroleum, crude-----	207,107		64,471	40,346	102,290
514 Residual fuel oil-----	6,630			861	5,749
742 Industrial mach., parts, nec-----	290				290
802 Bensol or benzene-----	1,480	1,480			
805 Other coal tar products-----	2,342			2,342	
826 Alcohols-----	73,456		27,360	39,507	6,589
900 Commodities, nec-----	150				150
970 Waterway improvement mat-----	67,826			67,826	

ORANGE, TEX. (SABINE RIVER) (PART OF WATERWAY)

Section included: Mouth, Neches River to mouth, Sabine River, thence upstream to old U. S. Highway 90, about 17.5 miles; Adams Bayou, about 2 miles; Cow Bayou, about 8 miles.

Freight traffic, 1960

(Short tons)

Commodity	Total	Foreign		Domestic		
		Exports	Imports	Internal		Local
				Receipts	Shipments	
Total-----	1,022,704	16	53,728	454,789	497,823	16,428
094 Shells, unmanufactured-----	247,851			247,851		
101 Rice-----	26,985		26,985			
107 Wheat flour-----	9,224		9,224			
405 Posts, poles, and piling-----	145					145
413 Lumber and shingles-----	1,574		1,574			10
417 Railroad ties-----	7,963		7,963			
421 Wood manufactures, nec-----	16	16				
510 Gas oil, distillate fuel oil-----	3,332			2,432		900
511 Petroleum, crude-----	191,406				191,406	
514 Residual fuel oil-----	162			147		15
518 Aliphatic naphtha-----	2,413			2,413		
519 Lubricating oils and greases-----	284				284	
520 Petroleum products, nec-----	2,987			2,987		
608 Iron and steel pipe-----	31,964			50		31,914
609 Rolled, finished stl mill prod-----	133,259			128,234		5,025
612 Metal mfrs and parts, nec-----	751			110		641
722 Const., mining mach., parts-----	831		78	586		167
731 Metalworking mach, pts exc SCI-----	20					
742 Industrial mach., parts, nec-----	3,043		74	275		2,694
780 Motor vehicles-----	13					13
802 Bensol or benzene-----	32,563			32,563		
805 Other coal tar products-----	23,349			22,051		1,298
826 Alcohols-----	294,705		7,682	13,075		257,545
829 Industrial chemicals, nec-----	4,613			1,181		3,432
846 Chemical specialties, nec-----	128		128			
900 Commodities, nec-----	3,193			84		2,334

REVIEW OF REPORTS ON SADDLE-NECKED WATERWAY, TEXAS

SUMMARY OF PERTINENT DATA CONCERNING LARGE TANK VESSELS OF THE WORLD AS OF NOVEMBER 1961

Classification of tanker (deadweight tonnage)	Total		Vessel registry, status, and dimensions												Average cargo capacity in barrels (4)					
	number of tankers	of tonnage	United States registry						Foreign registry											
	Com-pleted	Under construction	number	Draft (1)	Length (2)	Beam (3)	Com-pleted	Under construction	number	Draft (1)	Length (2)	Beam (3)	Com-pleted	Under construction	number	Draft (1)	Length (2)	Beam (3)		
				Feet/Inches	Feet/Inches	Feet/Inches				Feet/Inches	Feet/Inches	Feet/Inches				Feet/Inches	Feet/Inches	Feet/Inches		
20,000 to 20,999	85	15	-	15	30	10	584	0	74	4	70	-	70	31	0	568	11	72	7	166,707
21,000 to 21,999	45	-	-	-	-	-	-	-	-	-	45	-	45	31	8	588	2	73	11	164,820
22,000 to 22,999	15	1	-	1	32	4	595	0	80	0	14	-	14	32	2	595	1	75	0	179,900
23,000 to 23,999	13	-	-	-	-	-	-	-	-	-	13	-	13	32	2	613	1	76	9	166,614
24,000 to 24,999	67	3	1	4	32	6	622	0	84	0	63	-	63	32	3	602	7	79	9	203,512
25,000 to 25,999	22	4	-	4	32	5	604	3	81	4	18	-	18	32	5	604	3	81	4	207,300
26,000 to 26,999	45	7	-	7	32	11	619	10	83	4	38	-	38	32	10	629	1	81	4	223,740
27,000 to 27,999	37	13	-	13	32	5	628	0	82	6	24	-	24	32	10	628	7	82	5	225,795
28,000 to 28,999	54	-	-	-	-	-	-	-	-	-	54	-	54	32	7	632	2	83	0	237,732
29,000 to 29,999	42	13	1	14	33	2	644	8	84	0	28	-	28	33	7	645	8	83	2	250,010
30,000 to 30,999	28	13	-	13	34	2	646	7	84	4	15	-	15	33	10	645	11	84	2	240,250
31,000 to 31,999	67	-	-	-	-	-	-	-	-	-	67	-	67	34	5	661	4	85	9	246,903
32,000 to 32,999	94	13	-	13	34	2	661	0	90	0	81	-	81	34	6	663	4	86	8	273,848
33,000 to 33,999	34	2	-	2	34	4	661	0	90	0	32	-	32	34	6	670	7	87	2	286,512
34,000 to 34,999	9	-	-	-	-	-	-	-	-	-	9	-	9	35	7	679	4	87	0	278,000
35,000 to 35,999	36	3	-	3	34	10	676	0	93	0	33	-	33	35	8	688	2	89	4	286,140
36,000 to 36,999	26	4	-	4	36	6	675	0	84	0	22	-	22	35	11	629	2	90	4	294,400
37,000 to 37,999	4	3	-	3	36	9	715	0	93	0	1	-	1	36	1	695	0	91	2	311,364
38,000 to 38,999	24	-	-	-	-	-	-	-	-	-	24	1	24	35	6	692	5	92	7	287,754
39,000 to 39,999	15	1	-	1	36	6	695	8	93	0	14	-	14	35	10	695	8	93	0	319,000
40,000 to 40,999	34	3	2	5	36	10	682	0	93	0	29	-	29	35	10	703	1	95	10	264,000
41,000 to 41,999	14	-	-	-	-	-	-	-	-	-	14	-	14	35	10	718	10	94	2	335,300
42,000 to 42,999	11	1	2	3	37	3	685	0	97	0	8	-	8	36	10	712	6	97	7	343,500
43,000 to 43,999	3	-	-	-	-	-	-	-	-	-	3	-	3	36	7	712	3	97	0	351,700
44,000 to 44,999	1	-	-	-	-	-	-	-	-	-	1	-	1	36	5	722	0	97	0	359,900
45,000 to 45,999	24	-	2	2	38	0	703	6	102	0	20	2	22	37	3	735	8	100	1	387,333
46,000 to 46,999	57	12	-	12	38	3	705	0	101	0	44	1	45	37	7	745	0	100	2	395,000
47,000 to 47,999	20	2	-	2	38	6	710	0	102	0	17	1	18	37	7	742	5	98	10	384,400
48,000 to 48,999	5	-	-	-	-	-	-	-	-	-	2	3	5	37	9	705	0	102	0	392,600
49,000 to 49,999	3	-	1	1	38	10	713	0	100	0	-	2	2	38	10	705	0	102	0	400,800
50,000 to 50,999	6	1	-	1	39	0	710	0	102	0	5	-	5	37	8	816	0	105	7	408,900
51,000 to 51,999	1	-	-	-	-	-	-	-	-	-	-	1	1	39	4	752	0	106	0	417,100
53,000 to 53,999	4	-	-	-	-	-	-	-	-	-	4	-	4	39	1	775	5	102	1	433,500
56,000 to 56,999	1	-	-	-	-	-	-	-	-	-	1	-	1	40	6	789	0	106	0	463,074
60,000 to 60,999	2	-	-	-	-	-	-	-	-	-	2	-	2	41	9	810	0	104	5	478,645
64,000 to 64,999	2	-	-	-	-	-	-	-	-	-	2	-	2	42	5	800	0	108	0	523,500
67,000 to 67,999	3	-	1	1	43	0	770	0	104	0	2	-	2	43	0	803	0	107	11	548,000
68,000 to 68,999	7	1	2	3	49	0	782	0	116	0	4	-	4	49	0	782	0	116	0	556,200
70,000 to 70,999	1	-	-	-	-	-	-	-	-	-	1	-	1	43	7	810	0	113	0	572,500
72,000 to 72,999	1	-	-	-	-	-	-	-	-	-	1	-	1	44	0	808	0	110	0	589,000
73,000 to 73,999	1	1	-	1	44	3	784	0	113	0	-	-	-	-	-	-	-	-	-	597,100
75,000 to 75,999	1	-	-	-	-	-	-	-	-	-	-	1	1	44	6	810	0	117	0	613,400
77,000 to 77,999	2	-	-	-	-	-	-	-	-	-	-	2	2	44	9	820	0	113	0	629,800
78,000 to 78,999	1	-	1	1	45	0	848	0	110	0	-	-	-	-	-	-	-	-	-	638,000
85,000 to 85,999	7	-	-	-	-	-	-	-	-	-	7	-	7	46	2	854	9	125	0	707,320
86,000 to 86,999	2	-	-	-	-	-	-	-	-	-	-	2	2	46	4	820	0	125	0	703,400
87,000 to 87,999	1	-	-	-	-	-	-	-	-	-	1	-	1	46	6	833	0	122	0	711,600
88,000 to 88,999	1	-	-	-	-	-	-	-	-	-	-	1	1	46	6	833	0	122	0	719,700
104,000 to 104,999	1	-	-	-	-	-	-	-	-	-	1	-	1	48	6	900	0	135	0	850,600
106,000 to 106,999	2	2	-	2	48	7	895	0	132	0	-	-	-	-	-	-	-	-	-	867,000
130,000 to 130,999	1	-	-	-	-	-	-	-	-	-	-	1	1	51	4	905	6	141	1	10,630,000
Totals	982	118	13	131							833	18	851							

(1) Average draft of tanker in tonnage group on assigned salt water summer freeboard (international conference).
 (2) Maximum overall length of tanker in tonnage group.
 (3) Maximum molded beam of tanker in tonnage group.
 (4) Average cargo carrying capacity of tanker in tonnage group based on 7.24 to 8.68 Bbls. per ton.

REVIEW OF REPORTS ON
SABINE-NECHES WATERWAY, TEXAS
(1960)

Trips and drafts of vessels

Draft (feet)	Inbound						Outbound							
	Self propelled vessels			Non-self propelled vessels		Other	Total	Self propelled vessels			Non-self propelled vessels		Other	Total
	Passenger and dry cargo	Tanker	Towboat or tugboat	Dry cargo	Tanker			Passenger and dry cargo	Tanker	Towboat or tugboat	Dry cargo	Tanker		
36		3					3		17					17
35		62					62		187					187
34		28					28		169					169
33	1	1					5		50					50
32		16					16		5	410				415
31	7	64					71	8	586					594
30	7	9					16	58	85					143
29	16	18					34	79	197					276
28	35	38					73	77	42					119
27	36	32					68	54	33					87
26	42	18					60	76	31					107
25	54	24					78	62	17					79
24	47	37					84	64	22	1				87
23	61	44					105	71	10		1			82
22	69	81					150	71	16		1			88
21	40	82					122	50	9					59
20	60	380					440	67	77					144
19	69	387			1		457	61	18					79
18 and less	477	789	9,390	4,370	12,096	130	27,252	259	64	9,340	4,341	12,059	68	26,131
Total	1,021	2,116	9,390	4,370	12,097	130	29,124	1,062	2,040	9,340	4,344	12,059	68	28,913
Total net register tonnage	3,858,368	15,829,761	607,800	2,024,790	8,852,490	25,805	32,199,014	4,018,452	16,162,355	603,219	2,015,053	8,826,255	14,531	31,639,865
Passengers							160							183

Summary of traffic, Sabine-Neches Waterway, Tex. (Beaumont, Orange, Port Arthur, and Sabine Pass Harbor, Tex.)

BEAUMONT, TEX. (NECHES RIVER) (PART OF WATERWAY)

(1960)

Trips and drafts of vessels

Draft (feet)	Inbound						Outbound							
	Self propelled vessels			Non-self propelled vessels		Other	Total	Self propelled vessels			Non-self propelled vessels		Other	Total
	Passenger and dry cargo	Tanker	Towboat or tugboat	Dry cargo	Tanker			Passenger and dry cargo	Tanker	Towboat or tugboat	Dry cargo	Tanker		
36			3				3		14					14
35			5				5		167					167
34									122					122
33	1	1					2		22					22
32		14					14		155					155
31	5	49					54		4					171
30	7	5					12		28					49
29	11	5					16		38					55
28	21	11					32		45					66
27	21	2					23		27					52
26	22	1					23		50					66
25	32	14					46		31					35
24	24	13					37		30			1		44
23	32	15					47		42			1		47
22	36	49					85		36			1		40
21	28	41					69		18					23
20	25	254					279		31					46
19	37	107					144		30					36
18 and less	195	258	3,920	1,048	4,219	11	9,651	95	50	3,912	1,054	4,217	7	9,335
Total	497	847	3,920	1,048	4,219	11	10,542	506	847	3,912	1,057	4,217	7	10,546
Total net register tonnage	1,956,350	7,028,088	255,107	403,284	2,888,628	8,809	12,540,266	1,994,512	7,047,285	254,791	407,330	2,890,265	6,545	12,600,728
Passengers							33							128

PORT ARTHUR, TEX. (PART OF WATERWAY)

(1960)

Trips and drafts of vessels

Draft (feet)	Inbound*						Outbound*							
	Self propelled vessels			Non-self propelled vessels		Other	Total	Self propelled vessels			Non-self propelled vessels		Other	Total
	Passenger and dry cargo	Tanker	Towboat or tugboat	Dry cargo	Tanker			Passenger and dry cargo	Tanker	Towboat or tugboat	Dry cargo	Tanker		
36			3				3		17					17
35			62				62		187					187
34			28				28		169					169
33	1	4					5		50					50
32		16					16		410					415
31	7	63					70	8	582					590
30	7	9					16		85					141
29	16	17					33		196					275
28	35	38					73		77					119
27	36	32					68		54					87
26	42	17					59		76					106
25	54	24					78		62					77
24	47	37					84		64					84
23	61	42					103		71			1		82
22	69	80					149		71			1		88
21	40	80					120		50			1		59
20	60	376					436		67					143
19	70	386					456		17					78
18 and less	471	792	2,800	693	1,890	1	6,647	248	64	2,809	688	1,899	2	5,707
Total	1,016	2,106	2,800	693	1,890	1	8,507	1,049	2,027	2,809	688	1,899	2	8,474
Total net register tonnage	3,868,667	16,745,027	199,630	237,910	1,407,699	1,037	22,460,020	4,020,078	16,053,385	199,728	233,785	1,406,618	617	21,904,211
Passengers							127							55

* Includes vessels in transit.

SABINE PASS HARBOR, TEX. (PART OF WATERWAY)

(1960)

Trips and drafts of vessels

Draft (feet)	Inbound*							Outbound*							
	Self propelled vessels			Non-self propelled vessels		Other	Total	Self propelled vessels			Non-self propelled vessels		Other	Total	
	Passenger and dry cargo	Tanker	Towboat or tugboat	Dry cargo	Tanker			Passenger and dry cargo	Tanker	Towboat or tugboat	Dry cargo	Tanker			
36			3				3			17					17
35			62				62			187					187
34			28				28			169					169
33			4				4			50					50
33	1						1			410					410
32			16				16			586					586
31	7		64				71			81					594
30	7		9				16			58					143
29	16		18				34			79					276
28	35		38				73			42					119
27	36		32				68			54					87
26	42		18				60			76					107
25	54		24				78			17					79
24	47		37				84			64					87
23	61		44				105			10					82
22	69		81				150			16					88
21	40		82				122			50					59
20	60		380				440			67					144
19	69		387				457			61					79
18 and less	469		789	425	193	144	1	2,021	248	64	423	189	149	1	1,074
Total	1,013		2,116	425	193	145	1	3,893	1,051	2,040	423	192	149	1	3,896
Total net register tonnage	3,857,447		16,829,761	23,754	40,373	106,087	1,037	20,858,459	4,017,558	16,162,355	23,187	37,692	102,599	117	20,343,508

* Includes vessels in transit.

ORANGE, TEX. (PART OF WATERWAY)

(1960)

Trips and drafts of vessels

Draft (feet)	Inbound							Outbound								
	Self propelled vessels			Non-self propelled vessels		Other	Total	Self propelled vessels			Non-self propelled vessels		Other	Total		
	Passenger and dry cargo	Tanker	Towboat or tugboat	Dry cargo	Tanker			Passenger and dry cargo	Tanker	Towboat or tugboat	Dry cargo	Tanker				
28										1					1	
26			3				3			2					2	
25			1				1			1					1	
24			1				1			3					3	
23			2				2			2					2	
22			4				4			4					4	
21										1					1	
20			1				1			2					2	
19			1				1			1					1	
18 and less			15	4	1,465	547	851	76	2,958	15	1	1,470	540	851	85	2,962
Total			27	7	1,465	547	851	76	2,973	31	5	1,470	540	851	85	2,982
Total net register tonnage			85,860	30,865	73,315	203,531	568,678	6,642	968,891	91,310	27,187	73,660	198,507	568,124	7,376	966,164

REVIEW OF REPORTS

ON

SABINE-NECHES WATERWAY, TEXAS

ECONOMIC BASE STUDY

1. Population.- The Sabine-Neches area is composed of the estuaries of the Sabine and Neches Rivers from Sabine Pass upstream to the city of Orange, Texas, on the Sabine, and the city of Beaumont, Texas, on the Neches. The two-county area covering Jefferson and Orange Counties, Texas, embraces one of Texas' most highly industrialized areas known as the "Golden Triangle," which includes the cities of Beaumont, Orange, and Port Arthur, together with their satellite cities. At the turn of the century both counties were largely rural; and rice, cattle, grain, forage and forest products are still of great economic value today. The value of these products, however, is greatly overshadowed by the rapid industrial growth that began with the Twentieth Century. The following tabulation from U. S. Department of Commerce, Bureau of Census figures shows the urban growth during the seventy-year period 1890-1960.

<u>Year</u>	<u>Beaumont</u>	<u>Port Arthur</u>	<u>Orange</u>	<u>Nederland</u>	<u>Port Neches</u>	<u>Groves</u>
1890	3,296		3,173			
1900	9,427	900	3,835			
1910	20,640	7,663	5,527			
1920	40,422	22,251	9,212			
1930	57,732	50,902	7,913			
1940	59,061	46,140	7,472			
1950	94,014	57,530	21,174	3,805		
1960	119,175	66,676	25,605	12,036	8,696	17,304

2. The total urbanized population (1960) of Beaumont is 119,178 and of Port Arthur 116,365 for a combined 235,543. This figure is greater than the total obtained from the Jefferson County cities in the above table which reflects population of the cities proper and major suburbs only. The purely rural population of Jefferson County is shown as 10,116. Likewise the population of Orange County, exclusive of Orange proper, is 34,752. This last figure, however, includes some urbanized areas on the immediate outskirts of Orange.

3. Industries and resources.- The founding of Port Arthur as a seaport terminus for the Kansas City Southern Railway and the completion of a privately-financed channel to the Gulf of Mexico in 1899 was the beginning of the use of the area as a shipping center. The discovery of oil in the Spindletop Field in January 1901 brought the petroleum industry to Beaumont. These industries of transportation and petroleum have subsequently attracted petroleum refining, petrochemicals, shipbuilding, brass and iron foundries, rice mills, shell dredging, and other industries. Other natural resources in the area are: natural gas, salt, brick clay, sulfur, sand, and gravel.

4. The combined ports of Beaumont, Port Arthur, Orange, and Sabine Pass were credited with a total of 68,693,211 short tons of water-borne commerce (see table 1) in 1960, of which 58,410,202 tons, or approximately 85 percent were crude oil or refined petroleum products. Foreign trade accounted for 1,653,560 tons, or 2.8 percent of the petroleum tonnage, while coastwise commerce totaled 67.6 percent. Barge commerce divided between local and through traffic accounted for 15.6 percent and 14.0 percent, respectively. (See plate 1.)

5. As may be seen, petroleum accounts for the greater part of the tonnage handled by these ports, and the importance of the petroleum industry to the area may be understood when it is made apparent that approximately 10 percent of the refining capacity of the United States is located within the "Golden Triangle." (See plate 2.) These refineries are operated by:

Atlantic Refining Company -----	Port Arthur, Texas
Gulf Oil Corporation -----	Port Arthur, Texas
Texaco, Inc. -----	Port Arthur, Texas
The Pure Oil Company -----	Nederland, Texas
Texaco, Inc. -----	Port Neches, Texas
Socony-Mobil Oil Company, Inc. -----	Beaumont, Texas

These refineries, according to the 1960 Annual Report of the Oil & Gas Division of the Railroad Commission of Texas, have a combined daily rated capacity of 953,920 barrels of crude petroleum.

6. The local mineral resources of petroleum, natural gas, sulfur, salt, and calcium carbonate in the form of seashells, together with the petroleum by-products of the huge refining industry have attracted a large and rapidly growing petrochemical industry. (See plates 3 & 4.) Recent (1958 through 1961) new and expanded petrochemical industries in the area, according to Texas Industrial Expansion, Bureau of Business Research, The University of Texas, include:

Koppers Co. Inc., Plastics Division -----	Port Arthur, Texas
Texaco, Inc. -----	Port Arthur, Texas
The Pure Oil Company) combined	
Atlantic Refining Company) operation -----	Nederland, Texas
Jefferson Chemical Company -----	Port Neches, Texas
Goodrich-Gulf Chemical Corporation -----	Port Neches, Texas
Texas-U.S. Chemical Company -----	Port Neches, Texas
E. I. Dupont de Nemours -----	Beaumont, Texas
Olin-Mathieson Chemical Corporation -----	Beaumont, Texas
Goodyear Tire and Rubber Company -----	Beaumont, Texas
Texas Gulf Sulphur Company -----	Beaumont, Texas
Houston Chemical Corporation -----	Beaumont, Texas
Mobil Chemical Company -----	Beaumont, Texas

E. I. Dupont de Nemours -----	Orange, Texas
Crown-Zellerbach Corporation -----	Orange, Texas
Allied Chemicals Corporation -----	Orange, Texas
Firestone Tire and Rubber Company -----	Orange, Texas
Spencer Chemical Company -----	Orange, Texas
Phillips Chemical Co. -----	Echo, Texas

7. As may be seen, this roster reflects the names of many of America's industrial giants. Among the leading products of these chemical plants are: polyethylene, butadiene, ethylene glycol, polybutadiene, polyisoprene, naphthalene, methanol, and sulfuric acid.

8. The recent rapid increase in capital investments in the Sabine-Neches area, particularly in the fields of petroleum refining and petrochemicals, might give some wonder as to the growth potential to be expected. A recent analysis made by Henry G. McGrath and Luther R. Hill for the M. W. Kellogg Co. of New York appearing in precis on page 129 of the 20 November 1961 issue of the Oil & Gas Journal states that petrochemicals will continue to outstrip other chemicals and petroleum products in growth in the 1960's. The domestic budgets of various corporations reveal a larger share is being given petrochemicals than to refining with approximately \$800 million budgeted for 1961 alone. Petrochemicals will probably account for 41 percent of the tonnage and 64 percent of the value of all chemicals by 1970. Current investment in petrochemicals is estimated to be between \$6 billion and \$7 billion and should be \$12 billion by 1970, which would represent about 60 percent of the capital invested in the entire chemical industry. This is a growth from \$315 million in 1941. The percentage rate of growth from 1955 - 1960 may be seen on plate 5.

9. Petrochemicals have attracted more investment capital than refining since 1958; and this trend is expected to continue indefinitely. Some oil companies had an early start in this new industry; and the petroleum industry participation has increased so that the industry plays a significant role. Basic knowledge in marketing and manufacturing is being applied; and companies producing and processing oil and natural gas show enormous potential for the mass production of chemical building blocks. This participation by oil companies will probably increase; and the petroleum refining-industrial and chemical-industrial operations will tend to overlap with refining integrating forward towards finished products with a higher profit margin and chemical companies integrating backward to obtain lower cost sources of supply.

10. Foreign imports of crude oil are beginning to play an ever-increasing role in our petroleum industry as per capita energy requirements increase. This increase in the period 1940-1960 is shown on plate 6. The fact that the United States became a net oil importing nation in 1948 when imports of crude oil exceeded petroleum exports by about 53 million barrels might make it appear that petroleum reserves are no longer being increased at a rapid rate and that the end of production in this country is now in sight. Information gained from Petroleum Panorama, a 1959 issue of the Oil & Gas Journal commemorating oil's first

one hundred years (1859-1959) indicates that such exhaustion is by no means imminent since, with the exception of seven years, U. S. reserves have shown an annual increase since 1859. Early prediction had been made that the nation would run out of petroleum in 1921 which was extended to 1933. This extension was again prolonged to 1940; and new fields were discovered that continued to increase our known reserves in the face of ever-increasing demand. It is true that oil has become more and more difficult to discover and has generally been found at greater depths than in the past. Knowledge, however, has shown a corresponding increase making these more difficult discoveries possible. Between Drake's discovery well in 1859 and Spindletop in 1901, one billion barrels of oil were produced in the United States. The State of Texas alone produced that amount in 1951 and has equalled or exceeded that figure in 1952, 1953, 1955, 1956, and 1957 with an apparent diminution of only 1/2 billion barrels of reserve in the entire period. It is possible that Texas reserves could be increased if there were a higher allowable production. The amount of known reserves depends, in a measure, upon economics and politics. Most geologists, geophysicists, and geochemists believe that they can find future reserves; and it is believed that geological structures known as stratigraphic traps contain future reserves at least as large as those we have today. The famous East Texas field discovered by C. M. Joiner in 1930 is an example of a stratigraphic trap. This field had been condemned many times by the geologists of major oil companies; and two previous tests by Joiner in the area had been dry holes. There is no known direct method of discovering this type of field at the present time, though a method may be discovered at a future date.

11. Another method of increasing reserves is by increasing secondary oil production. This is done by increasing the percentage recovery from known fields which currently ranges from 25 to 30 percent. Recent experiments seem to indicate that this percentage recovery may be increased by such means as water flooding, gas repressuring, miscible phase recovery and in situ combustion to 40 percent and, ultimately, nearly 100 percent. It is estimated that the total content of fields discovered through 1958 in the United States was 309+ billion barrels that were no more than 33 percent recoverable under original producing methods. Improved recovery would have the effect of prolonging the lives of many of these fields and of rejuvenating many fields hitherto considered as exhausted. The Interstate Oil Compact Commission has estimated that our current reserves in excess of 30 billion barrels of recoverable oil can be increased to 43 billion barrels by recovery methods in current use. Just barely out of economic reach at the present time are the vast shales of Utah, Colorado, and Wyoming that contain an estimated 600 billion barrels of hydrocarbons and the Athabaskan Tar Sands of Northern Alberta which contain from 150 to 300 billion barrels of crude petroleum. When these deposits are exploited it is very likely that the extracted crude products will move by bulk carrier such as pipeline to existing refining and processing centers from where refined products will be distributed to ultimate marketing centers.

12. At the present time 32 out of the 50 states of the United States produce petroleum. Of the remaining 18 states at least Oregon, Idaho, Iowa, Georgia, North Carolina and South Carolina have fair possibility of discoveries. It is further possible that improved technology will bring more offshore wells into production that will be located in deeper water than is currently considered possible to exploit.

13. According to Future Growth of the World Petroleum Industry, a publication of the Petroleum Department of the Chase Manhattan Bank (Sep 1961), the present per capita consumption of petroleum products in the United States is 43.5 barrels, whereas it averages less than 5 barrels in the rest of the world. The increase in the rate of demand is accordingly expected, by the Chase Manhattan Bank, to be considerably less in the United States during the decade 1960-1970 than the worldwide rate. However, the over-all demand for oil and natural gas is expected to increase at the rate of 4 percent annually in this country. It is believed that the demand for natural gas in this nation will increase at the rate of 5.7 percent per annum, while the prospective oil demand will increase at a more modest 2.7 percent, which is still at a greater than population rate of increase.

14. The movement of crude oil from existing fields to existing refining centers together with the ever-increasing dependence on imports and increasing offshore production will probably tend to cause further increasing expansion of coastal refineries to serve existing and new markets. This fact, together with the accelerating importance of petrochemicals, should assure a bright future for the Sabine-Neches area. Assuming that the cost factor will still favor movement of crude and refined petroleum products by tanker and barge rather than by pipeline where water transportation is available and assuming that pipeline transportation of these products will remain more economical than movement by rail or highway carrier; it would appear that refinery facilities will probably remain in those areas with available water transportation as long as petroleum is of economic importance. This assumption would appear to be valid because of the retention of large refining centers at Wood River, Illinois on the Mississippi River, Whiting, Indiana on Lake Michigan and the large New Jersey refineries located with tanker access to the Atlantic Ocean. All of these refineries are located in proximity to marketing areas; and all have ready access to either barge or tanker transportation though they are not built adjacent to major production of crude petroleum. Much of the crude petroleum fed into these refineries is brought in by water-borne carrier; and much of the refined product moves out by the same means. Some of the crude brought in is imported from foreign sources; while some of the refined products shipped out represent exports to foreign markets.

15. Since the "Golden Triangle" was listed as the nation's largest petroleum refining center according to the Mineral Industry of Texas, 1958, published by the U. S. Bureau of Mines; it would seem reasonable to assume that it will remain an important refining center and that crude and refined

petroleum products will continue to use the Sabine-Neches Waterway until petroleum ceases to be of economic importance. If a future growth of about 2.7 percent for petroleum products is projected to the year 2015, it would appear that the crude and refined petroleum movement in the Sabine-Neches Waterway would be in the neighborhood of 250 million tons in that year. This estimate should, however, be tempered by other considerations such as the adaptation of other energy sources to economic use or the opening of new refining centers with similar or better collecting and distributing facilities.

16. National population projections made by the U. S. Army Engineer District, Fort Worth, in its DRAFT Trinity River and Tributaries, Texas, Economic Base Study for Comprehensive Review of Reports, dated April 1961, show for 2020, a United States population of 450 million and for 1995 a population of 322 million. If the above figures are interpolated for the year 2015, a year arbitrarily assumed as 50 years after completion of a proposed channel improvement on the Sabine-Neches Waterway, a population figure of about 396 million is obtained. This 396 million figure is about double the population estimated for 1965, the assumed first year of the project. This projection of future population is probably much more reliable in providing a basis for estimate of future use than is the extension of the present growth factor in overall demand.

17. To relate a projected per capita demand to a projected population, certain factors must be considered. It is reasonable to assume that a per capita demand over a short period of time, such as five years, will be about the same as it is today; while the per capita demand over a longer period could show considerable variation from the present. The long range per capita demand could remain constant, accelerate, or decelerate. To make an estimate of future petroleum demand it would be more conservative to assume a decelerated demand over a long period and assume that the per capita demand in 50 years would be about 75 percent of the present demand with an overall demand of about 1-1/2 times the present demand. This projection can be supported on the ground that other energy sources may replace petroleum to an extent, greater efficiency in the transformation of the chemical energy of petroleum to mechanical energy may be achieved, and, because of the limitations imposed by increased traffic volume caused by a larger population, the per capita use of private automobiles may actually decline in favor of improved public transportation.

18. The deep water petroleum commerce of approximately 41 million tons in 1960 should be increased by three percent to arrive at a tonnage of about 42.5 million rounded off to 43 million for 1965, the assumed first year of the proposed channel improvement project. Assuming that the movement of petroleum and petroleum products over the Sabine-Neches Waterway in 2015 will be increased by a factor of 1.5 over the starting date, the 2015 seagoing petroleum tonnage would be about 63.5 million tons of an estimated 90 million total petroleum. It is quite probable that the 50-year period of 2015-2065 will show a per capita decrease in petroleum

tonnage because of other improved energy sources. For this reason the estimated increase at the end of the second 50-year period is only 10 percent above the 2015 figure, or about 70 million tons for oceangoing commerce of a total of about 99 million tons of petroleum by all water carriers.

19. Transportation facilities and utilities.- The Sabine-Neches area is well-served by various means of transportation. The railroads serving Beaumont are: the Kansas City Southern, Missouri Pacific, Southern Pacific, and the Gulf, Colorado, and Santa Fe; while Orange has the Missouri Pacific and Southern Pacific; and Port Arthur is on the Kansas City Southern and the Southern Pacific.

20. A network of first class highways gives access from any land direction. These highways include Interstate No. 10, US 90, US 287, US 69, US 96, Texas 73, Texas 87, and Texas 124.

21. Several airlines serve the area and assure connections with all parts of the country. These lines are: Eastern Airlines, Trans Texas Airways, and Delta Airlines.

22. The area is one of the major port areas of the United States with Sabine Pass, Port Arthur and Beaumont being reached by a 36-foot channel and Orange by a 30-foot channel.

23. The Gulf Intracoastal Waterway stretching along the Gulf Coast opens inland waterway commerce between the "Golden Triangle," the Gulf Coast, the navigable portions of the entire Mississippi River System, and the Great Lakes to cheap bulk transportation for all forms of commodities.

24. Another major type of bulk transportation is the large number of pipelines conveying crude petroleum to the area's refineries, and petroleum products from the refineries to inland marketing areas and chemical plants.

25. The Gulf States Utilities Company serves the Sabine-Neches area with an extensive system of power transmission lines. It has recently added a one million kilowatt plant at Bridge City, Texas to its system and is spending \$205 million to meet anticipated future demands.

26. The United Gas Corporation serves both Beaumont and Orange with its system, while Port Arthur is served by Southern Union Gas Co.

27. Spoilbank development.- The spoil bank of the channel at Port Arthur, known as Pleasure Island, has been utilized for various public and private recreational purposes and Department of Defense Armories. Portions of the spoil bank are used for cattle grazing and sanitary fill. A paved county road extends southward along the spoil bank from Port Arthur and is linked to the Louisiana State highway system by toll

bridge across Sabine Lake. The spoil bank is connected to the mainland by the Port Arthur bridge which was constructed by Port Arthur and extended by the United States. Recently a residential real estate development known as Lake Front subdivision has been staked out on the spoil bank below Port Arthur.

28. Recreational facilities.- The recreational activities of the Sabine-Neches area are mainly boating and fishing with some hunting. The marshland area offers duck and goose hunting although the most favorable areas are leased to private groups; and the areas open to the general public are not too productive. The northern part of the area has fresh water fishing and some deer hunting. Sabine Lake offers fish, shrimp, and crabs and is rather extensively fished by sport fishermen though fishing is only fair and does not compare with that of the central and southern parts of the Texas Gulf Coast.

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TABLE 1

SABINE-NECHES WATERWAY, TEXAS (BEAUMONT, ORANGE, PORT ARTHUR AND SABINE PASS HARBOR, TEXAS)

TRAFFIC SUMMARY 1960

(short tons)

Locality	FOREIGN			DOMESTIC				Local	Through* traffic
	Total	Imports	Exports	Coastwise		Internal			
				Receipts	Shipments	Receipts	Shipments		
Beaumont, Tex.	27,113,480	318,803	872,595	1,324,865	17,012,670	4,925,259	2,504,882	154,906	-
Orange, Tex.	1,022,784	16	53,728	-	-	454,789	497,823	16,428	-
Port Arthur, Tex.	28,207,396	110,940	2,626,660	3,289,659	18,457,870	1,750,879	1,971,388	-	-
Sabine Pass Harbor, Tex.	365,282	-	-	1,480	97,158	151,716	114,928	-	-
Sabine-Neches Waterway	12,412,921	-	-	-	-	-	-	-	12,412,921
Total	69,121,863	429,259	3,552,983	4,616,004	35,567,698	7,282,643	5,089,021	171,334	12,412,921
Adjustment for local traffic**	- 428,652	-	-	-	-	- 428,652	- 428,652	428,652	-
GRAND TOTAL ALL TRAFFIC	68,693,211	429,259	3,552,983	4,616,004	35,567,698	6,853,991	4,660,369	599,986	12,412,921
Total tonnage through jetties at Sabine Pass	44,165,944								

* Internal traffic moved to and from points east of the Louisiana-Texas boundary to points west of Sabine-Neches.

** Internal traffic moved between the several ports located on the Sabine-Neches Waterway, while treated as receipts and shipments at the separate ports, is classified as local in the consolidated statement.

REVIEW OF REPORTS
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SABINE-NECHES WATERWAY

APPENDIX III - ENGINEERING DATA

1. General.- This appendix gives additional details pertaining to portions of the project and tributary area descriptive material which has been summarized in the text, and data pertaining to the engineering analysis of the requested improvements to Sabine-Neches Waterway.

2. Description of area.- The Federal project known as the Sabine-Neches Waterway, Texas, provides deepwater navigation to the ports of Port Arthur, Beaumont and Orange in the southeastern part of Texas through a jettied entrance channel, Sabine Pass and the Port Arthur Canal to Port Arthur, thence through the Sabine-Neches Canal to the mouth of the Neches and Sabine Rivers, thence in the Neches River to Beaumont and in the Sabine River to Orange.

3. Sabine Pass, which lies on the boundary between Texas and Louisiana, is located 225 miles west of New Orleans, Louisiana, and 65 miles east of Galveston, Texas. The pass is a natural outlet from Sabine Lake into the Gulf of Mexico. The Port Arthur and Sabine-Neches Canals are artificial channels that have been dredged adjacent to the shore of Sabine Lake. The Neches and Sabine Rivers empty into the north end of Sabine Lake. The Neches River has natural widths at mean low tide of about 1,000 feet near its mouth, 600 feet near the Beaumont turning basin and 400 feet upstream of the basin. For the Sabine-Neches Waterway improvement project, the bed of the stream has been dredged and several bends of the river have been cut off to provide for navigation requirements of depth and alignment. The Sabine River has natural widths at mean low tide of about 400 feet from its mouth to East Pass, 800 to 1,000 feet between East Pass and the Louisiana section of the Gulf Intracoastal Waterway, 600 feet near the Orange Municipal slip and about 400 feet at end of project channel.

4. The Sabine-Neches Waterway is connected with the Calcasieu River and Pass, Louisiana, project by the Gulf Intracoastal Waterway, which has an authorized depth of 12 feet and width of 125 feet, and leaves the Sabine-Neches Waterway at a point on the Sabine River about 3 miles downstream from Orange. The main channel of the Gulf Intracoastal Waterway extends in the Sabine-Neches Waterway from a point about 3 miles below Orange through the Sabine River and the Sabine-Neches Canal to the head of the Port Arthur Canal.

5. The Sabine-Neches Waterway is tidal throughout its length with a mean diurnal range in tide of about 2.2 feet at

the Gulf entrance, 1.0 foot at Port Arthur and 0.5 foot at Beaumont and Orange. Prolonged southerly winds raise the water surface in the channels by several feet and tropical hurricanes in the summer and fall months have caused tide heights of 14 feet above mean low tide at Sabine Pass and 8.2 feet above mean low tide at Port Arthur. Floods on the Neches River and Sabine River cause rises of short duration varying up to about 10 feet at Beaumont and about 8 feet at Orange. Mean low tide datum for this waterway is 0.87 foot below mean sea-level datum.

6. Existing improvements by local interests.- In addition to the local cooperation required by Congressional Acts, local interests have reportedly performed additional improvements as follows:

a. The Port Arthur Canal & Dock Co. is reported to have spent \$1,052,943.58 on dredging and rights-of-way for the Port Arthur Canal from Sabine to Port Arthur, including the east and west turning basins. The canal was dredged to a depth of 25 feet and a bottom width of 75 feet. The canal and turning basin were deeded to the United States on August 1, 1906.

b. The Gulf Refining Co., under War Department permit dated September 16, 1910, dredged a ship channel from the head of the Port Arthur west turning basin to, and including, a turning basin at its docks in Taylors Bayou, all at a reported cost of \$235,000. The improvement was donated without cost to the United States.

c. The city of Port Arthur reports expenditures of \$710,000 for revetment and a concrete pile bulkhead seawall about 24,941 feet long, extending along the city side of the Sabine-Neches Canal, which it claims reduces the amount of wash from passing vessels. The city estimates the value of lands donated to the United States for right-of-way for the Sabine-Neches Canal at \$1,000,000, and also reports expenditure of about \$400,000 in city funds for construction of bridges across the Sabine-Neches Canal at Port Arthur.

d. Local interests in 1938 dredged about 22,000 cubic yards of material from the Neches River, adjacent to the new warehouse No. 7 and beyond the upper limit of the Beaumont turning extension, at a cost of \$6,600. The improvement was incorporated in the Federal project by the River and Harbor Act of March 2, 1945.

e. In 1941, the Pennsylvania Shipyards, Inc., under contract with the Maritime Commission for improvement of its facilities, dredged a cutoff, 30 feet deep and 200 feet wide, in the Neches River immediately downstream from the U. S. Highway No. 90 bridge at Beaumont, at a cost of \$26,600.

f. The Orange County Navigation District in 1924 dredged a channel 32 feet deep, 200 feet wide and 3,000 feet long to the municipal wharf at a cost of \$15,000 and spent \$10,833 during 1934 and 1935 for maintenance of the channel, which was incorporated into the Federal project by the River and Harbor Act of August 26, 1937.

7. Existing highway bridge at Port Arthur.- The City of Port Arthur and the Commissioners Court of Jefferson County, supported by practically all other local interests at the hearing, requested replacement of the existing bascule highway bridge, which crosses the Sabine-Neches Canal, at Port Arthur. The bridge affords access to Pleasure Island and a county highway, which extends about 9 miles southeastward along the spoilbank and crosses a bridge at the lower end of Sabine Lake to connect with a state highway in Louisiana. According to local interests, vehicular use of the bridge at Port Arthur averages about 3,000 vehicles daily, and it is expected to increase to an average of 5,000 vehicles daily within the next few years. The existing bridge is shown on Exhibit 2.

8. Construction of the original 9- by 100-foot channel of the Sabine-Neches Canal was completed in about 1909 on a route roughly following the west shoreline of Sabine Lake. Prior to construction of the canal, the city of Port Arthur fronted on Sabine Lake and the Port Arthur Pleasure Pier Co., a private concern, had constructed amusement facilities on the outer end of a wooden pier extending about 1/2 mile into the lake. In 1912-14 the company expanded the pier and recreational facilities by constructing a concrete sheet pile enclosure and filling the enclosure with material dredged from Sabine Lake. To provide access from the city, the company constructed a single-leaf bascule bridge with 90 foot horizontal clearance across the Sabine-Neches Canal, which, by that time was authorized for deepening to 25 feet. In 1922 the project width was increased to 125 feet and the city of Port Arthur, which in 1920 had assumed ownership of the original bridge, added a second short bascule leaf to the east end of the bridge. Modification of the project in 1927 provided for a channel depth of 30 feet and a width of 150 feet. Following this improvement, the bridge was found to be in imminent danger of collapse and it was removed by the city in 1928. The present bridge was completed by the city in 1931.

9. The existing structure has a double-leaf bascule span with horizontal clearance of 208 feet between piers and 200 feet between fenders. The original construction in 1931 provided a 45-foot long girder approach span at each end. By 1946, four modifications of the project had increased the authorized dimensions of the Sabine-Neches Canal to 36 feet by 400

feet, except through a reach of about 4,000 feet in vicinity of the bridge. Congress, by the R&H Act of May 17, 1950 (House Doc. 174, 81st Cong., 1st sess.), authorized enlargement of the channel through the restricted reach to conform to the general project dimensions, including reconstruction of the bridge to extend the structure across the widened channel. This improvement was completed in 1953, but does not affect the navigation opening of the bridge. The purpose of the improvement was to alleviate strong tidal currents through the restricted reach. This was accomplished by removing the original 45-foot east approach span of the bridge and building 3 new approach spans, each 100 feet long, which permitted dredging through the bridge to the same dimensions as the remainder of the canal. The main piers, which support the two bascule leaves, are founded on untreated timber piles, which are covered by the concrete of the piers above elevation -40 feet. For a time, prior to extension of the bridge in 1953, the strong currents had eroded earth from the channel side of the east main pier to a depth below the concrete, so that some of the untreated piles were exposed. After the bridge was extended, deposition of material occurred around the pier so that at the present time the timber piles are not exposed. Recent soundings show water depths of 36 feet on the channel side and 30 feet on the east side of the east pier. It is not known whether some of the untreated piles were damaged by marine borers or otherwise, during the period of exposure; however, there is no indication that settlement or other movement of the pier has occurred. The original portion of the bridge, including the bascule navigation span, is now in very poor condition. The operating machinery and gears are badly worn. Due to inadequate maintenance and long intervals between painting, steel of the superstructure has been damaged by rusting. Adequate repairs to the existing bridge would involve replacement of all operating machinery and gears, considerable replacement of steel members of the bascule span, and complete replacement of the floor system and decking. It is possible, also, that the entire east main pier might have to be replaced if the supporting piles have been damaged to any appreciable extent.

10. With the present navigation opening of 200 feet being offset from the center of channel, the bridge does present a danger of collision to the larger supertankers using the channel. The very heavy volume of traffic on this waterway requires transiting of the bridge by over 2,000 trips of ocean going tankers and dry cargo vessels and over 5,000 barge tows of Gulf Intracoastal Waterway traffic each year. With its location about two blocks from the business district of Port Arthur and the large number of tankers on the waterway carrying cargos of explosive petroleum products, the danger of explosion from collision with the bridge offers a threat of a catastrophic accident in the heart of the city.

11. Navigation requirements for replacement of existing bridge.- With the improvements recommended in this report, the authorized dimensions of the Sabine-Neches Canal would be a depth of 40 feet and a bottom width of 400 feet. Local interests at Port Arthur have aggressively opposed further deposition of dredging spoil on Pleasure Island or in the adjacent shallow waters of Sabine Lake. As a result of this opposition, a policy was adopted several years ago which limits dredging in this reach of the waterway to that which can be performed by hopper dredges. While maintenance dredging or deepening over the existing channel width can be effectively performed in this manner, it would be prohibitively expensive to use hopper dredging for any substantial increment of widening. For this reason, the probability of any additional widening of the Sabine-Neches Canal is considered very low. It is believed that a clear horizontal opening of not less than the authorized channel width of 400 feet would be adequate for the foreseeable future. The minimum vertical clearance over the full channel width of 400 feet should be 138 feet above mean low tide, which is consistent with the clearances, which have been approved within the past few years for a number of other bridges crossing various channels along the Gulf coast with similar types of vessel traffic. Accordingly, any replacement structure for the existing bridge must provide minimum navigation clearances of 400 feet horizontally and 138 feet above mean low tide vertically.

12. Land traffic requirements for replacement of existing bridge.- The existing double-leaf bascule bridge was constructed in about 1931 to H-15 AASHO loading standards. The bridge provides a roadway width of 20 feet with 5-foot pedestrian walkways on each side of the roadway. Local interests state that the present vehicular use averages about 3,000 vehicles per day. No estimates of pedestrian use are available; however, the amusement facilities on Pleasure Island are generally located comparatively close to the business district of Port Arthur, and it is known that at times pedestrian use is heavy.

13. Alternatives considered.- Various alternatives to replace the existing bridge were considered, including ferry service, tunnel and various types of bridges. Approximate estimates indicated that the cost of a tunnel providing adequate depth clearances for dredging the channel and suitable gradients in the approaches for vehicular traffic would be prohibitive. Ferry service was rejected because of the large initial costs and annual costs of operation for ferries adequate to handle the volume of vehicular traffic without excessive delays during peak traffic periods. The ferries, in crossing the channel, also would offer some hazard to the large volume of vessel traffic using the waterway. Accordingly, it was concluded that a bridge offered the only practicable means of replacement.

14. Bridges considered.- The existing amusement facilities on Pleasure Island are located in a reach about opposite that part of Port Arthur between Foley Avenue on the south and Woodward Boulevard on the north, a distance of about 3 miles. For the purpose of this report, it has been assumed that relocation of the bridge would be at some point within these limits. The actual location would involve a number of factors that cannot be determined readily at this time. In considering the various types of bridge structures, it was determined that the required horizontal clear span of 400 feet would be excessive for a bascule span and that a bridge of this type would involve extremely large costs. Accordingly, it was given no further consideration and preliminary estimates of cost were made only for fixed bridges and vertical-lift movable bridges.

15. Comparison of costs of bridges.- Comparative preliminary estimates of cost were made for a fixed, high level bridge, with 138 feet vertical clearance; a semi-high level, vertical lift bridge with vertical clearances of 45 feet in the closed position and 138 feet in the open position; and a low level, vertical lift bridge, with vertical clearances of 11 feet in the closed position and 138 feet in the open position. Estimates were made for each of these bridges, with alternative horizontal clearances of 300 feet, 400 feet and 500 feet. The bridges were designed for highway and pedestrian standards equivalent to the existing bridge. Cost curves were plotted for the three types of bridges and are shown on exhibit 7. It was determined that the most economical bridge, which would provide the required navigation clearances and have vehicular and pedestrian capacity equivalent to the existing bridge, would be the fixed high level bridge with clearances of 400 feet horizontally and 138 feet vertically. Accordingly, this bridge was selected for the plan of improvement and its estimated costs were used as the basis for estimating cost apportionment between Federal and non-Federal interests. It is recognized that the design criteria for highway traffic requirements probably are not in accordance with modern standards and would be changed in the final design. Any provisions for heavier loadings or other changes required by present-day land traffic standards would be determined by local interests and the additional costs therefore would be borne by them.

16. Bridge foundation conditions.- In 1950 a large number of foundation borings were made for the relocation of the Port Arthur Engineer Field Office. Several deep borings were also made for the approach extension to the existing bridge to Pleasure Island in 1950. These borings indicate that the island in the area of these borings is composed of dredged clay fill from the surface to about 4 feet above sea level. Below the dredge fill about 4 feet of soft recent deposited silt, containing considerable organic material, rests upon the hard Beaumont Clay formation.

17. Bridge foundation design.- The new bridge across the canal can be constructed using pile foundations for the piers. Wood piles penetrating approximately 35 to 40 feet into the plastic to stiff Beaumont clay will have a bearing capacity of about 25 tons per pile. Sixteen-inch square prestressed concrete piles, with 30 to 35-foot penetration, will have a bearing capacity of 50 tons per pile.

18. Removal of existing bridge.- The estimate provides for the removal of the existing bridge superstructure and all of the substructures except the west abutment which is an integral part of the seawall. Piles in the 400-foot navigation channel would be pulled.

BANK EROSION PROTECTION

19. Local interests requested bank erosion protection along the channel side of the entire length of Pleasure Island to prevent further loss of valuable land and to eliminate the threat of extensive damage to the highway and to recreational developments on Pleasure Island opposite the city of Port Arthur. Pleasure Island is the local name for the spoilbank area which lies between the Port Arthur and Sabine-Neches Canals and Sabine Lake. The spoilbank was created by deposition of dredging spoil from original construction, numerous enlargements and periodic maintenance of the canals over many years. The original construction of both canals was generally along the west shoreline of Sabine Lake; although at various points the excavation was slightly inland. Along the Port Arthur Canal the small tracts of land remaining between the canal and Sabine Lake were privately owned, while prior to construction of the Sabine-Neches Canal fee-simple titles were conveyed to the United States for all land lying between the lakeshore and the west right-of-way obtained for the canal, so that after construction of the canal, all remaining land areas to the east were owned by the United States. However, most of the areas of original land have been dredged away during subsequent enlargements of the waterway so that, at the present time, most of the spoilbank overlies the former shallow waters along the west side of Sabine Lake.

20. At the present time, the width of the spoilbank ranges from 500 to 600 feet in the narrowest reaches to more than 2,000 feet in the widest. Elevations of spoil deposit range from 10 to 30 feet above mean low tide along the canal side and slope away from the canals to the present shoreline of the lake. Through several legislative actions of the state of Texas during the period 1925 to 1955, the city of Port Arthur obtained title to large tracts of the submerged lake bed including all of the spoilbank in front of Port Arthur and northeast therefrom to the mouth of the Neches River. The extensive recreational developments on the spoilbank near Port Arthur are

on this land. Jefferson County, prior to construction of the highway southward along the spoilbank to its lower end, including the bridge crossing into Louisiana, obtained right-of-way easements from a number of private ownership claimants and an easement from the state.

21. During the past 20 or more years, the city of Port Arthur and other local interests concerned with recreation have objected strenuously to further unconfined depositing of dredge spoil on the spoilbank. The objections were based primarily on alleged damage to the recreational potential, including sport fishing of Sabine Lake. After a period of several years, the Government agreed to deposit all spoil from future maintenance on land areas west of the canals rather than on the spoilbank. Since no such areas are available in the city of Port Arthur, this requires maintenance with hopper dredges over a considerable reach of the Sabine-Neches Canal, with the dredged material being hauled to depositing areas above and below the city and being rehandled by pipeline dredges into the land spoil areas.

22. The local concern with erosion along the canal side of the spoilbank results from actual and potential damage to the recreational developments near Port Arthur, and to the county highway extending southward. Erosion on the canal side results largely from wave and propeller wash of passing vessels in the canals. A long standing Federal policy views this type of damage as consequential to use of the waterway, with relief being either the responsibility of owners of individual vessels causing the damage or the responsibility of local interests under the "hold and save" requirements of local cooperation. Provision of bank protection would, to a certain extent, reduce Federal maintenance dredging costs by reducing the quantity of material in the channel. It is estimated that about 165,000 cubic yards of material annually are eroded from the spoilbank. Assuming that all of this material deposits in the navigation channel and is subsequently removed through maintenance dredging, a maintenance cost of about \$50,000 annually would result from the erosion. If construction of bank protection would eliminate all of this source of shoaling, an annual benefit of \$50,000 would accrue to the bank protection.

23. Slope erosion.- The bank erosion along the Sabine-Neches-Port Arthur canals spoilbank is caused primarily by the waves and vessel wash generated by passing vessels in the waterway. Erosion caused by small boats, currents, and wind-generated waves is minor. Loaded supertankers traveling at relatively high speeds produce the most severe waves. As the waves strike the bank a wave cut terrace is formed at about sea level. As the terrace is cut back, the bank above the terrace fails, and slides onto the terrace, where subsequent waves remove the

material leaving a gentle upward slope across the terrace to the foot of the high bank. This type erosion has taken place along the entire canal side of the island. In some areas the erosion is more severe than in others, which is probably due mainly to the differences in the materials forming the island. During all except low tide stages, the terrace is covered with water, ranging from a few inches to about 1.5 feet in depth.

24. Slope protection.- Local interests have tried various methods of slope protection along critical reaches of the canal. These areas are indicated on exhibit 2. Articulated concrete mats were displaced by the large waves and large concrete blocks were undermined as no blanket was placed beneath them. Broken concrete of various sizes piled or placed to form a wall at the toe of the slope has been very effective in preventing erosion of the toe by wave action. The existing shore is very irregular and extensive grading would be required to straighten and smooth it before protection could be placed directly on the slope. Without grading, a stone barrier could be placed in the shallow water near the toe of the high bank. The base would be on existing ground of about elevation zero, and the top at elevation +5 M.L.T. The barrier would consist of stone riprap on a 12-inch thick stone blanket. Based on a design wave height of 3 feet, stone of 2.50 specific gravity, and 1 on 2 side slopes, the riprap stone should vary from 100 pounds to 500 pounds in size. The 12-inch thick blanket of stones, varying in size from 1/2 inch to 8 inches, would prevent undermining of the riprap. This barrier would break waves before they strike the shore and the bank slope could be protected against weather erosion by turf. A section of the investigated protection is shown on exhibit 8.

25. Materials for slope protection.- Sound, durable stone having a minimum unit weight of 150 pounds per cubic foot would be used for riprap and blanket materials. The nearest suitable quarries are located about 325 miles from Port Arthur along the Balcones fault zone in the San Antonio-Austin area of Texas. The quarries produce stone of the quality and gradations required from the Edwards Limestone formation. Excellent limestone furnished for recent repair jobs on the Sabine Pass jetties was quarried in Kentucky and transported direct to the site by barge.

26. Dredging.- Data pertaining to the engineering aspects of channel dredging, including character of materials, rights-of-way, spoil disposal areas, estimates of increased annual maintenance, channel side slopes and overdepth dredging are discussed in appendix IV.

REVIEW OF REPORTS
ON
SABINE-NECHES WATERWAY, TEXAS

APPENDIX IV

ESTIMATES OF FIRST COST AND ANNUAL CHARGES

1. General.- This appendix presents information pertaining to detailed estimates of first cost, investment and annual charges of the requested improvements to Sabine-Neches Waterway.

2. Cost estimates.- Detailed estimates of first cost in this appendix include the cost for construction, lands, rights-of-way, and damages, contingencies, engineering and design, supervision and administration, and the annual costs of the various improvements include interest on the initial investment, amortization of the investment and costs of annual maintenance and advance replacement of the improvements.

3. Rights-of-way and spoil disposal areas.- Estimates of the unit costs of rights-of-way required for enlarging the Sabine-Neches Waterway were based on the estimated present values of the lands. Spoil disposal areas used in the past for construction and maintenance of the authorized project channels and basins would be used for disposal of materials from dredging work proposed under the various plans of improvement. Some additional areas would also have to be acquired.

4. Materials.- The materials to be encountered in dredging the requested improvements would consist of sand, sandy clay, clay and shell. These materials should offer no unusual dredging difficulties.

5. Unit prices.- The unit prices of dredging used in the estimates of construction cost for the inland channels and basins were based on use of a modern 27-inch pipeline dredge with an average daily output of 22,000 cubic yards of material from a 20-hour dredging day, with the exception of a six-mile stretch in the Sabine-Neches Canal, where a combination of hopper dredging and pipeline dredging would be used. The estimated unit prices for dredging from the Gulf of Mexico to the inner end of the jetty channel were based on use of the Corps of Engineers' hopper dredge "A. Mackenzie." All dredging prices were based on the experienced cost of similar work in the district during March 1962. Estimates of the number of aids to navigation to be relocated and constructed for the various improvements and the estimates of construction cost and maintenance were furnished by the Commander, Eighth Coast Guard District, New Orleans, Louisiana.

6. Interest rates.- Interest rates of 2-5/8 percent for Federal investment, 3 percent for non-Federal public investment and 4 percent for non-Federal private investment were used in computing the annual charges for interest on the investment and amortization of the investment over a 100-year period.

7. Maintenance of inland channels.- Estimates of the quantities of maintenance dredging to be removed annually were based on experienced shoaling rates of the existing channels and basins of the waterway. The cost estimates for maintenance dredging were based on the experienced cost of maintenance in the area during March 1962.

8. Maintenance of Sabine Bank channel.- The Galveston District has no experience with maintenance of long unprotected channels in the open Gulf of Mexico, such as the recommended 15.3 mile extension of the outer bar channel through Sabine Bank. The existing outer bar channel extends in the open Gulf about 3.6 miles seaward from the outer end of the Sabine Pass jetties. Natural depths in the Gulf range from about 20 feet at the shoreward end to about 37 feet at the seaward end. The authorized depth of this channel is 37 feet and, including overdepth dredging, it is maintained to a depth of about 41 feet. Thus, the dredging extends below the natural bed level of the Gulf from about 21 feet at the shoreward end to about 4 feet at the outer end. Maintenance dredging experience with the channel has shown that the rate of shoaling in the 5-year period 1954 through 1959 averaged about 2,660,000 cubic yards annually. Cross sections taken for dredging each year indicate that about 60 percent of the shoaling occurs in the first one-mile reach of channel beyond the end of the jetties and that only about 5 percent occurs in the seaward last mile. Thus, the shoaling rate in the outer 1 mile, where the depth of dredging below natural Gulf bed level averages about 5 feet, is approximately 265,000 cubic yards annually, or an average depth over the channel of about 0.8 feet. Along the proposed extension, natural Gulf bed depths range from about 32 feet to about 39 feet and average about 37 feet. Thus, with a 43-foot project, dredging, including overdepth, would be performed to about 47 feet, or about 10 feet below the average Gulf bed. Under this condition, it is estimated that the annual shoaling rate in the extended channel might average about 1.5 feet. Experience in maintaining the shorter entrance channels at Galveston and Freeport and experience of the New Orleans District at Calcasieu Pass have not indicated any greater problems than at Sabine Pass. After informal conferences with personnel of the Beach Erosion Board and the Waterways Experiment Station and taking into account the experienced rates described above, it is estimated that the shoaling rate of the Sabine Bank channel would not exceed 1.5 feet per year.

9. Overdepth and side slopes.- All estimates of quantities for dredging include an allowance for overdepth dredging. The allowances include 2 feet of advance maintenance plus 2 feet of allowable overdepth in the open waters or 1 foot of allowable overdepth in the landlocked channels and basins. Channel side slopes would be 1 vertical on 2 horizontal. Side slopes would extend below the 2 feet of advance maintenance dredging.

10. Contingency and other allowances.- The cost estimates include an allowance of 15 percent to cover contingencies during construction. The allowances for engineering and design and supervision and administration were estimated on the basis of experienced costs in the District in March 1962.

11. Preauthorization survey and study costs.- A total of \$35,000 has been expended for preauthorization survey and study costs, including preparation of this report. The estimated costs for study of the separate plan of improvement included \$23,000 for the 40-foot project, \$5,000 for the bridge study, and \$2,000 for the shallow-draft channel above Orange to Echo, Texas. An additional \$5,000 was spent on miscellaneous improvements investigated but not recommended.

12. Estimates of first cost.- Detailed estimates of first cost for the different phases of the plan of improvement are shown in tables A through C of this appendix and are appended hereto as follows:

Table A - Estimate of first cost for deepening to 43-40 feet the Sabine-Neches Waterway from the Gulf of Mexico to, but not including the Beaumont turning basin; widening the Port Arthur canal to 500 feet; widening the Neches River channel to 400 feet and constructing three turning points on the Neches River.

Table B - Estimate of first cost for constructing a high-level bridge to Pleasure Island at Port Arthur with a horizontal clearance of 400 feet and a vertical clearance of 138 feet above mean low tide.

Table C - Estimate of first cost for extending the Federal project above Orange to include a shallow-draft channel 12 feet by 125 feet from Orange to Echo, Texas.

13. Cost estimates for investigated plans of improvements are summarized in table D.

14. Cost estimates for investigated bridges are summarized in exhibit 7 to appendix III.

15. The existing bascule highway bridge at Port Arthur, which is to be replaced, is a double-lane bridge with a roadway width of 20 feet. The bridge was constructed in 1931 and was designed for H-15 live loading, in accordance with standard specifications for highway bridges of the American Association of State Highway Officials. The cost estimates used in this report for the replacement bridge are based on a designed roadway width of 20 feet and H-15 live loading and the estimated amounts to be apportioned to Federal and local interests have been computed accordingly. It is pointed out that the design standards of the existing bridge are probably deficient in meeting the requirements of prospective highway traffic on the replacement bridge. The requirements for additional width of roadway, capacity for heavier live loads, and similar betterments for improved service to vehicular and pedestrian traffic in the final design of the replacement bridge would be determined by local interests and the entire cost of such improvements would be apportioned to them. Since these requirements have not been determined, no estimate has been made at this time of the additional cost to be apportioned to local interests for betterments to serve the land traffic.

TABLE A (Cont'd)

Item:	:	:	:	Unit :	:
No. :	Item	: Unit	: Quantity	: cost	: Cost
b. U. S. Coast Guard					
	(1) Construct 3 lighted sound buoys			\$	33,000
	(2) Construct 17 lighted buoys				125,000
	(3) Construct 1 set of ranges (2 structures)				14,000
	(4) Relocate 12 sets of ranges				107,000
	(5) Relocate 27 minor lights				57,000
					<u>336,000</u>
c. Federal first cost					
	(1) Corps of Engineers				16,147,000
	(2) U. S. Coast Guard				<u>336,000</u>
	TOTAL FEDERAL FIRST COST				16,483,000
2. Non-Federal first cost					
a. Non-Federal public					
	(1) Rights-of-way	Acres	145	\$1,300	188,500
	(2) Spoil disposal areas	Acres	940	50	47,000
	(3) Levees	L.S.			<u>200,000</u>
	Subtotal, non-Federal public				435,000
b. Non-Federal private (relocations)					
	(1) Sabine Pass Channel				
	(a) Relocate U. S. Coast Guard's 2 cables at mile 4.6				3,200
	(2) Neches River				
	(a) Relocate Texas Pipe Line Company's 1-16" and 1-22" pipelines at mile 32.5				22,000
	(b) Relocate Shell Pipe Line Company's 1-10" pipeline; Texaco Inc.'s 1-10" pipeline; Texas Pipeline Company's 3-8" and 1-3" pipelines, Texas Gas Corporation's 1-8" pipeline and Freo Pipe Line Company's 2-10" pipelines at mile 32.5				160,500
	(c) Relocate U.S.M.A.'s power cable at mile 39.5				1,500
	(d) Relocate Texas Gas Corporation's 1-12" pipeline at mile 41.8				50,000

TABLE A (Cont'd)

Item: No. :	Item	: Unit :	: Quantity :	: Unit : : cost :	Cost
	(e) Relocate United Gas Pipe Line Company's 2-10" pipelines at mile 41.8			\$	147,000
	(f) Relocate Gulf Oil Company's 1-7" pipeline at mile 41.8				78,900
	(g) Relocate Gulf Oil Company's 1-6" pipeline at mile 41.8				78,900
	(h) Relocate Gulf Oil Company's 1 - 3/4" cable at mile 41.8				2,500
	Subtotal, non-Federal private				<u>544,500</u>
	c. Total non-Federal first cost				980,000
3.	Total first cost				
	a. Federal				16,483,000
	b. Non-Federal				<u>980,000</u>
	TOTAL FIRST COST				17,463,000

TABLE B

ESTIMATES OF FIRST COST
HIGH LEVEL FIXED BRIDGE

Item:	:	:	:	Unit :
No. :	Item	:Unit:	Quantity	: cost : Cost
1. Bridge construction cost				
a. Superstructures				
(1)	Struct Steel (Jt. Armor & Brg. Pls.)	Lbs	15,000	\$ 0.14 \$ 2,100
(2)	Struct Steel (Trusses)	Lbs	2,530,000	0.32 809,600
(3)	Struct Steel (Plate Grds)	Lbs	370,000	0.24 88,800
(4)	Conc (Decks, Walks & Curbs)	CY	2,850	45.00 128,250
(5)	Reinf. Steel	Lbs	643,800	0.15 96,570
(6)	Prestress Conc Bms (Type III)	LF	19,700	13.50 265,950
(7)	Aluminum Handrail	LF	9,090	5.50 49,990
	Subtotal			<u>1,441,260</u>
b. Substructure				
(1)	Conc in Piers	CY	16,800	50.00 840,000
(2)	Conc in Abutments	CY	30	45.00 1,350
(3)	Timber Piling, Untreated	LF	43,550	2.85 124,120
(4)	Prestress Conc Piling 16" Sq	LF	29,890	9.50 283,950
(5)	Reinforcing Steel	Lbs	2,300,000	0.15 345,000
(6)	Excavation for Piers & Abut	CY	10,240	3.25 33,280
(7)	Backfill for Piers & Abut	CY	1,500	1.00 1,500
(8)	Coffer Dam & Dewatering	Job		250,000
	Subtotal			<u>1,879,200</u>
c. Approaches				
(1)	Compacted Earth Fill	CY	52,100	0.75 39,070
(2)	Shell Base (8" Compacted)	CY	2,400	5.00 12,000
(3)	Asphaltic Surface Tr., 2"	Ton	600	12.00 7,200
(4)	Asphaltic Cement	Ton	34	32.00 1,090
(5)	Prime Coat	Gal	2,900	0.25 730
(6)	Filter Blanket	Ton	2,900	7.50 21,750
(7)	Riprap at Lakefront	Ton	4,900	9.00 44,100
(8)	Guardrail	LF	2,760	5.00 13,800
	Subtotal			<u>139,740</u>
d.	Fender System	Job		90,000
	TOTAL BRIDGE COST			<u>\$3,550,200</u>

TABLE B (Cont'd)

Item:	:	:	:	Unit :	
No.:	Item	:Unit:	Quantity	Cost	Cost
2.	Removal of existing bridges				
a.	Superstructure				
(1)	Struct steel	Ton	450	\$50.00	\$ 22,500
(2)	Machinery	Ton	75	50.00	3,750
(3)	Roadway decking	SF	7,100	0.20	1,420
(4)	Control house (2)	SF	300	4.50	1,350
	Subtotal				<u>29,020</u>
b.	Substructure				
(1)	Concrete above elev. -11	CY	130	10.00	1,300
(2)	Mass concrete	CY	2,320	7.50	17,400
(3)	Wood piling	Ea	400	35.00	14,000
(4)	Existing sheet piling	SF	10,500	1.00	10,500
	Subtotal				<u>43,200</u>
c.	Cofferdam				
(1)	Sheet piling, install & remove	SF	14,300	4.00	57,200
(2)	Care of water during const.	LS			30,000
(3)	Existing dolphins				
(a)	Excavation	CY	930	2.00	1,860
(b)	Sheet piling	SF	9,840	0.65	6,400
	Subtotal				<u>95,460</u>
	Total first cost, removal of bridge				167,680
3.	Removal of approach spans				
a.	Superstructure				
(1)	Struct steel	Ton	187	40.00	7,480
(2)	Roadway decking, slab	SF	9,700	0.15	1,460
	Subtotal				<u>8,940</u>
b.	Substructure				
(1)	Concrete	CY	551	7.50	4,130
(2)	Wood piling, 35'	Ea	98	35.00	3,430
(3)	Existing sheet piling, 35'	SF	8,432	1.00	8,430
	Subtotal				<u>15,990</u>
c.	Cofferdam				
(1)	Sheet piling, 55', install and remove	SF	18,000	4.00	72,000
(2)	Care of water during construction	LS			25,000
					<u>97,000</u>
	Total first cost, removal of approach spans				121,930

TABLE B (Cont'd)

Item:	:	:	:	Unit :	:
No.:	Item	:Unit:	Quantity :	Cost :	Cost
4.	Salvage value				
a.	Structural steel	Ton	637	\$15.00	\$ 9,560
b.	Machinery	Ton	75	20.00	1,500
c.	Steel sheet piling (existing)		No value		-
d.	Wood piling (existing)		No value		-
	Subtotal				<u>- 11,060</u>
5.	Total construction cost				3,828,750

TABLE B (Cont'd)
 APPORTIONMENT OF COST
 OF
 HIGH LEVEL FIXED BRIDGE

Construction	3,828,750	
A-E Services (5%)	<u>191,250</u>	
Total estimated cost of project		4,020,000
Less salvage		<u>0</u>
Cost of alteration to be apportioned		4,020,000
Cost to be borne by local interests		
Direct and special benefits	(1)	
Expectable savings in repair and maintenance costs	(1)	
Costs attributable to requirements of highway traffic	(1)	
Expired service life of old bridge		
C 30/50 x 300,000	180,000	180,000 (2)
Cost to be borne by the United States		3,840,000
Contingencies 20%		<u>768,000</u>
Total		4,608,000
Cost to be borne by local interests		180,000 (2)
Contingencies 20%		<u>40,000</u>
Total		220,000 (2)
Total apportioned cost of construction		4,828,000

.In addition to the total share of the construction cost to be borne by the United States, the Government costs of supervision and administration are estimated at \$230,000 and preauthorization studies which are estimated at \$5,000. Costs of rights-of-way and easements necessary for construction are to be borne entirely by local interests.

Summary of cost		
Federal, apportioned costs		4,608,000
non-apportioned		<u>235,000</u>
	Subtotal	4,843,000
Non-Federal apportioned cost		220,000 (2)
non-apportioned (lands and damages, incl. conting.)		<u>178,000</u>
	Subtotal	398,000
	Total	5,241,000

-
- (1) Desires of local interests relative to highway design requirements of new bridge and estimated costs thereof not determined at this time.
- (2) Does not include costs for direct and special benefits, expectable savings in repair and maintenance costs, and costs attributable to requirements of highway traffic.

TABLE C
ESTIMATES OF FIRST COST
SHALLOW-DRAFT CHANNEL TO ECHO, TEXAS

Item:	:	:	:	Unit	:			
No. :	Item	:	Unit	Quantity	:	Unit	:	Cost
1.	Federal first cost							
	a. Corps of Engineers							
	(09.0) Channels							
	Dredging	C.Y.		797,000		\$0.28		\$ 223,160
	Contingencies, 15%+							33,840
	Total, channels							<u>257,000</u>
	(29.0) PREAUTHORIZATION STUDIES							2,000
	(30.0) ENGINEERING AND DESIGN							6,000
	(31.0) SUPERVISION AND ADMINISTRATION							<u>26,000</u>
	TOTAL CORPS OF ENGINEERS							291,000
	b. U. S. Coast Guard							
	(1) 1 minor light							3,500
	(2) 5 daybeacons							<u>3,500</u>
	TOTAL U. S. COAST GUARD							7,000
	c. Federal first cost							
	(1) Corps of Engineers							291,000
	(2) U. S. Coast Guard							<u>7,000</u>
	TOTAL FEDERAL FIRST COST							298,000
2.	Non-Federal first cost							
	a. Non-Federal public							
	(1) Rights-of-way	Acres		40		350.00		14,000
	(2) Spoil areas	Acres		2,600		60.00		156,000
	(3) Retaining levees							None
	Total non-Federal public							<u>170,000</u>
	b. Non-Federal private							None
	c. Total Non-Federal first cost							170,000
3.	Total first cost							
	a. Federal							298,000
	b. Non-Federal							<u>170,000</u>
	TOTAL FIRST COST							<u>468,000</u>

TABLE D

ESTIMATES OF FIRST COST
INVESTIGATED PLANS OF IMPROVEMENT

Plans	Cost
1. 43-40' from Gulf to Pt. Arthur & Beaumont, 1000' outer bar & jetty channel, 600' Sabine Pass Chan, 500' to Port Arthur & Beaumont, widening at docks on Neches River, and alteration of Pt. Arthur bridge	\$36,335,000
2. 40' x 400' channel in Sabine River to IH 10 at Orange, 30' x 225' channel in Cow Bayou, and no change in channel around Harbor Island at Orange	13,643,000
3. Bank protection along Pt. Arthur & Sabine-Neches Canals	2,650,000
4. 45'-43' from Gulf to Port Arthur & Beaumont, widening Port Arthur Canal to 500' and Neches River Chan. to 400', three turning points in Neches River, and alteration of Port Arthur bridge	30,017,000
5. 34' x 200' channel in Sabine River to and including Orange Municipal Slip	1,192,000
6. 40' x 400' channel in Sabine Lake, alteration of hwy. bridge at mouth of Sabine Lake, and new bridge for GIWW traffic	25,000,000

16. Estimates of annual charges.- Detailed estimates of annual charges for the various phases of the plan of improvement are shown in the following tables E through G.

TABLE E
ESTIMATES OF ANNUAL CHARGES
40' PROJECT TO BEAUMONT, TEXAS

Item	:	Cost
Estimated construction period (months)		36
<u>1. Federal investment</u>		
a. Corps of Engineers		
(1) Estimated first cost		\$16,147,000
(2) Interest during 3 yrs construction		<u>635,900</u>
Total Corps of Engineers investment		16,782,900
b. U. S. Coast Guard		
(1) Estimated first cost		336,000
(2) Interest during 3 yrs construction		<u>13,200</u>
		349,200
c. Total Federal investment		17,132,100
<u>2. Federal annual charges</u>		
a. Corps of Engineers		
(1) Interest on investment (2.625%)		440,550
(2) Amortization (100 years)		35,750
(3) Maintenance dredging		<u>620,000</u>
Total Corps of Engineers		1,096,300
b. U. S. Coast Guard		
(1) Interest on investment (2.625%)		9,200
(2) Amortization on investment (100 yrs)		740
(3) Maintenance and replacement		<u>19,200</u>
Total U. S. Coast Guard		29,140
c. Total Federal annual charges		1,125,440

TABLE E (Cont'd)

Item	:	Cost
<u>3. Non-Federal investment</u>		
a. Non-Federal public		
(1) Estimated first cost	\$	435,500
(2) Interest during 3 yrs construction		<u>19,600</u>
Total non-Federal public investment		455,100
b. Non-Federal private		
(1) Estimated first cost		544,500
(2) Interest during 3 yrs construction		<u>32,670</u>
Total non-Federal private investment		577,170
<u>4. Non-Federal annual charges</u>		
a. Non-Federal public		
(1) Interest on investment (3%)		13,650
(2) Amortization (100 years)		750
(3) Maintenance		<u>24,000</u>
Total non-Federal public		38,400
b. Non-Federal private		
(1) Interest on investment (4%)		23,100
(2) Amortization (100 years)		<u>460</u>
Total non-Federal private		23,560
c. Total non-Federal		
		61,960
<u>5. Total annual charges</u>		
a. Federal		1,125,440
b. Non-Federal		<u>61,960</u>
TOTAL ANNUAL CHARGES		1,187,400

TABLE F

ESTIMATES OF ANNUAL CHARGES
HIGH LEVEL FIXED BRIDGE

Item	:	Cost
Estimated construction period (months)		36
<u>1. Federal investment</u>		
Corps of Engineers		
(1) Estimated first cost		\$4,843,000
(2) Interest during construction		<u>190,700</u>
Total Federal investment		5,033,700
<u>2. Federal annual charges</u>		
Corps of Engineers		
(1) Interest on investment (2.625%)		132,130
(2) Amortization on investment (100 years)		10,720
(3) Maintenance		<u>None</u>
Total Corps of Engineers		142,850
<u>3. Non-Federal investment</u>		
a. Non-Federal public		
(1) Estimated first cost		398,000
(2) Interest during construction		<u>17,900</u>
Total non-Federal investment		415,900
<u>4. Non-Federal annual charges</u>		
Non-Federal public		
(1) Interest on investment (3%)		12,480
(2) Amortization on investment (100 yrs)		660
(3) Maintenance		<u>25,000</u>
Total non-Federal public		38,140
<u>5. Total annual charges</u>		
a. Federal		142,850
b. Non-Federal		<u>38,140</u>
TOTAL ANNUAL CHARGES		<u>180,990</u>

TABLE G

ESTIMATES OF ANNUAL CHARGES
SHALLOW-DRAFT CHANNEL TO ECHO, TEXAS

Item	:	Cost
Estimated construction period (months)		3
<u>1. Federal investment</u>		
a. Corps of Engineers		\$ 291,000
b. U. S. Coast Guard		7,000
c. Total Federal investment		<u>298,000</u>
<u>2. Federal annual charges</u>		
a. Corps of Engineers		
(1) Interest on investment (2-5/8%)		7,640
(2) Amortization (100 years)		620
(3) Maintenance		<u>None</u>
Total Corps of Engineers		8,260
b. U. S. Coast Guard:		
(1) Interest on investment (2-5/8%)		180
(2) Amortization (100 years)		20
(3) Maintenance		<u>880</u>
		1,080
c. Total Federal annual charges		9,340
<u>3. Non-Federal investment</u>		
a. Non-Federal public		170,000
b. Non-Federal private		<u>None</u>
Total non-Federal		170,000
<u>4. Non-Federal annual charges</u>		
a. Non-Federal public		
(1) Interest on investment		5,100
(2) Amortization		<u>270</u>
Total non-Federal public		5,370
b. Non-Federal private		None
c. Total non-Federal		5,370
<u>5. Total annual charges</u>		
a. Federal		9,340
b. Non-Federal		<u>5,370</u>
TOTAL ANNUAL CHARGES		<u>14,710</u>

REVIEW OF REPORTS
ON
SABINE-NECHES WATERWAY, TEXAS

APPENDIX V

COMMENTS BY OTHER AGENCIES

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

P. O. Box 417
Temple, Texas
March 12, 1962

Colonel James S. Maxwell
District Engineer
U. S. Corps of Engineers
606 Santa Fe Building
Galveston, Texas

Dear Colonel Maxwell:

Thank you for the opportunity to review a draft of the review of reports on the Sabine-Neches Waterway, Texas.

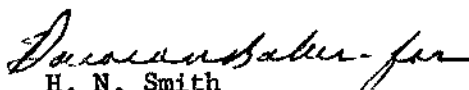
Review of data contained in the report indicates that the project area is predominantly industrial and that agriculture has been subjected to position of lesser importance in the economy of the area during recent years. Further, it appears that any works of improvement installed in upstream areas of either the Sabine or Neches Basin under programs administered by the Soil Conservation Service should be complementary to the proposed project.

Data relative to existing, planned and proposed upstream watershed projects of the Soil Conservation Service in the Neches River Basin previously have been made available to you during participation in activities of the U. S. Study Commission - Texas. Similar data will be completed for upstream areas of the Sabine River by about the end of the current calendar year. We shall be happy to make these available for your use at that time.

In view of composition of the project area and conditions existing therein, the Soil Conservation Service has no specific comments to offer on the report. If, however, we can assist you in any way, please let me know.

The continued cooperation and assistance extended to the Soil Conservation Service by personnel of the Galveston District is appreciated. It is felt that this coordination contributes greatly to more efficient planning and conservation of land and water resources in Texas.

Very truly yours,



H. N. Smith
State Conservationist

March 2, 1962

Lt. Col. J. S. Maxwell
District Engineer
Corps of Engineers
U. S. Army
Galveston, Texas

Dear Sir:

The undersigned parties have received your letter of date, February 12, 1962, requesting an expression of views on the following matters:

- (1) An alternate channel through Sabine Lake.
- (2) Financing by local interests of the necessary cash contributions for the Port Arthur Pleasure Island Bridge replacement.

In reply to your request we submit the following statement in reference thereto:

Proposition No. 1 - At the public hearing held December 6, 1960, the undersigned requested a study and report on deepening and widening of the existing authorized Channel of the Sabine-Neches Waterway only with a further request for a study and report on bank stabilization and replacement of the Port Arthur Bridge to Pleasure Island all on the existing Channel; and The Beaumont Navigation District of Jefferson County, Texas, based its financial sponsorship on this proposition. The undersigned parties do not and cannot give assurance of providing the necessary financial contributions or other requirements charged to and payable by local interests in connection with a Channel through Sabine Lake; and, we know of no legally constituted and financially responsible entity which can undertake the same. Therefore, we do not support the proposition, but support the improvements requested in our brief filed at the December 6, 1960, hearing.

EXHIBIT 2

Proposition No. 2 - The undersigned assure you that the financial contributions required to be made by local interests toward the cost of replacement of the Port Arthur Pleasure Island Bridge, as outlined in your letter, will be provided by a financially responsible Jefferson County-wide local agency. And, if this contribution is a condition to replacement of the Bridge, that same will be met.

Yours respectfully,

THE BEAUMONT NAVIGATION DISTRICT
OF JEFFERSON COUNTY, TEXAS

BY: John W. Newton
Chairman

ORANGE COUNTY NAVIGATION AND
PORT DISTRICT, ORANGE, TEXAS

BY: W. J. Butler
Chairman

DEEP WATER COMMITTEE OF THE
CHAMBER OF COMMERCE OF PORT
ARTHUR, TEXAS

BY: Murray Ball
Chairman

CITY OF PORT ARTHUR, TEXAS

BY: H. C. Cook
MAYOR

Orange County NAVIGATION AND PORT DISTRICT



PORT RAILINGS, WHARVES AND DOCKS OF PORT OF ORANGE

COMMISSIONERS:
C. H. Benckenstein, Jr.
W. J. Butler
Curtis Smith
Tom H. Lowe
Martin Ardoin
PORT DIRECTOR:
J. T. Arledge

COUNTY DOCKS - P. O. DRAWER 516 - PHONE TU 3-4363
ORANGE, TEXAS

March 14, 1962

Lt. Col. J. S. Maxwell
District Engineer
Corps of Engineers
U. S. Army
Galveston, Texas

Dear Sir:

The Orange County Navigation and Port District has executed the letter addressed to you, dated March 2, 1962, and also signed by the Beaumont Navigation District of Jefferson County, Texas, and others, with the understanding that it is not binding itself to object to any study of a channel through Sabine Lake if in the future the Corps of Engineers considers making such a study.

However, this District does not have at this time, nor does it foresee in the immediate future, funds that would be chargeable to local interests on account of Proposition No. 1.

Respectfully yours,

W. J. Butler
W. J. Butler,
President

WJB/rn

- cc: Mr. E. W. Easterling
Attorney at Law
715 American National Bank Building
Beaumont, Texas
- cc: Mr. John E. Gray, President
First Security National Bank
Beaumont, Texas.

EXHIBIT 3

HOWARD GARNEY
ATLANTA

ROBERT G. CARR
SAN ANGELO

J. F. CORLEY
HOUSTON

CARL L. DUPUY
LUFKIN

FRANK M. WOOD, CHAIRMAN
WICHITA FALLS

GAME AND FISH COMMISSION



HOWARD D. DODGEN
EXECUTIVE SECRETARY
AUSTIN

W. J. CUTBIRTH, JR.
ASS'T. EXECUTIVE SEC'Y
AUSTIN

W. O. REED
DALLAS

WILSON SOUTHWELL
SAN ANTONIO

BEN F. VAUGHAN, JR.
CORPUS CHRISTI

H. A. WALSH
EL PASO

AUSTIN, TEXAS

March 22, 1962

Mr. Kenneth Heagy
Chief, Engineering Division
Corps of Engineers
606 Santa Fe Building
Galveston, Texas

Dear Mr. Heagy:

Reference is made to SWNGW-2g, "The Review of Reports on Sabine-Neches Waterway, Texas", which you supplied to us for review and comment.

It is recommended that spoil placed on the marsh lands be confined to the smallest areas possible and diked off, if necessary, to prevent unnecessary spillage and siltation of adjoining marine habitat and that the natural drainages connecting the project channels to the surrounding marshlands be maintained as much as possible.

The elimination of the previously planned disposal areas in Sabine Lake will be most beneficial to the marine fisheries habitat.

Enclosed is the copy of the "Review of Reports". We appreciate the opportunity to review and comment on these proposed works.

Sincerely yours,

A handwritten signature in cursive script that reads "Eugene A. Walker".

Eugene A. Walker
Director, Program Planning

EAW:TRL/ep
Enclosure
CC Mr. Hofstetter
Mr. Degani

EXHIBIT 4



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES
REGION IV

OFFICE OF
REGIONAL DIRECTOR

ROOM 206 FEDERAL BUILDING
BARTLESVILLE, OKLAHOMA

April 27, 1962

Colonel James S. Maxwell, District Engineer
U. S. Army Engineer District, Galveston
Corps of Engineers
P. O. Box 1229
Galveston, Texas

Dear Colonel Maxwell:

Thank you for sending us a copy of the "Review of Reports on Sabine - Neches Waterway, Texas" dated March 1, 1962. We appreciate receiving copies of reports at the earliest date possible so that we may review them at field level.

The authorized dimensions of the Sabine-Neches Waterway from the Gulf of Mexico to Port Arthur and Beaumont are not adequate to accommodate with reasonable safety and convenience the large tankers now in use and under construction which will carry about 40 percent of the prospective petroleum commerce on the waterway. The proposed improvements will provide for a depth of 43 feet in the Sabine Bank channel and the outer bar channel and a 40-foot depth in all inland channels to Beaumont and in the Port Arthur turning basins; a width of 500 feet in the Port Arthur Canal and a width of 400 feet in the Neches River channel; three turning points on the Neches River; and a channel 12 feet deep and 125 feet wide in the Sabine River from Orange to the Southern Pacific Railroad bridge near Echo, Texas. The total first cost of the project is \$23,172,000.

A review of all available office data indicates that the proposed project would be beneficial to the mineral industries in the area. Petroleum refineries and petrochemical and chemical plants are located on the waterway and the enlargement of the channel will provide more expeditious handling of their cargo.

The Regional Office of the Bureau of Mines is in favor of the proposed works of improvement.

Sincerely yours,

Robert S. Sanford
Acting Regional Director
Region IV

EXHIBIT 5



ADDRESS ONLY THE
REGIONAL DIRECTOR

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE

P. O. BOX 1306
ALBUQUERQUE, NEW MEXICO

May 8, 1962

SOUTHWEST REGION
(REGION 2)
ARIZONA
COLORADO
KANSAS
NEW MEXICO
OKLAHOMA
TEXAS
UTAH
WYOMING

District Engineer
Corps of Engineers, U. S. Army
P. O. Box 1229
Galveston, Texas

Dear Sir:

This letter constitutes our report on the proposed improvements to the Sabine-Neches Waterway, Texas, and is intended to accompany the Corps of Engineers' Review of Reports, which describes the recommended plan of improvements. Our report, prepared in accordance with the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), has been coordinated with the Bureau of Commercial Fisheries. We have received concurrence from the Texas Game and Fish Commission by letter of March 30, 1962, signed by Mr. Eugene A. Walker, Director of Program Planning; and from the Louisiana Wild Life and Fisheries Commission, by letter of March 26, 1962, signed by Mr. L. D. Young, Jr., Director.

The Sabine-Neches Waterway is a deep-draft navigation channel from the Gulf of Mexico to ports at Port Arthur, Beaumont, and Orange, Texas. It passes through Sabine Pass, parallels the western and northern shores of Sabine Lake and extends up the Neches and Sabine Rivers to Beaumont and Orange, Texas, respectively.

The existing Waterway is 500 to 800 feet wide and 37 feet deep from the Gulf of Mexico to Sabine Pass; 500 feet wide by 36 feet deep through Sabine Pass; 400 feet wide by 36 feet deep from Sabine Pass to the mouth of the Neches River; 350 feet wide by 36 feet deep up the Neches River to Beaumont; and 200 feet wide by 30 feet deep from the mouth of the Neches River across the northern tip of Sabine Lake and up the Sabine River to Orange, Texas.

Spoil dredged from these channels during their construction, improvement, and subsequent maintenance was placed in the Gulf of Mexico, on marshlands in Texas and Louisiana, and in Sabine Lake. Pleasure island, a strip of land, 500 to 2,000 feet wide, paralleling a large portion of the western bank of Sabine Lake, was constructed of materials dredged from the project channels.

The proposed modifications to the Sabine-Neches Waterway would include extending the outer bar channel 15.3 miles to the Sabine

EXHIBIT 16

Bank and deepening it to 43 feet; deepening all inland channels to Beaumont and the Port Arthur and Taylor's Bayou turning basins to 40 feet; widening the Port Arthur Canal and the Neches River Channel to 500 and 400 feet, respectively; and constructing three turning points 1,000 feet wide by 40 feet deep on the Neches River at river miles 31.3, 37.2, and 41.0. The plan also provides for the construction of a shallow-draft channel in Sabine River 125 feet wide by 12 feet deep from the upstream limits of the existing Federal channel at Orange, Texas, 4.6 miles to a point near the Southern Pacific Railroad bridge at Echo, Texas.

Deepening and extending of the outer-bar channel will be accomplished by hopper dredge, and the spoil will be placed in the Gulf of Mexico.

The enlargement of inland channels to Beaumont and turning basins will be done by pipeline dredge, and most of the spoil will be placed on existing spoil dumps. However, about 940 acres of new area will be required for spoiling to improve the inland channels to Beaumont. Generally, the outer limits of existing spoil areas will be extended to obtain this acreage.

About 2,600 acres of new spoil area will be required for the dredging of the shallow-draft channel from Orange to Echo, Texas. Spoil will be placed on both sides of the proposed channel, between the abandoned U. S. Highway No. 90 and the Southern Pacific Railroad bridge in Calcasieu Parish, Louisiana; spoil will be placed also between the Little Cypress Bayou and the Southern Pacific Railroad bridge in Orange County, Texas.

The Neches and the Sabine Rivers in the project area are turbid meandering streams, with numerous contiguous oxbow lakes and cut-off channels. The natural widths of the stream channels range from 400 to 1,000 feet. Both rivers are tidal within the project area and discharge into the northern end of Sabine Lake, which empties into the Gulf of Mexico through Sabine Pass.

Sabine Lake is about 18 miles long by 9 miles wide and has a surface area of about 92,000 acres. Much of the lake bottom on the western side is covered by mud derived from channel and shell dredging. Wave action keeps this part of the lake turbid. The upper half of the lake is usually fresh, with a gradual increase in salinity toward the lower end.

Extensive marshlands lie adjacent to the inland channels south of Beaumont and Orange, Texas. A dense swamp forest of tupelo and cypress occurs north of Orange.

The marshlands south of Orange and Beaumont along the Sabine and Neches Rivers are fresh. Toward the coast and along the shores of Sabine Lake, the marshes gradually become brackish and grade into true salt marsh near the coast and adjacent to Sabine Pass.

Industrial and shipping activity in the project area is intense. Oil refineries, chemical plants, and shipping facilities are located on the marshlands adjacent to the channels. They are especially concentrated near the cities of Orange, Beaumont, and Port Arthur and along the Neches River Channel and Port Arthur Canal. Large ocean-going vessels navigate these channels, transporting industrial and agricultural products produced in or shipped into the project area. Vessel traffic on the Waterway is heavy.

Fish and wildlife habitat in the area has suffered greatly and will continue to suffer from the effects of industrialization, urbanization, and channelization. Untreated sewage and wastes from oil refineries, chemical plants, tankers, and barges are discharged into the channels of the Sabine-Neches Waterway. Some of these pollutants enter Sabine Lake at its headwaters, while others are carried along the Port Arthur Canal to the mouth of the Lake and into the Gulf of Mexico. At times, the mouth of the Lake at Sabine Pass is so polluted that crustaceans and finfish will not move into or out of the Lake. During high tides, much of the pollution in Sabine Pass is swept into the lower end of Sabine Lake.

Spoil dredged from the project channels and placed on the marshlands and in Sabine Lake has eliminated considerable marine fish and wildlife habitat. Filling, leveeing, and drainage of marshlands to accommodate large industrial plants have destroyed additional fish and wildlife habitat. Despite such losses, the remaining marshlands and estuarine waters support fish and wildlife resources of considerable value to sportsmen and commercial fishermen and trappers of Texas and Louisiana.

The principal fresh-water fishes caught by sport and commercial fishermen from the Sabine and Neches Rivers in the project area are catfishes, buffalofishes, carp, white crappies, largemouth bass, and sunfishes. During infrequent periods of low fresh-water flow, marine species such as spotted squeteague, redfish, flounder, sheepshead, and black drum enter the lower reaches of the rivers and are taken by sport and commercial fishermen. Commercial fishermen also catch bait shrimp and minnows from the project rivers.

Sport fishing on the Sabine and Neches Rivers in the project area amounts to about 40,000 man-days annually, valued at \$40,000.

Each year, commercial fishermen harvest from the project rivers about 50,000 pounds of fresh-water and marine finfish, 7 million minnows, and 65,000 pounds of bait shrimp with a total value of about \$55,000.

Although the water in Sabine Lake is nearly fresh at times, the fishery it supports is primarily marine. Spotted squeteague, redfish, flounder, black drum, croaker, spot, menhaden, shrimp, and blue crab are the principal species which inhabit the Lake.

Sport fishing in Sabine Lake is estimated at 147,000 man-days annually, valued at \$147,000.

The annual catch of fish from Sabine Lake by commercial fishermen is about 110,000 pounds of finfish, valued at \$28,000; 45,000 dozen crabs, valued at \$14,000; and 660,000 pounds of shrimp, valued at \$330,000. However, a more valuable fishery occurs in the Gulf of Mexico adjacent to Sabine Lake. This fishery is worth an estimated \$1 million annually and is composed of 99 percent, by weight, of estuarine-dependent species. The estuarine waters and marshlands in the project area contribute greatly to this fishery.

The marshlands in the project area form a portion of an important wintering area for migratory waterfowl and numerous other birds. Concentrations of snow and blue geese, mallards, pintails, teals, and coots winter on the marshlands adjacent to the project channels and the shores of Sabine Lake. Canada and white-fronted geese and most other species of ducks common to the Gulf Coast winter here in lesser but significant numbers. Mottled ducks, which are residents of the Texas Coast, nest in the project area. Wood ducks nest in the swamp forests along the Sabine River north of Orange.

Considerable acreages of marshland in the project area are leased by sportsmen, and waterfowl hunting is estimated at 6,000 man-days annually, valued at \$27,000.

Trapping is of considerable importance on the project marshlands, primarily for muskrats, mink, nutria, and raccoons. About 66,000 muskrats, valued at \$87,000; 2,000 mink valued at \$20,000; 12,000 nutria, valued at \$17,000; and 2,300 raccoon pelts and carcasses, valued at \$2,300 are taken annually. About 400 alligators, valued at \$4,000 also are taken annually.

The deepening, widening, and extension of the project channels and basins are not expected to result in immediate fish and wildlife losses. Similarly, the placement of spoil on existing disposal areas will not add to the destruction of fish and wildlife habitat caused by the original spoiling. The extension of existing spoil areas and the creation of new ones, however, will eliminate about 3,740 acres of marsh and swamp-forest habitat.

This immediate loss of fish and wildlife habitat will be small, compared to the losses expected in the future as a result of the project. The improved channels will stimulate industrial activity. New plants will be located on marshlands filled in by channel dredgings, and shipping will increase as a result of the industrial expansion. It is difficult to predict anything but the eventual elimination of nearly all marshland habitat adjacent to the project channels.

Pollution in the project channels, marshes, and Sabine Lake will be greatly increased by the expanded industrial and shipping activity along the Waterway. This will accelerate the decline in the productivity of estuarine waters in the project area, resulting in reduced sport and commercial catches of marine fishes from Sabine Lake and the Gulf of Mexico. Although it is possible to reduce pollution through local cooperation and legislation, this is not expected to take place in the immediate future. Thus, the marine-fish losses due to pollution will persist for a considerable period of time.

Marshlands lost through filling cannot be rehabilitated. Therefore, it is important that spoil placed on marshlands be restricted to the smallest areas possible. It may be necessary to dike some of the sites to prevent unnecessary spillage and siltation of adjoining areas.

The use of the estuarine marshlands as nursery grounds by the juveniles of many valuable species of finfish and crustaceans depends upon adequate access, provided by the numerous drainages. These outlets from the marshlands to the project channels should not be filled or blocked.

To keep fish and wildlife losses in the project area to a minimum, it is recommended:

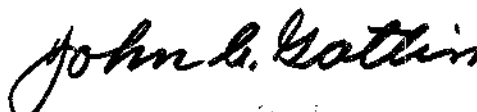
- (1) That spoil placed on the marshlands be confined to the smallest areas possible and be diked off to prevent unnecessary spillage and siltation of adjoining marsh habitat.

- (2) That the natural drainages connecting the project channels to the surrounding marshlands be maintained.
- (3) That spoil areas used for this project be reserved for the sole purpose of future spoil disposal.

This report is based upon information available to us from the Galveston District, Corps of Engineers, as of March 5, 1962. Any modifications to the project plans should be brought to the attention of the Bureau of Sport Fisheries and Wildlife, the Texas Game and Fish Commission, and the Louisiana Wild Life and Fisheries Commission.

We appreciate the opportunity extended to us to comment on the proposed work.

Sincerely yours,



John C. Gatlin
Regional Director

Copies (10)

Distribution:

- (2) Director, Louisiana Wild Life and Fisheries Commission, New Orleans, Louisiana
- (2) Executive Secretary, Texas Game and Fish Commission, Austin, Texas
- (2) Regional Director, Region IV, Texas Game and Fish Commission, Houston, Texas
- (2) Regional Engineer, Region 7, Public Health Service, Dallas, Texas
- (1) Regional Director, Region 4, Bureau of Mines, Bartlesville, Oklahoma
- (1) Chairman, Southwest Field Committee, United States Department of the Interior, Muskogee, Oklahoma
- (2) Regional Director, Region 2, Bureau of Commercial Fisheries, St. Petersburg Beach, Florida
- (2) Director, Biological Laboratory, Bureau of Commercial Fisheries, Galveston, Texas
- (2) Field Supervisor, Branch of River Basin Studies, Bureau of Sport Fisheries and Wildlife, Fort Worth, Texas

REVIEW OF REPORTS
ON
SABINE-NECHES WATERWAY, TEXAS

INFORMATION CALLED FOR BY
SENATE RESOLUTION 148, 85th CONGRESS
ADOPTED JANUARY 28, 1958

1. Authority.- The following information is furnished in response to Senate Resolution 148, 85th Congress, adopted January 28, 1958.

2. Requests of local interests.- At the public hearing in Port Arthur, Texas, on December 6, 1960, local interests requested the following: widening and deepening of the waterway to provide a 40-foot project to Port Arthur, Beaumont, and Orange, Texas; a 40' x 400' channel extension in the Sabine River upstream above Orange about 3.5 miles to Interstate Highway 10 bridge; enlargement of Cow Bayou channel below Highway 87 bridge to provide a 30' x 225' channel; widening of the Neches River Channel to 700 feet opposite five main oil terminals; a shallow-draft channel extension in the Sabine River from Orange, Texas, upstream about 8 miles to the Southern Pacific Railroad bridge near Echo, Texas; alteration of the existing Port Arthur highway bridge across the Sabine-Neches Canal to provide 500-foot horizontal and 135-foot vertical clearances; and bank stabilization for Pleasure Island along the Sabine-Neches Canal and the Port Arthur Canal. One individual also requested relocation of the deep-draft channel from Sabine Pass through Sabine Lake to the mouth of the Neches River. Subsequent to the hearing, a further request to consider reauthorization of the lower 2,200 feet of the abandoned Neches River Channel at Clarks Island was received.

3. Improvements considered.- The report considers all improvements requested by local interests. Cost analyses based on a 100-year project life were made. All requested improvements justified on this basis have been recommended for adoption. Items not recommended for adoption because of reasons other than lack of favorable economic justification are discussed in paragraphs 58 through 71 of the text.

4. The improvements proposed under the recommended plan of improvement have been discussed with the local interests that would provide the cooperation required for the improvements if and when adopted. They have expressed satisfaction with the recommended plan of improvement.

WATERWAY DIMENSIONS

SECTION OF WATERWAY	ADOPTED PROJECT DIMENSIONS		MODIFIED PROJECT DIMENSIONS			
			REQUESTED BY LOCAL INTEREST		RECOMMENDED IN THIS REPORT	
	BOTTOM WIDTH (FEET)	DEPTH (FEET) (1)	BOTTOM WIDTH (FEET)	DEPTH (FEET) (1)	BOTTOM WIDTH (FEET)	DEPTH (FEET) (1)
SABINE BANK CHANNEL	NONE	NONE	1000	43	800	43
SABINE PASS OUTER BAR CHANNEL	800	37	1000	43	800	43
SABINE PASS JETTY CHANNEL	800(2)	37(2)	1000(2)	40(2)	NONE	40
	500(3)	36(3)	600(3)	40(3)		40
SABINE PASS CHANNEL:	500	36	600	40	NONE	40
SABINE PASS ANCHORAGE BASIN (5)	1500	34	1000 (5)	40	NONE	40
	3000 (4)					
PORT ARTHUR CANAL	400	36	500	40	500	40
PORT ARTHUR:						
EAST TURNING BASIN	420	36	NONE	40	NONE	40
WEST TURNING BASIN	600 TO 325	36	NONE	40	NONE	40
CHANNEL TO TAYLORS BAYOU TURNING BASIN	250	36	NONE	40	200 TO 250 (7)	40
TAYLORS BAYOU TURNING BASIN	1000 TO 150	36	NONE	40	NONE	40
SABINE - NECHES CANAL:						
PORT ARTHUR CANAL TO MOUTH OF NECHES RIVER	400	36	500	40	NONE	40
MOUTH OF NECHES RIVER TO MOUTH OF SABINE RIVER	200	30	400	40	NONE	NONE
NECHES RIVER:						
MOUTH TO BEAUMONT TURNING BASINS (5)	350	36	500	40	400	40
BEAUMONT TURNING BASIN	500	34	NONE	NONE	NONE	NONE
BEAUMONT TURNING EXTENSION	350	34	NONE	NONE	NONE	NONE
BEAUMONT TURNING BASIN EXTENSION TO VICINITY OF BETHLEHEM SHIPYARD	200	30	NONE	NONE	NONE	NONE
SABINE RIVER:						
MOUTH TO CUT-OFF NEAR ORANGE MUNICIPAL SLIP	200	30	400	40	NONE	NONE
SABINE RIVER TO ORANGE MUNICIPAL WHARF	200	30	400	40	NONE	NONE
CUT-OFF NEAR ORANGE MUNICIPAL SLIP TO FOOT OF GREEN AVE.	200	30	400	40	NONE	NONE
FOOT OF GREEN AVE. TO INTERSTATE HIGHWAY 10 BRIDGE	NONE	NONE	400	40	125	12
INTERSTATE HIGHWAY 10 BRIDGE TO S.P.R.R. BRIDGE AT ECHO	NONE	NONE	125	12	125	12
COW BAYOU, MOUTH TO HIGHWAY 87 BRIDGE	100	13	225	30	NONE	NONE

- (1) DEPTH AT MEAN LOW TIDE
- (2) CHANNEL DIMENSION AT OUTER END
- (3) CHANNEL DIMENSION AT INNER END
- (4) LENGTH OF BASIN
- (5) LOCAL INTERESTS REQUEST RELOCATION TO ABANDONED CHANNEL AT SABINE PASS (1000 FEET WIDE AND 2.3 MILES LONG)
- (6) INCLUDES JUNCTION AREA TO TURNING BASIN
- (7) DEAUTHORIZATION OF UNCOMPLETED PORTION OF FEDERAL PROJECT IS RECOMMENDED.

