ALSO ISSUED AS S. DOC. NO. 99, 90/2

PORT ARANSAS-CORPUS CHRISTI WATERWAY, TEXAS (45-FOOT PROJECT)

LETTER

FROM

THE SECRETARY OF THE ARMY

TRANSMITTING

A LETTER FROM THE CHIEF OF ENGINEERS, DEPARTMENT OF THE ARMY, DATED JULY 9, 1968, SUBMITTING A REPORT, TOGETHER WITH ACCOMPANYING PAPERS AND ILLUSTRATIONS, ON A REVIEW OF THE REPORTS ON PORT ARANSAS-CORPUS CHRISTI WATERWAY, TEXAS (45-FOOT PROJECT), REQUESTED BY A RESOLUTION OF THE COMMITTEE ON PUBLIC WORKS, UNITED STATES SENATE, ADOPTED APRIL 14, 1960

PRESENTED BY MR. BYRD OF WEST VIRGINIA
(FOR MR. RANDOLPH)

JULY 26, 1968.—Referred to the Committee on Public Works and ordered to be printed with illustrations

U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON : 1968

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LETTER OF TRANSMITTAL

DEPARTMENT OF THE ARMY
WASHINGTON, D.C. 20310

July 22, 1968

Honorable Jennings Randolph
Chairman, Committee on Public Works
United States Senate
Washington, D. C. 20510

Dear Mr. Chairman:

I am transmitting herewith a favorable report dated 9 July 1968, from the Chief of Engineers, Department of the Army, together with accompanying papers and illustrations, on a review of the reports on Port Aransas-Corpus Christi Waterway, Texas (45-Foot Project), requested by a resolution of the Committee on Public Works, United States Senate, adopted 14 April 1960.

The views of the Governor of Texas and the Departments of the Interior, Transportation, and Health, Education, and Welfare are set forth in the inclosed communications.

The Bureau of the Budget notes that the benefits attributable to the Viola and the La Quinta Channels would accrue only to a single user on each channel. The Bureau has been assured, however, that a fully-integrated steel mill will locate near the La Quinta Channel, but it has not received assurances concerning potential multiple use of the Viola Channel.

I concur in the views of the Bureau of the Budget concerning the single user aspects. If the project is authorized and before any request for funds to initiate construction, the Chief of Engineers will obtain assurances from local interests that facilities adequate to insure multiple use of the recommended improvements will be constructed. Lacking such assurances we would apply the cost sharing principles as outlined in the letter from the Bureau of the Budget a copy of which is inclosed.

Subject to consideration of the above, the Bureau of the Budget advises there would be 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, 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,

Stanley R. Resor

1 Incl
Report

STANLEY R. RESOR
Secretary of the Army

COMMENTS OF THE BUREAU OF THE BUDGET

EXECUTIVE OFFICE OF THE PRESIDENT
BUREAU OF THE BUDGET
WASHINGTON, D.C. 20503

19 July 1968

Honorable Stanley R. Resor
Secretary of the Army
Washington, D. C. 20310

Dear Mr. Secretary:

Mr. Robert E. Jordan's letter of July 17, 1968, submitted the favorable report of the Chief of Engineers on Port Aransas-Corpus Christi Waterway, Texas (45-Foot Project), requested by a resolution of the Committee on Public Works, United States Senate, adopted April 14, 1960.

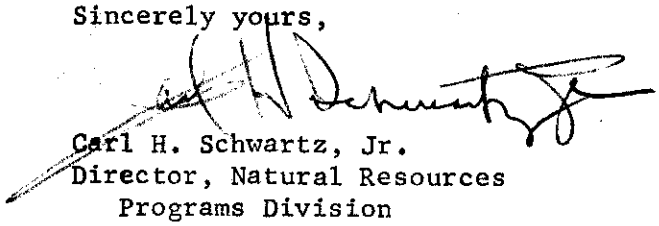
The Bureau of the Budget notes that the benefits attributable to the Viola and LaQuinta Channels would accrue only to single users on each channel. Subsequently, we have been assured that a fully-integrated steel mill will locate near the LaQuinta Channel.

We have not, however, received such assurances concerning potential multiple use of the Viola Channel. Consequently, if this project is authorized, and before appropriations are requested to initiate construction of either the Viola or LaQuinta Channels, the Bureau of the Budget would expect the Chief of Engineers to obtain assurances that each channel will benefit multiple users. Lacking such assurances, we would agree with the District and Division Engineers that additional cost sharing is warranted. A reasonable basis for such sharing would be payment by local interests annually, until such time as multiple use of the respective channel or channels actually occurs, of 50 percent of the annual charges for interest and amortization of the Federal first cost of the respective channel or channels.

Subject to your consideration of the above, 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, 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,



Carl H. Schwartz, Jr.
Director, Natural Resources
Programs Division

COMMENTS OF THE GOVERNOR OF TEXAS

JOHN CONNALLY
GOVERNOR OF TEXAS

July 3, 1968

Lt. General William F. Cassidy
Chief of Engineers
Department of the Army
Washington, D. C. 20315

Dear General Cassidy:

I have caused to be studied and have had a public hearing held on the report which you submitted to me on 31 May 1968 entitled "Port Aransas-Corpus Christi Waterway, Texas (45-foot Project)."

All evidence submitted shows this to be a feasible project and I recommend it to you for approval and the hope that it might be funded at an early date by the Congress.

Sincerely,

John Connally

UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

July 3, 1968

Dear General Cassidy:

This is in reply to your letter of May 31, 1968, requesting our comments on your proposed report on Port Aransas-Corpus Christi Waterway, Texas (45-Foot Project).

The Fish and Wildlife Service is pleased that the plan you are recommending for the Port Aransas-Corpus Christi Waterway adequately considers its recommendations for prevention of damage to fish and wildlife by placement of spoil only in the established spoil areas.

The Federal Water Pollution Control Administration indicates that water quality considerations have been given reasonable consideration and that the proposed channel changes are not likely to adversely affect water quality in the area.

To minimize damage to water quality during the construction period, however, it is recommended that the Corps of Engineers include appropriate provisions in construction contracts to assure that contractors will:

1. Exercise care in the relocation of petroleum product pipelines and other hazardous materials to prevent accidental spills that would be harmful to fish and wildlife.

2. Provide and operate sanitary facilities to adequately treat and dispose of domestic wastes in conformance with Federal and State water pollution control regulations.

3. Schedule dredging operations and disposal of spoil so as to reduce turbidity and siltation to the lowest level practicable. Spoil produced during dredging operations should be confined behind dikes or otherwise disposed of in such a way to preclude its flowing back into the Bay.

The National Park Service requests that the Chief, Southwest Archeological Center, National Park Service, Box 1562, Gila Pueblo, Globe, Arizona 85501, be kept informed of the progress of construction in order to arrange for archeological investigations in the project area.

The opportunity of presenting our views is appreciated.

Sincerely yours,

Robert G. Nelson

Deputy Assistant Secretary of the Interior

Lt. General William F. Cassidy
Chief of Engineers
Department of the Army
Washington, D. C. 20315

COMMENTS OF THE DEPARTMENT OF TRANSPORTATION

OFFICE OF THE SECRETARY OF TRANSPORTATION
WASHINGTON, D.C. 20590

July 16, 1968

ASSISTANT SECRETARY

Your Ref: ENGCW-PD

Lieutenant General William F. Cassidy
Chief of Engineers
Department of the Army
Washington, D.C. 20315

Dear General Cassidy:

This is in response to your May 31 letter to Secretary Boyd requesting departmental commentary concerning your proposed report on deepening the Port Aransas-Corpus Christi Waterway in Texas.

The presently authorized navigation project in Corpus Christi Bay provides for an entrance channel, inner harbor channels, docking areas and turning basins with a 40-foot depth. Your report recommends increasing the depth for approximately 40 miles of basins and channels to 45 feet to allow larger ships to serve these ports. The estimated first cost of the project is $19,042,000. It has a benefit/cost ratio of 4.8 to 1.

If this project were implemented, the primary concern of the Coast Guard would lie in relocating the required aids to navigation in this area. In this connection, the Commander of the 8th Coast Guard District on July 15, 1964, wrote to the District Engineer that the estimated cost of this work was $179,000.

Thank you for your courtesy in furnishing copies of this report to the Department for review.

Sincerely,

M. Cecil Mackey
Assistant Secretary
for Policy Development

COMMENTS OF THE DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE

July 3, 1968

REFER TO:

NATIONAL CENTER FOR
URBAN AND INDUSTRIAL HEALTH
222 E. Central Parkway
Cincinnati, Ohio 45202

Lt. General William F. Cassidy, USA
Office of the Chief of Engineers
Department of the Army
Washington, D. C. 20315

Dear General Cassidy:

As requested by your letter of May 31, 1968, the Public Health Service has completed review of the report on Port Aransas-Corpus Christi Waterway, Texas.

As a result of discussions with the Texas State Department of Health and our review, it has been determined that no public health problems resulting from the project's authorization are anticipated.

The Public Health Service, therefore, has no objection to authorization of this project.

Sincerely yours,

for Paul Kabler
Jerome H. Svore
Director

PORT ARANSAS-CORPUS CHRISTI WATERWAY, TEXAS

REPORT OF THE CHIEF OF ENGINEERS, DEPARTMENT OF THE ARMY

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20315

IN REPLY REFER TO
ENGCW-PD

9 July 1968

SUBJECT: Port Aransas-Corpus Christi Waterway, Texas

THE SECRETARY OF THE ARMY

1. I submit for transmission to Congress the report of the Board of Engineers for Rivers and Harbors, accompanied by the reports of the District and Division Engineers, in response to a resolution adopted 14 April 1960 by the Committee on Public Works of the United States Senate, requesting a review of the reports on the Port Aransas-Corpus Christi Waterway, Texas, with particular reference to providing increased channel and basin depths and widths; for flaring approaches to the turning basins; for further channel extensions, including a shallow-draft branch channel from Corpus Christi Bay into Nueces Bay; and for an exchange of water between the Nueces River and the Viola Turning Basin.

2. The District and Division Engineers recommend that the existing project for the Port Aransas-Corpus Christi Waterway be modified to provide for enlargement of the existing deep-draft channels and basins to a project depth of 45 feet, for construction of a new deep-draft turning point, for construction of a deep-draft mooring area and mooring facilities, and for widening of the channels and basins at certain locations; at an estimated total project construction cost of $20,682,000 and $150,800 annually for maintenance, operation, and replacements in addition to that now required, subject to certain requirements of local cooperation, including a total cash contribution of $2,658,000 toward the Viola and La Quinta channel improvements. The annual charges are estimated at $983,200 and average annual benefits at $4,687,700, resulting in a benefit-cost ratio of 4.8. The District and Division Engineers recommend that the authorized widths for the 40-foot project at the entrance channel to Corpus Christi main turning basin, in the main turning basin itself, and in the Avery Point turning basin be reduced for the proposed 45-foot project to avoid endangering structural foundations. They also recommend that the undredged northward

extension of the Inner Basin at Harbor Island and the undredged west turnout (wye connection) between the La Quinta Channel and the main channel of the waterway be deauthorized, and that the project name of Port Aransas-Corpus Christi Waterway, Texas, be changed to Corpus Christi Ship Channel, Texas.

3. The Board of Engineers for Rivers and Harbors concurs in general in the findings of the District and Division Engineers and recommends modification of the project in accordance with the plan of the District Engineer; however, the Board finds the cash contribution of $2,658,000 for the Viola and La Quinta channel improvements is not warranted, in view of the prospect for further developments on those channels by other waterway users. With this change, the net cost to the United States for the recommended improvements is $19,042,000 for construction and $148,000 annually for operation, maintenance, and replacements, all exclusive of navigation aids.

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

WILLIAM F. CASSIDY
Lieutenant General, USA
Chief of Engineers

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
BOARD OF ENGINEERS FOR RIVERS AND HARBORS
WASHINGTON, D.C. 20315

IN REPLY REFER TO
ENGBR

20 May 1968

SUBJECT: Port Aransas-Corpus Christi Waterway, Texas

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

1. Authority.--This report is in response to the following resolution adopted 14 April 1960:

> Resolved by the Committee on Public Works of the United States Senate, That the Board of Engineers for Rivers and Harbors, created under Section 3 of the River and Harbor Act, approved June 13,1902, be, and is hereby, requested to review the reports on the Port Aransas-Corpus Christi Waterway, Texas, submitted in House Document No. 361, 85th. Congress, 2nd. Session, Senate Document No. 33, 85th.Congress, 1st. Session, and previous reports, with a view to determining if the existing project should be modified in any way at this time, with particular reference to providing increased channel and basin depths and widths; for flaring approaches to the turning basins; and for further channel extensions, including a shallow draft branch channel from Corpus Christi Bay into Nueces Bay; and for an exchange of water between the Nueces River and the Viola Turning Basin.

2. Description.--The Federal project designated as Port Aransas-Corpus Christi Waterway, Texas, is on the southern coast of Texas, 180 miles southwest of Galveston and 132 miles north of the mouth of the Rio Grande. The channels of the authorized project have an overall length of about 40 miles and afford deepwater navigation to the ports of Harbor Island, Ingleside, La Quinta, and Corpus Christi, Texas. Corpus Christi Bay is a large shallow body of water located in Nueces County, about 14 miles long in a northwest-southeast direction and about 12 miles wide at its widest part, with general depths averaging 11 to 13 feet below mean low water (m.l.w.). The mean tidal range in Corpus Christi Bay is normally

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about 0.5 foot, but the water surface may be depressed as much as 3 feet below m.l.w. by strong north winds in the winter season and raised as much as 15 feet above m.l.w. by hurricanes which may occur between June and October.

3. Existing improvements.--The existing Federal project for Port Aransas-Corpus Christi Waterway provides generally for channels having a project depth of 40 feet from the Gulf of Mexico to deepwater ports at Harbor Island, Ingleside, and Corpus Christi, and a branch channel with a project depth of 36 feet along the north shore of Corpus Christi Bay to a turning basin at La Quinta. In addition, the project includes shallow-draft channels extending from the La Quinta channel across Ingleside Cove to a turning basin in Kinney Bayou (Jewel Fulton Canal) and from the Inner Basin near Harbor Island to the city of Port Aransas. A separate Federal project provides for a channel 30 feet deep and 200 feet wide from the Port Aransas-Corpus Christi Waterway at mile 12.5 southwesterly across Corpus Christi Bay to a turning basin at Encinal Peninsula. No maintenance work has been performed in that channel, and it has shoaled to the natural depths in the bay. Deep-draft, locally-dredged turning basins have been provided at the terminals of Humble Oil and Refining Company on Harbor Island and Sun Pipe Line Company at Ingleside. Local interests have also dredged and maintain berthing areas at wharves at Harbor Island, Ingleside, Corpus Christi, and La Quinta to depths commensurate with the waterway project depth. Numerous private shallow-draft slips and channels are located along the waterway.

4. Tributary area and commerce.--The nine-county tributary area includes Nueces, San Patricio, Jim Wells, Kleberg, Brown, Kenedy, Aransas, Bee, and Refugio Counties. Principal products of the area are grain, onions, winter vegetables, livestock, wool, natural gas, petroleum, and gypsum. Industrial development includes the processing of agricultural products, producing and refining petroleum and petroleum products, manufacturing chemical derivatives, cement, wood and metal products, and reducing ores for the production of aluminum and zinc.

5. The Port of Corpus Christi has developed rapidly since the opening of the deepwater channel in 1926. In the Corpus Christi trading area, there are some 12,500 producing oil wells and estimated oil reserves of 2 billion barrels. Extensive pipeline systems connect oilfields to terminals and refineries on the waterway. Six refineries in Corpus Christi have a total daily processing capacity of 243,000 barrels of crude oil. These and the

terminals at Ingleside and Harbor Island have storage facilities for 21 million barrels of petroleum and petroleum products. There are 24 natural gasoline and cycling plants, with a capacity of 50,000 barrels a day, within 50 miles of the city.

6. An aluminum plant at La Quinta processes ore into alumina and reduces the alumina to aluminum. Water movement of ores to La Quinta has increased at a rate of 220,000 tons annually since 1955. Corpus Christi also provides grain storage for 7,400,000 bushels. The tributary area is served by an extensive system of improved highways and three railroads. The principal outbound commodity movement on the waterway in 1964 was petroleum and its products. Bauxite ore moving to La Quinta was the principal import. The movement of petroleum by seagoing vessels accounted for 51 percent of the total waterway commerce.

7. Improvements desired.--Navigation improvements desired by local interests include deepening and widening the existing deep-draft channels and basins, further extensions of deep-draft channels, various bend easings and realignments, construction of a deep-draft anchorage basin, and provision for an exchange of water between the inland basins at Corpus Christi and the Nueces River. A change of the project name to the "Corpus Christi Ship Channel" also is desired. Local interests have indicated willingness to cooperate in the desired improvements.

8. Improvements proposed.--The District Engineer finds that substantial savings in transportation costs and reduction in hazards to navigation would result from enlargement of existing deep-draft channels and basins. The plan determined to be most suitable and advisable at this time comprises modification of the existing project for the Port Aransas-Corpus Christi Waterway to provide for deepening the outer bar channel to 47 feet and extending the channel to that depth in the Gulf of Mexico, a distance of about 1.2 miles; deepening the remaining deep-draft portion of the waterway to 45 feet, including the La Quinta channel and turning basin; widening the main channel to 600 feet between the Inner Basin at Harbor Island and a point 1,000 feet east of the ferry landing at Port Aransas, and widening to 500 feet between that point and the junction of La Quinta channel at mile 11.7; widening the channel from Avery Point to the Chemical turning basin to 400 feet, and the Tule Lake, Viola, and La Quinta channels to 300 feet; widening the Chemical, Tule Lake, Viola, and La Quinta turning basins to provide turning areas of 1,200-foot minimum diameter; enlarging the entrance

to the Inner Basin at Harbor Island to 730 feet; realigning the Industrial Canal to a location 25 feet northerly from its present position, and increasing the existing width of the Avery Point turning basin at the head of the Industrial Canal to 975 feet; constructing a turning point with turning area diameter of 1,200 feet at the La Quinta channel junction; easing certain bends; and constructing a mooring area and 6 mooring dolphins at Port Ingleside. A second mooring area and 7 additional dolphins are recommended, but construction would be deferred until required to meet the needs of navigation. No need was found for further extension of deep-draft channels or for provision of an exchange of water between the inland basins at Corpus Christi and the Nueces River.

9. Because deepening to 45 feet over the full bottom width of the existing 40-foot project would endanger certain structural foundations, the District Engineer recommends the following reductions in presently-authorized widths: entrance channel to Corpus Christi main turning basin, starting at a point 500 feet bayward from the Corpus Christi Harbor Bridge, from 400 feet to 300 feet; Corpus Christi main turning basin, from 1,000 feet to 800 feet; and Avery Point turning basin, from 1,000 feet to 975 feet. He also recommends that the undredged northward extension of the Inner Basin at Harbor Island and the undredged west turnout (wye connection) between the La Quinta channel and the main channel of the Port Aransas-Corpus Christi Waterway be deauthorized, and that the name of the Port Aransas-Corpus Christi Waterway, Texas, be changed to Corpus Christi Ship Channel, Texas.

10. The District Engineer further recommends that local interests contribute 50 percent of the first costs of dredging the Viola and La Quinta channels due to limited present use, and that they be authorized to contribute work in lieu of cash prior to the appropriation of the Federal share of funds for the improvements, with the understanding that the Federal Government would maintain components of such work that are acceptable to the Chief of Engineers at depths commensurate with available depths in the main waterway.

11. Costs and justification.--Based on April 1968 prices, the District Engineer estimates the total project construction cost of the proposed improvements at $20,682,000, exclusive of navigation aids, of which $16,384,000 would be Federal and $4,298,000, non-Federal. The non-Federal share of the costs includes $2,658,000 for cash or work contribution towards the Viola and La Quinta channel improvements. The annual charges are estimated at $983,200, including $148,000 for Federal maintenance, operation, and replacement in addition to that now required for the Port Aransas-Corpus Christi Waterway. He estimates that the recommended improvements

would provide average annual benefits of $4,687,700, consisting of $4,521,400 for savings in transportation costs and $166,300 for reduction in hazards to navigation. The benefit-cost ratio is 4.8, based on a 50-year period of analysis. The District Engineer recommends the improvements in accordance with his plan, subject to certain requirements of local cooperation. The Division Engineer concurs.

12. 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.

13. Views.--The Board of Engineers for Rivers and Harbors concurs in general in the views and recommendations of the reporting officers. The Board notes that the prospective benefits to deep-draft commerce are balanced between coastwise and foreign movements which generally originate or terminate at industries located near Corpus Christi. The Board recognizes the prospect of a study program for long-range regional harbor development at United States coastal ports; however, it feels that the rapidly increasing number of large tankers and bulk carriers calling at Corpus Christi requires expeditious prosecution of further channel improvements to keep pace with this growth.

14. The Board believes that non-Federal first costs for deepening berthing areas and access channels should properly be included in the economic analysis. These costs are presently estimated at $380,000; however, their inclusion will not affect the justification of the improvements. The proposed improvements are needed and economically justified, and the requirements of local cooperation are generally appropriate.

15. The Board notes that recent practice on channel improvements would not require a contribution by local interests for the so-called "single-user" aspect in cases where there is reasonable likelihood that other water-oriented industries would locate along the proposed channels and where the improvement under consideration can be viewed as the orderly and progressive development of a channel reach by existing and potential industries requiring deep-draft channels. Subsequent to the reporting officers' survey, the Board has been informed that an additional refinery terminal is being located in the

Viola channel reach, and that a large fully-integrated steel mill will be located adjacent to the La Quinta channel near Ingleside. Furthermore, it is known that the Nueces County Navigation District intends to encourage development of deep-draft channels and terminals farther inland on the La Quinta channel to and west of Portland. Accordingly, the Board considers that local contributions are inappropriate, in this case, for the Viola and La Quinta channels and turning basins, and therefore has deleted such requirements from its recommendations.

16. Recommendations.--Accordingly, the Board recommends that the existing project for the Port Aransas-Corpus Christi Waterway, Texas, be modified to provide for: deepening the outer bar channel to 47 feet and extending the channel to the 47-foot depth in the Gulf of Mexico, a distance of about 1.2 miles; deepening the remaining deep-draft portion of the waterway to 45 feet, including the La Quinta channel and turning basin; widening the main channel to 600 feet between the Inner Basin at Harbor Island and a point 1,000 feet east of the ferry landing at Port Aransas, and widening to 500 feet between that point and the junction of La Quinta channel at mile 11.7; widening the channel from Avery Point to the Chemical turning basin to 400 feet, and widening the Tule Lake, Viola, and La Quinta channels to 300 feet; widening the Chemical, Tule Lake, Viola, and La Quinta turning basins to provide minimum diameter turning areas of 1,200 feet; enlarging the entrance to the Inner Basin to 730 feet; realigning the Industrial Canal to a location 25 feet northerly from its present position, and widening the Avery Point turning basin at the head of the Industrial Canal to 975 feet; constructing a turning point with turning area diameter of 1,200 feet at the La Quinta channel junction; constructing mooring areas and dolphins at Port Ingleside, one mooring area with 6 dolphins to be constructed initially and the second, with 7 dolphins, to be constructed when required to meet the needs of navigation; easing of certain bends; and reducing the width of the entrance channel to Corpus Christi main turning basin, starting at a point 500 feet bayward from the Corpus Christi Harbor Bridge from 400 feet to 300 feet, Corpus Christi main turning basin from 1,000 feet to 800 feet, and Avery Point turning basin from 1,000 feet to 975 feet; all generally in accordance with the plan of the District Engineer and with such modifications thereof as in the discretion of the Chief of Engineers may be advisable; at an estimated cost to the United States of $19,042,000 for construction and $148,000 annually for operation, maintenance, and replacements in addition to that now required, all exclusive of navigation aids: 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 improvements and for 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 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 due to the construction works and subsequent maintenance of the proposed improvements;

c. Accomplish without cost to the United States all alterations of pipelines, power lines, cables, and other utility facilities, when and as required for construction of the improvements;

d. Provide and maintain without cost to the United States depths in berthing areas and local access channels serving the terminals commensurate with the depths provided in the related project areas; and

e. Establish regulations prohibiting discharge of pollutants into the waters of the improved channels by users thereof, which regulations shall be in accordance with applicable laws or regulations of Federal, State, and local authorities responsible for pollution prevention and control.

17. The Board also recommends that the undredged northward extension of the Inner Basin at Harbor Island and the undredged west turnout (wye connection) between the La Quinta channel and the main channel of the Port Aransas-Corpus Christi Waterway be deauthorized; and that the name of the Port Aransas-Corpus Christi Waterway, Texas project be changed to Corpus Christi Ship Channel, Texas.

FOR THE BOARD:

R. G. MacDONNELL
Major General, USA
Chairman

REPORT OF THE DISTRICT ENGINEER

REVIEW OF REPORTS ON
PORT ARANSAS-CORPUS CHRISTI WATERWAY, TEXAS
(45-FOOT PROJECT)

SYLLABUS

This report comprises the results of an investigation to determine the advisability of modifying the authorized navigation project for Port Aransas-Corpus Christi Waterway, Texas.

It was found that substantial benefits from savings in transportation costs and from reduction in hazards to navigation would accrue from modifying the project to provide for enlargement of the existing deep-draft channels and basins to a project depth of 45 feet, for the construction of a new deep-draft turning point, for the construction of a deep-draft mooring area and mooring facilities, and for widening of the channels and basins at certain locations, generally as described in the recommended plan of improvement. The recommended project depth of 45 feet would accommodate tankers and bulk carriers of up to 59,000 dwt with fully loaded draft of 41 feet.

The estimated first cost to the United States of the new work is $15,597,000, and the additional cost of annual maintenance to the United States is estimated at $168,000. The improvements would have annual charges of $1,012,800, annual benefits of $2,864,000, and a benefits to costs ratio of 2.8. The recommendations are subject to certain provisions of local cooperation, including cash or work contributions amounting to 50 percent of the Federal first cost of dredging the enlargements of the Viola Channel and turning basin and the La Quinta Channel and turning basin. These contributions presently are estimated at $761,500 for the Viola improvements, and $1,896,500 for the La Quinta improvements. Local interests would be permitted to contribute work on these two improvements prior to the appropriation of the Federal share of funds for the improvements. Completed components of such work that are acceptable to the Chief of Engineers would be maintained by the Federal government at depths commensurate with available depths in the main waterway.

The report also recommends that the undredged 2,000-foot northward extension of the Inner Basin and the undredged west turnout (wye connection) between the La Quinta Channel and the main channel be deauthorized, and that the name of the project be changed to Corpus Christi Ship Channel, Texas.

The investigation found that an additional deep-draft mooring area and 7 additional mooring dolphins probably would be necessary to accommodate the prospective traffic. This work, with estimated first costs of $787,000, would be deferred until there is demonstrated need for the additional facilities.

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

April 4, 1968

SUBJECT: Review of Reports on Port Aransas-Corpus Christi Waterway, Texas (45-Foot Project)

THROUGH: Division Engineer
U. S. Army Engineer Division, Southwestern
Dallas, Texas

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

INTRODUCTION

1. Scope.- This report comprises investigations of survey scope to determine the advisability of modifying the existing project for Port Aransas-Corpus Christi Waterway, Texas. Detailed field surveys and office studies were made to determine the most practicable plan of improvement. The field investigations consisted of hydrographic surveys to obtain channel cross sections; surveys to obtain data on wharves and marine terminal facilities, bridges, and utilities and other channel crossings; soil borings to obtain subsurface conditions for proposed improvements; and an economic survey to determine existing and prospective commerce and traffic movements on the waterway.

2. Purpose of the investigations.- The investigations were to determine the character and extent of improvements needed for existing and prospective waterway traffic, to evaluate what benefits would be derived from such improvements, and to make recommendations on the construction of improvements found economically justified at this time. All improvements requested by local interests were considered. In addition, alternate plans were investigated to assure that most feasible solutions to problems were recommended for construction, and that any improvements recommended were of optimum scale from an economic standpoint.

3. Arrangement of report.- The following sections of this report contain the results, conclusions, and recommendations of the Galveston District Engineer, based upon analysis of detailed technical data and investigations in the report appendixes. Arrangement of the appendixes is as follows:

Appendix I - Prior Reports

Appendix II - Economic Evaluation

Appendix III - Common Terminal Studies

Appendix IV - Engineering Data and Cost Estimates

Appendix V - Comments by other Agencies

4. Authority for this investigation.- This review report is submitted pursuant to the following resolution adopted April 14, 1960, by the Committee on Public Works of the United States Senate:

"Resolved by the Committee on Public Works of the United States Senate, That the Board of Engineers for Rivers and Harbors, created under section 3 of the River and Harbor Act, approved June 13, 1902, be, and is hereby, requested to review the reports on the Port Aransas-Corpus Christi Waterway, Texas, submitted in House Document No. 361, 85th Congress, 2nd Session, Senate Document No. 33, 85th Congress, 1st Session, and previous reports, with a view to determining if the existing project should be modified in any way at this time, with particular reference to providing increased channel and basin depths and widths; for flaring approaches to the turning basins; and for further channel extensions, including a shallow-draft branch channel from Corpus Christi Bay into Nueces Bay; and for an exchange of water between the Nueces River and the Viola Turning Basin."

5. Public hearings.- The views of local interests regarding proposed improvements were obtained at public hearings held in Corpus Christi on April 25, 1961 and March 10, 1964, and through subsequent conferences and correspondence. State, county, and local officials, representatives of business interests, and other interested persons attended the meetings. There were 62 persons present at the first hearing, and 64 persons at the second.

6. Improvements desired.- At the public hearings, Nueces County Navigation District No. 1 represented local interests and presented statements and briefs in support of improvements for the waterway. These improvements, as amended by subsequent correspondence, generally include: deepening and widening the existing deep-draft channels and basins, further extensions of deep-draft channels, various bend easings and realignments, construction of a deep-draft anchorage basin, and provision for an exchange of water between the inland basins at Corpus Christi and the Nueces River. A change of the project name to the "Corpus Christi Ship Channel" also was requested. The dimensions requested for the several reaches of the waterway, and the authorized dimensions of the channels and basins are shown in table 1.

TABLE 1

AUTHORIZED AND REQUESTED PROJECT DIMENSIONS

Section of waterway	Authorized project dimensions (feet)		Requested dimensions (feet)(2)		Length of section (feet)
	Depth (MLT)	Width (1)	Depth (MLT)	Width	
Outer Bar Channel	42	700	47	700	15,550(3)
Jetty Channel:					
Outer end	42 to 40	700 to 600	47 to 45	700 to 600	1,250
Between jetties	40	600	45	600	6,137
Inner end	40	600	45	600-730	2,000
Inner basin at Harbor Island	40(3)	600-1610(4)	45	730-1720	1,432
Channel to Port Aransas	12	100	No change		770
Turning basin at Port Aransas	12	200	No change		200
Anchorage basin at Port Aransas	12	300-400	No change		900
Inner basin to ferry landing at Port Aransas	40	400	45	600	2,205
Ferry landing to Corpus Christi turning basin	40	400	45	500	107,132
Corpus Christi turning basin	40	1000	45	800	5,419
Industrial Canal	40	400	45	400	5,733
Avery Point turning basin	40	1000	45	1000	1,150
Channel to Chemical turning basin	40	200	45	500 to 550	3,444
Chemical turning basin	40	920	45	1500	3,450
Tule Lake channel	40	200	45	400	14,500
Tule Lake turning basin	40	900	45	1000	1,000
Viola channel	40	200	45	400	9,650
Viola turning basin	40	700 to 900	45	1000 to 1200	1,500
La Quinta channel	36	200	45	300	29,427
La Quinta turning basin	36	1000	45	1200	800
West turnout to Main Channel PA-CC Waterway (5)	32	150	No change		----
Jewel Fulton Canal	12	100	No change		4,070
Jewel Fulton turning basin	12	200	No change		400
Inshore anchorage basin	None	None	45	2000	4,000 to 7,500
Rincon Canal: (6)					
PA-CC WW to R.R. bridge	None	None	12	100	13,000
R.R. bridge into Nueces Bay	None	None	12	300	4,900
Three side channels	None	None	12	250	2,400
Rincon extension	None	None	12	100	19,750
Rincon turning basin	None	None	12	400	700
Clara Driscoll channel	None	None	40	200	8,950
Clara Driscoll turning basin	None	None	40	1000	1,200
Nuecestown channel	None	None	40	200	12,000
Nuecestown turning basin	None	None	40	1000	1,000

(1) Existing project widths shown on plates 1 through 6 are authorized widths except where structures are within 50 feet of project bottom edge or where bend easing has been done under delegated authority to Chief of Engineers.
(2) Modified by existing physical limitations.
(3) Length of 42' channel; length of 47' channel would be 21,650 feet.
(4) Does not include undredged (inactive) 30' x 650' x 2,000' northward extension.
(5) Authorized but not constructed and inactive - deauthorization recommended in this report.
(6) Request withdrawn April 2, 1967.

7. The improvements desired by the navigation district were supported by statements or letters from the American Merchant Marine Institute, the Nueces County Commissioners Court, and business, industrial, and navigation interests. In addition to the improvements mentioned, the American Merchant Marine Institute recommended main channel turning points for the oil terminal areas at Harbor Island and Ingleside.

8. At the March 1964 public hearing, the International Longshoremen's Association at Corpus Christi advised that operators of foreign-flag vessels entering the port had tendency to use ship's crews for work classified as longshore work under contract with the association. Usage of the proposed anchorage basin as a place where work contracted for American labor would be done by foreign seamen was opposed by the association. The Texas Highway Department requested that adequate protection to preserve the integrity of its Harbor Bridge main piers be provided as a part of any further deepening of the waterway. Subsequent to the hearings, the U. S. Fish and Wildlife Service recommended relocation of the anchorage basin proposed by local interests to the land area of Harbor Island. Except for these three opposing views, all comments received were in favor of the desired improvements.

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

a. Tankers presently using the waterway require a channel of greater depth than the now authorized channel before full cargoes can be loaded and the ships operated at normal speeds, with a proper margin of safety.

b. Tankers and ore carriers presently being constructed, which are expected to use the waterway, will require greater channel depths and widths than are now authorized.

c. Delays to existing traffic, because of one-way navigation requirements, is becoming more of a problem, not only from the standpoint of monetary loss to shippers, but also from the standpoint of scheduling the use of wharves and port facilities. As the number of large vessels increase, ship delays and scheduling problems will pyramid.

d. The existing traffic on La Quinta Channel, together with potential traffic, requires a wider and deeper channel and basin than now exists.

e. The potential growth of the Corpus Christi Bay Area justifies the authorization of further channel extensions to potential industrial sites along the Nueces River.

f. The future growth and expansion of the Corpus Christi Bay Area will necessitate the development of additional shallow-draft commercial harbors and facilities in which the proposed Rincon Canal project would play a leading role. The present and prospective commerce and traffic would justify extension of the Rincon Canal westward in Nueces Bay a distance of 3.7 miles.

g. The proposed exchange of water between the Nueces River and the inland basins at Corpus Christi might result in decreasing the annual shoaling rate in the basins, and would eliminate possible water stagnation in the harbor and problems arising from dredging future channel extensions.

h. A suitably located and adequately sized anchorage basin would broaden the facilities and services of the port by affording the following advantages:

(1) A safe anchorage under most all weather conditions for vessels awaiting a berth, or waiting out adverse weather before proceeding to sea.

(2) A place where vessels upon arrival can be boarded and cleared by Immigration, Customs, and Public Health officials, thereby assuring the vessel of maintaining its position for the berth.

(3) A place where special cargo may be transferred from ship to barge or barge to ship, and where hazardous cargo can be handled.

(4) A place where vessels can be repaired, or moved to in case of an emergency.

(5) A passing place for large vessels.

i. Designation of the project as the "Corpus Christi Ship Channel" would be more descriptive and consistent with the names presently used to describe most other deep sea projects.

10. In connection with the requested improvements, the Nueces County Navigation District offered to provide the rights-of-way and spoil disposal areas and to save and hold the Federal government harmless from claims for damages.

DESCRIPTION

11. General.- The Federal project known as Port Aransas-Corpus Christi Waterway, Texas, is on the southern portion of the coast of Texas, 180 miles southwest of Galveston and 132 miles north of the mouth of the Rio Grande. The project affords deepwater navigation to the ports of Harbor Island, Ingleside, La Quinta, and Corpus Christi, Texas. Table 1 lists the authorized project dimensions for the various channels and basins. Plate 1 of this report and U. S. Coast and Geodetic Survey charts Nos. 523, 524, 892, 893, 1285, and 1286 show the project channels, connecting waterways, and the adjacent area. Plates 3 through 6 show details of the existing waterway, and proposed improvements thereto.

12. The channels and basins of the authorized project have an overall length of about 39.8 miles. The deepwater channel extends northwesterly about 3.4 miles from deepwater in the gulf through the Aransas Pass jettied entrance to an inner basin at the inner end of the jetty channel, thence westerly about 22.1 miles across Corpus Christi Bay to and including a turning basin at Corpus Christi, thence westerly about 1.3 miles through the Industrial Canal to and including the turning basin at Avery Point, thence westerly about 1.0 mile to and including the Chemical turning basin, thence westerly about 3.2 miles to and including a turning basin near Tule Lake, thence northwesterly about 2.0 miles to and including the Viola turning basin. A deepwater branch channel, about 5.4 miles long, extends along the north shore of Corpus Christi Bay to a turning basin at La Quinta. Jewel Fulton Canal, a shallow-draft channel about 0.8 miles long, extends from the La Quinta channel across Ingleside Cove to a turning basin in Kinney Bayou. A shallow-draft channel, about 0.2 miles long, extends to the town of Port Aransas.

13. The Gulf Intracoastal Waterway, which extends from Apalachee Bay, Florida, to Brownsville, Texas, joins the Port Aransas-Corpus Christi Waterway at mile 2.0 near Port Aransas, and leaves that waterway at mile 12.5, the junction of the channel to Encinal Peninsula. The Gulf Intracoastal Waterway main channel in this vicinity is 12 feet deep and 125 feet wide. A 12-foot by 125-foot alternate route follows along the northwest shore of Red Fish Bay and joins the Port Aransas-Corpus Christi Waterway near Ingleside at mile 10.3. A new route for the Gulf Intracoastal Waterway main channel, extending across Corpus Christi Bay in a southerly direction from mile 10.3, is authorized but not constructed. A 12-foot by 125-foot tributary channel of the Gulf Intracoastal Waterway extends from the city of Aransas Pass to the Inner Basin at Harbor Island.

14. During the 1940's, a channel 30 feet deep and 200 feet wide was dredged from the Port Aransas-Corpus Christi Waterway at mile 12.5 southwesterly across Corpus Christi Bay to a turning basin at Encinal Peninsula. No maintenance work in the channel has been performed, and the channel is shoaled to the natural depths in the bay of about minus 12 feet. The project has been carried in an inactive status for many years.

15. Corpus Christi Bay is a large shallow body of water, about 14 miles long in a northwest-southeast direction and about 12 miles wide at its widest part, with general depths of from 11 to 13 feet below mean low tide. The Port Aransas-Corpus Christi Waterway crosses the northern portion of the bay in a general east-west direction. The mean tidal range in Corpus Christi Bay is normally about 0.5-foot, but the water surface may be depressed as much as 3 feet below mean low tide by strong north winds in the winter season and may be raised as much as 15 feet above mean low tide by hurricanes, which may occur between June and October. All elevations in this report are referenced to mean low tide datum, which is 1 foot below United States Coast and Geodetic Survey mean sea level datum.

16. The branch channel to La Quinta, along the north shore of Corpus Christi Bay, lies in water about 6 feet deep and crosses Ingleside Point, Ingleside Cove, and Donnel Point. Ingleside Cove is a shallow water area having a maximum depth of about 6 feet. Spoil from construction of the channel has been deposited between 1,000 feet and 2,500 feet westward and southward of the channel. In general, the northern shore of Corpus Christi Bay from near McGloin Bluff to near Portland, a distance of about 8.5 miles, is bordered by a steep bluff, approximately 20 feet high. The bay shore beach between mean low tide and the base of the clay bluff varies in width from 50 feet up to about 200 feet.

17. Tributary area.- The City of Corpus Christi, with a population in 1965 estimated at 236,100 persons, is located centrally to nine counties comprising the immediate tributary area of the Port Aransas-Corpus Christi Waterway. Waterway movements of cotton from West Texas and beyond, wheat and flour from Kansas, Nebraska, and eastern Colorado, and petroleum from West Texas oilfields, does not permit exact definition of the thousands of square miles in the overall tributary area.

18. The nine county tributary area includes Nueces, San Patricio, Jim Wells, Kleberg, Brooks, Kenedy, Aransas, Bee, and Refugio Counties. The main products of the area are grain, onions, winter vegetables, livestock, wool, natural gas, petroleum and gypsum. Industrial developments consist of industries devoted to processing the agricultural products; producing and refining petroleum and petroleum products; manufacturing chemical derivatives, cement, wood and metal products; and reducing ore to produce aluminum and zinc.

19. The Port of Corpus Christi, the major city of the waterway, has developed rapidly since the opening of the deepwater channel in 1926. A major industrial expansion has been underway at the port since 1940. In the Corpus Christi trading area there are some 12,500 producing oil wells and an estimated oil reserve of 2 billion barrels. Extensive pipeline systems connect oilfields of the area, and from outside the area, to the terminals and refineries on the waterway. Six oil refineries in Corpus Christi have a total daily processing capacity of 243,000 barrels of crude oil. These refineries and the oil terminals at Ingleside and Harbor Island on the waterway have storage facilities for about 21,000,000 barrels of petroleum and petroleum products. There are 24 natural gasoline and cycling plants, having a capacity of about 50,000 barrels a day, within 50 miles of the city.

20. An aluminum plant is located at La Quinta, across the bay from Corpus Christi. The plant processes ore into alumina and reduces the alumina into aluminum. The movement of ores, particularly bauxite, has increased on the channel to La Quinta an average of 220,000 tons annually since 1955. Corpus Christi presently has a total grain storage capacity of 7,400,000 bushels. Producers Grain Port Terminal, a public grain elevator, has a total storage capacity of 6,360,000 bushels. The tributary area is served by an extensive system of improved highways. Three railroads, the Southern Pacific, the Missouri-Pacific, and the Texas Mexican Railroad, serve the city and Port of Corpus Christi and tributary area.

21. Bridges.- There are two bridges across the project channel, both completed in 1959. Table 2 lists bridge information pertinent to this report.

TABLE 2

BRIDGE CROSSINGS

Name and waterway mileage	Owner	Type	Clearance (feet) Horizontal	Vertical above MLT Closed	Vertical above MLT Open
Corpus Christi Harbor Bridge Mile 22.6 (1)	Texas Highway Department	Fixed highway	342	140(2)	N/A
Upper Harbor Bridge Mile 26.4 (1)	City of Corpus Christi et. al.	Vertical lift highway-railroad	300	11	140

(1) Refers to outer end of Aransas Pass jetty channel.
(2) Also provides for a vertical clearance of 116 feet over a horizontal distance of 400 feet.

22. Prior reports.- Information regarding prior reports that authorized the existing Federal navigation project for the Port Aransas-Corpus Christi Waterway is listed in appendix I.

23. Existing Corps of Engineers' project.- The original project for the improvement of Aransas Pass was authorized by the River and Harbor Act of March 3, 1879. The improvement was taken over by the Aransas Pass Harbor Company on June 30, 1890, under authority of the Act of May 12, 1890. This company relinquished its rights to the United States on March 27, 1899. The channel from Aransas Pass to Corpus Christi was first improved under the River and Harbor Act of March 2, 1907, and June 25, 1910.

24. The initial authorization for the existing project for the Port Aransas-Corpus Christi Waterway is contained in the River and Harbor Act approved March 3, 1899. Modifications of the project, as authorized by subsequent river and harbor acts, are given in the tabulation of prior reports, appendix I. The most recent modifications were authorized by the River and Harbor Act of 1958. They included enlarging La Quinta Channel to 36-foot project dimensions as described in Senate Document No. 33, 85th Congress, 1st session, and deepening of the main channel to 40 feet, extending the 40-foot main channel project to Viola, and providing for Federal maintenance of a 12-foot project in the locally dredged Jewel Fulton Canal, all as described in House Document No. 361, 85th Congress, 2nd session.

25. The authorized project dimensions for the various channels and basins now comprising the waterway are shown in table 1. The existing project also provides for two stone jetties at the Aransas Pass entrance extending into the Gulf of Mexico from St. Joseph and Mustang Islands with lengths of 11,190 and 8,650 feet, respectively, and for a stone dike on St. Joseph Island extending northward from the north jetty. The two stone jetties have been constructed to lengths of 9,240 and 7,385 feet, respectively, and the dike has been constructed 20,991 feet long. Except for inactive portions, all authorized improvements were completed in Fiscal Year 1966. Inactive items not constructed are: extensions of the North Jetty, 1,950 feet, the South Jetty 1,265 feet, and the Inner Basin at Harbor Island 2,000 feet; and a west turnout from La Quinta Channel to the main channel.

26. The total cost of constructing the existing project to June 30, 1967 was $26,136,646 as follows:

Federal costs			$18,867,974
Non-Federal costs			
Contributed funds		1,401,377	
Work performed in lieu of cash contribution		1,716,695	
Lands		620,200	
Relocations		1,527,000	
Harbor facilities (breakwater)		1,530,000	
Bascule bridge		400,000	
La Quinta Channel, 32-foot project			
Navigation aids	31,000		
Widening beyond project width	5,000		
Legal expense	19,000	55,000	
Jewel Fulton Canal		18,400	7,268,672
Total construction first cost			26,136,646

27. The total maintenance cost of the existing project to June 30, 1967 was $25,008,587, including Federal costs of $24,856,032 and work performed with contributed funds of $152,555. Annual maintenance costs for the project currently are estimated at $1,100,000 (April 1968) exclusive of jetty maintenance costs. Actual expenditures during the past 5 years averaged $760,000 annually. Since the project was not completed to full dimensions until the latter part of the 5-year period, the average actual costs are not representative of the present costs to maintain the project.

28. Local cooperation on existing project.- Local interests have furnished all usual items of local cooperation required for multi-user Federal navigation projects when and as required, have contributed $1,184,955 in cash towards the construction of the single-user La Quinta Channel 36-foot project, completed in July 1957; and have contributed $1,451,695 in value

of useful work performed on the single-user Viola Channel 40-foot project extension, completed in June 1965. Total non-Federal costs for the existing project of $7,421,227 include $7,268,672 for construction and $152,555 for maintenance.

29. Other navigation improvements.- Deep-draft locally dredged turning basins are located at the terminals of Humble Oil and Refining Company on Harbor Island, and of Sun Pipe Line Company at Ingleside. Local interests have dredged and maintained berthing areas at the wharves on the turning basins at Harbor Island, Ingleside, Corpus Christi, and La Quinta commensurate with the waterway project depth. Numerous private shallow-draft slips and channels have been dredged from the waterway throughout its entire length.

COMMERCE AND TRAFFIC

30. Terminal and transfer facilities.- There are 37 commercial wharves and piers along the Port Aransas-Corpus Christi Waterway used by deep-draft vessels. These installations have a total berthing space of about 26,000 feet, and have 636,000 square feet of transit shed area. The facilities are located at Harbor Island, Port Ingleside, La Quinta, Corpus Christi, Avery Point, Tule Lake, and Viola. Twenty-eight shallow-draft terminals are located along the waterway at Port Aransas, Old Ingleside, Corpus Christi, Avery Point, Tule Lake and Viola. Five additional shallow-draft terminals with traffic using the waterway are located on the south shore of Nueces Bay. The distribution of the terminal and transfer facilities is given in table 3. The frontispiece and exhibit 5 of appendix IV are aerial photographs of the Port of Corpus Christi. Photographs 1 and 2 are aerial views of deep-draft terminals on the waterway.

31. The 70 installations listed in table 3 are privately owned and operated except for three Federally owned wharves, two Nueces County ferry landings (Harbor Island and Port Aransas), and a city-owned barge wharf at Corpus Christi. Twenty-three wharves are owned by the Nueces County Navigation District and are open to all on equal terms under published tariff schedules. These wharves serve both barge and deep-draft traffic and, collectively, are equipped to handle a great variety of dry cargo and bulk commodities, as well as petroleum and petroleum products. The public wharves are located on the Corpus Christi, Avery Point, and Viola turning basins, the Industrial Canal and the channel to Tule Lake. Detailed information on most of the existing terminal facilities can be found in Port Series No. 25 (revised 1959) entitled "The Port of Corpus Christi, Texas," prepared jointly by the Corps of Engineers and the Maritime Administration.

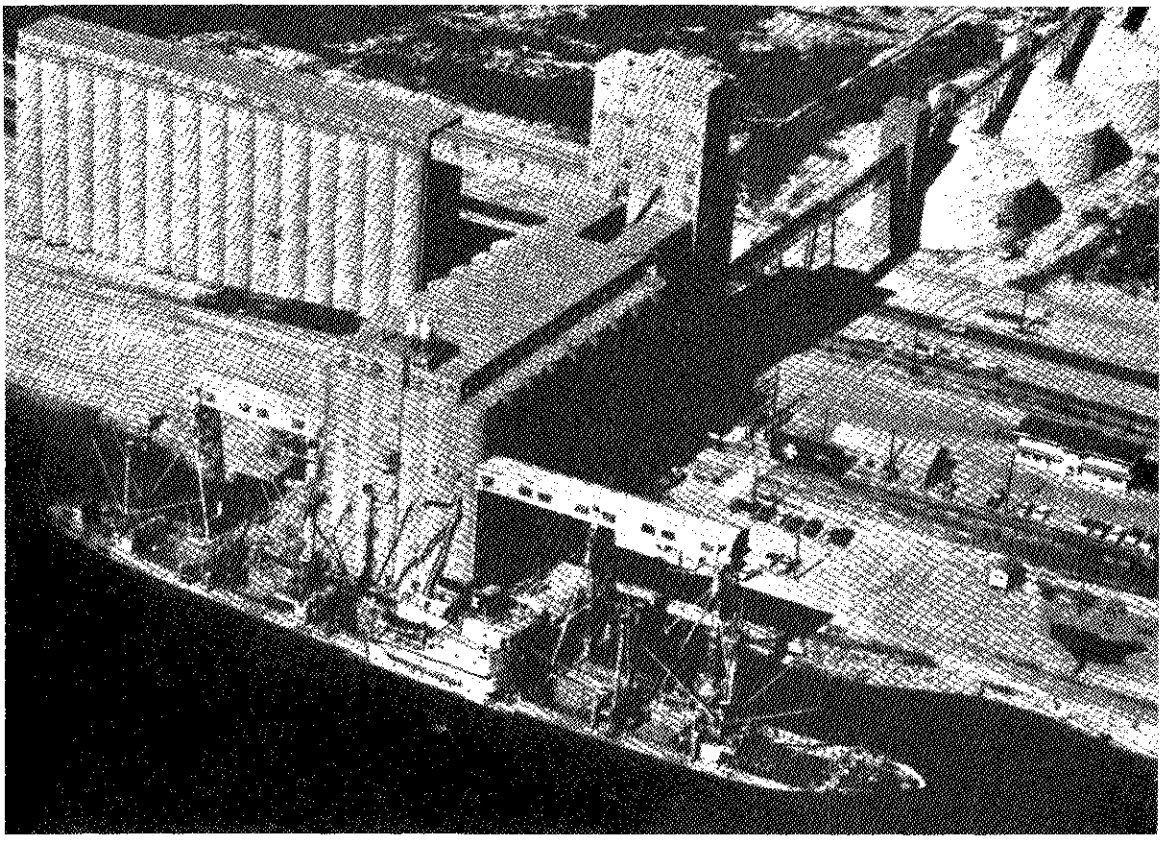
32. Existing public and private terminals will be adequate for prospective commerce in the immediate future. Additional facilities would be required to handle all increases in commerce expected to occur during the next 50 years. There is considerable vacant property available which should be adequate for this type of development.

TABLE 3

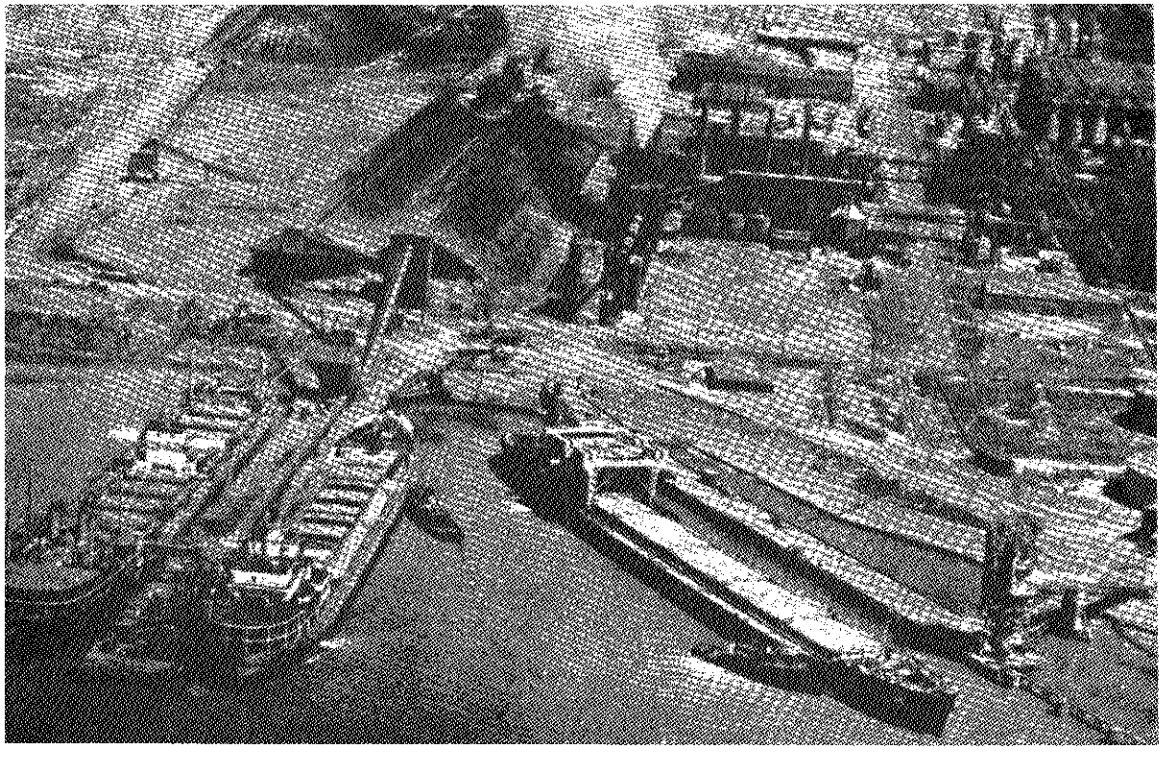
TERMINAL AND TRANSFER FACILITIES, WHARVES AND PIERS
BY LOCATION AND COMMODITY HANDLED AS OF MARCH 1967

Location	Deep-draft						Shallow-draft	Total
	General cargo and misc.	Petroleum and petroleum products	Chemicals	Grain	Ore	Coast Guard and CofE		
Harbor Island								
Number of installations	-	3	-	-	1(1)	1	4	9
Berthing space (L.F.)	-	2,000	-	-	2,460	152	700	5,312
Transit shed (S.F.)	-	-	-	-	-	-	-	-
Ingleside								
Number of installations	-	1	-	-	-	-	4	5
Berthing space (L.F.)	-	1,000	-	-	-	-	1,606	2,606
Transit shed (S.F.)	-	-	-	-	-	-	-	-
La Quinta								
Number of installations	-	-	-	-	2	-	2	4
Berthing space (L.F.)	-	-	-	-	1,942	-	1,816	3,758
Transit shed (S.F.)	-	-	-	-	-	-	-	-
Corpus Christi Turning Basin								
Number of installations	10	4	-	-	-	2	4	20
Berthing space (L.F.)	5,643	2,662	-	-	-	923	1,556	10,784
Transit shed (S.F.)	614,756	-	-	-	-	-	-	614,956
Industrial Canal								
Number of installations	1	3	-	1(2)	-	-	1	6
Berthing space (L.F.)	600	764	-	1,200	-	-	60	2,624
Transit shed	-	-	-	-	-	-	-	-
Avery Point Turning Basin								
Number of installations	-	-	1	-	-	-	3	4
Berthing space (L.F.)	-	-	1,480	-	-	-	805	2,285
Transit shed (S.F.)	-	-	21,000	-	-	-	-	21,000
Tule Lake Channel								
Number of installations	1	2	-	1(3)	1	-	8	13
Berthing space (L.F.)	600	1,680	-	800	1,000	-	4,906	8,986
Transit shed (S.F.)	-	-	-	-	-	-	-	-
Viola Turning Basin								
Number of installations	-	2	-	-	-	-	2	4
Berthing space (L.F.)	-	1,340	-	-	-	-	520	1,860
Transit shed (S.F.)	-	-	-	-	-	-	-	-
Nueces Bay								
Number of installations	-	-	-	-	-	-	5	5
Berthing space (L.F.)	-	-	-	-	-	-	1,745	1,745
Transit shed (S.F.)	-	-	-	-	-	-	-	-
Total installations	12	15	1	2	4	3	33	70
Total berthing space (L.F.)	6,843	9,446	1,480	2,000	5,402	1,075	13,714	39,960
Total transit shed (S.F.)	614,756	-	21,000	-	-	-	-	635,756

(1) Abandoned August 1965 - no longer in use.
(2) 5,600,000 bushel capacity.
(3) 6,500,000 bushel capacity.



Photograph 1 - Public Grain Elevator, Industrial Canal



Photograph 2 - Reynolds Metals Co. Wharves, La Quinta Turning Basin

33. Existing commerce.- The annual commerce on the waterway for each calendar year of the 10-year period 1955 through 1964 is plotted on the graph shown in figure 1. Total yearly tonnages varied from 21,744,814 tons in 1958 to 29,587,146 tons in 1964. The volumes of seagoing commerce in petroleum and petroleum products, ores, and grains are also plotted on figure 1. A tabulation of the tonnages for each year of the period is shown as table A of appendix II. A breakdown of the total commerce moved over various reaches of the waterway in 1964, identified whether moved by seagoing vessels or barges, is shown by figure 2. A tabulation of all commodities moved during 1964 is shown as exhibit 1 of appendix II. (Note: Studies for the economic analysis contained in this report, as discussed in detail in appendix II, were based on commerce and vessel traffic data available through calendar year 1964. Although such data for 1965 now has been published, the small difference between the 1965 and 1964 commerce does not indicate need to update the statistical data used for study purposes. Accordingly, other than for abbreviated mention in paragraph 4 of appendix II, the 1965 information has not been included in this report.)

34. The waterway experienced a decline in crude oil shipment from the Harbor Island terminal during the period from 1956 to 1958. Since that time, the tonnage of petroleum and petroleum products has remained at about the same level. Seagoing commerce in ores and grains steadily increased during the 1955-1964 period. The decrease in petroleum shipments is attributable to the completion of a pipeline from the west Texas oilfield area to Houston, Texas. For technical reasons, some crude oil previously shipped via Harbor Island to United States east coast ports now is moved by the "new" pipeline to Houston. There the crude oil is blended with oil from east Texas and Louisiana, then shipped on to the east coast refineries. Prior to 1958, the owner of one Harbor Island terminal handled shipments of the west Texas crude oil for several companies besides itself. The other companies now are using the "new" pipeline entirely for their crude oil movements. Some crude oil formerly moved through Harbor Island has been diverted to refineries at Corpus Christi for processing, then shipped in the form of products to the east coast ports. Although this diversion reduces the Harbor Island shipments, it does not appreciably affect the overall tonnage for the waterway.

35. The total annual commerce of the waterway has shown an average gain of about 600,000 tons annually during the 1955 through 1964 period. Although the 1964 commerce for Harbor Island, Ingleside, and Corpus Christi showed substantial increases over their 1955 amounts, the largest gain was for La Quinta where the tonnage increased at a rate of 240,000 tons annually.

36. The principal outbound commodity movement on the waterway in 1964 was petroleum and its products. Bauxite movement to La Quinta was the principal import. Petroleum movement by seagoing vessels accounted for about 51 percent of the total waterway commerce. Eighty percent of the commerce in petroleum and petroleum products was carried by seagoing vessels, the remaining 20 percent being handled by shallow-draft barges.

FIGURE 1

ANNUAL COMMERCE BY MAJOR COMMODITIES
AND TOTAL COMMERCE 1955-1964

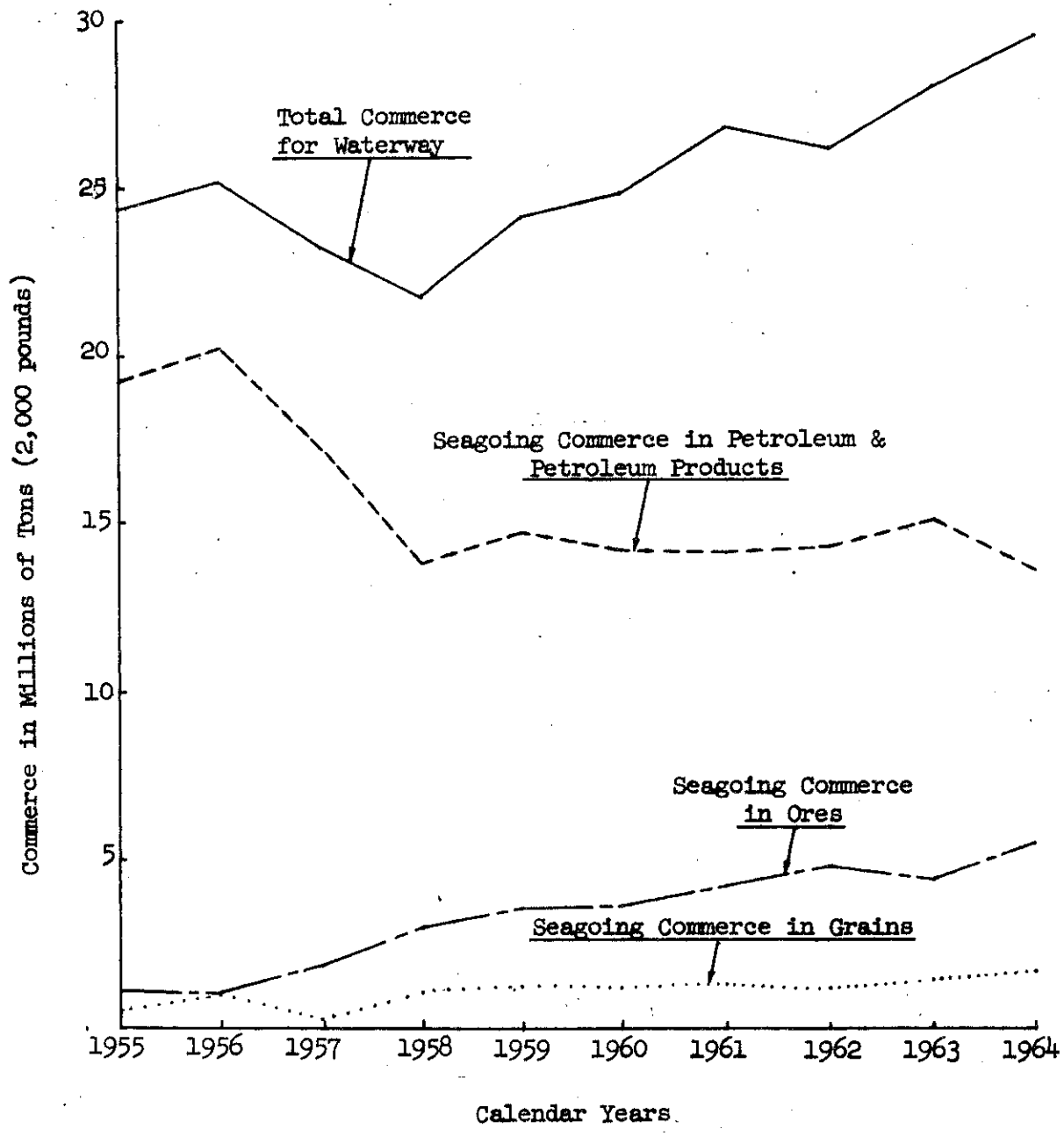
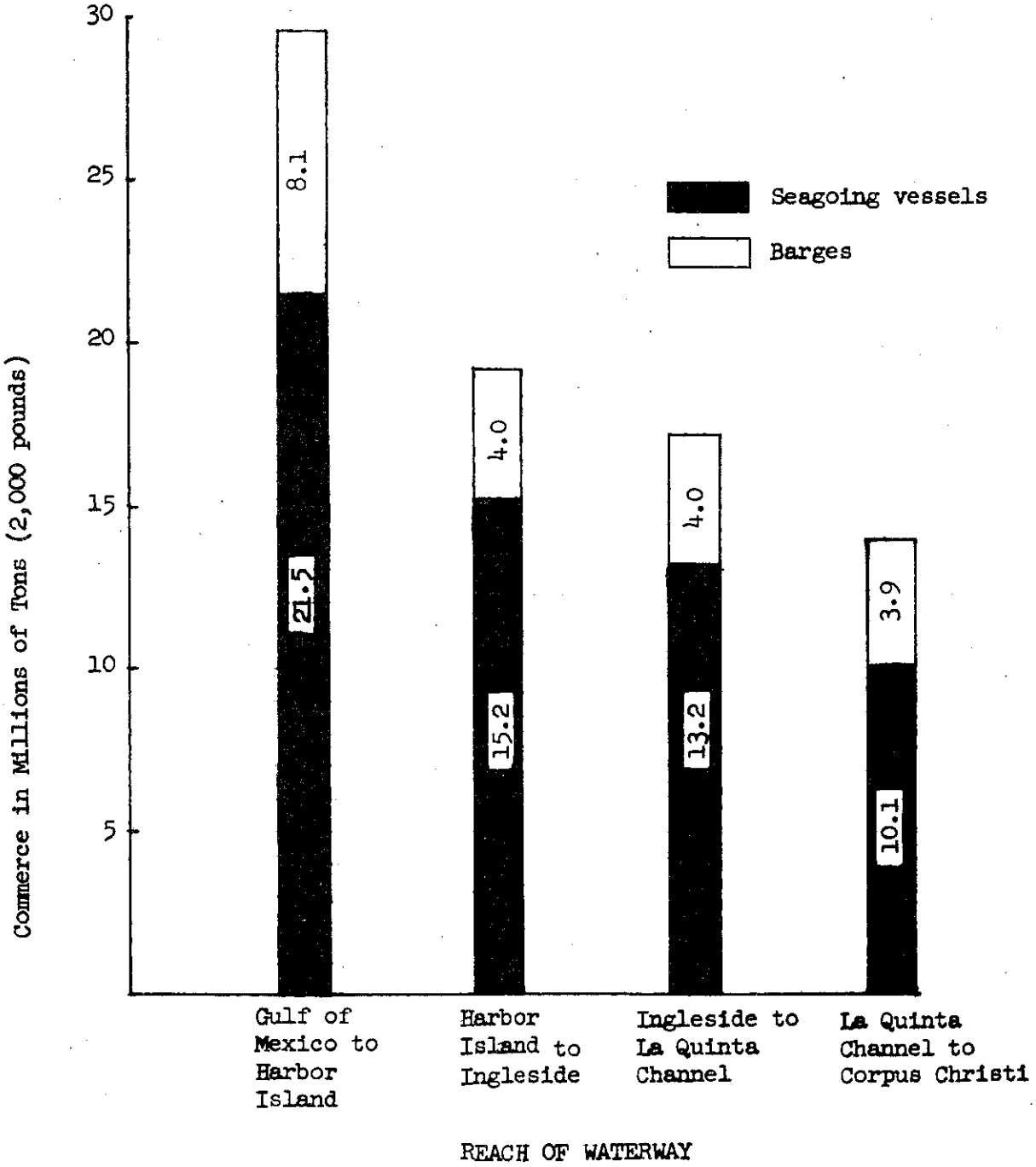


FIGURE 2

TOTAL COMMERCE MOVED OVER
VARIOUS REACHES OF THE WATERWAY
CALENDAR YEAR 1964



37. Prospective commerce.- The Corpus Christi area has a well developed industrial economy based on production, refining and shipping of petroleum; manufacturing of chemicals, cement, wood and metal products; reduction of ores to aluminum and zinc; and the processing and shipping of agricultural products. The various waterway terminals handle large volumes of both deep and shallow-draft commerce. Since this report concerns enlargement of the existing deep-draft channels, or construction of deep-draft channel extensions, estimates of additional future commerce chiefly concern those commodities susceptible to movement by deep-draft tankers or bulk carriers. The existing and prospective commerce of both deep and shallow-draft traffic for the major commodities at the four principal port areas on the waterway is shown on table 4.

38. In 1964 commerce on the waterway totalled almost 30,000,000 tons, including about 21,500,000 tons moved in deep-draft vessels. The deep-draft commerce comprised about 6.4 million tons of crude petroleum, 7.2 million tons of petroleum products, 5.5 million tons of bauxite and other ores, 1.7 million tons of grain, and 0.7 million tons of chemicals and miscellaneous products. Most of the petroleum and petroleum products were outbound coastwise shipments, bauxite and ores were foreign imports, grain was largely foreign exports, while the chemicals and other products covered a variety of movements.

39. To afford a basis for projections into the future of commerce on the waterway, various economic indicators as well as economic changes that could be expected in the future development of the area were studied. No radical change in the future production of petroleum and petroleum products is indicated. It is anticipated that petroleum and petroleum products will continue to be the principal commodity moved over the waterway, with little increase in the crude petroleum movements and a one percent per annum increase in petroleum products in future years. Grain exports should increase to about 5.2 million tons per annum by 1975, and remain thereafter at about that volume. Bauxite imports are expected to increase at a constant annual rate of one percent, and chemical deepwater shipments should steadily increase throughout the project life and reach 4.0 million tons in the year 2025. The projections indicate that the demand for deep-draft commerce on the waterway in the commodities named will total about 32 million tons annually by the year 2000 and 41 million tons by the year 2025. The commerce on the waterway in 1964 compared with the future commerce in 2025 is shown in table 4. Projected tonnages of commerce that would be available for foreign and coastwise transportation in large tankers or bulk carriers for 1975, 1980, 2000, 2020, and 2025 are shown in table 6, exhibit 5, appendix II. The amounts for 2000 and 2025 are broken down for the terminals of Harbor Island, Ingleside, La Quinta and Corpus Christi in table K of appendix IV.

40. Existing vessel traffic.- The present vessel traffic on the waterway is given in detail in exhibit 3 of appendix II. The exhibit shows the trips and loaded drafts of all vessels transiting the waterway, and the direction of movement, for calendar year 1964. For study purposes it was found desirable to determine the deep-draft traffic pattern to and from the important terminal points along the waterway. Table 5 is a summary of trips by vessels with design drafts greater than 19 feet in calendar year 1964.

TABLE 4

EXISTING AND PROSPECTIVE COMMERCE
BY COMMODITIES AND PORT LOCATION

Commodity	Corpus Christi		La Quinta Channel (Reynolds)		Ingleside (Sun Pipe Line Co.)		Harbor Island (Humble Terminal & Port Aransas)		Totals	
	1964	2025	1964	2025	1964	2025	1964	2025	1964	2025
Deep-draft										
1. Petroleum, crude	619,161	800,000	0	0	1,864,991	2,100,000	3,923,289	4,600,000	6,407,441	7,500,000
2. Petroleum products	6,878,985	13,209,000	68,487	221,000	152,248	290,000	93,494	180,000	7,193,214	13,900,000
3. Bauxite	0	0	3,093,487	10,000,000	0	0	2,241,494	0	5,334,981	10,000,000
4. Other ores	134,683	150,000	0	0	0	0	486	0	135,169	150,000
5. Grain	1,722,350	5,200,000	0	0	0	0	0	0	1,722,350	5,200,000
6. Chemicals	404,941	4,000,000	0	0	0	0	0	0	404,941	4,000,000
7. NEC	322,054	500,000	1,082	0	0	0	2,140	0	325,276	500,000
Subtotals, deep-draft	10,082,174	23,859,000	3,163,056	10,221,000	2,017,239	2,390,000	6,260,903	4,780,000	21,523,372	41,250,000
Shallow-draft										
1. Petroleum, crude	1,673,008	1,680,000	0	0	0	0	1,753,695	1,720,000	3,426,703	3,400,000
2. Petroleum products	1,359,963	1,360,000	0	0	0	0	39,815	40,000	1,399,778	1,400,000
3. Bauxite	0	0	0	0	0	0	2,302,714	0	2,302,714	0
4. Other ores	54,766	150,000	0	0	0	0	486	0	55,252	150,000
5. Grain	0	0	0	0	0	0	0	0	0	0
6. Chemicals	497,887	800,000	61,477	200,000	0	0	0	0	559,364	1,000,000
7. Seashells	260,615	290,000	0	0	0	0	10,496	10,000	271,111	300,000
8. NEC	68,072	81,000	8,066	8,000	0	0	10,986	11,000	87,124	100,000
Subtotals, shallow-draft	3,914,311	4,361,000	69,543	208,000	0	0	4,118,192	1,781,000	8,102,046	6,350,000
Totals - all commerce	13,996,485	28,220,000	3,232,599	10,429,000	2,017,239	2,390,000	10,379,095	6,561,000	29,625,418	47,600,000
Adjustment for local traffic									- 38,272	
Net total, all traffic									- 29,587,146	47,600,000

TABLE 5

TRIPS BY VESSELS WITH
DESIGN DRAFTS GREATER THAN 19 FEET
CALENDAR YEAR 1964

Draft in feet	Tule Lake to Viola	Upper Harbor Bridge to Tule Lake	Avery Point to Harbor Bridge	La Quinta junction to Corpus Christi	Ingleside to La Quinta junction	Port Aransas to Ingleside	Gulf to Port Aransas
40	0	0	0	1	1	1	1
38 & 39	1	0	13	18	18	52	93
36 & 37	0	0	5	5	5	5	17
34 & 35	6	7	22	48	119	138	189
32 & 33	11	22	56	120	120	120	120
30 & 31	44	66	136	279	318	320	331
19-29	1	39	61	281	281	281	281
Totals (1)	63	134	293	752	862	917	1,032

(1) Reported arrivals by local interests. For total inbound/outbound movements see exhibit 3 and table E of appendix II.

41. The data in table 5 covers deep-draft commercial vessels, including tankers, bulk carriers and cargo vessels, and vessels of the U. S. Navy. Practically all vessels with drafts of 30 feet and more were either tankers or bulk carriers. The total of 1,032 arrivals includes 420 arrivals by vessels with design drafts of 32 feet or greater. These vessels were mostly large supertankers or bulk carriers of 27,000 dwt and above. Round trips by vessels with loaded drafts of more than 36 feet included 24 to Corpus Christi, 33 to Ingleside, and 51 to Harbor Island, or a total of 108 trips (see figure 3 for comparison with prospective traffic).

42. Prospective traffic.- For analysis of the prospective use of supertankers and bulk carriers on the Port Aransas-Corpus Christi Waterway, a study was made to determine the present numbers and sizes of such vessels in the United States and foreign fleets, and the probable change in composition of the two fleets in future years. The study, presented in detail in appendix II, indicates that the rapid trend in the last few years to large size vessels will continue, and that tankers and bulk carriers in excess of 40,000 dwt (36-foot loaded draft) will be required during the 50-year project life period of the proposed improvements. A discussion of the analysis mentioned is contained in paragraph 10 of appendix IV. The computations for, and summary of, the estimated trips by tankers and bulk carriers of less than 36-foot draft and greater than 36-foot draft, for years 1964, 2000, and 2025, are shown in table K of appendix IV. Total round trips for the waterway by vessels requiring less than 36-foot draft of 549 in 1964 are expected to decrease to under 400 in 2020, then increase back to a little over 500 by 2025. The 108 total round trips in 1964 by vessels with loaded drafts greater than 36 feet are expected to increase to 360 by 2020, and to nearly 600 by the year 2025. A breakdown of the latter traffic for the four principal terminal areas along the waterway is shown on figure 3. Total prospective traffic of tankers and bulk carriers by 2025 is estimated at about 1100 round trips annually. No estimates were made of the prospective traffic by deep-draft general dry cargo vessels, or by shallow-draft vessels, since the proposed improvements would generate no benefits to vessels in these categories.

43. Design considerations for channels and turning points are outlined in paragraph 7 of appendix IV. The authorized main channel dimensions of 40 feet by 400 feet are considered adequate for two-way passage of tankers up to 40,000 dwt (36-foot loaded draft), with one vessel light and one vessel loaded. Based on project evaluation studies in appendix II, a vessel of 59,000 dwt (41-foot loaded draft) was selected as the design vessel. A channel depth of 45 feet is necessary to accommodate fully loaded vessels of this size. For channels subject to one-way usage, a channel width of 300 feet would accommodate the design vessel. A channel width of 400 feet would permit the passing of a large cargo vessel and a 59,000 dwt vessel. For the passage of two vessels the size of the design vessel, a channel width of 500 feet would be required. Based on the prospective waterway traffic, the main channel should provide for two-way traffic by vessels with drafts greater than 36 feet between the gulf and La Quinta Channel. Such two-way passage in the main channel upstream from La Quinta Channel is not indicated as necessary until about year 2000. Viola and La Quinta channels are expected to continue as one-user channels, and no

change in the present method of operating single vessels at one time on the channels is anticipated. Both channels are relatively short, and instances when two vessels would have simultaneous need to transit the channels would be infrequent. Any delay time would be of short duration, and would not cause losses of consequence on an annual basis.

DIFFICULTIES ATTENDING NAVIGATION

44. Difficulties attending navigation.- A considerable amount of the existing navigation problems on the waterway results from the operation of vessels larger than those for which the authorized project is designed. The present 40-foot project for the main channel is intended to accommodate vessels up to 40,000 dwt with loaded drafts of 36 feet. Such vessels would have a tolerance of 4 feet between their keels and the bottom of channel to allow for trim, squat, and clearance from the channel bottom. In 1964 there were ten 50,000 dwt tankers regularly frequenting terminals on the waterway, and transiting the channel with drafts at or near the 40-foot project depth. Accordingly, many of these vessels rub the channel bottom and banks with loss of steerage. This situation creates the hazard of such vessels taking sheers into the banks, and of collisions with passing vessels or shore facilities along the waterway. A similar situation exists on the La Quinta Channel 36-foot project, designed to accommodate vessels of 32-foot loaded draft, but being used by ore carriers with loaded drafts of nearly 36 feet. Deepening of the channels is needed to accommodate existing and prospective traffic.

45. The authorized project width of 400 feet for the main channel is designed to provide for the two-way passage of tankers up to 40,000 dwt, with one vessel light and one vessel loaded. The 200-foot authorized width for the Tule Lake, Viola and La Quinta Channels provides for one-way traffic only. All of the channels frequently are used by vessels larger than those for which the channels were designed. Such use is expected to continue by vessels even larger than those in the existing traffic. Widening of the main channel to provide for two-way traffic by loaded vessels larger than 40,000 dwt, and widening to provide for safe one-way traffic of larger vessels in the Tule Lake, Viola and La Quinta Channels, is needed.

46. The larger vessels of the existing traffic can be maneuvered in the existing turning basins only with extreme care and caution. Enlargement of the basins is desired to reduce the difficulty attendant to existing traffic, and to provide for the larger vessels expected to use the waterway.

47. The Inner Basin area is subject to very strong ebb and flood tides, and is the point of conveyance for tides flowing into and out of the main channel, the channel to Aransas Pass, and Lydia Ann Channel leading to Aransas Bay. Because of the tides and the cross-currents they create, inbound vessels often experience difficulty in maneuvering from

the jetty channel through the Inner Basin into the main channel. The Atlantic Company Wharf on Harbor Island has been damaged by vessel collision several times, and on many occasions vessels have dropped their anchors to avoid similar accidents. Outbound vessels also have difficulties from these currents when approaching the Inner Basin, particularly when vessels are moored at the Humble or Atlantic wharves on Harbor Island. When this condition exists, the outbound vessels pass on the opposite side of the existing 400-foot wide channel. If the currents are strong, the outbound vessel must be handled very carefully to avoid too close an approach to the bank. If caught by bank suction at that location, the outbound vessel could take a sheer and move toward the vessel or vessels at the Harbor Island wharves. Relief from the hazardous conditions created by the tidal currents in the Harbor Island area is believed possible by enlargement of the Inner Basin on the St. Joseph Island side, and by widening of the main channel in the reach along and on the opposite side from the Harbor Island terminals.

48. Considerable difficulty has been experienced at the downstream end of Tule Lake turning basin, particularly by loaded outbound vessels entering the basin from the Viola Channel. Upon entering the turning basin these vessels are only a short distance from the left descending bank, but are several hundred feet from the opposite side of the basin. This situation causes an unequal water pressure on the hull of the vessel, and tends to make the vessel move out towards the middle of the basin. The ship's course then must be corrected to head into the 200-foot wide Tule Lake Channel with only the remaining length of the turning basin left in which to maneuver. It is reported that 40 percent of the vessels rub the bank in leaving the basin. Some vessels have struck hard enough to cause "sheers" across the channel, rubbing the opposite bank before being brought under full control. Widening of Tule Lake and Viola Channels, and widening of the Tule Lake turning basin on its left descending side, is needed to mitigate the navigation difficulties at this location.

49. The Port Aransas-Corpus Christi Waterway does not provide for a deep-draft anchorage in protected waters. Vessels awaiting berthing areas along the waterway, or unable to enter the waterway because of adverse weather conditions, must anchor in the Gulf of Mexico. Unless the waters of the gulf are very calm, such vessels cannot be serviced except with difficulty. An inshore anchorage or mooring area is needed to permit safe small boat traffic between the vessels and shore, to permit water and other supplies to be furnished by barges, to permit safe handling of special or hazardous cargoes being transferred from ship to barge or barge to ship and to allow for shipboard preparations towards being ready for berthing as soon as wharf space becomes available.

50. Difficulties in navigating large vessels in certain rather sharp bends of the Tule Lake Channel are being experienced. These bends should be eased in addition to the channel widening mentioned in paragraph 45.

51. General.- The proposed navigation improvements under consideration in this report would have no bearing on water power, flood control, water quality, pollution abatement, irrigation, land reclamation, recreation, or any other purpose involving the control or conservation of water resources except fish and wildlife. The latter purpose is discussed in paragraph 52. At the April 1961 public hearing held to initiate this survey, local interests requested investigation to determine the need for an exchange of water between the harbor area at Corpus Christi and the Nueces River. The main purpose of the water exchange would be to prevent stagnation of the waters in the landlocked channels and basins. Reduction in the shoaling rates for the Corpus Christi main turning basin and entrance channel were suggested as additional benefits to be derived from the water exchange. The proposed water exchange is discussed in paragraph 53. During the progress of this survey, consideration was given to the construction of a common terminal facility in lieu of further enlargement of the existing project. Details of this investigation are contained in appendix III, and the results are discussed in paragraphs 58 through 63.

52. Fish and wildlife resources.- The project area contains important habitat for estuarine fishes and crustaceans. Waterfowl hunting is heavy adjacent to the project area. Dredged materials from the work recommended in the plan of improvement would be placed in established spoil disposal areas along the waterway. These spoil areas and the openings between them were recommended by the U. S. Fish and Wildlife Service in a report on maintenance dredging operations in the waterway dated January 1962. The U. S. Fish and Wildlife Service report on this survey states that "possibly submerged vegetation of value to fish and wildlife resources around the southern tip of Harbor Island and adjacent to the spoil banks would be affected by the project. These areas might be covered by spoil. However, in the past, spoil banks in this area have stabilized sufficiently to permit reestablishment of submerged vegetation near the edges. Based on the rehabilitative qualities previously experienced in this area, project damages to fish and wildlife habitat would be insignificant." Accordingly, the plan of improvement recommended in this survey does not include any specific spoil stabilization measures other than natural stabilization processes. A copy of the Fish and Wildlife Service letter report is contained in appendix V.

53. Flushing system for inland channels.- Two flushing system schemes were suggested by local interests for investigation. One proposal was to provide an unrestricted channel between the Nueces River and the Viola turning basin. The river now flows into Nueces Bay, and a continuous levee system prevents flood flows on the river from entering the waterway. Under the first proposal, the river floodwaters would move downstream through the inland channels and into Corpus Christi Bay, flushing the channels and basins with relatively fresh water. The second proposal was to install a pumping plant at the Viola turning basin and continuously pump water

from the basin into Nueces Bay. This proposal would flush the inland channels and basins by water from Corpus Christi Bay, and would have a direction of flow opposite from the first proposal.

54. Prior to making detailed investigations of the schemes, views and comments on the stagnation or pollution problem were requested from the Regional Program Director, Water Supply and Pollution Control, U. S. Department of Health, Education, and Welfare. (Note: Federal responsibility for pollution control was transferred to the Federal Water Pollution Control Administration subsequent to receipt of the views and comments requested.) That agency examined all applications for permits to the Texas Water Pollution Control Board, and made an inspection of the waterway with the Sewer Division of the City of Corpus Christi. Based on the results of this inspection and available information, the Regional Program Director advised that the discharge of municipal and industrial waste into the waterway was not causing a nuisance or a pronounced pollution problem.

55. Preliminary field studies of the shoaling problem at the Corpus Christi turning basin were made in September 1963. They included current measurements, collection of water samples for suspended sediment, salinity and pH analyses, collection of bottom samples, and dye dispersal tests. The Committee on Tidal Hydraulics, Corps of Engineers, was requested to assist in determining the causes and possible solutions of the shoaling problem. The views of the Committee are contained in a report dated August 1965, entitled "Sedimentation Problems in Entrance of Turning Basin, Corpus Christi, Texas." In general, the report describes and discusses extensive information and data gathering programs that would be required before possible solutions to the problem could be determined. The Committee advised in the report that diversion of the Nueces River into the Viola turning basin would cause very large increases in shoaling and maintenance dredging costs - besides creating other problems and, therefore, is inadvisable.

56. Deepening of the Corpus Christi turning basin to and including Viola turning basin, the last element of work for the authorized 40-foot project, was completed in September 1965. In the interim since that time, there has been a marked reduction in the shoaling rate of the problem area. However, the elapsed period is not sufficient to where conclusions can be drawn as to whether this effect of the waterway enlargement is of temporary or permanent nature. Under present conditions, there is no indicated urgency to make a shoaling study of the magnitude recommended by the Committee on Tidal Hydraulics. If and when the problem recurs, at that time it should be the subject of a special study.

57. In the absence of a pronounced stagnation or pollution problem, and because of the present relief from the shoaling problem, consideration of a flushing system for the inland channels at Corpus Christi was found unwarranted at this time, and the system is not considered further in this report.

58. Alternatives considered in lieu of further deepening.- At the end of World War II, the T-2 tanker was the "Workhorse" of the world tanker fleet and the requirements for channel and harbor facilities to accommodate ocean-going petroleum commerce centered around vessels of this size. The T-2 tanker, rated at about 17,000 deadweight tons, is about 523 feet long and has a fully loaded draft of about 30 feet. Following the war, the rapidly increasing costs of construction and operation of tankers started a trend toward construction of larger and larger vessels. At first vessels somewhat larger than the T-2 and ranging upwards of 25 to 30,000 dwt were referred to as "supertankers." This term soon lost its meaning, however, in describing vessel size, with the continued addition of much larger tankers to the fleet. Some of the very large vessels have been referred to as "giant tankers," but this term can also represent a wide range in size. Regardless of descriptive terms, the big vessels offer a number of economic advantages that will insure a continuing increase in size until some ultimate limits of structural stability or harbor capability are reached. With increased size, spectacular savings in unit transportation costs can be achieved. These savings result from lesser investment per unit of carrying capacity, lesser horsepower required per unit of cargo, and the fact that crew and labor costs are little more for larger ships than for smaller ones. With these advantages, a number of vessels exceeding 100,000 dwt are now in operation and vessels of over 300,000 dwt are under construction. To illustrate the rapidity of these changes, as recently as 1953 the 45,000 ton "Tina Onassis" was still the largest tanker afloat. In 1956 tankers of 30,000 or more deadweight tons represented only about 10 percent of the total tonnage of the world tanker fleet. By 1960 this percentage had risen to about 33 percent and by 1965 to about 58 percent. In the latter year over 50 percent of the total was in the range from 30,000 to 75,000 dwt. Although less numerous in total numbers, a rapidly increasing trend in size of other specialized vessels such as ore-carriers and grain carriers has also been evident.

59. Up to this time most of the extremely large tankers above 75,000 dwt are planned to carry crude oil from the rich oilfields of the Middle East, Persian Gulf, and South America to refining centers in Europe, the Far East, and the east coast of the United States. With repetitive runs between the same ports, these very large vessels probably will not be a critical factor in channel and harbor requirements for United States ports along the Gulf of Mexico, at least for some time to come. The petroleum commerce from the Texas ports is mostly outbound, with a high percentage of refined petroleum and petrochemical products. Although destinations are worldwide, a considerable portion moves to United States ports along the Atlantic north of Cape Hatteras. Even though the dispersion of market areas makes the extremely large vessels less suited to transporting refined products, the generally increasing size of the tanker fleet has brought more and more of the larger sized vessels into the gulf ports. Numerous vessels of 30,000 dwt and above are now serving the Texas ports. Even though tankers larger than 40,000 dwt cannot usually be operated to fully loaded capacity, vessels of 60,000 tons or more are now being used with some regularity. One tanker of over 100,000 dwt, converted for hauling grain, has made a few trips to Texas ports to move export grain. The vessel

has not operated to capacity and has experienced considerable difficulty at times. Based on the continuing trend in tanker construction, it seems reasonably certain that within a relatively short time, the "Workhorse" tanker fleet serving the Texas ports will be in the general range of 30,000 to 75,000 dwt, with the average vessel size tending to move upward within this range during future years. At this time it is considered appropriate to base the investigation of channel needs of the Port Aransas-Corpus Christi Waterway on the fully loaded requirements of vessels ranging up to about 59,000 dwt, recognizing that larger vessels would be limited to less than fully loaded operation during their infrequent trips on the waterway. Generally, the 59,000 dwt vessels have a length of about 800 feet and a loaded draft of about 41 feet.

60. It is recognized that analysis on this basis does not necessarily represent consideration of future needs for a long period. It represents, rather, consideration of needs that are now existing and the additional needs that will develop within the next few years. The urgency of satisfying the short-term needs and the complications of thoroughly investigating the long-term needs preclude a full investigation of this type at the present time. The problems of providing adequate channel and harbor facilities to accommodate the continually increasing size of tankers are not peculiar to the Port Aransas-Corpus Christi Waterway alone, or to the Texas ports collectively. Prohibitive costs would be required to improve all petroleum ports of the nation to fully accommodate the largest sized vessels now afloat. In some cases, such improvements would be physically impossible because of congested and developed areas adjacent to the waterways. It has been widely recognized that the problem of planning for full use of the largest vessels is at least regional in scope, and a number of studies have been initiated or planned to investigate the problem in depth. Numerous proposals have been advanced, including a limit on ship sizes, development of offshore or nearshore common terminal facilities, regional development of harbor systems, and others. When related to the existing pattern of industrial locations, all such proposals have disadvantages and only extensive studies of the broadest scope could develop the best overall solution. It is probable that no one solution will prove best in all cases and that the ultimate solution, from a national standpoint, will involve elements of many varied plans. Since the existing waterways cannot be ignored in approaching the problem, it appears likely that some plan of selective improvement into regional harbor systems may offer considerable promise in the final solution.

61. For comparison with the investigation of improvements to the waterway proposed in this report, consideration was given to alternative facilities that might serve in lieu of the waterway improvements. The study of alternatives considered is described in appendix III. The estimates of prospective commerce indicate annual movement of up to 13 million tons of petroleum and petroleum products and substantial amounts of ores, grain, and chemicals in vessels larger than 40,000 dwt during the project life of the proposed improvements. The alternatives considered to some degree, at least, included lightering, a pipeline system to other Texas petroleum ports, a common loading terminal about 6½ miles offshore in the

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Gulf of Mexico near Aransas Pass, and a common loading terminal just inshore from Aransas Pass near Harbor Island. The common loading terminals would include necessary pumping facilities and pipeline connections to the existing refineries at Corpus Christi and to the crude oil shipping terminals at Ingleside and Harbor Island. The inshore common loading terminal would include a large amount of storage facilities at Harbor Island.

62. Other than lightering, no true alternate to waterway improvements was found, since the prospective commerce in grain, ores and chemicals is not adaptable to movement through common loading and terminal facilities. Lightering as an alternate was not investigated in detail, since it is known that this is a costly operation and there are many practical disadvantages to handling a variety of products in this manner. The construction of pipelines to other Texas ports was not investigated in detail as an alternate, since extensive changes in marketing relationships would be required and a cursory examination indicated prohibitive cost levels. The offshore and inshore common loading terminals were investigated in some detail. Between these two, it was found that the inshore terminal at Harbor Island, with channel improvement from the gulf to this point, would be less costly and much more practicable from a service standpoint. This facility was found, however, to have estimated first costs approximately twice as large as the estimated first costs for channel improvements and estimated annual charges over 3 times greater. In addition to the unfavorable cost comparison, the facility would satisfy only a portion of the petroleum commerce needs, and the requirements of prospective commerce in grain, ores, and chemicals would remain unsatisfied.

63. Based on these studies, it is evident that deepening and improving the existing channels of the Port Aransas-Corpus Christi Waterway offer the most satisfactory and economical means of providing adequate facilities for the handling of commerce in very large vessels from this port at this time. The Port Aransas-Corpus Christi Waterway is favorably located with respect to economical deepening and enlargement of existing channels from the Gulf of Mexico. It is considered likely that this waterway would be an important element in any subsequent planning on a national or regional basis, involving selective improvement of ports or development of regional port or harbor systems. There can be no doubt that a major deep-draft port and harbor along the western gulf would be included in any such system. Corpus Christi is the only major metropolitan area along this reach of coast. It is about 200 miles southwest of the Houston-Galveston metropolitan area, the nearest comparable area along the coast. There is every indication that the Corpus Christi area will continue its rapid growth for the foreseeable future. With large segments of its basic economy being oriented to the petroleum and basic metals processing industries, the continuing need for seagoing transportation in very large vessels is assured. There are large areas of available lands near the waterways and sufficiently high to be safe from storm tides. If the port were expanded to accommodate regional needs, the availability of adequate land areas to serve the expanded activities would be an important consideration. From a standpoint of logical planning there appears to be no satisfactory alternative to improving the waterway on the basis of existing and projected future needs.

PROJECT FORMULATION

64. General.- In determining the most feasible plan of improvement, detailed engineering and economic consideration was given to the following:

a. Deepening the existing deep-draft channels and basins to accommodate the prospective vessel traffic of tankers and bulk materials carriers.

b. Widening the existing channels to accommodate the prospective traffic; either for one-way use by the large vessels, or to permit the two-way passage of large vessels.

c. Enlarging the existing turning basins, and constructing new turning points, to accommodate the prospective traffic.

d. Enlarging the existing channels and basins and easing bends at certain locations where deep-draft traffic now is experiencing steerage difficulties.

e. Constructing an inshore anchorage or mooring area for use by deep-draft vessels regardless of size.

65. Preliminary investigations were made to determine the needs for deep-draft channel extensions either from Viola turning basin to the Nuecestown turning basin site, or from Tule Lake turning basin to the Clara Driscoll turning basin site. The investigations found no indication of any need for such extensions at this time. Planning in 1961 for commercial development of the Rincon Point area failed to materialize, and a request for a shallow-draft channel to this vicinity later was withdrawn. Because of their apparent lack of economic justification, detailed investigations and studies of the three extensions mentioned were not made.

66. Plans considered.- The existing dimensions of the waterway are considered adequate to accommodate the largest dry cargo vessel that is likely to call at that port. It is expected that such vessels would make considerable use of an inshore anchorage or mooring area. Otherwise, this type of traffic would receive no appreciable benefits from enlarging the waterway's dimensions. The steerage difficulties at certain locations principally occur to the large tanker vessels. For all practicable purposes, the benefits to be derived from the improvements considered would accrue to tankers and bulk carriers of 40,000 dwt and greater. Accordingly, the development of improvements to the existing project lends itself to consideration of three separate portions of the project. The separate studies would consider: (a) improvement of the main channel from the Gulf of Mexico to Tule Lake for two-way traffic of supertankers and bulk carriers, including an inshore anchorage or mooring area, and including widening and curve easing at special problem areas; (b) improvement of the single-user Viola Channel and turning basin project for use by supertankers; and (c) improvement of the single-user La Quinta Channel and turning basin

project for use by large ore carriers. Various increments of additional depth and width were investigated in conjunction with analysis of the prospective commerce and traffic to determine the costs and benefits associated with each increment.

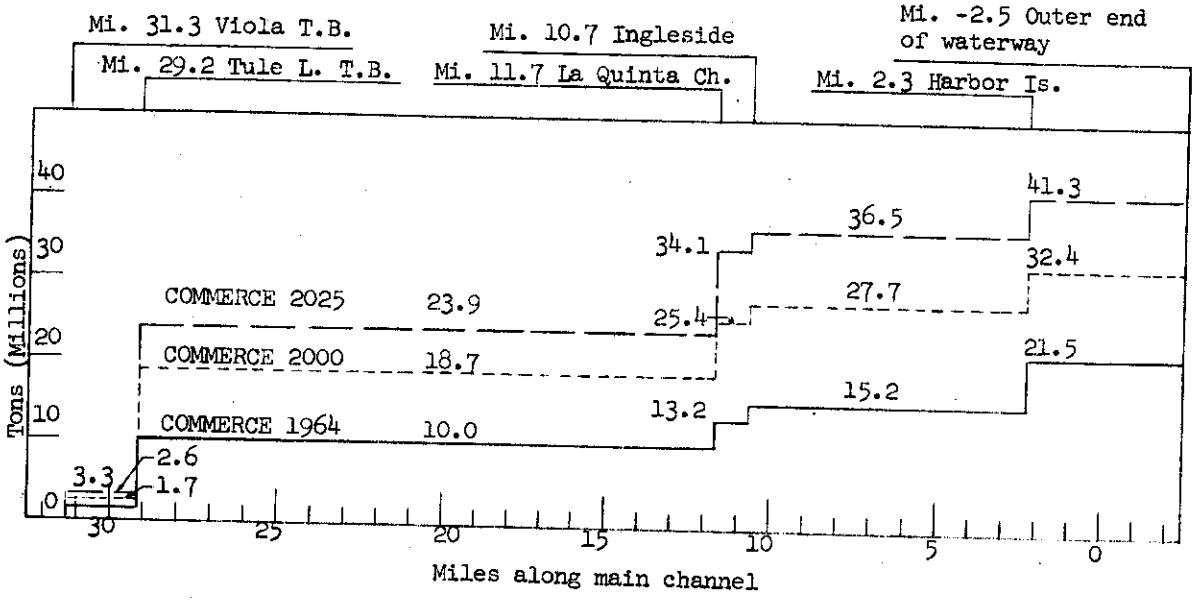
67. An analysis of channel and basin dimensions required for various sizes of tanker and bulk carrier vessels is given in appendix IV. This analysis shows that 43-foot depth is required for 51,000 dwt vessels; 45-foot depth for 59,000 dwt vessels; and 48-foot depth for 72,000 dwt vessels. Preliminary computations determined that deepening of all deep-draft channels to 45 feet would produce the maximum excess of benefits over costs, and the 59,000 dwt vessel was selected as the design vessel. Based on the general characteristics of the design vessel, a channel width of 300 feet is required for one-way traffic, and a channel width of 500 feet is required to permit the safe passage of loaded vessels of this size. Turning points for 59,000 dwt vessels, with lengths of about 800 feet, should have a diameter of 1,200 feet.

68. Figure 3 graphically shows the existing and prospective commerce susceptible to movement by tankers and bulk carriers. The figure also shows the existing and prospective traffic by vessels with drafts more than 36 feet. Derivation of the future traffic figures is explained in paragraph 10 of appendix IV. Prior to the end of the 50-year period of analysis, year 2025, traffic density in the main channel would be sufficient to require widening throughout to provide for two-way traffic by vessels of 59,000 dwt. At this time, widening of the main channel up to the La Quinta Channel junction, only, appears warranted. Sufficient traffic density to warrant widening of the main channel upstream from the La Quinta Channel junction is not indicated until about year 2000. The traffic analysis found no indicated need for widening the Tule Lake, Viola and La Quinta channels to provide for two-way traffic. The distances between the Chemical and Viola turning basins, and between the main channel and the La Quinta turning basin, are relatively short. On the infrequent instances when two vessels might meet in these reaches, a short delay for one ship would be required. Benefits accruing from additional widening to prevent this delay would not warrant the cost of the improvement.

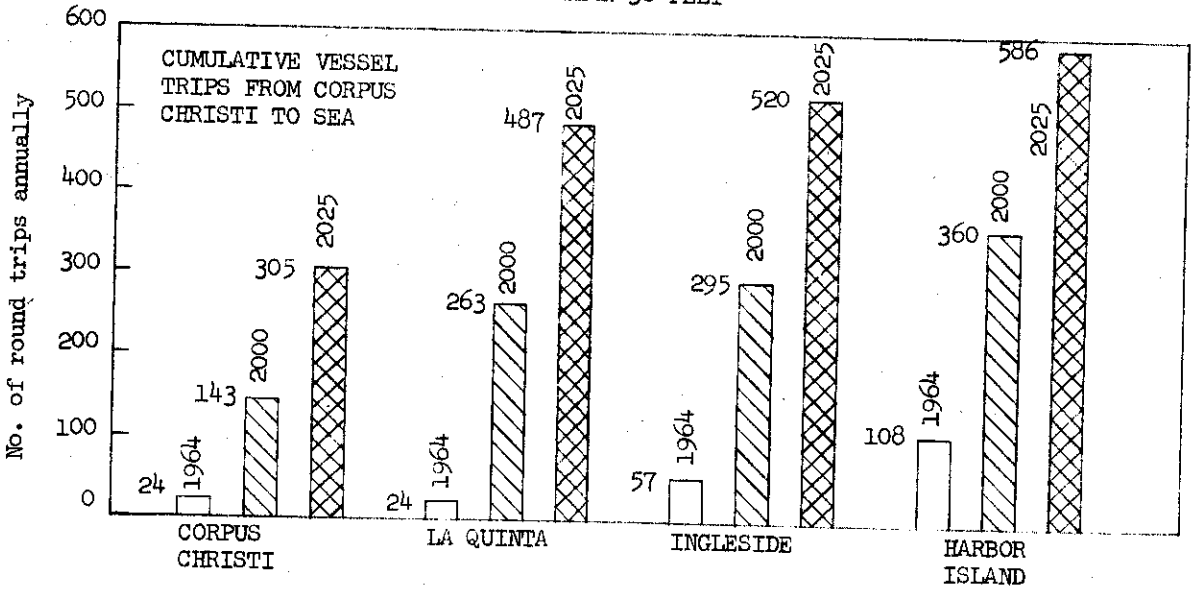
69. At the March 1964 public hearing, local interests suggested a large inshore anchorage area located adjacent to the main channel at about the upstream end of Harbor Island. This site is shown on plates 1 and 3. Investigations found that an off-channel mooring area near Port Ingleside would have many advantages over the Harbor Island site. In particular, a mooring basin or basins with attendant mooring facilities would have initial cost of less than 10 percent of the first cost for dredging the large anchorage area. Maintenance costs for the anchorage area would be very large, greatly exceeding such costs for a mooring area. For these and other considerations discussed in paragraph 19 of appendix IV, only the mooring areas at Port Ingleside were given detailed study. Investigations found that the Port Ingleside location could be developed by the dredging of two mooring areas, and the construction of 13 mooring dolphins.

FIGURE 3

EXISTING AND PROSPECTIVE COMMERCE
BY TANKERS & BULK CARRIERS



EXISTING & PROSPECTIVE TRAFFIC
BY VESSELS WITH DRAFTS
MORE THAN 36 FEET



By selected spacing of the dolphins at distances of from 250 feet to 400 feet apart, the facilities could be used by ships varying in size from small general cargo vessels up to those somewhat larger than the design vessel. The locations of the mooring areas and a spacing layout of the dolphins are shown on plates 3 and 4. The anchorage area suggested by local interests would have been adequate for only three vessels at one time. For the plan of improvement in this report, it is proposed to dredge mooring area A and construct three pairs of dolphins, which would accommodate the same number of vessels that could simultaneously use the suggested anchorage area. Construction of the remaining dolphins in area A, and construction of area B and its dolphins, would be deferred until there is demonstrated need for the facilities.

70. Under existing conditions, large tankers calling at the Harbor Island and Ingleside terminals have only limited turn-around areas. The maneuvering of such vessels to their wharves is difficult, and is hazardous under adverse weather and tide conditions. Enlargement of the Inner Basin, and widening of the main channel to 600 feet in the reach upstream from the Inner Basin, is proposed to relieve navigation steering problems discussed in paragraph 47. These two improvements would afford considerable relief also for the turning problem at the Harbor Island terminals. However, the area available would not be adequate for ships the size of the design vessel. Investigations found that a turning point at the junction of the main channel with the La Quinta Channel would satisfy the existing and future needs for this lower reach of waterway. A turning point at this location would improve the approach for inbound vessels entering the La Quinta Channel, and would greatly reduce navigation problems at that point for the occasional ships that call at both La Quinta and Corpus Christi. For these reasons, a turning point at this location was studied in detail.

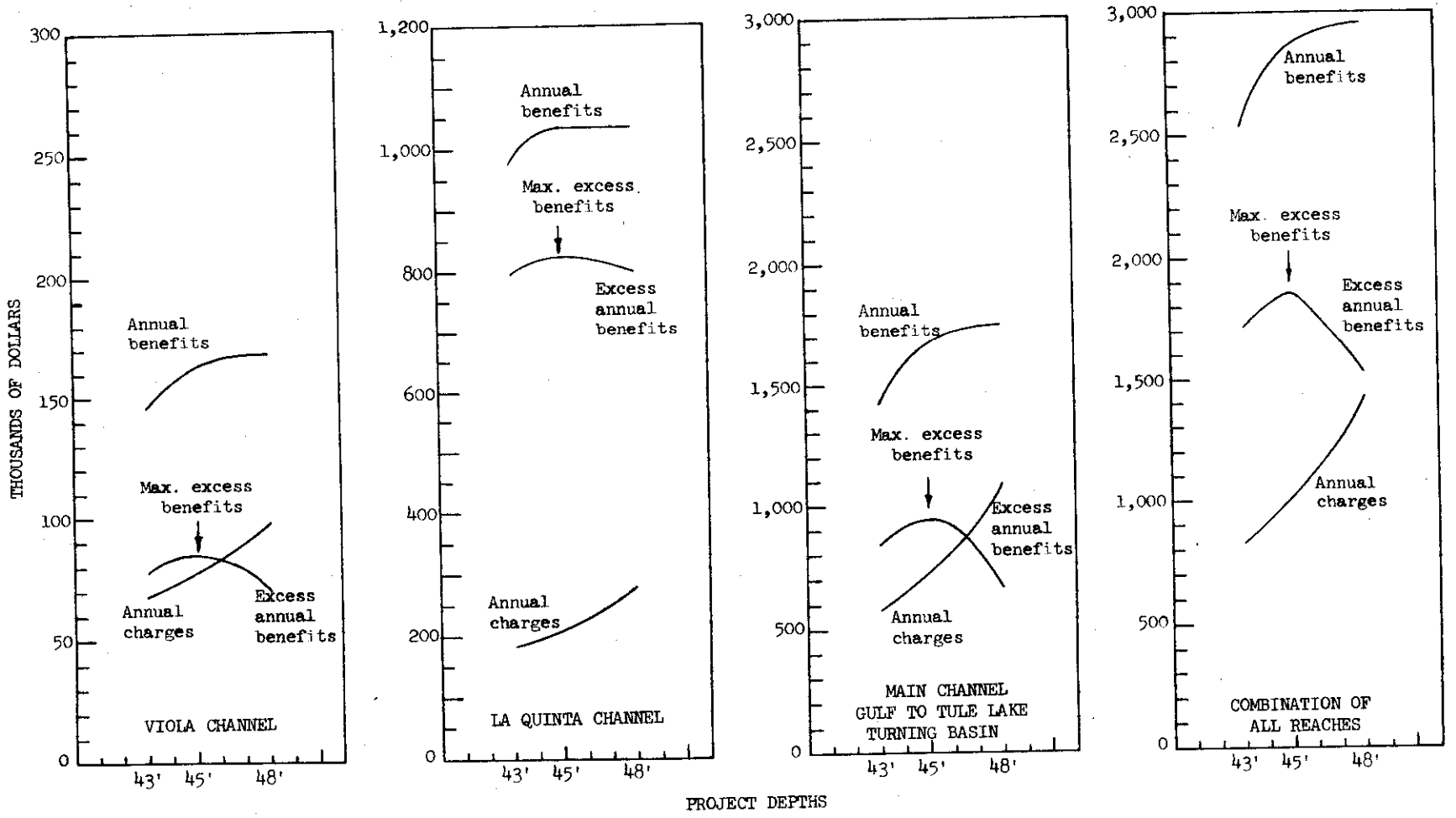
71. Comparison of plans.- Based on the foregoing considerations, three plans - varying only in project depth - were selected for comparison. All three plans include the construction of a new turning point at the La Quir Channel junction; the construction of a mooring area and six mooring dolphins at Port Ingleside; enlargement of the Inner Basin; widening of the main channel to 600 feet opposite the Harbor Island terminal area; widening of the main channel to 500 feet between Harbor Island and La Quinta Channel; widening of the Tule Lake, Viola and La Quinta Channels to 300 feet; enlargement of the Chemical, Tule Lake, Viola and La Quinta turning basins to have minimum diameter turning areas of 1,200 feet; and the easing of certain bends and other minor alignment changes. Project depths of 43 feet, 45 feet, and 48 feet were used for all items in the three plans. The waterway was divided into three reaches in order that the Viola and La Quinta Channels could be investigated individually as one-user projects. The estimated annual benefits, annual charges, excess benefits over charges, and benefits to costs ratios for the three plans are summarized as follows:

Project depth	Annual benefits	Annual charges	Excess benefits over charges	B/C ratio
(Main channel)				
43-foot	$1,419,800	$577,700	$ 842,100	2.4
45-foot	1,669,300	725,200	944,100	2.3
48-foot	1,758,600	1,087,700	670,900	1.6
(Viola Channel)				
43-foot	146,100	68,400	77,700	2.1
45-foot	162,600	78,100	84,500	2.0
48-foot	168,000	97,900	70,100	1.7
(La Quinta Channel)				
43-foot	970,700	180,900	789,800	5.3
45-foot	1,032,200	209,500	822,700	4.9
48-foot	1,032,200	238,300	793,900	4.3
(Total waterway)				
43-foot	2,536,600	827,000	1,709,600	3.0
45-foot	2,864,100	1,012,800	1,851,300	2.8
48-foot	2,958,800	1,423,900	1,534,900	2.0

72. Selection of plan.- Selection of the plan of improvement was based on comparison of the plans to determine the optimum scale of improvement from an economic standpoint. Figure 4 shows curves constructed by plotting the annual benefits, annual charges, and excess benefits over charges for each of the three reaches against project depths of 43 feet, 45 feet, and 48 feet. From inspection of the curves it may be seen that the benefits would be maximized, or the largest excess of benefits to costs would be obtained, from a plan affording a project depth of 45 feet in all three reaches. When considered separately, that is, by deepening from the existing project depth to one of the depths used for analysis, all improvements would have favorable benefits to costs ratios. However, the prospective benefits for vessels requiring more than 45-foot depth are insufficient to economically justify construction to any depth greater than 45 feet at this time. The following data shows that incremental deepening from 43 feet to 45 feet for the three reaches is justified, and that the next 3-foot increments for the reaches - from 45 feet to 48 feet - would have benefits to costs ratios of less than unity.

Depth	Incremental benefits	Incremental costs	Incremental B/C ratio
Main channel:			
43-foot			
45-foot	$249,500	$147,500	1.7
48-foot	89,300	362,500	0.25
Viola Channel:			
43-foot			
45-foot	16,500	9,700	1.7
48-foot	5,400	19,800	0.27
La Quinta Channel:			
43-foot			
45-foot	61,500	28,600	2.1
48-foot	0	28,800	0

FIGURE 4
MAXIMIZATION OF NET BENEFITS CURVES



73. Plan of improvement.- The plan of improvement provides for deepening the outer bar channel to 47 feet and extending the channel to the 47-foot depth in the Gulf of Mexico, a distance of about 1.2 miles; deepening the entire remaining deep-draft portion of the waterway to 45 feet, including the La Quinta channel and turning basin; widening the main channel to 600 feet between the Inner Basin at Harbor Island and a point 1,000 feet east of the ferry landing at Port Aransas, and widening to 500 feet between that point and the junction of La Quinta channel at mile 11.7; widening the channel from Avery Point to the Chemical turning basin to 400 feet, and widening the Tule Lake, Viola, and La Quinta Channels to 300 feet; widening the Chemical, Tule Lake, Viola, and La Quinta turning basins to provide minimum diameter turning areas of 1,200 feet; enlarging the entrance to the Inner Basin to 730 feet; realignment of the Industrial Canal to a location 25 feet northerly from its present position, and increasing the existing width of the Avery Point turning basin at the head of the Industrial Canal to 975 feet; constructing a turning point with turning area diameter of 1,200 feet at the La Quinta Channel junction; constructing mooring areas and dolphins at Port Ingleside, one mooring area and 6 dolphins to be constructed initially - the second area and 7 additional dolphins to be constructed when required to meet the needs of navigation; and easing at certain bends.

74. At certain locations deepening the waterway to 45 feet over the bottom widths of the existing 40-foot project would endanger structural foundations. In addition to the depth itself of 45 feet, consideration must be given to side slopes, to required overdepth dredging for advance maintenance of the project, and to allowable overdepth because of the inaccuracies of the dredging process. Accordingly, where structures would be endangered by the 45-foot project depth, bottom widths authorized for the existing 40-foot project should be reduced. For this reason, the plan of improvement provides for the following reductions in widths of the authorized project: entrance channel to Corpus Christi main turning basin starting at a point 500 feet bayward from the Corpus Christi Harbor Bridge, decrease from 400 feet to 300 feet; Corpus Christi main turning basin, reduce from 1,000 feet to 800 feet; and Avery Point turning basin, reduce from 1,000 feet to 975 feet. The plan of improvement eliminates further need for two authorized but not constructed improvements, and which are recommended for deauthorization, as follows: the 2,000-foot northward extension of the Inner Basin at Harbor Island; and the west turnout (wye connection) between the main and La Quinta Channels.

75. Other than the six mooring dolphins at Port Ingleside, all work in the plan of improvement concerns the excavation and disposal of materials. The improvements would require about 87 acres of land for rights-of-way. It is believed that the spoil disposal areas for the

existing project will be adequate for the plan of improvement, and for the future maintenance of the project. Upland spoil disposal areas are to be used as much as practicable. Excavated materials in open water areas would be placed in established spoil disposal areas along the waterway. All openings between these spoil disposal areas would be retained and maintained at their present dimensions.

SHORELINE CHANGES

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

AIDS TO NAVIGATION

77. Aids to navigation.- The Commander, Eighth Coast Guard District, New Orleans, Louisiana furnished estimates of the number and types of aids to navigation, and their costs for 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.

ECONOMIC EVALUATION OF PROJECT

78. General.- The economic evaluation of the proposed project for navigation in the Port Aransas-Corpus Christi Waterway included comparison of estimated benefits and costs to insure that: (a) the best plan has been developed, (b) the proper scale of development has been selected, and (c) the construction of proposed improvements was fully justified from an economic standpoint. The factors entering into formulation of the plan of improvement are discussed in paragraphs 64 through 72.

79. Estimates of first cost.- The total estimated first cost for the plan of improvement is $20,074,000, of which $15,776,000 would be apportioned to the Federal Government and $4,298,000 would be apportioned to the local interests. This division of first costs is based on the requirements of local cooperation set forth in paragraph 86. The Federal first costs would be allocated $15,597,000 to the Corps of Engineers, and $179,000 to the U. S. Coast Guard. The non-Federal first costs include cash contributions of $761,500 for the Viola Channel improvements and $1,896,500 for the La Quinta Channel improvements, or a total of $2,658,000. Detailed estimates of the first costs are contained in appendix IV, and are summarized in tables 6 and 7. All estimates are based on April 1968 price levels.

TABLE 6

ESTIMATES OF FIRST COSTS FOR ENLARGING MAIN CHANNEL
FROM GULF OF MEXICO TO TULE LAKE TURNING BASIN
(45-FOOT PROJECT)

Item	Cost
Federal first cost:	
Corps of Engineers, dredging	$11,762,000
Engineering and design	412,000
Supervision and administration	765,000
Subtotal, Corps of Engineers	12,939,000
U. S. Coast Guard, aids to navigation	120,000
Total Federal first cost	13,059,000
Non-Federal first cost:	
Non-Federal public: lands, rights-of-way spoil disposal areas, and levees	321,000
Non-Federal private, relocations	694,000
Total non-Federal first cost	1,015,000
Total first cost	14,074,000

TABLE 7

ESTIMATES OF FIRST COSTS FOR VIOLA AND LA QUINTA CHANNELS
(45-FOOT PROJECTS)

Item	Cost: Viola Channel	Cost: La Quinta Channel
Channels		
Dredging	$1,365,000	$3,423,000
Engineering and design	55,000	130,000
Supervision and administration	103,000	240,000
Subtotal, channels	1,523,000	3,793,000
Aids to navigation	26,000	33,000
Levees and spillways	77,000	38,000
Lands and damages		
Lands, rights-of-way, and spoil disposal areas	94,000	19,000
Relocations	None	397,000
Total first cost	1,720,000	4,280,000
Federal share of first costs		
Corps of Engineers, construction	761,500	1,896,500
U. S. Coast Guard	26,000	33,000
Total, Federal share of first costs	787,500	1,929,500
Non-Federal share of first costs		
Non-Federal, public		
Lands and damages	94,000	19,000
Levees and spillways	77,000	38,000
Cash contribution, construction	761,500	1,896,500
Total, non-Federal public	932,500	1,953,500
Non-Federal, private		
Relocations	None	397,000
Total, non-Federal share of first costs	932,500	2,350,500
Total project cost	1,720,000	4,280,000

80. Estimates of annual charges.- Total annual charges for the plan of improvement are estimated at $1,012,800. Detailed estimates of the investments and annual charges are contained in appendix IV, and are summarized in table 8. An interest rate of 3.25 percent and a period of 50 years for amortization of the investment were used for computation of annual charges.

TABLE 8

ESTIMATES OF INVESTMENTS AND ANNUAL CHARGES
FOR PLAN OF IMPROVEMENT

	Gulf to Tule Lake	Viola Channel	La Quinta Channel	Total
Investment:				
Federal	$14,379,000 1/	$787,500	$1,929,500	$17,096,000
Non-Federal	1,015,000	932,500	2,350,500	4,298,000
Annual charges:				
Federal	681,900	39,400	113,600	834,900
Non-Federal	43,300	38,700	95,900	117,900
Total annual charges	725,200	78,100	209,500	1,012,800

1/ Includes $1,320,000 present worth of deferred cost for construction and replacement of mooring dolphins.

81. Estimates of benefits.- The benefits to be derived from the plan of improvement primarily would be savings in transportation costs resulting from full loading of tankers and bulk carriers larger than those for which the existing project is designed. Additional benefits would be realized by the various widenings of the channels and basins, and the easing of curves, through a reduction in the hazards to navigation. The existing 40-foot main channel project is considered adequate for vessels up to 40,000 dwt, and the 36-foot La Quinta Channel project is adequate for vessels up to 24,000 dwt. Both channels regularly are used by vessels with design drafts greater than the 36-foot and 32-foot safe depths afforded by the 40-foot and 36-foot projects. An analysis of the operation costs of large tankers and bulk carriers of from 40,000 dwt to 72,000 dwt is presented in appendix II. This analysis was used to determine the savings that would result from movement of the prospective commerce by combinations of various sizes of larger vessels fully or partially loaded - together with the smaller vessels that still would be employed in such commodity movements. Through project formulation procedures, the most economical improvement was found to be a 45-foot depth project, which depth is recommended in the plan of improvement. This project depth would permit the operation of vessels up to 59,000 dwt fully loaded. Although their unit cargo costs would be somewhat greater than if fully loaded, vessels larger

than 59,000 dwt could operate light-loaded at considerable savings over the present costs for a 40,000 dwt vessel. If the waterway is improved as proposed in the plan of improvement, average savings per ton of about 19 cents for petroleum and petroleum products, 39 cents for grain, 33 cents for ores, and from 19 cents to 37 cents for chemicals would be realized.

82. Based on estimated amounts of the prospective commerce that would be moved during various periods of the 50-year period of analysis at the foregoing savings per ton, average annual equivalent benefits from savings in transportation costs were determined as follows: petroleum commerce, $1,717,400; grain, $1,525,000; chemicals, $124,800; and ores, $2,028,400. It is considered that these savings should be divided equally between the local project and the ports at the other end of the movements. Accordingly, the annual benefits in transportation savings that would accrue from the plan of improvement are estimated at: petroleum commerce, $858,700; grain, $762,500; chemicals, $62,400; ores, $1,014,200; a total of $2,697,800. Annual benefits from reduction in hazards to navigation are estimated at $166,300, making the total benefits $2,864,100. Details of methods and computations used to derive these estimated benefits are contained in appendix II. A summary of the benefits for pertinent reaches of the waterway is as follows:

Type of benefits	Average Annual Equivalent Benefits			
	Gulf to Tule Lake	Viola Channel	La Quinta Channel	Total waterway
Savings in transportation costs	$1,566,500	$117,100	$1,014,200	$2,697,800
Reduction in navigation hazards	102,800	45,500	18,000	166,300
Totals	1,669,300	162,600	1,032,200	2,864,100

83. Comparison of benefits and costs.- The estimated average annual benefits, the annual charges, and the ratio of benefits to charges for the plan of improvement for the Port Aransas-Corpus Christi Waterway, based on April 1968 price levels, is given in table 9.

TABLE 9

COMPARISON OF BENEFITS AND COSTS
FOR PLAN OF IMPROVEMENT

Item	Gulf to Tule Lake	Viola Channel	La Quinta Channel	Total
Average annual equivalent benefits	$1,669,300	$162,600	$1,032,200	$2,864,100
Annual charges	725,200	78,100	209,500	1,012,800
Ratio of benefits to charges	2.30	2.08	4.93	2.83

84. Apportionment of costs among interests.- The apportionment of the estimated first costs and annual costs of maintenance of the recommended improvements between the Federal and non-Federal interests is based on present Federal policies for navigation projects. For multi-user channels, construction and maintenance costs for the navigation improvements would be apportioned to the United States. The local interests costs for the construction and maintenance of these improvements include the costs for: rights-of-way; spoil disposal areas, including any necessary retaining dikes, bulkheads, and embankments; and the alteration of structures. For single-user channels, local interests provide the items of local cooperation stated for multi-user projects and share the first costs of construction equally with the United States. Maintenance of the single-user project would be a Federal expense, except for the necessary spoil disposal area costs assigned to the local interests.

85. The total construction first costs for improvements proposed to the single-user Viola and La Quinta Channels are estimated at $1,523,000 and $3,793,000, respectively. Based on the present policies, these amounts must be shared equally between the United States and local interests. The shares for each would be $761,500 for the Viola project and $1,896,500 for the La Quinta project. The proposed apportionment of the estimated first costs and annual maintenance and operation costs for the entire plan of improvement is shown in table 10.

TABLE 10

APPORTIONMENT OF COSTS FOR PLAN OF IMPROVEMENT

Item	Cost: Gulf to Tule Lake	Viola Channel	La Quinta Channel	Total
First costs				
Federal				
Corps of Engineers	$12,939,000	$761,500	$1,896,500	$15,597,000
U. S. Coast Guard	120,000	26,000	33,000	179,000
Total Federal first cost	13,059,000	787,500	1,929,500	15,776,000
Non-Federal				
Non-Federal public	321,000	932,500 1/	1,953,500 2/	3,207,000
Non-Federal private	694,000	None	397,000	1,091,000
Total non-Federal first cost	1,015,000	932,500	2,350,500	4,298,000
Total first cost	14,074,000	1,720,000	4,280,000	20,074,000
Additional Annual Cost of Maintenance and Operation				
Federal				
Corps of Engineers, dredging	81,700	7,000	35,000	123,700
Corps of Engineers, dolphins	44,300	0	0	44,300
U. S. Coast Guard, aids	None	400	None	400
Total additional Federal annual M&O costs	126,000	7,400	35,000	168,400
Non-Federal				
Non-Federal public, spoil levees and spillways	2,000	700	100	2,800
Non-Federal private, relocation	None	None	None	0
Total additional non-Federal annual M&O costs	2,000	700	100	2,800
Total, additional annual M&O costs	128,000	8,100	35,100	171,200

1/ Includes $761,500 for cash or work contribution.
2/ Includes $1,896,500 for cash or work contribution.

86. Proposed local cooperation.- Modification of the existing project for the Port Aransas-Corpus Christi Waterway to provide for the improvements proposed in this report would be subject to the requirements of local cooperation generally specified by law for Federal navigation projects. It is proposed that the local interests shall be required to participate in the plan of improvement as follows:

a. Provide without cost to the United States all lands, easements, and rights-of-way required for construction and subsequent maintenance of the improvements and for 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 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 due to the construction works;

c. Accomplish without cost to the United States all alterations of pipelines, powerlines, cables and other utility facilities, when and as required for construction of the improvements;

d. Provide and maintain without cost to the United States depths in berthing areas and local access channels serving the terminals commensurate with the depths provided in the related project areas;

e. In accordance with applicable Federal, State, and local laws and authorities, establish regulations or otherwise promote the adoption of measures to prohibit the discharge of pollutants into the waters of the proposed improvements by users thereof; and

f. Provide a cash contribution of 50 percent of the Federal first costs of dredging the enlargements of the Viola Channel and turning basin and the La Quinta Channel and turning basin, presently estimated at $761,500 for the Viola improvements and $1,896,500 for the La Quinta improvements; or contribute work on the improvements acceptable to the Chief of Engineers, that would reduce the new work quantities of materials required to complete the improvements. In the event a work contribution is made that does not equal 50 percent of the new work quantity of materials required for the improvement, the balance of the local interests' share of work will be paid as an estimated lump sum prior to commencement of the remaining work. For funds contributed by local interests, the final allocations of costs will be made after the actual costs have been determined.

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87. Initiation of studies.- Notices of the two public hearings held in Corpus Christi, Texas on April 25, 1961 and March 10, 1964 were sent to all known Federal, State, and local agencies that were believed to have interest in any navigation improvements proposed for the Port Aransas-Corpus Christi Waterway. Each fiscal year the Galveston District coordinates its entire General Investigations program with other Federal agencies. By this means the other agencies are advised of the nature and status of all surveys in progress.

88. Prior to completion of this report, the proposed plan of improvement was furnished to all Federal agencies that had indicated interest in the survey for field level review and comments. Replies from these agencies are included in appendix V and summarized in the following paragraphs.

89. U. S. Coast Guard.- The Commander, 8th Coast Guard District, furnished estimates of costs for relocation, establishment, and maintenance of the navigation aids that would be required for the 45-foot project, but otherwise made no comments.

90. U. S. Fish and Wildlife Service.- The Acting Regional Director, U. S. Fish and Widlife Service, Bureau of Sport Fisheries and Wildlife, advises that "project damages to fish and wildlife habitat would be insignificant."

91. U. S. Public Health Service.- The U. S. Public Health Service cooperated early in this survey by investigating the inner basins and channels at Corpus Christi for possible stagnation or pollution problems. The findings of that agency are summarized in paragraph 54. No comments on the final plan of improvement recommended in this survey were received.

92. Federal Water Pollution Control Administration.- The Regional Director, Federal Water Pollution Control Administration, advises that the views of his agency are properly expressed in this report. He requested that paragraph 57 of this report be changed to include the word "pronounced" before the phrase "stagnation or pollution problems," which has been done.

93. U. S. Soil Conservation Service.- The Texas' State Conservationist, Soil Conservation Service, advises that his agency "does not have any existing or proposed projects in the local area of the recommended plan of improvement."

94. U. S. Bureau of Mines.- The Acting Area Director, U. S. Bureau of Mines, Area IV, Mineral Resource Office, advises that his agency "would have no objection to recommended construction if the relationship between construction and existing oilfields is determined in field examination by qualified personnel and provisions are made for protection of oil wells and appurtenant facilities where conflicts exist." Since the plan of

improvement principally involves enlargement of existing channels and basins where there are no nearby oil wells, the possibility of any conflict at a future date is believed to be remote. However, preconstruction surveys for the proposed work would include consideration of any existing oil field development. If conflicts are found, they would be resolved at that time.

95. U. S. Bureau of Outdoor Recreation.- The Regional Director, U. S. Bureau of Outdoor Recreation, recommends that the Texas Parks and Wildlife Commission be given the opportunity to review and comment on the project plans, and that spoil from dredging operations be disposed of in a manner to be as inconspicuous as possible. He advises that "the proposed project is in accord with the Texas State Comprehensive Outdoor Recreation Plan and will not afford any additional significant outdoor recreation opportunities." Review of this survey by the Texas Parks and Wildlife Commission will be afforded at the time the survey is furnished by the Chief of Engineers to the Governor of Texas for his comments. The recommendation concerning spoil disposal operations is a matter to be considered during preconstruction planning, and was not investigated in detail by this survey.

DISCUSSION

96. Discussion.- This report comprises the results of investigations and studies to determine what modifications of the Port Aransas-Corpus Christi Waterway are deemed advisable at this time. Local interests requested extensive improvements, all of which were investigated. Preliminary investigations determined that certain improvements either were not feasible, or could not be economically justified, and these improvements were not given detailed consideration. The desired improvements fully investigated, in general, included: enlargement of all deep-draft channels and basins to accommodate the large tankers and bulk carriers in both existing and prospective waterway traffic; widening of the deep-draft channels to provide for the two-way passage of such vessels; the construction of an inshore deep-draft anchorage area; and enlargement of channels and basins at certain locations where existing traffic is encountering navigation difficulties.

97. All investigations of the improvements considered in detail resulted in favorable findings, and these improvements are recommended for construction in this report. In addition to the navigation improvements, local interests desire that the name of the project be changed to "Corpus Christi Ship Channel." Their opinion that this designation would be more descriptive and consistent with the names presently used to describe most other deep sea projects is concurred with. In the interest of simplicity and uniformity, it is considered desirable to change the name of the project from Port Aransas-Corpus Christi Waterway, Texas to Corpus Christi Ship Channel, Texas.

98. The River and Harbor Act of July 3, 1930 authorized a 2,000-foot long extension of the Inner Basin at Harbor Island. No actual need for this basin extension has ever developed, and the extension has never been dredged. There is no apparent need for the basin extension in the foreseeable future. The River and Harbor Act of September 3, 1954 authorized a 32-foot by 150-foot branch channel to La Quinta, including a 32-foot by 150-foot west turnout (wye connection) between the main and La Quinta Channels. No need for this turnout has developed, and it has not been dredged. There is no foreseeable need for this turnout, particularly in view of the turning point at the junction of the main and La Quinta Channels included in the plan of improvement. To obviate the necessity for carrying these two inactive elements in future reports as authorized but not completed work, their deauthorization is desirable.

99. The requirements of local cooperation described in paragraph 86 and the plan of improvement recommended in this report have been presented to the Nueces County Navigation District, which represents the local interests. That agency has accepted the plan and indicated willingness to furnish the required items of local cooperation.

100. Additional information called for by Senate Resolution 148, 85th Congress, adopted January 28, 1958, is contained in an attachment to this report.

CONCLUSIONS

101. Conclusions.- Based on the findings of this investigation it is concluded that:

a. The authorized dimensions of the Port Aransas-Corpus Christi Waterway deep-draft channels and basins are not adequate to accommodate with reasonable safety and convenience the prospective traffic of large tankers and bulk carriers.

b. There is need for an inshore mooring area and mooring facilities to accommodate vessels of the existing deep-draft traffic, and an additional mooring area and additional mooring facilities will be required to accommodate the prospective deep-draft traffic.

c. There is need for a turning point in the bay reach of the main channel to accommodate tanker traffic to the terminals of Harbor Island and Ingleside.

d. The authorized project widths should be increased at certain locations to relieve existing navigation difficulties, and reduced at other locations where increasing the project depth to 45 feet over the existing widths would endanger structures.

e. Modification of the authorized project as described in the plan of improvement, generally to accommodate fully loaded tankers and bulk carriers of up to 59,000 dwt, is the most feasible plan. Because of the single-user aspect of the Viola Channel and turning basin and of the La Quinta Channel and turning basin, the local interests should share in the costs of constructing the enlargements for these two elements of the waterway.

f. The total first cost of the proposed improvements is estimated at $20,074,000 of which $15,776,000 would be apportioned to the Federal Government ($15,597,000, Corps of Engineers; $179,000, U. S. Coast Guard) and $4,298,000 would be apportioned to the local interests. The non-Federal share of costs includes $2,658,000 for cash or work contribution towards the Viola and La Quinta improvements. The improvements would have annual charges of $1,012,800, annual benefits of $2,864,100, and a benefits to costs ratio of 2.8 based on April 1968 price levels. Additional annual costs of maintenance and operation are estimated at $171,200 of which $168,400 would be borne by the Federal Government ($168,000, Corps of Engineers; $400, U. S. Coast Guard) and $2,800 would be borne by local interests.

g. Estimated first costs of $787,000 for the construction of deferred work - 7 mooring dolphins and dredging mooring area B - should be handled as a deferred investment and included as part of the annual charges for the plan of improvement. The first cost amount of $20,074,000 for the plan of improvement stated in paragraph 99f excludes the deferred work first costs of $787,000.

102. It is further concluded that the name of the project should be changed to Corpus Christi Ship Channel, Texas, and that the authority for construction of the unconstructed portions of elements of improvement at the Inner Basin and at the lower end of La Quinta Channel, which were authorized, respectively, by the River and Harbor Acts of July 3, 1930 and September 3, 1954, should be rescinded.

RECOMMENDATIONS

103. Recommendations.- Accordingly, it is recommended that the existing project for the Port Aransas-Corpus Christi Waterway, Texas, be modified to provide for enlargement of the existing deep-draft channels and basins to a project depth of 45 feet, for the construction of a new deep-draft turning point, for the construction of a deep-draft mooring area and mooring facilities, and for widening of the channels and basins at certain locations, generally as described in the plan of improvement of this report, with such modifications thereof as in the discretion of the Chief of Engineers may be advisable, at an estimated first cost to the United States of $15,597,000 for new work, and an increase of $168,000 in the cost of annual maintenance, subject to the condition that the 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 improvements and for 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 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 due to the construction works;

c. Accomplish without cost to the United States all alterations of pipelines, powerlines, cables, and other utility facilities, when and as required for construction of the improvements;

d. Provide and maintain without cost to the United States depths in berthing areas and local access channels serving the terminals commensurate with the depths provided in the related project areas;

e. In accordance with applicable Federal, State, and local laws and authorities, establish regulations or otherwise promote the adoption of measures to prohibit the discharge of pollutants into the waters of the proposed improvements by users thereof; and

f. Provide a cash contribution of 50 percent of the Federal first costs of dredging the enlargements of the Viola Channel and turning basin and the La Quinta Channel and turning basin, presently estimated at $761,500 for the Viola improvements and $1,896,500 for the La Quinta improvements; or contribute work on the improvements, acceptable to the Chief of Engineers, that would reduce the new work quantities of materials required to complete the improvements. In the event a work contribution is made that does not equal 50 percent of the new work quantity of materials required for the improvement, the balance of the local interests' share of work will be paid as an estimated lump sum prior to commencement of the remaining work. For funds contributed by local interests, the final allocations of costs will be made after the actual costs have been determined.

104. It is also recommended that the undredged northward extension of the Inner Basin at Harbor Island and the undredged west turnout (wye connection) between the La Quinta channel and the main channel of the Port Aransas-Corpus Christi Waterway be deauthorized; and that the name of the Port Aransas-Corpus Christi Waterway, Texas, be changed to Corpus Christi Ship Channel, Texas.

105. It is further recommended that the local interests be authorized to contribute work for the Viola and La Quinta improvements, under the foregoing local cooperation requirements and prior to the appropriation of the Federal share of funds for the improvements, with the understanding that the Federal Government would maintain completed components of such work that are acceptable to the Chief of Engineers at depths commensurate with available depths in the main waterway.

FRANKLIN B. MOON
Colonel, CE
District Engineer

3 Incl
1. Plates 1 thru 6
2. Appendixes I thru V
3. Senate Resolution 148 attachment

[First endorsement]

SWDPL-F
SUBJECT: Review of Reports on Port Aransas-Corpus Christi Waterway, Texas (45-Foot Project)

DA, Southwestern Division, Corps of Engineers, 1114 Commerce Street, Dallas, Texas 75202, 16 Apr 68

TO: Chief of Engineers

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

C. C. HAUG
Major General, USA
Division Engineer

REVIEW OF REPORTS

ON

PORT ARANSAS-CORPUS CHRISTI WATERWAY, TEXAS

(45-FOOT PROJECT)

APPENDIX II

PROJECT EVALUATION

REVIEW OF REPORTS
ON
PORT ARANSAS-CORPUS CHRISTI WATERWAY, TEXAS
(45-FOOT PROJECT)

APPENDIX II

PROJECT EVALUATION

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APPENDIX II

PROJECT EVALUATION

1. General.- This appendix contains economic data and estimates of benefits that would be derived from proposed navigation improvements to the Port Aransas-Corpus Christi Waterway. The improvements evaluated consist principally of deepening and widening the authorized channels and basins to accomodate prospective traffic on the several reaches of the waterway. The improvements are described in detail in paragraphs 73 through 75 of the text and are shown in plates 1 through 6 of this report.

2. This appendix consists of three sections; (a) commerce, (b) vessel traffic, and (c) benefits. The section pertaining to commerce contains data on existing and prospective deep-draft commerce that would move over the waterway during the project life of the proposed improvements. The section on vessel traffic presents information on trips and drafts of vessels using the waterway, and an analysis of the prospective traffic related to channel depth requirements. The section pertaining to benefits presents the analyses and computations that were used to estimate the savings that would result from improvement of the waterway.

3. The analyses and computations contained herein are based on data and statistics compiled from various sources. These sources include a field survey of traffic using the waterway; investigations of the physical features of the waterway pertaining to traffic, hazards to navigation, and efficiency of movement of commerce, records and statistics furnished by maritime and industry representatives, and interviews with local interests.

4. At the time the studies were made the latest statistics on commerce and vessel traffic were in the Corps of Engineers' publication "Waterborne Commerce of the United States" for calendar year 1964. Subsequently the calendar year 1965 publication has been issued. Comparison of the 1965 statistics with those for 1964 shows only slight changes between the two years. Commerce on the Port Aransas-Corpus Christi Waterway in 1965 totaled 29,928,314 tons, compared with 29,587,146 tons for 1964. The most significant change was noted in the trips of vessels with drafts greater than 36 feet. In this category there were 95 vessel trips on the waterway in 1965 compared with 79 in 1964, thus reflecting the continuing movement to larger and deeper draft vessels. In view of the small difference between the 1965 and 1964 commerce it was not considered necessary to update the statistical data used in the analyses for this report.

5. Existing commerce.- A tabulation of total commerce moved over the waterway for the period 1955 through 1964 is shown in exhibit 1 of this appendix. This exhibit also shows in detail the different types of commodities moved during the year 1964. The principal commodities are petroleum and petroleum products, ores, grains, and chemical products. The Port Aransas-Corpus Christi Waterway serves four port areas, Harbor Island, Ingleside, La Quinta, and Corpus Christi. The total annual commerce at each of these ports for the 10-year period 1955 through 1964 is given in table A, which shows that, although annual fluctuations occur, there has been a rather steady trend of increase over the 10-year period.

TABLE A

PORT ARANSAS-CORPUS CHRISTI WATERWAY
TOTAL ANNUAL COMMERCE
1955-1964

Year	Commerce (short tons)					
	Corpus Christi	La Quinta	Ingleside	Harbor Island	Local traffic*	Total
1955	12,723,872	980,549	1,869,165	9,043,311	-286,894	24,330,003
1956	13,546,606	819,249	1,203,009	9,800,758	-224,192	25,145,430
1957	14,180,124	917,420	1,184,289	7,017,839	-123,257	23,176,415
1958	12,560,739	2,661,391	1,238,532	5,328,386	-44,234	21,744,814
1959	14,163,686	2,815,532	1,460,470	5,705,797	-33,070	24,112,415
1960	14,977,581	2,793,556	1,431,288	5,657,189	-19,171	24,840,443
1961	14,848,007	2,891,030	1,378,841	7,686,071	-43,828	26,760,121
1962	12,949,616	3,581,035	1,587,872	8.114,590	-44,695	26,188,418
1963	14,332,292	3,215,491	1,703,969	8,822,197	-28,755	28,045,194
1964	13,996,485	3,232,599	2,017,239	10,379,095	-38,272	29,587,146

* Internal traffic moved between the ports located on the Port Aransas-Corpus Christi Waterway, while treated as receipts and shipments at the separate ports, is classified as local in the table and used as an adjustment for local traffic.

Source: Waterborne Commerce of the United States

6. Petroleum and petroleum products are the commodities of largest volume movement over the waterway, and accounted for 64 percent of total commerce moved in 1964. Table B shows that in 1964 about 80 percent of the petroleum commerce moved in seagoing tankers and the remaining 20 percent moved in barges over the Gulf Intracoastal Waterway. The analysis of the petroleum commerce is discussed in detail in the Economic Base Study, attached as exhibit 5 to this appendix.

TABLE B

PORT ARANSAS-CORPUS CHRISTI WATERWAY
COMMERCE IN PETROLEUM AND PETROLEUM PRODUCTS
BARGE AND SEAGOING
1955-1964

Year	Commerce (short tons)				
	Seagoing		Total seagoing	Barge	Total
	Foreign	Coastwise			
1955	1,108,234	18,038,755	19,146,989	2,758,733	21,905,722
1956	2,146,054	18,028,036	20,174,090	2,579,940	22,754,030
1957	2,752,692	14,475,416	17,228,108	2,796,722	20,024,830
1958	584,879	13,211,573	13,796,452	3,308,212	17,104,664
1959	678,481	14,013,563	14,692,044	3,083,801	17,775,845
1960	179,715	13,976,161	14,155,876	3,208,702	17,364,578
1961	129,245	14,021,873	14,151,118	4,181,330	18,332,448
1962	142,807	14,175,705	14,318,512	3,025,391	17,343,903
1963	332,891	14,734,514	15,067,405	3,987,942	19,055,347
1964	81,218	13,519,437	13,600,655	4,826,481	18,427,136

Source: Waterborne Commerce of the United States - 1964.

7. The movement of ores on the Port Aransas-Corpus Christi Waterway accounted for 26 percent of total commerce in 1964. Table C indicates a rapidly increasing movement of this commodity during the 10-year period. The movements reflect imports to a zinc smelter in Corpus Christi and bauxite imports to two large aluminum plants. One of these plants, owned by the Reynolds Metals Company, is on the La Quinta Channel

of the Port Aransas-Corpus Christi Waterway, while the second, owned by the Aluminum Company of America, is located at Point Comfort on the Matagorda Ship Channel. The Matagorda Ship Channel was under construction during the several years prior to 1966. During this period the Aluminum Company of America moved imported ore to its plant at Point Comfort by deep-draft shipment to Harbor Island on the Port Aransas-Corpus Christi Waterway. There, the ore was lightered into barges and moved through the Lydia Ann Channel, the Gulf Intracoastal Waterway, Aransas Bay and Matagorda Bay to the plant at Point Comfort. The Matagorda Ship Channel was opened to deep-draft commerce in 1966 and the imported ore is now moving directly to the Alcoa plant in the deep-draft vessels. The immediate reduction in commerce on the Port Aransas-Corpus Christi Waterway because of this change is estimated at approximately 2,300,000 tons annually. The ore commerce is analyzed in more detail in the Economic Base Study.

TABLE C

PORT ARANSAS-CORPUS CHRISTI WATERWAY
COMMERCE IN ORES
BARGE AND SEAGOING
1955-1964

	Commerce (short tons)				
	Seagoing		Total		
Year	Foreign	Coastwise	seagoing	Barge	Total
1955	1,116,239	--	1,116,239	52,820	1,169,059
1956	1,035,416	--	1,035,416	54,853	1,090,269
1957	1,847,986	--	1,847,986	56,215	1,904,201
1958	2,984,594	--	2,984,594	59,790	3,044,384
1959	3,569,096	50	3,569,146	274,720	3,843,866
1960	3,667,452	--	3,667,452	1,015,771	4,683,223
1961	4,241,002	--	4,241,002	1,141,280	5,382,282
1962	4,825,254	--	4,825,254	1,273,726	6,098,980
1963	4,404,025	--	4,404,025	1,616,119	6,020,144
1964	5,209,054	261,096	5,470,150	2,357,966	7,828,116

Source: Waterborne Commerce of the United States -1964.

8. Grain has become the third largest commodity moved over the Port Aransas-Corpus Christi Waterway, accounting for 6 percent of total commerce moved in 1964. As shown in table D, approximately 98 percent of this product is moved on seagoing vessels destined for foreign countries. About two-thirds of the grain shipments are sorghums produced in the area tributary to Corpus Christi.

TABLE D

PORT ARANSAS-CORPUS CHRISTI WATERWAY
COMMERCE IN GRAINS
BARGE AND SEAGOING
1955-1964

Year	Commerce (short tons)				
	Seagoing		Total seagoing	Barge	Total
	Foreign	Coastwise			
1955	532,901	--	532,901	--	532,901
1956	494,093	3,327	497,420	20,935	518,355
1957	280,853	7,130	287,983	7,392	295,375
1958	628,150	232	628,382	--	628,382
1959	1,254,342	--	1,254,342	--	1,254,342
1960	1,213,254	133	1,213,387	--	1,213,387
1961	1,279,842	14,611	1,294,453	--	1,294,453
1962	1,196,045	348	1,196,393	--	1,196,393
1963	1,446,340	703	1,447,043	--	1,447,043
1964	1,722,350	--	1,722,350	--	1,722,350

Source: Waterborne Commerce of the United States - 1964

9. Chemical and petrochemical products have become the fourth largest commodity, in terms of tonnage, to move over the Port Aransas-Corpus Christi Waterway. The recent growth pattern of this commodity indicates that chemicals have the potential of becoming a major export item during the life of the proposed project. In 1955, 133,170 tons of chemical products were moved over the waterway, while the reported tonnage for 1964 was 414,733 tons, indicating an average annual increase of about 31,300 tons over a nine-year period.

10. Prospective commerce.- Studies were made of the factors affecting future trends of waterborne commerce, including the production of plant installations along the waterway. Other economic changes that could be expected in the future development of the area were also studied and are described in detail in exhibit 5, Economic Base Study. These studies indicate that petroleum and petroleum products will continue to be the principal commodity moved over the waterway, followed by the movement of ores, grains, and chemical products.

11. The total commerce on the Port Aransas-Corpus Christi Waterway in 1964 was 29,587,146 short tons, the highest recorded up to that time. The lowest total during the preceding 10 years was in 1958 when 21,744,814 short tons were moved. The 1964 commerce comprised 21,523,372 tons of foreign and coastwise shipments in ocean-going vessels and 8,063,774 tons of barge commerce, mostly through the Gulf Intracoastal Waterway. Of the ocean-going commerce, about 13.6 million tons were petroleum and petroleum products, about 1.7 million tons were in grain, 5.4 million tons in ores, and 0.4 million tons in chemical products. The remaining 0.4 million tons included a wide variety of commodities moved in small amounts. As discussed in the Economic Base Study, it is estimated that the movement of petroleum and petroleum products, ores, grains, and chemical products will sustain an aggregate average annual increase of about one percent over a project life of 50 years. On this basis, it is estimated that in the year 2025, about 40,600,000 tons of commerce will be moved in seagoing vessels, comprising 21.4 million tons of petroleum and petroleum products, 5.2 million tons of grain, 10.0 million tons of ores, and 4.0 million tons of chemicals. Table 6 of the Economic Base Study shows the projected tonnages of bulk commodities estimated to move in deep-draft vessels over the improved waterway throughout the life of the project. As indicated in tables B, C, and D, the present commerce in petroleum and petroleum products is virtually all coastwise to United States ports, while the commerce in ores and grains is virtually all to or from foreign ports. This pattern is not expected to change.

VESSEL TRAFFIC

12. General.- The determining factors relative to needs for increased channel dimensions are in the prospective use by the very large vessels engaged in bulk movement of petroleum, grain, ores, and chemicals. The pattern of use by tankers is representative of the vessel needs of all of the commodities. To evaluate these needs, a study of current trends in the construction of tank vessels was made to determine the composition of the existing tanker fleets to obtain data for estimates of the size changes that could be expected during the life of the proposed project. A summary of data obtained for both the United States and the world tanker fleets is given in exhibit 2. Following World War II, the rapidly increasing costs of construction and operation of tankers started a spectacular trend toward the construction and operation of larger and larger vessels. At the end

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of the war, the T-2 tanker rated at about 17,000 deadweight tons was considered large. As recently as 1953, the 45,000 tons "Tina Onassis" was still the largest tanker afloat. Now almost 500 vessels larger than the "Tina Onassis," and ranging up to the 209,000 dwt "Idemitsu Maru," are in service. Tankers of over 300,000 dwt are under construction. The eventual limit in increasing size is not apparent at this time, although some authorities suggest that the practical structural limits may be reached at about 500,000 dwt. Up to this time most of the very large tankers of over 75,000 dwt are planned to carry crude oil from the rich oilfields of the Middle East, Persian Gulf and South America to refining centers in Europe, the Far East, and the east coast of the United States. With repetitive runs between the same ports, these very large vessels probably will not be a critical factor in channel and harbor requirements for United States ports along the Gulf of Mexico, at least for some time to come. However, numerous vessels larger than 30,000 dwt are now serving Texas ports in coastwise trade and, although not operated to fully loaded capacity, vessels of 60,000 dwt or more are being used with some degree of regularity. The characteristics of both the U. S. Fleet and the World Fleet, will be considered in this appendix for evaluation purposes. The characteristics pertaining to U. S. registered vessels will be used to evaluate benefits attributable to the coastwise movement of petroleum and petroleum products and chemicals in domestic trade. The characteristics pertaining to foreign registered vessels will be used to evaluate benefits attributable to the movement of grain, chemicals, and ore in foreign trade.

13. World tanker fleet.- As shown on exhibit 2, the analysis of the world tanker fleet is based on 3,216 existing vessels aggregating over 83 million deadweight tons, and 261 vessels, aggregating almost 20 million dwt, under construction. At present, 9 vessels larger than 100,000 dwt are in operation and 47 more are under construction. Exhibit 2 further shows that there will be at least 890 tank vessels of 40,000 dwt or larger, and having loaded drafts of 36 feet or more, in the world tanker fleet in the near future. Based on the total number of vessels only about 4 percent of the existing world fleet have loaded drafts exceeding 41 feet, although about 73 percent of the vessels under construction will have loaded drafts greater than 41 feet. Of the 679 completed vessels exceeding 40,000 dwt, 653 are under foreign registry. The composition of the future World Tanker Fleet will continue to change; however, as discussed above, the extremely large vessels are not expected to use the Port Aransas-Corpus Christi Waterway with any degree of regularity. Vessels of up to 40,000 dwt can operate fully loaded on the existing waterway channels. Accordingly, for the purpose of evaluating the needs for increased channel dimensions, only the vessels in the 40,000 to 72,000 dwt group will be considered. The loaded draft of these vessels ranges from 36 feet to 44 feet. There are 485 existing vessels aggregating over 24 million deadweight tons within this range, and 61 additional vessels aggregating about 3.7 million dwt are under construction. Compared with total fleet smaller than 72,000 dwt, this increment represents about 15 percent of the existing total number of vessels and about 31 percent of the total aggregate tonnage. When the vessels under construction are

added, the increment between 40,000 and 72,000 dwt will then represent about 17 percent of the total number of vessels of 72,000 dwt or smaller and about 34 percent of total vessel tonnage in this category. It is expected that future construction of vessels will continue the trend of increasing size and that the average vessel size will continue to become larger as the older vessels of the fleet become unserviceable and are removed from service. During the life of the project it is estimated that vessels between 40,000 and 72,000 dwt will comprise about 50 percent of the vessels using the Port Aransas-Corpus Christi Waterway, with respect to total carrying capacity.

14. U. S. Tanker Fleet.- The 1964 U. S. Tanker Fleet had approximately 40 percent of its total tonnage in ships 20 years or older. Vessels in this category consist mostly of the T-2 tankers built during the early 1940's and which, by present tank vessel standards, are obsolete. It is expected that most of these vessels will be scrapped in the near future. With these tankers removed, the tonnage of tankers in the group of 40,000 to 110,000 dwt would comprise about 26 percent of total U. S. tonnage in the present fleet.

15. It is difficult to identify construction trends for tank vessels destined for the domestic coastwise trade. Sun Oil Company studies show that in 1954 the United Kingdom accounted for 35.3 percent of world tonnage of tank ship construction, while Japan accounted for 37.7 and 42.5 percent of world tank ship construction in 1963 and 1964, respectively. The United States' share of this shipbuilding for the same years was 2.7, 1.0, and .5 percent, respectively. It may be seen that lack of tank ship construction in United States yards has prevented accumulation of sufficient statistics upon which to base trend studies for coastwise tank vessel sizes. Conversely, construction in foreign yards is influenced by the large proportion of tank vessels of 80,000 dwt and over to the degree that size trends on the medium size tank vessels would be distorted. However, on the basis of harbor limitations, commodity movement requirements, operating characteristics, and unit transportation costs, it appears certain that the use of tank ships of 40,000 dwt and larger will steadily increase over the project life. With the larger tankers, seagoing movement of petroleum is fully competitive with large diameter pipeline transportation. According to the September 1964 issue of the Maritime Reporter, 66,700 ton tankers are being constructed "to challenge the tanker's chief competitor, the big pipeline." The steadily increasing size of vessels in the United States fleet is illustrated by the comparison of total tonnage in vessels of 27,000 dwt and larger to the total tonnage of all vessels in the fleet. In 1951 the 27,000 dwt and larger vessels represented 3.5 percent of the total fleet. By 1956 this had increased to 12 percent and by 1959 to 26 percent. In 1964 these vessels represented 49 percent of the total fleet. Exhibit 2 shows 26 tankers of 40,000 dwt or over in the 1964 U. S. fleet. With the obsolete T-2 tanker component removed, these vessels would represent about 26 percent of the existing fleet. As other older and smaller vessels

are removed from service and replaced by new and larger vessels, this percentage will continue to rise. Because of harbor limitations, however, it is believed that extremely large vessels of over 72,000 dwt will have only limited use in coastwise service and, thus, will not comprise an important segment of the U. S. fleet. For the purpose of this report, tankers of the United States fleet assumed to be in service over the project life are considered to be in the size distribution of the 40,000 to 72,000 dwt portion of the 1964 World Tanker Fleet and are estimated to comprise about 50 percent of the total U. S. fleet tonnage.

16. Port Aransas-Corpus Christi Waterway traffic.- Exhibit 3 shows the number of trips and drafts of vessels on the waterway for the year 1964. On the basis of loaded drafts, this exhibit shows that tankers are already crowding, and sometimes exceeding, the existing draft tolerances. Vessel drafts up to 36 feet presents no problems on the existing 40 foot channel; however, exhibit 3 shows that vessels with drafts greater than 36 feet transited the waterway 79 times during the year. Considering tanker drafts of 31 feet or greater to be representative of movements at fully loaded drafts, the 79 movements of vessels with drafts greater than 36 feet comprise about 16 percent of the total fully loaded movements. Exhibit 2 shows that less than 10 percent of the vessels in the present fleet have loaded drafts greater than 36 feet. Thus, it is evident that vessel operators are utilizing the existing channel to its draft limits. Ship owners have stated that larger ships will be put into service if adequate channel and harbor dimensions are provided for safe operation. These larger vessels would not depend on additional commerce, but would supplant or replace the smaller vessels to take advantage of lower ton-mile costs.

17. Channel to La Quinta traffic.- The major commerce moving over the Channel to La Quinta is bauxite ore. This commodity is imported from the Haiti-Jamaica area to the Reynolds Metals Company at La Quinta in ore carriers. Since this traffic is not wholly responsive to tank vessel trends or characteristics, it is considered necessary to evaluate the Channel to La Quinta separately. The presently authorized dimensions for this branch channel are 36 feet by 200 feet, which should accommodate vessels with drafts of up to 32 feet without difficulty. Table E shows the number of trips and drafts of vessels for calendar year 1964. Review of this table indicates that ore carriers with drafts exceeding 32 feet navigated the channel 79 times, representing about 41 percent of the total vessel trips.

18. Reynolds Metals Company, the only user of this channel, is presently receiving bauxite in two 33,000 dwt ore carriers which, because of limited depths on the existing project channel, generally are operated about 3 feet light loaded. This company has contracted for construction of a 52,000 dwt ore carrier with 40 feet loaded draft, to be placed in service in 1969. Officials have stated that another 52,000 dwt vessel will be put into service in 1975 if adequate channel and harbor dimensions

are provided for safe operation. These larger vessels would replace the smaller carriers, which would reach their amortization life of 20 years in 1975.

TABLE E

TRIPS AND DRAFTS OF VESSELS ON
LA QUINTA CHANNEL - C. Y. 1964

Draft (ft.)	Number of trips of vessels					
	Inbound			Outbound		
	Seagoing	Others	Total	Seagoing	Others	Total
35	63	-	63	-	-	-
34	-	-	-	-	-	-
33	5	-	5	11	-	11
32	-	-	-	-	-	-
31	4	-	4	6	-	6
30	-	-	-	2	-	2
29	-	-	-	-	-	-
28	-	-	-	-	-	-
27	3	-	3	4	-	4
26	-	-	-	-	-	-
25	-	-	-	-	-	-
24	-	-	-	2	-	2
23	-	-	-	-	-	-
22	-	-	-	62	-	62
21	11	-	11	6	-	6
20	9	-	9	2	-	2
19	-	-	-	-	-	-
18 & less	-	35	35	-	35	35
Totals	95	35	130	95	35	130

Source: Reynolds Metals Company Marine Division

BENEFITS

19. General.- The benefits that would accrue from the proposed improvements considered in this report would be obtained from savings in transportation costs, and a reduction in existing hazards to navigation. Benefits were evaluated on proposed project depths of 43, 45, and 48 feet. For illustration, computations relative to the 45-foot project are presented in detail in this appendix; however, the evaluation procedures used were identical in all three cases. The projected benefits for future

years were based on 1968 price levels. The projected future benefits were converted to an average annual equivalent benefit according to procedures contained in EM 1120-2-118, using an interest rate of 3-1/4 percent and a period of 50 years. The average annual equivalent benefits for the three depths studied are summarized in table P. The studies and procedures used to determine the benefits are described in the following paragraphs.

20. Cost of operation of vessels.- Estimated hourly operating costs, cargo capacities, and average operating speeds of several sizes of tankers and bulk cargo carriers in the United States and World Fleet were reviewed to obtain average transportation costs per ton of commerce moved. General cargo vessels were not included in this study, because, generally, these vessels operate with loaded drafts of less than 32 feet and can navigate the existing waterway without difficulty. Thus, no benefits would accrue to these vessels from additional improvements to the waterway. The general data relative to operating costs of vessels was obtained from the Transportation Economics Section of the Office, Chief of Engineers. The estimated hourly operating costs cover a 345-day annual operating season, allowing 20 days for repairs, special surveys, etc., which is considered to be standard operating practice. Operating costs are given for United States and foreign registered vessels and take into account such items as interest, depreciation, overhead, and vessel and voyage charges. The cargo capacity of individual vessels in the same tonnage group varies from vessel to vessel. However, for computation purposes it was considered sufficient to use an approximation that equates the average cargo capacity, in short tons, to the deadweight ton displacement of a vessel.

21. Adjusted hourly costs.- Data concerning the principal characteristics of representative types of tankers was furnished by OCE to aid in the economic evaluation of the waterway. These characteristics are typical for each class of vessels listed and are not applicable to any particular vessel. The vessels are listed in classes according to their deadweight tonnage. In order to compare costs between vessels, it was necessary to reduce all pertinent vessel data to a common base. This was accomplished graphically. First, the deadweight tonnage was plotted against the loaded draft, in feet, of the classes representing the world fleet. A line drawn through the mean of these points established a relation between deadweight tonnage and loaded draft. Next, the operating costs per hour at sea and the immersion factors for each class of vessels were similarly plotted against their respective deadweight ton capacities. This graphical analysis indicated that, within the deadweight tonnage limits being studied, the draft, immersion factor, and operating costs are all functions of the deadweight tonnage of a vessel. From the graphical analysis given above, the hourly cost and immersion factors at 17-knot speed for vessels with drafts increasing by one foot increments from 32 feet to 44 feet were determined and are shown in table F.

TABLE F

ADJUSTED HOURLY OPERATING COSTS AND IMMERSION FACTORS
OCEAN-GOING VESSELS WITH AVERAGE SPEED OF 17 KNOTS

D.W.T.	Draft (feet)	Hourly operating costs at sea: United States tankers	World tankers	World ore carriers	Immersion factor (long tons per inch of draft)
24,000	32	$231	$136	$137	95
27,500	33	244	143	144	103
31,200	34	255	151	151	112
35,000	35	267	158	157	121
40,000	36	280	167	162	130
43,000	37	292	177	169	139
47,000	38	304	187	175	148
51,000	39	315	196	182	156
55,000	40	327	204	191	164
59,000	41	338	211	200	171
63,000	42	348	217	210	179
67,000	43	360	223	219	186
72,000	44	370	229	226	193

22. Cost per ton.- The data in table F were used in computing the operating cost per ton on seagoing vessels fully loaded and light loaded. Cost per hour of vessels in port was assumed to be equal for all vessels and is not included in the data shown in table F since the differential operating cost would not be affected. It is also assumed that the hourly cost of operating a vessel one to five feet light loaded is the same as when fully loaded. The following computations for a 40,000 dwt tanker under American registry illustrates the method used for computing the cost per ton in moving petroleum from Corpus Christi to a port north of Cape Hatteras on the East Coast.

Cargo capacity = 40,000 short tons

Cost per hour = $280

Round trip distance = 4,000 nautical miles

Time at sea = 4,000 nautical miles ÷ 17 knots = 235.3 hrs

Cost per round trip = $280 x 235.3 = $65,884

Cost per ton fully loaded = 65,884 ÷ 40,000 = $1.65 per ton

Immersion factor = 130 long tons per inch of draft

Cost per ton loaded one foot light =

$$65{,}884 \div \left(40{,}000 - (130 \times 12 \times \frac{2240}{2000})\right) = \$1.72 \text{ per ton}$$

23. Petroleum and petroleum products.- Table G shows the computed cost per ton for movement of petroleum and petroleum products in coastwise trade. The costs are given for tankers of 40,000 to 72,000 dwt capacities in draft increments of 1 foot and for fully loaded and light loaded vessels. Estimates of costs were not prepared for foreign registered tankers moving petroleum since they account for less than one percent of total petroleum moved from this area. The average sailing distance between the Port Aransas-Corpus Christi Waterway and Atlantic seaboard ports north of Cape Hatteras is estimated at 4,000 nautical miles per round trip.

TABLE G

COST OF MOVING PETROLEUM IN TANKERS
COASTWISE TRADE

Size D.W.T.	Draft (feet)	Cost per short ton of cargo*								
		Fully loaded	1-foot light	2-feet light	3-feet light	4-feet light	5-feet light	6-feet light	7-feet light	8-feet light
40,000	36	$1.65								
43,000	37	1.60	1.67							
47,000	38	1.52	1.59	1.66						
51,000	39	1.45	1.52	1.58	1.66					
55,000	40	1.40	1.46	1.52	1.59	1.67				
59,000	41	1.35	1.40	1.46	1.53	1.60	1.67			
63,000	42	1.30	1.35	1.41	1.47	1.53	1.61	1.69		
67,000	43	1.26	1.31	1.36	1.41	1.48	1.54	1.62	1.70	
72,000	44	1.21	1.25	1.30	1.36	1.41	1.47	1.54	1.62	1.70

* Cost per ton based on average round trip distance of 4000 nautical miles

NOTE: Underlined costs are for maximum size of tanker considered operational in 45-foot channel at load-draft shown in column heading.

24. Tankers with drafts of 36 feet, or 40,000 dwt, can operate fully loaded on the authorized channel. Vessels up to 41-foot drafts, or 59,000 dwt, could operate fully loaded on the improved channel. Tankers with drafts of greater than 36 feet can operate on the existing channel but must be loaded light. The estimated savings in cost for operating tankers fully loaded instead of light loaded, obtained from table G, are shown in table H. The savings were weighted in accordance with the proportion of the deadweight tonnage of each tanker group to the combined deadweight tonnage of all tankers in the future United States fleet. As stated in paragraph 15, the future United States tanker fleet was assumed to have the same size distribution as the 40,000 dwt portion of the 1964 World tanker fleet. Table H shows the weighted average saving for the deadweight tonnage groups of tankers between 40,000 and 72,000 dwt.

TABLE H

WEIGHTED SAVINGS PER TON
PETROLEUM AND PETROLEUM PRODUCTS
COASTWISE TRADE

Tanker group D.W.T.	Project cost per ton: 40'	Project cost per ton: 45'	Differential savings per ton	Weight for cost comparison (percent)	Weighted savings (cents per ton)
40,000 to 43,000	1.67	1.60	$.07	17.7	1.2
43,000 to 47,000	1.66	1.52	.14	32.0	4.5
47,000 to 51,000	1.66	1.45	.21	19.8	4.2
51,000 to 55,000	1.67	1.40	.27	13.1	3.5
55,000 to 59,000	1.67	1.35	.32	7.9	2.5
59,000 to 63,000	1.69	1.35	.34	3.1	1.1
63,000 to 67,000	1.70	1.36	.34	2.9	1.0
67,000 to 72,000	1.70	1.36	.34	3.5	1.2
		TOTALS		100.0	19.2

25. It is estimated that 50 percent of the prospective seagoing petroleum commerce will move in tankers larger than 40,000 dwt during the life of the project. Tankers in this category are expected to comprise at least 50 percent of the fleet during the life of the proposed project and provide an average savings of 19.2 cents per ton. The benefits have been estimated on the basis of initial use of the improved project in the year 1975 and the projected commerce for that year and during a 50-year project life period thereafter. The derivation of the projected commerce for various years in the future is summarized in table 6 of the Economic Base Study. Pertinent data for selected years and the projected annual benefits that would accrue in these years are shown in table I. As discussed in paragraph 19, the projected future benefits were reduced to average annual equivalent benefits. The total average annual equivalent benefits from the movement of petroleum and its products in tankers larger than 40,000 dwt are estimated at $1,717,400. One-half of these benefits, or $858,700 annually, would be credited to the Port Aransas-Corpus Christi Waterway and the remainder would be credited to the Atlantic seaboard ports north of Cape Hatteras.

TABLE I

ANNUAL BENEFITS FOR SELECTED YEARS
PETROLEUM AND PETROLEUM PRODUCTS
COASTWISE TRADE

Year	Prospective annual commerce (tons)	Savings per ton	Annual benefits (1)
1975	16,000,000	$ .192	$ 3,072,000
1980	16,400,000	.192	3,148,800
2000	18,400,000	.192	3,532,800
2020	20,800,000	.192	3,993,600
2025	21,400,000	.192	4,108,800

(1) One-half creditable to Port Aransas-Corpus Christi Waterway.

26. Grains.- Approximately 98 percent of all grain shipments that moved over the Port Aransas-Corpus Christi Waterway during the period 1958 through 1964 were in foreign registered tanker vessels. These shipments were analyzed to determine their quantities and destinations. The results of this study are shown as exhibit 4 to this appendix. The study revealed that grain was exported from Corpus Christi to 41 countries, which could be grouped into six general geographic areas, Northern Europe, Mediterranean, Far East, South America, Gulf-Caribbean, and Africa. The countries in the Northern Europe area imported 63.4 percent of the total during the study period. The countries around the Mediterranean Sea accounted for 15.8 percent and the Far East area followed with 15.6 percent. The remaining three areas, South America, Gulf-Caribbean, and Africa, accounted for the remaining 5.2 percent. An average round trip haul distance from Corpus Christi to each of the six geographic areas was estimated. The average cost per ton for movement of grains was determined by relating the haul distance for each area with its total grain imports during the study period. The average round trip distance for all shipments was computed at 12,300 nautical miles. As discussed in Economic Base Study, it is assumed that the destination of future shipments of grain will follow generally the same patterns of distribution. Accordingly, the estimates of cost per ton for movement of grain during the life of the proposed project were based on a round trip distance of 12,300 nautical miles and the hourly operating costs shown on table F. Table J shows these computed costs, which are given for draft increments of one foot for fully loaded and light loaded tanker vessels.

TABLE J

COST OF MOVING GRAIN IN TANKERS
FOREIGN TRADE

Size D.W.T.	Draft (feet)	Cost per short ton of cargo*								
		Fully loaded	1-foot light	2-feet light	3-feet light	4-feet light	5-feet light	6-feet light	7-feet light	8-feet light
40,000	36	3.02								
43,000	37	2.98	3.11							
47,000	38	2.88	3.01	3.14						
51,000	39	2.78	2.90	3.03	3.17					
55,000	40	2.68	2.80	2.92	3.05	3.20				
59,000	41	2.59	2.69	2.81	2.93	3.06	3.21			
63,000	42	2.49	2.59	2.70	2.81	2.94	3.08	3.23		
67,000	43	2.39	2.49	2.59	2.69	2.81	2.94	3.08	3.23	
72,000	44	2.30	2.39	2.48	2.58	2.69	2.81	2.94	3.08	3.23

* Cost per ton based on average round trip distance of 12,300 nautical miles.

NOTE: Underlined costs are for maximum size of tankers considered operational in 45-foot channel at load-draft shown in column heading.

27. Table K shows a comparison of transportation costs per ton for vessels larger than 40,000 dwt operating light loaded on the existing 40-foot project and operating fully loaded on the proposed 45-foot project. The resulting differential savings from this comparison were weighted in proportion to the deadweight tonnage of each tanker group with the combined total deadweight tonnage for all groups. The weighted savings was computed at 39.1 cents per ton. Future grain commerce for the port of Corpus Christi has been estimated in the Economic Base Study to reach 5,200,000 tons per year in 1975, and to remain at that level throughout the project life of 50 years. It is estimated that 75 percent of this future commerce will move in tankers ranging from 40,000 to 72,000 dwt. On this basis, the average annual equivalent benefits for the movement of grain in the Port Aransas-Corpus Christi Waterway are estimated at $1,525,000. Half of these benefits, or $762,500 would be credited to this waterway and the other half would be credited to the receiving ports.

TABLE K

WEIGHTED SAVINGS PER TON
GRAIN-FOREIGN TRADE

Tanker group D.W.T.	Cost per ton: Existing 40' depth*	Cost per ton: Proposed 45' depth**	Differential savings per ton	Weight for cost comparison (percent)	Weighted savings (cents per ton)
40,000 to 43,000	$3.11	$2.98	$0.13	15.6	2.0
43,000 to 47,000	3.14	2.88	.26	27.8	7.2
47,000 to 51,000	3.17	2.78	.39	18.2	7.1
51,000 to 55,000	3.20	2.68	.52	13.9	7.2
55,000 to 59,000	3.21	2.59	.62	6.9	4.3
59,000 to 63,000	3.23	2.59	.64	12.1	7.7
63,000 to 67,000	3.23	2.59	.64	2.5	1.6
67,000 to 72,000	3.23	2.58	.65	3.0	2.0
			TOTALS	100.0	39.1

* Vessels operating light loaded.
** Vessels operating fully loaded.

28. Chemicals.- The movement of chemical and petrochemical products over the Port Aransas-Corpus Christi Waterway has been estimated to reach 4,000,000 tons in the year 2025. Waterborne commerce statistics for the period 1955 through 1964 show that an average of 53 percent of all chemical commerce in seagoing vessels has gone to foreign ports, and the remaining 47 percent has gone to ports along the Atlantic coast north of Cape Hatteras.

29. Foreign trade statistics furnished by the Department of Commerce for the period 1958 through 1964 were analyzed to determine quantities and destinations of chemicals leaving the port of Corpus Christi. As shown in exhibit 4, it was found that 32 different countries were receiving these chemicals. To arrive at a representative haul distance for the movement of this commodity, the receiving countries were grouped into six geographic areas, Northern Europe, Mediterranean Sea, South America, Far East, Gulf-Caribbean, and Africa. The countries in the Northern Europe area received 38.3 percent of the total chemical exports, followed by the

Mediterranean area with 30.8 percent and South America with 20.0 percent. The other three areas accounted for the remaining 10.9 percent. An average round trip haul distance from Corpus Christi to each of the six areas was estimated. The average cost per ton for movement of chemicals was determined by relating haul distance to each area to its share of total chemical commerce moved during the period. The weighted average round trip haul distance for all chemicals was computed at 11,470 nautical miles. As discussed in the Economic Base Study, it is expected that the destinations of future chemical exports from Corpus Christi will continue in the same pattern as that established during the past decade. The estimated costs per ton for movement of chemicals, based on the average round trip haul distance of 11,470 nautical miles and the hourly operating costs of tankers ranging from 40,000 to 72,000 dwt, set forth in table F, are shown in table L.

TABLE L

COST OF MOVING CHEMICALS IN TANKERS
FOREIGN TRADE

Size D.W.T.	Draft (feet)	Cost per short ton of cargo*								
		Fully loaded	1-foot light	2-feet light	3-feet light	4-feet light	5-feet light	6-feet light	7-feet light	8-feet light
40,000	36	2.82								
43,000	37	2.78	2.90							
47,000	38	2.68	2.80	2.93						
51,000	39	2.59	2.70	2.83	2.96					
55,000	40	2.50	2.61	2.72	2.84	2.98				
59,000	41	2.41	2.51	2.62	2.73	2.86	3.00			
63,000	42	2.32	2.41	2.52	2.62	2.74	2.87	3.01		
67,000	43	2.23	2.32	2.41	2.51	2.62	2.74	2.87	3.01	
72,000	44	2.15	2.23	2.31	2.41	2.51	2.62	2.74	2.87	3.01

* Cost per ton based on average round trip distance of 11,470 nautical miles.

NOTE: Underlined costs are for maximum size of tankers considered operational in 45-foot channel at load-draft shown in column heading.

30. Table M shows a comparison of transportation costs per ton for vessels larger than 40,000 dwt operating light loaded on the existing 40-foot project and operating fully loaded on the proposed 45-foot project. The differential savings between the costs on the existing and proposed projects were weighted in proportion to the deadweight tonnage of each group of tankers with the combined deadweight tonnage of all tankers in the 40,000 to 72,000 dwt class of the World Fleet.

TABLE M

WEIGHTED SAVINGS PER TON
CHEMICALS-FOREIGN TRADE

Tanker group D.W.T.	Cost per ton: Existing 40' depth*	Cost per ton: Proposed 45' depth**	Differential savings per ton	Weight for cost comparison (percent)	Weighted savings (cents per ton)
40,000 to 43,000	$2.90	$2.78	$0.12	15.6	1.9
43,000 to 47,000	2.93	2.68	.25	27.8	7.0
47,000 to 51,000	2.96	2.59	.37	18.2	6.7
51,000 to 55,000	2.98	2.50	.48	13.9	6.7
55,000 to 59,000	3.00	2.41	.59	6.9	4.1
59,000 to 63,000	3.01	2.41	.60	12.1	7.3
63,000 to 67,000	3.01	2.41	.60	2.5	1.5
67,000 to 72,000	3.01	2.41	.60	3.0	1.8
			TOTALS	100.0	37.0

* Vessels operating light loaded.
** Vessels operating fully loaded.

31. As discussed in the Economic Base Study, the movement of chemicals in foreign trade is expected to increase from 318,000 tons in 1975 to 2,120,000 tons by 2025. This commerce would move in foreign registered vessels ranging in size from 16,000 to 72,000 dwt. However, only those tankers with cargo capacities of 40,000 to 72,000 dwt would derive savings in transportation costs from the proposed improvements of the channel. The column headed "Supertanker Commerce" under foreign trade in table O, shows the projected tonnage to be moved by these vessels during the life of the proposed project. Based on these quantities and the estimated average savings of 37.0 cents per ton, the average annual equivalent benefits for movement of chemicals in foreign trade are estimated at

$93,800, of which one-half or $46,900 would be credited to the Port Aransas-Corpus Christi Waterway. The remaining one-half would be credited to receiving ports.

32. The coastwise movements of chemicals from Corpus Christi for the period 1955 through 1964 were almost all to ports along the Atlantic seaboard north of Cape Hatteras and this pattern is expected to prevail during the life of the project. The average round trip haul distance to this area is 4,000 nautical miles. Table N shows the costs per ton for the existing and proposed projects, based on hourly operating costs for United States registered tankers on a round trip haul distance of 4,000 nautical miles. The differential savings per ton between operating light loaded on the existing project and operating fully loaded on the proposed project were weighted in proportion to the deadweight tonnage of each group of vessels to the combined deadweight tonnage of all tankers in the future United States tanker fleet. The weighted average savings per ton was computed at 19.2 cents per ton.

TABLE N

WEIGHTED SAVINGS PER TON
CHEMICALS-COASTWISE TRADE

Tanker group D.W.T.	Cost per ton: Existing 40' depth*	Cost per ton: Proposed 45' depth**	Differential savings per ton	Weight for cost comparison (percent)	Weighted savings (cents per ton)
40,000 to 43,000	$1.67	$1.60	$0.07	17.7	1.2
43,000 to 47,000	1.66	1.52	.14	32.0	4.5
47,000 to 51,000	1.66	1.45	.21	19.8	4.2
51,000 to 55,000	1.67	1.40	.27	13.1	3.5
55,000 to 59,000	1.67	1.35	.32	7.9	2.5
59,000 to 63,000	1.69	1.35	.34	3.1	1.1
63,000 to 67,000	1.70	1.36	.34	2.9	1.0
67,000 to 72,000	1.70	1.36	.34	3.5	1.2
			TOTALS	100.0	19.2

* Vessels operating light loaded.
** Vessels operating fully loaded.

33. Coastwise movements of chemicals from Corpus Christi are estimated to increase from 282,000 tons in 1975 to 1,880,000 tons in 2025. This commerce would move in United States registered tanker vessels ranging in size from 16,000 to 72,000 dwt, although only those tankers with capacities of 40,000 to 72,000 dwt would realize savings in transportation costs from the proposed improvements to the channel. Based on these quantities and the estimated average savings of 19.2 cents per ton, the average annual equivalent benefits for this trade are estimated at $31,000, of which one-half or $15,500 would be credited to the Port Aransas-Corpus Christi Waterway and the other half would be credited to ports along the Atlantic seaboard north of Cape Hatteras.

34. Ores - Channel to La Quinta.- The benefits that would be derived from the proposed enlargement of the Channel to La Quinta would be a savings in the transportation cost of bauxite imported from the Haiti-Jamaica area. These savings would be realized through the use of larger and more economically operated vessels, discussed in paragraph 18.

35. The deposits of bauxite in the Haiti-Jamaica area are more than adequate for supply during the 50-year life period of the proposed project and no change in haul distance is anticipated. The round trip distance from Corpus Christi to this area averages 2,850 nautical miles. Based on this distance and the hourly operating costs for ore carriers shown in table F, the transportation costs per ton were computed for 33,000 and 52,000 dwt vessels. The transportation cost for the 33,000 dwt ore carriers light loaded 3 feet was computed at 93 cents per ton. The rate for a 52,000 dwt carrier when fully loaded was computed at 60 cents per ton.

36. The annual commerce and benefits accrued from savings in transportation costs of bauxite for selected years are shown in table O. These savings are estimated on the basis of future plans of the Reynolds Metals Company for operation of the plant on the La Quinta Channel. The average annual equivalent benefits computed from these annual savings are $2,028,400, of which one-half or $1,014,200 are credited to the Port Aransas-Corpus Christi Waterway and the other half credited to the Haiti-Jamaica ports.

TABLE O

ANNUAL BENEFITS FOR SELECTED YEARS
ORE TRADE
CHANNEL TO LA QUINTA

Year	Prospective annual commerce (tons)	Savings per ton	Annual benefits (1)
1975	4,400,000	$ .33	$ 1,452,000
1980	4,800,000	.33	1,584,000
2000	6,600,000	.33	2,178,000
2020	8,700,000	.33	2,871,000
2025	10,000,000	.33	3,300,000

(1) One-half creditable to Port Aransas-Corpus Christi Waterway.

37. Reduction in hazards to navigation.- Complete data are not available on the number and cost of accidents to navigation on the Port Aransas-Corpus Christi Waterway. Some incidents of groundings have been reported for the past few years; however, it is known that other incidents of more or less consequence have occurred and have not been reported. Review of exhibit 3 will show that 127 trips were made by vessels drawing 36 feet or more of water. Many of these trips are attempted or made with favorable stages of high tide. In some cases, however, the trips are made with less than optimum clearance between the vessel keel and the channel bottom. Under such conditions, vessels often do not handle well and shears and groundings result. It is estimated that about 13 to 15 such groundings occur annually, with damages averaging about $6000 from delay time and cost of repairs to vessels. The proposed deepening of the channel would eliminate most of these groundings and thus result in annual benefits totaling about $78,000. Based on traffic moving over the various waterway sements, about 25 percent of the total, or $19,500, should be credited to improvement of the Channel to Viola as annual benefits due to the reduction of hazards to navigation.

38. The Aransas-Corpus Christi Pilots report frequent difficulty with inbound loaded vessels approaching the Inner Basin at Harbor Island during ebbtides. The strong ebbtide currents from the Lydia Ann and Aransas Channels strike the approaching inbound ship on the starboard quarter, while the ebbtide current from the Corpus Christi Channel strikes the ship on the port bow, with the resultant forces tending to cause the vessel to sheer to the right towards the wharves on Harbor Island. This situation is particularly hazardous when large tankers are moored at Humble's #1 Oil Dock. On occasion loaded vessels must drop anchor to avoid

collision at this point. The hazardous condition is somewhat less with a floodtide; nevertheless, this portion of the channel must be navigated with extreme caution. Although no severe accident has occurred at this location up to this time, the possibility exists that a collision involving tank vessels loaded with highly volatile petroleum products could result in a major disaster with heavy loss of lives and damages ranging into the millions of dollars. It is estimated that an average of about 10 bank scrappings occur annually due to vessels hugging the south bank in an effort to counteract the ebbtide currents, with an average damage cost of $2000 per incident. The proposed widening at this location would eliminate these damages and result in annual benefits of about $20,000.

39. Outbound heavily loaded tankers often encounter difficulty in navigating the southeast end of Tule Lake Turning Basin where it narrows to a channel width of 200 feet. Pilots report that loaded vessels often sheer to the right in this area due to the unequal pressures on their sides and that about 40 percent rub the bank. Although damages to these vessels have not been extensive because of the soft mud banks, minor repairs and more frequent repainting of the ship's hull must be made. It is estimated that each of these incidents averages about $1000 in damages to the ship. Based on an average of about 26 such incidents annually, the proposed widening of the channel at this point would eliminate these damages and result in annual benefits totaling about $26,000.

40. Reynolds Metals Company has furnished data showing costs of delay time and bottom damage repairs to its vessels resulting from groundings in the Channel to La Quinta. The average annual damages for the period December 1957 through March 1964 are reported at $18,000. The difficulties are encountered mainly on the exit curve from the main waterway channel to the La Quinta and on the curve approaching the turning basin. The problems are caused by inadequate channel widths and depths for the large vessels now using the channel. It is estimated that the proposed widening and deepening of this channel will eliminate the hazards of grounding and bank scrapping and result in annual benefits of $18,000.

41. The existing project is satisfactory for two-way traffic of 36-foot draft vessels with 94 feet beams, one loaded and one light. However, larger vessels have been calling at this port with increased frequency. The meeting of such vessels is considered as hazardous and the waterway pilots have adopted a "no-meeting" policy for 2 large vessels on the existing 400 feet wide channel. As a result, on occasion, one such vessel must standby while another one clears the waterway. This delay time is usually about three hours and occurs on an average of about twice a month. An extensive study of vessel movements indicated that the portion of waterway between Harbor Island and Channel to La Quinta was the most heavily traveled by the large vessels and most of the delay time incidents occurred in this reach. The provision of 45-foot depth and minimum 500 feet channel width in the main channel as far inland as the La Quinta Channel would eliminate these delay time losses and result in annual benefits of $24,300.

42. Land enhancement.- The designated spoil disposal areas for the proposed deepening of the Port Aransas-Corpus Christi Waterway are shown on plates 2 through 5 of the text. These areas are owned by Nueces County Navigation District and have been designated as spoil disposal areas for all future new construction and maintenance dredging. Present elevations on these areas vary from 5 feet below MLT to 5 feet above MLT. The designated spoil areas will be required for disposal of spoil for the foreseeable future and no change in land use is expected to occur during the project life of the proposed improvements. Thus no land enhancement benefits will accrue from deposit of the spoil.

43. Summary of benefits.- The estimated average annual equivalent benefits accrued from savings in transportation costs and a reduction in hazards to navigation for the investigated 43, 45, and 48 foot projects are shown in table P. These benefits were estimated separately for 3 main segments of the waterway as follows: Outer Bar Channel through Tule Lake Channel, Channel to Viola, and Channel to La Quinta.

TABLE P

AVERAGE ANNUAL EQUIVALENT BENEFITS

	Type of Benefits	Bar Channel to Tule Lake Turning Basin	Channel to Viola	Channel to La Quinta	Total Waterway
43-Foot Project	Savings in Transportation Costs				
	(1) Petroleum & Petroleum Products	$ 637,400	$100,600		$ 738,000
	(2) Chemicals				
	Coastwise Trade	13,400			13,400
	Foreign Trade	38,300			38,300
	(3) Grain	627,900			627,900
	(4) Ores			$ 952,700	952,700
	Reduction in Hazards to Navigation	102,800	45,500	18,000	166,300
	TOTALS	$1,419,800	$146,100	$ 970,700	$2,536,600
45-Foot Project	Savings in Transportation Costs				
	(1) Petroleum & Petroleum Products	$ 741,600	$117,100		$ 858,700
	(2) Chemicals				
	Coastwise Trade	15,500			15,500
	Foreign Trade	46,900			46,900
	(3) Grain	762,500			762,500
	(4) Ores			$1,014,200	1,014,200
	Reduction in Hazards to Navigation	102,800	45,500	18,000	166,300
	TOTALS	$1,669,300	$162,600	$1,032,200	$2,864,100
48-Foot Project	Savings in Transportation Costs				
	(1) Petroleum & Petroleum Products	$ 776,500	$122,500		$ 899,000
	(2) Chemicals				
	Coastwise Trade	16,300			16,300
	Foreign Trade	49,800			49,800
	(3) Grain	813,200			813,200
	(4) Ores			$1,014,200	1,014,200
	Reduction in Hazards to Navigation	102,800	45,500	18,000	166,300
	TOTALS	$1,758,600	$168,000	$1,032,200	$2,958,800

REVIEW OF REPORTS ON
PORT ARANSAS-CORPUS CHRISTI WATERWAY, TEXAS
COMMERCIAL STATISTICS FOR 1964

Section included: Gulf of Mexico to turning basins at Corpus Christi, at Avery Point, near Tule Lake, and at Viola, Tex., about 32 miles; branch channel to La Quinta, about 6 miles; channel to Port Aransas, about 0.4 mile. Controlling depth: December 1964, bar channel, 44 feet; bay channel, 34 feet; to Avery Point, 37 feet; to vicinity Tule Lake, 36 feet; to Viola, 39 feet; to La Quinta, 32.5 feet; to Port Aransas, 11 feet. Project depth: Bar channel, 42 feet; remainder of project, 40 feet, except Port Aransas channel, 12 feet, and Branch Channel to La Quinta, 36 feet, mean low tide.

Comparative statement of traffic

Year	Tons (excluding duplications)	Passengers	Year	Tons (excluding duplications)	Passengers
1955	24,330,003	226	1960	24,840,443	208
1956	25,145,430	228	1961	26,760,121	440
1957	23,176,415	378	1962	26,188,418	265
1958	21,744,814	150	1963	28,045,194	317
1959	24,112,415	293	1964	29,587,146	328

Consolidated statement of waterborne commerce for the Port Aransas-Corpus Christi Waterway, Tex.
(Corpus Christi and Harbor Island, Tex.)

Freight traffic, 1964

(Short tons)

	Commodity	Total	Foreign		Domestic				
			Imports	Exports	Coastwise		Internal		Local
					Receipts	Shipments	Receipts	Shipments	
	Total	29,587,146	5,190,160	2,391,686	88,176	13,853,350	2,213,100	5,476,661	374,013
010	Meat and products, fresh	21	---	21	---	---	---	---	---
033	Condensed and evaporated milk	2	---	2	---	---	---	---	---
035	Dried milk	11,941	---	11,941	---	---	---	---	---
040	Fish and products, fresh	42	---	---	---	---	---	42	---
047	Fish and prod incl canned nec	33	33	---	---	---	---	---	---
049	Shellfish and products	6	---	6	---	---	---	---	---
094	Shells, unmanufactured	271,111	---	---	---	---	---	136,703	134,408
098	Animal products, inedible, nec	31	---	31	---	---	---	---	---
100	Corn	775	---	775	---	---	---	---	---
103	Wheat	600,294	---	600,294	---	---	---	---	---
104	Oats	25	---	25	---	---	---	---	---
107	Wheat flour	48,616	---	48,616	---	---	---	---	---
108	Grain sorghums	1,046,608	---	1,046,608	---	---	---	---	---
109	Flour, flour-grain prep, nec	23,611	---	23,611	---	---	---	---	---
110	Animal feeds, nec	2,421	---	2,421	---	---	---	---	---
123	Vegetables and prep, canned	2	---	2	---	---	---	---	---
127	Vegetables and prep, nec	27,292	---	27,260	---	32	---	---	---
185	Molasses, sugar prod, edible	25,155	---	8,077	---	17,078	---	---	---
190	Liquors and wines	334	334	---	---	---	---	---	---
205	Rubber tires and inner tubes	56	---	56	---	---	---	---	---
207	Rubber manufactures, nec	4	1	3	---	---	---	---	---
232	Flaxseed	37,426	---	37,426	---	---	---	---	---
240	Oils, fats, waxes, veg, crude	1,280	---	---	---	1,280	---	---	---
260	Seeds, except oilseeds	4	4	---	---	---	---	---	---
290	Molasses, inedible	29,054	29,054	---	---	---	---	---	---
297	Vegetable prod, inedible, nec	6	3	3	---	---	---	---	---
300	Cotton, unmanufactured	78,067	---	78,067	---	---	---	---	---
320	Cotton manufactures	2	---	2	---	---	---	---	---
326	Sisal, henequen, jute, unmfr.	12	---	12	---	---	---	---	---
390	Textile products, nec	17	17	---	---	---	---	---	---
413	Lumber and shingles	3	---	3	---	---	---	---	---
421	Wood manufactures, nec	1	1	---	---	---	---	---	---
445	Paper base stocks, nec	165	---	165	---	---	---	---	---
450	Standard newsprint paper	4,079	2,581	---	---	---	1,498	---	---
475	Paper and mfrs, nec	4	---	4	---	---	---	---	---

EXHIBIT 1
APPENDIX II

REVIEW OF REPORTS ON
PORT ARANSAS-CORPUS CHRISTI WATERWAY, TEXAS
COMMERCIAL STATISTICS FOR 1964

Consolidated statement of waterborne commerce for the Port Aransas-Corpus Christi Waterway, Tex. (Corpus Christi and Harbor Island, Tex.)--Continued

Freight traffic, 1964--Continued

(Short tons)

	Commodity	Total	Foreign		Domestic				
			Imports	Exports	Coastwise		Internal		Local
					Receipts	Shipments	Receipts	Shipments	
507	Gasoline	3,535,903	---	---	37,548	2,937,720	194,689	362,854	3,092
510	Gas oil, distillate fuel oil	3,666,726	---	---	---	3,393,808	190,739	25,734	56,445
511	Petroleum, crude	9,834,144	---	---	---	6,407,441	1,420,730	1,977,764	28,209
512	Jet fuel, all types	17,262	---	---	---	17,262	---	---	---
513	Kerosene	382,149	---	---	---	345,168	13,171	22,476	1,334
514	Residual fuel oil	404,849	55,292	11,936	---	126,998	66,984	87,290	56,349
516	Petroleum asphalt	6,772	---	---	---	---	6,772	---	---
518	Aliphatic naphtha	239,961	---	13,660	---	68,674	56,880	96,951	3,796
519	Lubricating oils and greases	43,767	---	330	19,364	22,455	1,618	---	---
520	Petroleum products, nec	138,753	---	---	---	1,941	68,564	46,327	21,921
522	Natural gasoline	156,850	---	---	---	141,058	---	15,792	---
523	Building cement	3,386	---	---	---	---	3,386	---	---
526	Stone and mfrs, nec	558	---	8	---	---	---	550	---
530	Glass and glass products	562	562	---	---	---	---	---	---
540	Clays and earths	26	---	26	---	---	---	---	---
547	Clay products, nec	2	2	---	---	---	---	---	---
555	Nonmetallic minerals, mfrs nec	11,337	11,064	273	---	---	---	---	---
602	Iron and steel scrap	12	---	12	---	---	---	---	---
603	Iron, steel semifinished prod	2,278	1,663	---	---	---	615	---	---
606	Tools and basic hardware	289	285	4	---	---	---	---	---
608	Iron and steel pipe	31,584	6,611	99	---	---	24,874	---	---
609	Rolled, finished stl mill prod	24,487	21,029	142	---	---	2,564	752	---
611	Metal mfrs, parts nec exc SCi	56	---	56	---	---	---	---	---
612	Metal mfrs and parts, nec	42	42	---	---	---	---	---	---
613	Manganese	1,211	---	---	---	---	1,211	---	---
614	Chrome	41,551	41,551	---	---	---	---	---	---
617	Aluminum ores, concent., scrap	7,639,826	4,874,441	199,611	---	260,929	---	2,304,845	---
618	Aluminum metal and alloys	23,232	224	21,323	---	---	486	1,199	---
620	Copper ore, concent., scrap	919	---	919	---	---	---	---	---
632	Copper alloy forms and scrap	1,291	---	1,291	---	---	---	---	---
640	Lead ores, concent., and scrap	69,685	68,634	1,051	---	---	---	---	---
642	Lead and alloys	880	---	880	---	---	---	---	---
652	Nickel ore, concent., scrp, fms	56	---	56	---	---	---	---	---
670	Zinc ore, concent., and scrap	61,275	39,371	---	---	---	---	21,904	---
672	Zinc forms	33,033	1,120	83	---	167	2,083	29,580	---
682	Nonfer ores, metls, scrap, nec	50	---	50	---	---	---	---	---
690	Precious metals and mfrs	1	1	---	---	---	---	---	---
701	Electrical machinery exc SCi	45	---	45	---	---	---	---	---
710	Engines, turbines, parts, nec	17	---	17	---	---	---	---	---
722	Const., mining mach., parts	230	---	230	---	---	---	---	---
730	Metalworking machinery, parts	3	3	---	---	---	---	---	---
731	Metalworking mach, pts exc SCi	4	---	4	---	---	---	---	---
742	Industrial mach., parts, nec	125	---	25	---	---	---	100	---
745	Machinery, parts nec exc agri	6	6	---	---	---	---	---	---
770	Agricultural mach., parts	65	---	17	---	---	48	---	---
781	Motor vehicles exc. SCi	4	---	4	---	---	---	---	---
782	Motor vehicle parts	2	2	---	---	---	---	---	---
783	Watercraft and parts	146	---	---	---	---	146	---	---
785	Watercraft and parts exc. SCi	77	---	77	---	---	---	---	---
787	Motor vehicles parts exc. SCi	28	---	28	---	---	---	---	---
790	Aircraft and parts	50	---	---	---	---	---	---	50
796	Vehicles and parts, nec	4	---	4	---	---	---	---	---
801	Crude and refined coal tar	2,534	---	---	---	---	2,534	---	---
802	Benzol or benzene	195,022	---	20,429	---	2,867	---	170,232	1,494
805	Other coal tar products	217,285	---	---	---	55,980	72,894	85,141	3,270
806	Other coal tar prod exc. SCi	92,415	---	92,415	---	---	---	---	---
810	Medicines and preparations	4	---	4	---	---	---	---	---
825	Sulphuric acid	52,021	---	---	---	---	---	52,021	---
826	Alcohols	56,564	---	22,770	---	24,287	5,669	3,838	---
827	Sodium hydroxide, caustic soda	125,688	---	11,606	---	38	53,919	---	60,125
828	Other ind chem, exc. SCi	76,294	---	76,294	---	---	---	---	---

Consolidated statement of waterborne commerce for the Port Aransas-Corpus Christi Waterway, Tex. (Corpus Christi and Harbor Island, Tex.)--Continued

Freight traffic, 1964--Continued

(Short tons)

	Commodity	Total	Foreign		Domestic				
			Imports	Exports	Coastwise		Internal		Local
					Receipts	Shipments	Receipts	Shipments	
829	Industrial chemicals, nec	78,271	46	---	31,264	28,161	13,661	5,139	---
837	Synthetic resins	1,539	---	1,539	---	---	---	---	---
844	Chemical specialties, nec	40	---	40	---	---	---	---	---
845	Carbon black	852	---	852	---	---	---	---	---
846	Chemical specialties, nec	9,791	---	---	---	---	---	9,791	---
847	Pigments, paints, varnishes	55	---	55	---	---	---	---	---
848	Pigments, paints, varnishes	55,613	35,977	---	---	---	---	19,636	---
851	Other nitrogenous fert, mat	317	---	317	---	---	---	---	---
865	Soap and toilet preparations	1	---	1	---	---	---	---	---
900	Commodities, nec	8	2	---	---	6	---	---	---
901	Commodities, nec, exc. SCi	2	---	2	---	---	---	---	---
920	U. S. articles returned	204	204	---	---	---	---	---	---
925	Water	10,680	---	---	---	---	7,320	---	3,360
926	Ice	205	---	---	---	---	45	---	160
980	Low-valued shipments	115	---	*115	---	---	---	---	---
999	Department of Defense and SCi	27,555	---	27,555	---	---	---	---	---
	Total ton-miles, 450,993,146.								

* The error due to sampling is between 20 and 27 percent.

EXHIBIT 2
APPENDIX II

COMPOSITION OF UNITED STATES AND WORLD TANKER FLEETS
DECEMBER 1964

Draft in feet	U. S. Tanker Fleet			World Tanker Fleet			Approx-imate average D.W.T.	Under construction World Fleet		
	No.	Tons per group	Percent of total	No.	Tons per group	Percent of total		No.	Tonnage	Percent of total
13 to 20	2	8,200	.1	133	516,000	.6	3,900			
20 to 25	2	9,800	.1	141	826,600	1.0	5,900			
25 to 30	11	142,000	2.1	443	5,807,200	7.0	13,100	8	83,500	.4
30	122	2,136,100	31.7	777	13,630,600	16.4	17,500	7	103,600	.5
31	9	191,800	2.8	280	5,518,300	6.6	20,200	20	389,900	2.0
32	38	939,900	13.9	216	5,100,900	6.1	24,000	11	244,800	1.3
33	24	660,900	9.8	137	3,714,600	4.5	27,500			
34	37	1,116,900	16.6	208	6,472,100	7.8	31,200	1	33,000	.2
35	8	249,600	3.7	202	6,603,700	7.9	35,000	3	108,200	.6
36	0	0	-	129	4,948,500	6.0	40,000			
37	6	234,800	3.5	102	4,323,400	5.2	43,000	1	42,700	.2
38	10	474,700	7.1	164	7,799,100	9.4	47,000			
39	5	246,900	3.7	94	4,824,600	5.8	51,000	6	291,500	1.5
40	1	66,700	1.0	56	3,180,100	3.8	55,000	13	707,100	3.6
41	0	0	0.0	35	1,920,500	2.3	59,000			
42	2	91,000	1.3	12	752,400	.9	63,000	41	2,638,600	13.5
43	0	0	-	10	709,400	.9	67,000			
44	1	67,200	1.0	12	849,200	1.0	72,000			
45	0	0	-	11	810,100	1.0	76,500	54	4,065,800	20.9
46	0	0	-	17	1,386,500	1.7	81,500	20	1,659,000	8.5
47	0	0	-	13	1,127,500	1.4	87,000			
48	0	0	-	15	1,364,700	1.6	93,000	29	2,681,300	13.8
49	1	108,400	1.6	6	608,500	.7	100,000			
50	0	0	-	1	79,800	.1	110,000	23	2,529,900	13.0
51	0	0	-	1	115,400	.1	115,000			
52	0	0	-	0	0	-				
53	0	0	-	0	0	-				
54	0	0	-	1	130,200	.2	130,000	5	683,000	3.5
55 & Over	0	0	-	0	0	-		19	3,221,100	16.5
Totals	279	6,744,900	100.0	3216	83,119,900	100.0		261	19,483,000	100.0

Source: Analysis of World Tank Ship Fleet, Sun Oil Company, Economics Dept., 1964

REVIEW OF REPORTS ON
PORT ARANSAS-CORPUS CHRISTI WATERWAY, TEXAS
TRIPS AND DRAFTS OF VESSELS FOR 1964

Trips and drafts of vessels

Draft (feet)	Inbound						Outbound						
	Self propelled vessels			Non-self propelled vessels		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		
39								3					3
38		1				1		44					44
37								31					31
36	18	1				19	1	28					29
35	89	4				93	2	80					82
34	11	3				14	7	67					74
33	8	4				12	11	50					61
32	10	8				18	22	80					102
31	9	15				24	15	87					102
30	7	12				19	27	20					47
29	11	15				26	23	9					32
28	14	11				25	16	14					30
27	20	12				32	23	10					33
26	12	10				22	22	8					30
25	32	24				56	23	6					29
24	22	44				66	24	10					34
23	27	65				92	26	5					31
22	34	69				103	90	9					99
21	31	68				99	59	4					63
20	31	95				126	50	3					53
19	37	99				136	29	3					32
18 and less	282	108	2,901	2,573	3,289	9,153	253	48	2,904	2,726	3,240	2	9,173
Total	705	668	2,901	2,573	3,289	10,136	723	619	2,904	2,726	3,240	2	10,214
Total net register tonnage	3,563,745	6,618,016	221,728	1,851,676	2,216,680	14,471,845	3,623,191	6,070,943	200,550	2,000,670	2,249,170	60	14,144,584
Passengers						210							118

EXHIBIT 3
APPENDIX II

GRAIN EXPORTS FROM CORPUS CHRISTI 1958-1964

Geographical area (1)	Tonnage (2) (short tons)	Sailing distance (3) nautical miles	Ton-miles
Northern Europe	5,541,365	5280	29,258,407,200
Mediterranean	1,380,971	6616	9,136,504,136
Far East	1,363,490	9882	13,474,008,180
South America	332,132	5127	1,702,840,764
Gulf-Caribbean	104,884	916	96,073,744
Africa	17,481	6067	106,057,227
Totals	8,740,323		53,773,891,251

Avg. Distance = 53,773,891,251 ÷ 8,740,323 = 6150 nautical miles

Round Trip Average Sailing Distance = 12,300 nautical miles

CHEMICAL EXPORTS FROM CORPUS CHRISTI 1958-1964

Geographical area (1)	Tonnage (2) (short tons)	Sailing distance (3) nautical miles	Ton-miles
Northern Europe	415,673	5254	2,183,945,942
Mediterranean	334,051	5823	1,945,178,973
South America	217,405	5679	1,234,642,995
Far East	82,442	9381	773,388,402
Gulf-Caribbean	25,125	571	14,346,375
Africa	10,877	6804	74,007,108
Totals	1,085,573		6,225,509,795

Avg. Distance = 6,225,509,795 ÷ 1,085,573 = 5735 nautical miles

Round Trip Average Sailing Distance = 11,470 nautical miles

(1) Obtained from Form SA-705, Dept. of Commerce
(2) Obtained from "Waterborne Commerce of the United States"
(3) Obtained from H.O. 117, Table of Distances Between Ports, U. S. Navy Dept.

EXHIBIT 4
APPENDIX II

REVIEW OF REPORTS

ON

PORT ARANSAS-CORPUS CHRISTI WATERWAY, TEXAS

(45-FOOT PROJECT)

ECONOMIC BASE STUDY

EXHIBIT 5
APPENDIX II

REVIEW OF REPORTS
ON
PORT ARANSAS-CORPUS CHRISTI WATERWAY, TEXAS
(45-FOOT PROJECT)

ECONOMIC BASE STUDY

TABLE OF CONTENTS

REVIEW OF REPORTS
ON
PORT ARANSAS-CORPUS CHRISTI WATERWAY, TEXAS
(45-FOOT PROJECT)

1. Purpose and scope.- This economic base study is presented as an exhibit to the economic appendix prepared to determine the economic feasibility of proposed improvements to the Port Aransas-Corpus Christi Waterway. This exhibit will develop the historical and projected growth of the standard indicators and others found to be related to the use of this waterway.

2. General.- The Port Aransas-Corpus Christi Waterway is a channel providing access for ocean traffic from the Gulf of Mexico to the port facilities in the vicinity of Corpus Christi, Texas. Entrance to the waterway from the Gulf of Mexico is provided by Aransas Pass, a pass between two barrier islands paralleling the Texas Coast.1/ The northernmost of these barriers is Saint Joseph Island, and the southernmost is Mustang Island with its small resort and fishing city of Port Aransas.

3. A recently completed deepwater channel improvement project has provided this waterway with a channel depth of 40 feet extending from the Aransas Pass Jetty Channel to the Viola Turning Basin in the harbor of Corpus Christi. This improved waterway has a length of about 28 miles. The deepening of the existing channel from 36 feet to 40 feet except at the Gulf of Mexico Entrance Channel, where the channel depth was increased from 38 feet to 42 feet, was the result of a study published in House Document Number 361, 2d Session, 85th Congress. The improved Port Aransas-Corpus Christi Waterway now has channel depths and widths unsurpassed by any harbor on the Texas Gulf Coast. These channel dimensions are comparable to the presently authorized dimensions of the Sabine-Neches Waterway, the Houston Ship Channel, and the Texas City Channel serving other major petroleum seaports of the Texas Coast at Port Arthur, Houston, and Texas City. An investigation now in progress will consider the current requirements for comparable channel dimensions at Freeport, Texas.

4. After the opening of the improved Port Aransas-Corpus Christi Waterway, the S.S. Manhattan, a tank ship rated at 108,950 deadweight tons, sailed from the port of Corpus Christi with a load of grain for Pakistan. The Manhattan sailed partially loaded because, even though full advantage was taken of tide, overdepth, and first year maintenance of the recently improved channel, the vessel could not be loaded beyond a draft of 41 feet forward and 40 feet aft to negotiate the improved channel safely.

5. Although the S. S. Manhattan is not representative of the average tank ship presently using the Gulf Coast ports, it is also not unique as there are six tank ships in service rated at over 100,000 deadweight tons.[2] There are, in addition, about 550 tank ships of over 40,000 deadweight tons in the world fleet which would be unable to sail fully loaded using the present 40-foot channel.

6. The rapid increase in the demand for petroleum and its products since the close of World War II has imposed greater requirements for transportation of these materials from points of origin and processing to points of consumption. This increased volume of materials to be moved in conjunction with rapidly mounting labor and operating costs, for the several modes of transportation, have resulted in the construction of more and larger pipelines, larger tank ships, more barges, larger railway tank cars, and larger tank trucks.

7. The trend towards larger ships may be readily seen in a statistical review of vessels presently under construction in the world's shipyards. A report published in February 1966[3] showed that six tank vessels each of greater than 100,000 deadweight tons were under construction in German and Japanese shipyards at the time of publication. Three of the four vessels under construction in Germany were 170,800 deadweight tons each and the fourth was 151,800 deadweight tons. The two ships being built in Japan were 150,000 and 144,000 deadweight tons. In addition to these giant vessels, 28 tankers, 9 ore, bulk or oil carriers, and 10 ore or bulk carriers between 40,000 and 100,000 deadweight tons were under construction in various shipyards around the world.

8. From the high percentage of tank ships building it can be seen that the industry expects continued high requirements for movement of petroleum and its products for the foreseeable future. The numbers and sizes of the bulk and ore carriers under construction, indicate the increasing roles played by grain and ores in waterborne commerce.

9. An analysis of the cargoes handled at the various installations of the port of Corpus Christi in 1964[4] shows that about 62 percent of all cargoes were related to petroleum and its products, about 26 percent to ores and concentrates, and about 6 percent to grain. The three major categories of petroleum and products, ores and minerals, and grain together accounted for over 94 percent of the 29,587,146 tons handled at the port installations of Corpus Christi in 1964. The present traffic in chemicals, though comparatively small, shows promise of future growth. The deep-draft tonnage in bulk chemicals increased by over two-thirds between 1955 and 1959, inclusive, and a little more than doubled between 1959 and 1964. The increasing diversion of crude petroleum and natural gas into chemical industry feed stocks and the entry of the products into domestic and foreign trade should ultimately more than compensate for the deep-draft tonnages lost by the petroleum refining industry.

The chemical industry is producing large amounts of fertilizers and other bulk chemicals each year in response to increasing world demand. It is also probable that expanding markets and the development of new chemical products, which have marked the rapid expansion of the petrochemical industry during recent years, will continue and that large volumes of future commerce will be generated by this industry.

10. Cities and SMSA's.- The Corpus Christi Standard Metropolitan Statistical Area5/consists of Nueces and San Patricio Counties, Texas, an area of about 1,518 square miles. The estimated 1965 population of the SMSA is 279,400 persons of whom about 193,900 live within the city limits of Corpus Christi. The expansion of the SMSA from Nueces County alone to both Nueces and San Patricio Counties was made in 1965. The city of Corpus Christi is the seventh city in size in Texas according to the 1960 census of population6/ and the seventy-fourth in the United States. Corpus Christi, a trading post known as Kinney's Ranch at the time of the Mexican War, derived its present name from Corpus Christi Bay when the city was incorporated in 1852. The city's first census in 1860 showed 175 persons, and this number increased slowly to 10,522 by the 1920 census. The opening of the port in 1926 and the opening of the first large industrial plant in 1934 ushered in a period of rapid growth that has continued to the present.7/

11. Industrial development.- The discovery of petroleum and natural gas in south Texas made Corpus Christi, by virtue of its deep-water navigation facilities and its supply of industrial water, a natural location for petroleum refineries. The Delhi-Taylor Oil Corporation refinery, later sold to the Hess Oil and Chemical Corporation, was built in 1934 on land served by the Corpus Christi Main Harbor.8/ The increasing discoveries and supply of crude petroleum and the demands for petroleum products imposed by World War II resulted in the location of several additional petroleum refineries along the various harbor reaches. The postwar demands for petroleum increased rather than diminished and, in 1952 the Suntide Refinery, Corpus Christi's largest, was put "on stream."9/

12. A study of petroleum refineries showed that the Corpus Christi refineries increased their total refining capacities from a total of 210,000 barrels of crude petroleum per day in 1956 to 239,500 barrels per day in 1965.10/ The total daily increase of about 23,000 barrels represents an increase of about 10.6 percent for the decade. According to the Annual Analysis of the Petroleum Industry,11/ published by the Petroleum Department of the Chase Manhattan Bank, the United States consumption of energy from all sources increased by about 1.8 percent between 1960 and 1961. Petroleum supplied about 44.6 percent of the total energy used in this country in 1961, and the consumption of petroleum increased by about 1.1 percent over the previous year. This percentage increase in consumption was about the same as the average percentage increased in refinery capacity in Corpus Christi during the 10-year period from 1956 to 1965, inclusive.

13. Petroleum commerce.- Studies of petroleum commerce on the Port Aransas-Corpus Christi Waterway as reported in Waterborne Commerce of the United States for the years 1955, 1959, and 1964, representing the latest 10-year period for which statistics are available, reveal a decline in annual tonnage of deep-draft petroleum commerce of 5,546,334 short tons between 1955 and 1964. Most of this loss occurred in deep-draft crude petroleum shipments where a diminution of 5,235,811 tons was reported between 1955 and 1964. Tonnages of petroleum products shipped in deep-draft vessels remained fairly constant over the 10-year period and varied between about 7.2 million and about 7.5 million tons for the three years of 1955, 1959, and 1964, selected for purpose of comparison. The deep-draft movements of petroleum and petroleum products for the same three years are shown graphically in figure 1.

14. An analysis was made of the movement of petroleum and products in the Port Aransas-Corpus Christi Waterway by barge. The results of the analysis are shown graphically in figure 2. As with the deep-draft commerce, it is noted that movements of petroleum products have remained relatively stable. For crude petroleum, however, barge movements practically doubled between 1955 and 1964, in contrast to the marked decline in deep-draft movements in the same period. Thus, it would appear that shifting of some crude oil movement from deep-draft vessels to barges, as well as the increasing use of pipelines in recent years, has contributed to the loss in deep-draft crude petroleum tonnage in the Port Aransas-Corpus Christi Waterway. For a number of years, the Coastal States Crude Gathering Company operated an eight-inch pipeline with an estimated 25,000 barrel per day or 1.4 million tons annual capacity as a crude petroleum transmission line from Corpus Christi to Houston. This pipeline was converted to a products line in 1965, when a new 12-inch crude petroleum line with an estimated capacity of about 56,250 barrels per day or about 3.1 million tons annually was placed in service. The Humble Pipeline Company plans to complete a new 16-inch pipeline from its Ingleside Station on Corpus Christi Bay to the Humble Oil & Refining Company's Baytown refinery on the Houston Ship Channel late in 1966. This pipeline will serve the Texas City and Houston refining complex as well as the Baytown refinery.

15. The capacity of this new pipeline will be 100,000 barrels of crude petroleum per day or about 5.6 million tons annually. This pipeline will probably eliminate much of the present water movement of crude petroleum from the Humble Oil & Refining Company's Harbor Island terminal on Aransas Pass to the Houston area although it is not believed that movements to the East Coast and other distant points will be affected. Crude petroleum to supply this line will enter the gathering system from such distant areas as the Kelsey-Bass Field in Starr County and the Sacatosa Field in Maverick County.[12/]

16. Grain.- Grain shipments by deep-draft navigation from Corpus Christi have more than tripled during the period from 1955 to 1964, inclusive. Over half of this grain is grain sorghum grown principally in northwest Texas and in the Rio Grande Plain adjacent to Corpus Christi.

Grain sorghum is used principally for livestock feed and is usually Texas' chief grain crop in both acreage and value. Although much of the grain shipped from Corpus Christi is supplied locally, a large amount is shipped from northwest Texas to Corpus Christi for export. Grain sorghums increased greatly in importance after the years of 1956 and 1957, with the development of a high yield hybrid seed by the Texas Agricultural Experiment Station and the United States Department of Agriculture.[13]

17. Wheat exports accounted for about 40 percent of the total grain shipments from Corpus Christi. This relatively large total probably resulted from the current United States foreign policy of shipping stored grain surpluses, principally wheat, to foreign nations. Current reports indicate that carry-over surpluses are no longer a problem and that adjustments are being made in production quotas to effect larger annual production yields in the United States. Thus, barring the possibility of production shortages resulting from widespread crop failures due to adverse weather conditions or other natural disasters, it seems possible that this policy will be continued indefinitely. If annual production is substantially increased, the program may be expanded for the dual purpose of affording aid to agriculture in the United States and providing relief from famine conditions in heavily-populated countries of the world. In this event, increasing tonnages of grain would probably be exported through Corpus Christi and other grain ports with some probable diversion of the tanker fleet as grain carriers in the export grain trade. The increase in the Port Aransas-Corpus Christi grain export trade from 1955 to the years 1959 and 1964 is shown graphically in figure 3.

18. Chemical tonnage.- Chemical tonnage, though small when compared to the tonnages of petroleum and products, ores, and grain, has shown excellent growth characteristics and should show rapid future development. All classes of chemicals were considered available for movement by bulk carrier in this analysis. This chemical tonnage is shown for the years 1955, 1959, and 1964 in figure 3.

19. Ores.- Ores are shipped into the Corpus Christi SMSA in quantity to support the operations of the American Smelting and Refining Company zinc smelter in Corpus Christi and the Reynolds Metals Company's San Patricio plant at La Quinta for the production of alumina and of primary aluminum metal. Deep-draft commerce in ores other than bauxite has remained fairly constant during the 10-year period from 1955 to 1964, inclusive. The importation of bauxite, the crude ore of aluminum, however, has increased about five and one-half fold during the same time period. Much of this tonnage, however, has resulted from factors not related to the present demand for the product of the La Quinta operation.

20. An undetermined tonnage of bauxite has been imported during this period for stockpiling purposes. Although rich in many resources, the United States is deficient in its deposits of bauxite and consumes 41 percent of the world's supply to which it contributes merely eight percent.[14]

21. The deep-draft tonnages of ores moved into Port Aransas-Corpus Christi Waterway are shown for the years 1955, 1959, and 1964 in figure 3. The portion of this commerce, which related to the operations of the Aluminum Company of America's Point Comfort, Texas plant, was diverted from the Port Aransas-Corpus Christi Waterway in early February 1966 to the Matagorda Ship Channel upon the opening of the latter to deep-water traffic. Based upon the importations in 1964, about 43 percent of the total ore traffic was consigned to the Point Comfort plant and, thus, would no longer move on the Port Aransas-Corpus Christi Waterway.

22. The bauxite transported by barge for the years 1955, 1959, and 1964 is shown in figure 4. This gives a measure of the probable loss in bauxite tonnage to the Matagorda Ship Channel. It is quite probable that future plant expansion in the Reynolds Metals La Quinta plant will more than compensate for this loss, but the Port Aransas-Corpus Christi Waterway deep-draft tonnage in bauxite will probably be less than the tonnage shown in 1964 for a period of several years.

23. While the benefits from the proposed improvements of the Port Aransas-Corpus Christi Waterway would have considerable effect on deeper draft cargo vessels such as large tank ships and large bulk carriers, the proposed improvement would have little effect on shallow draft navigation or on deep-draft freight ships of the general cargo type. For this reason certain cargo items were omitted from the study as they were considered as falling within the general cargo category. Items desgnated general cargo accounted for somewhat less than six percent of all cargoes reported at the various installations of the Port Aransas-Corpus Christi Waterway in 1964 and would be of relatively minor importance in any event.

24. Projections.- The present dimensions of the Port Aransas-Cropus Christi Waterway, excepting the La Quinta Channel, are fully adequate for fully loaded use of vessels ranging up to 40,000 deadweight tons. Projections of future commodity movements were therefore limited to those adapted to bulk type movement and that likely would be generated in sufficient quantities as to require transportation in vessels exceeding 40,000 deadweight tons. In constructing these projections, various economic indicators were selected for study. These were: value added by manufacture, value of farm products sold, and value of mineral production. Of these indicators, value added by manufacture reflects the processing of petroleum, reduction of ores, the milling of grains into flour and feeds, and the production and refining of chemicals. The value of farm

products sold would reflect, to an extent, the grain or bulk farm products projected to be available for future shipments. This would, of course, be dependent upon the need of foreign nations, and possible changes in the United States foreign policy relative to foreign aid, particularly in foodstuffs and grains. The value of mineral production shows not only the present values of minerals within the immediate area but also gives an indication of probable future supply.

25. Value added by manufacture.- The value added by manufacture was obtained from the projected population of the present Corpus Christi Standard Metropolitan Statistical Area, comprising Nueces and San Patricio Counties. Although an estimate of value added by manufacture based upon statistical sampling was available for Nueces County for 1960,[15] like information was not available for San Patricio County. An estimate for San Patricio County, obtained from the Texas Education Agency Economic Index published in the Texas Almanac for 1964-1965,[5] was combined with that of Nueces County to obtain the estimated 1960 value added by manufacture for the SMSA. The projected value added by manufacture was computed from the estimated projected population and projected per capita income.

26. The projected population of the Corpus Christi SMSA compared to Texas and the United States is shown in table 1.

TABLE 1

POPULATION (thousands)

Year	United States[16]	Annual % growth	Texas	Annual % growth	Corpus Christi SMSA	Annual % growth
1960	180,676		9,580		267	
		1.54		1.75		2.18
1975	227,225*		12,427*		368*	
		1.54		1.75		2.17
1980	245,313		13,543		410	
		1.62		1.70		2.71
2000	338,219		18,962		700	
		1.67		1.74		2.72
2020	470,750		26,795		1,198	
		1.67		1.74		2.72
2025	511,705#		29,186#		1,369#	

* Interpolated
\# Extrapolated at the year 2000 - year 2020 rate of growth

This table is based upon the Series B census projections to 1985 with Bureau of the Census population projections through 2010. The national projection for the year 2020 was obtained from letter SWDGA-6 subject: National Economic Growth Projections 1980-2020, dated 18 February 1966,[17] and the projection for the year 2025 was extrapolated beyond 2020 at the same rate. The projections for Texas and the Corpus Christi SMSA were computed by using the national projected population for each year through 2020 as a basis. The projections for 2025 were, like the national projection for 2025, obtained by extrapolation of the projected rate to 2020.

27. Personal income.- Per capita personal income is projected from the historical year 1960 to the years 1975, 1980, 2000, 2020 and 2025 and is shown in table 2.

TABLE 2

PER CAPITA PERSONAL INCOME
(1960 constant dollars)

Year	United States[17]	Annual % growth	Texas	Annual % growth	Corpus Christi SMSA	Annual % growth
1960	$2,221		$1,930		$1,886	
		2.31		2.81		2.80
1975	3,142*		2,925*		2,854*	
		2.34		2.81		2.80
1980	3,524		3,357		3,278	
		2.26		2.31		2.34
2000	5,507		5,297		5,202	
		2.21		2.32		2.36
2020	8,518		8,382		8,286	
		2.21		2.32		2.36
2025	9,512#		9,398#		9,320#	

* Interpolated
\# Extrapolated at the year 2000 - year 2020 rate of growth

The per capita incomes for Texas and the Corpus Christi SMSA were based upon the national growths for the years 1980, 2000, and 2020. The United States per capita incomes for 1975 and 2025 were obtained by interpolation and extrapolation respectively on the growth rates of the succeeding and preceding years.

28. The value added by manufacture is shown for the historical year 1960 and the projected years 1975, 1980, 2000, 2020, and 2025 for the United States, Texas, and the Corpus Christi SMSA in table 3.

TABLE 3

VALUE ADDED BY MANUFACTURE
(millions of 1960 constant dollars)

Year	United 17/ States	Annual % growth	Texas	Annual % growth	Corpus Christi SMSA	Annual % growth
1960	$ 163,571		$ 5,817		$ 144	
		4.89		5.04		4.69
1975	334,748*		12,162*		286*	
		4.89		5.04		4.69
1980	425,121		15,548		360	
		4.40		4.46		5.41
2000	1,005,836		37,215		1,033	
		4.40		4.52		5.44
2020	2,379,827		90,039		2,979	
		4.40		4.52		5.44
2025	2,951,474#		112,384#		3,884#	

* Interpolated
\# Extrapolated at the year 2000 - year 2020 rate of growth

Values added by manufacture for Texas and the Corpus Christi SMSA were computed from the national values. The national value added by manufacture for 1975 was obtained by interpolation between the historical 1960 value and the projected 1980 value. Values for the nation, Texas, and the Corpus Christi SMSA for the year 2025 were obtained by extrapolating the projected 2020 values at the 2000 to 2020 rate of growth.

29. Value of farm products sold.- The value of farm products sold is projected in this study for Nueces and San Patricio Counties alone. While it is recognized that the farm products used in bulk export trade from the Corpus Christi area are not limited to these counties, it is believed that this increase will serve as a measure of the entire area supplying export grain to the Port Aransas-Corpus Christi Waterway. Comparative values for the United States, Texas, and the Corpus Christi SMSA expressed in millions of 1960 constant dollars are shown in table 4.

TABLE 4

VALUE OF FARM PRODUCTS SOLD
(millions of 1960 constant dollars)

Year	United 17/ States	Annual % growth	Texas	Annual % growth	Corpus Christi SMSA	Annual % growth
1960	$31,046		$2,057		$ 38	
		1.83		2.04		2.63
1975	40,751*		2,785*		56*	
		1.83		2.04		2.64
1980	44,639		3,080		64	
		1.75		1.83		1.37
2000	63,154		4,425		84	
		1.29		1.37		1.36
2020	81,594		5,804		110	
		1.29		1.37		1.36
2025	87,009#		6,218#		118#	

* Interpolated
\# Extrapolated at the year 2000 - year 2020 rate of growth

30. Projections of value of farm products sold for the United States were computed by interpolation for the year 1975 and by extrapolation beyond 2020 and for the year 2025. Projections of the value of farm products sold were computed for Texas and the Corpus Christi SMSA from the statistical year 1960 and based upon the national projections. As in the case of the projections made for the United States, the projections computed for Texas and for the Corpus Christi SMSA for the year 1975 were obtained by interpolation between 1960 and 1980, and the projections for the year 2025 were obtained by extrapolation beyond the year 2020.

31. Value of mineral production.- The value of mineral production is projected in table 5 for the United States, Texas, and the Corpus Christi SMSA for the years 1975, 1980, 2000, 2020, and 2025.

TABLE 5

VALUE OF MINERAL PRODUCTION
(millions of 1960 constant dollars)

Year	United States 17/	Annual % growth	Texas	Annual % growth	Corpus Christi SMSA	Annual % growth
1960	$18,032		$ 4,117		$114	
		2.58		2.72		2.42
1975	26,423*		6,158*		163*	
		2.58		2.72		2.42
1980	29,990		7,048		184	
		2.40		2.46		2.34
2000	48,192		11,468		292	
		2.40		2.51		2.31
2020	77,440		18,821		461	
		2.40		2.51		2.31
2025	87,191#		21,313#		517#	

* Interpolated
\# Extrapolated at the year 2000 - year 2020 rate of growth

32. The national value of mineral production for the United States for the year 1975 was obtained as a value interpolated between 1960 and 1980 at the annual growth predicted between those years. The United States value of mineral production for 2025 was obtained by extrapolation beyond 2020 at the predicted rate between 2000 and 2025. The values of mineral production for Texas and for the Corpus Christi SMSA were based upon the national growths for the years 1980, 2000, and 2020 with interpolation for 1975 and extrapolation for 2025.

33. It is estimated that the starting date for a channel improvement project, if authorized, would be 1975. The improvement envisaged would provide a project depth of 45 feet for the Port Aransas-Corpus Christi Waterway with sufficient channel width and easing of bends to allow for the transit of vessels of the giant tanker or giant bulk carrier type. The reason for the introduction of these large ships would be for the transportation of overseas and coastwise shipments of petroleum, grains, bulk chemicals, and ores in a more economical manner. The savings would be reflected by larger ratios of cargo tonnage to ship crewmen, larger ratios of cargo tonnage to fuel, and lower vessel construction costs per ton cargo capacity with attendant lessening of interest costs.

34. The value added by manufacture in 1960 for the Corpus Christi SMSA in 1965 depended in a large measure on the petroleum refineries, petro and other chemical operations, and the reduction of ores to primary

metals. The capacity of the Corpus Christi petroleum refineries has shown a past growth of about one percent per annum. This growth has not been uniform but has occurred in a rather spasmodic manner as additional units were added to existing refineries or more efficient units were substituted. The additional units would generally increase refinery capacity by increasing feed and the greater efficiency of the new units would tend to increase output per barrel of feed.

35. Although there has been a large loss of deep-draft bulk crude petroleum cargoes between 1955 and 1964, this loss can be attributed to other modes of transportation rather than to loss of supply. The Corpus Christi SMSA gathers crude petroleum for distribution to east coast refineries from as far west as Maverick County on the Rio Grande. A portion of this crude petroleum moves by 12-inch pipeline from Corpus Christi to Houston, and a new 16-inch pipeline will largely supplant both coastwise deep-draft and barge navigation between Corpus Christi and Houston in late 1966 but will probably not affect movement east of the Houston Ship Channel.

36. Based upon the assumption that the amount of crude petroleum delivered to the Port Aransas-Corpus Christi Waterway will increase as a result of future discovery, extension of the present gathering systems from inland points of South Texas to the Corpus Christi SMSA, and the increasing employment of secondary recovery systems in fields formerly regarded depleted, it is believed that the amount of crude petroleum available for transportation by deep-draft tanker to refineries on the Atlantic coast will be no less than the amount transported by this mode in 1959. Although the prospects of major Texas offshore discoveries of petroleum and natural gas were not considered as being too good in the late 1950's and early 1960's, this idea has been modified considerably by the discovery of an extensive field of natural gas lying southeastward of Galveston. This field is known as the Buccaneer Field and was developed by the Shell Oil Company. The natural gas from this field, which was discovered about 1961, is transmitted to the vicinity of Freeport, Texas by the Blue Dolphin Pipeline, a 20-inch line. Other offshore leases in the vicinity are owned by 25 or more oil or chemical companies,18/and it is believed that there will be active exploitation of these leases and other potential fields to the south, which presently exist as geophysical anomalies, when the need arises.

37. The deep water tonnage of bauxite entering the Port Aransas-Corpus Christi Waterway, based upon the 1964 distribution of that ore, suffered a decline of over 43 percent with the opening in early 1966 of the Matagorda Ship Channel to the Aluminum Company of America's Point Comfort, Texas, reduction plant. It is believed that this loss is only temporary, however, and will be recouped as a result of increasing national and world demand for aluminum metal and the current expansion in

production facilities to accomodate the demand. The present expansion in the domestic aluminum industry is the greatest since the 1950's and was made in response to the fact that the industry operated at near capacity in 1965.19/ Projects under way at the present time will increase American capacity by about 370,000 tons or by nearly 14%. Canadian capacity will increase by about 100,000 tons. The unprecedented long term economic expansion both in the United States and abroad, and the untapped markets for aluminum in the developing nations are given as reasons that the domestic and world aluminum industries require greater capacity.

38. An estimate by the chairman of the Reynolds Metals Company indicated a $1 billion capital investment by the domestic industry by 1970. The executive vice-president of American Metal Climax, Inc., summed the situation up with, "Taking the most pessimistic forecast of future growth, the capital required for expansion of all phases of aluminum operations would by 1980 appear to exceed the combined resources of everyone now in the business."

39. The unloading and storage facilities available at the site of the San Patricio Reduction Plant together with its facilities for the production of alumina, the purified oxide, as a salable commodity to other reduction plants render the San Patricio location an excellent receiving point for Caribbean and South American ores. It is assumed that the loss of ore tonnage in 1966 to Point Comfort should be offset by increased tonnage to the Reynolds plant on the La Quinta Channel before the year 1990. Bauxite tonnages are assumed to increase at a rate of 3-3/8% per annum from 1964 to 1975 and at the national population rate after 1975 for the life of the project. It is also assumed that the tonnage of other ores imported to the United States via the Port Aransas-Corpus Christi Waterway will remain at a constant annual quantity of about 160,000 tons.

40. Based upon the assumption that there will be a change in the agricultural and foreign aid policies of the United States wherein as a foreign aid policy the United States will undertake to supply food stuffs to the developing nations and, at the same time, allow American agriculture to operate without the restrictions imposed by acreage quotas of wheat, feed grains, cotton, and other commodities, the deep-draft bulk grain shipments over the Port Aransas-Corpus Christi Waterway by 1975 should quadruple the shipment of 1959. This higher tonnage should remain constant during the life of the project to 2025 as further increases in grain shipments would probably be assigned to seaports not now engaged in the grain trade.

41. The growth in the manufacture of chemicals is probably the most promising of all growths. The chemical products capable of being moved as bulk cargoes on large tankers and bulk carriers would probably

consist of coal tar products, industrial chemicals, solid fertilizers, sulfuric acid, caustic soda, and alcohols. Many of these crude, intermediate, or refined chemicals are exported to foreign countries and are items of increasing importance in foreign trade.

42. Preliminary reports show that the Port Aransas-Corpus Christi Waterway deep-draft commerce in chemicals rose from 404,942 tons in 1964 to 499,316 tons in 1965, a gain of over 23 percent. Commerce in chemical commodities at the present time is not so large that these commodities could not be carried efficiently in vessels no larger than T-2 tankers. It is also true that many of these chemicals are now carried as general cargo in existing ships. It is considered likely that an industry, showing the growth history of the chemical industry, will ultimately develop a commerce many times that which is now in existence. Based upon this assumption, it is believed that some existing chemical commodities and some yet undiscovered chemicals will be manufactured in large quantities. This could readily bring the vessels of greater than 40,000 deadweight tons into use in the chemical trade to provide transportation at lower cost and provide price competition at the markets.

43. The deep-draft tonnage on the Port Aransas-Corpus Christi Waterway has shown a rapid although irregular growth pattern. The years 1955, 1959, and 1964 were selected for this study because they represent the most recent decade for which data are available. Although the growth is variable from year to year and may show some occasional regression, the general trend is one of rapid increase. The factors of growth during the selected decade for the 5 year periods 1955-59 and for 1959-64 were 1.463 and 2.082 which represent annual growth rates of about eight percent and fifteen percent, respectively. This growth pattern during the later five year period represents a great acceleration over the high rate of the earlier growth. If the growth be measured for the span of the 10 year period from 1955 through 1964, the growth factor becomes 3.041 representing an average annual growth of nearly twelve percent. The above factors are cited to show the rapid growth potential in this chemical commerce which is dependent upon various factors. Important factors influencing this growth are: availability of raw materials, including fuel, transportation, labor, plant space, and markets. All of these factors are presently in existence in the immediate area. Future supplies of fuel and raw materials may be economically transported into the area if the large existing supplies should prove to be inadequate. Existing facilities for transportation and manufacture can be expanded if needed, and large numbers of skilled and semi-skilled workers live within the laborshed. The projected increase in population should assure at least minimal growth in the

domestic markets for chemicals. New products and increased per capita demands for existing chemicals should expand this present growth at a rate reflecting the effects of augmented population, per capita personal income, and value of agricultural products resulting from greater use of chemical fertilizers.

44. On the basis of the above analysis it is believed that a conservative estimate of the deepwater tonnages in chemicals to be expected by the year 2025 on the Port Aransas-Corpus Christi Waterway would be no less than 10 times the 1964 tonnage or 4 million tons. This growth factor of ten for the 62 year period would indicate an average annual growth of a little over three and three quarters percent.

45. Summary.- The estimated tonnage of deep-draft commerce available for both foreign and American coastwise transportation in large bulk carriers, for which savings could be claimed by the improved Port Aransas-Corpus Christi Waterway, is shown in table 6. These projected tonnage estimates reflect the potential deepwater commerce in bulk cargoes for the Port Aransas-Corpus Christi Waterway to the year 2025. These bulk cargoes include crude petroleum, petroleum products, grain, bauxite, and chemicals. All of these bulk cargo classes with the exception of chemicals are now handled over the waterway in annual amounts exceeding 1 million tons, and the expansion rate of the chemical cargoes seems to indicate that traffic in this last class will easily exceed 1 million tons in volume before the end of the Twentieth Century. Selected indicators of population, per capita personal income, value added by manufacture, and value of farm products sold were developed and were projected to the year 2025 to determine conservative growth rates for chemical shipments. Value of mineral production was used as a measure of probable future mineral requirements. It was estimated that crude petroleum shipments by deep-draft tanker, in spite of increasing shipments of this commodity by pipeline, would remain constant as a result of increased importation to meet domestic needs. A minimum average annual increase of one percent in deep-draft tonnage of petroleum products is projected for the improved waterway. This increase is less than the projected national population increase and allows future new refinery construction in other areas. Grain shipments should attain a maximum of 5.2 million tons. Preliminary reports seem to show that bauxite shipments over the Port Aransas-Corpus Christi Waterway declined by about 1.5 million tons in 1966 as a probable result of the opening of the Matagorda Ship Channel. This new channel makes it possible for direct deep-draft shipment of bauxite by the Aluminum Company of America from its South American and Caribbean mines to the reduction works at Point Comfort, Texas. Prior to the opening of this channel the ore destined for Point Comfort had been stockpiled at Harbor Island on the Port Aransas-Corpus Christi Waterway from where it was transported by barge to the Point Comfort operation. The loss in deep-draft tonnage should be eventually compensated by continued growth of the Reynolds Metals Company plant served by the waterway.

TABLE 6

PORT ARANSAS-CORPUS CHRISTI WATERWAY

HISTORICAL AND PROJECTED TONNAGES OF BULK COMMODITIES IN DEEP-DRAFT NAVIGATION

	COMMODITY											
	CRUDE PETROLEUM		PETROLEUM PRODUCTS		GRAIN		ORE		CHEMICALS		TOTAL	
Year	Millions of tons	Factor of Increase from 1959	Millions of tons	Factor of Increase from 1959	Millions of tons	Factor of Increase from 1959	Millions of tons	Factor of Increase from 1964	Millions of tons	Factor of Increase from 1959 initial	Millions of tons	Factor of Increase from 1959
1959	7.5	1.000	7.2	1.000	1.3	1.000	3.5*	--	0.2	1.000	19.7	1.000
1964	6.4	0.859	7.2	0.995	1.7	1.373	5.4*	1.000	0.4	2.133	21.1	1.071
1975	7.5	1.000	8.5	1.173	5.2	4.000	4.4	0.815	0.6	1.519**	26.2	1.330
1980	7.5	1.000	8.9	1.232	5.2	4.000	4.8	0.889	0.7	1.209#	27.1	1.376
2000	7.5	1.000	10.9	1.504	5.2	4.000	6.6	1.222	1.6	2.587#	31.8	1.614
2020	7.5	1.000	13.3	1.835	5.2	4.000	8.7	1.611	3.3	5.534#	38.0	1.929
2025	7.5	1.000	13.9	1.928	5.2	4.000	10.0	1.852	4.0	6.692#	40.6	2.061

*Includes deep-draft serving both Reynolds and Alcoa
**Factor of increase from 1964
#Factor of increase from 1975

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DEEP-DRAFT TONNAGES
PORT ARANSAS-CORPUS CHRISTI WATERWAY, TEXAS
(CORPUS CHRISTI AND HARBOR ISLAND, TEXAS)
FOR
YEARS 1955, 1959, and 1964
PETROLEUM AND PRODUCTS

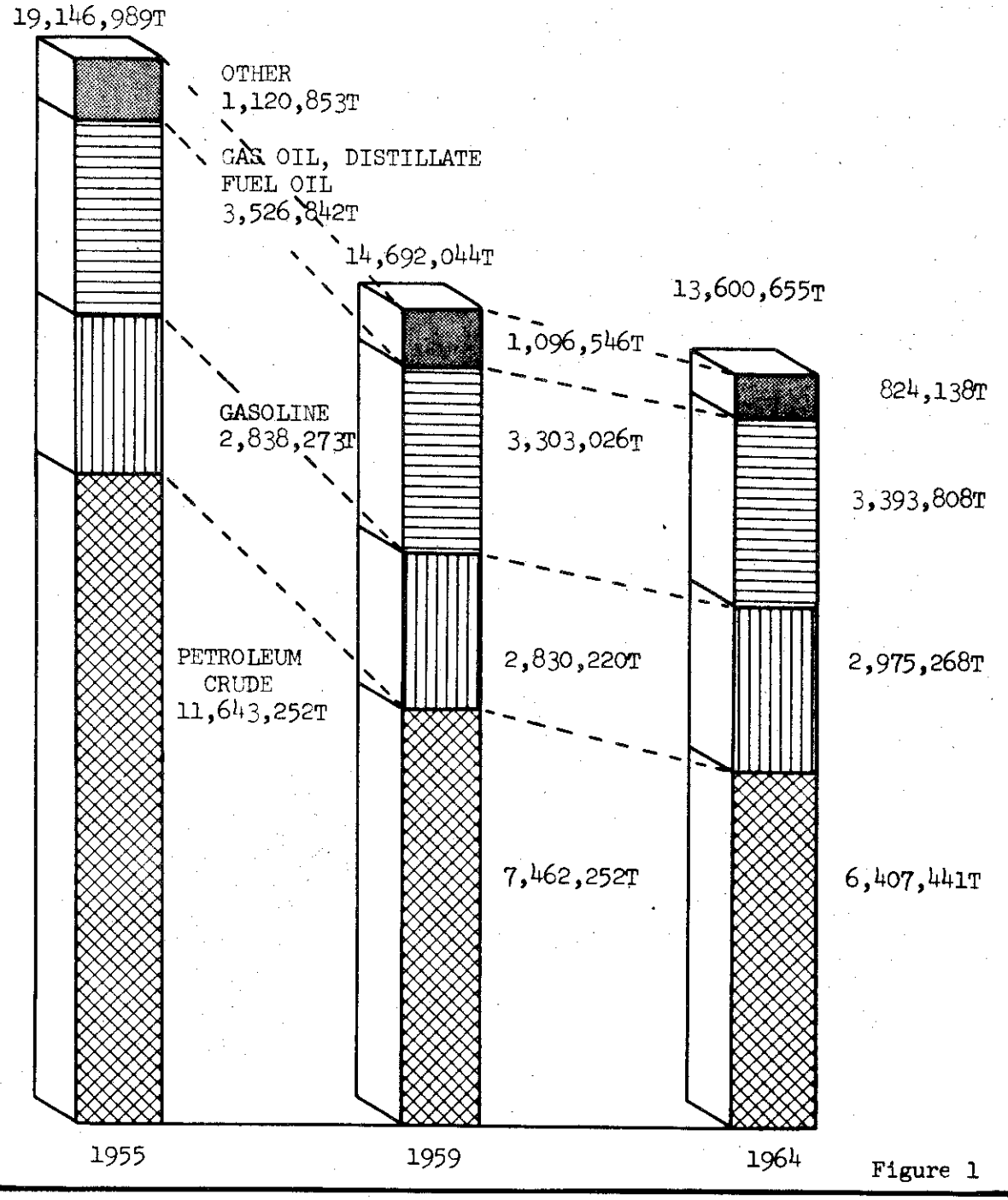


Figure 1

SHALLOW-DRAFT TONNAGES
PORT ARANSAS-CORPUS CHRISTI WATERWAY, TEXAS
(CORPUS CHRISTI AND HARBOR ISLAND, TEXAS)
FOR
YEARS 1955, 1959, and 1964
PETROLEUM AND PRODUCTS

A Petroleum products not elsewhere classified

1955	1959	1964
465,569 T	393,822 T	482,825 T

B Gas oil, distillate fuel oil

1955	1959	1964
154,916 T	153,749 T	216,473 T

C Gasoline and motor fuel

1955	1959	1964
439,872 T	435,680 T	557,543 T

D Petroleum, crude

1955	1959	1964
1,271,180 T	2,002,437 T	3,398,494 T

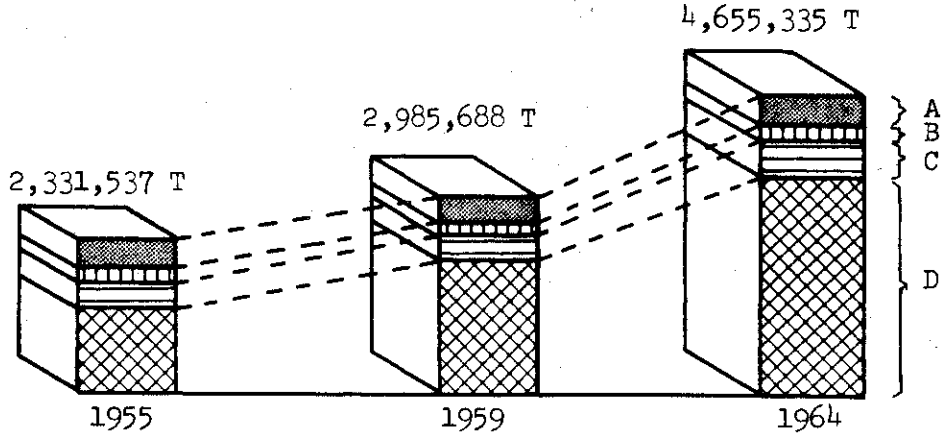
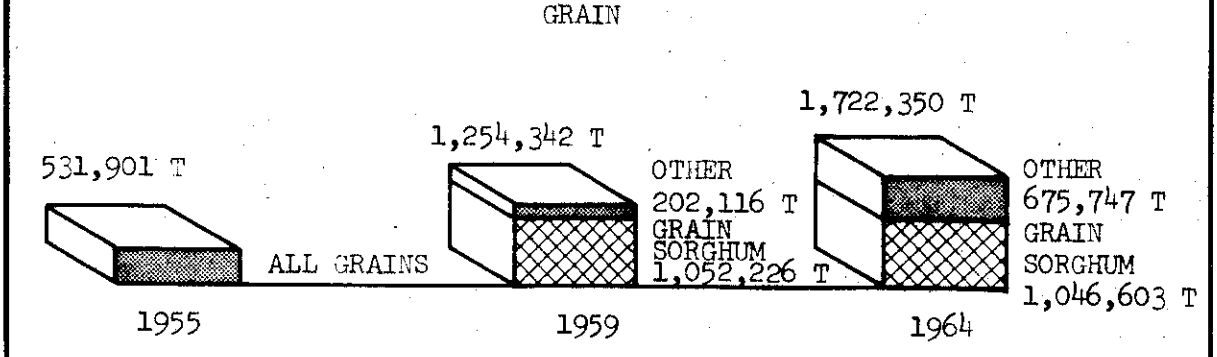
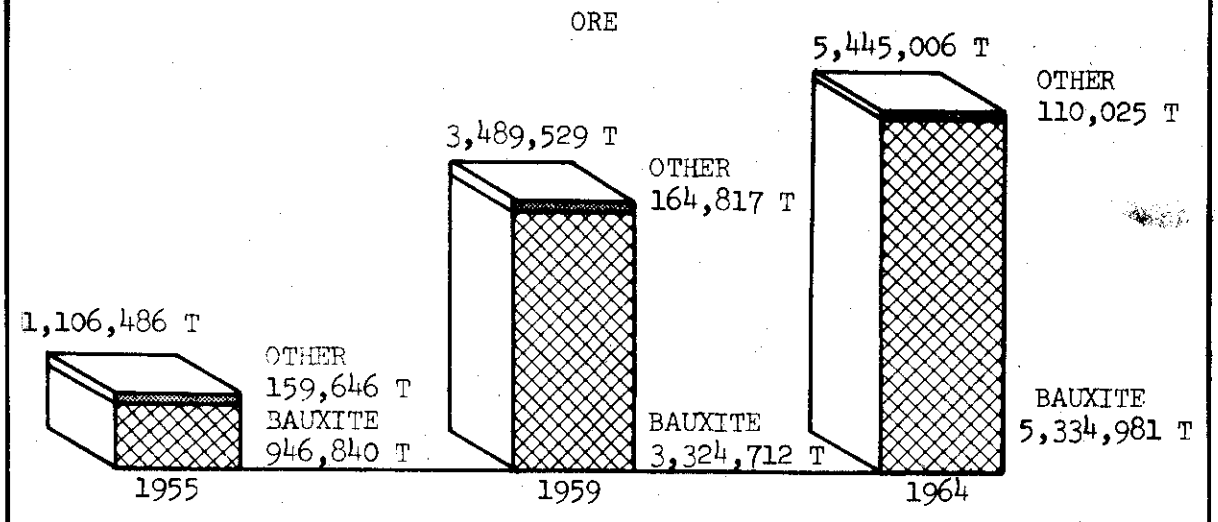


Figure 2

DEEP-DRAFT TONNAGES
PORT ARANSAS-CORPUS CHRISTI WATERWAY, TEXAS
(CORPUS CHRISTI AND HARBOR ISLAND, TEXAS)
FOR
YEARS 1955, 1959, and 1964





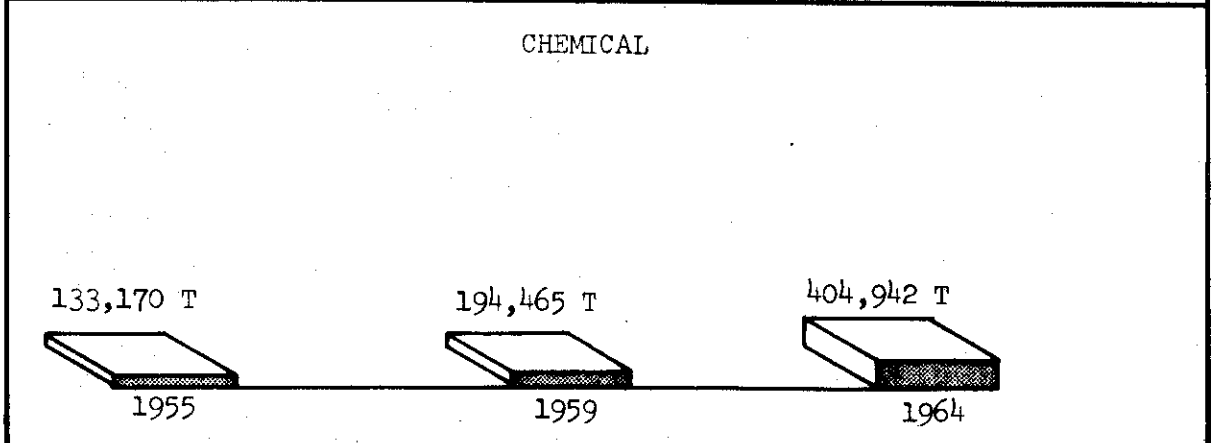


Figure 3

ANALYSIS OF BAUXITE TONNAGES
PORT ARANSAS-CORPUS CHRISTI WATERWAY, TEXAS
(CORPUS CHRISTI AND HARBOR ISLAND, TEXAS)
FOR
YEARS 1955, 1959, and 1964

A---BAUXITE DESTINED FOR DELIVERY TO POINT COMFORT, TEXAS

1955---8,511 TONS 1959---205,905 TONS 1964---2,304,845 TONS
This tonnage was lost to the Port Aransas-Corpus Christi Waterway when the Matagorda Ship Channel was opened to deep draft ore shipments on 1 February 1966 and will presumably drop to zero when existing stockpiles have been removed to Point Comfort, Texas.

B---BAUXITE TRAFFIC FOR DELIVERY BY DEEP DRAFT NAVIGATION TO LA QUINTA ON THE PORT ARANSAS-CORPUS CHRISTI WATERWAY

1955---938,329 TONS 1959---3,118,807 TONS 1964---3,030,136 TONS

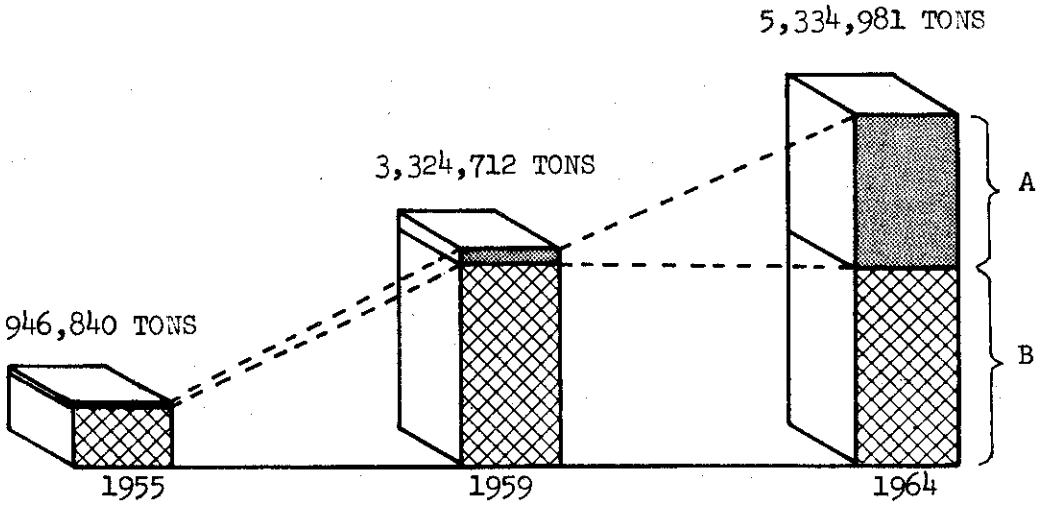
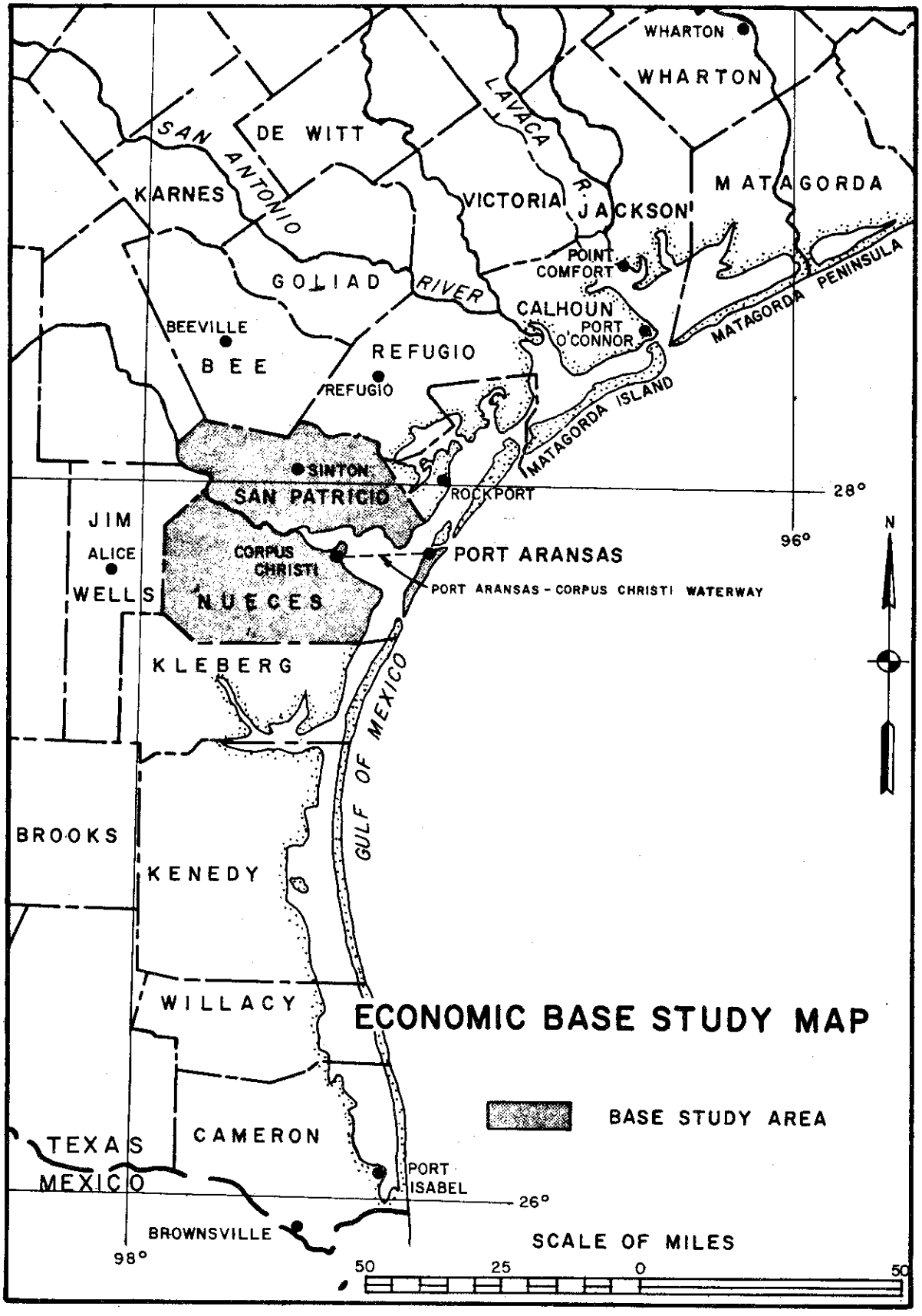


Figure 4


WHARTON
WHARTON
SAN ANTONIO
DE WITT
LAVACA R.
KARNES
VICTORIA
JACKSON
MATAGORDA
POINT COMFORT
GOLIAD
RIVER
CALHOUN
PORT O'CONNOR
MATAGORDA PENINSULA
BEEVILLE
BEE
REFUGIO
REFUGIO
MATAGORDA ISLAND
SINTON
SAN PATRICIO
ROCKPORT
28°
96°
JIM
ALICE
CORPUS CHRISTI
PORT ARANSAS
PORT ARANSAS - CORPUS CHRISTI WATERWAY
WELLS
NUECES
KLEBERG
GULF OF MEXICO
N
BROOKS
KENEDY
WILLACY
ECONOMIC BASE STUDY MAP
BASE STUDY AREA
TEXAS
CAMERON
PORT ISABEL
MEXICO
26°
BROWNSVILLE
98°
SCALE OF MILES
50
25
0
50

REVIEW OF REPORTS ON

PORT ARANSAS-CORPUS CHRISTI WATERWAY, TEXAS

(45-FOOT PROJECT)

APPENDIX III

COMMON TERMINAL STUDIES

REVIEW OF REPORTS ON
PORT ARANSAS-CORPUS CHRISTI WATERWAY, TEXAS
(45-FOOT PROJECT)

APPENDIX III

COMMON TERMINAL STUDIES

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REVIEW OF REPORTS ON
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(45-FOOT PROJECT)

APPENDIX III

COMMON TERMINAL STUDIES

INTRODUCTION

1. Purpose.- Since World War II, there has been a marked and continuing trend toward larger and larger vessels in the ocean-going tankship category. The same trend has been evident to lesser degrees in bulk ore-carriers and dry cargo vessels. In recent years a number of large tank vessels have been modified to carry bulk grain, and are being extensively used for this purpose in world commerce. Also, in recent years, there has been a movement toward "containerized" or pre-packaged handling of dry cargoes, and some of the newer dry cargo vessels have been designed to accommodate this method of handling in the most efficient manner. One shipping company has announced plans for several ocean-going vessels which, by means of submersible loading techniques, will transport a number of loaded barges across oceans to continue movement from ocean terminals to final destination through inland waterways. All of these innovations and the trend toward larger vessels have been designed to improve transportation efficiency and counteract the spiraling costs of vessel construction and operation. Along with increasing size, the modern vessels are highly automated, so that the operating crew requirements of the largest vessels are no greater, and, in some cases, are less, than for the smaller, older vessels.

2. The increasing size of vessels has been most spectacular in the liquid bulk carriers used, for the most part, in handling petroleum, petroleum products, and chemicals. Several tankers exceeding 100,000 deadweight tons are now in operation in the world fleet. Several others ranging up to 300,000 d.w.t. are under construction or have been contracted for construction. At this time the ultimate limit of size is uncertain. Various designers have expressed opinions that the practical limits of structural soundness may be reached somewhere between 500,000 and 750,000 d.w.t. However, it is evident that a substantial portion of the world tanker fleet will consist of tankers in the 35,000 to 75,000 d.w.t. class by 1975 and that these vessels will be in general use throughout the world.

3. At this time most of the extremely large vessels, either in service or planned, are designed for hauling crude petroleum from the oilfields of the Near-East of South America to the large market areas of Europe or the United States. With only the one commodity to be handled and recurring runs between the same origin and destination ports, the problems of providing terminal and handling facilities at the ports are simplified. In the Near-East, offshore terminal facilities are used extensively. In Europe, the solution will apparently be through use of a small number of improved or naturally deep intermediate ports, with distribution from these ports to final destination being made either by pipelines or by the use of smaller vessels. While solutions of this nature are comparatively simple for handling crude petroleum from a single source, the problems are complicated immeasurably when requirements are introduced to handle a large variety of refined products or several crudes from different sources. The Texas Gulf coast has a number of important deep-draft waterways serving major petroleum refining and petrochemical producing complexes. Approximately 25 percent of the nation's refining capacity is served by these waterways. Large amounts of refined products and crude oil from several sources and with widely varying characteristics move from these ports. All of these waterways now have authorized general project depths of 40 feet extending to ports as far as 50 miles inland from the Gulf of Mexico. With each increment of additional depth, the problems of further improvement become more severe. In addition to the long inland reaches, the relatively wide and flat continental shelf requires offshore extensions of improved channels in the open gulf. This problem is worse along the upper Texas coast where the continental shelf is considerably wider than along the lower coast. Nevertheless, it is evident that the present waterways will not be able to fully accommodate most of the vessels in general use within the next few years. If these vessels are to be used, either the waterways must be further improved or alternative means of handling must be devised. Since all vessels entering or leaving a port must also use another port, the problem cannot, of course, be studied to a fully meaningful conclusion by investigating only a single port.

4. While commerce from the Port Aransas-Corpus Christi Waterway moves throughout the world, a substantial portion of the petroleum commerce moves between that port and ports on the east coast of the United States. Some of these ports now have depths of 45 feet, while others have this depth authorized or planned. Accordingly, this depth was selected as a criterion for investigating the feasibility of providing alternative means for utilizing vessels with depth requirements in this range in lieu of further improvement of the waterway. The results of these studies are presented herein.

5. Scope.- Two alternate solutions for accommodating larger vessels in lieu of further deepening of the Port Aransas-Corpus Christi Waterway were investigated in detail. One alternate would provide a common terminal and tank farm facility directly inshore from the Gulf of Mexico. The other alternate would provide an offshore pipeline and mooring facility in the gulf. The descriptions of the major components of these alternates and a detailed breakdown of the initial investment, replacement costs, and operation and maintenance costs of these systems are included in this appendix. The major advantages and disadvantages of these alternates and a cost comparison of these facilities with channel improvements of the Port Aransas-Corpus Christi Waterway are also included.

DESCRIPTION OF STUDIES

6. General.- The expanding markets for petroleum and petroleum products and the increasingly competitive market demands of the industry have caused a continual and progressive trend to the use of larger bulk carrying vessels in recent years. To illustrate the increasing use of larger vessels, the October 1964 issue of "World Petroleum" magazine published statictics illustrating the trends in tankship sizes for the period from 1959 through 1964. In 1959 there were 126 tanker vessels with capacities of 40,000 d.w.t. and larger registered in the world fleet. This number had almost tripled to 311 by 1962 and by 1964 had increased to 463. A conservative extension of this trend indicates that there will be in excess of 600 of these tankers in operation by 1970 and approximately 700 by 1975. These larger vessels not only are increasing in number at a very rapid pace, but because of their size, are also carrying a greater volume of the world trade in petroleum and petroleum products.

7. Limits of future channel improvements.- Some ports in the United States may have already reached the feasible limits of harbor deepening and widening. Bridge clearances and the rock bottom of the continental shelf have caused several harbor authorities and private concerns on the Atlantic coast to seek more economical solutions to accommodate these larger vessels. Offshore and near inshore terminal facilities are being investigated. At Corpus Christi the practical physical limits have not yet been reached; however, several problems are encountered in further expansion of the channel. Further channel deepening requires a further extension of channel in the open gulf beyond the existing jetties. The horizontal clearance of Corpus Christi Harbor Bridge limits further widening of the present channel at this point. While these and other factors do not prevent some degree of further channel improvement, there is undoubtedly some limit beyond which additional improvement would not be practicable.

8. Waterway characteristics.- At the present time, the largest use of vessels exceeding 40,000 d.w.t. capacity on the Port Aransas-Corpus Christi Waterway is for petroleum and petroleum products transport. However, in addition to 70 percent of the petroleum and petroleum products, table K of appendix IV shows that 75 percent of all grain, 40 percent of the chemical and petrochemical products, and 100 percent of the bauxite ores and alumina will be shipped by vessels exceeding 36-foot drafts capacity by year 2025. Therefore, for this waterway, a true alternate to channel improvements should be capable of handling these commodities as well as petroleum and petroleum products.

9. Lighterage system.- The only apparent alternate to channel improvements to accommodate both tankers and bulk carriers would be through a lighterage system. Under this system large tankers and bulk carriers would take on as much cargo at the present loading berths as the existing channel dimensions would permit. Then, the vessels would proceed to a protected deepwater anchorage basin connected by enlarged channels to the gulf. At this point the partially loaded vessels would be loaded to full displacement by the use of lighters.

10. If a terminal basin were located near Harbor Island, this alternate would require channel deepening and widening from the gulf for a distance of about $5\frac{1}{2}$ miles. A preliminary analysis of this type of operation related to the prospective commerce indicates average annual charges in excess of $2,000,000. These charges include the required channel enlargement, towing and barge operations, delay time for double handling, and losses due to evaporation and handling. This estimate far exceeds the cost of harbor and channel improvements.

11. Moreover, there are a number of operational disadvantages to the use of lighters which rule it out as a practical solution for common handling of petroleum products. Lightering of flammable liquids is an unsafe practice. Many tanker owners and charter parties prohibit the use of lighters for materials of low flash point. This exclusion is written into many sales contracts where the buyer furnishes the vessel. Lightering also introduces problems of quality and quantity control, which are critical for many of the products shipped from Corpus Christi. Where tankers take on cargoes of several products, the cargo configurations which control list and draft could result in serious imbalance in quantities of commodities to be lightered. Because of these operational disadvantages and the estimated high annual costs, a lighterage system was deemed to be impractical and was not considered further.

12. Functional requirements of alternates considered.- The lighterage system would be the only alternate to channel deepening that

could accommodate both tankers and bulk carriers. Elimination of this alternate for the reasons outlined in paragraphs 10 and 11 limits consideration of alternatives to the commerce in petroleum and petroleum products.

13. The petroleum shipping operations at Corpus Christi are primarily in crude oils, refined products, and petrochemicals. Most of the crude oils are shipped from the ports at Ingleside and Harbor Island. The refined products and petrochemicals are shipped from six independent refineries at Corpus Christi. These independent refineries are known as "custom refiners" because their conventional refined products are manufactured to the specifications of the individual buyers, usually major oil companies.

14. For product movement from the port of Corpus Christi, it was determined that petroleum commodities moving in sufficient quantities for supertanker transport could be divided into the following four general categories: (1) finished gasolines and gasoline blending stocks, (2) naphthas, jet fuels, kerosenes, and certain other products with a fair degree of compatibility and color characteristics, (3) distillate fuel oils including burner fuels, furnace oils, and various grades of diesel fuels, and (4) crude oils and field condensates. Petrochemicals and various special hydrocarbons, which are shipped from the port of Corpus Christi, are not of sufficient quantities to warrant pipeline transportation to common loading facilities.

15. There are many variations of specification requirements within each of the four categories considered and the products of different refineries are not necessarily interchangeable. The characteristics of a single product may vary widely from time to time at the same refinery to meet differing requirements of customer specifications. Therefore, common handling and storage facilities must be designed with a high degree of flexibility entailing complex quality control procedures to serve the various refineries at Corpus Christi.

16. Solutions considered in lieu of channel improvements.- For shipment of these products, it was considered that the alternate facilities would be required to handle about 13 million tons annually from the ports at Corpus Christi, Ingleside, and Harbor Island. Three alternatives that would meet this requirement were considered for practical aspects and workability and are described below.

17. Pipeline to Houston, Texas City and/or Port Arthur, Texas.- This alternate would not be a true alternate to tanker movement, since changes in market destinations would be inherent in the plan and only portions of the products could be handled. Basically this plan would

provide for the construction of pipelines which would transport most of the refined products to the Houston area for integration into the Colonial pipeline system. Crude oils would be shipped to Houston, Texas City, and/or Port Arthur for local use or transshipment by water. A rough estimate indicated that a minimum pipeline construction cost of about 20 million dollars would be required to handle the principal light oil refined fuel products alone. There is no certainty that the Colonial system could or would handle the added volumes. It is certain, however, that the necessary crude oil pipelines and other facilities required to even approximate an alternative facility would be at least double the costs estimated for the products line. In view of the unquestioned high costs and the uncertainty of its practicability from a market relation standpoint, further investigation of this alternate was not considered warranted.

18. Pipelines and common loading terminal at Harbor Island.- The Harbor Island terminal alternate would provide for construction of a common loading terminal and storage tank farm facility at Harbor Island, about 2 miles inshore from the gulf near Port Aransas, Texas. This terminal would be connected to the refineries and storage facilities at Harbor Island, Ingleside, and Corpus Christi by pipelines. The products would be pumped through pipelines from these three locations to the terminal tank farm. The tank farm would provide adequate temporary storage facilities for simultaneous loading of three supertanker vessels. Because this alternate would provide a workable means for accommodating petroleum commerce, it was investigated in more detail and a more detailed discussion of this alternate and its related costs is included in subsequent paragraphs.

19. Pipelines to offshore sea terminal.- The offshore gulf terminal alternate would provide for construction of overland and submerged pipelines to a common loading terminal about $6\frac{1}{2}$ miles offshore in the Gulf of Mexico near Port Aransas. Pumping plants, located at each of the three ports, would transfer the products to the sea terminal. Three vessels could be accommodated simultaneously by the terminal which would consist of buoyed anchorage areas and submerged pipeline hoses. The terminal area would be located in water about 60 feet deep. No channel improvements would be required for this alternate. The offshore gulf terminal alternate would provide a workable solution for common product handling; however, it would present several complex problems of product handling and quality control, and would be expensive, both to construct and operate. A more detailed discussion of this alternate and its related costs is included in subsequent paragraphs.

20. Summary of alternates considered.- The common terminal alternates, generally described in paragraphs 18 and 19, offer workable

and feasible solutions to the common handling of petroleum products. The Harbor Island terminal alternate is more sound from an operating standpoint. The offshore gulf terminal alternate, while presenting some problems related to product handling and quality control, does offer a workable means of handling these products. These two alternates, including the major components required for each system, were investigated in detail. An exhibit showing the general layout of these two alternates, a breakdown of construction, operation and maintenance, and replacement costs for the two alternates, and a comparison of first costs between the alternate improvements and the cost of enlarging the 40-foot project to accommodate petroleum commerce, are included in this appendix. The Harbor Island terminal alternate and the offshore gulf terminal alternate are identified as alternates 1 and 2, respectively, on exhibit 1 of this appendix. The lighterage system alternate and the pipeline to Houston, Texas City, and/or Port Arthur, Texas alternate were eliminated from further investigation because of their undesirability and operational disadvantages.

HARBOR ISLAND TERMINAL ALTERNATE

21. General.- This alternate would transfer the petroleum commerce by pipelines from the various plants, refineries, and storage facilities to a common loading terminal and berthing facility on Harbor Island. A general layout of this system is shown on exhibit 1 of this appendix.

22. The major components of this system include (1) a collection system of pipelines from the various plants and refineries at Corpus Christi to a booster pump station, (2) a booster pump station at Avery Point, (3) an overland and submerged pipeline system from this pumping plant to the common terminal, and (4) a loading terminal, tank farm, and basin at Harbor Island. This alternate would require channel deepening to -45 feet MLT from the gulf through the jetty channel to and including a basin at the terminal. The components required for this system are described in the following paragraphs.

23. Collection system from various plants and refineries. There are six petroleum refineries that produce, refine, or supply almost all the petroleum commerce that is shipped from the port of Corpus Christi. To collect the products from these plants for incorporation into a common pipeline system, three pipeline systems would be required. The three pipeline systems would cross the channel and extend to a centrally located booster pumping plant on the north side of the waterway at Avery Point. The locations and alignment of the three systems of interconnecting pipelines and their common booster pump plant were selected to avoid the more heavily developed and congested areas adjacent to the waterway.

24. One collection pipeline system would serve Suntide Refining Company. This pipeline system would cross the channel immediately downstream from Viola turning basin and extend underground across the southern edge of Nueces Bay to the pumping station. The distance from the refinery to the pump station is about 28,800 feet. The pipeline system would consist of one 14-inch line for refined gasoline products, one 12-inch line for distillate fuel products, and one 8-inch line for jet fuels, kerosenes, and related products. No appreciable amounts of crude oils are shipped from this refinery.

25. The second pipeline system would serve the plants of Hess Oil and Chemical Corporation, Coastal States Petrochemical Company, and Southern Pipeline Company. This pipeline system would consist of one 14-inch line for refined gasoline products, one 12-inch line for distillate fuels, one 8-inch line for jet fuels, kerosenes, and related products, and one 8-inch line for crude oils. This pipeline system would cross the waterway at about channel mile 25 and extend overland for a distance of about 4,600 feet to the booster pump station.

26. A third interconnecting pipeline system would serve Pontiac Refining Company and Southwestern Oil and Refining Company on the Industrial Canal. This pipeline system would consist of one 14-inch line for related gasoline products, one 12-inch line for distillate fuels, and one 8-inch line for jet fuels, kerosenes, and related products. No appreciable amounts of crude oils are shipped from these refineries. This pipeline system would cross the Industrial Canal near mile 24 and extend westerly across the southern edge of Nueces Bay to the pump station, a distance of about 15,800 feet.

27. Each of the individual petroleum refineries would use their present cargo loading pumps to transfer products into the suction of the booster pumps. In this way, the costs of rights-of-way in the heavily developed port area and the high cost of channel crossings would be minimized. Considering production rates at Corpus Christi which total about 243,000 barrels per day, this system would be adequate for the individual refineries to alternately transfer their products to storage facilities at a terminal on Harbor Island.

28. Booster pump station.- The three collection pipeline systems would be connected through manifolds to four high pressure booster pumps at a centrally located pumping station at Avery Point. The pump station size was selected to achieve transfer rates consistent with the loading rates and production rates of the plants at Corpus Christi. This rate is about 20,000 barrels per hour. Four high pressure pumps would be required to provide for the four categories of products to be shipped. Diesel powered internal combustion engines

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would be used to operate these pumps. A 1,500-horsepower booster pump would be required to move the refined gasoline products through a 14-inch pipeline with a pressure head of 600 pounds per square inch. A 750-horsepower pump would be required to move the distillate fuel products, at 500 psi pressure, through a 12-inch line. An 8-inch pipeline for jet fuels, kerosenes, and related products would require a 150-horsepower pump for a pressure of 400 psi. An 8-inch line for crude oils also would require a 150 horsepower pump for a pressure of 450 psi. The four pumps, with the required operating and maintenance facilities and a pumphouse, would be located north of the harbor area on Avery Point. The pumps would be operated, as needed, to transfer the products from the individual plants to the common terminal at Harbor Island.

29. Pipeline system to Harbor Island terminal.- A pipeline system consisting of four lines would be used to transfer the products across two bays and overland to the common loading terminal at Harbor Island. The selected pipeline route from the booster pumping plant to the terminal is shown on exhibit 1. The route was selected to minimize rights-of-way costs by avoiding developed areas and to minimize the costs of expensive underwater coatings for the pipelines crossing bay areas. The pipeline system would extend north from the pumping plant at Corpus Christi across Nueces Bay for a distance of about 3 miles. The system would then turn easterly and proceed overland about 17 miles, north of the communities of Portland and Ingleside, to Red Fish Bay. The pipelines would then cross the Gulf Intracoastal Waterway and Red Fish Bay and proceed southeasterly for about 5 miles to the terminal at Harbor Island. The total distance would be about 25 miles. This would include about 8 miles of submerged bay and marsh crossing and 17 miles of overland crossing. An additional 12-inch overland pipeline would be required to accommodate Sun Pipe Line Company at Port Ingleside. This pipeline would extend northeasterly from Port Ingleside for about 4 miles until it joined the main pipeline system. Sun Pipe Line Company would use their present cargo loading pump to transfer crude oil through a 12-inch pipeline and into the main pipeline system. Five highway crossings and three railroad crossings would be required by this pipeline route.

30. The four lines required for this system would consist of one 14-inch line for refined gasoline products, one 12-inch line for distillate fuels, and two 8-inch lines for kerosenes, jet fuels, etc. and crude oils. A 12-inch line would be required to transport the large volumes of crude oil from Port Ingleside. Therefore, the main crude oil line from Corpus Christi would be enlarged to 12 inches between its junction with the line from Port Ingleside and the terminal at Harbor Island. These main pipelines would terminate at a manifold and distribution system at the common terminal.

31. The submerged bay and marsh pipelines would be laid in trenches along the bottom of the bay and would be provided with protective coatings for protection against marine and salt deterioration. The overland pipelines would be laid underground with three feet minimum cover and the necessary rights-of-way for installation and maintenance would be acquired. The highway and railroad crossings would be placed at depths consistent with the requirements of the responsible agencies and companies. Pipelines crossing navigation channels would be laid in trenches beneath the channel with suitable clearances for navigation requirements.

32. Two existing petroleum shipping terminals are located downstream from the proposed common terminal location on Harbor Island. These two terminals, which primarily are crude oil storage and shipping facilities, would continue to ship their petroleum commodities over their existing wharves rather than transfer them to the common terminal.

33. Harbor Island terminal layout.- A schematic layout of the Harbor Island terminal alternate is shown on inset 1 of exhibit 1. The terminal would be located parallel to the waterway on a 195-acre tract of land. Elevations at this location vary from a few feet to about 10 feet above mean low tide. Adequate quantities of fill material would be dredged from the terminal basin to raise the elevation of the entire tract to about 10 feet above mean low tide.

34. The terminal loading facilities would be capable of handling three supertankers simultaneously. The tank farm facility would provide adequate storage capacities for the loading of two vessels. The third vessel would be loaded directly from the pipeline system.

35. Storage facilities.- The tank farm would provide storage tanks for the four categories of products discussed in paragraph 14 of this appendix. Storage tanks would also be provided for petrochemicals, specialty products, and ballast and bunker fuels. These products and supplies would be barged to the terminal for transloading. The storage tanks would be standard ground level petroleum storage tanks constructed on pile-supported concrete bases. Each large tank with 150,000-barrel capacity would be encircled by fire protection levees. These levees would be constructed to sufficient height to contain the volume of crude oils or refined products stored in the tank in case or rupture.

36. Storage capacity for 1,800,000 barrels of refined gasoline products, 900,000 barrels of kerosene and jet fuel products, 1,800,000 barrels of distillate fuels, and 1,200,000 barrels of crude oils would be provided. Tankage would also be provided for 400,000 barrels of petrochemical products and 150,000 barrels of specialty products such as additives for refined products.

37. Tank farm piping.- The system of pipelines from Corpus Christi and Port Ingleside to the terminal would be dispersed through a manifold

system to appropriate storage tanks. When these products were needed for tanker loading, they would be pumped back from the tanks at 150 psi through the manifold to the loading berths by a 2,450-horsepower pumping plant located at the terminal. The piping system within the terminal would require about 7,500 feet of 14-inch pipeline, 20,550 feet of 12-inch pipeline, and 7,700 feet of 8-inch pipeline. These lines would be installed underground with necessary valving at each tank.

38. Berthing facilities.- Berthing facilities would be provided for three supertanker vessels with lengths of up to 800 feet. A sheet pile bulkhead, 3,570 feet in length, would be constructed along the basin side of the terminal. Three vessel wharves with adequate mooring dolphins, hose handling equipment, fire fighting equipment and other necessary appurtenances would be provided.

39. Quality control.- Almost all of the refined products shipped from this terminal would require very close quality control. These products would have to be sampled and tested as they are loaded for shipment to meet customer specifications. A suitable field testing laboratory would be provided at the terminal for this purpose.

40. Channel improvements and basin requirements.- The Harbor Island terminal alternate would require deepening about 5.3 miles of the existing navigation channels from the Gulf of Mexico to Harbor Island. The outer bar channel would be extended about 1.2 miles and deepened to a minimum depth of 47 feet below mean low tide. The remaining channels between the gulf and the terminal facility would be deepened to a minimum depth of 45 feet. Relocation of two minor lights would be required to perform these channel improvements. No alterations other than these two navigation aids would be required. About three acres of additional rights-of-way at Port Aransas would be required for channel widening in conjunction with the deepening.

OFFSHORE GULF TERMINAL ALTERNATE

41. General.- This alternate would transfer the petroleum commerce by pipelines from the various plants, refineries, and storage facilities to a common loading terminal about 6½ miles offshore in water about 60 feet deep. A general layout of this system is shown on exhibit 1 of this appendix.

42. The major components of this system include (1) a collection system of pipelines from the various plants and refineries at Corpus Christi to a booster pump station, (2) a booster pump station at Avery Point, (3) an overland and submerged pipeline system from this pumping plant to the gulf terminal, and (4) a loading terminal, buoyed anchorage areas, and submerged pipeline hoses in the Gulf of Mexico. No channel improvements would be required for this alternate. The components required for this system are described in the following paragraphs.

43. Collection system from various plants and refineries.- Three pipeline systems would be required for this alternate, as with the Harbor Island terminal alternate. However, four 30-inch diameter pipelines would be required for economic power consumption levels in lieu of the smaller 8-inch to 14-inch lines required for the Harbor Island terminal alternate.

44. Booster pump station.- The three collection pipeline systems for this alternate also would join at a pumping station on Avery Point. A 14,000-horsepower pumping station to achieve the 20,000 barrels per hour transfer rate used for the Harbor Island alternate was selected for the offshore terminal alternate.

45. Pipeline system to offshore gulf terminal.- A pipeline system consisting of four 30-inch lines would be used to transfer the products across Nueces and Corpus Christi Bays, Mustang Island, and about 6½ miles into the Gulf of Mexico to an offshore terminal. Two additional 30-inch pipelines would be required, one from Port Ingleside and the other from Harbor Island, to accommodate the crude oil from the terminals at these locations. Two additional booster pumps with a total of 9,000 horsepower would be required, one each at Port Ingleside and Harbor Island.

46. Offshore gulf terminal layout.- A general layout of the offshore gulf terminal alternate is shown on inset 2 of exhibit 1. Three vessels could be accommodated by the terminal which would consist of three anchorage stations and hose buoy facilities for each vessel.

FIRST COSTS AND ANNUAL CHARGES

47. Detailed estimates of first costs and annual charges for work included in both alternates are shown in tables A through G of this appendix. Construction, operation and maintenance, and replacements costs for the Harbor Island terminal alternate are included in tables A, B, and C respectively. The construction, operation and maintenance, and replacements cost estimates for the offshore gulf terminal alternate are shown in tables D, E, and F respectively. Table G summarizes the first costs and annual charges for the Harbor Island and offshore gulf terminal alternates and compares them with the cost of enlarging the 40-foot project.

48. Construction cost estimates.- The construction cost estimates for the Harbor Island and offshore gulf terminal alternates are given in tables A and D respectively. In addition to cost of construction, these estimates include lands and damages, engineering and design, and supervision and administration costs. The interest that would accrue during an estimated 6-year construction period is added to the total first costs to obtain the total investments for the two alternates. An interest rate of 3.25 percent was used.

49. Operation and maintenance cost estimates.- The operation and maintenance cost estimates for the Harbor Island and offshore gulf terminal alternates are shown on tables B and E respectively. These annual costs are derived primarily from a percentage of the construction cost. Added to these costs are the annual salaries for a permanent staff that would be required to operate the various systems of either alternate. The costs shown are exclusive of pumping energy costs. These costs would be difficult to compute accurately because of numerous assumptions that would have to be made. Cursory estimates, varying from $50,000 to $100,000 annually, indicated that the pumping energy costs would not be significant when compared with the total annual charges of the two alternates. Therefore, no detailed estimates of the pumping energy costs were made.

50. Replacement cost estimates.- The replacement cost estimates for the Harbor Island and offshore gulf terminal alternates are given in tables C and F respectively. These annual costs are the equivalent annual costs, amortized over the 50-year project life, for the items that would require replacement within this period.

51. Comparison of costs.- Table G summarizes and compares the first costs, investments, and annual charges for three alternate improvements that would accommodate most of the prospective petroleum commerce for the Port Aransas-Corpus Christi Waterway. Because the alternates were limited to handling petroleum and petroleum products, they would not provide for movement of ore to La Quinta, or grain and chemicals from Corpus Christi, in the larger vessels. Therefore, the summarized estimates of costs, which are shown in the first column for the 45-foot project, do not include the cost of improving the La Quinta channel, constructing the proposed turning point at La Quinta Channel junction, or constructing the proposed mooring facilities at Ingleside. The total first cost of the 45-foot project is divided into two reaches for comparison purposes. The reach from deep water in the Gulf of Mexico to the site of the Harbor Island common terminal would be identical for both the 45-foot project and the Harbor Island terminal alternate.

52. The total first costs for the Harbor Island and offshore gulf terminal alternate, respectively, are 2 and 3.4 times the total first costs for constructing the 45-foot project. It is estimated that the

construction period for the 45-foot project would be about 4 years. However, the two alternates would require about 6 years for their construction periods. Therefore, the investment costs for the Harbor Island and gulf terminal alternates increase to 2.2 and 3.8 times the investment cost of the 45-foot project.

53. The largest percentage of cost differential between the 45-foot project and the two alternate projects are the annual charges. This is primarily because of the high operation, maintenance, and advance replacement costs required by the terminal alternates. The respective total annual charges for the Harbor Island terminal and the offshore gulf terminal alternates are 3.3 and 6.5 times the total annual charges for the 45-foot project.

DISCUSSION OF ALTERNATES

54. Functional comparison of alternates.- The comparison between the possible alternatives to overall deepening was made on the basis of the estimated quantities of commodities that otherwise would be transported in vessels larger than 40,000 d.w.t. on the waterway by year 2025, the end of the economic life of the project. This, of course, overestimates the earlier years requirements for alternative facilities. It does, however, give a basis of comparison for construction of facilities with approximately equal capacities and is believed to be adequate for this investigation.

55. The alternate facilities investigated were designed on the basis of handling only petroleum and petroleum products. Thus, they would not be true alternates to channel improvement in that only a portion of the prospective commerce requiring transportation in the larger vessels could be handled. Other than lightering, no satisfactory alternate appears to be feasible for ore carriers and shipments of grain and chemicals in the large vessels. Experience with lightering ore and grain, which has been done on a few occasions along the gulf coast, has shown that the double handling costs with available equipment and delay time of the vessels far exceed the normal costs associated with channel improvements. Where substantial quantities of these commodities are to be handled, there appears to be no satisfactory alternate, at least with present vessels and handling equipment.

56. For the petroleum and petroleum products, alternative facilities were considered on the basis of handling about 13 million tons annually from the ports at Corpus Christi, Ingleside, and Harbor Island. Three alternate facilities that would move equivalent volumes of petroleum and petroleum products were investigated.

57. Advantages and disadvantages of each alternate.- A pipeline system to Houston, Texas City, and/or Port Arthur, Texas was not investigated in detail because of its unquestioned high costs and the uncertainty as to its practicability from a market relation standpoint. This basic plan would provide for construction of pipelines to move most of the refined products to the Houston area for integration into the Colonial pipeline system and the crude oils to Houston, Texas City, and/or Port Arthur for local use or transshipment by water.

58. An offshore loading terminal alternate was investigated on the basis that no channel improvement would be required and that the terminal could accommodate three vessels simultaneously. Within the framework of any reasonable estimate of cost, this plan was found to be impracticable for the range of products that would have to be handled. As shown in tables D and G the estimated first cost of the pipelines, pumps, anchorage facilities, etc. is about $57 million. There are many disadvantages to this plan. There would be no practical way to change from one product to another within the length of the individual loading lines. Each of the 30-inch lines that would be included in the design of this alternate would have holdup capacities of about 180,000 barrels, or over 25,000 tons. The problems of quality control of products would be tremendous and there would be no convenient or economical way to offload any contaminated or degraded products reaching the vessels. Even the crude line would have such problems between sweet and sour crudes. Quantity measurements would offer substantial problems, since the accepted measurements are usually on the basis of gauged shore tanks. With these tanks separated from the vessel by miles of large diameter pipelines, obtaining accurate and acceptable measurements would become a serious problem. For handling the many products from the six refineries at Corpus Christi, the only feasible system of this kind would be in providing a number of smaller lines for each shipper. Even this would involve many problems and obviously would be more costly than construction of the smaller number of common lines, as described above. In view of the many problems and few apparent advantages, this system was dropped from further consideration.

59. An inshore loading terminal facility at Harbor Island, capable of accommodating three vessels simultaneously, was investigated on the basis that the entrance channels of the Port Aransas-Corpus Christi Waterway would be deepened to 45 feet. Assuming a common loading terminal was to be provided, there would be many obvious advantages to a land location slightly inshore, compared to a location several miles offshore in the open gulf. Substantial storage facilities with short loading lines to the vessels could be provided in lieu of long loading lines along the ocean bottom to the offshore location. Vessels and their crews could be serviced and supplied with much greater ease at

the inland location. Hazards from adverse weather and sea conditions would be much less. A great many other advantages are readily apparent and there is no question that for the Port Aransas-Corpus Christi Waterway, an inland terminal at Harbor Island would be far superior and much less costly than an offshore loading facility. Sufficient storage capacity would be provided at the Harbor Island terminal to permit loading of two fuel cargoes for different shippers and to permit accumulation of a third cargo without shutting down the pipelines. Design loading rates would provide about 7,000 tons/hr to each tanker. Sixty-four individual storage tanks ranging in size from 25,000 barrels to 150,000 barrels would provide storage for 6,470,000 barrels of the various products and crude oils. The estimated total first cost of the Harbor Island loading and storage facility, including the channel improvements required to provide a depth of 45 feet from the gulf to Harbor Island is about $33 million.

SUMMARY

60. Forty-five-foot (comparison) project.- Excluding the La Quinta Channel, the proposed turning point at the La Quinta Channel junction, and the proposed mooring facilities at Ingleside, the Port Aransas-Corpus Christi Waterway could be improved to 45-foot depth and permit the operation of vessels up to 59,000 dwt fully loaded at a first cost of about $16.6 million. The excluded items are omitted from this comparison project because comparable facilities would not be provided by the terminal alternates. Estimated total annual charges for the 45-foot comparison project would be about $770,000.

61. Feasibility of alternates.- The only feasible alternative would be construction of a common loading terminal facility at Harbor Island with pipeline connection to the several refineries in the Corpus Christi area and the crude oil shipping facility at Ingleside. This plan would require channel improvement to provide a minimum depth of 45 feet from the Gulf of Mexico to Harbor Island. The total cost of the facility, including the channel improvement, is about $33 million. Estimated total annual charges, exclusive of pumping energy costs, would be about $2.5 million. The facility would not be a true alternate for a channel depth of 45 feet throughout the waterway project, including La Quinta Channel, since it would handle only liquid components of the prospective commerce to be moved in vessels of up to 59,000 dwt. It would not, however, provide for movement of ores and grain to La Quinta and Corpus Christi in the larger vessels.

CONCLUSION

62. Conclusion.- The most feasible means of providing for use of larger vessels of up to 59,000 dwt at this location is deepening and enlarging the existing navigation project to provide a minimum depth of 45 feet.

TABLE A

CONSTRUCTION COST ESTIMATE - HARBOR ISLAND TERMINAL ALTERNATE

Item No.	Item	Unit	Quantity	Unit price	Cost
1	14" pipeline - bay & marsh	L.F.	78,900	$14.12	$ 1,114,000
2	14" pipeline - congested	L.F.	12,500	8.13	102,000
3	14" pipeline - overland	L.F.	89,800	8.13	730,000
4	12" pipeline - bay & marsh	L.F.	105,400	12.95	1,365,000
5	12" pipeline - congested	L.F.	12,500	7.42	93,000
6	12" pipeline - overland	L.F.	116,100	7.42	861,000
7	8" pipeline - bay & marsh	L.F.	94,800	8.02	760,000
8	8" pipeline - congested	L.F.	17,100	3.37	58,000
9	8" pipeline - overland	L.F.	174,200	3.37	587,000
10	Pipeline ROW/damages - congested	L.F.	42,100	1.36	57,000
11	Pipeline ROW/damages - overland	L.F.	380,100	0.91	346,000
12	Channel crossings				
	(a) Viola - 3 lines		L.S.		175,000
	(b) Avery Pt. - 4 lines		L.S.		200,000
	(c) C.C. Basin - 3 lines		L.S.		200,000
	(d) GIWW - 4 lines		L.S.		100,000
13	Highway crossings	Each	5	25,000.00	125,000
14	Railroad crossings	Each	3	20,000.00	60,000
15	Pumps:				
	(a) 1,500 H.P. @ 600 psi	H.P.	1,500	175.00	263,000
	(b) 750 H.P. @ 500 psi	H.P.	750	175.00	131,000
	(c) 150 H.P. @ 400 psi	H.P.	150	250.00	38,000
	(d) 150 H.P. @ 450 psi	H.P.	150	250.00	38,000
	(e) 2,450 H.P. @ 300 psi	H.P.	2,450	175.00	429,000
16	Pumphouse (80' x 50')	S.F.	4,000	5.00	20,000
17	Pumphouse (100' x 200'	S.F.	20,000	5.00	100,000
18	Interconnecting manifold		L.S.		50,000
19	Tank farm manifold		L.S.		360,000
20	Land - tank farm	Acre	195	2,000.00	390,000
21	Terminal storage tanks:				
	(a) 38 tanks @ 150,000 bbl each	Bbl	5,700,000	1.25	7,125,000
	(b) 22 tanks @ 25,000 bbl	Bbl	550,000	2.00	1,100,000
	(c) 4 tanks @ 55,000 bbl	Bbl	220,000	1.80	396,000
22	Tank farm piping:				
	(a) 14"	L.F.	7,500	8.13	61,000
	(b) 12"	L.F.	10,550	7.42	78,000
	(c) 8"	L.F.	7,700	3.37	26,000
	(d) Cargo loading pipelines (12")	L.F.	10,000	9.15	92,000
	(e) Cargo loading hoses (12")	L.F.	1,200	20.00	24,000
23	Pipeline valves:				
	(a) 14"	Each	17	2,500.00	43,000
	(b) 12"	Each	29	2,000.00	58,000
	(c) 8"	Each	41	1,000.00	41,000
24	Sheet pile bulkhead - 3570'	S.F.	107,100	7.00	750,000
25	Berthing docks (50' x 200')	Each	3	50,000.00	150,000
26	Mooring pile clusters	Each	12	10,000.00	120,000
27	Office & lab. (80' x 100')	S.F.	8,000	5.00	40,000
28	Fire retaining levees	L.F.	38,000	4.00	152,000
	Subtotal - shore facilities				$19,008,000
	Terminal basin, dredging				2,812,000
	Contingencies				4,223,000
	Subtotal - construction				26,043,000
	Engineering & design				1,707,000
	Supervision & administration				2,450,000
	Subtotal first cost, shore facilities and terminal basin				$30,200,000
	First cost for enlarging 40-foot project between gulf and terminal basin				2,752,000 1/
	Total first cost				32,952,000
	Interest during construction period (6 year)				3,313,000
	Total investment				$36,265,000

1/ See table G, column 1.

TABLE B

OPERATION AND MAINTENANCE - HARBOR ISLAND TERMINAL ALTERNATE

Item No.	Item	No. of units	Total first cost	% of first cost	Annual O&M
1	Pipelines - bay & marsh		$3,239,000	2.0	$ 64,800
2	Pipelines - overland		2,431,000	1.0	24,300
3	Pipeline channel crossings	4	675,000	1.0	6,700
4	Rail & highway crossings	8	185,000	1.0	1,800
5	Pumps - 5000 H.P.		899,000	1% + $15/HP	83,900 1/
6	Pumphouses, office, & lab.	4 bldg.	160,000	2.0	3,200
7	Tank farm piping & manifolds		691,000	1.0	6,900
8	Pipeline valves		142,000	1.0	1,400
9	Terminal storage tanks		8,621,000	3.0	258,600
10	Terminal dock equipment		270,000	2.0	5,400
11	Sheet pile bulkhead		750,000	2.0	15,000
	Permanent staff for operating systems:				
	a. Supervisor - 1				12,000
	b. Maintenance personnel - 10 @ $7,000				70,000
	c. Clerk - 1				6,000
	TOTAL ANNUAL OPERATION & MAINTENANCE COST				$560,000

1/ Exclusive of pumping energy costs - see paragraph 49, page 136

TABLE C

REPLACEMENT COSTS - HARBOR ISLAND TERMINAL ALTERNATE

Item No.	Item	Life (yrs)	Replacement (1) factors $(P.W.)_R$ $(P.P.)_{50}$	First costs	Equivalent annual cost 50 years
1	Pipelines - bay & marsh	20	$(0.5275)_{20}$ $(0.04073)_{50}$	$3,239,000	$ 69,600
			$(0.2782)_{40}$ $(0.04073)_{50}$		36,700
2	Pipelines - overland	25	$(0.4495)_{25}$ $(0.04073)_{50}$	2,431,000	44,500
3	Pipeline channel crossings	20	$(0.5275)_{20}$ $(0.04073)_{50}$	675,000	14,500
			$(0.2782)_{40}$ $(0.04073)_{50}$		7,700
4	Rail & highway crossings	25	$(0.4495)_{25}$ $(0.04073)_{50}$	185,000	3,400
5	Pumps - 5,000 H.P.	25	$(0.4495)_{25}$ $(0.04073)_{50}$	899,000	16,500
6	Tank farm piping & manifolds	25	$(0.4495)_{25}$ $(0.04073)_{50}$	691,000	12,700
7	Pipeline valves	25	$(0.4495)_{25}$ $(0.04073)_{50}$	142,000	2,600
8	Terminal storage tanks:				
	a. Petrochemicals & specialty products (22 tanks)	20	$(0.5275)_{20}$ $(0.04073)_{50}$	1,100,000	23,600
			$(0.2782)_{40}$ $(0.04073)_{50}$		12,500
	b. Crude, gasoline, distillate, kerosene, etc.	25	$(0.4495)_{25}$ $(0.04073)_{50}$	7,521,000	137,700
9	Buildings & facilities	30	$(0.3831)_{30}$ $(0.04073)_{50}$	160,000	2,500
10	Sheet pile bulkhead	20	$(0.5275)_{20}$ $(0.04073)_{50}$	750,000	16,100
			$(0.2782)_{40}$ $(0.04073)_{50}$		8,500
11	Berthing docks	25	$(0.4495)_{25}$ $(0.04073)_{50}$	150,000	2,700
12	Mooring pile clusters	25	$(0.4495)_{25}$ $(0.04073)_{50}$	120,000	2,200
			Total annual replacement cost		414,000

(1) Replacement factor is the present worth factor at the replacement time multiplied by the partial payment over the 50-year life of the project.

TABLE D

CONSTRUCTION COST ESTIMATE - OFFSHORE GULF TERMINAL ALTERNATE

Item No.	Item	Unit	Quantity	Unit price	Cost
1	30" pipeline - bay & marsh	L.F.	538,100	$34.59	$18,613,000
2	30" pipeline - submarine	L.F.	168,900	44.99	7,599,000
3	30" pipeline - overland	L.F.	63,300	21.58	1,366,000
4	30" pipeline - congested	L.F.	42,100	21.58	909,000
5	Pipeline ROW/damages - congested	L.F.	42,100	1.36	57,000
6	Pipeline ROW/damages - overland	L.F.	63,300	0.91	58,000
7	Channel crossings:				
	(a) Viola - 3 lines	Each	1		300,000
	(b) Avery Pt. - 4 lines	Each	1		400,000
	(c) CC Basin - 3 lines	Each	1		400,000
	(d) PACC WW - Mi. 13 - 4 lines	Each	1		400,000
	(e) PACC WW - Mi. 11 - 1 line	Each	1		100,000
	(f) PACC WW - Mi. 2.5 - 1 line	Each	1		100,000
8	Pumps:				
	(a) 14,000 H.P.	H.P.	14,000	225.00	3,150,000
	(b) 9,000 H.P.	H.P.	9,000	175.00	1,575,000
9	Pumphouse (80' x 50')	S.F.	4,000	5.00	20,000
10	Pumphouse - 2 @ (50' x 40')	S.F.	4,000	5.00	20,000
11	Offshore mooring buoy station	Each	3	2,000,000	6,000,000
		Subtotal			41,067,000
		Contingencies (20%)			8,213,000
		Engineering & design (7%)			3,450,000
		Supervision & administration			4,129,000
		Total construction cost			$56,859,000
		Interest during construction period (6 years)			5,544,000
		TOTAL INVESTMENT			$62,403,000

TABLE E

OPERATION AND MAINTENANCE - OFFSHORE GULF TERMINAL ALTERNATE

Item No.	Item	No. of units	Total first cost	% of first cost	Annual O&M
1	Pipelines - bay & marsh		$18,613,000	2.0	$372,300
2	Pipelines - submarine		7,599,000	2.0	152,000
3	Pipelines - overland		2,275,000	1.0	22,700
4	Pipeline channel crossings	6	1,700,000	1.0	17,000
5	Pumps - 23,000 H.P.		4,725,000	1% + $15/HP	392,200 1/
6	Pumphouses	3	40,000	2.0	800
7	Offshore mooring station	3	6,000,000	2.0	120,000
	Permanent staff for operating systems:				
	a. Supervisor - 1				12,000
	b. Maintenance personnel - 10 @ $7,000				70,000
	c. Clerk - 1				6,000
	TOTAL ANNUAL OPERATION & MAINTENANCE COST				$1,165,000

1/ Exclusive of pumping energy costs - see paragraph 49, page 136

TABLE F

REPLACEMENT COSTS - OFFSHORE GULF TERMINAL ALTERNATE

Item No.	Item	Life (yrs)	Replacement (1) factor $(P.W.)_R$ $(P.P.)_{50}$	First cost	Equivalent annual cost 50 yrs.
1	Pipelines - bay & marsh	20	$(0.5275)_{20}$ $(0.04073)_{50}$	$18,613,000	$ 400,000
			$(0.2782)_{40}$ $(0.04073)_{50}$		211,000
2	Pipelines - submarine	20	$(0.5275)_{20}$ $(0.04073)_{50}$	7,599,000	163,300
			$(0.2782)_{40}$ $(0.04073)_{50}$		86,100
3	Pipelines - overland	25	$(0.4495)_{25}$ $(0.04073)_{50}$	2,275,000	41,700
4	Pipeline channel crossings	20	$(0.5275)_{20}$ $(0.04073)_{50}$	1,700,000	36,500
			$(0.2782)_{40}$ $(0.04073)_{50}$		19,300
5	Pumps, 23,000 H.P.	25	$(0.4495)_{25}$ $(0.04073)_{50}$	4,725,000	86,500
6	Pumphouses	30	$(0.3831)_{30}$ $(0.04073)_{50}$	40,000	600
7	Offshore mooring station	20	$(0.5275)_{20}$ $(0.04073)_{50}$	6,000,000	129,000
			$(0.2782)_{40}$ $(0.04073)_{50}$		68,000
			Total annual replacement cost		1,242,000

(1) Replacement factor is the present worth factor at the replacement time multiplied by the partial payment over the 50-year life of the project.

TABLE G

COMPARISON OF COSTS OF ALTERNATE IMPROVEMENTS CONSIDERED IN LIEU OF ENLARGING 40-FOOT PROJECT TO ACCOMMODATE PETROLEUM COMMERCE

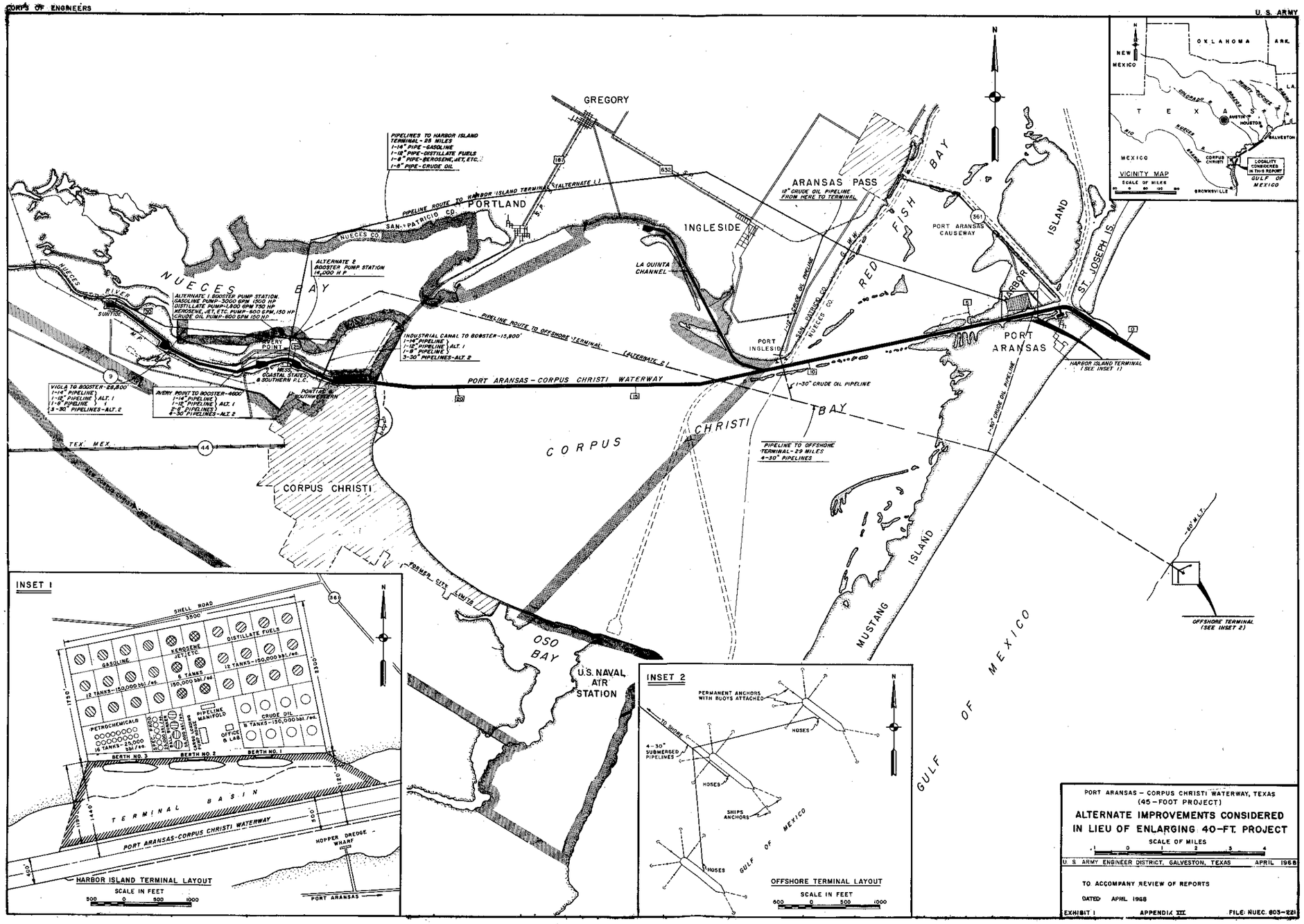
45-Foot Project 1/		Harbor Island Terminal alternate		Gulf Terminal alternate	
First costs		**First costs**		**First costs**	
Outer bar to Harbor Island terminal alternate:		Outer bar to Harbor Island terminal alternate:		Pipelines	$30,302,000
Channels	$2,172,000	Subtotal first costs (same as for 45-foot project)	$ 2,752,000	Pumping stations	4,765,000
Alterations	None			Offshore mooring facilities	6,000,000
Lands and damages	4,000	Shore facilities	19,008,000	Contingencies	8,213,000
Navigation aids	6,000	Basin (45-foot)	2,812,000	Engr. & Des.	3,450,000
Contingencies	328,000	Contingencies	4,223,000	Supv. & Admin.	4,129,000
Engr. & Des.	81,000	Engr. & Des.	1,707,000	Total, first costs	56,859,000
Supv. & Admin.	161,000	Supv. & Admin.	2,450,000		
Subtotal, first costs	2,752,000	Subtotal, first costs	30,200,000		
Harbor Island terminal alternate to Viola turning basin:		Total, first costs	32,952,000		
Channels	9,981,000				
Alterations	578,000				
Lands and damages	255,000				
Navigation aids	121,000				
Contingencies	1,709,000				
Engr. & Des.	410,000				
Supv. & Admin.	814,000				
Subtotal, first costs	13,868,000				
Total, first costs	16,620,000				
Investment - Construction period - 4 yrs. (benefits accrue during construction); Interest rate - 3-1/4%; Amortization period - 50 yrs.		**Investment** - Construction period - 6 yrs; Interest rate - 3-1/4%; Amortization period - 50 yrs.		**Investment** - Construction period - 6 yrs; Interest rate - 3-1/4%; Amortization period - 50 yrs.	
Total investment	16,620,000	First cost	32,952,000	First cost	56,859,000
		Int. during construction	3,313,000	Int. during construction	5,544,000
		Total investment	36,265,000	Total investment	62,403,000
Annual charges		**Annual charges**		**Annual charges**	
Int. & amort. (4.073%)	677,000	Int. & amort. (4.073%)	1,477,000	Int. & amort. (4.073%)	2,542,000
O&M, dredging	88,000	O&M, channels	29,000	2/ O&M, facilities	1,165,000
O&M, nav. aids	400	2/ O&M, facilities	560,000	Advance replacement	1,242,000
Total annual charges	765,400	O&M, basin	60,000	Total annual charges	4,949,000
		Advance replacement	414,000		
		Total annual charges	2,540,000		

1/ Costs for the La Quinta Channel, the proposed turning point at La Quinta Channel junction, and the proposed mooring facilities at Ingleside are omitted from this estimate since comparable improvements are not included in the terminal alternates.

2/ Additional to costs required for loading at existing terminals, and exclusive of pumping energy costs.

CORPS OF ENGINEERS

U. S. ARMY



PORT ARANSAS – CORPUS CHRISTI WATERWAY, TEXAS
(45-FOOT PROJECT)

ALTERNATE IMPROVEMENTS CONSIDERED IN LIEU OF ENLARGING 40-FT. PROJECT

SCALE OF MILES

U. S. ARMY ENGINEER DISTRICT, GALVESTON, TEXAS APRIL 1968

TO ACCOMPANY REVIEW OF REPORTS

DATED APRIL 1968

EXHIBIT I APPENDIX XIII FILE: NUEC. 603-221

97-528 O-68 (Face p. 146)

REVIEW OF REPORTS ON

PORT ARANSAS-CORPUS CHRISTI WATERWAY, TEXAS

(45-FOOT PROJECT)

APPENDIX IV

ENGINEERING AND COST DATA

97-528 O-68—11

REVIEW OF REPORTS ON
PORT ARANSAS-CORPUS CHRISTI WATERWAY, TEXAS
(45-FOOT PROJECT)

APPENDIX IV
ENGINEERING DATA AND COST ESTIMATES

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PORT ARANSAS-CORPUS CHRISTI WATERWAY, TEXAS
(45-FOOT PROJECT)

APPENDIX IV

ENGINEERING AND COST DATA

1. General.- This appendix presents engineering and cost data pertinent to studies to determine the advisability of modifying the existing project for the Port Aransas-Corpus Christi Waterway, Texas. Data presented in this appendix relate particularly to design considerations, subsurface conditions, detailed estimates of first costs, investments, and annual charges for the proposed plan of improvement, and a summary of the first costs for other improvements considered but not recommended for construction at this time.

2. Improvements considered.- The existing project provides generally for a 40-foot by 400-foot main channel from the Gulf of Mexico to the city of Corpus Christi, for 40-foot by 200-foot channel extensions to Tule Lake and Viola, for a 36-foot by 200-foot branch channel to La Quinta, and for shallow-draft improvements at Port Aransas and in Jewel Fulton Canal near Ingleside. All improvements desired by navigation interests at this time concern enlargement of the deep-draft portions of the waterway.

3. The existing main channel is adequate for general use of tankers and ore carriers up to about 40,000 d.w.t. with fully loaded drafts of up to 36 feet. La Quinta Channel is being used by ore carriers of up to about 33,000 d.w.t. with 35 feet draft. A channel bottom width of 400 feet is adequate for two-way passage of a 40,000 d.w.t. vessel and a smaller vessel, but is not adequate for passage of two 40,000 d.w.t. vessels. The 200-foot bottom width of Tule Lake, Viola, and La Quinta channels is adequate for one-way traffic of deep-draft vessels only. Local interests generally desire enlargement of the waterway to accommodate prospective two-way traffic by tankers and bulk carriers with size greater than 40,000 d.w.t.

4. For various reasons stated in the report text, preliminary examinations found that certain improvements requested by local interests did not warrant further consideration and detailed investigation. Desired improvements that were investigated are: deepening of existing 40-foot and 36-foot channels to 45-foot depth; enlargement of the maneuvering area of the Inner Basin at Harbor Island; widening of the existing 400-foot main channel to 600 feet in the reach upstream from the Inner Basin and in front of the Humble Company wharves at Harbor Island, and to 500 feet thence to Corpus Christi; widening of the 350-foot channel to the Chemical turning basin to 500 feet; widening of the 200-foot Tule Lake and Viola channels to 400 feet; widening of the 200-foot La Quinta channel to 300 feet; enlargement of the turning areas at the Avery Point, Chemical, Tule Lake, Viola, and La Quinta turning basins; and construction of a deep-draft inshore mooring area.

5. Various increments of additional depth and width were investigated in conjunction with analysis of the prospective commerce to determine the costs and benefits associated with each increment. The maximum depth investigated was 48 feet, which would accommodate fully loaded vessels up to about 72,000 d.w.t. Three alternatives to overall deepening of the waterway were investigated in a preliminary manner. An alternate plan for transporting petroleum and petroleum products to Houston, Texas City, and Port Arthur, Texas, was investigated only briefly in view of the unquestioned high costs of the plan. Appendix III of this report contains the results of studies for the other two alternative plans; an offshore loading terminal in the Gulf of Mexico, and a common loading terminal inshore at Harbor Island.

6. Plan of improvement.- The plan of improvement, selected on the basis of formulation procedures, provides for a general increase in project depths of 5 feet. This would increase the depth of the outer bar channel to 47 feet and increase to 45 feet the depth of all inland channels from Aransas Pass entrance to and including the turning basins at Corpus Christi, and including the branch channel to La Quinta, where the existing depth would be increased 9 feet. The main channel across the easterly portion of Corpus Christi Bay would be enlarged to provide a minimum channel width of 500 feet from the junction of the La Quinta and main channels to the gulf entrance. The channel from Avery Point to the Chemical turning basin would be widened 50 feet to a total width of 400 feet, and the Tule Lake, Viola, and La Quinta channels would be widened 100 feet to total widths of 300 feet. Increased widths would be provided for the Inner Basin at Harbor Island, and for the Avery Point, Chemical, Tule Lake, Viola, and La Quinta turning basins. The outer bar channel would be extended about 1.2 miles to reach the natural depth of 47 feet in the Gulf of Mexico. Inshore deep-draft mooring areas and facilities would be located along the main channel in the vicinity of Port Ingleside. The junction of the main and La Quinta channels would be enlarged to provide a turning point at that location.

7. Design considerations for channels and turning points.- Based on the project evaluation studies outlined in appendix II of this report, a vessel of 59,000 d.w.t. was selected as the design vessel. The general characteristics of tankers and bulk carriers in the 1964 World Fleet varying from 20,000 d.w.t. to 100,000 d.w.t. are listed in table J of this appendix. From this table, the design vessel has draft of 41 feet, length overall of 800 feet, and beam width of 110 feet.

8. 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 advise that uneven loading of the vessel by the stern, or trim, of from 2 to 3 feet frequently is advisable, and an allowance of 1 foot to this factor is considered warranted. The squat or sinkage of a vessel 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 the 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 supertankers and bulk carriers up to 59,000 d.w.t. moving at speeds up to 5 knots in channels 300 feet wide and 45 feet deep, and moving at speeds of from 6 to 8 knots in channels from 400 feet to 500 feet wide and 45 feet deep. An allowance of 2 feet for clearance between the keel of the vessel and the bottom of the channel is considered adequate in channels such as the Port Aransas-Corpus Christi Waterway which have soft bottoms. These factors give a total required channel depth 4 feet greater than the mean draft of the design vessel. From these considerations, a channel depth of 45 feet would accommodate fully loaded vessels up to 59,000 d.w.t.

9. Based on criteria contained in chapter 10 of the Tidal Hydraulics Committee Report No. 3, dated 1965, indicated channel widths are: 300 feet for one-way traffic of vessels of 59,000 d.w.t. with beams of 110 feet; 400 feet for the passing of a large cargo vessel of 15,000 d.w.t. with beam of 75 feet and a tanker of 59,000 d.w.t. with beam of 110 feet; and 500 feet for the passing of two tankers of 59,000 d.w.t. and beams of 110 feet. Also from THC Report No. 3, the turning area indicated for 59,000 d.w.t. vessels with length of 800 feet would be a circular area having a diameter of 1,200 feet. Derivation of these dimensions is illustrated on exhibit 2 of this appendix.

10. The prospective bulk materials movements for the various waterway reaches by the years 2000 and 2025 were analyzed to determine the prospective tanker or bulk carrier traffic, and to determine whether the trips by large vessels from 40,000 d.w.t. to 59,000 d.w.t. would be of sufficient frequency to warrant provision for two-way traffic of these vessels. Estimates were made of the percentage of prospective bulk material commerce that would move in vessels with drafts less than 36 feet, and of the percentage that would be transported by vessels with drafts greater than 36 feet, for the years 2000 and 2025. Average capacities were estimated for vessels with drafts less than 36 feet, and greater than 36 feet, that are now transporting the various commodities, and similar capacities were estimated for the future traffic. By dividing the estimated percentages of commerce by the estimated vessel capacities, estimates of annual vessel trips were derived. The computations for, and summary of, the estimated trips by vessels requiring less than 36 feet draft and greater than 36 feet draft, for years 1964, 2000, and 2025, are shown in table K of this appendix. Existing and prospective traffic by vessels with drafts greater than 36 feet at Harbor Island, Ingleside, junction of the main and La Quinta channels, and Corpus Christi are illustrated by figure 3 in the report. From the foregoing analysis it was concluded that, prior to the year 2025, traffic density in the main channel would be sufficient to require provision for two-way traffic by vessels with drafts greater than 36 feet. However, traffic density in the main channel upstream from the La Quinta Channel junction would not be sufficient to require provision for two-way traffic by 36 feet and greater draft vessels until about the year 2000.

11. Cost estimates and annual charges.- Detailed estimates of first costs and annual charges for work included in the plan of improvement are shown in tables C through H of this appendix. Table A of this appendix summarizes the first costs, annual charges, annual benefits, and benefit-costs ratios of the recommended plan. Table B of this appendix summarizes the first costs for improvements investigated but not included in the plan of improvement. The estimates of first costs include the costs of construction, lands and damages, engineering, design, supervision and administration. Estimates of annual charges include interest and amortization of the investment over a 50-year period, and the additional annual maintenance costs of the improvements to the waterway project. For computing the Federal and non-Federal annual charges, an interest rate of 3.25 percent was used.

12. Contingency allowances of 15 percent for dredging and mooring dolphin construction, 20 percent for relocation or alteration of structures, and 25 percent for lands, damages, and construction of spoil area levees and spillways, are included in the cost estimates. Unit prices used in the cost estimates are based on the average prevailing construction costs for the area as of April 1968. Estimates for dredging of the inland channels and basins are based on the use of a pipeline dredge with a 27-inch discharge, having a monthly output of 600,000 cubic yards. Estimates for dredging from the Gulf of Mexico to the Inner Basin at Harbor Island are based on the use of the Corps of Engineers' hopper dredge "McFarland." The estimated additional quantities of materials to be removed in connection with maintenance of the various reaches, based on experienced shoaling rates in the waterway, and the respective additional maintenance costs for the reaches are:

Reach of waterway	Additional annual shoaling (cu. yds.)	Additional annual maintenance cost
Outer Bar and Jetty Channels to and including Inner Basin	37,000	$ 9,000
Main Channel:		
Inner Basin to Ferry Landing	45,000	17,000
Ferry Landing to La Quinta Channel, including turning point	91,000	16,000
La Quinta Channel to Corpus Christi turning basin	68,000	13,000
Corpus Christi turning basin	44,000	11,000
Corpus Christi turning basin to Tule Lake turning basin	60,000	12,000
Subtotals, 45-foot project to Tule Lake turning basin	345,000	78,000
La Quinta Channel and turning basin	151,000	35,000
Viola Channel and turning basin	35,000	7,000
Totals, plan of improvement	531,000	120,000

13. Lands and damages.- Estimates of the costs for rights-of-way are based on the present value of the lands. Upland spoil disposal areas used for construction and maintenance of the existing project would be utilized in enlarging the inland channels and basins. No additional lands for spoil disposal purposes would be required. However, one new levee system would be required for La Quinta Channel at Ingleside Point, and existing levees at Corpus Christi would need rehabilitation and raising. Materials excavated in open water areas would be placed in established spoil disposal areas along the waterway.

14. Subsurface investigations.- A large number of 3-inch Shelby tube borings were made to depths of about 50 feet in connection with dredging the existing 40-foot and 36-foot project channels. Exhibit 1 of this appendix shows the locations and logs of typical borings obtained during the prior soils investigations. Additional borings were made at the site of the requested anchorage area near Harbor Island, and two of the additional borings are shown on exhibit 1.

15. The materials to be encountered in enlarging the channels and basins consist of soft clays and silts, and sands varying from loose to very dense. Caliche is encountered occasionally upstream from the Corpus Christi main turning basin, and is encountered along most of the reach of main channel between station 250+00 and La Quinta Channel. It is believed that the caliche encountered in the borings can be removed by pipeline dredge; however, some caliche may be encountered that would require special dredging operations.

16. Overdepth and side slopes.- All estimated quantities of materials to be dredged include allowances for overdepth dredging over the channel bottom width. Except for two reaches of La Quinta Channel, the allowances include 2 feet for advance maintenance, which is considered required overdepth, plus 2 feet of allowable overdepth in open water areas or 1 foot of allowable overdepth in landlocked channels and basins. Because of high shoaling rates in La Quinta Channel between mile 0 and mile 0.6, and between mile 3.4 and the upper end of the turning basin at mile 5.4, advance maintenance allowances of 6 feet and 4 feet respectively were included in the quantity estimates. Quantities were computed for channel side slopes of 1 vertical on 3 horizontal for the main channel from the Gulf of Mexico to Corpus Christi, 1 vertical on 2 horizontal from Corpus Christi turning basin to Viola turning basin, and 1 vertical on 1.5 horizontal in La Quinta channel and turning basin. The side slopes would extend from the bottom limits of the required overdepth dredging.

17. Alteration of structures.- The project would require alteration of 30 navigation aids and 8 submarine pipelines. No piers, wharves, bulkheads, or similar structures would need alteration or removal. Navigation aids to be altered are: on main channel - 18 minor lights; Tule Lake channel - 5 ranges; Viola channel - 2 ranges; and La Quinta channel - 2 ranges and 3 minor lights. One new minor light would be required for Viola channel. All cost estimates in connection with the navigation aids

were furnished by the U. S. Coast Guard. The pipelines to be altered are located: one in Corpus Christi Bay, four in the Industrial Canal, and three in La Quinta channel. All known pipeline crossings are located on the report plates, and those crossings to be altered have been identified.

18. Mooring area considerations.- Without an inshore anchorage or mooring area, vessels awaiting berthing areas along the waterway, or being delayed from entering the waterway because of weather conditions, must anchor in the Gulf of Mexico. The periods of offshore anchorage last from several hours up to several days. During much of these periods, transportation of crews to shore in small boats, and boarding of the vessels by Customs Inspectors, Public Health Officers, and other officials, is not possible because of rough seas. The requested anchorage basin would have provided for three ships. At the inshore area, small boat traffic would have been possible to and from shore most of the time. The ships could receive fresh water and other supplies by barge, and preliminary preparations towards receiving or discharging cargo could be made.

19. Based on the district's experience of constructing and maintaining large basins and anchorage areas, it was evident that the requested anchorage not only would have a large first cost but would have high maintenance costs. Although inshore, the anchorage would still be exposed to the wind due to lack of high terrain. The large surface area of the basin would permit the generation of sizable wind waves that could make small boat navigation hazardous. Investigations for a suitable alternate facility found that an off-channel mooring area near Port Ingleside would have many advantages over the Harbor Island site. The high bluffs of Ingleside Point would provide wind protection from "Northers" during the winter season. Existing spoil banks on the south side of the main channel would prevent appreciable build-up of wind waves during the prevailing south and southeasterly winds in the summer months. The landing site for personnel and service vessels would be several miles closer to Corpus Christi. When access to berthing spaces became available, less travel distance and time in moving vessels to their destination would be involved.

20. A 150-foot wide mooring area would be adequate for the design vessel, with 110-foot beam width, together with an alongside service barge. By spacing mooring dolphins at distances of from 250 feet to 400 feet apart, the facilities could be used by ships varying in size from small general cargo vessels up to those somewhat larger than the design vessel. The locations of two mooring areas selected for the plan of improvement are shown on plates 2 and 3. A spacing layout for 13 mooring dolphins in the areas is shown on plate 2. The plan of improvement contemplates initial construction of mooring area A and three pairs of dolphins. Construction of the remaining dolphins in area A, and construction of area B and its dolphins, would be deferred until there was demonstrated need for the additional facilities. The spacing of the dolphins to be constructed first in area A is such that, when remaining intermediate dolphins are constructed, usable distances between the dolphins would result.

21. Design of mooring dolphins.- The recommended dolphins would be similar, except for a larger diameter of the cell, to existing steel sheet pile structures in use by another district for the mooring of hopper dredges. General details of the dolphins are shown on exhibit 3 of this appendix. Because of greater project depth at the proposed mooring basin, longer piling would be needed. Otherwise, the existing and proposed dolphins would be substantially the same. The estimated costs for the proposed dolphins are based on average prevailing marine construction costs for the area as of April 1968. Because of their location in open waters, the proposed dolphins would be appropriately marked by navigation lights.

22. Soil borings in the vicinity of the mooring area indicate that caliche may be encountered in driving the piling of the dolphins. There are two steel sheet pile mooring dolphins at the oil terminal facilities in the adjacent Sun Pipe Line Company basin. Existence of these similar structures in the immediate area indicates that no unusually difficult construction problems should be involved.

23. Preauthorization study costs.- The sum of $122,000 has been expended for preauthorization survey and study costs including preparation of the report. The cost estimates in this appendix are exclusive of the preauthorization study costs.

24. Mileage table.- For reference purposes, a mileage table showing distances from the gulf end of the jetty channel to points along the waterway is shown on table I. Distances shown for La Quinta Channel are measured from the recommended turning point at its former junction with the main channel.

TABLE A

SUMMARY OF FIRST COSTS, ANNUAL CHARGES, ANNUAL BENEFITS AND B/C RATIOS FOR PLAN OF IMPROVEMENT

Item	Main channel	Viola Channel	La Quinta Channel	Total
Federal first cost				
Corps of Engineers	$12,939,000	$ 761,500	$1,896,500	$15,597,000 1/
U. S. Coast Guard	120,000	26,000	33,000	179,000
Total Federal first cost	13,059,000	787,500	1,929,500	15,776,000
Non-Federal first cost				
Non-Federal public	321,000	932,500	1,953,000	3,207,000 2/
Non-Federal private	694,000	None	397,000	1,091,000
Total non-Federal first cost	1,015,000	932,500	2,350,500	4,298,000
Total first cost	14,074,000	1,720,000	4,280,000	20,074,000
Federal annual charges				
Corps of Engineers	$ 677,000	$ 38,000	$ 112,200	$ 827,200
U. S. Coast Guard	4,900	1,400	1,400	7,700
Total Federal annual charges	681,900	39,400	113,600	834,900
Non-Federal annual charges				
Non-Federal public	15,000	38,700	79,700	133,400
Non-Federal private	28,300	0	16,200	44,500
Total non-Federal annual charges	43,300	38,700	95,900	177,900
Total annual charges	725,200	78,100	209,500	1,012,800
Average annual equivalent benefits	$ 1,669,300	$ 162,600	$1,032,200	$ 2,864,100
B/C ratio	2.3	2.0	4.9	2.8

1/ Use $15,600,000 for funds required for construction exclusive of deferred work (7 dolphins and dredging mooring area "B") with estimated first cost of $787,000.

2/ Includes cash contributions as follows:

For Viola Channel improvements	$ 761,500
For La Quinta Channel improvements	1,896,500
Total non-Federal cash contribution	$2,658,000

TABLE B

ESTIMATES OF FIRST COSTS FOR INVESTIGATED IMPROVEMENTS

Item	Main Channel	Anchorage Basin (Mooring Area)	Viola Channel	La Quinta Channel	Total
43-foot project 1/					
Federal first costs					
Corps of Engineers	$ 8,890,000	$ 860,000	$ 660,000	$1,598,500	$12,008,500
Coast Guard	120,000	0	26,000	33,000	179,000
Total, Federal	9,010,000	860,000	686,000	1,631,500	12,187,500
Non-Federal first cost					
Public	151,000	0	816,000	1,621,500	2,588,500
Private	694,000	0	None	397,000	1,091,000
Total, Non-Federal	845,000	0	816,000	2,018,500	3,679,500
Total first costs	9,855,000	860,000	1,502,000	3,650,000	15,867,000
Annual charges					
Federal	457,900	84,000	34,600	98,600	675,100
Non-Federal	35,800	0	33,800	82,300	151,900
Total	493,700	84,000	68,400	180,900	827,000
48-foot project 1/					
Federal first costs					
Corps of Engineers	17,307,000	1,030,000	903,000	2,193,500	21,433,500
Coast Guard	120,000	0	26,000	33,000	179,000
Total, Federal	17,427,000	1,030,000	929,000	2,226,500	21,612,500
Non-Federal first costs					
Public	430,000	0	1,091,000	2,222,500	3,743,500
Private	3,540,000	0	158,000	411,000	4,109,000
Total, Non-Federal	3,970,000	0	1,249,000	2,633,500	7,852,500
Total first costs	21,397,000	1,030,000	2,178,000	4,860,000	29,465,000
Annual charges					
Federal	832,900	91,000	46,200	130,800	1,109,000
Non-Federal	163,800	0	45,300	107,500	323,000
Total	996,700	91,000	97,900	238,300	1,423,900
Requested improvements 2/					
Federal first costs					
Corps of Engineers	17,050,000	9,340,000	1,505,000	1,535,000	29,430,000
Coast Guard	135,000	14,000	22,000	33,000	204,000
Total, Federal	17,185,000	9,354,000	1,527,000	1,568,000	29,634,000
Non-Federal first costs					
Public	945,000	387,000	2,085,000	1,561,000	4,978,000
Private	694,000	None	None	397,000	1,091,000
Total, Non-Federal	1,639,000	387,000	2,085,000	1,958,000	6,069,000
Total first costs	18,824,000	9,741,000	3,612,000	3,526,000	35,703,000

1/ Channel and basin widths same as for recommended 45-foot project.

2/ 45' × 500' main channel from Harbor Island to Corpus Christi; 45' × 500' channel between Avery Point and Chemical turning basins; 45' × 400' channel between Chemical and Viola turning basins; 45' × 300' in the Channel to La Quinta; and 41' × 4,000' to 7,500' long anchorage basin.

TABLE C

ESTIMATES OF FIRST COSTS FOR
45-FOOT PROJECT TO TULE LAKE TURNING BASIN

Item No.	Item	Unit	Quantity	Unit price	Cost
1.	Federal first cost				
	a. Corps of Engineers				
	(09.0) Channels				
	(1) Outer bar channel	C.Y.	1,884,000	$0.32	$ 602,880
	(2) Jetty channel	C.Y.	1,156,000	0.38	439,280
	(3) Inner Basin to ferry landing	C.Y.	1,244,000	0.43	534,920
	(4) Ferry landing to La Quinta junction	C.Y.	11,391,000	0.38	4,328,580
	(5) La Quinta junction to C.C.T.B.	C.Y.	6,197,000	0.17	1,053,490
	(6) Corpus Christi Turning Basin	C.Y.	790,000	0.34	268,600
	(7) C.C.T.B. to Chemical T.B.	C.Y.	1,531,000	0.34	520,540
	(8) Chemical Turning Basin	C.Y.	1,103,000	0.35	386,050
	(9) Chemical T.B. to and including Tule Lake T.B.	C.Y.	3,794,000	0.35	1,327,900
	(10) Turning point at La Quinta junction	C.Y.	800,000	0.27	216,000
	(11) Mooring area "A"	C.Y.	390,000	0.37	144,300
	(12) Mooring dolphins 1/	Ea.	6	67,500.00	405,000
	Subtotal				10,227,540
	Contingencies (15% ±)				1,534,460
	Total, channels				11,762,000
	(30.0) Engineering and design (3.5%)				412,000
	(31.0) Supervision and administration (4.0%, S&I; 2.5%, OH)				765,000
	Total Corps of Engineers				12,939,000
	b. U. S. Coast Guard				
	(1) Relocate 18 minor lights				54,000
	(2) Relocate 5 ranges (Tule Lake Channel)				50,000
	Subtotal				104,000
	Contingencies (15% ±)				16,000
	Total U. S. Coast Guard				120,000
	c. Federal first cost				
	(1) Corps of Engineers				12,939,000
	(2) U. S. Coast Guard				120,000
	Total Federal first cost				13,059,000

1/ See end of table C for further breakdown of this item.

TABLE C (Cont'd)

Item No.	Item	Unit	Quantity	Unit price	Cost
2.	Non-Federal first cost				
	a. Non-Federal public				
	(1) Acquisition cost	Ownership	2	$ 800.00	$ 1,600
	(2) Rights-of-way				
	(a) PACC channel (@ Pt. Aransas)	Acres	3	1,000.00	3,000
	(b) C.C.T.B. to Tule Lake T.B.	Acres	16	7,500.00	120,000
		Acres	24	2,500.00	60,000
	(3) Spoil area	-	-	-	None
	(4) Levees	Job	L.S.	72,000.00	72,000
	Subtotal				256,600
	Contingencies (25% ±)				64,400
	Total non-Federal public				321,000
	b. Non-Federal private				
	(1) Relocate Tenn. Gas Transmission Co. 1-12" gas pipeline @ mile 9.7				122,000
	(2) Relocate Halliburton Portland Cement Co. 1-6" pipeline @ mile 24.1				113,000
	(3) Relocate Gulf Refining Co. 1-6" oil pipeline @ mile 24.1				113,000
	(4) Relocate Sunray Coastal Pipeline Co. 1-8" pipeline @ mile 24.1				115,000
	(5) Relocate Republic Oil Co. 1-8" pipeline @ mile 24.1				115,000
	Subtotal				578,000
	Contingencies (20% ±)				116,000
	Total non-Federal private				694,000
	c. Non-Federal first cost				
	(1) Non-Federal public				321,000
	(2) Non-Federal private				694,000
	Total non-Federal first cost				1,015,000
3.	Total first cost				
	a. Federal				13,059,000
	b. Non-Federal				1,015,000
	Total first cost				14,074,000

TABLE C (Cont'd)

SUPPLEMENTAL COST BREAKDOWN FOR ONE
37-FOOT DIAMETER MOORING DOLPHIN

Item	Unit	Quantity	Unit price	Cost
SA-23 steel sheet piling, 85' long	S.F.	9,860	$ 4.50	$44,370
Mooring post	Ea.	1	1,390.00	1,390
Steel bracing	L.F.	102	8.00	816
Steel band plates	L.F.	232	15.00	3,480
Rubber fenders and hardware	L.F.	75	75.00	5,625
Steel backing plates for rubber fenders	L.F.	75	30.00	2,250
Timber piling, 65' long	L.F.	650	4.00	2,600
Concrete for mooring post and dolphin cap	C.Y.	16	80.00	1,280
Soil fill	C.Y.	2,170	0.50	1,085
Steel cable, 1" dia.	L.F.	600	2.00	1,200
Miscellaneous hardware	Job	L.S.	1,800.00	1,800
Epoxy coating, steel sheet piling	S.F.	3,016	0.50	1,508
Total cost of dolphin				67,404
			Use	67,500

TABLE D

ESTIMATES OF FIRST COST FOR
VIOLA CHANNEL 45-FOOT PROJECT

Item No.	Item	Unit	Quantity	Unit price	Cost
1.	Channels				
	a. Dredging	C.Y.	3,200,000	$ 0.37	$1,184,000
	Contingencies (15% ±)				181,000
	Subtotal, dredging				1,365,000
	b. Engineering and design (4%)				55,000
	c. Supervision and administration (4.5% S&I; 3.0% OH)				103,000
	d. Subtotal, channels				1,523,000
2.	Levees and spillways	Job	L.S.	64,000.00	64,000
	Contingencies (20%)				13,000
	Subtotal, levees and spillways				77,000
3.	Relocations				None
4.	Lands and damages				
	a. Rights-of-way	Acres	29	2,500.00	72,500
	b. Spoil disposal areas	-	-	-	None
	c. Acquisition cost	Ownership	3	800.00	2,400
	Contingencies (25%)				19,100
	d. Subtotal, lands and damages				94,000
5.	Navigation aids				
	a. Range relocations	Ea.	2	10,000.00	20,000
	b. Establishment of minor light	Ea.	1	3,000.00	3,000
	Contingencies (15%)				3,000
	c. Subtotal, navigation aids				26,000
6.	Total, first costs				1,720,000

TABLE E

ESTIMATES OF FIRST COSTS FOR
LA QUINTA CHANNEL 45-FOOT PROJECT

Item No.	Item	Unit	Quantity	Unit price	Cost
1.	Channels				
	a. Dredging	C.Y.	8,755,000	$0.34	$2,976,700
	Contingencies (15%)				446,300
	Subtotal, dredging				3,423,000
	b. Engineering and design (3.8%)				130,000
	c. Supervision and administration (4%, S&I, 3%, OH)				240,000
	d. Subtotal, channels				3,793,000
2.	Levees and spillways				
	a. Rehabilitation of existing levees	Job	L.S.	7,500	7,500
	b. New levee and spillway on Ingleside Point	Job	L.S.	24,000	24,000
	Contingencies (20%)				6,500
	c. Subtotal, levees and spillways				38,000
3.	Relocations				
	a. United Gas Pipeline Co. 1-10" natural gas line at mile 2.0	Job	L.S.	113,000	113,000
	b. Arkansas Fuel Oil Co. 1-2½" gas pipeline at mile 2.0	Job	L.S.	103,000	103,000
	c. Tennessee Gas Transmission Co. 1-12" gas pipeline at mile 3.3	Job	L.S.	115,000	115,000
	Contingencies (20%)				66,000
	d. Subtotal, relocations				397,000
4.	Lands and damages				
	a. Rights-of-way	Acres	15	900.00	13,500
	b. Spoil disposal areas	-	-	-	None
	c. Acquisition cost	Ownership	2	800.00	1,600
	Contingencies (25%)				3,900
	Subtotal, lands and damages				19,000
5.	Navigation aids				
	a. Range relocations	Ea.	2	10,000	20,000
	b. Minor light relocations	Ea.	3	3,000	9,000
	Contingencies (15%)				4,000
	c. Subtotal, navigation aids				33,000
6.	Total first costs				4,280,000

TABLE F

APPORTIONMENT OF COSTS FOR 45-FOOT PROJECTS IN VIOLA AND LA QUINTA CHANNELS

Item No.	Item	Cost: Viola Channel	Cost: La Quinta Channel
1.	Federal share of first costs		
	a. Corps of Engineers, construction	$ 761,500	$1,896,500
	b. U. S. Coast Guard	26,000	33,000
	Total, Federal share of first costs	787,500	1,929,500
2.	Non-Federal share of first costs		
	a. Non-Federal public		
	(1) Lands and damages - acquisition costs, R-O-W, and spoil areas	94,000	19,000
	(2) Levees and spillways	77,000	38,000
	(3) Cash contribution, construction	761,500	1,896,500
	Total non-Federal public	932,500	1,953,500
	b. Non-Federal private, relocations	None	397,000
	Total, non-Federal share of first costs	932,500	2,350,500
3.	Total project first costs	1,720,000	4,280,000

TABLE G

ESTIMATES OF INVESTMENTS AND ANNUAL CHARGES FOR
45-FOOT PROJECT TO TULE LAKE TURNING BASIN

Item No.	Item	Cost
	Estimated construction period (months) (Benefits accrue as work progresses)	48
1.	Federal investment	
	a. Corps of Engineers	
	(1) Initial investment	$12,939,000
	(2) Deferred investment	1,320,000 1/
	Total Corps of Engineers investment	14,259,000
	b. U. S. Coast Guard	120,000
	Total Federal investment	14,379,000
2.	Federal annual charges	
	a. Corps of Engineers	
	(1) Initial investment ($12,939,000)	
	(a) Interest and amortization (4.073%)	527,000
	(b) Additional annual maintenance) dredging	78,300
	) dolphins	10,700
	Subtotal Corps of Engineers annual charges	616,000
	(2) Deferred investments ($1,320,000 x .44592 = $588,600)	
	(a) Interest and amortization (4.073%)	24,000
	(b) Additional annual maintenance) dredging	3,400
	) dolphins	33,600
	Subtotal Corps of Engineers annual charges	61,000
	Total Corps of Engineers annual charges	677,000
	b. U. S. Coast Guard	
	(1) Interest and amortization (4.073%)	4,900
	(2) Maintenance and advance replacement	None
	Total U. S. Coast Guard	4,900
	c. Total Federal annual charges	681,900
3.	Non-Federal investment	
	a. Non-Federal public	321,000
	b. Non-Federal private	694,000
	Total non-Federal investment	1,015,000

1/ Includes $787,000 for deferred work (7 dolphins and dredging mooring area "B") and $533,000 for replacement of original 6 dolphins.

TABLE G (Cont'd)

Item No.	Item	Cost
4.	Non-Federal annual charges	
	a. Non-Federal public	
	(1) Interest and amortization	$ 13,000
	(2) Additional annual maintenance (levees, spillways)	2,000
	Total non-Federal public	15,000
	b. Non-Federal private	
	(1) Interest and amortization	28,300
	(2) Maintenance	None
	Total non-Federal private	28,300
	c. Total non-Federal annual charges	43,300
5.	Total annual charges	
	a. Federal	681,900
	b. Non-Federal	43,300
	Total annual charges	725,200

TABLE H

ESTIMATES OF INVESTMENTS AND ANNUAL CHARGES FOR
45-FOOT PROJECTS IN VIOLA AND LA QUINTA CHANNELS

Item No.	Item	Cost: Viola Channel	Cost: La Quinta Channel
	Estimated construction period (months)	5	14
1.	Federal investment		
	a. Corps of Engineers	$761,500	$1,896,500
	b. U. S. Coast Guard	26,000	33,000
	Total Federal investment	787,500	1,929,500
2.	Federal annual charges		
	a. Corps of Engineers	($761,500)	($1,896,500)
	(1) Interest on investment (3.25%)	24,700	61,600
	(2) Amortization, 50 years (.823%)	6,300	15,600
	(3) Additional maintenance - dredging	7,000	35,000
	Total Corps of Engineers	38,000	112,200
	b. U. S. Coast Guard	($26,000)	($33,000)
	(1) Interest on investment (3.25%)	800	1,100
	(2) Amortization, 50 years (.823%)	200	300
	(3) Additional maintenance - navigational aids	400	None
	Total U. S. Coast Guard	1,400	1,400
	c. Total Federal annual charges	39,400	113,600
3.	Non-Federal investment		
	a. Non-Federal public	932,500	1,953,500
	b. Non-Federal private	None	397,000
	Total non-Federal investment	932,500	2,350,500
4.	Non-Federal annual charges		
	a. Non-Federal public	($932,500)	($1,953,500)
	(1) Interest on investment (3.25%)	30,300	63,500
	(2) Amortization, 50 yrs (.823%)	7,700	16,100
	(3) Additional maintenance - levees and spillways	700	100
	Total non-Federal public annual charges	38,700	79,700
	b. Non-Federal private	(0)	($397,000)
	(1) Interest on investment (3.25%)	None	12,900
	(2) Amortization, 50 yrs (.823%)	None	3,300
	Total non-Federal private annual charges	0	16,200
	c. Total non-Federal annual charges	38,700	95,900
5.	Total annual charges		
	a. Federal	39,400	113,600
	b. Non-Federal	38,700	95,900
	Total annual charges	78,100	209,500

TABLE I

MILEAGE TABLES

PORT ARANSAS-CORPUS CHRISTI WATERWAY

Mile	Item
-2.5	Outer end of recommended 47' × 700' outer bar channel
0	Start of transition from 47' × 700' outer bar channel to 45' × 600' jetty channel; outer end of South Jetty
0.2	Outer end of recommended 45' × 600' jetty channel
2.0	Inner Basin at Harbor Island; junction with Port Aransas, Aransas Pass and Lydia Ann Channels
2.3	Humble wharves and basin at Harbor Island
5.4	Requested 2000' × 4000' anchorage basin
10.3	GIWW main channel junction
10.7	Sun Pipe Line Co. wharf and basin at Ingleside
11.7	La Quinta channel junction
11.9	Midpoint recommended 1200' dia. turning point
12.5	GIWW main channel junction; Encinal Channel junction
22.6	U. S. Highway 181 bridge (Corpus Christi Harbor Bridge)
22.7 to 23.7	Main turning basin
24.7 to 25.0	Avery Point turning basin
25.7 to 26.0	Chemical turning basin
26.4	Upper Harbor Br. (Navigation Blvd/RR)
29.0 to 29.2	Tule Lake turning basin
31.0 to 31.3	Viola turning basin

La Quinta Channel

0	Junction with PA-CC WW main channel
2.2	Junction with Jewel Fulton Canal
5.6 to 5.8	La Quinta turning basin

TABLE J

GENERAL CHARACTERISTICS OF TANKERS AND BULK CARRIERS
IN 1964 WORLD FLEET

Deadweight tons	Draft (feet)	Length overall (feet)	Beam (feet)
20,000	30	570	75
24,000	32	605	78
27,000	33	625	82
31,000	34	650	86
35,000	35	670	90
40,000	36	690	94
43,000	37	720	97
47,000	38	750	100
51,000	39	770	104
55,000	40	790	108
59,000	41	800	110
63,000	42	810	112
67,000	43	825	115
72,000	44	835	118
79,000	45	845	121
85,000	46	850	124
90,000	47.5	860	126
95,000	49	860	128
100,000	50	860	130

TABLE K

ANALYSIS TO DETERMINE
EXISTING AND PROSPECTIVE TRAFFIC BY TANKER/BULK CARRIER VESSELS

ESTIMATED DEEP-DRAFT BULK MATERIAL MOVEMENTS BY TERMINAL AREAS (TONS)

Terminal area	Port of Corpus Christi			La Quinta Channel			Ingleside			Harbor Island			Totals		
Year	1964	2000	2025	1964	2000	2025	1964	2000	2025	1964	2000	2025	1964	2000	2025
Commodity															
Petroleum, crude	619,161	800,000	800,000	0	0	0	1,864,991	2,100,000	2,100,000	3,923,289	4,600,000	4,600,000	6,407,441	7,500,000	7,500,000
Petroleum, products	6,878,985	10,430,000	13,209,000	68,487	100,000	221,000	132,248	230,000	290,000	93,494	140,000	180,000	7,193,214	10,900,000	13,900,000
Bauxite	0	0	0	3,093,487	6,600,000	10,000,000	0	0	0	2,241,494		0	5,334,981	6,600,000	10,000,000
Other ores	134,683	145,000	150,000	0	0	0	0	0	0	486	0	0	135,169	145,000	150,000
Grain	1,722,350	5,200,000	5,200,000	0	0	0	0	0	0	0	0	0	1,722,350	5,200,000	5,200,000
Chemicals	404,941	1,600,000	4,000,000	0	0	0	0	0	0	0	0	0	404,941	1,600,000	4,000,000
MEC	322,054	425,000	500,000	1,082	0	0	0	0	0	2,140	0	0	325,276	425,000	500,000
Totals	10,082,174	18,600,000	23,859,000	3,163,056	6,700,000	10,221,000	2,017,239	2,330,000	2,390,000	6,260,903	4,740,000	4,780,000	21,523,372	32,370,000	41,250,000

	Assumed percentage of traffic by vessels with drafts of:						Assumed average capacity (DWT) for vessels requiring drafts of:			
	Less than 36'	36' and greater	Less than 36'	36' and greater	Less than 36'	36' and greater	Less than 36'	36' and greater	Less than 36'	36' and greater
Year	1964		2000		2025		1964		Future	
Commodity transported										
Petroleum, crude and/or products	90 to 35	10 to 65	60 to 30	40 to 70	30	70	32,000	40,000	35,000	51,000
Bauxite and processed ore	100	0	0	100	0	100	28,000	None	None	55,000
Grain	90	10	50	50	25	75	32,000	40,000	35,000	51,000
Chemicals	100	0	90	10	60	40	22,000	None	24,000	43,000

Computations for estimating vessel (round) trips
by tankers/bulk carriers

Year	Terminal area and commodities handled	Total commerce (tons) (1)	Percent of traffic by vessels with drafts: <36' (2)	>36' (3)	Amount of commerce (tons) moved by vessels with drafts: <36' (4)	>36' (5)	Average DWT of vessels with drafts: <36' (6)	>36' (7)	Number of trips vessels with drafts: <36' (8)	>36' (9)	Total (10)
					(Col.1 x Col.2)	(Col.1 x Col.3)			(Col.4 ÷ Col.6)	(Col.5 ÷ Col.7)	
1964	Port of Corpus Christi										
	Petroleum, crude and products	7,500,000	90	10	6,750,000	750,000	32,000	40,000	210	20	230
	Grain	1,720,000	90	10	1,548,000	172,000	32,000	40,000	48	4	52
	Chemicals	405,000	100	0	405,000	0	22,000	NA	18	0	18
	Subtotal, trips-Corpus Christi								276	24	300
	La Quinta Channel										
	Bauxite and alumina	3,090,000	100	0	3,090,000	0	28,000	NA	110	0	110
	Ingleside										
	Petroleum, crude and products	2,017,000	35	65	700,000	1,317,000	32,000	40,000	21	33	54
	Harbor Island										
	Petroleum, crude and products	4,017,000	50	50	2,000,000	2,017,000	32,000	40,000	62	51	113
	Bauxite	2,241,000	100	0	2,241,000	0	28,000	NA	80	0	80
	Total trips for 1964								549	108	657
2000	Port of Corpus Christi										
	Petroleum, crude and products	11,230,000	60	40	6,738,000	4,492,000	35,000	51,000	193	88	281
	Grain	5,200,000	50	50	2,600,000	2,600,000	35,000	51,000	74	51	125
	Chemicals	1,600,000	90	10	1,440,000	160,000	24,000	43,000	60	4	64
	Subtotal, trips-Corpus Christi								327	143	470
	La Quinta Channel										
	Bauxite and alumina	6,600,000	0	100	0	6,600,000	NA	55,000	0	120	120
	Ingleside										
	Petroleum, crude and products	2,330,000	30	70	699,000	1,631,000	35,000	51,000	20	32	52
	Harbor Island										
	Petroleum, crude and products	4,740,000	30	70	1,422,000	3,318,000	35,000	51,000	41	65	106
	Total trips for 2000								388	360	748
2025	Port of Corpus Christi										
	Petroleum, crude and products	14,000,000	30	70	4,200,000	9,800,000	35,000	51,000	120	192	312
	Grain	5,200,000	25	75	1,300,000	3,900,000	35,000	51,000	37	76	113
	Chemicals	4,000,000	60	40	2,400,000	1,600,000	24,000	43,000	100	37	137
	Subtotal, trips-Corpus Christi								257	305	562
	La Quinta Channel										
	Bauxite and alumina	10,000,000	0	100	0	10,000,000	NA	55,000	0	182	182
	Ingleside										
	Petroleum, crude and products	2,390,000	30	70	717,000	1,673,000	35,000	51,000	20	33	53
	Harbor Island										
	Petroleum, crude and products	4,780,000	30	70	1,434,000	3,346,000	35,000	51,000	41	66	107
	Total trips for 2025								318	586	904

Summary of vessel (round) trips

Terminal area & commodities	Trips by vessels requiring less than 36' draft: 1964	2000	2025	Trips by vessels requiring more than 36' draft: 1964	2000	2025
Port of Corpus Christi						
Petroleum, crude and products	210	192	120	20	88	192
Grain	48	74	37	4	51	76
Chemicals	18	60	100	0	4	37
La Quinta						
Bauxite and alumina	110	0	0	0	120	182
Ingleside						
Petroleum, crude and products	21	20	20	33	32	33
Harbor Island						
Petroleum, crude and products	62	41	41	51	65	66
Bauxite	80	-	-	0	-	-
Cumulative totals						
Corpus Christi	276	327	257	24	143	305
La Quinta	386	327	257	24	263	487
Ingleside	407	347	277	57	295	520
Harbor Island	549	388	518	108	360	586

REVIEW OF REPORTS ON

PORT ARANSAS-CORPUS CHRISTI WATERWAY, TEXAS

(45-FOOT PROJECT)

APPENDIX V

COMMENTS BY OTHER AGENCIES

REVIEW OF REPORTS ON
PORT ARANSAS-CORPUS CHRISTI WATERWAY, TEXAS
(45-FOOT PROJECT)

APPENDIX V

COMMENTS BY OTHER AGENCIES

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REVIEW OF REPORTS ON
PORT ARANSAS-CORPUS CHRISTI WATERWAY, TEXAS
(45-FOOT PROJECT)

APPENDIX V

COMMENTS BY OTHER AGENCIES

INTRODUCTION

In accordance with the Interagency Agreement on Coordination of Water and Related Land Resources Activities approved by the President on May 26, 1954, the recommended plan of improvement was furnished to all Federal agencies believed to have possible interest in navigation improvements to the Port Aransas-Corpus Christi Waterway for field level review. Letters from these agencies containing their views are presented in this appendix.

This appendix also presents letters from the U. S. Coast Guard, furnishing estimates of costs for aids to navigation, and from the Nueces County Navigation District. The navigation district, representing local interests for the project, indicates its acceptance of the recommended plan of improvement, and its willingness to furnish the required items of local cooperation.

TREASURY DEPARTMENT
UNITED STATES COAST GUARD

ADDRESS REPLY TO:
COMMANDER
8TH COAST GUARD DISTRICT
CUSTOMHOUSE
NEW ORLEANS 16, LA.

o-1
3263/CC
Ser 303

July 15, 1964

From: Commander, Eighth Coast Guard District
To: District Engineer, U. S. Army Engineer District Galveston

Subj: Review of Reports on Port Aransas-Corpus Christi Waterway, Texas

Ref: (a) Your ltr., file SWGGW-2b, dated 8 June 1964

1. Enclosed are the estimates as you requested in reference (a). The locations of the new aids are not firm and therefore have been omitted.

OTTIS H. ABNEY
By direction

Encl: (1) Cost estimate

Copy to:
5701/ERI-GALV
7110

PORT ARANSAS-CORPUS CHRISTI WATERWAY
COST ESTIMATES FOR AIDS TO NAVIGATION

	Section of Waterway	Proposed Work	Cost Estimate
1.	Outer Bar Channel Extension	Relocate existing buoyage to mark extension	$ None
2.	Outer Bar Channel	Relocate existing buoyage as required	None
3.	JettyChannel	Relocate existing buoyage as required	None
4.	Inner Basin to Ferry Landing	Relocate: 1 minor light	3,000.00
		Total	$ 3,000.00
5.	Ferry Landing to Corpus Christi Turning Basin	Widening on both sides.	
		Relocate: 25 minor lights	$75,000.00
		Buoyage	None
		Total	$75,000.00
		Widening on one side only.	
		Relocate: 13 Minor lights	$39,000.00
		5 pairs of ranges	55,000.00
		Buoyage	None
		Total	$94,000.00
6.	Industrial Canal	Relocate: 1 range	$10,000.00
		Total	$10,000.00
7.	Channel to Tule Lake	Relocate: 3 minor lights	$ 9,000.00
		1 range	10,000.00
		Buoyage	None
		Total	$19,000.00
8.	Chemical Turning Basin	-	None
9.	Channel to Viola and Viola Turning Basin	Relocate: 2 Minor lights	$ 6,000.00
		1 range	10,000.00
		Establish: 1 minor light	3,000.00
		Total	$19,000.00
10.	Channel to Nuecestown and Nuecestown Turning Basin	Establish: 6 Minor light	$18,000.00
		1 daybeacon	500.00
		4 unlighted buoys 5th class types	2,000.00
		3 lighted buoys 5x11LR types	9,000.00
		Total	$29,500.00
11.	Channel to Clara Driscoll and Clara Driscoll Turning Basin	Establish: 6 Minor lights	$18,000.00
		1 range	10,000.00
		7 unlighted buoys 5th class types	3,500.00
		1 lighted buoy 5x11LR type	3,000.00
		Total	$34,500.00

Enclosure (1)

Section of Waterway	Proposed Work	Cost Estimate
12. Channel to La Quinta and La Quinta Turning Basin	Relocate: 5 Minor lights	$15,000.00
	2 ranges	20,000.00
	Total	$35,000.00
13. Inshore Anchorage Area	Relocate: 2 Minor lights	$ 6,000.00
	Establish: 2 Minor lights	6,000.00
	Total	$12,000.00
14. Channel from Corpus Christi to Nueces Bay	Establish: 1 Lighted buoy 5x11LR type	$ 3,000.00
	5 Unlighted buoys 5th class type	2,500.00
	30 Daybeacons	15,000.00
	Total	$20,500.00

15. There is no additional annual maintenance costs for aids that are being relocated.

16. The estimated life of the new aids are as follows:

Minor light	-	15 years
Range	-	20 years
Daybeacon	-	15 years
Unlighted buoy 5th class type	-	20 years
Lighted buoy 5x11LR type	-	20 years

17. The estimated annual maintenance costs for the aids that will be established is as follows:

Minor light	-	$250.00 per year
Range	-	700.00 per year
Daybeacon	-	40.00 per year
Unlighted buoy 5th class type	-	45.00 per year
Lighted buoy 5x11LR type	-	260.00 per year

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
POST OFFICE BOX 1306
ALBUQUERQUE, NEW MEXICO 87103

January 29, 1968

District Engineer
Corps of Engineers, U. S. Army
P. O. Box 1229
Galveston, Texas 77550

Dear Sir:

By letter dated October 6, 1967, your reference SWGED-P, Mr. D. T. Graham requested our comments on the proposed and revised improvements of the Port Aransas-Corpus Christi Waterway, Texas. This letter constitutes the Bureau of Sport Fisheries and Wildlife report on the proposed work and is intended to accompany the Corps of Engineers Survey Report on this work. This report supersedes our report dated September 2, 1966.

Our report has been prepared under the authority of and in accordance with the provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and has been coordinated with the Bureau of Commercial Fisheries. The Texas Parks and Wildlife Department assisted in the preparation of this report and has concurred in the views expressed herein as indicated by the enclosed copy of a letter dated December 19, 1967, and signed by Mr. J. R. Singleton, Executive Director.

Two previous reports, dated November 1956 and June 20, 1963, were prepared and issued by the Bureau for the entire waterway. Reports on individual segments of the waterway were prepared for Turtle Cove Anchorage Basin, March 6, 1950; Branch Channel to the Reynolds Metal Company, July 29, 1952; Gulf Intracoastal Waterway in the Vicinity of Aransas Pass, June 29, 1953; Channel Improvement at the Entrance to Corpus Christi Turning Basin, January 12 and February 11, 1954; Proposed Enlargement of the Channel to La Quinta, March 16, 1956; Harbor Island to Channel to La Quinta between Corpus Christi and Redfish Bays, January 16, 1962; Channel to Encinal Peninsula in Corpus Christi Bay, February 27, 1962; and Jewel Fulton Channel, March 22, 1962.

The Port Aransas-Corpus Christi Waterway is a deep-draft navigation channel that extends from deep water in the Gulf of Mexico through the Aransas Pass Jetty Channel thence westerly between Harbor and Mustang Islands and across Corpus Christi Bay for about 20.75 miles to the Corpus Christi Turning Basin. The remaining portion extends westerly and northwesterly about 8.2 miles paralleling the shores of Nueces Bay and the Nueces River to the Viola Turning Basin. Several branch channels extend from the waterway, one of which is the Channel to La Quinta along the northern portion of Corpus Christi Bay.

The proposed plan of improvement would consist of (1) deepening the main channel to 45 feet from the Outer Bar Channel to the Viola Turning Basin; (2) widening the main channel to 500 feet between the westward extension of the inner basin at Port Aransas and the junction with the Channel to La Quinta; (3) enlarging the Channel to La Quinta to 45 by 300 feet; (4) widening the Tule Lake and Viola Channels to 300 feet; (5) enlarging the Chemical, Tule Lake, Viola, and La Quinta turning basins to provide a minimum turning diameter of 1,200 feet; (6) constructing a turning basin at the junction of the La Quinta Channel and the main channel with a minimum turning diameter of 1,200 feet; (7) constructing two 150-foot wide mooring areas adjacent to the main channel between the La Quinta Channel and the Gulf Intracoastal Waterway near Port Ingleside; (8) and constructing mooring dolphins along the landward side of the mooring areas. The dredged materials from these improvements would be placed in spoil disposal areas established by the Corps of Engineers along the waterway. These established spoil areas and the openings between them were recommended in the Bureau's report on the Maintenance Dredging, Harbor Island to La Quinta Channel, dated January 16, 1962. The openings would be retained and maintained at their present dimensions.

The project area contains important habitat for estuarine fishes and crustaceans including such species as red and black drums, spotted and sand seatrouts, Atlantic croaker, flounder, striped mullet, sheepshead, gafftopsail catfish, blue crab, and brown and white shrimps. A sparse population of oysters also is present.

The most important fish and crustacean habitat in the project area is the shallow vegetated area around the southern tip of Harbor Island and the vegetated areas adjacent to the spoil banks along the main and tributary channels. These areas are used as fish and crustacean spawning and nursery habitat. The Harbor Island area also is popular for sport fishing.

Important species of waterfowl in the project area are canvasback, redhead, lesser scaup, American widgeon, pintail, blue-winged and green-winged teals, shoveler, Canada goose, and snow goose. Waterfowl hunting is heavy adjacent to the project area.

Possibly submerged vegetation of value to fish and wildlife resources around the southern tip of Harbor Island and adjacent to the spoilbanks would be affected by the project. These areas might be covered by spoil. However, in the past, spoil banks in this area have stabilized sufficiently to permit reestablishment of submerged vegetation near the edges. Based on the rehabilitative qualities previously experienced in this area, project damages to fish and wildlife habitat would be insignificant.

The opportunity to comment on the changes in the project plan is appreciated.

Sincerely yours,

W. O. Nelson, Jr.
Acting Regional Director

Enclosure

Copies (10)

Distribution:
(5) Executive Director, Texas Parks and Wildlife Department, Austin, Texas
(2) Regional Director, Bureau of Commercial Fisheries, Region 2, St. Petersburg, Florida
(2) Laboratory Director, Biological Laboratory, Bureau of Commercial Fisheries, Galveston, Texas
(1) Regional Coordinator, Southwest Region, USDI, Muskogee, Oklahoma
(1) Area Director, Bureau of Mines, Area 4, Bartlesville, Oklahoma
(2) Field Supervisor, Bureau of Sport Fisheries and Wildlife, Division of River Basin Studies, Fort Worth, Texas

97-528 O-68—13

TEXAS
PARKS AND WILDLIFE DEPARTMENT

JOHN H. REAGAN BUILDING
AUSTIN, TEXAS 78701

December 19, 1967

Mr. William T. Krummes
Regional Director
Bureau of Sport Fisheries and Wildlife
P. O. Box 1306
Albuquerque, New Mexico

Dear Mr. Krummes:

This is in response to your letter of December 7, 1967 and the attached review draft of a report concerning the Corps of Engineers proposed Port Aransas-Corpus Christi Waterway, Texas.

We have reviewed this draft and concur with the report as presented.

Sincerely yours,

J. R. Singleton

J. R. Singleton
Executive Director

JRS:KCJ:pw

cc: Mr. John Degani, Division of River Basin Studies, Fort Worth.

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
P. O. Box 648
Temple, Texas 76501

February 19, 1968

Colonel Franklin B. Moon
District Engineer
U. S. Army Corps of Engineers
606 Santa Fe Building
P. O. Box 1229
Galveston, Texas 77550

Dear Colonel Moon:

I have reviewed the draft copy of the report on Port Aransas-Corpus Christi Waterway, Texas. The report comprises the results of an investigation to determine the advisability of modifying the existing navigation project. The investigations were made to determine the extent of improvements needed for future waterway traffic, to evaluate benefits and to make recommendations on the construction of improvements found economically justified at this time.

The recommended plan of improvement to modify the project as described in the report would accrue substantial benefits from savings in transportation costs and from reduction in hazards to navigation. The project depth of 45 feet in the deep-draft channels and turning basins would accommodate tanker and bulk carriers of up to 50,000 dwt fully loaded draft of 41 feet.

The Soil Conservation Service does not have any existing or proposed projects in the local area of the recommended plan of improvement. Modifying existing navigational waterway would have no bearing on flood prevention, drainage, irrigation, or any other purpose in the conservation of our water resources.

I appreciate this opportunity to review and make comments on this survey report.

Sincerely yours,

H. N. Smith

H. N. Smith
State Conservationist

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF MINES
AREA IV
Mineral Resource Office

Office of
AREA DIRECTOR

ROOM 206 FEDERAL BUILDING
BARTLESVILLE, OKLAHOMA 74003

February 28, 1968

Mr. D. T. Graham, Chief
Engineering Division
U.S. Army Engineer District, Galveston
P.O. Box 1229
Galveston, Texas 77550

Refer to: SWGED-P

Dear Mr. Graham:

Thank you for the draft Review of Reports on Port Aransas-Corpus Christi Waterway, Texas (45-foot project). Your attention is directed to the listed production value of mineral commodities in the counties adjacent to Corpus Christi Bay.

County	Produced substance	Value in dollars 1966
Nueces	Natural gas, petroleum, natural gas liquids, cement, lime, shell, and sand and gravel.	$85,408,029
San Patricio	Petroleum, natural gas, natural gas liquids, stone, sand and gravel, and clays.	45,998,722

A review of our office information without benefit of field examination shows that the Corpus Christi Bay area has many oil and gas fields. Pipelines that serve the area are satisfactorily depicted on plates 2, 4, and 5 and necessary protection or relocations are indicated. However, we see no comments concerning the proximity of the main channel to oilfields.

Note that the main channel, mile 22 to 31.2, will probably skirt or cross Corpus Christi, Saxet, and Angelita oilfields. From Port Ingleside eastward to about miles 8-9, the main channel crosses Red Fish Bay oilfield.

The Area IV Mineral Resource Office would have no objection to recommended construction if the relationship between construction and existing oilfields is determined in field examination by qualified personnel and provisions are made for protection of oil wells and appurtenant facilities where conflicts exist.

We would appreciate receiving a complete copy of the report, including appendixes, for our files.

Sincerely yours,

Floyd D. Everett

Floyd D. Everett
Acting Area Director

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF OUTDOOR RECREATION
MID-CONTINENT REGION
BUILDING 41, DENVER FEDERAL CENTER
DENVER, COLORADO 80225

IN REPLY REFER TO:
D6427TG

March 7, 1968

District Engineer
U.S. Army Engineer District
Corps of Engineers
Post Office Box 1229
Galveston, Texas 77550

Dear Sir:

In response to your request of February 9, 1968, we have reviewed your Review of Reports on Port Aransas - Corpus Christi Waterway, Texas (45-Foot Project), and are pleased to supply the following comments. Our remarks are based primarily on the relationship of your report to P.L. 89-72, the Federal Water Project Recreation Act.

The purpose of the project is to modify the authorized navigation project for Port Aransas - Corpus Christi Waterway, Texas, by providing for the enlargement of the existing deep-draft channels and basins to a project depth of 45 feet, for the construction of a deep-draft mooring area and mooring facilities, and for widening of the channels and basins at certain locations. The recommended project depth of 45 feet would accommodate tankers and bulk carriers of up to 50,000 dwt with fully loaded draft of 41 feet.

It is recommended that the Texas Parks and Wildlife Commission be given the opportunity to review and comment on the project plans as submitted and that any spoil resulting from dredging operations be disposed of in a manner so as to appear as inconspicuous as possible.

As far as can be determined at this time without field investigation, the proposed project is in accord with the Texas State Comprehensive Outdoor Recreation Plan and will not afford any additional significant outdoor recreation opportunities.

Thank you for the opportunity to review your report.

Sincerely yours,

for R. H. Shaw
Maurice D. Arnold
Regional Director

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
REGIONAL OFFICE
1114 Commerce Street
Dallas, Texas 75202

PUBLIC HEALTH SERVICE

March 28, 1968

REF: SWGED-P

Mr. D. T. Graham, Chief
Engineering Division
Galveston District, Corps of Engineers'
Department of the Army
P. O. Box 1229
Galveston, Texas 77550

Dear Mr. Graham:

In accordance with your request, the Public Health Service, Region VII, Dallas, Texas, has reviewed the draft copy of "Review of Reports on Port Aransas-Corpus Christi Waterway, Texas (45-Foot Project)."

We have discussed the report and its proposals with representatives of the Texas State Department of Health. As a result of these discussions and the review, we conclude that the proposals are satisfactory from the health aspects standpoint.

Thank you for the opportunity to review this report.

Sincerely yours,

Charles W. Northington

Charles W. Northington, P.E.
Regional Program Chief
Water Supply and Sea
Resources Program

UNITED STATES
DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
SOUTH CENTRAL REGION
1402 ELM STREET, 3RD FLOOR
DALLAS, TEXAS 75202

March 29, 1968

District Engineer
Galveston District, Corps of Engineers
P. O. Box 1229
Galveston, Texas 77550

Dear Sir:

In accordance with your letter of February 9, 1968, this office has reviewed your draft of the proposed survey report, "Port Aransas-Corpus Christi Waterway, Texas."

It is found that the views of the Federal Water Pollution Control Administration are properly expressed in this report. However, it is pointed out that the statement at the bottom of page 32 implies that there is not a pronounced pollution problem in the area under study, whereas on page 33, paragraph 57, you state that there is an absence of pollution problems. It is felt that these two statements are not entirely consistent. It is suggested that paragraph 57 be changed to include the word, "pronounced" before the phrase, "stagnation or pollution problems."

This report has also been reviewed in accordance with Executive Order 11288, and it is pointed out that more specific comments on the project and recommendations with regard to water quality control during construction will be made at the time of the Interagency Review, in accordance with Executive Order 11288.

Sincerely yours,

for WILLIAM C. GALEGAR
Regional Director

PORT OF CORPUS CHRISTI

NUECES COUNTY NAVIGATION DISTRICT

ADDRESS ALL OFFICIAL BUSINESS TO
PORT DIRECTOR
P. O. BOX 1541
CORPUS CHRISTI, TEXAS 78403

CORPUS CHRISTI, TEXAS

APRIL 1, 1968

FILE: P-1-35 (A)
SWGED-P

COLONEL FRANKLIN B. MOON
DISTRICT ENGINEER
U. S. CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77550

DEAR SIR:

THIS WILL ACKNOWLEDGE RECEIPT OF YOUR LETTER OF MARCH 22, 1968 ADVISING OF CERTAIN CHANGES IN THE OBLIGATIONS OF LOCAL INTERESTS IN CONNECTION WITH THE ENLARGEMENT AND IMPROVEMENT OF THE CORPUS CHRISTI SHIP CHANNEL.

THESE CHANGES INCREASE LOCAL INTERESTS SHARE OF THE COST ON THE VIOLA CHANNEL IMPROVEMENTS FROM $689,000 TO $761,000 AND ON THE LAQUINTA CHANNEL FROM $1,686,000 TO $1,896,500.

ALSO, THERE HAS BEEN ADDED A REQUIREMENT CONCERNING POLLUTION CONTROL WHICH READS AS FOLLOWS:

> "E" IN ACCORDANCE WITH APPLICABLE FEDERAL, STATE, AND LOCAL LAWS, AND AUTHORITIES, ESTABLISH REGULATIONS OR OTHERWISE PROMOTE THE ADOPTION OF MEASURES TO PROHIBIT THE DISCHARGE OF POLLUTANTS INTO THE WATERS OF THE PROPOSED IMPROVEMENTS BY USERS THEREOF.

A MINOR CHANGE HAS ALSO BEEN MADE IN THE WORDING OF SECTION 86F PERTAINING TO THE VIOLA AND LAQUINTA CHANNELS.

The Navigation Commission by letter dated December 18, 1967 agreed to provide the items of local cooperation which accompanied your letter of October 6, 1967. The changes in the items of local cooperation outlined on the previous page have also been reviewed by the Navigation Commission.

The Navigation Commission concurs in the proposed plan of improvement and is willing to furnish the items of local cooperation outlined in Section 86 of the report.

Yours very truly,

R. E. SALLEE, Chairman
Navigation and Canal Commission

RES:LT

REVIEW OF REPORTS
ON
PORT ARANSAS-CORPUS CHRISTI WATERWAY, TEXAS
(45-FOOT PROJECT)

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 by local interests.- At public hearings held in Corpus Christi, Texas on April 25, 1961 and March 10, 1964, and by subsequent conferences and correspondence, local interests requested extensive waterway improvements, principally to provide for a project depth of 45 feet. The requested improvements are discussed in paragraphs 6 through 10 of the text.

3. Improvements considered.- Based on preliminary investigations certain of the requested improvements did not warrant further consideration. All remaining improvements desired were investigated in detail, and were considered in the formulation of the plan of improvement recommended in the report.

4. The recommended plan of improvement has been presented to the local interests that would be responsible for providing the cooperation required for the improvements if, and when, adopted. They have expressed satisfaction with the plan.

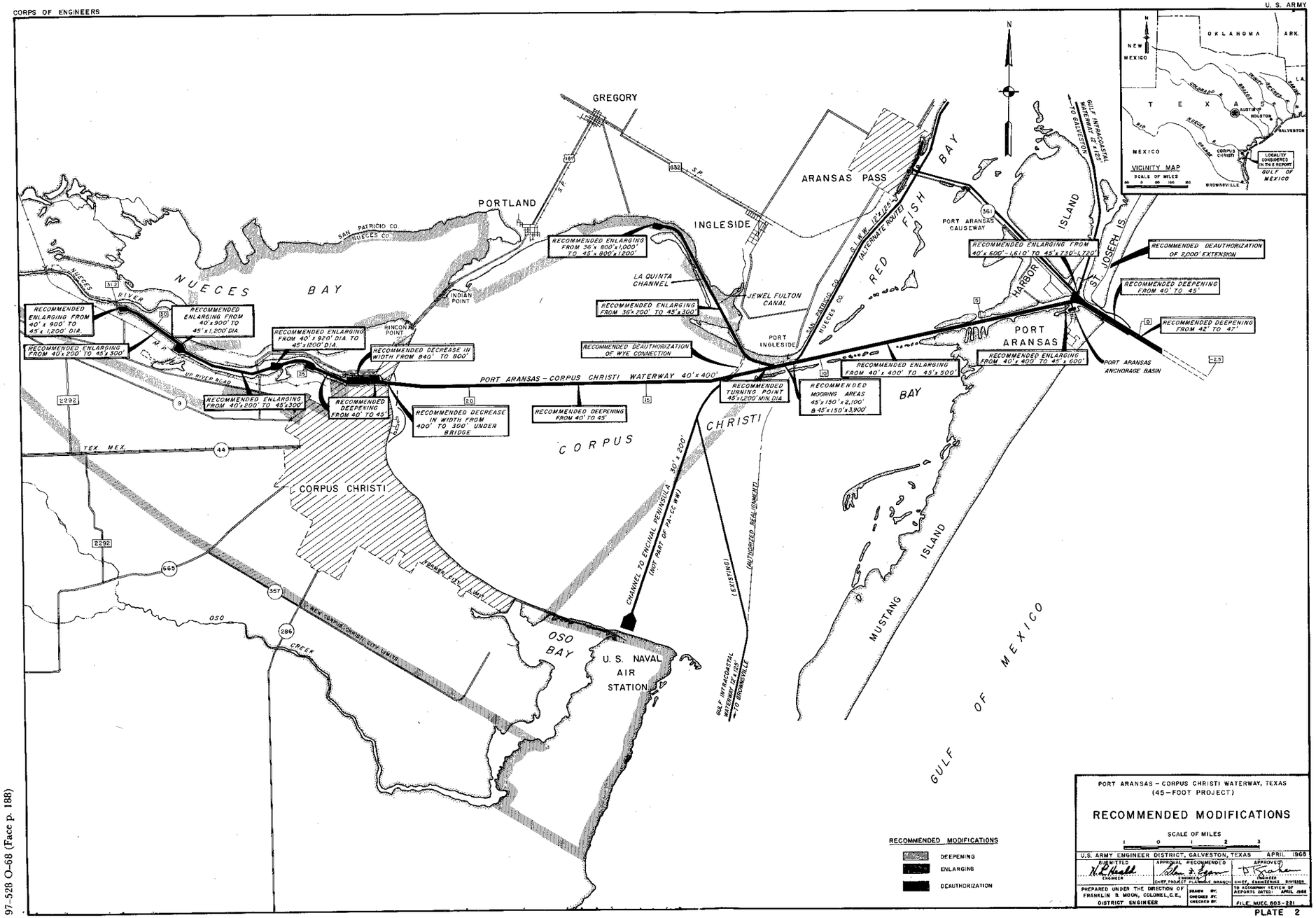
5. A comparison of the costs and benefits for the proposed improvements based on 50-year and 100-year periods of analyses is shown in the following table:

ESTIMATED ANNUAL CHARGES AND BENEFITS
FOR RECOMMENDED PLAN OF IMPROVEMENT

		Period of analysis (years)	
		50	100
Federal investment	$16,364,600		
Non-Federal investment	4,298,000		
Annual charges			
Federal		$ 834,900	$731,200
Non-Federal		177,900	148,500
Total annual charges		1,012,800	879,700
		(use)	880,000
Average annual equivalent benefits		2,864,100	3,029,000
Benefits to cost ratio		2.83	3.44

CORPS OF ENGINEERS

U. S. ARMY



PORT ARANSAS – CORPUS CHRISTI WATERWAY, TEXAS
(45-FOOT PROJECT)

RECOMMENDED MODIFICATIONS

SCALE OF MILES 0 1 2 3

U.S. ARMY ENGINEER DISTRICT, GALVESTON, TEXAS APRIL 1968

SUBMITTED	APPROVAL RECOMMENDED	APPROVED
ENGINEER	CHIEF, PROJECT PLANNING BRANCH	CHIEF, ENGINEERING DIVISION

PREPARED UNDER THE DIRECTION OF FRANKLIN S. MOOL, COLONEL, C.E., DISTRICT ENGINEER

DRAWN BY:
CHECKED BY:
CHECKED BY:

TO ACCOMPANY REPORT OF REPORTS DATED: APRIL 1968

FILE: NUCC 603-221

PLATE 2

97-528 O-68 (Face p. 188)