APPENDIX A – ECONOMIC ANALYSIS

Economic Analysis
Galveston Ship Channel Extension

Introduction and Purpose

This analysis was conducted to consider the economic feasibility of deepening a segment of the Galveston Ship Channel (GSC). The *Houston-Galveston Navigation Channels, Texas, Galveston Channel Project, Final Limited Reevaluation Report*, dated 31 May 2007 (2007 LRR) confirmed the feasibility of deepening the GSC to 45 feet; however, the deepened channel only extends as far as Pier 38. The remaining 2,571 feet of the channel serves publicly-owned Piers 39, 40, and 41, which have historically handled general cargo, and two additional privately-owned docks that handle liquid sulphur and bulk dry commodities, such as barite and cement. The channel serving these remaining facilities has an authorized depth of 40 feet. Figure 1 shows the approximate limits of the 45-foot channel, the 40-foot channel, and their relation to docks along the channel.

Prior Studies

The recent deepening of the GSC was initially recommended in the 1987 Galveston Bay Area Navigation Study (GBANS), which evaluated various channel depths on the Houston and Galveston Ship Channels. The environmental complexities of the project required further study and a reevaluation report, *Houston-Galveston Navigation Channels, Texas, Limited Reevaluation Report and Final Supplemental Environmental Impact Statement* (1995 LRR) was completed in 1995. The reevaluation recommended that the Houston and Galveston ship channels be deepened to 45 feet, after determining that the originally recommended 50-foot channel was no longer economically feasible. The Houston Ship Channel (HSC) was deepened, but the local sponsor did not have funding available to complete the Galveston portion of the 1995 LRR, so that portion of the project was deferred. The Port of Galveston (POG) assumed the role of non-Federal sponsor from the City of Galveston in 2006 and requested that the deepening project be resumed. The 2007 LRR was then conducted to update the economic analysis of the previously recommended and authorized plan.

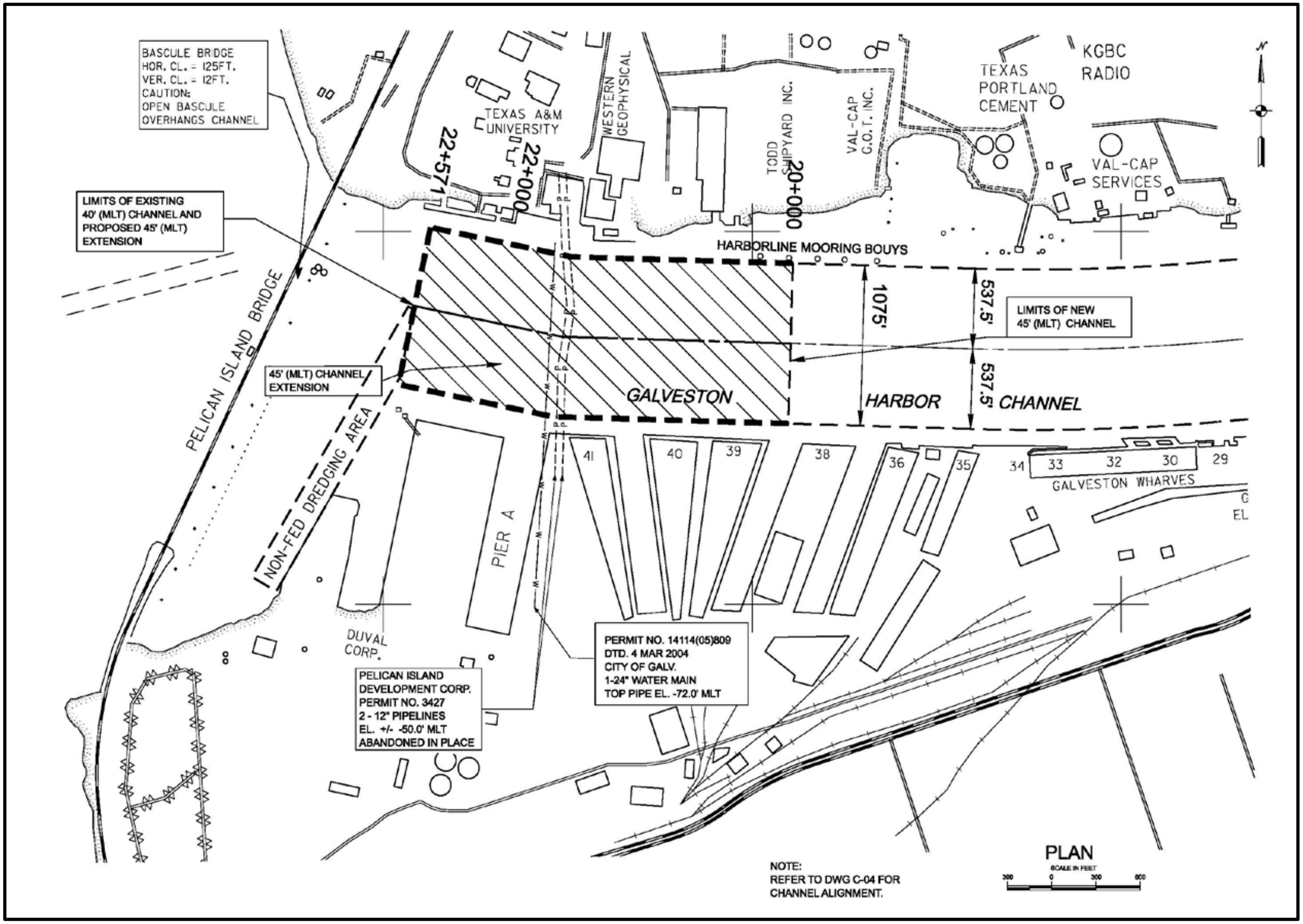


Figure 1 – Approximate Limits of Channel

Basis for the Analysis

Economic benefits can accrue to a navigation project in several ways, because wider and deeper channels reduce the overall cost of transporting goods to markets here and abroad. Wider channels generally reduce delay times that result when vessels are required to pass, and deeper channels allow larger volumes of goods to be transported with each vessel movement, as light-loaded vessels are more fully loaded or smaller vessels are replaced with deeper-drafting vessels.

This analysis is focused solely on the economics of deepening the channel. The national economic benefits are a result of lowering the cost of transporting goods to market over the entire period of analysis, which is 50 years in this case. In order to estimate benefits and costs over that time period, a forecast will be made of the commodities to be transported, vessel characteristics and operating costs, and channel dredging and maintenance costs.

Additional economic impacts may follow from the project in the form of increased employment, tax revenues, and business income, among others. These effects are categorized as regional economic benefits. Regional economic benefits are important in the consideration of local support for a project, but they do not increase the national economic benefits that are used to calculate the benefit-cost ratio (BCR). Because they are not included in the BCR, regional economic benefits have not been calculated at this stage of the analysis.

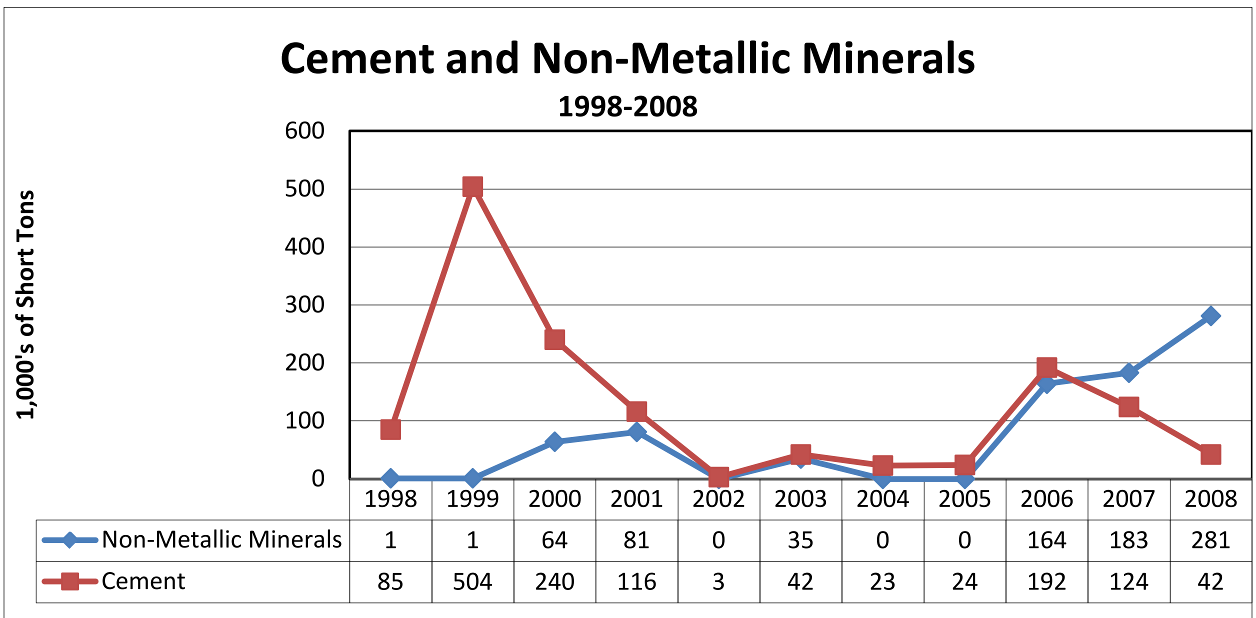
Traffic Trends

Previous reports, such as the 1995 LRR, determined that the subject reach was uneconomic because at the time there were no portside facilities in place. Therefore, the economic analysis of the proposed extension is somewhat uncertain, because most of the docks along this segment of the GSC do not have a history of consistent operations that can be examined for long-term trends. However, Waterborne Commerce Statistics Center (WCSC) data were examined to identify the commodities that are moving through this segment of the channel. The WCSC data shows that the liquid sulphur facility has a lengthy operating history, but the other docks show intermittent usage so benefits at these docks may largely rest on new activity, rather than growth in present or historic activity. As an example of such new activity, Texas International Terminals reported in May 2011 that it had secured new contracts for various commodities that will be brought into this segment of the channel needing a 45 foot draft. Various commodities that will be used for fertilizer have contracts with minimum tonnage each year, and in anticipation of increased tonnage, new storage facilities have already been built with additional facilities in the process of being built. However, the project is not anticipated to increase shipping traffic, but rather will allow for more efficient loading of the existing ship traffic. In addition, the POG has plans to expand benefits for its facilities at Piers 39-41, and has a permit issued by USACE-Galveston District to fill the slips at Piers 37-41.

Barite and Other Bulk Goods

The bulk goods terminal currently would receive the most benefits from deepening the last 2,571 feet of the channel in Galveston. The WCSC records show varying volumes of foreign imports and exports of bulk commodities. Beginning in 2006, the operators of the bulk terminal began receiving regular shipments of barite and cement on light-loaded Panamax vessels. Other materials move through the facility on barges, but it is the light-loaded shipments of barite and cement that are of primary interest in this economic analysis because the vessels could have been fully loaded if the channel were deeper than 40 feet. A review of the detailed WCSC data confirmed that imports of cement and non-metallic minerals (barite) increased significantly in 2006, after several years of little or no activity. Figure 2 shows the annual volume of Portland cement and non-metallic goods on the GSC from 1998-2008. Eighty-seven percent, or 281,000 short tons, of the 2008 total were delivered to the bulk terminal.

Figure 2 - Annual Volume of Cement and Non-Metallic Minerals Imports – Galveston



	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Non-Metallic Minerals	1	1	64	81	0	35	0	0	164	183	281
Cement	85	504	240	116	3	42	23	24	192	124	42

Barite is a non-metallic mineral that is primarily used in the petroleum industry as a weighting agent in natural gas and oil field drilling muds to suppress high formation pressures and prevent blowouts. Barite can be mined and the crude barite can be ground for use, but it must be ground to a small uniform size according to the American Petroleum Institute's (API) specifications before it can be used as a weighting agent. Only grinding operations are located along the Gulf of Mexico, and the majority of barite that goes through the grinding process has been imported from China or India because it is cheaper than transporting the mined barite from Nevada. The leading companies that mined and ground barite in the U.S. are also major oil service companies, thus, providing barite for their own use.

Beyond the capability to grind crude barite, another competitive factor between plants in Texas and the Gulf of Mexico is having foreign trade zone (FTZ) status. Only half of the grinding operations along the Gulf of Mexico have FTZ status for their grinding mills in the U.S. FTZ status allows the ground barite produced by the mills to be reported as imports for consumption and not crude barite received from foreign suppliers, which has a tariff of $1.25 per metric ton. Therefore, the barite grinder in Galveston that has FTZ status has a competitive edge because it can import the barite at a lower cost. In addition, Galveston is not part of a multiple ports of call trade route. The crude barite is shipped directly to the Galveston barite milling plant with no stops along the way, further limiting the cost.

The barite market is based on expected gas and oil exploration and drilling; therefore, the annual U.S. consumption is largely tied to the number of active drilling rigs in any given year. A comparison of the barite consumption levels to active drill rig counts each year from 1998-2008 shows that 76 percent of the variance in barite consumption is explained by the drill rig counts. This indicates that barite consumption is fairly well correlated to drill rig activity levels.

Table 1 displays annual imports and annual consumption in the U.S. from 1998 to 2008. Domestic production is centered largely in the Rocky Mountain region and is consumed within that region or exported to Canada[1]. Imports have risen from 1.85 million metric tons in 1998 to 2.4 million in 2008, with a peak of 2.69 million in 2005. Imports comprise approximately 80 percent of total U.S. consumption, and 98 percent of imports come from China, with the remaining two percent imported from India. Taken together, these facts indicate that oil and gas exploration in the U.S. will require imports of barite from China to the gulf coast of the U.S. According to the USGS' 2011 Minerals Summary for Barite, the world's barite resources are about two billion tons. The U.S. has imported an annual average of 2,260,000 tons of barite over the past five years. There are concerns that the API-grade material from China has been depleted, but additional mine capacity is being developed, which may increase costs. Even with these considerations, there is assumed to be a sufficient supply of barite over the 50-year planning horizon. As in the past, annual volumes will be driven by the active number of drill rigs, which is driven in turn by the market prices of natural gas and crude oil.

[1] U.S. Geological Survey (USGS), 2007 Mineral Commodity Summary – Barite

Table 1 - Barite Consumption and Imports (1,000s Tons)

Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Imports	1,850	836	2,070	2,470	1,510	1,620	2,000	2,690	2,550	2,600	2,620
Consumption,	2,340	1,280	2,460	2,870	1,920	2,230	2,460	3,080	3,070	3,040	2,960
Net import as % of consumption	0.80	0.66	0.84	0.86	0.78	0.77	0.78	0.84	0.81	0.85	0.79
Import growth rate, year over year		-54.81%	147.61%	19.32%	-38.87%	7.28%	23.46%	34.50%	-5.20%	1.96%	0.77%
Compound Ann Growth, Imports		-54.81%	5.78%	10.11%	-4.95%	- 2.62%	1.31%	5.49%	4.09%	3.85%	3.54%

Source: USGS 2009 Mineral Commodity Summary - Barite

The very brief history of cement and barite volumes makes it difficult to develop a long-term forecast of future imports to Galveston. For purposes of this evaluation, actual tonnage data from 2006 through 2008 were used to establish an estimate of base year tonnage levels, and then three scenarios were developed for growth over the remainder of the period. A review of the 2006 through 2008 bulk commodity traffic revealed that barite was the commodity that would have most benefited from a deeper channel during that timeframe, with some potential additional benefit to cement shipments. In 2008, for example, 281,000 short tons were imported on Panamax vessels and 192,000 of those tons, or 68 percent, were on light-loaded vessels, due to the draft constraint. This is a slight increase from the prior year, 2007, when the statistics show that 270,000 short tons were imported and 194,000 of those tons, or 72 percent, were light-loaded. All of the light-loaded cargo volume in these figures was barite imported from China.

The historical record is too brief to draw any reasonable correlations between total U.S. barite imports and the volumes that come to the bulk terminal in Galveston. The most that can be said is that the activity is presently occurring, the Galveston bulk terminal has the capacity to continue handling barite, and the access to deep water makes the GSC a rational choice for staging barite and other materials used in Gulf of Mexico oil and gas exploration.

Because of the uncertainty in future volumes, three rates of growth were used to extrapolate from present levels. At the low end, a zero-percent growth rate was used and volumes were assumed to hold steady at the bulk terminal's 2008 levels. The median growth rate is based on a number of factors. The U.S. Energy Information Administration's Annual Energy Outlook's (AEO) 2011 Reference growth rate for 2010-2035 for crude oil is 0.50 percent and for natural gas is 1.60 percent and the lowest positive compound annual growth rate for the past 10 years of barite imports to the U.S. (the majority imported to the Gulf Coast) is 1.31 percent. Therefore, an average 1.1 percent growth rate was assumed for the median growth rate. The high growth rate is assumed to be twice the median growth rate at 2.2 percent, which is also approximately half of the highest compound growth rate during the past five years for barite imports to the U.S. The median growth rate scenario was meant to represent the most likely growth rate, and the low and high growth rate scenarios took into consideration the unknowns with this commodity. These rates for the median and high scenarios assume that the GSC bulk terminal would hold onto a constant share of the U.S. import volume. The terminal operator may seek growth at a higher rate, as evidenced by the initial jump in volume during 2006, and then settle into a maintenance-level of growth once the activity is firmly established. There is no clear basis for a high rate of near-term volume growth, so for purposes of this analysis a constant rate of growth was assumed for each of the three scenarios. Table 2 displays the forecast volume of bulk imports at the end of each decade during the period of analysis, assuming that 2014 is the first year that a newly deepened channel and associated facilities are in full operation.

Table 2 - Volume of Bulk Terminal Imports (short tons)

Year	Low 0.00%	Median 1.10%	High 2.20%
2014	192,000	203,000	214,000
2024	192,000	226,000	266,000
2034	192,000	253,000	331,000
2044	192,000	282,000	412,000
2054	192,000	314,000	512,000
2064	192,000	351,000	636,000

Fleet Characteristics

The vessels bringing foreign commodities to the bulk terminal are generally 60,000 – 70,000 Deadweight Tons (DWT) vessels with design drafts of 40-44 feet, measuring 740-feet long by 106-feet wide. With a deepened channel, the commodities could be carried on an 80,000 DWT vessel with a design draft of 45-47 feet. Specifically, the barite is shipped on handymax-size bulk carriers with 35,000-60,000 DWT or Panamax vessels with 50,000-80,000 DWT. With a deepened channel, it is expected that the Panamax vessels would be used more often to their limits without the need to light-load.

The accepted underkeel clearance in Galveston is one foot and the draft of barite vessels has ranged between 35 and 40 feet. The design draft of those vessels has ranged between 39 and 47 feet. The newer bulk vessels carrying barite have design drafts up to 47 feet, which could be used more readily if the Galveston channel is deepened. The operating conditions are shown below in Table 3.

Table 3 – Operating Drafts in Galveston Ship Channel

Existing Operating Drafts	Expected Operating Drafts
Up to 40 Feet	Up to 45 Feet

The HSC, which is a 45-foot deep channel, also has barite grinding operations and thus imports crude barite. However, the barite is transported to the Jacintoport Care Terminal along the HSC, and the depth along those terminal docks is only 40 feet. Therefore, the vessels carrying barite only draft at 38 feet. The Corpus Christi Ship Channel has the same circumstances as the HSC. To date, the HSC and the Corpus Christi Ship Channel have not had a need to deepen past 40 feet to accommodate deeper barite vessels.

Table 4 displays the characteristics and costs of the without-project vessel to an 80,000 DWT vessel that could be used with a deepened channel. The table presents results for each incremental foot of dredging, showing the cost savings available for channels from 41 to 45 feet in depth. Because the with-project vessel is assumed to be the same in each increment, the total voyage costs is the same, but the maximum load is constrained by the depth of the channel, resulting in lower costs per ton as the channel is dredged deeper. As shown in the bottom line, the savings per ton increase from $1.45 for a 41-foot channel to $3.13 for a 45-foot channel.

Table 4 – Bulk Transportation Cost Savings per Ton

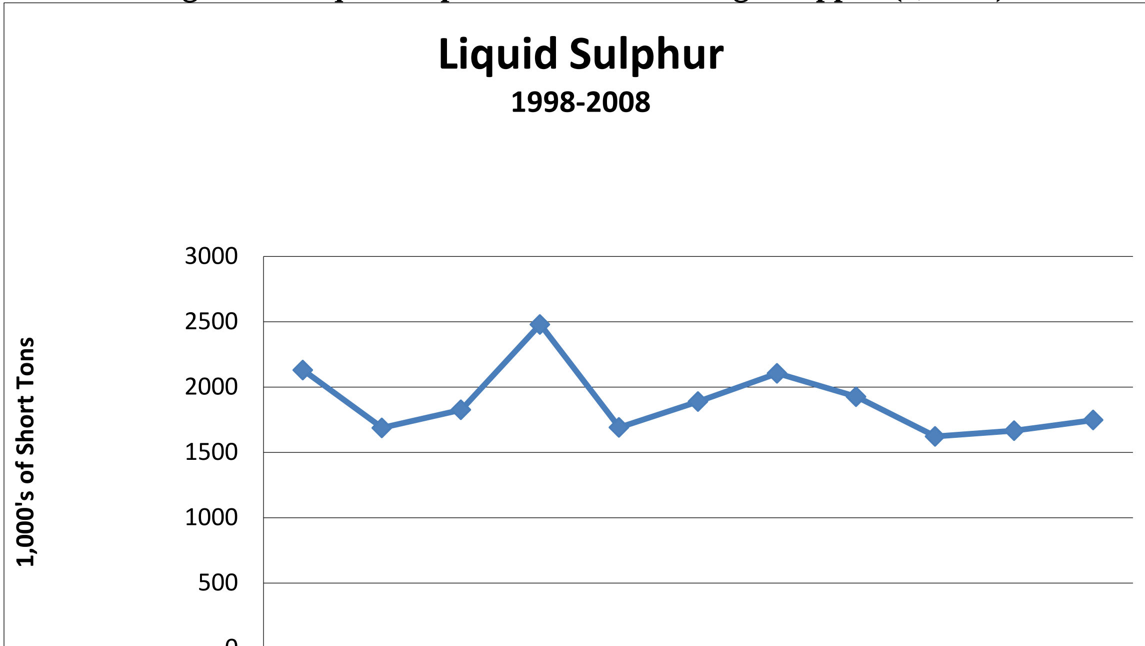
Channel Depth	40 foot	41-foot	42-foot	43-foot	44-foot	45-foot
Vessel Deadweight Tons	60,000	80,000	80,000	80,000	80,000	80,000
Design Draft (ft)	41.6	45.6	45.6	45.6	45.6	45.6
Cargo Capacity (%)	95%	95%	95%	95%	95%	95%
Cargo Capacity (short tons)	57,000	76,000	76,000	76,000	76,000	76,000
Immersion Factor (tons per inch)	153.5	183.7	183.7	183.7	183.7	183.7
Underkeel Clearance (ft)	1	1	1	1	1	1
Hourly Cost at Sea (from EGM)	1104	1213	1213	1213	1213	1213
Hourly Cost in Port (from EGM)	622	860	860	860	860	860
One-Way Trip Mileage from China	10,100	10,100	10,100	10,100	10,100	10,100
Speed (Knots)	14.7	14.8	14.8	14.8	14.8	14.8
Total Voyage Cost (mileage/speed)*(hourly vessel cost)	$759,385	$827,783	$827,783	$827,783	$827,783	$827,783
Other Components (Loading and Unloading and Port Time)						
Maximum Load	52,211	63,658	65,862	68,066	70,270	72,474
Cost Per Ton	$14.54	$13.00	$12.57	$12.16	$11.78	$11.42
Loading/Unloading Rate (short tons/hour)	5,250	5,250	5,250	5,250	5,250	5,250
Hours in Port	30	30	30	30	30	30
Total Loading Cost	$18,660	$25,800	$25,800	$25,800	$25,800	$25,800
Total Unloading Cost	$17,660	$25,800	$25,800	$25,800	$25,800	$25,800
Total Loading and Unloading Cost	$37,320	$51,600	$51,600	$51,600	$51,600	$51,600
Total Cost Per Ton	$15.26	$13.81	$13.35	$12.92	$12.51	$12.13
Savings Per Ton		**$1.45**	**$1.91**	**$2.34**	**$2.75**	**$3.13**

The present value of bulk commodity transportation savings that could be realized during each year of the period of analysis was calculated by multiplying the unit cost savings at each depth by the annual traffic forecast under each of the low, median and high scenarios discussed previously. The equivalent annual value for each scenario was then calculated from the total present values by amortizing the total over a 50-year period using the fiscal year (FY) 13 discount rate of 3.750 percent. These numbers were carried forward to Table 8 to calculate total benefits and the BCRs.

Liquid Sulphur

Liquid sulphur shipments have the longest recent record of continuous deep-draft activity on this segment of the GSC. Figure 3 shows recent traffic levels in a chart of annual liquid sulphur exports from 1998-2008. The average annual volume over that period was approximately 1,900,000 short tons.

Figure 3 - Liquid Sulphur - Annual Tonnage Shipped (1,000's)



	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Liquid Sulphur	2130	1687	1826	2479	1691	1889	2105	1926	1622	1666	1748

The liquid sulphur is shipped to Louisiana (15%) and Tampa Bay, Florida (85%) on a dedicated vessel, the Sulphur Enterprise, which has a maximum loaded draft of 35 feet. The Sparkman Channel in Tampa Bay is authorized to a depth of 41 feet, but is currently only maintained to 34 feet. The Sparkman Channel has a relatively small number of users, all of which consist of private interests. In addition to the liquid sulphur, the use of traffic in that region includes cruise ships and grain, both of which tend to draft around 27 feet. The Sparkman Channel allows a maximum draft of 35.5 feet[2], which means the draft of the Sulphur Enterprise is sufficient to allow fully loaded shipments while maintaining the minimum required underkeel clearance. Accordingly, the channel at the receiving end of the shipments constrains the potential for benefits from deepening the GSC. Benefits from deepening this specific Tampa channel would accrue to the Tampa project up to a depth of 40 feet. Beyond that depth, the benefits would be shared between the receiving (Tampa) and shipping (Galveston) docks on the route.

The dedicated vessel also presents a constraint, but not a permanent one. The Sulphur Enterprise was built in 1994 and would require replacement at some time within the period of analysis. If the channel depth were available, the transportation cost saving should be sufficient to warrant a transition, perhaps not immediately, to a deeper draft vessel. Other constraints may be present in

[2] Tampa Bay Pilots Assoc, www.tampabaypilots.org, accessed 7/23/09

the business' operating chain, but for purposes of this analysis, those constraints are also assumed to be adjustable to the shipping volumes allowed by a deeper channel.

Table 5 displays the potential cost savings that could be realized if the channels at both ends of the sulphur route were deepened. The calculations in the table estimate the cost-per-ton for shipping the liquid sulphur on the existing vessel at present channel depths, as well as the cost for shipping on a larger vessel (60,000 DWT) on incrementally deeper channels. The bottom line shows the savings-per-ton for each additional foot of depth if both channels were deepened beyond 40 feet, indicating that 45-foot channels would allow a potential savings of $0.29 per ton.

Until the Sparkman Channel in Tampa is deepened, there is no assurance that these potential benefits would be realized. To gauge the impact of these potential benefits, this analysis used three different assumptions about the timeframe for a deepening of the Sparkman Channel. If the channel were deepened in project year 5, 12, or 25 of our period of analysis, the average annual cost savings would be as shown in Table 6 below for each increment of deepening. The benefits would be constrained to the depth of the shallower of the two channels.

Table 5 - Sulphur Exports - Potential Cost Savings per Ton

Channel Depth	35-foot	40-foot	41-foot	42-foot	43-foot	44-foot	45-foot
Vessel Deadweight Tons	35,000	60,000	60,000	60,000	60,000	60,000	60,000
Design Draft (ft)	35.2	41.6	41.6	41.6	41.6	41.6	41.6
Cargo Capacity (%)	95%	95%	95%	95%	95%	95%	95%
Cargo Capacity (short tons)	33,250	57,000	57,000	57,000	57,000	57,000	57,000
Immersion Factor (tons per inch)	109.7	153.5	153.5	153.5	153.5	153.5	153.5
Underkeel Clearance (ft)	1	1	1	1	1	1	1
Hourly Cost at Sea (from EGM)	889	1104	1104	1104	1104	1104	1104
Hourly Cost in Port (from EGM)	497	622	622	622	622	622	622
Round-Trip Mileage Galveston to Tampa	1,360	1,360	1,360	1,360	1,360	1,360	1,360
Speed (Knots)	14.5	14.7	14.7	14.7	14.7	14.7	14.7
Total Voyage Cost (mileage/speed)*(hourly vessel cost)	$83,382	$102,139	$102,139	$102,139	$102,139	$102,139	$102,139
Other Components (Loading and Unloading and Port Time)							
Maximum Load	32,987	52,211	54,053	55,895	57,737	59,579	61,421
Cost Per Ton	$2.53	$1.96	$1.89	$1.83	$1.77	$1.71	$1.66
Loading/Unloading Rate (short tons/hour)	5,250	5,250	5,250	5,250	5,250	5,250	5,250
Hours in Port	6.3	9.9	10.3	10.6	11.0	11.3	11.7
Total Loading Cost	$3,123	$6,186	$6,404	$6,622	$6,840	$7,059	$7,277
Total Unloading Cost	$3,123	$6,186	$6,404	$6,622	$6,840	$7,059	$7,277
Total Loading and Unloading Cost	$6,245	$12,371	$12,808	$13,244	$13,681	$14,117	$14,554
Total Cost Per Ton	$2.72	$2.19	$2.13	$2.06	$2.01	$1.95	$1.90
Savings Per Ton for Deepening Tampa from 35' to 40'		**$0.52**	**$0.59**	**$0.65**	**$0.71**	**$0.77**	**$0.82**
Incremental savings - Deepening Tampa beyond 40'			**$0.07**	**$0.13**	**$0.19**	**$0.24**	**$0.29**

Table 6 - Tampa Bay Deepening Scenarios – Avg. Annual Cost Savings

Deepened in Year	Depth of Channel				
	41-foot	42-foot	43-foot	44-foot	45-foot
5	$ 100,700	$ 194,800	$ 282,900	$ 365,500	$ 443,200
12	$ 72,400	$ 140,100	$ 203,500	$ 262,900	$ 318,800
25	$ 35,900	$ 69,400	$ 100,700	$ 130,100	$ 157,800

The savings shown in Table 6 are attributable to deeper channels at both ends of the sulphur routes. If the full savings amount is claimed as benefits, then costs of deepening the Sparkman Channel would also need to be recognized in the benefit-cost analysis. However, those costs would lead to benefits to other activities in the Tampa area that are not going to be explored or counted here, so the costs should be excluded as well.

In conclusion, while there is a history of deep-draft activity of liquid sulphur, there are constraints to experiencing benefits in Galveston. Even if a deeper draft vessel began transporting the liquid sulphur, there would continue to be a constraint until the Sparkman Channel is deepened. However, without any indication that deepening the Sparkman Channel is a likely or even probable scenario, any benefits to Galveston should not be assumed. Therefore, none of the savings shown in Table 5 will be included in the benefit-cost analysis of the Galveston channel deepening.

Container Traffic

The container terminal at GSC has been idle in recent years and the historic data give little indication of the potential for growth in container traffic through the POG. As shown below in Table 7, volume peaked in 1992 at 120,000 tons equivalent units (TEUs) then steadily declined to less than 10,000 TEUs after 2002. The existing container facilities are located at Pier 10. When containers are unloaded and transferred to trucks at this location, they must use Wharf Road and Harborside Drive to leave the area. This route takes them through pedestrian-heavy areas around the cruise terminals and nearby piers that have restaurants, shops, museums, a hotel and other tourist-friendly attractions. To overcome potential conflicts between truck traffic and pedestrian traffic in the vicinity of Pier 10, the POG is planning to move the container terminal to Piers 39, 40 and 41. This site is closer to the rail yard and would also allow trucks to bypass the pedestrian-heavy areas of the port. Warehouses have been demolished at the site; however, development of the new terminal is still in the planning, or pre-planning, phase.

Aside from the local logistical issues, container activity in the POG also has to find its place in the larger logistical chain that moves goods from origin (often foreign) to destination (within the region and beyond). Although the POG is close to the deep water of the Gulf of Mexico, the much larger container terminals in nearby Houston have a slight location advantage, because trucks from the POG must drive an additional 30-50 miles to reach regional distribution centers and other customers. These large regional distribution centers are owned and operated by large national retailers like Walmart and Home Depot. Container-traffic growth is directly related to the location and capacity of these distribution centers. The farther the containers must travel after unloading from a vessel, the higher the total transportation costs will be for the cargo. However, if the containers are traveling outside the region on trains, the POG could overcome the Houston cost advantages, but trains are generally only considered more advantageous for distances of 600 miles or more. That is not the market that the POG has traditionally served, and it is not clear that the new terminal and associated facilities are planned to serve that market.

Table 7 – Port of Galveston Container Volume, 1990-2010

YEAR	TOTAL TEUs
1990	51,167
1991	93,634
1992	120,138
1993	97,818
1994	83,212
1995	40,423
1996	9,609
1997	14,376
1998	13,391
1999	68,874
2000	82,943
2001	83,796
2002	42,780
2003	9,911
2004	10,291
2005	7,308
2006	10,755
2007	9,356
2008	8,666
2009	11,108
2010	7,793
Source: American Association of Port Authorities	

Alternately, the POG may have the opportunity to partner with the Port of Houston as container volumes at the terminals in Barbour's Cut and Bayport continue to grow. Volumes in 2009 were down as a result of the slowing economy, but Houston volume has held up better than many other container ports, like Los Angeles, Long Beach and New Orleans according to industry reports. As the economy recovers, volumes are expected to return to the previous growth pattern, which means that the Port of Houston will soon require additional container terminal capacity. The Ports of Houston and Galveston have signed a partnership agreement to assess the viability of a container facility on Pelican Island, which is served by the recently deepened (to 45 feet) reach of GSC. However, development of the Pelican Island facility does not appear to have any effect on the benefits of the proposed extension of the 45-foot channel, because the site under investigation for the Pelican Island terminal is adjacent to the recently deepened 45-foot channel and turning basin.

Though the container terminal at GSC has been idle in recent years, the POG does have intentions to move the terminal and expand its benefits when it is feasible. There has been interest from various parties to purchase the land and develop a container terminal at the subject reach of the GSC, and while to date, no plans have materialized, the POG continues to explore its opportunities. In addition, the Port of Galveston expects that if a container facility is built in this reach, it would be within five years of the reach being deepened. It is believed that the container vessels would require a two foot underkeel clearance and could thus draft 42-43 feet, and the vessels would likely provide shuttle operations for 4,000-6,500 TEUs.

To summarize, container traffic at the Port of Galveston is positioned to grow, but there is little historical evidence to suggest that volumes will be such that benefits can be attributed to an extension of the 45-foot channel as there is no historical evidence of draft-constrained container vessels in this channel. A new Pelican Island terminal would be accessed via the existing 45-foot channel. A new terminal at the Port of Galveston Piers 39-41 could easily accommodate the historic volume of TEUs annually, but that volume of traffic is a few years from developing. The new facility may even benefit from the recent trend towards containerization of grains and other bulk goods that have not typically been shipped via container. That could complement, or compete with, the nearby grain elevator and bulk terminal. A market study would be required to determine the potential demand for cargo to be transported outside the region and to assess the capacity of existing truck and rail infrastructure to handle the volume of containers that would benefit from a deeper channel.

Comparison of Alternatives

Table 8 displays a summary of the economic analysis. The benefits were calculated for a 50-year period of analysis using FY 2013 Federal Discount rate of 3.750 percent and the deep-draft vessel operating costs contained in the Economic Guidance Memorandum (EGM 11-05). The deepening calculations were estimated using a Microsoft Excel spreadsheet model. Columns are presented for 42-, 43-, 44-, and 45-foot channels. The benefits are presented at the top of the table and display the results previously discussed for containers, sulphur, and bulk materials.

Low, median and high scenarios are presented that consider the implications of the timing of a deepening of the sulphur dock in Tampa, Florida and the growth rate of tonnage volumes moving through the bulk commodities terminal in Galveston. Average annual benefits are summed for each scenario and range from a low of $380,000 for the 42-foot channel low scenario to $1,061,000 for the 45-foot channel high scenario. These scenarios are not absolute extremes, but are reasonable approximations of how benefits would vary given these assumptions about future conditions.

The table goes on to present average annual costs for each increment of channel depth, increasing from $334,300 for a 42-foot channel to $577,600 for a 45-foot channel. The costs include the amortized value of project first costs plus interest during construction, but exclude any incremental operations and maintenance costs above the costs to maintain the present 40-foot channel. The average annual costs do take into consideration associated costs for non-federal interests to deepen the berths, as well as those related to the construction of a weight relieving platform behind Texas International Terminals' bulkhead for the 43-, 44-, and 45-foot draft alternatives.

The BCRs were determined for each scenario by comparing average annual benefits to the corresponding average annual costs. The 45-foot channel has the highest net excess benefit results of $226,400 and an expected BCR value of 1.4. The low and high scenarios show that the BCR is likely to fall between 1.1 and 1.8. The critical factors in achieving a result in the upper end of this range is the volume and transport distance of foreign imports arriving at the bulk terminal.

An economic analysis was also conducted using an interest rate of 7.0 percent per the Office of Management and Budget (OMB) Circular No. A-94 Revised by using the same methodology as explained above. The BCR for the 45-foot channel is 0.8 at the 7.0 percent interest rate.

Table 9 displays a summary of the economic analysis for the extension with beneficial use sites using the same methodology as explained above. None of the scenarios have positive net excess benefits. In addition, the alternatives with the beneficial use sites would require cost sharing.

Table 8 – Summary of Economic Analysis – Galveston Channel Extension BCR Calculation for Identified Plan

Galveston Channel Extension PACR

Summary of Economic Analysis

	42-foot			43-foot			44-foot			45-foot		
	Low	Median	High	Low	Median	High	Low	Median	High	Low	Median	High
Avg Annual Benefits												
Containers	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sulphur	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Bulk Terminal	$380,000	$491,000	$647,000	$466,000	$602,061	$794,000	$547,000	$706,000	$931,000	$623,000	$804,000	$1,061,000
Total AAB	$380,000	$491,000	$647,000	$466,000	$602,061	$794,000	$547,000	$706,000	$931,000	$623,000	$804,000	$1,061,000
Costs												
Project First Cost		$7,614,300			$9,665,180			$11,410,060			$13,154,940	
Interest During Construction		$35,766			$45,400			$53,596			$61,792	
Sub-Total Project Costs		$7,650,066			$9,710,580			$11,463,656			$13,216,732	
Avg Annual Cost (AAC)		$341,000			$432,800			$511,000			$589,100	
Incremental O&M		$0			$0			$0			$0	
Total AAC		$341,000			$432,800			$511,000			$589,100	
Benefit-Cost Ratio (AAB/AAC)	1.1	**1.4**	1.9	1.1	**1.4**	1.8	1.1	**1.4**	1.8	1.1	**1.4**	1.8
Net Excess Benefits (AAB-AAC)	$39,000	$150,000	$306,000	$33,200	$169,261	$361,200	$36,000	$195,000	$420,000	$33,900	$214,900	$471,900

Critical Inputs & Assumptions:

Discount Rate	3.750%	
Period of Analysis, years	50	The costs for the Non-Federal interests to deepen the berths were included as associated costs.
Design Vessel Draft, feet	46	An additional $300,0000 in associated costs for construction of a weight relieving platform behind Texas International Terminals' bulkhead are included in the 43, 44, and 45 foot draft alternatives.
Bulk Tonnage, Barite and Cement		
Draft-Constrained Tonnage, 2008, s.t.	192,000	Typically, historical trends would be extrapolated, but there is little history here, so bulk tonnage is based on 2008. Bulk commodity shipments have historically been light-loaded.
Annual Growth Rate Scenarios		
Low	0.0%	Future growth is expected to be driven by Barite imports, which in turn are driven by drill rig activity. The low growth rate is based on no growth. The median growth rate is based on a compound annual growth rate from 1998-2008 as well as AEO estimates. The high growth rate is assumed to be twice of the median rate.
Median	1.1%	
High	2.2%	
Sulphur, Avg Annual Tonnage '98-08	1,888,000	Trendline for Galv Sulphur shipments is flat, with some annual variability.
Sulphur Growth Rate	0%	
Tampa Channel Deepening	Project Year	Sulphur vessel draft is constrained by depth at receiving dock in Tampa. Vessel is limited to 35' draft (with 1' underkeel in 36' channel). If that specific Tampa channel is deepened beyond 40', benefits begin to accrue to sulphur shipments. Three assumptions were examined for year of deepening.
Low	25	
Median	12	
High	5	While a share of Tampa deepening costs should be included here, if all sulphur benefits are to be included, due to the probability of Tampa deepening the Sparkman Channel, no benefits or Tampa costs are included.
Containers		No historical evidence of draft-constrained container vessels in GSC. Would need market study or similar analysis that examines origin-destination of likely commodities. Would also need to examine capacity limits of available dockspace/upland storage. Identify associated costs for uplands and loading/unloading.

Table 9 – Summary of Economic Analysis -- Galveston Channel Extension BCR Calculation With Beneficial Use Sites

Galveston Channel Extension PACR

Summary of Economic Analysis

	42-foot			43-foot			44-foot			45-foot		
	Low	Median	High	Low	Median	High	Low	Median	High	Low	Median	High
Avg Annual Benefits												
Containers	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Sulphur	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Bulk Terminal	$380,000	$491,000	$647,000	$466,000	$602,061	$794,000	$547,000	$706,000	$931,000	$623,000	$804,000	$1,061,000
Total AAB	$380,000	$491,000	$647,000	$466,000	$602,061	$794,000	$547,000	$706,000	$931,000	$623,000	$804,000	$1,061,000
Costs												
Project First Cost		$11,373,223			$14,039,816			$17,640,466			$20,973,677	
Interest During Construction		$143,207			$176,783			$222,121			$264,092	
Sub-Total Project Costs		$11,516,430			$14,216,599			$17,862,587			$21,237,769	
Avg Annual Cost (AAC)		$513,300			$633,700			$796,200			$946,700	
Incremental O&M		$0			$0			$0			$0	
Total AAC		$513,300			$633,700			$796,200			$946,700	
Benefit-Cost Ratio (AAB/AAC)	0.7	**1.0**	1.3	0.7	**1.0**	1.3	0.7	**0.9**	1.2	0.7	**0.8**	1.1
Net Excess Benefits (AAB-AAC)	($133,300)	($22,300)	$133,700	($167,700)	($31,639)	$160,300	($249,200)	($90,200)	$134,800	($323,700)	($142,700)	$114,300

Critical Inputs & Assumptions:		
Discount Rate	3.750%	
Period of Analysis, years	50	The costs for the Non-Federal interests to deepen the berths were included as associated costs.
Design Vessel Draft, feet	46	An additional $300,0000 in associated costs for construction of a weight relieving platform behind Texas International Terminals' bulkhead are included in the 43, 44, and 45 foot draft alternatives.
Bulk Tonnage, Barite and Cement		
Draft-Constrained Tonnage, 2007, s.t.	192,000	Typically, historical trends would be extrapolated, but there is little history here, so bulk tonnage is based on 2008. Bulk commodity shipments have historically been light-loaded.
Annual Growth Rate Scenarios		
Low	0.0%	Future growth is expected to be driven by Barite imports, which in turn are driven by drill rig activity. The low growth rate is based on no growth. The median growth rate is based on a compound annual growth rate from 1998-2008 as well as AEO estimates. The high growth rate is assumed to be twice of the median rate.
Median	1.1%	
High	2.2%	
Sulphur, Avg Annual Tonnage '98-08	1,888,000	Trendline for Galv Sulphur shipments is flat, with some annual variability.
Sulphur Growth Rate	0%	
Tampa Channel Deepening	Project Year	Sulphur vessel draft is constrained by depth at receiving dock in Tampa. Vessel is limited to 35' draft (with 1' underkeel in 36' channel). If that specific Tampa channel is deepened beyond 40', benefits begin to accrue to sulphur shipments. Three assumptions were examined for year of deepening.
Low	25	
Median	12	
High	5	
		While a share of Tampa deepening costs should be included here, if all sulphur benefits are to be included, due to the probability of Tampa deepening the Sparkman Channel, no benefits or Tampa costs are included.
Containers		No historical evidence of draft-constrained container vessels in GSC. Would need market study or similar analysis that examines origin-destination of likely commodities. Would also need to examine capacity limits of available dockspace/upland storage. Identify associated costs for uplands and loading/unloading.

Summary

The results of the economic analysis show that there is an economically rational justification to deepen the GSC to 45-feet through the reach that is presently authorized to 40 feet. Volume continues to increase at the bulk terminal for minerals used in oil & gas exploration and a significant share (68 percent) of this volume is constrained by the current channel depth. As shown in the economic analysis, the traffic history is limited and somewhat inconsistent in this segment, so while the forecast of future conditions is uncertain, the new contracts secured by Texas International Terminals does indicate that tonnage will increase and will need a 45 foot draft. In addition, the bulk dock is located at the end of the deep-draft channel, and bulk commodities stand to gain the most economic efficiencies by their very nature as bulk items that make best use of deeper drafting vessels. While the bulk goods terminal would receive the most benefits from deepening this reach, as explained above, there is a reasonable prospect of multiple users, as required by ER1105-2-100. For example, while sulphur volumes have been quite stable over the last decade or more, there is no near-term need for a deeper channel due to depth constraints in channels at the primary destination port, but there is a possibility that benefits will be gained at GSC. In addition, the POG continues to explore other opportunities for container traffic. However, any benefits to the containers and sulphur dock would be incidental to a deeper channel that reaches the bulk terminal.

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