Savannah Harbor Expansion Project

Channel Extension Evaluation

1. Background

In 1997, the original hydrographic survey for the entrance channel extension, which was conducted in association with the Savannah Harbor Expansion Project, extended 25,000 feet beyond the existing end of the Federal project, which occurred at Station -60+000B. That survey also extended approximately 3,000 feet oceanward of the -50-foot contour, the depth necessary for the deepest entrance channel alternative that was being considered in the feasibility study. At the oceanward extent of the hydrographic survey the water depth was consistently deeper than 54 feet at that time and no additional surveys were conducted. Given that an adequate depth was verified beyond the – 50-foot contour, it was recommended at the time that the entrance channel be extended 25,000 feet for the 50-foot channel depth (to Station -85+000B).

2. Need for Revised Design

In a 23 October 2009 meeting, James Cameron, retired USCG, pointed out that the current NOAA Chart#11512 indicates some shallower shoals offshore of the original 1997 survey area. The Corps obtained and evaluated existing NOAA surveys and conducted a bathymetric survey later that month. The new information indicates that there are additional shoals offshore, beyond the end of the entrance channel as it is currently designed using the 1997 hydrographic surveys.

In response to this new information, the Corps evaluated alternative channel extensions in this area. The length of the extension would be dependent upon design channel depth and alignment. For the maximum case, a 48 foot authorized navigation project, the channel would be extended approximately 7 miles longer than the currently proposed bar channel and along the currently proposed alignment. Alternate routes that would turn a portion of the bar channel to the south or to the north would be approximately 2 to 3 miles longer than the currently proposed bar channel. Construction costs could be minimized by creating new fish habitat areas with the excavated sediments. These features would be created by normal operation of a hopper dredge (bottom dumping) which would deposit harvested sands in a designated area to create variations in elevation of the ocean floor.

3. Channel Extension Requirements

3.1. Current Entrance Channel. As previously stated the current entrance channel for the existing federal project ends at Station -60+000B. The original maximum design proposal would have to extend this channel along the same alignment out to Station -85+000B a distance of 25,000 feet. With the discovery of shoals beyond that point, the Corps needs to either extend the proposed entrance channel through the shoals out to deep water, a distance of approximately 7 miles, or locate a more direct, shorter, and less costly route to deeper water.

3.2. Route Requirements. Additional Entrance Channel Extension routes should be developed with the goal of providing the most direct route from the vicinity of the current entrance channel to the 50-ft contour either north or south of the current and proposed entrance channel.

3.3. State Line Implications. The SC-GA state line follows the north toe of the channel to buoy R6 then proceeds along the azimuth of 104 degrees and continues to the 12-mile territorial limit. This is important because the project sponsor, GDOT, would prefer that all routes remain in Georgia waters.

3.4. Guidelines. In accordance with guidelines included in the Engineering Manual for Hydraulic Design of Deep-Draft Navigation Channels, EM 1110-2-1613, 2 feet of additional underkeel clearance is included in the design for the Savannah Harbor entrance channel to account for greater vertical motion in that area from wave conditions. Therefore, for an authorized 48-foot project depth on the inner harbor, the entrance channel would be 2-feet deeper, requiring a total depth of 50 feet in those reaches. In both the inner harbor and entrance channel up to 2 feet of additional dredging will be allowed below the design channel as a dredging tolerance (allowable over depth) to facilitate the dredging process.

3.5. NED Evaluation. The evaluation process should identify the NED route for each project depth: 44-, 45-, 46-, 47-, and 48-feet.

3.6. Aids to Navigation. Any change in the present entrance channel configuration will require additional Aids to Navigation. The costs to construct a tower ($1,000,000) would be substantially more than the cost of an additional buoy ($30,000), so the difference in what aids are needed for a given design may have a substantial impact on the costs of that particular design.

4. Establishment of Alternatives

4.1. Route Development Issues.

4.1.1. Possible Shoaling Problems. Prior to proposing any alternative routes, the Corps determined that there weren't any shoals seaward of the -50-foot contour, that could not be avoided. CESAS examined NOAA Chart#11512 (updated 2005) and obtained the latest electronic survey data from this site: http://map.ngdc.noaa.gov/website/mgg/nos_hydro/viewer.htm. The data did not indicate shoaling at the terminus of any of the evaluated routes.

4.1.2. Sediment Characteristics. Due to concerns about offshore shoals the Corps is considered alternative Alignments for extending the entrance channel for the Savannah Harbor Expansion Project. The deepest depth the District considered for the entrance channel was -50-feet mean lower low water (MLLW). Due to the similarity of ocean sediments surrounding the entrance channel, the District believes that sediments in the new reach would be similar to those found between Stations -60+000B and -85+000B in the previously proposed alignment. Confirmatory sampling would need to be performed through additional channel borings which are schedule to be done during the PED phase of the project. Previous core data suggests that the entrance or ocean bar channel sediments are primarily sand, with exceptions between the jetties and at Station -45+000B, which have large silt and clay components.

4.1.3. Cultural Resources. To date cultural resource studies have cleared the initially proposed entrance channel extension from Station -60+000B to -85+000B. A review of the history of the area indicates that shipwrecks could be encountered with any excavation offshore of the river entrance. The likelihood of such encounters generally decreases with distance from the mouth of the river. Two wrecks, a French Privateer and a British warship, are believed to be located off the river entrance and could potentially be encountered with any additional channel extension. There are also potential munitions from the Fort Screven firing range, off of Tybee Island, which was used during WWII. Although the District is not aware of any information indicating the presence of a historic resource within any of the alignments that were considered, it would conduct side scan sonar and magnetometer surveys during PED to confirm the absence of historic resources within the selected route. Evaluations of sediment placement at Site 12 will also be performed during PED.

4.1.4. Environmental Issues/Mitigation. Endangered species (Right Whales) are a consideration. Based on preliminary communications with the National Marine Fisheries Service any drastic change in the alignment of the channel would require us to revisit the Right Whale question.

4.1.5. Ship Simulator Requirements. Discussions with ERDC indicated that sea state questions associated with any of the new proposed channel extension alternatives would have to be evaluated using a ship simulator. The final four alternatives were run through the ship simulator.

4.2. Initial Alternative Development. The first step in developing alternative routes was to established segments that could be used as building blocks to develop routes with the purpose of finding the shortest route to deep water (i.e., the 50-foot contour). These segments as shown in Table 1, describe each segment in terms of stations, distance and direction. The table also defines the amount of material to be dredged to deepen that segment to the 50-foot depth and the 52-foot depth.

Table 1: Segments Developed for Alternate Route Creation

Segment	From		To		Cubic Yards (50 foot depth)	Cubic Yards w/Overdepth (-52 foot depth)
S-00	-60+000B		-85+000B		935,779	1,948,936
S-01	-85+000B		-123+000B		1,074,437	2,183,091
S-02	-60+000B		-82+000B		1,036,516	2,106,041
S-03	-82+000B	E	17,600ft		652,584	1,200,919
S-04	-60+000B		-78+000B		858,715	1,788,435
S-05	-78+000B	S	19,200ft		1,665,428	2,836,327
S-06	-60+000B	S	33,250ft		4,008,595	5,548,307
S-07	-60+000B	E	42,100ft		5,765,123	7,741,124
S-08	-60+000B	SE	38,600ft		2,657,805	4,212,500
S-09	-38+000B	SE	53,800ft		14,687,190	19,827,700
S-10	-38+000B		-60+000B		2,174,030	3,261,728
S-11	-50+000B	SE	42,700ft		7,777,317	10,500,000

4.3. Development of Eight Alternative Route. From the segments in Table 1, Savannah District developed a group of eight (8) alternative channel routes as shown in Figure 1 on the next page and Table 2 below. These routes were designed from the beginning of the current entrance channel (Station- 60+000B) out to the 50-foot contour. Route S-08 was developed as a result of input from the Savannah Bar Pilots.

Table 2: Route Description and Quantities

Route Description	Route	CY (-50)	w/Overdepth (-52)
Straight Line 60+000 to 123+000	S-01	2,010,216	4,132,027
60+00 to 82+000 S-3, then east to -50 mllw	S-03	1,689,100	3,306,960
60+000 to 78+000 S-5, then South to -50 mllw	S-05	2,524,143	4,624,762
60+000 on tract SE S-6 to -50 mllw	S-06	4,008,595	5,548,307
60+000 on Tract E S-7 to -50 mllw	S-07	5,765,123	7,741,124
60+000 on tract ESE S-8 to -50 mllw	S-08	2,657,805	4,212,500
38+000 on tract SE S-9 to -50 mllw	S-09	14,687,190	19,827,700
50+000 on tract SE S-11 to -50 mllw	S-11	7,777,317	10,500,000

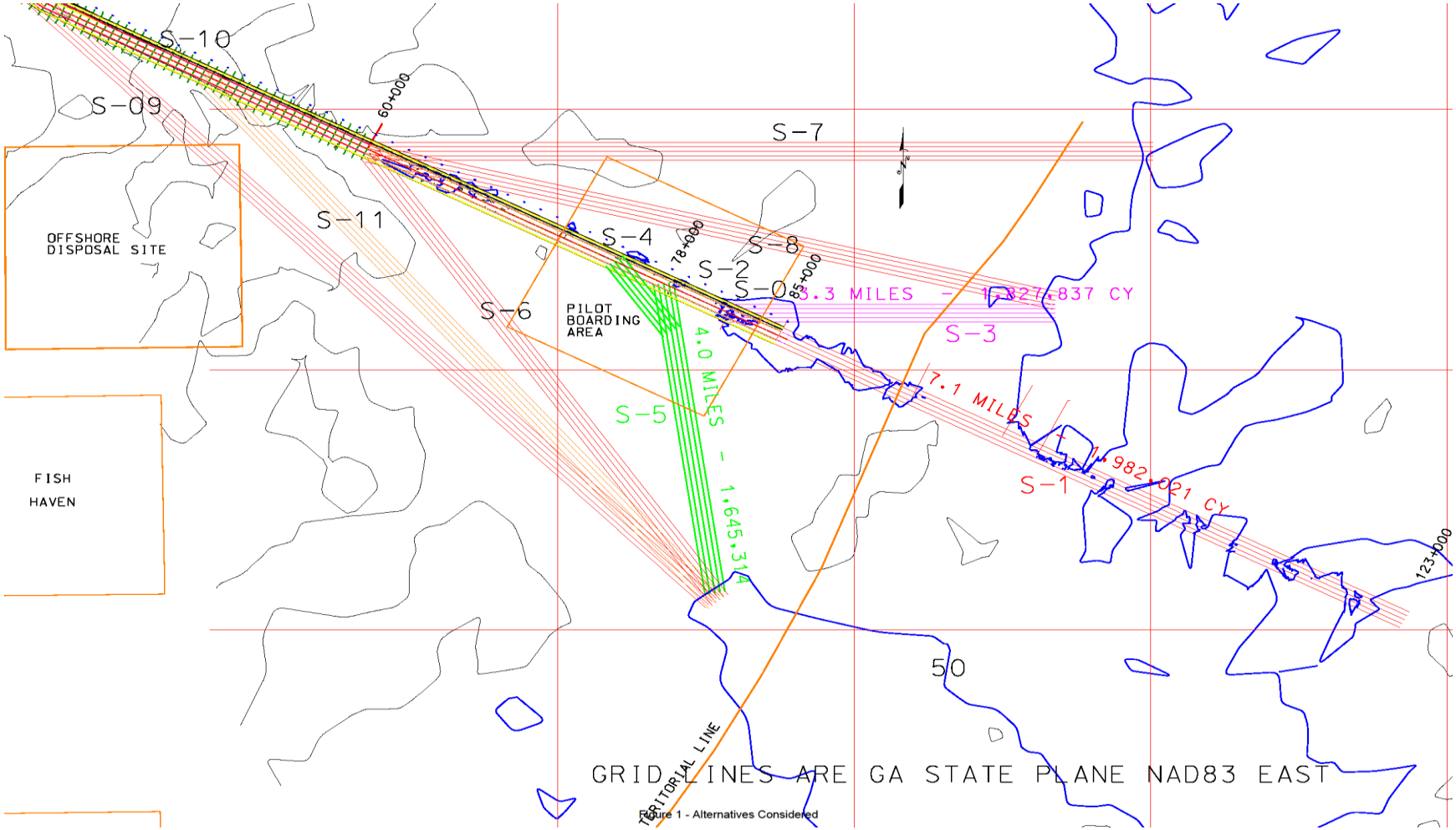

Figure 1: Alternatives Considered

5. Evaluation of Alternatives

5.1. Evaluation of Eight Original Alternatives. The initial evaluation of the original eight routes focused on projected new work dredged sediment quantities and the costs to dispose of those materials. For the purpose of this preliminary cost assessment, $5.00 per cubic yard (CY) was used. This consisted of a $4.00/CY initial cost with a 25% contingency added. This cost was developed from dredging costs that had been previously prepared for the GRR by cost engineering. The dredging volumes in Table 3 include allowable over depth.

During the initial evaluation phase, based on new work dredged material quantities and the costs to remove them, 4 of the initial 8 routes were eliminated. The eight initial routes with their new work dredging costs are listed in Table 3.

Table 3: Route Costs for New Work Dredging

			CY w/Over depth	Dredging	Total
Route Description	**Route**	**CY (-50)**	**(-52)**	**$/CY**	**Cost**
60+00 to 82+000 S-3, then east to -50 mllw	S-03	1,689,100	3,306,960	$5.00	$16,534,800
Straight Line 60+000 to 123+000 S-1	S-01	2,010,216	4,132,027	$5.00	$20,660,135
60+000 on tract ESE S-8 to -50 mllw	S-08	2,657,805	4,212,500	$5.00	$21,062,500
60+000 to 78+000 S-5, then South to -50 mllw	S-05	2,524,143	4,624,762	$5.00	$23,123,810
60+000 on tract SE S-6 to -50 mllw	S-06	4,008,495	5,548,307	$5.00	$27,741,535
60+000 on tract E S-7 to - 50 mllw	S-07	5,765,123	7,741,124	$5.00	$38,705,620
50+000 on tract SE S-11 to -50 mllw	S-11	7,777,317	10,500,000	$5.00	$52,500,000
38+000 on tract SE S-9 to -50 mllw	S-09	14,687,190	19,827,700	$5.00	$99,138,500

After the initial evaluation of alternatives based on new work disposal costs, the PDT selected the four routes depicted in Table 4 on the next page and in Figure 2 on the following page, for further evaluation. These include the following:

Straight line extension of originally proposed channel (S-01),
Northern extension of the channel (S-03),
Southern extension of the channel (S-05), and
Northern extension proposed by the Bar Pilots (S-08).

While only existing disposal sites were used in the initial analysis of alternative routes, it was apparent that due to the amount of sediment and the distance from existing sites that a new area would be desirable for the placement of excavated new work sediments, the deposition of which could provide a beneficial use in the form of a nearby enhancement to fish habitat.

5.2. Additional Disposal Requirements. Prior to the need to further extend the bar channel, disposal plans called for the new work dredged sediment from the originally proposed channel extension (Stations -57+000B to -85+000B) to be placed in Site 11. This site has a total capacity of 2.1 million cubic yards to -10 feet MLLW and is located below the mean lower low water contour (MLLW) in the nearshore area off Tybee Island. At a revised top elevation of -26 feet MLLW, the site would have a capacity of 700,000 cubic yards. This mound would provide a different habitat for fish than the adjacent ocean floor, thereby improving fish habitat in the area to a significant degree.

Table 4: Remaining Routes by Project Depth and Dredging Costs

			44-Ft Project		45-Ft Project		46-Ft Project		47-Ft Project		48-Ft Project	
Route	**Description**	**Miles****	**CY**	**Cost***	**CY**	**Cost***	**CY**	**Cost***	**CY**	**Cost***	**CY**	**Cost***
S-03	North Extension	7.5	622,079	$3,110,395	1,158,287	$5,791,435	1,956,727	$9,783,635	2,744,262	$13,721,310	3,708,369	$18,541,845
S-01	Straight Extension	11.9	810,796	$4,053,980	1,435,898	$7,179,490	2,277,843	$11,389,215	3,322,986	$16,614,930	4,553,436	$22,767,180
S-08	North Extension (Pilots)	7.2	1,667,123	$8,335,615	2,242,371	$11,211,855	2,925,432	$14,627,160	3,736,308	$18,681,540	4,613,909	$23,069,545
S-05	South Extension	6.9	1,253,928	$6,269,640	2,061,493	$10,307,465	2,791,770	$13,958,850	3,980,864	$19,904,320	5,026,171	$25,130,855

**Length in miles beyond the existing entrance channel (Station 60+000B)

*Cost - based on $5.00/CY for dredging the sediment and placing it in the ODMDS

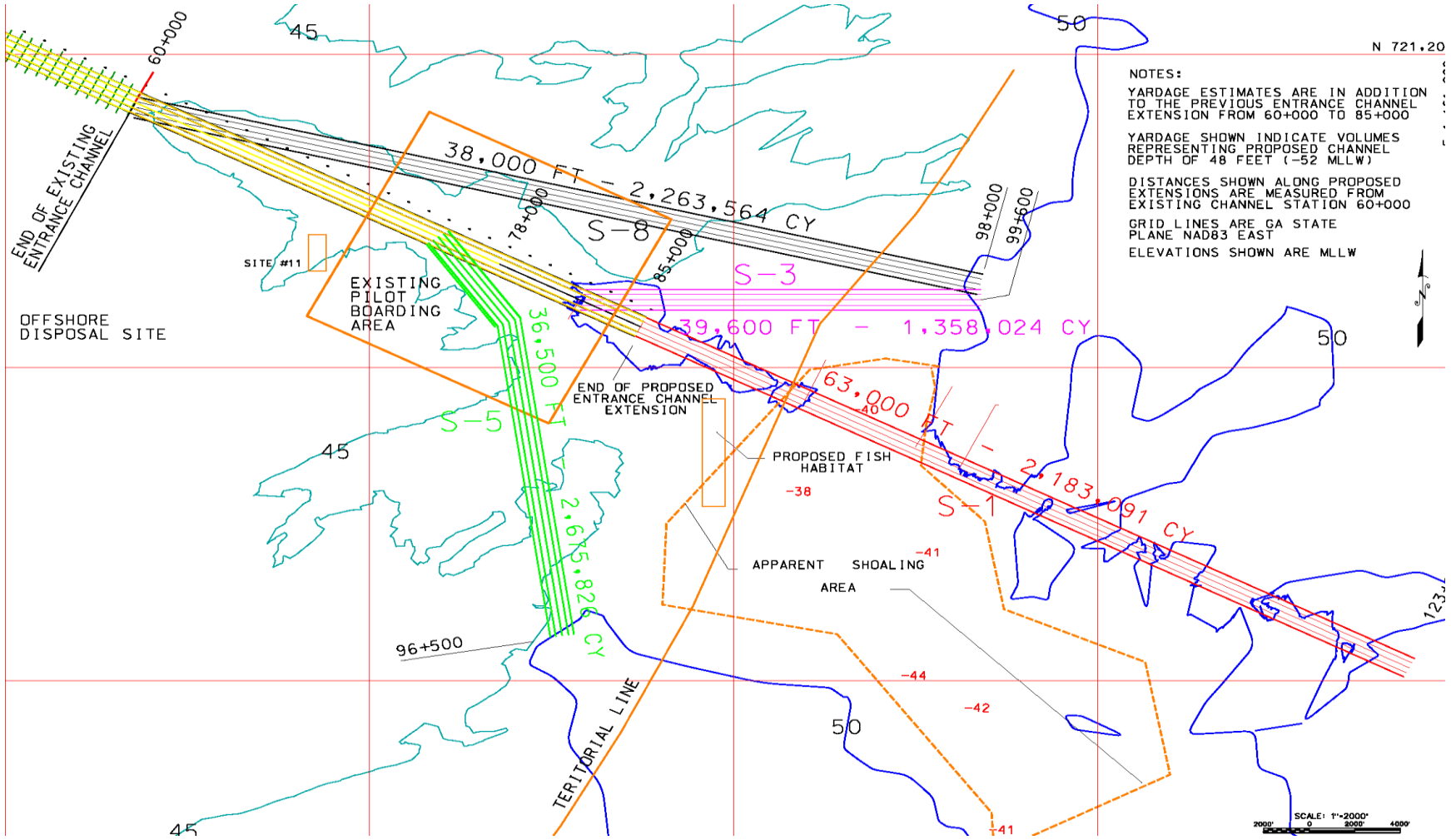

Figure 2: Selected Alternatives

With the required extension of the initial entrance channel, another sediment placement site, Site 12, is proposed for deposition of the additional sediment. This site, like Site 11, would also be used to provide a different habitat for fish than the adjacent ocean floor. These features would be created by normal operation of a hopper dredge (bottom dumping) to deposit sediments and create variations in ocean floor elevations. No significant environmental resources are known to exist at this site. The District would conduct confirmatory studies during PED. [NOTE: As a result of comments received during review of the Draft GRR and Draft EIS, Savannah District revised the sediment placement plan and no longer proposes to deposit all new work sediments in Sites 11 and 12. All new work sediments from the entrance channel will be deposited into existing disposal sites (ODMDS or upland CDF).]

6. Selection of Final Alternatives

6.1. Savannah Bar Pilots Input. The four remaining routes were then discussed with the Savannah Bar Pilots to ensure that any of the proposed alignments of the bar channel satisfied the safety requirements related to vessel maneuverability and operations. Upon review of the channel designs, the Bar Pilots advised that alignments including bends and/or sharp angles should be avoided. Alternatively, they recommended a bar channel alignment (S-08) that was relatively straight and contiguous to maximize the safety and stability of vessels located beyond the present entrance channel. The pilots provided the information below during their review of the four remaining routes:

- S-05 – The channel, as defined by the 50-foot contour, is too narrow going into this extension; also the turns are tight. This route is a 6.9 mile extension from the existing entrance channel (Station -60+000B), requires two turns (the first of which is 27.2°and the second is 27.2°), both of which add to sailing time and operating cost. There are also too many shallow spots for a deeply-loaded vessel.

- S-03 – This route is a 7.5-mile extension from the existing entrance channel (Station -60+000B) and requires one 27° turn. This is the second choice of the Bar Pilots.

- S-01 – The channel extension from Station -60+000B to station -123+000B is 11.9 miles. The extra distance would increase both the vessel operating costs and the cost to the pilots. The extra 12 miles of distance would double the transit time.

- S-08 – This route is similar in distance to S-03 (7+ miles), but contains only a 13° turn to get into the present shipping channel. According to the pilots this is a safer more direct route than S-03, or S-05, and shorter than S-01. This route is preferred by the pilots.

In addition to preferring route S-08 the Bar Pilots recommended that while the fleet is changing slowly over time, they would use two Pilot Boarding areas. They would retain the existing boarding area to service those ships with shallower drafts, and provide an additional Pilot Boarding area 2 nautical miles (KN) beyond the end of alternative route S-8 for deeper draft vessels. Operationally, ships with drafts that allow access to the current boarding area would continue to use it and larger deeper draft ships would use the new boarding area.

6.2. Dredging and Disposal Costs. After review by the Bar Pilots, the four remaining routes were more closely examined in terms of the quantity of new work sediment to be dredged, the sediment placement sites to be used, and the costs for dredging as calculated by Cost Engineering. The dredging quantities for the final four routes were calculated from Station -57+000B rather than -60+000B because of disposal site usage. New work dredged sediment quantities were further refined for the remaining four (4) routes and dredging costs were developed by Cost Engineering based on distance from the proposed dredged sediment placement sites (Site 11 and Site 12). Details concerning the placement of new work dredged sediment by project depth and route are listed in Table 5 below. [NOTE: As a result of comments received during review of the Draft GRR and Draft EIS, Savannah District revised the sediment placement plan and would deposit all new work materials from the entrance channel into existing disposal sites (ODMDS or upland CDF).]

Table 5: Placement of New Work Dredged Sediment

Route	Range	Placement Site	48-foot Project	47-foot Project	46-foot Project	45-foot Project	44-foot Project
S-08	-60+000B to -98+600B		4,215,500	3,401,689	2,657,805	2,041,954	1,534,125
	-57+000B to- 60+000B	ODMDS	401,409	334,619	267,627	200,417	132,998
S-03	-60+000B to -98+600B		3,306,960	2,409,643	1,689,100	957,870	489,082
	-57+000B to- 60+000B	ODMDS	401,409	334,619	267,627	200,417	132,998
S-01	-60+000B to -98+600B		4,132,027	2,988,367	2,010,216	1,235,481	677,708
	-57+000B to -60+000B	ODMDS	401,409	334,619	267,627	200,417	132,998
S-05	-60B+000 to -98+600B		4,624,762	3,646,245	2,524,143	1,861,076	1,131,856
	-57+000B to -60+000B	ODMDS	401,409	334,619	267,627	200,417	132,998

Table 6 shows the amount of sediment to be removed and the cost to deposit it by project depth and by least costly to most costly. These routes/alternatives were then reviewed in a System of Accounts. Evaluation of the two remaining alternatives revealed the following relationships:

- Route S-03 has the lowest first cost for every project depth,
- Route S-08 is the second least costly for the 47- and 48-foot project depths, and
- Route S-01 is the second cheapest for the 44- through 46-foot project depths.

Table 6: Route Costs by Project Depth

	48-foot Project	Dredging Cost	Total	Total Cost
Route	**(CY)**	**(CY)**	**Cost**	**w/ 20% Contingency**
S-08	4,613,909	$4.03	$18,594,053	$22,312,864
S-03	3,708,369	$4.03	$14,944,727	$17,933,672
S-01	4,533,436	$4.72	$21,397,818	$25,677,382
S-05	5,026,171	$4.03	$20,255,469	$24,306,563
	47-foot Project	**Dredging Cost**	**Total**	**Total Cost**
Route	**(CY)**	**(CY)**	**Cost**	**w/ 20% Contingency**
S-08	3,736,308	$4.12	$15,393,589	$18,472,307
S-03	2,744,262	$4.12	$11,306,359	$13,567,631
S-01	3,322,986	$4.83	$16,050,022	$19,260,027
S-05	3,980,864	$4.12	$16,401,160	$19,681,392
	46-foot Project	**Dredging Cost**	**Total**	**Total Cost**
Route	**(CY)**	**(CY)**	**Cost**	**w/ 20% Contingency**
S-08	2,925,432	$4.26	$12,462,340	$14,954,808
S-03	1,956,727	$4.26	$8,335,657	$10,002,788
S-01	2,277,843	$4.99	$11,366,437	$13,639,724
S-05	2,791,770	$4.26	$11,892,940	$14,271,528
	45-foot Project	**Dredging Cost**	**Total**	**Total Cost**
Route	**(CY)**	**(CY)**	**Cost**	**w/ 20% Contingency**
S-08	2,242,371	$4.46	$10,000,975	$12,001,170
S-03	1,158,287	$4.46	$5,165,960	$6,199,152
S-01	1,435,898	$5.22	$7,495,388	$8,994,465
S-05	2,061,493	$4.46	$9,194,259	$11,033,111
	44-foot Project	**Dredging Cost**	**Total**	**Total Cost**
Route	**(CY)**	**(CY)**	**Cost**	**w/ 20% Contingency**
S-08	1,667,123	$4.74	$7,902,163	$9,482,596
S-03	622,079	$4.74	$2,948,654	$3,538,385
S-01	810,796	$5.56	$4,508,026	$5,409,631
S-05	1,253,928	$4.74	$5,943,619	$7,132,342

6.3. Impacts to O&M: Dredging the entrance channel extension there would result in a short term (3-year) increase in O&M of the bar channel. With each of the routes evaluated, there would be an initial peak in the first year after construction which would gradually taper off for the following two years, with stabilization in the fourth year after construction. This is depicted in Table 7. When computing the annual costs per route in Table 11, the average of the costs for the three-year stabilization period were used.

Table 7: Impacts to O&M (47-ft Project)

Route	1-Yr. Post Deepening O&M (cy)	1-Yr. Post Deepening O&M Costs	2-Yr. Post Deepening O&M (cy)	2-Yr. Post Deepening O&M Costs	3-Yr. Post Deepening O&M (cy)	3-Yr. Post Deepening O&M Costs	Annual O&M (cy)	Annual O&M Costs
S-1	52,780	$124,033	47,125	$110,744	41,470	$97,455	18,850	$44,298
S-3	33,264	$78,170	29,700	$69,795	26,136	$61,420	11,880	$27,918
S-5	30,604	$71,919	27,325	$64,214	24,046	$56,508	10,930	$25,686
S-8	31,920	$75,012	28,500	$66,975	25,080	$58,938	11,400	$26,790

6.4. Economics Analysis. Beyond the initial cost of extending the entrance channel, the District performed a limited economic evaluation of the impacts of the newly-configured entrance channel routes. For this evaluation the following assumptions were made:

- Vessels travel at an 10 knot speed through the entrance channel
- Required turn(s) within the entrance channel that were less than 20°would add 9 minutes to the time required to transit the entrance channel. These durations will be confirmed using the Ship Simulator Studies.
- Required turn(s) within the entrance channel that were more than 20°would add 15 minutes to the time required to navigate the entrance channel. These durations will be confirmed using the Ship Simulator Studies.
- The number of ships using the new entrance channel is based on Table 3-16 of the Economic Appendix titled Without Project Container Vessel Sailing Draft Inbound and outbound for vessels with a draft of 38 feet or better (current Table 8).
- The cost per twenty-foot equivalent unit (TEU) is based on FY 2007 Containership Operating Costs per TEU (Figure 3-1 in Economic Appendix). This cost was $3,300/hr based on an average of 6000 TEU per vessel at a cost of $0.55 per TEU.

Table 8: Vessels Calling on the Port of Savannah By Year and By Depth

	Draft – No. of Vessels					Total No.
Year	>38-feet	>39-feet	>40-feet	>41-feet	>42-feet	Vessels
2010	205	124	112	79	7	527
2020	355	241	514	481	28	1619
2030	519	351	750	703	41	2364
2040	750	505	1080	1013	59	3407
2050	1048	704	1507	1415	83	4757

Using the above assumptions, Table 9 shows the total cost of a vessel transmitting the extension for the 47-foot project depth alternative.

Table 9: Vessel Cost to Navigate Proposed Entrance Channel Extensions

Route	Description	Channel Length Miles	Ship Speed (kts)	Cruise Time	Turning Time	Total Time	Cost/TEU/hr	Total Cost
S-03	North Extension	7.5	10	0.7500	0.2500	1.0000	$3,300.00	$3,300
S-01	Straight Extension	11.9	10	1.1900	0.0000	1.1900	$3,300.00	$3,927
S-08	North Extension (Pilots)	7.2	10	0.7200	0.1500	0.8700	$3,300.00	$2,871
S-05	South Extension	6.9	10	0.6900	0.5000	1.1900	$3,300.00	$3,927

Table 10 incorporates the results from Table 9 and multiplies it by the number of vessels with drafts greater than 38 feet expected to call on the Port of Savannah within a given year. This calculation shows the total cost per year to transit the designated route.

Table 10: Total Cost of Vessel Calls by Route and Year based on the 47-ft Project

Route	Description	Year	No. Vessels	Navigation Cost/Vessel	Total Cost
S-03	North Extension	2010	527	$3,300	$1,739,100
S-01	Straight Extension	2010	527	$3,927	$2,069,529
S-08	North Extension (Pilots)	2010	527	$2,871	$1,513,017
S-05	South Extension	2010	527	$3,927	$2,069,529
S-03	North Extension	2020	1619	$3,300	$5,342,700
S-01	Straight Extension	2020	1619	$3,927	$6,357,813
S-08	North Extension (Pilots)	2020	1619	$2,871	$4,648,149
S-05	South Extension	2020	1619	$3,927	$6,357,813
S-03	North Extension	2030	2364	$3,300	$7,801,200
S-01	Straight Extension	2030	2364	$3,927	$9,283,428
S-08	North Extension (Pilots)	2030	2364	$2,871	$6,787,044
S-05	South Extension	2030	2364	$3,927	$9,283,428
S-03	North Extension	2040	3407	$3,300	$11,243,100
S-01	Straight Extension	2040	3407	$3,927	$13,379,289

S-08	North Extension (Pilots)	2040	3407	$2,871	$9,781,497
S-05	South Extension	2040	3407	$3,927	$13,379,289
S-03	North Extension	2050	4757	$3,300	$15,698,100
S-01	Straight Extension	2050	4757	$3,927	$18,680,739
S-08	North Extension (Pilots)	2050	4757	$2,871	$13,657,347
S-05	South Extension	2050	4757	$3,927	$18,680,739

Table 11 shows the average annual cost of construction, the yearly O&M costs, and the yearly shipping costs to provide total annual cost for each of the final four proposed routes: S-03, S-01, S-08, and S-05. Based on these calculations, Route S-08 is the least costly option. Route S-08 is also the preferred route by the Savannah Bar Pilots and the route that minimizes potential effects on endangered right whales.

Table 11: Annual Costs per Route Evaluated (47-ft Project)

Route	Description	Construction Avg Ann Costs	Yearly O&M	Shipping Costs	Total 2010
S-03	North Extension	$620,000	$69,795	$1,739,100	$2,428,895
S-01	Straight Extension	$750,000	$110,744	$2,069,529	$2,930,273
S-08	North Extension (Pilots)	$844,000	$66,975	$1,513,017	$2,423,992
S-05	South Extension	$899,000	$64,214	$2,069,529	$3,032,743
					2020
S-03	North Extension	$620,000	$69,795	$5,342,700	$6,032,495
S-01	Straight Extension	$750,000	$110,744	$6,357,813	$7,218,557
S-08	North Extension (Pilots)	$844,000	$66,975	$4,648,149	$5,559,124
S-05	South Extension	$899,000	$64,214	$6,357,813	$7,321,027
					2030
S-03	North Extension	$620,000	$69,795	$7,801,200	$8,490,995
S-01	Straight Extension	$750,000	$110,744	$9,283,428	$10,144,172
S-08	North Extension (Pilots)	$844,000	$66,975	$6,787,044	$7,698,019
S-05	South Extension	$899,000	$64,214	$9,283,428	$10,246,642
					2040
S-03	North Extension	$620,000	$69,795	$11,243,100	$11,932,895
S-01	Straight Extension	$750,000	$110,744	$13,379,289	$14,240,033
S-08	North Extension (Pilots)	$844,000	$66,975	$9,781,497	$10,692,472
S-05	South Extension	$899,000	$64,214	$13,379,289	$14,342,503
					2050
S-03	North Extension	$620,000	$69,795	$15,698,100	$16,387,895
S-01	Straight Extension	$750,000	$110,744	$18,680,739	$19,541,483
S-08	North Extension (Pilots)	$844,000	$66,975	$13,657,347	$14,568,322
S-05	South Extension	$899,000	$64,214	$18,680,739	$19,643,953

Based on a Discount Rate of 4.125% (FY 2011) for the 50-year life of the project with construction coming in the first year.

Yearly O&M - Based on interpolation from current channel
Shipping costs - Based on an hourly rate of $3,300/hour and the time it takes to navigate the extension

7.0 Planning System of Accounts:

	Route S-01	Route S-03	Route S-05	Route S-08
1. PLAN DESCRIPTION	Straight Extension (Station -60+000B to -123+000B)	North Extension (Station -60+000B to -99+600B)	South Extension (Station -60+000B to -96+500B)	North Extension (Pilots) (Station -60+000B to -98+600)
2. IMPACT ASSESSMENT				
A. National Economic Development (NED				
(1) Project New Work Construction Cost	$16,428,843	$13,567,631	$19,681,392	$18,472,307
(2) Project New Work Annual Cost	$ 750,000	$ 620,000	$ 899,000	$ 844,000
(3) Annual O&M Costs	$ 110,744	$ 69,796	$ 64,212	$ 66,975
(4) Annual Shipping Costs	$ 2,069,529	$ 1,739,100	$..2,069,529	$ 1,513,017
(5) Total Project Annual Costs	$ 2,930,273	$ 2,428,895	$ 3,032,743	$ 2,423,992
B. Environmental Quality				
(1) Water Quality Dredging	Adverse	Adverse	Adverse	Adverse
(2) Water Quality Disposal	Minor Adverse	Minor Adverse	Minor Adverse	Minor Adverse
(3) Threatened & Endangered Species	No Impact	No Impact	No Impact	No Impact
(4) Cultural Resources & Historic Properties	No Impact	No Impact	No Impact	No Impact
C. Regional Economic Development	No Impact	No Impact	No Impact	No Impact
D. Other Social Effects				
(1) Safety	No Impact	No Impact	No Impact	No Impact
3. PLAN EVALUATION				
A. Contribution to Planning Objectives				
(1) Efficiently gets ships to deep water (-50-ft contour)	Longest distance of the routes to get to -50-foot contour. Also a large number of shoals to dredge through.	The 2nd longest distance of the routes to get to -50-foot contour.	The 2nd shortest distance of the routes to get to -50-foot contour.	Other than Route S-01 the straightest route with the 2nd shortest distance of the routes to get to deep water.
(2) Provides optimum level of navigation efficiency	Yes, straight line course from the end of the current entrance channel to deep water.	No, contains one 27° turn at the end of the initial proposed entrance channel (-85+000B) before making a straight line course to deep water.	No, starts with a narrow passage within the -50-foot contour from the south and the route has two turns of greater than 27°.	Yes, has only one 13° turn in the channel extension.
(3) Minimized environmental impacts	Yes	No, has a possible impact on endangered species (right whale).	No, has a possible impact on endangered species (right whale).	Yes

	Route S-1	Route S-3	Route S-5	Route S-8
B. Response to Planning Constraints				
(1) Financial capability of local sponsors to cost-share projects construction	The most expensive option, but local cost-share of $8,214,422 is within local capabilities, and has no impact on the local sponsor to cost – share in the construction.	The least costly of the four routes evaluated at a local cost-share of $6,783,815 and well within the local sponsors capability to cost-share in the construction.	The second most expensive option, but local cost-share of $9,840,696 is within local capabilities, and has no impact on the local sponsor to cost – share in the construction.	The second least expensive option, and the local cost-share of $9,236,154 is within the capability of the local sponsor to cost –share in the construction.
(2) Institutional Acceptability	The high cost of the route, as well as the distance, is not acceptable of the Savannah Bar Pilots.	The reasonable cost of the route makes it acceptable to the local sponsor; however, it may have greater impacts on the right whale.	The high cost of the route is not acceptable to the local sponsor, while the route with its narrow entrance and two turns is not acceptable of the Savannah Bar Pilots.	The reasonable initial construction cost of the route and its annual cost for the life of the project make it the choice of the local sponsor, while it is also the route favored by the Savannah Bar Pilots.
C. Response to Evaluation Criteria				
(1) Completeness	Yes	No, due potential concerns with endangered species (Right Whale).	No, due to potential concerns with endangered species (Right Whale).	Yes
(2) Effectiveness	Yes	Yes	Yes	Yes
(3) Efficiency	No, Route S-01 is the most expensive of the routes evaluated.	Yes	No, Route S-05 is the second most expensive route.	Yes, most cost effective plan, consistent with protecting the Nation's environment.
(4) Acceptability	No, the increased distance is unacceptable to the Savannah Bar Pilots.	No, due to potential concerns with endangered species (Right Whale).	No, the narrow approach channel and the number of turn is unacceptable to the Savannah Bar Pilots.	Yes

8. Results of Requirements Analysis

Based on estimated project construction costs, Route S-03 is the least expensive (initial cost) for each of the evaluated project depts.; 44-, 45-, 46-, 47-, and 48-feet. However, when factors such as yearly O&M costs and shipping costs are included, Route S-8 is the least costly route for all project depths. The Bar Pilots prefer Route S-08 because they believe it would provide a better, safer route operationally then Route S-03. Another important factor is potential impacts to the right whale (endangered species). The original proposed entrance channel extension (the part of Route S-01 between Stations -60+000B and -85+000B) would have no impact on right whales. When comparing the two alignments, the originally proposed Route S-01 and the new preferred Route S-8, there would be a negligible variation in channel construction or maintenance related potential effects on right whales, as well as negligible effects resulting from deep-draft vessel use of the channel extension. Because of the turns involved with Routes S-03 and S-05 they may have an impact on right whales. The continuation of Route S-01 until it passes through the shoals is considered by the Savannah Bar Pilots to be too long.

9. Recommendation

As a result of these analyses, Savannah District selected Route S-08 (Figure 3) for the extension to the entrance channel pending successful completion of the tasks listed below. The following sampling and analysis would be performed during PED to confirm the District's understanding of conditions on that alignment:

- Core borings in the proposed channel for analysis of the sediment to be removed, including grain size analysis and contaminants evaluation(bioassay), and

- Cultural Resources evaluation of Route S-08 and sediment placement sites including side-scan sonar and magnetometer studies.

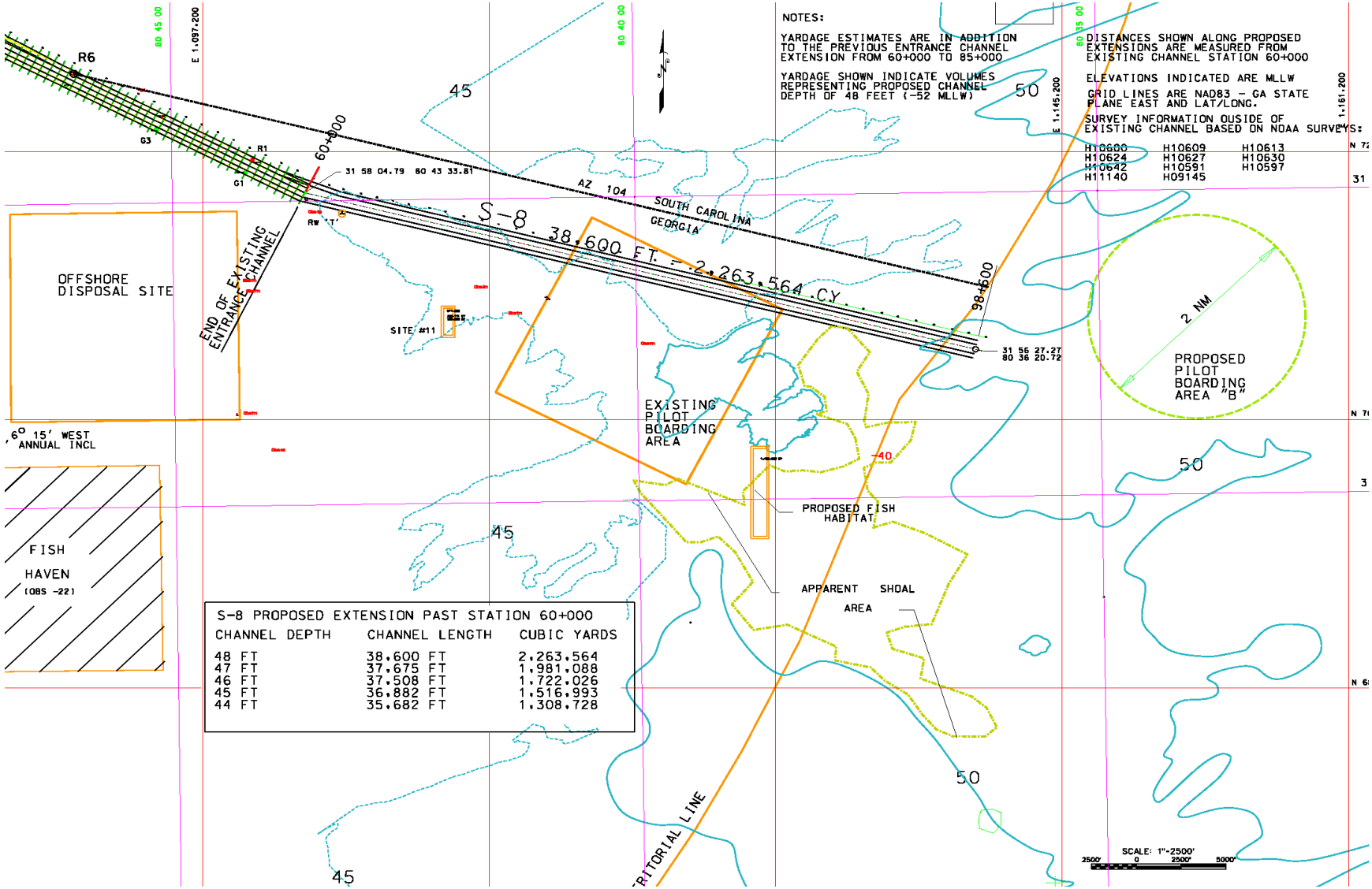

Figure 3: Selected Alternative Route (S-8)