

Table of Contents

1 Introduction 1

 1.1 Location and Setting 5

 1.2 Authorizations..... 5

 1.3 Study Purpose and Scope..... 6

 1.4 Existing Navigation Project..... 8

 1.4.1 Navigation Channel..... 8

 1.4.2 Advance maintenance 9

 1.4.3 Turning Basins 12

 1.4.4 Sediment Control Works..... 14

 1.4.5 Freshwater Control Works 16

 1.4.6 Long Term Management Strategy 18

 1.4.7 Dredged Material Management Plan 18

 1.5 Public Involvement 22

 1.6 Planning Process and Report Organization 23

2 Prior Studies, Reports, and Existing Water Projects 25

 2.1 Savannah Harbor Deepening Feasibility Report, 1991 25

 2.2 Savannah Harbor Expansion Reconnaissance Report, 1996 25

 2.3 Savannah Harbor Deepening Feasibility Report (Section 203) and Tier I
EIS 1998 25

 2.3.1 Chief’s Report on Savannah Harbor Deepening Feasibility Study
(Section 203) 26

 2.3.2 Record of Decision on Savannah Harbor Deepening Feasibility Study
(Section 203)..... 26

 2.4 Savannah Harbor Dredged Material Management Plan-2011 Annual Work
Plan.....27

 2.5 Environmental Improvement (Section 1135) Study 29

 2.6 Savannah Harbor Long Term Management Strategy 29

 2.7 Lower Savannah River Basin Environmental Restoration Project..... 31

3 Problems and Opportunities 31

 3.1 Problems 31

 3.2 Opportunities 32

4 Inventory of Existing Conditions 32

 4.1 Overview of Existing Navigation Resources..... 33

 4.2 Existing Container Ship Industry Operations 34

 4.3 Existing World Container Ship Fleet..... 37

 4.4 Existing Savannah Harbor Operations..... 40

 4.4.1 Garden City Terminal Infrastructure and Operations 42

 4.4.2 Regional Landside Transportation Infrastructure 43

 4.5 Existing Garden City Terminal Cargo 44

4.5.1	Hinterland and Regional Distribution Centers	46
4.6	Existing Garden City Terminal Vessel Operations.....	46
4.7	Existing Socio-Economic Profile	49
4.8	Existing Environmental Resources	50
4.8.1	Geology and Sediments.....	50
4.8.2	Water Resources.....	51
4.8.3	Air Quality	53
4.8.4	Marine and Estuarine Resources	53
4.8.5	Terrestrial Resources.....	54
4.8.6	Wetlands.....	56
4.8.7	Special Status Species and Resource Areas	56
4.8.8	Recreational Resources	56
4.9	Existing Conditions: Cultural Resources	57
4.9.1	The Wreck of the CSS Georgia.....	58
4.9.2	Fort Pulaski National Monument (GA)	59
4.9.3	Fort James Jackson National Historic Landmark (GA)	59
4.9.4	Savannah National Historic Landmark District (GA).....	59
4.9.5	Savannah River Civil War Cribs.....	60
5	Forecast of Without-Project Conditions	60
5.1	Panama Canal: Deepening Existing Locks (2010) and Expansion (2014).....	60
5.2	US East Coast and Gulf Coast Port Configurations and Capacities	61
5.3	Garden City Terminal Infrastructure and Capacity	64
5.4	Containerized International Trade Projections	65
5.4.1	Commodity Forecast Baseline: Garden City Terminal	68
5.4.2	2008 Savannah Harbor Tonnage Forecast	71
5.4.3	2010 Updated Savannah Harbor Tonnage Forecast.....	72
5.4.4	Final Savannah Harbor Commodity Tonnage Forecast	74
5.4.5	Commodity Forecast: Garden City Terminal TEUs	76
5.5	International Container Ship Fleet.....	77
5.5.1	World Fleet.....	77
5.5.2	Savannah Harbor Fleet.....	78
5.5.3	Load Factor Analysis	82
5.5.4	Savannah Harbor Fleet Projections.....	85
5.6	Without-project Conditions: Socio-Economic Profile.....	89
5.7	Without-project Conditions: Environmental Resources	90
5.7.1	Population Growth and Associated Development	90
5.7.2	Sea-level rise	91
5.7.3	Environmental Regulations.....	92
5.7.4	Environmental Management	93
5.8	Without-Project Conditions: Study Area Cultural Resources	93
6	Formulation of Alternative Plans	94

6.1	Planning Goals	94
6.2	Project Objectives	95
6.3	Planning Constraints	96
6.4	Plan Formulation Criteria	96
6.5	Management Measures	99
6.5.1	Preliminary Screening of Management Measures	102
6.6	Evaluation of Alternative Non-structural Measures	104
6.6.1	Reduce Underkeel Clearance Requirement	104
6.6.2	Modification of Garden City Terminal	106
6.7	Evaluation of Alternative Structural Measures.....	107
6.8	Alternative Terminal Locations	111
6.8.1	Alternative Terminal Locations: Transportation Cost Differences.....	111
6.8.2	Alternative Terminal Locations: Criteria Evaluation.....	112
6.8.3	Alternative Terminal Locations: Cost Evaluation.....	116
6.8.4	Alternative Terminal Locations: Summary Assessment.....	117
6.9	Development of a Regional Southeastern US Container Port	119
6.10	Other Channel Modifications (Structural Alternatives).....	121
6.10.1	Meeting Areas	121
6.10.2	Bend Wideners	123
6.10.3	Straightening of the River	123
6.10.4	Turning Basin Expansion.....	123
6.11	Development of Alternative Plans	124
6.12	Description of Alternative Plans	126
6.12.1	Plan A – No Action	126
6.12.2	Plan B – Channel Deepening Alternatives.....	126
7	Alternative Plan Evaluation: Benefits	128
7.1	Transportation Cost Savings Model Benefits	129
7.2	Meeting Area and Tide Delay Benefits	132
7.2.1	Meeting Area Benefits	132
7.2.2	Tide Delay Reduction Benefits	135
7.2.3	Cumulative Benefits – Meeting Area and Tide Delay Reduction.....	137
7.3	Total Average Annual Equivalent Project Benefits.....	137
8	Alternative Plan Evaluation: Environmental Impacts	138
8.1	Impact Avoidance	139
8.1.1	Modified Channel Design	139
8.1.2	Dredged Material Placement Location Selection.....	141
8.1.3	Alternative Disposal Methods or Beneficial Use of Dredged Sediments	141
8.1.4	Dredged Material Placement Technique Selection	144
8.2	Impact Assessment	146
8.2.1	Groundwater Impacts	154

8.2.2	Erosion Impacts.....	155
8.2.3	Air Quality Impacts.....	156
9	Alternative Plan Evaluation: Mitigation Planning	157
9.1	Mitigation Measure Identification	157
9.2	Marsh Mitigation Plan Development.....	158
9.2.1	Identification of Lands to be Acquired	168
9.2.2	Salt Water and Brackish Wetland Compensation	169
9.3	Dissolved Oxygen Mitigation Plan Development	171
9.4	Shortnose Sturgeon Mitigation Plan Development	174
9.5	Striped Bass Mitigation Plan Development.....	176
9.6	Chloride Mitigation Plan Development.....	178
9.6.1	Chloride Impacts to Savannah’s Municipal and Industrial Water Treatment Plant	178
9.6.2	Mitigation for Impacts at City of Savannah’s Water Treatment Plant..	181
9.7	Secondary Impacts.....	185
9.8	Cumulative Impacts	185
10	Alternative Plan Evaluation: Costs.....	186
10.1	Identification of Alternative Plan Elements.....	186
10.2	Detailed Descriptions of Alternative Plans	187
10.2.1	Shared Plan Elements.....	187
10.2.2	Incremental Project Elements	189
10.3	Alternative Plan Costs.....	191
10.3.1	Construction Cost Narrative.....	191
10.3.2	Incremental Dredging-Related Costs	195
10.3.3	Incremental Mitigation Costs.....	196
10.3.4	Total Incremental Construction Costs.....	197
10.3.5	Interest During Construction.....	197
10.3.6	Operation and Maintenance Costs	198
10.3.7	Total Average Annual Equivalent Costs.....	199
10.4	Value Engineering Analysis.....	200
11	Plan Comparison	202
11.1	Net Benefits of Alternative Plans.....	202
11.2	NED Plan Identification.....	204
11.3	Summary of Accounts and Plan Comparison	204
12	Uncertainty Considerations	229
12.1	Economic Analysis Uncertainty.....	229
12.1.1	Jasper County Terminal Sensitivity Analysis	229
12.1.2	Alternative Sensitivity Analyses	234
12.2	Cost Risk Analysis	240
12.3	Environmental Impact and Mitigation Uncertainty	241
12.3.1	Uncertainty in Salinity Predictions	242

12.3.2	Risk with Salinity Predictions.....	242
12.3.3	Uncertainty in Dissolved Oxygen Predictions	242
12.3.4	Risk with Dissolved Oxygen Predictions.....	243
12.3.5	Uncertainty in Biological Responses	243
12.3.6	Risk in Biological Responses.....	244
12.4	Risk in Sea-Level Change Assumptions	244
13	Public Involvement, Review, and Consultation	245
13.1	Public Involvement Program.....	245
13.2	USACE Environmental Operating Principles	247
13.3	Application of USACE Campaign Plan.....	249
13.4	Scoping and Draft EIS	253
13.5	Agency and Public Coordination	254
13.6	Summary of Comments on November 2010 Draft GRR and Draft EIS.....	256
14	Selected Plan	259
14.1	Environmental Effects.....	263
14.2	Mitigation Details	264
14.2.1	Mitigation Costs.....	267
14.3	Plan Construction.....	267
14.4	Operation and Maintenance	272
14.4.1	Advance Maintenance.....	273
15	Plan Implementation Requirements	273
15.1	Section 902 Cost Limitation	273
15.2	Cost Sharing	285
15.3	Financial Analysis of Non-Federal Sponsor’s Capabilities	290
15.4	Land Requirements	290
15.5	Non-Federal Sponsor’s Responsibilities	291
16	Conclusions	294
17	District Engineer’s Recommendation.....	297

List of Tables

Table 1-1: Savannah Navigation Channel Dimensions	9
Table 1-2: Advance Maintenance Areas (feet below MLLW)	12
Table 1-3: Turning Basin Locations and Dimensions	14
Table 1-4: Savannah Harbor Navigation Project Dredged Material Containment Areas.....	20
Table 4-1: Controlling Depths at Major US East Coast Ports, the Panama Canal, and Major Foreign Trading Partner Ports	36
Table 4-2: Current World Containership Fleet (July 13, 2010).....	38
Table 4-3: World Container Ship Orderbook by Scheduled Delivery Date	38
Table 4-4: 2013 World Container Ship Fleet (July 13, 2010).....	39
Table 4-5: World Fleet Existing and Ordered Post-Panamax Vessels (number of vessels)	40
Table 4-6: Savannah Harbor Waterborne Freight Traffic: 1995 – 2009 (thousands of short tons)	41
Table 4-7: Garden City Terminal TEU Volumes (1995 – 2010).....	45
Table 4-8: 2007 Savannah Harbor Container Ship Arrival and Departure Drafts (number of calls)	47
Table 4-9: Savannah Harbor Economic Impact – 2009 (millions of 2009 dollars).....	50
Table 5-1: Panama Canal Maximum Vessel Dimensions.....	61
Table 5-2: New, Planned, or Proposed Container Terminals U S East and Gulf Coasts	61
Table 5-3: Savannah Harbor Container Ship Services.....	66
Table 5-4: Savannah Harbor Historical Containerized Import Tonnage	69
Table 5-5: Historical Savannah Harbor Containerized Export Tonnage	70
Table 5-6: Commodity Forecast Baseline (Year-2010) Tonnage	70
Table 5-7: Global Insight's 2008 Savannah Harbor Containerized Trade Forecast – Imports (Metric Tons)	71
Table 5-8: Global Insight's 2008 Savannah Harbor Containerized Trade Forecast – Exports (Metric Tons)	72
Table 5-9: 2010 Savannah Harbor Import and Export Tonnage Forecast	73
Table 5-10: Savannah Harbor Updated Tonnage Forecast Year-to-Year Rates of Change	74
Table 5-11: SHEP Containerized Trade Forecast - Import Metric Tons	75
Table 5-12: Savannah Harbor Containerized Trade Forecast - Export Metric Tons.....	75
Table 5-13: Container Box Weight by Service	76
Table 5-14: TEU Forecast for Selected Years	77
Table 5-15: Route Percent Share of Panamax and Post-Panamax Vessel Tonnage.....	81
Table 5-16: Example Load Factor Analysis Capacity Allocation – 107,000 DWT Vessel.....	83
Table 5-17: Projected Maximum Vessel Drafts: Savannah Harbor.....	84
Table 5-18: Estimated Vessel Unit Costs	85

Table 5-19: Projected FE (Panama) ECUS Vessel Calls: Garden City Terminal 86

Table 5-20: Projected ECUS MED Vessel Calls: Garden City Terminal..... 86

Table 5-21: Projected FE (Suez) ECUS Vessel Calls: Garden City Terminal 87

Table 5-22: Total Projected Vessel Calls: Garden City Terminal 88

Table 5-23: Local Area Population Projections 89

Table 5-24: Local Area Employment Projections..... 89

Table 5-25: Savannah Harbor Market Area Population Projections (2005 – 2030) 90

Table 6-1: Annual Waterborne Transportation Cost Savings and Landside Transportation Cost Increases (2003) 112

Table 6-2: Evaluation of Alternative Terminal Sites 116

Table 6-3: Facility Costs, Dredging & Mitigation Costs, and Total Costs for Alternative Terminals (2003)..... 116

Table 6-4: Summary Assessment of Alternative Terminals 118

Table 6-5: Evaluation of Higher Ranked Alternative Terminal Sites (2003). 119

Table 6-6: Ship Simulation Results: Bend Widening 123

Table 7-1: Savannah Share of Voyage Cost 130

Table 7-2: Average Annual Equivalent Transportation Cost Savings by Project Depth..... 131

Table 7-3: Incremental Transportation Cost Savings by Project Depth 132

Table 7-4: LNG Vessel Fleet (bcm) (2015-2030)..... 134

Table 7-5: General Cargo Fleet – Annual Vessel Calls (2017-2030) 134

Table 7-6: Meeting Area Average Annual Benefits 135

Table 7-7: Tide Delay Benefits 136

Table 7-8: Average Annual Benefits - Tide Delay Reduction..... 136

Table 7-9: Cumulative Benefits – Meeting Areas and Tide Delay Reduction 137

Table 7-10: Total Average Annual Equivalent Incremental Deepening Benefits 137

Table 8-1: Savannah Harbor Expansion Project-Modeling Reports..... 149

Table 8-2: Summary of Project-Related Impacts without Mitigation..... 151

Table 8-3: Summary of Project-Related Impacts with Mitigation..... 153

Table 9-1: Preliminary Mitigation Measure Ranking 161

Table 9-2: Mitigation Planning Dual Approach: Measures and Combinations 162

Table 9-3: Preliminary Marsh Mitigation Evaluation: -48 Foot Deepening Alternative..... 162

Table 9-4: Marsh Mitigation Plan Evaluation: -48 Foot Deepening Alternative..... 164

Table 9-5: Marsh Mitigation Plan Cost Effectiveness: -48 Foot Deepening Alternative..... 165

Table 9-6: Summary of SOP Calculations: 48 Foot Alternative..... 167

Table 9-7: Wetland Preservation Calculations..... 167

Table 9-8: Impacted Wetland Characteristics 169

Table 9-9: Re-Vegetation Rate for Created Marsh	170
Table 9-10: Dissolved Oxygen System Requirements.....	172
Table 9-11: Striped Bass Weighted Average Impact.....	177
Table 9-12: Striped Bass Annual Mitigation Costs	177
Table 9-13: Striped Bass Lump Sum Compensation Value	178
Table 10-1: Dredged Material Volume Estimates ¹ : Meeting Areas (cubic yards).....	188
Table 10-2: Dredged Material Volume Estimates: ¹ Incremental Deepening Alternatives (cubic yards)	190
Table 10-3: Dredging Related Costs: Incremental Deepening Alternatives (October 2010 Dollars)	195
Table 10-4: Mitigation-Related Costs: Incremental Deepening Alternatives (October 2010 Dollars)	196
Table 10-5: Total Construction First Costs: Incremental Deepening Alternatives (October 2010 Dollars).....	197
Table 10-6: Total Investment Costs including Interest During Construction	198
Table 10-7: Total Annual O&M Costs: Incremental Deepening Alternatives (October 2010 Dollars).....	199
Table 10-8: Average Annual Equivalent (AAEQ) Project Costs: Incremental Channel Deepening Alternatives	199
Table 11-1: Economic Analysis of Alternative Deepening Plans (FY 2011)	203
Table 11-2: Meeting Area Average Annual Equivalent Net Benefits	203
Table 11-3: Savannah Harbor Expansion – System of Accounts	206
Table 12-1: Jasper County Terminal Sensitivity Analysis - 1	233
Table 12-2: Jasper County Terminal Sensitivity Analysis - 2	234
Table 12-3: Transportation Cost Model Sensitivity Analyses AAEQ Cost Savings.....	236
Table 14-1: Selected Plan (47-Foot Deepening) Economic Highlights.....	261
Table 14-2: Existing and Selected Plan Widths (feet)	262
Table 14-3: Existing and Selected Plan Depths (feet below MLLW)	263
Table 14-4: Environmental Effects of the Selected Plan	264
Table 14-5: Selected NED Plan Mitigation Costs	267
Table 15-1: SHEP Federal Funding Allocation	274
Table 15-2: SHEP Project Costs History	276
Table 15-3: SHEP Project Average Annual Costs and Benefits History.....	279
Table 15-4: SHEP Project Cost Comparison (1999 Authorized Plan and Selected Plan).....	Error! Bookmark not defined.
Table 15-5: SHEP Project Cost Sharing Comparison (1999 Authorized Plan and Selected NED Plan)	Error! Bookmark not defined.
Table 15-6: Savannah Harbor Expansion Cost Allocation for the Selected NED 47-Foot Plan (FY12 Price Levels)	286
Table 15-7: Cost Sharing Explanations.....	289

List of Figures

Figure 1-1: Savannah Harbor Expansion Project..... 2

Figure 1-2: Inner Harbor 3

Figure 1-3: Typical Dredging Section – Inner Harbor..... 10

Figure 1-4: Typical Dredging Section – Entrance Channel 11

Figure 1-5: Savannah Harbor Turning Basins 13

Figure 1-6: Tidegate 15

Figure 1-7: Freshwater Control Works 17

Figure 1-8: Savannah Harbor Disposal Areas..... 20

Figure 1-9: Approved Unconfined Placement Areas for Maintenance Material 21

Figure 4-1: Selected World Harbor Depths Comparison 37

Figure 4-2: Savannah Harbor Historical Commodity Growth with Trendline 41

Figure 4-3: Garden City Terminal Historical Loaded TEUs 45

Figure 4-4: Garden City Terminal 2007 Arrival and Departure Drafts 47

Figure 5-1: FE (Panama) ECUS Trade Map 67

Figure 5-2: FE (SUEZ) ECUS Trade Map..... 67

Figure 5-3: Projected World Container Fleet by TEU Capacity..... 78

Figure 5-4: Projected Post Panamax Vessel Calls at Savannah..... 80

Figure 5-5: Savannah Harbor First Generation Post-Panamax Vessel Calls by
Service Route 81

Figure 5-6: Savannah Harbor Second Generation Post-Panamax Vessel Calls by
Service Route 82

Figure 6-1: Alternative Terminal Locations 109

Figure 8-1: Typical Channel Cross Section 140

Figure 9-1: Mitigation Options 160

Figure 9-2: Proposed Locations for Dissolved Oxygen Improvement Systems 173

Figure 9-3: Proposed Impoundment Location 183

Figure 13-1: Summary of Comment Subject Areas 256

Figure 14-1: Selected Plan Construction Schedule 271

Appendices

Appendix A: Economics

Appendix B: Real Estate

Appendix C: Engineering

Appendix D: Plan Formulation

Appendix E: Quality Control

This Page Intentionally Blank