APPENDIX A

REAL ESTATE PLAN

APPENDIX A
REAL ESTATE PLAN (REP)

1. The study area for the Poplar Island Restoration Project, Maryland, Section 204 feasibility study encompasses the immediate area around an island chain, the remnants of Poplar Island, located 1 mile northwest of Tilghman Island in Talbot County, Maryland, and 50 miles south of Baltimore, Maryland. The Section 204 Initial Appraisal Report, dated 31 August 1994, documented the results of preliminary evaluations for habitat restoration at the island.

2. Various project alternatives have been studied pertaining to restoration of the island, but all have basically the same real estate requirements. The real estate requirements are as follows:

Fee ownership interests are required for land above the ordinary high water mark within the "footprint" of the project. The navigation channels to be dredged for placement material to create the island are below the ordinary high water mark, are under navigational servitude, and will require no acquisition. The habitat restoration site will come in contact with five small remnant islands; North Point Island, Middle Poplar Island, South Central Poplar Island, South Poplar Island, and Coaches Island. The first four islands are all 500 feet or less in width and have previously been acquired in fee by the State of Maryland. They are in danger of completely eroding away in the next few years. Therefore, they are not considered to have any real estate value for crediting purposes. The larger, privately-owned Coaches Island, approximately 162 acres in size as stated in the 1982 deed of the current owner, is adjacent to, and will have its entire southern shore and a portion of the northwestern shore protected by the project. The current size of Coaches Island is estimated to be approximately 74 acres. The project is being designed such that the fill will abut and may overlap the ordinary high water mark along a portion of the Coaches Island shore. Under Maryland state law, the owner of Coaches Island could conceivably become the owner of the entire restored island by rights of accretion. To prevent this, the Non-Federal Sponsor will acquire a total of approximately 2.83 acres. A 5 foot wide perimeter of Coaches Island, containing approximately 0.6 of an acre, adjacent to the project to establish ownership of the entire project, and a small peninsula at the southwest corner of the island will be acquired, containing approximately 2.23 acres, to shorten the dike construction around that portion of the project. The Non-Federal Sponsor intends to operate and maintain the project lands in perpetuity under an agreement and with the support of the Maryland Environmental Trust, a non-profit organization established for the preservation and proper management of environmentally sensitive properties in Maryland. There is currently no federally-owned land at the project site.

3. No P.L. 91-646 relocations will be necessary for this project.

4. The Maryland Port Administration, the Non-Federal Sponsor, has the necessary experience, manpower and resources to acquire any real estate required for the project. They also have condemnation authority.

5. A real estate cost estimate is enclosed as Exhibit "A". The gross appraisal indicates $65,000 for 0.6 of an acre of fast land in the 5 foot perimeter, and $1,100 for 2.23 acres of marsh land in the peninsula, for a total estimated fair market value of $66,100. Including a 15% contingency, the total real estate costs are estimated to be $74,059. The gross appraisal also determined the remainder of the island will not be affected by the severing of the 5 foot perimeter and peninsula. Therefore, no severance damages were provided in the gross appraisal.

6. A real estate map of the project is enclosed as Exhibit "B".

7. There is no present or anticipated mineral activity in the vicinity of this project.

8. A description of the estate required for this project for wetland creation and fish and wildlife enhancement is as follows:

Estate No. 1, Fee simple title to the land described in schedule A, subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines. A reservation for a riparian access easement across the 5 foot perimeter will be provided to the owner.

9. The Non-Federal Sponsor is aware that due to the time required to acquire the real estate, a Right-of-Entry (ROE) for construction will first have to be acquired to meet a mid-1996 construction initiation date. The owner of Coaches Island is supportive of the project, and we do not foresee any problems in acquiring either an ROE or the required real estate in fee. The schedule for real estate acquisition is as follows:

	COE Initiate	COE Complete	LS Initiate	LS Complete
Receipt of final drawings from Engineering/PM.	12/15/95	02/27/96		
PCA Execution.	02/27/96	04/06/96		04/06/96
Formal transmittal of final ROW drawings to LS and instruct to acquire LERRD.	04/06/96	04/08/96		

Conduct landowner meetings.			05/01/96	07/29/96
Prepare mapping and legal description.			05/10/96	05/31/96
Obtain title evidence.			04/08/96	04/19/96
Review title evidence.	04/22/96	04/26/96		
Obtain tract appraisal.			06/01/96	06/15/96
Review tract appraisal.	06/15/96	06/30/96		
Conduct negotiations.			07/01/96	07/29/96
Perform closing.			08/15/96	09/14/96

10. There are no utilities or other facilities to be relocated for this project.

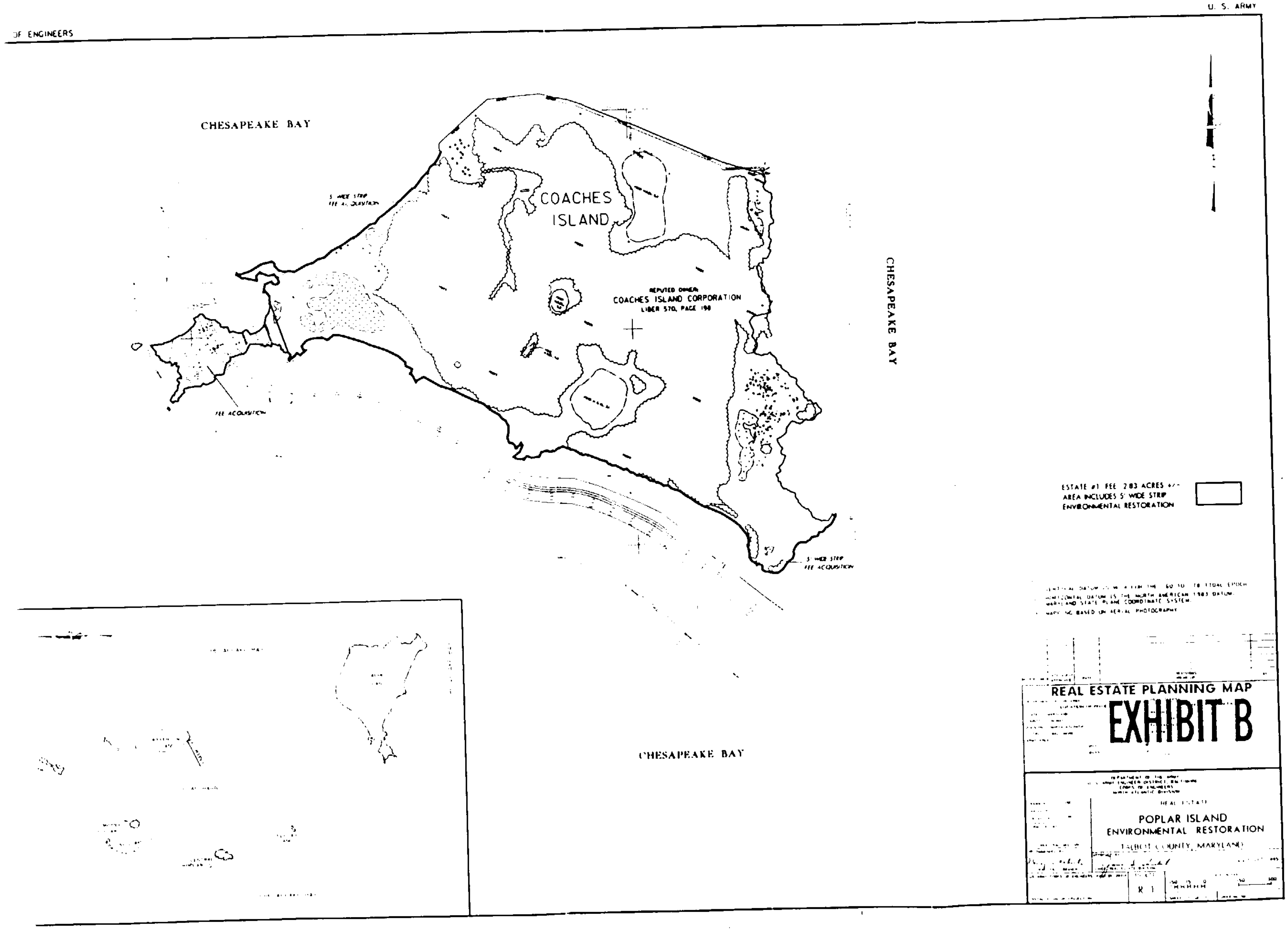
11. Surveys conducted at both the proposed dredge site and the placement site have shown that there is little potential for HTRW or other environmental contaminants on lands within the project area.

12. One private landowner is being positively affected and the project is supported by various state, local, Federal, and private interests. The owner of Coaches Island is agreeable to the project and the acquisition, since it will provide protection to his property from continued erosion. Therefore, the project is considered non-controversial.

REAL ESTATE DIVISION
COST ESTIMATE RATES
November 1995

		AMOUNT	CONTINGENCY	SUBTOTAL
01010401	Real Estate Acquisition Documents (Cadastral prep. of R. E. Requirements Mapping)			
0102----	ACQUISITIONS			
010201--	By Gov't			
010202--	By Local Sponsor (LS)			
01020201	Survey & Legals	$ 700	$ 105	$ 805
01020202	Title Evidence	$ 600	$ 90	$ 690
01020203	Negotiations	$ 1,000	$ 150	$ 1,150
010203--	By Gov't on behalf of LS			
010204--	Review of LS			
01020401	Survey & Legals	$ 75	$ 11	$ 86
01020402	Title Evidence	$ 75	$ 11	$ 86
01020403	Negotiations	$ 75	$ 11	$ 86
0103----	CONDEMNATIONS			
010301--	By Gov't			
010302--	By Local Sponsor (LS)			
010303--	By Gov't on behalf of LS			
010304--	Review of LS			
0105----	APPRAISALS			
010501--	By Gov't			
010502--	By Local Sponsor (LS)	$ 750	$ 113	$ 863
010503--	By Gov't on behalf of LS			
010504--	Review of LS	$ 180	$ 27	$ 207
0106----	PL 91-646 ASSISTANCE			
010601--	By Gov't			
010602--	By Local Sponsor (LS)			
010603--	By Gov't on behalf of LS			
010604--	Review of LS			
0107----	TEMPORARY PERMITS/LICENSES/RIGHTS-OF-WAY			
010701--	By Gov't			
010702--	By Local Sponsor (LS)			
010703--	By Gov't on behalf of LS			
010704--	Review of LS			
0115----	REAL ESTATE PAYMENTS			
011501--	Land Payments			
01150101	By Gov't			
01150102	By Local Sponsor (LS)	$66,100	$ 3,900	$70,000
01150103	By Gov't on behalf of LS			
01150104	Review of LS	$ 75	$ 11	$ 86
011502--	PL 91-646 Assistance Payments			
01150201	By Gov't			
01150202	By Local Sponsor (LS)			
01150203	By Gov't on behalf of LS			
01150204	Review of LS			
011503--	Damage Payments			
01150301	By Government			
01150302	By Local Sponsor (LS)			
01150303	By Government on behalf of LS			
01150304	Review of LS			
	TOTALS	$69,630	$ 4,429	$74,059

EXHIBIT A


U. S. ARMY
OF ENGINEERS
CHESAPEAKE BAY
COACHES ISLAND
COACHES ISLAND CORPORATION
CHESAPEAKE BAY
FEE ACQUISITION
ESTATE #1 FEE 283 ACRES +/-
AREA INCLUDES 5' WIDE STRIP
ENVIRONMENTAL RESTORATION
CHESAPEAKE BAY
REAL ESTATE PLANNING MAP
EXHIBIT B
REAL ESTATE
POPLAR ISLAND
ENVIRONMENTAL RESTORATION
TALBOT COUNTY, MARYLAND

APPENDIX B

ENVIRONMENTAL DATA

COMMON/LEAST TERN HABITAT EVALUATION PROCEDURE

USED HABITAT SUITABILITY INDEX (HSI) FOR REPRODUCTION WHICH FOCUSES UPON VEGETATIVE COVER.
FORAGING CONDITIONS ASSUMED TO BE NON-LIMITING TO TERNS.
ACCORDING TO MODEL NESTING IS RESTRICTED TO SPARSELY- AND NON-VEGETATED AREAS.
VEGETATED AREAS NOT INCLUDED SINCE THEY ARE OF NEGLIGIBLE VALUE AS NESTING HABITAT.

Alignment No./ Area/ % Wetlands/ Upland Elev.	No. of bare substrate islands (within placed material, one per wetland cell)	Bare substrate islands (acres) (2 acres /island)	Variable A: %veg cover	Suitability Index (SI) of A	Variable B: avg veg height "	SIB	HSI = SIA x SIB	Least Tern HUs (= HSI x total bare island acres)
No Action	0	0						0
1/820/50/10	3	6	0-20	1	0-10	1	1	6
1/820/70/10	3	6	0-20	1	0-10	1	1	6
1/820/100	3	6	0-20	1	0-10	1	1	6
3/1110/50/10	4	8	0-20	1	0-10	1	1	8
3/1110/70/10	4	8	0-20	1	0-10	1	1	8
3/1110/100	4	8	0-20	1	0-10	1	1	8
2/1340/50/10	5	10	0-20	1	0-10	1	1	10
2/1340/70/10	5	10	0-20	1	0-10	1	1	10
2/1340/100	5	10	0-20	1	0-10	1	1	10
1/820/50/20	3	6	0-20	1	0-10	1	1	6
1/820/70/20	3	6	0-20	1	0-10	1	1	6
3/1110/50/20	**4**	**8**	**0-20**	**1**	**0-10**	**1**	**1**	**8**
3/1110/70/20	4	8	0-20	1	0-10	1	1	8
2/1340/50/20	5	10	0-20	1	0-10	1	1	10
2/1340/70/20	5	10	0-20	1	0-10	1	1	10

LEAST TERN COST EFFECTIVENESS ANALYSIS

Alignment No./ Area/ % Wetlands/ Upland Elev.	Least Tern HUs (= HSI x total bare island acres)	Initial Total Cost ($ million)
No Action	0	
1/820/50/10	6	78.0
1/820/70/10	6	74.9
1/820/100	6	59.1
3/1110/50/10	8	104.7
3/1110/70/10	8	100.0
3/1110/100	8	76.3
2/1340/50/10	10	124.7
2/1340/70/10	10	116.9
2/1340/100	10	89.4
1/820/50/20	6	88.6
1/820/70/20	6	81.6
3/1110/50/20	**8**	**122.1**
3/1110/70/20	8	110.8
2/1340/50/20	10	147.3
2/1340/70/20	10	131.0

STACKED IN ORDER OF ASCENDING OUTPUTS

Alignment No./ Area/ % Wetlands/ Upland Elev.	Least Tern HUs (= HSI x total bare island acres)	Initial Total Cost ($ million)
No Action	0	
1/820/100	6	59.1
1/820/70/10	6	74.9
1/820/50/10	6	78.0
1/820/70/20	6	81.6
1/820/50/20	6	88.6
3/1110/100	8	76.3
3/1110/70/10	8	100.0
3/1110/50/10	8	104.7
3/1110/70/20	8	110.8
3/1110/50/20	**8**	**122.1**
2/1340/100	10	89.4
2/1340/70/10	10	116.9
2/1340/50/10	10	124.7
2/1340/70/20	10	131.0
2/1340/50/20	10	147.3

COST INEFFICIENT SOLUTIONS STRUCK THROUGH

Alignment No./ Area/ % Wetlands/ Upland Elev.	Least Tern HUs (= HSI x total bare island acres)	Initial Total Cost ($ million)
No Action	0	
1/820/100	6	59.1
~~1/820/70/10~~	~~6~~	~~74.9~~
~~1/820/50/10~~	~~6~~	~~78.0~~
~~1/820/70/20~~	~~6~~	~~81.6~~
~~1/820/50/20~~	~~6~~	~~88.6~~
3/1110/100	8	76.3
~~3/1110/70/10~~	~~8~~	~~100.0~~
~~3/1110/50/10~~	~~8~~	~~104.7~~
~~3/1110/70/20~~	~~8~~	~~110.8~~
~~3/1110/50/20~~	**~~8~~**	**~~122.1~~**
2/1340/100	10	89.4
~~2/1340/70/10~~	~~10~~	~~116.9~~
~~2/1340/50/10~~	~~10~~	~~124.7~~
~~2/1340/70/20~~	~~10~~	~~131.0~~
~~2/1340/50/20~~	~~10~~	~~147.3~~

GREAT EGRET HABITAT EVALUATION PROCEDURE

USED HSI FOR REPRODUCTION

ACCORDING TO MODEL NESTING IS RESTRICTED TO VEGETATED AREAS

BARE AND SPARSELY VEGETATED ISLANDS AS WELL AS MARSH ARE OF NEGLIGIBLE VALUE AS NESTING HABITAT

FORAGING CONDITIONS ASSUMED TO BE NON-LIMITING

ALL CREATED AND REMNANT ISLAND HABITATS ARE INCLUDED SINCE IT IS ASSUMED THAT WITHOUT A PROJECT ALL WILL BE LOST TO EROSION

Alignment No./ Area/ % Wetlands/ Upland Elev.	Variable A: cover as % of island w/ >=1 m height woody veg	Suita-bility Index (SI) of A	Placed material added to isolated vegetated small (<5) islands (acres)	Natural island upland acreage < 25 acres in size (Poplar & Jefferson)	Total acreage of islands < 25 acres in size (full acreage value)	Total acreage of natural islands 25 to 50 acres in size	Total upland acreage of natural islands 50 to 250 acres in size (Coaches)	Prorated acreage value of Coaches Island (acres x 0.3)	Uplands of contiguous placed material (acres) (> than 250 acre size)	Prorated value of contig-uous placed material (acres x 0.1)	Total veg islands acres (incl prorated)	Habitat Units (= SI x Total acres)
No Action				0	0	0	0				0	0
1/820/50/10	100	1	6	9	15	0	52	15.6	410	41	71.6	72
1/820/70/10	100	1	6	9	15	0	52	15.6	246	24.6	55.2	55
1/820/100	100	1	6	9	15	0	52	15.6	0	0	30.6	31
3/1110/50/10	100	1	8	9	17	0	52	15.6	555	55.5	88.1	88
3/1110/70/10	100	1	8	9	17	0	52	15.6	333	33.3	65.9	66
3/1110/100	100	1	8	9	17	0	52	15.6	0	0	32.6	33
2/1340/50/10	100	1	10	9	19	0	52	15.6	670	67	101.6	102
2/1340/70/10	100	1	10	9	19	0	52	15.6	402	40.2	74.8	75
2/1340/100	100	1	10	9	19	0	52	15.6	0	0	34.6	35
1/820/50/20	100	1	6	9	15	0	52	15.6	410	41	71.6	72
1/820/70/20	100	1	6	9	15	0	52	15.6	246	24.6	55.2	55
3/1110/50/20	**100**	**1**	**8**	**9**	**17**	**0**	**52**	**15.6**	**555**	**55.5**	**88.1**	**88**
3/1110/70/20	100	1	8	9	17	0	52	15.6	333	33.3	65.9	66
2/1340/50/20	100	1	10	9	19	0	52	15.6	670	67	101.6	102
2/1340/70/20	100	1	10	9	19	0	52	15.6	402	40.2	74.8	75

	Jefferson Island (acres)	Coaches Island (acres)	Poplar Island remnants (acres)
Total area	17	74	5
Tidal marsh	9	22	4

GREAT EGRET COST EFFECTIVENESS ANALYSIS

Alignment No./ Area/ % Wetlands/ Upland Elev.	Great Egret Habitat Units (= SI x Total acres)	Initial Total Cost ($ million)
No Action	0	
1/820/50/10	72	78.0
1/820/70/10	55	74.9
1/820/100	31	59.1
3/1110/50/10	88	104.7
3/1110/70/10	66	100.0
3/1110/100	33	76.3
2/1340/50/10	102	124.7
2/1340/70/10	75	116.9
2/1340/100	35	89.4
1/820/50/20	72	88.6
1/820/70/20	55	81.6
3/1110/50/20	**88**	**122.1**
3/1110/70/20	66	110.8
2/1340/50/20	102	147.3
2/1340/70/20	75	131.0

STACKED IN ORDER OF ASCENDING OUTPUTS THEN COSTS

Alignment No./ Area/ % Wetlands/ Upland Elev.	Great Egret Habitat Units (= SI x Total acres)	Initial Total Cost ($ million)
No Action	0	
1/820/100	31	59.1
3/1110/100	33	76.3
2/1340/100	35	89.4
1/820/70/10	55	74.9
1/820/70/20	55	81.6
3/1110/70/10	66	100.0
3/1110/70/20	66	110.8
1/820/50/10	72	78.0
1/820/50/20	72	88.6
2/1340/70/10	75	116.9
2/1340/70/20	75	131.0
3/1110/50/10	88	104.7
3/1110/50/20	**88**	**122.1**
2/1340/50/10	102	124.7
2/1340/50/20	102	147.3

COST INEFFICIENT SOLUTIONS STRUCK THROUGH

Alignment No./ Area/ % Wetlands/ Upland Elev.	Great Egret Habitat Units (= SI x Total acres)	Initial Total Cost ($ million)
No Action	0	
1/820/100	31	59.1
3/1110/100	33	76.3
2/1340/100	35	89.4
1/820/70/10	55	74.9
~~1/820/70/20~~	~~55~~	~~81.6~~
3/1110/70/10	66	100.0
~~3/1110/70/20~~	~~66~~	~~110.8~~
1/820/50/10	72	78.0
~~1/820/50/20~~	~~72~~	~~88.6~~
2/1340/70/10	75	116.9
~~2/1340/70/20~~	~~75~~	~~131.0~~
3/1110/50/10	88	104.7
~~3/1110/50/20~~	**~~88~~**	**~~122.1~~**
2/1340/50/10	102	124.7
~~2/1340/50/20~~	~~102~~	~~147.3~~

GREAT EGRET COST EFFECTIVENESS ANALYSIS

ECONOMICALLY INEFFECTIVE SOLUTIONS STRUCK THROUGH

Alignment No./ Area/ % Wetlands/ Upland Elev.	Great Egret Habitat Units (= SI x Total acres)	Initial Total Cost ($ million)
No Action	0	
1/820/100	31	59.1
3/1110/100	33	76.3
2/1340/100	35	89.4
1/820/70/10	55	74.9
3/1110/70/10	66	100.0
1/820/50/10	72	78.0
2/1340/70/10	75	116.9
3/1110/50/10	88	104.7
2/1340/50/10	102	124.7

Alignment No./ Area/ % Wetlands/ Upland Elev.	Great Egret Habitat Units (= SI x Total acres)	Initial Total Cost ($ million)
No Action	0	
1/820/100	31	59.1
~~3/1110/100~~	~~33~~	~~76.3~~
~~2/1340/100~~	~~35~~	~~89.4~~
1/820/70/10	55	74.9
~~3/1110/70/10~~	~~66~~	~~100.0~~
1/820/50/10	72	78.0
~~2/1340/70/10~~	~~75~~	~~116.9~~
3/1110/50/10	88	104.7
2/1340/50/10	102	124.7

ECONOMICALLY EFFECTIVE SOLUTIONS

Alignment No./ Area/ % Wetlands/ Upland Elev.	Great Egret Habitat Units (= SI x Total acres)	Initial Total Cost ($ million)
No Action	0	
1/820/100	31	59.1
1/820/70/10	55	74.9
1/820/50/10	72	78.0
3/1110/50/10	88	104.7
2/1340/50/10	102	124.7

COASTAL WETLANDS HEP
VALUE ASSESSMENT BRACKISH MARSH COMMUNITY MODEL

Alignment No./ Area % Wetlands Upland Elev.	Tidal Wetlands (acres)	Total open water (acres) (within tidal marsh)	Tidal ponds (no.) (within placed material of low marsh: 1/cell))	Tidal ponds (acres) (within placed material of low marsh)	Acres of Tidal Ponds >= 1.5 ft deep @ low tide (10% of total pond area)	Acres of total open water within tidal marsh <=1.5 ft deep at low tide	V1: %of wetland area covered by emergent vegetation	SI1: 0.009 x V1+ 0.1	V2 % of open water area w/ SAV (assume 10%)	SI2 (= 0.007 x V2) + 0.3	SI3: marsh edge and interspersion (pictorial interpretation)	V4: %open water <= 1.5 ft deep	SI4: if % >= 80, then SI = (-0.02 x V4) + 2.6	SI5: avg annual salinity	V6: aquatic organism access (narrative)	HSI*	HUs
Created marsh																	
No Action																	
1/820/50/10	410	21.3	3.0	6.0	0.6	20.7	94.80804	0.953272	10	0.37	0.4	97.18138	0.656372	1	0.85	0.75199	308
1/820/70/10	574	22.8	3.0	6.0	0.6	22.2	96.02149	0.964193	10	0.37	0.4	97.37264	0.652547	1	0.85	0.75582	434
1/820/100	820	24.4	3.0	6.0	0.6	23.8	97.02607	0.973235	10	0.37	0.4	97.5396	0.649208	1	0.85	0.758963	622
3/1110/50/10	555	28.4	4.0	8.0	0.8	27.6	94.88599	0.953974	10	0.37	0.4	97.18139	0.656372	1	0.85	0.752255	418
3/1110/70/10	777	30.4	4.0	8.0	0.8	29.6	96.08123	0.964731	10	0.37	0.4	97.37264	0.652547	1	0.85	0.756022	587
3/1110/100	1110	32.5	4.0	8.0	0.8	31.7	97.07072	0.973637	10	0.37	0.4	97.53959	0.649208	1	0.85	0.759113	843
2/1340/50/10	670	35.5	5.0	10.0	1.0	34.5	94.70471	0.952342	10	0.37	0.4	97.18139	0.656372	1	0.85	0.751639	504
2/1340/70/10	938	38.1	5.0	10.0	1.0	37.1	95.94232	0.963481	10	0.37	0.4	97.37264	0.652547	1	0.85	0.755552	709
2/1340/100	1340	40.6	5.0	10.0	1.0	39.6	96.96689	0.972702	10	0.37	0.4	97.53959	0.649208	1	0.85	0.758764	1017
1/820/50/20	410	21.3	3.0	6.0	0.6	20.7	94.80804	0.953272	10	0.37	0.4	97.18138	0.656372	1	0.85	0.75199	308
1/820/70/20	574	22.8	3.0	6.0	0.6	22.2	96.02149	0.964193	10	0.37	0.4	97.37264	0.652547	1	0.85	0.75582	434
3/1110/50/20	**555**	**28.4**	**4.0**	**8.0**	**0.8**	**27.6**	**94.88599**	**0.953974**	**10**	**0.37**	**0.4**	**97.18139**	**0.656372**	**1**	**0.85**	**0.752255**	**418**
3/1110/70/20	777	30.4	4.0	8.0	0.8	29.6	96.08123	0.964731	10	0.37	0.4	97.37264	0.652547	1	0.85	0.756022	587
2/1340/50/20	670	35.5	5.0	10.0	1.0	34.5	94.70471	0.952342	10	0.37	0.4	97.18139	0.656372	1	0.85	0.751639	504
2/1340/70/20	938	38.1	5.0	10.0	1.0	37.1	95.94232	0.963481	10	0.37	0.4	97.37264	0.652547	1	0.85	0.755552	709
Existing tidal marsh on Coaches, Jefferson, and Poplar Island Remnants																	
	35	0.5	3	0.5	0.05	0.45	98.57143	0.987143	10	0.37	0.4	90	0.8	1	0.85	0.775324	27

*HSI =[[3.5 X (SI1 cubed x SI2 X SI6) exp1/5] + [(SI3 + SI4 + SI5)/3]]/4.5

COST EFFECTIVENESS ANALYSIS
COASTAL WETLANDS HABITAT UNITS

Alignment No./ Area/ % Wetlands/ Upland Elev.	Total HUs (Created plus Existing)	Initial Total Cost ($ million)
No Action	0	0
1/820/50/10	335	78.0
1/820/70/10	461	74.9
1/820/100	649	59.1
3/1110/50/10	445	104.7
3/1110/70/10	614	100.0
3/1110/100	870	76.3
2/1340/50/10	531	124.7
2/1340/70/10	736	116.9
2/1340/100	1044	89.4
1/820/50/20	335	88.6
1/820/70/20	461	81.6
3/1110/50/20	**445**	**122.1**
3/1110/70/20	614	110.8
2/1340/50/20	531	147.3
2/1340/70/20	736	131.0

STACKED IN ORDER OF ASCENDING OUTPUTS

Alignment No./ Area/ % Wetlands/ Upland Elev.	Total HUs (Created plus Existing)	Initial Total Cost ($ million)
No Action	0	0
1/820/50/10	335	78.0
1/820/50/20	335	88.6
3/1110/50/10	445	104.7
3/1110/50/20	**445**	**122.1**
1/820/70/10	461	74.9
1/820/70/20	461	81.6
2/1340/50/10	531	124.7
2/1340/50/20	531	147.3
3/1110/70/10	614	100.0
3/1110/70/20	614	110.8
1/820/100	649	59.1
2/1340/70/10	736	116.9
2/1340/70/20	736	131.0
3/1110/100	870	76.3
2/1340/100	1044	89.4

COST INEFFICIENT SOLUTIONS STRUCK THROUGH

Alignment No./ Area/ % Wetlands/ Upland Elev.	Total HUs (Created plus Existing)	Initial Total Cost ($ million)
No Action	0	0
1/820/50/10	335	78.0
~~1/820/50/20~~	~~335~~	~~88.6~~
3/1110/50/10	445	104.7
~~3/1110/50/20~~	**~~445~~**	**~~122.1~~**
1/820/70/10	461	74.9
~~1/820/70/20~~	~~461~~	~~81.6~~
2/1340/50/10	531	124.7
~~2/1340/50/20~~	~~531~~	~~147.3~~
3/1110/70/10	614	100.0
~~3/1110/70/20~~	~~614~~	~~110.8~~
1/820/100	649	59.1
2/1340/70/10	736	116.9
~~2/1340/70/20~~	~~736~~	~~131.0~~
3/1110/100	870	76.3
2/1340/100	1044	89.4

COST INEFFICIENT SOLUTIONS RE
COST INEFFECTIVE SOLUTIONS S

Alignment No./ Area/ % Wetlands/ Upland Elev.	Total HUs (Created plus Existing)	Initial Total Cost ($ million)
No Action	0	0
~~1/820/50/10~~	~~335~~	~~78.0~~
~~3/1110/50/10~~	~~445~~	~~104.7~~
~~1/820/70/10~~	~~461~~	~~74.9~~
~~2/1340/50/10~~	~~531~~	~~124.7~~
~~3/1110/70/10~~	~~614~~	~~100.0~~
1/820/100	649	59.1
~~2/1340/70/10~~	~~736~~	~~116.9~~
3/1110/100	870	76.3
2/1340/100	1044	89.4

PRIMARY PRODUCTIVITY ANALYSIS

Alignment No.	Site Area (acres)	Percent Tidal Wetlands	Tidal Wetlands (acres)	Upland Elevation (ft)	Wetlands Primary Productivity Output (+) (grams dry org matter / m2/ yr)	Uplands Primary Productivity Output (+) (grams dry org matter / m2/ yr)	Lost Estuarine Primary Productivity (-) (grams dry org matter / m2/ yr)	Total Gain in Primary Productivity Output (grams dry org matter / m2/ yr)	Initial Total Cost ($ million)
Created Island Habitats									0
1	820	50	410	10	1025000	492000	1476000	41000	78.0
1	820	70	574	10	1435000	295200	1476000	254200	74.9
1	820	100	820		2050000	0	1476000	574000	59.1
3	1110	50	555	10	1387500	666000	1998000	55500	104.7
3	1110	70	777	10	1942500	399600	1998000	344100	100.0
3	1110	100	1110		2775000	0	1998000	777000	76.3
2	1340	50	670	10	1675000	804000	2412000	67000	124.7
2	1340	70	938	10	2345000	482400	2412000	415400	116.9
2	1340	100	1340		3350000	0	2412000	938000	89.4
1	820	50	410	20	1025000	492000	1476000	41000	88.6
1	820	70	574	20	1435000	295200	1476000	254200	81.6
3	**1110**	**50**	**555**	**20**	**1387500**	**666000**	**1998000**	**55500**	**122.1**
3	1110	70	777	20	1942500	399600	1998000	344100	110.8
2	1340	50	670	20	1675000	804000	2412000	67000	147.3
2	1340	70	938	20	2345000	482400	2412000	415400	131.0
Existing Island Habitats									
Archipelago Remnants	96	36	35	-	87500	73200			

COST EFFECTIVENESS ANALYSIS			
INCREASE IN PRIMARY PRODUCTIVITY			
Alignment No./ Area/ % Wetlands/ Upland Elev.	Total Gain in Primary Produc- tivity Output (grams dry org matter / m2/ yr)	Initial Total Cost ($ million)	
No Action	0	0	
1/820/50/10	41000	78.0	
1/820/70/10	254200	74.9	
1/820/100	574000	59.1	
3/1110/50/10	55500	104.7	
3/1110/70/10	344100	100.0	
3/1110/100	777000	76.3	
2/1340/50/10	67000	124.7	
2/1340/70/10	415400	116.9	
2/1340/100	938000	89.4	
1/820/50/20	41000	88.6	
1/820/70/20	254200	81.6	
3/1110/50/20	**55500**	**122.1**	
3/1110/70/20	344100	110.8	
2/1340/50/20	67000	147.3	
2/1340/70/20	415400	131.0	

STACKED IN ORDER OF ASCENDING OUTPUTS			
Alignment No./ Area/ % Wetlands/ Upland Elev.	Total Gain in Primary Produc- tivity Output (grams dry org matter / m2/ yr)	Initial Total Cost ($ million)	
No Action	0	0	
1/820/50/10	41000	78.0	
1/820/50/20	41000	88.6	
3/1110/50/10	55500	104.7	
3/1110/50/20	**55500**	**122.1**	
2/1340/50/10	67000	124.7	
2/1340/50/20	67000	147.3	
1/820/70/10	254200	74.9	
1/820/70/20	254200	81.6	
3/1110/70/10	344100	100.0	
3/1110/70/20	344100	110.8	
2/1340/70/10	415400	116.9	
2/1340/70/20	415400	131.0	
1/820/100	574000	59.1	
3/1110/100	777000	76.3	
2/1340/100	938000	89.4	

COST INEFFICIENT SOLUTIONS STRUCK THROUGH		
Alignment No./ Area/ % Wetlands/ Upland Elev.	Total Gain in Primary Productivity Output (grams dry org matter / m2/ yr)	Initial Total Cost ($ million)
No Action	0	0
1/820/50/10	41000	78.0
~~1/820/50/20~~	~~41000~~	~~88.6~~
3/1110/50/10	55500	104.7
~~3/1110/50/20~~	~~55500~~	~~122.1~~
2/1340/50/10	67000	124.7
~~2/1340/50/20~~	~~67000~~	~~147.3~~
1/820/70/10	254200	74.9
~~1/820/70/20~~	~~254200~~	~~81.6~~
3/1110/70/10	344100	100.0
~~3/1110/70/20~~	~~344100~~	~~110.8~~
2/1340/70/10	415400	116.9
~~2/1340/70/20~~	~~415400~~	~~131.0~~
1/820/100	574000	59.1
3/1110/100	777000	76.3
2/1340/100	938000	89.4

COST INEFFICIENT SOLUTIONS REMOVED		
COST INEFFECTIVE SOLUTIONS STRUCK THROUG		
Alignment No./ Area/ % Wetlands/ Upland Elev.	Total Gain in Primary Productivity Output (grams dry org matter / m2/ yr)	Initial Total Cost ($ million)
No Action	0	0
~~1/820/50/10~~	~~41000~~	~~78.0~~
~~3/1110/50/10~~	~~55500~~	~~104.7~~
~~2/1340/50/10~~	~~67000~~	~~124.7~~
~~1/820/70/10~~	~~254200~~	~~74.9~~
~~3/1110/70/10~~	~~344100~~	~~100.0~~
~~2/1340/70/10~~	~~415400~~	~~116.9~~
1/820/100	574000	59.1
3/1110/100	777000	76.3
2/1340/100	938000	89.4

H	COST EFFECTIVE SOLUTIONS		
	Alignment No./ Area/ % Wetlands/ Upland Elev.	Total Gain in Primary Productivity Output (grams dry org matter / m2/ yr)	Initial Total Cost ($ million)
	No Action	0	0
	1/820/100	574000	59.1
	3/1110/10C	777000	76.3
	2/1340/10C	938000	89.4

HABITAT DIVERSITY CALCULATION UTILIZING SHANNON WEAVER INDEX

Proportions = (acres of particular habitat type) (total relevant project area) Total project area is 3rd column for all variables except finger groins.

Alignment No. Area % Wetlands Upland Ele.	Alignment No.	Site Area (acres) (Foot-print)	Footprint plus Finger Groins	No. of cells pro-ceeding N to S	Percent Tidal Wetlands	Tidal Wetlands (acres)	Low marsh (acres) (incl islands, open water, tidal creeks)	Low marsh (acres) (not incl islands and open water habitat)	Propor-tion of	High marsh (acres)	Propor-tion of	Upland forest (acres) (incl ponds but not islands)	Propor-tion of	Upland scrub (acres) (incl ponds but not islands)	Propor-tion of	Bare substrate islands (acres)	Propor-tion of	Vegetated islands (acres)	Propor-tion of	Finger Groins (linear ft)	Finger Groins (acres)	Propor-tion of	Total open water (acres) (within tidal marsh)	Propor-tion of	Shannon Weaver Diversity Index (applied to created habitat categories)	Diversity Index x Total Area
No Action		Undefined			0	0	0	0		0		0		0		0		0		0					Undefined	
1 820 50 10	1	820	822	3	50	410	328	295	0.36	82	0.10	205	0.25	205	0.25	6	0.007317	6	0.007317	3000	2.1	0.00251	21.3	0.026	0.640	526
1 820 70 10	1	820	822	3	70	574	459	424	0.52	115	0.14	123	0.15	123	0.15	12	0.014634	6	0.007317	3000	2.1	0.00251	22.8	0.028	0.607	499
1 820 100	1	820	822	3	100	820	656	620	0.76	164	0.20	0	0.00	0	0.00	18	0.021951	6	0.007317	3000	2.1	0.00251	24.4	0.030	0.336	276
3 1110 50 10	3	1110	1113	4	50	555	444	400	0.36	111	0.10	278	0.25	278	0.25	8	0.007207	8	0.007207	4000	2.8	0.00248	28.4	0.026	0.639	711
3 1110 70 10	3	1110	1113	4	70	777	622	575	0.52	155	0.14	167	0.15	167	0.15	16	0.014414	8	0.007207	4000	2.8	0.00248	30.4	0.027	0.606	674
3 1110 100	3	1110	1113	4	100	1110	888	839	0.76	222	0.20	0	0.00	0	0.00	24	0.021622	8	0.007207	4000	2.8	0.00248	32.5	0.029	0.334	372
2 1340 50 10	2	1340	1343	5	50	670	536	481	0.36	134	0.10	335	0.25	335	0.25	10	0.007463	10	0.007463	5000	3.4	0.00256	35.5	0.026	0.641	861
2 1340 70 10	2	1340	1343	5	70	938	750	692	0.52	188	0.14	201	0.15	201	0.15	20	0.014925	10	0.007463	5000	3.4	0.00256	38.1	0.028	0.609	818
2 1340 100	2	1340	1343	5	100	1340	1072	1011	0.75	268	0.20	0	0.00	0	0.00	30	0.022388	10	0.007463	5000	3.4	0.00256	40.6	0.030	0.338	453
1 820 50 20	1	820	822	3	50	410	328	295	0.36	82	0.10	205	0.25	205	0.25	6	0.007317	6	0.007317	3000	2.1	0.00251	21.3	0.026	0.640	526
1 820 70 20	1	820	822	3	70	574	459	424	0.52	115	0.14	123	0.15	123	0.15	12	0.014634	6	0.007317	3000	2.1	0.00251	22.8	0.028	0.607	499
3 1110 50 20	**3**	**1110**	**1113**	**4**	**50**	**555**	**444**	**400**	**0.36**	**111**	**0.10**	**278**	**0.25**	**278**	**0.25**	**8**	**0.007207**	**8**	**0.007207**	**4000**	**2.8**	**0.00248**	**28.4**	**0.026**	**0.639**	**711**
3 1110 70 20	3	1110	1113	4	70	777	622	575	0.52	155	0.14	167	0.15	167	0.15	16	0.014414	8	0.007207	4000	2.8	0.00248	30.4	0.027	0.606	674
2 1340 50 20	2	1340	1343	5	50	670	536	481	0.36	134	0.10	335	0.25	335	0.25	10	0.007463	10	0.007463	5000	3.4	0.00256	35.5	0.026	0.641	861
2 1340 70 20	2	1340	1343	5	70	938	750	692	0.56	188	0.14	201	0.15	201	0.15	20	0.014925	10	0.007463	5000	3.4	0.00256	38.1	0.028	0.601	808

Relative Habitat Diversity

Cost Effectiveness Analysis

Alignment No./ Area/ % Wetlands/ Upland Elev.	Initial Total Cost ($ million)	Shannon Weiner Diversity Index (applied to habitat categories)	Diversity Index x Total Area
1/820/50/10	78.0	0.640	526
1/820/70/10	74.9	0.607	499
1/820/100	59.1	0.336	276
3/1110/50/10	104.7	0.639	711
3/1110/70/10	100.0	0.606	674
3/1110/100	76.3	0.334	372
2/1340/50/10	124.7	0.641	861
2/1340/70/10	116.9	0.609	818
2/1340/100	89.4	0.338	453
1/820/50/20	88.6	0.640	526
1/820/70/20	81.6	0.607	499
3/1110/50/20	**122.1**	**0.639**	**711**
3/1110/70/20	110.8	0.606	674
2/1340/50/20	147.3	0.641	861
2/1340/70/20	131.0	0.601	808

In ascending order of outputs, then costs

Alignment No./ Area/ % Wetlands/ Upland Elev.	Initial Total Cost ($ million)	Shannon Weiner Diversity Index (applied to habitat categories)
3/1110/100	76.3	0.33
1/820/100	59.1	0.34
2/1340/100	89.4	0.34
2/1340/70/20	131.0	0.60
3/1110/70/10	100.0	0.61
3/1110/70/20	110.8	0.61
1/820/70/10	74.9	0.61
1/820/70/20	81.6	0.61
2/1340/70/10	116.9	0.61
3/1110/50/10	104.7	0.64
3/1110/50/20	**122.1**	**0.64**
1/820/50/10	78.0	0.64
1/820/50/20	88.6	0.64
2/1340/50/10	124.7	0.64
2/1340/50/20	147.3	0.64

Economically inefficient solutions struck through

Alignment No./ Area/ % Wetlands/ Upland Elev.	Initial Total Cost ($ million)	Shannon Weiner Diversity Index (applied to habitat categories)
3/1110/100	76.3	0.33
1/820/100	59.1	0.34
~~2/1340/100~~	~~89.4~~	~~0.34~~
2/1340/70/20	131.0	0.60
3/1110/70/10	100.0	0.61
~~3/1110/70/20~~	~~110.8~~	~~0.61~~
~~1/820/70/10~~	~~74.9~~	~~0.61~~
~~1/820/70/20~~	~~81.6~~	~~0.61~~
~~2/1340/70/10~~	~~116.9~~	~~0.61~~
3/1110/50/10	104.7	0.64
~~**3/1110/50/20**~~	~~**122.1**~~	~~**0.64**~~
~~1/820/50/10~~	~~78.0~~	~~0.64~~
~~1/820/50/20~~	~~88.6~~	~~0.64~~
~~2/1340/50/10~~	~~124.7~~	~~0.64~~
~~2/1340/50/20~~	~~147.3~~	~~0.64~~

Alignment No./ Area/ % Wetlands/ Upland Elev	Initial Total Cost ($ million)	Diversity Index x Total Area
1/820/50/10	78.0	526
1/820/70/10	74.9	499
1/820/100	59.1	276
3/1110/50/10	104.7	711
3/1110/70/10	100.0	674
3/1110/100	76.3	372
2/1340/50/10	124.7	861
2/1340/70/10	116.9	818
2/1340/100	89.4	453
1/820/50/20	88.6	526
1/820/70/20	81.6	499
3/1110/50/20	**122.1**	**711**
3/1110/70/20	110.8	674
2/1340/50/20	147.3	861
2/1340/70/20	131.0	808

Alignment No./ Area/ % Wetlands/ Upland Elev.	Initial Total Cost ($ million)	Diversity Index x Total Area
1/820/100	59.1	276
3/1110/100	76.3	372
2/1340/100	89.4	453
1/820/70/10	74.9	499
~~1/820/70/20~~	~~81.6~~	~~499~~
1/820/50/10	78.0	526
~~1/820/50/20~~	~~88.6~~	~~526~~
3/1110/70/10	100.0	674
~~3/1110/70/20~~	~~110.8~~	~~674~~
3/1110/50/10	104.7	711
~~**3/1110/50/20**~~	~~**122.1**~~	~~**711**~~
2/1340/70/20	131.0	808
2/1340/70/10	116.9	818
2/1340/50/10	124.7	861
~~2/1340/50/20~~	~~147.3~~	~~861~~

APPENDIX C

EXECUTIVE SUMMARIES FROM TECHNICAL REPORTS

POPLAR ISLAND RESTORATION PROJECT
SITE DEVELOPMENT GUIDELINES

ENVIRONMENTAL STUDY AND ENGINEERING DESIGN
CHESAPEAKE BAY, MARYLAND

PIN NO. 600105-H
MPA CONTRACT NO. 595904

Prepared for

Maryland Department of Transportation
Maryland Port Administration

Prepared by

Gahagan & Bryant Associates, Inc. &
Moffatt & Nichol, Engineers
Joint Venture

March 23, 1995

EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers (USACE) is responsible for maintaining the Federal navigation channels which serve the Port of Baltimore, and the Maryland Port Administration (MPA) is responsible for providing placement areas for the material which is dredged from the channels. These channels require periodic maintenance dredging. This dredged material must be managed in an environmentally sound and cost effective manner. The Poplar Island Restoration Project offers an opportunity for beneficial use of clean dredged material removed from the southern approach channels to the Port of Baltimore. Coordination between MPA and the Maryland Environmental Service (MES), USACE and the Poplar Island Working Group (PIWG) has led to a concept for reconstruction of Poplar Island using dredged material. An initial approach to this concept was described in the Prefeasibility Report (PFR). This approach would return Poplar Island to a size comparable to that which existed during the last century and would allow for creation of important and diverse aquatic, intertidal and upland habitat.

The following report summarizes important Site Development Guidelines (SDG) which will provide a framework for the overall planning, design, and environmental analyses of the Poplar Island Restoration Project. The specific goals of this SDG report are listed below:

- Present a summary of the Site Development Guidelines.
- Provide a review of the Prefeasibility Report (PFR) for the project.
- Summarize the status of various elements of the work completed by the design team.

The report is separated into eight sections as described below:

Section 1. Introduction. This section of the report summarizes the overall objectives of the project which are listed as follows:

- Recreate Poplar Island

- Create/restore desirable habitat
- Optimize the capacity of the site for placement of dredged material as well as benefits to wildlife habitat
- Prepare a cost effective project design
- Prepare an environmentally acceptable design.

Section 2. Site Conditions. This portion of the report presents a summary of the environmental site conditions which will dictate the project design. A brief summary of each condition is provided below:

- **Bathymetry and Topography**. Depths within the project area range from 2 to 12 feet below Mean Lower Low Water (MLLW).
- **Winds**. Design winds for the site were developed on the basis of data collected at Baltimore-Washington International (BWI) airport. These winds, which can exceed 90 miles per hour during a 100-year storm, were used to develop design wave conditions. Predominant wind direction is from the northwest.
- **Water Levels**. Normal water levels at the site are dictated by astronomical tides which have a mean range of 1.8 feet from MLLW to Mean Higher High Water (MHHW). Extreme water levels are dictated by storm tides which can be as high as 6.7 feet above MLLW during a 100-year storm. The Mean Spring High Water (MSHW) elevation is defined to be 2.4 feet above MLLW; this elevation will be considered to be the boundary between wetland and upland.
- **Waves**. The largest waves approach the site from the north and south. The 100-year return period waves are about 10 feet in height and have a wave period nearing 6 seconds.
- **Currents**. Tidal currents in the vicinity of Poplar Island are relatively weak. Construction of the Project will change current patterns and circulation in the vicinity of Poplar, Coaches and Jefferson Islands.
- **Soil Conditions**. Soil types at the site consist of four basic stratums. Stratum 1 is a surficial silty sand. Stratum 2 is a soft to hard silty clay. Stratum 3 is a stiff silty clay with pockets of sand. Stratum 4 is a very soft gray silty clay. A sizable

pocket of silty fine sands, with 0 to 7 feet of silty clay overburden, was encountered in the southern portion of the site, adjacent to Coaches Island. A stratum of surficial, very soft silty clay was encountered northeast of the site. A pocket of cemented sands (ironite) was encountered west of South Central Poplar Island.

Section 3. Site Layout. Layout of the footprint for the proposed island restoration must consider:

- The 1847 footprint.
- Location of existing oyster bars.
- Location of remnant islets.
- Interactions with Jefferson and Coaches Islands.
- Water depths
- Foundation conditions
- Efficiency of shape.
- Ratio of upland and intertidal habitat
- Impacts to flora and fauna
- Archeological features

The PFR island footprints focused on restoring Poplar Island to, nearly as possible, its 1847 geometry. The footprint identified as the PFR Base Plan with an area of 930 acres was modified due to soft silty clays to the north, and is indicated as Alignment 1 with an area of 820 acres. Two additional footprints have been developed as alternatives to the PFR approach. Both of the alternative alignments connect to Coaches Island and have larger areas than the PFR footprint. Alignment 2 would provide an island area of about 1350 acres whereas Alignment 3 would provide an island area of 1125 acres. There are advantages to creating the larger footprints because the site can store substantially more dredged material with a marginal increase in dike lengths. Decisions regarding final selection of the footprint should be made on the basis of cost effectiveness as well as wildlife habitat benefits. Critical to these decisions, however, is the coordination of real estate issues pertaining to connections to Coaches Island. These issues must be resolved in order to proceed with a specific alignment for final design.

Section 4. Dike Construction. There are a number critical factors which will dictate design of the containment dikes for the Poplar Island Restoration Project. These factors are described below:

- **Design Life, Return Period and Optimization Studies.** The dike design life and the return period condition (or alternatively, level of risk) chosen for design are critical factors which will have a profound impact on project initial and/or maintenance costs. Previously, USACE would normally specify a return period of 73 years for projects of this type which corresponds to a 50% level of risk for a 50 year project life. This has now been superseded by the revised COE Regulation ER-1110-2-1407 (November 30, 1990) which dictates that a fuller range of alternatives be studied to account for differences in cost of repair, periodic replacements and rehabilitation. The PFR presented designs for a 25-year return period which corresponds to a 50% level of risk for a 17-year project life. The recommended approach for this project is to select design conditions on the basis of an optimization procedure which balances initial construction and long-term maintenance costs.
- **Geotechnical Factors.** Soil conditions at the site, along with construction methodology, will dictate the dike side slopes and maximum safe crest elevations. Recent boring investigations and design studies indicate that a slope of 3 horizontal to 1 vertical can be achieved using sand excavated from the project. This sand would serve as the core of the dike. Additional alternatives incorporating cores constructed of geotubes or clay borrow will also be investigated. Foundation conditions along the dike alignment are generally favorable in terms of dike stability and settlement.
- **Dike Height.** The dike height is dictated by soils conditions and wave runup and overtopping. Assuming a sand core, soils conditions do not appear critical as regards dike crest elevations. A dike with crest armor can sustain a larger amount

of wave overtopping and can therefore be lower than a dike without crest armor. Wave overtopping computations indicate that the western dike without crest armor should have a crest elevation ranging from 8 feet MLLW for a 5-year storm to 11.5 feet MLLW for a 100-year storm. Similarly, the western dike with crest armor should have a crest elevation ranging from 4.5 feet MLLW for a 5-year storm to 10.5 feet MLLW for a 100-year storm. The crest elevation for eastern dike without crest armor should range from 4 feet MLLW to 8 feet MLLW for 5 and 100-year, respectively. Similarly, the eastern dike incorporating crest armor should have a crest elevation of 3.5 feet MLLW for a 5-year storm to 7.5 feet MLLW for a 100-year storm. Physical model tests and optimization studies will be conducted to finalize the dike crest elevations.

- **Armor Stone & Toe Protection**. Armor stone has been sized using the van der Meer method which accounts for random wave behavior instead of the Hudson equation (Shore Protection Manual) which tends to be overly conservative. Computations indicate that armor sizes for the western dike should range from 0.8 tons for a 5-year storm to 2.4 tons for a 100-year storm. Similar computations for the east dike section give required armor stone sizes ranging from 100 pounds for a 5-year storm to 600 pounds for a 100-year storm. The above stone requirements assume a double layer of armor stone. Hart Miller Island incorporated a single layer of armor. Single layer armor has some safety disadvantages, but can result in cost savings. Estimates of single layer armor rock sizes have been made for the western dike and indicate that armor sizes should range from 1 ton for a 5-year storm to 4.5 tons for a 100-year storm. The final armor stone sizes, whether single or double layer, should be designed on the basis of physical model tests. Above grade toe protection is recommended for each dike section.
- **Conceptual Dike Sections**. Conceptual dike cross sections have been prepared for 25-year return period design conditions. These cross sections were developed for the purpose of discussions and to make an initial assessment of project quantities and costs. Final design conditions will be evaluated on the basis of optimization studies. Typical western dike cross sections were developed for

single and double armor layers and a sand and clay core. Typical eastern dike cross sections were prepared for a double layer of armor and sand and clay cores.

- **Soils for Dike Construction Methods.** The following construction methods and borrow sources will be examined:
  - Side borrow using mechanical methods
  - Onsite borrow using hydraulic dredging
  - Offsite borrow using hydraulic dredging
- **Construction in Lifts.** Dried maintenance material could be used to augment an initially constructed dike section.

Section 5. Cost Estimates and Alternatives Analysis. The basic capital cost of the site will be dictated by the perimeter dike construction cost. Cost estimates for other site capital costs and site operations costs will also be prepared. These cost estimates are an integral part of preliminary design studies and alternatives analysis.

Section 6. Environmental Issues. This section of the report describes the environmental issues and concerns that are associated with constructing a beneficial use and habitat creation site using dredged material at the Poplar Island location. Primary topics discussed are as follows:

- **Loss of Open Water.** Reconstruction of Poplar Island will constitute a loss of approximately 1150 acres of shallow open water.
- **Loss of Fish and Macroinvertebrate Habitat.** Loss of the snag areas (fallen trees, etc.) along the western shores of the remnant islands that provide a cover resource will be offset by large rock to be used for construction of the dike.
- **Changes in Wave Regime.** Reconstruction of Poplar Island will transform an area of high wave energy into one that is lower within the Poplar Harbor area (in the lee of the maximum fetch distance and greatest depths).
- **Changes in Tidal Hydrodynamic Regime.** The local tidal regime within the Poplar Island wetlands and surrounding the island may change, however not significantly. Baywide tidal pattern changes will be negligible.

- **Need for Additional Habitat.** Reconstruction of Poplar Island will provide needed tidal wetland habitat and promote the growth of subaquatic vegetation (SAV) by providing suitable protected shallow water habitat.
- **Impacts to Adjacent Islands.** Impacts to adjacent islands are expected to be minimal.
- **Impacts to Oyster Beds.** Impacts to oyster beds will be minimized during construction; monitoring will be conducted and efforts will be made to avoid unacceptable impacts. Following construction, Poplar Island would serve to protect the beds.
- **Restrictions to Hydraulic Dredging.** Seasonal restrictions on hydraulic dredging are presented.

Section 7. Habitat Creation. This section summarizes requirements that must be met in order to construct the viable wetland habitat following placement of the dredged material. Primary components of this section are:

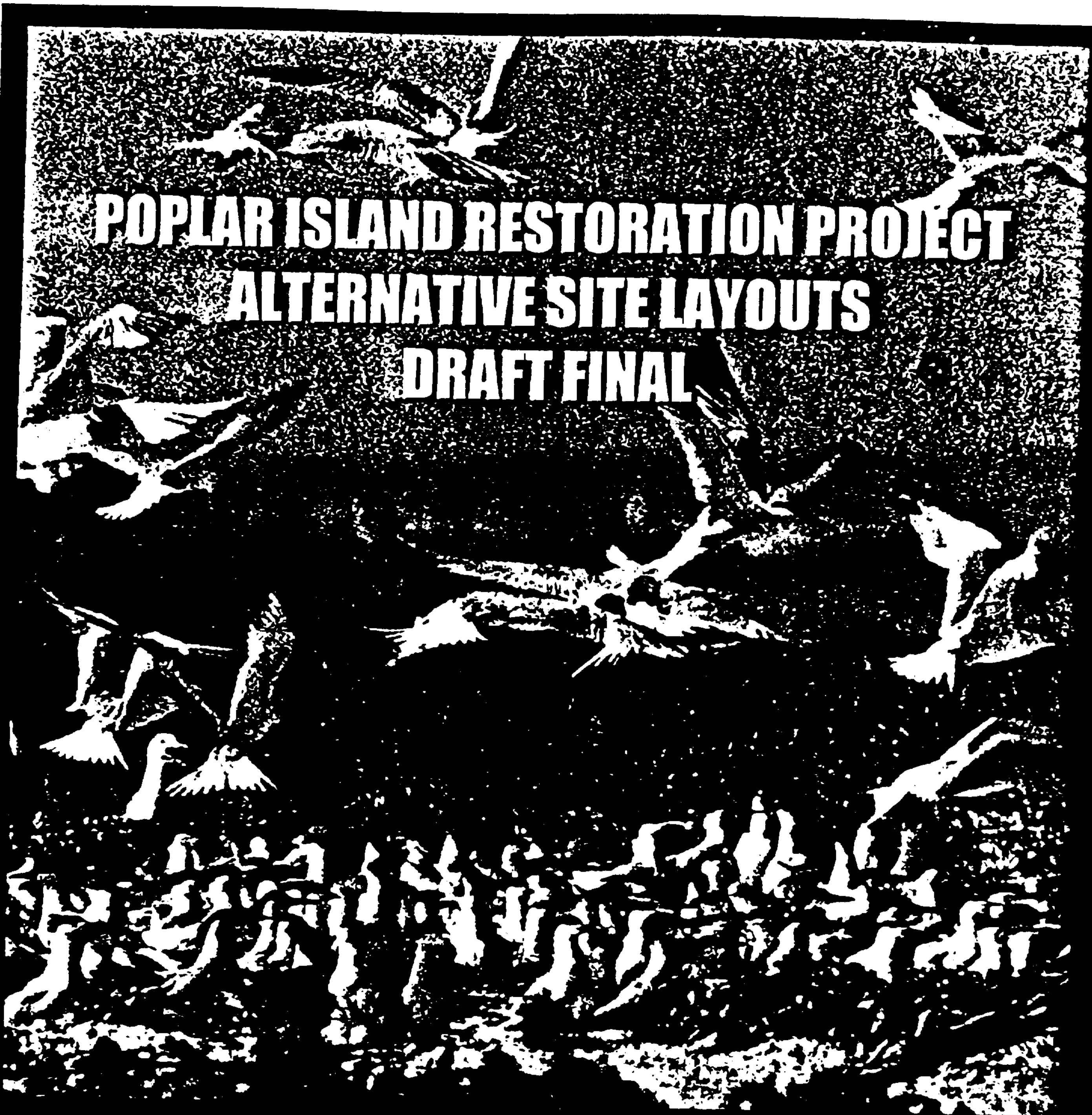
- Definitions of Habitat Terms
- Vegetation Types
- Dredged Material Characteristics
- Material Consolidation
- Final Elevations and Vegetated Zones
- Peninsula Dikes
- Tidal Circulation
- Issues Involved in Habitat Development
- Target Flora and fauna

Section 8. Prefeasibility Report (PFR) Review. Review of the PFR focuses on several important areas of site design and development which will be given detailed consideration in the preliminary design, alternatives evaluations and final design phases. These are:

- Staged construction of the perimeter dike
- Site operational life
- Projected dredging quantities
- Orientation of wetlands
- Wetland cell elevations and slope
- Cell water level control

This section concludes with a summary of PFR Base Plan characteristics.

POPLAR ISLAND RESTORATION PROJECT
ALTERNATIVE SITE LAYOUTS
DRAFT FINAL



ENVIRONMENTAL STUDY AND ENGINEERING DESIGN
CHESAPEAKE BAY, MARYLAND

PIN NO. 600105-H
MPA CONTRACT NO. 595904

Prepared for

Maryland Department of Transportation
Maryland Port Administration

Prepared by

Gahagan & Bryant Associates, Inc. &
Moffatt & Nichol, Engineers
Joint Venture

June 16, 1995

EXECUTIVE SUMMARY

The *Alternative Site Layouts* report is one of a series being prepared as part of the detailed planning and design of the Poplar Island Restoration Project. The project consists of the reconstruction of tidal wetland and upland habitats by making a beneficial use of dredged materials removed from the southern Bay approach channels to the Port of Baltimore. This report presents the results of the dike design optimization and discusses the three alternative site layouts (820, 1110 and 1340 acres) which generally follow the historical footprint of Poplar Island. Details of the project objectives, the present conditions at the project site, and a description of the project are contained in the *Site Development Guidelines (SDG)* (GBA - M&N JV, January 1995).

The purpose of this report is to present the characteristics of the site alternatives, the dike design optimization, and the associated costs needed to assist decision makers in selecting the site layout carried to final design. The designs and the analyses contained in this report have been carried to the 20% completion level.

The objectives of this beneficial use site are:

- Optimization of the volumetric capacity of the site for dredged material
- Preparation of a cost-effective design within available funding
- Restoration of Poplar Island to approximately its 1847 footprint
- Creation/restoration of desirable habitat
- Design of all aspects of the site in an environmentally acceptable manner

A summary of environmental site conditions that are relevant to the design is provided below:

- **Bathymetry and Topography**. Depths within the project area range from 2 to 12 feet below Mean Lower Low Water (MLLW).

- **Wind Conditions**. Design winds for the site were developed on the basis of data collected at Baltimore-Washington International (BWI) airport. These winds, which can exceed 90 miles per hour during a 100-year storm, were used to develop design wave conditions. Predominant wind direction is from the northwest.

- **Water Levels**. Normal water levels at the site are dictated by astronomical tides which have a mean range of 1.8 feet from MLLW to Mean Higher High Water (MHHW). Extreme water levels are dictated by storm tides which can be as high as 6.7 feet above MLLW during a 100-year storm. The Mean Spring High Water (MSHW) elevation is defined to be 2.4 feet above MLLW; for this project this elevation will be considered to be the boundary between wetland and upland.

- **Wave Conditions**. The largest waves approach the site from the north and south. The 100-year return period waves are about 10 feet in height and have a wave period nearing 6 seconds.

- **Currents**. Tidal currents in the vicinity of Poplar Island are relatively weak (less than one foot per sec.) Construction of the project will change current patterns and circulation in the vicinity of Poplar, Coaches and Jefferson Islands comparable to conditions circa 1847.

- **Soil Conditions**. Soil types at the site consist of four basic stratums. Stratum 1 is a surficial silty sand. Stratum 2 is a soft to hard silty clay. Stratum 3 is a stiff silty clay with pockets of sand. Stratum 4 is a very soft gray silty clay. A sizable pocket of silty fine sands, with 0 to 7 feet of silty clay overburden, was encountered in the southern portion of the site, adjacent to Coaches Island. A stratum of surficial, very soft silty clay was encountered northeast of the site. A pocket of cemented sands (ironite) was encountered west of South Central Poplar Island.

Three alternative footprints are presented for final selection by decision makers. These footprints are designated as Alignments No. 1, No. 2 and No. 3. Alignment No. 1 is a variation of the

"Base Plan" identified in the Prefeasability Report. This footprint has been adjusted at the northern end of the site to avoid an area of soft foundation materials. The northwest portion of the dike is parallel to the line which demarks the eastern boundary of oyster bar N.O.B. 8 - 10. The eastern dike is more-or-less aligned along the 1847 position of the eastern shoreline of Poplar Island. The southeast portion of the perimeter dike is roughly perpendicular to the northwest dike segment and is bayward of the 1847 shoreline. For the purposes of this report, the term "Western Perimeter Dike" includes the north, northwest, south, and southwest segments of the dike. The term "Eastern Perimeter Dike", on the other hand, refers to the northeast, east and southeast portions of the dike. Alignment No. 1 has a nominal site area of 820 acres. Alignment No. 2 is an extension of Alignment No. 1 to the south and east and fronts on the southern shoreline of Coaches Island. The southeast and south segment of the perimeter dike generally follow the -8 foot MLLW contour. This alignment is the largest considered with a nominal area of 1,340 acres. Alignment No. 3 has an area of 1,110 acres which just exceeds the average areas of Alignments No. 1 and No. 2.

The project requires the construction of a perimeter dike both to contain dredged materials as they are placed and to provide protection from wave action for the developed habitats. Interior dikes will be constructed to separate upland and tidal wetland habitat and to partition the site into manageable cells. The perimeter and interior dikes will be constructed of sand borrowed from within the site footprint. Perimeter dikes will be protected from wave attack by rock slope protection on the exposed portions. Perimeter dikes will have an armored toe dike to provide additional protection during and after construction.

Initial construction costs for the project site are demonstrated by the dike construction costs. Accordingly, a detailed cost optimization analysis was conducted to develop cost-effective designs for both the Western Perimeter Dike (dike segment exposed to waves from the north, west and south) and the Eastern Perimeter Dike (dike segment exposed to the relatively low-energy waves from the east).

The cost optimization analysis indicates that the optimal structure slope for the perimeter dike ranges from 3:1 to 4:1. Overall, the optimal design return period for the Western Perimeter Dike is about 35 years, however, the optimal return period for the primary armor stone is 25 years. The optimal design return period for the armored eastern dike is about 50 years. Similarly, the optimal return period for the design of the eastern dike armor stone is 50 years. The unarmored option for the Eastern Perimeter Dike is also 50-years. It should be noted however, that the unarmored dike is vulnerable to long term erosion. Additional shoreline stabilization structures may have to be added to the cost of this alternative. The additional cost associated with the additional stabilization structures would render this option more costly than the Eastern Perimeter Dike (armored rock option).

The creation and restoration of desirable habitat is the primary object the of this project. Factors which are important to the development of habitat at the site include final elevations of placed dredged material, surface slopes, tidal circulation, water quality, material consolidation and vegetation establishment. These factors will be focused on during habitat development planning.

Initial site construction costs, habitat development and annual management costs for the life of the project are developed for each alignment. The percentage of tidal wetland habitat was examined for levels of 50, 70 and 100 percent tidal wetlands for each of the three alternative alignments. The upland areas were examined for elevations of +10 and +20 ft. MLW.

September 1, 1995

PHASE I TERRESTRIAL AND MARINE ARCHEOLOGICAL SURVEYS FOR THE POPLAR ISLAND RECLAMATION PROJECT AND PHASE II INVESTIGATIONS OF SITE 18TA237, TALBOT COUNTY, MARYLAND

DRAFT REPORT

R. Christopher Goodwin & Associates, Inc.
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Frederick, Maryland 21701

PREPARED FOR:

GBA-M&N A Joint Venture
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ABSTRACT

This report presents the results of Phase IB marine and terrestrial archeological surveys of the Poplar Island Reclamation Project area, and of the Phase II evaluation of Site 18TA237 on South Central Island. These investigations were carried out during November and December, 1994, and July, 1995, by R. Christopher Goodwin & Associates, Inc. under contract to The Joint Venture of Gahagan & Bryant Associates, Inc. and Moffatt & Nichol, Engineers. This project was conducted in compliance with the National Environmental Policy Act (NEPA) of 1969, with Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, and with Article 83B, Sections 5-617 - 618 of the Annotated Code of Maryland.

These investigations were designed to identify potential submerged archeological resources through the use of magnetometer and sub-bottom profiler surveys of the submerged portions of the 1847 Poplar Island footprint (Alternative Alignment #1) and of the access channel, and through magnetometer and side-scan sonar survey of the shallow areas near Coaches Island (Alternative Alignments #2 and #3), and to identify sites and site boundaries on the remaining terrestrial areas. The terrestrial portion of the study examined the four remaining islets of Poplar Island and the immediate shoreline of Coaches Island within proposed Alternative Alignments #2 and #3. As the result of initial Phase I investigations on South Central Island, Site 18TA237 was recommended for Phase II evaluation. The U.S. Army Corps of Engineers, Baltimore District, the Maryland Port Administration, and the Joint Venture decided to proceed with this Phase II evaluation during the Phase I investigations of Coaches Island because the site was immediately threatened by erosion.

The Phase IB study included background research, marine survey, near-shore dredging, terrestrial survey, and laboratory analysis. The terrestrial survey examined eight previously recorded archeological sites on five islands. Seven sites were not relocated or were too disturbed to warrant additional investigation. One site (18TA237) on South Central Island was recommended for additional Phase II investigation based on its research potential. Phase II evaluation of 18TA237 involved close interval shovel testing, test unit excavation, near-shore dredging, and laboratory

analysis. The site was found to be a redeposited and reworked beach deposit. No intact features were identified. No additional investigation was warranted or recommended for Site 18TA237.

The marine survey recorded 27 magnetic and acoustic anomalies. Sub-surface testing was recommended for six target areas. This testing should entail reacquisition of each target location, bottom searches and probing to determine the extent of the site, and limited underwater excavation using diver-held excavation equipment to the extent necessary to determine the potential National Register eligibility of each site.

October 17, 1995

PHASE II EVALUATION OF SIX MARINE ANOMALIES FOR THE POPLAR ISLAND RECLAMATION PROJECT, TALBOT COUNTY, MARYLAND

ADDENDUM TO PHASE I TERRESTRIAL AND MARINE ARCHEOLOGICAL SURVEYS FOR THE POPLAR ISLAND RECLAMATION PROJECT AND PHASE II INVESTIGATIONS OF SITE 18TA237, TALBOT COUNTY, MARYLAND

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CHAPTER I

INTRODUCTION

This addendum to R. Christopher Goodwin & Associates, Inc.'s *Phase I Terrestrial and Marine Archeological Surveys for the Poplar Island Reclamation Project and Phase II Investigations of Site 18TA237, Talbot County, Maryland*, presents the results from the Phase II underwater archeological investigations and sub-surface testing of six (6) anomalous target areas recommended for further investigations by Goodwin & Associates, Inc. Sub-surface testing was recommended for these anomalies because they lie within the boundaries of the Poplar Island Land Reclamation Project Area, and potentially were at risk of being adversely affected by the future construction work planned for the project.

Intensive archeological field investigations were conducted by R. Christopher Goodwin & Associates, Inc. from August 25 - September 1, 1995, and were concluded on September 7, 1995. These investigations entailed: the reacquisition of initial target locations using Differential Global Positioning System (DGPS) positioning; the refinement of these positions with a proton precession magnetometer and diver surveys; identification and delimitation of the anomalous sites; and evaluation of potential National Register of Historic Places eligibility for each target. For the magnetic anomalies, magnetometer surveys were conducted over a 22,500 sq ft area around their initial target locations, using a 25 ft track-line spacing. Diver investigations also were completed at every target, with an average of 11,852 sq ft of seabed surveyed per anomaly. Identification and delimitation of the extent of each anomaly, and its potential for National Register eligibility, was accomplished using diver-held metal-detection equipment, sub-surface probing, and limited underwater excavation. Shell and soil samples also were collected and analyzed to determine the date and origin of mollusk shell beds and to identify soil types.

During the course of the Phase II investigations, a total of 135,000 sq ft of the Bay floor was resurveyed with the magnetometer, and 130,378 sq ft of seabed was mapped by divers. Of the six anomalous targets that were investigated, the sources of four of the anomalies were located and identified. These anomalies consisted of: (1) a biogenic concentration of mixed species mollusk shell; (2) discrete geological deposits; and (3) a concentration of modern (twentieth century) refuse. Anomalies that were not located during the Phase II investigations are likely to have been too small to be considered historically significant; are buried deeply beneath sand overburden, and are unlikely to be adversely affected by the deposition of additional sediments above them; or were moved or destroyed by the powerful forces of wind, waves, and strong tidal currents that prevail in the waters surrounding the Poplar Island group. Because no National Register-eligible cultural features were discovered during the Phase II underwater investigations, R. Christopher Goodwin & Associates, Inc. recommends no further archeological investigations of any of the six targets: 10-727, 10-755, 30-1151, 40-665, 48-819, and the cluster formed by anomalies 58-1477, 60-579, 62-1508.

POPLAR ISLAND RESTORATION PROJECT HYDRODYNAMIC AND COASTAL ENGINEERING DRAFT FINAL REPORT

ENVIRONMENTAL STUDY AND ENGINEERING DESIGN
CHESAPEAKE BAY, MARYLAND

PIN NO. 600105-H
MPA CONTRACT NO. 595904

Prepared for

Maryland Department of Transportation
Maryland Port Administration
Maritime Center II
2310 Broening Highway
Baltimore, Maryland 21224

Prepared by

Gahagan & Bryant Associates, Inc. &
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September 28, 1995

EXECUTIVE SUMMARY

The *Hydrodynamic and Coastal Engineering* report is one of a series being prepared as part of the detailed planning and design of the Poplar Island Restoration Project. The project consists of the reconstruction of tidal wetland and upland habitats by making a beneficial use of dredged material removed from the southern Bay approach channels to the Port of Baltimore. The purpose of this report is to present the coastal engineering aspects of the project. Emphasis is placed on factors that govern the design of the perimeter dikes and the physical impacts of the island footprint on areas in and around Poplar Island. This report presents the project objectives, a description of the project, the details of the present conditions at the project site, a discussion of the three alternative site layouts (820, 1110 and 1340 acres) that generally follow the historical (circa 1847) footprint of Poplar Island, a description of the selected alignment, an evaluation of hydrodynamic conditions at the site, the components of the dike design, the results of the dike design optimization analysis, a reliability analysis of the design, and the results of physical model test for the design.

The objectives of this beneficial use site are:

- Optimization of the volumetric capacity of the site for dredged material
- Preparation of a cost-effective design within available funding
- Restoration of Poplar Island to approximately its 1847 footprint
- Creation/restoration of desirable habitat
- Design of all aspects of the site in an environmentally acceptable manner

A summary of environmental site conditions that are relevant to the design is provided below:

- **Bathymetry and Topography**. Depths within the project area range from 2 to 12 feet below Mean Lower Low Water (MLLW).

- **Wind Conditions**. Design winds for the site were developed on the basis of data collected at Baltimore-Washington International (BWI) airport. These winds, which can exceed 90 miles per hour during a 100-year storm, were used to develop design wave conditions. Predominant wind direction is from the northwest.

- **Water Levels**. Normal water levels at the site are dictated by astronomical tides which have a mean range of 1.8 feet from MLLW to Mean Higher High Water (MHHW). Extreme water levels are dictated by storm tides which can be as high as 6.7 feet above MLLW during a 100-year storm. The Mean Spring High Water (MSHW) elevation is defined to be 2.4 feet above MLLW; for this project this elevation will be considered to be the boundary between wetland and upland.

- **Wave Conditions**. The largest waves approach the site from the north and south. The 100-year return period waves are about 10 feet in height and have a wave period nearing 6 seconds.

- **Currents**. Tidal currents in the vicinity of Poplar Island are relatively weak (less than one foot per sec.) Construction of the project will change current patterns and circulation in the vicinity of Poplar, Coaches and Jefferson Islands comparable to conditions circa 1847.

- **Soil Conditions**. Soil types at the site consist of four basic stratums. Stratum 1 is a surficial silty sand. Stratum 2 is a soft to hard silty clay. Stratum 3 is a stiff silty clay with pockets of sand. Stratum 4 is a very soft gray silty clay. A sizable pocket of silty fine sands, with 0 to 7 feet of silty clay overburden, was encountered in the southern portion of the site, adjacent to Coaches Island. A stratum of surficial, very soft silty clay was encountered northeast of the site. A pocket of cemented sands (ironite) was encountered west of South Central Poplar Island.

The project requires the construction of a perimeter dike both to contain dredged materials as they are placed and to provide protection from wave action for the developed habitats. Interior dikes will be constructed to separate upland and tidal wetland habitat and to partition the site into manageable cells. The perimeter and interior dikes will be constructed of sand borrowed from within the site alignment. Perimeter dikes will be protected from wave attack by rock slope protection on the exposed portions. Perimeter dikes will have an armored toe dike to provide additional protection during and after construction.

Initial construction costs for the project site are demonstrated by the dike construction costs. Accordingly, a detailed cost optimization analysis was conducted to develop cost-effective designs for both the Western Perimeter Dike (dike segment exposed to waves from the north, west and south) and the Eastern Perimeter Dike (dike segment exposed to the relatively low-energy waves from the east).

The cost optimization analysis indicates that the optimal structure slope for the perimeter dike ranges from 3:1 to 4:1. Overall, the optimal design return period for the Western Perimeter Dike is about 35 years, however, the optimal return period for the primary armor stone is 25 years. The optimal design return period for the armored eastern dike is about 50 years. Similarly, the optimal return period for the design of the eastern dike armor stone is 50 years.

Three site alignments have been examined (No. 1, No. 2 and No. 3) jointly through a series of discussions with MPA, COE and MES staffs and the Poplar Island Working Group. Alignment No. 3 was initially selected as the proposed project; further cost optimization analysis was performed to revise the alignment to the most cost-effective alternative.

A reliability analysis shows that the structure has more than a 90% chance that it will suffer damage that will require maintenance over the 100-year design life. This finding is to be expected and has been incorporated into the optimization analysis and long-term maintenance costs for the project presented in this report. Results of the physical model test confirm the armor stone size proposed for the dike design. The results also show that the crest height is adequate for the optimized design section, and that considerable overtopping will be associated with the higher water levels (i.e. storm surge) that will occur during larger return period (less frequent) storm events.

POPLAR ISLAND RESTORATION PROJECT
HYDRODYNAMIC AND COASTAL ENGINEERING ADDENDUM

ENVIRONMENTAL STUDY AND ENGINEERING DESIGN
CHESAPEAKE BAY, MARYLAND

PIN NO. 600105-H
MPA CONTRACT NO. 595904

Prepared for

Maryland Department of Transportation
Maryland Port Administration
Maritime Center II
2310 Broening Highway
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February 14, 1996

EXECUTIVE SUMMARY

The purpose of this addendum is to build on the previous hydrodynamic modeling studies and to present results for four additional configurations for Poplar Island, namely: (1) the full 1110 acre site having a minimum 100 foot tidal channel between Coaches Island and the proposed Poplar Island, (2) the full 1110 acre site having a minimum 100 foot tidal channel between Coaches Island and the proposed Poplar Island, however, the tidal channel is cut through the southwestern peninsula of Coaches Island to allow for increased flow through the tidal channel compared to configuration no. 1, (3) a reduced area for Poplar Island of approximately 600 acres that would constitute a Phase I construction scenario for the project, and (4) a reduced area for Poplar Island of approximately 600 acres that would constitute a Phase I construction scenario for the project, along with a "connector dike" that would extend from Poplar Island to Coaches Island, would prevent flow between these two islands, be hydrodynamically equivalent to the full 1110 acre island, and provide protection to Poplar Harbor.

Velocities and Direction of Tidal Flows

Tidal currents in the vicinity of Poplar Island are relatively weak (i.e. less than one foot per second). Construction of the project with the tidal channel (either without the cut or with the cut) will change current patterns and circulation in the vicinity of Poplar, Coaches and Jefferson Islands comparable to conditions circa 1847. Construction of the approximately 600-acre Poplar Island, i.e. Option No. 1, will cause increased flow velocities through the gap between Poplar Island and Coaches Island, and will not provide protection to Poplar Harbor. Construction of the connector dike along with Option No. 1 will protect Poplar Harbor from wave action originating from the west, and will allow for tidal flows around the project site similar to that for the full 1110-acre Poplar Island.

Residence Times

Construction of the 1110-acre project with a tidal channel shows that a channel without a cut has a longer residence time in the area around the southwest peninsula of Coaches Island than a channel with the cut. For Option No. 1 compared to existing conditions, residence time is increased in the Poplar Harbor area between Poplar Island and Jefferson Island . Conversely, residence time is decreased in the area of the gap. For Option No. 1 with a connector dike, residence times are comparable to that for the full 1110-acre Poplar Island, with the exception of a slight increase in residence time in the area between the connector dike and the southern perimeter of Poplar Island.

Sedimentation

For Option No. 1, sedimentation changes resulting from a northwest wind are comparable to the full 1,100 acre site. Sedimentation changes occurring as a result of wind from the south direction show that erosion along the eastern shoreline of Coaches Island is comparable to the full 1,100 acre site; in addition, significant erosion would occur in the area of the gap. Sedimentation resulting from a northwest wind for Option No. 1 with the connector dike show changes comparable to the full 1,100 acre. Sedimentation changes occurring as a result of wind from the south direction show erosion along the eastern shoreline of Coaches Island comparable to that for the full 1,100 acre site. The presence of the connector dike serves to prevent the erosion in the gap between Poplar Island and Coaches Island.

HABITAT DEVELOPMENT REPORT FOR POPLAR ISLAND, TALBOT COUNTY, MD

Prepared For:

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10/20/95

EXECUTIVE SUMMARY

Loss of land to erosion is a common phenomenon in the Chesapeake Bay. Shoreline erosion negatively impacts water quality and habitat through sedimentation and the concomitant reduction in light penetration into the water column. The erosion also frequently leads to the loss of both wetland and upland habitat. Poplar Island, in Talbot County, MD, is an example of how significant erosion in the Bay can be. Historically the island was over 1,000 acres in size. Within approximately 100 years, the island has eroded to the point where only a few small remnants of islands are visible at low tide. Some of the eroded sediment adds to the volume of material that accumulates in the Chesapeake Bay shipping channels, increasing the need for routine maintenance dredging. Disposal of the dredged material is often problematic. One solution to dredged material placement is the beneficial use of the sediments.

The Poplar Island Restoration project offers an opportunity for beneficial use of clean dredged material removed from some of the approach channels to the Port of Baltimore. Coordination between MPA and Maryland Environmental Services (MES), the U.S. Army Corps of Engineers (COE) Baltimore District, and the Poplar Island Working Group has led to a concept for the reconstruction of Poplar Island using dredged material. An initial approach to this concept was described in the Prefeasibility Report (PFR) (MES 1994). This approach would restore Poplar Island to a size comparable to that which existed during the last century, and would allow for the development of diverse aquatic, intertidal, and upland habitat.

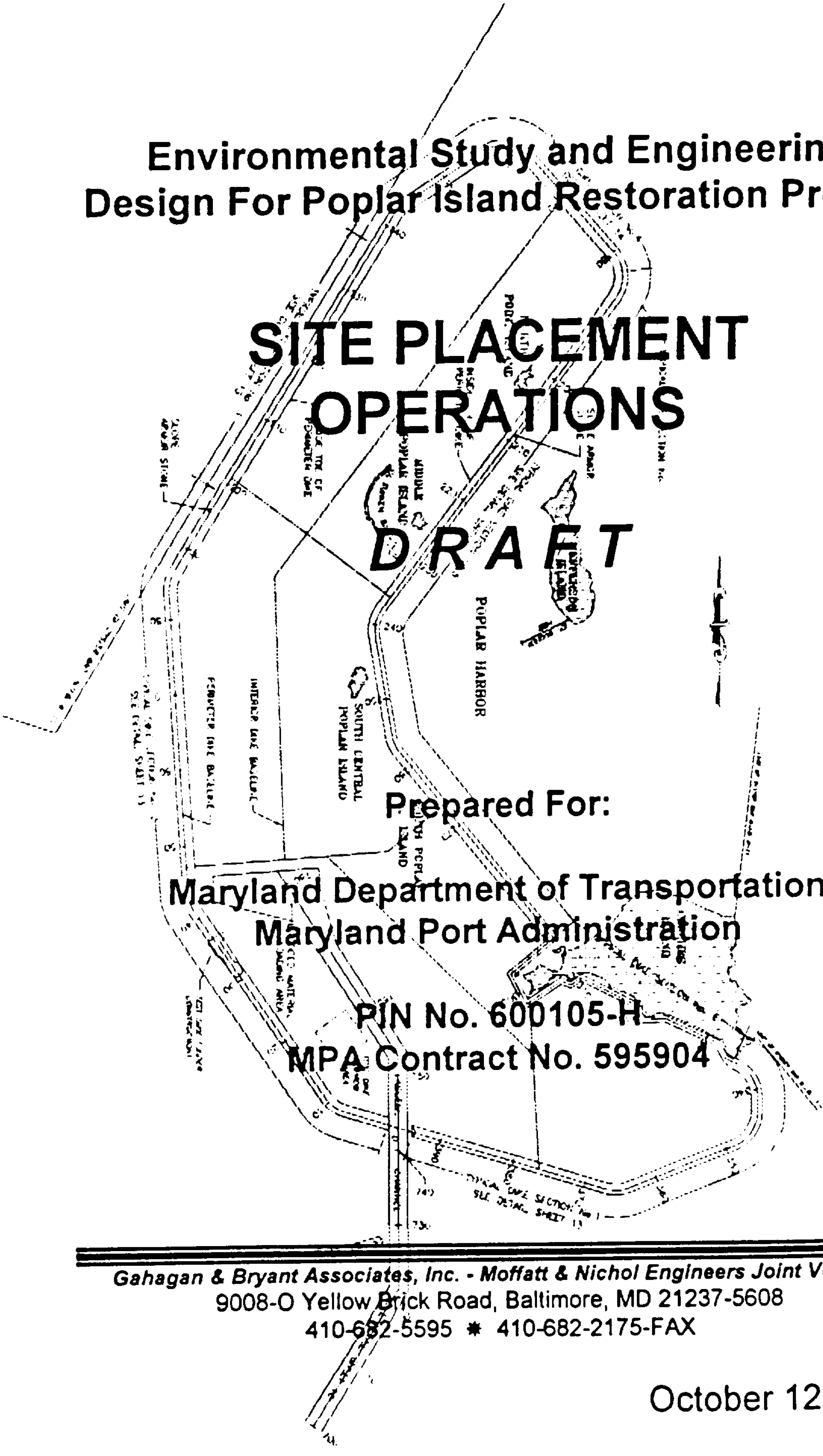
The following report summarizes important Habitat Development Guidelines that will guide the planning, design and implementation of the Poplar Island Restoration Project. The specific goals of this report are listed below:

- Provide general design guidelines for cell sizes, and acreages of various habitat components, such as wetland and uplands;
- Provide general specifications for various habitat components;
- Describe habitat development alternatives;
- Provide habitat maintenance guidance; and
- Include general cost estimates for habitat development.

Environmental Study and Engineering Design For Poplar Island Restoration Project

SITE PLACEMENT OPERATIONS

DRAFT



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SUMMARY

This *Site Placement Operations* report is one of a series being prepared as part of the detailed planning and design of the Poplar Island Restoration Project. The project consists of the reconstruction of tidal and upland habitats by making a beneficial use of dredged materials removed from the southern Bay approaches to the Port of Baltimore. This report is prepared in response to the requirements of Paragraph 1.3.6 of Exhibit B of Contract No. 595904 with the Maryland Department of Transportation, Maryland Port Administration (MPA). The report is part of the work effort performed under Task 8.1.7, Site Placement Operations, of the Project Schedule. The site configurations and operational procedures described have been developed by the GBA - M&N Joint Venture and its subconsultants as part of a joint discussion and review with the Office of Harbor Development of the MPA and the Corps of Engineers, Baltimore District and work progress reviews by several state and federal agencies.

PURPOSE AND SCOPE OF WORK

The purpose of this report is to develop a detailed placement operation manual. This draft is the first step in the formulation of the final operating manual.

The scope of work includes the following tasks:

- Define site and cell areas to be developed.
- Determine annual volumes of material to be dredged and placed at site.
- Determine typical contractor operations.
- Develop cell filling schedules.
- Outline site management methods, including monitoring, water level control, consolidation and desiccation, cell habitat development and periodic reporting.

SITE LAYOUT AND FEATURES

Site features are based on the 50 Percent Contract Drawings. The site features and their function are summarized in the table below.

SITE FEATURES, 1110 Acre Site
(All Values in Feet)

Feature	Phased Construction	Full Site Construction
Perimeter Dike:		
Length	25,000	39,560
Top elevation	8.0 to 11.5	8.0 to 11.5
Interior Dikes:		
Longitudal		
Length	10,100	15,400
Top elevation	10	10
Wetland Cross		
Length	1,400	3,800
Top elevation	6	6
Upland Cross		
Length	1,200	3,400
Top elevation	10	10
Spillways:		
Type A		
Tidal wetland cells	2	4
Type B		
Upland Cells	2	3
Type C		
Supplementary	–	–
Access Channel:		
Design depth	25	25
Bottom width	250	250
Length	8,217	8,217
Off loading Area:		
Design depth	25	
Maximum length	1,400	1,400
Maximum width	700	700
Service Dock:		
Length	100	100
Top elevation	6	6
Pad area	0.5 acres	0.5 acres
Staging Area:		
Elevation	10	10
Length	1,800	1,800
Width	150	150
Area	6 acres	6 acres

The Site Features shown are still under review and can be expected to change as the design progresses. No significant changes in the analyses and the procedures presented are anticipated as a result of these refinements.

The selected site is the result of a 14 month process of analyzing alternate site layouts to select the site which best meets the project objectives.

The proposed site was selected by the Project Inter-agency Working Group which consists of the Office of Harbor Development of the Maryland Port Administration, the U.S. Corps of Engineers and several State Agencies..

At the time of preparation of this report there is still uncertainty as to the phasing of site construction. Because of funding limitations it may be necessary to construct the site in two phases. Phase 1 would be approximately 500 to 600 acres and Phase 2 would add the remaining acres for a total site area of 1110 acres.

DREDGED MATERIAL VOLUMES

The greatest volume of dredged material to be placed at the site will be fine-grained maintenance materials from the Outer Harbor Approach Channels. There may also be some new work materials containing clays and sands that will be placed at the site. This will not change the basic site operations requirements but may require some adjustments in procedures. Therefore the basic operations procedures will be dictated by the characteristics of the predominate fine-grained maintenance materials.

The Alternative Site Layouts report (Section 3) contains a projection of an average annual maintenance dredging volume of 1.7 million cubic yards per year. For the purpose of this report, an average annual volume of material placed in the site of 2.0 million cubic yards is used.

DREDGING CONTRACTOR OPERATIONS

The most economical and environmentally sound method of placing maintenance dredged material into Poplar Island is by loading large hopper scows with clamshell dredges, towing the scows to the site and unloading the barges by hydraulic pumpout dredges. This method is similar to the operation presently being employed at Hart-Miller Island.

This is the most appropriate method in that the distance between the dredging site and Poplar Island (approximately 35 miles) and the type of material being dredged (fine-grained maintenance material) make hydraulic or hopper dredges.

CELL CHARACTERISTICS

The adopted development plan for Poplar Island provides for the construction of a 1,110 acre site consisting of 50 percent tidal wetland habitat and 50 percent upland habitat. The cell arrangements and characteristics used in the analyses presented in this report are summarized in the table below.

CELL CHARACTERISTICS, 1110 Acre Site
Volumes In million cy

Cell Characteristics Cell No.	Area, ac	Type	Average Bottom Elevation	Average Final Elevation	Volume (cy)	V.O. Ratio	Capacity (cy)
1	175	Tidal Wetland	-4.7	1.4	1.7	0.72	2.37
2	188	Upland	-8.2	20	8.6	0.62	13.80
3	139	Tidal Wetland	-3.9	1.4	1.2	0.69	1.71
4	149	Upland	-6.2	20	6.3	0.62	10.16
5	87	Tidal Wetland	-3.7	1.4	0.7	0.69	1.03
6	140	Tidal Wetland	-3.9	1.4	1.2	0.69	1.72
7	232	Upland	-5.5	20	9.5	0.62	15.39
Total	**1110**				**29.1**		**46.2**
Total Tidal Wetland Acres			**555**	**50%**			
Total Upland Acres			**555**	**50%**			

Notes: **Cell Volume** is calculated using the average depth of fill (Average Finished Elevation minus Average Bottom) over the area of the cell.

VO Ratio is the ratio of the Cut Volume measured in the channel being dredged to the volume occupied by the same material after 2 to 3 years of consolidation and desiccation in a cell. The consolidation and desiccation during this time is on the order of xxxxxx percent of the long-term volume change which will take place. The VO Ratio is significantly affected by the placement and materials management procedures described in Section 7.

Cell Capacity is the volume of dredged material which can be placed in a cell measured in cut cubic yards. It is determined by dividing Cell Volume by the VO Ratio.

The cell arrangements shown are still under review and can be expected to change as the design progresses. No significant changes in the analyses and the procedures presented are anticipated as a result of these refinements. The total site area of 1,110 acres and the 50 Percent tidal wetland habitat ratio will be maintained.

CELL FILLING SCHEDULES

Cell filling schedules describe the projected sequence of cell filling and the volumes of material to be placed each year. Each year's filling schedule will be based upon the target elevations for each cell, actual cell material elevations and total volume of material to be placed at the site. The desired rate of filling over the operational life of the site for both tidal wetland and upland cells as well as the optimal placement volume for each cell each year must be considered in the detailed cell filling schedule to be prepared each year. The annual cell filling schedules will be developed based on the above factors as well as the considerations developed in the other sections of this report.

Simulations of cell filling for an average annual placement of 2.0 million cubic yards were made for the first eleven years of site operational life for the total site development of 1110 acres. This analysis is useful for indicating the likely time to reach various cell elevations which defines the development schedules for wetland and upland cells, the sequence for raising upland cell dikes as well as the general effects of particular filling patterns. These conditions defined by these simulations may change markedly after the first year. Even though there will be variations in the volume of material placed annually, the simulations are very useful for determining which cell or cells should be developed initially.

This simulation indicates that after 11 years the remaining site capacity will be approximately 24.3 million cubic yards.

With annual lift thickness of 2 to 4 feet, the material would be placed over a 4 month period during the winter months and allowed to dry for about 8 months.

The site operating staff can use the analyses presented as a basis for refining the year by year plans for determining the volume of material to be placed in the site cells. These annual estimates will also take into account actual channel material characteristics, cell elevations and cell material water contents and resulting void ratios.

CONSOLIDATION AND DESICCATION OF DREDGED MATERIALS

The desired degrees of consolidation and desiccation of dredged materials is markedly different for the tidal wetland and for the upland cells. In tidal wetland cells consolidation and desiccation will achieve what is necessary to minimize continuing settlement of the wetland cell surface after initial habitat development and will achieve a cell surface material water content that will provide optimal soil texture for habitat vegetation.

After material surface levels have reached and exceeded MLLW in the upland cells operational efforts will be made to achieve full desiccation of the upland cell surface. Full desiccation of the surface layer will provide for maximum capacity of the upland cells in a cost-effective manner.

Full achievement of the described consolidation and desiccation will require placement of annual cell lifts on the order of 2 to 4 feet in thickness, proper cell spillway operations during and after each placement and effective materials management ("crust management") in the cells. Large increases over the 2.0 million cubic yards per year used in the analyses contained in this report will require careful planning and adjustments of site operations in order to maximize site effectiveness.

CELL WATER LEVEL CONTROL

The removal of water from the cells is a major factor in the consolidation and desiccation of dredged materials. Cell water levels are controlled by the placement and removal of weir boards in the cell spillways. There are three principal aspects to control of cell water levels:

1. Control of effluent suspended solids during placement operations.
2. Minimization of cell water levels to reduce wave wash on dike slopes.
3. Decant of surface water after placement operations to control drying and consolidation of cell materials.

CELL HABITAT DEVELOPMENT

Tidal wetland and upland cell development is described in detail in a separate report entitled *Habitat Development Report* (ECI September 1995). Various aspects of habitat development which are directly affected by site operational procedures are described in the other sections of this report.

SITE MANAGEMENT AND REPORTING

Periodic observation and reporting of site conditions will aid in determining if the site objectives are being met. In order to achieve the desired objectives of the wetland cells and the maximum capacity of the upland cells, the filling of the site will have to be scheduled annually to maximize the drying of the material placed and the site capacity. The basic guidelines are:

- Maximum lift should be kept to four feet or less in each cell.
- Placement of material should be performed during the winter months in order to maximize dewatering of the material during the summer months.
- During material placement, cell water levels should be kept to a minimum to maximize dewatering time and minimize entrained water in the material.

Annual estimated cell elevations and void ratios should be checked by surveys and material analysis at scheduled intervals.

- Before placement of material
- After placement of material
- After drying periods

Daily operating reports should be made by the crust management operating personnel. These reports should provide the following information:

- Number of personnel
- Types of equipment being used
- Operating time of each piece of equipment
- Which spillways are active
- Stored water in cells
- Weather conditions

Topographic and hydrographic surveys should be made periodically to determine the actual cell volume occupied.