EXECUTIVE SUMMARY

An Interim Progress Review Briefing (IPR) was held for the Cat Island, Section 204 study on February 21, 2008 with Corps of Engineers Headquarters (HQ) and the Great Lakes and Ohio River Division. As a result of the meeting, HQ directed the Detroit District to convert the Cat Island Section 204 study to a Dredged Material Management Plan (DMMP) study. The Cat Island Section 204 study evaluated beneficial uses of dredged material, which included constructing three islands and a wave barrier. The Islands would be created with clean dredged material from the outer navigation channel, resulting in primarily navigation benefits with secondary ecosystem restoration benefits. This document identifies specific measures necessary to manage the volume of material likely to be dredged over a 20 - year period within Green Bay Harbor.

The Green Bay Harbor Federal Navigation Project is located at the southern portion of Green Bay, Wisconsin, on Lake Michigan's western shore and extends up the Fox River to a location just downstream of DePere lock and Dam, which is about 204 miles north of Chicago, Illinois. Bayport Confined Disposal Facility (CDF) is the current disposal placement site for dredged material from the outer and inner Federal navigation channels at Green Bay Harbor. Bayport CDF is owned by Brown County and a tipping fee is assessed to the Federal Government to place dredged material. With the current dredging cycle and utilizing the Bayport CDF for disposal of maintenance dredged material, it is anticipated that Bayport CDF will be at full capacity in 2015. A disposal plan to accommodate, at a minimum, 20-years of future dredged material capacity, consisting of the outer Federal channel at 2,350,000 cy and the inner Federal channel at 1,956,000 cy is needed.

Numerous alternatives for dredged material disposal at the Harbor have been investigated to date. These include beneficial use of material such as various island creations, open water placement, beach nourishment, additional Dredged Material Disposal Facilities (DMDF) and no action. This study seeks a disposal solution that is the least costly, engineeringly, economically and environmentally feasible project alternative.

Based upon the investigation presented in this Phase II Dredged Material Management Plan document, a combination of constructing an in-water DMDF (Cat Island chain) and the Expanded Bayport CDF is designated as the "Base Plan". The use of Bayport CDF addresses the inner harbor channel material and the in-water DMDF (Islands) will contain the outer harbor channel material. It is engineeringly feasible, environmentally acceptable (Federal Standards) and least costly and it forms the basis for future actions leading toward adequately handling dredged material disposal for a minimum of 20 years for Green Bay Harbor and provides the maximum potential environmental beneficial use. The risk adjusted total first costs of the Base Plan are $113,017,000 [1], including constructing the in-water DMDF (Islands), expanding the existing Bayport CDF, dredging costs and tipping fees.

[1] Appendix F, Part II, Table F-II-19, page F-II-33. FY10 dollars.

The locally preferred plan is also the Base Plan with annual benefits of $24,514,942 and annual costs of $8,206,382 resulting in annual net benefits of $16,308,560 and a benefit-cost ratio of 3.0 [2]. The fully funded total construction cost for the Cat Island chain is $32,738,000 and is cost shared at 65% Federal and 35% non-Federal ($21,279,700 and $11,458,300 respectively). The fully funded total construction cost for the expansion of the Bayport CDF is $7,265,000 and is cost shared at 65% Federal and 35% non-Federal ($4,722,250 and $2,542,750 respectively) based on Policy Guidance letter #47 which states that under the 217 agreement, the operation and maintenance of Bayport CDF will be funded thru a tipping fee. Since Bayport CDF was part of a previous Federal Project, no cost sharing credit (10%) will be given for LERRDs. Also, under the 217 agreement, the private CDF facility owner-operator can construct the facility and then recoup his expenses through a tipping fee. The benefits from constructing the in-water DMDF (islands and wave barrier) would provide 20-year dredged capacity and restore approximately 1,449 acres of habitat, and thereby serving both navigation and environmental purposes. The in-water DMDF (islands) provides dredged material capacity for navigation as well as have positive economic and secondary environmental benefits in providing a synergistic and cost-reducing approach, and is determined to be in the public interest. Therefore, the combination of island creation and 36 acre expanded Bayport CDF is the recommended plan to address the needs of both, the inner and outer harbor.

Any references in this report regarding elevations refer to International Great Lakes Datum (IGLD), 1955. To convert to IGLD 1985, add 0.7 feet.

[2] Annual calculations based on 4.375% interest and 20-year project life. FY10 dollars.

PHASE II REPORT
DREDGED MATERIAL MANAGEMENT PLAN
GREEN BAY HARBOR, WISCONSIN

September 2010

U.S. ARMY CORPS OF ENGINEERS
DETROIT DISTRICT

PHASE II REPORT
DRAFT DREDGED MATERIAL MANAGEMENT PLAN
GREEN BAY HARBOR, WISCONSIN

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GREEN BAY HARBOR, WISCONSIN
DREDGED MATERIAL MANAGEMENT PLAN (DMMP)

1. PROJECT DESCRIPTION

Green Bay Harbor is located in the city of Green Bay, between Outagamie and Brown Counties Wisconsin, which is located about 204 miles north of Chicago, Illinois. The harbor is positioned at the southern portion of Green Bay on Lake Michigan's western shore and extends up the Fox River to a location just downstream of DePere lock and dam (See Figure 1). The authorized project at Green Bay Harbor has two segments which consist of an outer and inner channel. The outer channel is approximately 11 ¼ miles long, 300 to 500 feet wide and 26 feet deep. From Grassy Island in the Bay to a point about ½ mile upstream from the mouth of the Fox River, the project has a reduced channel depth of 24 feet and is 300 feet wide. The inner channel (See Figure 2) begins at a ½ mile upstream of the mouth of the Fox River and extends approximately 7 miles upstream to the city of DePere. From the ½ mile point to approximately 3.5 miles upstream (Chicago and North Western Railway bridge) the channel width varies but the authorized channel depth continues at 24 feet. A turning basin upstream of the Chicago and North Western Railway Bridge has a reduced depth of 20 Feet. Beyond the turning basin the Federal channel continues to be reduced to a depth of 18 feet deep and 75 feet wide that extends to the end of the authorized Federal navigation channel.

2. SCOPE OF THE STUDY

This study is conducted under the guidance of the Planning Guidance Notebook (ER 1105-02-100), Appendix E, paragraph 15, dated 22 April 2000. The purpose of this Dredged Material Management Plan (DMMP) study is to determine if additional suitable dredged material placement sites are located in the vicinity of Outagamie and Brown County that will satisfy future dredge disposal needs of a 20-year capacity associated with the Green Bay Harbor. The decision to recommend implementing the final Management Plan is based upon finding at least one potential solution that would be engineeringly, economically and environmentally feasible, will be in accord with current Federal policies and budgetary priorities, and will be supported by the project's sponsor, Brown County.

The purpose of this DMMP document is to: (a) present studies that have been conducted to date; (b) provide an economic assessment to justify continued maintenance dredging; (c) discuss potential options that appear viable for disposal of dredged material; and (d) select a Management Plan for Green Bay Harbor dredged material disposal.

The level of detail in this Phase II DMMP document is limited by the extent of information available in the study time frame. In this phase of the study process, problems and

opportunities of the project are defined and potential alternatives are formulated and analyzed to identify a plan (or plans) that would handle the dredging volume for a 20-year period.

3. AUTHORIZATION AND DEVELOPMENT HISTORY

3.1 General

Authorizing legislation for dredging Green Bay Harbor has evolved over the years. Legislation specific to Green Bay Harbor is shown on Table 2.

Prior to 1965, dredged material from Green Bay Harbor was generally placed in open water. In 1966 the Bayport Confined Disposal Facility (CDF), constructed by the City of Green Bay and Brown County, began accepting dredged material from Green Bay Harbor with occasional disposal in open water. A summary of disposal locations for annual maintenance dredging is displayed below in Table 1.

With the current dredging cycle the Bayport Confined Disposal Facility (CDF), utilized for disposal of maintenance material, is anticipated to be at full capacity in 2015. As a condition of using the CDF, a tipping fee is assessed for disposal of dredged material from maintenance dredging the outer and inner channel. To facilitate accommodating future disposal needs Brown County has indicated a willingness to share the future cost of material disposal and act as the local private CDF facility owner-operator for the plan developed under this study. The locally preferred plan is the same as the Base Plan.

Table 1 Channel Maintenance History					
FY	Total Cost[1]	Cubic Yards	Cost/cy[1]	Placement Site	Contractor or Government
1957	N/A	49,800	N/A	Open Water	Government
1958	N/A	15,050	N/A	Open Water	Government
1958	N/A	143,195	N/A	Open Water	Government
1959	N/A	59,391	N/A	Open Water	Government
1960	N/A	16,285	N/A	Open Water	Government
1960	N/A	19,554	N/A	Open Water	Government
1961	N/A	37,061	N/A	Open Water	Government
1961	N/A	110,642	N/A	Open Water	Government
1961	N/A	19,400	N/A	Open Water	Government
1962	N/A	18,185	N/A	Open Water	Government
1963	N/A	118,093	N/A	Open Water	Government
1964	$1,173,398	180,192	$6.53	Open Water	Government
1965	$821,441	180,664	$4.52	Open Water	Government
1965	$1,150,815	426,343	$2.66	Open Water	Government
1965	$385,489	50,960	$7.53	Open Water	Government
1966	$182,179	34,330	$5.32	Bayport CDF	Government
1966	$760,173	116,681	$6.50	Bayport CDF	Government
1967	$119,473	11,480	$10.41	Bayport CDF	Government
1967	$9,929,398	376,891	$26.35	Bayport CDF	Contractor
1967	$926,622	50,000	$100.12	Bayport CDF	Contractor
1968	N/A	75,600	N/A	Bayport CDF	Government
1969	N/A	664,225	N/A	Open Water	Government
1970	N/A	1,416,690	N/A	Open Water	Government
1971	$7,072,665	940,000	$7.50	Bayport CDF/ Open Water	Contractor
1972	$6,262,231	960,000	$6.54	Bayport CDF	Government
1972	$582,470	240,000	$2.43	Bayport CDF	Government
1973	$1,594,615	540,000	$2.96	Bayport CDF	Government
1973	$5,966,432	940,000	$6.36	Bayport CDF	Government
1973	$887,992	100,000	$8.89	Open Water	Government
1974	$636,147	57,000	$11.15	Open Water	Government
1974	N/A	1,335,963	N/A	Bayport CDF	Government

Continued on next page

1 All values are in FY10 dollars

Table 1, Continued Channel Maintenance History					
FY	Total Cost[1]	Cubic Yards	Cost/cy[1]	Placement Site	Contractor or Government
1975	$3,412,266	821,214	$4.16	Bayport CDF	Government
1975	$2,757,445	83,618	$32.98	Bayport CDF	Government
1977	$1,540,552	300,000	$5.14	Bayport CDF	Government
1978	$147,288	315,794	$0.45	Bayport CDF	Government
1978	$617,779	24,650	$25.05	Bayport CDF	Government
1979	$1,560,377	665,708	$2.35	Bayport CDF	Government
1979	$527,528	25,750	$20.48	Renard Island CDF	Government
1979	$524,421	145,500	$3.61	Bayport CDF	Government
1981	$235,831	34,175	$6.91	Renard Island CDF	Government
1981	$2,040,261	559,587	$3.65	Renard Island CDF	Government
1982	$881,416	209,602	$4.21	Renard Island CDF	Government
1982	$1,863,577	177,831	$10.48	Renard Island CDF	Contractor
1983	$936,069	273,606	$3.41	Renard Island CDF	Government
1984	$421,386	53,273	$7.91	Renard Island CDF	Government
1984	$1,171,993	131,344	$8.93	Renard Island CDF	Contractor
1985	$2,149,146	120,143	$17.89	Bayport CDF	Contractor
1985	$1,108,670	102,143	$10.85	Renard Island CDF	Contractor
1986	$1,415,088	66,740	$21.20	Renard Island CDF	Contractor
1987	$1,947,481	114,127	$17.07	Bayport CDF	Contractor
1987	$3,245,143	156,980	$20.68	Renard Island CDF	Contractor
1988	$2,786,609	166,989	$16.69	Bayport CDF	Contractor
1989	$884,397	49,421	$17.90	Bayport CDF	Contractor
1990	$1,247,999	161,150	$7.75	Renard Island CDF	Contractor
1990	$630,257	46,413	$13.59	Bayport CDF	Contractor
1991	$1,105,707	168,202	$6.58	Renard Island CDF	Contractor
1992	$1,721,968	145,987	$11.80	Bayport CDF	Contractor
1992	$1,175,914	164,080	$7.17	Renard Island CDF	Contractor
1993	$1,580,575	190,062	$8.31	Renard Island CDF	Contractor
1993	$1,518,908	127,802	$11.89	Bayport CDF	Contractor
1994	$1,659,428	145,564	$11.40	Bayport CDF	Contractor
1995	$1,343,108	184,697	$7.28	Renard Island CDF	Contractor

Continued on next page

1 All values are in FY10 dollars

Table 1, Continued Channel Maintenance History					
FY	Total Cost[1]	Cubic Yards	Cost/cy[1]	Placement Site	Contractor or Government
1996	$1,565,872	141,034	$11.10	Bayport CDF/ Renard Island CDF	Contractor
1997	$1,942,843	167,612	$11.59	Bayport CDF	Contractor
1998	$2,619,993	233,661	$11.21	Bayport CDF	Contractor
1999	$1,318,375	102,284	$12.89	Bayport CDF	Contractor
2000	$1,684,313	133,075	$12.66	Bayport CDF	Contractor
2001	$3,195,669	160,683	$19.87	Bayport CDF	Contractor
2002	$2,224,470	113,934	$19.53	Bayport CDF	Contractor
2003	$2,230,133	115,098	$19.38	Bayport CDF	Contractor
2005	$1,769,824	89,981	$19.67	Bayport CDF	Contractor
2005	$1,491,961	84,550	$17.65	Bayport CDF	Contractor
2006	$2,121,622	87,188	$23.63	Bayport CDF	Contractor
2007	$2,343,191	124,000	$19.23	Bayport CDF	Contractor
2008	$3,599,150	228,000	$15.79	Bayport CDF	Contractor
2009	$4,164,978	255,331	$16.31	Bayport CDF	Contractor
Totals	$111,882,524	**17,272,438**			

1 All values are in FY10 dollars

Section 123 of the 1970 River and Harbor Act (Public Law 91-611) authorized the Corps of Engineers to construct, operate, and maintain contained placement areas for contaminated dredged material in the Great Lakes area. This law provided for the construction of CDFs specific to the region, with local interests supplying lands, easements and right-of-ways. A 25% non-Federal cost share was waived in cases where the private CDF facility owner-operator was participating in a wastewater treatment program and was not violating water quality standards. However, construction of a new CDF under Section 123 is no longer possible due to a change in the law, Section 201 of WRDA '96. Construction of the 110 acre portion of Bayport CDF was at 100% non-Federal cost. In accordance with Section 217 (c) of the Water Resources Development Act (WRDA) of 1996, the Corps reimbursed Brown County through a tipping fee.

Until passage of the WRDA '86, there was no legal authority for the requirement to cost share the construction of a new CDF. Cost sharing for construction of Dredged Material Disposal Facilities (DMDF) associated with the construction and operations and maintenance of Federal navigation projects for harbors and inland waters was established by WRDA '86. It specifies that land-based and aquatic dredged material disposal facilities shall be considered as general navigation features of the project. Section 101 of WRDA '86, as amended by Section 201 of WRDA '96, codified as 33 U.S.C. Sect. 2211, and states in pertinent part:

(a) Construction.-

(1) PAYMENTS DURING CONSTRUCTION. - The non-Federal interests for a navigation project for a harbor or inland harbor, or any separable element thereof, on which a contract for physical construction has not been awarded before the date of enactment of this Act shall pay, during the period of construction of the project, the following costs associated with general navigation features:

(A) 10 percent of the cost of construction of the portion of the project which has a depth not in excess of 20 feet; plus

(B) 25 percent of the cost of construction of the portion of the project which has a depth in excess of 20 feet but not in excess of 45 feet; plus

(C) 50 percent of the cost of construction of the portion of the project, which has a depth in excess of 45 feet.

(2) ADDITIONAL 10 PERCENT PAYMENT OVER 30 YEARS. - The non-Federal interests for a project to which paragraph (1) applies shall pay an additional 10 percent of the cost of the general navigation features of the project in cash over a period not to exceed 30 years, at an interest rate determined pursuant to section 106. The value of lands, easements, rights-of-way, and relocations provided under paragraph (3), and the costs of relocations borne by the non-Federal interests under paragraph (4) shall be credited toward the payment required

under this paragraph.

(3) LANDS, EASEMENTS, AND RIGHTS-OF-WAY. -The non-Federal interests for a project to which paragraph (1) applies shall provide the lands, easements, rights-of-way, and relocations (other than utility relocations, under paragraph (4)) necessary for the project including lands, easements, rights-of-way, and relocations (other than utility relocations accomplished under paragraph (4) that are necessary for dredged material disposal facilities.

(4) UTILITY RELOCATIONS. - The non-Federal interests for a project to which paragraph (1) applies shall perform or assure the performance of all relocations of utilities necessary to carry out the project, except that in the case of a project for a deep draft harbor and in the case of a project constructed by non-Federal interests under Section 204, one-half of the cost of each such relocation shall be borne by the owner of the facility being relocated and one-half of the cost of each such relocation shall be borne by the non-Federal interests.

(5) DREDGED MATERIAL DISPOSAL FACILITIES FOR PROJECT CONSTRUCTION. - In this subsection, the term “general navigation features” includes constructed land-based and aquatic dredged material disposal facilities that are necessary for the disposal of dredged material required for project construction and for which a contract for construction has not been awarded on or before the date of enactment of this paragraph.

(b) Operation and maintenance

(1) In general

The Federal share of the cost of operation and maintenance of each navigation project for a harbor or inland harbor constructed by the Secretary pursuant to this Act or any other law approved after November 17, 1986, shall be 100 percent, except that in the case of a deep-draft harbor, the non-Federal interests shall be responsible for an amount equal to 50 percent of the excess of the cost of the operation and maintenance of such project over the cost which the Secretary determines would be incurred for operation and maintenance of such project if such project had a depth of 45 feet.

(2) Dredged material disposal facilities

The Federal share of the cost of constructing land-based and aquatic dredged material disposal facilities that are necessary for the disposal of dredged material required for the operation and maintenance of a project and for which a contract for construction has not been awarded on or before October 12, 1996, shall be determined in accordance with subsection (a) of this section. The Federal share of operating and maintaining such facilities shall be determined in accordance with paragraph (1).

TABLE 2
AUTHORIZING LEGISLATION

ACT	WORK AUTHORIZED	DOCUMENTS
June 23, 1866	Outer Channel and revetment at Grassy Islands[1]	Annual Report, 1867, p. 70.
July 13, 1892	Inner Channel[2]	Unpublished report approved Aug 3, 1892
June 26, 1910	Turning Basin DePere	H. Doc. 222, 61st Cong., 2d Sess.
August 8, 1917	Maintenance of turning basin at DePere;	H. Doc. 1017, 64th Cong., 1st Sess.
March 3, 1925	Increase inner channel depth and turning basin to 18 feet	H. Doc. 294, 68th Cong., 1st Sess.
August 30, 1935 [3]	Deepen outer channel to 22 feet; widen channel in Fox River through City of Green Bay to 22 feet.	Rivers and Harbors Committee Doc. 40, 72d Cong., 2d Sess.
August 26, 1937	Turning basin above Chicago & N.W. Ry. Bridge	Rivers and Harbors Committee Doc. 73, 74th Cong., 2d Sess.
March 2, 1945	Turning basin at mouth of East River	H. Doc. 95, 76th Cong., 1st Sess.
October 23, 1962	Deepen and widen entrance channels and Fox River	H. Doc. 470, 87th Cong., 2d Sess.
November 17, 1986	Deepen the Fox River channel at Green Bay, WI to 27 feet	H.R. 6 (FORMERLY s.1567), 99TH Cong. 2nd Sess. (WRDA 1986, Sec 601c)
November 8, 2007	From Station 190+00 to Station 378+00 reduce the width to 75 feet and reduce the depth to 6 feet.	H.R. 1495, 110th Cong. 1st, Sess.

1. Completed under previous project
2. Included in Public Works Administration Program January 3, 1934.
3. Including Emergency Relief Administration Work authorized May 28, 1935.

3.2 Green Bay Harbor

Green Bay Harbor is located at the southern portion of Green Bay on Lake Michigan's western shore and extends up the Fox River to a location just downstream of DePere lock and dam, approximately 204 miles north of Chicago, Illinois. The River and Harbor Acts of 23 Jun 1866, 13 Jul 1892, and 26 Jun 1910, authorized the dredging of the harbor to accommodate robust commercial shipping activity. See Figure 1 for project map of the harbor.

3.3 Open Water Placement

Through the early 1960s, dredged material from Green Bay Harbor was placed in open water on an annual basis. A shift to utilization of an upland site known as the Bayport Confined Disposal Facility (CDF), in conjunction with occasional disposal in open water, began in 1966. Disposal in open water was terminated in 1974, and dredged material has since been placed at one of two locations: the Bayport CDF and an in-water CDF named Renard (Kidney) Island.

3.4 Renard Island CDF

Renard Island CDF at Green Bay Harbor is an offshore island located northwest of Bay Beach Park. The Renard Island CDF was constructed in 1979 under Section 123 of the River and Harbor Act of 1970 (PL 91-611). The size of the disposal area is about 54 acres with a design capacity of approximately 1,200,000 cubic yards. Renard Island CDF was last utilized for placement of dredged material in 1996 (See Figures 2, 3 and 5).

Initiatives were undertaken in the early 1980s to determine the merits of expanding Renard Island to increase its capacity by 126 acres, and the Brown County Board approved a resolution to expand the facility on January 16, 1985. The USACE asked the Wisconsin Department of Natural Resources (WDNR) for a Section 401 Water Quality Certification on 13 June 1985; however, a legal challenge by the State Public Intervener prevented issuance of the certificate. Numerous studies were completed by the USACE, which demonstrated that the expansion of Renard Island CDF would have no adverse impact on the environment. These included a $400,000 Water Quality Modeling study completed in 1993. In June 1994, the State Supreme Court issued a decision clearing the way for the USACE to again apply for Section 401 certification. Following a September 1995 WDNR notice of intent to provide certification, it received a petition for a contested case hearing challenging certification of the CDF. A hearing was held 26-30 August and 10 September 1996, and the decision to approve the CDF expansion was denied in July 1997.

Renard Island closure has been on-going for many years. The District received funding in 2010 to provide a final cover but issues with construction of a causeway to the island caused a delay. The potential future use of the island is recreational/environmental.

3.5 Bayport CDF

The Bayport CDF is located in Brown County, west of the mouth of the Fox River in the city of Green Bay. The original Bayport site was constructed in 1965 by the city of Green Bay and Brown County. This site was offered to the USACE by the City as a local cooperation requirement for the harbor deepening project authorized by the River and Harbor Act of 1966. In 1977, modification of a portion of the Bayport CDF was authorized and funded under Section 123 of the River and Harbor Act of 1970 (PL 91-611) for continued placement of maintenance dredged material. The site was used for placement of dredged material from 1966 to 1977. See Figures 2 and 4.

Between 1985 and 1988, the City of Green Bay offered additional areas for disposal of dredged material (referred to as Cells 1 and 3). In 1988, the City of Green Bay raised the existing dikes, by approval of the WDNR, providing additional capacity. The county purchased 120 acres in 1990 but it was not utilized at that time. In 1994, approximately 75,000 cubic yards were placed in Cells 1 and 3. By letter dated 23 February 1994, the WDNR concurred with the 1994 placement, but refused any further expansion of the existing facility until Brown County had completed a long-term placement plan for the expansion of the facility. However, in 1995, the WDNR approved the raising of internal berms in cell 3 to the level of berms in cell 1. Accordingly, 90,000-100,000 cubic yards of FY 1997 maintenance dredge material was placed in cell 3. See Figures 2 and 4.

In 1997, Brown County requested (by letter, dated 24 June 1997) the Corps' participation under Section 217 of WRDA 1996 and to develop an agreement, whereby the Corps agreed to utilize 110 of the 120 acres owned by Brown County, consisting of cells 2,4,5,6,7 and 8, the remaining 10 acres are for transmission line easements and access. . The original total design capacity for the 110-acre expansion was approximately 2,272,000 cy of dry material. Under Section 217c provision of WRDA 1996, Public Law 104-303, the expansion was constructed at 100% non-Federal cost. The Corps would utilize the facility to place annual maintenance dredge material on a fee basis, as determined in the Section 217 agreement. The Memorandum of Agreement (MOA) was signed on 4 June 2001. (See Appendix I, 217 Agreements, for details of the June 2001 agreement)

3.6 Previous Studies

Cat Island Chain Restoration Design Development Report, dated April 28, 2005 prepared by W. F. Baird & Associates Ltd. for the U.S. Army Corps of Engineers, Detroit District.

This report was prepared to develop design information for alternatives to restore the Cat Island Chain. The report included field investigations and measurements to define existing conditions and provide test data for numerical & physical models. A geomorphic analysis was accomplished to understand the long term historic evolution of Cat Island chain and other adjacent features, including; Long Tail Point, Frying Pan Point, and Little Tail Point.

Physical modeling was developed to understand the protection requirements for headlands, beach stability, and overtopping characteristics. Numerical modeling of waves, hydrodynamics (water levels and currents) and sediment transport was accomplished to understand the impacts of the islands on circulation patterns and turbidity levels in the lower bay used to refine the layout and construction sequencing of the islands to achieve maximum benefits in terms of promoting the recovery of aquatic vegetation in the lee of the islands. This report also developed plans and cross-sections, based on the modeling efforts, to promote restoration of habitat and creating storage capacity for dredged material. Finally, this report identified and evaluated construction issues for land and water based construction activities.

Reconnaissance Study, Lower Fox River, Wisconsin and Green Bay, Wisconsin and Michigan, Environmental Dredging (June 2001).

A "Limited" *Dredged Material Management Plan (DMMP) for Green Bay Harbor, Wisconsin, June 1998,* prepared by the Detroit District Corps of Engineers. The purpose of the DMMP report was to present a Base Plan (Federal Standard) for the management of dredged material at Green Bay Harbor for the next 20 years, in support of Brown County Harbor Commission's request for Corps of Engineers' participation under Section 217 WRDA 1996. The "Limited" DMMP recommended that the Base Plan (Federal Standard) for Green Bay Harbor, Wisconsin, is the expansion of the existing Bay Port CDF.

Draft Lower Green Bay, Hydrodynamic and Mass Transport numerical model study, Feb 1987, Waterways Experimental Station

Green Bay Harbor, Wisconsin, Confined Disposal Facility, *Final Environmental Impact Statement*, (July 1985).

Green Bay Harbor, Wisconsin, Supplemental Design Memorandum of the 1962 modification, Final Report (August 1980) Chicago District.

Final Environmental Impact Statement, Operation, Maintenance and Dredged Material Disposal Facility, Green Bay Harbor, Wisconsin, (November 1977).

Final Environmental Impact Statement, Maintenance Dredging and Contained Disposal of Dredged Material at Green Bay Harbor, Wisconsin (May 1976) Chicago District.

4. DESCRIPTION OF EXISTING CONDITION

4.1 General

Evaluation of Green Bay Harbor channel sediments was completed in accordance with the Great Lakes Dredged Material Testing and Evaluation Manual (USEPA/USACE, 1998). The Manual presents guidance on testing and evaluation for proposed discharges of dredged material into U.S. waters of the Great Lakes Basin. The physical and chemical testing conducted indicated that the sediments in the inner channel areas may have deleterious impacts to water quality and benthic organisms restricting its use. The material dredged from beyond mile three in outer harbor (Figure 6) is suitable for unrestricted uses. The area of the channel from approximately one-half mile upstream of the Fox River mouth, to approximately three miles into the bay is in flux with regard to sediment quality because of varying river currents and storm load outputs. The material in the flux area is expected to vary in classification from unrestricted to restricted depending on conditions over a 20-year period. Historical testing results indicate that approximately 30% of the shoal material within the flux area would be available for unrestricted use. Future evaluations of the Federal channel sediments will be periodically conducted, consistent with the Great Lakes Testing and Evaluation Manual (USEPA/USACE 1998), to ensure that material is disposed of in accordance with its classification.

The channel limits identified in the Green Bay Harbor Dredged Material Management Plan (DMMP) study are all Federal channels from 11- ¼ miles into the bay to approximately 7 miles to the upstream limit of the Fox River.

Sediment samples were obtained in 2006 from the outer harbor (beginning at river mile 3 to the end of the Federal navigation channel). The physical and chemical analysis showed that the material is clean with metals below background, and PCB results were non-detectable. Future evaluations will be conducted frequently from a point ½ mile upstream of the mouth of the Fox River to 3 miles in the bay to determine or confirm the viability of placing the dredged material for island creation.

4.2 Outer Harbor

The outer Federal channel begins at 11-1/4 miles into the bay and extends upstream to a point ½ mile into the mouth of harbor entrance. The project channel depth and width vary in the bay. The segment from 11-1/4 miles to 3 miles into the bay has a depth and width of 26 feet and 500 feet respectively. The segment from 3 miles into the bay upstream to a point ½ mile into the harbor entrance has a depth and width of 24 feet and 300 feet, respectively. See Figures 3 & 6.

4.3 Inner Harbor

The inner channel begins at a point ½ mile into the mouth of the harbor entrance and extends 7 miles upstream within the Fox River to the City of DePere. From the ½-

mile point to approximately 3.5 miles upstream (Chicago and North Western Railway Bridge) the channel width varies, but the authorized channel depth continues at 24 feet. WRDA 07, Section 3173, authorized a reduction of the Federal navigation channel depth and width beginning at the turning basin, upstream of the Chicago and North Western Railway bridge (station 190+00) to the upstream limit at Depere (station 378+00) to 6 feet and 75 feet respectively. See Figure 2.

4.4 Bayport CDF

Currently, the dredged material from Green Bay Harbor (defined above) is placed in the Bayport Confined Disposal Facility (CDF). The Bayport CDF is located adjacent to the shoreline, west of the harbor entrance. Under a 217 agreement, the Corps pays a tipping fee to place dredged material from the inner and outer segments of the harbor into the Bayport facility. (WRDA 1996, Section 217(c), authorized the Corps to enter into an agreement with public or private entities in the design and construction of dredged material disposal facilities. The Government may reimburse the entity, subject to appropriations through payment of a subsequent tipping fee.) Bayport continues to receive dredged material that is both suitable and unsuitable for open lake placement from the inner and outer channel harbor segments of Green Bay Harbor. See Figure 4.

The future DMDF must be able to contain, at a minimum, a 20-year dredged material capacity (including backlog), which in this case is approximately 2,350,000 cubic yards (cy) for the outer Federal channel and 1,956,000 for the inner channel for a total of 4,306,000 cy. The large backlog in the Navigation Channel is due to a lack of funds available to completely maintain the channel. The quantities dredged for the past ten years have been severely restricted based on funding; they do not represent functional channel requirements. Consequently, Green Bay Harbor has built up a very large amount of backlog material in the navigation channel. The current backlog quantity calculated for Green Bay Harbor is almost 700kcy at currently maintained functional channel dimensions. Due to the incredible need for dredging this harbor, over the past 3 years Green Bay Harbor has been funded at a higher level and dredging costs have decreased. Calculations on the requirements for this dredge material disposal facility are based on recent dredging quantities in Green Bay Harbor that represent realistic requirements. In 2008, 228kcy were removed with 255kcy in 2009 with an estimated 288kcy in 2010. Although these quantities have reduced some of the backlog in Green Bay Harbor, most of this quantity removed was needed to maintain the navigation channel at status quo. Capacity calculations were based on the average dredging history for 2007 through 2009 to more accurately reflect dredging needs. Since sponsor is aware of permitee responsibilities and has decided not to provide additional capacity for their use (they may use the landfill), permittee quantity needs are not included in the 20 year dredging capacity requirements. The 20-year maintenance dredging capacity requirement, based on the 2007 through 2009 quantities and on dredging needs, is 215,300 cy per year (117,500 cy outer harbor and 97,800 cy inner harbor).

5. PROJECTION OF FUTURE CONDITIONS IN THE ABSENCE OF A MANAGEMENT PLAN

In the absence of a Management Plan, there is approximately enough identified remaining capacity for 6 years. After the 2015 dredge cycle, the Bayport CDF will be essentially filled to capacity and a new site will be required. After that, the lack of dredging would result in shoal buildup, which would reduce channel depth, forcing ships to light load (partially load) or discontinue transit into the Green Bay Harbor. Light loading reduces draft, which allows the vessels to clear the shoals, but reduced vessel carrying capacity and increases per-unit shipping costs. This consequently increases costs to industry and the consumer. Also, shoaled channels cause more sediment re-suspension from ship hulls and prop wash.

The local sponsor would prefer the construction of the Cat Island Chain, but it is highly unlikely that the local sponsor could finance the construction of the islands and a wave barrier on their own.

Without project conditions remaining dredged cycles

Calendar Year	Project Year	Sediment Placed In existing CDF From the inner and outer harbor (including backlog)	
2012	1	215,300	(Baseline) **
2013	2	215,300	
2014	3	215,300	
2015	4	215,300	* CDF will be essentially full
2016	5	215,300	New site required
2017	6	215,300	New site required
2018	7	215,300	New site required
2019	8	215,300	New site required
2020	9	215,300	New site required
2021	10	215,300	New site required
2022	11	215,300	New site required
2023	12	215,300	New site required
2024	13	215,300	New site required
2025	14	215,300	New site required
2026	15	215,300	New site required
2027	16	215,300	New site required
2028	17	215,300	New site required
2029	18	215,300	New site required
2030	19	215,300	New site required
2031	20	215,300	New site required

* calculated based on data from Brown County, owners of the Bayport CDF
**Assume 2012 is the first year the facility will be available.

Green Bay Harbor was last dredged in 2009. Approximately 255,331 cubic yards was dredged and placed in the Bayport CDF. After dredging in 2011, the Bayport CDF has an estimated maximum of 861,200 cubic yards of capacity remaining. It is anticipated that this amount will be dredged by the year 2015, meaning that there would then be insufficient storage space in the current CDF for another dredging cycle. Therefore, after the 2015 dredging cycle, a new DMDF will have to be established for all future sediments.

According to Detroit District Operations Office, prior-to-dredge and after-dredge surveys reveal that the Green Bay Harbor entrance channel shoals up to 3 feet annually in certain locations. The sides of the channel most often shoal heavier than the center but trouble spots of high shoaling occasionally occur in the channel center. Also, shoaling tends to occur heavily at the corners where the channel changes direction, often interfering with a vessel's turning capability. For budgetary reasons over the last decade, the Harbor has not been dredged to authorized depth for the entire width of the channels. For example, the outer channel has an authorized width of 500 feet, but is currently dredged to approximately 100 feet, a width that allows one-way traffic only.

Conversations with personnel at the Harbor reveal that because the channels have been dredged to authorized depth, albeit at restricted width, vessels carrying domestic cargo, called Lakers, do not currently light load at the Harbor. But in the absence of a management plan, shoaled deposits will accumulate and force vessels to carry less freight than normal, an action referred to as light loading. Light loading also increases transportation costs because shippers have to make extra trips to move the same amount of freight. These are NED losses.

Estimating at what future point, these NED losses occur is problematic. The non-uniformity of shoaling potentially allows vessels to maneuver around obstructions for some period of time. According to personnel at the Harbor, vessels will attempt to "push through" shoaled areas when possible. (Reference, U.S. Coast Pilot, Under-keel clearances, National Oceanic and Atmospheric Administration.) To date, the Detroit District has performed no study to model or quantify the effects of shoaling on channel depths; lacking such a model, any estimate of the number of years elapsed before light loading occurs, and to what extent, remains speculative.

When Detroit District ceased dredging the entire authorized width of the entrance channel in 1998, the undredged portions of the channel shoaled to block vessel traffic roughly 5-7 years thereafter. The exact time frame is unspecified because vessels naturally limited themselves to using the dredged portion of the channel. It was not until the outgoing salties began experiencing problems at the Harbor, circa 2003, that the extent of vessel accessibility loss became evident.

At some point in the future, the cessation of maintenance dredging would render the Harbor unusable to all but the smallest vessels. Under such conditions, assuming production levels of the end-users remain stable, the freight normally trafficked through the Harbor would need to be rerouted. Conversations with Brown County Office of Port & Solid Waste personnel regarding ports concluded that the most likely alternate routing is an all-land route from the point of origin to the point of destination, which is the Green Bay area for most freight coming into the Harbor.

As explained in section 4.4 of Appendix F, Economic Assessment, NED benefits generated by the Harbor are estimated at approximately $57.4 million dollars annually. An all-land rerouting of Green Bay tonnage would negate the entirety of NED benefits.

6. PROBLEMS AND OPPORTUNITIES

This section summarizes problems (current) and opportunities that were developed during the evaluation for placement of dredged material from Green Bay Harbor.

6.1 Problems and Current Status

There is approximately 6 years of dredged material capacity remaining in the Bayport CDF under its current design (essentially full after 2015 dredging cycle). Commercial navigation use of the harbor will maintain near present tonnage levels but if continued dredging does not take place, significant shoaling within the navigation channel will result.

6.2 Opportunities

The opportunity statements presented in this section evolved from evaluating the area resources and problems evident in the development of the Dredged Material Management Plan (DMMP) for Green Bay Harbor:

(a) Create a multipurpose project which can serve both, navigation and ecosystem restoration interests;

(b) Locate future (long-term) sites for consideration to place dredged material;

(c) Evaluate beneficial uses for dredged material.

7. ALTERNATIVE PLANS

The measures presented in the following paragraphs are those that remain as potential options for consideration in handling future maintenance dredging needs of Green Bay Harbor navigation channels. The Green Bay Harbor management plan considers a full range of measures, including: Island Creation, open water placement, continued use of existing CDF, expansion and/or other CDF options and beneficial use of the dredged material. Measures are alternatives or parts of alternatives that do not necessarily meet the 20-year dredged material disposal capacity requirement. All measures in this report are referred to as alternatives. The economic appendix identifies measures as standalone components prior to formulating alternatives. A summary of alternative placement options for the annual maintenance-dredging program is displayed at the end of this section in Table 3.

Each Management Plan will include an assessment of potential beneficial uses of dredged material for meeting both navigation and non-navigation objectives, including fish and wildlife habitat creation. Alternatives 2-8 and15 are multipurpose projects, which serve both navigation and ecosystem restoration objectives using dredged material.

7.1 Alternative 1 - No Action.

This alternative involves no Corps action and would approximate the without project condition listed above. This alternative proposes to continue to use Bayport CDF for the dredged material from the inner and outer Federal channels of Green Bay Harbor under the 217 agreement until the year 2015 when a new facility would be needed. The Corps will also continue to pay a tipping fee for the use of the facility. The future no action condition includes the removal of approximately 400,000 cy from the current facility to Renard Island.
If no action is taken to address this problem, it is anticipated that the backlog of shoal material will continue to increase, suspension of maintenance dredging of the Federal navigation channels would occur, and vessels will continue operate by light loading while risking grounding as long as they can.

7.2 Alternative 2 - Construct a single island (West Island) DMDF, a partial wave barrier and an access road.

This alternative proposes to construct an in-water DMDF, single island (West Island) and a partial wave barrier located within Green Bay, WI. This in-water DMDF (island) would provide dredged material capacity of approximately 630,000 cy and re-establish a portion of the deteriorated Cat Island Chain and surrounding shallow water habitat. It is one of three islands being considered for construction and it is the most western island, located closest to the northwest shoreline. (See Figure 6) The size of the proposed island is approximately 74 acres. A temporary access road would be constructed initiating at the shoreline of the mainland and extending into the water approximately 3,600 linear feet to the West Island. A wave barrier (approximately 3,000 linear feet) would be constructed along the northeast side of

the West Island to protect the in-water DMDF (island) and the shallow water habitat behind it (Duck Creek delta wetland and Peters Marsh) against wave action from the bay. Construction of the West Island and a partial wave barrier would create a reduction in wave height and restore approximately 420 acres of water habitat and 74 acres of terrestrial habitat for a total restoration of 494 acres. See Appendix A, Attachment B, Alternative 2 for a plan view.

7.3 Alternative 3 - Construct a single island (West Island) DMDF, a complete wave barrier and an access road.

This alternative also proposes to construct an in-water DMDF, single island (West Island) with a complete wave barrier to extend the length of the original Cat Island Chain located within Green Bay, WI. This alternative would also create a dredged material capacity of approximately 630,000 cy (See Figure 6). The size and location of this island and the temporary access road would be the same as Alternative 1 above. A complete wave barrier would be constructed along the northeast side of the West Island and extend approximately 8,600 feet eastward to protect the island and the shallow water habitat behind it (Duck Creek delta wetland and Peters Marsh) against wave action from the bay. Construction of the West Island and a complete wave barrier would create a reduction in wave height and restore approximately 1,423 acres of water habitat and 74 acres of terrestrial habitat for a total restoration of 1,497 acres. See Appendix A, Attachment B, Alternative 3 for a plan view.

7.4 Alternative 4 - Construct a two island (West and Middle Islands) DMDF, a partial wave barrier, and an access road.

This alternative proposes to sequentially construct an in-water DMDF, two island (West and Middle Islands) and a partial wave barrier located within Green Bay, WI. This in-water DMDF (two islands) would provide dredged material capacity of approximately 1,350,000 cy and re-establish a portion of the deteriorated Cat Island Chain and surrounding shallow water habitat (See Figure 6). The size of the two island are as follows; West Island (approximately approximately 74 acres) and Middle Island (approximately 92 acres). The two islands would encompass a total of approximately 166 acres. The construction of the two islands and partial wave barrier could be phased-in over a period of time as needed. A temporary access road would be constructed initiating at the shoreline of the mainland and extend into the water 3,600 linear feet, connecting to the starting point of the wave barrier. The wave barrier would extend 5,400 feet eastward along the northeast side of West and Middle Island to protect the in-water DMDF (two islands) and the shallow water habitat behind it (Duck Creek delta wetland and Peters Marsh) against wave action from the bay. Construction of the West Island and Middle Island and a partial wave barrier would create a reduction in wave height and restore approximately 875 acres of water habitat and 166 acres of terrestrial habitat for a total restoration of 1,041 acres. See Appendix A, Attachment B, Alternative 4 for a plan view.

7.5 Alternative 5 - Construct a two island (West and Middle Islands) DMDF, a complete wave barrier, and an access road.

This alternative proposes to sequentially construct an in-water DMDF, two island (West and Middle Islands) and a complete wave barrier located within Green Bay, WI. These islands would be positioned near the deteriorated Cat Island Chain. This alternative would also create a combined dredged material capacity of approximately 1,350,000 cy (See Figure 6). The size and location of these islands and the access road are the same as discussed in Alternative 4 above. The difference between this alternative and Alternative 4 above is that the complete wave barrier is constructed prior to the islands versus a partial wave barrier as each island is constructed. A complete wave barrier would extend 8,600 feet eastward along the northeast side of West and Middle Islands to protect the in-water DMDF (islands) and the shallow water habitat behind it (Duck Creek delta wetland and Peters Marsh) against wave action from the bay. Construction of the West Island and Middle Island and a complete wave barrier would create a reduction in wave height and restore approximately 1,331 acres of water habitat and 166 acres of terrestrial habitat for a total restoration of 1,497 acres. See Appendix A, Attachment B, Alternative 5 for a plan view.

7.6 Alternative 6 - Construct a three island (West, Middle and East Islands) DMDF, a partial wave barrier, and an access road.

This alternative proposes to sequentially construct an in-water DMDF, three island (West, Middle, and East Islands) and a partial (incrementally constructed) wave barrier located within Green Bay, WI. The three islands are centrally located between the northwest shoreline and the Federal navigation channel (See Figures 6 and 7). This alternative would create a dredged material capacity of approximately 2,350,000 cy. The size of the three island are as follows; West Island (approximately 74 acres), Middle Island (approximately 92 acres) and East Island (106 acres). The three islands would encompass a total of approximately 272 acres. The construction of the in-water DMDF (three islands and wave barrier) could be phased-in over a period of time as needed. A temporary access road would be constructed initiating at the shoreline of the mainland and extend into the water 3,600 linear feet, connecting to the starting point of the wave barrier. The wave barrier would extend 8,600 feet eastward along the northeast side of the three islands to protect the in-water DMDF (islands) and the shallow water habitat behind it (Duck Creek delta wetland and Peters Marsh) against wave action from the bay. Construction of the West, Middle and East Island and a partial wave barrier would create a reduction in wave height and restore approximately 1,225 acres of water habitat and 272 acres of terrestrial habitat for a total restoration of 1,497 acres. See Appendix A, Attachment B, Alternative 6 for a plan view.

7.7 Alternative 7 - Construct a three island (West, Middle and East Islands) DMDF, a complete wave barrier, and an access road.

This alternative proposes to construct an in-water DMDF, three island (West, Middle, and East Islands) and a complete wave barrier located within Green Bay, WI. (See Figures 6 and 7). This alternative would also create a dredged material capacity of approximately 2,350,000 cy of dredged material. The size and location of these islands and the access road are the same as discussed in Alternative 6 above. The difference between this alternative and Alternative 6 above is that the complete wave barrier and in-water DMDF (islands) will be constructed at once versus a partial wave barrier and each island constructed sequentially. The three islands would encompass a total of approximately 272 acres. The wave barrier would extend 8,600 feet eastward along the northeast side of the three islands to protect the islands and the shallow water habitat behind it (Duck Creek delta wetland and Peters Marsh) against wave action from the bay. Construction of the West, Middle and East Island and a complete wave barrier would create a reduction in wave height and restore approximately 1,225 acres of water habitat and 272 acres of terrestrial habitat for a total restoration of 1,497 acres. See Appendix A, Attachment B, Alternative 7 for a plan view.

7.8 Alternative 8 - Construct a single island (East Island) DMDF, a complete wave barrier, and an access road.

This alternative proposes to construct an in-water DMDF, single island (East Island) and a complete wave barrier located within Green Bay, WI. (See Figure 6). This alternative would create a dredged material capacity of approximately 1,000,000 cy of dredged material. It is one of three islands being considered and it is the most easterly island, located closest to the Federal navigation channel. The size and location of this island and the access road are the same as discussed in Alternative 6 above. The major difference between this alternative and similar alternatives above, is that the complete wave barrier is constructed prior to the East island and it is nearest the Federal navigation channel. This island would encompass a total of approximately 106 acres. The wave barrier would extend 8,600 feet eastward along the northeast side of the island to protect the in-water DMDF (island) and the shallow water habitat behind it (Duck Creek delta wetland and Peters Marsh) against wave action from the bay. Construction of the East Island and a complete wave barrier would create a reduction in wave height and restore approximately 1,391 acres of water habitat and 106 acres of terrestrial habitat for a total restoration of 1,497 acres. See Appendix A, Attachment B, Alternative 8 for a plan view.

7.9 Alternative 9 – Open Water Placement.

This alternative envisions placing dredged material in an open water disposal site, approximately 50 miles from the mouth of the Fox River, in either Lake Michigan via Sturgeon Bay Channel or at a comparable site in mid to northern Green Bay. The character of the dredged material from the outer Federal channel (Bay Mile 3 to 11) is classified as suitable for in-water placement.

7.10 Alternative 10 – Beach Nourishment.

This alternative proposes to place dredged material on the beaches within Green Bay shoreline as a beneficial use. Beach nourishment is becoming a more utilized option where local conditions warrant. Beach nourishment is ideal in shoreline areas that are classified as "erosional", where more material is lost through natural erosion than is deposited via littoral drift. Also, beach nourishment helps to expand recreational beaches at local or state parks, if near by. Lastly, sandy material can be placed on shorelines in preserve areas to enhance shoreline habitat.

7.11 Alternative 11 – Brown County Expanded Bayport CDF (Scenario 1- Inner Channel Only).

This alternative proposes to expand Bayport CDF (construct in yr 2023) for the dredged material from the inner channel of Green Bay, Harbor. Approximately 400,000 cy of dried dredged material will be transferred from the existing Bayport CDF to Renard Island CDF for capping purposes, which will provide additional capacity and it will be funded through O&M. Based on only the inner harbor demand, and 400,000 cy of dried dredged material being transferred from the existing Bayport CDF to Renard Island CDF, it is anticipated that there are approximately 16 years of remaining capacity. Then, Brown County would need to provide capacity of approximately 800,000 cy (for yrs 2024 thru 2031) to meet the total 20-year dredged material capacity (1,956,000 cy) needs for the inner channel. The expansion would consist of constructing a 36 acre Dredged Material Disposal Facility (DMDF) adjacent to the existing Bayport CDF containing dry cells for stock piling dry dredged material. The existing Bayport CDF will continue to process wet dredged material. The process will consist of temporary storage of the wet dredged material in designated cells until it is dried, then transferring it to the 36 acre expansion site. Taking into consideration, the 400,000 cy for Renard Island, the proposed 36 acre DMDF site will be designed to contain approximately 800,000 cy. This alternative will provide additional placement capacity for years 2020 thru 2031. The Corps will continue to pay a tipping fee for the Operation & Maintenance of the facility.

7.12 Alternative 12 – Brown County Expanded Bayport CDF (Scenario 2 -Inner and Outer Channels)

This alternative proposes to expand Bayport CDF as described in Alternative 11 above and construct an additional Dredged Material Disposal Facility (DMDF), near Holland Twp., WI (construct in yr 2016) to provide dredged material capacity for the inner and outer channels of Green Bay, Harbor. Based on the inner and outer harbor demand, it is anticipated that there are approximately 9 years of remaining capacity. Then, Brown County would need to provide capacity of approximately 3,444,800 cy (for yrs 2019 thru 2031) to meet the total 20-year dredged material capacity (4,300,000 cy) needs for the inner and outer channels. The DMDF would consist of constructing a 100 acre DMDF approximately 20 miles from the Bayport

CDF, near Holland, WI, containing dry cells for stock piling dry dredged material.

The existing Bayport CDF will continue to process wet dredged material. The process would consist of the temporary storage of the wet dredged material in designated cells until it is dried, then transferring it to the 36 acre expansion site and the 100 acre DMDF. Approximately 400,000 cy of dried dredged material will be transferred from the existing Bayport CDF to Renard Island CDF. Taking into consideration, the 400,000 cy for Renard Island, and the 800,000 cy for the proposed 36 acre expansion site, the 100 acre DMDF will be required to contain approximately 2,271,200 cy. The Corps will continue to pay a tipping fee for the Operation & Maintenance of the facility.

7.13 Alternative 13 – Modify Interior Contours within Renard Island CDF and Transport Dredged Material by Barge.

This alternative proposes to reshape the islands' (approx. 54 acres) interior contour using dredged material and provide a cover. The sponsor (Brown County) requested the Corps to include a closure plan for Renard Island in this DMMP. They have future plans to convert the island to a recreational park with hiking trails, open spaces and a park shelter. Dredged material from the Federal channel could be pumped from a barge into cells and allowed to dry. Three cells (approx. 10 acres each) would be constructed, so dredged material placement could be alternated between the cells every three years. This would allow a two year drying time. The dried dredged material could then be moved and shaped into hills with various elevations. See Figure 5. The cells could be constructed using onsite material to create temporary push up berms. The modifications to the interior could provide a dredged material capacity of approx. 466,362 cy (includes 2.5 feet of cover, Reference, *Closure Plan Renard Island, Brown County Port and Solid Waste Department, Brown County, Wisconsin* Feb 2008, Section 3.3 Final Grading Plan). Dredged material from the inner harbor channel (approx. 288,895 cy) would be used to shape the hills, followed by dredged material from the outer harbor channel (177,467 cy, Reference, *Closure Plan Renard Island, Brown County Port and Solid Waste Department, Brown County, Wisconsin* Feb 2008, Section 3.3 Final Grading Plan) would act as a cover. Nutrients in channel sediments are sufficient to create vegetation quickly and act as topsoil. A perimeter swale would be included to collect surface water run-off. Geotextile fabric would be placed on the inside slope of the existing perimeter dike for seepage protection. Final cover elevations vary from 5 ft to 20 ft above the dikes.

7.14 Alternative 14 – Modify Interior Contours within Renard Island CDF, Construct a Causeway and Transport Dredged Material by Truck.

This alternative also proposes to reshape the islands' (approx. 54 acres) interior contour using dredged material and provide a cover as discussed in alternative 13 above. The main difference from Alternative 13 above is in the transportation. The sponsor is proposing that the Corps truck dry dredged material from Bayport CDF and then transport it to Renard Island. A causeway would be constructed allowing trucks access to the island.

7.15 Alternative 15 – Combination of Alternative 7 and Alternative 11.

This alternative proposes to combine *Alternative 7 - Construct a three island (West, Middle and East Islands) DMDF, a complete wave barrier, and an access road with Alternative 11 – Brown County Expanded Bayport CDF (Inner Channel Only)* to address the inner and outer dredged material capacity harbor needs. (See description above).

7.16 Alternative 16 – Combination of Alternative 9 and Alternative 11.

This alternative proposes to combine *Alternative 9 – Open Water Placement with Alternative 11 – Brown County Expanded Bayport CDF (Inner Channel Only)* to address the inner and outer dredged material capacity harbor needs. (See description above).

7.17 Alternative 17 – Combination of Alternative 4 and Brown County Expanded Bayport CDF (Scenario 3).

This alternative proposes to combine *Alternative 4 – Construct a two island (West and Middle Islands) DMDF, a partial wave barrier, and an access road* with expanding Bayport CDF (construct in yr 2023) as described in Alternative 11 above and construct an additional Dredged Material Disposal Facility (DMDF), near Holland Twp., WI (construct in yr 2022) to provide dredged material capacity for the inner and outer channels of Green Bay, Harbor. Based on the inner and outer harbor demand, it is anticipated that there are approximately 9 years of remaining capacity. Then, Brown County would need to provide capacity of approximately 3,444,800 cy (for yrs 2019 thru 2031) to meet the total 20-year dredged material capacity (4,300,000 cy) needs for the inner and outer channels.

The 36 acre expanded Bayport CDF (construct in yr 2023) includes the dredged material from the Inner Channel only and would provide dredge material capacity of approximately 800,000 cy (yrs 2024 thru 2031). Approximately 400,000 cy of dried dredged material will be transferred from the existing Bayport CDF to Renard Island CDF, providing capacity for years 2028 thru 2031 for the inner harbor material. The construction of the West and Middle Island will provide dredged material capacity of approximately 1,350,000 cy (yrs 2012 thru 2022). The portion of the outer channel equivalent to the capacity of the East Island (1,000,000 cy) will be placed in the 100 acre DMDF located at Holland Twp., WI, approximately 20 miles from the Bayport CDF.

The existing Bayport CDF will continue to process wet dredged material. The process would consist of the temporary storage of the wet dredged material in designated cells until it is dried, then transferring it to the 36 acre expansion site and the 100 acre DMDF. Taking into consideration, the 400,000 cy for Renard Island, and the 800,000 cy for the proposed 36 acre expansion site, the 100 acre DMDF will be required to contain approximately 1,000,000 cy.

The Corps will continue to pay a tipping fee for the Operation & Maintenance of the facility.

Table 3
Summary of Alternatives, Construction cost
(FY10 dollars)

	Alternative	Estimated Construction cost	Contingency	Eng.& Design S&A E&D During Const. PPM/Contracting As Builds	Total Construction Cost, without dredging or escalation
1	No Action	N/A		N/A	N/A
7	West, Middle & East Island DMDF/ Complete Barrier	N/A		N/A	N/A
9	Open Water Placement	N/A		N/A	N/A
11	Brown County Expanded Bayport CDF (Scenario 1 - Inner Channel Only) 36 acres	N/A		N/A	N/A
12	Brown County Expanded Bayport CDF (Scenario 2 - Inner & Outer Channel) 36 acres & Holland Twp 100 acres.	$26,956,135	$6,199,911	$3,899,000	$37,055,046[(1)]
15	Combination of Alt. 7 & 11	$28,478,736	$5,695,747	$3,462,760	$37,637,244[(1)]
16	Combination of Alt. 9 & 11	$5,055,426[(2)]	$1,061,639	$1,180,400	$ 7,297,465[(1)]

Table 3, Summary of Alternatives, Construction Cost, continued					
17	Combination of Alt 4 & Brown County Expanded Bayport CDF Scenario 3 (36 acres & Holland Twp. 100 acres)	$34,658,953	$8,664,738	$4,708,132	$48,031,823[(1)]

Note:
1) The cost estimates for the alternatives were developed using an Excel spread sheet as a preliminary evaluation while the selected plan has an additional cost estimate developed in MII.
2) Contingencies vary for each alternative as a result of the risk assessment.
3) See Appendix C, Cost Engineering for details.

8. EVALUATION OF ALTERNATIVE PLANS

8.1 Alternative 1 - No Action.

The Corps would be able to meet its operation and maintenance dredging objectives for the inner and outer channels of Green Bay Harbor for approximately the next 6 years using the Bayport CDF. After the 2015 dredge cycle, a new facility will be needed. Unless additional disposal areas are developed, dredging of material from designated navigation channels could not occur which would threaten the viability of the channel as a means to efficiently move goods and commodities. Under the "No Action" option, a backlog of maintenance dredging would grow, which will limit full utilization of the channel, resulting in increased transportation costs. Navigation needs for the harbor would not be met and therefore this alternative is not acceptable as a solution.

8.2 Alternative 2 - Construct a single island (West Island) DMDF, a partial wave barrier and an access road.

The navigation benefits of this alternative are that it would provide additional dredged material placement capacity of approximately 630,000 cubic yards. It also has secondary environmental benefits of approximately 74 acres of upland habitat and, combined with a partial wave barrier, would restore approximately 420 acres of Peters Marsh and Duck Creek wetland for a total of 494 acres. However, although this project has navigation benefits, it would not meet the 20-year dredged material capacity needed for the DMMP, which is the primary objective, and therefore it will not be considered further. (See Table 6 at the end of this section for a summary of dredged material capacity, construction and operation cost.)

8.3 Alternative 3 - Construct a single island (West Island) DMDF, a complete wave barrier and an access road.

This alternative would also provide navigation benefits with the additional dredged material placement capacity of approximately 630,000 cubic yards. It also has secondary environmental benefits of approximately 74 acres of upland habitat and, combined with the full wave barrier, would support the restoration of approximately 1,423 acres of Peters Marsh and Duck Creek wetland for a total of 1,497 acres. Although this project has navigation benefits, it would not meet the 20-year dredged material capacity needed for the DMMP, which is the primary objective, and therefore it will not be considered further. (See Table 6 at the end of this section for a summary of dredged material capacity, construction and operation cost.)

8.4 Alternative 4 - Construct a two island (West and Middle Islands) DMDF, a partial wave barrier, and an access road.

The navigation benefits of this alternative are that it would provide additional dredged material placement capacity of approximately 1,350,000 cubic yards. The secondary environmental benefits from the construction of the two islands would provide a combined 166 acres of upland habitat and with the partial wave barrier it would support the restoration of approximately 875 acres of the remnant Peters Marsh and Duck Creek wetland for a total of 1,041 acres. This alternative will not meet the needs of the inner harbor, however, since this alternative could be combined with other alternatives to meet the needs of the inner and outer harbor it will be considered further in the trade off analysis. (See Table 6 at the end of this section for a summary of dredged material capacity, construction and operation cost.

8.5 Alternative 5 - Construct a two island (West and Middle Islands) DMDF, a complete wave barrier, and an access road.

This alternative would also provide navigation benefits with the additional dredged material placement capacity of approximately 1,350,000 cubic yards. It also has secondary environmental benefits of from the construction of the two islands that would provide a combined 166 acres of upland habitat and, with the full wave barrier, would support the restoration of approximately 1,331 acres of the remnant Peters Marsh and Duck Creek wetland for a total of 1,497 acres. Although this project would provide navigation benefits, it would not meet the 20-year dredged material capacity needed for the DMMP, which is the primary objective, and therefore it will not be considered further. (See Table 6 at the end of this section for a summary of dredged material capacity, construction and operation cost.)

8.6 Alternative 6 - Construct a three island (West, Middle and East Islands) DMDF, a partial wave barrier, and an access road.

Alternative 6 provides navigation benefits with the addition of dredged material placement capacity for approximately 2,350,000 cubic yards of material. The in-water DMDF (islands) would provide 272 acres of upland habitat and with the partial (incrementally constructed) wave barrier supporting the restoration of approximately 1,225 acres of the remnant Peters Marsh and Duck Creek wetland complex for a total of 1,497 acres of habitat created. This alternative provides appropriate disposal for dredged material classified as suitable for unrestricted use (the outer channel and approximately 30%of the flux area, as described in Section 4.1 above). This alternative alone does not meet the need of the entire harbor, but could be used in combination with an alternative plan for material from the inner harbor whose use is restricted. Alternative 6 will not be evaluated further since Alternative 7 provides the exact same features at a lower cost. (See Table 6 at the end of this section for a summary of dredged material capacity, construction and operation cost.) See Figures 1 and 6.

8.7 Alternative 7 - Construct a three island (West, Middle and East Islands) DMDF, a complete wave barrier, and an access road.

The navigation benefits of this alternative are that it would provide dredged material placement capacity of approximately 2,350,000 cubic yards. The in-water DMDF (islands) would provide a combined 272 acres of upland habitat and with the full wave barrier supporting the restoration of approximately 1,225 acres of the remnant Peters Marsh and Duck Creek wetland complex for a total of 1,497 acres of habitat created. The difference between this alternative and Alternative 6 above is that the three islands in Alternative 6 are constructed in phases versus this alternative where all three islands and the wave barrier are constructed at once. This alternative provides appropriate disposal for dredged material classified as suitable for unrestricted use (the outer channel and approximately 30%of the flux area, as described in Section 4.1 above). This alternative alone does not meet the need of the entire harbor, but could be used in combination with an alternative plan for material from the inner harbor whose use is restricted. Therefore, this alternative will be considered further in the trade off analysis. (See Table 6 at the end of this section for a summary of dredged material capacity, construction and operation cost.) The sponsor has indicated that future use of the islands will not include a port or harbor facilities. They expect the islands to remain in a natural state, allowing for some potential educational opportunities and passive human recreation.See Figures 1 and 6.

8.8 Alternative 8 - Construct a single island (East Island) DMDF, a complete wave barrier, and an access road.

This alternative would provide navigation benefits with the additional dredged material placement capacity of approximately 1,000,000 cubic yards. It also has secondary environmental benefits of from the construction of the island that would provide

a combined 106 acres of upland habitat and with the full wave barrier it would support the restoration of approximately 1,391 acres of the remnant Peters Marsh and Duck Creek wetland for a total of 1,497 acres. Although this project would provide navigation benefits, it would not meet the 20-year dredged material capacity needed for the DMMP, which is the primary objective, and therefore it will not be considered further. (See Table 6 at the end of this section for a summary of dredged material capacity, construction and operation cost.)

8.9 Alternative 9 – Open Water placement.

This alternative would provide navigation benefits with unlimited dredged material placement capacity for placement of dredged material from the outer harbor channel, Bay mile 3 to Bay mile 11 ¼. Cost estimates were prepared assuming 2,350,000 cy. This alternative provides appropriate disposal for dredged material classified as suitable for unrestricted use (the outer channel and approximately 30%of the flux area, as described in Section 4.1 above). This alternative will meet the 20-year dredged material capacity needs for the outer channel of Green Bay Harbor.

The feasibility of open water placement of dredged material is dependent upon several parameters which include character of the material, haul distance to the disposal site, water column impacts, dispersive versus non-dispersive nature of the material, and extent of capping requirements (if any). An open water placement site would need to have a depth which would be sufficient to provide adequate protection against storm erosion and lake bottom velocities which cause acceptable particle movement of the dredged material. The use of open water sites could result in the burial of bottom habitat, and releases of turbidity.

From the standpoint of the Federal Standard, a case for locating an open-water dredged material placement area outside of southern Green Bay appears feasible, and could provide an adequate mixing zone volume to demonstrate compliance with applicable State water quality standards. The analysis determined a site approximately 50 miles from the mouth of the Fox River, in either Lake Michigan via Sturgeon Bay Channel or at a comparable site in mid to northern Green Bay would be environmentally feasible. The cost for open water placement over a 20-year period is estimated to be $212,660,350.

Because of the circulation pattern and the shallow nature of the Green Bay area, it would not be practical to place dredged material in the southern portion of Green Bay. The circulation pattern in the bay is counter clockwise, it enters from the Lake Michigan, then the cool water flows southward along the western shore, while warmer water returns in the eastern part of the bay. Any dredged material placed in the southern part of the bay would be re-suspended and may reenter the Federal navigation channel. (Reference, Currents and Temperatures in Green Bay, Lake Michigan, by Gerald S. Miller and James H. Taylor, NOAA.

This alternative will not meet the needs of the inner harbor alone, however, since this alternative could be combined with other alternatives to meet the needs of the inner and outer

harbor it will be considered further in the trade off analysis.

8.10 Alternative 10 - Beach Nourishment

This alternative considers the feasibility of using the material to enhance area beaches or return the material into the natural system from which it came. The District has been very proactive in attempting to develop beneficial uses for the dredged material. Unfortunately, the dredged material is characterized as 50% fine-grained organic silts and 50% sand. The "fine grain" nature of this material makes it physically unsuitable for beach nourishment. Current Wisconsin Department of Natural Resources water quality standards do not permit open water placement of dredged material; therefore, it is not likely that the State would issue a 401 Water Quality Certification for this alternative, and therefore it will not be considered further.

8.11 Alternative 11 – Brown County Expanded Bayport CDF (Scenario 1- Inner Channel Only).

This alternative would provide navigation benefits with the additional placement capacity of approximately 1,173,600 cy (12yrs x 97,800 cy/yr) for years 2020 thru 2031. The expansion would consist of constructing cells to contain dry dredged material, using 36 acres that are adjacent to the existing Bayport CDF. See Fig 10. The operation process would consist of placing wet dredged material within the cells of the existing Bayport CDF then transfer it to the 36 acre expansion site as it dries. In addition 400,000 cy of dried dredged material will be transferred to Renard Island for capping the site. When both of those operations are implemented, they will extend the life of Bayport CDF. The cost share for the construction cost for the 36 acre expansion site would be 65% Fed /35% non-Fed (25 percent of GNF plus an additional 10 percent of GNF less LERR) under the 217 agreement. Expanded Bayport CDF will not receive LERRDs credit (up to 10%), since it was given for a previous Federal Project. The operation and maintenance cost for this facility will continue, and it will be funded by the Corps through a tipping fee.

This alternative would provide capacity for the inner harbor for 20-years of dredged material placement assuming that the outer channel harbor dredged material would be placed in open water or be used to restore the Cat Island chain. It is projected that the private CDF facility owner-operator would set the tipping fee to approximately $5.74/cy (in 2010 dollars) from the first year of expansion 2019, through 2031 to recuperate their investment and estimated annual operations cost (See Appendix F- Economic Analysis). This alternative would meet a portion of the navigation objectives and therefore, it will be considered further in the trade-off analysis.

8.12 Alternative 12 – Brown County Expanded Bayport CDF (Scenario 2- Inner and Outer Channels)

This alternative would provide navigation benefits with the additional placement capacity of approximately 3,444,800 cy (16 yrs x 215,300 cy/yr) for years 2016 thru 2031. The 36 acre

expanded Bayport CDF site will provide additional storage capability for the inner harbor channel dredged material, and the 100 acre Holland Twp. site will provide storage capability for the outer harbor channel dredged material, which will accommodate the 3,444,800 cy capacity. The cost for construction of the expansion to the existing Bayport CDF (36 acres) and the additional Holland Twp. DMDF (100 acres) site cost is $37,055,046. The expansion to the Bayport CDF and the Holland Twp. Site would consist of constructing cells to contain dry dredged material. The operation process would consist of placing wet dredged material within the cells of the existing Bayport CDF, then transfer the inner harbor dredged material to the 36 acre site and the outer harbor dredged material to the Holland Twp. site as it dries. In addition, 400,000 cy of dried dredged material will be transferred to Renard Island for capping the site. When both of those operations are implemented, they will extend the life of Bayport CDF. The cost share for the construction cost for the 36 acre expansion site is 65% Fed /35% non-Fed under the 217 agreement. Expanded Bayport CDF will not receive LERRDs credit (up to 10%), since it was given for a previous Federal Project. The Holland Twp. site would be 75% Fed /25% non-Fed (including a 10% credit for LERRDS) under the 217 agreement. The operation and maintenance cost for both facilities will continue, and it will be funded by the Corps through a tipping fee.

This alternative would provide capacity for the inner and outer harbor for 20-years of dredged material placement. The Corps would continue to pay a tipping fee for the use of the Bayport CDF and the Holland Twp site. It is projected that the private CDF facility owner-operator would increase the tipping fee to approximately $5.74/cy from the first year of the expansion, 2016, through 2031 to recuperate their investment and estimated annual operations cost (See Appendix F- Economic Analysis). This alternative would meet the navigation objectives and therefore, it will be considered further in the trade-off analysis.

8.13 Alternative 13 – Modify Interior Contours within Renard Island CDF and Transport Dredged Material by Barge.

It was determined that as part of the closing operation for Renard Island, dredged material from Bayport CDF will be used to cap the site through access from a temporary bridge. See alternative 14 below. As such, implementation of this alternative is no longer viable and will not be considered further.

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8.14 Alternative 14 – Modify Interior Contours within Renard Island CDF, Construct a Causeway and Transport Dredged Material by Truck.

It was determined that as part of the closing operation for Renard Island, dredged material from Bayport CDF will be used to cap the site. Also, construction of a temporary bridge will provide access to transport dredged material. Both operations will be funded through O&M. Since the 400,000 cy will be provided from Bayport CDF, it will increase its remaining dredged material capacity and extend the CDF life span. As such, the additional capacity will be incorporated into Alternatives 11 & 12 to reduce their required capacity.

This alternative will be implemented as part of the closing of Renard Island, and funded through O&M, there it will not be considered further.

8.15 Alternative 15 – Combination of Alternative 7 and Alternative 11.

Placement of dredge material in the in-water DMDF (Cat Island Chain) will address the needs for the 20–year dredged material capacity for the outer Federal channel. Placement of dredge material in Bayport CDF (36 acre) expansion will meet the needs for the 20 –year dredged material capacity for the inner Federal channel. The Brown County Office of Port & Solid Waste supports the construction of the in-water DMDF (Cat Island Chain) because it will restore the habitat within the three islands. The Fish and Wildlife Service has been a proponent of the project because of the secondary environmental benefits it provides. In addition, it will protect the deteriorated marsh and wetlands located behind it within the bay. Placement of dredged material from the outer Federal channel to the in-water DMDF (islands) will provide environmental benefits as well as extend the life of Bayport CDF. This alternative will serve as multi-purpose use, meeting both navigation and environmental objectives and therefore, it will be considered further in the trade-off analysis. See Table 4 below to compare the "with- and without-" project conditions. Nutrients in the channel sediments are sufficient to support vegetation, which is expected to develop quickly from the seed bank existing in the channel sediments.

Table 4
With and without project condition, future dredged cycles

Calendar Year	Project Year	Outer Harbor (cy)	Placement	Inner Harbor (cy)	Placement
2012	1	117,500	West Island	97,800	Bayport
2013	2	117,500	West Island	97,800	Bayport
2014	3	117,500	West Island	97,800	Bayport
2015	4	117,500	West Island	97,800	Bayport * Without Project Condition
2016	5	117,500	West Island	97,800	Bayport
2017	6	117,500	Middle Island	97,800	Bayport
2018	7	117,500	Middle Island	97,800	Bayport
2019	8	117,500	Middle Island	97,800	Bayport
2020	9	117,500	Middle Island	97,800	Bayport
2021	10	117,500	Middle Island	97,800	Bayport
2022	11	117,500	Middle Island	97,800	Bayport
2023	12	117,500	East Island	97,800	Bayport ** With Cat Island Chain
2024	13	117,500	East Island	97,800	Expand Bayport***
2025	14	117,500	East Island	97,800	Expand Bayport
2026	15	117,500	East Island	97,800	Expand Bayport
2027	16	117,500	East Island	97,800	Expand Bayport
2028	17	117,500	East Island	97,800	Expand Bayport
2029	18	117,500	East Island	97,800	Expand Bayport
2030	19	117,500	East Island	97,800	Expand Bayport
2031	20	117,500	East Island	97,800	Expand Bayport
	Total	2,350,000 cy		1,956,000 cy	

* Bayport CDF will be essentially full under without project conditions
** Bayport CDF will be essentially full under with project conditions
*** Increase tipping fee to recuperate expansion cost

8.16 Alternative 16 – Combination of Alternative 9 and Alternative 11.

Placement of dredge material in open water will address the needs for the 20–year dredged material capacity for the outer Federal channel, as well as extend the life of Bayport CDF. Continued placement of dredged material in an expanded Bayport CDF will meet the needs for the 20 –year dredged material capacity for the inner Federal channel. Dredged material from the segment Bay mile 3 to Bay mile 11 ¼ will be placed in the open water placement site. Dredged material from a point ½ mile inward of the mouth of the harbor entrance to Bay mile 3 (flux area) will be tested in accordance with the Great Lakes Dredged Material Testing and Evaluation Manual (USEPA/USACE 1998) periodically to determine if portions of it may be suitable for open water placement. Dredged material from a point ½ mile inward of the mouth entrance to the upstream limit (7-miles) will continue to be placed in Bayport CDF.

Currently, the Wisconsin Department of Natural Resources regulations do not permit open water placement of dredged material. This alternative would meet the navigation objectives and therefore, will be considered further in the trade off analysis.

8.17 Alternative 17 – Combination of Alternative 4 and Brown County Expanded Bayport CDF (Scenario 3).

Placement of dredge material in the in-water DMDF (West and Middle Island of the Cat Island Chain) will address the first 11 years (2012 thru 2022) of the 20 – year dredged material capacity for the outer Federal channel. The remaining 9 years (2023 thru 2031) of capacity needed for the outer channel will be placed in the Holland Twp site (100 acres). Placement of dredge material in the expanded Bayport CDF (36 acres) will meet the needs for the 20 –year dredged material capacity for the inner Federal channel.

The 36 acre expanded Bayport CDF site will provide additional storage capability of 1,173,600 cy for the inner harbor channel dredged material. The in-water DMDF (two islands) will provide storage capacity of 1,350,000 cy and the 100 acre Holland Twp. site will provide storage capability of 1,000,000 cy for the outer harbor channel dredged material for a total outer harbor channel capacity of 2,350,000 cy. The cost for construction of the expansion to the existing Bayport CDF (36 acres), the in-water DMDF and the Holland Twp. DMDF (100 acres) site $48,031,823. The expansion to the Bayport CDF and the Holland Twp. Site would consist of constructing cells to contain dry dredged material. The operation process would consist of placing wet dredged material within the cells of the existing Bayport CDF, then transfer the inner harbor dredged material to the 36 acre site and the outer harbor dredged material to the Holland Twp. site as it dries. In addition, 400,000 cy of dried dredged material will be transferred to Renard Island for capping the site. When these operations are implemented, they will extend the life of Bayport CDF. The cost share for the construction

cost for the 36 acre expansion site and the Holland Twp. site would be 75% Fed /25% non-Fed (including a 10% credit for LERRDS) under the 217 agreement. The operation and maintenance cost for both facilities will continue, and it will be funded by the Corps through a tipping fee.

The Brown County Office of Port & Solid Waste supports the construction of the Cat Island Chain, but they would prefer three islands over two, because it will provide greater navigation benefits. The Fish and Wildlife Service has been a proponent of the project because of the environmental benefits it provides. In addition to the navigation benefits, it will protect the deteriorated marsh and wetlands located behind it within the bay. This alternative will serve navigation purposes as well as meeting environmental objectives and therefore, it will be considered further in the trade-off analysis. See Table 5 below to compare the "With and without project conditions, future dredged cycles using Bayport Expansion Scenario 3".

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This alternative would provide capacity for the inner and outer harbor for 20-years of dredged material placement. The Corps would continue to pay a tipping fee for the use of the Bayport CDF. It is projected that the private CDF facility owner-operator would increase the tipping fee to approximately $5.74/cy from the first year of the expansion, 2020, through 2031 to recuperate their investment and estimated annual operations cost (See Appendix F - Economic Analysis, p. F-II-19). This alternative would meet the navigation objectives and therefore, it will be considered further in the trade-off analysis.

Table 5
With and without project condition, future dredged cycles using Bayport Expansion and Holland site, Scenario 3

Calendar Year	Project Year	Outer Harbor (cy)	Placement	Inner Harbor (cy)	Placement
2012	1	117,500	West Island	97,800	Bayport
2013	2	117,500	West Island	97,800	Bayport
2014	3	117,500	West Island	97,800	Bayport
2015	4	117,500	West Island	97,800	Bayport * Without Project Condition
2016	5	117,500	West Island	97,800	Bayport
2017	6	117,500	Middle Island	97,800	Bayport
2018	7	117,500	Middle Island	97,800	Bayport
2019	8	117,500	Middle Island	97,800	Bayport
2020	9	117,500	Middle Island	97,800	Bayport
2021	10	117,500	Middle Island	97,800	Bayport
2022	11	117,500	Middle Island	97,800	Bayport
2023	12	117,500	Holland site	97,800	Bayport ** With Cat Island Chain
2024	13	117,500	Holland site	97,800	Expand Bayport ***
2025	14	117,500	Holland site	97,800	Expand Bayport
2026	15	117,500	Holland site	97,800	Expand Bayport
2027	16	117,500	Holland site	97,800	Expand Bayport
2028	17	117,500	Holland site	97,800	Expand Bayport
2029	18	117,500	Holland site	97,800	Expand Bayport
2030	19	117,500	Holland site	97,800	Expand Bayport
2031	20	117,500	Holland site	97,800	Expand Bayport
	Total	2,350,000 cy		1,956,000 cy	

* Bayport CDF will be essentially full under without project conditions
** Bayport CDF will be essentially full under with project conditions
*** Increase tipping fee to recuperate expansion cost

A summary of the construction cost, disposal of dredged material costs and dredged material capacity for each alternative are shown on Table 6.

Table 6,
Summary of Alternatives

	Alternative	Total Construction Cost, with contingency, Eng.& Design S&A E&D During Const. PPM/Contracting	Volume,[4] (Cubic Yards)	Total Project cost, including dredging	Dredging Capacity, (Years) [1] Includes Backlog
1	No Action	0	861,200		8.0 (Inner and Outer)
6	West, Middle, & East Island/ Partial (incremental) Barrier		2,350,000	$ 69,477,074	20.0 (Outer)
7	West, Middle, & East Island/ Complete Barrier		2,350,000	$ 69,173,472	20.0 (Outer)
9	Open Water Placement	$0	Unlimited	$ 212,660,350	Unlimited
11	Brown County Expanded Bayport CDF (Scenario 1- Inner Channel Only) (36 acres)	See Alt. 15 & 16	(782,400) [3] 1,173,600[2]	See Alt. 15 & 16	20 (Inner)
12	Brown County Expanded Bayport CDF (Scenario 2- Inner & Outer Channels) (36 acres & Holland Twp, 100 acres)	$37,055,046	1,564,800 (391,200) 1,880,000 (470,000)[3]	$ 212,699,876	20 (Inner and Outer)

Note:
1) The Dredged Capacity (years) for alternatives 1 thru 10 is based on an average of 117,500 cy from the outer channel.
2) The 1,173,600 cy expansion and the existing Bayport capacity will meet the 1,956,000 cy capacity required for 20 years. See Section 4.4 Bayport CDF.
3) Numbers shown in brackets represent the capacity used prior to expansion. See Table 8 for details.
4) Base year 2011

Table 6, Continued
Summary of Alternatives

	Alternative	Total Construction Cost, with contingency, Eng.& Design S&A E&D During Const. PPM/Contracting	Volume, (Cubic Yards)	Total Project cost, including dredging	Dredging Capacity, (Years) [9] Includes Backlog
15	**Comb. Alt. 7 & 11**	**$37,673,243**	**2,350,000 1,173,600 (782,400)[5]**	**$ 122,140,983**	**20 (Outer and Inner)**
16	Comb. Alt. 9 & 11	$ 7,297,465	2,350,000 1,173,600 (782,400)[5]	$ 258,297,885	20 (Outer and Inner)
17	Combination of Alt 4 & Brown County Expanded Bayport CDF (Scenario 3) (36 acres & Holland Twp, 100 acres)	$ 48,031,823	2,350,000 1,173,600 (782,400)[5]	$ 176,572,791	20 (Outer and Inner)

Note:
5) Numbers shown in brackets represent the capacity used prior to expansion. See Table 8 for details.
6) Contingencies will vary based on the results of Risk Assessment

Table 7
Summary of Evaluation of Alternatives

	Alternative	Placement	Capacity	Total Cost [1]	Average Annual Cost[2]	Dredging Capacity, (Years) Included Backlog	Recommend Further [3]
1	No Action	N/A	0	N/A	N/A	8.0 (Inner and Outer)	N, Insufficient capacity
2	West Island/ Partial Barrier	Island Creation	630,000	N/A	N/A	5.4 (Outer)	N, Insufficient capacity
3	West Island/ Complete Barrier	Island Creation	630,000	N/A	N/A	5.4 (Outer)	N, Insufficient capacity
4	West & Middle Island/ Partial Barrier	Island Creation	1,350,000	N/A	N/A	11.5(Outer)	N, Insufficient capacity
5	West & Middle Island/ Complete Barrier	Island Creation	1,350,000	N/A	N/A	11.5(Outer)	N, Insufficient capacity
6	West, Middle, & East Island/ Partial Barrier	Island Creation	2,350,000	N/A	N/A	20.0 (Outer)	N, Insufficient capacity
7	West, Middle, & East Island/ Complete Barrier	Island Creation	2,350,000	N/A	N/A	20.0 (Outer)	N, Insufficient capacity
8	East Island/ Complete Barrier	Island Creation	1,000,000	N/A	N/A	8.5 (Outer)	N, Insufficient capacity
9	Open Water Placement	Open Water	2,350,000	$212,660,350	$10,646,137	Unlimited	N, Insufficient capacity
10	Beach Nourishment	Beach Nourish.	Unlimited	N/A		Unlimited	N

(1) Includes, construction, transportation, operations and maintenance. See Appendices C & F for details.
(2) Each is annualized at the FY10 Federal discount rate of 4.375%. See Appendix F Tables F-II-14 through F-II-16 for details
(3) Plans that did not meet the 20 year capacity were not considered further.

Table 7 Continued Summary of Evaluation of Alternatives							
	Alternative	Placement	Capacity	Total Project Cost with dredging	Average Annual Cost[5]	Dredging Capacity, (Years) Included Backlog	Recommend Further
11	Brown County Expanded Bayport CDF (Scenario 1 Inner channel Only) (36 acres)	Upland	1,173,600	N/A	N/A	20 (Inner)	N, Insufficient capacity
12	Brown County Expanded Bayport CDF (Scenario 2 - Inner & Outer Channels) (36 acres & Holland Twp, 100 acres)	Upland	3,444,800 (391,200) (470,000) [(4)]	$ 212,699,876	$12,267,043	20 (Inner and Outer)	Y
13	Renard Island, Barge	Upland	288,895 177,467	N/A	NA	1.3 (Inner) 0.8 (Outer)	N, Insufficient capacity
14	Renard Island, Causeway	Upland	288,895 177,467	N/A	NA	1.3 (Inner) 0.8 (Outer)	N, Insufficient capacity
15	**Comb. Alt. 7 & 11**	**Island Creation & Upland**	**2,350,000 1,173,600 (782,400)** [(4)]	**$ 122,140,983**	**$7,544,668 ***	**20 (Outer and Inner)**	**Y**
16	Comb. Alt. 9 & 11	Open Water & Upland	2,350,000 1,173,600 (782,400) [(4)]	$ 258,297,885	$13,466,991	20 (Outer and Inner)	Y
17	Combination of Alt 4 & Brown County Expanded Bayport CDF (Scenario 3) (36 acres & Holland Twp, 100 acres)	Island Creation & Upland	2,350,000 1,173,600 (782,400) [(4)]	$ 176,572,791	$10,124,818	20 (Outer and Inner)	Y

* Least costly Average Annual Cost for the inner & outer harbor, i.e. greatest net annual benefits.
(4) Numbers shown in brackets represent the capacity used prior to expansion. See Table 8 for details.
(5) See Appendix F, Table F-II-16

9. TRADE-OFF ANALYSIS

Each of the following alternatives recommended for further consideration are compared in the following paragraphs as to their advantages and disadvantages if implemented.

9.1 Alternative 12 – Brown County Expanded Bayport CDF (Inner and Outer Channels).

Advantages: If Brown County expands the existing Bayport CDF by 36 acres and constructs the Holland Twp. site (100 acres) when it reaches design capacity, this combination will meet the future capacity requirements for both the inner and outer harbor. From a Federal perspective, this alternative is engineeringly feasible, environmentally acceptable (Federal Standards) and therefore would meet the 20 - year dredged material capacity requirements for maintenance dredging of Green Bay Harbor. The construction cost of the expansion would be cost shared 65% Fed / 35 % non-Fed, per the 217 agreement. Expanded Bayport CDF will not receive LERR credit (up to 10%), since it was given for a previous Federal Project. The Holland Twp site would be cost shared 75% Fed / 25 % non-Fed, per the 217 agreement.

Disadvantages: Comparing the average annual cost of this alternative at $12,267,043 (See Table 7) to **Alternative 15 – Combination of Alternative 7 and Alternative 11** over a 20 year period, it is not the least costly. The Corps will continue to pay a tipping fee for operation & maintenance of the Bayport CDF. There will be no environmental benefits to using the Bayport CDF and therefore the restoration of 1,449 acres will not be implemented. Therefore, it will not be considered further. See Appendix F Economic Assessment for details on average annual cost.

9.2 Alternative 15 – Combination of Alternative 7 and Alternative 11.

Advantages: The creation of the three islands and the expansion of Bayport CDF (36 acres) will meet the requirements for dredged material capacity for both the inner and outer harbor Federal channels for a 20-year period. It serves as a single purpose project for navigation, while providing secondary benefits by re-creating the Cat Island chain (272 acres). Restoration of Petes Marsh and Duck Creek Delta Wetland combined will provide 1,497 acres. This site is closer to the dredging operation areas compared to the greater distance of hauling dredged material to open water and is the locally preferred plan. It will reduce transportation and placement cost compared to Bayport CDF. The Fish & Wildlife Service supports the restoration of the Cat Island Chain. From a Federal perspective, this alternative is engineeringly feasible, environmentally acceptable (Federal Standards) and least costly and therefore would meet the 20 - year dredged material capacity requirements for maintenance dredging of Green Bay Harbor. Comparing the average annual cost of this alternative at $7,544,668 (See Table 7) to all of the other alternatives over a 20 year period, it is the least costly. This alternative meets the requirements for the Base Plan. Therefore it will be considered further.

Disadvantages: The environmental benefits will be accrued over the long term, not the first year. The Corps will continue to pay a tipping fee for operation & maintenance of the Bayport CDF. See Tables 9 & 10 for cost summaries.

Table 8
Cost Summary of Alternative 15 – Combination of Alternative 7 and Alternative 11. (2010 price level)

		Quantity	Unit	Cost estimate
	West, Middle and East Island construction	1	LS	$23,423,310
	Dredging Inner & Outer Harbor channels	4,300,000 cy	$14.87/ cy	$63,941,000
	Expanded Bayport (36 acres)	1	LS	$ 5,055,426
	Contingency (20%)	1	LS	$18,483,947
	Total with contingency (prior to Risk Assessment)			$110,903,683
	Non-construction cost including, E&D, S&A, Eng. during Design, Eng Tech Review ATR, Contracting, Project Mgmt	1	LS	$11,237,300
	Total cost for Alt. 15			$122,140,983
	Average Annual Cost[2]			$7,544,668

Notes
1) See Appendix C for details
2) See Appendix F, Part II, Table F-II-16

9.3 Alternative 16 – Combination of Alternative 9 and Alternative 11.

Advantages: Meets the requirements for dredged material capacity for both the inner and outer harbor Federal channels. There is no construction or cost sharing required for open water placement. Open water placement addresses the outer channel requirements and Brown County expansion of Bayport CDF (36 acres) addresses the inner channel dredged material requirements.

Disadvantages: Comparing the average annual cost of this alternative at $13,466,991 (see Table 7) versus **Alternative 15 – Combination of Alternative 7 and Alternative 11** over a 20 year period, it is not the least costly and therefore, it will not be considered further. No beneficial use. The Wisconsin Department of Natural Resources regulations do not permit open water placement of dredged material.

9.4 Alternative 17 – Combination of Alternative 4 and Brown County Expanded Bayport CDF (Scenario 3).

Advantages: The creation of the two islands, the expansion of Bayport CDF (36 acres) and the Holland Twp site will meet the requirements for dredged material capacity for both the inner and outer harbor Federal channels for a 20-year period. This alternative will serve navigation purposes, while providing secondary benefits by re-creating a portion of the Cat Island chain (166 acres), Petes Marsh and Duck Creek Delta Wetland combined for a total of 1,225 acres.

Disadvantages: Although this alternative meets the navigation needs, constructing only two of the three Islands will not provide the maximum potential environmental benefits. The two islands would provide a combined 166 acres of upland habitat versus three islands would provide 272 acres, a loss of 106 acres. The partial wave barrier for two islands would support the restoration of approximately 875 acres versus a wave barrier for three islands would provide 1,225 acres, a loss of 350 acres. The total loss would be 456 acres of Peters Marsh and Duck Creek wetland. Comparing the average annual cost of this alternative at $10,124,818 (See Table 7) versus **Alternative 15 – Combination of Alternative 7 and Alternative 11** over a 20 year period, it is not the least costly *and therefore, it will not be co*nsidered further. See Appendix F Economic Assessment for details on average annual cost.

10. SELECTION OF FINAL PLAN

10.1 Base Plan

One overriding factor in selecting the recommended plan is the determination of the **Base Plan**. In accordance with ER 1105-2-100, "Base Plan. Disposal of dredged material associated with the construction or maintenance dredging of navigation projects should be accomplished in the least costly manner consistent with sound engineering practice and meeting all Federal environmental requirements. This constitutes the base plan for the navigation purpose. If the ecosystem restoration project is part of the base plan, it is a navigation (harbor or inland system) construction or maintenance cost and funded accordingly. Where the ecosystem restoration project is not part of the base plan for the navigation purpose, the base plan serves as a reference point for measuring the incremental costs of the ecosystem restoration project that are attributable to the environmental purpose."

This document has been prepared in accordance with recent procedures established for development, review and implementation of DMMP's. Based on current information in this Phase II DMMP Document, ***Alternative 15- Combination of Alternative 7 and Alternative 11*** meets the criteria as engineeringly feasible, environmentally acceptable and least costly, where least costly is determined by comparing the average annual costs of the alternatives. Alternative -7 consists of constructing three islands (West, Middle and East Islands), a complete wave barrier, and an access road and Alternative -11 consists of Brown County

Expanded Bayport CDF (Inner Channel Only) Accordingly, information that follows is presented on the basis that reflects this option as the Base Plan. See Figure 6, which shows a plan view.

10.2 Project Advantages

Selection of Alternative -15, provides navigation benefits through the construction of the in-water DMDF (Cat Island Chain) to address the maintenance dredging for the outer channel and expanding Bayport CDF (36 acres) for maintenance dredging of the inner channel. It was chosen over the other alternatives because of the following major advantages: it is least costly while being both engineeringly feasible and environmentally acceptable (under Federal Standards). It has the least average annual cost (ER 1105-2-100) compared to other alternatives.

Other advantages include a site sufficient enough in size to meet the required 20 - year capacity while being situated where mechanical or hydraulic offloading is easily accessed. The increase of the dredged material capacity from the construction of the DMDF would extend the life of the existing Bayport CDF. The in-water DMDF (three islands) would provide secondary environmental benefits, a combined 272 acres of upland habitat and, with a full wave barrier, would support the restoration of approximately 1,225 acres of Petes Marsh and Duck Creek wetland for a total of 1,497 acres. The in-water DMDF (island creation) provides dredged material capacity for navigation, secondary environmental benefits, a synergistic and cost-reducing approach, and is determined to be in the public interest. The sponsor has indicated that future use of the islands will not include a port or harbor facilities. They expect the islands to remain in a natural state, allowing for some potential educational opportunities and passive human recreation.

Funding to continue to use the Bayport CDF would be negotiated over the life of the facility. A Section 401 (CWA) water quality certification, or waiver thereof, would be obtained from the state prior to signing a Finding of No Significant Impact.

10.3 Real Estate

The local sponsor will need to acquire the necessary real estate interests for the access road connecting the shoreline to the Cat Island Chain. The local private CDF facility owner-operator already acquired the necessary real estate interests for Bayport expansion. The construction of the islands will not require Lands, Easements, Rights–of-Way and Relocations (LERRDs) for the islands. The state of Wisconsin provided a lake bed grant to Brown County under the 2005 Assembly Bill 868 (Revised March 31, 2005) For more detailed analysis, see Appendix D, “Real Estate Plan”. This appendix includes discussion of the lakebed grant.

10.4 Project Design

The Engineering Appendix (see Appendix A) includes a brief narrative, location map, plan

view, cross section, detail, and quantitative calculations for developing *Alternative 7 - Construct a three island (West, Middle and East Islands) DMDF, a complete wave barrier, and an access road.* It also includes an addendum for a VE study.

The Bayport CDF expansion (36 acres) to accommodate only the inner harbor dredged material would be built by Brown County and cost shared 65% Fed / 35% non-Fed (25 percent of GNF plus an additional 10 percent GNF less LERR) under the 217 agreement.

10.5 Project Construction

The project construction sequence is such that the access road to the West Island, which also functions as a wave barrier, would be constructed first. The West Island would be constructed next, followed by the Middle Island and finally the East Island. The access road and islands would be constructed using quarry run or shot rock, with a crest width of 15 ft and a crest elevation of +6 ft LWD. The Green Bay area where the access road and islands will be located is relatively shallow. So, land equipment could be used to construct both the access road and the islands. (See Appendix A for details)

The construction of the 36 acre expansion of Bayport CDF would be conducted by Brown County in the year 2023.

10.6 Project Cost

Table 9 below is a summary of costs for constructing the in-water DMDF (Cat Island Chain). See Tables 9 & 10 for a summary of Alternative 15.

Table 9
Cost Estimate for Alternative 7 - Construct a three island (West, Middle and East Islands), a complete wave barrier, and an access road. (2010 price level)

	Feature – Capital Costs	Quantity	Unit	Unit Price[4]	Estimated Cost ($)
1	Mob & Demob	1	L.S.	$314,158	314,158
2	Armor Stone	122,514	TN	$ 55.79	$6,835,253
3	Bedding Stone	16,933	TN	$36.93	$625,442
4	Shot Rock	482,800	TN	$ 25.47	$12,299,978
5	Geotextile	50,800	SY	$ 3.74	$190,474
6	Coarse Gravel/Cobble	116,200	TN	$26.10	$3,032,928
7	Culvert 8” PVC	600	LF	$71.87	$43,120
8	Culvert 12” RCP	3,100	LF	$26.44	$81,957
	Total Construction				$23,423,000
	Contingency				$4,685,000
	Total Construction Cost with Contingency				$28,108,000
	Feature – Indirect Costs	**Quantity**	**Unit**	**Unit Price**	**Estimated Cost ($)**
	Engineering & Design pre. Const. (3% of capital costs)	1	LS	$ 703,000	$703,000
	Construction Management S&A	1	LS	$1,874,000	$1,874,000
	Engineering During Const.	1	LS	$ 117,000	$117,000
	Program Mgmt	1	LS	$25,000	$25,000
	Eng. Tech. ATR	1	LS	$15,000	$25,000
	Contracting & Reprographics	1	LS	$30,000	$25,000
	Lands & Damages	1	LS	$11,000	$10,000
	Planning during construction	1	LS	$31,000	$25,000
	Planning & Environmental Compliance	1	LS	$53,000	$44,000
	Subtotal, Non-Construction				$ 2,848,000
	with Contingency				$ 3,417,000
	Total				$ 31,524,000
	Total Fully Funded Cost				$ 32,738,000

Note:
1). All alternative costs were developed utilizing an Excel spreadsheet. After plan selection, the selected alternatives costs were developed in MII.
2). See detailed cost estimate provided in Appendix C.

Table 10 below is a summary of costs for constructing the 36 acre expansion of Bayport CDF for the inner channel. See Tables 9 & 10 for a summary of Alternative 15. Since the facility is owned by Brown County the cost share for the construction will be 65% Fed/ 35% non-Fed (25 percent of GNF plus an additional 10 percent GNF less LERR) under a 217 agreement. Expanded Bayport CDF will not receive LERR credit (up to 10%), since it was given for a previous Federal Project. However, the Federal Government will continue to pay a tipping fee for the operation & maintenance of the CDF. The tipping fee will increase from the date of the expansion (2023).

Table 10
Cost Estimate for expanding Bayport CDF (2010 price level)

	Feature – Capital Costs	**Quantity**	**Unit**	**Unit Price**	**Estimated Cost ($)**
1	Mob & Demob	1	L.S.	$190,372	$190,372
2	Clearing & Grubbing	36	Acres	$1386.5	$49,913
3	Topsoil & Stockpiling	58,080	CY	$3.55	$206,207
4	Silt Fence	5,194	LF	$3.69	$19,159
5	Perimeter Fence	5,194	LF	$47.81	$248,334
6	Groundwater monitoring wells	4	EA	$2585	$10,340
7	Rouge Grade	43.6	MSF	$25.96	$1,132
8	Dike Construction	5,010	LF	$662	$3,316,954
9	Gravel Road	7,792.6	SY	$23.36	$182,070
10	Topsoil & Seeding Dikes	44,979	SY	$1.45	$65,195
	Total Construction				$4,289,000
	Contingency				$858,000
	With contingency				$ 5,147,000
	Feature – Indirect Costs	**Quantity**	**Unit**	**Unit Price**	**Estimated Cost ($)**
	Engineering & Design pre. Const. (3% of capital costs)	1	LS	$ 129,000	$ 129,000
	Construction Management S&A (8%)	1	LS	$343,000	$343,000
	E & D During Const. (0.5%)	1	LS	$ 21,000	$ 21,000
	Program Mgmt	1	LS	$25,000	$25,000
	Eng. Tech. ATR	1	LS	$2,000	$2,000
	Solicitation/Contracting	1	LS	$25,000	$25,000
	Planning During Construction	1	LS	$25,000	$25,000
	Subtotal, Non-Construction				$ 570,000
	With Contingency				$ 684,000
	Total				$5,831,000
	Total Fully Funded Cost				$7,265,000

Table 10, continued Cost Estimate for expanding Bayport CDF (2010 price level)					
	Feature – Capital Costs	**Quantity**	**Unit**	**Unit Price[4]**	**Estimated Cost ($)**
1	Closure Cap for Expanded Bayport CDF	139,392	CY	$ 5.39	$ 751,744
2	Topsoil & Seed	209	CSY	$67.0	$14,006
	Total Construction				$765,000
	Contingency				153,000
	With Contingency				$918,000
	Feature – Indirect Costs	**Quantity**	**Unit**	**Unit Price**	**Estimated Cost ($)**
	Engineering & Design pre. Const. (3% of capital costs)	1	LS	$ 23,000	$ 23,000
	Construction Management S&A (8%)	1	LS	$61,000	$61,000
	E & D During Const. (0.5%)	1	LS	$ 4,000	$ 4,000
	Program Mgmt	1	LS	$5,000	$5,000
	Eng. Tech. ATR	1	LS	$2,000	$2,000
	Solicitation/Contracting	1	LS	$25,000	$25,000
	Planning During Construction	1	LS	$5,000	$5,000
	Planning & Environmental Compliance	1	LS	$1,000	$1,000
	Subtotal Non- Construction				$126,000
	With Contingency				$151,000
	Total				$1,069,000
	Total Fully Funded Cost				$1,587,000

Notes:
1). The cost estimate for this alternative was developed in MII after it was determined to be the selected plan, where as the other alternatives were developed using an Excel spread sheet.
2). See detailed cost estimate provided in Appendix C.

10.7 Locally Preferred Plan

The locally preferred plan is the same as the Base Plan *Alternative 15- Combination of Alternative 7 and Alternative 11*.

10.8 Annual Benefits

National Economic Development (NED) benefits for navigation projects are most often expressed as transportation cost savings. Average annual Harbor transportation cost savings associated with continuing to maintain harbor channel depths is the difference in average annual transportation costs between the without project condition and providing currently maintained depths of 26/24 feet. Average annual harbor transportation cost savings associated with maintaining a 26/24 foot channel depth are $24,514,942 (as shown in **Table 11**.

Table 11 presents the average annual transportation costs associated with the top five commodities both with and without the project. The difference represents the average annual transportation benefits.

Table 11
Average Annual Transportation Cost Savings
Associated with Maintaining Current Channel Depths.
(in FY10 dollars)

Commodity	Without Project Condition Average Annual Transportation Costs	With Project Condition Average Annual Transportation Costs	Average Annual Transportation Benefits
Cement and Concrete	$9,814,500	$4,575,166	$5,239,334
Coal	$62,127,600	$48,252,556	$13,875,044
Sodium Chloride	$6,356,000	$3,438,752	$2,917,248
Limestone	$7,256,000	$5,035,636	$2,220,364
Pig Iron	$2,102,800	$1,839,848	$262,952
Total	**$87,656,900**	**$63,141,958**	**$24,514,942**

NED losses are incurred when a lack of maintenance dredging leads to shoaling that restricts vessel loading. If Green Bay harbor dredging were to cease, the federal navigation channel would fill in rather quickly with sediment. The infilling would take only a few years in certain areas, particularly those that intersect zones of high sediment transport. Conversely, there might be some parts of the channel that would take considerably longer to completely fill. Regardless of these areas of low deposition, the channel would be unusable once any part of it fills in, which, based on a 3 foot per year shoaling rate, is likely to take only a few years. The equilibrium depth of the harbor would vary along the 11 miles of federal channel in Green Bay since the depth of the bay varies. Assuming no dredging, depth would approach that of the bay on either side of the present channel with a limiting depth of 5 feet. See Appendix F page F-II-35 for present worth calculations

10.9 Risk and Uncertainty in Environmental Benefits for the Base Plan

Risk and uncertainty of the expected environmental benefits has been addressed through the Environmental Assessment. The main environmental benefit of the project is the sheltering of a large shallow water area in the head of the bay by recreating the former Cat Islands. The islands will also provide some additional habitat and variety. The risk to this benefit is that if not all the islands are built, then a smaller area of the bay would be sheltered. Once the islands are constructed, the environmental risk and uncertainty relate to the amount and type of vegetation that would develop.

For both the islands and the shallow bay waters to be protected by the islands, the species composition that will develop is dependent on natural propagation and vegetation/seed bank in the dredged material being used to fill the islands. It is expected that species composition of the new habitat will be similar to that of nearby habitats. Any vegetative protective habitat will be an improvement over existing conditions. As such, there is no negative risk.

There is little risk relative to the amount of vegetation that will develop on the islands. The islands would quickly become vegetated. This habitat could be enhanced by state and local interests, to modify habitat for specific species.

The risk relative to the amount of aquatic habitat depends on water depth. Island construction during periods of below average water depth would maximize the area of aquatic vegetation that develops. Island construction during periods of above average water surface elevations would initially result in less aquatic vegetation developing until low water conditions return.

11. DESCRIPTION OF SELECTED MANAGEMENT PLAN

11.1 General

The plan is intended to provide a means to manage the dredged material from the Green Bay Harbor for a period of 20 years. The design capacity of the selected alternative must achieve a 20 - year capacity, be the least costly and engineeringly feasible, while meeting all Federal environmental standards.

11.2 Cost Apportionment

Project implementation will be cost shared in accordance with Sections 101 and 214 of WRDA 86 as amended, Section 217 of WRDA 96, per Policy Guidance Letter No 47, *Cost Sharing for Dredged Material Disposal Facilities and Dredged Material Disposal Facilities Partnerships* dated, 3 April 1998, and memorandum, CECW-AA (CELRD-GL-ET-G CELRE-PP-PM/16 Feb 1999), Subject Section 217 Agreement for Bayport CDF, dated April 29, 1999. See Appendix I for copies of the agreements. TITLE I of WRDA '96 (see discussion on Page 3, Paragraph 3) which states that, "Dredged Material Disposal Facilities for O&M will now be considered a general navigation feature (GNF) and cost shared in accordance with Title I of WRDA '86. According to WRDA '86, SEC 101 HARBORS, subsection (a)(1) PAYMENTS DURING CONSTRUCTION, the cost to the non-Federal interest is based on the authorized depth of the channel. The authorized channel depth for the Green Bay Harbor varies between 26 feet below IGLD at the down-stream limit to 18 feet at the upstream limit on the Fox River. The portion of the harbor being considered for dredged material placement in the Cat Island Chain meets the criteria within the 20 to 45 ft range, which has a non-Federal cost share of 35%; 25% during the construction of a DMDF and 10% in cash over a period not to exceed 30 years.

The Base Plan consists of a combination of constructing the Cat Island Chain to address maintenance dredging of the outer harbor and expanding Bayport CDF to accommodate only the inner harbor. Since the in-water DMDF (Cat Island Chain) is a General Navigation Feature, the construction cost will be cost shared 65% Fed/35% Non-Fed (25 percent of GNF plus an additional 10 percent GNF less LERR) (Regarding the 35%, see discussion above).

Since Brown County has agreed to expand Bayport CDF, it would initially pay 100% of the construction cost then recuperate 65% through a tipping fee under the 217(c) agreement. The sponsors cost of operation and maintenance would be also be recuperated through the tipping but it would be a negotiated cost with the Corps. Expanded Bayport CDF will not receive LERR credit (up to 10%), since it was given for a previous Federal Project. However, the Federal Government will continue to pay a tipping fee for the Operation & Maintenance of the facility.

12. SUMMARY OF APPENDICES and the ENVIRONMENTAL ASSESSMENT

12.1 Design Report; The Engineering Appendix includes a design of the islands and access road, Operation and Maintenance, design calculations, survey and mapping data, construction procedures and figures. It ,also includes a VE study.

12.2 Geotechnical Data; The Geotechnical Appendix includes data on subsurface conditions, borings, settlement calculations and bearing capacity calculations.

12.3 Cost Engineering Report; The Cost Engineering Appendix includes cost summary tables and a TRACES report.

12.4 Hydraulics and Hydrology; There are two hydraulic and hydrology appendices, the first is a excerpt of hydrological information from the *Cat Island Chain Restoration, Design Development Report* (Baird Report, April 2005) and the second is an analysis of open water placement.

12.5 Economic Assessment

12.5.1 National Economic Development Benefits

NED benefits for navigation projects are most often expressed as transportation rate savings. Transporting a commodity via the Great Lakes waterway incurs a shipping cost, or rate. If the waterway did not exist, this commodity would be shipped via land and doing so incurs a rate as well. When the water transportation rate is less than the land transportation rate, the waterway has generated a rate savings for that commodity. In this manner, the use of Green Bay Harbor saves transporters money which is the NED benefit of continued dredging of the harbor. The economic analysis utilized the results of the Great Lake Levels System Analysis of Navigation Depths (GL-SAND) model developed by Buffalo District to determine

the benefits achieved through dredging.

See Appendix F, Part II, sections IV - VI for more detail on the calculations for the numbers presented in Table 12.

Table 12 - Annual Benefits, Costs and Net Benefits by Alternative					
Benefit-Cost Ratios - 20-Year Project Evaluation Period - 4.375% Annual Interest Rate					
	Alternative				
	1	12	15	16	17
	No	36 & 100	3 Islands	Open Water	2 Islands
	Action	acre CDF's	& CDF	& CDF	& CDF's
Annual Benefits					
Without Project Transportation Costs	$87,656,900	$87,656,900	$87,656,900	$87,656,900	$87,656,900
With Project Transportation Costs	$87,656,900	$63,141,958	$63,141,958	$63,141,958	$63,141,958
Average Annual Plan Benefits	$0	$24,514,942	$24,514,942	$24,514,942	$24,514,942
Annual Costs					
W/Project Harbor Maintenance Costs	$ -	$12,267,043	$7,544,668	$13,466,991	$10,124,818
W/O Project Harbor Maintenance Costs	$ -	$ -	$ -	$ -	$ -
Plan Costs	$ -	$12,267,043	$7,544,668	$13,466,991	$10,124,818
Benefit-Cost Ratios					
Average Annual Benefits	$ -	$24,514,942	$24,514,942	$24,514,942	$24,514,942
Average Annual Costs		$12,267,043	$7,544,668	$13,466,991	$10,124,818
Benefit-Cost Ratio	0.00	2.00	3.25	1.82	2.42
Annual Net Benefits	$ -	$12,247,899	$16,970,274	$11,047,951	$14,390,124

These calculations resulted in the determination that Alternative 15, with the lowest average annual costs is the Base Plan. Further, since alternative 15 also has the greatest net benefits, it is the NED Plan.

12.5.2 Economic Justification for Continued Maintenance Dredging

Once the selection of Alternative 15 as the base plan was made, the Walla Walla District Cost-Risk Analysis Team prepared a detailed cost-risk analysis and provided revised contingencies which were then incorporated into the Total Project Cost Summary and revised average annual costs and net benefits were calculated.

Utilizing the risk adjusted cost estimate, alternative 15 has the lowest average annual costs ($8,206,382) and is thus, the Base Plan. Alternative 15 also has the greatest net benefits ($16,308,560) and is therefore, the NED Plan with a Benefit-Cost ratio of 3.0.

Table 13 - Benefit-Cost Ratio for Selected Plan	
20-Year Project Evaluation Period - 4.375% Annual Interest Rate	
	Alt. 15 3 Islands & CDF
Benefits	
Without Project Transportation Costs	$87,656,900
With Project Transportation Costs	$63,141,958
Plan Benefits	$24,514,942
Costs	
With Project Harbor Maintenance Costs	$8,206,382
Without Project Harbor Maintenance Costs	$ -
Plan Costs	$8,206,382
Benefit-Cost Ratios	
Annual Benefits	$24,514,942
Annual Costs	$8,206,382
Benefit-Cost Ratio	3.0
Annual Net Benefits	$16,308,560

12.6 Real Estate Plan; The Real Estate Appendix includes a discussion of Real Estate fee information, LERRDs, costs and the non-Federal acquisition capability.

12.7 Environmental Assessment; includes a discussion of the DMMP alternatives, potential impacts of the proposed island creation on the human environment, and preliminary comments received during coordination of the DMMP.

An Environmental Assessment (EA) of the potential impacts of construction of islands at, Green Bay Harbor, Wisconsin has been prepared pursuant to the National Environmental Policy Act (NEPA). The attached EA indicates that no significant cumulative or long term adverse environmental effects would be expected to result from the construction of islands.

The EA is available to the public for a 30-day review period. Following this period and a review of the comments received, a final determination will be made by the District Engineer

regarding the necessity of preparing an Environmental Impact Statement (EIS) for the proposed construction of islands. Expansion of the Bay Port CDF would be a local private CDF facility owner-operator undertaking. This work would be required to be permitted and conducted in accordance with existing Federal, State and local laws and regulations. As plans for the expansion are developed this effort would be reviewed to determine if additional NEPA documentation is required.

13. RESULTS OF COORDINATION WITH LOCAL, STATE AND FEDERAL AGENCIES

On February 21, 2008 the Detroit District held an alternative formulation briefing for Cat Island Chain Section 204, which resulted in HQs directing the district to convert the study to the Green Bay Harbor DMMP. The District informed Brown County of the results and shortly after and they agreed to be the sponsor for the Green Bay Harbor DMMP. Numerous conference calls and meetings were held with Brown County to inform them of our study progress and to address concerns. Since the Wisconsin Department of Natural Resources and Fish & Wildlife Service have been involved in the Cat Island Section 204 they were well-informed of the project. On 23 July the District requested a Planning Aid Letter from Fish & Wildlife Service to assist in the Environmental Assessment. The sponsor has provided a letter of interest. See Appendix H – Correspondence for additional information.

14. COST SHARING AND FINANCING

14.1 Management Plan Studies

The cost associated with Management Plan studies for continued maintenance dredging of existing Federal navigation projects are O&M costs and are 100% Federally funded. Project sponsors, port authorities, and other project users, are partners in dredged material management and must pay the costs of their own participation in the dredged material management studies including participation in meetings, providing information and other coordination activities.

Budgeting priorities for the navigation purpose is limited to the Base Plan. Therefore, the cost for any component of a management plan study attributable to meeting more stringent local or state requirements than Federal laws and regulations shall be a non-Federal cost. The Corps of Engineers does not anticipate any additional costs will be incurred beyond those associated with the execution of the base plan related to compliance with any required local or state laws and regulations. Study activities related to dredged material management for the Federal project but not required for continued maintenance dredging and dredged material disposal, will not be funded by the Federal Government and will not be included in the dredged material management studies unless funded by others.

14.2 Implementation

Costs for implementing Management Plans for existing projects are O&M costs and shall be shared in accordance with navigation O&M cost sharing provisions applicable to the project as authorized. The cost for any component of a Management Plan attributable solely to meeting state water quality standards (which are generally more restrictive than those satisfying the Base Plan) will be a non-Federal cost. Table 14 presents the implementation costs exclusive of potential tipping fees. Current estimated tipping fees, based on actual tipping fees paid with an inflationary factor, of $5.74 were calculated by Detroit District. Actual tipping fees will be determined in the future based on actual expenses via an agreement between the U.S. Army Corps of Engineers and the Bayport Port Authority.

Table 14
Base Plan Implementation,
Federal and Non-Federal Cost share

Initiate Construction (Year)	**Operational (Year)**	**Construction Cost**	**Fed**	**Non-Fed**
West, Middle and East Island (2011)	(2012)	$32,738,000	$21,279,700 (65%)	$11,458,300 (35%)[4]
Expand Bayport CDF (2023)	(2024)	$7,265,000	$4,722,250 (65%)	$2,542,750 (35%)[4]
CDF Closure Cost	(2032)	$1,587,000	$1,031,550 (65%)	$ 555,450 (35%)[4]
Total	---------	$41,590,000	$27,033,500	$14,556,500

Notes:
1). Average dredging for the outer channel is 117,500 cy
2). See Table 9 for details.
3). Expanded Bayport CDF will not receive LERR credit, since it was given for a previous Federal Project.
4). 25 percent of GNF plus an additional 10 percent of GNF less LERR

15. CONCLUSION/RECOMMENDATION

Green Bay Harbor is in need of additional dredged material placement capacity as a result of limited capacity in the Bayport CDF. The Base Plan consists of a combination of constructing an in-water DMDF (three islands of the Cat Island Chain) and the expansion of Bayport CDF and as a result, would address maintenance dredging for both the inner and outer Federal channels. It serves as a single purpose project for navigation, while providing secondary environmental benefits by re-creating the Cat Island chain (272 acres) and with the restoration of Petes Marsh and Duck Creek Delta Wetland combined will provide 1,497 acres. The expansion of Bayport CDF does not provide environmental benefits. The Base Plan would provide savings as a result of the local sponsor cost sharing both the placement islands and expanding Bayport CDF, as required by Section 101 of WRDA 86 (as amended), and because transport and placement of material in the islands will be less costly than placement at the Bayport CDF. Smaller Federal savings are realized if the islands are constructed sequentially, and habitat benefits are delayed. This report is in compliance with applicable statutes, executive orders and policies outlined in ER1105-2-100.

Lack of additional capacity would result in dredging of the Green Bay Harbor being curtailed, or not taking place. With the increased shoaling, the navigation capability would be adversely affected.

Approval of the project assumes and is predicated upon the Wisconsin DNR granting of 401 WQC for construction of the Cat Island Chain.

Because of the significant navigation benefits and the overall cost effectiveness, it is recommended that the Detroit District proceed with detailed design and plans and specifications to construct the Base Plan (Cat Island Chain) presented in the Phase II Final Dredged Material Management Plan document to provide management of dredged material for a 20-year period for Green Bay Harbor.

Maintenance dredging of Green Bay Harbor would allow continued economic benefits associated with navigation of this commercial harbor.

The recommendations contained herein reflect the information available at this time and current Department policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding.

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Commanding