JOINT FEDERAL / STATE APPLICATION FOR THE ALTERATION OF ANY TIDAL WETLAND IN MARYLAND

- All applications must be accompanied by plan drawings which show the location and character of the proposed work. For specific information on what is required on the plans, refer to the instruction package. 8-1/2" x 11" black & white drawings are required for every application. Full construction plans are required for projects submitted to the Waterway Permits Division.
- Any application which is not completed in full or is accompanied by poor quality drawings may be returned and will result in a time delay to the applicant.
- If you need help understanding how to fill out the application form, please refer to the instruction booklet.

APPLICATION NUMBER:
(To be assigned by the agencies)

1. APPLICANT INFORMATION:

Name: Maryland Department of Natural Resources **Telephone:** (410) 260-8261

Address: 580 Taylor Avenue, B-2

City: Annapolis **State:** Maryland **Zip:** 21401

2. AGENT / ENGINEER INFORMATION:

Name: _____ **Telephone:** ( )

Address: _____

City: _____ **State:** _____ **Zip:** _____

3. PRINCIPAL CONTACT, if not the applicant:

Name: Eric Campbell **Telephone:** (410) 260-8261

4. PROJECT DESCRIPTION: The purpose of this project is to acquire oyster shell that can be used in several different ways to restore oyster populations and oyster fisheries in the Bay. See Attachment for details.

5. PROJECT PURPOSE:

- ☐ Shore Erosion Control
- ☐ Utility Installation
- ☐ Create Waterfowl Habitat
- ☐ Temporary Construction
- ☐ Beach Nourishment
- ☐ Residential/Commercial Development
- ☐ Other: (describe) _____
- ☐ Erosion/Sediment Control
- ☐ Improve Navigable Access
- ✓ Improve Fish Habitat
- ☐ Stream Channelization
- ☐ Maintenance/Repair
- ☐ Small Pond
- ☐ Storm Drain/Stormwater Management
- ☐ Marina
- ☐ Fill
- ☐ Bridge
- ☐ Dam
- ☐ Road
- ☐ Culvert

CERTIFICATION:

I hereby designate and authorize the agent named above to act on my behalf in the processing of this application and to furnish any information that is requested. I certify that the information on this form and on the attached plans and specifications is true and accurate to the best of my knowledge and belief. I understand that any of the agencies involved in authorizing the proposed works may request information in addition to that set forth herein as may be deemed appropriate in considering this proposal. I grant permission to the agencies responsible for authorization of this work, or their duly authorized representative, to enter the project site for inspection purposes during working hours. I will abide by the conditions of the permit or license if issued and will not begin work without the appropriate authorization. I also certify that the proposed works are not inconsistent with Maryland's Coastal Zone Management Plan.

APPLICANT MUST SIGN: _____ **Date** 7/1/09

PLEASE COMPLETE THE REVERSE SIDE

PCA 13910
OBJ 4142

6. PROJECT LOCATION: This project is in ☑ Tidal ☐ Non-Tidal Waters. (Please Ccheck One)

County: Baltimore (dredging)/Statewide (planting) Name of Waterway: Chesapeake Bay and Tributaries

Site Address or Location: _____

Directions from nearest intersection of two state roads: _____

County Book Map (A.D.C.) Coordinates: Map: _____ Letter: _____ Number: _____

7. TYPE OF PROJECT:

Work Proposed	Overall Length *(in feet)*	Average Width *(in feet)*	Maximum Distance Channelward From Mean High Water *For projects in tidal waters (in feet)*
☐ Bulkhead			
☐ Revetment			
☐ Vegetative Stabilization			
☐ Gabions			
☐ Groins or Jetties			
☐ Boat Ramp			
☐ Pier			
☐ Breakwater			
☐ Road Crossing			
☐ Utility Line			
☐ Outfall Construction			
☑ Dredging ☐ New ☐ Maintenance ☑ Hydraulic ☐ Mechanical			See attachment

☑ Other: For other projects, please supply project dimensions including the area of disturbance (acreage), volume of fill (cubic yards), type of fill, and area (acreage) of wetlands to be impacted. Planting of shell material, see attachment

8. PROPOSED STARTING DATE: _____

9. CONTRACTOR'S NAME (If Known): _____

10. LAND USE:

Current Use Is: ☐ Agriculture ☐ Wooded ☐ Marsh/Swamp ☐ Meadow ☐ Developed

Present Zoning Is: ☐ Residential ☐ Commercial ☐ Agriculture ☑ Other: Fishing, Boating

11. OTHER PERMITS REQUIRED: ☐ Building Permit ☐ Soil Conservation District ☐ Other: _____

12. NOTIFICATION OF ADJACENT PROPERTY OWNERS:

The applicant/agent will be informed by the perming agencies when notification of adjacent property owners is required.

IMPORTANT: PLEASE MAIL FIVE COPIES OF THE APPLICATION, SITE PLAN, AND VICINITY MAP (WITH PROJECT LOCATION PINPOINTED) TO:

MDE, WATER MANAGEMENT ADMINISTRATION
REGULATORY SERVICES COORDINATION OFFICE
MONTGOMERY PARK BUSINESS CENTER – ST 430
1800 WASHINGTON BOULEVARD
BALTIMORE, MD 21230-1708
(410) 537-3762 OR 1-800-876-0200

1.0. Project Description

The purpose of this project is to acquire oyster shell that can be used in several ways to restore oyster populations and oyster fisheries in the Bay. Shell may be used to improve existing oyster bars to enhance natural recruitment, to provide a foundation for hatchery-spawned seed oysters deployed to encourage reestablishment of an abundant and self-sustaining oyster population, to provide substrate for leased bottom in support of aquaculture, and to provide substrate needed to sustain oyster fisheries in Maryland. All of these efforts are components of recommendations of the Chesapeake Bay Program's 2000 Agreement, the Maryland Oyster Advisory Commission, and the 2005 Oyster Management Plan and are necessary to implement the preferred alternative specified in the *Final Programmatic Environmental Impact Statement for Oyster Restoration in Chesapeake Bay Including the Use of a Native and/or Nonnative Oyster* (USACE et al. 2009).

A Maryland Geological Survey (MGS) study of the Man-O-War shoal (Figure 1) indicated that the shoal comprises between 86 million and 103 million bushels of oyster shell (J. Halka, MGS, pers. comm.). DNR intends ultimately to remove approximately 30% of the available shell (about 30 million bushels) to use primarily to restore oyster habitat and oyster populations for ecological purposes. In response to stakeholders' concerns about the potential ecological effects of a shell-dredging project of this magnitude, DNR is requesting an initial five-year permit to dredge five million bushels of shell as part of a comprehensive monitoring project to assess the ecological consequences of removing shell from the shoal.

The comprehensive monitoring program, which is described in greater detail in Section 7.0, will be designed as a before-after-control-impact (BACI) study. Data on water quality, oyster populations, and fish and benthic communities will be collected seasonally at one to three proposed dredging sites and two reference locations at the shoal in Year 1 of the permit period. In Year 2, approximately two million bushels of shell will be removed using a hydraulic dredge making cuts at one to three locations along the periphery of the shoal. Each cut will be no wider than 500 feet and extend no more than one-third of the distance through the shoal (Figure 1). Water quality will be monitored during the dredging process. A minimum thickness of two feet of shell will be left in place at the bottom of each cut. The arrangement of dredge cuts is intended to provide irregular habitat features that would increase the surface area of hard substrate at Man-O-War shoal that is available for colonization by epibenthic biota and would attract fish that use hard-bottom habitat.

In Year 2 and Year 3 of the permit period, water quality, oyster populations, and fish and benthic communities will be monitored seasonally in the dredged cut(s) and in two undisturbed reference locations at the shoal. Results of the monitoring program will be analyzed, and a report will be prepared at the end of Year 4. If findings of the studies indicate that the test dredging has produced no adverse effects, an additional three million bushels of shell will be dredged in Year 5 using peripheral cuts, as in Year 2. If dredging continues in Year 5, DNR will submit an application to continue dredging at the shoal in future years until the maximum 30 million bushels of shell have been removed.

The permit requested at this time would allow dredging at any time of year. The optimal period to dredge shell for use in capturing natural spat set would be from June through mid July. Shell to be used for planting hatchery-produced seed oysters or for aquaculture could be dredged at any time of year. Dredging would be scheduled to minimize user conflicts (e.g., with recreational fishing).

As noted previously, 90% of shell to be dredged from Man-O-Was shoal will be planted on sanctuary bars or other non-harvest bars for ecological restoration; the remainder will be deployed at aquaculture sites, harvest reserves, and open harvest areas. Specific sites will be identified as part of preparing new oyster restoration plans for Chesapeake Bay. Sites will be selected in cooperation with the Oyster Advisory Commission that is composed of representatives of a diverse array of stakeholders. Some shell may be stockpiled for short periods if specific locations for planting have not been established before dredging begins.

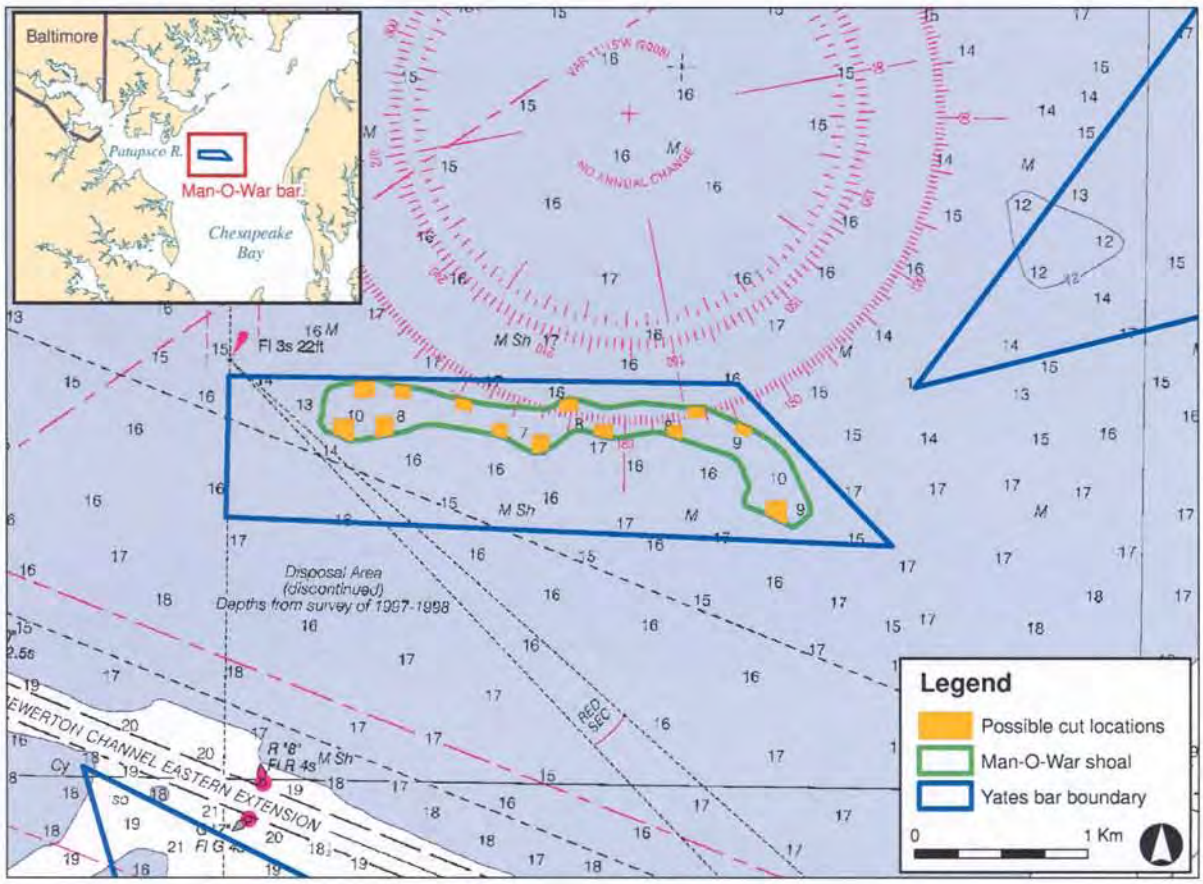

Figure 1. The location and general shape of Man-O-War shoal. Dark lines indicate the boundaries of oyster bars mapped by Yates (1911). Yellow rectangles within the outline of the shoal illustrate the types of cuts anticipated as shell is removed by dredging along the perimeter.

The following sections provide greater detail concerning all of aspects of the proposed dredging program.

2.0. Project Need

Oysters once contributed significantly to maintaining water quality and habitats in the Chesapeake Bay ecosystem, supported an economically important fishery, and were of great cultural value to many residents of the Bay area. The population of the native Eastern oyster (*Crassostrea virginica*) has declined to about 1% of its historical abundance. The importance of the ecological role of the Eastern oyster within the Bay's ecosystem (i.e., maintaining and improving water quality and creating habitat) gained increased attention as a result of the precipitous decline of the oyster population during the 1980s. As a result, State and Federal agencies increasingly began working together to restore oysters. The Chesapeake Bay Program identified oyster restoration as a key component for improving the health of the Bay and established specific management goals for restoring the abundance of oysters in the Bay in its 1987, 1994, and 2000 agreements. The lead agencies responsible for preparing the recently published *Final Programmatic Environmental Impact Statement for Oyster Restoration in Chesapeake Bay Including the Use of a Native and/or Nonnative Oyster* (PEIS) concluded that enhanced restoration activities for, and increased commercial cultivation (i.e. aquaculture) of, the native oyster will be the best approach to achieving ecological and economic objectives.

The availability of hard substrate is critical for increasing the numbers of oysters in the Bay; however, sedimentation and deterioration of oyster shell together are reducing hard-bottom habitat in Chesapeake Bay faster than the remaining population of Eastern oysters can produce new shell. Oyster larvae must adhere (set) to a clean hard substrate, preferably oyster shell, after two to three weeks in the water column, or they will die. In Chesapeake Bay, however, sediment that is washed into the Bay rapidly covers hard substrates, thereby reducing the amount of available habitat upon which oyster larvae can settle (Smith et al. 2005). Deterioration of old shell is another significant factor contributing to loss of oyster habitat. Old shell deteriorates as a result of disarticulation, bioerosion, breakage, and dissolution (Powell et al. 2006) at rates ranging from 20% to 50% per year (Mann 2007). The result of these combined forces is a severe and continuing decline in the area of suitable habitat for settlement of oyster larvae.

Oyster grounds in Chesapeake Bay once encompassed more than 450,000 acres. New acoustic techniques for surveying the bottom of the Bay suggest that less than 1% of Maryland's historic oyster grounds can be classified as clean or lightly sedimented shell. Most of the substrate that is suitable for settlement of oyster larvae is within areas where the State has planted shell recently. Between the Maryland Bay Bottom Survey (1978 to 1983) and recent surveys (1999 to 2000; Smith et al. 2005), the amount of habitat on sampled bars declined by nearly 70%, or about 3.5% per year (USACE et al. 2009). The current (2004) area of oyster habitat in the Bay is estimated to be 76,030 acres. Assuming that the rate of loss on the 18 bars sampled between 1999 and 2001 is representative of the rate of loss of habitat throughout the Bay, more than 2,500 acres of oyster habitat are lost each year without a sustained and growing oyster population.

The "Repletion" program has been a significant element of Maryland's oyster management efforts in the past. The term repletion describes two approaches for encouraging settlement, growth, and survival of oysters by planting shell: (1) "permanent" plantings, in

which shell is planted in areas where large spat sets occur naturally, and the resulting spat are left in place until they are large enough to be harvested; and (2) seed-area plantings, in which shell is planted in areas of high salinity where large spat sets are most likely, and the resulting spat are moved to areas of lower salinity to attempt to protect them from disease. Shell for the repletion program was obtained by dredging buried shell from historical deposits located primarily in the upper Bay. This oyster shell dredging and planting program began in 1960, and about five million bushels were dredged and planted per year until 1990. Beginning in 1991, the program was reduced to about 1.5 to 2.8 million bushels per year. Some stakeholders opposed shell dredging because it alters the bottom substrate, may adversely affect other fisheries, and creates a sediment plume. The shell-dredging program ceased in 2006 when the dredging permit issued by USACE and the Maryland Department of Environment expired (DNR 2006). At that time, DNR decided not to reapply for the permit required to continue the program.

In its 2009 report to the Governor and General Assembly, the Maryland Oyster Advisory Commission (OAC) stated that a shortage of high-quality habitat for settlement and growth of oyster larvae represents a significant limitation of the oyster population's potential for expansion and that recent limitations on the availability of dredged shell have curtailed shell-planting programs. The OAC recommended that DNR apply for a permit to dredge shell from Man-O-War shoal.

As described in the PEIS, survey data collected from 1994 through 2006 showed no statistically significant change in oyster abundance in Maryland, suggesting that the repletion program and other management actions over that time period did not result in an enhancement of the Bay's oyster stock. Given the apparent failure of past management and enhancement approaches, both the PEIS and the OAC concluded that enhanced and new restoration measures need to be implemented.

Newer restoration methods that have shown promising signs of success involve creating three-dimensional mounds of shell that mimic historical reef structures and grouping the mounds together to cover large areas. For example, the USACE created the largest network of sanctuary reefs in the Bay in the Great Wicomico River in 2004. Low-relief reef (LRR) totals 54.8 acres; medium-relief reef (MRR), on which the shell surface is elevated above the bottom, totals 29.8 acres. Sampling of the constructed reefs has shown positive results, including an increase in the local oyster population by a factor of 62, multiple age classes of oysters, strong recruitment over multiple years, and both vertical and cohesive growth of the reefs. The MRR appears to be accreting shell faster than it is being lost. The total population on these constructed reefs is estimated to be 184.5 million oysters, and this new population is a considered to represent direct augmentation of the wild oyster population in the Great Wicomico River (C. Seltzer, Norfolk District, USACE, pers. comm.). Although significant mortality due to disease is expected in the future, recent research has suggested that this subpopulation exhibits a level of resistance to disease akin to that of a hatchery-produced strain of disease-resistant Eastern oysters (R. Carnegie, VIMS, pers. comm. to C. Seltzer, USACE). Overall, the outcome of the project in the Great Wicomico River differs from prior restoration efforts in several ways: (1) recruitment has been strong and steady for several years; (2) a significant proportion of the constructed reefs is

achieving positive shell balance; and (3) oysters are growing at greater densities than on any other sub tidal reefs in Chesapeake Bay.

Investigations will be required to determine if methods such as those employed in the Great Wicomico River would be similarly effective in Maryland waters, which are generally of lower salinity. Such methods require much greater amounts of shell than have been used historically in Maryland. Maryland's repletion program involved spreading shell to a thickness of three to six inches over the footprints of historical bars. In the later years of that program, when only 1.5 to 2.8 million bushels of shell were being dredged per year, about 350 acres were planted with shell annually. That acreage represents only 14% of the amount of hard-bottom habitat estimated to be lost Bay-wide each year. Approaches such as those used in the Great Wicomico River require significantly larger quantities of substrate; an estimated 1.9 million bushels of shell were used to construct about 90 acres of three-dimensional reef there. The total shell proposed to be dredged from Man-O-War shoal from this permit and future permits,, about 30 million bushels, would be sufficient to create perhaps 15 medium-relief and high-relief oyster bars covering about 1,400 acres, if all the shell were to be used to construct such bars. If the shell were to be used for low-relief restoration projects, even more acreage could be rehabilitated; however, medium-relief and high-relief reefs may be more resilient to siltation than low-relief structures and thus remain more viable for larval settlement for a longer period of time.

The objective of the proposed shell-dredging program is to use 90% of the dredged shell for ecological restoration (i.e. placed in areas off-limits to commercial harvesting). As noted earlier, the continuing loss of oyster habitat in the Bay is, to a substantial degree, a result of the lack of a growing oyster population. Oysters create their own habitat through growth of shell, and a healthy population can grow at a rate that exceeds the rate at which shell is lost due to degradation and siltation. The use of dredged shell as substrate for placing hatchery seed in low salinity waters, where oyster mortality due to disease is low, will result in live oysters growing and increasing shell stock and reef structure over time. However, spat set would be infrequent in low salinity waters, so repeated seed planting may be required to sustain such reefs. The promising results observed in the Great Wicomico River and other locations in Virginia suggest that medium-relief and high-relief reefs may contribute to enhanced oyster reproduction, settlement, and survival in areas of higher salinity. These factors would result in shell accretion and growth of the reef only so long as harvest is prohibited. Although oysters in high-salinity areas are expected to suffer significant disease mortality, die offs due to disease are a necessary step in the selection and propagation of disease resistance in the population, and the gradual evolution of disease resistance is expected in the local oyster stocks. DNR recognizes that deposits of buried shell are a limited and non-renewable resource, and the proposed uses of the shell to be removed from Man-O-War shoal emphasize efforts that will result in the growth and development of oyster reefs that can sustain themselves into the future, without the need for continual addition of new substrate.

3.0 Alternate Substrate Sources Considered

The OAC's 2009 report recommended that DNR consider all alternatives to using dredged shell to create oyster habitat, including rehabilitating oyster bars through surface dredging, reclaiming previously planted shell, purchasing shell from out-of-state suppliers, and using alternative materials. That recommendation recognized the critical need for large amounts of substrate for oysters and the limited availability of buried shell. The OAC reviewed all potential locations for dredging shell before recommending Man-O-War shoal as the most appropriate location. Table 1 identifies the various sources of shell the OAC considered.

Table 1. Potential locations for dredging of shell identified by DNR, with shell volumes as estimated by Maryland Geological Service. The third column lists estimates of the number of acres that could be planted with shell to a depth of 6 inches. Sites designated with * are located in striped bass spawning areas.

Shell Option	**Estimated Shell Capacity (Bushels[1]) Min - Max**	**Restoration Potential at 30% Removal and 6" Placement (acres)**
Man-O-War	86M – 103M	1720 - 2060
Seven Foot Knoll	7M – 8M	140 - 160
Potomac River*	34M (assumes 150k/ac)	680
Shad Battery Shoal*	24M (assumes 150k/ac)	480
Plum Point*	13M (assumes 150k/ac)	260
Worton Point*	7 – 8M (assumes 150k/ac)	140 - 160
Shell Reclamation Permit – pending approval	25M	1000 (100% of permitted amount)

The volume of shell at Man-O-War shoal is an order of magnitude greater than the volumes at all the other locations. Completely removing a shoal is likely to result in significant modification of existing habitat for fish and other Bay organisms. Consequently, one constraint on the proposed dredging program is to remove no more than 30% of a shell deposit. Removing 30% of the total volume of shell at Man-O-War shoal would produce the greatest amount of shell for restoration efforts of the six locations evaluated while maintaining the basic integrity of the shoal and minimizing habitat alterations. In addition, four of the six sites with shell remaining are located in striped bass spawning areas, which are sensitive areas that should be avoided. These factors served as the basis for the OAC's recommendation.

[1] One Maryland bushel = 0.06 cubic yards

The last row of Table 1 presents an estimate of the amount of shell expected to be recovered under the shell reclamation program. The permit for shell reclamation is expected to be issued in the summer of 2009. That project will enable DNR to recover previously planted oyster shell that has become covered with sediment over time and, therefore, is no longer providing suitable habitat for oysters. Previously planted shell originated from DNR's past shell dredging program, which recovered buried shell from the upper Chesapeake Bay. DNR requested authorization to reclaim 1.5 million cubic yards (25 million bushels) of previously planted oyster shell during the 2007-2016 permit period. The amount of shell to be reclaimed exceeds the amounts of buried shell available at five of the six potential dredging locations shown in Table 1 and is about half of the amount available from Man-O-War shoal. The two sources, together, provide a substantial amount of shell that could be used for restoration efforts.

A limited amount of shucked shell is available each year from the few shucking houses that remain in Maryland and from restaurants. All of the available shucked shell is currently used for hatchery production of spat-on-shell. Experience with planting of hatchery spat over the past several years has demonstrated that spat-on-shell have a much greater survival rate than unattached spat when planted on Bay bottom, primarily due to reduced predation from species such as cow nosed rays.

According to an Alternate Substrate permit that the Corps of Engineers issued to DNR in September 2008 (CENAB-OP-RMN 2007-03659-M24), several alternatives to shell can be placed in the Bay to provide substrate for oysters, including clamshell, limestone, crushed concrete, stone, and steel slag. Under the permit, DNR may plant up to 1.5 million cubic yards of alternate materials (equivalent in volume to 25 million bushels of shell) on charted oyster bars within Maryland. All materials must be free of building debris and protruding rebar and placement of materials must allow for a minimum depth of 8 feet of water over them at mean low water. Since 2002, DNR has planted approximately 71 acres with the equivalent of 985,000 bushels of alternative habitat materials at a cost of $1.7 million, or $24,000 per acre.

Estimates of the 2008 costs of alternative materials ranged between $32 and $51 per cubic yard, averaged over Bay zones (costs differ by zone as a result of differing transport costs) (Table 2). That range exceeds the estimated $16-per-cubic-yard cost of dredged oyster shell that DNR used in budgeting shell programs. Clearly, all the alternative substrates are more costly than dredged shell; therefore, given a fixed amount of funding, more habitat could be restored with dredged shell than with all other permitted substrates. Non-shell substrates have several limitations in addition to cost. Most of the materials acquire spat sets at lower rates than shell does, and the available volume of some materials is too small to support a large-scale restoration program. Nonetheless, the nearly 25 million bushel-equivalents of non-shell substrate that can be deployed under the 2008 permit is equal to the volume of shell expected to be reclaimed, and nearly equal to the amount that could be removed from Man-O-War shoal.

DNR is currently working on updating the State's oyster restoration and management plan. Specific restoration projects have not yet been defined; consequently, the amount of shell or other substrate that may be needed to implement a program that has a high probability of resulting in a restored, self-sustaining oyster population in the Bay cannot be estimated at this time. As noted earlier, some of the restoration approaches that appear to have the greatest

promise of success require much greater volumes of shell than the historical repletion efforts that have been ineffective. This factor, when considered in the context of the rapid annual rate of loss of oyster habitat in the Bay, argues for affording DNR access to the greatest amount of shell and other substrate that can be obtained to enhance the potential for success. Approximately two million bushels of shell were used to construct the three-dimensional reefs in the oyster restoration project on the Greater Wicomico River. Considering that figure, a total of 80 million bushels of shell and alternative substrates would provide for creation of 40 similar high-relief reefs in Maryland, if all the substrate were used for that purpose. Although that number of sites represents only about 4% of the 1,181 historically charted oyster bars in Maryland, reestablished, productive, self-sustaining reefs would serve as a source of increased numbers of larvae that could colonize other available habitat and contribute to shell growth and accretion over broader regions of the Bay. An effort of the magnitude made possible through use of dredged and reclaimed shell as well as alternate materials, therefore, would represent a substantial enhancement of restoration activities, consistent with the preferred alternative defined in the PEIS.

Table 2. Cost estimates ($/cubic yard) for alternate materials and cost of dredged shell, 2008 dollars; costs are approximate averages across Bay zones. Source: DNR and Langenfelder Marine, Inc. (2008).

Limestone	$51
Crushed concrete	$47
Clam Shell	$51
Stone (granite)	$38
Steel slag	$32
Dredged oyster shell	$16

4.0. Potential Effects of Removing Shell from Man-O-War Shoal

Dredging shell has the potential to cause a variety of environmental consequences. During dredging, organisms occupying the existing shoal habitat would be affected, water quality in the area of dredging would be altered, and recreational use of the shoal would be displaced. Once shell has been dredged, the size and shape of the shoal will be altered, which could result in changes in use of the shoal by fish and other biota and possible changes in the characteristics of substrate in the dredged area. The following sections address the possible effects on each of the potentially affected elements of the environment of Man-O-War shoal.

4.1. Water Quality

Existing Conditions - Water quality at Man-O-War shoal is typical for that portion of the upper Bay. Surface salinity ranges from about 3 ppt in April to 10 ppt in September. Water temperature ranges from 36° F in January to 79° F in July, and dissolved oxygen ranges from about 2 mg/l in June to about 10 mg/l in January (Table 3). In general, water quality at the site is good, although low DO excursions during summer months do occur.

Table 3. Monthly surface water quality at the fixed station CB3.2 (Source: DNR 2009)

	Monthly Surface Water Quality (1985-2006)								
	Dissolved Oxygen (mg/L)			Water Temperature (F)			Salinity (ppt)		
Month	**Minimum**	**Mean**	**Maximum**	**Minimum**	**Mean**	**Maximum**	**Minimum**	**Mean**	**Maximum**
January	6.6	9.51	11.9	31.28	36.1	41	0.35	7.63	13.93
February	7.5	9.35	10.8	31.28	36.42	40.28	1.74	7.48	13.86
March	4.5	7.59	10.4	36.32	41.86	47.12	1.57	5.17	8.44
April	1.9	5.26	8.2	46.04	51.32	56.75	0	3.28	7.84
May	0.9	2.32	4.9	56.48	62.9	72.32	0.68	4.07	8.44
June	0.2	1.69	3.5	66.38	72.63	77.81	1.26	5.15	8.66
July	0.15	1.74	5.15	74.84	78.81	81.23	2.17	6.68	11.18
August	0.41	2.04	4.1	75.56	78.35	81.5	1.88	8.32	12.59
September	0.3	4	7.7	63.86	73.41	78.08	0.02	9.92	15.54
October	1.2	5.34	8.11	55.76	62.51	67.1	3.6	9.02	13.93
November	3.8	7.33	10.57	43.88	51.73	57.2	1.29	7.79	13.93
December	5.6	7.61	10.7	36.86	42.86	51.8	0.84	6.99	13.33

Effects of Past Shell-dredging Operations – As a result of stakeholders' concerns regarding the effect of dredging buried shell from the Upper Bay in the past, DNR implemented several monitoring programs to assess the environmental effects of those operations. Findings from those studies provide some insight as to what might occur during the dredging program proposed in this permit application.

The effects of dredging for shell on water quality around Hart-Miller Island and Poole Island were monitored during dredge operations between July and October 1986 (DNR 1987). The observed effects resulted from both the dredging itself and from cleaning the shell after it was placed on the barge. Temperature, pH, DO, salinity and conductivity showed no significant changes due to dredging operations, but dredging caused an increase in turbidity, total suspended solids (TSS), volatile solids, and biochemical oxygen demand (BOD). Those water quality parameters were greater in the sediment plume than upstream of the plume, and greater at the bottom than at the surface. The plume defined by the elevated levels of these parameters ranged from 300 to 600 feet wide and from 1000 to 1800 feet long, depending on tide and weather conditions. From these minimum and maximum dimensions, the size of the plume within which TSS and other parameters were elevated above ambient levels ranged from 7 acres to 24 acres. Turbidity and TSS measures were elevated the most of the four parameters (TSS in plume = 294 mg/l, upstream = 61 mg/l; turbidity in plume = 175 NTU, upstream = 30 NTU). The long-term average TSS in that general area of the Chesapeake Bay (Segment CB3MH) during that season was about 9 mg/l (CBP 2009b). Water quality was not measured after the cessation of dredging; consequently, no information is available from which to determine how quickly the values returned to background levels. Sediment grain-size analysis showed that the fraction of grain sizes greater than 8 μm was eight times greater in the plume than in the non-plume surface water and five times greater than in the non-plume bottom water. The other four grain-size categories also were three times greater in the plume area than outside the plume on average (DNR 1987). Large particles would be expected to settle out of the water column more rapidly than smaller particles.

In August 1998, TSS and turbidity were monitored in a plume the created by a dredging operation east of Poole Island during different tidal stages (Wikel et al. 1999). During maximum flood and ebb tides, TSS and turbidity concentrations in the plumes decreased exponentially with longitudinal distance from the dredge in the direction of the current flow. The highest TSS concentrations (ranging from 80 mg/l to > 280 mg/l) and turbidity (> 200 NTU) were within 500 m of the dredge. Ambient concentrations of TSS and turbidity were reached at distances ranging 2,500 m to 4,500 m from the dredge. During slack tides, high TSS and turbidity concentrations were found in areas within 500 m of the dredge. Ambient concentrations were attained at distances of 1,000 to 1,500 m from the dredging site. Monitoring was not continued after cessation of dredging; consequently, no information is available from which to determine the total time required for the suspended material to dissipate. Additional plume monitoring was conducted from July to September 1999. TSS and turbidity were monitored in plumes in the same study area (Wikel et al. 1999, 2000). Residual turbidity, characterized by low, near-ambient NTU levels, occupied the study area up to two hours after dredging activity ceased (Wikel et al 2000). This report also suggested that continuous dredging created greater levels of TSS and turbidity than intermittent dredging.

One additional concern regarding the consequence of shell dredging on water quality is that removing shell could reduce the circulation of water through the excavated depressions, resulting in localized oxygen depletion. To address this issue, dissolved oxygen concentrations in past dredge cuts were monitored in four areas (Hart-Miller Island, Poole Island, Tolchester, and outside Fairlee Creek) in the upper Chesapeake Bay from June to September in 1999 to determine if dredge cuts become hypoxic (0-2 mg/l) areas (Tarnowski et al 2000). Results

showed no evidence of hypoxia within dredge cuts and no statistical correlation between DO and depth in the study area. The explanations provided for the lack of effect included locally strong water currents, irregular bottom topography, and turbulence in the area that prevented tidally induced salinity stratification.

Some stakeholders expressed the concern that dredging shell may result in resuspending sequestered nutrients (nitrogen, phosphorous) that could exacerbate phytoplankton production and ultimately contribute to oxygen depletion. MGS did not measure nutrients in core samples collected to estimate the volume of shell in the shoals. The material dredged from shell deposits is primarily shell rather than the depositional material that is typically dredged from shipping channels in the Bay; consequently, the volume of material that becomes suspended in the water column during shell-dredging is minimal compared with the volume that typically becomes suspended during channel dredging, and the material suspended during shell dredging is unlikely to result in detectable changes in nutrient concentrations in the water column.

Potential Ecological Effects of Changes in Water Quality Related to Dredging Shell – The most obvious effect of shell dredging is the turbidity plume created during active dredging. Monitoring studies showed that a critical parameter for biota, dissolved oxygen was not depressed within the relatively small plume. In addition, the studies showed that the maximum levels of TSS measured in the plume were well below levels that may adversely affect biota. For example, lethal turbidity levels for exposure to uncontaminated sediment begin at 4,000 mg/l (Peddicord and McFarland 1978), which is more than 10 times greater than the average sediment load typically found in the shell-dredging plume. Also, sediment-induced mortality of adult striped bass occurred only after continued exposure over a 10-day period in a closed environment. Tarnowski et al. (2000) also demonstrated that dissolved oxygen levels were not depressed in affected areas immediately following shell dredging. No contaminants and no significant nutrients are likely to occur in buried shell deposits such as those that make up Man-O-War shoal; therefore, no adverse effects related to nutrients or contaminants are expected. Based on monitoring of prior shell-dredging operations, the primary effect of dredging at Man-O-War shoal will be the presence of a visible turbidity plume that may range in size up to tens of acres when dredging occurs during running tides; however, the presence of the plume is unlikely to result in any significant biological or ecological effects, and the plume is likely to dissipate nearly completely within several hours of cessation of dredging.

4.2. Oysters

Existing Conditions - Man-O-War shoal was created as a result of continuous growth of oyster populations over thousands of years; however, oyster production on the shoal currently is very limited. Data collected during DNR's annual fall survey from 1987 to the present (Figure 2) show that the greatest density of oysters was observed in 1995, which was a dry year (USGS 2009). The greatest density of boxes (dead oysters, most likely killed by diseases) was documented in 1996 (Figure 3), immediately following the year with the greatest density of live oysters. These results illustrate how mortality constrains oyster abundance at this site. On average, the Man-O-War oyster bar has a lower density of oysters than the other three oyster bars

in the CB3MH segment (roughly between the mouths of the Magothy, Patapsco, and Chester rivers), which is categorized as low salinity (Figure 4).

Significant spat set on oyster bars in low-salinity waters is infrequent, as observed at Man-O-War (Figure 2). The only year in which spat were found in samples collected for the annual fall oyster survey was 2002, and numbers then were very low (3 spat per ½ bushel). For comparison, the average number of spat per bar in the Tangier Sound, which is usually a good set area, is 90 spat per bar, per year, and the set in 2002 was 136 spat per bar. The average number of spat based on all bars sampled in DNR's annual fall oyster survey (1990-2007) is 39 spat per bar, per year.

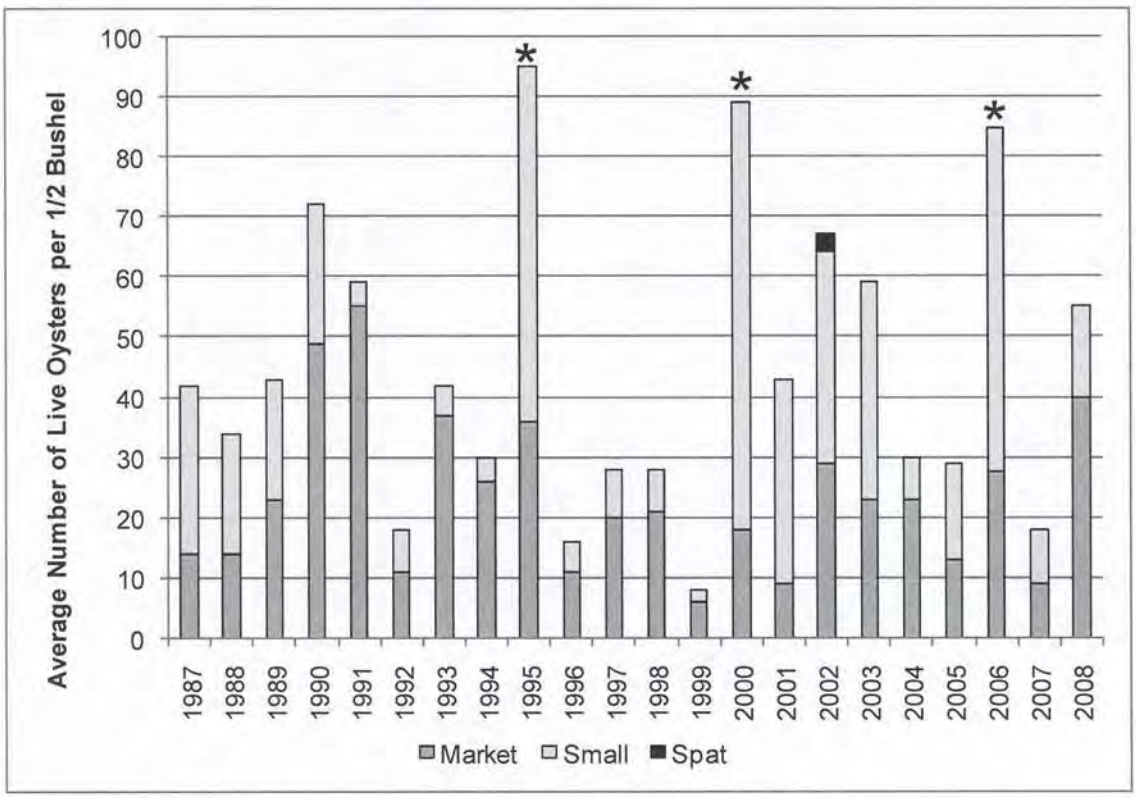

Figure 2. The average number of live oysters in each size class on Man-O-War oyster bar per ½ bushel from 1987 to 2008. Market oysters are greater than 76 mm, small oysters are between 31 mm and 75 mm, and spat are less than 30 mm. Seed was added to the bar in 1995, 2000, and 2006, as denoted with an asterisk.

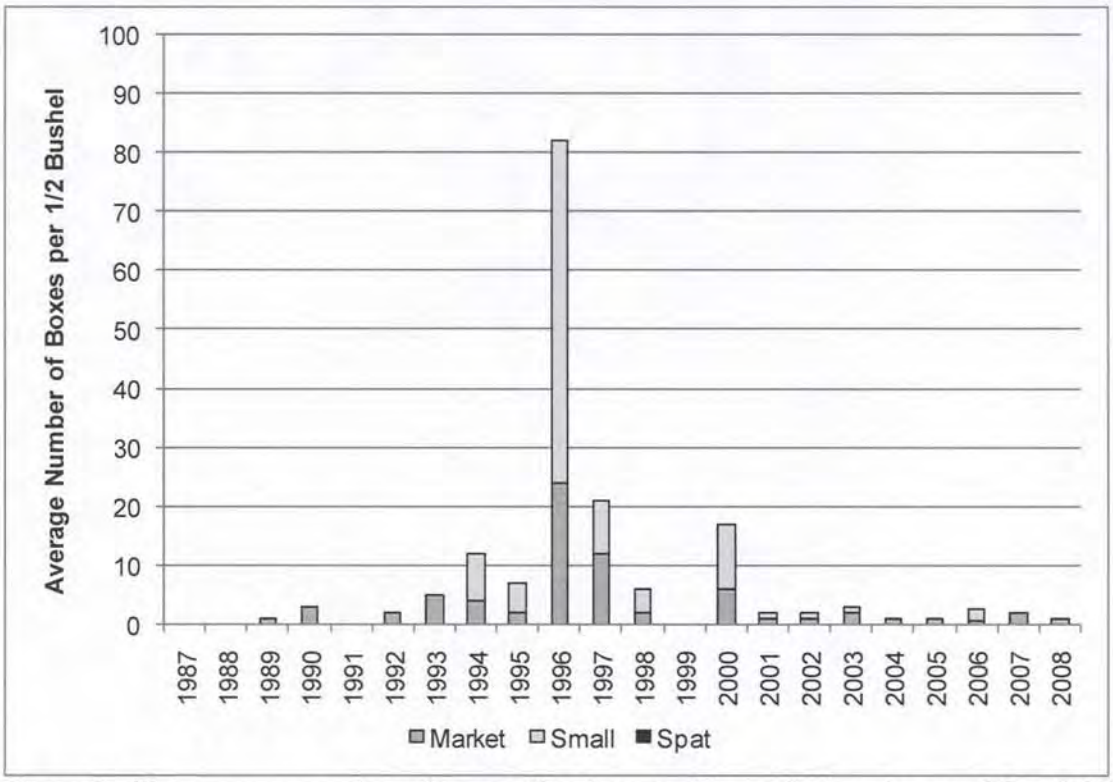

Figure 3. The average number of boxes (dead oysters) in each size class on Man-O-War oyster bar per ½ bushel from 1987 to 2008. Market oysters are greater than 76 mm, small oysters are between 31 mm and 75 mm, and spat are less than 30 mm.

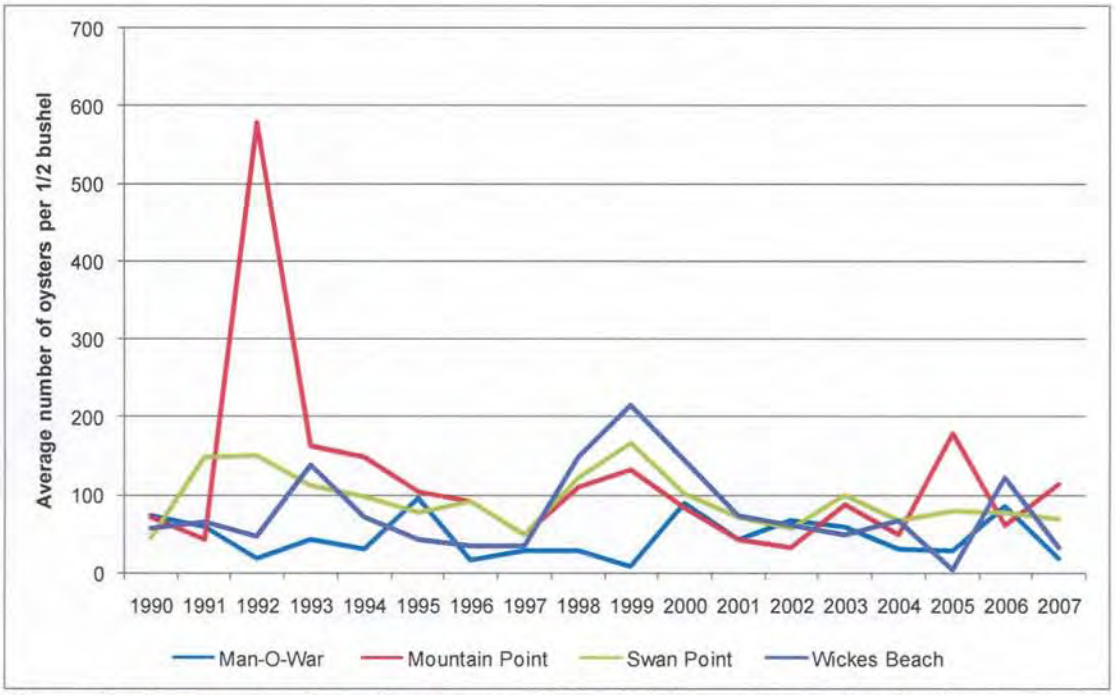

Figure 4. Average number of oysters per ½ bushel for each year for the four oyster bars in the CB3 MH oyster segment (categorized as a low-salinity oyster bar).

Over the years, DNR has attempted to enhance oyster production at Man-O-War shoal. Fresh shell was added to the east side of the bar in 1988. Man-O-War was planted with seed in 1995, 2000, and 2006, and these years coincide with the three years in which the fall survey recorded the greatest densities of live oysters there (Figure 2). In 2000, 29 acres was planted with 18,548 bushels of seed (13,563,283 oysters), and in 2006, 29 acres was planted with 39,635 bushels of seed (28,983,218 oysters).

Harvest of market-size oysters from Man-O-War shoal was 90 bushels in 2007, 121 bushes in 2008, and 297 bushels in 2009; however, anecdotal accounts reported to DNR suggest that some oystermen harvested much greater amounts from the shoal in those years. Reporting of harvest location generally is considered to be relatively unreliable; therefore, the level of uncertainty regarding the quantity of oysters that may have been taken annually from this location is significant. But to put the 2007 landings in perspective, the 90 bushels reported taken from the shoal in that year represent 0.05% of reported state-wide oyster landings.

The existing data suggest that Man-O-War shoal maintains a low-density oyster population that is occasionally enhanced through management measures but is unlikely to grow substantially and may not sustain itself over time.

Potential Effects of Dredging Shell – As described in Section 4.1, dredging shell will create a sediment plume, and heavier sediment particles are likely to settle out near the location of the dredge head and the dredge barge, where shell will be washed. No other active oyster bars are in the immediate vicinity of Man-O–War shoal, and barge operations will be conducted to minimize the amount of time during which the plume extends over the undisturbed portions of the shoal (e.g., the dredge will operate from a location adjacent to the shoal as opposed to over the shoal itself to the extent possible). Also, the amount of sediment suspended as a result of dredging shell is very limited, as described in the preceding section. As a result, significant sedimentation over existing shell on the shoal as a result of the dredging activity is unlikely.

This permit application requests approval to remove approximately 5 million bushels of the shell from Man-O-War shoal. The preliminary plan for shell removal is to make multiple cuts into the shoal along its periphery in years two and five of the permit term. The approach is intended to preserve the basic integrity of the shoal structure. Most of the surface area of the shoal will remain undisturbed and serve as a base for future shell or seed planting. As currently planned, shell will remain at the bottom and along the sides of the dredged cuts and, thus, potentially will increase the total shell surface area on which spat may set if conditions are conducive to a spat set in any future year. In addition, the increased surface area will provide opportunities for colonization by epibenthic organisms that support the food chain of the biological communities that occupy hard substrate in the Bay.

These potentially positive outcomes of dredging shell might not be realized if the dredged shoal loses its structural integrity. To assess whether dredged cuts become filled with sediment or collapse from the sides, MGS conducted detailed bathymetric surveys of previously permitted Areas A, D, and F (J. Halka, MGS, pers. comm.). Area A is located west of Tolchester Beach;

Areas D and F are east of Pooles Island, Area D is on the west side of the C&D Approach Channel, and Area F is on the east side of the channel (Figure 5).

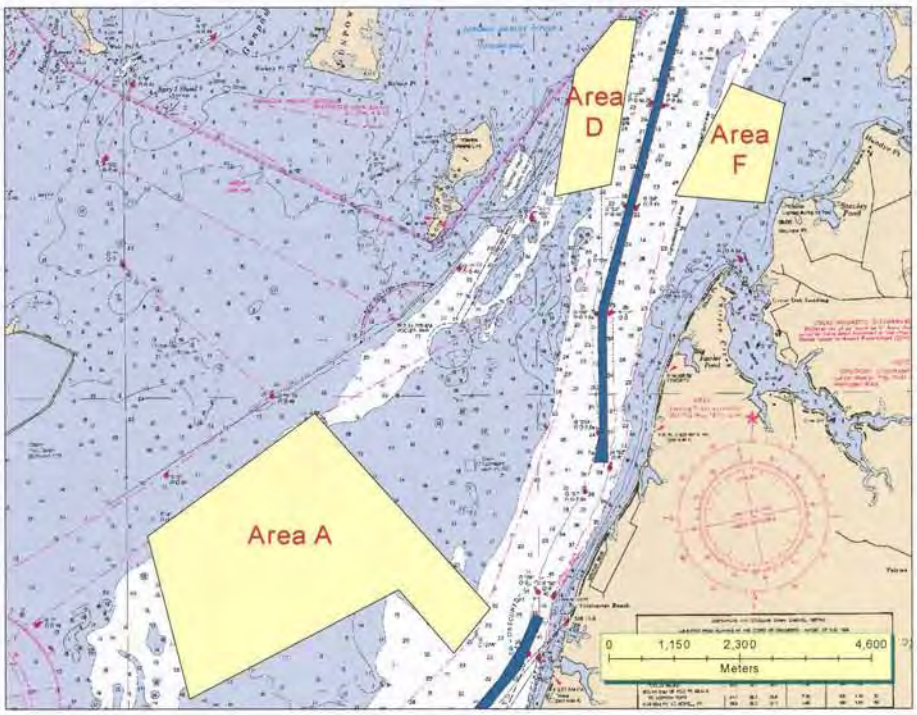

Figure 5. Locations of previously permitted shell-dredging operations .

These sites were permitted beginning in 1960 and used until the permit expired in 2005. Figure 6 shows an example from Area D; sonar survey track lines from March 2006 are in red. Areas identified as "cuts" are in blue, and the remaining ridges are in yellow. The track lines from the dredge as it was excavating are shown in the center of each blue dredged area. Vertical profile data collected along the green trackline in Figure 6 are shown in Figure 7.

Figure 7 shows the fathometer trace along the trackline shown in green in Figure 6. At the left side of the figure is a natural depression that is not associated with the dredging operation; the remaining depressions in the profile are a result of shell removal six to fifteen years prior to this survey being conducted (C. Judy, DNR, pers. comm.). MGS concluded from this survey that the cuts into the shell deposits remained stable over time. No evidence of down-slope movement or mass wasting was observed in any of the dredge cuts, and the cut walls remained steep sided. In addition, there was no evidence of any discernable accumulation of sediment in the bottom of the dredge cuts.

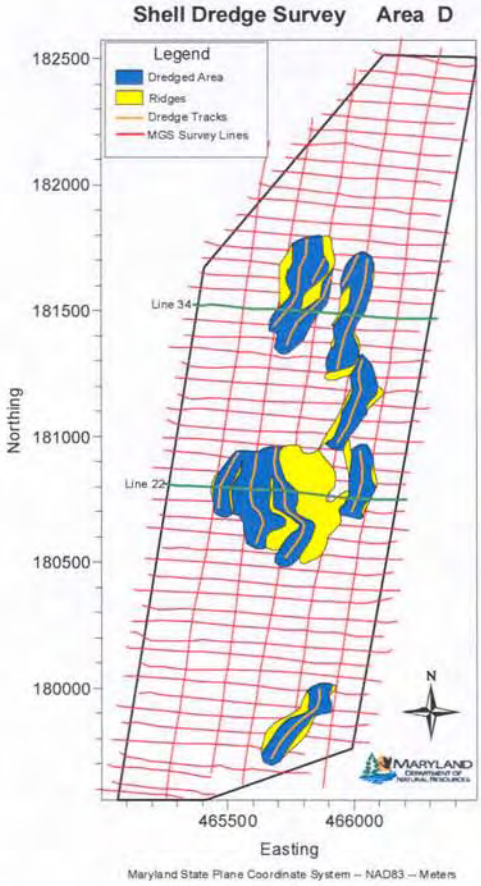

Figure 6. Pattern of dredging and surveying of Area D.

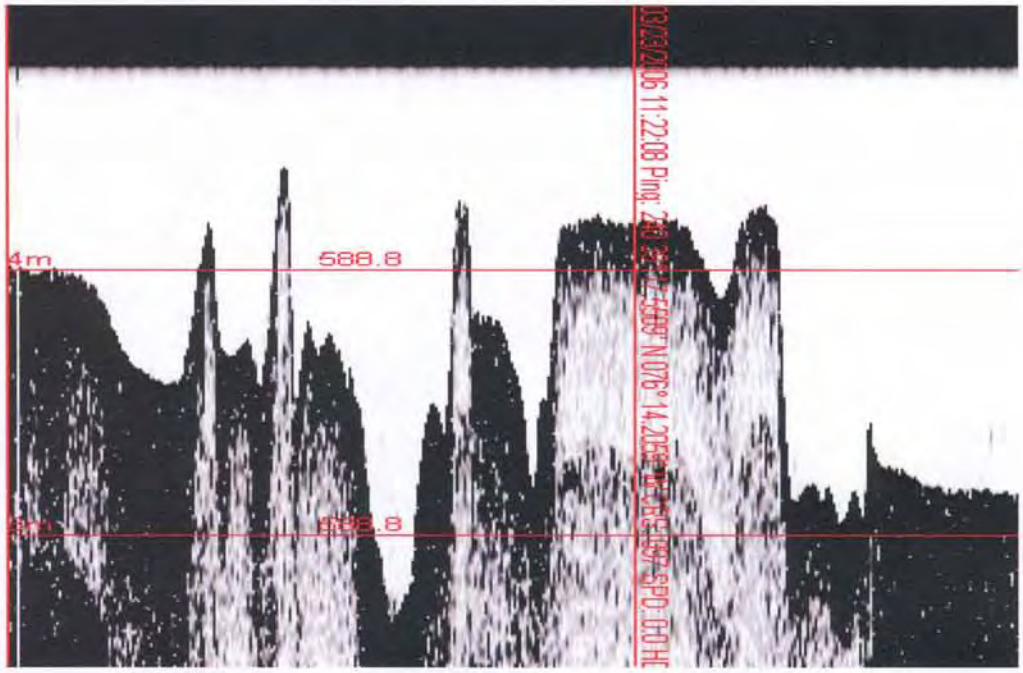

Figure 7. Vertical profile along a survey track line, shown in green in Figure 6, in Area D.

4.3. Benthic community

Benthic communities are structured by the physical and chemical environment as well as by complex interactions among species in the ecosystem. As a result, they can serve as an indicator of the environmental status of the location in which they reside. Specific kinds of benthic communities occur in different kinds of habitat. The community that occurs on hard substrate in low salinity waters of the Bay is of particular interest in this case. Oysters are excluded from this discussion because they were considered separately in the preceding section.

Existing Conditions - The Chesapeake Bay Program's Long-Term Benthic Monitoring Program has sampled benthos in the Bay annually since 1984 (Llanso et al. 2008). Random sampling started in 1996, but over the entire 14 years of sampling, only one benthic sample occurred within the Man-O-War shoal/Yates bar boundary. Based on that one sample collected in 2005, the Man-O-War site (no.12610) was scored as a "good" benthos area in a low mesohaline habitat with 82% silt/clay. The two benthic species with the highest abundance were *Macoma balthica* (a small saltwater clam) and *Leptocheirus plumulosus* (an amphipod). That sample characterized organisms living in the sediment and did not collect the kinds of epibenthic organisms that would be found colonizing shell surfaces; however, the data suggest that the general environmental quality of the Man-O-War shoal area is good.

The main stem of the upper Chesapeake Bay, where Man-O-War oyster bar is located, generally has good benthic conditions compared with other bay strata (Llanso et al. 2008;Figure 8). The data suggest a general improvement in environmental quality over the sampling period.

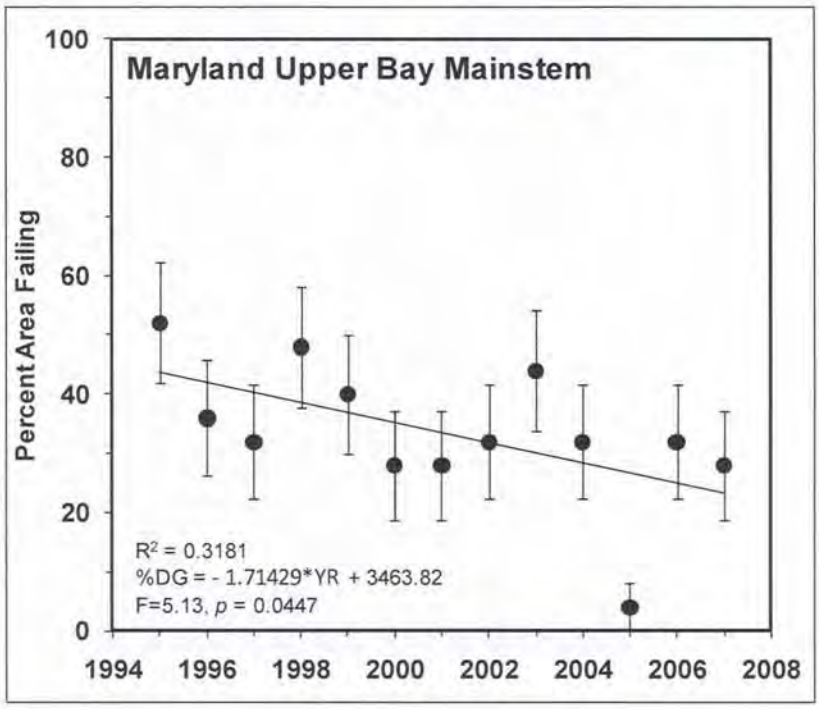

Figure 8. Percent of the Maryland upper main-stem strata failing the Chesapeake Bay benthic community restoration goals, 1995 to 2007. Error bars indicate ± 1 SE.

Potential Effects of Dredging Shell – In order to assess whether past shell dredging affected benthic communities, sampling was conducted three times in 1988 (prior to dredging, 30 days after dredging, and 120 days after dredging) at three kinds of sites: Man-O-War shoal as a reference location, a fresh cut dredged in 1988, and an older cut from 1987. The objective of the study was to determine if dredging had caused changes in the benthic community in response to any changes in sediment characteristics, bottom habitat, and topography (Duguay 1990). The benthic communities occupying the flat areas between the dredged cuts remained similar to the communities found in the undisturbed reference area, both in the size and composition of the population. Where dredging removed the shell substrate, and the area was converted to silt/clay, the benthic community changed to a form consistent with that new kind of substrate. (Note that the dredging proposed in this permit application would leave a significant layer of shell at the bottom of each cut and, thus, would not change the kind of habitat in the dredged area). Findings of this study were consistent with those of Pfitzenmeyer (1975, 1981), who reported that benthic populations of dredged areas return to natural and stable populations within a year or less. The authors concluded that dredging and dredge activities in buried deposits of oyster shell deposits had no measurable adverse effect on the benthic invertebrate fauna of the dredging location.

Shell dredging takes place in many locations along the Atlantic and Gulf coasts of the U.S. where oysters have occurred historically, and some information is available about the effects of such dredging in other areas. A study in 1975 examined the effects of dredging shell on soft-bottom benthic communities in Tampa Bay, Florida (Conner and Simon 1979). Changes in sediment parameters, including increased particle size, reduced organic content, and reduced silt/clay were observed up to 6 months after dredging, but after 12 months no significant differences in sediment characteristics remained between pre- and post-dredging samples. Dredging caused an immediate loss of benthos: 40% fewer species, 66% decrease in abundance, and 87% decrease in biomass. Amphiod taxa were the least affected, and bivalves were the most affected groups of species. Significant differences in benthic abundance, biomass, and number of taxa between the dredged site and the control site persisted for up to six months after dredging; values at the dredged site always were less than those at the reference site. No significant difference in benthic abundance and number of taxa remained at 12 months after dredging, except at one dredged site at which biomass remained significantly lower than at the control.

Based on the findings of previous studies, dredging shell from Man-O-War shoal is likely to result in a loss of benthos, both biomass and numbers of species, in the dredged cuts immediately following dredging, and bivalve species probably will be most affected; however, benthic communities probably will recover to pre-dredging levels of abundance, biomass, and number of species within 6 to12 months after dredging is completed.

4.4. Fish Communities

One major concern regarding dredging shell from Man-O-War shoal is the potential effect on fish communities and, consequently, on the value of the location for recreational and commercial fishing. Several fish surveys are useful for characterizing the species that can be found in the vicinity of the Man-O-War shoal at various times and on the possible effects of the proposed shell-dredging project on those species.

Existing Conditions - DNR conducted trawl surveys from July to October,1986, in sediment plumes created by dredging operations in the upper bay, in locations upstream of the dredging activity, at an old dredge cut, and in an area closed to dredging (DNR 1987). All four sites were in the vicinity of Hart-Miller Island and Poole Island. A follow up trawl study conducted in July 1987 evaluated later effects. DNR also conducted a gillnet survey in December and March, 1987, around Hart-Miller Island and Poole Island to estimate fish abundance in undisturbed areas and dredge cuts (DNR 1988). A follow-up gillnet survey in March, 1988, examined abundance of striped bass and white perch in dredged and undisturbed areas. Results of those four studies characterize the fish species in the vicinity of Man-O-War oyster bar in areas that were dredged and those that were not dredged (Table 4).

Nineteen species were found in the four studies; striped bass and white perch were the only species reported in all four. A mortality study conducted during the process of dredging showed that no adult fish died as a direct result of the suction of the dredge or exposure to the plume of sediment caused by dredging (DNR 1987). That study could not assess the mortality of eggs, larvae, and juveniles because the net mesh was too large to catch small fish.

Table 4. Fish species found (X) in four surveys conducted by DNR around Hart-Miller Island and Poole Island in the vicinity of the Man-O-War oyster bar from 1986 to 1988. The gillnet survey of 1988 recorded only catches of white perch and striped bass.

	Trawl		**Gillnet**	
Species	**July-August 1986**	**July 1987**	**Dec-March 1987**	**March 1988**
Alewife			X	
American Eel	X	X		
Atlantic Menhaden	X	X	X	
Bay Anchovy	X	X		
Blue Crab	X	X		
Channel Catfish	X	X		
Gizzard Shad			X	
Herring			X	
Hogchoker	X	X		
Naked goby	X	X		
Northern Pipefish		X		
Oyster Toadfish	X			
Silverside	X			
Spot	X	X		
Striped Bass	X	X	X	X
Summer Founder	X			
Weakfish	X			
White Perch	X	X	X	X
Winter Flounder		X	X	

Annual fish trawl surveys have been conducted in March, May, July, September, and November every year since 2002as part of ChesMMAP (Bonzek et al. 2008). The most commonly found fish species in the vicinity of Man-O-War shoal bar were white perch, striped bass, and spot (Table 5).

Table 5. Presence and absence of fish species found in the ChesMMAP trawl survey from 2002 to 2007 in the months of March (3), May (5), July (7), September (9), and November (11) around the Man-O-War oyster shoal. N = not sampled, X = presence, O = absence.

	2002					2003					2004					2005					2006					2007				
	3	5	7	9	11	3	5	7	9	11	3	5	7	9	11	3	5	7	9	11	3	5	7	9	11	3	5	7	9	11
At. Croaker	N	O	N	X	O	N	N	N	O	O	O	O	N	O	O	O	O	N	O	O	O	N	X	X	O	N	O	N	N	O
Bluefish	N	O	N	X	O	N	N	N	O	O	O	O	N	X	O	O	O	N	X	O	O	N	O	O	O	N	O	N	N	O
Butterfish	N	O	N	O	O	N	N	N	O	O	O	O	N	O	O	O	O	N	O	O	O	N	O	O	O	N	O	N	N	O
N Kingfish	N	O	N	X	O	N	N	N	O	O	O	O	N	O	O	O	O	N	O	O	O	N	O	O	O	N	O	N	N	O
Scup	N	O	N	O	O	N	N	N	O	O	O	O	N	O	O	O	O	N	O	O	O	N	O	O	O	N	O	N	N	O
Spot	N	O	N	X	O	N	N	N	X	O	O	O	N	O	X	O	O	N	O	X	O	N	X	X	X	N	O	N	N	X
Striped Bass	N	X	N	O	X	N	N	N	O	O	X	O	N	O	X	O	X	N	O	X	X	N	X	X	X	N	X	N	N	X
Summer Flounder	N	O	N	X	X	N	N	N	O	O	O	O	N	X	O	O	O	N	O	O	O	N	O	O	O	N	O	N	N	O
Weakfish	N	O	N	X	O	N	N	N	X	O	O	O	N	O	O	O	O	N	X	O	O	N	O	O	O	N	O	N	N	O
White Perch	N	X	N	X	X	N	N	N	X	X	X	X	N	X	X	X	X	N	X	X	X	N	X	X	X	N	X	N	N	X

One recent fish survey (June 2006) near Baltimore Harbor, north of Man O War shoal, was conducted as an element of environmental studies to evaluate the potential effects of a liquid natural gas facility proposed for Sparrows Point on the Patapsco River. Five fish species were collected: white perch, Atlantic croaker, spot, striped bass, and Atlantic menhaden. White perch made up 84% of the total catch, followed by croaker (9%), and spot (4%). The other species each made up 1% or less of the catch. Findings of all of the studies, combined, provide a comprehensive picture of the fish species that are likely to be found in the vicinity of Man-O-War shoal and, thus, to be exposed to any effects of dredging shell.

DNR's studies in 1986 and 1987 provide some information about how the most common species may respond to dredging. In the 1986 trawl survey, fish abundance was greatest in the plume (255 fish per 6 minutes trawled) and in moderately dredged areas (250 fish per 6 minutes trawled). The third largest catch (190 fish per 6 minutes trawled) came from the heavily dredged area, and fish abundance was least in the area outside of the plume (120 fish per 6 minutes trawled). Data were reported for only the five most abundant species: white perch, spot, channel catfish, blue crab, and American eel. No abundance data were documented for the other species collected. The number of species collected at each site was greatest is moderately dredged areas (13 species), in the plume (12), and in heavily dredged areas (11). The number of species was smallest at the site outside of the plume (9). Findings of the 1987 trawl survey were similar to those of the 1986 study. Fish abundance and number of species were greatest in heavily dredged areas (about 750 fish per 100 minutes trawled and10 species). Moderately dredged areas afforded

the second largest catch (300 fish per 100 minutes trawled and 8 species). Undisturbed areas had the least abundance (about 100 fish per 100 minutes trawled and 8 species). One interpretation of those findings is that dredging caused benthic organisms to be suspended in the water column and exposed organisms in bottom sediments and, thus, created foraging opportunities for many fish species. In the 1987 gillnet survey, catch was greater in the undisturbed, flat areas (50 fish per 100 feet of net) than in dredged areas (20 fish per 100 feet of net). Two explanations proposed for the difference in the findings of the two kinds of surveys were (1) that temperature in the dredged area was two to three degrees cooler than in the undisturbed area, and (2) that in the dredged area the gillnet may not have sampled edge habitat that is known to attract fish because it could not be placed within 50 feet of the edges of the dredge cuts. In the 1988 gillnet survey, only striped bass and white perch catches were recorded, and there was no significant difference between the catches in dredged areas (36 fish per 100 feet of net) and in undisturbed areas (34 fish per 100 feet net). Although the scope of these four studies was relatively limited, they generally suggest that the fish communities in areas in which shell dredging occurred were not substantially altered either during dredging activity or after dredging was completed.

Characterizations of Essential Fish Habitat – Essential fish habitat (EFH) is defined by the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), 1996 revision, as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Only species that are federally managed are covered under the MSFCMA. EFH evaluations for fish species that may use the portion of the Bay around Man-O-War shoal could provide insight concerning the species and life stages that might be exposed to dredging effects. The project area is located in the main stem of Chesapeake Bay, an area within which NOAA has designated EFH for 11 species of fish (Table 6). The whole main stem, extending from tidal fresh to polyhaline waters, is considered to be EFH, and most of the species for which the Bay has been designated EFH are found only in regions of higher salinity, not in the low-salinity waters typical of Man-O-War shoal. In fact, of the 11 EFH species listed in Table 6, only the summer flounder was taken in the fisheries surveys described above.

Summer flounder is a demersal species that has a high affinity for the substrate. The distribution of summer flounder ranges from eastern Georges Bank to Florida; however, the species is most abundant south of Cap Cod (Collette and Klein-MacPhee 2002). Larvae are most common at depths of 100 to 230 feet about 12 to 50 miles from shore in the northern mid-Atlantic Bight from September to February. Spawning occurs offshore during fall and winter. Planktonic larvae and post-larvae migrate inshore from October to May and complete metamorphosis in coastal and estuarine nursery areas. Juveniles and adults inhabit shallow coastal and estuarine areas during spring and summer and then move offshore in fall, where they remain for the winter. Juveniles may inhabit marsh creeks, seagrass beds, mud flats, or open bay areas but are absent from polluted areas lacking food or in areas of poor water circulation. Juveniles have been recorded in Chesapeake Bay. Young-of-year summer flounder have been found in Chesapeake Bay tidal creeks with salinities greater than15 ppt, but they are more abundant in higher salinity areas. Kind of bottom substrate and availability of prey are the most important factors determining distribution of summer flounder. Juveniles may prefer mixed, sandy, mud, substrates or vegetated habitats. Adult summer flounder prefer sand bottoms but can be found in both mud and sand habitats. Larvae consume zooplankton and small

crustaceans. Juveniles and adults may feed on small crustaceans such as shrimp or benthic invertebrates such as polychaetes (Packer et al. 1999).

Table 6. Essential fish habitat designations for species and life stages occurring in the vicinity of Man-O-War shoal (Mainstem Chesapeake Bay). X=EFH has been designated within the region for this species and lifestage; S=The EFH designation for this species includes the seawater salinity zone of the Bay (salinity ≥25 ppt); M=The EFH designation for this species includes the mixing water/brackish salinity zone of the Bay (between 0.5ppt and 25 ppt).

Species	Scientific Name	Eggs	Larvae	Juveniles	Adults	Spawning Adults	Found in the vicinity of Man O War shoal
Red Hake	*Urophycis chuss*			S	S		N
Windowpane Flounder	*Scopthalmus aquosus*			M,S	M,S		N
Atlantic Sea Herring	*Clupea harengus*				S		N
Atlantic butterfish	*Peprilus triacanthus*	M,S	M,S	M,S	M,S		N
Summer Flounder	*Paralicthys dentatus*		M,S	M,S	M,S		**Y**
Scup	*Stenotomus chrysops*			S	S		N
Black Sea Bass	*Centropristus striata*			M,S	M,S		N
King Mackerel	*Scomberomorus cavalla*	X	X	X	X		N
Spanish Mackerel	*Scomberomorus maculates*	X	X	X	X		N
Cobia	*Rachycentron canadum*	X	X	X	X		N
Red Drum	*Sciaenops occelatus*	X	X	X	X		N

Summer flounder larvae are most common offshore but may be found in the vicinity of Man-O-War shoal as they are migrating inshore. Juveniles and adults may also occur in the area, although they prefer more saline regions. Summer flounder were present during a summer trawl survey (DNR 1987). The species also was collected during the ChesMMAP surveys of September and November, 2002, and during September, 2004 (Bonzek et al. 2008). Larvae, juveniles, and adults could potentially be affected directly through physical injury or mortality during dredging operations. Indirectly, summer flounder are susceptible to effects as a result of habitat reduction or reduced benthic food resources associated with dredging activities or through effects on pelagic food resources caused by a sediment plume; however, the characteristics of shell-dredging plumes described earlier suggest that adverse effects are

unlikely, and the proposed approach to remove shell from the periphery of the shoal, leave shell substrate in cuts, and leave the main body of the shoal intact would minimize habitat reduction.

Reef-Orientated Fish Species Present in the Vicinity of the Project Area - Several species of fish in the Bay use oyster bars as a primary source of habitat, for spawning, foraging, and as refuge from predation year-round (Coen et al 1999). These include naked goby, skilletfish, blennies, and oyster toadfish. These species would be the most directly affected by any modifications of their oyster bar habitat.

Naked gobies (*Gobiosoma bosci)* are found in the Chesapeake Bay year-round in a wide range of salinities, including tidal freshwater. They reside mostly in shallow waters around oyster bars and vegetation. In the winter, gobies migrate to deeper waters or burrow in muddy substrate. The diet of gobies consists of small crustaceans. They spawn from May through the late fall, laying their eggs in empty oyster shells (CBP 2009a). During shell dredging, individual fish could potentially be directly affected by the action of dredging. The proposed plan to remove shell only from the periphery of the shoal and to leave shell at the bottom of all cuts, and the fact that the structure of the cuts is likely to be stable suggests that loss of goby habitat due to dredging shell is unlikely and, in fact, that the increased surface area of exposed shell may actually increase total available habitat for this species.

Skilletfish (*Gobiesox strumosus*) can be found throughout Chesapeake Bay as far north as the Magothy River. During the warmer months, skilletfish reside in shallow waters, usually on oyster bars, but they can reside in eelgrass beds and muddy substrate. In the winter, skilletfish migrate to deeper waters of the Bay. Skilletfish feed on small crustaceans and bristle worms, and lay their eggs from April to August in empty oyster shells (CBP 2009a). Man-O-War shoal is located north of the Magothy River; therefore it this species is unlikely to occur in the area in substantial abundance, and no effects are anticipated.

Striped blenny and feather blenny (*Chasmodes bosquianus* and *Hypsoblennius hentz*) are abundant, year-round inhabitants of Chesapeake Bay. In warmer months, they reside in shallow waters, preferably on oyster reefs, but they also can reside in SAV or mud flats. In the winter months, blennies migrate to deeper waters in the Bay. The diet of blennies consists of small crustaceans and mollusks, and spawning occurs from early spring to August, when blennies lay their eggs in empty oyster shells, preferably on live oyster bars (CBP 2009a). Blennies are most abundant on live oyster bottom; consequently, enhancing the oyster population on Man-O-War shoal following shell dredging (i.e., through management actions and increased shell surface area for natural spat set) could increase the abundance of these species.

Oyster toadfish (*Opsanus tau*) are found in Chesapeake Bay year-round and are very abundant bottom-dwellers in wrecks, debris, vegetation, oyster reefs, and rocky or muddy bottoms. In the winter months, oyster toadfish migrate to deeper waters. Their diet consists of small crabs and crustaceans, as well as small fish and mollusks. Oyster toadfish spawn in the shallow waters of Chesapeake Bay from April to October (CBP 2009a). Individual fish may be directly affected by the action of dredging but, as suggested for the other reef-dependent species, the proposed approach to removing shell from the shoal may result in an increase in available habitat for this species.

Other Common Species Present in the Vicinity of the Project Area - The following species are not federally managed (i.e., they have no designated EFH) but were taken in the greatest abundance during the DNR's surveys (1987, 1988) and ChesMMAP (Bonzek 2008).

Striped bass *(Monroe saxatilis)* is a piscivorous species that resides in Chesapeake Bay in a variety of environmental conditions. The species is anadromous, spawning in fresh or nearly fresh water once each year between April and June. Striped bass eggs tolerate temperatures ranging from 14°C to 23°C, and larvae tolerate temperature ranging from 10°C to 24°C. The temperature range for juvenile striped bass ranges from 10°C to 27°C. Fish in these three life stages reside in the fresh or nearly fresh water habitat where spawning occurred. Adult striped bass tolerate a wider range of temperatures from (0°C - 30°C) and feed on fish and invertebrates.

Striped bass eggs and larvae will not be affected by the proposed dredging at Man-O-War shoal because the spawning area for this species is located well to the north of the shoal (north of Bush River). Adult and older juvenile striped bass are likely to be found at the shoal regularly. Individual juveniles and adults are unlikely to be directly affected by the action of dredging because of their mobility. The alterations of the structure of the shoal structure resulting from shell removal as proposed here will create irregular topography within the shoal that may contribute to increases in epibenthic organisms and other organisms that occupy shell habitat and serve as forage for striped bass. In addition, the additional structure created by the dredge cuts as well as any enhancement of the live oyster bottom that may result from subsequent management actions may attract fish and result in increased densities.

White perch (*Monroe americana*) reside everywhere in Chesapeake Bay but prefer substrates with fairly level bottom topography and silt, mud, clay, or sand bottom substrate. Spawning usually occurs in freshwater but can occur in salinities up to 4.2 ppt. Larvae prefer salinities of 3 to 5 ppt. Juvenile white perch can remain in low-salinity nursery areas for up to a year, then the fish begin to prefer demersal habitat and occasionally migrate offshore during the day. Adults can be found at water temperatures ranging from 2°C to 32.5°C and can tolerate salinities ranging from fresh water to sea water. Shell-dredging effects on white perch are expected to be similar to those on striped bass. Early life stages are unlikely to be affected because Man-O-War shoal is not in a major white perch spawning area (north of Back River). Habitat effects would be expected to be the same as described previously, including the likelihood of an increase in the quality and quantity of habitat for this species

Spot *(Leiostomus xanthurus)* migrate seasonally as adults, entering bays and estuaries in the spring. In the late summer or fall, spot move offshore to spawn. Adult spot are primarily found in salinities greater than 5 ppt, but juveniles can be found at lower salinities as well as in tidal freshwater. Primary nursery areas for juvenile spot occur in low-salinity areas of the Bay and tidal creeks, and spot also can be found associated with eelgrass communities and oyster beds. As water temperatures decrease during the fall, most juveniles migrate to the ocean, but some may overwinter in deeper waters of the Bay. Juvenile spot would be likely to be found in the project area throughout the summer, but adults would be less likely to occur. Individual fish are unlikely to be affected by the action of dredging because of their mobility. Habitat effects would be expected to be the same as described for striped bass and white perch, including the likelihood of an increase in the quality and quantity of habitat for this species

Bay anchovy (*Anchoa mitchilli*) is a non-migratory, schooling species that resides in Chesapeake Bay year round. It is a major source of food for many predatory fish in the Bay, including striped bass. Spawning occurs between April and September where temperature is warmer than 12°C and salinity is greater than 10 ppt. Bay anchovy tolerate wide ranges of salinity and temperature. Bay anchovies will be present in the project area and, as plankton feeders, could be affected by plume effects on phytoplankton and zooplankton. The plume characteristics described previously, however, are unlikely to have adverse biological effects and are expected to dissipate rapidly after cessation of dredging. Bay anchovies do not use bottom substrates; therefore, they would be unaffected by the proposed alterations of Man-O-War shoal.

4.5. Recreational fishing

Man-O-War shoal is in the same general area of the Bay as Seven Foot Knoll and Nine Foot Knoll. Based on anecdotal information from sports fishermen, those shoals are generally are considered to be good for white perch fishing and, in years past, were relatively good for striped bass. Hicks et al. (2004) documented that hard-bottom habitats in the Bay are favored locations for many recreational fishermen, and that primary target species including croaker, spot, and striped bass. Unfortunately, neither DNR nor the National Marine Fisheries Service conduct recreational fishing surveys that provide geographically specific data for fishing effort to the scale of such a small area of the Bay as Man-O-War shoal; consequently the relative importance of Man-O-War shoal as a fishing location compared with other knolls and lumps in the upper Bay cannot be evaluated specifically. The potential for the proposed dredging program to affect the level of recreational fishing activity is pursued at the shoal, however, can be assessed.

Dredging shell from Man-O-War shoal could alter the habitat in ways that could decrease the fishery value of the site; however, findings summarized in Section 4.4 suggest that the proposed dredging, (i.e., partial cuts into the periphery of the shoal) is not likely to decrease the habitat value of the shoal for the fish species considered, including striped bass and white perch, and that it may result in enhancing habitat for those and other species. To test the validity of this these projection, the fish community will be monitored (as described in Section 7.0) for two years after initial dredging to detect any changes in use of the shoal by important recreational fish species. Further dredging using the proposed approach would continue only if no significant deleterious effects are observed. If any significant changes in fish usage of the shoal are observed in response to the initial experimental cuts, alternative dredging approaches will be implemented.

Dredging activity could interfere with recreational fishing. Fishing boats will be unable to fish the specific location where dredging is being conducted, and boaters may avoid areas of turbidity in the plume generated as a result of dredging, even though past monitoring studies have suggested that, in fact, the density of fish may be greater in the plume than in unaffected waters. DNR will seek to minimize displacement of fishing activity by scheduling dredging activity so that most work occurs fishing activity is be expected to be minimal, such as during winter. Some dredging, however, probably will be required in June and July if the dredged shell

is to be used to capture natural spat set. Displacement of fishing activity will be unavoidable at those times.

Although adverse effects on recreational fishing have been a major point of contention surrounding past shell dredging operations in the upper Bay, this difficulty may be assuaged by the fact that most the shell to be recovered in future operations will be used for ecological restoration intended to reestablish live oyster bottom in locations where hard-bottom oyster habitat is declining. Hicks et al. (2004) confirmed the very high value that recreational fishermen attach to such hard-bottom habitat. They estimated that the creation of 2,000 acres of new hard-bottom habitat in the Bay at 73 locations would increase the net value of recreational fishing activity in the Bay by $640,000 per year. Their study suggests that the benefits of the proposed shell dredging program are likely to significantly outweigh the very limited impediments to on recreational fishing that would be expected to result from the program as it is currently proposed.

4.6. Recreational and Commercial Boating

No boating survey data are available to document the numbers of commercial and recreational vessels that frequent the area of Man-O-War shoal. The Brewerton Shipping Chanel, through which commercial vessels access Baltimore Harbor, is located approximately 3 km southwest of Man-O-War shoal (Figure 1); therefore, dredging activity at the shoal will not interfere with commercial shipping. Man-O-War shoal is in relatively close proximity to western shore tributaries that contain by numerous marinas and waterfront homes and docks, including the Patapsco and Back rivers. Boating traffic through the shoal area probably is substantial during the warm months of the year. As in the case of recreational fishing activity, the presence of the dredge during dredging operations may displace boating activity at and through the dredging site. In addition, dredging may create what some observers might consider to be adverse effects on aesthetics due to the turbidity plume. Such effects are unavoidable but will be temporary and minimal in scope.

4.7. Cultural Resources

One issue that must be addressed before any dredging activity is conducted in tidal waters of Maryland is to determine if the proposed dredging will affect any underwater cultural resources. DNR has consulted the Maryland Historical Trust (MHT) and received confirmation that the proposed program will not affect any cultural resources. The MHT's confirmation letter is included as Attachment A.

5.0 Potential Ecological Effects of Use of the Dredged Shell

Any permit issued in response to this application will include specifications for how and where shell dredged from Man-O-War shoal is to be used. Shell used in any manner has the potential to result in ecological consequences, both positive and negative. This section describes and evaluates those potential consequences.

5.1 Use of Dredged Shell

DNR intends to use 90% of the shell dredged from Man-O-War shoal at bars and locations designated as sanctuary bars or non-harvest bars (i.e. placed in areas off-limits to commercial harvesting) for ecological restoration; the rest is to be used on harvest reserves, aquaculture sites, and open harvest areas. Planting of shell will be consistent with the guidelines provided in the Chesapeake Bay Program's 2004 Oyster Management Plan.

5.2 Amount of Habitat to be Restored

Past use of dredged shell in Maryland's repletion program involved creating layers of shell 3 inches to 6 inches deep, using about 7,500 bushels per acre. The 5 million bushels of shell to be removed from Man-O-War shoal could be used to refurbish about 667 acres of bar habitat according to those past procedures; the full 30 million bushels of shell that might ultimately be obtained from Man-O-War shoal could refurbish about 4,000 acres. Such use of dredged shell in the past has proven to be unsuccessful for enhancing oyster populations, and newly dredged shell generally will not generally be deployed in that manner. Recent restoration programs that have shown signs of success, discussed in Section II, require much larger amounts of shell per acre. The estimates presented there are that as few as 1,400 acres of habitat may be enhanced with the total amount of shell that could be dredged from Man-O-War shoal. However, the objective is to ensure that the habitat created using the dredged shell creates a live oyster reef and a sustainable oyster population that results in shell accretion and improved reproductive success, such that no further additional substrate will be required.

5.3 Potential Fate of Placed Shell

Shell planted in Maryland's past repletion program that received no significant spat set usually became silted over within about five years (Smith et al 2005). Such covered shell soon will be subject to reclamation according to the permit discussed in Section 3.0. Reclaiming previously planted shell that was lost due to sedimentation is inefficient and costly; therefore, past planting procedures will be avoided to the extent possible; nevertheless, shell from past repletion programs that has been covered with silt can be reclaimed, which makes it a reusable resource until it degrades and breaks down.

Shell planted on sanctuary bars in low-salinity areas is subject to siltation, as are bars throughout the Bay. Sanctuary bars in low-salinity waters, however, will be seeded with hatchery-reared spat-on-shell. Mortality due to disease is low in low-salinity waters; therefore, planted oysters are expected to grow over many years, resulting in accretion of shell and growth of the oyster bar that is likely to compensate for substrate loss due to degradation of old shell and siltation. These bars probably will not become self-sustaining because oyster reproduction generally is poor in low-salinity areas, and regular seed planting in future years probably will be needed to sustain the bars. While the bars may have to be sustained with repeated seeding, these growing reefs will contribute to local improvements in water quality as a result of increased water filtration by the oysters and in improved habitat for species for which hard bottom and shell habitat is essential.

Innovative approaches will be employed when placing shell in higher salinity waters, as suggested by the programs in Virginia that have shown signs of success. Large, three-dimensional sanctuary reefs that are constructed where they could serve as sources of larvae to colonize other bars in surrounding areas could contribute to selection for, and propagation of, disease resistance in local oyster stocks. Ultimately such reefs could result in sustained growth of the oyster population. Sustained population growth would result in shell accretion that could sustain the bars enhanced or created as a result of these innovative approaches.

The relatively small amounts of shell that may be used to support the expansion of oyster aquaculture in Maryland would be placed to serve as substrate for planting hatchery-produced seed. Shell would be provided for start-up operations. Once an operation is established, aquaculturists will be expected to maintain their own shell base through such measures as deployment of shucked shell or private purchase of shell. However, provision of shell by the state is likely to be required during initial years of aquaculture establishment and enhancement.

Relatively small amounts of shell would be used to continue repletion activities that are funded by oyster fees paid by watermen. Shell for continued repletion would be planted in high-salinity areas where recruitment is generally high and, subsequently, would be removed with attached spat and relocated to open-harvest bars in low-salinity areas, where mortality is low. Those bars would be subject to being harvested when the seed oysters grow to market size, and some dredged shell would be lost when the oysters are harvested. DNR would sample the original seed locations and potential open-harvest bars for disease prevalence before relocating any seed. Disease testing would be done during DNR's regular fall oyster survey and supplemented by sampling at bars identified as candidate sites for seed removal and planting. Seed would be moved from one location to another only if the disease prevalence in the seed source location is lower than the disease prevalence in the open harvest location at which the seed would be planted so that this program would not contribute to exacerbation or expansion of the distribution of oyster diseases within Maryland waters.

5.4. Possible Placement Locations

DNR currently is revising the oyster management and restoration plan. As a result, specific locations for and kinds of restoration activities for which dredged shell will be used have

not yet been designated. Selection of shell planting sites will be based upon scientific findings of the PEIS, input from the OAC, and guidance provided in a Bay-wide restoration plan being developed by the USACE. Except at aquaculture sites, shell would be placed only on, and immediately adjacent to, existing charted oyster bars. Locations could be anywhere within the historic range of distribution of oysters in Maryland's portion of the Chesapeake Bay. Dredging of shell would not commence until usage and specific sites are identified, although some shell may be stockpiled for short times for later use.

5.5. Ecological Consequences of Shell Placement

Discharge of shell from the shell barge at any placement location will create few water quality problems, because shell will have been washed on deck as it was being dredged. The placement of dredged shell in nearly all cases will be in areas where a similar kind of substrate has been lost or degraded. Thus, shell placements will result only in habitat improvements, without adverse effects.

Shell planting could result in habitat changes, but only at aquaculture sites or in locations where existing footprints of bars are expanded. In those instances, planting of shell would convert some existing soft-bottom habitat to hard-bottom habitat, with accompanying changes in the biological communities that would occupy such sites. In such cases, the area of hard-bottom habitat that is currently relatively limited would increase to the benefit of a wide range of species, from diving ducks to fish. The areas affected in this way are anticipated to be virtually insignificant when compared to the total acreage of soft bottom habitat in the Bay. Thus, this ecological change would not be considered a negative effect.

6.0 Economic Considerations

DNR has estimated the cost of shell dredging at $16/cubic yard, or approximately $1/bushel.[2] The total cost for removing 30% of the shell from Man-O-War shoal would be on the order of $30 million. During Year 2 of the period of the requested permit, approximately 2 million bushels would be dredged at a cost of about $2 million, which is roughly DNR's annual budget for shell dredging. Thus, funds are likely to be available for dredging the 5 million cubic yards of shell requested in this permit application over the five-year term of the permit.

The cost of reclaiming previously planted shell is about the same as the cost of dredging historical shell; unit costs for alternate substrates were presented in Section 3.0. Most of the shell to be dredged will be used for ecological restoration. Completing a cost/benefit analysis would require estimating the indirect economic benefits of restored oyster bars. Work by the University of Maryland, in cooperation with the Oyster Recovery Partnership, is presently ongoing to develop such estimates. This is being done by quantifying the dollar value of the water quality benefits of increased filtration by oysters, the benefits of an increase in oyster bar habitat for recreational fishing, and other positive economic enhancements from oyster restoration. No estimates are available at this time that could be compared with the estimated cost of dredging shell that is essential for restoration efforts. The small amount of shell that would be used to continue the repletion program to sustain some wild oyster fishery is anticipated to be paid for primarily from oyster fees paid by watermen. Shell will be essential for a major expansion of oyster aquaculture in Maryland, and the economic benefits of an expansion of this industry will be realized only if the amount of shell needed to establish a significant number of grow-out bars is available.

[2] One bushel = 0.06 cubic yards; one cubic yard = 16.7 bushels

7.0 Mitigation and Monitoring

7.1 Water Quality During Dredging

DNR proposes to monitor water quality effects while dredging is being conducted. Water quality will be assessed at a selected number of sampling stations during dredging, and immediately after dredging activities cease. Water quality samples will be collected in the immediate dredging area as well as in surrounding areas to assess conditions in the water column, including turbidity, nutrients (ammonium, nitrate, nitrate, total Kjeldahl nitrogen, orthophosphorus, and total phosphorus), chlorophyll, and other water quality characteristics (dissolved oxygen, temperature, salinity, pH).

Water quality samples will be collected at sites up and down the tidal current axis from the point of dredging at intervals of 50 m and 500 m from the dredging operation. Samples will be collected at 0.5 m below the surface, above the bottom, and above the pycnocline (or mid-depth if no pycnocline is present). If water is deeper than 10 meters, additional samples would be collected 1.5 m above the bottom and below the surface. If the dredging method used results in an overboard discharge of wash water, three to five samples of wash water will be collected (with recorded dredging volume) at equal intervals during the dredging process. The data from the fixed water quality sampling will be used for water quality mapping of near surface water quality conditions in and around the dredging site during and after dredging operations. This will provide additional information about some water quality conditions and a measure of spatial variability of turbidity and chlorophyll levels up- and down current of dredging operations.

7.2 Oysters

The Man-O-War oyster bar will continue to be monitored as a part of the annual fall oyster survey. This survey will continue to determine the average number of live and dead oysters in each size class and record spat set. Disease prevalence (Dermo and MSX) and shell length also will be recorded. To address the potential for siltation of live oyster bottom from the dredge operations, three to five sediment samples will be collected from the surface of the shoal prior to and annually after dredging is initiated. These data will allow classification of shallow overlying sediments (sand/silt/fines) to establish whether sediments suspended as a result of dredging activity have resettled and silted over existing hard bottom.

7.3 BACI Water Quality, Fish and Benthos Monitoring

Several sites will be selected at the shoal for sampling, one or two (depending on how many cuts are planned) from which shell will be dredged (i.e., "impact" sites) and two sites (control sites) that are not in proximity to the dredge sites but have similar environmental characteristics (e.g., water depth to top of shoal). Fish communities will be sampled, at all sites in year 1: (before dredging) with emphasis on two key species, striped bass and white perch. Standard water quality parameters and samples of the benthic community and sediment will be

taken at the same sites. Sampling will be performed during three seasons: spring, summer and fall, with a sufficient number of samples for statistical analysis. The sampling program will be repeated in years three and four of the permit term, with sampling being done within the dredge cuts at the impact site(s). Data analysis will examine differences in fish abundance and composition, benthic community composition, water quality, and substrate before and after dredging at the impact sites and between reference and impact sites. Significant differences, with degraded biological communities and environmental quality at the impacts sites, would indicate adverse environmental impacts.

7.4 Structural Integrity of Dredge Cuts

In Year 4 of the term of the permit, acoustic surveys of the dredged cuts will be performed to assess whether the structure of the cuts has been retained and whether any sedimentation of the cut floors has occurred over that relatively short term.

7.5 Monitoring Report

A report summarizing the results of all monitoring conducted as part of the project will be prepared in Year 4 of the permit term. The findings of the study will serve as the basis for proceeding or not proceeding with the final dredging in year five of the permit term as currently planned. The findings will also provide the basis for a decision to apply for subsequent permits for proceeding with the additional shell removal planned for Man-O-War shoal.

8.0 Stakeholder Coordination

DNR will coordinate the shell dredging and planting program primarily with the Maryland Oyster Advisory Commission, which includes representatives of all stakeholders with interest in oyster restoration in the bay. Input from other interested parties will be taken into account. Interested stakeholders will be encouraged to contribute to defining the overall objectives for the program, the allocation of material among management designations, location of shell-placements, project specification guidelines, and project performance standards.

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Governor
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Maryland Department of Planning
Maryland Historical Trust

Richard Eberhart Hall
Secretary
Matthew J. Power
Deputy Secretary

November 14, 2008

Mr. Eric Campbell
DNR Chesapeake Shellfish Program
580 Taylor Ave, B-2
Annapolis, Maryland 21401

Re: Proposed shell dredging permit application for Man O War shoals

Dear. Mr. Campbell:

DNR Chesapeake Shellfish Program contacted the Maryland Historical Trust (Trust) on behalf of the Oyster Advisory Commission about the presence of known historic resources within Man O War shoals prior to submitting a new shell dredging permit application. Furthermore, DNR provided a rectilinear boundary delineated by the following coordinates defining the project area: 39 11' 23.164" N, 076 23' 23.922" W; 39 11' 23.164" N, 076 21' 12.053" W; 39 10' 43.065" N, 076 23' 23.922" W; and, 39 10' 43.065" N, 076 21' 12.053"W. The Trust's records indicate that there are no known historic resources within this area. The Craighill Channel Lower Range Front Light Station, built in 1873 and listed on the National Register of Historic Places, is directly to the West of the project area within the partial boundary of Man O War Shoals and should be avoided.

Any type of dredging activities have the potential to impact unknown historical resources. The Trust requests that if historic or archaeological materials (e.g., ceramics, arrowheads, bones, stone tools, historic wooden structures, etc.) are discovered during activities related to this project, the agency official determine actions that can be taken to resolve adverse effects, and to notify the Trust within 48 hours of discovery.

Thank you for the chance to comment on the proposed undertaking. If you have questions or require further assistance, please contact me at 410-514-7668 or bjordan@mdp.state.md.us. Thank you for providing us this opportunity to comment.

Sincerely,

Brian Jordan
Assistant State Underwater Archaeologist, Project Review and Compliance