QUALITY CONTROL (QC) AND
INDEPENDENT TECHNICAL REVIEW (ITR) PLAN

1.0 PURPOSE

This review plan presents the process that assures quality products for the Chesapeake Bay Oyster Recovery, MD and VA master plan. This QC and ITR plan defines the responsibilities and roles of each member on the study and technical review team.

The product to be reviewed by the technical review team is the Chesapeake Bay Oyster Recovery, MD and VA master plan and environmental impact statement (EIS). Under the provisions of new U.S. Army Corps of Engineers (USACE) policy, as detailed in EC1105-2-408 dated May 31, 2005, the ITR will be conducted by specialists from organizations outside of the district responsible for the study. ITR will be conducted for all decision documents and will be independent of the technical production of the project. This QC and ITR plan is, by reference, a part of the project management plan for this master plan.

2.0 APPLICABILITY

This document provides the quality control plan for the Chesapeake Bay Oyster Recovery, MD and VA master plan. It identifies quality control processes and independent technical review for all work to be conducted under this study authority, including in-house, sponsor and contract work.

3.0 REFERENCES

EC 1105-2-408 “Peer Review of Decision Documents” (May 31, 2005)
EC 1105-2-407 “Planning Models Improvement Program: Model Certification” (May 31, 2005)
EC 1105-2-409 “Planning in a Collaborative Environment” (May 31, 2005)
ER 1105-2-100 “Planning Guidance Notebook and Appendices”

4.0 GENERAL PROJECT DESCRIPTION

The Chesapeake Bay Oyster Recovery, MD and VA master plan is being developed jointly by the Baltimore and Norfolk Districts, under authority of Section 704(b) of the Water Resources Development Act (WRDA) of 1986, as amended by Section 505 of WRDA 1996, Section 342 of WRDA 2000, Section 113 of the FY02 Appropriations Act, and Section 126 of the FY06 Appropriations Act. In WRDA 1986, as amended, the Corps of Engineers received the authorization to construct “reefs and related clean shell substrate for fish habitat, including manmade 3-dimensional oyster reefs, in the Chesapeake Bay and its tributaries in Maryland and Virginia.” Although the project authorization was passed in 1986, funding for the project was not made available until 1995. The Baltimore District prepared decision documents in 1996 and 2002 supporting the construction of oyster bars in Maryland waters and has implemented projects with the Maryland Department of Natural Resources (MDNR) as the non-Federal sponsor. In addition, the Norfolk District prepared decision documents in 2001, 2003, and 2005 supporting construction of oyster reefs in Virginia waters (constructed or scheduled for

construction) with the Virginia Marine Resources Commission (VMRC) as the non-Federal sponsor. Over 700 acres of oyster reefs under authority of Section 704(b) have been either constructed or approved for construction in the Chesapeake Bay by the Corps of Engineers.

The success of the Chesapeake Bay Oyster Recovery, MD and VA Project and the continued crucial need for conservation, restoration, enhancement, and the creation of oyster habitat in the Chesapeake Bay have raised interest in this work in both the oyster restoration community and Congress. This interest has led the oyster restoration teams from the Baltimore District and Norfolk District to undertake preparation of a native oyster restoration master plan for future work that looks at the entire Chesapeake Bay and proposes a more comprehensive plan for oyster restoration in the Chesapeake Bay watershed. Initially, each district was addressing Maryland and Virginia waters separately. However, in December 2005, senior leadership within each district recommended that the master plan be developed, prepared and documented by a single integrated team. This position has been endorsed by both the District Support Team (DST) and the Regional Integration Team (RIT). The master plan will address the Chesapeake Bay as a single watershed and recommend one plan encompassing a fully integrated strategy for restoring the native oyster consistent with the Corps of Engineers mission areas and authorities.

5.0 REVIEW REQUIREMENTS

Although the primary independent review entity is external to Baltimore and Norfolk Districts, the decision was made that the initial quality control (QC) review will be handled by NAO. Tom Yancey of NAO was originally assigned in December 2005 as the QC team member. With his recent retirement, NAO will be identifying a replacement. The initial QC activities will include:

(1) Prepare and coordinate the quality control plan (QCP) for the native oyster restoration master plan;

(2) Attend and document project team meetings for the purpose of providing planning and policy guidance and advice, and identifying and assisting in the resolution of technical and policy issues.

(3) Attend and document, including follow-up actions, monthly “mini-PRB” meetings for the oversight team members (chiefs of Planning NAB and NAO, and NAD DST);

(4) Conduct separate technical review meetings, as needed, with the project team to address technical and policy issues, including follow-up actions to resolve these issues;

(5) Research technical and policy matters, including coordination with the vertical team (DST/RIT) and external independent review team, as necessary, to facilitate resolution of issues for the project team;

(6) Participate in all milestone meetings including issue resolution conferences (IRC’s) and other vertical team meetings;

(7) Review and provide written comments on all products including the draft master plan and/or interim products, thereof, and read-ahead packages in preparation of milestone meetings and IRC's. Coordinate responses with the project team and ensure documentation of responses;

(8) Maintain coordination with the external ITR team leader including providing invitations to participate in technical review meetings, IRC's, and other milestone meetings; and

(9) Maintain a file on documentation for technical and policy review.

Pursuant to EC 1105-2-408, item 2 c (2), models used in the preparation of decision documents covered by this circular will be reviewed in accordance with EC 1105-2-407, *Planning Models Improvement Program: Model Certification*, and are not subject to the requirements of the 1105-2-408 circular. The uses and applications of models in individual studies that lead to the preparation of decision documents covered by this circular will be reviewed in accordance with the requirements of this circular.

A number of models are being considered for use in the preparation of the decision documents for this project including a model developed by NAO, models developed originally by the non-native oyster EIS team and contractors, and models developed by contractors for NAB [note that the non-native EIS is a Bay-wide activity currently being prepared under the oversight of the Corps of Engineers, sponsored by the State of Maryland and the Commonwealth of Virginia, entitled "Programmatic EIS to Evaluate Oyster Restoration Alternatives, including the Proposed Action of Introducing the Oyster Species *Crassostrea ariakensis.*"] Three oyster modeling projects are being undertaken as part of the ongoing non-native oyster EIS efforts: a demographic model by Versar, a larval transport model by a University of Maryland team led by Elizabeth North, and a Chesapeake Bay Environmental Model Package (CBEMP) developed by Carl Cerco and Mark Noel at the U.S. Army Engineer Research and Development Center (ERDC) [Note: The non-native oyster EIS work is being conducted separate from this project; that effort falls under the Section 510 program.].

The first two models are to undergo a peer review by the scientific community as part of their involvement in the non-native oyster EIS. These three models will likely be the prime tools used to guide plan formulation for the native oyster restoration master plan. Additionally, in coordination with Ken Paynter and Mike Liddel at the University of Maryland, a growth and disease model was developed for low to mid-salinity waters. This model is also undergoing scientific peer review as part of the manuscript publication process. NAO has formulated an oyster biomass model for use in high salinity waters that could be incorporated as part of plan formulation. There are additional oyster modeling efforts underway that may be useful to our project: an ecoservices model being developed by Ken Paynter's group at the University of Maryland, and an ecosystem benefits model and a cost-benefit analysis being developed by Elizabeth North's group (also at the University of Maryland), plus a metapopulation stock assessment being developed at the Virginia Institute of Marine Science.

Pursuant to EC 1105-2-408, due to the somewhat complex nature of the planning phase of this project an ITR team was assigned to this master plan even though the effort predated the EC. This assignment has been approved by North Atlantic Division, and approval will be sought from the Environmental Planning Center of Expertise. The New England District was selected to perform the ITR in accordance with policy. The ITR team is responsible for ensuring that all technical products of the study team meet Corps regulations, standards, and current guidance. Based upon the initial risk screening process conducted by the project team noted in Section 9, it is anticipated that while this study will be challenging and beneficial, it will not be novel, controversial or precedent setting, nor have highly significant national importance. As a result, external peer review will not be necessary. The ITR will focus on reviewing the underlying assumptions, conclusions, recommendations, models, and analyses in the context of established policy and guidance.

Ms. Barbara Blumeris, regional technical specialist for plan formulation, New England District, has been selected to lead the ITR team. It should be noted that the ITR team has already been briefed on the extent of their duties, and they understand that the review team's involvement in the study process is ongoing and continuous. Ms. Blumeris, in coordination with the ITR team, will be responsible for the following activities:

(1) Lead and manage the ITR.

(2) Coordinate the assembly of an appropriate ITR team.

(3) Attend all milestones meetings by video teleconference or telephone, including IRC's and other vertical team meetings, as appropriate.

(4) Conduct external technical review meetings with the project team, as necessary, to resolve identified issues early on.

(5) Maintain ongoing and continuous review of distinct products as they are completed.

(6) Conduct reviews and provide written comments with coordinated responses of major products and draft and final report including environmental documentation. A memorandum for the record (MFR) will be the basis of accountability for the review of major products, including the draft and final master plan. A review team member will prepare the MFR and it will become part of the review team's records. Specific issues raised in the review will be documented in a comment, response, action required, and action taken format. Minor grammatical or editorial comments should NOT be included as part of the MFR, but sent to the project team separately.

6.0 REVIEW PROCESS

It is anticipated that the ITR review process will begin after the ITR team has been assigned, and will initially cover the project management plan and the models to be used in the analysis. As alternative plans are formulated, the review process will focus on data, assumptions and the

engineering, scientific, economic, social and environmental analysis process. Major review process milestones are listed below:

- Initiation of Master Plan
- P-6 Feasibility Scoping Meeting
- ITR team assigned by PCX
- Formulation Analysis Notebook (P-7 RAM) to ITR Team
- P-7 Plan Formulation Meeting
- P-8 Milestone – AFB RAM
- AFB
- Draft Report Review
- Final Report Review

7.0 REVIEW COST

The cost of the ITR is to be determined between the team and the PCX. It is assumed that documents to be reviewed will be transmitted electronically. Comments will be made and addressed in Dr. Checks. It is also assumed that the external ITR team will be working virtually. Only under extreme circumstances should the external ITR team, or a representative of that team, be required to physically attend team or milestone meetings. The team should participate in all P milestone meetings; however, via conference call or video teleconference.

8.0 REVIEW SCHEDULE

Note that since the commencement of this study preceded the requirement for PCX involvement and development of this review plan, the review schedule below does not match the major review process milestone list above.

TASK	START DATE	FINISH DATE
Develop ITR Plan and post to Web Site, PCX	20-March-07	30-Apr-07
Identify Regional ITR resources and Recommend ITR Plan to PCX	TBD	
PCX Approves or Assigns ITR Team	TBD	
Review of Models	TBD	
ITR Team Review of FSM Documents	Waived	
Feasibility Scoping Meeting (FSM)	Waived	
Review of Formulation Analysis Notebook	TBD	
P-7 Meeting	TBD	
Preparation for AFB	TBD	
Alternative Formulation Briefing	TBD	
Review of Draft Master Plan	18-June 2008	22-July 2008

9.0 PROJECT RISK

The project team in coordination with the PCX will assess the risk associated with this project based upon five factors and rate the project quantitatively among five levels of project risk of failure ranging from low to high (risk score class). The scoring of each project risk item will be shown in the review plan score guide (Table 9.1) and an overall average project risk assessment score will be calculated. The exact value of the scores are not as important as compared to the risk score class (low, medium or high) to which the average project risk assessment score is classified.

The project team will consider previous Baltimore and Norfolk District project experience when making this analysis. The PCX will attempt to tie this to a national scale of rating. The project schedule and cost will be assessed as a low degree of risk if they both remain flexible and a high degree of risk if the project schedule and cost are to be fixed. Staff technical experience will be assessed as a low degree of risk if the staff has a high level of ecosystem restoration experience and a high degree of risk if the staff has a low level of ecosystem restoration experience. The results of the evaluation are to be tabulated as follows:

Table 9.1 Review Plan Score Guide

Project Risk Item	**Risk Assessment Score (Low Degree to High Degree)**					**Score**
	Low		Medium		High	
Project Complexity	1	2	3	4	5	
Customer Expectations	1	2	3	4	5	
Product Schedule/Cost	1	2	3	4	5	
Staff Technical Experience	1	2	3	4	5	
Failure Impact and Consequences	1	2	3	4	5	
Average Project Risk Assessment Score						

10.0 REVIEW PLAN

The components of the review plan (ITR only not external peer review) were developed pursuant to the requirements of EC1105-2-408.

10.1 Team Information

The decision document that will be the ultimate focus of the peer review process is the Chesapeake Bay Oyster Recovery, MD and VA master plan. The purpose of the decision document and associated EIS will be to guide the Corps' efforts to restore habitat for the

development and protection of a sustainable population of native oysters in Chesapeake Bay. The project team is listed below. This list provides the points of contact of NAB and NAO team members who are available to answer specific technical questions as part of the review process. The list also provides the names and organization of participating outside entities.

District Project Team Members:

CENAB-PP-C Project Manager	CENAO-PM-PR Regional Economist
CENAE-EP-P Study Team Leader,	CENAO-PM-P Plan Formulation/Internal QC
CENAB-PL-P Modeling/Biologist	CENAO-PM-PE Modeling/Biologist
CENAB-PL-P NEPA Compliance 410.962.4934	

Independent Technical Review Team:

NAE Team Members**	
ITR Leader, Plan Formulation	CENAE-EP-PS
ITR Economist	CENAE-EP-PS
ITR Marine Biologist	CENAE-EP-VE
ITR Hydrology and Hydraulics	CENAE-EP-EW

**Approved by Division

10.2 Scientific Information

Based upon the self evaluation by the project team, it is unlikely that the USACE report to be disseminated will contain influential scientific information. Influential scientific information is defined by the Office of Management Budget as scientific information the agency reasonably can determine will have or does have a clear and substantial impact on important public policies or private sector decisions. The environmental restoration measures that were identified will be evaluated using standard biological and economic processes.

As the modeling efforts that are being developed through the non-native EIS are still being completed, no final decisions have been made regarding which models will be applied to this project. It is anticipated that the larval transport model will be the best tool for site selection and prioritization given its promise in identifying sources and sinks of oyster reproduction.

A brief summary of all models introduced in Section 5.0 follows:

- Models being developed as part of non-native oyster EIS:

1. Demographic model by Versar

This tool is constructed to model growth, survival, mortality, and spatial distribution of oysters. For each bar (specified by MDNR), the model starts in the fall with the current state of the population given as the current frequency distribution of oysters in 5 millimeter size classes. The flow regime (wet, average, and dry) is randomly selected for the current year according to one of two probability models. Natural spat settlement is derived from the results of North et al.'s larval transport model and from the MDNR annual fall survey of oyster bars. This demographic model is structured to account for stocking as well as harvest mortality. The flow regime selected, along with salinity, also determines the probability of some catastrophic events, such as an MSX incursion (MSX is the parasitic disease *Haplosploridium nelsoni*) or winter freshet. A probability model predicts summer freshets. The individuals that survive grow in a one-year increment according to a Von Bertalanffy growth model. Food is assumed to be not limiting at any time or place. Growth is not influenced by changing densities. The remaining population, along with new spatfalls and stocking, provides the starting population for the following year. The model is designed to run for 10 years. The model does not include any changes to habitat availability or changes to environmental conditions (water quality, disease rates of Dermo, and probability of an MSX event).

2. Larval transport model by E. North (UMCES)

This model combines hydrodynamic modeling with a particle transport model to determine larval transport. Results to be compiled include identification of the best seed regions and best sink regions (not bar-specific). The model is a basic larval transport model and does not include any environmental effects on the survival of the settled larvae. For example, dissolved oxygen and predation will affect the number of larvae that survive after settlement. These processes are not included in this model, but rather the demographic model. The information from the larval transport model will be provided to the demographic model, which will evaluate these issues. The model relies on an estimate of current oyster habitat which has been developed from historical oyster boundaries in Maryland and Virginia. In the model, particles (gametes) are released to the water column from the current habitat in proportion to the size of the reefs. Hydrodynamics and larval swimming behavior are simulated, along with settling to identify the fate of the larvae. It is likely that the model would need to be re-run for use in the formulation of alternatives for the master plan to include a revised habitat layer (from that used for the non-native EIS) and to take into account environmental effects on the survival of the settled larvae..

3. Chesapeake Bay Environmental Model Package (CBEMP) (Cerco and Noel)

CBEMP consists of a coupled system of models including a 3-dimensional hydrodynamic model, a 3-dimensional eutrophication model, and a sediment diagenesis model. For the

non-native EIS, CBEMP was used to assess the environmental benefits of oyster restoration in Chesapeake Bay. Restoration levels up to fifty times the 1994 base biomass were examined. The model starts with a set biomass, uniformly distributed across historical oyster habitat. Examination of results emphasized dissolved oxygen, chlorophyll concentration, and water clarity. Ecosystem services performed by oysters include nitrogen removal and SAV restoration. Population processes including recruitment and larval setting are not considered. Mortality from harvest, predation, and disease are combined into one spatially uniform mortality term. The model uses a mass-balance equation to calculate changing (cumulative) oyster biomass. Population estimates are in the form of total mass rather than number of individuals.

- Additional Elizabeth North models:

1. Ecosystem benefits of oyster restoration

This model evaluates the effects of oyster filtration on water quality Bay-wide. The results identify tributaries where restoration can have the greatest impact on water filtration.

2. Cost-benefit analysis

The work focuses on a cost-effective/risk analysis of oyster restoration siting. That is, an economics model is being coupled with one that includes the costs of reef construction and a 3-dimensional hydrodynamic model. The goal is to identify where the cost of restoring reefs will provide the greatest benefit.

- NAB growth and disease model developed by University of Maryland (Paynter and Liddel):

This model focuses on the growth of the eastern oyster, and one of its primary diseases, Dermo. A Von Bertalanffy growth model is used to estimate growth in response to monthly variations in temperature and salinity. The goal is to predict the growth and survival of planted oysters and determine the suitability of a given site for an oyster restoration project or reserve planting. The model does not include reproduction or mortality due to MSX. This model is currently calibrated for a salinity range of 6 to 26 parts per thousand (ppt).

- NAO oyster biomass model:

The NAO oyster biomass model determines the expected oyster population on an oyster reef based on various parameters. Parameters and equations used for model development were pulled from scientific literature, current unpublished research, and in consultation with the scientific community. The model created is a Leslie matrix, a biological model used to project population dynamics, but does not estimate growth. The equations defined in the model are pulled largely from Mann and Evan 1998; that is, the model is primarily based on research done in the James River and is pertinent at a salinity of 20 ppt. The model is currently being revised and updated to accommodate a broad salinity range application.

- VIMS metapopulation stock assessment:

  Rom Lipcius (VIMS) is developing a model similar to the North et al. larval transport model. The Lipcius team's model can provide results at a much finer scale to guide focus on individual bars. The model tracks concentration of larvae and thereby allows a larger number of particles to be modeled as compared to the North model. However, the Lipcius model does not have the ability to track individual larvae behavior in the water column or include age cues.

While the restoration and/or protection of oyster reef resources will require innovative steps to achieve quality habitat the efforts envisioned to date will not result in a highly influential scientific assessment.

10.3 Timing
The ITR process will begin with an assessment of key models to be used in the evaluation and comparison of alternative plans in this master plan. It is anticipated that work would start within days of naming the external ITR team. The estimated schedule is noted in Section 8 of this review plan.

10.4 External Peer Review Process
It is unknown if there will be external peer review of the master plan and EIS.

10.5 Public Comment
Public involvement is anticipated throughout the master plan effort. Public scoping meetings in Maryland were held in February 2005. Further public involvement activities have not been scheduled at this time.

It is anticipated that summaries of public involvement meetings will be disseminated to the ITR team following the meetings. This will allow the public response to be available to the ITR team.

10.6 ITR Reviewers [This will be updated based on project team and MVD negotiations.]
It is anticipated that four to five reviewers total should be available in the following disciplines: hydraulic modeling, economics, ecology, planning, and cost estimating. The reviewer contact information should be stated in Section 10.1 of this review plan.

The expertise that should be brought to the review team includes the following:

1) Water Quality Modeling (Hydraulic Engineering) – The reviewer should have extensive knowledge of estuary hydraulic modeling, wave dynamics and analysis.

2) Economics – The reviewer should have a solid understanding of economic models including cost-effective incremental cost analysis (e.g. IWR Plan Suite) and its application to ecological restoration. The reviewer should also have an understanding of the risk and uncertainty associated with the models, data and results that are used in the analysis.

3) Ecology – The reviewer should have a solid background in the restoration of oyster reefs and associated estuarine habitat, and understand the factors that influence the reestablishment of native species of plants and animals.

4) Planning – The reviewer should have recent experience in reviewing plan formulation processes for aquatic ecosystem restoration studies and be able to draw on "lessons learned" in advising the project team of best practices.

5) Cost Estimating – As required by HQUSACE, the review will be conducted by Cost Estimating Center of Expertise (NWW).

10.7 External Peer Review Selection

This will be determined based on the need for external peer review, which is to be determined as discussed above.