Model Review Plan
Lock Performance Simulation Model used in Olmsted Locks and Dam Post Authorization Change Report

Waterway Analysis Model - WAM

Planning Center of Expertise
for Inland Navigation
Huntington District
23 October 2009

Executive Summary

The Waterway Analysis Model (WAM) is used in the inland navigation business line to estimate delays at locks and dam projects given different levels of traffic. The model has been in use for over 30 years and is considered a legacy model. As such it is recommended that it for a level (4) of review.

The proponent of the model is the Planning Center of Expertise for Inland Navigation (PCXIN) located in the Huntington District.

The documentation and review efforts are estimated to require a total of 140 days and $120,700 to complete.

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1. Purpose

The purpose of the review is to determine if the Waterway Analysis Model (WAM) is appropriate for the problem at hand and whether the computations are being performed correctly. The model is used in inland navigation studies for the principle purpose of estimating delays at traffic levels for which no historic data exists. The output is important in determining the economic feasibility of constructing larger lock chambers.

The model has the capability of modeling more than one project, but the standard version is restricted to one project. This review will address only the one project version of the model. Documentation and review will include the supplementary models used to generate the shipment list input to WAM.

2. References and Guidance

The review plan is based on requirements and guidance in five papers: 1) the Engineering Circular (EC) that requires model certification; 2) draft guidance elaborating on the documentation and review process; 3) the instructions for documenting and reviewing models; 4) the procedure for processing model reviews; and 5) the checklist for model reviews.

2.1 EC 1105-2-407; "Planning Models Improvement Program: Model Certification", dated 31 May 2005.

2.2 EC 1105-2-412; "Assuring Quality of Planning Models", dated 30 July 2009.

2.3 "Protocols for Certification/Approval of Planning Models", undated but draft document includes date of 24 June 2009 in name.

2.4 Email from HQ dated 7 September 2007 under the subject "Interim Guidance for PCX's to Proceed with Model Certification (included as Attachment 1 to this paper).

2.5 Questions to consider when performing a model review. Questions provided by Headquarters (HQ).

3. Background

WAM is used in inland navigation studies for the principle purpose of estimating delays at lock and dam projects. The model is written in SIMSCRIPT computer language.

The principle input to the model is a list of tows whose number equals the number of vessels that require lockage through a navigation project on an annual basis. Each tow has attributes such as direction of movement, length of tow, width of tow, and other

characteristics that affect the lockage time. The number and characteristics of the tows are developed from LPMS.

A second set of data are the statistics that describe the shape and parameters of the distributions of time for the approach, entry, chambering, and exist times. These statistics are compiled by lock chamber and direction of movement. The data are developed from LPMS data and fitted to distributions using commercial off-the-shelf software.

The model operates by processing vessel arrivals at the project and then generating times for the approach of the vessel to the lock, the entry of the vessel into the lock, the chambering time, and the exit of the vessel from the lock. The arrival time and "lockage" times are generated based on statistical distributions derived from historical data. The model processes each vessel through one of the chambers at the lock. If a vessel arrives and there is no chamber available to serve the vessel, the vessel is placed in queue until a chamber becomes available. Vessels waiting in queue are said to be "delayed". For two chamber projects, the model factors in any possible additional time for locking through the second chamber while the first is busy, as well as an additional processing time if the second chamber is smaller and requires the vessel to reconfigure prior to entry. The number of vessel arrivals can be increased or decreased to measure the effects of changes in traffic on delays. Downtime (stalls) can be factored into the analysis by inputting durations of outages for reasons such as accidents and weather.

The model has the capability of modeling more than one project, but the standard version is restricted to one project. This review will address only the one project version of the model.

4. Documentation to be provided by Proponent

The proponent of WAM is the Center of Expertise for Inland Navigation (PCXIN) located in the Huntington District of the Corps of Engineers. It will provide the following documents to the reviewer(s).

4.1 Documentation

The model will be documented using Table 2 of the draft protocols as a template (Attachment 2). It is expected that extensive portions of the draft documentation of the WAM that was prepared several years ago can be copied into the review documentation to minimize the model documentation effort. A Users Manual will also be provided.

4.2 Other Pertinent Information

The model is considered a legacy model. It was originally developed by Dr. Michael Bronzini of CACI, Inc. in the 1970s as part of the national waterways study. It is written in the SIMSCRIPT computer language and has been used extensively since its

development. A partial list of studies which included use of WAM is provided in Table 1. A copy of the Olmsted Reevaluation Report will be provided to the reviewer(s) to illustrate the use of WAM in Corps studies.

Table 1: Partial List of Studies that included use of WAM		
	Study	**Approximate Date of Completion of Study**
1	Gallipolis (Byrd) Feasibility Study	1982
2	Upper Monongahela River Feasibility Study	1984
3	Locks and Dams 52 and 53 Feasibility Study (Olmsted)	1988
4	Lower Monongahela River Feasibility Study	1990
5	Winfield Feasibility Study	1992
6	Marmet Feasibility Study	1994
7	McAlpine Feasibility Study	1998
8	Kentucky Feasibility Study	1998
9	Chickamauga Feasibility Study	2000
10	Interim Feasibility Report: J.T. Myers and Greenup Locks Improvements	2000
11	Ohio River Mainstem System Study	2006
12	Olmsted Reevaluation Report	2007

5. Type/Scope of Review

5.1 Type of Review

It is recommended that the Waterway Analysis Model (WAM) be reviewed for certification at level 4, which is the least extensive level of review. The recommendation is based on the fact that WAM is a legacy model with over 30 years of use without problems in terms of computational inaccuracies or appropriateness to the problem under investigation. It appears to meet the criteria of a level 4 review as defined by EC 1105-2-407:

> "Level 4 review for current frequently used models that were developed by Corps Districts, Corps Labs and other agencies and contractors that have withstood historical informal reviews. The capabilities and limitations of these models are generally well understood. The review of

frequently used existing products will include examination of the individual product's review documentation to determine if the product warrants certification without a level 1 or 2 review."

5.2 National Model

WAM is a model that can be used by District personnel throughout the Corps, provided they have knowledge of how to run the model, and access to the inputs of the model. These requirements, plus the fact that the model is typically used infrequently by any one district, restricts those capable of running the model to a select few who probably number less than 5.

5.3 Intermediate Complexity

The model is more complex than a simple spreadsheet but less complex than most other evaluation models used within the Corps. There is a relatively low risk of making an incorrect investment decision due to model error. The model has been used for 30 years without incident and can be considered a legacy model that requires minimum review. It is proposed that WAM have a level 4 review, which is the least extensive of the four levels.

6. Description of Tasks

6.1 Documentation

The first step in the certification process is the documentation of the model. The model description will be documented by the model developer following the guidance in Table 2 of the "Protocols" (included as Attachment 2 to this paper). Partial documentation of the WAM is available from a draft Users Manual which will be finalized and provided to the reviewer. Documentation for the certification process will draw heavily from the Users Manual. Documentation of testing will be less detailed than required for new models since WAM can be considered a legacy model.

6.2 Review

The model will be reviewed as to whether it is appropriate to the problem under study and computationally correct using Attachment 2 as a checklist. In addition, the review will consider its use in studies dating back to the 1980s, and whether the information indicates the model is appropriate to the situation under study, whether the outputs of the model are generally consistent, and the degree to which the recommendations appear linked to the outputs of the model. A list of studies that involved use of WAM is provided in Table 1. The last two studies underwent extensive formal review, the first (Myers and Greenup interim feasibility report) by an expert outside the Corps and the second (the Ohio River Mainstem Systems Study) by an internal expert.

6.3 Quality Assurance

The Planning Center of Expertise for Inland Navigation (PCXIN) will perform a quality assurance review to ensure that the documentation and review followed guidance and that the recommendation is logical given the review and documentation.

6.4 Approval/Disapproval

The approving authority is Headquarters of the U.S. Army Corps of Engineers (HQUSACE). HQUSACE has ultimate decision making authority regarding the certification of a model. They may approve certification or disapprove pending additional testing and documentation.

The PCXIN will transmit the review package and recommendation to HQUSACE through Headquarter's Planning Branch (CECW-P). The role of Civil Works Planning is to decide whether to approve the certification of the model.

7. Certification Review Team Composition

There are four teams responsible for different products/decision in the model certification process. They are the model documentation team, the review team, the quality assurance team, and the approval team.

6.1 Documentation Team

Documentation is most effectively and efficiently accomplished by the model developer. Documentation and verbal explanation of the model will be performed Mr. Mark Lisney of the Institute of Water Resources, who has modified the model code and has run the model countless numbers of times. He will be assisted by Ms. Sharon Weekley, who is being groomed as the principle runner of WAM in the Planning Center of Expertise for Inland Navigation (PCXIN) in Huntington District.

Table 2: Model Documentation Team

Name	Organization	Phone	Qualification
Mark Lisney	Institute for Water Resources	502-499-5675	Most experienced user of WAM in Corps
Sharon Weekley	Huntington District	304-399-5334	Experienced user

6.2 Review Team

The review team will be headed by Dr. Jerry Bilbrey of Troy University, Assistant Professor of Management who will have primary responsibility for ensuring the model is conceptually appropriate for the purpose it is used. He will also be responsible for testing the model, documenting the review, ensuring all comments are submitted to the PCXIN, and coordinating with the PCXIN. The second member of the team will be Dr. Keith Sinkhorn of Peru State College, whose primary responsibility will be in verifying the

WAM is using statistics in an appropriate manner and whose secondary responsibility will be to support Dr. Bilbrey in the overall assessment of the model.

Table 3: Model Review Team			
Name	**Organization**	**Phone**	**Qualification**
Dr. Jerry Bilbrey	Troy University	334-808-6205	Taught and created planning programs
Dr. Keith Sinkhorn	Peru State College		

The qualifications of the recommended review team members are listed below. Both Dr. Bilbrey and Dr. Sinkhorn are considered highly qualified to perform such the review.

Dr. Bilbrey's Background and Qualifications

1. Ph.D. in Industrial Engineering from the University of Louisville in 2004.
2. M.E. in Computer Engineering from the University of South Carolina in 1999.
3. B.S. in Industrial Engineering from Tennessee Technological University in 1996.
4. Programmed and taught programming in several different languages (C/C++, Visual Basic, and Java).
5. Taught linear programming modeling using Excel.
6. Taught simulation modeling using AutoMod (discrete event simulation software).
7. Built a simulation model of the commercial traffic on Ohio River.
8. Built a model for testing scheduling algorithms for the single machine scheduling problem.
9. Built an artificial intelligence model (using Neural Networks) for evaluating risk of financial planners.
10. Built an artificial intelligence model (using Neural Networks) for choosing potential stock market winners from S&P 500.
11. Built a waterway analysis model with HEC-5 to determine potential worst-cast drought consequences on the ACT (Alabama- Coosa Tallapoosa) River Basin.

Dr. Sinkhorn's Background and Qualifications

1. Ph.D. Industrial Engineering, University of Louisville, 2003.
2. M.A. Mathematics, University of Louisville, 1999.
3. B.S. Applied Mathematics, Brescia University, Owensboro, KY, 1996.
1. 4. Taught Engineering at Colorado State University - Pueblo for five years.
5. In 2009 he joined the staff at Peru State College where he will teach mathematics and physics.
6. Scholarly interests include:
    - 6.1 Applied operations research
    - 6.2 Stochastic vehicle routing
    - 6.3 Centrality notions in graphs
    - 6.4 Heuristic methods for single and multiple objective combinatorial optimization

6.3 Quality Assurance Team

Quality assurance will be performed by Mr. David Weekly or his designate in the Planning Center of Expertise for Inland Navigation (PCXIN). Mr. Weekly is currently technical co-leader of the PCXIN, but previously was involved in modifying and running the WAM. He will be able to provide expert insight to the quality control process.

Table 4: Quality Assurance Team			
Name	**Organization**	**Phone**	**Qualification**
David Weekly	Planning Center of Expertise for Inland Navigation (PCXIN)	304-399-6955	Chief, PCXIN

6.4 Approval Team

The decision to certify or not to certify the WAM will be made by panel of senior leaders in HQUSACE headed by the Chief of Planning, Mr. Harry Kitch. The panel members will review the model documentation, the comments by the reviewers and the responses by the model proponent, and all other material they consider relevant to determine if certification is warranted.

Table 5: Model Approval Team			
Name	**Organization**	**Phone**	**Qualification**
Harry Kitch	Headquarters, USACE	202-761-4127	Chief, CECW-P

8. Schedule of Deliverables

The principle products developed during the review are the documentation of the model, the list of comments and responses from the review, and the model review package forwarded to HQ. Task 3 represents the completion of documentation of the model, and is scheduled to occur 45 calendar days after the initiation of the review process. Task 6 represents the completion of the review, and is scheduled 90 after initiation. Task 12 represents completion of the review package by the PCX, and occurs 105 days after initiation. The tasks and schedule are listed in Table 6.

Table 6: Schedule

Table 6: Schedule													
		Responsible party	Study orientation telecon			Review orientation telecon			Test model meeting		Discuss review telecon		
	Task		1	15	30	45	50	60	70	90	95	110	140
	Study orientation telecon	IWR/Troy/PCXIN											
1	Document model	IWR											
2	Document legacy use of model	IWR											
3	Document risk associated with model	IWR											
	Review orientation telecon	IWR/Troy/PCXIN											
4	Review model	Troy U											
	Test model meeting	IWR/Troy											
5	Test	Troy U											
6	Comment	Troy U											
7	Document review process	Troy U											
8	Make recommendation	Troy U											
	Discuss review telecon	IWR/Troy/PCXIN											
9	Manage model review	PCXIN											
10	Coordinate documentation and review efforts	PCXIN											
11	Perform quality assurance review	PCXIN											
12	Prepare documentation for HQ	PCXIN											
13	Coordinate with Division and HQ	PCXIN											

8.1 Documentation

The documentation will be prepared using Table 2 as an outline. Documentation is scheduled for completion within 45 days of the start of the effort.

8.2 Review

The documentation will be reviewed to determine whether appropriate testing of the model was performed, given the level 4 review. Comments and responses will be documented in DrChecks. Comments will be entered into DrChecks within 21 days of the start of the review effort. Responses will be entered within another 14 days, or 35 days after the start of the review. The final 10 days are available for resolution of unresolved comments, if possible.

8.3 PCX Management

The PCXIN will manage the funds and coordinate activities, as necessary. The PCXIN will perform a quality assessment (QA) of the model documentation prior to its submittal to the review person and then will assist in resolving any problems that may arise. The PCXIN will submit its own recommendation regarding model certification to HQ, with the model documentation, comments and responses, and the reviewer's recommendation as attachments. The submittal will be done within 15 days of the completion of the review effort.

9. Cost Estimate

The cost estimate is based on the participation of expert personnel for the documentation, review, and oversight. If the designated personnel are not available, then the cost will have to be increased as reflected in the contingency.

Table 7: Cost

Cost of Certification Effort							
	Task	Hours	Costs	IWR	Troy U	PCXIN	HQ
	Study orientation telecon		$ 3,000	$ 1,000	$ 1,000	$ 1,000	
1	Document model	120	$ 18,000	$ 18,000			
2	Document legacy use of model	24	$ 3,600	$ 3,600			
3	Document risk associated with model	24	$ 3,600	$ 3,600			
	Subtotal for documentation		$ 25,200				
	Review orientation telecon		$ 3,000	$ 1,000	$ 1,000	$ 1,000	
4	Review model	120	$ 18,000		$ 18,000		
	Test model meeting		$ 7,500	$ 2,500	$ 2,500	$ 2,500	
5	Test	40	$ 6,000		$ 6,000		
6	Comment	24	$ 3,600		$ 3,600		
7	Document review process	24	$ 3,600		$ 3,600		
8	Make recommendation	16	$ 2,400		$ 2,400		
	Discuss review telecon		$ 3,000	$ 1,000	$ 1,000	$ 1,000	
	Subtotal for review		$ 41,100				
9	Manage model review	32	$ 4,800			$ 4,800	
10	Coordinate documentation and review efforts	40	$ 6,000			$ 6,000	
11	Perform quality assurance review	24	$ 3,600			$ 3,600	
12	Prepare documentation for HQ	50	$ 7,500				
13	Coordinate with Division and HQ	40	$ 6,000			$ 6,000	
	Subtotal for coordination		$ 27,900				
	Contingency		$ 25,000			$ 25,000	
	Grand Total		$ 120,700	$ 30,700	$ 39,100	$ 50,900	$ -

Attachment 1: E-Mail Guidance on Model Certification

Folks,

Here's some much anticipated guidance on proceeding with Model Certifications in the absence of our formal PMP.

Although it has been slower than we had hoped, we have finally made substantial headway this FY in our efforts to start certifying planning models, per EC 1105-2-407. The draft protocols for certification (attached, also see Groove site) provide a solid basis for conducting and documenting our certification process. We currently have two pilot certifications underway (as Levels 1 or 2), under a contract being directed by IWR. And we have also received an excellent prototype certification package (as Level 3) prepared by the Nashville District and the Flood Damage PCX for a regional simulation model (attached, also see Groove site).

Recognizing that there is a substantial backlog of demand for certifying models, we now feel confident that we can move forward with the PCX's to begin model certifications under interim conditions described herein. Ultimately we will still need to develop a PMP among the PCX's to fully implement our certification process, but these interim procedures will allow us to make progress in certification while we learn by doing. This will help us to define a process that works well for the Planning CoP and can eventually be captured in the certification PMP.

The interim process will largely follow the process in the EC and the draft protocols, but will have a few more check points with HQ. As you will recall, EC 1105-2-407 identifies seven steps in the Certification process: http://www.usace.army.mil/publications/eng-circulars/ec1105-2-407/entire.pdf

By necessity, each Certification action will require a customized certification plan akin to a PMP, both for billing purposes and for delineation of the scope of review. The certification plan should fulfill Steps 1-4 from the EC (and by following the draft protocols), as well as provide a cost estimate to the proponent. Under interim conditions, the PCX will submit each certification plan to CECW-P for approval prior to initiating the review.

Upon receiving direction to proceed from CECW-P, the PCX will implement the review process as described in Steps 5-6 from the EC. Under interim conditions, in Step 7 the PCX will submit its recommendation for certification to CECW-P, but the determination of certification will be made by HQ.

Finally, under interim conditions an AAR in MG Riley's four-question format (attached) will be completed after each certification process so we can capture our lessons learned and share them among the full PCX team.

Action: Please submit a list of known model certification requests to Margaret Johanning (and post to the groove work space) prior to the PCX phone conference scheduled for 27 September. (We received a similar list about a year ago, so you can start by updating that list). For the call on the 27th, be prepared to discuss the potential for your PCX proceeding with any/all of these certification requests, as well as to discuss questions or comments you may have regarding these interim procedures.

Harry E. Kitch, P.E.

Deputy, Planning Community of Practice

Leader, Flood Damage Reduction Business Line

Directorate of Civil Works

Attachment 2: Table 2 from Protocols

Table 2: Outline for Model Documentation			
Cover Sheet			
	a.	Model Name	
	b.	Functional Area	
	c.	Model Proponent	
	d.	Model Developer	
1. Background			
	a.	Purpose of Model	
	b.	Model Description and Depiction	
	c.	Contribution to Planning Effort	
	d.	Description of Input Data	
	e.	Description of Output Data	
	f.	Statement on the capabilities and limitations of the model	
	g.	Description of model development process including documentation on testing conducted (Alpha and Beta tests)	
2. Technical Quality			
	a.	Theory	
	b.	Description of system being represented by the model	
	c.	Analytical requirements	
	d.	Assumptions	
	e.	Conformance with Corps policies and procedures	
	f.	Identification of formulas used in the model and proof that the computations are appropriate and done correctly	
3. System Quality			
	a.	Description and rationale for selection of supporting software tool/programming language and hardware platform	
	b.	Proof that the programming was done correctly	
	c.	Availability of software and hardware required by model	
	d.	Description of process used to test and validate model	
	e.	Discussion of the ability to import data into other software analysis tools (interoperability issue)	
4. Usability			

Table 2: Outline for Model Documentation			
	a.	Availability of input data necessary to support the model	
	b.	Formatting of output in an understandable manner	
	c.	Usefulness of results to support project analysis	
	d.	Ability to export results into project reports	
	e.	Training availability	
	f.	Users documentation availability and whether it is user friendly and complete	
	g.	Technical support availability	
	h.	Software/hardware platform availability to all or most users	
	i.	Accessibility of the model	
	j.	Transparency of model and how it allows for easy verification of calculations and outputs	

Attachment 3: Review Recommendation and Documentation

DEPARTMENT OF THE ARMY
BUFFALO DISTRICT, CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207-3199

REPLY TO
ATTENTION OF

Planning Branch

6 October 2008

MEMORANDUM FOR Planning Center Of Expertise for Flood Risk Management, US Army Engineer Division, South Pacific 1455 Market Street, San Francisco, CA 94103-1398

SUBJECT: Certification of Planning Model used in Bolivar Dam Rehabilitation Evaluation Report

1. I have performed the review of the planning model used in the Bolivar Dam Rehabilitation Evaluation Report as requested by the USACE Planning Center of Expertise for Flood Risk Management (FRM-PCX). The review was performed in accordance with EC 1105-2-407, "Planning Models Improvement Program: Model Certification", and the "Protocols for Certification of Planning Models under the Planning Models Improvement Program (PMIP)", dated July 2007.

2. Based on the review, I recommend that the FRM-PCX forward the model and documentation to CECW-P with a recommendation for certification as a regional model that is both appropriate to the problem and is computationally correct.

3. Attached are copies of (1) recommendation for Certification, (2) model documentation provided by the Pittsburgh District, and (3) comments and responses made during the review.

Jon Brown

JON BROWN
CELRB-PM-PB
Regional Technical Specialist
in Navigation Economics

3 Encls
1. Recommendation for Certification
2. Model Documentation
3. Comments and Response

Recommendation of Certification
of Planning Simulation Model
Used in the Bolivar
Rehabilitation Evaluation Report

I hereby recommend that the simulation model developed for use in generating the economic impacts and repair costs for the base condition and two alternative plans for the Bolivar Dam Major Rehabilitation project in the Huntington District of the Army Corps of Engineers be certified. This recommendation is based my detailed review of the model which is deemed appropriate for addressing the performance of Bolivar Dam in terms of structural integrity in order to compute the economic consequences of a failure or some other type of unsatisfactory performance. A spot check of the calculations showed them to be computed accurately. The review was performed in accordance with the draft protocols for model certification dated, 6 Oct 2005 and in compliance with EC 1105-2- 407, "Planning Models Improvement Program: Model Certification". Following the review, a set of comments and questions regarding the model were submitted to the model developer. The response to comments successfully resolved all issues.

The review indicated that the model should be classified as a regional model with its use limited to personnel proficient in MS Excel and Palisade's @Risk. It is recommended as a regional model because it is designed specifically for the analysis of the Bolivar Dam Major Rehabilitation project and there is no User Manual.

BROWN.JONATHAN.W.1228694742 06 Oct 08

Jon Brown, CELRB-PM-PB
Regional Technical Specialist,
Navigation Economics

date

E4 - 1

Bolivar Dam Simulation Model

Documentation for Certification

Submitted by Huntington District to

Planning Center of Expertise

For Flood Risk Management

May 2008

Model Name:	Bolivar-12-03-07.XLS (Bolivar Dam Simulation Model)
Functional Area:	Dam Safety - Flood Risk Management
Model Proponent:	Huntington District
Model Developer:	Bill Frechione of Pittsburgh District
Year Developed:	2008

The purpose of this paper is to describe the simulation model used in the Bolivar Dam rehabilitation evaluation study. The model was originally developed by the Nashville District for use in the Wolf Creek Dam study; modified in 2006 for use in the Center Hill Dam study; further modified for use in the Bolivar Dam study; and again modified for use in the Bolivar Study. Certification of planning models was not required at the time the Wolf Creek analysis was performed but the Center Hill and Bolivar versions of the model was reviewed and submitted to HQ with a recommendation for certification.

Model certification is required by EC 1105-2-407, "Planning Models Improvement Program: Model Certification", dated 31 May 2005. This document is organized according to the outline provided as Attachment 1 which was extracted from the draft "Protocols for Certification of Planning Models under the Planning Models Improvement Program" dated 6 October 2005. This document was reviewed and modified in accordance with the comments and responses for the independent technical review (ITR) process (Attachment 5).

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INDEPENDENT TECHNICAL REVIEW
COMMENT/RESPONSE SHEET

Complete and Return to: Bill Frechione, CELRP-BR-E

Project: Bolivar Dam Rehabilitation Evaluation Report – (Model to Evaluate Economic Consequences of Seepage Problems at Bolivar Dams)

Reviewer/Section: Jon Brown, CELRB-PM-PB **Date:** 30-Sep-08

Comment 1. General: the review was performed in conformance with the draft protocols for model certification (**PMIP-10-28-05.doc**) developed by the Institute for Water Resources which provide guidance for model certification as required by EC 1105-2-407 "Planning Models Improvement Program: Model Certification".
This model review consisted of a review of the documentation of the model (**Model-doc-12-03-07rev.doc**) and the excel file "model" used in the simulation: **Bolivar-02-13-08.xls**. Overall, the Excel/@Risk model and supporting documentation is of high quality. The model accomplishes its intended purpose of estimating the reduction in adverse economic impacts attributable to the alternatives from those of the base condition by simulating the economic performance of Bolivar Dam given a schedule of hazard rate functions (probability that the project may fail) and the possible adverse consequences of failure. I have checked the program logic and checked numerous cell formulas in each of the worksheets and have found them to be correct. The reviewer believes that the model conforms to the requirements specified for Regional/Local Models a specified in Protocols for Certification of Planning Models Under the Planning Models Improvement Program (Oct 2005). Additionally, when comparing the expected value using the simulation model with results provided from the analytical method (area under the damage frequency curve), the results are almost identical. This greatly helps to validate that the model's validity. No response is required.

Response 1. OK.

Comment 2. In the workbook, **[Bolivar-02-13-08.xls]9.Repair-cost**, dam repair costs by depth (coming from an external source, **[Life Cycle Model Repair Data - base.xls]Sheet1**) and project rehab costs found in **[Bolivar-02-13-08.xls]M-Caces** are used in the analysis seem to have no uncertainty associated with them. ER1110-2-1302, provides policy, guidance, and procedures for cost engineering responsibilities for all civil works (CW) projects and specifies that a cost risk analysis shall be performed. Why is there no uncertainty associated with costs in the analysis?

Response 2. There is significant uncertainty in the cost estimates for repair and rehab costs but it was the interpretation of the PDT that the detailed cost risk analysis was only required for the cost estimate of the recommended project. The repair and rehab cost estimates are screening level cost estimates that are comparable in their uncertainty and that are intended to provide reasonable and comparable estimates that will allow the full range of alternatives to be reduced to the economic plan. The time and cost to perform cost risk analysis on these screening level costs would significantly increase the time and cost of the study at very little benefit. The cost of the recommended plan were submitted to the Walla Walla cost center of expertise for them to perform cost risk analysis.

Comment 3. In the workbook, **[Bolivar-02-13-08.xls]11. Lost-flood-prot**, the average cumulative historic flood damages prevented by the project as updated on an annual basis by the

Attachment 4: General Questions to Consider in Doing a Model Review

MODEL ASSESSMENT CRITERIA

General Questions

1. Is the purpose of the models clearly defined?

2. Can the models described achieve the stated purpose?

Technical Quality

3. Comment on the overall technical quality of the models.

4. Are the models based on well-established contemporary theory?
    a. Is the available science applied correctly?
    b. Are the models empirically supported?

5. Are the models realistic representations of the actual systems?

6. Are the analytical requirements of the models properly identified?

7. Do the models address and properly incorporate the analytical requirements?

8. Are the assumptions clearly identified, valid, and do they support the analytical requirements?

9. Are the formulas used in the models mathematically correct and are the model computations appropriate and done correctly?

10. Comment on the ability of the models to address risk and uncertainty.

11. Comment on the ability of the models to calculate benefits for total project life.

12. Do the models adequately assess the full range of ecosystem benefits associated with wetlands in this geographic range?

13. Will the models be useful in capturing and quantifying the full extent of benefits expected to be obtained from anticipated coastal restoration projects?

System Quality

14. Have the models been sufficiently tested and validated, or do critical errors still exist?

Usability

15. Comment on the models' usability.

16. Comment on the availability of the data required by the models.

17. How easily are model results understood?

18. Comment on how useful the information in the results is for supporting project objectives.

19. Is user documentation available, user friendly, and complete?

20. Are the models transparent and do they allow for easy verification of calculations and outputs?

OTHER GENERAL QUESTIONS

21. Can the models be adapted to other geographic regions?
    a. If so, how much can the models be modified before they need to be reviewed again?

22. Is it clear where the models' geographic boundaries fall?

23. Is the approach to the development and use of the models described clearly enough to allow the approach to be repeated and obtain the same or similar results?
    a. If not, why?
    b. If not, what needs to be done to make the approach repeatable?

24. Comment on the ability of the models to calculate benefits for total project life.

25. Can the models be used for both mitigation and restoration projects?
    a. For which application are they most suitable?

26. Comment on whether the models are more suitable for prioritizing projects or if they are also appropriate for assessments.

27. Are the applications of the models defensible?

28. Comment on whether there are any resolution issues with the models (i.e., size of the area that can effectively be evaluated).
    a. At what scale (e.g. acres, hundreds of acres) can the models be effectively applied?

29. Comment on whether all of the most important variables are included in the models.
    a. Are variables that are both stressors and drivers included in the models?
    b. Should additional variables be included?
    c. Are some of the variables more sensitive than others?

30. To what extent is best professional judgment used in the models?

31. To what extent are the models developed specifically for the Louisiana Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA)?

32. Are error checks built into the models?

33. Are USACE policies and procedures related to the model clearly identified?

34. Do the models properly incorporate USACE policies and accepted procedures?

35. Is sea level change addressed by the models?
    a. If yes, is it internal to the models or does it need to be addressed externally?

36. Do the models work using both sensible and non-sensible data (e.g., negative land area)?