Ecosystem Restoration Planning Model Best Practices

22-May-2012

Ecosystem Restoration Planning Models

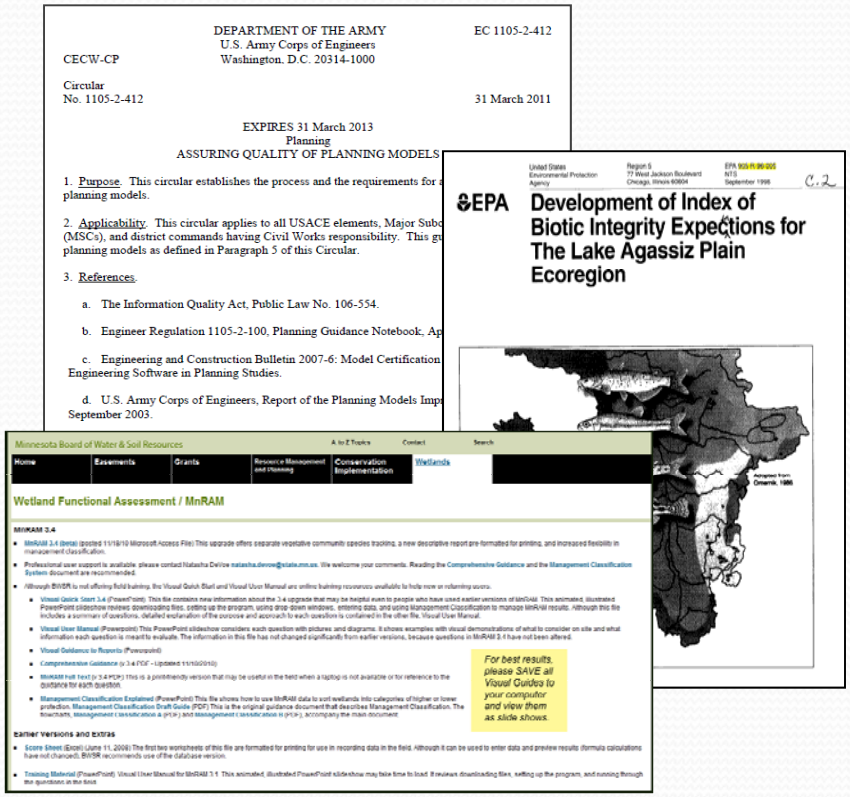
Today's talk:

1) Planning Models

- Documentation
- Selection
- Development
- Application

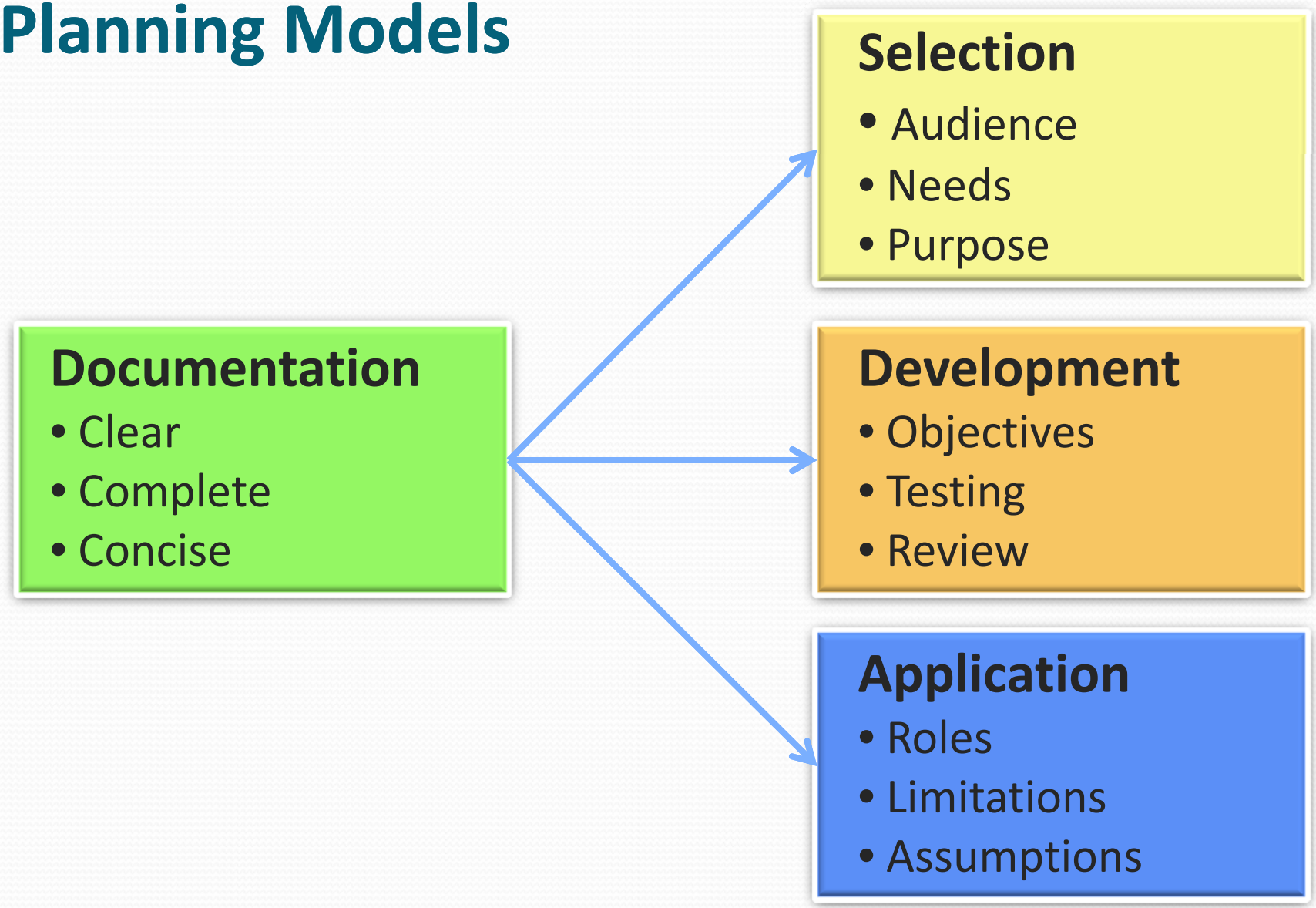
2) Existing Resources

3) Emerging Resources



Context: Management of ecosystem restoration planning products in an evolving planning environment

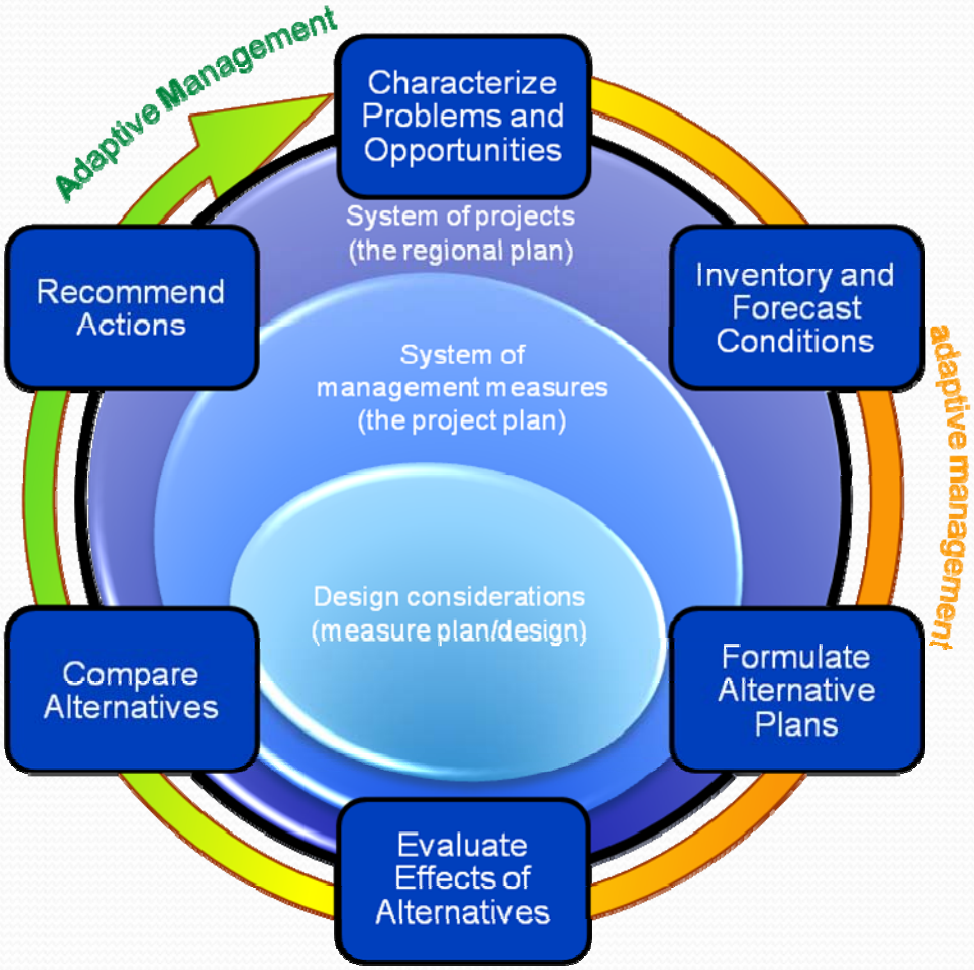
Planning Models



Planning Model Documentation

Be Clear – *Work on…*

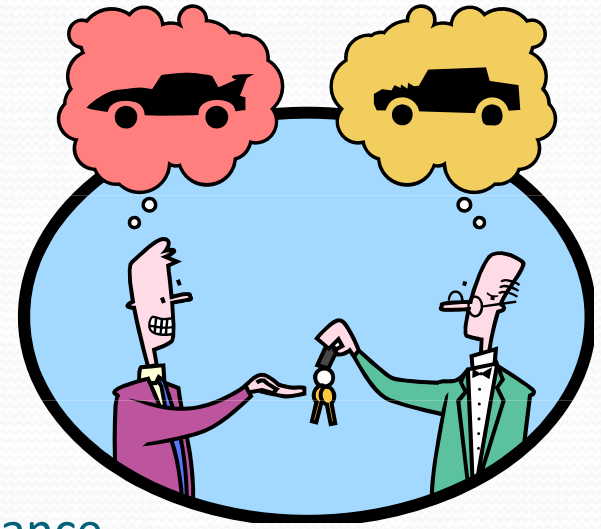
- **Knowing your audiences**
  - Reviewers
  - Stakeholders
  - Others
- **Simplifying information**
  - Diagrams
  - Charts
  - Tables
  - Formulas
- **Packaging information**
  - Processes and functions
  - Categories of interest
  - Phases of activity



Planning Model Documentation

Be Complete – *Describe…*

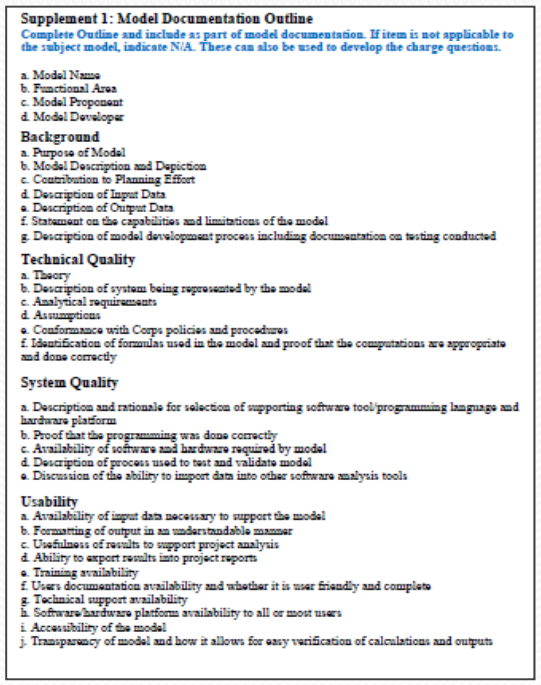
- **Purposes**
  - Scope of need or demand (e.g., study type or location)
  - Context of need or demand (e.g., study phase or arena)
- **Objectives**
  - Expectations (e.g., may differ by arena or phase of study)
  - Realities (e.g., to whatextent can the need be reasonably satisfied)
- **Assumptions**
  - Model itself
  - Inputs and boundaries
- **Limitations**
  - Application
  - Interpretation
- **Involvement**
  - When, who, why, how, and what
- **Quality Assurance and Quality Control**
  - Testing, evaluation, review, oversight, and maintenance



Planning Model Documentation

Be Concise – *Focus on…*

- **Relevance**
  - For purposes of review
  - For purposes of application
  - For purposes of interpretation of results
- **Quality**
  - Technical writing
  - Illustrations
- **Organization**
  - Logical sequencing
  - Avoid redundancy
- **Brevity**
  - Might it be possible to consider expressing sentiments phrased as long sentences using fewer words...
- **Elegance**
  - Seek intuitive explanations of complex information



Supplement 1: Model Documentation Outline

Complete Outline and include as part of model documentation. If item is not applicable to the subject model, indicate N/A. These can also be used to develop the charge questions.

a. Model Name
b. Functional Area
c. Model Proponent
d. Model Developer

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

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

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

Usability

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

Planning Model Selection

Document

- Purpose, scope, complexity of the investigation
- Setting and context of the investigation
- Nature of answers expected
- Pace at which answers are expected
- Partners, contributors, stakeholders, and roles served by each

Of rebuilding wheels…

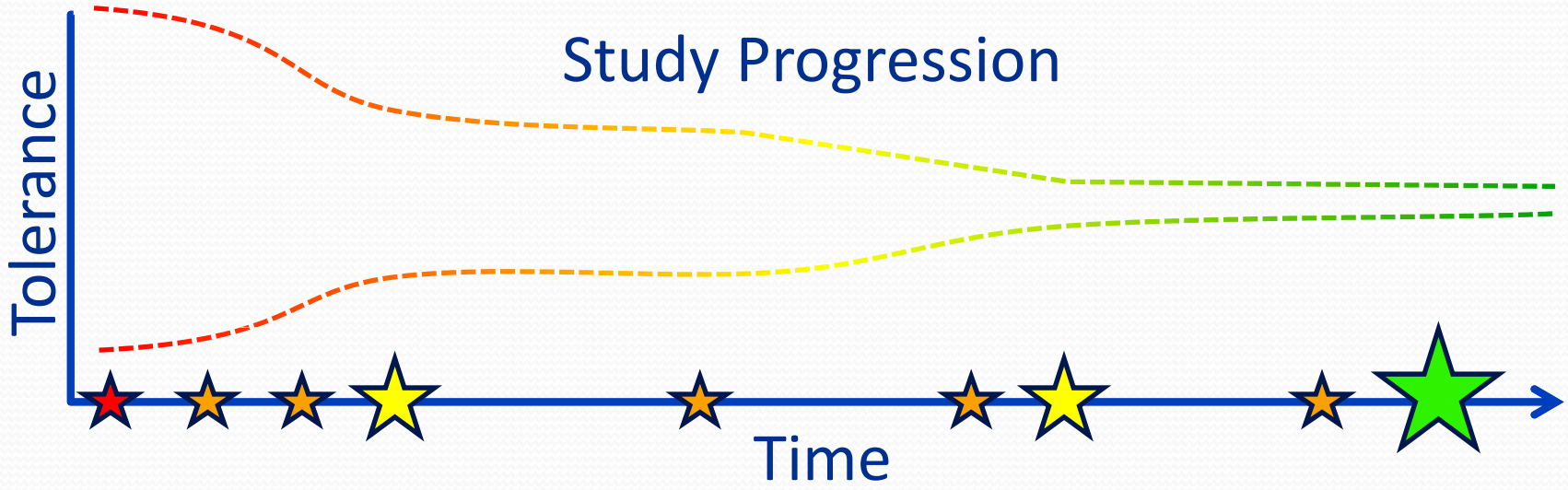
"A **new idea comes** suddenly and **in a rather intuitive way**. But intuition is nothing but the outcome of earlier intellectual experience."

– Albert Einstein

Planning Model Selection

Understand and describe

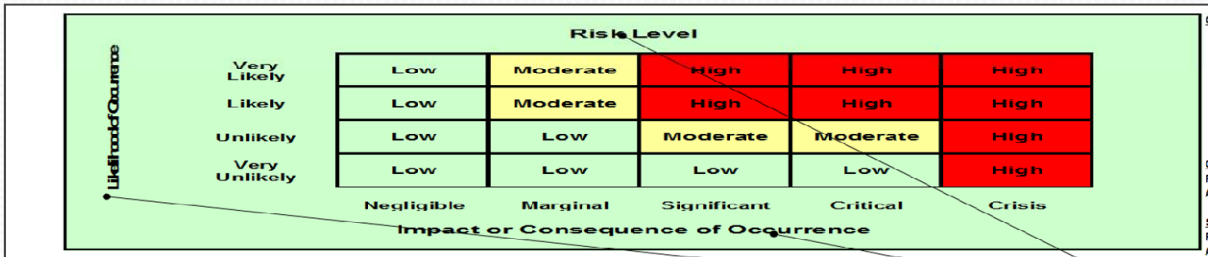
- Adaptations or modifications of method
- Risk tolerances of those involved
- Consequences of being wrong
- Strategies to manage errors and uncertainty



Planning Model Selection

Characterize knowledge objectives

- Pace at which knowledge must be attained
- Tolerable levels of fidelity, accuracy, and precision
- Accepted limitations/boundaries of interpretation



Overall Project Scope

Cost Impacts
For the [Enter Project Title Here] Project, any cost impact of $ Million or higher shoul
Anything over $ Million should be considered at least "Marginal."

Schedule Impacts
For the [Enter Project Title Here] Project, any schedule impact of months or greater
Anything over months should be considered at least "Marginal."

Risk No.	Risk/Opportunity Event	Concerns	PDT Discussions	Project Outcome				Project Schedu		
				Likelihood*	Impact*	Risk Level*	Rough Order Impact ($)	Likelihood*	Impact*	Risk Lev
Contract Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)										
	PROGRAM MGMT									
PPM-1						0				0
PPM-2						0				0

… Consider differences in needs that might occur at points during activity's lifecycle.

Planning Model Development

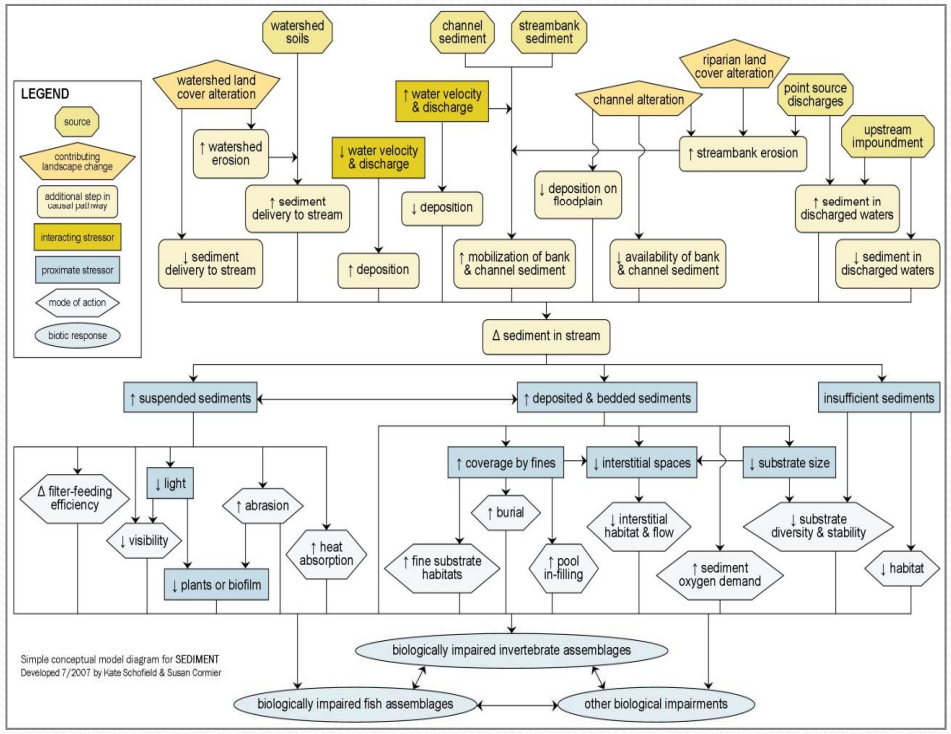
Document

- Justification for model development
- Intended uses and applications
- Assumptions and limitations
- Quality assurance and quality control activities
- Resource and data requirements
- User instructions/guidance
- Sources of information consulted during model development

Planning Model Development

Understand and describe

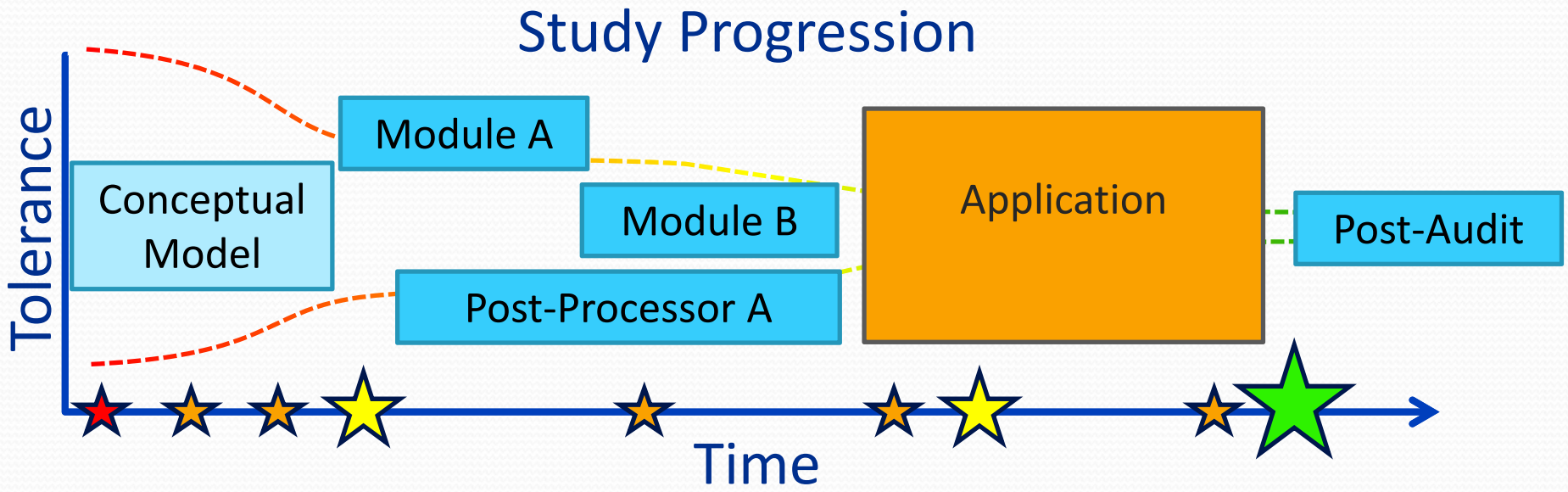
- Critical assumptions
- Spatial boundaries
- Aspatial boundaries
- Recognized limitations on interpretation of results



Planning Model Development

Characterize modeling objectives

- Tolerable levels of fidelity, accuracy, and precision
- Tolerable limits on interpretation
- Development strategy



… Consider a modular and adaptable modeling architecture or platform

Planning Model Application

Document

- Sources of model parameters and inputs
- Boundary conditions
- Quality assurance and quality control activities
- Alignment of investigation needs with model assumptions
- Interpretations of model results

Table 5-3 Evaluation criteria for the regional model

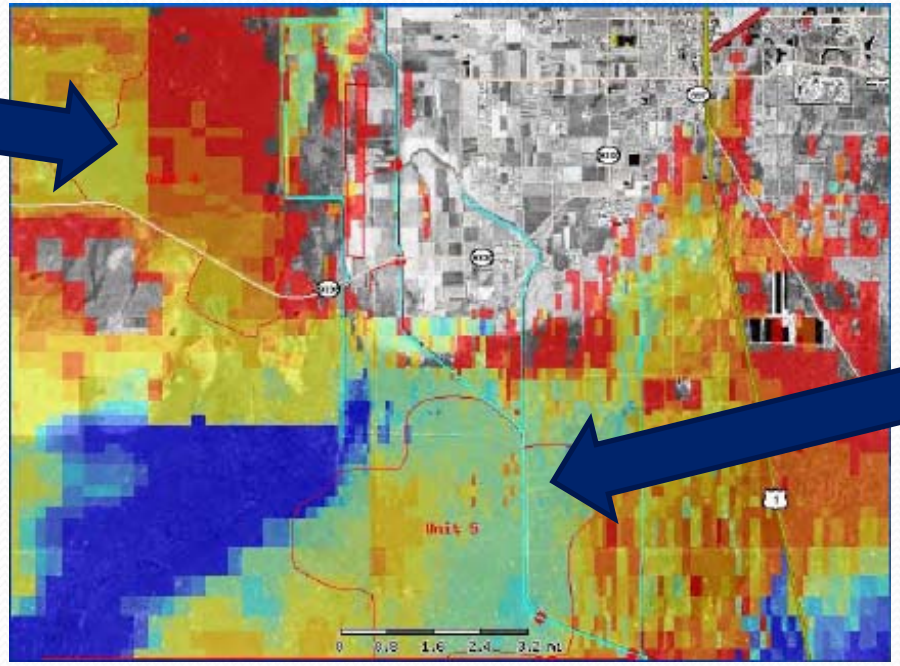
Evaluation Criteria Definitions and Priority							
Evaluation Criteria		*Weights*	*Definition of Rankings*				
No.	*Description*		0	1	1.1	1.2	1.3
First Priority							
1	Rainfall/ET	16	Uniform rain and PET. Actual ET calibrated	Temporally varied rainfall and ET. AET calibrated.	Spatially and temporally varied rainfall and PET utilizing multiple gauges, and a consistent methodology for actual ET based on land use, crop type, … etc.	INTENTIONALLY BLANK	Spatially and temporally varied rainfall. AET computed as part of integrated unsaturated zone solution.
2	Flow Representation	16	Lumped parameter model (link-node)	Distributed but simplified (e.g. Horton's or Izzdac equation for overland, kinematic equation for canal or 2-D for ground water)	Diffusive flow in surface water and 2D flow in ground water	Dynamic wave in canals, diffusive wave in overland and quasi 3D in ground water	Dynamic wave in surface water, full 3D variably saturated flow in ground water
3	Operation & Management	16	Internal boundary with prescribed flows or simple if/then rules based on the structure book for each structure or other simple approach	INTENTIONALLY BLANK	INTENTIONALLY BLANK	Complex operation of multiple structures based on multiple criteria + Regulation Schedule + Rainfall Driven Operation + water shortage/rationing logic	As in 4 + optimization routine
4	Surface/Ground water interaction	14	No interaction	Loosely coupled (one system as a sink/source for the next)	Coupled through a simple time lag approach	2 out of 3 fully coupled (overland, canal, and ground water)	All 3 systems fully coupled
5	Hydraulic Structures	14	Not simulated	Simplified/passive hydraulic structure simulation capabilities, rating curves and/or no operation (Steady state or Quasi-dynamic routing)	Accurate simulation of hydraulic structures + simple/active operations (Quasi-dynamic routing)	Accurate simulation of hydraulic structures + multi-criteria decision logic based on combination of local and regional triggers	Accurate simulation of hydraulic structures + optimization of their operation (Dynamic routing through structures)
6	Subregional Models	12	Not possible to extract boundary conditions for subregional model	Possible to extract flow and stage/head boundary conditions for subregional models with some interpolation schems (e.g. Telescopic Mesh Refinement)	INTENTIONALLY BLANK	INTENTIONALLY BLANK	Fully scalable and capable of being utilized in regional, subregional modeling, and site specific modeling
7	Water delivery to near shore regions	12	None	Near shore regions treated as boundary conditions. Tidal effects not taken into consideration	Near shore regions as boundary conditions. Tidal effect taken into consideration.	Density corrected heads in near shore and estuarine environment, which are included in the regional model	Full density dependent flow in estuaries and near shore regions which are encompassed in the regional model
8	Water Budget	11	Overall water budget computed and balanced	As 1 + basin wide water budget	As 2 + detailed water budget by layer and basin including sources and specific sinks/sources	As 3 + detailed water budget for each structure by the type of release (environmental, flood control, and water supply)	As 4 + flexibility to easily define/modify water budget zone boundaries
9	Code Maturity	10	New untested code.	Methodology peer reviewed and code verified against analytical solution by developer	Code verified against analytical and other numerical models by independent reviewers	Code extensively used throughout the modeling industry with documented applications	Code extensively used throughout the modeling industry with documented applications + extensive code verification by independent reviewers
10	Reasonable runtime	10	Prohibiting runtime. Model cannot be used for alternative evaluation (multi-decadal runs cannot be performed within a reasonable period of time).	Excessive runtime. Model can be used for alternative evaluation but with extensive resource allocation (only one multi-decadal runs can be performed within a reasonable period of time).	High runtime. Model can be used for alternative evaluation (at least two multi-decadal runs can be performed concurrently within a reasonable period of time).	Low runtime. Model can be used for alternative evaluation (more than three multi-decadal runs can be performed concurrently within a reasonable period of time).	Optimal runtime. Model can be used effectively for alternative comparison (up to 5 concurrent multi-decadal runs can be compared within a "very" reasonable period of time)
11	Levee Seepage	10	Not simulated	2-D groundwater flow equation on single ground water layer below levees. No seepage through levees	Quasi 3-D ground water flow below levees, seepage through levees	Full 3-D flow below and through levees	Full 3-D flow below and through levees with detailed discretization of the levee material and ability to represent seepage control measures

Planning Model Application

Understand and describe

- Observed model sensitivities and insensitivities
- Vulnerabilities to invalidation of underlying assumptions
- Sources of information consulted during model application

Critical Habitat
Seasonal Depth

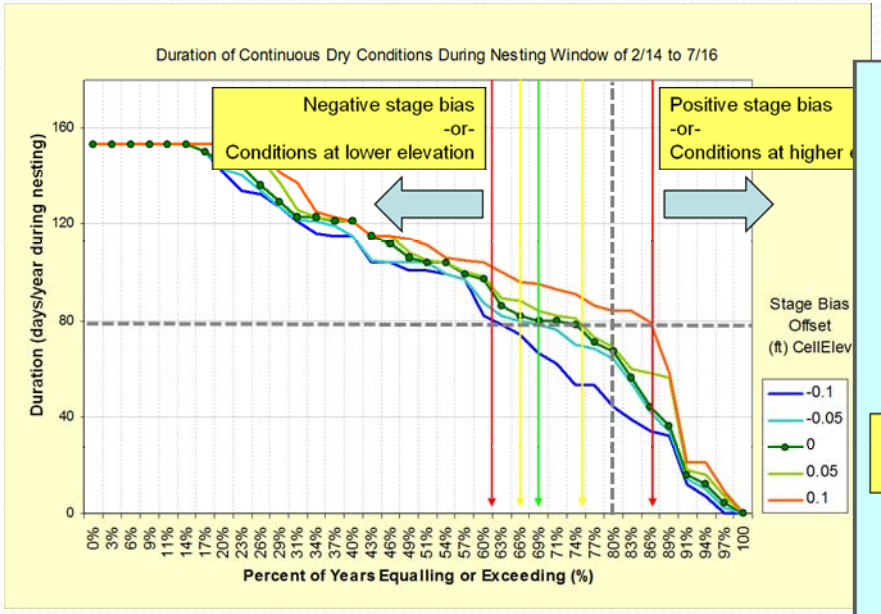


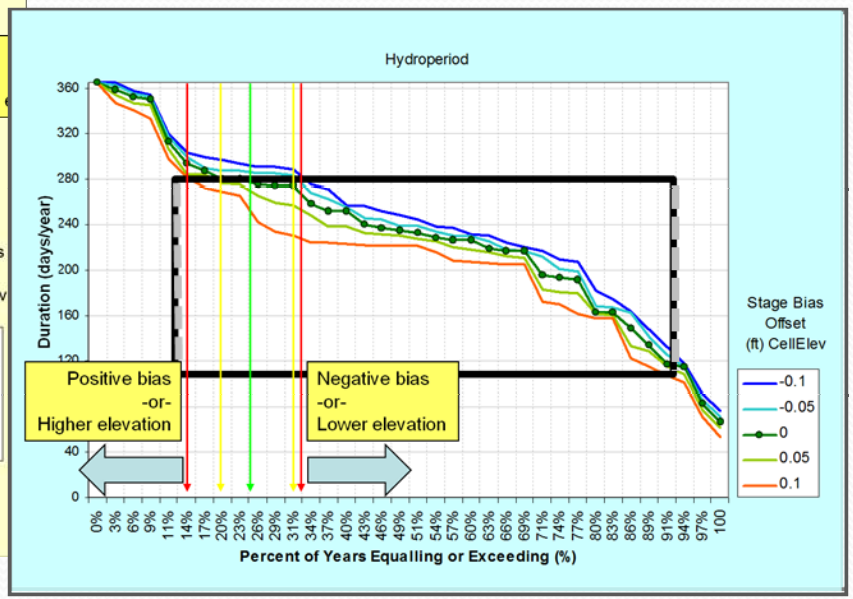
Critical Habitat
Seasonal Depth

Planning Model Application

Characterize model results

- Sensitivities and relative confidence in results
- Sensitivities to reasonable deviations from assumed conditions

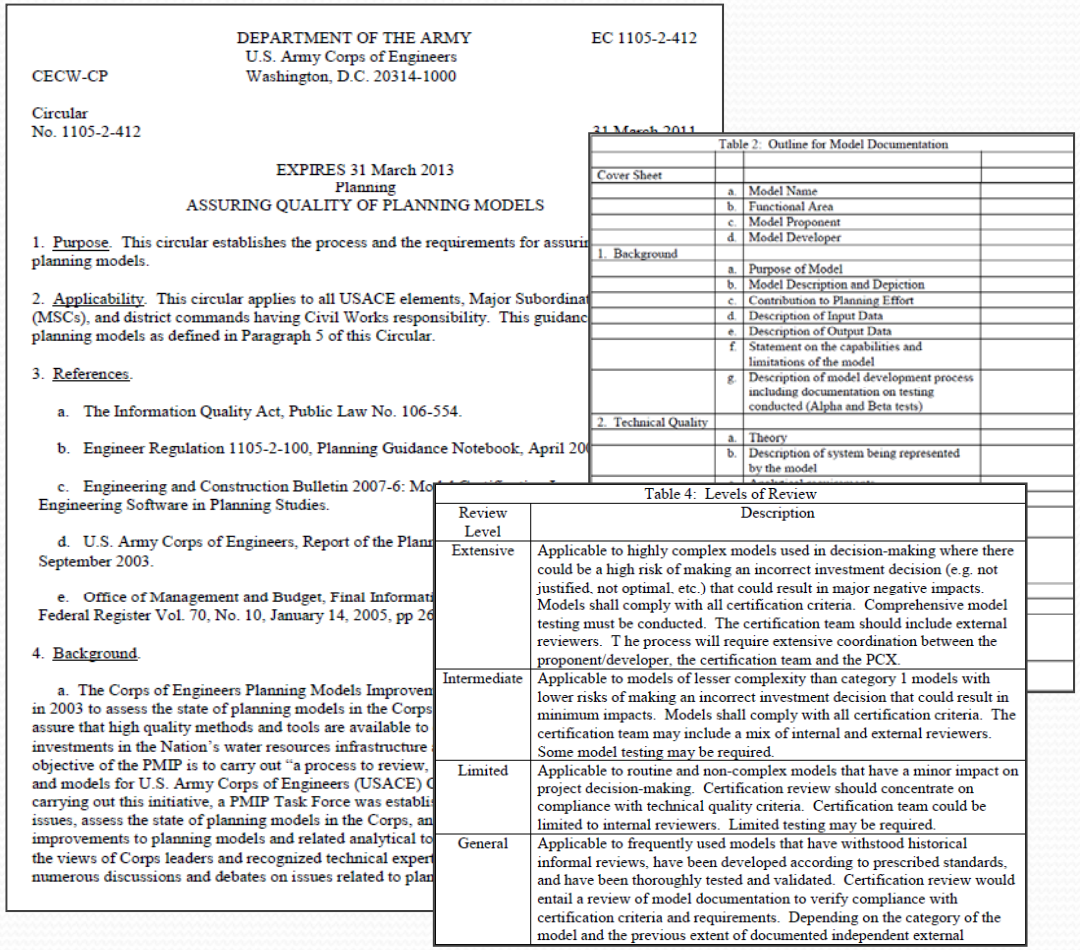




… Consider bracketing, sensitivity, scenario, or uncertainty analyses for rapid assessment of decision confidence and uncertainty.

Existing Resources

Engineer Circular 1105-2-412



DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
Washington, D.C. 20314-1000

EC 1105-2-412

CECW-CP

Circular
No. 1105-2-412

31 March 2011

EXPIRES 31 March 2013
Planning
ASSURING QUALITY OF PLANNING MODELS

1. Purpose. This circular establishes the process and the requirements for assuri
planning models.

2. Applicability. This circular applies to all USACE elements, Major Subordinat
(MSCs), and district commands having Civil Works responsibility. This guidanc
planning models as defined in Paragraph 5 of this Circular.

3. References.

a. The Information Quality Act, Public Law No. 106-554.

b. Engineer Regulation 1105-2-100, Planning Guidance Notebook, April 20

c. Engineering and Construction Bulletin 2007-6: Mo
Engineering Software in Planning Studies.

d. U.S. Army Corps of Engineers, Report of the Plan
September 2003.

e. Office of Management and Budget, Final Informati
Federal Register Vol. 70, No. 10, January 14, 2005, pp 26

4. Background.

a. The Corps of Engineers Planning Models Improven
in 2003 to assess the state of planning models in the Corps
assure that high quality methods and tools are available to
investments in the Nation's water resources infrastructure
objective of the PMIP is to carry out "a process to review,
and models for U.S. Army Corps of Engineers (USACE) C
carrying out this initiative, a PMIP Task Force was establi
issues, assess the state of planning models in the Corps, an
improvements to planning models and related analytical to
the views of Corps leaders and recognized technical exper
numerous discussions and debates on issues related to plan

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

Table 4: Levels of Review

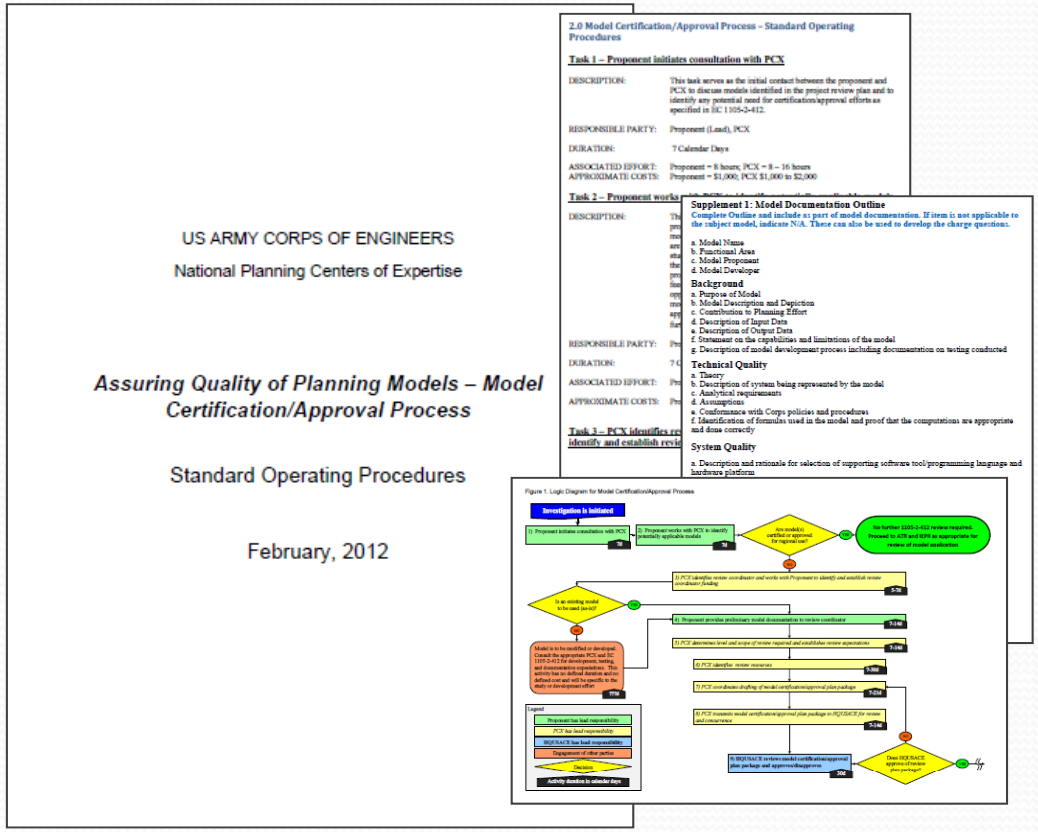
Review Level	Description
Extensive	Applicable to highly complex models used in decision-making where there could be a high risk of making an incorrect investment decision (e.g. not justified, not optimal, etc.) that could result in major negative impacts. Models shall comply with all certification criteria. Comprehensive model testing must be conducted. The certification team should include external reviewers. T he process will require extensive coordination between the proponent/developer, the certification team and the PCX.
Intermediate	Applicable to models of lesser complexity than category 1 models with lower risks of making an incorrect investment decision that could result in minimum impacts. Models shall comply with all certification criteria. The certification team may include a mix of internal and external reviewers. Some model testing may be required.
Limited	Applicable to routine and non-complex models that have a minor impact on project decision-making. Certification review should concentrate on compliance with technical quality criteria. Certification team could be limited to internal reviewers. Limited testing may be required.
General	Applicable to frequently used models that have withstood historical informal reviews, have been developed according to prescribed standards, and have been thoroughly tested and validated. Certification review would entail a review of model documentation to verify compliance with certification criteria and requirements. Depending on the category of the model and the previous extent of documented independent external

THE WHAT

- Policy
- Process
- Definitions
- Expectations
- Criteria

Existing Resources

Planning Model Review Standard Operating Procedure


US ARMY CORPS OF ENGINEERS

National Planning Centers of Expertise

Assuring Quality of Planning Models – Model Certification/Approval Process

Standard Operating Procedures

February, 2012

2.0 Model Certification/Approval Process – Standard Operating Procedures

Task 1 – Proponent initiates consultation with PCX

DESCRIPTION: This task serves as the initial contact between the proponent and PCX to discuss models identified in the project review plan and to identify any potential need for certification/approval efforts as specified in EC 1105-2-412.

RESPONSIBLE PARTY: Proponent (Lead), PCX

DURATION: 7 Calendar Days

ASSOCIATED EFFORT: Proponent = 8 hours; PCX = 8 – 16 hours

APPROXIMATE COSTS: Proponent = $1,000; PCX $1,000 to $2,000

Supplement 1: Model Documentation Outline

Complete Outline and include as part of model documentation. If item is not applicable to the subject model, indicate N/A. These can also be used to develop the charge questions.

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b. Functional Area
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Technical Quality

a. Theory
b. Description of system being represented by the model
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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

System Quality

a. Description and rationale for selection of supporting software tool/programming language and hardware platform

Figure 1. Logic Diagram for Model Certification/Approval Process

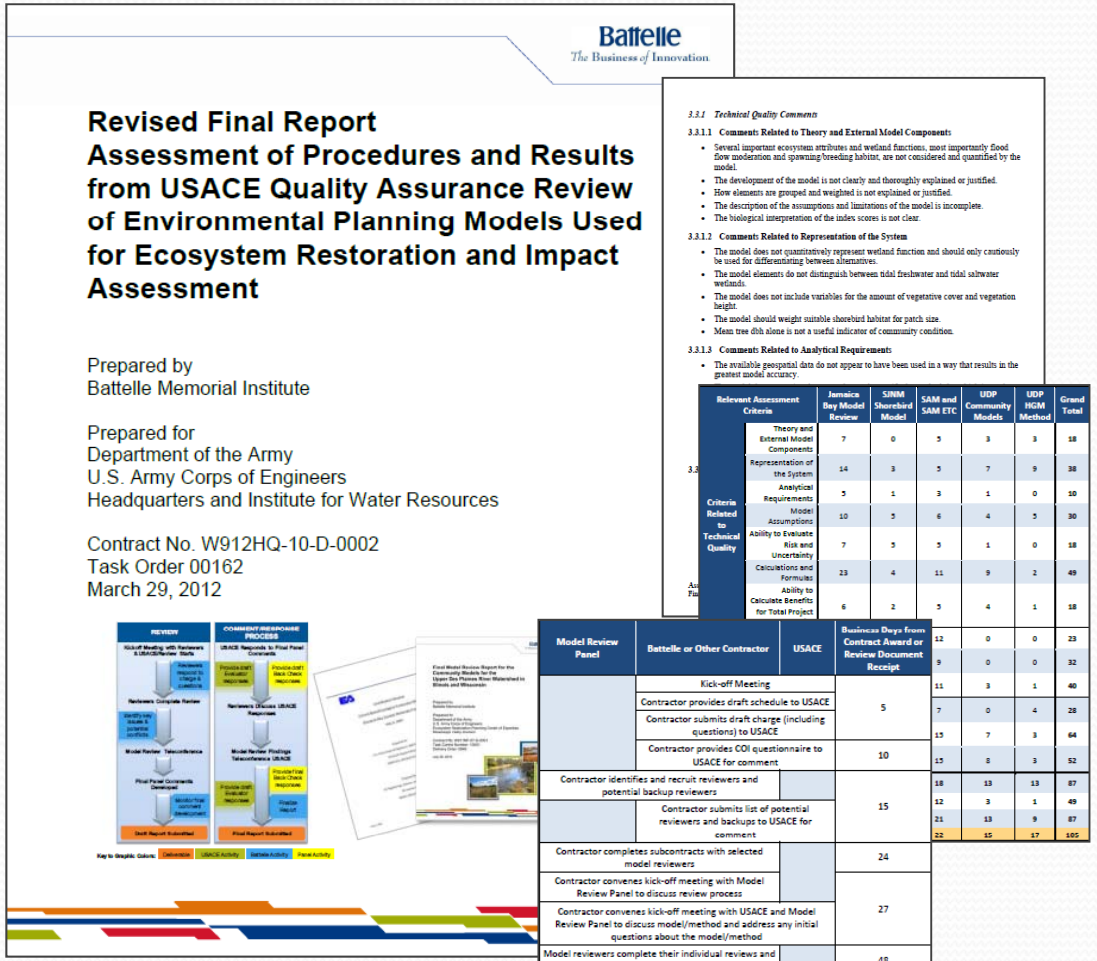
Investigation is initiated

THE HOW

- Procedures
- Timelines
- Costs
- Questions
- Templates

Existing Resources

Assessment of Procedures and Results from USACE Planning Model Review



Battelle
The Business of Innovation

Revised Final Report
Assessment of Procedures and Results from USACE Quality Assurance Review of Environmental Planning Models Used for Ecosystem Restoration and Impact Assessment

Prepared by
Battelle Memorial Institute

Prepared for
Department of the Army
U.S. Army Corps of Engineers
Headquarters and Institute for Water Resources

Contract No. W912HQ-10-D-0002
Task Order 00162
March 29, 2012

3.3.1 *Technical Quality Comments*

3.3.1.1 **Comments Related to Theory and External Model Components**

- Several important ecosystem attributes and wetland functions, most importantly flood flow moderation and spawning/breeding habitat, are not considered and quantified by the model.
- The development of the model is not clearly and thoroughly explained or justified.
- How elements are grouped and weighted is not explained or justified.
- The description of the assumptions and limitations of the model is incomplete.
- The biological interpretation of the index scores is not clear.

3.3.1.2 **Comments Related to Representation of the System**

- The model does not quantitatively represent wetland function and should only cautiously be used for differentiating between alternatives.
- The model elements do not distinguish between tidal freshwater and tidal saltwater wetlands.
- The model does not include variables for the amount of vegetative cover and vegetation height.
- The model should weight suitable shorebird habitat for patch size.
- Mean tree dbh alone is not a useful indicator of community condition.

3.3.1.3 **Comments Related to Analytical Requirements**

- The available geospatial data do not appear to have been used in a way that results in the greatest model accuracy.

Relevant Assessment Criteria		Jamaica Bay Model Review	SJNM Shorebird Model	SAM and SAM ETC	UDP Community Models	UDP HGM Method	Grand Total
Criteria Related to Technical Quality	Theory and External Model Components	7	0	5	3	3	18
	Representation of the System	14	3	5	7	9	38
	Analytical Requirements	5	1	3	1	0	10
	Model Assumptions	10	5	6	4	5	30
	Ability to Evaluate Risk and Uncertainty	7	5	5	1	0	18
	Calculations and Formulas	23	4	11	9	2	49
	Ability to Calculate Benefits for Total Project	6	2	5	4	1	18
		12	0	0	0	0	23
		9	0	0	0	0	32
		11	3	1	1	0	40
		7	0	4	0	0	28
		15	7	3	0	0	64
		15	8	3	0	0	52
		18	13	13	0	0	87
		12	3	1	0	0	49
		21	13	9	0	0	87
		22	15	17	0	0	105

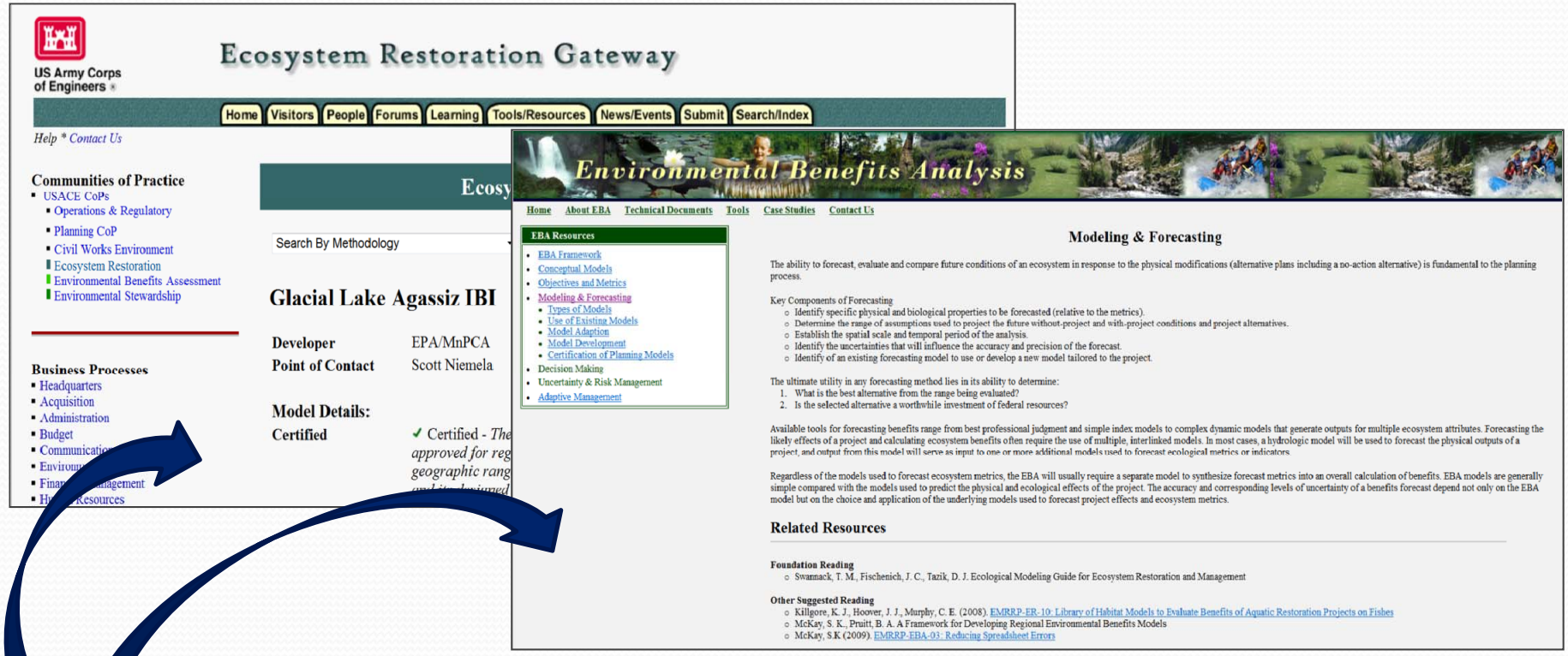
Model Review Panel	Battelle or Other Contractor	USACE	Business Days from Contract Award or Review Document Receipt
	Kick-off Meeting		
	Contractor provides draft schedule to USACE		5
	Contractor submits draft charge (including questions) to USACE		
	Contractor provides COI questionnaire to USACE for comment		10
Contractor identifies and recruit reviewers and potential backup reviewers			
	Contractor submits list of potential reviewers and backups to USACE for comment		15
Contractor completes subcontracts with selected model reviewers			24
Contractor convenes kick-off meeting with Model Review Panel to discuss review process			
Contractor convenes kick-off meeting with USACE and Model Review Panel to discuss model/method and address any initial questions about the model/method			27
Model reviewers complete their individual reviews and submit comments			48

THE WHY

- Activities
- Findings
- Observations
- Trends/Patterns
- Lessons Learned

Existing Resources -USACE

http://cw-environment.usace.army.mil/restoration.cfm



http://cw-environment.usace.army.mil/eba/index.cfm

e.g., Reducing Spreadsheet Errors - S. Kyle Mckay (ERDC TN-EMRRP-EBA-03)

Existing Resources – Other Agencies

http://www.epa.gov/crem/

U.S. ENVIRONMENTAL PROTECTION AGENCY

Council for Regulatory Environmental Modeling

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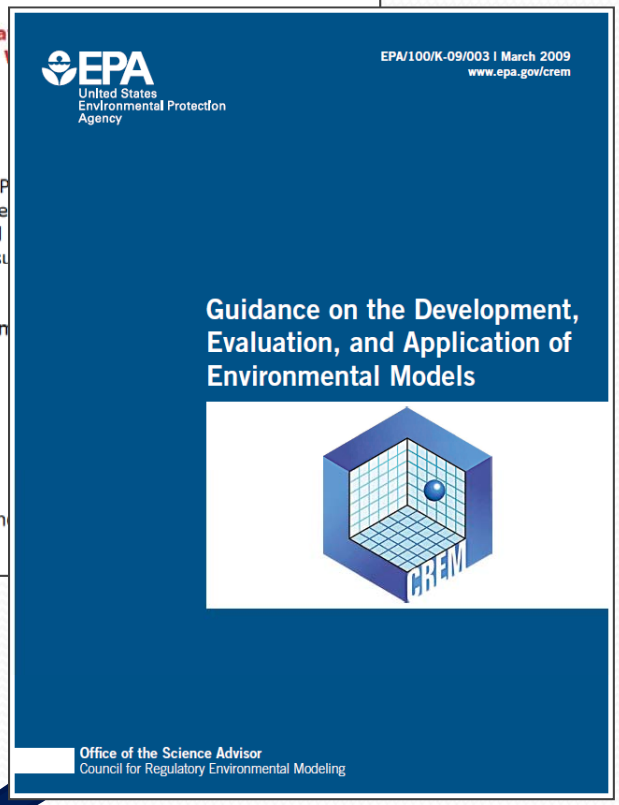
Our Web site will undergo scheduled maintenance from 8am ET to 5pm ET on Saturday, Ma
may find that our web pages are slow to load or that certain applications are not working.
inconvenience.

Basic Information

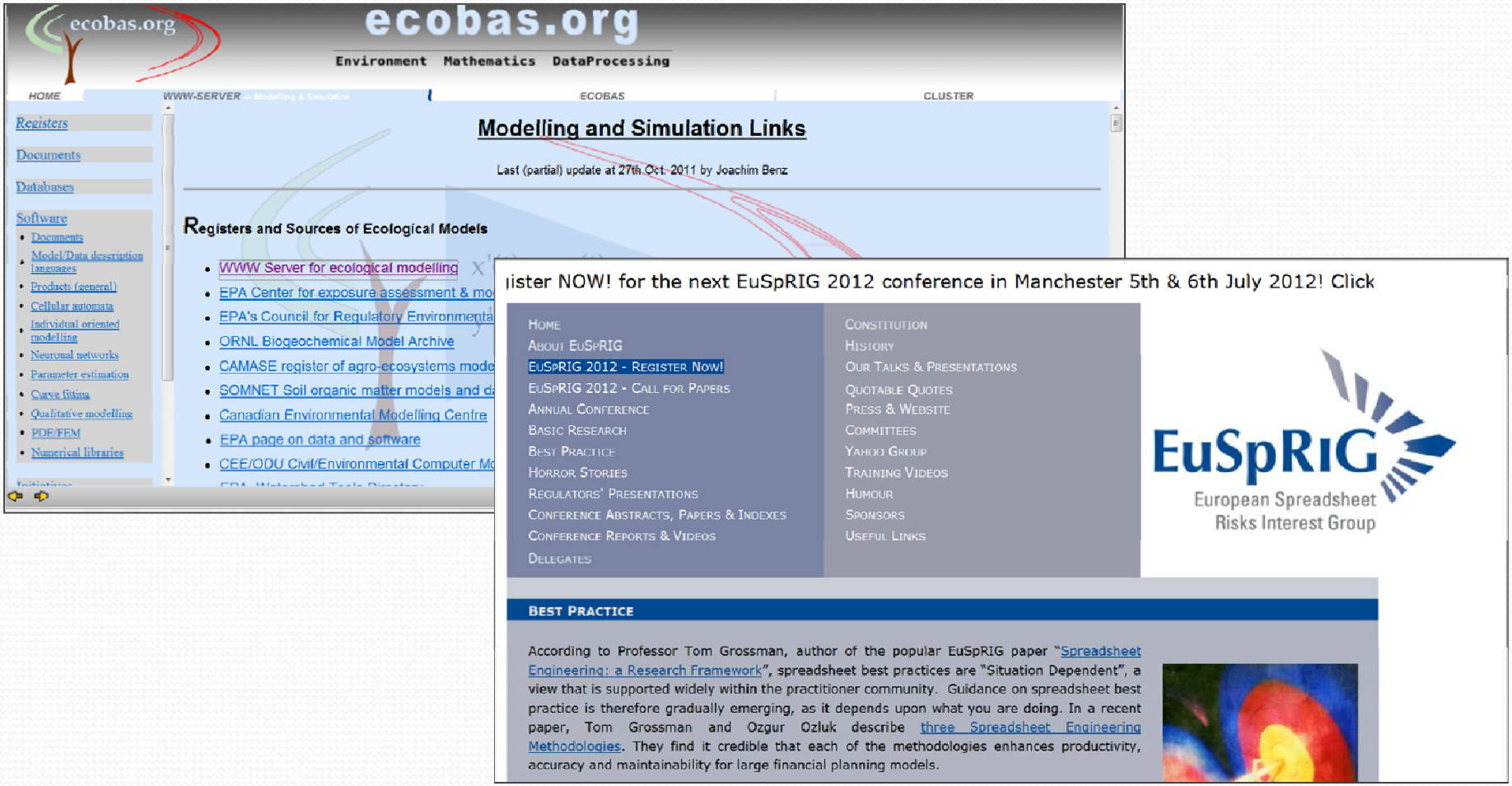
Given the crucial role that models play in informing regulatory decision making, the EP established the Council for Regulatory Environmental Modeling (CREM) in 2000 in an e to improve the quality, consistency and transparency of the models for environmental decision making. The CREM works with the EPA's program and regional offices to ensu that EPA:

- establishes and implements criteria so that model-based decisions satisfy regulatory requiren and Agency guidelines;
- documents and implements best management practices to use models consistently and appropriately;
- documents and communicates the data, algorithms, and expert judgments used to develop models;
- facilitates information exchange among model developers and users so that models can be iteratively and continuously improved;
- proactively anticipates scientific and technological developments so EPA is prepared for the n generation of environmental models.



Existing Resources - Other

http://ecobas.org/www-server/mod-info/index.html



http://www.eusprig.org/best-practice.htm

Emerging USACE Resources

Ecosystem Management and Restoration Research Program

Environmental Benefits Modeling and Forecasting Guidebook and Training
T. Swannack and others - Provide methods, protocols, and guidelines that strengthen the ability to model environmental benefits and forecast benefit streams resulting from prospective restoration alternatives (effort ongoing)

Enhanced Library Database of Planning Models for Ecosystem Restoration
C. Fischenich and others – Expand the Ecosystem Restoration Gateway model library and increase the availability of information about each of the listed models

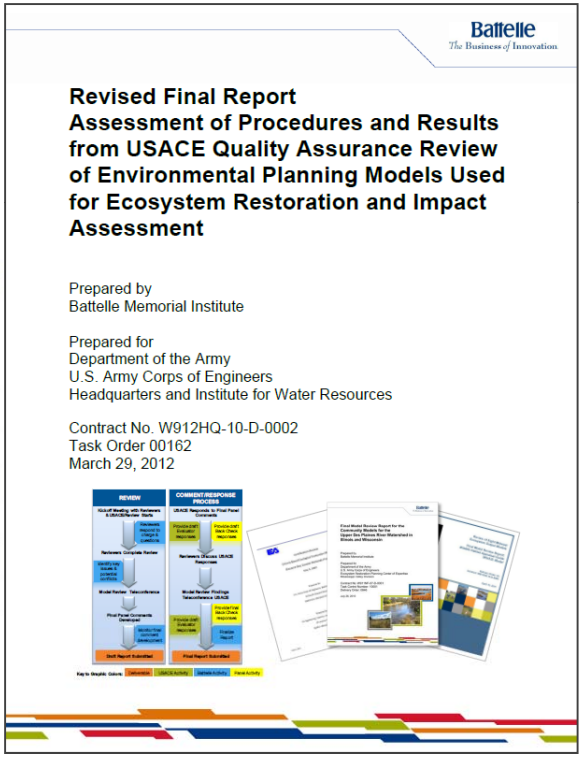
Watch for others at:
http://cw-environment.usace.army.mil/restoration.cfm

USACE Planning Model Quality Assurance Review Results

Region/Project	Review	Model or Method	# Reviewers	# Final Panel Comments	Significance, #		
					High	Medium	Low
Southern Arizona Arid Riverine Systems and Associated Riparian Habitats	Planning-based Wetlands Functional Assessment Model	Arid River Model[1]	3	5	3	2	0
Jamaica Habitat Restoration	Evaluation of Planned Wetlands Model	Jamaica Bay EPW[1]	4	41	21	20	0
Western C-111	Benefit Evaluation Methodology						
Tamiami Trail	Limited Reevaluation Rep Ecosystem Output Mode						
Biscayne Bay Coastal Wetlands Project	Criteria Based Ecologica Evaluation Matrix (CBEE						
St. Johns-New Madrid (SJNM) Floodway	EnviroFish Model, Versic 1.0						
SJNM Floodway	Delta Region of Hydrogeomorphic Methodology Guidebook						
SJNM Floodway	Waterfowl Assessment Methodology						
SJNM Floodway	Habitat Model for Migratir Shorebirds in the Alluvia Valley						
SJNM Floodway	Assessment of Shorebir Habitat within the St. John New Madrid Basins						

Region/Project	Review	Model or Method	# Reviewers	# Final Panel Comments	Significance, #		
					High	Medium	Low
Mid-West	Shorebird Migration Model for Portions of the Northern Plains/Prairie Pothole Region of the	NPPP Shorebird Model[1]	4	7	3	3	1
Mid-West	Aquatic Habitat Appraisal Guide (AHAG) Model	AHAG[1]	4	14	12	2	0
Mid-West	Wildlife Habitat Appraisal Guide (WHAG) Model	WHAG[1]	5	13	9	4	0
Mid-West	Dabbling Duck Migration Model for the	Dabbling Duck Migration Model[1]					
Mid-West	Migratory Habitat Model for Diving Ducks Using the	Diving Duck Migration Model[1]					
Mid-West	Bluegill Habitat Suitability Index Model for Winter Conditions for Backwater Habitats	Modified Bluegill HSI Model[1]					
Mid-West	Modified Mink HSI Model	Modified Mink HS Model[1]					
Mid-West	Smallmouth Bass Habitat Suitability Index (HSI) Model	Smallmouth Bas HSI Model[1]					
Upper Mississippi River Lock and Dam 22	Fish Passage Connectivity Index Model	Fish Passage Model[1]					
Sacramento River Bank Protection Project	Standard Assessment Methodology (SAM) and SAM Electronic Calculation Template	SAM and SAM ECT[1] (ECT)					

Region/Project	Review	Model or Method	# Reviewers	# Final Panel Comments[1]	Significance, #		
					High	Medium	Low
Upper Des Plaines River Basin	Regional Guidebook for Applying the Hydrogeomorphic Approach to Assessing Wetland Functions of Depressional Wetlands in the Upper Des Plaines River Basin	UDP HGM Method	3	17	9	6	2
Upper Des Plaines River Basin	Community Models for the Upper Des Plaines River Watershed in and	UDP Community Models	4	15	9	4	2
Clear Creek, TX	Clear and Wet Coastal Prairie Community Index Models	Clear Creek Community Models[1]	4	15	13	2	0
Louisiana and East Texas Coastal Wetlands	Wetland Value Assessment Models	WVA Models[1]	6	22	17	4	1
Middle Restoration Project	Island Community Units Model	Mid-Chesapeake ICU Model[1]	6	37	not assigned	not assigned	not assigned
Modified Charleston Method (MCM) W-14 Project	Modified Method	W-14 MCM[1]	3	12	8	4	0
Chatfield Reallocation Study	Chatfield Ecological Functions Approach	Chatfield PMJM	1	3	0	2	1



Amanda Maxemchuk, Battelle

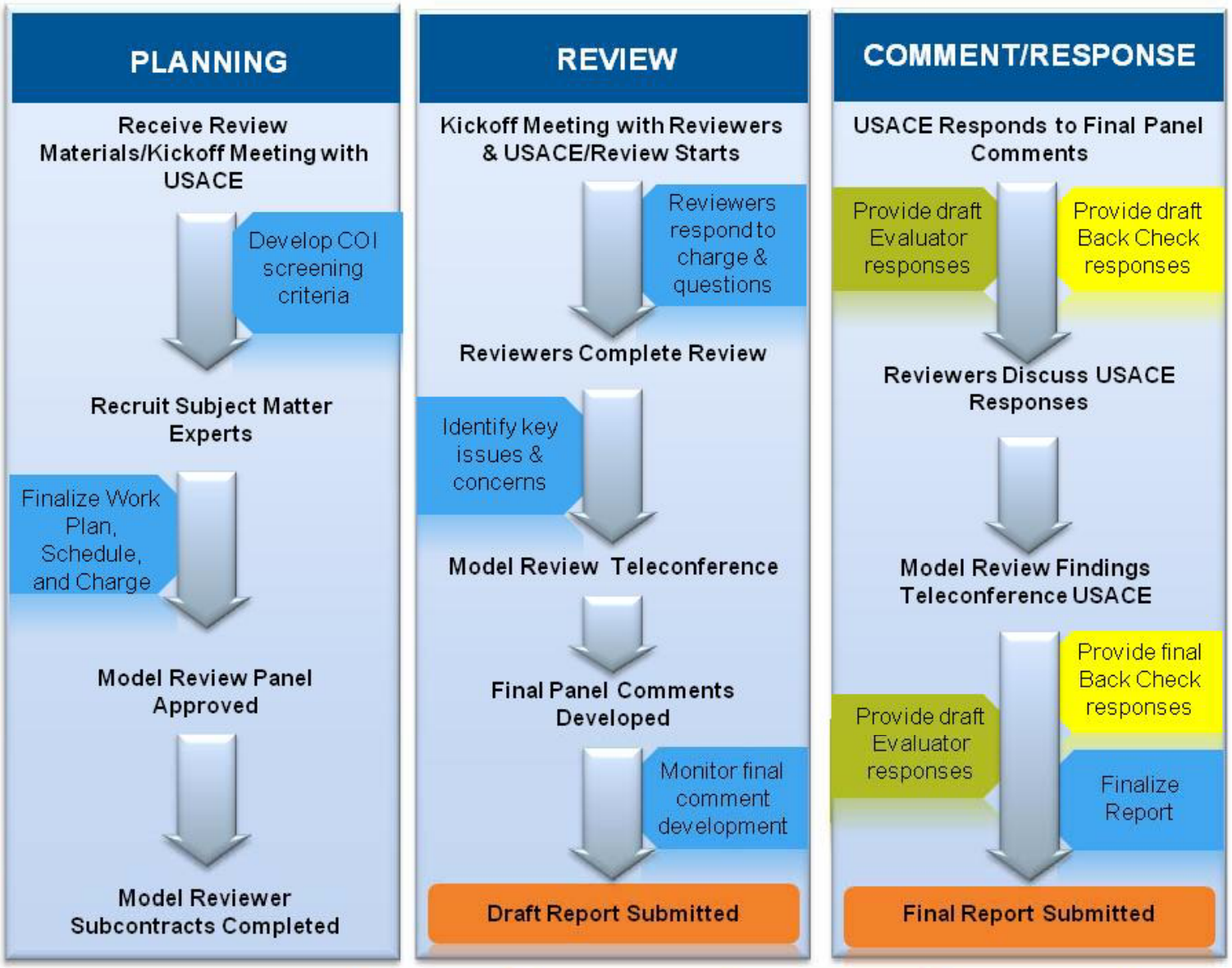
May 22, 2012

Agenda

- Objective and Purpose
- Model Review Process Overview
- Models Reviewed
- Model Review Results
- Recommended Considerations

Objective and Purpose of Model Reviews

- The USACE Planning Models Improvement Program (PMIP) was established in 2003 to assess the state of planning tools being used by USACE and to make recommendations to assure that high quality methods and tools are available to enable informed decisions on investments in the Nation's water resources infrastructure and natural environment.
- Main Objective: to carry out a process to review, improve, and validate analytical tools and models for USACE Civil Works business programs.
- Purpose: to evaluate the ***technical quality, system quality and usability*** of planning models in accordance with:
  - EC 1105-2-412, *Assuring Quality of Planning Models* (31 March 2011)
  - *Protocols for Certification/Approval of Planning Models* (EC 1105-2-412 Attachment)


PLANNING
Receive Review Materials/Kickoff Meeting with USACE
Develop COI screening criteria
Recruit Subject Matter Experts
Finalize Work Plan, Schedule, and Charge
Model Review Panel Approved
Model Reviewer Subcontracts Completed
REVIEW
Kickoff Meeting with Reviewers & USACE/Review Starts
Reviewers respond to charge & questions
Reviewers Complete Review
Identify key issues & concerns
Model Review Teleconference
Final Panel Comments Developed
Monitor final comment development
Draft Report Submitted
COMMENT/RESPONSE
USACE Responds to Final Panel Comments
Provide draft Evaluator responses
Provide draft Back Check responses
Reviewers Discuss USACE Responses
Model Review Findings Teleconference USACE
Provide draft Evaluator responses
Provide final Back Check responses
Finalize Report
Final Report Submitted
Key to Graphic Colors:
Deliverable
USACE Activity
Battelle Activity
Panel Activity

Final Panel Comment Structure

Final Panel Comments can be composed of as many as five parts:

1	• A **clear statement** of the concern (all reviews)
2	• **Relevant model assessment criteria** (based on Protocols for the Certification/Approval of Planning Models) (some reviews)
3	• The **basis** for the comment (all reviews)
4	• The **significance** of the comment (i.e., high, medium, or low) regarding how the issue impacts the model (most reviews)
5	• **Recommendations** to resolve the issue identified in the comment (all reviews)

Final Panel Comment Structure, continued

Final Panel Comment Significance Levels:

High	• Affects the model's ability to serve its intended purpose
Medium	• Affects the level of understanding or performance of the model
Low	• Affects the technical quality of the model or its documentation

Example Final Panel Comment

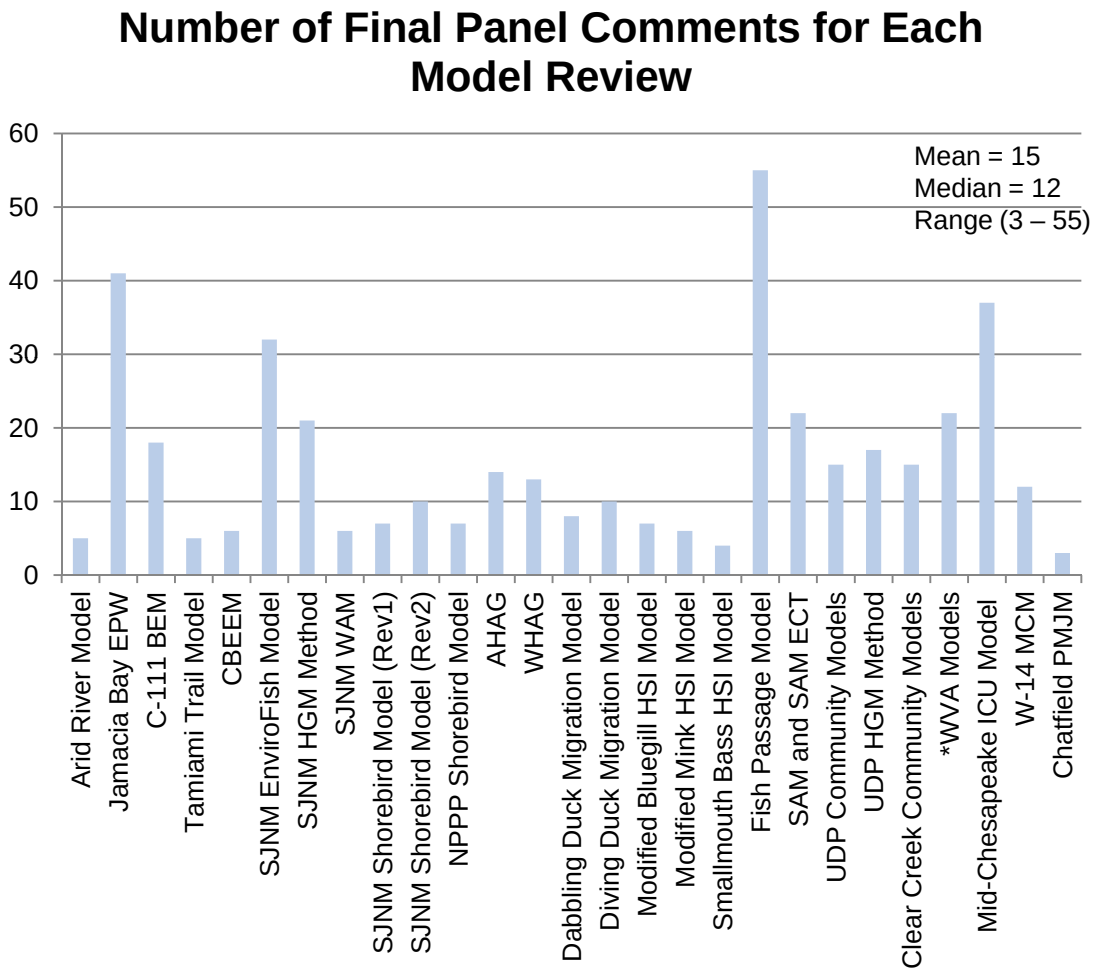
Comment 1:
Whether the model is capable of achieving its intended purpose is uncertain.
Relevant Model Assessment Criteria:
Review of: Model Testing and Validation Results
Basis for Comment:
The model can potentially satisfy the basic purposes for which it was developed, particularly its role in routine regulatory review, where rapid assessment tools that can quantify both unavoidable impacts and compensatory mitigation are routinely needed. The model is a habitat-suitability index (HSI) model, which is a type of rapid assessment tool that is widely used for these purposes. Like other his models, it still suffers from assessing only local physical habitat when other controls may be equally or more important determinants of habitat quality and habitat use (e.g., temperature, which is at least partly controlled by releases of cold bottom-water from reservoirs, and salinity, which is largely controlled by the interactions between stage/discharge and sea level). The model can be used to make relative comparisons between alternative conditions, which is the basic requirement of any assessment tool to be used in routine regulatory review. However, it is not clear if those relative comparisons are accurate and sensitive enough to satisfy the routine regulatory review purposes for which it was developed. This uncertainty is related either to the fact that the existing validation exercise presented in the model documentation lacks transparency or that it does not adequately determine the model's ability to accurately characterize habitat quality for all focus fish species and life history stages. (Note: The Basis for Comment developed has been truncated for presentation purposes.)
Significance – High:
The model may lack the accuracy and/or sensitivity that is necessary to accurately distinguish between project alternatives with regards to their potential effects on each focus fish species and life history stage.
Recommendations for Resolution:
1. Clearly explain the methods by which the model results were converted to qualitative scores. These methods should be quantitative and repeatable. 2. Clearly identify the name, affiliation, expertise, and potential conflicts of interest of each of the experts who assessed habitat conditions. These experts should be qualified and unbiased. 3. Clearly explain the data, criteria, and procedures the experts used in assigning the qualitative scores. These methods should be quantitative and repeatable. 4. Repeat the validation exercise using model index scores for each focus fish species and life history stage. 5. Clearly state if and how the validation exercise was used to revise the model (i.e., used as part of the calibration of the model) and/or quantify the potential errors that might arise from the application of the model (i.e., used as a true validation of the model).

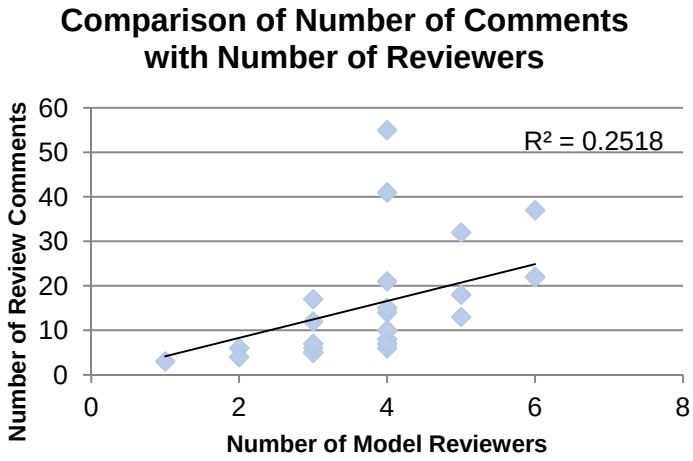
Summary of Models Reviewed

- 16 separate reviews of 34 individual planning models and methods:
  - Battelle – 11 reviews (22 models)
  - USACE – 3 reviews (3 models)
  - EA Engineering, Science and Technology, Inc. – 1 review (1 model)
  - Abt Associates – 1 review (8 models)
- 418 Final Panel Comments were generated:
  - Does not represent the total number of comments
  - Some Final Panel Comments had multiple parts

RESULTS

Number of Final Panel Comments Across Reviews





*** WVA included a review of eight very similar models.**

Variables Affecting Number of Comments

- **Number** of reviewers/expert disciplines
- **Complexity** of the model
- **Level of contribution** of each individual model reviewer (e.g., model base more on biological scientific theory than physical scientific theory)
- **Amount of time** for the review (reviews on compressed schedules may receive fewer comments, potentially indicating a reduction in review quality)

- Note: Inclusion of a review of model spreadsheets or software **does not appear to affect** the number of review comments (27 of 34 models had spreadsheets or software)

Model Review Panel Members

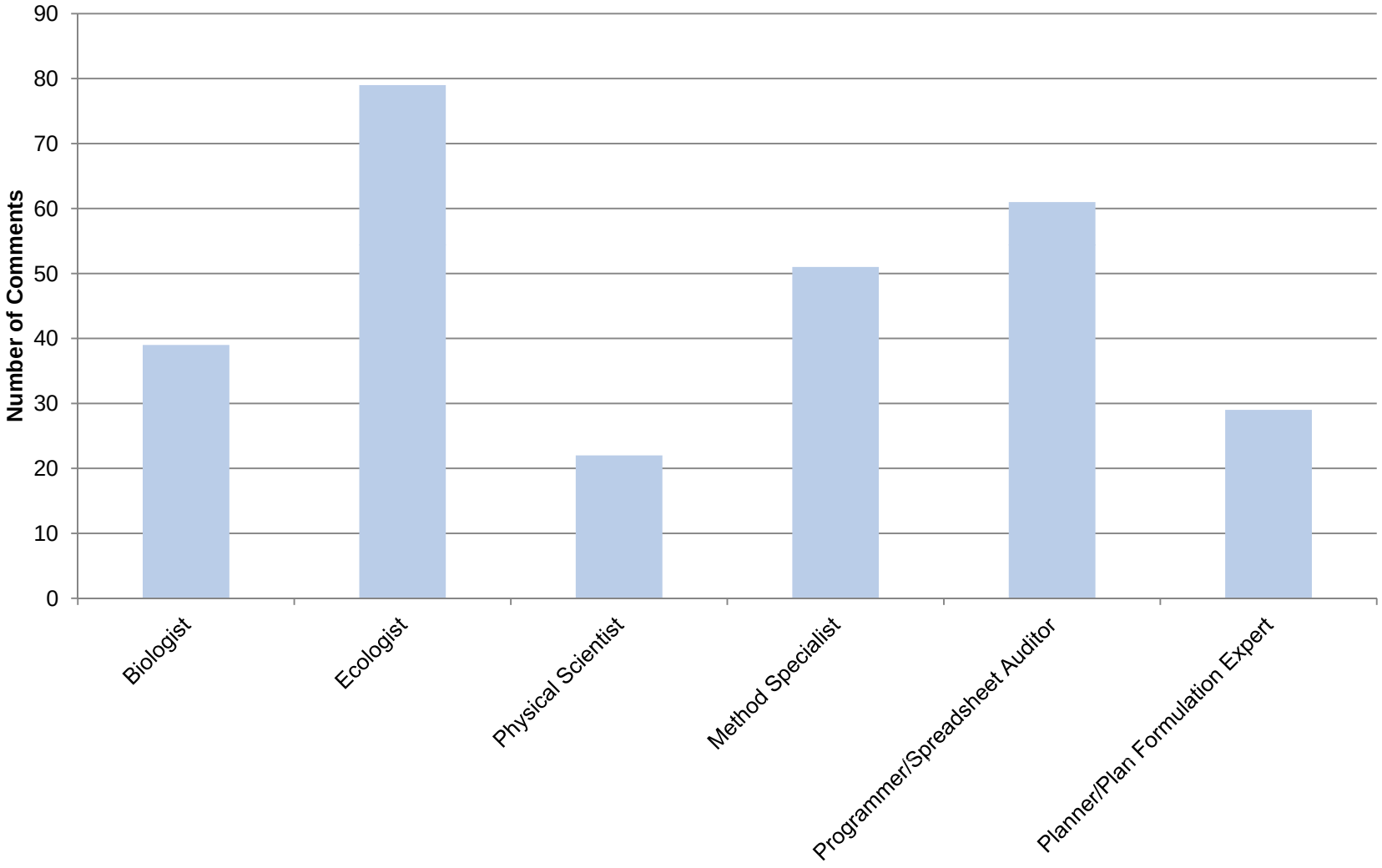
- 1 – 6 reviewers per Model Review Panel (mean = 4)

- Information on expertise of the reviewer **providing the comment** available for 281 of the 418 comments (5 of 16 reviews)

Model Review Panel Members, continued

- Subject matter expert categories:
  - **Physical Scientist** *(Geomorphologist/Geologist, Geophysicist, Hydraulic Engineer, and Wetland Hydrologist)*
  - **Biologist** *(Aquatic Biologist, Avian Biologist, Fishery Biologist, Fishery Ecologist, Population Biologist/Modeler, Preble's Meadow Jumping Mouse Expert, and Waterfowl Biologist)*
  - **Ecologist** *(Biologist-Ecologist, Coastal Ecosystems Ecologist, Coastal Wetlands Ecologist, Estuarine Ecologist, Forested Wetland Ecologist, Freshwater Ecologist, Prairie Ecologist, and Wetland Ecologist)*
  - **Method Specialist** *(Habitat Evaluation Procedures Specialist, Hydrogeomorphic Method Specialist, and Wetland Habitat Assessment Specialist)*
  - **Software Programmer/Spreadsheet Auditor** *(Java Specialist and Programmer/Spreadsheet Auditor)*
  - **Planner/Plan Formulation Expert** *(Required understanding the Corps of Engineers planning process)*

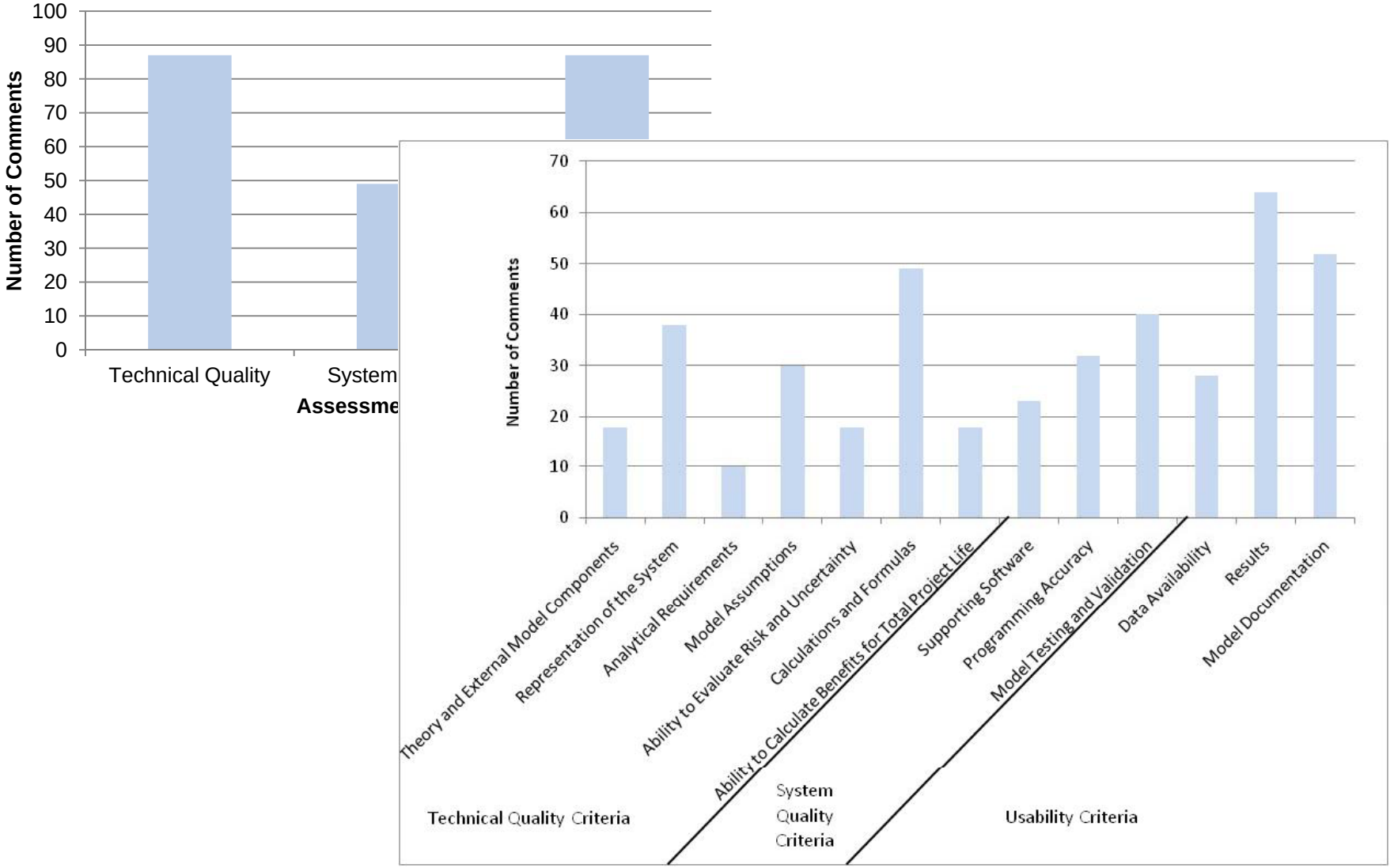
Number of Comments for Each Discipline Category For All Reviews



Model Review Comments

- The greatest number of comments were related to the technical quality and usability of the models reviewed.
- The greatest number of comments were assigned a high level of significance (issues affecting the ability of the models to serve their intended purpose), followed by those assigned medium significance (issues affecting understanding or level of performance).

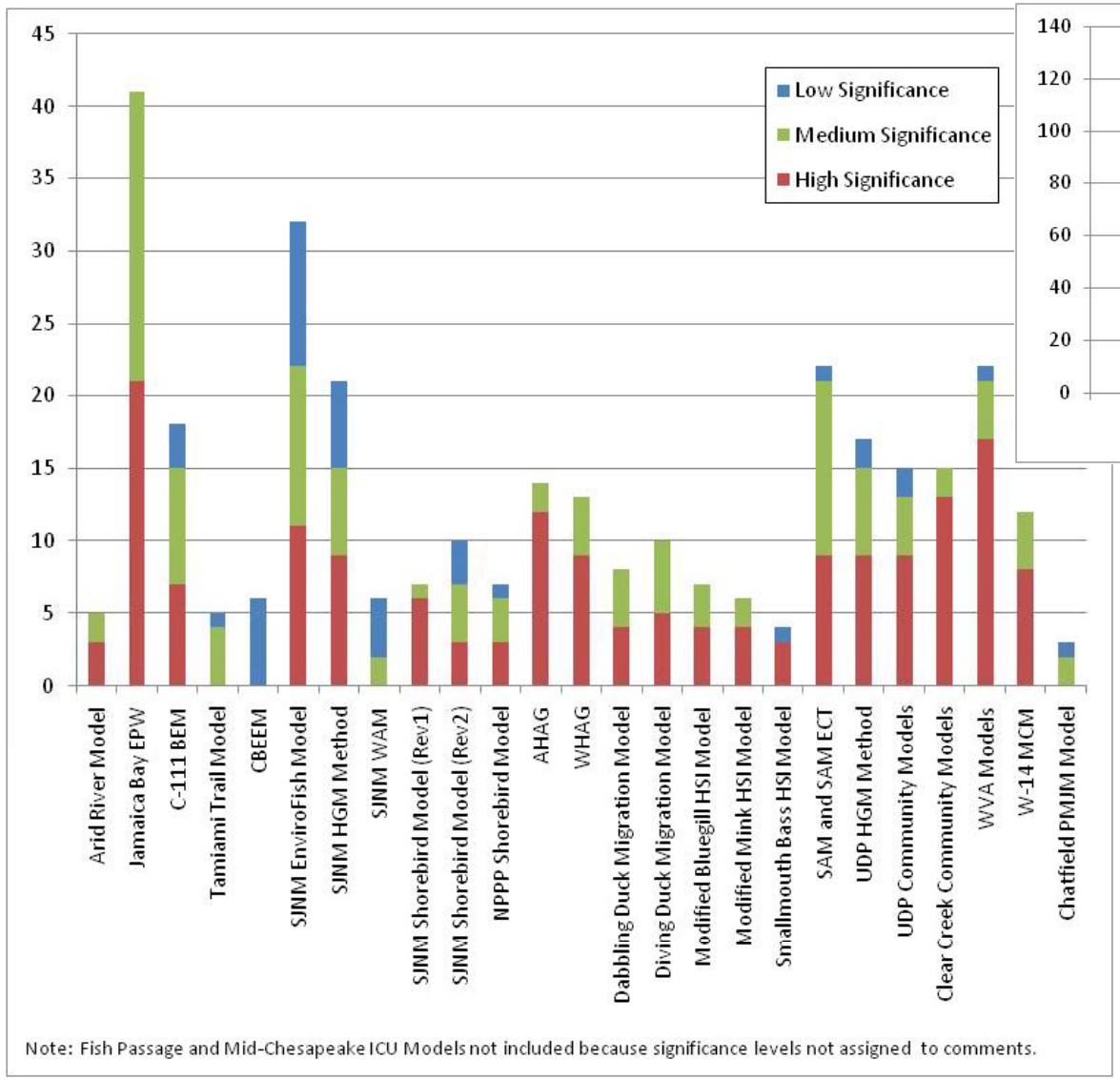
Number of Comments Related to Assessment Criteria Across Five Reviews



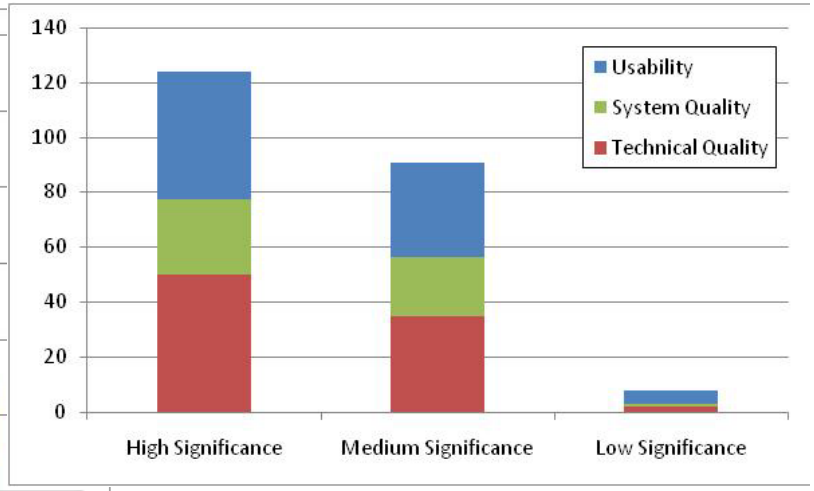
Number of Comments for Each of the Assessment Criteria

Model Assessment Criteria		Jamaica Bay Model Review	SJNM Shorebird Model	SAM and SAM ETC	UDP Community Models	UDP HGM Method	Grand Total
Criteria Related to Technical Quality	Theory and External Model Components	7	0	5	3	3	**18**
	Representation of the System	14	3	5	7	9	**38**
	Analytical Requirements	5	1	3	1	0	**10**
	Model Assumptions	10	5	6	4	5	**30**
	Ability to Evaluate Risk and Uncertainty	7	5	5	1	0	**18**
	Calculations and Formulas	23	4	11	9	2	**49**
	Ability to Calculate Benefits for Total Project Life	6	2	5	4	1	**18**
Criteria Related to System Quality	Supporting Software	11	0	12	0	0	**23**
	Programming Accuracy	23	0	9	0	0	**32**
	Model Testing and Validation	23	2	11	3	1	**40**
Criteria Related to Model Usability	Data Availability	15	2	7	0	4	**28**
	Results	34	5	15	7	3	**64**
	Model Documentation	24	2	15	8	3	**52**
Technical Quality		**36**	**7**	**18**	**13**	**13**	**87**
System Quality		**31**	**2**	**12**	**3**	**1**	**49**
Usability		**37**	**7**	**21**	**13**	**9**	**87**
Total Number of Comment		**41**	**10**	**22**	**15**	**17**	**105**

Number of Comments at Each Significance Level



Note: Fish Passage and Mid-Chesapeake ICU Models not included because significance levels not assigned to comments.



General Issues of High Significance

Technical Quality	➢ Model formulas and how well the model represents the system (there will always be something else to consider) ➢ Unclear or inappropriate assumptions
System Quality	➢ Calculation errors ➢ Limited evidence of model testing and validation
Usability	➢ Potential misuse of the model ➢ Worksheets difficult to review and use; model outputs difficult to find ➢ Sensitivity of model results to model inputs ➢ Precision and ability of results to distinguish between project alternatives

General Issues of Medium Significance

Technical Quality	➢ How the model was developed ➢ Major assumptions and limitations ➢ Level of subjectivity ➢ Ability to evaluate risk and uncertainty ➢ Explanation of the collection, precision, and accuracy of input data required
System Quality	➢ User guidance on model inputs
Usability	➢ Ability to verify and validate model results ➢ Biological/ecological interpretation of model results/outputs ➢ User interface design ➢ Number of alternatives or plans that can be compared at once

General Issue of Low Significance

Technical Quality, System Quality and Usability

- Quantity and quality of information in the user documentation
- Model software/spreadsheet interface

Future Model Development

RECOMMENDED CONSIDERATIONS

Model Documentation

Model documentation should include clear, detailed descriptions of:

- The intended purpose of the model and how model outputs will be used by decision-makers
- Major assumptions and limitations
- The spatial resolution and geographic boundaries of the model (e.g., resolution of raster data or elevation data; project boundaries)
- **Separate** model documentation, tutorials, and spreadsheet/software user documentation that includes:
  - Model Version
  - Developers
  - Technical Support Contacts
  - How to: use the spreadsheet, prepare input data, model inputs

Testing and Validation

- Link model outputs to ecologically significant conditions.
- Field-verify that index values accurately reflect habitat suitability/quality.
- Perform **and document** model testing and validation.

HSI = 0.8 = Habitat Parameters?

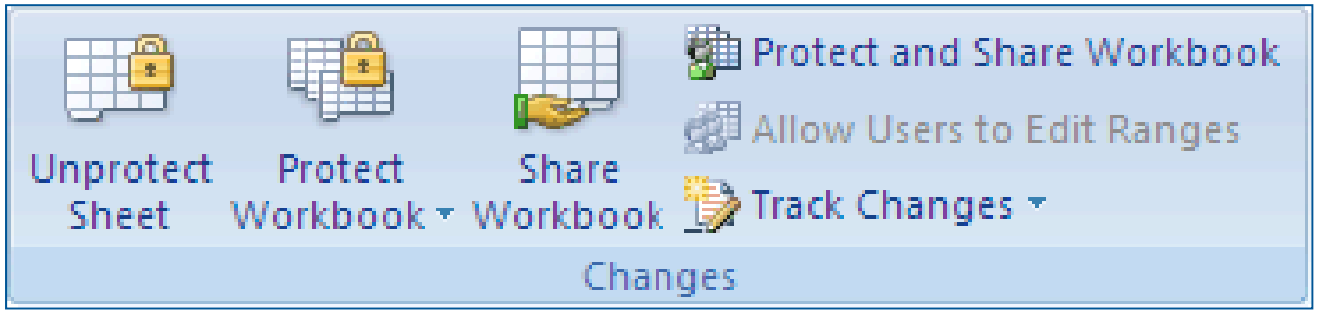
What does this look like in the field?

Analytical Requirements

- Use the highest reasonable level of precision.
- Assign quantitative boundaries to qualitative variables to improve model sensitivity to differences in variable scores and reduce subjectivity, which can lead to differences in results between users.
- Use sufficient data to represent all sets of reference conditions.

Spreadsheets and Software

- Include the version number and date, as well as the names and contact information for the developers.
- Document all revisions to the model.
- Keep spreadsheets simple.
- Protect model calculation worksheets.

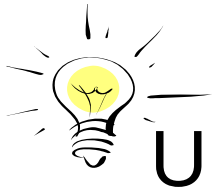


Spreadsheets and Software Utility

- Build in error checks and set up warnings.
- Design the model spreadsheet or software to accommodate as many alternatives as desired.
- Allow the user to define filenames and file locations.
- Make model outputs transparent and easy to find and understand.

Unique But Notable Recommendations

- For Habitat Suitability Index (HSI) type models, carefully consider:
  - Which species, guilds or life history stages should be represented?
  - What are the most appropriate parameters to represent habitat quality?
  - What is the level of precision needed for model parameters?
- Develop performance measures that consider changes in critical model variables for highly dynamic environments (e.g. fluctuations in salinity).
- Provide a detailed technical rationale for the number of years and range of years used to characterize hydrologic conditions.



Unique But Notable Recommendations

- Include variables that address the importance of habitat patch size and shape, habitat corridors, and habitat connectivity.
- Account for differences in feeding guilds and season in waterfowl, shorebird, and fish HSI models.
- Be cognizant of rounding issues.
- Make results from alternative model assumptions tamper-evident.

Most Important Recommendations

- Minimize the level of subjectivity and variation in user inputs
- Demonstrated/additional model testing and validation
- Complete and organized documentation:
  - Model Documentation
  - User Guide
  - Quick Start Guide (software)
  - Spreadsheet Documentation
  - Tutorial
  - Developer's Guide
  - Test and Release Plan

VALUE OF MODEL REVIEWS

- Identification and correction of calculation errors in model spreadsheets or software
- Ability to recognize and reduce the potential for errors and inaccuracies
- Identification of ways to improve the model code, interface, and documentation for future revisions of the model spreadsheets or software
- Improved resolution of model results
- Improved model documentation

Questions?