Chesapeake Bay Decision Framework

Purpose: The decision framework is designed to address two issues: the need for transparency and accountability in the Bay program; and a need to effectively implement adaptive management. In both cases developing and documenting a rationale for all activities that links them clearly and logically to program's goals is essential. The decision framework is intended to facilitate the development and articulation of that logic by providing a structure for: identification of goals; reasoned development of strategies; purposeful design of monitoring; and planning for effective assessment of efficacy.

The decision framework is a tool for development of the essential logic that must underpin any successful environmental management program. Simply providing input for each step outlined in the framework will not guarantee a sound or well-reasoned logic. That can only arise from the conscientious efforts of those identifying and pursuing program goals. The framework is simply a structure for consistent presentation and effective coordination of all its activities.

What follows is a brief summary of the purpose of each of the seven steps in the framework and some guidance on the key characteristics of appropriate input.

1. Articulate program goals

Purpose: Without an explicit, unambiguous goal it is impossible to know precisely what is being sought and therefore whether any of the planned activities are justified.

Key characteristics: The goal statement should identify a measurable outcome. Preferably it should be realistic and attainable within a practical time period. But there is no reason it cannot be aspirational. The key is that it must be explicit. Terms like "healthy" or "sustainable" or "natural" are open to endless debate, and therefore not particularly useful in goal statements. If they are used, it is essential that there be an accompanying statement that defines them in terms of measurable parameters. For example, "clean" waters might be defined as those meeting all water quality standards, "natural" conditions might be defined as specific parameters matching those in a particular reference site.

The goal statement should be sufficiently explicit, or well enough defined, that anyone reading it would have no doubt about what the aspiration is.

2. Describe factors influencing goal attainment

Purpose: In order to know what must be done to attain the specified goal, it is necessary to know how the ecosystem operates, and therefore, what has to be managed. Ideally, a well developed ecosystem model would always be available to answer these questions. This is almost never the case, and

ultimately a sophisticated model or even a really well-informed understanding of the system is not essential before management efforts can begin. It is entirely possible to learn while doing, and that is exactly what most environmental management programs must do. The key to constant improvement, however, is to be explicit about the beginning understanding. When the starting point is identified, monitoring can identify consistent or inconsistent behavior and thus inform subsequent adjustments of the understanding.

The initial understanding is also what justifies the initial management actions. Accountability demands openness about the certainty of management action efficacy. It is acceptable to take actions in the face of significant uncertainty, as long as there is reasonable assurance that the action was considered in light of all that is known about the system.

Key Characteristics: The decision framework suggests a starting point for this assessment that is relatively unsophisticated, and not terribly time consuming. The idea is that qualitative and conceptual understandings are sufficient to start a process that should be iterated frequently and hopefully with increasing sophistication as understandings increase. In the first iteration, it is most important to identify factors in both the natural and human systems. The objective is to be as complete as reasonably possible. The framework suggests facilitating this identification by considering factors that might fall under the broad categories of biological, chemical, physical, geological, and human factors. Sub-categories are also suggested in an effort to promote comprehensive consideration.

Identification of factors is a process that can easily wander into levels of sophistication that rapidly exceed the utility of an initial assessment. In the first iteration "lumping" is preferable to "splitting" in factor identification.

Once identified, all factors should be rated for both their importance in affecting goal attainment, and the ability to be managed. This is a simple articulation of the rationale for any management strategy. Program accountability would expect that all important factors would be managed if the goal was to be attained. This can also be a test of goal practicality. If there are factors critical to goal attainment that are also difficult or impossible to manage, the practicality of the goal may be suspect.

3. Assess current management efforts – identify gaps

Purpose: Once critical factors influencing goal attainment are identified, the next step is to identify and assess ongoing management efforts. For factors currently under some management, the efficacy of the management with respect to the goal should be assessed. The objective is to determine if the ongoing management effort is sufficient to achieve the goal, or whether enhancement is necessary. Factors that are not being managed will require development of a new strategy.

Key Characteristics: In the initial iteration of this assessment, there is no need and perhaps no basis for a detailed evaluation of existing management efforts. The first objective is to identify needs for new

management efforts and opportunities for coordination of existing efforts. In time, monitoring will develop the basis for more rigorous evaluation, and a more robust rationale for any revisions necessary.

4. Develop management strategy

Purpose: Management strategies are the actions that the program will undertake to address the factors affecting goal attainment. In many programs, strategy development is accomplished through some form of logic modeling or results chain development. There are many versions of this practice, and there are a variety of tools to facilitate the undertaking. None of them are explicitly called for in the decision framework, in the expectation that it is possible to develop well reasoned strategies without those methods.

Key Characteristics: Strategies should all be directly tied to the critical factors. Anything not linked to a critical factor has little reason to be part of the program, in so far as it is thus not addressing a program goal.

Strategies should be described in terms that make them measurable. There are two things that should be considered in this context. The first is description of the management action called for by the strategy. What exactly is going to be undertaken? Evaluators refer to this as the "intervention." The second thing is the desired outcome. What should happen as a result of the intervention? Both the intervention and the outcome should be observable and measurable.

It is useful to consider the time over which interventions should produce observable outcomes. This information is critical to the design of the monitoring program.

5. Develop monitoring program

Purpose: Monitoring is necessary to answer two basic accountability questions: Are we doing what we said we would do? Is the outcome what is expected and desired?

Key Characteristics: There should be a direct link between the monitoring program and the strategy, which should be clearly tied to the goal. In this way the rationale for the monitoring should be very clear. As noted above the monitoring should have two specific purposes: to document that the strategy is being implemented as planned; and to determine if the system is responding as expected. The parameters or indicators monitored should be clearly identified and the frequency of monitoring should be based on what will be necessary to document status and trends in the context of any system variability.

In some strategies it may be necessary to propose a third type of monitoring metric. The logic of the decision framework is based on clear identification of the underlying understanding about the ecosystem. In some cases this will be little more than a hypothesis. In these cases the assumptions

about system processes should be explicit, but identified as assumptions. It can be important for adaptive management to include monitoring to assess the accuracy of these assumptions. It is possible that monitoring of an intervention and an outcome will not be sufficient to assess underlying assumptions and this will impede efforts to enhance management efficacy.

6. Assess performance

Purpose: For both accountability and adaptive management it is essential to evaluate the performance of the management effort. Two assessments are needed. For accountability the question is whether the management intervention was effectively delivered. This is typically a very simple and straightforward assessment. Did we do what we said we needed to do when we said we needed to do it? For adaptive management it is important to know if the system responded as expected. Did the outcomes appear at the level and at the pace expected?

Key characteristics: The assessment of performance should occur in two phases: before the management even begins, and then intermittently after commencement. The initial assessment is really an expression of the understanding of how the system operates and the certainty surrounding that understanding. The way this is identified is by specifying what the monitoring program is expected to show over time. When the strategy is developed and the monitoring parameters are identified, program managers should clearly identify the trajectory of monitored values they anticipate. This reflects their current understanding of how the system behaves and when they expect to attain the goal.

Program managers should also provide a clear identification of the variation around the expected system trajectory they believe would be consistent with the system behavior matching their expectations. This envelop of reasonable uncertainty reflects their confidence in the initial understanding of system behavior. It must be explicit over the time period to anticipated goal attainment, because it also establishes the criteria for performance assessment at interim points.

If the consensus expected system response to an intervention is +15% in two years, and the confidence in that expectation is that it will actually be somewhere between +5% and +30%, then the thresholds for deciding the intervention is working as expected are effectively established. For adaptive management, this is setting the decision criteria for “staying the course” or revising the strategy.

7. Manage adaptively

Purpose: In order to constantly improve the effectiveness of the management program, there must be a process for continually reducing the uncertainty in management strategies. The decision framework attempts to enable this by promoting explicit identification of the understanding that drives management efforts, and detailed prediction of expected system

behavior based on that understanding. Well designed monitoring then enables constant assessment of the accuracy of that understanding and informs revision of the understanding to reduce the uncertainty in the next iteration.

Decision Framework implementation – examples of the issues at each step

1. Articulate program goals

Example: The Chesapeake Action Plan goal to "Protect and restore vital aquatic habitats" is insufficiently explicit, absent considerable additional definition, to be very useful. Defining aquatic vital habitats to mean SAV beds, oyster beds, wetlands, and anadromous fish spawning reaches begins to provide some useful programmatic bounds. Defining what constitutes protection and restoration would be the final piece necessary to establish a goal that can support effective adaptive management.

2. Describe factors influencing goal attainment

Example: In the Chesapeake Bay system, tidal wetland restoration will be affected by geomorphology, salinity, herbivory, sea level rise and shoreline development. Geomorphology is critical to success and can be managed only on local scales, often at great expense. Salinity is a critical determinant of wetland type, and essentially unmanageable. But, appropriate planning can accommodate this factor. Herbivory can be a significant factor locally, but is not critical at the scale of the entire Bay. It can be managed with appropriate resources and authority. Sea level rise is a critical factor for long term success and is beyond our management capacity. Combined with existing geomorphology it is a major constraint on restoration goals. Shoreline development is a critical factor, and current management tools are inadequate to address its impact in a system experiencing sea level rise.

3. Assess current management efforts – identify gaps

Example: Impacts to nontidal wetlands are regulated by state and federal programs throughout the Bay watershed. Existing programs all operate with an "avoid-minimize-replace" sequence of actions to prevent loss of the resource. Individually and collectively the existing programs have failed to achieve the no-net loss objective. A variety of non-regulatory programs exist to enable and encourage protection and/or restoration of nontidal wetlands. These programs collectively achieve too little to stem the net loss of the resource, let alone attain the net gain goal. Success will require significant expansion of existing protection and restoration programs, expansion of regulatory authority to address impacts originating outside current jurisdictional boundaries, and proactive planning for the impacts of climate change.

4. Develop management strategy

Example: The factors affecting our ability to attain the water quality goals for the Bay include: our understanding of the nature of the problem; the technical tools to fix the problem; the resources and

authority to implement the fixes; and the public will to undertake the effort. The strategy to attain the goal has involved a lot of research and development to understand the problem and create the tools to address the problem; voluntary efforts to create the resources and will to fix the problem; and now legal actions to enhance those efforts. This is an example of a very high level strategy.

A more explicit strategy might be the one to reduce point source nutrient loads to the Bay and its tributaries. Key factors affecting this goal include: treatment plant technology, funding, climatic conditions, and continued development. Increased treatment performance has been achieved by regulatory modification of discharge permits which is driving plant technology upgrades. Funding issues have been addressed with public funding, and implementation of trading programs to facilitate strategic planning of expensive upgrades. Climatic variability and continued development are addressed by improved treatment capability and caps on permitted load discharges.

5. Develop monitoring program

Example: Improving water quality by planting riparian forest buffers along miles of Bay tributaries is founded on reasonably strong science that documents the benefits of forest buffers. The assumption is that miles of new forest buffers will result in improved water quality. The strategy to achieve the goal addressed the issues of increased public understanding of the values of buffers (using outreach education), identification of appropriate sites (using remote sensing and local knowledge), and provision of necessary resources (grants and cost share programs). Appropriate monitoring for adaptive management would include tracking the implementation efforts (how many miles of buffers were actually planted); and tracking the desired outcome (did local water quality improve). Reducing uncertainty in the simple system model, however, might require additional monitoring to track other factors that could impact local water quality, confounding the signal generated by the forest buffer (e.g. changes in local land use, altered hydrology, or climatic variability).

6. Assess performance

Example: Oyster restoration typically involves creation of new oyster reefs by placement of oyster shell in piles or spread across the Bay bottom. Restoration success in areas that are not merely put-and-take efforts is defined in terms of the long-term persistence of an oyster population on the site. Assessing success is accomplished by sampling a site and documenting the number of living oysters and the population age structure. With knowledge of the life cycle, typical growth rates, and fecundity of native oysters, the degradation rates of un-colonized shell, and the relationship of disease organisms and salinity, it is possible to identify a trajectory for both population size and composition that would be consistent with potential survival of the reef after one, two, three, four, and five years. It should be possible to identify failure almost immediately if few or no live oysters are found at any point. Establishment of sizeable, persistent cohorts of older oysters over time would be the metric of potential success.

7. Manage adaptively

Example: Efforts to facilitate SAV restoration in the lower Bay by dispersal of seeds or other propagules has been attempted for many years. Repeated failures to establish self-sustaining populations, combined with emerging research on population dynamics, has led to revised strategies, that focus resources and efforts on other restoration activities that have higher probabilities for success. This is an example adaptive management driven by clear goals, defined strategies, effective monitoring, and careful assessment.

Important Considerations for Implementation of the Decision Framework

- **Perfection is the enemy**
  This entire process is meant to be iterated. Indeed it must be iterated to be effective. Therefore getting everything just right on the first pass is not essential. In a sense it is best to leave folks with a sense that improvements are very possible – this promotes the commitment to iteration. Most importantly, too much time spent on developing detailed information almost always turns people off to the entire process. It is much, much better to push through the process focusing on the relationship between the steps, so that an initial construct is developed.

- **Understanding the underlying logic is the primary goal of the first iteration**
  The value of the decision framework lies in the establishment of very clear links between goals, strategies, monitoring, assessment, and adaptation. Once people understand the essential rationale, it becomes a general construct that is easily applied to a wide variety of issues, and it becomes a characteristic of program management. What we seek is a programmatic ethos that ensures no actions are taken that are not clearly linked to articulated goals, fully evaluated at appropriate and frequent intervals, and planned to evolve based on improved understanding. The structure of the Decision Framework is nothing more than a simple way to enable and reinforce the application of that logic.

- **Identifying benefits derived from process is important to sustaining interest and use of the framework.**
  There are several benefits that routinely emerge in the first pass through the framework, even when that pass is relatively unsophisticated.
  - First, the value of clearly articulated or precisely defined goals is usually self-evident if the step is undertaken by a group. The diversity of opinions about what is meant or intended suffices to underscore the value of clarity. Simply asking questions about the goal to highlight uncertainties in the terminology is usually sufficient facilitation.
  - Evaluation of goal practicality based on honest assessments of the program's capacity to manage critical factors influencing outcomes is usually another valuable insight. Again this is relatively simple to facilitate since groups tend to be reasonably objective about assessing manageability. The trick is to ensure there is a reasonable effort to identify critical factors from both the human and natural parts of the system. Typically, there are factors in the natural system that cannot be managed (e.g. tides, temperature, storms, population levels), and there are factors in the human system that are difficult to manage (e.g. preferences, political will, economic conditions).
  - Identifying gaps or duplications in existing management programs focused on specific goals is a major benefit for partnership-based programs. The opportunity to make existing efforts more effective and/or more efficient through coordination and collaboration is one of the potential benefits of this process.

- Clear identification of critical monitoring needs is a major benefit of the framework. Prioritization of information needs is much easier when there is a strong connection between a program goal, the relevant management strategy, and the evaluation plan for the strategy.
- Program accountability is easy to demonstrate when decision thresholds are identified at the outset of a management strategy. If everyone knows what response is expected from a management intervention, what uncertainty surrounds that expectation, and what the plans are if the response does not meet those expectations – adaptive management is clearly in place and program evaluation is transparent.

- **Identification of factors influencing goal attainment is the poor man's ecosystem model.** The goal of adaptive management is to reduce the uncertainties affecting the design of management strategies. Strategies are developed based on current understandings of how managed systems operate. Therefore it is necessary to start by specifying what is known about system behavior. This can be accomplished in a wide variety of ways including:
  - full blown ecosystem models that incorporate human and natural components (the Atlantis model is an example);
  - best available ecosystem models (examples might include EocPath-EcoSim or the current Chesapeake Bay model);
  - logic models (results chain modeling, Miradi modeling, etc.)

  While all of these have utility and value, they represent a level of sophistication that does not typically generate program management benefits commensurate with the effort required. For the initial iteration of the Decision Framework, the resolution of system understanding necessary is not particularly great. In fact it will be much easier to engage and sustain general understanding of the essential program logic and framework benefits if groups can be kept "out of the weeds."

  What is important in the effort to identify factors affecting attainment of program goals is conscientious consideration of both natural and human components of the system. The Decision Framework provides a generic checklist as one strategy for facilitating this. There is nothing that makes this approach particularly superior to any other. It is purposefully general, promoting a coarse level of thinking about the system. Typically, even groups using this checklist will veer into detailed thinking about particular influences. Successful facilitation requires a commitment to generalization and achieving this outcome may require some manipulation of group inputs by the facilitator.

- **Identification of strategy performance expectations typically must overcome initial resistance.** Experienced environmental managers, and particularly scientists, are generally quite familiar with the natural variability of complex ecosystems. As a result, they can and will provide a multitude of well-reasoned arguments against specification of ecosystem responses to management interventions. Despite their reservations, it is essential that they be convinced to

do so. Adaptive management requires that the program learn from its actions, and it can only learn if it can evaluate the accuracy of what it currently "knows." Specification of expected responses defines what is currently known. This may, and typically will, come with much attendant uncertainty. The uncertainty should be accepted, but should be explicitly identified. This is accomplished by forecasting observable responses (appropriate monitoring parameters must be specified and levels must be predicted over some reasonable time period), and by identifying the range of reasonably anticipated variance around the forecast. Anyone who proposes a management strategy automatically has some basic expectation for a response. It is the role of the facilitator to use this fact to drag from the group some consensus vision of what this response may be.

The group engaged in this exercise should be brought to an understanding that they are articulating their collective understanding of the system, and thereby establishing the basis for evaluation of their proposed strategy. Failure to do this, denies the need for program accountability, since this is the essence of accountability.

Specifying system response expectations also establishes the basis for adaptive management. It enables identification of decision thresholds at future intervals – times when monitoring data can tell whether the system is responding within the bounds or even relatively uncertain expectations. If the system response lies outside those bounds, there are only two possible explanations:

1. The management intervention is not being implemented as planned; or
2. The understanding of the system is flawed.

It will be important for the group to consider what would be done as a consequence of either of these findings. But, in the initial iteration of the Decision Framework, that level of planning may not be essential. Effective prospective planning for the adaptive management step requires more advanced understanding of what can be accomplished in the monitoring and assessment steps. Much like sophisticated system modeling, too much detail in these steps can detract from the goal of imparting a strong appreciation of the essential logic in the framework. It is often best to leave consideration of these additional issues for subsequent iterations of the process.