

# Framework for America's Great Watershed Scorecard

## Prioritizing measurements and tracking results in the Mississippi River Basin

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### Abstract

This document is a review of a potential framework that could be used to demonstrate regional and national progress toward achieving sustainable economic, social and environmental management of the Mississippi River Watershed. The focus is to begin to define the values that characterize the overall of goals of the Mississippi River Watershed, and indicators that could be used to measure the status and progress towards achieving those goals. **This is not meant to be a final product, but an example to initiate discussion at the AGWI Summit and guide the development of appropriate values and indicators and a scorecard framework.**

### Why make a scorecard?

It is a daunting task to make sense of the multitude of measurements collected in even a small region. In an area as large and important as the Mississippi River Basin, the ability to distill the key messages from the vast array of data collected across multiple sectors is of critical importance to empowering informed decision-making and prioritizing management activities. Stakeholders at multiple levels need meaningful access to relevant results. The most general audiences, including politicians and the general public require a different level of information access than the informed policy wonk, the management agency director, or the academic researcher. This requires a multifaceted strategy to communicate results of monitoring and measurement. A scorecard can be an important gateway into the data stream that can provide access to the information most appropriate for each stakeholder need.

Key benefits of a scorecard process can include:

- Quick access to relevant results for multiple audiences,
- Ability to prioritize issues, objectives, and strategies,
- Track the effects of management actions,
- Stakeholder engagement

For a scorecard to be effective, an appropriate and transparent framework for integrating information must be developed. Common frameworks (including Pressure-State-Response, and Risk Assessment based frameworks) are appropriate for some ecological assessments, but may not be appropriate for integration of data from diverse sources like social and economic sectors. The scorecard framework presented here is based on goals identified in America's Great Watershed Initiative, derived from principles of Integrated River Basin Management, which includes balanced information from Social, Economic and Environmental sectors.

### Information for multiple audiences and users

Scorecards provide a gateway to information at multiple levels of detail and synthesis, providing valuable information to multiple stakeholders. Using a transparent framework such as the one described above can provide not only the synthesis required to communicate results to broad audiences, it also

provides access to the analytical underpinning of the results (Figure 1). Providing access to information at several levels allows users to drill down to the level of aggregation and synthesis appropriate to their use, knowledge base, or interest.

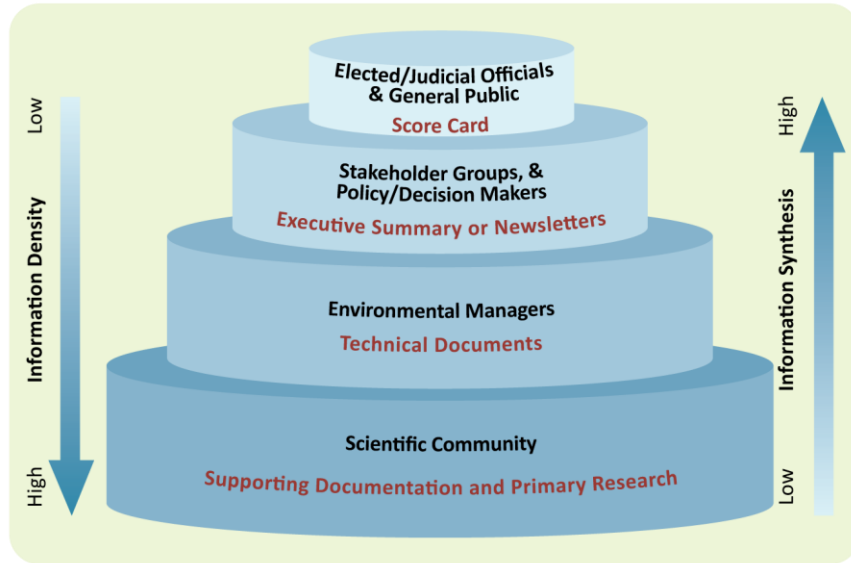


Figure 1. Information richness and synthesis provides relevant information to multiple stakeholders.

### **Monitoring and Measurement**

*We can measure almost anything, but how do we focus and prioritize our efforts?*

Measures have many purposes. Measures are used to communicate things like the status and changes over time of social, environmental and economic attributes, evaluations of strategy, project, and program effectiveness and efficiency, and they inform adaptive management. They are used to highlight needs, gain social and financial support for actions, and validate platforms for changes in policy. The uses of measures and the types of decisions being supported are what drive the formulation of measures. Measures development should focus on communicating specific information that will be used by specific groups. A user group may be broad, but should be defined. The first step is to define the user groups and the measures, and how the information should be communicated. Measures for different users are not simply a “roll-up” of monitoring data and detailed information up the management chain. The user groups, decisions being made, and the minimum necessary information to support decisions, need to be defined before generating measures.

*Monitoring* is the act of collecting information about something over time. *Measures* are a way to place monitoring information into context. That context is often in terms of changes over time in relation to a specific objective.

### Example: Gulf of Mexico Hypoxia

The anoxic area of the Gulf hypoxia zone is monitored over time. The hypoxia zone is measured in terms of its long-term average, its five-year running average, and its area in reference to objectives for the region (Figure 2). Instead of just reporting the value of the hypoxic area over time, we can state that the five-year running average is 18% higher than the long-term average, and that it is about 2.6 times larger than the objective that has been set for the hypoxia zone.

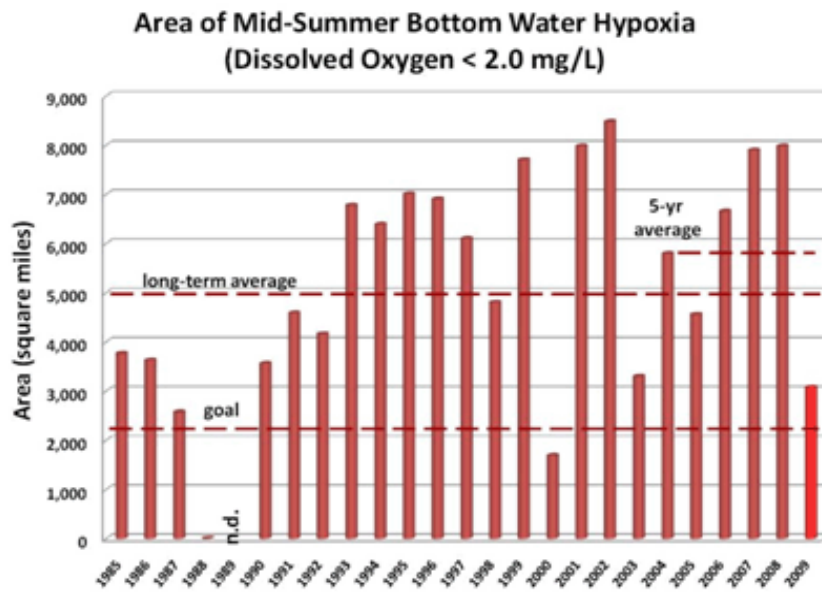


Figure 2. Area of Mid-Summer Bottom Water Hypoxia. (Source: Louisiana Marine Consortium/NOAA, USGS. [http://toxics.usgs.gov/hypoxia/hypoxic\\_zone.html](http://toxics.usgs.gov/hypoxia/hypoxic_zone.html))

The reported measure is not always the direct value of the attribute that is being monitored – it is a way of communicating information about that attribute in a specific context.

There are several types of monitoring and measures approaches that are used to generate information. Nichols and Williams (1996) summarized two monitoring approaches that are commonly implemented: *surveillance monitoring* and *targeted monitoring*. These authors define targeted monitoring as being focused on evaluating *a priori* hypotheses, models of responses to management, and supporting decisions regarding management actions. Nichols and Williams define surveillance monitoring as the collection of data on a wide range of attributes over time, and while not collected in the context of a specific management goal or question to answer a specific question, these data may have many potential uses.

These two monitoring approaches lie on extremes of a continuum, with the U.S. Long Term Ecological Research program somewhere in between (Wintle et al 2010). Proportional investments in targeted monitoring and surveillance monitoring are best determined by assessing trade-offs. These trade-offs are between improved management arising from the resolution of specified unknowns through targeted monitoring, and avoided costs (or windfalls) arising from the timely discovery of additional unknowns through surveillance monitoring (Wintle et al 2010).

Both groups of authors suggest that monitoring program should be designed through a rational, structured process that involves a clear articulation of the purpose of the program. The context and framework for programmatic measures should define the data collection needs.

### **Goals, Values, and Objectives: Deciding what to monitor and measure**

A precursor to America's Great Watershed Initiative, the Mississippi Watershed Initiative (MWI 2011) drafted 7 overarching goals for a sustainable Mississippi Watershed. These goals provide a suite of general statements about what integrated river basin management is intended to accomplish. These goals can serve as an ad hoc model to help illustrate how we might establish an overarching structure for measures.

#### ***Seven AGWI Goals***

- Nurture healthy, productive ecosystems
- Supply abundant, clean water to our farms and communities
- Provide reliable flood control
- Create world class recreational opportunities
- Serve as the nation's marine highway
- Support our local, state, and national economies
- Enhance national security

Broad, overarching goals such as these need defined values to describe these goals in explicit terms and guide development of meaningful measures. Values define the few things about each goal that should be evaluated over time to characterize whether goals are being met. Values are often fairly broad categories as well, and have sets of explicit indicators that track a suite of specific attributes of values to define their status and trends over time. For instance, common use of public recreational areas may be a value of world class recreation. The number of visitor use/days of recreational areas may be an indicator of that value.

How would we know when world class recreational opportunities have been realized? Objectives need to be defined for each value and for the overall goal in order to evaluate whether they have been met. Objectives are narrow, precise, time-bound, measureable milestones to achieve towards fulfilling values and overarching goals. For instance, an objective for the number of visitor use/days to be achieved by a specific future date needs to be defined. Otherwise, we cannot say anything about the status of that value – whether it is good, poor, or whether desired levels have been achieved. An overall objective that integrates values needs to be defined to evaluate whether the overarching goal has been achieved. That may be as simple as all objectives for each individual value have been met.

The overall intent of Integrated River Basin Management in the Mississippi River Basin is to achieve the seven goals through attaining the suite of economic, social and ecological values across all of them. The first focus of measures in our program should be to define the values that characterize goals, and indicators to measure the status and progress towards achieving them. Objectives (and perhaps some values and indicators) need to be set for each sub-basin because of the different geographies, issues, and changes that have taken place over time, in addition for the Mississippi River basin as a whole. At this time, we will focus on defining values and indicators. Objectives will require more time and discussion within each sub-basin, and will be a process we will support over the next year.

***Example Goal Descriptions***

**Clean Water:**

Farms, ranches, industry, and municipalities should have access to water that meets requirements for drinking, irrigation, manufacturing, and recreation, and maintain or lower water supply costs that result from poor water quality. Water should not be in shortage during low-flow times due to altered flows as a result of land-use management and channelization which speeds water movement throughout the ecosystem, and poorly managed exploitation of water resources, which result in extreme low water levels during natural low flow periods.

**Healthy and Productive Ecosystems:**

Healthy & productive ecosystems provide abundant native fish, wildlife and vegetation - which in turn offer services and products to society, including clean water, food, recreation opportunities, and the economic benefits associated with them. Health ecosystems require healthy freshwater habitats, which depend on certain degrees of natural regimes of processes and patterns, such as sediment transport, seasonal flow dynamics and exchange of nutrients between a river channel and its connected floodplain. Nurturing healthy ecosystems will require protecting and rehabilitating the major patterns and processes that generate and maintain habitats and the fish, wildlife and vegetation they support.

If all measures illustrate that goals and their values are being met, sustained, or progress is being made toward achieving them, IRBM is being completely successful. These measures will also identify goals and their values that are in need of social and political support to advance management actions to achieve objectives. These overview measures are often presented in a “scorecard” that summarizes the status and progress towards achieving goals and values. Scorecards communicate successes and needs to a broad audience and to decision makers in a simple yet meaningful way.

Table 1a is an example of what a scorecard might look like once values, indicators and objectives are defined for the goals of the Mississippi River basin and sub-basins. It illustrates how an overall score/grade may be presented for each goal that summarizes the related values and indicators within it. It is not meant to be a final product, but an example to initiate discussion at the meeting and guide the development of appropriate values and indicators and a scorecard framework. Table 1b is an example of how values and the indicators that are used to assess their status may be presented.

Table 1a. A potential structure of a General Scorecard for AGWI Goals. The status of goals may be an average value of values. (NOTE: The content of this table is meant to be illustrative, and not an accurate or final product).

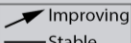
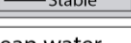
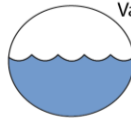


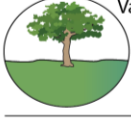

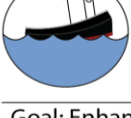








<h1>AGWI Goals and Values Scorecard</h1> <h2>Mississippi River Basin</h2> <p>★ Environment ★ Social ★ Economic</p>		<b>Status</b> <b>A</b> Very Good <b>B</b> <b>C</b> Moderate <b>D</b> <b>F</b> Very Poor		 Improving  Stable	Upper Mississippi	Lower Mississippi	Missouri	Ohio	Arkansas/White/Red	Overall Mississippi River
			<b>Goal:</b> Maintain supply of abundant, clean water. <b>Values:</b> Water quality ★★★ Water security ★★★ Municipal water supply costs ★★★ Agricultural water supply costs ★★★		C	C	B	B	B	B
	<b>Goal:</b> Provide reliable flood control. <b>Values:</b> People at risk/losses ★ Financial/property at risk/losses ★★	C	C	B	B	B	B	B		
	<b>Goal:</b> Support local, state, and national economies. <b>Values:</b> Food, fiber, fuel production ★ Employment per sector ★ Household income ★	A	C	B	B	B	B	B		
	<b>Goal:</b> Nurture healthy, productive ecosystems. <b>Values:</b> Gulf hypoxia zone ★★★ Fish, wildlife, vegetation ★★★ Ecosystem services ★★	C	C	B	B	B	B	B		
	<b>Goal:</b> Create world-class recreational opportunities. <b>Values:</b> Recreational licenses sold ★★ Recreational area usage ★★ Recreation dependent economies ★★	C	A	B	B	B	B	B		
	<b>Goal:</b> Serve as the nation's Marine Water Highway. <b>Values:</b> Navigation infrastructure ★ Volume transported ★ Transportation stoppage days ★ Recreational boating use/days ★	A	A	B	B	B	B	A		
	<b>Goal:</b> Enhance national security. <b>Values:</b> Energy production (per sector) ★ % capacity from renewables ★	C	C	B	B	B	B	B		

Table 1b. Draft Indicators for Values of each Goal. Objectives for each value will be defined and have an indicator tracking status and change towards achieving each objective. (NOTE: The content of this table is meant to be illustrative, and not an accurate or final product).

Supply abundant, clean water to our farms and communities 	Water quality <sup>★ ★</sup>	<ul style="list-style-type: none"> <li>• water quality for designated uses (EPA)</li> <li>• water supply shutdowns</li> <li>• undrinkable wellwater supplies</li> </ul>
	Water security <sup>★ ★</sup>	<ul style="list-style-type: none"> <li>• water scarcity (Hoekstra et al., 2012)</li> </ul>
	Municipal water supply costs <sup>★ ★</sup>	<ul style="list-style-type: none"> <li>• filtration and sediment management costs</li> </ul>
	Agricultural water supply costs <sup>★</sup>	<ul style="list-style-type: none"> <li>• water supply costs (per gallon)</li> </ul>
Provide reliable flood control 	People at risk/losses <sup>★</sup>	<ul style="list-style-type: none"> <li>• number of people affected by floods</li> </ul>
	Financial/property at risk/losses <sup>★</sup>	<ul style="list-style-type: none"> <li>• financial losses by floods</li> </ul>
Support local, state, and national economies 	Food, fiber, fuel production <sup>★</sup>	
	Employment per sector <sup>★</sup>	
	Household income <sup>★</sup>	
Nurture healthy, productive ecosystems 	Gulf hypoxia zone <sup>★</sup>	<ul style="list-style-type: none"> <li>• area of hypoxic zone</li> </ul>
	Fish, wildlife, vegetation <sup>★</sup>	<ul style="list-style-type: none"> <li>• indicator fish species populations</li> <li>• ratio of native/nonnative fish species biomass and numbers</li> <li>• freshwater-dependent bird species populations</li> <li>• extent of native riparian vegetation</li> </ul>
	Ecosystem Services <sup>★ ★</sup>	<ul style="list-style-type: none"> <li>• values of services provided</li> </ul>
Create world-class recreational opportunities 	Recreational licenses sold <sup>★ ★</sup>	
	Recreational area usage <sup>★</sup>	
	Recreational dependent economies	
	Fishing tournaments <sup>★ ★</sup>	
	Game species size records <sup>★</sup>	
Serve as the nation's Inland Water Highway 	Navigation infrastructure <sup>★</sup>	
	Volume transported <sup>★</sup>	
	Transportation stoppage days <sup>★</sup>	
	Recreational boating use/days <sup>★</sup>	
Enhance national security 	Energy production (per sector) <sup>★</sup>	
	% capacity from renewables <sup>★</sup>	

### **Broader Context for Scorecard Measures: Drivers, Strategies and Results**

Strategies are plans of action designed to achieve or contribute to achieving an objective. The scorecards represented above report on status and directional change of goals and values using indicators for the sets of values. They can highlight values that are in need of attention. They do not identify causes of changes, management actions to take, interactions among values or the results of managing for values, or support details of adaptive management for specific strategies. Measures that inform such management decisions are structured around hypotheses of cause and effect, and pressure/response models of management actions and the impacts (changes that occur as a result of implementing strategies). Such measures are typically program and project specific, and are more numerous and generally of higher resolution than the information summarized in a scorecard. Drivers are what influence the status of values, and they include natural and anthropogenic forces which have large-scale influences on the system of interest. Strategies are approaches designed to address drivers in order to make changes in the status of values and achieve objectives.



### **Example: Applying the framework to Gulf of Mexico Hypoxia**

The area of the hypoxic zone is an indicator related to the values and goal of a healthy Gulf ecosystem. It is ultimately driven primarily by patterns of Mississippi river outflow volume, temperature and nitrogen concentrations. River outflow volume is a product of climate, and land and water management practices. Temperature is driven primarily by climate, but affected to a degree by water management practices. Nitrogen concentrations are driven primarily by stream loadings from fertilizer use, land management practices, and effluent from concentrated animal feeding operation and municipal waste, but the total volume of water in the Mississippi influences concentration – and climate has a large impact on this. Measuring natural drivers such as climate is necessary to track background changes, or natural “counterfactuals” that affect the Gulf hypoxic zone in addition to anthropogenic forces. Some anthropogenic forces may be addressed through strategies to lower nitrogen outflows.

Strategies have several major components that can be summarized at a broad level. For instance, one strategy that has been to support farmers through the National Resources Conservation Service (NRCS) of the US Department of Agriculture (USDA) is to implement a range of agricultural best management practices (BMPs) to lower nitrogen loadings throughout the Upper Mississippi River Basin. The funding necessary to support this program is one of the critical success factors to allow the strategy to be realized. Critical success factors are those most important factors that can be measured and tracked to ensure that a strategy has the means to function. The total acreage of different BMPs have been tracked (an *outcome* – the actions resulting from a strategy). The change in nitrogen loadings (the *impact*) resulting from this scope of implementation has been estimated. The ultimate impact – change in an indicator for the value related to nitrogen levels for the mouth of the Mississippi River – need to be evaluated to see if this strategy is working, and if it is sufficient to achieve objectives.

The effectiveness and dose/response relationships (total acreage/reduction in loadings) of different BMPs and their relationships have been evaluated (e.g. USDA, 2010), along with the nitrogen levels at the mouth of the Mississippi River. These measures are evaluated and support decisions regarding adaptive management and additional strategy development. BMPs may be implemented in more effective landscapes, the Farm Bill may be changed to support a broader array of BMPs that are more effective, or additional strategies may be developed and implemented as well since it seems that BMP implementation is insufficient to achieve the objective.

As an example, an additional strategy to develop policies that support markets and incentivizes diversification and intensification of cropping systems and optimization of different appropriate agricultural practices within watersheds may be added. Diversification of present cropping systems, or other similar systems approaches, may drastically improve environmental

performance through advancing watershed management beyond the incremental BMP approach.

A simplified set of reporting measures for strategies and their results can be organized through structuring the measures by critical success factors (e.g. program design, policy changes, staff capacity, financing, etc.), outcomes (e.g. acres of implementation of agricultural BMPs , acres and miles of Navigation and Environmental Sustainability Program activities, etc.), and impacts (changes to indicator values that are measuring progress towards objectives)). Each strategy would contribute to sustaining and/or improving sub-basin and overall Mississippi River basin values to achieve objectives (Table 2).

Table 2. Potential structure for reporting major critical success factors, outcomes and impacts of strategies

Issue	Strategy	Critical Success Factors	Outcomes	Impacts
Elevated nitrogen concentrations resulting in large Gulf hypoxia zone	Implement more efficient and effective agricultural BMPs	XX Changes in Farm Bill Policy  X\$ Appropriations  Support NRCS through trainings, outreach	25 Million acres of most vulnerable lands have xyz BMPs	25% reduction in nitrogen loadings into Mississippi River basin  15% reduction in nitrogen concentrations at mouth of Mississippi River
	Support diversification	Establish policy to design and test new markets and management practices  X\$ Appropriations support development of practices and markets	10 million acres of cropland is practicing new agricultural approach to diversification	20% reduction in in nitrogen loadings into Mississippi River basin  15% reduction in nitrogen concentrations at mouth of Mississippi River

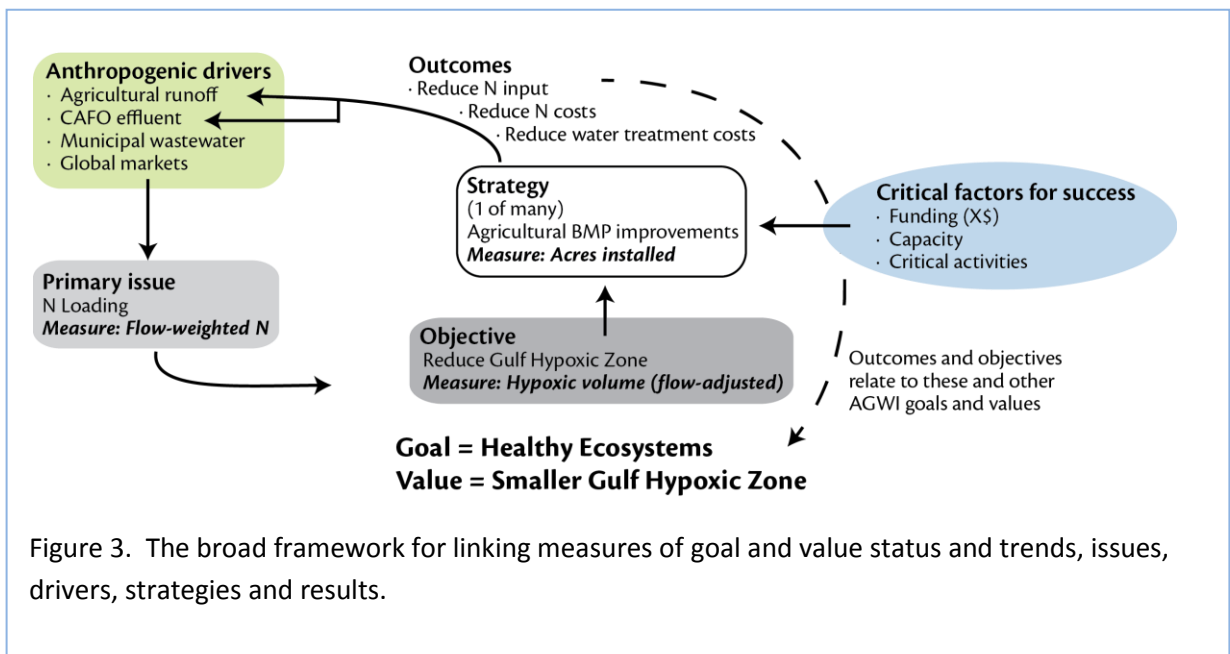
A strategy may provide impacts and benefits to goals and values other than the one that it is primarily designed for. Summarizing these can illustrate integrated benefits from a given strategy. An example of summarizing this information is shown in Table 3.

Table 3. An example summarizing impacts of a given strategy to highlight integrated strategies.

Strategy	Direct Impacts	Suite of Benefits (Goals/Values)
Implement more efficient and effective agricultural BMPs	25% reduction in nitrogen loadings into Mississippi River basin  15% reduction in nitrogen concentrations at mouth of Mississippi River	Nurture healthy productive ecosystems <ul style="list-style-type: none"> <li>• sediment regime, water quality and habitat improvements- will result in increased fish, wildlife, and vegetation.</li> <li>• Increased ecosystem services</li> </ul> Serve as the nation's Inland Water Highway <ul style="list-style-type: none"> <li>• lower sediment removal costs</li> </ul> Supply abundant, clean water to our farms and communities <ul style="list-style-type: none"> <li>• lower/maintain sediment removal and chemical treatment costs and shut downs for municipal water supplies</li> </ul> Create world-class recreational opportunities <ul style="list-style-type: none"> <li>• increased fish and wildlife and healthy environment results in more recreational usage, increase in associated economies</li> </ul> Support local, state, and national economies <ul style="list-style-type: none"> <li>• lower chemical and nutrient costs for farmers</li> </ul> Enhance national security <ul style="list-style-type: none"> <li>• lower sediment removal costs for energy sources (dams, cooling withdraw sources)</li> </ul>

**Fitting Measures Together in a Broader Context: How do these measures link together?**

The measures for goals, values, drivers, strategies, critical success factors, outcomes, and impacts can fit together as illustrated in Figure 3. This provides a way to identify values and goals that are not being met, evaluate the issues, design and implement strategies to address issues, and evaluate whether strategies are providing sufficient progress in achieving objectives for values and goals. It is not necessary to provide all of this information in one table or one report card, as the measures communication provided in a given table or report card is designed for the specific user group. All of the measures can be organized in a data matrix to highlight the values in need of attention, organize the strategies that are being supported to address each value, the outcomes and impacts that have occurred, and the changes in status and trends in values that have resulted. Linkages among all outcomes, impacts and values will illustrate mutual benefits that arise, and help guide IRBM efforts in a more efficient and effective way.



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