A CATALOG OF OUTCOME MEASURES IN USE AND OTHER FINDINGS FROM DNRE DIVISION CHIEF INTERVIEWS*

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CATALOG

Division programs typically fit in the following three broad categories. Note: single divisions may have programs that fall into more than one of the categories below.

I. **Actively engaging outcome measures with well-defined goals, though outcomes are typically narrow and media-specific**

Description: Programs in this category have well-defined outcome measures and goals. Programs are not necessarily fully developed with respect to use of outcome measures (e.g. some fundamental monitoring capability or program response mechanism is missing and under development; many divisions are currently focused on building monitoring capability). Nonetheless, the measures and goals are explicit and in-place, and play an active role in program planning, administration, and evaluation. However, many of the outcome measures used by programs in this category are narrow and media-specific. Additionally, while some of the outcome goals have been developed in collaboration with advisory groups, others have been developed strictly internally or are imposed by Federal requirements.

Characteristics: Programs in this category have **proactive** mechanisms to achieve desired outcomes, rather than purely reactive mechanisms like permitting. If they have **output requirements**, they tend to be less onerous requirements, like simple reporting, and do not displace outcomes from the center of program activities. Typically **access to or availability of information** is not a significant hurdle, or at least there are identifiable, feasible pathways to establishing access or availability. Outcome measures appear to have been selected based on Federal requirements, availability of funding and associated funding restrictions, availability of information, constituent priorities, and saliency with the public. As a result, outcome measures tend to be narrow and media-specific.

Examples: The Air Quality Division uses outcome goals in the form of National Ambient Air Quality Standards (NAAQS). Goals for these outcomes are set by the EPA and play a central role in program planning, administration, and evaluation. Progress toward goals is measured by the division's extensive ambient air quality monitoring system. While the division must provide output reports to the legislature, this requirement does not detract from outcome-oriented work.

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The Waste & Hazardous Materials Division, in consultation with its solid waste stakeholder group, has established an outcome goal of utilizing 50 percent of the municipal solid waste generated by the state by 2015. While the division currently lacks the ability to measure solid waste generation or utilization, it is attempting to fill that gap with a third party, volunteer monitoring system. Once it has monitoring capability in place, the division intends to allocate resources strategically based on its progress toward the ultimate 50 percent utilization goal.

II. Essentially oriented toward outcomes, though outcomes are not explicit and/or do not have well-defined goals attached

Description: Programs in this category are geared to achieve outcomes. However, those outcomes may not be explicit, usually because a lack of monitoring capability or access to information makes use of outcome metrics infeasible, or because there is some incentive or requirement to focus on outputs. Instead of focusing directly on outcomes, programs may be oriented toward *outputs* that are proxies for outcomes (e.g. camping permits or compliance rates). Some proxies are better than others; for example, focusing on compliance rates precludes re-assessment of the regulations themselves. Similar to Category I, ultimate outcomes are media-specific.

Even if program outcomes are explicit, they may not be attached to well-defined goals. These programs tend to operate by taking small steps with limited resources in the direction of an outcome.

Characteristics: Programs in this category have **proactive** mechanisms to achieve desired outcomes. Their focus on outputs may be explained by a lack of **monitoring capability or access to information** at the outcome level, or an **incentive or requirement to focus on outputs**. In this category, outputs tend to be consistent with desired outcomes; however, in some cases they are not perfect substitutes (e.g. compliance rates).

Examples: The Waste & Hazardous Materials Division seeks to increase significant operational compliance at registered underground storage tank facilities by 1 percent each year. The division uses compliance rate, as measured by its inspectors, as a proxy for its outcome goal, which remains implicit (e.g. number of new leaking storage tanks, and ultimately groundwater quality, both of which are more difficult to measure).

The Recreation Division uses output metrics like number of camper days as proxies for ultimate, implicit outcome goals like nature education and access to outdoor leisure. These outputs are directly linked to the division's funding stream.

III. **Largely not oriented toward outcomes**

Description: Programs in this category do not incorporate outcome measures in program planning, administration, or evaluation. Programs may monitor for outputs that are proxies for outcomes (e.g. compliance rates), but have little resources or authority to use those measures meaningfully. Additionally, programs are typically focused on non-outcome-oriented outputs. Because of onerous statutory requirements combined with limited resources, this may actually preclude focus on outcome-related work.

Characteristics: Programs in this category are almost purely **reactive**. They may currently have insufficient **regulatory authority, resources, and/or information** to use outcome measures in any meaningful way. **Statutory requirements for outputs** may preclude the prioritization of program activities to achieve outcomes with limited resources. Enabling statutes may not be designed to consider long-term outcomes.

Examples: The Land & Water Division reviews permit applications to fill or dredge wetlands. This purely reactive program operates with limited funding and strict statutory requirements for timeliness, which prohibits the division from proactively pursuing outcomes like extent or type of wetland ecosystems. Furthermore, the division lacks the ability to monitor wetlands on public lands and does not have access to information concerning wetlands on private lands.

The Remediation & Redevelopment Division lacks access to information regarding the status of privately owned cleanup sites. Limited funding combined with tight statutory output requirements in this division means limited staff often spend their time on response activity plans submitted to the division that do not necessarily respond to the highest priority risks instead of working with the regulated community on outcomes.

The Air Quality Division monitors for some (non-CAA) air toxics, but only when grant funding is available. While these toxics are linked to a number of environmental outcomes, the division has no authority to regulate these toxics for existing sources.

These categories describe existing division programs with respect to their use of outcome measures. While most of the programs fit into one of the first two categories, in all but a few cases, the outcome measures that are in use are narrow and media-specific. It should be noted that in the course of discussing the potential for broader, cross-media outcome measures, nearly all divisions identified additional program-level outcome measures (and supporting programs) that would fit into such a scheme. However, these divisions report constraints in terms of regulatory authority, resource availability, access to information, and political opposition that would prohibit meaningful use of these measures.

GENERAL OBSERVATIONS FROM INTERVIEWEES

Concerns raised with the outcome measures concept include the following:

- While use of outcome measures makes sense conceptually, they can be too "theoretical" and disconnected with on-the-ground program activities, particularly given resource and statutory constraints. Without sufficient resources, outcome goals may just be "platitudes on paper." Many divisions are relegated to a "maintenance mode," in which they have just enough resources (or not enough) to protect investments and to meet minimum statutory requirements. In this context, achieving an "outcome" of any kind seems infeasible.
- Where divisions feel as though programs are already effective and efficient, or where divisions face seemingly insurmountable constraints, implementing outcome measures feels like a purely academic exercise.
- Measuring for outcomes can be onerous ("a horrendous accounting nightmare"), much more so than measuring outputs. Monitoring for outcomes may divert resources from program activities, and not always with a payback (real or perceived). "Do you want me out there doing the work, or in here punching the numbers?"
- Particularly in reactive or tightly constrained divisions, or in programs where setting outcome goals would require "chasing the margins" (e.g. achieving *100 percent* swimmable beaches), outcome measures may be discouraging or even threatening to staff. This may also be the case with outcomes that rely on multiple divisions or even actors outside of the department. A few divisions have encountered or expect to encounter staff resistance to outcome measures because of an anxiety that they will be used inappropriately in performance reviews. (Note: this is in part dependent on division culture; some divisions are reportedly more accustomed to unmet goals than others, or feel safer with the prospect of failure).
- "Marginal goals" might also be problematic for obtaining funding (i.e. asking for resources to achieve only marginal gains for outcome measures that are perhaps already "satisfactory" might trigger backlash, even funding cuts).
- Using broad-level outcome goals, even those with widespread support, may highlight potential areas of regulation that are politically contentious. This may unnecessarily expose the divisions to conflict.

On the other hand, interviewees also noted, or concurred with, several potential benefits of employing an outcome-based model. These include the following:

- Having outcome goals may help to identify gaps in monitoring or programs, or activities that are no longer necessary. Divisions are typically already aware of gaps, but having outcome goals in place may provide an impetus to close those gaps, a communication tool to stakeholders and legislators about which gaps should be closed, or even a way to highlight which gaps might be filled by non-governmental organizations. (Note: some outcomes are less salient with the public than others, which has implications for the effectiveness of outcome measures as

a communication tool. Additionally, divisions face major constraints in closing some of these gaps).

- Having indices for end goals may help to guide decisions with limited resources.
- Tying staff activities to actual environmental, economic, or cultural outcomes may be good for staff morale and replace the "do to do" mentality with "do to get." It is important for staff to feel like they are working toward something and to see a connection with overarching department goals.
- With outcome goals, divisions with the resources and statutory basis to be proactive can pursue defined endpoints rather than less focused movement in a general direction. While the latter does not preclude effective use of strategy, the former institutionalizes it.
- An outcome-based model creates optimism toward program goals, rather than pessimism. The emphasis is on achieving goals, rather than constraints faced. The "we have to be happy with small steps" attitude may be replaced with "if small steps aren't sufficient, then we need to re-evaluate how to take bigger steps." While this type of critical re-evaluation already characterizes many divisions, it is not institutionalized.
- Structuring a department-wide problem-solving process around outcomes (similar to the "Ford model") might encourage divisions to "muddle through" problems related to programs that may not be core division priorities, but nonetheless fit into broader department goals. Additionally, while divisions currently coordinate their efforts on major items, this model may facilitate that coordination by helping managers to understand what is happening in the other divisions on a more regular basis.
- Some divisions may have the expertise or monitoring network that could aid other divisions in use of outcome measures at relatively low cost. These opportunities are perceived by at least some to be underexploited in the department. The "Ford model" may open channels for this type of cross-division cooperation.

CONSTRAINTS

Constraints to transitioning to an outcome-based model for environmental governance fall into three broad categories: understanding, capacity, and motivation. Division leadership and program-level staff need to *understand* the outcome measures concept and its implications for program planning, administration, and evaluation; they need to have the *capacity* to implement the required goal-setting, monitoring, and program response activities; and they need to be *motivated* to do so.

Understanding

A common source of confusion among division leadership is the distinction between *outputs* and *outcomes*. Many of the measures offered by division chiefs or their designees as *outcomes* might be better classified as *outputs* (e.g. compliance rates, management plans, etc.). Developing commonly understood working definitions for this terminology is essential to gaining understanding at all levels of the department.

There also needs to be greater understanding that managing for outcomes and managing for outputs are not necessarily mutually exclusive. To achieve an *outcome*, a division must produce an *output*; there is a continuum of measures that ranges from the minutest outputs (e.g. staff hours), to secondary outputs (e.g. number of permits issued or inspections completed), to intermediary measures that are outcomes in a sense but still process-based (e.g. compliance rates), to ultimate outcomes (e.g. environmental, economic, or social condition). Managing for all levels of outputs, *if geared toward ultimate outcomes*, is essential for implementing an outcome-based model efficiently.

An important distinction to be drawn, then, is between outputs that are appropriate elements of a strategy to achieve ultimate outcomes, and those that are not. Even the most outcome-oriented divisions include some management for the latter, usually because of statutory requirements, constituent pressure, or financial incentives. However, confusion over how "strategic outputs" would fit into an outcome-based model has led several of these divisions to express hesitation or concern with that model. Divisions may have output-oriented management practices that make sense from an effectiveness and efficiency standpoint and that support ultimate outcomes. Division leadership may incorrectly perceive these management practices to be inconsistent with the use of outcome measures. This is clear evidence of an understanding gap.

A more fundamental understanding gap relates to the practical, program-level implications of an outcome-based model. Without a clear design and plans for implementation of that model, the concept remains abstract and perceptions will vary widely. "Cross-media outcomes" are particularly abstract, and the role for individual divisions is consequently unclear.

These concepts need to be further developed and clearly defined at the leadership level and the department will need to invest time and effort in gaining sufficient understanding at all levels.

Capacity

Using outcome measures effectively means setting clear goals, measuring progress toward those goals, and implementing program-response mechanisms as needed to ensure those goals are reached. Capacity for these activities is constrained by limited or inflexible resources, insufficient statutory basis, limited access to or availability of information, or in some cases a sensitive political environment.

Almost all divisions emphasized constraints that would prevent them from achieving outcome goals. For any given outcome, a division can identify a number of hypothetical program-response actions for which statutory, political, or resource support does not exist. Yet, assuming goals are set realistically, this should not affect the use of outcome-oriented management practices. Goals can be established based on existing programs and capacity within those programs. For purely reactive or highly constrained programs, outcomes may actually be *negative* (e.g. targets for *limiting* wetland impacts), which defies intuition but nonetheless matches the realities of division capabilities. That said, divisions with greater discretion will benefit more from outcome measures (and consequently tend to use them more often already) than divisions that are more tightly bound by statutory, political, or resource constraints (those self-described as relegated to "maintenance mode").

In terms of implementing outcome measures themselves, however, divisions do face real constraints in establishing new monitoring capability where needed to measure progress toward goals. Program outcomes are often difficult or costly to measure, or the needed information lies with a regulated community that is unwilling and unobligated to share. Monitoring for cross-media outcomes would be particularly difficult, as funding streams are often media-specific.

Without ability to measure outcomes, one of the major benefits from setting outcome goals is lost. Additionally, diverting resources from program activities to measure outcomes may be counterproductive. Automating or otherwise streamlining monitoring practices; promoting reporting by the regulated community or third parties; monitoring by sample or modeling; and developing suitable, more easily measured proxies for desired outcomes may be strategies for overcoming this barrier. Many of these strategies are already in use, however, and further development may require investment of already tight resources.

Moreover, the process of developing outcome measures for use may require substantial dedication of scarce staff hours. One division that has extensively developed outcome measures and goals reports that the process itself of incorporating outcome-based management into *existing* division activities was *not* resource-intensive; however, this

may not be the case if outcomes are developed with the level of public involvement prescribed by the EAC Roadmap.

Finally, meaningful use of *long-term* outcome measures requires long-term division adherence and support once outcome measures have been established. Frequent turnover of division leadership was occasionally cited (usually by designees rather than division chiefs) as a major barrier to this type of long-term management. Institutionalizing long-term outcome measures at the department level may help to insulate from division-level staffing changes, although would not shield from political changes at the executive level.

Motivation

Even with a thorough understanding of outcome-based management and the necessary capacity, successful implementation depends on the level of motivation among division leadership and program-level staff. Cultivating that motivation first and foremost means determining the value of an outcome-based model for division staff.

Most divisions fit into Categories I or II (described above), and as such, are essentially oriented toward outcomes already. While an outcome-based model would formalize the selection of desired outcomes and more explicitly align program activities with those outcomes, the benefits of doing so are largely nuanced and intangible. The meat of an outcome-based model is the multidisciplinary dialogue it supports for ongoing, adaptive management for *cross-media* outcomes. It also provides a foundation for a Ford-style, department-wide problem-solving process around outcomes. That process can institutionalize the type of innovation and creative problem-solving that characterizes many of the divisions' existing efforts. One interviewee suggested that the department start by developing outcomes that cut across multiple divisions.

Even still, the implications (real or perceived) of a new, cross-media focus for re-engineering Division programs may be daunting for staff, regardless of its conceptual benefits. A more tangible motivator for staff may be the prospect that aligning department activities toward cross-media outcomes might have for broadening the structure of funding streams or for tying back some of the more onerous output requirements. However, the extent to which use of cross-media outcome measures would have these types of effect is unclear.

Department leadership should have a conversation about where these benefits and others might apply, and how best to harness them. That understanding would then need to be shared with program-level staff. This should entail first and foremost conveying a firm commitment from the division chief to an outcome-based model. It should also entail clearly communicating the benefits to staff, involving staff in the development of outcomes measures and goals, tying staff activities to broader outcomes in a tangible but non-threatening way, incorporating outcome measures into existing "operating philosophies," and reinforcing the message that creativity and innovation is encouraged even if it fails.

Appendix A

Case Study: Water Bureau Measures of Success

The former Water Bureau developed a number of outcome measures labeled "Measures of Success." Five broad-level, major outcome goals are derived from the division's core mission statement and encompass several more specific sub-goals. Attached to each of these sub-goals is a specific metric, an historical trend, a broad-level qualitative scale to portray progress, and a "program response" highlighting any adjustments being made to the Bureau's outputs to achieve the ultimate outcome. These elements together serve to "focus efforts, motivate staff, communicate progress, improve environmental health and compliance conditions, increase […] accountability, and foster collaboration." The division recognizes that achieving its stated goals is ideal, but that the "objective is the development of cogent strategies to meet them."

The Measures of Success were developed internally by staff. The division has since been soliciting feedback from stakeholders and the broader public, and intends to continue to modify the outcome measures as needed. Preliminary specific outcome measures appear to be selected primarily based on saliency with the public (e.g. potable water, swimmable beaches, edible fish). Some measures were selected despite a current lack of supporting program or monitoring capability, and the division is now taking steps to close those gaps. Other measures were designed to match available information.[†]

The Water Bureau (now the Water Resources Division) is now in the process of integrating the use of these outcome measures as a regular component of program planning, administration, and evaluation. Each measure is monitored for regularly and the feedback loop is connected by the "program response" mechanism.

Below are the "major goals" and "goals" from the Water Bureau's Measures of Success. These are the ultimate outcome measures at the heart of this management tool. The full document, including specific measures, progress evaluations, and program responses, can be found on the Department's website:

Department of Environmental Quality. "Water Bureau Measures of Success." November 13, 2009. Last accessed 8/2/10 at http://www.michigan.gov/documents/deq/wb-announce-measures-success_300834_7.pdf

Major Goal 1: Ensure Safe Drinking Water:

Goal 1: By 2015, 100 percent of the population served by community water systems (CWS) will receive drinking water that meets all applicable health-based drinking water standards through effective treatment and source water protection.

Goal 2: By 2015, 100 percent of the noncommunity water systems (NCW) will provide drinking water that meets all applicable health-based drinking water standards through effective treatment and source water protection.

[†] For example, the Water Bureau established a goal for nutrient total phosphorus levels for two impaired lakes for which they have existing monitoring capability (Lake Allegan and Lake Macatawa).

Major Goal 2: Protect Groundwater: Ensure that groundwater is safe to drink, and that groundwater is conserved in adequate quantity to support all uses (drinking water, industrial use).
Goal 1: Groundwater meets all applicable health based standards for drinking.

Major Goal 3: Enhance Recreational Waters: Ensure that all recreational waters are safe for human contact.
Goal 1: Clean, safe beaches - By 2014, 100 percent of Great Lakes and inland lake beaches monitored by beach programs will be safe for swimming.
Goal 2: Swimmable rivers and streams - All rivers and streams will meet total body contact water quality standards (WQS). This is developed for beaches, but there is no coordinated or compiled monitoring of rivers and streams. This needs to be examined and developed.
Goal 3: Eliminate untreated sewage discharges - The long-term combined sewer overflow (CSO) goal is complete elimination of untreated CSO discharges. For sanitary sewer overflow (SSO), the goal is to minimize untreated SSO discharges, recognizing that SSOs may occur in a well designed and operated sewer system in response to rainfall that exceeds the 25-year, 24-hour storm (our design storm). An interim goal is to reduce the volume of SSOs discharged annually, from approximately 58 million gallons in 2007 to less than 20 million gallons in 2020, due to events less than the 25-year, 24-hour storm.

Major Goal 4: Ensure Consumable Fish: Protect human health and wildlife by reducing exposure to contaminants in fish to levels that are safe.
Goal 1: Eliminate mercury contamination.
Goal 1A: Reduce the mercury levels in edible portions of Great Lakes, inland lakes, and stream fish to below 0.35 mg/kg by 2020.
Goal 1B: All streams will achieve 1.3 ng/l of total mercury as an annual average ambient concentration by 2020.
Goal 1C: Reduce the load of mercury in permitted point source discharges of mercury with a goal of achieving 1.3 ng/l in all such discharges by 2020.
Goal 2: Eliminate PCB contamination.
Goal 2A: Reduce PCB levels in edible portions of Great Lakes, inland lakes, and river fish to below 0.05 mg/kg by 2025.
Goal 3: Eliminate dioxin contamination.
Goal 3A: By 2025, achieve an average concentration of .00053 ug/kg dioxin (TEQ) levels in fish in the Saginaw River and Saginaw Bay.

Major Goal 5: Protect and Restore Aquatic Ecosystems: Restore and maintain watersheds, and their aquatic ecosystems to provide healthy habitat for fish, plants, and wildlife.
Goal 1: Ensure healthy aquatic biota: Through 2015, ensure that the condition of the state's wadeable streams does not degrade, such that there is no statistically significant increase in the percent of streams rated "nonattaining," and no statistically significant decrease in streams rated "attaining."
Goal 2: Protect natural hydrology: Assure that new water withdrawals do not create an adverse resource impact on surface water bodies.
Goal 3: Protect the Great Lakes.
Goal 3A: By 2014, remove ten beneficial use impairments within areas of concern in Michigan.

Goal 3B: Meet the total phosphorus goal in Saginaw Bay of 15 ug/l and maintain a neutral trend in total phosphorus in Grand Traverse Bay.
Goal 3C: Prevent future introductions of aquatic invasive species into the Great Lakes.
Goal 3D: Enhance the quality of the Outstanding International Resource Waters – Lake Superior Basin.
Goal 4: Achieve the nutrient total phosphorus levels for the following impaired lakes: Lake Allegan (60 ug/l) and Lake Macatawa (50 ug/l), with a goal of achieving these levels by 2020.

Appendix B

Case Study: DNR Core Criteria and Indicators

The former Department of Natural Resources developed an extensive list of outcome measures labeled "Core Criteria and Indicators (C&I)" as part of its forest planning efforts. Groundwork for the C&I began at the regional Ecoteam level in the late 1990's, following international protocols on sustainable forest management. In 2006, the Statewide Resource Planning Team picked up that effort at the state-wide level, completing its work in 2008. The core C&I are now intended to be used as a standardized part of Ecoregional Resource Plans.

The document defines in detail seven broad-level, "cross-media" criteria for "sustainable resource management" that span program areas of multiple divisions. Each of these criteria is broken down into a number of more specific indicators. Attached to each indicator are a number of concrete, measurable metrics.

Specific criteria, indicators, and metrics were initially chosen based on those already in use in-house, those in widespread use outside of Michigan, and public input. The public engagement process was extensive throughout the initial ecoregional process. The state-wide effort built on that foundation, but was completed internally. A final opportunity for public review as part of the approval process for the Michigan State Forest Management Plan did not yield any public comments on the C&I.

Metrics were developed based on what the Department felt it *should* be monitoring, rather than what it *does* or even potentially *could* monitor. As such, the document serves as a broad-level articulation of what the Department considers important as it seeks to sustainably manage complex landscapes. The process itself of developing, refining, and building supporting consensus for the C&I, though challenging, provided an opportunity for important dialogue among scientists within the Department and between the Department and stakeholders about the elements that should comprise "sustainable resource management."

Where metrics are measurable, the document also provides a framework for gathering data and for evaluating the status and sustainability of management practices. Most (but not all) of the metrics are actually measured, though with varying frequency (typically at 1, 5 or 10 year intervals) based on data availability and other constraints. Consequently, the usefulness of the C&I in terms of on-the-ground program management varies on a metric-by-metric basis. Some metrics are measured for regularly and are integrated into program decision-making, while others are not monitored at all. For example, Metric 2.1.1—area and severity of insect and disease infestation—is measured annually and used to prioritize and allocate resources for monitoring and planning pro-active measures. On the other hand, Metric 2.8.1—miles and width of vegetated riparian corridors—is not monitored at all.

While the C&I were developed at the Department-wide level, metrics are measured and used on a divisional basis. Consequently, the tool does not provide a centralized source for information related to program decisionmaking or performance. Unlike the Water Bureau's Measures of Success, the document does not provide historical trends, assess the status of each metric, or describe programmatic adjustments being made in response to a particular metric's status. In line with the international and national protocol

for sustainable forestry C&I, the broad-level document also does not offer specific targets for individual metrics.

Below is the entire DNR Core Criteria and Indicators document. The document can be found with additional information regarding its development and use in Appendix H of the Michigan State Forest Management Plan, on the Department's website:

Department of Natural Resources. "Michigan State Forest Management Plan." April 10, 2008. Last accessed 8/2/10 at http://www.michigan.gov/documents/dnr/SFMP-Apr10-2008_236059_7.pdf

Michigan Department of Natural Resources Core Criteria and Indicators

CRITERION 1 Conservation of Biological Diversity

Biological diversity, or biodiversity, is the variability among living organisms and the ecological systems of which they are a part. Biodiversity can be measured at the landscape, ecosystem, species and genetic levels. Each level of biodiversity has three components: 1) Compositional diversity -the number of elements within a system; 2) Structural diversity –the variety of patterns within a system; and 3) Functional diversity -the number of ecological processes within a system. The conservation of biodiversity ensures that all ecosystems maintain their integrity, continue to be productive and are able to adapt to changing conditions.

INDICATOR 1.1 The extent of uncommon or rare natural features.

Identification and recognition of uncommon geological sites, plant and animal species, and ecological communities can make a difference between success and failure at sustaining our heritage and protection of natural systems over the long run.

***METRIC** 1.1.1 Percent and extent of rare natural communities relative to historical conditions.*
***METRIC** 1.1.2 Percent and extent of uncommon geophysical features relative to historical conditions.*
***METRIC** 1.1.3 Percent and extent of uncommon hydro-physical features relative to historical conditions e.g. aquifers, artesian wells, springs, waterfalls, recharge zones.*

INDICATOR 1.2 The extent of landscape and ecosystem diversity.

The number of patches, their characteristics, size, shape and connectivity determines the complexity of landscapes. Ecosystem diversity is the kind and number of ecosystems in an area. Landscape diversity is the variety of ecosystems across a landscape, and reflects the patterns of association of ecosystems with one another and the recurrence of these patterns in a given landscape. The impacts of change in landscapes are expressed through shifts in ecosystem diversity.

***METRIC** 1.2.1 Percent and extent of vegetation types relative to historical conditions.*
***METRIC** 1.2.2 Number of natural community types.*
***METRIC** 1.2.3 Distribution of natural community types.*
***METRIC** 1.2.4 Percentage, area and representativeness of vegetation types in designated protected areas of natural and scientific interest.*
***METRIC** 1.2.5 Level of fragmentation, connectivity, shape, size and spatial distribution of vegetation types.*

INDICATOR 1.3 The extent of species population diversity.

Species diversity refers to the number and relative abundance of species found in an area. The impacts of change in ecosystems are expressed through shifts in species biodiversity.

***METRIC** 1.3.1 Distribution, dispersion and population trends of focal species.*
***METRIC** 1.3.2 Absolute and relative abundance of vegetation types and their importance as habitat for focal species.*
***METRIC** 1.3.3 Trends in habitat of focal species.*

***METRIC** 1.3.4 Species classified as threatened, endangered, rare or vulnerable, their population trends and habitat condition.*
***METRIC** 1.3.5 Species richness of plants and animals within representative ecosystems.*

INDICATOR 1.4 The extent of genetic diversity.

Genetic diversity includes the range of genetic characteristics found within a species and among different species.

***METRIC** 1.4.1Proportion of forest area as plantations using native vs. non-native genotypes.*
***METRIC** 1.4.2 Proportion of water bodies with native vs. non-native fish-stock genotypes in both inland and Great Lakes waters.*
***METRIC** 1.4.3 Proportion of water bodies with fishery sustained by natural reproduction.*
***METRIC** 1.4.4 Herbaceous native vs. non-native species plantings on roads, trails, easements, openings, savannas, grasslands and wetlands on managed lands.*

CRITERION 2 Ecosystem Condition and Productivity

Ecosystem condition is a measure of relative freedom from stress and the relative level of physical/biological energy within an ecosystem. Ecosystem productivity refers to the rate of production of biomass (organic matter) within an ecosystem. This results from interactions between plants, animals and micro-organisms or biotic components and abiotic factors such as soil, water and climate. Sustainable productivity is dependent upon the ability of ecosystems to recover from or adapt to both natural and human-induced disturbances. A healthy and diverse ecosystem is more resilient in its ability to respond or adapt to, or to recover from these disturbances in its environment.

INDICATOR 2.1 The scope, scale and intensity of disturbance and stress.

Ecosystems are dynamic and are constantly subject to changes in composition and structure. Many of these changes are adaptations to disturbance. Disturbances generally cause ecosystems to revert to earlier successional stages or establish new patterns of succession. Fundamental to the continued health, vitality and productivity of ecosystems are their ability to adapt to the various stresses placed upon them. Disturbances may be part of natural ecological cycles or the result of human activities. Human-induced stress and disturbance include introduced (exotic) species, prescribed burning, fire suppression, populations out of balance with available habitat, pollution and land-use practices. Natural disturbances include native insects, high wind events, flooding and fire.

***METRIC** 2.1.1 Area and severity of insect and disease infestation.*
***METRIC** 2.1.2 Area and severity of flooding, drought, wind and fire activity.*
***METRIC** 2.1.3 Presence, extent and number of invasive exotic species.*
***METRIC** 2.1.4 Area and location by county of severe mammalian herbivory.*
***METRIC** 2.1.5 Area and intensity of timber harvest by type.*
***METRIC** 2.1.6 Area and intensity of timber salvage by type.*
***METRIC** 2.1.7 Number and distribution of active and non-restored mineral and non-mineral extraction sites per township.*
***METRIC** 2.1.8 Miles and density of utility corridors and numbers of communication structures.*
***METRIC** 2.1.9 Miles of undeveloped Great Lakes, inland lakes, rivers and stream shoreline.*
***METRIC** 2.1.10 Mean concentration of Chlorophyll A during annual growing season in inland lakes.*
***METRIC** 2.1.11 Miles of streams designated as priority for beaver-trout management per DNR Policy 39.21-20.*

INDICATOR 2.2 The extent and change of biomass.

Biomass is the total mass of organic matter in all living organisms within a specific unit area, such as an ecosystem. It is an integrating measure of ecosystem condition, providing a measure of the productivity, health and vitality of all species and habitat types. Evidence that the condition of habitat types is constant or improving indicates that they are being managed in a sustainable way.

***METRIC** 2.2.1 Volume, net annual growth, mortality and removals by forest type and age class.*

INDICATOR 2.3 The extent and type of structure within aquatic ecosystems.

Vegetation and other biotic and abiotic materials provide the physical structure within which most organisms live. Ecosystem structure is the variety of patterns within a system, and includes the presence and arrangement of these physical structures in three-dimensional space. Species richness in some taxa is correlated with ecosystem community structure.

***METRIC** 2.3.1 Alteration of surface and sub-surface geology of valley segment.*

***METRIC** 2.3.2 Alteration of surface and sub-surface hydrology of valley segment.*

***METRIC** 2.3.3 Number and location of lake and stream restoration projects.*

INDICATOR 2.4 The extent and type of structure within upland and wetland ecosystems.

Vegetation and other biotic and abiotic materials provide the physical structure within which most organisms live. Ecosystem structure is the variety of patterns within a system, and includes the presence and arrangement of these physical structures in three-dimensional space. Species richness in some taxa is correlated with ecosystem community structure.

***METRIC** 2.4.1 Tree size: basal area per acre/hectare for different forest cover types.*

***METRIC** 2.4.2.Distribution of cliffs, outcrops, sinks and glacial erratics.*

***METRIC** 2.4.3 Snags per area, Basal area, mean DBH and decay class.*

***METRIC** 2.4.4 Large woody debris per area, mean DBH and decay class.*

***METRIC** 2.4.5 Number of vegetative species and structural diversity by age class for forested systems.*

INDICATOR 2.5 The condition of water quality.

Long-term productivity and resilience of habitats, and a potable water supply for humans and wildlife, are dependent upon abundant and clean water resources. Management policies that address stream crossings, watershed management and riparian areas help to maintain water flow patterns, water levels and water quality, and ensure that the condition of aquatic ecosystems are maintained and improved.

***METRIC** 2.5.1 Distribution and acres of lakes and miles of streams of artificial nitrification (nitrates and phosphates).*

***METRIC** 2.5.2 Pesticide and contaminant residue concentrations in surface water as measured by fish advisories and eagle nesting success.*

***METRIC** 2.5.3 Percentage of impervious surface in watersheds.*

INDICATOR 2.6 Carbon cycle and greenhouse gas emissions.

The carbon cycle represents an important set of processes linking plant and animal communities with climate change. The release or removal of CO_2 to and from the atmosphere impacts global ecological cycles. Forests, wetlands and water bodies can act as either sinks (a vigorous and growing forest) or sources for atmospheric carbon, depending on whether they are primarily storing carbon or releasing it. Knowledge of the influence of natural disturbances and human intervention on this role can indicate the type of forest practices required for sustainable management.

***METRIC** 2.6.1 Area of forest permanently, semi-permanently, or temporarily converted to nonforest land use (Also see Indicator 5.3 Land Use).*

***METRIC** 2.6.2 Changes in carbon pool in vegetative biomass.*

***METRIC** 2.6.3 Number of wildfire acres and fuels reported by county and township.*

***METRIC** 2.6.4 Trends in metric tons of greenhouse gas emissions by region or county.*

INDICATOR 2.7 The variance in and type of disruption of hydrological cycles.

Hydrological cycles involve the movement of water from the atmosphere to the surface of the earth in the form of precipitation; from soils to streams to lakes to the atmosphere; and from soil to plants to the atmosphere. Because of their vast area in the state, forests play a major role in Great Lakes hydrological cycles. Changes in forestland cover and management influence the storage and movement of water and the timing of the various components of the hydrological cycle. Forests can influence stream and river hydrographs by regulating the flow of water into wetlands, streams and lakes. Consequently, sustainable forest management plays a crucial role in contributing to the regulation of the hydrological cycle.

***METRIC** 2.7.1 Number, distribution and acres of impoundments affected by natural and artificial water control structures.*

***METRIC** 2.7.2 Surface area of lakes and wetlands.*

***METRIC** 2.7.3 Total flow data for rivers and streams.*

INDICATOR 2.8 The effectiveness of soil conservation.

The long-term productivity and resilience of forests and other habitats are dependent upon the maintenance of appropriate levels of soil oxygen, nutrients, organic matter and water. In order to ensure that terrestrial and aquatic ecosystems are maintained and improved, management policies must be implemented that provide for specific management practices or the protection of sensitive sites.

***METRIC** 2.8.1 Miles and width of vegetated riparian corridors.*

***METRIC** 2.8.2 Number and location by county of soil erosion and sedimentation BMP violations.*

***METRIC** 2.8.3 Number, location by county, type and funding for soil erosion and sedimentation restoration projects.*

***METRIC** 2.8.4 Trends in soil quality as measured by pH by eco-region.*

CRITERION 3 Social/Cultural/Spiritual

Social/Cultural: The Northern Lower and Upper Peninsula Eco-regions in which the State Forest is located are predominantly rural, natural resource rich regions of Michigan with large amounts of public forest land. Current social values rely on tourism, recreation, and resource extraction based on the existing natural resources. Life styles and values of the people of this region are strongly connected to its natural resources. Therefore, sustainability of these natural resources is essential to the social and cultural fabric of the region. Spiritual: Spiritual values or *existence values* are personal feelings and sentiments that natural resources stir within the human spirit. This criterion is concerned with the continued ability of the resources to provide these values. Because spiritual values are personal in nature and to a large degree intangible, the indicators pertain primarily to ecosystem features of that appeal to the senses or address the ability of people to use those resources.

INDICATOR 3.1 Extent of archaeological and historical sites.

Resource management planning takes into account the identification and protection of known unique or significant Native American and Euro-American social, cultural and or spiritual sites.

***METRIC** 3.1.1 Number of known archaeological sites. (More weight can be given to sites that are on the National Register of Historic Places. This register includes prehistoric sites as well.)*

***METRIC** 3.1.2. Number (presence, extent, location) of area(s) of historical/cultural significance. (Many times these areas may show no signs of their significance, e.g. a Native American Indian trail corridor where the trail is no longer visible, or a spot at which a meeting or discovery took place.)*

INDICATOR 3.2 The extent of undeveloped natural resources.

The existence and maintenance of large undeveloped forests or other similar resources at landscape scales are a significant influence upon social/cultural/spiritual values.

***METRIC** 3.2.1 Size and distribution of Natural, Wilderness and Wild areas and the allowed use of those areas.*

INDICATOR 3.3 The extent and type of aesthetics landscapes.

The visual or aesthetic quality of natural landscapes are a significant influence upon social/cultural/spiritual values. (Also see metrics under Indicator 2.1.)

***METRIC** 3.3.1 Number of designated access opportunities to view scenic vistas and/or wildlife.*

***METRIC** 3.3.2 Miles of road by use class, distribution and density*

INDICATOR 3.4 The extent and type of traditional uses for cultural forest products (e.g. berries, syrup, mushrooms, black ash, cattails, etc.).

The use of cultural forest products is a form of recreation that originates from historic needs for subsistence. These activities continue to exist for both subsistence and pure recreation.

While they do not serve as a significant basis for segments of the state and local economies, they do provide a foundation for traditional social well being. Level of participation and potential resource impacts are also important to consider.

***METRIC** 3.4.1 Number of traditional harvest festivals across the state – blueberry, morel mushrooms, thimbleberry etc.*

***METRIC** 3.4.2 Number of special use permits, e.g. fire wood, Christmas greens (Lycopodium), seeds, cones.*

***METRIC** 3.4.3 Extent of tribal gathering activities, e.g. black ash, bark, berries, medicinal plants, - commercial vs. subsistence.*
***METRIC** 3.4.4 Amounts, kinds and impacts of medicinal plant gathering.*
***METRIC** 3.4.5 Kinds of and numbers of membership in non-forest product producer organizations.*

CRITERION 4 Outdoor Recreation

The ability to maintain and strengthen the quality of leisure pursuits in the access of resources and amenities while minimizing social or environmental degradation.

INDICATOR 4.1 The type, extent and quality of hunting, trapping and fishing.

Hunting, trapping and fishing are important forms of recreation that originate from historic needs for subsistence. These activities continue to exist for both purposes of subsistence and pure recreation. They serve as a significant basis for large segments of the state and many local economies, as well as for providing a foundation for traditional social well being.
***METRIC** 4.1.1 User days per activity.*
***METRIC** 4.1.2 Number of animals testing positive for pathogens.*
***METRIC** 4.1.3 Population indices for selected species.*
***METRIC** 4.1.4 Estimated harvest by selected species.*
***METRIC** 4.1.5 Amount and locations by county of Commercial Forest (CF) lands, changes in status.*
***METRIC** 4.1.6 Satisfaction of recreational experience for selected programs.*

INDICATOR 4.2 The extent, type and quality of designated trail use – motorized and non-motorized (hiking, ORV, snowmobile, skiing, equestrian).

Trails that are designated for authorized hiking, Off-road Vehicle, snowmobile, skiing and equestrian uses are significant locations for recreation that form a significant basis for large segments of the state and many local economies, as well as providing a foundation for traditional social well being.
***METRIC** 4.2.1 Amount of money and other resources (hours of staff and volunteer time) available for infrastructure and trail maintenance and development.*
***METRIC** 4.2.2 User days per activity.*
***METRIC** 4.2.3 Miles of trail systems by trail ownership and management type.*
***METRIC** 4.2.4 Accident trends per activity per season.*
***METRIC** 4.2.5 Satisfaction of recreational experience for selected programs.*

INDICATOR 4.3 Nature Appreciation and Education

One measure for nature appreciation and education is the existence of places where people can interact with natural communities that exist in perpetuity, and where natural processes occur to some degree, such as natural areas, wilderness areas, high conservation value areas and ecological reference areas.
***METRIC** 4.3.1 Miles of public Great Lakes, inland lakes and stream shoreline.*
***METRIC** 4.3.2 Percentage, area and representativeness of vegetative types in areas of natural and scientific interest.*
***METRIC** 4.3.3 Existence and level of nature oriented and eco-tourism activities, e.g. guiding and interpretive services for kayaking, canoeing, birding, elk viewing, wildlife viewing, hunting, fishing, photography, backpacking etc.*
***METRIC** 4.3.4 Satisfaction of recreational experience for selected programs.*

INDICATOR 4.4 The extent, type and quality of camping – including dispersed and designated site camping. (Refer also to social economic assessment contract.)

Camping is an important form of recreation that originates from historic needs for shelter while traveling through a natural setting. Camping activities of both forms are a significant basis for large segments of the state and many local economies, as well as providing a foundation for traditional social well being.
***METRIC** 4.4.1 Number, type and distribution of campground facilities – rustic, modern, semimodern, cabin rentals.*
***METRIC** 4.4.2 Number of campsites by type in public and private campgrounds.*
***METRIC** 4.4.3 User days by campground and campsite.*
***METRIC** 4.4.4 Number of dispersed camps per year.*

***METRIC** 4.4.5 Satisfaction of recreational experience for selected programs.*

INDICATOR 4.5 The extent, type and quality of water recreation – motorized and non-motorized (including swimming, scuba diving, kayaking, etc.).

Water recreation is an important form of recreation that has roots in historic modes of transportation and for fulfilling needs for exercise and adventure. Both forms of water recreation are a significant basis for large segments of the state and many local economies, as well as providing a foundation for traditional social well being.

***METRIC** 4.5.1 Trends in water activity user days e.g. power/sail boating, jet-skis, canoes, rafting/tubing, kayaking, swimming, snorkeling, fishing, water skiing, boat races, cruise ships, sail boarding, etc.*

***METRIC** 4.5.2 Trends in water recreation equipment sales.*

***METRIC** 4.5.3 Trends in commercial water recreation operators.*

***METRIC** 4.5.4 Number of water access sites and boat slips by type and capacity for watercraft and available amenities.*

***METRIC** 4.5.5 Change in status of water body designation and use.*

***METRIC** 4.5.6 Satisfaction of recreational experience for selected programs.*

INDICATOR 4.6 Public land open to outdoor recreation.

Trends in all land open to outdoor recreation, not just forest land.

***METRIC** 4.6.1 Amount of public land open to outdoor recreation, by agency (e.g. Federal, State, local conservancy and conservation easement lands).*

CRITERION 5 Ownership Patterns

The pattern and distribution of ownership and use of lands greatly affects the ability to sustain natural resources. Management options, resource demand and ecological processes are affected by how the land is managed, fragmented, and patterned. Successful sustainable management depends upon the degree of functional connectivity across ownerships, boundaries, and landscapes.

INDICATOR 5.1 The degree of stewardship.

Stewardship is the practice of carefully managing land usage and associated resources to ensure natural systems are maintained or enhanced for use by future generations.

***METRIC** 5.1.1 Number, acres and distribution of Forest Stewardship, Conservation Reserve Program, Qualified Forest Program, American Tree Farm, Commercial Forest and Landowner Incentive Program private land management plans and percent of private ownership with management plans.*

***METRIC** 5.1.2 Number of acres and location by county of private land with public conservation easements.*

***METRIC** 5.1.3 Number, kinds, acres and by county of conservation easements.*

***METRIC** 5.1.4 Number, kinds, and acres by county of cooperative planning "agreements" across ownerships, e.g. Clay Lake Plains Plan, Two Hearted River Watershed Plan, Les Cheneaux Economic Forum, Munuscong Watershed Plan, St. Mary's River Plan.*

***METRIC** 5.1.5 Numbers, acres, and percentage of forested lands certified by county for sustainable forestry by ownership.*

INDICATOR 5.2 The extent of accessibility to public lands.

The extent to which a parcel or area of land can be reached and used by people.

***METRIC** 5.2.1 Number by county of access easements to public lands.*

***METRIC** 5.2.2 Number of acres and location by township of public land without access landlocked by private ownerships.*

***METRIC** 5.2.3 Trends in numbers and location by county of barrier free facilities.*

INDICATOR 5.3 The degre e of stability of land use.

The stability of land use or large-scale trends in land use can have direct effect upon the landscape resources base from which social/cultural/spiritual values are derived.

***METRIC** 5.3.1 Percent of forest land and non-forest land by county.*

***METRIC** 5.3.2 Acres of forest land converted to developed land.*

***METRIC** 5.3.3 Amount of ownership fragmentation and parcelization of land.*

***METRIC** 5.3.4. Number and size of forested parcels added to or removed from the Commercial Forest Program.*

***METRIC** 5.3.5 Distribution of forest land ownership by acres.*
***METRIC** 5.3.6 Percent change by ownership class.*

CRITERION 6 Economic Health

A wide range of goods and services are derived by and from managing natural resources in the Northern Lower and Upper Peninsulas of Michigan. In addition to the traditional forest products sector, the resource base supports mining, commercial fishing and an ever-growing tourist and recreation industry. These goods and services create jobs and provide economic stability to the region.

INDICATOR 6.1 The extent and trends of local and community economic health.

Trends in planning and investment are important gauges of sustainable natural resource management and in local and community economic health. (Also see social economic assessment contract.)

***METRIC** 6.1.1 Number of local economic development plans.*
***METRIC** 6.1.2 Trends in job/income/employment/retirement data.*
***METRIC** 6.1.3 Contribution of the resource use to gross domestic product (GDP) of all sectors of the economy.*
***METRIC** 6.1.4 Diversity of forest economic activity.*
***METRIC** 6.1.5 Capital outlay and investment trends.*

INDICATOR 6.2 The extent of non-timber economic benefits of the forest.

The extent of non-timber economic benefits are an important gauge of sustainable natural resource management and in local and community economic health. Also see social and economic assessment contract.

***METRIC** 6.2.1 Number of recreation and tourism jobs/economic activity.*
***METRIC** 6.2.2 Total expenditures by individuals by select activity.*
***METRIC** 6.2.3 Value and jobs/economic activity related to mineral, oil, and gas extraction.*

INDICATOR 6.3 The extent and type of timber and wood products produced.

The extent and type of timber and wood products are important gauges of sustainable natural resource management and in local and community economic health. Also see social and economic assessment contract.

***METRIC** 6.3.1 Timber volume, growth and mortality by county.*
***METRIC** 6.3.2 Timber harvest by species by county.*
***METRIC** 6.3.3 Value and volume of wood products by county.*
***METRIC** 6.3.4 Number of jobs/economic activity, e.g. logging, hauling and mills.*

CRITERION 7 Institutional Processes

Institutional processes address the legal and institutional framework for the application of ecosystem management. They address the policies, legislation, regulations and guidelines that drive and direct ecosystem practices; and direct how institutions cooperate with others in the application of ecosystem management. Institutional processes include the quality and quantity of opportunities for public involvement in ecosystem planning leading to resource management decisions.

INDICATOR 7.1 The extent of the legal framework for ecosystem management.

The framework should include the existence and/or application of laws, regulations, policies and guidelines for land management. The framework should also consider and meet legal obligations with respect to duly established Native American treaty rights. (Note the metrics here are very important to the public based on the public meetings that were held).

***METRIC** 7.1.1 Presence of and compliance with land management laws and regulations based on continued Forest Certification management review system, Natural Resource Commission(NRC) and other open meetings, and stake holder reports.*
***METRIC** 7.1.2 Presence of and compliance with wildlife management laws and regulations.*
***METRIC** 7.1.3 Presence of and compliance with recreation laws and regulations.*
***METRIC** 7.1.4 Presence of and compliance with fisheries management laws and regulations.*
***METRIC** 7.1.5 Presence of and compliance with Native American treaty rights.*

METRIC *7.1.6 Presence of and compliance with Department and Division policies, procedures and guidelines.*
METRIC *7.1.7 Number and extent of laws that reference ecosystem management.*

INDICATOR 7.2 The extent of an institutional framework.

An effective institutional framework is necessary to implement ecosystem management processes effectively.

METRIC *7.2.1 Trends in public participation processes.*
METRIC *7.2.2 The number of public advisory committees.*

INDICATOR 7.3 The extent of resources allocated for ecosystem management values.

Sufficiency of resources is necessary to effectively implementation ecosystem management processes.

METRIC *7.3.1 Resources allocated within the Department for ecosystem management planning and monitoring.*
METRIC *7.3.2 Participation in external planning efforts, e.g. National Forest plan revisions.*
METRIC *7.3.3 Expenditure of resources and dedicated funds for implementation of "on-theground" projects.*
METRIC *7.3.4 Expenditure of resources and dedicated funds for research in ecosystem management.*