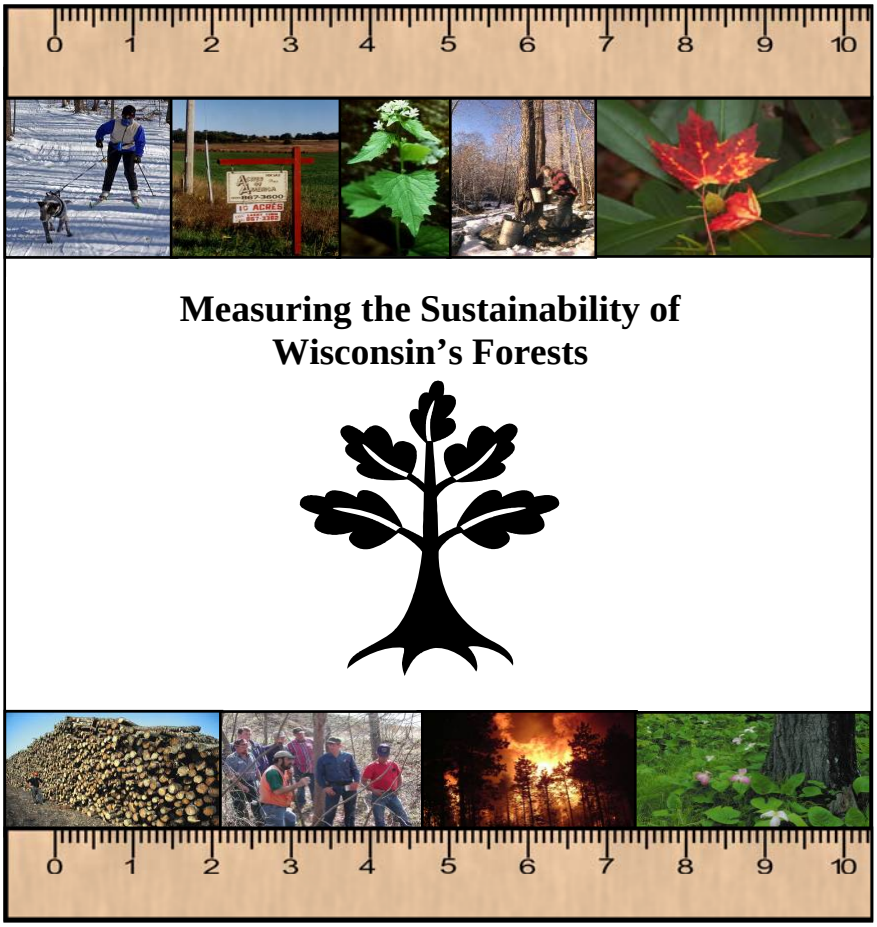
# Wisconsin's Forest Sustainability Framework

A Product of the Wisconsin Council on Forestry



**Measuring the Sustainability of Wisconsin's Forests**

Final Report
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# Preface

Chair, Mark Rickenbach

After twelve months of thoughtful consideration, discussion, and review, the Advisory Committee has completed its work and is pleased to present its final version of the Wisconsin Sustainability Framework to the Council. In transmitting this document, I believe it is important that the Council and other stakeholders be aware of what the Advisory Committee accomplished, what remains to be done, our priorities for additional monitoring data, and topics that emerged from our process that others might want to consider further.

I will begin with a reiteration of the Committee's charge: "To provide the Wisconsin Council on Forestry a comprehensive, but manageable set of indicators to assist them in understanding Wisconsin's forest conditions and trends." Toward this goal, three initial objectives were posited: (1) decide on a set of criteria, indicators, and metrics; (2) set desirable conditions to the metrics; and (3) encourage partnerships among stakeholders that might aid in monitoring and communicating trends over time. The Committee completed the first and third objectives, but, for reasons that will be explained below, did not actively pursue the second.

## Accomplishments

Our work produced nineteen indicators of sustainable forestry across seven different criteria. The task of selecting measurable indicators is really a process of choosing how to define sustainability for Wisconsin's forests at a statewide level. As such, our selection process not only reflected the suitability of specific measurements and techniques, but also the underlying values that people hold about forests. Indicators can inform our decision making about forests, measure change, and raise awareness about sustainable forestry. We chose indicators for their applicability at a statewide scale and ability to be compared to other initiatives occurring regionally and nationally (i.e., "The Montreal Process"). Therefore, this Framework will be most valuable to those interested in statewide issues as opposed to more localized settings. As data are collected on the indicators, the Framework will be a valuable tool to monitor actions from the Statewide Forest Plan and in preparing the next Statewide Forest Assessment (2010).

To further assist the development of the Framework, and reflect broader perspectives, the Committee solicited advice from technical specialists, tribal communities, and lay people from a variety of areas to review the Framework and suggest additions or changes. We received a small number of responses from tribes and the general public. The Framework is a technical document and we expect its size and complexity were not easily accessible to the public. Clearly, a broader response would have been desirable, but at this point, we believe that the Framework represents a serious first approximation representing a broad perspective. Over time, as the Framework is applied and people become familiar with it, it can be further adapted to reflect the fullest range of perspectives that people hold about Wisconsin's forests.

## Continuing Importance of Desired Conditions

As mentioned above, the Committee did not set desirable conditions for the indicators. Time was a consideration: the Committee had a rigorous schedule of monthly meetings that often

considered scores of different metrics to evaluate. In this effort, we greatly benefited from the technical expertise (supplied both in writing and in person) from the DNR. This support was invaluable to the Committee; however, it was not sufficient to allow us to make the more nuanced decisions of how those indicators should track over time. In addition, we would have been basing our determinations of preferred future conditions on the input of relatively few technical experts. This is not a criticism of the DNR, which provided excellent support, but a recognition that science and its application to policy questions should include multiple voices and perspectives from diverse backgrounds to allow for a deeper consideration of implications. Lastly, the experience of others suggests that large scale frameworks (i.e., state and national) should be cautious about setting targets because of the trouble in reaching consensus at such a broad scale[1].

Clearly, this remains a critical task that Committee members and external reviewers believe is essential for the Framework to guide forest policy. Toward that end, we highly recommend that the Council consider further effort in this direction. Specifically, it would be valuable to engage technical experts from multiple backgrounds and experiences (e.g., industry, NGO, agency, university) on specific criteria such that the best available science can be brought to bear on the process of setting targets and sufficiently vetted by those with the best knowledge to do so. This would not necessarily require more meetings. For example, expert opinion has been successfully gathered using the Delphi process where experts participate in an iterative process without actually meeting in person. Regardless of the approach, the development of desired levels, ranges of acceptable variation, or other tools to assist people—particularly non-technical stakeholders—to evaluate trends at appropriate scales is essential.

Improving Monitoring Capacity—Filling the Gaps

In attempting to measure something as all-encompassing as "sustainable forestry", we occasionally concluded that existing data sources were inadequate (i.e., "data gaps" were present). In such situations, we considered three alternatives: (1) use several metrics that when combined can measure an indicator, (2) select an imperfect metric noting its limitations, or (3) note that a data gap exists, and identify appropriate data and/or methods to address. When data gaps existed, the Committee, based on technical expert input, posited new or expanded use of existing data to adequately assess specific indicators. When the need for new data entailed minimal data collection or reorganizing existing sources, we noted these procedures in the Framework. In our assessment, 29 data needs required additional new resources (e.g., staff time, new methodologies, etc.) and were tracked separately.

Realizing that our needs would easily outstrip available resources, a subset (n=8) of Committee members individually ranked and collectively discussed these items toward identifying priorities. Prioritization was based on an item's importance to successful monitoring, feasibility and operability, and added value and benefits for other potential uses. The eight items below represent the determination of the most important priorities for improving monitoring capacity of the sustainability of Wisconsin's forests. It is not a consensus list, but reflects the items that ranked highest (i.e., through analysis of ranking modes and medians) and remained so after

[1] Hagan, J.M., and A.A. Whitman. 2007. Considerations in the selection and use of indicators for sustaining forests. National Commission on Science for Sustainable Forestry Report. August, 2007. online: www.manometmaine.org

further discussion by those participating. The full list, which we recommend that others review, is in the Data Gaps section of the report.

We strongly encourage the Council to advance these priorities through appropriate mechanisms. Starred items ("*") are items which the Committee sees as requiring a significant investment of time and/or resources. Items are ordered by the applicable criterion and/or indicator(s).

- Delineate conservation and management lands. This map/GIS coverage would delineate private lands by legal and administrative definition. It is important as a tool to judge how lands are protected and for how long under different legal parameters such as contracts, easements, trusts, purchased development rights, etc. (Criteria 1, Indicator 1)
- Continue urban forest assessment*. As described below, urban forest data are essential for understanding all of Wisconsin's forest resources. As such, it is imperative to continue the Urban Forest Assessment pilot study conducted by FIA and WI DNR. This is the only data source on urban forests. (C1, I1)
- Create models that analyze stand structure*. Current models of stand structure are often weak at distinguishing stand characteristics beyond volume, stem quality, etc, as opposed to ecological characteristics such as old growth structure. Such revised models could be linked to biodiversity changes over time and provide insights as to how and why things are changing and how management might be used to maintain and/or enhance biodiversity. (C1, I2)
- Increase frequency of WISCLAND*. WISCLAND is an initiative that developed land cover data derived from satellite imagery last taken in1992 and could provide better data to forest cover type groups reported by species (I2); this data could be used in place of NLCD data for fragmentation metrics (I3); this could provide information on the area of forestland adjacent to surface water and the amount of forestland by watershed (I10). (C1, I 2, 3; C4, I10, 11)
- Implement systematic monitoring specific to the Natural Heritage Index*. Need assessment directly related to forest and woodland communities and forest associated species of concern. WDNR-ER does this inventory, but they are not funded adequately to ensure a monitoring system that will show trends over time. (C1, I4)
- Create a common database for invasive plants*. This would be used in combination with FIA surveys that report on invasive woody and shrub data. The common database would have standard survey methods and would be accessible to everyone. (C3, I7)
- Describe legal framework of forestry. Need a database of all standards, laws, policies, and reporting mechanisms that relate to sustainable forestry in order to evaluate their combined effectiveness. (C7, I18)
- Reframe Framework toward environmental services*. Essentially providing a list of the environmental services that forests provide. Many of them are throughout this framework; those that aren't would need to be identified. (Entire Framework)

Integrating Tribal Perspectives

Throughout the process, the Committee benefited from the inclusion of a tribal representative. Wisconsin's tribes are important forest landowners and governments in Wisconsin. Jonathan Gilbert (Great Lakes Indian Fish & Wildlife Commission) helped the Committee better understand the varied perspectives that Wisconsin tribes bring to forests and their use by society. A common theme was that different tribes bring different histories and relationships to

forests, which in turn shape their values related to defining and measuring sustainable forestry. In addition to Jon's contribution, the Committee and the DNR sought to engage tribal interests through the Framework process and tribes appeared to view this inclusion with guarded optimism. Overall, this was a tentative, but, in my opinion, positive step toward including tribes in statewide forestry discussions. Future efforts that build mutual trust are necessary and the Council should actively seek to engage tribes on multiple levels for their outlook and expertise on forestry issues.

Into the Urban Forest

In attempting to comprehensively measure sustainable forestry, we found that current data describing the urban forest are limited. However, Wisconsin's urban forests are a significant resource that are worth billions of dollars and annually provide increased property values. They provide functional benefits such as pollution removal, carbon sequestration, and reduced building energy consumption of over $64 million per year; and foster safer and healthier communities. Our Framework begins the process of including urban forests in the broader picture of all forests, but additional work is necessary. Recent pilot federal and state inventories of urban forests must be continued and expanded to provide a complete picture of Wisconsin's forests and the roles, benefits, and challenges of its urban forests. Additional work is needed at multiple levels to further integrate the urban forest into the Framework, and into forestry thinking more broadly.

Conclusion

The Committee strove to create a framework that is applicable to the needs of Wisconsin. Measuring sustainable forestry will be an evolving task and we hope this Framework provides a solid starting point. The Council should be congratulated on initiating this effort. Wisconsin is in the national vanguard of creating and using indicator systems. We are charting a new course, one that seeks to openly investigate our management practices in order to improve and enhance our forest toward sustainability.

Throughout this process, the Committee benefited from the assistance of numerous individuals and we would like to acknowledge their participation and thank them. First, the Committee benefited greatly from the facilitation efforts of William Klase (UWEX Basin Educator) and from the planning and support activities of Amy Peterson, Rebecca Gass, and Mark Heyde (DNR Division of Forestry), We also appreciate the technical experts (listed in the Acknowledgments section) who brought their insights to our discussions. In particular, we want to recognize Vern Everson (DNR Division of Forestry) who attended all Committee meetings and provided important insights throughout the process. Lastly, I would to thank the Committee members and alternates for their efforts in this process.

Mark Rickenbach
Chair, Wisconsin Sustainability Framework Advisory Committee
Associate Professor, Department of Forest and Wildlife Ecology, University of Wisconsin
28 November 2007

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# Framework List

**Criterion**
*Indicator*
Metric

## Criterion 1: Conservation of Biological Diversity

*1. Area of total land, forestland, and reserved forestland*
- 1.1 Forest and total land area
- 1.2 Forest density
- 1.3 Legally and administratively reserved forestland (i.e., limited management)
- 1.4 Urban forest

*2. Forest type, size class, age class, successional stage*
- 2.1 Forest cover type
- 2.2 Size class
- 2.3 Age group

*3. Extent of forestland conversion, fragmentation, and parcelization*
- 3.1 Forestland developed
- 3.2 Net change in forestland
- 3.3 Additions to and conversions from forestland
- 3.4 Forest parcel size
- 3.5 Lands with various legal limitations on conversion
- 3.6 Road density
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*4. Status of forest/woodland communities and associated species of concern*
- 4.1 Forest & woodland communities
- 4.2 Forest associated species of concern
- 4.3 Bird populations
- 4.4 Mammal populations

## Criterion 2: Maintenance of Productive Capacity of Forest Ecosystems

*5. Area of timberland*
- 5.1 Amount of timberland

*6. Annual growth and removals of forest products*
- 6.1 Net growth and removals
- 6.2 Type of removals
- 6.3 Total growing stock and tree grade of both merchantable timber and non-merchantable tree species on forestland available for timber production
- 6.4 Annual removal of non-timber forest products

## Criterion 3: Maintenance of Forest Ecosystem Health and Vitality

*7. Area of forestland affected by potentially damaging agents*

- 7.1 Tree mortality and damage type
- 7.2 Catastrophic events
- 7.3 Climate
- 7.4 Disease and insects
- 7.5 Invasive plants

*8. Area and percent of forestland subject to levels of specific air pollutants that may cause negative impacts on forest ecosystems*

- 8.1 Ozone damage

## Criterion 4: Conservation and Maintenance of Soil and Water Resources

*9. Soil quality on forestland*

- 9.1 Area and percent of forest whose designation or land management focus includes protection of soil resources
- 9.2 Proportion of forest management activities that meet soil management guidelines to protect soil resources
- 9.3 Total soil carbon
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- 9.5 Bulk density
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*10. Area of forestland adjacent to surface water and forestland by watershed*

- 10.1 Percentage of riparian areas that are forested by watershed
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- 11.1 Area and percent of forest whose designation or land management focus includes protection of water resources
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- 13.3 Production and consumption of roundwood equivalent

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15.2 State forestry agency funding
15.3 Funding for forestry research
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*16. Forest ownership, land use, and specially designated areas*

16.1 Forestland and population
16.2 Forestland ownership
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## Criterion 7: Legal and Institutional Framework for Forest Conservation and Sustainable Management

*18. Extent to which the legal and institutional structure supports the sustainable management of forests*

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18.3 Statewide or regional forest-related organizations

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19.1 Statewide forest planning (and assessment)
19.2 Private non-industrial forest planning
19.3 Industrial forest planning
19.4 Government (including tribal) forest planning

# Acknowledgements

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# Introduction

*Wisconsin's Forest Sustainability Framework* (*Framework)* lays out a blueprint for measuring forest conditions and trends on both public and private lands in Wisconsin. The information presented within this report is a starting point. The *Framework* does not currently provide data, but rather establishes a "recipe" to measure forest sustainability. It is a common set of indicators the forest community can use to discuss the state of Wisconsin's forests. The *Framework* presented within this document was developed to create a comprehensive measurement tool to evaluate the sustainability of Wisconsin's forests. All metrics were chosen because they represent the most appropriate tool to measure a given aspect of sustainability. The *Framework* will be used to help monitor the goals of the *Statewide Forest Plan* and as the template for the next *Statewide Forest Assessment (Assessment)* in 2010. As part of the *Assessment* process, data will be gathered for each of the metrics described in the *Framework*. Once completed, the *2010 Assessment* will act as a bellwether of the state's forest sustainability. It will provide policymakers and the general public with a database of succinct, comprehensive, and scientifically sound data on forests. This information will be used to create policy, develop management standards, and assess forest health. The *Framework* is not meant to set desired conditions. Setting goals and benchmarks for sustainability will be a future step in the planning process.

The conceptualization of a Wisconsin *Framework* began in 2006, when the Wisconsin Council on Forestry called for an active increase in the accountability of sustainable forest management in Wisconsin. The Council charged an Advisory Committee with the task to build a *Framework* that identifies the major aspects of sustainable forestry that should be tracked through time. The *Framework* is structured around seven criteria of sustainability: biological diversity, productive capacity, ecosystem health and vitality, soil and water resources, contributions to global carbon cycle, socioeconomic and ecosystem services, and the legal and institutional framework for conservation and management. The report also identifies key gaps where data do not exist or have not been assembled to support statewide reporting. These gaps are presented at the end of the document, in the Data Gaps section.

The *Framework* establishes a consistent and effective means for conducting an *Assessment* and monitoring the goals of the *Wisconsin Statewide Forest Plan (Plan)*. One of the overarching goals of the *Plan*, as well as the Wisconsin Council on Forestry, is to promote sustainable forest management. While individual definitions of sustainability differ slightly in their details, Wisconsin State Statute 28.04 (1) (e) defines sustainable forestry as *the practice of managing dynamic forest ecosystems to provide ecological, economic, social, and cultural benefits for present and future generations*. The blueprint provided in the *Framework* is critical for evaluating progress towards this goal. Over time, trends will indicate areas for improvement in sustainability as well as highlight successes.

**Scope**

The *Framework* is organized into three levels: criteria, indicators, and metrics. This organization is based on established regional and national models using the criteria and indicators system. **Criteria** define broad categories of sustainability and are comparable to goals. Criteria included in this report address issues such as conservation of biological diversity, conservation and maintenance of soil and water systems, and a variety of other issues. Associated with each criterion are a number of **indicators**, which provide specific measurements to assess the issue described in the criterion. Each indicator is, in turn, associated with a number of **metrics**, which identify the specific data needed to measure indicators. Said in more simple terms, this *Framework* presents seven primary goals, with a number of measurements and tools for measuring our progress toward these goals.

It is important to note that while indicators may show us what current conditions and trends *are*, they do not tell us what the desired conditions or objectives *should be*. This *Framework* is intended only to lay out a plan for collecting and reporting data. Using this data to establish the desired condition or range of conditions of a forest is a political task informed by science. Desired conditions and benchmarks could be set as part of the *Assessment* process. These political discussions must consider how best to integrate the environmental, economic, and social benefits of Wisconsin's forests over time.

**Scale**

The purpose of this *Framework* is to provide a blueprint with which to assess the sustainability of forests at a statewide scale. Reporting the data at a statewide level will allow the data and trends from the Wisconsin report to be compared with that of other states that are using criteria and indicator frameworks. Statewide data can also be combined with results from other northeastern states to analyze regional sustainability.

Metrics were chosen in part based on the availability of consistent data across the entire state. Many of the metrics use data that are statewide in scale, while other data sources provide reliable data down to the county level. For some metrics, a statewide scale is inappropriate given the degree to which the data may vary by region. Metrics that require sensitivity at a finer scale are noted in the metric description.

**Link to Wisconsin's Forest Planning Process**

Once completed, the *Wisconsin Sustainability Framework* could be used in several different, though linked planning projects within the DNR Division of Forestry. The *Framework* can serve as a format to conduct the *Assessment* process which will result in better knowledge of current forest conditions and trends, as well as insight on the interactions and tradeoffs between different forest amenities and resources. This information could then be used to develop objectives for the next revision of the *Statewide Forest Plan (Plan)*,

The *2004 Plan* was created before the development of the *Framework*. The *Plan*, a document which sets direction to create and maintain sustainable forests, is based on goals and objectives. Through public input, the existing *Plan* developed potential actions to implement these goals and objectives. Within the *Plan*, the criteria and indicators framework was identified as a system to better quantify and measure aspects of sustainable forestry. The goals of the *Plan* can be

linked to criteria and indicators presented within the *Framework*, allowing us to assess the progress of sustainable forestry and the implementation of the *Plan*. Unresolved forest issues from the *Plan* will then be identified as issues for the next *Assessment*.

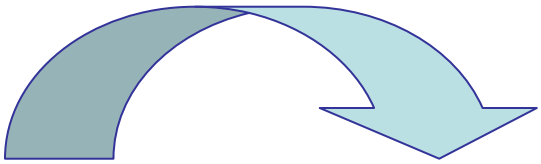
Figure 1 presents a diagram of the forest planning process, and describes the inter-relationships between the *Framework*, *Assessment*, and *Plan*.

The five goals of the *2004 Statewide Forest Plan* establish a foundation upon which forest sustainability issues can be organized and discussed. These goals work to ensure that:

1. Forests are healthy and protected.
2. Forests provide a diverse range of native plant and animal species and their habitats.
3. Forests are productive, providing raw material for consumers and economic stability for local communities.
4. Forests are conserved and managed with sound stewardship practices.
5. Forests provide multiple recreational opportunities.

Within the *Framework* you will note that each criterion is linked to one or more of these goals. For a full description of *2004 Statewide Forest Plan* goals, please see Appendix E.

**Figure 1**



### 1. Statewide Forest Assessment

Using the *Framework* to assess forest resources from ecological, economic, and social perspectives, the *Assessment* will identify and analyze major forest trends and issues.

### 2. Prioritize Trends & Issues

Seek input from citizens, businesses, government, and non-government organizations to prioritize forest trends and issues.

### 3. Develop Options

Use public input to develop preferred options to address each trend & issue.

### 4. Develop Objectives & Actions

Develop an objective for each trend and issue based on preferred options developed in step 3, and develop an action to reach future benchmarks.

### 5. Statewide Forest Plan

Write the Statewide Forest Plan, incorporating the objectives and potential actions organized by trends and issues.

### 6. Implementation

Develop and pursue actions to accomplish each *Plan* objective; work with partners to accomplish actions.

### 7. Monitor the Plan

Based on future determined benchmarks, use the *Framework* to monitor whether we are meeting the objectives of the Statewide Forest Plan.

The Forest Planning Process

**Regional and International Context**

Wisconsin's *Framework* for monitoring sustainable forestry through criteria and indicators sits within a broad context of similar regional, national, and international planning efforts. The international system of criteria and indicators (C&I), known as the Montreal Process[2], was developed during the United Nations Conference on Security and Cooperation in Europe. This conference, held in Montreal, Quebec, invited a group of worldwide experts in the sustainable development of boreal and temperate forests to discuss how to measure and track progress toward the goal of forest sustainability. Out of these proceedings, participants developed a process of forest assessment organized around seven criteria—large categories of forest sustainability—and 67 indicators—methods of measuring these categories. This process, now termed the Montreal Process, has since been adapted for use on numerous national, regional, and statewide planning initiatives.

In developing its own *Framework*, Wisconsin made extensive use of existing C&I models. The Northeastern Area Association of State Foresters (NAASF), along with the Northeastern Area State and Private Forestry (NA), a unit of the U.S. Forest Service, developed a set of 18 base[3] indicators of forest sustainability that follow the seven criteria of the Montreal Process C&I framework. Several other states have also developed their own C&I frameworks, including New Hampshire, Maine, and Oregon.

Through these various planning efforts, we have learned that carefully chosen C&I frameworks can flow from local to international scales. Wisconsin's *Framework* is based on several other regional and national frameworks. Using these systems as a base will allow us to compare Wisconsin's monitoring efforts with similar efforts taking place across the country and the world. We have also learned that frameworks are flexible systems that can be adapted and changed as information, experience, and data are gained. Therefore, although other C&I frameworks were used to develop this one, we will, in the future, refine our *Framework* to meet our state's particular needs.

**Process**

To begin to develop a C&I model that would be effective in the State of Wisconsin, the Wisconsin Council on Forestry convened an Advisory Committee (Committee) in December of 2006 to begin work on the *Framework*. The Committee was composed of a broad array of interested forestry partners from government, non-profit, industry, tribal, and university sectors who met from March through November 2007. This report is a product of their work. The review process for the *Framework* includes an expert, tribal, and public review to refine the final product. (See Appendix B).

In developing a statewide C&I program for sustainable forest management, Wisconsin has modeled its report and process after the State of Oregon's report, *Oregon Indicators of Sustainable Forest Management*. This report provided a solid template for Wisconsin to work from, as well as a completed product to adapt for our state's needs. Wisconsin also used the base 18 forest sustainability indicators established by the NAASF and the NA S&PF. The comprehensive set of

[2] http://www.rinya.maff.go.jp/mpci/

[3] United States Department of Agriculture, National Report on Sustainable Forests (February 2004) 12. *http://www.na.fs.fed.us/sustainability/base/base.shtm*

indicators and existing data in the base 18 was a starting point from which the Committee could add or subtract metrics to best measure Wisconsin's forest conditions. We appreciate this foundational work which we were able to build upon.

Two of the most challenging aspects of developing the *Framework* were incorporating metrics on ecosystem services and urban forestry. Because research on ecosystem services is still growing, there is little baseline data to use within this *Framework*. Urban forestry, although not a new field, has not been well integrated into broader research on forests and their use. Consequently, limited data currently exists to assess the urban forest structure (e.g., species, size, age, and condition). The Committee recognizes that these are two critical areas in which sustainability should be measured, and limitations on data and availability in these areas are noted within the *Framework*. As new data or research techniques arise, this information will be incorporated into the *Framework*. Where urban forestry data sets exist, the information will be used.

**Data Gaps**

While reading the report, you will notice that a wealth of forest data exists. You may also notice some areas where research and data sources are lacking. These gaps exist because of a lack of data, not because a metric is unimportant. The C&I process is still developing, and many valid data sources do not currently exist for a potential metric. For the purposes of this report, the Committee decided that metrics without an existing, reliable, long-term, or scientifically sound data source would not be included. Types of data that would be useful as a metric, but which do not yet exist in an appropriate format were added to the Data Gaps list on page 85. Due to factors such as funding, evolving technology, environmental events, or societal concerns, new research and data become available. As this data occurs, it will be incorporated into the existing *Framework* to create a more comprehensive assessment tool.

# Report Structure

This report is organized into seven chapters; each describes a criterion of sustainability and details the multiple indicators and metrics used to measure the criterion. Below is the template for each chapter. Text in italics describes what you will find under each heading.

## Criterion A:

*Description of the criterion: Criteria define broad categories of sustainability and are comparable to goals. An example is: "to maintain and enhance the long-term socioeconomic benefits that forests provide to society."*

**Connection to the Statewide Forest Plan:** *List of the Statewide Forest Plan goals that relate to this Criterion.*

**Indicator 1:** *Indicators provide specific measurements and are comparable to an objective. The indicator description will include what the indicator will measure and how it will be presented visually.. A sample indicator is: "provision of outdoor recreation opportunities and facilities."*

**Relevance:** *Discussion of why this indicator is relevant to measuring sustainability.*

**Metric Descriptions:** *Table of the metrics used to measure the indicator. Metrics are the specific items used to measure the indicators and are comparable to an action. An example of a metric is: "identify recreation activities, number of users, and number and types of facilities." The table used to describe the metric also includes several other components described below.*

| Metric | Data Source | Data Scale | Data Cycle | Reporting Responsibility |
|---|---|---|---|---|
| *1.1 (Title of metric)* | *(Name of group or agency that collects this data)* | *(What scale this data will be reported at)* | *(How often this data is collected)* | *(Who will report the data)* |

**1.1 Metric** *Title of metric and a description of how the data is collected.*

**Data Availability:** *Description of the availability of the data and if there are any issues with how often the data is collected.*

**Limitations/Considerations:** *Discussion on any limitations or considerations with the data such as inappropriate scale, collection difficulties, or ability to assess the indicator.*

**Quality Assurance:** *Description of how good the data are.*

**Related Indicators:** *This section describes which metrics from other frameworks correspond to Wisconsin's Framework.*

**References:** *A list of references that provide the data for the metrics and provide background information on the metrics.*

# Criterion 1: Conservation of Biological Diversity

Biological diversity is a fundamental requirement for forest health, sustainability, and productivity. In addition, there are human values related to the conservation of biological diversity. These include:

- Utilitarian values, including the needs of present and future human generations for food, chemicals, medicines, structural materials, and genetic sources for plant and animal breeding, as well as indirect needs for ecosystem functions like pollution mitigation, atmospheric balancing, water supply, maintenance of soil fertility, carbon storage, and flood control.
- Recreational, aesthetic, and spiritual values of a diverse and varied forest.
- Ethical values, for many people believe that other species have an intrinsic right to exist and that resource managers have a responsibility to ensure their survival.
- Traditional ecological knowledge and values. Indigenous peoples recognize forests and all their components as essential to their peoples' continued existence and perpetuation of their unique cultural identities.

The indicators and metrics for Criterion One give a generalized picture of the extent of forests and major forest types in Wisconsin. However, our knowledge of most other plant and animal species' life history traits, habitat associations, population sizes, distributions, trends, and response to disturbance or environmental change is significantly lacking. There are not enough available data to evaluate whether or not Wisconsin's forests are sustaining native biological diversity, and there are no coordinated efforts in progress to gather necessary data consistently, periodically, or on a statewide basis. The largest gaps occur in metrics that address Indicator Four ('Status of forest/woodland communities and associated species of concern'), which is crucial to assessing biological diversity.

No one indicator can tell us whether we are conserving our biological diversity. When assessing this criterion, the indicators and metrics should be reviewed as a whole. Research in biodiversity is continually evolving and new data sources will be incorporated into this criterion as they become available. The indicators and metrics presented were chosen because they represent the best available data. (See the section "Data Gaps" for a list of data that could help better inform our understanding of sustainable forestry.)

**Connection to Wisconsin's Statewide Forest Plan:**
Criterion One and its four indicators provide a means to measure two of Wisconsin's Statewide Forest Plan (SFP) goals that promote the conservation of biological diversity.

- Goal Two: Forests provide a diverse range of native plant and animal species and their habitats
- Goal Four: Forests are conserved and managed with sound stewardship practices

## Indicator 1: Area of total land, forestland, and reserved forestland

This indicator will provide tabular and graphical information about the amount of forestland in Wisconsin. It will include data on area of forestland, forest density, reserved forestland, and the urban forest.

### Relevance:

Tracking the total area of forestland is important to know whether the state is gaining or losing overall forest cover. In the broadest sense, the area and proportion of protected forest ecosystems indicates the emphasis a society places on preserving representative ecosystems for biodiversity conservation. Important forest management questions can be addressed by maintaining information on a network of comprehensive and representative forest types within protected areas. Traditionally, protected areas have been set aside, in part for their conservation, scenic, and recreational values, and might not represent the full range of biodiversity. Over time, forest types within protected areas will change. Adequate protection of diverse ecosystems and species in reserved areas may provide more management flexibility in forests under management for timber production and other extractive purposes.

This indicator directly relates to the following trends and issues identified in Wisconsin's Statewide Forest Plan:

- Trend 1: Wisconsin's forests are aging and forest succession is occurring.
- Trend 2: Forestland is increasing.
- Issue 28: Land trusts and state and county land purchases.
- Issue 39: The role of public forests.
- Trend/Issue 46: Absentee landowners affect urban canopy.

### Metric Descriptions:

| Metric | Data Source | Data Scale | Data Cycle | Reporting Responsibility |
|---|---|---|---|---|
| 1.1 Forest and total land area—Amount of forestland; Percentage of forestland and non forestland | FIA | Statewide | Annual | WDNR-FR |
| 1.2 Forest density | NLCD | Statewide | Periodic updates | WDNR-FR |
| 1.3 Legally & administratively reserved forestland—Acres of land | FIA | Statewide | Annual | WDNR-FR |
| 1.4 Urban forest—Forest and tree cover in urban areas | USFS, Northern Research Station, Urban Forestry Unit | Statewide | One-time data from 2002 pilot project. Proposal is for every 5 years. | WDNR-Urban Forestry Program |

1.1 Forest and total land area

All data for this metric are collected by the USFS Forest Inventory and Analysis (FIA) Program in cooperation with WDNR. (See Appendix D for a discussion of FIA methodology). The amount of forestland in Wisconsin will be presented in a graph beginning in the year 1630. Historically, data for this inventory was collected every 10-12 years up until 2004, when forest inventories were annualized. The percentage of forestland and non-forestland in Wisconsin will be presented in a separate pie chart. Forestland is defined by FIA as at least 1.0 acre in size and 120.0 feet wide measured stem-to-stem from the outer-most edge. Forested strips must be 120.0 feet wide for a continuous length of at least 363.0 feet in order to meet the acre threshold. Forested strips that do not meet these requirements are classified as part of the adjacent nonforest land. Forestland is at least 10% stocked by trees of any size or has been at least 10% stocked in the past. Additionally, these lands are not subject to nonforest use(s) that prevent normal tree regeneration and succession such as regular mowing, intensive grazing, or recreation activities.

1.2 Forest density

This map will be based on data from the 1992 National Land Cover Data (NLCD) from Multi-Resolution Land Characteristics Consortium (MRLC). The National Land Cover Data include a raster matrix of 30- by 30-meter pixels that were classified into multiple land-cover classes. The data were aggregated to estimate the percentage of forest cover for each 1- by 1-km cell. A cell was considered forested if it was classified as deciduous, evergreen, mixed forest, or as forested wetland. A new map is being generated with the 2001 NLCD data and will be used when it is released.

1.3 Legally and administratively reserved forestland

Data that will be used in this metric are collected by FIA in cooperation with WDNR. Further detail will be provided by The Nature Conservancy (TNC) on private ownerships. This metric will show the amount of forestland in different categories of timber utilization (either none, or some based on a management plan). FIA defines "reserved" forestlands as those withdrawn from timber utilization by law or administrative regulation; they include predominantly public lands, such as national wilderness areas, national parks, and some state parks. "Administratively" reserved forestland includes those lands that are protected as forest but allow for timber utilization over the life of a property. Timber use on these lands is prescribed through the property's management plan. Properties in this form of management include private lands with conservation easements. Different levels of administrative restrictions on forestlands provide for different levels of biodiversity. The TNC will help to define and categorize the private lands data they provide (e.g., coding the degree to which biodiversity conservation is a stated management objective for forests under different ownership or management scenarios).

1.4 Urban forest

The extent of urban forests is not currently tracked by FIA. The USFS, Northern Research Station, Urban Forestry Unit conducted a pilot urban forest assessment project in 2002, and plans are being made to more intensively sample the urban forests in the future. WDNR is increasing the number of sampling plots in urban areas and by about 2012, there will be enough data for statistical reliability within regions in Wisconsin. The Urban Forestry Unit determined forest cover and tree cover for the state using data from the Multi-Resolution Land

Characteristics (MRLC) consortium, 2001 NLCD; the USFS FIA urban plots; and the U.S. Census Bureau (for metropolitan areas).

**Data Availability:**
FIA and NLCD are secure sources of data and are easily accessible. State and federal knowledge of privately protected and reserved forestland is limited and a statewide source of this information is needed. TNC will assist the state by providing information on their ownerships.

Urban forestry data are slowly increasing as more sampling projects are funded. Local municipal tree inventories may also provide a partial basis to assess the urban forest. More widespread economic and ecological data will be available in the future. At that time, new metrics should be incorporated into the *Framework*.

**Limitations/Considerations:**
These metrics do not measure biodiversity per se, but rather inform whether or not Wisconsin's forests have the capacity to provide for elements of biodiversity associated with total forestland area, density, and protected areas.

Although it is not known to what degree urban forests support biodiversity, our understanding is evolving with recent urban ecosystem studies. Urban forests typically provide habitat for relatively common species that are not in decline at present, while also providing important stopover habitat for migratory birds, some of which may be uncommon. At the same time, urban forests can be serious habitat sinks, potentially contributing to population declines or misleading biodiversity management efforts. Most known benefits of urban forests are not directly related to biological diversity, but more research is needed to understand potential connections.

**Quality Assurance:**
The FIA data system has strict protocols for quality assurance and control. Urban forest data are increasing in statistical quality as more funding allows for more research.

**Related Indicators:**
- NA/NAASF base 18: Indicator 1
- Montreal 2003: Indicators 1, 2, and 3
- Montreal 2010: Indicators 1, 2, and 3
- FSC: Principle 7
- SFI: Objective 1
- ATFS: Standard 6

**References:**

Luther, Thomas. 2005. Forest density in the Northern United States. Durham, NH: U.S. Department of Agriculture, Forest Service, Northeastern Area State and Private Forestry, Information Management and Analysis.

Miles, Patrick D. 2005. Forest inventory mapmaker. [Web-application program]. Version 2.1. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. (11/4/2005). [http://www.ncrs2.fs.fed.us/4801/fiadb/index.htm].

Morin, Randall S. 2005. Forest density. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station, Forest Inventory and Analysis.

Nowak, David J. USDA Forest Service, Northeastern Research Station, Urban Forestry Unit (Syracuse, NY).

Smith, W. B., Miles, P.D., Vissage, J.S., and Pugh, S.A. 2004. Forest resources of the United States. 2002. A technical document supporting the USDA Forest Service 2005 update of the RPA Assessment. Gen. Tech. Rep. NC-241. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. 137 p. [http://www.ncrs.fs.fed.us/pubs/viewpub.asp?key=1987].

Waddell, K.L.; Oswald, D.D.; Powell, D.S. 1989. Forest statistics of the United States, 1987. Resource Bulletine PNW-RB-168. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 106 p.

## Indicator 2: Forest type, size class, age class, successional stage

This indicator will provide tabular and graphical information about the structure of forestland in Wisconsin. It will include data on area of forest types, using size and age classes as a proxy for successional stage and structural complexity.

### Relevance:

This indicator will use age-class distribution by broad forest type as a coarse measure of the landscape-scale structure of Wisconsin's forests. Many forest species are wholly or partly dependent on a particular successional stage. Understanding the mix of successional stages within a forest will therefore be important for providing species habitat. A diverse distribution of forest types and age-classes is also important for providing a mix of timber and non-timber products, supporting specific guilds of wildlife species, and maintaining aesthetic and recreational values. From a biodiversity perspective, a variety of successional stages and a balanced age class distribution is considered desirable across a landscape.

This indicator directly relates to the following trends and issues identified in Wisconsin's Statewide Forest Plan:

- Trend 1: Wisconsin forests are aging and forest succession is occurring.
- Issue 3: Some tree species are declining.
- Issue 11: Stands of old forest are rare.
- Issue 19: Succession is changing forest composition and potential forest products.

### Metric Descriptions:

| Metric | Data Source | Data Scale | Data Cycle | Reporting Responsibility |
|---|---|---|---|---|
| 2.1 Forest cover types | FIA | Statewide | Annual | WDNR-FR |
| 2.2 Size class | FIA | Statewide | Annual | WDNR-FR |
| 2.3 Age group—Amount of forestland by age group and forest type | FIA | Statewide | Annual | WDNR-FR |

2.1 Forest cover types

Forest cover types and the abundance and distribution of tree species will be extracted from Wisconsin FIA data and will be presented as a graph by acreage. All data to be used in this metric are collected by the FIA Program in cooperation with WDNR. (See Appendix D for a discussion of FIA methodology).

2.2 Size class

Size class data that will be used in this metric is broken into six categories by tree diameter at breast height, acreage, and habitat group. Stand size is a classification of stocked forestland based on the size class of live trees on the area; that is, sawtimber, poletimber, or sapling-seedling

- *Sawtimber stands (9.0"+ softwood; 11.0"+ hardwood)*—Stands with 50% or more of live tree stocking in sawtimber or poletimber trees, and with sawtimber stocking at least equal to poletimber stocking.

- *Poletimber stands (5.0"-8.9" softwood; 5.0"-10.9" hardwood)*—Stands with 50% or more of live tree stocking in poletimber and/or sawtimber trees, and with poletimber stocking exceeding that of sawtimber.
- *Sapling-seedling stands (0.1"-4.9")*—Stands with over 50% of the live tree stocking in saplings and/or seedlings.

All data are collected by FIA in cooperation with WDNR. State and ecological province data will be downloaded from Forest Inventory Database Online (FIDO). (See Appendix D for a discussion of FIA methodology).

2.3 Age group

This metric will report the acreage of forestland by age group for selected forest types. All data to be used are collected by FIA in cooperation with the WDNR. State and ecological province data will be downloaded from FIDO. (See Appendix D for a discussion of FIA methodology).

**Data Availability:**

FIA data are readily available from the USFS via a web-based system. There is a new web interface that will replace FIA MapMaker. It is called Forest Inventory Database Online, or FIDO. It is available at: http://fiatools.fs.fed.us/fido/index.htm (click on "state reports"). If WISCLAND was updated regularly, it would be a better source for forest cover type groups reported by species. The Advisory Committee recognizes the need for a continual updating of WISCLAND and this item is noted as one of the top data gaps in this report (see page 85).

**Limitations/Considerations:**

Although there is no direct inventory of the extent of forest by successional stage for the northern United States, the USFS has tracked changes in forestland acres by forest cover type and age through the FIA Program. Therefore, age class information is often used as a surrogate measure for successional state, with the recognition that this is a weak approximation. When interpreting the data, it will be important to note differences among forest types in the relationship of successional state to stand age. The Advisory Committee recognized this lack of data and identified the need for a model that analyzes stand structure on the Data Gaps list (page 85).

**Quality Assurance:**

The FIA data system has strict protocols for quality control and assurance.

**Related Indicators:**

- NA/NAASF base 18: Indicator 2
- Montreal 2003: Indicator 2
- Montreal 2010: Indicator 2
- FSC: Principle 7
- SFI: Objective 1
- ATFS: Standard 3

**References:**

Forest Inventory Database Online (FIDO). [http://fiatools.fs.fed.us/fido/index.htm].

Miles, Patrick D. 2005. Forest inventory mapmaker. [Web-application program]. Version 2.1. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. (11/4/2005). [http://www.ncrs2.fs.fed.us/4801/fiadb/index.htm].

Smith, W. B.; Miles, P.D.; Vissage, J.S.; Pugh, S.A. 2004. Forest resources of the United States. 2002. A technical document supporting the USDA Forest Service 2005 update of the RPA Assessment. Gen. Tech. Rep. NC-241. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. 137 p. [http://www.ncrs.fs.fed.us/pubs/viewpub.asp?key=1987].

## Indicator 3: Extent of forestland conversion, fragmentation, and parcelization

This indicator will provide tabular and graphical information about the changes in forestland throughout Wisconsin. It will include data that tracks forestland conversions and will show changes in fragmentation and parcelization.

### Relevance:

Fragmentation is the breaking up of large and contiguous ecosystems, natural communities, and habitats into smaller areas surrounded by altered habitat, developed land, disturbed land, or aquatic substrate. The fragmentation of forest area into small pieces may change ecological processes and reduce biological diversity. The type of fragmentation of greatest concern today is the permanent and long-term conversion of forestland to non-forest uses and development. Often, this conversion is associated with human development, including urban and suburban expansion, and the construction of roads in formerly rural areas.

Parcelization, often observed to be associated with fragmentation, is the subdivision of a single forest ownership into two or more ownerships. Adjacent ownerships may or may not be in similar habitat types. The forestland itself may not change immediately when broken up into separate tracts, but it becomes more susceptible to fragmentation (e.g. some tracks may be sold for development) and is more difficult to manage for landscape-scale benefits (e.g. multiple landowners with diverse objectives). Average forest parcel size is decreasing in Wisconsin. This indicator will include several measures of the extent to which forests are distributed as large blocks. Forest product-based economies, forest species that depend on forest cover, and recreational forest users are all impacted by fragmentation.

This indicator directly relates to the following trends and issues identified in Wisconsin's Statewide Forest Plan:

- Issue 12: Forest is becoming more fragmented.
- Trend 31: Large blocks of industrial forestland are changing hands rapidly.
- Trend 32: More people are purchasing forestland.
- Trend 34: Demographics of forestland owners are changing.
- Trend/Issue 35: Less forestland is available for public use.
- Trend/Issue 42: Development in fire prone areas.
- Trend 44: Urbanization is increasing.
- Trend/Issue 45: Development is increasing.
- Trend/Issue 49: The effects of global population growth.

### Metric Descriptions:

| Metric | Data Source | Data Scale | Data Cycle | Reporting Responsibility |
|---|---|---|---|---|
| 3.1 Forestland developed | WDOR; NASS | County | Annual | WDATCP |
| 3.2 Net change in forestland | FIA | Statewide and regional | Annualized inventory | WDNR-FR |
| 3.3 Additions to and conversions from forestland | WDOR; NASS; FIA | Statewide | Annual | WDNR-FR |
| 3.4 Forest parcel size | FIA; NRI; NASF; NRCS | Statewide | Annual | WDATCP |

| | | | | |
|---|---|---|---|---|
| 3.5 Lands with various legal limitations on conversion | WDNR-MFL | Statewide | On demand | WDNR-FR |
| 3.6 Road density | WDOT; WDNR | Multiple scales | Annual | WDNR-FR |
| 3.7 Housing density | UW-Madison; U.S. Census Bureau | Statewide | Every 10 years | WDNR-FR |

3.1 Forestland developed

This metric will rely on data from the Wisconsin Department of Revenue (WDOR), which reports forestland sales acreages, per acre sale price, and the amount of forestland being diverted to other uses. Data from the National Agricultural Statistics Service (NASS) showing agricultural and forestland that is sold, converted, or that stays in the same use will also be used. These data will be reported in tables.

3.2 Net change in forestland

Data will be derived from metric 1.1 using FIA data (See data description in metric 1.1).

3.3 Additions to and conversions from forestland

Data for this metric will be derived from the analysis of metrics 3.1 and 3.2. Original data are from WDOR.

3.4 Forest parcel size

Forest parcel size will be displayed in two graphs for this metric. The first will show the amount of all privately owned forestland holdings by forest parcel size (acres). This will include private forestlands owned by companies. The second graph will show the amount of private forestland specifically owned by non-industrial "family" forest owners.

Data used in this metric will come from the 1993 survey of private forest landowners conducted by FIA units in cooperation with the National Association of State Foresters (NASF) and the USDA Natural Resources Conservation Service (NRCS). Questionnaires were mailed to 23,334 owners of 28,194 privately owned forested sample plots. Sample plot locations came from Natural Resources Inventory (NRI) or FIA plots. Responses from 6,810 ownerships that control 7,965 of these sample plots were included in the report for the northern United States.

The National Woodland Owner Survey will also be used in this metric. This study is conducted by FIA to increase understanding of private forest landowners in the United States. Questionnaires are mailed to individuals and private groups that own woodlands where the FIA has established forest monitoring plots. Twenty percent of these ownerships are contacted each year, with complete samples being completed in years that end in 2 or 7 to coincide with the national census, inventory, and assessment programs. The target accuracies of the data are +/- 10% at the state level.

3.5 Lands with various legal limitations on conversion

This metric will use the same data collection methods as those outlined in metric 3.1. This metric specifically counts those lands protected from conversion to non-forest uses (e.g. development) and can include public lands and those under conservation easements, purchase of development rights, transfer of development rights, Managed Forest Law (MFL) parcels, land trust

properties, etc. These lands are either managed for timber utilization or not. Each land category will be reported separately. Data

3.6 Road density

Data will be presented as a map with town roads being the finest level. Data will come from the Department of Transportation (WDOT), and can be overlaid on forested lands. Road density can be computed at various scales—township, county, region.

3.7 Housing density

Data will be derived from the US Census and can be presented down to the census block level either in a map or tabular format.

**Data Availability:**

Information on forestland sales is available from the NASS. Wisconsin's information is based on data collected by the WDOR. Beginning in 2005, NASS began presenting forestland conversion statistics on their website.

NRCS and NRI data are only regional. NASS provides data by state.

There may be opportunities to use the 2001 NLCD for analyses of forest landscape patterns and road density. It is unclear what additional analyses may be planned at the national scale, and whether data will be updated periodically to allow for repeat analyses to detect changes in forest pattern. If WISCLAND were updated, it would provide a better source of data than NLCD for fragmentation. The Advisory Committee recognizes the need for a continual updating of WISCLAND and this item is noted as one of the top data gaps in this report (see page 85).

**Limitations/Considerations:**

Data on private lands with various legal limitations on conversion is limited (metric 3.5). This gap ranked high on the Advisory Committees prioritized list of data needs (see Data Gaps, page 87). No group currently tracks this information across the state and across organizations. There will be a limited amount of data on private lands that are not enrolled in state tax law programs.

Forest roads and roads on private lands are not included in Metric 3.6. No comprehensive data source maps these roads; these types of roads are an important component in analyzing the effects roads have on forest conditions.

**Quality Assurance:**

Data sources identified are reputable and quality is not a problem.

**Related Indicators:**

- NA/NAASF base 18: Indicator 3
- Montreal 2003: Indicator 5
- Montreal 2010: Indicator 3
- FSC: Principles 2 & 7
- SFI: Objective 1
- ATFS: Standard 3

**References**:

Birch, Thomas W. 1996. Private forest-land owners of the Northern United States, 1994. Resource Bulletin. NE-136. Radnor [Newtown Square], PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 293 p.

Butler, Brett J.; Leatherberry, Earl C. 2004. National woodland owner survey 2003 preliminary results. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station. [http://www.fs.fed.us/woodlandowners/publications/nwos_draft_tables_july_2004.pdf].

Lund, Daryl. National Resources Inventory [unpublished data received 10/6/2005]. Washington, D.C.: U.S. Department of Agriculture, Natural Resources Conservation Service, Resources Inventory and Assessment Division, George Washington Carver Center.

National Agricultural and Statistics Service website. [www.nass.usda.gov] and [http://www.nass.usda.gov/Statistics_by_State/Wisconsin/Publications/Land_Sales/index.asp].

National Land Cover Data website. [www.epa.gov/mrlc/ncld.html].

Natural Resources Inventory website. Details on how inventory is conducted. [http://www.nrcs.usda.gov/technical/NRI/].

## Indicator 4: Status of forest/woodland communities and associated species of concern

Graphs and maps will depict the status of key forest communities by using examples of species of birds and mammals that are associated with specific forest types and may signal a change in biodiversity.

### Relevance:

This indicator will use the population trends of selected species as a surrogate measure of the biological diversity supported by Wisconsin's forests. Changes in these species' abundance can indicate environmental stress, including unfavorable changes in forest habitat. Data will be gathered on selected forest bird species and forest mammals. Mammal populations that will be reported are: fisher, bobcat, wolf, deer, and pine marten. Mammal population studies are limited and populations of these species represent the best available data that are consistent and have long-term monitoring.

This indicator directly relates to the following trends and issues identified in Wisconsin's Statewide Forest Plan:

- Issue 3: Some tree species are declining.
- Trend 4: Limited oak regeneration in southern Wisconsin.
- Issue 5: Information on biodiversity is scarce.
- Trend 7: List of threatened and endangered species is growing.
- Issue 9: Some biotic communities and important development stages of biotic communities are rare.

### Metric Descriptions:

| Metric | Data Source | Data Scale | Data Cycle | Reporting Responsibility |
|---|---|---|---|---|
| 4.1 Forest and woodland communities | WDNR-ER | Statewide | Ongoing | WDNR-ER |
| 4.2 Forest-associated species of concern | WDNR-ER | Statewide | Ongoing | WDNR-ER |
| 4.3 Bird populations | BBS | Statewide | Annual | WDNR- ER |
| 4.4 Mammal populations | WDNR-WL | Statewide | Annual | WDNR-WL |

4.1 Forest and woodland communities

Data for this metric will come from Wisconsin's Natural Heritage Inventory (NHI). WDNR, Bureau of Endangered Resources (WDNR-ER) coordinates these data for the state and provides original data to the national program, NatureServe. These data are accessible on the WDNR-ER website: http://dnr.wi.gov/org/land/er/wlist/Working_List_2006.pdf

The Wisconsin NHI Working List contains species known or suspected to be rare in the state and natural communities native to Wisconsin. This metric will list and describe the condition of forest and woodland communities.

4.2 Forest-associated species of concern

Data for this metric will come from Wisconsin's NHI. WDNR-ER coordinates this data for the state and provides original data to the national program, NatureServe. These data are accessible on the WDNR-ER website: http://dnr.wi.gov/org/land/er/wlist/Working_List_2006.pdf.

Forest-associated species in WDNR-ER data were determined based on their habitat. Forest-associated data are only provided for animal species (does not include plants) and are not complete for all invertebrate groups. Further discussion with WDNR-ER would provide opportunities to determine which species are "forest associated" and could include forest-associated plant species. Species listed in this metric will include those that are legally designated as "Endangered" or "Threatened" as well as species in the advisory "Special Concern" category.

4.3 Bird populations

This metric will identify select bird species associated with each forest type age group class from metric 2.3. Assistance in the selection of appropriate bird species will come from the WDNR, Bureau of Wildlife (WDNR- WL). The graph will display North American Breeding Bird Survey (BBS) trend data for the selected birds, along with charts showing acreage changes over time for their associated forest habitat. WDNR-ER will also assist in selecting bird species associated with the forest types and age classes, and will also help produce the analysis.

BBS is a long-term, broad-scale, avian monitoring program initiated in 1966 to track the status and trends of North American bird populations. Each year during June, participants collect bird population data along roadside survey routes. Each survey route is 24.5 miles long with stops at 0.5-mile intervals. At each stop, a 3-minute point count is conducted. During the count, every bird seen within a 0.25-mile radius, or heard, is recorded. Surveys start one-half hour before local sunrise and take about five hours to complete. Routes are randomly located in order to sample habitats that are representative of the entire region.

Once analyzed, the BBS data provide an index of population abundance that is used to estimate population trends and relative abundance at various geographic scales. Trends are estimated using the route-regression methods described by Geissler and Sauer (1990). Regional trends are estimated as a weighted average of trends on individual routes. Consult the Breeding Bird Survey Web site [http://www.pwrc.usgs.gov/BBS/] for a detailed description of how they estimate trends.

4.4 Mammal populations

This metric will report the populations of specific mammal species that may indicate the forest condition of specific cover types. Certain mammal species may signal habitats that are provided by a forest's ecosystem services. For example, wolf population reports can indicate ecosystem connectivity and functionality due to their position as top predators. Deer population reports may help explain changes in forest cover acreages. Population reports for this metric will come from the WDNR- WL. Interpretations of data in these reports are subject to change as a result of data verification and more extensive data analysis by the WDNR-WL. Species populations reported in this metric will include deer, fisher, bobcat, wolf, and marten.

**Data Availability:**
The Wisconsin Bird Conservation Initiative (WBCI) is making efforts to compile data from multiple bird surveys and make it available from a central location. This is a good future source of information. WBCI also hopes to complete the development of web-based information about bird habitat associations, and to compile information from literature and experts about responses of local bird populations to different forest management activities.

**Limitations/Considerations:**
In general, data that directly address Indicator 4 are lacking. Mammal data are largely reported from trapping and hunting; data are at a coarse scale. Trends in species populations, reported over broad areas, cannot be linked to specific changes in forests, so conclusions about cause and effect will be educated guesses at best. Research that links species population changes directly to experimental manipulations of forest composition and structure are needed.

The NHI data also have some shortcomings. Many areas of the state have not been surveyed, and many existing surveys are not up-to-date. NHI is an inventory, not a monitoring effort. As such, it does not have the ability to revisit and inventory existing sites, which creates some data gaps for the purposes of this indicator. In order to properly present the metrics presented above, consultations with experts will be needed to frame the selection of forest species and communities important as indicators of biological diversity. The Advisory Committee recognizes the need for monitoring NHI data and this item is noted as one of the top data gaps in this report (see page 85).

BBS provides the best available data on bird populations, but tends to underreport species that are distant from roads, species that are vocal later in the season (e.g. woodpeckers), and nocturnal species.

**Quality Assurance:**
Data used in this indicator have shortcomings as noted above.

**Related Indicators:**
- NA/NAASF base 18: Indicator 4
- Montreal 2003: Indicators 7, 8, & 9
- Montreal 2010: Indicators 5 & 8
- FSC: Principle 6
- SFI: Objective 4
- ATFS: Standard 6

**References**:
McNees, Jason. 2005. NatureServe Central Databases [unpublished data received 8/19/2005]. Arlington, VA: NatureServe.

North American Breeding Bird Survey website. [http://www.pwrc.usgs.gov/BBS/].

Sauer, John. 2005. The North American breeding bird survey, results and analysis: species group summary for woodland breeding birds, 1966-2004 [unpublished data]. Laurel, MD: U.S. Geological Survey, Patuxent Wildlife Research Center. [http://www.pwrc.usgs.gov/bbs/bbs2004.html].

WDNR-Bureau of Endangered Resources website. [http://dnr.wi.gov/org/land/er/].

WDNR-Bureau of Wildlife. Wildlife Surveys website. [http://dnr.wi.gov/org/land/wildlife/harvest/harvest.htm].

# Criterion 2: Maintenance of Productive Capacity of Forest Ecosystems

One way to measure the sustainability of a forested ecosystem is to determine if it is being managed to produce wood and non-timber products in a way that allows for continual renewal of the forest. Essentially, productive capacity is maintained as long as the harvesting of forest and non-timber products does not exceed growth rates. However, even when harvesting does not exceed growth rates, it is important to consider the quality of the standing forest resource, not purely the quantity. If harvesting does exceed growth rates, natural capital stocks become depleted and the amount of products flowing from these stocks must decline. The classic example of this scenario is from the turn of the century when the forests of Wisconsin were cutover; timber was used to develop the region and trees were cleared to provide agricultural land for homesteaders. This harvesting was not ecologically or economically sustainable—forests were not reproducing, and the economy, once supported by rapid tree harvesting, soon went into a bust period. The productive capacity of forest ecosystems is also dependent on making appropriate land use decisions. If the most productive timber land is used for other purposes, society's ability to sustain large quantities of forest products will be diminished.

**Connections to Wisconsin's Statewide Forest Plan**
Criterion Two will help to identify whether Wisconsin is reaching Goal Three and Four of Wisconsin's Statewide Forest Plan.

- Goal Three: Forests are productive, providing raw material for consumers and economic stability for local communities
- Goal Four: Forests are conserved and managed with sound stewardship practices

## Indicator 5: Area of timberland

This indicator will use graphs to describe the total amount forest area available for different types of timber production. It will also provide a collective view of the management status and production capacity of Wisconsin's forests.

**Relevance:**
This indicator will provide information that may be used to calculate the productive timber capacity of existing forests, and show how much forest is potentially available for timber production, compared with total forest area. Knowing how much forestland is available and capable of providing desired goods and services is a critical indicator of the balance of forest ecosystems relative to potential end uses.

Pertinent definitions from FIA include:

"Timberland" is forestland that is producing or is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation. Areas qualifying as timberland are capable of producing in excess of 20 cubic feet per acre per year of industrial wood in natural stands. Currently inaccessible and inoperable areas are included.

"Reserved Forestland" is forestland withdrawn from timber utilization through statute, administrative regulation, or designation without regard to productive status.

"Other Forestland" is forestland other than timberland and reserved forestland. It includes available forestland that is incapable of annually producing 20 cubic feet per acre of industrial wood under natural conditions because of adverse site conditions such as sterile soils, dry climate, poor drainage, high elevation, steepness, or rockiness.

This indicator directly relates to the following trends and issues identified in Wisconsin's Statewide Forest Plan.

- Trend 2: Forestland is increasing.
- Trend 22: Forests are in demand for a mix of uses.
- Trend 31: Large blocks of industrial forestland are changing hands rapidly.
- Issue 39: Role of public forests.

Metric Descriptions:

| Metric | Data Source | Data Scale | Data Cycle | Reporting Responsibility |
|---|---|---|---|---|
| 5.1 Amount of timberland | FIA | Statewide | Annual | WDNR-FR |

5.1 Amount of timberland

This metric will measure the percentage of forest that is either categorized as timberland, reserved forestland, or other forestland in Wisconsin. Inventory data that will be used in this metric are collected by FIA in cooperation with WDNR. Each inventory begins with the interpretation of a remotely sensed, or "phase 1," sample that classifies the land by various remote sensing classes. FIA ground plots, or "phase 2" plots, are designed to cover a 1-acre area; however, not all trees on the plot are measured. Recent inventories use a national standard, fixed-radius

plot layout for sample tree selection. (See Appendix D for a description of FIA sampling methods).

**Data Availability:**
Information is readily available from FIA.

**Limitations/Considerations:**
Understanding the amount of timberland is helpful, but is best coupled with analysis of other variables to be useful. Unfortunately, data on timberland is limited:

- Data and analysis is lacking on harvest accessibility limitations due to steep slopes and wet land on some of the timberland in the state.
- Data and analysis is limited on the number and acreage of private woodland ownerships that are too small to attract a timber buyer, reducing actual availability of timberland for harvest. In essence, existing data does not adequately describe the point when a forest becomes too small to be productive timberland.

**Quality Assurance:**
Data from FIA are consistent.

**Related Indicators:**

- Northeast Area BASE 18: Indicator 5
- Montreal Process 2003: Indicator 10
- Montreal Process Proposed 2010: Indicator 10
- FSC: Principles 7 and 8
- SFI: Objectives 1 and 2
- ATFS: Standard 4

**References:**

Miles, Patrick D. 2005. Forest inventory mapmaker. [Web-application program]. Version 2.1. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. (11/4/2005). [http://www.ncrs2.fs.fed.us/4801/fiadb/index.htm].

Smith, W. B.; Miles, P.D.; Vissage, J.S.; Pugh, S.A. 2004. Forest resources of the United States. 2002. A technical document supporting the USDA Forest Service 2005 update of the RPA Assessment. Gen. Tech. Rep. NC-241. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. 137 p. [http://www.ncrs.fs.fed.us/pubs/viewpub.asp?key=1987].

U.S. Department of Agriculture, Forest Service, St. Paul, MN: North Central Research Station. Amount of timberland data. [http://www.ncrs2.fs.fed.us/4801/fiadb/index.htm]. (Accessed 11/3/2005).

Waddell, K.L.; Oswald, D.D.; Powell, D.S. 1989. Forest statistics of the United States, 1987. Resource Bulletin PNW-RB-168. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 106 p.

## Indicator 6: Annual growth and removals of forest products

This indicator will present data related to the growth, removal, and quality of forest products. Amount of removals will be listed by tree type and will be presented in tables and graphs. The total growing stock and tree grade of both merchantable and non-merchantable tree species will also be presented in graphs. The annual harvest of non-timber products will be described for products that have data available.

**Relevance:**
These metrics can help explain how much the forest is growing as well as how intensely we are harvesting the woods. The data will describe what the current quality of trees is. This indicator directly relates to the following trends and issues identified in Wisconsin's Statewide Forest Plan.

- Trend/Issue 20: Global demand for forest products is increasing.
- Trend 26: Harvested trees are being used more efficiently.
- Trend 30: Maintaining an adequate supply of high quality nursery seedlings for reforestation and conservation purposes.
- Trend/Issue 38: Clearcutting and other even-age management techniques are controversial.
- Trend 43: Consumption patterns are not linked to production.

Metric Descriptions

| Metric | Data Source | Data Scale | Data Cycle | Reporting Responsibility |
|---|---|---|---|---|
| 6.1 Net growth and removals | FIA | Statewide | Annual | WDNR-FR |
| 6.2 Type of removals | FIA | Statewide | Annual | WDNR-FR |
| 6.3 Total growing stock and tree grade of both merchantable timber and non-merchantable tree species on forestland available for timber production | FIA | Statewide | Annual | WDNR-FR |
| 6.4 Annual removal of non-timber forest products | Trade group surveys; Forestry agencies; FIA | Statewide | 10 years for trade groups and agencies; Annualized FIA inventories | WDNR-FR |

6.1 Net growth and removals

This metric will compare net growth of growing stock with wood harvest (removals) of products on timber land. Net growth of growing stock is equal to gross growth minus mortality. Growth is the net annual increase in the volume of growing stock between inventories after accounting for effects of mortality, but before accounting for the effects of harvest. Mortality is the volume of trees that died since previous measurement. Removals measure the average annual volume of living trees harvested between inventories.

This metric will be used to assess whether wood harvesting is reducing the total volume of forest trees available for timber production. Timberland, as defined by the FIA, is forestland that is producing or is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation. The volume of trees on timber land is considered sustainable as long as removals (harvest and land clearing) do not exceed growth (net of mortality).

All data to be used in this metric are collected by FIA in cooperation with WDNR. Removals data will come from FIA sample locations. Mill studies will supplement this information by providing the volume of roundwood and residues utilized by industry. Ecological province data will be downloaded from FIDO. (See Appendix D for a description of FIA methodology.)

6.2 Type of removals

The type of removals will be distinguished as either removals for harvest or removals due to land change. All data to be used in this metric are collected by FIA in cooperation with WDNR. The data from FIA sample locations reports type of removals of growing stock on timberland. Mill studies will supplement this information by providing the volume of roundwood and residues utilized by industry.

6.3 Total growing stock and tree grade of both merchantable timber and non-merchantable tree species on forestland available for timber production

Growing stock is a classification that includes only live trees meeting standards for quality or vigor. Cull trees, live trees with poor form, rot, and defects, are not considered in growing-stock calculations. Growing-stock volume is calculated for growing stock that is at least 5.0 inches in diameter when measured at breast height (4.5 feet above ground level). Growing-stock inventory figures change constantly due to forest growth, mortality, timber harvest, removals related to forest resource management, and losses resulting from conversion of forest to other land uses.

The tree grade of the growing stock will be included in these tables in order to gauge what the quality of the growing stock is. Tree grade can indicate not only economic but ecological forest conditions. Knowing the overall grade of trees will explain whether the best quality trees are being harvested, leaving only the lowest quality. Tree grade is a classification of the lower 16 feet of the bole of standing trees based on external characteristics as indicators of the quality and quantity of lumber that could be produced from a tree. Tree grade is broken into four classifications (1 is highest quality, 4 is lowest quality).

6.4 Annual removal of non-timber forest products

Non-timber forest products removed in Wisconsin include but are not limited to the following categories: game animals, furbearing mammals, food products, medicinal plants, items for arts and crafts, fuel wood, evergreen boughs, and mosses. The majority of non-timber products are not regulated, so therefore there is no systematic effort to collect data. Data for this metric will be collected by identifying specific products (e.g. maple syrup) and surveying trade groups for the extent of removals (e.g. Wisconsin Maple Syrup Producers Association). The amount of Christmas trees, boughs and peat moss removals on public lands will be obtained from

government forestry departments through permit data. FIA collects data on willow branches, birch bark, and boughs.

**Data Availability:**
Information is readily available from FIA for metrics 6.1 and 6.2. There is little historical data regarding the amount of forestland available for the harvest of non-timber forest products outlined in metric 6.4. This metric will therefore be dependent on private organizations to share their information on non-timber harvest levels.

**Limitations/Considerations:**
Current (2005) FIA net growth and removals statistics include only one year (20%) of the data for the 5-year cycle. 2004 data includes 100% of the prior cycle data.

The net growth-to-removals ratio is a measure that approximates the notion of sustainable production. When net growth exceeds removals (ratio greater than 1.0) the result is an increase in growing stock inventory volume. When removals exceed net growth (ratio less than 1.0), the result is a reduction in the merchantable volume of live tree stems. Since individual effects on growth, mortality, and removals influence this statistic, caution is required for interpretation. Because decline in growth may be due to increases in mortality, trend data for net growth and removals should be reviewed in conjunction with mortality data.

**Quality Assurance:**
Sampling error is high for net growth and removals, especially on a less than statewide basis. Non-harvest removals (i.e. land use change and silvicultural operations) are difficult to measure.

**Related Indicators:**
- NA/NAASF_base18: Indicator 6
- Montreal Process 2003: Indicators 11, 12, 13, 14, 34
- Montreal Process Proposed 2010: Indicators 11, 12, 13, 14
- FSC: Principle 5 (5.1, 5.4, 5.6)
- SFI: Objective 1
- ATFS: none

**References:**
Miles, Patrick D. 2005. Forest inventory mapmaker. [Web-application program]. Version 2.1. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. (11/3/2005). [http://www.ncrs2.fs.fed.us/4801/fiadb/index.htm].

Smith, W. B.; Miles, P.D.; Vissage, J.S.; Pugh, S.A. 2004. Forest resources of the United States. 2002. A technical document supporting the USDA Forest Service 2005 update of the RPA Assessment. Gen. Tech. Rep. NC-241. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. 137 p. [http://www.ncrs.fs.fed.us/pubs/viewpub.asp?key=1987].

U.S. Department of Agriculture, Forest Service. Forest Sustainability Indicators Information System Technical Notes Report. [www.fs.fed.us/sustainability/indicators].

U.S. Department of Agriculture, Forest Service. March 2007. Forest Sustainability Assessment for the Northern United States. NA-TP-01-07CD. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Area State and Private Forestry.

# Criterion 3: Maintenance of Forest Ecosystem Health and Vitality

Ecosystem health depends on the functionality of natural, non-degraded ecosystem components and processes. The underlying premise is that forest species and ecosystems have evolved to function within particular environmental conditions determined largely by geological and climactic forces. Humans, meanwhile, have historically adapted their economic and social activities to these environmental conditions and ecological processes. Humans also adapt natural environments to serve their needs, in the process altering natural processes and environments.

Substantial modification of environmental conditions threatens species' adaptive capacities, ecosystems' functional capacities, and associated human economies and societies. To the extent that exotic species, air pollution, diseases and the various effects of climate change threaten forests, associated economies and communities are likewise threatened.

It is difficult to address forest ecosystem health at a broad statewide scale due to the diversity of variables affecting forests at smaller scales. Data supporting indicators for this criterion are focused on damaging factors rather than those measuring positive health and vitality, because these positive types of measurements are not available. Data is limited on the health of all forest ecosystem components, such as plants and the forest floor. In particular, there is a lack of knowledge surrounding herbaceous plants—this gap is listed in the Data Gaps section of this *Framework*. For a more global perspective on forest ecosystem health, see Criterion 4, which focuses on water and soils

**Connection to Wisconsin's Statewide Forest Plan**
Criterion three will help to identify whether Wisconsin is reaching Goal One of Wisconsin's Statewide Forest Plan.

- Goal One: Forests are healthy and protected

## Indicator 7: Area of forestland affected by potentially damaging agents

This indicator will describe areas of forestland negatively affected by weather events, climate, invasive species, animal damage, and other agents. Graphs, maps, and reports will display this information.

### Relevance:

This indicator will analyze and report the effects of climate, fire, insects, animals, disease, and invasive plants on ecological processes in forests. When ecological processes are altered beyond some critical threshold, they may produce significant changes to forest condition. The behavior of many natural processes and agents has been altered due to human activities such as fire exclusion, intensive forest management, and introduction of exotic species. Metrics presented with this indicator will help us to identify chronic and acute forest health issues and document long-term trends. They will alert us to issues that may be mitigated and help to set priorities for addressing forest health issues. They may also identify and explain successional changes in our forests.

This indicator directly relates to the following trends and issues identified in Wisconsin's Statewide Forest Plan.

- Issue 3: Some tree species are declining.
- Issue 8: Invasive exotic species are an increasing threat.
- Trend10: Forest disturbance patterns are changing.
- Trend 13: Average acreage burned by forest fires has declined.
- Trend 15: Warming of earth may affect forest composition, structure and function.
- Issue 14: Control of fire affects forest composition.

### Metric Descriptions:

| Metric | Data Source | Data Scale | Data Cycle | Reporting Responsibility |
|---|---|---|---|---|
| 7.1 Tree mortality | FIA | Statewide | Annual | WDNR-FR |
| 7.2 Catastrophic events | WDNR-FR | Statewide | Annual | WDNR-FR, FHP |
| 7.3 Climate | NOAA; WDOT; State Climatology Office; WDOA; | Region and Statewide | Annual | WDNR-FR |
| 7.4 Disease and insects | WDNR-FR; WDATCP | Statewide | Annual | WDNR-FR, FHP |
| 7.5 Invasive plants | FIA | Statewide | Annual | WDNR-FR |

7.1 Tree mortality and damage type

This metric will report, in graph format, the annual mortality of growing stock on timberland (i.e., the average annual volume of sound wood that died from natural causes during the period between inventories). A second graph will report crown dieback and transparency as damage types. Data for this metric will come from surveys done only in the summer (FIA P3 plots). Urban forests will not be included in the tree mortality reports, but will be included in the damage type graphs as a separate category. This metric serves as a proxy for forest health.

"Timberland," as defined by FIA, is forestland that is producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation. Areas qualifying as timberland are capable of producing in excess of 20 cubic feet per acre per year of industrial wood in natural stands. Currently inaccessible and inoperable areas are included. See metric 5.1 for amount of timberland in Wisconsin.

All data that will be used in this metric are collected by FIA in cooperation with WDNR. (See appendix D for a discussion on FIA data collection methodology).

7.2 Catastrophic Events

Catastrophic events in Wisconsin include wildfire, wind, ice, and hail storms. Data for this metric will be presented in several graphs and maps.

a) Wildfires: The number and acres of wildfires and prescribed burns in the "Protection Area" (lands protected by WDNR) of the state are tracked by the Division of Forestry, Bureau of Fire Protection and reported in the Fire Incident Report. Data gathered includes acres burned, cover type, location information, fuel models, climate information, structures lost and saved, suppression resources and costs, and fire causes. The "Protection Area" covers almost 57% of the state. In 2007, data will be available for fires in "Cooperative Areas" (lands where DNR assists other agencies in fire suppression).

b) Wind: Wind-related weather events are typically mapped by the DNR when the events are greater than 5,000 acres and the majority of land disturbed is forest. These maps are produced by the WDNR, Forest Health and Protection (FHP) Program or the regional forestry programs.

c) Ice and hail storms: Ice and hail storm events are typically mapped by the DNR when the events are greater than 2,000 acres and the majority of land affected is forest. These maps are produced by the WDNR FHP Program or the regional forestry programs.

7.3 Climate

There are various components of climate that affect different forest types. Data will be presented on several climate variables (drought, average temperature, duration of lake ice, heating/cooling/growing degree days, and frost tubes), which will be accessed through agency web-sites. Taken in combination or separately, the data from these metrics may be used to track long-term climate trends that affect specific forest types or the state's forest resource as a whole.

a) Drought: The Palmer Drought Severity Index (PDSI) is a meteorological drought index based on the principles of a balance between moisture supply and demand, which is used to assess the severity of dry or wet spells of weather. Data from the PDSI is available from the National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center. The index generally ranges from -6 to +6, with negative values denoting dry spells and positive values indicating wet spells. The PDSI map shows the number of months of moderate, extreme, or severe drought in the northern United States. The monthly PDSI values are calculated by the national Climatic Data Center by climate divisions. There are no data for major portions of northern Wisconsin.

b) Average temperature: Average temperatures for Wisconsin are presented in PDSI maps by season from 1971 to 2000. Data are from the State Climatology Office website: [http://www.aos.wisc.edu/%7Esco/seasons/index.html].

c) Duration of lake ice: The dates of the freeze ("ice in") and thaw ("ice out") for nearly three dozen lakes in Wisconsin have been monitored for more than 150 years. From these dates, the total ice duration on the lakes for each season has been computed, representing the total number of days that ice remained on the lakes. The State Climatology Office provides this data on their website: [http://www.aos.wisc.edu/~sco/lakes/WI-lake_ice-1.html].

d) Heating/cooling/growing degree days: Data on heating, cooling, and growing degree days in Wisconsin are available from the Department of Administration (WDOA) website: [http://www.doa.state.wi.us/degreedays/]. The data are available by month, year (1990-2007), and for 14 major cities. Data for heating and cooling degree days are available statewide. Degree day is simply a way of measuring how hot or cold it has been over a 24 hour period. Whenever the average, or mean temperature is below 65° Fahrenheit, that day is designated a heating degree day. Whenever the average is above 65° Fahrenheit, that day is designated a cooling degree day. Growing degree days use the same formula as cooling degree days, but use a base cut-off temperature lower than 65° Fahrenheit. This base depends on the crops that are grown in the area. Corn growing degree days are more complicated to determine since corn growth in Wisconsin stops if the temperature is below 50° Fahrenheit, or remains above 86° Fahrenheit, and has various values when the maximum and minimum temperatures are between 50° and 86° degrees Fahrenheit.

e) Frost tubes: Wisconsin Department of Transportation (WDOT) monitors 28 frost tubes around the state. Frost tubes are installed in bituminous pavements that are manually read for frost and thaw depths under the pavement surface. They are located in WDOT's Northeast Region (2 frost tubes), Northcentral Region (17 frost tubes), Southwest Region (2 frost tubes), and Northwest Region (7 frost tubes). Data will be obtained from WDOT.

Frost depth is reported by NOAA on their website, by region of Wisconsin: [http://www.crh.noaa.gov/ncrfc/content/soilTemp/soilTemp_gd.php?pe=TB&depth=02]. Maps display the temperature of the soil at multiple depths (2", 4", 8", 20", 40", and 60"), where the ground is bare or where the ground is covered with vegetation. The data are collected by government agencies, universities, and volunteer observers.

7.4 Disease and Insects

The WDNR produces risk maps for most of the major disease and insect threats to Wisconsin's forests. Data are collected by a variety of means: 1) Aerial survey followed by ground checks serving as quality control; 2) Targeted surveys where impact and extent for specific damage-causing agents is calculated; and 3) Analysis of remote sensing products. WDATCP assists in the collection of forest pest data. The maps that will be presented in the completed metric will reflect Wisconsin's greatest disease and insect threats. Survey data is summarized annually in two reports: the Forest Health Highlights and Annual Report. To view risk maps and data for other threats, see Wisconsin's Forest Health Report: [http://dnr.wi.gov/org/land/forestry/Fh/pdf/AnnualReport2005.pdf].

Data on disease and insect threats to the urban forest was collected from a pilot study in 2002 and 2008 by the WDNR-FR and USFS Northern Research Station.

7.5 Invasive Plants

FIA has been collecting invasive woody and shrub data for two years. In the future, these efforts will be expanded to include some herbaceous plant data. In 2006, WDNR-FR conducted an assessment of invasive plants at specific locations on state-owned forests. Both of these data sets will be used for this metric to list the type and extent of invasive species in Wisconsin.

**Data Availability:**

FIA data are available from the USFS through a web-based system. WDNR forest health and protection survey data are available through the annual publication of Forest Health Highlights and the Forest Health and Protection Annual Report. Both of these publications are available for free on the web. DNR Forest Health and Protection surveys vary in terms of repeatability. Some surveys have standard methods, others do not.

PDSI and other drought and climate data are available directly from the NOAA, National Climatic Data Center.

WDNR is planning to begin tracking prescribed burns completed by the DNR, but there is no complete tracking system that includes other organizations or private burns.

Urban forest data only exist for the years 2002 and 2008. Funding needs to be secured for consistent future sampling. (This item ranked high on the Advisory Committee's prioritization of data needs. See Data Gaps list, page 85.)

There is not a common database or survey method used to assess invasive plants in the state. The Advisory Committee ranked this data need as one of the critical gaps in knowledge (See Data Gaps, page 85).

**Limitations/Considerations:**

PDSI data are available annually by climate division (sub-state) and state back to 1895, and can be compiled for a region. Although widely accepted, one limitation to the PDSI is that it indexes all land, not specifically forestland affected by drought. Additional GIS processing and analysis is required to address this issue. There are several Palmer Drought indices and analysis of this metric will require the assistance of experts who can assess implications of drought on different forest types.

FIA data can be used to look at statewide trends; there are not enough plots in the state to draw conclusions about an area land base that is smaller than the state.

**Quality Assurance:**

The FIA data collection system has strict protocols for quality assurance and control that must be met. Quality assurance of forest health surveys is typically met by ground-truthing aerial surveys and using standardized methodologies for most surveys, including jack pine budworm, white pine blister rust, and annosum root rot.

**Related Indicators:**

- NA/NAASF base 18: Indicator 7
- Montreal Process 2003: Indicator 15 and 16
- Montreal Process Proposed 2010: Indicator 15 and 16
- FSC: Principle 8 (8.2c)
- SFI: Objective 4
- ATF: Standard 5 (Indicator 5.2.2, 5.3.1, 5.3.2)

**References:**

Miles, Patrick D. 2005. Forest inventory mapmaker. [Web-application program]. Version 2.1. [http://www.ncrs2.fs.fed.us/4801/fiadb/index.htm]. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. (11/4/2005).

NOAA National Climatic Data Center website. [http://lwf.ncdc.noaa.gov/oa/climate/research/monitoring.html].

NOAA Drought Monitoring website. [http://www.cpc.ncep.noaa.gov/products/monitoring_and_data/drought.html].

Smith, W. B.; Miles, P.D.; Vissage, J.S.; Pugh, S.A. 2004. Forest resources of the United States. 2002. A technical document supporting the USDA Forest Service 2005 update of the RPA Assessment. Gen. Tech. Rep. NC- 241. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. 137 p. [http://www.ncrs.fs.fed.us/pubs/viewpub.asp?key=1987].

Wisconsin's Forest Health Report. Available online. [http://dnr.wi.gov/org/land/forestry/Fh/pdf/AnnualReport2005.pdf].

## Indicator 8: Area and percent of forestland subject to levels of specific air pollutants that may cause negative impacts on forest ecosystems

This indicator shows the amount of ozone damage that occurs primarily as foliar injury in forests. This indicator will be presented in graphs and maps.

### Relevance:

Air pollutants are considered to have a significant cumulative effect on forest ecosystems. They affect regeneration, productivity, and species composition. In the United States, inputs of sulfur, nitrogen, and tropospheric ozone are the primary concern in forested ecosystems. Their effects include soil and water acidification, base cation depletion, and foliar injury. Currently in Wisconsin, ozone is the primary monitored pollutant of concern.

This indicator directly relates to the following trends and issues identified in Wisconsin's Statewide Forest Plan.

- Issue 17: Pesticides and pollutants can threaten the health of ecosystems.

### Metric Descriptions

| Metric | Data Source | Data Scale | Data Cycle | Reporting Responsibility |
|---|---|---|---|---|
| 8.1 Ozone damage | FIA; WDNR-FR, FHP | Statewide | Annual | WDNR-FR |

8.1 Ozone damage

Data presenting ozone damage to trees will come from the Ozone Plant Bioindicator Injury Index. This index varies annually and generally shows agreement with ambient air quality (stress, as measured by foliar injury, decreases during low ozone exposure periods and increases as exposures increase). As ozone exposures increase, not only does foliar injury increase, but the number of species expressing injury also increases. The current detection monitoring protocols assess foliar injury only. Productivity is not monitored.

The sampling rules for the ozone biomonitoring sites are as follows:

- Biosites are wide-open areas, at least one acre in size, within or alongside forested areas.
- Each site contains at least 30 individual plants of at least two bioindicator species. The eastern and western FIA regions average 3.5 and 2.5 species per biosite, respectively.
- Access to the biosite locations must be easy, and they must be free of significant soil compaction and other man-made disturbance.
- Up to 30 plants of each species are randomly selected for injury evaluation. Plants less than 12 inches in height, suppressed, shaded, or with more than half the crown out of reach are not evaluated.
- Each plant is rated for the proportion of leaves with ozone injury (injury amount) and the mean severity of symptoms (injury severity) using a modified Horsfall-Barratt scale with breakpoints at 0, 6, 25, 50, 75, and 100 percent.
- Voucher leaf samples (three leaves of each injured species evaluated at each location) are collected to provide the necessary validation of the ozone injury symptom observed in the

field by the field crews. One expert reviews all of the vouchers for eastern bioindicator species, and a second expert reviews all of the western bioindicator species.

**Data Availability:**
Ozone surveys are annual surveys conducted in the summer and are the best long-term source of data.

**Limitations/Considerations:**
Establishing a network of plots or statewide plot intensification is recommended. By establishing plot networks that focus on timber type and injury agent, monitoring can be accomplished more efficiently. The alternative to this is to intensify plots on a statewide level. Research shows that productivity may be impacted without evidence of foliar injury. The indicator could therefore be modified to collect additional data on plant productivity as well as foliar injury.

**Quality Assurance:**
FIA standards of quality are assured.

**Related Indicators:**
- NA/NAASF base 18: None
- Montreal Process 2003: Indicator 16
- Montreal Process Proposed 2010: None
- FSC: None
- SFI: None
- ATF: None

**References:**
FIA ozone data. Available online. [http://nrs.fs.fed.us/fia/topics/ozone/data/].

# Criterion 4: Conservation and Maintenance of Soil and Water Resources

Soil and water are essential elements of natural capital in all terrestrial ecosystems. They constitute the foundation for the human economy and for the "economy of nature" with its birds, mammals, fish, reptiles, amphibians, invertebrates, and plants. Forest ecosystems depend on soil and water resources to support the growth of trees (which themselves constitute a form of natural capital). The amount and characteristics of soil and water resources determine the capacity of ecosystems to sustain forests, forest economies, and forest-dependent societies. This criterion can help inform and provide more depth to the indicators within Criterion One ("Conservation of Biological Diversity").

**Connection to Wisconsin's Statewide Forest Plan**
Criterion Four will help to identify whether Wisconsin is reaching Goal One and Four of Wisconsin's Statewide Forest Plan.

- Goal One: Forests are healthy and protected
- Goal Four: Forests are conserved and managed with sound stewardship practices

## Indicator 9: Soil quality on forestland

This indicator will describe soil quality on forestland. It also will incorporate data for forest areas where soil protection guidelines are a part of management plan. Data will be presented in graphs and maps.

**Relevance:**
Soil conditions influence forest composition, structure, and function, as well as the quality of water resources. There are many different variables that can be measured to try to determine the influence of soil on the productivity of a forest. Soil pH and carbon, for instance, strongly influence biological and chemical reactions in the soil, and are general measures of soil quality. Erosion removes stored nutrients and organic matter from the soil surface, diminishes the capacity of the soil to support vegetation, and can represent a threat to soil, water, and related forest resources[4]. Unfortunately, many of the soil factors important to sustainable forest functions are inadequately monitored across space and over time. Soil properties can be expensive to measure and can be highly variable. As a result, information needed to develop soil management guidelines and thresholds is uncertain and the long-term impacts of many forest management practices are unknown.

Because it is difficult to measure soil properties, metrics 9.1 and 9.2 provide insight to forest soil protection efforts. Metrics 9.3-9.6 describe current efforts by the USFS to assess soil quality. It is more difficult to discuss positive or negative trends from this data without an analysis incorporating factors such as landscape position, soil type, and vegetation. What the data can show are trends over time that can highlight potential problem areas.

This indicator does not directly relate to any trends and issues identified in Wisconsin's Statewide Forest Plan. However, the quality of soil is directly linked to the quality of water and forest health.

- Issue 18: Forests contribute to the protection of water resources.

Metric Descriptions

| Metric | Data Source | Data Scale | Data Cycle | Reporting Responsibility |
|---|---|---|---|---|
| 9.1 Area and percent of forest whose designation or land management focus includes protection of soil resources | WDNR-FR, Forest Tax Section & Forestlands Section | Statewide | Upon request | WDNR-FR |
| 9.2 Proportion of forest management activities that meet soil management guidelines to protect soil resources | WDNR-FR, Forest Tax Section & Forestlands Section | Statewide | Upon request | WDNR-FR |
| 9.3 Total soil carbon | FIA | Statewide | Rotation of plots | WDNR-FR |

[4] USDA Forest Service NA S&PF. 2003. "Base Indicators of Forest Sustainability: Metrics and Data Sources for State and Regional Monitoring."

| | | | | |
|---|---|---|---|---|
| | | | every 5-10 years | |
| 9.4 Estimated bare soil | FIA | Statewide | Rotation of plots every 5-10 years | WDNR-FR |
| 9.5 Bulk density | FIA | Statewide | Rotation of plots every 5-10 years | WDNR-FR |
| 9.6 Calcium-aluminum ratio | FIA | Statewide | Rotation of plots every 5-10 years | WDNR-FR |

9.1 Area and percent of forest whose designation or land management focus includes protection of soil resources

This metric will show the area and percent of forestland in the state where protection of soil resources is included in the management plan. In general, an increasing area, percent, and proportion of these forestlands would show that soil resources are being protected at the same or increased levels. Data for this metric will come from the WDNR Forest Tax Law Section and Forestlands Section. These sources will provide information for private lands that are enrolled in tax law and stewardship programs, as well as for public lands. As a condition on entry, the tax law and stewardship programs require consideration of soil protection measures. Soil protection measures in tax law programs require the WDNR-FR to approve harvest practices and review the practice post harvest. This metric will not provide information on other private lands, such as those enrolled in conservation easements (not supported by public programs) that have specific soil protection measures. This metric will be presented in tables.

9.2 Proportion of forest management activities that meet soil management guidelines to protect soil resources

This metric will show the area and percent of forestland in the state where forest management activities are meeting soil management guidelines. Data for this metric will come from the WDNR Forest Tax Law Section and Forestlands Section. The data will be presented in tables and will show the proportion of management activities that meet soil management guidelines on public and private lands. Soil management guidelines are practices designed to prevent and minimize soil compaction and rutting. The two practices which are currently monitored include employing low ground pressure equipment and using slash on skid trails.

9.3 Total soil carbon

Soil quality is monitored by FIA on a subset of the standard FIA plots. The sampling intensity is one plot to 96,000 acres and these plots are referred to as the FIA Phase 3 (P3) plots. Soil carbon on these plots is assessed through the collection of soil samples, which are submitted to a regional laboratory for analysis. Soil carbon is then analyzed for three depths: forest floor, 0-10 cm (0-4 inches), and 10-20 cm (4-8 inches). Total soil carbon (carbon at all three depths) for this metric will be reported in a map and graph.

Data for this metric are mapped by the U.S. EPA Environmental Monitoring and Assessment Program (EMAP) hexes. EMAP hexes are 160,000 acres—the same size as the old Forest Health Monitoring hexes and a little larger than the FIA Phase 3 hexes (96,000 acres); therefore, the coverage of EMAP hexes closely matches the availability of FIA soils data. Data for this metric will be obtained through a special request to the FIA indicators information system.

9.4 Estimated bare soil
Soil quality is monitored by FIA on a subset of the standard FIA plots. The sampling intensity is one plot to 96,000 acres and these plots are referred to as the FIA Phase 3 (P3) plots. Estimates of bare soil are made visually, in four subplots within each plot. For this metric, data will be mapped and graphed using the same method described in Metric 9.3.

9.5 Bulk density
Data for this metric will be collected, mapped, and graphed using the same method described in Metric 9.3. Bulk density is assessed through the collection of soil samples, which are submitted to a regional laboratory for analysis. Bulk density is analyzed for two depths: 0-10 cm (0-4 inches) and 10-20 cm (4-8 inches). Bulk density at the 0-10 cm depth will be reported in a map and graph.

9.6 Calcium-aluminum ratio
Data for this metric will be collected, mapped, and graphed using the same method described in Metric 9.3. Calcium and aluminum are assessed through the collection of soil samples, which are submitted to a regional laboratory for analysis. Calcium and aluminum are analyzed for two depths: 0-10 cm (0-4 inches) and 10-20 cm (4-8 inches). The ratio of calcium to aluminum (at 0-10 cm) will be reported in a map and graph.

**Data Availability:**
The DNR data is available upon request.

The FIA soil samples are collected on a 5-year rotation. Every year, 20% of the sites are visited. There is no historic baseline data to compare current data to.

**Limitations/Considerations**
The DNR data will not include information on private lands that are not enrolled in a tax or stewardship program. The data collected will favor those forest activities in which a professional forester was involved.

FIA soil protocols and data are intended for regional and national analysis. Since the sampling is not intensive enough to measure spatial distribution (expansion factors have not been developed), data will be reported in the graphs by the percentage of plots. The results are difficult to interpret without incorporating analysis of additional information on landscape position, soil type, vegetation, and other factors. Estimates of bare soil are only a "snap-shot in time" as bare soil may be a temporary condition.

**Quality Assurance:**
The FIA soil samples are collected at a low sampling intensity and at a depth of 1-10cm, which may be inappropriate for some soils.

**Related Indicators:**
- NA/NAASF base 18: Indicator 8
- Montreal Process 2003: Criterion 4—Indicator 21, 22
- Montreal Process Proposed 2010: Indicator 18
- FSC: Principle 6 (6.1, 6.3); Principle 7 (7.1); Principle 8 (8.2); Principle 10 (10.6)

- SFI: Objective 2 (Performance Measure 2.3)
- ATFS: None

**References:**

Perry, Charles, 2005, USDA Forest Service, Forest Inventory and Analysis, Soil Quality Indicator. St. Paul, MN: USDA Forest Service, Forest Inventory and Analysis Program.

USDA NRCS National Soil Survey Center website. [http://soils.usda.gov/ ].

## Indicator 10: Area of forestland adjacent to surface water and forestland by watershed

This indicator will describe the amount of forested areas adjacent to surface water and also the amount of forestland within a watershed. This indicator will be presented in graphs and maps.

**Relevance:**
A riparian area is the area of land and water forming a transition from aquatic to terrestrial ecosystems along streams, lakes, and open water wetlands. Riparian areas help slow and filter storm water runoff, maintain shoreline stability, regulate water temperatures, and provide habitat for many species of fish, mammals, birds, reptiles, amphibians, and insects. These areas are also important as reservoirs of biodiversity, protecting more rare and threatened species than almost any other natural area. Within a larger watershed, forests help to regulate surface and groundwater flow and maintain water quality. As human populations and communities grow to encroach on forests, it is becoming increasingly important to protect groundwater recharge areas. Retaining the quality of surface waters and protecting riparian habitat is also important for the health of our streams, lakes, and wetlands.

The metrics describing this indicator can help us investigate the connection between forests, biodiversity and water quality. Data presented may be useful in identifying areas to concentrate reforestation efforts, or to show the results of previous reforestation efforts. Data could also be used to develop land use policies for developments near water bodies. Generally, an increase in area of forestland adjacent to surface water and within a watershed will benefit water quality.

This indicator directly relates to the following trends and issues identified in Wisconsin's Statewide Forest Plan.

- Issue 18: Forests contribute to the protection of water resources.
- Trend 44: Urbanization is increasing.
- Trend 45: Development is increasing.

**Metric Descriptions**

| Metric | Data Source | Data Scale | Data Cycle | Reporting Responsibility |
|---|---|---|---|---|
| 10.1 Percentage of riparian areas that are forested by watershed | WISCLAND and WDNR 1:24K scale hydrography | Statewide | Updated Periodically | WDNR-FR |
| 10.2 Percentage of forestland by watershed | WISCLAND and WDNR 1:24K scale hydrography | Statewide | Updated Periodically | WDNR-FR |

10.1 Percentage of riparian areas that are forested by watershed
This metric will show the percentage of riparian areas that are forested by watershed. For this analysis, riparian areas are defined as land within 300 feet on each side of the perennial and intermittent streams, and within a 300-foot buffer from the shoreline on open water. A riparian area is considered forested if it falls into one of the following WISCLAND Land Cover (WLC) classes: deciduous forest, coniferous forest, mixed forest and woodland, lowland shrub, forested wetlands, and shrubland (WLC level 2 classes 161, 175, 190, 217, 222, and 250). Data will be

presented at the level of 8-digit hydrologic unit codes (HUCs). In general, an increasing amount of forested riparian areas is desired. Data will be presented in charts and maps based on analysis of the 1992 WISCLAND, DNR 1:24K scale hydrography and USGS hydrologic unit maps. Data will be summarized to display the number of watersheds by percentage of forest categories (0-20, 21-40, 41-60, 61-80, and 81-100).

10.2 Percentage of forestland by watershed

This metric will show the percentage of forestland by watershed. For this analysis, land is considered forested if it falls into one of the following WLC classes: deciduous forest, coniferous forest, mixed forest and woodland, lowland shrub, forested wetlands, and shrubland (WLC level 2 classes 161, 175, 190, 217, 222, and 250). Data will be presented at the level of 8-digit HUCs. In general, an increasing amount of forestland is desired. The data will be presented as charts and maps based on analysis of the 1992 WISCLAND, DNR 1:24K scale hydrography and USGS hydrologic unit maps. This data will be summarized to display the number of watersheds by percentage of forest categories (0-20, 21-40, 41-60, 61-80, and 81-100).

**Data Availability:**

WDNR will analyze the data for metrics 10.1 and 10.2.

**Limitations/Considerations:**

There is no regular reporting cycle for WISCLAND. The WISCLAND land cover data are derived primarily from 1992 satellite imagery. After processing, the data have a minimum mapping unit of five acres, meaning that most land cover features five acres or larger can be resolved in the data. The Advisory Committee recognizes the need for a continual updating of WISCLAND and this item is noted as one of the top data gaps in this report (see page 85).

**Quality Assurance:**

Watershed analysis may be too coarse of a scale to provide any sensitive results.

**Related Indicators:**

- NA/NAASF base 18: Indicator 9
- Montreal Process 2003: Criterion 4—Indicator 23
- Montreal Process Proposed 2010: Indicator 20, 21
- FSC: Principle 5 (5.5), Principle 6 (6.5), Principle 9, Principle 10 (10.6)
- SFI: Objective 3
- ATFS: None

**References:**

WDNR-FR. Best Management Practices website. [http://dnr.wi.gov/forestry/Usesof/bmp/].

## Indicator 11: Water quality in forested areas

This indicator will provide information about the water quality in forested areas. Data will be presented in graphs and maps.

**Relevance:**
Maintaining a watershed in a forested condition can help to protect water quality. Forest management practices can be planned, implemented, and maintained to ensure that soil is stabilized and to prevent sediment and other pollutants from harming lakes, streams, wetlands, and groundwater. This indicator will point out areas of the state where water quality is protected. Analyzing the proportion of forest management activities that meet water quality Best Management Practices (BMPs), and areas where Master Loggers work, will give an indication of the number of forest acres that are managed appropriately. Impervious surface is also important to water quality. As impervious surface in a watershed increases, water quality decreases because infiltration is interrupted and hard surfaces create flashy runoff that increases erosion and water temperature.

This indicator directly relates to the following trends and issues in Wisconsin's Statewide Forest Plan.

- Issue 17: Pesticides and pollutants can threaten the health of ecosystems.
- Issue 18: Forests contribute to the protection of water resources.
- Issue 29: Logger certification.
- Trend 32: More people are purchasing forested lands.
- Trend 44: Urbanization is increasing.
- Trend 45: Development is increasing.

**Metric Descriptions**

| Metric | Data Source | Data Scale | Data Cycle | Reporting Responsibility |
|---|---|---|---|---|
| 11.1 Area and percent of forest whose designation or land management focus includes protection of water resources | WDNR-FR Forest Tax Section & Forestlands Section | Statewide | Upon request | WDNR-FR |
| 11.2 Proportion of forest management activities that meet BMPs to protect water quality | WDNR- BMP Monitoring Program | Statewide | 3-year rotation | WDNR-FR |
| 11.3 Number of certified loggers and acres managed | GLTPA | Statewide | Every 5 years | GLTPA |
| 11.4 Stream miles impaired by sediment, nutrients, and temperature | U.S. EPA, 303(d) Impaired Waters List | Statewide | Every 2 years | WDNR-WT |
| 11.5 Impervious surface | WISCLAND | Statewide | No cycle | WDNR-FR |

11.1 Area and percent of forest whose designation or land management focus includes protection of water resources. (E.g. national forest, state lands, county forests, MFL participants)
This metric will show the area and percent of forestland in the state where protection of water resources is included in the management plan. In general, an increasing area, percent, and proportion of these forestlands would show that water resources are being protected at the same or increased levels. Data for this metric will come from the DNR Forest Tax Law Section and Forestlands Section. These sources will provide information for private lands that are enrolled in tax law and stewardship programs, as well as for public lands. Data does not encompass other private lands, such as those enrolled in conservation easements (with public affiliation such as Conservation Reserve Program (CRP)) that have specific soil protection measures. This metric will be presented in tables.

11.2 Proportion of forest management activities that meet BMPs to protect water quality
This metric will show the percent of forestland in the state meeting Best Management Practices (BMPs) to protect water quality. In general, an increasing trend in correct application of BMPs would show that water resources are being protected at the same or increased levels. Collection of the data to be used in this metric is coordinated by WDNR staff in the Forestry BMP Program on a three year cycle. Data are collected by BMP monitoring teams and results are reported in yearly BMP monitoring reports.

11.3 Number of certified loggers and acres managed
This metric will list the number of loggers certified under the Master Logger Certification in Wisconsin. The acres of forest they conduct practices on will also be presented. Master Loggers are trained in water and soil protection measures and their performance must meet or exceed strict standards to maintain certification. In general, an increasing trend in the number of Master Loggers and/or number of acres managed would indicate that water resources are being protected at the same or increasing levels. Master Logger data is available from the Great Lakes Timber Professionals Association (GLTPA).

11.4 Stream miles impaired by sediment, nutrients, and temperature
Under Section 303(d) of the Clean Water Act, states are required to report streams that are impaired by one or more pollutants, which therefore do not meet one or more water quality standards for a state. States are asked by the U.S. EPA to update 303(d) lists every two years.

For this indicator, stream segments impaired by sediment, nutrients, and/or temperature will be summarized for each 8-digit HUC watershed. The data will be summarized to display the miles of impaired stream by categories of percentage of watershed that is forested (0-20, 21-40, 41-60, 61-80, and 81-100) by state, and for the northern United States.

11.5 Amount of impervious surface
This metric will show the percentage of impervious surface by watershed. For this analysis, land will be considered impervious if it falls into high intensity urban/developed or low intensity urban/developed WLC classes (WLC level 2 classes 101 and 104). The data will be presented at the level of 8-digit HUCs, and as charts and maps based on analysis of the 1992 WISCLAND and USGS hydrologic unit maps. The data will be summarized to display the number of watersheds by percentage of forest categories (0-20, 21-40, 41-60, 61-80, and 81-100).

**Data Availability:**
Master Logger information is maintained by the GLTPA. The remainder of the data is maintained by the WDNR.

**Limitations/Considerations**
There is no regular reporting cycle for WISCLAND. The WISCLAND land cover data are derived primarily from 1992 satellite imagery. After processing, the data have a minimum mapping unit of five acres, meaning that most land cover features five acres or larger can be resolved in the data.

A water body may be suffering from sediment, nutrient, or temperature problems as identified in the Wisconsin 303 (d) Impaired Waters List; however, those problems maybe unrelated to forestry activities. (e.g. a dam or leaking septic systems causing the impairment). Watershed analysis may be too coarse a scale for any sensitive results.

Urban forestry researchers are developing models to determine how the urban forest canopy mitigates impervious surfaces (metric 11.5). This information will be utilized when it becomes available.

**Quality Assurance:**
The quality of these data are satisfactory.

**Related Indicators:**
- NA/NAASF base 18: Indicator 10
- Montreal Process 2003: Criterion 4
- Montreal Process Proposed 2010: Indicator 20, 21
- FSC: Principle 5 (5.5), Principle 6 (6.5) Principle 9, Principle 10 (10.6)
- SFI: Objective 3
- ATFS: Indicator 9.2.1

**References:**
U.S. Environmental Protection Agency. Impaired streams data. NHD Indexed locations for Section 303(d) Listed Waters. [http://www.epa.gov/waters/data/downloads.html].

Watershed Exchange and Technology (WET) Partnership. [http://www.fs.fed.us/na/morgantown/frm/water/wet/wet.htm].

Wisconsin Professional Loggers Association. Master Logger Certification website. [http://www.wpla.org/master.html].

# Criterion 5: Maintenance of Forest Contribution to Global Carbon Cycles

Perhaps more than any other criterion, Criterion 5 reflects the fact that forests exist within the context of the global environment and the world's economic and social activities. The global carbon cycle is a natural process, but it is dramatically affected by land use changes and the fossil fuel combustion that currently powers the human economy. The capacity of forests to sequester carbon may be—or may become— a primary factor for determining the capacity of fossil fueled economies. The global economy may be a function not only of the global environment, but particularly of the forested environment.

Carbon dioxide is a major greenhouse gas. Forests naturally take in and store carbon as plants grow, in the process providing a large carbon "sink." At other points in their life, trees and other forest products are produced into merchantable products, becoming carbon "sources." Information regarding forest carbon content provides important information for regulating atmospheric carbon. Knowledge of biomass provides similar information as biomass is approximately 50% carbon. Biomass is also a renewable energy source that could be used in place of fossil fuels.

**Connection to Wisconsin's Statewide Forest Plan**
Criterion five will help to identify whether Wisconsin is reaching Goal One and Three of Wisconsin's Statewide Forest Plan.

- Goal One: Forests are healthy and protected
- Goal Three: Forests are productive, providing raw material for consumers and economic stability for local communities

## Indicator 12: Forest ecosystem biomass and forest carbon pools

This indicator will describe changes in carbon pools specifically in relation to forests. It will show the amount of carbon stored in above- and below-ground biomass and in different cover types. Over time, it will show whether forestlands are acting as gains or losses to the carbon pool. This indicator will be presented in graphs and maps.

**Relevance:**
As a nation and a global population, our technologies emit carbon. Forests provide a primary vehicle for sequestering carbon from the atmosphere. During the photosynthesis process, carbon is removed from the atmosphere and becomes part of the plant mass. Managing forests to sequester carbon therefore reduces the net amount of carbon dioxide accumulating in the atmosphere. Less carbon dioxide in the atmosphere may help reduce the extent or severity of human-induced climate change. This indicator provides an estimate of forest carbon sequestration that may be subtracted from the gross emission to estimate net emissions. Currently, soil carbon changes are not included in this indicator; however, forest soils are estimated to sequester carbon at a higher rate than above ground biomass.

This indicator directly relates to the following trends and issues identified in Wisconsin's Statewide Forest Plan.

- Trend 2: Forestland is increasing.
- Trend 15: Warming of earth may affect forest composition, structure and function.
- Issue 16: Forests affect carbon emissions and sinks.
- Issue 23: "Green" accounting represents a new way of evaluating the benefits of forests.
- Issue 52: Wood biomass for energy production.

**Metric Descriptions:**

| Metric | Data Source | Data Scale | Data Cycle | Reporting Responsibility |
|---|---|---|---|---|
| 12.1 Forest ecosystem biomass | FIA | Statewide | Annual | WDNR-FR |
| 12.2 Forest carbon pools | FIA | Statewide | Annual | WDNR-FR |
| 12.3 Forest carbon by forest type | FIA | Statewide | Annual | WDNR-FR |
| 12.4 Change in forest carbon | FIA | Statewide | Annual | WDNR-FR |

12.1 Forest ecosystem biomass
The map for this metric will show the carbon in above-ground live tree biomass in metric tons/ha by county. Data for this metric will be obtained through a special request to the USFS Northern Research Station Forest Carbon Dynamics and Estimation Research Work Unit. Within this data, a set of above-ground biomass regression equations (Jenkins et al. 2003) are utilized to estimate carbon from tree-level data. Counties having less than five percent of total land area in forest are excluded from the analysis.

12.2 Forest carbon pools
The graphs for this metric will display the distribution of carbon pools (million metric tons) in Wisconsin by 1) below-ground dead wood, 2) down dead wood (with stumps), 3) above-ground live tree, 4) below-ground live tree (roots), 5) understory, 6) forest floor, and 7) above-ground standing dead tree. Currently, comparisons can be made between 1996 and 2003 data sets. Data

were obtained through a special request to the USFS Northern Research Station Forest Carbon Dynamics and Estimation Research Work Unit. Within this data, a set of above-ground biomass regression equations (Jenkins et al. 2003) are utilized to estimate carbon from tree-level data. Counties having less than five percent of total land area in forest are excluded from the analysis.

Data will also be derived from the Carbon Calculation Tool [www.nrs.fs.fed.us/pubs/2394], an online data source that draws on FIA data. This data source will be used if it proves to be regularly available in the future.

Data on carbon pools in urban forests will come from the USFS FIA Urban Forestry Pilot project for 2002 and 2008 and will be reported separately.

12.3 Forest carbon by forest type

Data in this metric will be displayed in two graphs. One graph will summarize total carbon pools (million metric tons) by coniferous and broad-leaved forests in Wisconsin. The total carbon pool of each forest type will subsequently be divided by its location in soil, below-ground carbon, or above-ground carbon. Above-ground carbon includes that from live trees, standing dead trees, down dead wood (including stumps), the forest floor, and the understory. Below-ground carbon includes both below-ground live tree carbon (roots) and below-ground dead wood. The second graph for this metric will summarize above-ground tree carbon by forest cover type group (in acres). This will include carbon from both live trees and standing dead trees.

Data will be obtained through a special request to the USFS Northern Research Station Forest Carbon Dynamics and Estimation Research Work Unit. Within these data, a set of above-ground biomass regression equations (Jenkins et al. 2003) are utilized to estimate carbon from tree-level data for the various tree components.

12.4 Change in forest carbon

The data produced from this metric will represent the annual average change in forest ecosystem carbon at the state level. Results will be presented in a map of the northern United States. Change will be calculated between the two most recent FIA inventories for each state. Data for this metric will be obtained through a special request to the USFS Northern Research Station Forest Carbon Dynamics and Estimation Research Work Unit.

Within these data, a set of above-ground biomass regression equations (Jenkins et al. 2003) are utilized to estimate carbon from tree-level data for the various tree components. Average years for each inventory were calculated using an areally-weighted algorithm (i.e., larger plots had more weight in the calculations). The difference between the two inventory totals are then divided by the difference in years to arrive at change in carbon per year.

Data will also be derived from the Carbon Calculation Tool [www.nrs.fs.fed.us/pubs/2394], an online data source that draws on FIA data. This data source will be used if it proves to be regularly available in the future.

Data on carbon pools in urban forests will come from the USFS FIA Urban Forestry Pilot project for 2002 and 2008.

**Data Availability**:
Data are available regularly through normal FIA data sources and are analyzed and reported by the USFS Northern Research Station Forest Carbon Dynamics and Estimation Research Work Unit.

**Limitations/Considerations:**
There are some data gaps associated with the metrics in Criterion 5. Biomass by component (stump, bole, tops, and limbs) data is lacking in recent FIA online data. Data on carbon sequestered in forest soils, forest floor, and down woody material is also limited.

**Quality Assurance:**
Carbon estimates are based on FIA data and are augmented by carbon conversion factors from ecological studies.

**Related Indicators:**
- NA/NAASF base 18: Indicator 11
- Montreal Process 2003: Indicator 26, 27, 28
- Montreal Process Proposed 2010: Indicator 22, 23, 24
- FSC: None
- SFI: None
- ATFS: None

**References:**
Jenkins, Jennifer C., Chojnacky, David C., Heath, Linda S., and Birdsey, Richard A. 2003. National-scale biomass estimators for United States tree species. Forest Science. 49(1): 12-35.

Nichols, Mike. Nov. 2005. Unpublished data based on FIA data and augmented by carbon conversion factors from ecological studies. Durham, NH: USDA Forest Service, Northeastern Research Station, Forest Carbon Dynamics and Estimation Research Work Unit (NE-4104). For additional information on the state level data, contact Mike Nichols at mnichols@fs.fed.us or 603-868-7682.

Smith, W. B., Miles, P.D., Vissage, J.S. and Pugh, S.A. 2004. Forest resources of the United States. 2002. A technical document supporting the USDA Forest Service 2005 update of the RPA Assessment. Gen. Tech. Rep. NC-241. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Research Station. 137 p. [http://www.ncrs.fs.fed.us/pubs/viewpub.asp?key=1987].

# Criterion 6: Socioeconomic Benefits of Forests and Their Ecosystem Services

Forests provide numerous socioeconomic benefits through ecosystem services. These include carbon sequestration, erosion control, clean water, and heat mitigation. The natural processes that produce these benefits, however, are often taken for granted or are unknown. Land ownership designations, number of acres in different land use classifications, and management objectives are variables that help to predict the future of forests and their ability to produce ecosystem services over the long term.

Estimating the economic impacts of forest use raises a complex set of issues that are only partially addressed through traditional means. Two primary difficulties of assessing the economic value of forest resources are: 1) While forests themselves provide the raw material for substantial economic activity, trees and other wood products are not the only inputs in this production process. 2) Many of the values we associate with forests are of a non-market nature.

The forest industry helps quantify some economic aspects of forests through markets and supply and demand chains. The health of the forest industry can be tracked by analyzing the value of wood products, employment, or investments in infrastructure. Measuring the amount of funding for research, education, and outreach may give some indication of the industry's commitment to sustainably managing forests.

Beyond forest product markets, the economic value of forests becomes harder to quantify. Many of these values are related to people, societies, and culture, and are often intangible and difficult to measure. For example, it is difficult to place value on a sense of place, and the resulting indirect benefits of this sense to land values, the real estate market, or business recruitment. For indigenous peoples, the cultural components of forests (E.g. food, medicine, and ceremonial uses) are essential to the perpetuation of a Tribe's very existence. Social and cultural benefits are hard to measure quantitatively and in isolation. Their benefits should be assessed as a whole, by evaluating the entire interactive assemblage of plants, animals, waters, soils, and geology found within a forest.

**Connection to Wisconsin's Statewide Forest Plan:**
Criterion Six and its five indicators provide a means to measure three of Wisconsin's Statewide Forest Plan goals that promote the socioeconomic benefits of forests and their ecosystem services.

- Goal Three: Forests are productive, providing raw material for consumers and economic stability for local communities
- Goal Four: Forests are conserved and managed with sound stewardship practices
- Goal Five: Forests provide multiple recreational opportunities

## Indicator 13: Wood and wood products production, consumption, and trade

This indicator will report the value of wood and non-timber products, production and consumption levels, and the recovered paper used in mills. Data will be presented in graphs.

**Relevance:**
This metric will indicate potential drains on the forest resource, and identify opportunities for management. Production of wood and non-wood products is dependent upon the supply of raw materials, the demand for finished products, and the capability to process the raw materials into desired products. Consumption varies due to changes in the available supplies of a resource, the efficiency of production methods, and people's willingness and ability to pay for a product. Over time, these levels change in response to dynamic biological, economic, and social factors.[5]

This indicator directly relates to the following trends and issues identified in Wisconsin's Statewide Forest Plan:

- Trend/Issue 20: Global demand for forest products is increasing.
- Issue 24: Sustainable management certification is emerging and the global market for sustainable forest products may give certified Wisconsin forests a strategic competitive advantage.
- Trend 25: Rates of wood product recycling are increasing.
- Trend 26: Harvested trees are being used more efficiently.
- Trend/Issue 43: Consumption patterns are not linked to production.
- Trend/Issue 49: The effects of global population growth.
- Issue 52: Wood biomass for energy production.

**Metric Descriptions:**

| Metric | Data Source | Data Scale | Data Cycle | Reporting Responsibility |
|---|---|---|---|---|
| 13.1 Value of wood-related products | IMPLAN | Statewide | Annual | WDNR-FR |
| 13.2 Production of roundwood | FIA; TPO | Statewide | 5 years | WDNR-FR |
| 13.3 Production and consumption of roundwood equivalent | FIA; TPO; Shifley Report; US Census Bureau | Statewide | 5 years (production), annual (consumption) | WDNR-FR |
| 13.4 Recovered paper | WI Paper Council | Statewide | Annual | WDNR-FR |
| 13.5 Value of non-timber forest products | FIA; WDNR-FR; CN-NF; industry organizations | Various | Various | WDNR-FR |
| 13.6 Chain-of-custody certified forest product businesses | Forest Certification Resource Center | Statewide | Annual | WDNR-FR |

13.1 Value of wood-related products

Measuring the value of wood products and shipments in Wisconsin is important in tracking the industry's contribution to Wisconsin's overall economy and the overall health of the wood

[5] USDA FS NA S&PF. March 2007. Forest Sustainability Assessment for the Northern United States.

products industry. This information is available through the use of IMPLAN (Impact Planning Software, MIG 2003) software through Minnesota IMPLAN Group. For this metric, these data will be displayed in a graph and distinguished by product (paper, wood product, wood furniture, and logging).

13.2 Production of roundwood

An important indicator of a sustainable forest is the level of actual timber harvested. This information is an important measure of whether or not the current timber cutting levels can be sustained. Production levels are also a good indication of the health of the forest products industry. Data for this metric will come from Timber Product Output (TPO) reports available through the USFS.

TPO data consists of 11 variables that describe the roundwood products harvested, logging residues left behind, timber otherwise removed, and wood and bark residues generated by the county's primary wood-using mills. These data (presented in two graphs) will show the production of roundwood harvested by both product type and by major species group. Roundwood is made up of logs, bolts, or other round sections cut from trees for industrial manufacture or consumer uses.

The roundwood products that will be presented by major species group are:

- Sawlogs: usually eight feet in length or longer, processed into a variety of sawn products.
- Pulpwood: roundwood product that will be reduced to individual wood fibers by chemical or mechanical means. The fibers are used to make a broad generic group of pulp products that includes paper products, as well as chipboard, fiberboard, insulating board, and paperboard.
- Fuelwood: the volume of roundwood harvested to produce some form of energy (e.g., heat, steam) in residential, industrial, or institutional settings.
- Other: this category includes veneer logs; composite products; posts, poles, and pilings; and miscellaneous other products.

13.3 Production and consumption of roundwood equivalent

Roundwood equivalents of harvest are defined as an estimate of the solid volume (i.e., total wood content) of a processed log in cubic units derived by multiplying the final products by a product recovery factor. The procedure for estimating roundwood equivalent of products provides a simple technique for estimating the major portion of timber harvest levels. This technique is less expensive than conducting surveys and can be done on an annual basis, which provides a benchmark that can be used in conjunction with the FIA survey approach, helping to ensure the accuracy of both methods.

By measuring per capita consumption of roundwood, comparisons can be made with other regions and states regarding their consumption. Usage trends also become more noticeable. This information is available through the U.S. Forest Products Laboratory and U.S. Forest Service publications such as *The Status of Timber Resources in the North Central United States.* Information is also in the *Shifley Report*, and in data from the U.S. Forest Products Laboratory and the U.S.

Census Bureau. Some of these reports, however, may not be up-to-date. In the case of the *Shifley Report*, the last publication date is 2002.

13.4 Recovered paper

This metric will display the amount of recovered paper consumed by paper and paperboard mills in Wisconsin in graph form. By using recovered paper, mills in Wisconsin can reduce waste in landfills and increase process efficiency. This information is available through the Wisconsin Paper Council.

The Wisconsin Paper Council surveys the mills belonging to member companies annually. Recovered paper includes various grades of paper that have been recycled by the consumer or recovered by paper and paperboard mills. The total recovered paper will be reported in the metric and will include the following:

- Mixed paper: a mixture of various qualities of paper not limited as to type of packing or fiber content.
- Newspaper: baled newspaper containing less than five percent of other papers.
- Corrugated cardboard: baled corrugated containers having liners of test liner, jute, or kraft.
- Pulp substitutes
- High-grade de-inking: baled, sorted, fresh dry newspapers, not sunburned, free from magazines, white blank, pressroom over issues, and paper other than new, containing not more than the normal percentage of rotogravure and colored sections.

13.5 Value of non-timber forest products

Non-timber forest products include non-woody species such as mushrooms, ferns, and other understory plants; non-woody parts of trees such as cones, fruits, bark, foliage, and sap; and woody material such as firewood, poles, and boughs. Non-timber forest products can be a significant source of subsistence and income and can supplement timber cutting revenues from forests.

Currently it is difficult to value non-timber forest products as there are no common measurements. Data for this metric will be collected from organizations and industries that track the trade flow of non-timber forest products. FIA tracks birch bark and boughs. Amount of firewood, boughs, and Christmas trees sold on county, state and national land are available from those agencies. The value of other products such as maple syrup will be collected from industry organizations such as the North American Maple Project.

13.6 Chain-of-custody certified forest products businesses

This metric will list the number of forest product businesses that are certified as chain-of-custody. This data will indicate the growth or decline of businesses that are investing in certification. Certification programs include SFI, FSC, and the Canadian Standards Association (CSA). A non-profit organization called metaFore compiles this information and provides it on their website:
[http://www.metafore.org/index.php?p=Forest_Certification_Resource_Center&s=147].

**Data Availability:**
The next TPO update is planned for 2007 based on 2006 data.
Information for each metric is readily available from the data sources listed in the metrics table.

**Limitations/Considerations:**
Data from IMPLAN are not up-to-date. Estimates of impacts rely upon an economic model. Though commonly used, the model is somewhat complex.
TPO data is more reliable, especially for small areas as a measure of harvest volume; however, these data are only collected every five years.

**Quality Assurance:**
Determining the value of non-timber products depends on how commercialized the product is. Numbers for established industries like maple syrup or cones is easier than goods not highly commercialized like lichen and fungi.

**Related Indicators:**
- NA/NAASF base 18: Indicator 12
- Montreal 2003: Indicators 29, 30, 31, 33
- Montreal 2010: Indicators 25, 26, 28
- FSC: Principle 5
- SFI: Objective 7
- ATFS: None

**References**:
Johnson, Tony G., ed. 2001. United States timber industry-an assessment of timber product output and use, 1996. Gen. Tech. Rep. SRS-45. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 145 p.

Minnesota IMPLAN Group, Inc (MIG, Inc) website. [http://www.implan.com/].

Howard, James L. USDA Forest Service, Forest Products Laboratory, Timber Demand and Technology Assessment (Madison, WI).

U.S. Department of Commerce, Census Bureau population estimates website. [http://www.census.gov/population/www/index.html].

USDA Forest Service, Forest Inventory and Analysis. 2005. Timber Product Output Database Retrieval System. Online database. [http://ncrs2.fs.fed.us/4801/timberproducts/index.htm]. (10/11/2005).

## Indicator 14: Outdoor recreational participation and facilities

This indicator will assess the amount of forest-based recreation and how much public land is being provided for recreation. It will measure the number of facilities such as recreation trails, campgrounds, and structures like boat launches and picnic grounds on public lands.

### Relevance:

Outdoor recreation is an important basis for tourism and contributes to the health and well-being of communities. Forest-based recreation benefits local economies by drawing in tourists and visitors from outside the region; people who then patronize local businesses. Yet these visitors can also create conflicts over forest use. Different types of land ownership (e.g., industrial forestland, public forests, or conservation easements) provide different recreation opportunities. As many industrial landowners sell their forestland, a greater burden is placed on public forests to provide facilities and a variety of recreational uses. Providing enough resources to meet visitor demand can become difficult for public forests with few other recreational resources in the region.

This indicator directly relates to the following trends and issues identified in Wisconsin's Statewide Forest Plan:

- Trend/Issue 21: Demand for forest-based recreation and associated services is increasing.
- Trend/Issue 22: Forests are in demand for a mix of uses.
- Trend/Issue 35: Less forestland is available for public use.
- Trend/Issue 36: Stakeholders are more involved in forest decisions.
- Trend/Issue 37: Conflicting use of forests is a public debate.
- Issue 39: Role of public forests.
- Trend/Issue 40: Motorized recreation is becoming more popular.
- Trend/Issue 41: More trails are being created and used.
- Issue 51: The cultural values of forests can be hard to quantify and may be underestimated.

### Metric Descriptions:

| Metric | Data Source | Data Scale | Data Cycle | Reporting Responsibility |
|---|---|---|---|---|
| 14.1 Participation in outdoor recreation | SCORP | Region | 10 years | WDNR-PR |
| 14.2 Public lands open to recreation | SCORP | County | 10 years | WDNR-PR |
| 14.3 Recreational facilities on public lands | SCORP | County | 10 years | WDNR-PR |
| 14.4 Public recreation trails | WDNR-PR | Statewide | Annual | WDNR-PR |
| 14.5 Number of campgrounds | SCORP | Region | 10 years | WDNR-PR |

14.1 Participation in outdoor recreation.

Statewide Comprehensive Outdoor Recreation Plan (SCORP) data provides days of participant activity for 95 outdoor recreation activities. For this metric, activities that typically take place in forested settings such as hunting, wildlife watching, cross-country skiing, and hiking will be highlighted for analysis. Data is divided within eight regions of the state.

14.2 Public lands open to recreation
This metric will list the acres of public land (federal, state, county and municipal) open to outdoor recreation by agency. For this metric, public forestry agencies will report acres of public forests, parks, fish/wildlife areas, and other specially designated public land. Federal lands include National Park Service, US Fish and Wildlife, Bureau of Land Management, Conservation Reserve Program, and USFS lands. The amount of land so designated in Wisconsin is a measure of the importance national and state residents place on the availability of public lands for outdoor recreation. Acres reported will include all land cover types, not just forestlands. (See metric 16.6 for the amount of private forestland that is open to public recreation).

14.3 Recreational facilities on public lands
For this metric, public forestry agencies will report recreational facilities on public forests, parks, fish/wildlife areas and other specially designated public land. Facilities reported will include: campsites, day use areas, boat landings, viewing and learning areas, beaches, and trails. The number of developed facilities so designated in Wisconsin is a measure of the importance national and state residents place on the availability of outdoor public recreational facilities. Data is readily available from SCORP at the county level for this metric.

14.4 Recreation trails
The WDNR-PR tracks the number of miles of trail for walking/hiking, horse, surfaced bike, mountain bike, snowmobile, x-country ski, and ATV uses. Miles are tracked by whether they exist on state park and forestland, or on state trails.

14.5 Number of campgrounds
Data from the SCORP displays the number of both public and private campgrounds (electrical / non-electrical designation) by county.

**Data Availability:**
Information for each metric is readily available from the data sources listed in the metrics table. There are many miles of trails on county forests, but there is no database to easily access this information.

**Limitations/Considerations:**
SCORP data provide an inventory of all land that is open to outdoor recreation, not just forestland or those areas specially designated for outdoor recreation.

**Quality Assurance:**
SCORP data may vary by county, as different agencies provide the data and may not adhere to standard protocols.

**Related Indicators:**
- NA/NAASF base 18: Indicator 13
- Montreal 2003: Indicator 35, 36, 37, 42
- Montreal 2010: Indicator 41, 42
- FSC: Principle 5
- SFI: None

- ATFS: None

**References**:

WDNR. 2006. The 2005-2010 Wisconsin Statewide Comprehensive Outdoor Recreation Plan. PR-026-2006. Available on-line: [http://dnr.wi.gov/planning/scorp].

## Indicator 15: Investments in forest health, management, research, education, and wood processing

This indicator will provide tabular and graphical information on funding for forestry agencies, research, and education programs. The number of graduates from various forestry programs will be compared across the region. Capital expenditures by wood product manufacturers will also be tracked.

### Relevance:

Investments in forest management, research, education, and wood processing represent a belief by state and federal government that forestry is an important resource in Wisconsin and it needs to be financially supported. Competition for forest-related funding is fierce and dependent on many other variables. Data on the number of forestry graduates and education opportunities in forestry help forecast whether or not there will be an educated employment pool in the future. Landowner education is a critical component to the future health of Wisconsin's forests. As more landowners purchase forestland, it becomes an increasing challenge to reach these landowners. Unfortunately, it is difficult to measure how many landowners we are reaching and what investment we are making in educating this population because there are many programs and associations that work to provide education through a multitude of venues. Until a better metric or data source is available, we are not able to measure the investments we make in landowner education.

This indicator directly relates to the following trends and issues identified in Wisconsin's Statewide Forest Plan:

- Issue 48: Public outreach and education about forestry should be augmented.

### Metric Descriptions:

| Metric | Data Source | Data Scale | Data Cycle | Reporting Responsibility |
|---|---|---|---|---|
| 15.1 NA S&PF funding | NA S&PF | Statewide | Annual | WDNR-FR |
| 15.2 State forestry agency funding | WDNR-FR | Statewide | Annual | WDNR-FR |
| 15.3 Funding for forestry research | CSREES; state universities | Statewide | Alternate years | CSREES |
| 15.4 Capital expenditures by manufacturers of wood-related products | U.S. Dept of Commerce-Census Bureau and Economic Census | Statewide | 5 years | WDNR-FR |
| 15.5 Funding for forestry education (K-12 programs) | WDNR-FR | Statewide | 5-10 years | WDNR-FR |
| 15.6 Number of university and technical college forestry graduates | WDNR-FR; FAEIS | Statewide | 5-10 years | WDNR-FR |
| 15.7 Funding for continuing forestry education for foresters and loggers and number of participants | WDNR-FR | Statewide | 5-10 years | WDNR-FR |

15.1 USFS, Northeastern Area State & Private Forestry (NA S&PF) funding

The metric will present a graph listing the amount of NA S&PF funding given to partners in Wisconsin. This type of funding is a direct measure of federal investment in Wisconsin forests

and the forest products industry. Data is readily available from NA S&PF, Office of Business Management and WDNR-FR. Five categories will be reported within the metric: Urban and Community Forestry, Forest Legacy, Forest Stewardship, Cooperative Fire Protection, and Forest Health.

15.2 State forestry agency funding

State funding for the WDNR-FR Program is a direct measure of state investment in Wisconsin forests and the forest products industry. In this metric, funding will be broken out by source: state, federal, other government, revenue, private/other, and will be displayed in tabular format.

15.3 Funding for forestry research

Funding for forestry research at universities in Wisconsin is a direct measure of federal, state and private investment in Wisconsin's forests and the forest products industry. Data is readily available from USDA Cooperative State Research, Education, and Extension Service (CSREES). The CSREES maintains the Current Research Information System (CRIS) for documenting and reporting research projects in agriculture, food and nutrition, and forestry. Funding source categories reported include federal, state, industry, self-generated (funds generated by the university for forestry research), and other non-federal sources (e.g., foundations). Data will be compiled by the CSREES by special request. All universities included in these data obtain some funding through CSREES. University Forestry Departments will be queried for the amount of funding that comes from other sources.

15.4 Capital expenditures by manufacturers of wood-related products

Total capital expenditures include new and used expenditures for: (1) permanent additions and major alterations to manufacturing establishments, and (2) machinery and equipment used for replacement and additions to plant capacity, if they were of the type for which depreciation accounts are ordinarily maintained. Capital expenditures by wood-related product manufacturers in Wisconsin are a direct measure of private industry investment in Wisconsin forests and the forest products industry.

Data for this metric is readily available from U.S. Department of Commerce, Census Bureau and Economic Census. The Economic Census is conducted by the U.S. Department of Commerce, Bureau of the Census every five years, in years ending in "2" and "7" (such as 1997, 2002, 2007). There is some time lag in the ability to analyze this data. As required by Federal law governing census reports, no data are published that would disclose information regarding an individual establishment or company. This results in some missing data in states or industries for which there are a smaller number of establishments.

15.5 Funding for forestry education (K-12 programs)

This metric will track the amount of funding for K-12 forestry education programs as reported through the annual reports of forest-related programs. Certain programs will be highlighted: Wisconsin Environmental Education Board (WEEB) grants to fund education initiatives, Wisconsin Forest Resource Education Alliance (WIFREA), Trees for Tomorrow, Learning, Experiences and Activities in Forestry (LEAF), Project Learning Tree (PLT), and Basin Educator programs.

15.6 Number of university and technical college forestry graduates
The number of university and technical college forestry graduates from Society of American Foresters (SAF) accredited programs in Wisconsin, Michigan, and Minnesota will be displayed in tabular format. WDNR-FR will collect this data.

15.7 Funding for continuing forestry education for foresters and loggers and number of participants
Funding will be tracked for continuing forestry education programs for foresters and loggers. The number of participants will be tabulated. This data will be collected by WDNR-FR.

**Data Availability:**
Data are available for the majority of these metrics. For metric 15.7, some education programs do not track participation and only estimates may be available.

**Limitations/Considerations:**
Metrics 15.2, 15.5, 15.6, and 15.7 will require new initiatives by the WDNR-FR in order to collect data. This will be primary data; there are no current databases of this information.
Universities receive a large amount of funding from sources other than CSREES for forestry research. For this reason, Metric 15.3 does not present a complete picture of forestry research funding. The majority of these metrics highlight a portion or a segment of existing funding sources, education initiatives, and organizations. Data collected will not provide the total investments in forest health, management, research, education, and wood processing.

**Quality Assurance:**
There are no major quality assurance concerns with the data sources.

**Related Indicators:**
- NA/NAASF base 18: Indicator 14
- Montreal 2003: Indicator 38, 39
- Montreal 2010: Indicator 34, 35
- FSC: None
- SFI: Objective 10
- ATFS: Indicator 9.2.1

**References:**
James, T. and Gross, T. 2005. USDA Forest Service, Foundation Financial Information System [Database]. Newtown Square, PA: USDA Forest Service, Northeastern Area, Information Management and Analysis.

Norland, Eric. 2005. Data on funding for forestry research at forestry universities from the Current Research Information System. [http://cris.csrees.usda.gov]. USDA Cooperative State Research, Education, and Extension Service.

## Indicator 16: Forest ownership, land use, and specially designated areas

Graphs and maps will depict the categories of forest ownership, types of land use, and specially designated areas in the state. The various land ownerships and types of use will be described by their legal status.

### Relevance:

Different forest ownerships are managed for different objectives. Understanding who owns forestland can therefore help predict future trends for various forest uses like wood production, recreation resources, wildlife habitat, and ecosystem services. As the amount of ownership in certain categories changes, it can signify a potential decline or increase in these services. For example, a large portion of industrial forestland has been parceled and sold to small private owners. These once-large forest tracts, now parcelized and fragmented, may no longer be open to recreation. There are also special designations that can protect forests from development or preserve their working land status. Knowing a land's designation is critical to determining its level of protection and may help to predict the future of that property. A statewide map of land ownership can help prioritize areas to protect for high conservation value or forest production.

This indicator directly relates to the following trends and issues identified in Wisconsin's Statewide Forest Plan:

- Issue 12: The forest is becoming more fragmented.
- Issue 24: Sustainable management certification is emerging and the global market for sustainable forest products may give certified Wisconsin forests a strategic competitive advantage.
- Issue 27: Rising forestland property taxes are impacting short and long term forest management decision-making.
- Issue 28: Land trusts and state and county land purchases.
- Trend 31: Large blocks of industrial forest land are changing hands rapidly.
- Trend 32: More people are purchasing forested lands.
- Trend 34: The demographics of forest landowners are changing.
- Trend 35: Less forest land is available for public use.
- Trend/Issue 37: Conflicting use of forests is a public debate.
- Issue 39: Role of public forests.
- Trend/Issue 49: The effects of global population growth.

### Metric Descriptions:

| Metric | Data Source | Data Scale | Data Cycle | Reporting Responsibility |
|---|---|---|---|---|
| 16.1 Forestland and population | U.S. Dept of Commerce-Census Bureau; FIA | County | 10 years | WDNR-FR |
| 16.2 Forestland ownership | USFS FIA- Woodland Owners Survey | Statewide | 5 years | WDNR-FR |
| 16.3 All public lands | WDNR-FR | Statewide | Annual | WDNR-FR |
| 16.4 Protected lands | CBI | Statewide | Periodic | WDNR-FR |
| 16.5 Private land with public conservation easements | FLP | Statewide | Annual | WDNR-FR |
| 16.6 Forestland in property tax | WDNR-FR | Statewide | Annual | WDNR-FR |

| | | | | |
|---|---|---|---|---|
| incentive programs | | | | |
| 16.7 Forest acres certified | WDNR-FR | Statewide | Annual | WDNR-FR |

16.1 Forestland and population
Data will be presented in tables with population and forestland by county. Population data will come from the Census Bureau and forest land data will come from USFS FIA. These data could be displayed spatially with population density overlaid on forest cover.

16.2 Forestland ownership
Data for this metric will distinguish the ownership of forestland, and will come from FIA's National Woodland Owner Survey. Ownership will be divided into six categories: private non-industrial, private forest industry, county or municipal, state, tribal and federal.

16.3 All public lands
This metric will use maps and tables to show all publicly owned land in Wisconsin and how it is designated. Public ownership includes: county, municipal, state, federal, and federal energy regulatory commission (FERC) lands. Tribal lands will also be displayed. Designations for the public lands include, but are not limited to: fish/wildlife, forests, parks, natural areas, and easements.

16.4 Protected lands
The definition of "protected" forestland has been subject to debate. The Conservation Biology Institute (CBI) Protected Areas Database Version 4 (2006) provides baseline conservation information about protected areas in the United States. It includes land holdings that have a protection level of Gap 1, 2, 3 or 4 (see definitions below). It will be useful in helping natural resource managers assess which habitat types, species, etc. are adequately protected in existing reserve networks, and in identifying where gaps in protection exist. The database emphasizes federal and state owned areas, but includes county, city, and private reserves when data are available.

Gap 1. An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a natural state within which disturbance events (of natural type, frequency, intensity, and legacy) are allowed to proceed without interference, or are mimicked through management. Examples: National Parks, Nature Preserves, Wilderness Areas.

Gap 2. An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a primarily natural state, but which may receive uses or management practices that degrade the quality of existing natural communities, including suppression of natural disturbance. Examples: State Parks, National Wildlife Refuges, National Recreation Areas.

Gap 3. An area having permanent protection from conversion of natural land cover for the majority of the area, but subject to extractive uses of either a broad, low-intensity type (e.g., logging) or localized, intense type (e.g., mining). It also confers protection to federally listed

endangered and threatened species throughout the area. Examples: National Forests, most Bureau of Land Management Land, Wildlife Management Areas.

Gap 4. There are no known public or private institutional mandates or legally recognized easements or deed restrictions held by the managing entity to prevent conversion of natural habitat types to anthropogenic habitat types. The area generally allows conversion to unnatural land cover throughout.

16.5 Private land with public conservation easements

The USFS, Forest Legacy Program (FLP) works to protect important forest areas that are threatened by conversion to non-forest uses. The program is implemented by state and local governments, land trusts, landowners, and the USFS. It is entirely voluntary and Wisconsin has elected to join the program. The FLP protects important forested lands by purchasing conservation easements or fee titles from willing landowners. Priority is given to lands that have important scenic or recreational values: riparian areas; areas with fish and wildlife values, including threatened and endangered species; or areas with other ecological values. Data on acres of lands in the northern United States that are protected from conversion to non-forest uses with assistance from the FLP are maintained by the NA S&PF. For this metric, acres of private land permanently conserved by a state/county government easement program will be included. Although the FLP is focused on protecting important forestland, data collected by the agency include all acres of conserved land, not just those that are currently forested.

16.6 Forestland in property tax incentive programs

For this metric, WDNR-FR will provide the number of parcels and acres of forestland enrolled in state property tax incentive programs (MFL and FCL). This data will include both private and industrial lands. This data can be presented spatially, but only by a minimum of 40 acre parcels, which may be larger than the actual parcel enrolled in the program. The percent of land in these programs that are entered as open or closed to public access will be reported. If a property is enrolled as open, it allows the public to hunt, fish, cross-country ski, and hike on the property. This allowance effectively increases the amount of public recreation land in the state. (See metric 14.2 for amount of public recreation lands).

16.7 Forest acres certified

This metric will list the amount of land certified by the Forest Stewardship Council (FSC); Sustainable Forestry Initiative (SFI); and American Forest Foundation, American Tree Farm System (ATFS). Data are available from the certification systems and WDNR-FR.
Lands in these programs include county, state, and private forests. Certification programs can be characterized as "voluntary forest management standards with a monitoring component." This metric should be cross-referenced with metric 18.1.

**Data Availability:**

There are no issues with accessing data for these metrics.

**Limitations/Considerations:**

None.

**Quality Assurance:**

The quality of these data are satisfactory.

**Related Indicators:**

- NA/NAASF base 18: Indicator 15
- Montreal 2003: Indicators 1, 3
- Montreal 2010: Indicators 1, 17
- FSC: Principle 2
- SFI: Objective 12
- ATFS: None

**References:**

American Forest Foundation, American Tree Farm System website. [http://www.treefarmsystem.org/].

Conservation Biology Institute. Protected Areas Database website. [http://www.consbio.org/cbi/projects/PAD/index.htm].

Forest Stewardship Council website. [http://www.fscus.org/].

Sustainable Forestry Initiative website. [http://www.sfiprogram.org/].

USDA Forest Service, Forest Legacy Program website. [http://www.na.fs.fed.us/legacy/index.shtm].

## Indicator 17: Employment and wages in forest-related sectors

This indicator will use a table to display the number of people employed in various sectors of the forestry field, including the wood-related products manufacturing sector, public agencies (federal, state, county, and tribal forestry departments and university staff), logging companies, and private consulting firms (when available). Employee salaries/wages will also be displayed.

**Relevance:**
Tracking the number of employees in the forest industry and other forest sectors helps to gauge the overall health of the industry, and gives and indication of the value the state places on forestry concerns. Employment and salary trends are often linked to other issues occurring in the forestry field. For instance, the drop in the number of logging firms may signal a lack of access to merchantable timber sales, or dropping stumpage prices.

This indicator directly relates to the following trends and issues identified in Wisconsin's Statewide Forest Plan:

- Trend/Issue 20: Global demand for forest products is increasing.
- Trend/Issue 21: Demand for forest-based recreation and associated services is increasing.
- Issue 33: More private forestry assistance is needed.

**Metric Descriptions:**

| Metric | Data Source | Data Scale | Data Cycle | Reporting Responsibility |
|---|---|---|---|---|
| 17.1 Wood-related products and manufacturing employees, payroll, and wages | IMPLAN | Statewide | Every 5 years | WDNR-FR |
| 17.2 Forest employment and salaries | USFS; DNR-FR; WI-SAF ; Forest Guild | Statewide | Every 10 years | WDNR-FR |

17.1 Wood-related products and manufacturing employees, payroll, and wages
Measuring the employment of wood products manufacturers is important in tracking the industry's socioeconomic benefit to state and local communities. These impacts are best quantified through direct, indirect, and induced employment. This information is available through the use of IMPLAN software through Minnesota IMPLAN Group, Inc (MIG, Inc). The input-output modeling software allows for the development of indirect and induced employment.

17.2 Forest employment and salaries
Depending on available data sources, this metric will list the number of people employed in the following forest occupations for both the private and public sectors: logger, forester, academic/researcher, and various forest specialists. Data for public employers is an indicator measuring the government's commitment to forest management. This is also an indicator of the ability to actually achieve work planned.

Data for this metric are available from the WDNR-FR, USFS, Human Capital Management and the Forest Product Laboratory. The number of cooperating foresters will come from the WDNR-

FR Directory of Foresters. The number of Wisconsin SAF and Forest Guild members will also be reported.

**Data Availability:**
Private companies may be reluctant to release data on salaries and wages. No one source tracks all private forestry employment. Several sources will be needed to acquire adequate data for this indicator and to capture all forestry employment not in the wood production sector.

**Limitations/Considerations:**
There are many occupations related to forests, such as wildlife biologists, policy analysts, or park rangers, which are not measured in this indicator. It is not possible to track all of the various sectors.

**Quality Assurance:**
For metric 17.2, some double counting of employees will likely occur due to the use of multiple data sets.

**Related Indicators:**
- NA/NAASF base 18: Indicator 16
- Montreal 2003: Indicators 44, 45
- Montreal 2010: Indicators 36, 37
- FSC: Principle 4
- SFI: None
- ATFS: None

**References:**
Minnesota IMPLAN Group, Inc (MIG, Inc) website. [http://www.implan.com/].

# Criterion 7: Legal and Institutional Framework for Forest Conservation and Sustainable Management

Sustainable forest management depends on the existence of rational social agreements that promote and protect responsible resource management, public awareness, property rights, and other socio-cultural functions. These functions may be encouraged and enforced through social institutions, economic incentives, or standards and guidelines written into legislation. It could be argued that legal and institutional structures are the backbone of sustainable forest management. However, the existence of laws, policy, and standards/guidelines do not ensure sustainability. To be effective, these structures must be able to comprehensively address a variety of trends related to forest sustainability and take responsive actions that will ensure sustained use, management, and protection of forest resources. Such actions are fostered through well-focused and technically sound plans, and assessments that are sensitive to a range of forest values and are coordinated within a variety of forest-related sectors.

**Connection to Wisconsin's Statewide Forest Plan**
As the backbone of sustainable forest management, criterion seven affects all five goals of Wisconsin's Statewide Forest Plan.

- Goal One: Forests are healthy and protected
- Goal Two: Forests provide a diverse range of native plant and animal species and their habitats
- Goal Three: Forests are productive, providing raw material for consumers and economic stability for local communities
- Goal Four: Forests are conserved and managed with sound stewardship practices
- Goal Five: Forests provide multiple recreational opportunities

## Indicator 18: Extent to which the legal and institutional structure (laws, policies, standards/guidelines) supports the sustainable management of forests

This indicator will describe the suite of Wisconsin's forest management standards. For this indicator, we define *standards* as: laws, policies, rules, and codes at all levels of government; agency guidance; and major court cases[6]. (To avoid confusion with other meanings of the word standards, all references to this definition of *standards* will be italicized). A comprehensive list of all *standards* that affect forest management does not currently exist. This indicator will use data from an existing survey that categorized *standards* and noted 1) whether or not a *standard* existed for categories of forest management, 2) whether a *standard* was voluntary or mandatory, and 3) whether that *standard* contained a monitoring component (compliance or implementation focused). This indicator is different from the others in that it will create a format for a metric with a substantial portion of missing "data" (i.e. the list of *standards*). The list of *standards* in Wisconsin needs to be collected, and then evaluated. (Developing the list of *standards* is an item in the Data Gaps section). Data will be displayed in a table format.

**Relevance:**
Although there are many laws and policies that govern forestry in Wisconsin, they are normally addressed individually and are rarely viewed as a whole. Every law or policy does not need to address all aspects of forestry; rather, the body of all laws/policies should be comprehensive as a whole. Evaluating the legal and institutional structure that exists in Wisconsin will determine if there are areas of sustainable forestry that are not being addressed. For this indicator we will only answer yes or no if a *standard* exists to guide a certain aspect of sustainable forestry. Ideally, and potentially in the future, the existing laws/policies will then be analyzed to determine their effectiveness.

Forest advisory committees and organizations are critical components of sustainable forestry, now, and in the future. These groups are influential at both local and statewide scales as they can influence the course of legislation and other policy. Noting what committees and organizations exist provides the opportunity to assess whether there are forest issues with no representative body.

This indicator does not directly relate to the any of the trends and issues identified in Wisconsin's Statewide Forest Plan, but rather can be used to verify the trends identified in other indicators. Indicators listed elsewhere in this report will identify specific areas of forest management that are not sustainable. Once developed, Indicator 18 will help to identify where the state's legal and institutional structure can help resolve these areas.

[6] Laws give statutory authority to sustainably manage the forest of Wisconsin. Administrative Rules must be authorized by statute and serve as agency policy that governs people's rights or conduct and have the force of law. Manual Codes are a compilation of internal policies and are directly related to implementing a statute, rule, or external directive to the Department. Guidance does not affect private rights and interests. Guidance is broken into three categories:

1. Procedural – documents that deal with internal management of the agency
2. Program – documents that explain implementation of statutory and administrative rule standards in context of existing case law
3. Technical – documents containing information regarding the state of the art or good practice procedures that are not mandated by the state but are commonly accepted in technical circles or by a particular profession.

This indicator directly relates to the following trends and issues identified in Wisconsin's Statewide Forest Plan:

- Issue 6: It is a challenge to make scientific information relevant to decision-making.
- Trend/Issue 50: Integration with other agencies and disciplines.

## Metric Descriptions

| Metric | Data Source | Data Scale | Data Cycle | Reporting Responsibility |
|---|---|---|---|---|
| 18.1 Types of forest management *standards* by category, noted as voluntary or mandatory, and whether they contain a monitoring component | NA S&PF; NAASF | Statewide | 5 years | WDNR-FR |
| 18.2 Statewide or regional statutory forest advisory committees | WDNR-FR | Statewide, regional | 10 years | WDNR-FR |
| 18.3 Statewide or regional forest-related organizations | WDNR-FR | Statewide, regional | 10 years | WDNR-FR |

18.1 Types of forest management *standards* by category, noted as voluntary or mandatory, and whether they contain a monitoring component

This metric will provide data to analyze whether the body of laws are supporting sustainable forests. Data will be displayed in a table with *standards* divided into categories, noted as voluntary or mandatory, and monitoring components explained. The nine categories in which the *standards* will be grouped are: silviculture, water/soil, wildlife/biodiversity, tenure and use rights, indigenous people's rights, public involvement and education, planning and assessment, conservation of special environmental values, and taxation and fiscal incentives. These categories were chosen to reflect the spectrum of topics that affect sustainable forestry.

Existing data for this metric comes from a survey conducted by the USFS NA S&PF. In this survey, state forestry agencies were asked whether or not they had *standards* addressing silviculture and water/soil. Agencies responded either yes or no; they were not asked to name which *standards* they were referring to. Additional categories will be added (tenure and use rights, indigenous people's rights, public involvement and education, planning and assessment, conservation of special environmental values, taxation and fiscal incentives) that create a more robust metric to evaluate *standards*. The table format for this metric will allow for the generic information from the survey to be reported alongside specific *standards* to be incorporated as that information is gathered. Collecting more specific *standards* is an item on the Data Gaps list.

18.2 Statewide or regional statutory forest advisory committees

This metric will provide a list of all statewide or regional statutorily created forest advisory committees. Information provided with each committee will include the name of the organization, what statute authorizes it, and what the mission or purpose of the group is. These committees can directly influence what *standards* are developed, and can provide evaluation and analysis of current policy. The current list contains: Council on Forestry, Natural Resource Board, Urban Forestry Council and the State Forest Stewardship Coordinating Committee.

18.3 Statewide or regional forest-related organizations

This metric will be a list of the statewide or regional forest-related organizations. It will list the name of the organization and what the mission or purpose of the group is.

**Data Availability**

Current data available for these metrics are limited. Results of the NA S&PF survey are limited in that the survey does not specifically state which *standards* exist. A list of all *standards* impacting forest management should be developed in order to completely analyze the legal and institutional structure of forest management in Wisconsin. The lists of forest advisory committees and forest-related organizations will be developed from stakeholders involved with the Statewide Forest Plan. These lists will be re-evaluated annually by the WDNR-FR.

**Limitations/Considerations**

Data in this indicator will be more qualitative than quantitative. A narrative discussion, in addition to the table of *standards* and their characteristics, may be the best format to present information. Currently, the BMP program is the only *standard* that incorporates an evaluation of effectiveness. Even when a list of *standards* is developed and the lists of committees and organizations are compiled, analysis will still be needed to determine whether these *standards* are effective and working to sustainably manage the state's forests.

**Quality Assurance**

These metrics should be re-evaluated every five to ten years to determine whether there are new *standards* in place, and whether there have been additional metrics developed that will assist in analyzing the *Framework*. These metrics have limited benefit by themselves. Their worth comes from an analysis of how they work together and how effective they are. This analysis is yet to be designed and implemented.

**Related Indicators**

- NA/NAASF base 18: Indicator 48, 49, 50, 51, 52, 53, 54, 57, 58
- Montreal Process 2003: Indicator 48, 49, 50, 51, 52, 53, 54, 57, 58
- Montreal Process Proposed 2010: (same as 2003)
- FSC: Principle 1
- SFI: Objective 8 (8.4), Objective 11, Objective 12 (12.1, 12.2), Objective 13
- ATFS: Standard 2

**References**

Wormstead, Sherri. 2005. Data from the questionnaire of state forestry agencies for the base indicators of forest sustainability [unpublished data collected directly from the state forestry agencies by the USDA Forest Service, Northeastern Area and the Northeastern Area Association of State Foresters]. Durham, NH: USDA Forest Service, Northeastern Area State and Private Forestry, Information Management and Analysis.

## Indicator 19: Forest-related planning and assessment

This indicator will describe in a narrative format the different types of forest planning and assessments that exist in the state (statewide, private non-industrial, industrial, government, and tribal). It will detail how plans and assessments are conducted and give an update on the status of major plans. This indicator also describes statewide assessment efforts. The number of Stewardship acres and plans will be presented in a table.

### Relevance:

Forest management plans, whether on public or private lands, provide the opportunity for a forest to be measured and analyzed, for the long-term objectives of the owner to be stated, and for sustainable management to be developed. A plan may also serve as a proxy to measure how well a forest is managed; the existence of a plan most likely means that a natural resource professional was involved in developing forest management, and that certain ecological standards are being met within that forest. Tabulating the number of Stewardship Plans within the state gives us a direct measure of the number of sustainably managed forests. As more forest lands, both public and private, become third party certified sustainable, more management plans are being reviewed and monitored on a regular schedule.

A good public land planning process is conducted in the public arena, involves diverse stakeholders, analyzes alternative actions and incorporates ecosystem management principles. By stating what public land plans exist and how they are implemented, this indicator will allow us to compare planning processes and evaluate their effectiveness. Assessments are critical to the planning process as they provide the data necessary to analyze past practices and determine appropriate future projects.

This indicator directly relates to the following trends and issues identified in Wisconsin's Statewide Forest Plan:

- Issue 6: It is a challenge to make scientific information relevant to decision-making.
- Issue 23: "Green" accounting is a new way of evaluating forest benefits.
- Issue 27: Rising forestland property taxes are impacting short and long-term forest management decision-making.
- Issue 33: More private forestry assistance is needed.
- Trend/Issue 36: Stakeholders are more involved in forest decisions.
- Trend/Issue 37: Conflicting use of forests is a public debate.
- Issue 39: Role of public forests.
- Issue 47: Criteria and indicators for sustainable forestry are being developed.
- Trend/Issue 50: Integration with other agencies and disciplines.

### Metric Descriptions:

| Metric | Data Source | Data Scale | Data Cycle | Reporting Responsibility |
|---|---|---|---|---|
| 19.1 Statewide forest planning and assessment | WDNR-FR | Statewide | 10 years | WDNR-FR |
| 19.2 Private non-industrial forest planning | WDNR-FR, Tax Law Section; NA S&PF | Statewide | Annual | WDNR- FR |

| | | | | |
|---|---|---|---|---|
| 19.3 Industrial forest planning | WDNR-FR, Tax Law Section | Statewide | 5 years | WDNR-FR |
| 19.4 Government and tribal forest planning | WDNR-FR; tribes | Statewide | 5 years | WDNR-FR |

19.1 Statewide forest planning and assessment

This metric will describe, in a narrative format, the status of the statewide planning process and how the Statewide Forest Plan is being implemented. It will also report issues that arise from the plan. The 10-Year Assessment will also be addressed. The metric will discuss how the results of the Assessment are being implemented in the next Statewide Forest Plan.

19.2 Private non-industrial forest planning

For this metric, the number of forest stewardship plans, MFL plans, and FCL plans will be displayed in a table covering the last 10 years. Another table will show the total acres these plans encompass. Data will come from the WDNR-FR, Forest Tax Law section and NA S&PF.

19.3 Industrial forest planning

This metric will show the number of acres of industrial forestlands in the MFL and FCL. It will also show the number of acres of Forest Legacy easements not within MFL/FCL. Data will come from the WDNR-FR, Forest Tax Law section.

19.4 Government and tribal forest planning

This metric will describe the status of planning efforts on national, state and county forests. It will also update planning initiatives on tribal lands. Municipalities that have urban forest plans will be reported as well.

**Data Availability**

The number of management plans (and acres) for private non-industrial and industrial lands enrolled in tax law programs is easily available from the WDNR-FR. There are no sources of data that monitor the number of private lands that are not enrolled in a tax law or have a Stewardship Plan. Updates on the planning efforts of the various governmental entities will require contacting agency planners periodically.

**Limitations/Considerations**

These metrics can show how many plans have been written, but they cannot show how well these plan have been implemented, or analyze their effectiveness. For government and tribal plans, effectiveness can be monitored over time by comparing forest plan actions to findings from their assessments.

**Quality Assurance**

There are no issues with the quality assurance of these metrics.

## Related Indicators

- NA/NAASF base 18: Criterion 7 (Indicator49, 54, 60, 61)
- Montreal Process 2003: Criterion 7 (Indicator49, 54, 60, 61)
- Montreal Process Proposed 2010: (same as 2003)
- FSC: Principle 6 (6.1), Principle 7 (7.1, 7.2, 7.4), Principle 8, Principle 9 (9.1, 9.3, 9.4)
- SFI: Objective 4 (4.1), Objective 6, Objective 8 (8.2), Objective 12 (12.3)
- ATFS: Standard 3

## References

USDA Forest Service. 2005. Performance, Management, Accountability System [on-line database]. [http://www.spfnic.fs.fed.us] [now available at: http://spfnic.fs.fed.us/nicportal]. (5/13/2005).

# Data Gaps

This list includes items that would assist in creating a more comprehensive *Forest Sustainability Framework*. As the Advisory Committee worked through the *Framework*, data sources that were deemed desirable but not readily available were moved to the data gaps list. This list is not prioritized; it is simply a listing of those items with their descriptions. The Advisory Committee, through a process of ranking, prioritized items based on their importance to successful monitoring, feasibility and operability, and added value and benefits to other potential uses. The top eight items are highlighted below (***) and discussed in the Preface. Throughout the report, the most critical items are noted.

## Data Gaps

| Reference | | Item | Description |
|---|---|---|---|
| Criterion 1 | Indicator 1 | ***Map of private forestland by legal and administrative definition | A map of private lands delineated by legal and administrative definition is needed to judge how lands are protected and for how long under different legal parameters such as contracts, easements, trusts, purchased development rights, etc. |
| | | ***Urban Forest Assessment | Need a continuation of the Urban Forest Inventory pilot study conducted by FIA and WI DNR. This is the only statewide data source for urban forests. |
| | Indicator 2 | Tree Species Models | Need better models to assess size and age class, and successional stage for individual tree species; better hardware/software to complete this. |
| | | ***Stand Structure Models | Need models that analyze stand structure. A model specifically for old growth is needed. This can be linked to biodiversity if monitoring changes over time, investigating why things are changing and how that is affecting forest biodiversity. |
| | Indicators 2 & 12 | LIDAR (optical remote sensing technology) | An increased frequency of LIDAR can increase the statistical reliability of some forest cover type species like hemlock; could also provide better information on biomass by species. |
| | Indicators 2, 3 & 10 | ***WISCLAND | An increased frequency of WISCLAND could provide better data to forest cover type groups reported by species (Indicator 2); This data could be used in place of NLCD data for fragmentation (I3); this could provide information on the area of forestland adjacent to surface water and the amount of forestland by watershed (I10). |

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| | Indicator 3 | Forest Fragmentation | NLCD could be used, but would require analysis and protocol development. Would need to ensure the periodic updating of NLCD. |
| | | NLCD | Ensure the updating of NLCD every 10 years at minimum to provide data needed to assess forest fragmentation. |
| | Indicator 4 | ***Natural Heritage Inventory (NHI) | Implement systematic monitoring specific to NHI. Need assessment directly related to forest and woodland communities and forest associated species of concern. WDNR-ER does this inventory, but they are not funded adequately to ensure a monitoring system that will show trends over time. |
| | | Native American species of concern | Native American Tribes have species they are specifically concerned about that are not necessarily on the NHI list. These should be represented and recognized. A comprehensive list from all the tribes should be compiled. |
| | | Amphibians | Create a monitoring system for forest-related amphibian species of concern. Amphibians can be excellent indicators of ecosystem health. Choosing a few species of concern and monitoring populations over time can be an indicator of forest health. |
| **Criterion 2** | Indicator 6 | Timber Product Output (TPO) Report | Increase TPO to an annual survey and expand it to include non-forest industry wood fiber consumers and producers (bio-energy). The TPO is an excellent way to track the amount and type of removals. By increasing the frequency and expanding to bio-energy, it will be a much better source of data than FIA. |
| **Criterion 3** | Indicator 7 | ***Invasive Plants | Create a common database for organizations to share for tracking invasive plants. This would then be used in combination with FIA surveys that report on invasive woody and shrub data. The common database would have standard survey methods and would be accessible to everyone. |
| | | FIA - Damage Type | Expansion of FIA plots for damage type (P3 plots). Essentially this is looking at crown dieback and transparency as a proxy for forest health. Tracked over time, natural mortality vs. mortality from damaging agents can be seen. |

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| | | Herbaceous Plant Survey | A mid- and under-story herbaceous plant survey would be an ideal compliment to animal damage data. Need a habitat classification type with mid- and under-story herbaceous plant survey. Changes in the understory could be seen more quickly than tracking tree data. |
| | | Animal Damage (deer browse) | Need analysis that links browse surveys to deer management units and population to understand animal damage to the forest. |
| | Indicator 8 | Ozone Plots | Intensify ozone FIA and Forest Health Management plots. Currently forest damage data due to ozone is collected on 31 plots in the state. Quadrupling the intensity would increase the chances of finding problems early. It would also increase the validation on a statewide scale. |
| **Criterion 4** | Indicator 11 | Index of Biological Integrity (IBI) | Increase the monitoring intensity of IBI in forested settings. Currently information on IBI is collected on different streams across the state depending on funding and priorities. This would increase IBI collection specifically on forested streams to increase knowledge of water quality in forested areas. |
| **Criterion 5** | Indicator 12 | Global Carbon Cycling | Need better metrics to measure the contribution of forest products to the global carbon cycle. A few of the larger private companies are tracking this information already, but is it not available on a larger statewide scale. |
| | | Biomass | Need better metrics for remote sensing tree volumes (biomass) by species. This would ensure information on forest ecosystem biomass that is currently lacking. Use LIDAR as a source of data. |
| **Criterion 6** | Entire *Framework* | ***Environmental Services | Essentially provide a list of the environmental services that forests provide. Many of them are throughout this *Framework*; those that aren't would need to be identified. |
| | Indicator 13 | Bioenergy Report | Consistent statewide analysis of energy production and consumption needs to be completed and the implications analyzed. |
| | | Non-Timber Forest Products | Need database created on the value and removals of non-timber forest products. |

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| | Indicator 14 | Forest Recreation Survey | More intensive recreational survey needed that focuses specifically on forestlands that spans social, ecological, and economic effects of recreation. |
| | | Mapping Forest Recreation Trails | Map of trails on forestland (motorized and non-motorized, all uses). Need more data collection and then multiple partners' data sets combined into GIS. |
| | | Recreation User Satisfaction/Conflict | Need data on recreation user satisfaction/conflict regarding multiple use on forestland. |
| | Indicator 15 | Forestry Scholarships | Need basic evaluation of what scholarships are being provided over time. If necessary in the future, scholarships could be increased as a way to recruit new people to the field of forestry. |
| **Criterion 7** | Indicator 18 | ***List of Standards, Laws & Policies | Need a database of all 'standards', laws, policies, and reporting mechanisms in Wisconsin that affect sustainable forestry. |
| | Indicator 19 | Forest Planning | Need evaluation to determine if forest plans are being carried through to effectively meet the goals stated. |

# General References

Guyon, L.J., and J.M. Edgington. 2004. Illinois report on sustainable forest management: criteria and indicators – summary report. Illinois Forestry Development Council.

The Heinz Center. 2005. The State of The Nation's Ecosystems. [http://www.heinzctr.org/ecosystems/report.html]

Montreal Working Group. [http://www.rinya.maff.go.jp/mpci/]

Oregon Department of Forestry. 2007. Oregon Indicators of Sustainable Forest Management. Oregon Department of Forestry, Salem, Oregon. [http://www.oregon.gov/ODF/RESOURCE_PLANNING/Sustainable_Forest_Indicators_Project.shtml#top].

USDA Forest Service. 2002. Sourcebook on Criteria and Indicators of Forest Sustainability in the Northeastern Area. USDA Forest Service Northeastern Area State and Private Forestry and Northeastern Forest Resource Planners Association. Newtown Square, PA. NA-TP-03-02. [http://www.na.fs.fed.us/spfo/pubs/sustain/crit_indicators/02/cover.pdf]

USDA Forest Service. 2003. Base Indicators of Forest Sustainability: Metrics and Data Sources for State and Regional Monitoring. [http://www.na.fs.fed.us/spfo/pubs/sustain/base_ind/03/base_indicators.pdf].

USDA Forest Service. 2003. Sustainability Assessment Highlights for the Northern United States. USDA Forest Service Northeastern Area State and Private Forestry. Newtown Square, PA. NA-TP-05-03. [http://www.na.fs.fed.us/pubs/tps/sustainability/northern_us07/assessment_northern_us_lr.pdf]

17th Meeting of the Working Group on Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests (Montréal Process). July 24-28, 2006. Sapporo, Japan. [http://www.mpci.org/meetings/17_e.html#annex_f].

# Appendix A: Acronyms

| | |
|---|---|
| ATFS | American Tree Farm System |
| BBS | Breeding Bird Survey (North American) |
| BMP | Best Management Practice |
| CBI | Conservation Biology Institute |
| C&I | Criteria and Indicators |
| CN-NF | Chequamegon-Nicolet National Forest |
| CSREES | Cooperative State Research, Education & Extension Service (USDA) |
| EMAP | Environmental Monitoring & Assessment Program (EPA) |
| EPA | US Environment Protection Agency |
| FCL | Forest Crop Law |
| FHP | Forest Health Protection Unit (WDNR) |
| FIA | Forest Inventory & Analysis Program (USFS) |
| FIDO | Forest Inventory Database Online (USFS) |
| FLP | Forest Legacy Program (USFS) |
| FSC | Forest Stewardship Council |
| GLTPA | Great Lakes Timber Professionals Association |
| HUC | Hydrologic Unit Classification |
| IBI | Index of Biological Integrity |
| IMPLAN | Impact Planning Software |
| LCA | Life Cycle Analysis |
| LIDAR | Light Detection and Ranging (optical remote sensing technology) |
| MFL | Managed Forest Law |
| MRLC | Multi Resolution Land Characteristics Consortium |
| NAASF | Northeastern Area Association of State Foresters |
| NASF | National Association of State Foresters |
| NASS | National Agricultural Statistics Service |
| NHD | National Hydrography Dataset |
| NHI | Natural Heritage Inventory |
| NLCD | National Land Cover Dataset |
| NOAA | National Oceanic & Atmosphere Administration |
| NRCS | Natural Resources Conservation Service (USDA) |
| NRI | Natural Resources Inventory |
| NVCS | National Vegetation Classification System |
| PDSI | Palmer Drought Severity Index |
| SAF | Society of American Foresters |
| SCORP | Statewide Comprehensive Outdoor Recreation Plan |
| SFI | Sustainable Forest Initiative |
| TNC | The Nature Conservancy |
| TPO | Timber Product Output |
| USDA | United States Department of Agriculture |
| USFS | U.S. Forest Service |
| NA S&PF | Northeastern Area State and Private Forestry (a unit of the USFS) |
| WBCI | Wisconsin Bird Conservation Initiative |

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|---|---|
| WDATCP | Wisconsin Department of Agriculture, Trade, and Consumer Protection |
| WDNR | Wisconsin Department of Natural Resources |
| WDNR-ER | Wisconsin Department of Natural Resources-Endangered Resources |
| WDNR-FR | Wisconsin Department of Natural Resources-Forestry |
| WDNR-PR | Wisconsin Department of Natural Resources-Parks |
| WDNR-WT | Wisconsin Department of Natural Resources-Water |
| WDNR-WL | Wisconsin Department of Natural Resources-Wildlife |
| WDOA | Wisconsin Department of Administration |
| WDOR | Wisconsin Department of Revenue |
| WDOT | Wisconsin Department of Transportation |
| WLC | WISCLAND Land Cover |
| WISCLAND | Wisconsin Initiative for Statewide Cooperation on Landscape Analysis & Data |

# Appendix B: Summary of Review Process

**Expert Review:**
The draft *Framework* was sent to over 40 expert reviewers. A range of experts were chosen who could address all the specialties represented in the indicators and metrics. Experts were asked to review the report for technical accuracy, the use of appropriate and best sources of data, and effectiveness of the metrics selected. The experts were not asked to suggest new criteria or revise the framework of the process. Comments and edits from the experts were considered by the Advisory Committee and many were incorporated into the final report. Appendix C lists the experts that provided comments.

**Tribal Review:**
The Native American Tribes of Wisconsin, as government land managers, play a role in sustainably managing Wisconsin's forests. Tribal input in the revision process was solicited. The WDNR presented information on the *Framework* drafting process and requested input at the Voigt Tribal Task Force meeting May 3, 2007, and at an all tribal meeting hosted by Forest County Potowatomi on May 9, 2007. All state tribes were sent the draft report and asked to review and provide edits on the appropriateness of the metrics and suggestions for further metrics.

**Public Review:**
Throughout the process of creating the *Framework*, the public was invited to provide comments and attend any of the five publicly noticed Advisory Committee meetings. A draft report was available for the public to review and comment on in October, 2007. The report was distributed to the public online, offered in hard copy, and announced through press releases on Department websites and newsletters, forestry organization's websites and newsletters, mass email, and the Council on Forestry website. Comments could be made on-line or sent by ground mail. The public's comments were considered by the Committee. This final *Framework* is a recommendation to the Council. The Council has the ability to make changes based on public comments if they desire.

Please contact the WDNR-FR if you would like to read the comments that were received.

# Appendix C: Invited Expert Reviewers

| Name | Title | Organization |
|---|---|---|
| Benson, Miles | Private Consulting Forester | Private firm |
| Bratkovich, Steve | Project Manager | Dovetail Partners |
| Christenson, Jimmy | Attorney (Retired) | WDNR |
| Dallman, Matt | Director of Conservation | TNC |
| Demchik, Michael | Associate Professor | UW-Steven's Point |
| Fernholz, Kathryn | Executive Director | Dovetail Partners |
| Gaulke, Peter | NEPA Specialist | USFS |
| Haines, Anna | CLUE Director, Associate Professor | CLUE – UW-Steven's Point |
| Hall, Dave | Science Committee Chair | WWOA |
| Martin, Karl | Research Scientist | WDNR-FR |
| Olson, Eric | Extension Land Use Specialist | CLUE – UW-Steven's Point |
| Perry, Charles "Hobie" | Research Soil Scientist | USFS |
| Rogers, Elizabeth | Ecologist | Forest County Potawatomi |
| Turner, Clarence | Forest Planner | MN DNR |
| Walker, Melody | Plant, Pest & Disease Specialist | WDATCP |
| Welsch, Dave | Forester/Watershed Specialist | USDA-Durham NH |
| Werner, Les | Lecturer in Urban Forestry | UW-Steven's Point |
| Wormstead, Sherri | Sustainability Specialist | USFS NA S&PF |
| Zumeta, Dave | Executive Director | MN Council on Forestry |

# Appendix D: FIA Methodology

All FIA data to be presented in this *Framework* are collected by the USDA Forest Service, Forest Inventory and Analysis (FIA) Program in cooperation with WDNR. The FIA Program is mandated by Congress in the Forest and Rangeland Resources Planning Act of 1974 and the McSweeney-McNary Forest Research Act of 1928.

Prior to 2000, FIA inventories in the United States were done on a periodic basis, with new inventories conducted in each state every 13-15 years. Under the new annualized inventory, data are collected on a rolling cycle, with data collected on all plots within a state every 5-7 years. In Wisconsin, data is collected on a 5-year cycle with the first cycle completed in 2004.

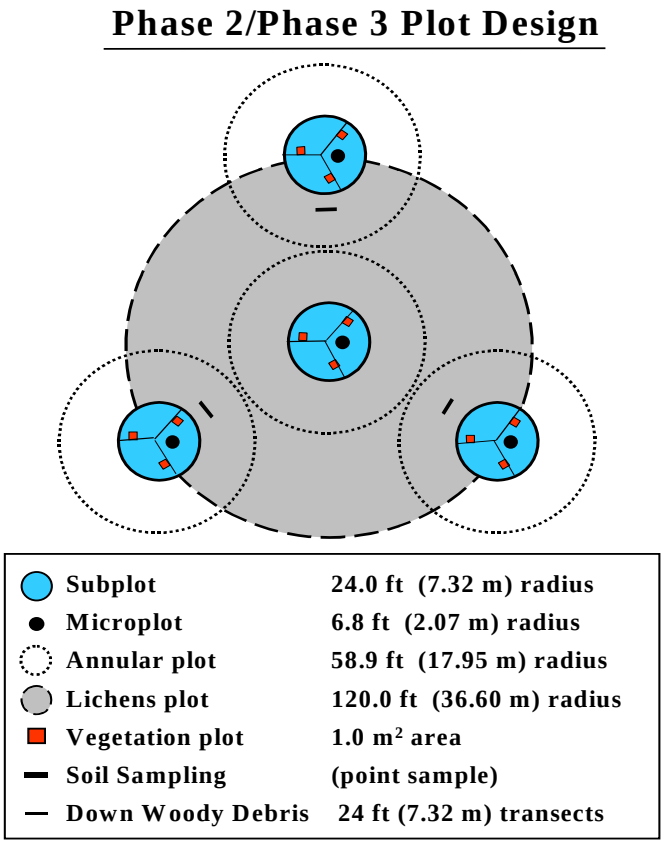
Each state inventory begins with the interpretation of a remotely sensed, or "phase 1," sample. Phase 1 is the traditional aerial photography and/or remote sensing activity used to characterize the acreage of forest and non-forestland in the US. Phase 2 are the traditional FIA ground plots that focus on forest and tree information as it relates to timber, but not exclusively. Phase 3 are the ground plots previously installed and measured by the Forest Health Monitoring (FHM) program, and are a subset of the phase 2 plots. It is on phase 3 plots that information relating to forest health from a broader perspective is collected.

Collectively, the forest monitoring component of FIA provides a nationwide, systematic sample of a wide array of measurements on forested ecosystems. These measurements are used by a diverse set of customers for many purposes. For example, FIA data have been used to map habitat for endangered animal species and to identify areas of forest decline.

FIA inventories are designed to meet the specified sampling errors at the state level at the 67-percent-confidence level (one standard error). The Forest Service handbook mandates that the sampling error for area cannot exceed three percent per one million acres of timberland.

**Plot Layout**

An FIA plot consists of a cluster of four circular subplots spaced in a fixed pattern (see figure below). The plot is designed to provide a sampling location for all P2 and P3 measurements. Subplots are never reconfigured or moved; a plot may straddle more than one condition class, such as two different forest types or a forest and a meadow.




Additional information on the FIA program and FIA methodology can be accessed at the following website: http://fia.fs.fed.us/

# Appendix E: Statewide Forest Plan Goals

1. **Forests are healthy and protected.**

Wisconsin's forest ecosystems serve a multitude of ecological roles, including habitat for species, water quality protection, carbon sequestration, and moderation of temperature extremes in cities. To ensure the provision of these functions and their many other values, forests are protected from wildfire, insects, and disease, including invasive exotic species. Threats to human safety and property near fire-prone forests are minimized through preventative measures and forest fire suppression capabilities.

2. **Forests provide a diverse range of native plant and animal species and their habitats.**

Wisconsin's forests contain healthy, viable populations of forest-dependent species. Forest community types representing a range of successional stages are maintained to ensure the availability of diverse habitats for species.

3. **Forests are productive, providing raw material for consumers and economic stability for local communities.**

Wisconsin's forests are kept well stocked with merchantable timber to provide an adequate supply of forest products for Wisconsin consumers. Sustainable forestry practices on both private and public lands maximize residual stand quality and promote abundant regeneration of a range of species. Sound forest management supplies local mills and manufacturers with a range of species for fabrication of diverse wood products. Forest products provide income to landowners and a reliable, enduring source of employment for local communities.

4. **Forests are conserved and managed with sound stewardship practices.**

Forest management is practiced on both public and private lands to ensure the forestland base and associated ecological, social, and economic benefits are maintained for current and future generations. Forest management practices are guided by the most current science and are applied based on the desire to maintain the full range of forest ecosystem values, including habitat for diverse species, clean water, air, and soil, recreational opportunities for all user groups, and scenic beauty. The direct and indirect benefits of forests depend on a stable forestland base.

5. **Forests provide multiple recreational opportunities.**

Wisconsin's forests provide opportunities for diverse forms of recreation. These opportunities are expanded, subject to the limitations imposed by available land and fragile habitats, in response to increasing demand. Conflicts between user groups are managed through community planning.