THE STATE OF MINNESOTA
SUSTAINABLE BUILDING GUIDELINES
SUMMARY VERSION 1.0

Part of the Buildings, Benchmarks and Beyond (B3) Project

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Executive Summary

The Minnesota Legislature required the Departments of Administration and Commerce, with the assistance of other agencies, to develop sustainable building design guidelines for all new state buildings by January 15, 2003. According to the legislation, the guidelines must:

- Exceed existing energy code by at least 30 percent
- Achieve lowest possible lifetime costs for new buildings
- Encourage continual energy conservation improvements in new buildings
- Ensure good indoor air quality
- Create and maintain a healthy environment
- Facilitate productivity improvements
- Specify ways to reduce material costs
- Consider the long-term operating costs of the building including the use of renewable energy sources and distributed electric energy generation that uses a renewable source of natural gas or a fuel that is as clean or cleaner than natural gas.

To achieve these goals, *The State of Minnesota Sustainable Building Guidelines* (MSBG) build on previous local and national efforts. The guidelines are designed to be clear, simple and easily monitored with explicit documentation that will record progress. They are designed to be compatible with national guidelines such as LEED™ while maintaining regional values, priorities and requirements. Most importantly, the guidelines set up a process that will eventually lead to a full accounting of the actual economic, human, community, and environmental outcomes.

The guidelines are organized into the following categories: Performance Management, Site and Water, Energy and Atmosphere, Indoor Environmental Quality, and Materials and Waste. Guidelines are required when they clearly contribute to the desired economic, human, community, and environmental outcomes. Some guidelines are recommended rather than required until their direct financial benefits to the State can be clearly demonstrated. However, in some of these cases, the team is required to evaluate implementing the guideline.

Sustainable design is a means to reduce energy expenditures, enhance the health, well-being and productivity of the building occupants, and improve the quality of the natural environment. All of these can contribute to high-performance State buildings with lower life cycle costs. To move toward ensuring these outcomes, the guidelines attempt to quantify the economic, human, community, and environmental outcomes for each project.

This is Summary Version 1.0 of *The State of Minnesota Sustainable Building Guidelines.* This version will be tested on pilot projects during its initial use and refined based on that experience.

Introduction

Preface

An interdisciplinary team of local and national experts has developed sustainable building guidelines for the State of Minnesota Departments of Administration and Commerce that will be used on all new state buildings. This is Summary Version 1.0 of *The State of Minnesota Sustainable Building Guidelines.* This version will be tested on pilot projects during its initial use and refined based on that experience. The guide that results from this project will eventually replace the existing Minnesota Sustainable Design Guide.

The guidelines are a part of the Buildings, Benchmarks & Beyond (B3) Project consisting of four components. Project management is led by LHB, Inc.; the guideline development process is led by The Center for Sustainable Building Research (CSBR); public building benchmarking is led by The Weidt Group; and the project delivery process is led by the Adams Group. The management component of the B3 project facilitates integration of the guideline and benchmarking efforts, and coordinates public input. The guidelines component is described above and is the subject of this document. Benchmarking, will identify the energy performance of existing public buildings in order to direct energy conservation improvements where they are most needed and most cost-beneficial. As new state-funded projects are constructed and operated in accordance with the new sustainable guidelines, more detailed information on energy and other sustainable performance factors will also be tracked.

Background

Applicable Legislation:

The departments of Administration and Commerce, with the assistance of other agencies, must develop sustainable building design guidelines for all new state buildings by January 15, 2003. According to the legislation, the guidelines must:

- Exceed existing energy code by at least 30 percent
- Achieve lowest possible lifetime costs for new buildings
- Encourage continual energy conservation improvements in new buildings
- Ensure good indoor air quality
- Create and maintain a healthy environment
- Facilitate productivity improvements
- Specify ways to reduce material costs
- Consider the long-term operating costs of the building including the use of renewable energy sources and distributed electric energy generation that uses a renewable source of natural gas or a fuel that is as clean or cleaner than natural gas.

The State has further clarified the scope of Summary Version 1.0 of the guidelines to focus on new office and higher education classroom facilities, although many of the guidelines are suitable for other building types and renovation projects.

Existing Guidelines:

The Minnesota Sustainable Design Guide (MSDG) was initiated in 1997 by Hennepin County with a grant from the Minnesota Office of Environmental Assistance (OEA) and is currently maintained by the University of Minnesota. It embodies many regionally specific strategies in an open framework. The guide is a management tool with interconnected sets of information on design process, strategies, and case studies with a flexible scorekeeping system.

The LEED™ guidelines (Leadership in Energy and Environmental Development) developed by the U.S. Green Building Council (USGBC) have emerged in recent years as a national standard with a high level of visibility and increasing market acceptance. Other prominent guidelines and assessment tools that form the foundation for LEED™ and MSDG are BREEAM™ and GBTool[1]. LEED™ has been adapted for use in many regions of the U.S. and Canada. Some of these efforts include guidelines for New York City, North Carolina, Pennsylvania, and LEED Canada.

Key Problems and Issues

In spite of the many models of existing guidelines, there are some fundamental problems that have not yet been addressed adequately. For example:

- Current guidelines, like LEED™ use prescriptive, point-based, and proxy measures that simplify both compliance and enforcement but in many cases do not connect to real economic, human, community, and environmental outcomes and in some cases may lead away from desired results.
- The life cycle costs and benefits of sustainable design strategies are not well documented or available early enough in the process to affect significant improvements.
- There is no planning framework or process that allows managers to actually make sustainable choices during project initiation and capital budget planning.
- National guidelines such as LEED™ are not always regionally appropriate and are not applicable to all project types in all cases.
- Fixed standards are rarely right for every building in every location.

Vision

Based on experience and analysis of other systems as well as the direction of the client, the desired attributes of *The State of Minnesota Sustainable Building Guidelines* are listed below.

- Performance-based, moving from proxies to real performance indicators related to cost, people, community and, eventually, environment. These true outcomes become the inputs for a complete life cycle analysis tool for decision makers.
- Clear, simple and easily monitored or calculated.
- Explicit documentation to hold agencies and designers accountable.
- Self-Improving, with project documentation informing further guideline development and the State's benchmarking activities.
- Compatible with national models such as LEED™ while maintaining regional values, priorities and requirements.

[1] BREEAM™ (Building Research Establishment Ltd.'s Environmental Assessment Method); GBTool (Green Building Assessment Tool)

To address these challenges, the first phases of the project attempt to do the most important things first and do them well. The framework for performance *accounting* is established in early phases; the tools to confirm that desired outcomes are achieved and verify performance *accountability* are developed in following phases. Ultimately, outcomes will be incorporated into a complete life cycle cost analysis whenever possible. The short and long term vision includes:

Early Phases:

- A set of clear goals, objectives, guidelines, and performance criteria for state funded buildings in Minnesota (correlated to LEED™ and MSDG).
- Wherever possible, move from proxy measures to actual performance-based outcomes in these areas— economic, human, community, and environmental.
- A step-by-step process that assists in implementing the guidelines.

Following Phases:

- A comprehensive, integrated set of decision support tools to assist public agencies in facility planning and design, capital budget planning, cost/benefit analysis, environmental assessment, worker productivity impact, and community impact.
- An evolving knowledge base with information fed back from benchmarking, project experience and post occupancy evaluations.
- A publicly maintained one-stop source of information on sustainable buildings in Minnesota.

Key Guideline Concepts

1. Reduction in Guidelines

   Guidelines have been eliminated that are either already required by code or do not apply in this region.

2. Required Guidelines

   Guidelines are required when they clearly contribute to the desired economic, human, community or environmental outcomes. Guidelines are sometimes recommended rather than required until their benefits to the State can be clearly demonstrated. In some of these cases, however, the team is required to evaluate implementing the guideline to calculate the costs and benefits for their particular project.

3. Connection to Real Outcomes

   Performance-based guidelines replace prescriptive measures wherever appropriate. Because it is not possible to make a complete transition to a system with performance-based outcomes at this time, each section includes a required Outcome Documentation guideline for submitting information related to economic, human, community, and environmental outcomes. The purpose is to collect data on outcomes wherever possible and educate all participants in the process of determining outcomes. The performance indicators of real outcomes to be calculated in applying these guidelines (to be further developed in following phases) include the following:

   Project Life-cycle Costs
   - Project capital costs
   - Operation and maintenance costs

   Human Impacts and Related Cost
   - Health and Well-being

- Productivity
- Absenteeism
- Employee turnover
- Health care costs

Environmental Impacts

- Primary energy
- Global warming potential
- Air pollution index
- Water pollution index
- Resource depletion
- Waste production

Community Impacts and Related Cost

- Community infrastructure demand and associated costs
- Community assets contributed by project
- Economic impacts
- Social impacts

4. Relationship to LEED™ and the existing Minnesota Sustainable Design Guide (MSDG)

It is envisioned that these guidelines will replace the current Minnesota Sustainable Design Guide; however, versions of both systems will be posted on the internet during the transition period.

The guidelines contained in this document do not require any connection to LEED™ guidelines. There is a clear correspondence, however, that allows owners and designers to seek LEED™ certification if they desire. Compared to LEED™, these guidelines have, in effect, made a number of credits into prerequisites, removed credits that are required by code, and added some guidelines including Outcome Documentation. The correspondence between *The State of Minnesota Sustainable Building Guidelines* and LEED™ is shown in the Guideline Summary Table.

Effort will be made to indicate where these guidelines meet or exceed requirements for compliance with LEED™ Credits, as well as where guidelines may need further enhancements to comply with LEED™ requirements. It is not the purpose of *The State of Minnesota Sustainable Building Guidelines* to follow LEED™ requirements specifically, but wherever requirements are the same or similar, documentation required for these guidelines may be useful in achieving LEED™ credit. There is no guarantee, however, that compliance with these guidelines will result in a LEED™ credit. Refer to LEED™ sources for specific requirements and documentation required for certification.

One benefit of making *The State of Minnesota Sustainable Building Guidelines* transparent to LEED™ is that LEED™ certification serves as one incentive to achieve higher performance than the basic requirements of these guidelines. (Once it is possible to determine the true life-cycle cost impacts of higher performance buildings, the benefits accrued to the project and the State will be another effective incentive.)

How to Use the Guidelines

The guidelines are organized into the following topic categories (see Guideline Summary Table):

- Performance Management
- Site and Water
- Energy and Atmosphere
- Indoor Environmental Quality
- Materials and Waste

At the beginning of each section, there is an overview, goals, objectives, and a list of guidelines for that topic. All guidelines are required unless otherwise noted as recommended. This is followed by definitions for that section if applicable, and then documentation for each guideline that states the intent, performance criteria, and tools/calculations. A glossary is included at the end of the guidelines. The process for implementing the guidelines is explained in the Performance Management section. Each section includes an Outcome Documentation guideline where the key performance information, as well as economic, human, community, and environmental performance indicators are determined as much as possible at this time. These outcomes will be inputs for the total life-cycle analysis tool to be developed in subsequent versions of the guidelines.

THE STATE OF MINNESOTA SUSTAINABLE BUILDING GUIDELINE SUMMARY

Version 1.0

	MSBG GUIDELINES (Required except as noted by * which indicates recommended)	COMPARISON TO LEED™** Potential LEED™ Credits		Potential LEED™ Points For MSBG Requirements	Potential LEED™ Points For MSBG Requirements & Recommendations
	PERFORMANCE MANAGEMENT				
P.1	Guideline Management				
P.2	Commissioning	EA	Prereq 1, Credits 3, 5	2	2
P.2	Integrated Design and Construction Process	IEQ	Credits 1, 3.1, 3.2	3	3
P.3	Planning for Conservation				
P.5	Process Documentation for Performance Management				
	SITE AND WATER				
S.1	Avoid Critical Sites	SS	Credit 1	1	1
S.2	Erosion and Sedimentation Control	SS	Prereq 1	0	0
S.3	Stormwater Management	SS	Credit 6.1, 6.2	2	2
S.4	Reduce Site Disturbance	SS	Credit 5.1, 5.2	2	2
S.5	Restorative Design*				
S.6	Reduce Site Water Use for Plant Materials	WE	Credit 1.1. 1.2	1	2
S.7	Reduce Light Pollution	SS	Credit 8	1	1
S.8	Appropriate Location and Density*	SS	Credit 2	0	1
S.9	Brownfield Redevelopment*	SS	Credit 3	0	1
S.10	Encourage Efficient Transportation Alternatives*	SS	Credit 4.1—4.4	0	4
S.11	Use Graywater to Reduce Wastewater Treatment Impacts*				
S.12	Use Biological Wastewater Treatment System*	WE	Credit 2	0	1
S.13	Building Water Efficiency	WE	Credit 3.1, 3.2	2	2
S.14	*Outcome Documentation for Site and Water*				
	ENERGY AND ATMOSPHERE				
E.1	Reduce Energy Use by at least 30%	EA	Prereq 1, Credit 1.1—1.5	4	10
E.2	Efficient Equipment and Appliances				
E.3	Evaluate Renewable and Distributed Energy Generation	EA	Credit 2.1—2.3, 6	0	4
E.4	Atmospheric Protection*	EA	Prereq 3, Credit 4	1	1
E.5	*Outcome Documentation for Energy and Atmosphere*				
	INDOOR ENVIRONMENTAL QUALITY				
I.1	Restrict Environmental Tobacco Smoke	IEQ	Prereq 2	0	0
I.2	Indoor Air Quality and Ventilation Framework				
I.3	Specify Low-emitting Materials	IEQ	Credit 4.1—4.4	4	4
I.4	Ventilation Based on Anticipated Pollutants	IEQ	Credit 5	1	1
I.5	Ventilation Based on Carbon Dioxide Limits				
I.6	Moisture Control	IEQ	Prereq 1, Credit 2	1	1
I.7	Thermal Comfort	IEQ	Credit 7.1	1	1
I.8	Daylight*	IEQ	Credit 8.1	0	1
I.9	Quality Lighting				
I.10	View Space and Window Access*	IEQ	Credit 8.2	0	1
I.11	Whole Body Vibration in Buildings				
I.12	Effective Acoustics and Positive Soundscapes				
I.13	Personal Control of IEQ Conditions and Impacts	IEQ	Credit 6.1, 6.2	0	2
I.14	Encourage Healthful Physical Activity*				
I.15	*Outcome Documentation for Indoor Environmental Quality*				
	MATERIALS AND WASTE				
M.1	Evaluation of Design for Resource Use	MR	Credits 1, 3	0	5
M.2	Evaluation of Material Properties for Improved Performance	MR	Credits 4—7	0	6
M.3	Waste Reduction and Management	MR	Credit 2.1, 2.2	1	2
M.4	*Outcome Documentation For Materials and Waste*				
	43 Total Guidelines, 33 Required Guidelines		TOTALS	27	61
			Corresponding LEED™ Certification Level	*(Certified)*	*(Platinum)*

**Comparison to LEED™ points is estimated. MSBG requirements overlap with LEED™ credits, however, following MSBG does not require, nor automatically result in LEED™ certification.

Performance Management Guidelines

Overview

Too often, goals for environmental and operating cost savings are not realized due to problems with the implementation process. In the complex sequence of planning, design, construction, and operation it is not enough to set a goal for improved performance—there needs to be follow through and verification to avoid missing the biggest opportunities early on and to prevent poor coordination causing well-intended approaches to fail in operation.

The Performance Management section outlines the processes to support successful performance improvements. Guideline Management and Commissioning ensure that *The State of Minnesota Sustainable Building Guidelines* (MSBG) are implemented by documenting progress towards performance criteria throughout the planning, design, and construction phases. Monitoring of key systems will continue throughout occupancy and provide information on an ongoing basis to the benchmarking database, which will provide information for planning and constructing future State projects.

Other Performance Management guidelines address the creation and use of the well-integrated team necessary for a well-integrated solution, and the thorough evaluation of current and future needs so that remodeled or new facilities are well-utilized and represent a responsible use of economic and natural resources over time. While the Performance Management section supports the actions defined in other sections, there may be specific actions and benefits that come out of the processes in this section; these will be accounted for in the outcome documentation of other appropriate sections. The documentation that is filed under this section is limited to process information.

Goal

To employ processes that improve the ongoing performance of facilities towards lowest lifecycle costs, and positive environmental, human, and economic outcomes; and to improve understanding of the effect of facility development and operational decisions on environmental, human, and economic outcomes in order to inform and improve the guidelines and benchmarking methods over time.

Objectives

- Define a simple process for review of compliance and progress towards guidelines throughout project development and operation.
- Document and assemble information that captures design information as well as estimated and actual performance to facilitate guideline improvement and tracking of progress towards desired guideline outcomes.
- Define a quality planning, control and verification process to ensure that specific steps take place that are needed to support the operational achievement of performance criteria.
- Initiate and utilize an integrated team approach to support integrated solutions.
- Review current and future needs thoroughly so as to maximize utilization of space.

Guidelines

P.1 Guideline Management
P.2 Commissioning
P.3 Integrated Design and Construction Process
P.4 Planning for Conservation
P.5 Process Documentation for Performance Management

Forms

P-A Compliance Summary Form
P-B Performance Management Process Documentation Form

P.1 Guideline Management

Intent

To facilitate and document guideline compliance in a simple and efficient manner; to capture design and performance data to facilitate guideline improvement and tracking of progress towards desired guideline outcomes.

Performance Criteria

Guideline Management Process: The Guideline Management Process is designed to ensure that the project complies with guidelines by regularly reviewing and documenting compliance with the guidelines from initial phases through ongoing occupancy. The Guideline Management Process is led by the Guideline Leader and consists of the following key components:

- At the start of each phase (or year of operation), the Guideline Leader reviews the MSBG guidelines and associated Outcome Documentation Forms, plans the tasks to be done for that phase to keep on track for meeting the guidelines, and communicates this with the work team. There is no documentation required of this step.[1]
- If exceptions to the MSBG guidelines are sought, the Guideline Leader (whether from the agency/owner in early phases or from the design team in later phases) shall request the variance in writing to the Appropriated Agency for Variance Review before the completion of the schematic design phase. For each guideline for which variance is requested, the request for variance shall include the name of the guideline, an explanation of why variance is requested, and supporting information demonstrating the reason whether it be for financial hardship or other reasons.
- The Work Team for the responsible organization (planning team, design team, construction team, or operations team depending on phase) works towards the MSBG requirements. At the end of the phase, the work team completes the documentation and statement of compliance as required in the Compliance Summary Process Documentation Form and gives it to the Guideline Leader. [2]
- The Guideline Leader collects the Outcome Documentation Forms for each topic area at the end of each phase (or annually during facility operation), summarizes the extent of compliance and the progress towards outcomes for the whole project and organizes all of this into a cohesive, end-of-phase Guideline Report.
- The Guideline Leader submits the Guideline Report to the Appropriated Agency for Compliance Review, and archives relevant documentation for that phase (or year) that supports the Guideline Report in the project files, for future reference.

[1] To make the process of implementing the guidelines smoother, it is recommended, but not required, that the Guideline Leader documents a Performance Plan that bridges the MSBG guidelines to the specifics of the project and helps to plan for specific skills or tools needed for the phase. In the absence of a project-customized performance plan, the MSBG guidelines and the associated Outcome Documentation Forms act as a default performance plan.

[2] In addition to the documentation required in the Outcome Documentation Form, the work team and Guideline leader may optionally add other comments. These comments can include: clarifying information on the documentation provided, a description of tools, consultants, and processes used, how key decisions were made, or other comments. This supplemental information can be useful later for use in MSBG revisions.

- The Guideline Leader submits a second copy of the Guideline Report to CSBR who will use it to update the Project Archive as part of the MSBG Tracking Process.

Compliance Review Process: The Compliance Review Process is designed to provide checkpoints for regularly reviewing compliance with the guidelines over time from initial phases through ongoing occupancy. The Appropriated Agency leads the Compliance Review Process which consists of the following key components:

- The Appropriated Agency receives the end-of-phase Guideline Report from the Guideline Leader.
- The Appropriated Agency reviews the extent and nature of compliance as documented by the Guideline Leader and decides if the extent of compliance is acceptable. (The Appropriated Agency, is not responsible for *determining* compliance, but may question if compliance is achieved if in doubt.)
- The Appropriated Agency then either approves the extent of compliance for that phase, or directs the Guideline Leader to revisit compliance measures with the team.
- After successful completion of the correction period or the first year of operation, which ever is longer, the Appropriated Agency may end its role in Compliance Review. In any case, the annual reporting will continue to be sent to CSBR throughout the life of the project's operation.

Variance Review Process: The Variance Review Process defines the steps for reviewing a request to not adhere to a portion of the guideline as written. It is led by the Appropriated Agency and consist of the following key steps:

- The Appropriated Agency receives the variance request in writing from the Guideline Leader before the completion of the schematic design phase.
- After review, the Appropriated Agency either accepts or rejects the request for variance, or may specify a compromise or conditions for the variance. The response from the Appropriated Agency shall be sent in writing to the Guideline Leader within 15 business days.

MSBG Tracking Process:. This consists primarily of updating and maintaining the Project Archive. Related activities may include posting data from the Project Archive on an informational MSBG website, using Project Archive information to improve the usability and effectiveness of the MSBG guidelines, and translating reported building performance in to economic, human, and environmental outcomes for use by the State of Minnesota as part of the Benchmarking Process. CSBR implements the process, acting on direction of the State. This process consists of the following elements:

- CSBR receives Guideline Reports and Commissioning Reports from the Guideline Leader.
- CSBR uses the information received to update and maintain the Project Archive.
- CSBR uses the information from the Project Archive as described above at the direction of the State of Minnesota.

P.2 Commissioning

Intent

To verify that the building is designed, constructed, and calibrated to meet performance goals; and to manage and monitor operational performance to verify maintenance of performance levels over time.

Performance Criteria

Design and Construction Commissioning Process: Design and Construction Commissioning refers to the commissioning process that shall begin in schematic design and conclude after the correction period or after completion of a full year of operation, which ever is last. The Design and Construction Commissioning process is the means to verify and document that the systems of a facility operate in accordance with their design intent and that the operations staff fully understands the system operational procedures. This includes documenting system operational goals and design parameters, planning for verification and testing in the design and specifications, confirming the successful completion of the verification process, documenting the system operational procedures and training the operations staff. The Design and Construction Commissioning Process is coordinated by the Commissioning Leader and executed by the Commissioning Team.

Key components of the Design and Construction Commissioning Process include:

- Establish Planning Baseline, Programming Baseline, and before the end of schematic design phase, establish the Design Baseline.
- Before the end of the Schematic Design phase, engage a Commissioning Team and establish the role of Commissioning Leader.[3]
- Before the end of the Schematic Design phase, review the design intent and basis of design documentation, incorporating this into a Design and Construction Commissioning Plan that includes the required Commissioning Scope defined in the MSBG Guidelines. Update the Commissioning Plan in each phase with increasing detail, and noting the characteristics upon which design and demonstration of performance will be based as they become more defined each phase.
- At least once during each of Design Development and Construction Documents phases, evaluate progress of work towards the Commissioning Plan, documenting the progress and recommendations into a Commissioning Report before the end of each phase so that the design may be adjusted in response to the findings.
- Incorporate commissioning criteria and scope into the Construction Documents.
- Review contractor submittals for commissioned equipment during the Construction Administration phase.
- Verify installation, functional performance, training, and operation and maintenance documentation during construction and correction period.
- After construction, complete an initial Commissioning Report comparing work completed to the Commissioning Plan and identifying outstanding items or seasonally deferred items to be completed later.
- At 10 months into the correction period, review building operation with Operations and maintenance staff, and create a plan for resolution of outstanding commissioning-related issues.
- After the 10 month correction period review, or after seasonally deferred commissioning work, whichever is longer, complete a Commissioning Report, stating that the tasks for the Design and Construction Commissioning Plan are complete and design intent has been achieved.

Ongoing Operations Commissioning Process: Ongoing Operations Commissioning shall be planned for during design, but focuses on the ongoing operations of the facility after construction through the next use of the facility. The Ongoing Operations Commissioning process is the means to verify and document that the systems of a facility and the facility as a whole continue to

[3] It is recommended to engage the Commissioning Leader and Team as early as possible, ideally in Predesign phase.

operate in accordance with their design intent overtime . This includes planning, implementation, and documentation for regular preventative maintenance, Measurement and Verification of system and whole building performance, and improvement and correction of that performance. The Ongoing Operations Commissioning process is coordinated by the Commissioning Leader and executed by the Commissioning Team. Initial operations input is provided by the participation of the Facility Operations Manager on the Design and Construction Commissioning Team. Later in design, the Ongoing Operations Commissioning Team is formed and leads the planning for ongoing commissioning after occupancy.

Key components of the Ongoing Operations Commissioning Process include:

- Include the Facility Operations Manager or their representatives as part of the initial Design and Construction Commissioning Team for the new facility in order to represent operations issues from the beginning of the Design and Construction Commissioning Process.
- Identify the Ongoing Operations Commissioning Leader and Commissioning Team during the Design Development phase.
- Draft the Ongoing Operations Commissioning Plan during the Design Development phase and coordinate operations issues with design and construction issues before construction documents are complete.
- Refine or create Measurement and Verification Baseline(s).
- During the correction period, refine and complete the Ongoing Operations Commissioning Plan.
- During occupancy, implement the Ongoing Operations Commissioning Plan acting on findings according to the plan if covered in the plan, or according to the judgment of the Facility Operations Manager.
- At the end of each year of operations, complete an Ongoing Operations Commissioning Report. (See section detailing Ongoing Operations Commissioning Report for those items required to be reported annually.)
- Review the Ongoing Operations Commissioning Plan at least annually updating it as needed to reflect changes in equipment or practices.

Design and Construction – Commissioning Scope:
All scope items are Required unless otherwise labeled "Recommended"

- Design Elements needed for Energy and Water Measurement and Verification:
- Systems Commissioning of:
  Required: Mechanical HVAC Comfort, Energy, and Renewable Energy Systems, Testing Adjusting and Balancing; Electrical Systems, including Lighting and Daylighting Controls; Indoor Air Quality Elements and Systems
  Recommended: Plumbing Systems; Interior Materials (specification, installation); Envelope Integrity
- Indoor Air Quality Procedures During Construction
- User Comfort and Satisfaction Assessment as one indicator of overall IEQ Guidelines performance criteria.
- Construction Waste Management Procedures During Construction

Ongoing Operations – Commissioning Scope:
All scope items are Required unless otherwise labeled "Recommended"

- Site Systems Operations and Maintenance Practices Evaluation

  - Device and System Level and Whole building Water Measurement and Verification
- Water Systems Operations and Maintenance Practices Evaluation

- Device and System Level Energy Measurement and Verification
- Whole Building Energy Measurement and Verification based on Metering and Calibrated Energy Simulation:

Size (sq.ft.)	Metering	with Submetering	Calibrated Simulation (annual Energy Use)
<10,000	Required	Recommended	Recommended
10-50,000	Required	Required	Recommended
>50,000	Required	Required	Required

- Energy Systems Operations and Maintenance Practices Evaluation

- Indoor Environmental Quality (IEQ) Measurement and Verification:
  Required: Air Quality, Thermal Comfort, Quality of Lighting
  Recommended: Vibrations, Acoustics and Noise. Access to Daylight, View space and window access, Personal Control of IEQ conditions and impacts, Opportunities and encouragement for healthful physical activity
- IEQ Systems Operations and Maintenance Practices Evaluation
- User Complaint/ Work Request Logs related to User Comfort and Satisfaction as an indicator of ongoing IEQ performance
- *Recommended: User Comfort and Satisfaction Assessment as an indicator of ongoing IEQ performance*

- *Recommended: Materials Measurement and Verification*
- Waste Measurement and Verification
- Materials and Waste Systems Operations and Maintenance Practices Evaluation

- *Recommended: Systems Recommissioning: At regular intervals or in response to other events or triggers at the discretion of the owner.*

P.3 Integrated Facility Development Process

Intent

To facilitate an integrated solution by involving stakeholders and the entire inter-disciplinary team from beginning to end. The integrated team approach allows creative approaches to the design solution to be explored more completely in the early phases of a project. This leads toward a lower lifecycle cost for the building and improvements in personal and organizational productivity.

Performance Criteria

- Facilitate communication and the process for an interdisciplinary team and stakeholders (By Guideline Leader, or Work Team Project Manager)

Specific Steps include

- Assemble appropriate stakeholder team
  Include representation from every discipline that will be involved in the project, Owner's decision making, user, occupant, operations and maintenance representatives, and at least one representative from the community, and at least one agency "client" or visitor representative. Also include owner representative and commissioning agent if applicable. Choose members who can make a commitment through post-occupancy review phase.
- Establishment of a Team Roster and Communication Plan outlining who gets copied on what, distributed to all team members.
- Conduct planning/ review workshops at each phase with all team members. The goal is exchange between team members and broad-based input and understanding of the goals and approaches the project will take.
  - Comprehensive Business Planning Workshop at Agency planning phase
  - Programming Workshop during Predesign Programming
  - Facility Performance Workshop within the first 2-3 weeks of the schematic design phase
- Convene multi-discipline team at least once per design phase for integrated progress review towards guidelines
- Convene stakeholder team regularly for integrated progress review. Stakeholder team to meet a minimum of once per phase
- Convene General Contractor and Sub-contractors for pre-construction kick-off meeting to review the MSBG goals and objectives
- Incorporate discussion about the progress toward project outcomes during every construction meeting.
- Recommended: After occupancy, Facility Operations Manager, and Human Resources Manager and others that form an cross disciplinary points of view on Facility Operations shall meet annually to review operation practices, complaints, and building maintenance issues.

P.4 Planning for Conservation

Intent

To maximize utilization of facilities and modify them less over time by careful analysis of current and future needs and resources.

Performance Criteria

- Utilize a three step review process that aims at evaluating alternatives to new construction in order of:
  - No new construction
  - Renovation of an existing building(s)
  - Optimize space use when building new buildings and plan for future use and adaptability

- Document process showing that a thorough review of "building less" options was completed with explanation of how the project is proceeding and why this path was chosen. Refer to Materials & Waste[4] and Energy[5] for calculation tools.

- The analysis requires that the design team evaluate the environmental and economic impacts regarding reuse of an existing building versus building a new building as well as an analysis of how the space use needs could be most efficient.

- The resource reuse gained when reusing a building shall be measured against the materials needed to build a new building. The savings gained because less energy is used in a smaller building shall also be measured. The energy savings will be based on typical energy usage for the building type and based on total building square footage.

P.5 Process Documentation for Performance Management

Intent

To establish compliance accountability, and record significant elements of the personnel, process, and overall project information for reference and use in MSBG tracking and guideline improvement over time.

Performance Criteria

- Complete Process Documentation Forms at the end of each phase to document key process and project reference information relevant to the reported phase of the project.
  See Forms P-A, and P-B

[4] Building less is a critical component of the Planning for Conservation guideline. It is important that the ideas for building less are discussed in every phase of the project. It is also important that a measuring tool be used to determine what the environmental and economic benefits are for building less. The measuring tool for using fewer resources can be found in Materials & Waste, M.5.

[5] Building less most likely will reduce the amount of energy needed. The designer should calculate typical energy usage for the original programmed building and subsequent buildings that would have less programmed space.

Form P-A: Compliance Summary Form - PAGE 1 OF 2

Project Name: **Project Address:**

CHECK LIST

☐ **Attach Documentation Forms for Each Section:** (P, S, E, I, M)

☐ **Enter Date of Submittal:**

☐ **Name of Phase being Completed and Submitted for Compliance:** **(See list eg. "Schematic Design")**

☐ **Complete the following Table for the phase being completed**

	Guideline # and Name	Responsible Role Name: (Example Role Names listed below for design phase.)	Guideline Pursued?
	PERFORMANCE MANAGEMENT		
P.1	Guideline Management	Guideline Leader	Yes, Required
P.2	Commissioning	Commissioning Leader	Yes, Required
P.3	Integrated Design and Construction Process	Architect	Yes, Required
P.4	Planning for Conservation	Appropriated Agency	Yes, Required
P.5	Process Documentation	All above are responsible for the portion of outcome documentation related to the guidelines they are leading.	Yes, Required
	SITE AND WATER		
S.1	Avoid Critical Sites	Appropriated Agency	Yes, Required
S.2	Erosion and Sedimentation Control	Architect	Yes, Required
S.3	Stormwater Management	Civil Engineer	Yes, Required
S.4	Reduce Site Disturbance	Lanscape Architect	Yes, Required
S.5	Restorative Design*	Lanscape Architect	
S.6	Reduce Site Water Use for Plant Materials	Lanscape Architect	Yes, Required
S.7	Reduce Light Pollution	Electrical Engineer	Yes, Required
S.8	Appropriate Location and Density*	Appropriated Agency	
S.9	Brownfield Redevelopment*	Appropriated Agency	
S.10	Encourage Efficient Transportation Alternatives*	Architect	
S.11	Use Graywater to Reduce Wastewater Treatment Impacts*	Mechanical Engineer	
S.12	Use Biological Wastewater Treatment System*	Mechanical Engineer/ Civil Engineer	
S.13	Building Water Efficiency	Mechanical Engineer	Yes, Required
S.14	*Outcome Documentation for Site and Water*	All above are responsible for the portion of outcome documentation related to the guidelines they are leading.	Yes, Required
	ENERGY AND ATMOSPHERE		
E.1	Reduce Energy Use by at least 30%	Mechanical Engineer (or Energy Consultant)	Yes, Required
E.2	Efficient Equipment and Appliances	Appropriated Agency	Yes, Required
E.3	Evaluate Renewable and Distributed Energy Generation	Mechanical Engineer	Yes, Required
E.4	Atmospheric Protection*	Mechanical Engineer	
E.5	*Outcome Documentation for Energy and Atmosphere*	All above are responsible for the portion of outcome documentation related to the guidelines they are leading.	Yes, Required
	INDOOR ENVIRONMENTAL QUALITY		
I.1	Restrict Environmental Tobacco Smoke	Appropriated Agency	Yes, Required
I.2	Indoor Air Quality and Ventilation Framework	Mechanical Engineer	Yes, Required
I.3	Specify Low-emitting Materials	Architect	Yes, Required
I.4	Ventilation Based on Anticipated Pollutants	Mechanical Engineer	Yes, Required
I.5	Ventilation Based on Carbon Dioxide Limits	Mechanical Engineer	Yes, Required
I.6	Moisture Control	Mechanical Engineer	Yes, Required
I.7	Thermal Comfort	Mechanical Engineer	Yes, Required
I.8	Daylight*	Architect	
I.9	Quality Lighting	Electrical Engineer	Yes, Required
I.10	View Space and Window Access*	Architect	
I.11	Whole Body Vibration in Buildings	Structural Engineer	Yes, Required
I.12	Effective Acoustics and Positive Soundscapes	Architect (or Acoustical Consultant)	Yes, Required
I.13	Personal Control of IEQ Conditions and Impacts	Mechanical/ Electrical Engineer	Yes, Required
I.14	Encourage Healthful Physical Activity*	Architect	
I.15	*Outcome Documentation for Indoor Environmental Quality*	All above are responsible for the portion of outcome documentation related to the guidelines they are leading.	Yes, Required
	MATERIALS AND WASTE		
M.1	Evaluation of Design for Minimum Resource Use	Architect	Yes, Required
M.2	Evaluation of Material Properties for Improved Performance	Architect	Yes, Required
M.3	Waste Reduction and Management	Architect	Yes, Required
M.4	*Outcome Documentation For Materials and Waste*	All above are responsible for the portion of outcome documentation related to the guidelines they are leading.	Yes, Required

Form P-A: Compliance Summary Form - PAGE 2 OF 2

☐ **Complete the Signatures for each responsible party in the table below:**

By signing this you indicate the project is on track towards compliance with the guidelines for which you are responsible as listed above, and that related documentation to these guidelines is accurate to the best of your

Role Name responsible for selected guidelines as indicated above	Signature and Printed Name of Responsible Party and Firm	Date
Guideline Leader		
Agency Contact		
Architect		
Civil Engineer		
Landscape Architect		
Structural Engineer		
Mechanical Engineer		
Electrical Engineer		
Interior Designer		
Energy Consultant		
Acoustic Consultant		
Construction Contractor		
Facilities Operations Manager		
Commissioning Leader		
Other: List		

FORM P-B: PERFORMANCE MANAGEMENT —PROCESS DOCUMENTATION
For work through phase: _____as of the date:_____

PROJECT DATA

- Client, and Work Team List with contact information (attach)
- Project Master Schedule (attach)
- Full Time Equivalent Employees (FTE) _____ Peak Number of Visitors_____
- Building Operating Hours (by season if varies)
  _____
- Estimated Years of planned use by Owner_____ Est. Years between major reconfigurations_____
- Project Budget (attach) $/sq.ft. construction cost_____
- Space Program with Building Function Narrative (Attach)
- Building Area: Gross sq.ft. _____ Net sq.ft._____
- Gross Building Volume cu.ft. _____
- Outline of construction types for each building system (Attach)
- Estimated Annual Energy Cost $/sf for this building or this building type_____

SPACE UTILIZATION DATA

- Net to Gross Sq.Ft. Ratio _____
- Net Area per FTE Employees _____
- Gross Volume to Gross Floor Area Ratio:_____
- Short Narrative on process that aims at evaluating alternatives to new construction in order of: No new construction, Renovation of an existing building(s), Optimize space use when building new buildings and plan for future use and adaptability. Include explanation of how the project is proceeding and why this path was chosen (Attach, see P.4 for description)
- Estimated Total Construction Cost Savings from Reduced Area of New Construction_____
- Estimated Total Construction Cost Savings from Reused/Remodeled Area versus New Construction _____
- Estimated Total Annual Energy Cost Savings from Reduced Area of New Construction_____

TEAM AND COMMUNICATION DATA

- Stakeholder team list (attach, see P.3 for description)
- Identify Agenda, Attendees, and Key results from stakeholder planning/ review workshops held in the current phase. (attach eg. Agenda and Meeting Minutes, see P.3 for description)
- Identify Agenda, Attendees, MSBG goals and objectives as presented, and key questions or concerns at pre-construction kick-off meeting with General Contractor and Sub-contractors. (Attach)
- Identify Personnel involved, and communication methods for discussing MSBG compliance after occupancy. (Attach)

COMMISSIONING DATA

- Attach Commissioning Plan, and Commissioning Report (and referenced related reports) for this phase. See P.2 for descriptions.

Site and Water Guidelines

Overview

Building construction transforms land that provides valuable ecological services. Society has only recently begun to understand that these services have a quantifiable economic value. Site selection and design affect transportation and energy use which leads to ground-level ozone, acid rain, smog, and global climate change. Current development practices on the land can lead to uncontrolled stormwater runoff, degraded water and soil quality, and destruction of habitat. The State of Minnesota Sustainable Building Guidelines (MSBG) seek to restore and improve site water and soil quality, and to reduce negative impacts associated with site selection and design.

Goal

To design and maintain sites which have soil and water quality capable of supporting healthy, bio-diverse plant, animal, and human communities, which reduce water and energy consumption, and which minimize pollutant contributions related to transportation requirements.

Objectives

- Maintain and improve the ability of the soil to maintain its structure against adverse impacts.
- Restore/improve the hydrologic cycle of water on the site to avoid adverse impacts on the site and downstream of the site.
- Reduce consumption of potable water.
- Improve the biodiversity of the site by introducing flora/fauna which will help contribute to the sustainability of the site over time.
- Reduce energy consumption and pollution contributions to air and water related to site location and associated transportation requirements.
- Restore/improve the outdoor environmental quality (OEQ) of the site to enhance occupant productivity, building performance, and community benefits.

Guidelines (Required except where noted with * which indicates recommended)

S.1 Avoid Critical Sites
S.2 Erosion and Sedimentation Control
S.3 Stormwater Management
S.4 Reduce Site Disturbance
S.5 Restorative Design*
S.6 Reduce Site Water Use for Plant Materials
S.7 Reduce Light Pollution
S.8 Appropriate Location and Density*
S.9 Brownfield Redevelopment*
S.10 Encourage Efficient Transportation Alternatives*
S.11 Use Graywater to Reduce Wastewater Treatment Impacts*
S.12 Use Biological Wastewater Treatment System*
S.13 Building Water Efficiency
S.14 Outcome Documentation for Site and Water

Forms

S-A Site and Water Outcome Documentation Form

S.1 Avoid Critical Sites

Intent

To avoid development on sites whose natural features and functions are particularly valuable to the larger community; to avoid development on sites where soil, water, and flora/fauna indicators are in a fragile condition because of surrounding development or the natural state of the site.

Performance Criteria

Do not develop buildings on portions of sites that meet any one of the following criteria:

- Prime farmland as defined by the American Farmland Trust.
- Land whose elevation is lower than 5 feet above the elevation of the 100-year flood as defined by the Federal Emergency Management Agency (FEMA.)
- Land which provides habitat for any animal or plant species on the Federal or State threatened or endangered list.
- Land which is within 100 feet of any wetland as defined by 40 CFR, Parts 230-233 and Part 22, OR as defined by local or state rule or law, whichever is more stringent.
- Land which prior to acquisition for the project was public parkland, unless land of equal or greater value as parkland is accepted in trade by the public landowner (Park Authority projects are exempt.)

S.2 Erosion and Sedimentation Control

Intent

To reduce the loss of soil and sediment during construction and occupancy by reducing the impacts of wind and water on the soil and to reduce the amount of soil and sediment entering streams causing downstream impacts.

Performance Criteria

- Design, specific to site, a sediment and erosion control plan than conforms to "Urban Small Sites Best Management Practices" (Metropolitan Council), prevents sedimentation within acceptable limits as set by local authority or watershed district having jurisdiction, whichever is more stringent.

- The plan shall meet the following objectives:
    - Prevent sedimentation of storm sewer.
    - Prevent soil erosion before, during, and after construction by controlling stormwater runoff and wind erosion. [1]
    - Protect hillsides using erosion control measures. [2]
    - Prevent air pollution due to dust and particulate matter.

[1] Strategies to consider include: stockpiling topsoil for reuse, silt fencing, sediment traps, construction phasing, stabilization of slopes, and maintaining and enhancing vegetation and groundcover.
[2] Strategies to consider include: hydro seeding, erosion control blankets, and/or sedimentation ponds to collect runoff.

S.3 Stormwater Management

Intent

To minimize negative impacts on the natural site hydrologic cycle as much as possible by reducing downstream impacts, improving the overall water quality and clarity, and recharging groundwater through infiltration.

Performance Criteria

- Achieve no net decrease in the rate and quantity of on-site water recharge from existing to developed conditions; OR, if existing imperviousness is greater than 50%, implement an infiltration or storage plan that results in a 25% increase in the rate and quantity of on-site water recharge.
- Provide treatment systems designed to remove solids and pollutants for on-site water recharge to comply with water quality standards of Local Governing Unit (LGU) or "Urban Small Sites Best Management Practices" (Metropolitan Council), whichever is more stringent. It is the intent of these Guidelines to update tools and criteria such as Best Management Practices on an ongoing basis, to include the most comprehensive, stringent and consistent approach as possible for compliance.
- Achieve no net increase in the rate and quantity of stormwater runoff from existing to developed conditions; OR, if existing imperviousness is greater than 50%, implement a stormwater management plan that results in a 25% decrease in the rate and quantity of stormwater runoff.
- Provide treatment systems designed to remove 80% of the average annual post development total suspended solids (TSS), and 40% of the average annual post development total phosphorous (TP), by implementing Best Management Practices (BMPs) outlined by Local Governing Unit (LGU) or in "Urban Small Sites Best Management Practices" (Metropolitan Council), whichever is more stringent.

S.4 Reduce Site Disturbance

Intent

To conserve existing site features during planning and construction to promote biodiversity on the site and to restore natural areas damaged by construction so the site can sustain its water, soil, and plant cover functions.

Performance Criteria

- On previously developed sites: maintain or improve 50% of the existing biodiversity in accordance with existing conditions and surrounding site context. Determine spatially by area measurement.
- On Greenfield sites: Limit site disturbance including earthwork and clearing of vegetation to 40 feet beyond the building perimeter, 5 feet beyond primary roadway curbs, walkways, and main utility branch trenches, and 25 feet beyond pervious paving areas that require additional staging areas in order to limit compaction in the pervious paved area
- On all sites: Provide a minimum of 75% of all species planted on the site from stock identified as native to the local area and as identified in resources listed at the end of this guideline. In addition, a minimum of 75% of all trees and shrubs, by quantity, are to be native material.

S.5 Restorative Design
(Recommended, Not Required)

Intent

Go beyond guideline S.4 to further conserve existing site features during planning and construction to promote biodiversity on the site and restore natural areas damaged by construction so the site can sustain its water, soil, and plant cover functions.

Performance Criteria

This criterion is recommended but not required by these guidelines:

- On previously developed sites: maintain or improve 75% of the existing biodiversity in accordance with existing conditions and surrounding site context. Determine spatially by area measurement.

S.6 Reduce Site Water Use for Plant Materials

Intent

To limit, reduce, or eliminate exterior potable water demand for propagating plants and lawn areas.

Performance Criteria

- Use high efficiency irrigation technology, OR, use captured rain or recycled site water, to reduce potable water consumption for irrigation by 50% over conventional means.[3]

Tools / Calculations

TYPICAL WATER CONSUMPTION FOR UNDERGROUND IRRIGATION SYSTEMS

	TYPE OF SPRINKLER	**AREA 1 acre (43,560 sq. ft.)**
1.	**Pop-up Spray Head – 15' spacing:** Used for small lawns, boulevards, narrow areas of grass, shrubs Average of 3.0 gallons per minute (gpm) per head	**450 gpm**
2.	**Pop-up mid-range Rotary Sprinkler – 40' spacing:** Used for large lawns, and similar open areas Average of 3.4 gallons per minute (gpm) per head	**113 gpm**
3.	**Pop-up long-range Rotary Sprinkler – 55" spacing:** Used for athletic fields, golf courses, and similar large open areas Average of 15 gallons per minute (gpm) per head	**450 gpm**

[3] Recommendation for additional performance: Use only captured rain or recycled site water for an additional 50% reduction (100% total reduction) of potable water for site irrigation needs, OR, do not install permanent landscaped irrigation systems.

S.7 Reduce Light Pollution

Intent

Eliminate light trespass from the site, improve night sky access, and reduce development impact on nocturnal environments.

Performance Criteria

- Do not exceed Illuminating Engineering Society of North America (IESNA) footcandle level requirements as stated in the Recommended Practice Manual: Lighting for Exterior Environments.

S.8 Appropriate Location and Density

(Recommended, Not Required)

Intent

To direct development, where appropriate, to existing urban, suburban, or rural areas with in-place infrastructure to reduce development pressure on undeveloped land or Greenfield sites; to conserve natural resources, reduce energy use and pollution contributions related to transportation requirements; and to promote a sense of increased community interaction.

Performance Criteria

These performance criteria are recommended, not required by these guidelines.

- Compare existing zoning requirements for specific site types. Select a site which presents the most comprehensively positive impact for environmental, economic, community, and human benefits.

  In this analysis consider the following scenarios:
  - Urban and suburban locations: Select sites which reuse existing urban/suburban and industrial sites; are located near mass transit and public amenities to encourage walking to services instead of driving; and can utilize existing infrastructure such as utilities, roadways, services, etc. Select sites that support Minnesota's Community-Based Planning Act.
  - Urban and suburban locations: Increase localized density to conform to existing or desired density goals as listed in Minnesota's Community-Based Planning Act.
  - Rural locations: Avoid Greenfield sites which may not meet the threshold for a potentially significant environmental impact under Minnesota Statute CH. 116D, but which negatively impact green space and soil and water conditions.

S.9 Brownfield Redevelopment

(Recommended, Not Required)

Intent

Redevelop damaged or contaminated sites to reduce development pressure on undeveloped land, conserve natural resources, and promote new sense of community renewal, identity, and revitalization.

Performance Criteria

This criterion is recommended but not required by these guidelines.

- Develop on a site classified as a Brownfield and provide remediation as required for EPA's Sustainable Redevelopment of Brownfields Program and that support Minnesota's Community-Based Planning Act.

S.10 Encourage Efficient Transportation Alternatives

(Recommended, Not Required)

Intent

To reduce negative land development and pollution impacts caused by transportation requirements. To reduce dependence on the automobile, reduce the amount of pavement impacting natural systems, and to allow for more ecologically responsive approaches to the site.

Performance Criteria

These criteria are recommended, not required by these guidelines.

- Locate the building within 1/4 mile of two or more bus lines or a light rail station, and within 1/4 mile of retail and public services.
- Provide suitable means for securing bicycles, with convenient changing/shower facilities for use by cyclists, for 5% or more of building occupants.
- Install alternative-fuel refueling station(s) for 3% of the total vehicle parking capacity of the site.
- Size parking capacity not to exceed minimum local zoning requirements; add no new parking for rehabilitation projects; and provide preferred parking for hybrid vehicle owners, carpools or van pools capable of serving 5% of the building occupants.
- Locate preferred parking, pick-up areas, and covered waiting spaces within close proximity of the building, with markings clearly designating these areas.

S.11 Use Graywater to Reduce Wastewater Treatment Impacts

(Recommended, Not Required)

Intent

To reduce use of potable water for wastewater systems and decrease the amount of graywater exiting the site.

Performance Criteria

This criterion is recommended, but not required by these guidelines.

- Use graywater systems to reduce the use of potable water for wastewater on the site and/or within the building and decrease the amount of graywater exiting the site.[4] No specific limits or required reduced amounts are set, because each project's requirements will be site specific, based on soil quality, current runoff volumes, local ordinances, and projected use.

[4] Use graywater for non-potable water uses such as irrigation, toilets, vehicle washing, sewage transport, HVAC/process make-up water, etc. Technologies include, but are not limited to constructed wetlands, basins, cisterns, and ponds; a mechanical re-circulating sand filter; and graywater reclamation and plumbing systems.

S.12 Use Biological Wastewater Treatment System

(Recommended, Not Required)

Intent

To reduce wastewater and use of potable water for wastewater systems.

Performance Criteria

This is recommended, not required by these guidelines.

- Use a biological waste treatment system to reduce the volume of blackwater entering the municipal system and use of potable water.[5] No specific limits or required reduced amounts are set, because each project's requirements will be site specific, based on soil quality, current runoff volumes, local ordinances, and projected use.

S.13 Building Water Efficiency

Intent

To minimize potable water use in buildings to conserve water resources and minimize water and wastewater treatment infrastructure cost.

Performance Criteria

- Reduce water use in building by 30% compared to code (1992 Energy Policy Act requirements).

Tools/ Calculations

FIXTURE	ENERGY POLICY ACT OF 1992 FLOW REQUIREMENT
Water Closets (GPF)	1.6
Urinals (GPF)	1.0
Showerheads (GPM)*	2.5
Faucets (GPF)*	2.5
Replacement Aerators (GPM)*	2.5
Metering Faucets (gal/CY)	0.25
*At flowing water pressure of 80 pounds per square inch (psi)	

[5] Alternatives include peat moss drain fields, constructed wetlands, aerobic treatment systems, solar aquatic waste systems (or living machines), and composting or ecologically-based toilets, etc.

FLUSH FIXTURE TYPE	WATER USE (GPF)
Conventional Water Closet	1.6
Los-Flow Water Closet	1.1
Ultra Low-Flow Water Closet	0.8
Composting Toilet	0.0
Conventional Urinal	1.0
Waterless Urinal	0.0

FLOW FIXTURE TYPE	WATER USE (GPM)
Conventional Lavatory	2.5
Low-Flow Lavatory	1.8
Kitchen Sink	2.5
Low-Flow Kitchen Sink	1.8
Shower	2.5
Low-Flow Shower	1.8
Janitor Sink	2.5
Hand Wash Fountain	0.5

Supply information required for evaluation of impacts (environmental, economic, human, and community) in Outcome Documentation Report Form (Appendix S-A)

S.14 Outcome Documentation for Site and Water

Intent

To determine the information that supports an understanding of the economic, human, community and environmental outcomes related to site and water issues for the project.

Performance Criteria

See Form S-A.

- Compile information as required on S-A Documentation Form. Provide calculations indicated. Attach additional documentation, including plant lists, drawings, and related items required to support claims for compliance with guidelines.

FORM S-A: SITE AND WATER —OUTCOME DOCUMENTATION
For work through phase: _____as of the date:_____

LAND

- Type of site (check all that apply):
  Greenfield _____ Brownfield _____ Urban infill _____ Other _____
- Size of site (acres) _____
- Brownfield restored (acres) _____
- Wetland (% of site):
  Destroyed _____ Preserved _____ Restored _____ Created _____
- Site density (building floor area/site area):
  Before development _____ After development _____
- Building footprint (square feet):
  Before development _____ After development _____ Area of green roof _____
- Flora/fauna (% of site):
  Before development _____ After development _____
  (Attach list of plants installed)

WATER

- Did community build new sewer/utility infrastructure for this project? _____ Cost _____
- Were erosion/sedimentation control plans developed for construction? _____ For occupancy? _____
- Potable water used (gallons per year):
  Baseline (meets code) _____ Project design _____
- Water discharged to sanitary sewer (gallons per year): _____
- Water (gray) discharged to storage or site (gallons per year):
  For reuse within the building _____ For irrigation _____
- On site water recharge: Rate before _____ Quantity before _____
  Rate after _____ Quantity after _____
- Stormwater runoff: Rate before _____ Quantity before _____
  Rate after _____ Quantity after _____
- Water quality: Total suspended solids before _____ Total phosphorous before _____
  Total suspended solids after _____ Total phosphorous after _____
- Surface areas: Pervious surface before _____ Impervious surface before _____
  Pervious surface after _____ Impervious surface after _____

TRANSPORATION

- Did community build or change roads for this project? _____ Cost _____
- What is the distance to the nearest bus line? _____
- What is the distance to the nearest mass transit line? _____
- Are showers and bike racks provided? _____ Location/number _____
- Is preferred parking provided for car pools? _____ What types? _____
- Are alternative fueling stations provided? _____ What types? _____
- Parking provided on site: Before _____ After _____

SITE LIGHTING

- Amount of light leaving the site at night: Before _____ After _____

SITE COSTS

- Total site costs _____ Total infrastructure costs _____

Energy and Atmosphere Guidelines

Overview

Energy consumption for building operations represents approximately one third of the total energy use in the state. This section of the MSBG provides guidance on mitigating both the cost of energy and associated ecological impacts to our state's economy. Minnesota, through its Conservation Improvement Program, already has a decade's history of successfully promoting energy conservation at the levels required by this guide. For each building, there are multiple paths to conservation. Other sections of the MSBG having requirements for indoor air quality, lighting design, daylighting and other factors pertaining to human health and comfort complement this section and collectively enable individual resolution of the conservation objective while achieving superior interior environments.

To further reduce impacts on the environment and to promote community economic development, this guide recommends the investigation of renewable and distributed forms of power generation using wind, solar and biomass technologies as well as other cleaner forms of hydrogen or hydrocarbon-based power generators. Combined Heat and Power (CHP) systems may be an appropriate solution for individual buildings or groups of State facilities.

Goal

To provide energy efficient buildings that reduce the State's expenditures on imported fuel and power and have the lowest reasonable environmental impacts resulting from energy generation and the use of refrigerants harmful to the atmosphere. A parallel goal is to support and enhance the State's building benchmarking activities for ongoing operations performance.

Objectives

- Design new buildings to use 30% less energy than code[1]
- Provide building performance data for benchmarking activities
- Reduce plug loads and process energy through energy-smart purchasing practices
- Encourage the consideration of power usage from renewable energy and cleaner generation systems whether generated on-site or purchased from off-site, "green power" generated in Minnesota.
- Encourage the balanced consideration of Global Warming Potential, Ozone Depletion Potential and Atmospheric Lifetime in selecting refrigerants
- Help assure that long-term operations meet or exceed original design operating parameters

Guidelines (Required except where noted with * which indicates recommended)

E.1 Reduce Energy Use by at least 30%[2]
E.2 Efficient Equipment and Appliances
E.3 Evaluate Renewable and Distributed Energy Generation
E.4 Atmospheric Protection *
E.5 Outcome Documentation for Energy and Atmosphere

[1] Legislation allows a significant payback period of up to 15 years. However, results should be much better than that for most buildings. Payback periods less than the following figures should be readily achievable; 3 years for a building over 120,000 square feet; 4 years for a building between 80,000 to 120,000 square feet; 5 years for a building between 50,000 to 80,000 square feet; 6 years for a building between 30,000 to 50,000 square feet and; 7 years for a building less than 30,000 square feet

[2] Legislation governing this guideline requires a 30% conservation of energy relative to the Minnesota State Energy Code. Savings of greater than 30% and up to 60% are achievable for many building types with payback periods well under the allowable 15-year time frame. Agencies are encouraged to seek these savings greater than 30%.

Exclusions for Energy and Atmosphere

1. Buildings less than 5,000 gross square feet in floor area
2. Buildings that are not heated

Forms

E-A Energy and Atmosphere Outcome Documentation

E.1 Reduce Energy Use by at Least 30%

Intent

To ensure that annual energy costs are reduced by at least 30% as required by the Minnesota Legislature. A whole building, comparative analysis methodology must be used before the Construction Document phase of the design process to determine the energy conservation solution with the lowest lifetime cost.

Performance Criteria

- Reduce design energy costs compared to the energy cost budget by at least 30%[2] for regulated energy components as described in the Minnesota State Energy Code in effect as of 15 January 2003. Compliance with the Performance Criteria are only valid under the following conditions:
  - Only one building geometry may be used for a given project analysis.
  - Only one set of plug and process loads may be used for a given project analysis.
  - Only one mechanical system type may be used for a given project analysis.
  - Design teams must first use the Indoor Environmental Quality section I.1 of this guide to establish base operation parameters for outside air requirements.

E.2 Efficient Equipment and Appliances

Intent

To reduce energy use associated with plug loads and process loads in buildings. These energy savings are in addition to those attributed to the building itself which are accounted for in guideline E.1.

Performance Criteria

- Select new equipment and appliances that meet Energy Star criteria.

E.3 Evaluate Renewable and Distributed Energy Generation

Intent

To encourage the consideration and use of renewable energy sources and cleaner forms of hydrogen and hydrocarbon-based distributed generation systems to reduce atmospheric pollution. This can provide a stimulus to the State's economy through investments in local jobs and materials while reducing the State's expenditures on imported fuel and power.

Performance Criteria

- There is no required amount of renewable or distributed energy generation for State buildings at this time. However, an analysis is required that includes the environmental, economic, and

community impacts from supplying a percentage[3] of the building's total energy use with on-site or off-site renewable or cleaner distributed generation systems. The evaluation should assess the benefits for solar, wind, or biomass energy systems as well as micro-turbines and fuel cells, as applicable.

E.4 Atmospheric Protection
(Recommended, Not Required)

Intent

To encourage the investigation and evaluation of refrigerants to reduce environmental impacts harmful to the atmosphere. Energy conservation should be achieved with the lowest reasonable environmental impacts.

Performance Criteria[4]

There are no required levels for atmospheric pollution from refrigerants at this time except for CFC reduction which is required in the MN State Building Code. It is recommended that the following three criteria be met.

- Achieve an atmospheric Lifetime (AtL) $\leq$ 33. Atmospheric Lifetime is a measure of the average persistence of the refrigerant if released. A longer lifetime has worse environmental effects.
- Achieve an Ozone Depletion Potential (ODP) $\leq$ 0.034. Ozone Depletion Potential is a normalized indicator based on the ability of a refrigerant to destroy atmospheric ozone, where CFC-11 = 1.00. A higher ODP has worse environmental effects.
- Achieve a Global Warming Potential (GWP) $\leq$ 3500. Global Warming Potential is an indicator of the potency of the refrigerant to warm the planet by action as a greenhouse gas. A higher GWP has worse environmental effects.

[3] Renewable and cleaner distributed generation percentages may be as little as 1% or as great as 100% depending on the outcome of the evaluation and may be achieved through the construction budget by paying for the design and installation of a renewable or cleaner distributed generation system or through the operating budget through a contract to purchase renewable or cleaner distributed generation. Calculations for the cost of the percentage of renewable and distributed generation for the project should be calculated after the requirement for 30% or greater energy conservation has been met.

[4] CFCs generally have high Ozone Depletion Potential and Global Warming Potential with long Atmospheric Lifetimes. CFCs are therefore not allowed by these guidelines and prohibited by State law. Halons have a higher Ozone Depletion Potential though a lower Global Warming Potential but a much longer Atmospheric Lifetime. Halons should not be used if possible. HCFCs such as R-123, which other guides put in the same class as Halons, can have an Ozone Depletion Potential, a Global Warming Potential and an Atmospheric Lifetime two orders of magnitude less than CFCs and Halons. HFCs, offer near zero Ozone Depletion Potential, but some have high Global Warming Potential. For example, R-134 has an Ozone Depletion Potential of 0.0 but a Global Warming Potential and an Atmospheric Lifetime approximately 10 times greater than R-123, an HCFC alternative. Substituting an HFC, which tends to be less energy efficient than an HCFC, may result in the use of more energy, resulting in a further increase in global warming.

Tools / Calculations

Table of Refrigerant Climate Data Meeting the Guidelines[5] [6]

Refrigerant	Atmospheric Lifetime in Years	Ozone Depletion Potential	Global Warming Potential
HFC-152a	1.4	0	120
HCFC-123	1.4	0.012	120
HCFC-21	2	0.01	210
HFC-32	5	0	550
HCFC-124	6.1	0.026	620
HFC-245fa	7.2	0	950
HFC-134a	13.8	0	1300
HCFC-22	11.9	0.034	1700
HFC-125	29	0	3400
HFC-227ea	33	0	3500

E.5 Outcome Documentation for Energy and Atmosphere

Intent

To calculate and record the community, environmental, and life-cycle economic, impacts related to energy use and generation for the building. These results are inputs for the total building outcome documentation and life cycle cost analysis.

Performance Criteria

Complete E-A Outcome Documentation Form at the end of each phase to document design decisions for those portions of the guideline implemented at that time.

[5] James M. Calm "Refrigerant Data Summary" Engineered Systems Magazine Nov 2001.

[6] Additional criteria such as equipment efficiency and net environmental impact may be applied to the selection of the refrigerants to be used in a project.

FORM E-A: ENERGY AND ATMOSPHERE—OUTCOME DOCUMENTATION

For work through phase: _____as of the date:_____

- Fill out tables below based on project design (atmosphere and life cycle factors will be provided):

Economic Performance Indicators	Units	Code Baseline	Design Solution	Savings	% Savings	% Renewable
Annual Energy Cost	Dollars per sf					
Incremental Construction Costs	Dollars per sf					
Simple Payback						

Energy Performance Indicators	Units	Code Baseline	Design Solution	Savings	% Savings	% Renewable
Electric Consumption	kWh					
Electric Demand	kW					
Natural Gas consumption	Therms					
Purchased chiller water	Ton-hrs					
Purchased Steam	Mlbs					
Primary Energy	?					

Atmosphere Performance Indicators	Units	Code Baseline	Design Solution	Savings	% Savings	
CO2 Emissions	Tons					
SOx Emissions	Tons					
NOx Emissions	Tons					
Particulate Emissions	Tons					
Others?						

Life Cycle Assessment Indicators (Athena)	Units	Code Baseline	Design Solution	Savings	% Savings	
Primary Energy	MJ					
Solid Waste	kg					
Air Pollution Index						
Water Pollution Index						
Global Warming Potential	kg					
Weighted Resource Use	kg					

- Describe and evaluate two scenarios using renewable and distributed energy systems. Fill out a table similar to the table in item #1 for each scenario.
- List all refrigerants used in the building mechanical equipment. For each refrigerant indicate:
  Atmospheric lifetime _____ Ozone depletion potential _____ Global warming potential _____

Indoor Environmental Quality Guidelines

Overview

The provision of Indoor Environmental Quality at levels that support productive human habitation is equal and complementary to the environmental and economic goals for sustainable building. Appropriate indoor environmental qualities of air, temperature, sound, light, visible and physical space and occupants' ability to personally control these are the building's contributions to the biological bases of occupant comfort, health and well-being. Harmful effects on occupants of poor indoor environmental quality are well documented in laboratory and field studies. Similarly, enhanced indoor environmental quality helps occupants feel and perform at their best, with subsequent health, well-being and productivity benefits for themselves and their work organizations. These indoor environmental quality guidelines are constructed to first and foremost ensure that no harm comes to occupants, then to optimize environmental quality conditions to correspond with human physiological processes, and finally to fine tune environmental conditions to work activities in a way that further enhances personal and organizational productivity.

Goal

To provide exemplary indoor air quality and other interior environmental conditions to promote occupant health, well-being and productivity. Here, "health" is more than the absence of disease and "well-being" includes provision of physical comfort and psychological satisfaction with the physical work environment.

Objectives

- Provide a clean building that will minimize pollutant sources in the structure and its occupants.
- Provide a dry building to minimize structural and health problems associated with water intrusion and accumulation.
- Provide a well-ventilated building to dilute pollutants and bioeffluents emitted by the building materials, the occupants and their activities.
- Provide for occupant thermal comfort.
- Provide daylight for general ambient illumination.
- Provide interior view space or views to the exterior.
- Provide lighting solutions of high quality for visual tasks and preferred interior rendering.
- Provide interior conditions that avoid harmful vibration and noise effects and produce a positive soundscape acceptable to occupants and appropriate to their tasks.
- Provide for local occupant control of localized indoor environmental conditions in order to quickly correct harmful conditions and to better support work performance.
- Provide an interior spatial arrangement that encourages healthy human interaction and movement

Guidelines (Required except where noted with * which indicates recommended)

I.1 Restrict Environmental Tobacco Smoke
I.2 Indoor Air Quality and Ventilation Framework
I.3 Specify Low-emitting Materials
I.4 Ventilation Based on Anticipated Pollutants
I.5 Ventilation Based on Carbon Dioxide Limits
I.6 Moisture Control
I.7 Thermal Comfort
I.8 Daylight*
I.9 Quality Lighting
I.10 View Space and Window Access*
I.11 Whole Body Vibration in Buildings

I.12 Effective Acoustics and Positive Soundscapes
I.13 Personal Control of IEQ Conditions and Impacts
I.14 Encourage Healthful Physical Activity*
I.15 Outcome Documentation for Indoor Environmental Quality

Forms

I-A Indoor Environmental Quality Outcome Documentation Form

I.1 Restrict Environmental Tobacco Smoke

Intent

To reduce indoor pollutants by eliminating environmental tobacco smoke (ETS) from occupied areas of the building.

Performance Criteria

- Establish a no smoking policy for the building.
- Smoking policy will state where smoking outside of building can occur, such that design considerations will not introduce ETS into the building from outdoor sources.
- Design documentation must state explicitly that the building was designed assuming that smoking would not occur in the building.

I.2 Indoor Air Quality and Ventilation Framework

Intent

To ensure good indoor air quality by requiring most of the general procedures and information contained in the industry ventilation standard.

Performance Criteria

- Meet ASHRAE Standard 62-2001, and all appropriate addenda except when superceded by other sections of these guidelines (see guidelines I.3, I.4, and I.5).

I.3 Specify Low-emitting Materials

Intent

To reduce indoor chemical pollution in a building by choosing low-emitting materials and furnishings through construction, operations and maintenance. Since material emissions are a factor in the ventilation rate required by the guidelines, lower emitting materials may also reduce the ventilation rate.

Performance Criteria

Comply with requirements of indoor air quality (IAQ) limits for indoor air pollutants, meet or outperform volatile organic compounds(VOC) limits for adhesives, sealants, paints, composite wood products, finishes, furnishings, and carpet systems as follows:

- Adhesives must meet or outperform the VOC limits of South Coast Air Quality Management District rule #1168 by, AND all sealants used as a filler must meet or exceed Bay Area Air Quality Management District Reg. 8, Rule 51.

- Paints and coatings must meet or outperform the VOC and chemical component limits of Green Seal requirements, for materials used in spaces occupied within 72 hours of application. Paints containing a minimum of 20% recycled content, which may not meet Green Seal low emission requirements, may be used as a primer in spaces unoccupied within 72 hours of application. Refer to Guideline M.3 for recycled content recommendations.
- Carpet systems must meet or outperform the Carpet and Rug Institute Green Label Indoor Air Quality Test Program.
- Composite wood and agrifiber products must contain no added urea-formaldehyde resins.
- Furnishings must meet or outperform the VOC and chemical component limits of the State of California Model Office Furniture System Final Environmental Specifications (Rev. 12/18/00), Sections A and B: Indoor Air Quality, for materials used in spaces occupied within 72 hours of installation.

I.4 Ventilation Based on Anticipated Pollutants

Intent

To ensure good indoor air quality by identifying pollutant concentration target values for use by the design team to calculate ventilation rates for a space.

Performance Criteria

Calculate ventilation requirements based on the pollutant concentration ranges shown below. These are concentration ranges that are typically seen in buildings with acceptable indoor air quality in the U.S.—they are not intended to be action levels. If sources that are listed in the Table will be present in the building or at the building site then the pollutant target should be part of the ventilation calculation for this building.

Pollutant	Sources	Guideline Range
Formaldehyde (HCHO)	Pressed-wood products, furniture and furnishings	0.01 to 0.05 ppm
Ozone (O_3)	Electrostatic appliances, office machines, ozone generators, outdoor air	0.01 to 0.02 ppm
Total Volatile Organic Compounds (TVOC)	New building materials and furnishings, consumable products, maintenance materials, outdoor air	100 to 300 $\mu g/m^3$
Particles ($PM_{2.5}$)	Combustion products, cooking, candles, incense, outdoor air	1 to 10 $\mu g/m^3$

Radon is not listed in the guideline table since it is a pollutant that is best controlled using source prevention techniques rather than ventilation. If construction is to occur in one of the 68 Minnesota counties considered "zone 1" by the US EPA, guidance contained in the EPA document, "Radon Prevention in the Design and Construction of Schools and other Large Buildings", must be followed.

Calculation Method

- The design team shall work with the owner to choose concentration guidelines that are appropriate for the building's program and local site.
  - Choose concentration targets within the required target ranges for those pollutants listed in the performance criteria.
  - Choose additional concentration targets based on other indoor or outdoor pollutants identified in Predesign Programming or Site Selection phases.

- Gather emission information for all pollutant sources listed in I.3, and those listed in I.4 performance criteria under the "Sources" column. Also obtain emission information for any other pollutant sources the team has identified for the particular site and project conditions.

- Based on concentration targets and emission information above, calculate corresponding ventilation rates using mass balance calculation procedures such as IAQDT developed by the National Institute of Standards and Technology (NIST), OR the mass balance equations given in Appendix I-C. One estimate will result from each pollutant.

- Compare these ventilation rates with those calculated in Guideline I.5 based on C02 concentrations. The guideline design ventilation rate for each space is the largest of the values required to control pollutant concentrations (I.4) or CO2 concentrations (I.5.)
  Note: The ventilation rate determined by this method will most likely, but not necessarily, be greater than that determined by ASHRAE 62. It is the responsibility of the mechanical engineer of record to determine a design ventilation rate that meets code through compliance or variance.

- Coordinate with the energy analysts for the project, so that actual design ventilation rates are the same in both ventilation and energy design processes. The design team should consider using strategies that will provide the opportunity to reduce energy use associated with ventilation. The list recommended to consider includes, but is not limited to:
  - CO2 or other occupancy control to reduce ventilation in the building when it is unoccupied.
  - Use of ventilation strategies that increase ventilation efficiency such as displacement ventilation.
  - Using economizer cycles when possible.
  - Using heat recovery strategies in the ventilation design chosen.

I.5 Ventilation Based on Carbon Dioxide Limits

Intent

To provide adequate ventilation to control bioeffluents from building occupants.

Performance Criteria

- The CO_2 concentration in occupied zones[1] shall not exceed 450 ppm above outdoor concentrations.

Calculation Method

- Determine design occupancy levels to calculate design CO2 emissions in occupied zones.[2] Use estimated actual design occupancy levels or ASHRAE design occupancy levels by space type.

- Determine ventilation rates needed to limit CO2 concentrations to 450 ppm above the outdoor concentrations in all occupied zones[2].

- Compare these ventilation rates with those calculated in Guideline I.4 based on pollutant concentrations. The guideline design ventilation rate for each space is the largest of the values

[1] Occupied zone: the region within an occupied space between 3 and 72 in. (75 and 1800 mm) above the floor and more than 2 ft (600 mm) from the walls or fixed air-conditioning equipment. [ASHRAE Standard 62-2001]
[2] Occupied zone: the region within an occupied space between 3 and 72 in. (75 and 1800 mm) above the floor and more than 2 ft (600 mm) from the walls or fixed air-conditioning equipment. [ASHRAE Standard 62-2001]

required to control pollutant concentrations (I.4) or CO2 concentrations (I.5.)
Note: The ventilation rate determined by this method will most likely, but not necessarily, be greater than that determined by ASHRAE 62. It is the responsibility of the mechanical engineer of record to determine a design ventilation rate that meets code through compliance or variance.

- Coordinate with the energy analysis process, so that actual design ventilation rates are the same in both ventilation and energy design processes. The design team should consider using strategies that will provide the opportunity to reduce energy use associated with ventilation. See I.4 for a list of recommended strategies to consider.

I.6 Moisture Control

Intent

To prevent exterior water intrusion, leakage from interior water sources, or other uncontrolled accumulation of water.

Performance Criteria

- Design the building envelope to resist moisture penetration, and, if it occurs, provide drainage planes to the exterior during the heating season and drainage planes to the interior during the cooling season (Lstiburek, 02).
- Design HVAC systems (and exterior wall/window construction) to hold interior relative humidity (RH) between 20 and 50%. (Wyon, 02)
- Design building envelope elements so that surface temperatures remain warm enough to resist indoor condensation.
- Specify maximum moisture content of materials used in construction to assure that subsurface layers are dry enough to prevent moisture trapping by surface finish materials (Harriman et al., 2001)

I.7 Thermal Comfort

Intent

To provide for occupant thermal comfort through control of operative temperature, which includes wet bulb, dry bulb and globe temperatures, relative humidity (RH), mean radiant temperature (MRT), and air velocity.

Performance Criteria[3]

- No continuous indoor exposure to Operative Temperature greater than 80°F or less than 64°F. Note: Operative Temperature (OT) is also known as Wet Bulb Globe Temperature, (OT = 0.7 Normal Wet Bulb + 0.2 Globe Temperature + 0.1 Dry Bulb Temperature)
- No continuous indoor exposure to greater than 0.30 asymmetry in MRT across three body plane hemispheres (front-back, side-side, top-bottom).

[3] Higher Thermal Comfort performance is achievable with the following criteria:
- Full compliance in keeping thermal variables within ASHRAE 55-1992 winter and summer comfort zones.
- Vary dry bulb temperature (DBT) via building control system so as to avoid thermal boredom. Produce ramped drifts of up to + 2.0°F/hr in peak-to-peak variation around neutral temperature.

OR when taken from all continuously occupied positions, the wall, floor, and ceiling surface temperatures shall be no more than 20°F different from each other.

- Air velocity shall be no less than 10fpm for continuously occupied spaces.
- Interior relative humidity (RH) not continuously greater than 50% or less than 20% in continuously occupied workspace.

I.8 Daylight

(Recommended, Not Required)

Intent

To provide daylight for ambient illumination at levels and conditions known to produce physiological and psychological benefits. Daylight contributes to a perception of a 'bright and cheery' workplace through provision of volumetric brightness (also called "room-surface brightness.") The important qualities of daylight are its inherent variation, power spectrum (color), and the predominantly horizontal component of its illumination vector (direction of illumination).

Performance Criteria

These criteria are recommended but not required by these guidelines:

- In continuously occupied space, daylight contribution to required ambient light shall be at least 50%, measured as an average on an annual basis, at a point equal to the ceiling distance height from the furthest wall from the windows.
- On an average annual basis, with electric lighting off, the illumination contribution of daylight reflected from the rear wall (or partition) of a space adjacent to exterior windows shall be no less than 20% of the total daylight illumination. This shall be measured at a line parallel to the rear wall at workplane height at a distance equal to ceiling height of the space.

I.9 Quality Lighting

Intent

To provide lighting (natural and artificial) of high quality for visual tasks and preferred interior rendering. The important lighting quality characteristics and effects include: glare-free, good (natural) color rendering, enhanced sense of spaciousness, and attractive rendering of people for social exchanges. Quality lighting enhances effectiveness of social communication and contributes to creating the perception of a 'bright and cheery' workplace through volumetric brightness.

Performance Criteria[4]

- A glare index based on Visual Comfort Probability (VCP) or Discomfort Glare Rating(DGR) or Unified Glare Rating (UGR) of no less than 70% in all continuously or intermittently occupied spaces except storage areas and mechanical rooms.

[4] Higher Lighting Quality performance is achievable with the following criteria:

- Increase CRI at least 90 for all continuously or intermittently occupied spaces.
- From a distance equal to the ceiling height on a line parallel with all permanent interior partitions, the horizontal illumination value of light reflected from a solid wall should be at least 50% of the vertical illumination value measured or simulated without interior furnishings at a level equal to average standing eye height.

- A Color Rendering Index of at least 80 for all ambient luminaires in continuously occupied spaces and restrooms.
- A Color Rendering Index (CRI) of at least 90 for ambient luminaires in all intermittently occupied meeting spaces.

I.10 View Space and Window Access
(Recommended, Not Required)

Intent

To provide interior view space or views to the exterior, that possess preferred and demonstrably beneficial characteristics. The benefits are the ability for focal rest to avoid eyestrain, and access to visual information about changing outside conditions. A view amenity also aids varying attention cycles and relieves the stress of mental work.

Performance Criteria[5]

These criteria are recommended but not required by these guidelines:

- From every continuously occupied position in spaces there shall be visual access to an external window view that is at least 5-10 degrees in horizontal visual angle at no greater than the 50th percentile standing average eye height.
- From every assigned and continuously occupied workstation position at seated eye level there shall be available at least a continuous 20 degrees horizontal and 15 degrees vertical view space that is at least 20 feet in sight vector length.

I.11 Whole Body Vibration in Buildings

Intent

To provide interior conditions that avoid harmful vibration effects produced by wind sway, transmitted outdoor sources, indoor machinery (especially HVAC) and foot traffic. This will avoid prolonged exposure to unhealthy vibration levels, and enable prolonged comfortable work at a workstation. It will also diminish anxiety and stress due to wind sway on upper floors as well as maintain the value of the building.

Performance Criteria[6]

- Return period of greater than 0.5% g horizontal acceleration in top third of building is not less than 6 years.
- Floor vibration shall be kept above Splittgerber Minimum Complaint Level (approximately 0.001 A rms,g across 4-8 hz resonant with human body components) or 8 hr reduced comfort level (approximately 0.15m/sec2 across 4-8 hz resonant with human body components) for all continuously occupied spaces, restrooms and meeting rooms.

[5] Higher performance is achievable with the following view space criteria:

- Views to horizon lines, clouds, tree lines and clusters and natural waterscapes.

[6] Higher performance is achievable with the following vibration criteria:

- Extend floor vibration criterion to all intermittently occupied spaces except storage areas.

I.12 Effective Acoustics and Positive Soundscapes

Intent

To provide interior conditions that avoid harmful noise effects and produce a basis for a positive soundscape acceptable to occupants and appropriate to their tasks. The benefits are avoiding exposure to: unhealthy noise levels, the elevated stress which accompanies higher background noise levels and noise distraction impacts on mental work. Effective acoustics enable effective speech communications at normal speaking voice while providing for local speech privacy.

Performance Criteria[7]

- Recurrent background noise from external and internal sources shall not exceed 70db.
- All continuously occupied office space shall meet a NCC (Noise Criterion Curve) of no greater than NC-50.
- All classroom space shall meet an NCC of no greater than NC-45.
- Reverberation time for all continuously occupied space shall be no less than 0.4 sec and no greater than 0.8 sec.
- Speech Interference Level (SIL) for continuously occupied office spaces shall be no greater than 55db.
  OR: Articulation Index shall be no less than 0.55.

I.13 Personal Control of IEQ Conditions and Impacts

Intent

To provide for local occupant control of interior conditions to better support work performance. Personal control will enable immediate improvement of intermittent discomfort and will help indicate personal availability or current work status. It will also allow workers to increase personal comfort in changing organizational contexts. However, occupants shall not be put in recurrent uncomfortable conditions, so that continuous adaptation is necessary to maintain comfort.

Performance Criteria[8]

- Provide adjustable task lighting to include 'on', 'off', and intermediate levels.
- Demonstrate means of ameliorating direct solar gain, intermittent noise, drafts or low air circulation, and building control system malfunctions at all continuously occupied and assigned positions.

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[7] Higher acoustic performance is achievable with the following criteria:

- Reduce NCC criterion to NCC 45 for continuously occupied spaces and no greater than NCC 40 for intermittently occupied meeting spaces like conference rooms.
- Create a background 'positive soundscape' through introduction of sounds that provide variations similar to benign natural environments. (white noise is generally not a preferred solution for acoustic soundscapes.)

[8] Higher performance is achievable with the following personal control criteria:

- Increase flexibility of workspace through adoption of standards for ergonomically adjustable and movable furniture elements. (BIFMA Office Furniture Standard, European CEN Workplace Standard, NASA Man-System Integration Standards)
- Use tools to perform Spatial Syntax and other (e.g. Isovist) analyses that can be used to improve flexibility and habitability of workspace.

- Neck extension for continuously viewing monitors at workstation shall not be greater than 0 degrees vertical. Head rotation for continuous viewing shall not be greater than 10 degrees horizontal.
- At keyboard rest, there shall be no continuous deviation from an approximate 0 degree angle in elevation from elbows at sides at rest through wrists to fingertips on keyboard.

I.14 Encourage Healthful Physical Activity
(Recommended, Not Required)

Intent

To provide spatial conditions conducive to incidental physical activity. Movement (like walking) between workplace destinations helps maintain cardiovascular fitness, mental alertness, and encourages synergistic staff interactions that improve morale and well-being.

Performance Criteria[9]

These criteria are recommended but not required by these guidelines:

- All new buildings shall have an 'open' or 'enhanced' stair design connecting the main (entry level) floor with at least the next two floors above it and the first floor beneath it. This encourages and enables building occupants to safely and conveniently use the stairs to travel between floors in their daily building circulation.[10]

I.15 Outcome Documentation for Indoor Environmental Quality

Intent

Establish benchmarks and link IEQ requirements (and chosen recommendations) with measurable occupant benefits. These results are inputs for the total building outcome documentation and life cycle cost analysis.

Performance Criteria

Complete I-A Outcome Documentation Form at the end of each phase to document design decisions for those portions of the guideline implemented at that time.

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[9] Higher performance toward healthful activity is achievable with the following criteria:

- Encourage staff to walk to routinely used building service centers and interior destinations through design of circulation path and its amenities. Features that encourage physical activity include:
  - Separation of restrooms and service centers (like mailrooms and refreshment dispensers and break rooms) from work areas
  - Enhanced daylight and views along a circulation path
  - Different routes to popular interior destinations
  - Interior circulation paths that allow round trips without reversal of direction.
  - Interior circulation paths with adjoining meeting niches and nooks that encourage spontaneous staff interaction along the path lengths.

[10] Amenities that encourage such casual and continuous use of stairs include: position of stairs in floor plan, openness of stairway to surrounding interior views, provision of rest and incidental meeting nooks along stairway length, reversal or curving of stairway to facilitate expanded user view of stair traffic, proper stairway riser/tread ratios, surfacing, and grab handle meeting HFES (not minimum building code) design recommendations.

FORM I-A: INDOOR ENVIRONMENTAL QUALITY— OUTCOME DOCUMENTATION

For work through phase: _____as of the date:_____

INDOOR AIR QUALITY

- For each major type of occupied space, provide the following ventilation indicators:
  Area _____ Ventilation rate (cfm/sf) _____ % outside air _____ CO2 concentration _____
- For each major type of occupied space, provide the following emissions indicators:
  Area _____ Emission rates of interior finish materials (VOCs) _____
  (Attach a list of interior finish materials)
- For each major type of occupied space, provide the following thermal comfort design assumptions:
  Temperature range _____ Relative humidity range _____

DAYLIGHT, LIGHTING AND VIEW

- For each major type of occupied space, provide the following daylight indicators:
  Area _____ Daylight Factor _____
  Average annual daylight contribution (see Guideline I.8) _____ (% of total)
  Average annual daylight contribution reflected from back wall _____ (% of total)
- For each major type of occupied space, provide the following quality lighting indicators:
  Area _____ Lighting type _____ Lighting quantity (footcandles at desktop) _____
  Glare index _____ Color rendering index _____ Lighting power density (W/sf) _____
- For each major type of occupied space, provide the following view indicators:
  Area _____ % area with direct line of sight to a window _____
  Visual access angle to external windows (see Guideline I.10) _____
  Visual access angle and distance for internal view (see Guideline I.10) _____

ACOUSTICS AND VIBRATION

- For each major type of occupied space, provide the following acoustic indicators:
  Area _____ Background noise (db) _____ Reverberation time _____
  Speech interference level (db) _____ Articulation index _____
  Indicate the Noise Criterion Curve (NCC) used for design _____
- Provide the following whole body vibration indicators (see Guideline I.11):
  Return period of >0.5% g horizontal acceleration in top third of building (years) _____
  Floor vibration criteria _____

PERSONAL CONTROL AND HEALTH

- For each major type of occupied space, provide the following personal control indicators:
  Access to operating windows _____ Temperature control _____ Air movement control _____
  Lighting control _____ Glare control _____ Furniture adjustment (ergonomic standards) _____
- Indicate building design strategies used to encourage healthful activity _____

Materials and Waste Guidelines

Overview

Selection and use of materials and resources for more sustainable building has been an evolving process since the first recycled content products hit the market in the early 1970's. Costs related to increased waste from construction, depletion of non-renewable resources, and air and water pollution from production and distribution are becoming increasing drains on our economy. Because the building industry consumes over 3 billion tons of raw materials annually – around 40 percent of the total material flow in the global economy – the need to reduce the effects of building material extraction, processing, delivery, use, and disposal has become imperative to improving the health of our economy and our communities. To this end, guidelines and rating systems have sought to guide practitioners toward choices that reduce waste and the negative environmental impacts associated with materials through prescriptive requirements for such characteristics as amount of recycled content, locally produced or assembled products, and sustainably harvested wood. *The State of Minnesota Sustainable Building Guidelines* (MSBG) are moving away from prescriptive requirements toward material selection based on Life Cycle Assessment (LCA) and Life Cycle Cost (LCC), which will provide a better connection to real effects and costs based on outcome-based performance criteria. However, until there is more complete data available, MSBG will still use prescriptive requirements to effect change. To gather the necessary performance data, MSBG requires "Outcome Documentation" (M.4,) which provides measurements of the environmental, economic, community and health impacts related to materials selection.

Current tools associated with LCA include ATHENA (www.athenasmi.org) and BEES (Building for Environmental and Economic Sustainability –www.bfrl.nist.gov/oae/software/bees.html.) These programs offer basic information on the environmental impacts associated with full life cycle review of materials and products – from extraction/harvesting through production/ manufacturing, transportation, use/reuse, and disposal. Where information from LCA and LCC data is available, it has been provided in easily accessible charts to assist in making informed decisions to use or not use a variety of individual materials as well as assemblies. The aim of MSBG is to gather additional data from projects, both technical and anecdotal, and to augment current information in order to improve the selection process and provide real choices, based on quantifiable data specific to our region.

Goal

To produce projects with the lowest reasonable life cycle cost and environmental impact, while providing the highest level of community and human benefits, based on material resource use and waste management.

Objectives

- Evaluate design alternatives to optimize the life cycle of the building and to minimize a project's material resource use over its lifecycle considering alternatives such as: designing for reduced construction through shared use of spaces, building or material reuse, design for disassembly/future reuse of building components, and design for flexibility and adaptability, appropriate to intended building and material life and selecting building systems taking into account their economic, human, community, and environmental outcomes over the lifecycle of the facility.
- Evaluate material alternatives to optimize their total life cycle performance considering material property alternatives such as: high recycled content, locally/regionally produced, made from rapidly renewable agricultural byproducts, ability to be reused, recycled, or that are biodegradable, and maximum durability based on anticipated life of interior construction, equipment, finishes, and furnishings.

- Reduce and manage wastes generated during the construction process and operation of buildings (building occupancy.)
- Determine the project's net environmental, economic, and community impacts over it's lifecycle related to quantity and type of material used and the way that waste is reduced and managed.

Guidelines

M.1 Evaluation of Design for Resource Use
M.2 Evaluation of Material Properties for Improved Performance
M.3 Waste Reduction and Management
M.4 Outcome Documentation for Materials and Waste

Forms

M-A. Materials and Waste Outcome Documentation Form

M.1 Evaluation of Design for Resource Use

Intent

First, to evaluate the benefits of planning for conservation approaches such as designing buildings appropriate to their projected life cycle and minimizing a project's material resource use over that lifecycle. Secondly, to evaluate and select building systems taking into account their economic, human, community, and environmental outcomes over the lifecycle of the facility.

Performance Criteria

Planning for Conservation Analysis:

- In this guideline, there are no requirements for how to respond to planning for conservation strategies; however, an analysis is required to evaluate these strategies for their economic, human, community and environmental outcomes.
- Establish a Planning Baseline of the same type as the proposed project. The Planning baseline shall identify the resource use for a conventional new building with conventional construction. Determine the typical industry construction for this project type for each of the following building systems: Substructure, Exterior Shell, Roofing, Interior Walls, Interior Finishes, Furnishings. Base the evaluation on a selected life projected for the building. If the agency responsible does not set a specific life of the building, use a 50 year minimum life for major structural, shell and cladding components. For interior construction, finishes, and furnishings assume an industry standard model of life cycle for project type and scale.

- Evaluate the following recommendations compared to the Planning Baseline for their benefits towards economic, human, community, and environmental outcomes and document the information on Form M-A as appropriate to the level of detail required at this point:
  - Design for Less Space: Maximize use of space by sharing space/services, expanding hours of use, or other means to reduce overall square footage requirements from traditional building model for specific project type. Refer to P.3 Planning for Conservation for Tasks by Phase.
  - Design for Building Reuse: Reuse an existing building versus building a new building, to save or minimize material resources.
  - Design for Less Resource Use: Reuse existing building materials, equipment, finishes, or furnishings versus constructing using new materials, to save or minimize material resources.
  - Design for Flexibility, Adaptability, and Disassembly: Reduce material resource use through design that: allows for adaptability of space and building components to

accommodate new or alternative uses, provides flexibility to accommodate projections of churn, minimizes ongoing material requirements associated with renovation or remodeling, and provides capability for disassembling for reuse for a minimum of 25% of the mass of the building structure and 25% of the interior construction (partitions, finishes,` furnishings.)

- Design for Appropriate Life of Substructure and Structural Systems, Exterior Cladding and Shell, and Building Systems (Durability): Provide evaluation of building system components that meet agency requirements for life of building. Recommendation, if not specifically determined by client, is for a 50 year life for major building structural components, exclusive of interior construction, finishes, and furnishings.

- After analyzing the alternatives, select desired planning for conservation approaches above and incorporate them into a Programming Baseline, updating variables for items such as lifecycle planned for the building, reused building area versus new, or other reduced area of construction. If construction types have changed due to this analysis, for example to better accommodate disassembly, then also incorporate these into the Programming Baseline.

Building System Life Cycle Analysis:

- Compare the construction types of the Programming Baseline with at least two alternatives for each of the following building systems: Substructure, Exterior Shell, Roofing, Interior Walls, Interior Finishes, Furnishings. These may be various traditional options or other proposed alternative building systems. The comparison shall consider impacts on economic, human, community and environmental outcomes where data is available. Use examples of typical building systems provided in resources for these Guidelines, or use proposed alternative examples created with Life Cycle Analysis software (recommended programs such as ATHENA or BEES.).
- Based on project sustainable goals, evaluate the comparisons and select those systems that offer the most beneficial outcomes for all of the project concerns. This set of chosen construction types will be combined with the other information in the Program Baseline to form a new Design Baseline which will serve as the Materials and Waste baseline for comparison in all following phases.
- Complete requirements for Outcome Documentation of final building systems selection and evaluation for total material resources used.

M.2 Evaluation of Material Properties for Improved Performance

Intent

To determine the value and encourage the use of materials and products that meet specific prescriptive requirements understood to provide improved life cycle performance. Proof of improved life cycle performance will encourage increased demand for these building materials and products and, therefore, increased availability for use.

Performance Criteria

This guideline does not require implementation of any minimum level of materials or products meeting these criteria. However, in most cases a recommended minimum level is suggested and an analysis is recommended that considers the economic, human, community and environmental outcomes from supplying a percentage of the building's total mass with materials and products meeting these criteria.

Material properties to be evaluated:

- High recycled content
- Locally/regionally produced and manufactured.
- Made from rapidly renewable agricultural byproducts
- Able to be reused, recycled, or that are biodegradable
- Maximum durability based on anticipated life of exterior and interior construction, equipment, finishes, and furnishings

Evaluate material or product selections compared to the Design Baseline based on the following criteria and indicate benefits based on Life Cycle Assessment (LCA) information where available, or anecdotal information in the form of descriptive paragraphs where LCA is not available at this time. For consistency in collecting data for comparison, the following levels are recommended for evaluation:

- Materials that contain, in aggregate, a minimum weighted average of 20% post-consumer recycled content material, OR, a minimum weighted average of 50% post-industrial recycled content material.
- Materials manufactured[1] regionally within a radius of 250 miles of project site to specified qualifications, or are manufactured within the State of Minnesota and contain products from state-sponsored, approved, or acknowledged recycling programs.
- Materials locally/regionally produced[1] (from within 500 miles of the project site, or within the State of Minnesota, or which contain materials from State of Minnesota recycling programs.)
- Wood products (for wood building components, including but not limited to structural framing and general dimensional framing, flooring, finishes, furnishings, and non-rented temporary construction applications such as bracing, concrete formwork, and pedestrian barriers) certified in accordance with approved third party authorities, which meet the following criteria at a minimum:
  - Provide 'chain of custody' for all wood products;
  - Use "on-the-ground' performance-oriented evaluation techniques that do not rely only on procedural review;
  - Do not use a different standard for products obtained from suppliers not owned by the company seeking certification; and
  - Do not allow 'conversion' of natural forests to plantations.
- Materials made from rapidly renewable agricultural byproducts.
- Materials made from reusable, recyclable, or biodegradable resources. Refer to M.1 for materials specifically selected to promote minimum resource use.

Materials and products which have more than one recommended characteristic will, in most cases, provide higher cumulative benefits than those with only one characteristic.

M.3 Waste Reduction and Management

Intent

To minimize use of resources and negative environmental impacts through careful reduction and management of wastes generated during the construction process and operation of buildings (building occupancy.)

[1] Refer to Definitions in Glossary.

Performance Criteria

- Construction waste: Minimize waste generated from construction, renovation and demolition of buildings through detailing and specifications. Divert construction, demolition, and land clearing debris from landfill disposal. Redirect recyclable material back to the manufacturing process and reuse, recycle, and/or salvage at least 75% (by weight) of construction, demolition, and land clearing waste (per State of Minnesota requirements.)[2]
- Packaging waste: Reduce and recycle packaging waste associated with the construction process, and encourage manufacturers to ship their product using reusable, recyclable, returnable, or recycled content packaging. Reuse or return 50% of all packaging material, by weight, to suppliers or manufacturers. [3]
- Hazardous waste: Establish a goal of at least a 50% reduction in the use of hazardous materials through project construction and building operation. Appropriately store, handle, and dispose of hazardous waste generated during building construction, operation, and decommissioning.

M.4 Outcome Documentation for Materials and Waste

Intent

To document the environmental, economic, and community impacts related to material use and waste management in buildings. Human benefits to occupants of low-emitting materials are covered and documented under Outcome Documentation for Indoor Environmental Quality.

Performance Criteria

Complete M-A Outcome Documentation Form at the end of each phase to document design decisions for those portions of the guideline implemented at that time.

[2]Recommendation for higher achievement on construction waste management: Recycle and/or salvage an additional 15% (90% total by weight) of the construction, demolition, and land clearing waste.

[3] Recommendation for higher achievement on packaging waste management: Return an additional 25% (75% total by weight) of all packaging material to suppliers or manufacturers

FORM M-A: MATERIALS AND WASTE—OUTCOME DOCUMENTATION

For work through phase: _____as of the date:_____

LESS RESOURCE USE BY DESIGN

- Is there an existing building(s) on site? _____ Size and type _____
- Reuse of existing building (s): Shell (percent and area) _____ Interiors (percent and area) _____
- Building life cycle (years): Baseline model _____ Project design model _____
- Building program (sf): Baseline model _____ Project design model _____
- How much was program reduced by efficient planning and sharing of space? _____
- Was the project design for flexibility or adaptability to future uses? _____ Explain _____

MATERIAL AND PRODUCT CHARACTERISTICS

- Total material on project: Volume _____ Cost _____
- Total post-consumer (PC) recycled content on project: Volume _____ Cost _____
- Total post-industrial (PI) recycled content on project: Volume _____ Cost _____
- Total materials produced within 500 miles of project: Volume _____ Cost _____
- Total materials produced from rapidly renewable sources: Volume _____ Cost _____
- Total material which can be reused: Volume _____ Cost _____
- Total material which came from salvaged sources: Volume _____ Cost _____
- Total material which can be recycled: Volume _____ Cost _____
- Total material which is biodegradable: Volume _____ Cost _____
- Total materials which are FSC certified wood products: Volume _____ Cost _____
  (Attach lists of materials in each category—questions 8-16)

WASTE REDUCTION

- Is there a construction waste management plan? _____
- Construction waste: Baseline (typical): % landfilled _____ % recycled _____
  Project design model: % landfilled _____ % recycled _____
- Packaging waste: Baseline (typical): % landfilled _____ % recycled _____
  Project design model: % landfilled _____ % recycled _____
- Is there a building waste management plan? _____
- Building waste: Baseline (typical): % landfilled _____ % recycled _____
  Project design model: % landfilled _____ % recycled _____