MINNESOTA B3 GUIDELINES®

# New Buildings and Major Renovations

## Version 3.2 Revision ~~02~~03

## June ~~2024~~2026

Center for Sustainable Building Research
College of Design · University of Minnesota


# Print Version Contents

**Appendices: Templates and calculators not included in print version**

Appendix M-3b2 Construction Waste Recycling Economics Calculator

Appendix M-3b3 Construction and Demolition Waste Reporting Calculator

Appendix M-3b3 Packaging Waste Recycling Economics Calculator

All SB 2030 Documents Available at ~~b3mn.org/2030energystandard/~~b3mn.org/2030energystandard

# B3 Guideline Version History

The B3 Guidelines are a set of building project requirements and recommendations which build on regional and national efforts to achieve goals of reducing energy consumption and carbon emissions, enhancing the health, well-being and productivity of building occupants, and improving the quality of the environment. They are designed to be compatible with other national guidelines and rating systems while maintaining regional values, and priorities. They are also intended to be clear, simple, and easily monitored with explicit documentation to record progress. The B3 Guidelines set up a process for quantifying the human, community, environmental, and life-cycle economic costs and benefits to help to fully account for the actual costs and benefits of sustainable building design.

The B3 Guidelines are required for projects funded directly or indirectly, in whole or in part, from Minnesota bond monies after January 1, 2004. The guidelines have been updated several times since the beginning of this program: Version 1.1 was the applicable version for new construction projects receiving bond money from 2004 to 2006. Version 2.0 followed for new construction projects receiving bond money prior to 2009. In 2009, Version 2.1 was released with the online B3 Guidelines Tracking Tool when the B3 Guidelines became also applicable for major renovation projects. After August 1, 2009, the Sustainable Buildings 2030 (SB 2030) Energy Standard became the energy efficiency requirement of the program. This standard included a focus on increasing efficiency requirements across a wide array of building types, and providing several paths to compliance.

In 2013, Version 2.2 was released, which included significant updates in site and water management, stormwater management, the incorporation of bird-safe building design, and process requirements reorganized (commissioning).

In 2017 version 3.0 was released and is applicable for projects that began schematic design on or after July 1, 2017 and which had not started predesign and begun tracking in the B3 Guidelines Tracking Tool by January 1, 2019. This revision included updates to the materials related section.

In 2018 version 3.1 was released and is applicable for projects beginning predesign or signed up in the B3 Guidelines Tracking tool after January 1, 2019 and prior to January 1, 2020. Version 3.1 contained substantial revisions to the Site and Water section and the Indoor Environmental Quality Guideline section.

The guidelines contained in this document comprise version 3.2 and are applicable for projects beginning predesign or enrolled in the B3 Guidelines Tracking Tool on or after January 1, 2020 and prior to later version applicable dates. Version 3.2 contains revisions to the Energy and Atmosphere Guideline section.

Note that this document reflects the third revision of Version 3.2 of the program; all projects using version 3.2 will see the relevant updates to program documentation and tracking requirements. Though there are modest changes to the information requested from project teams, it is *not* expected that any project fully compliant with version 3.2 of the B3 Guidelines program prior to this revision would fail to achieve compliance after these updates.

## Guidelines Organization

The guidelines are organized into the following topic categories:

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

- Materials and Waste

In this document, the guidelines are grouped by category. Each category begins with the intent of that topic. Guidelines are noted as required or recommended, and each guideline is presented with specific intent, the required and recommended performance criteria, guidance on meeting the guideline, required Tracking Tool submissions, and additional resources, such as glossaries. This document also includes a list of project information collected by the B3 Guidelines Tracking Tool that does not correspond to specific guidelines.

# Applicability

With the expansion of the legislation in 2008 to include major renovations, the two main types of projects subject to B3 Guidelines are New Buildings and Major Renovations. Each has their own criteria for required use. Note that statute may require projects other than those listed below to meet the B3 Guidelines and SB 2030.

**New Buildings Applicability Criteria:**

All new buildings funded in whole or part by Minnesota bond monies after January 1, 2004 must comply with B3 Guidelines. Additions are considered New Buildings that require compliance with B3 Guidelines if they have both of the following characteristics:

- Either not heated, or if heated the addition has its own heating plant(s) (e.g., boiler, etc.) whether or not its source of energy (e.g., fuel) is from an adjacent building.
- Either not cooled, or if cooled, the addition has its own cooling plant(s) (e.g., chiller, rooftop unit, etc.) whether or not its source of energy (e.g., electricity) is from an adjacent building.

Exceptions to compliance with the B3 Guidelines as a whole are *not* allowed based on size of building, number of utility connections, or whether a building is heated, cooled or electrically lit. However, some individual guideline criteria have detailed applicability criteria.

**Major Renovations Applicability Criteria:**

All Major Renovation work funded in whole or part by Minnesota bond monies after January 1, 2009 must comply with the guidelines. Renovation work is considered under Major Renovations and requires compliance with the guidelines if it has both of the following characteristics:

- Renovated area includes 10,000 sq. ft. or more.
- It encompasses at least the replacement of the mechanical, ventilation, or cooling system of the building, or a section of the building.

Exceptions to compliance with the B3 Guidelines as a whole are *not* allowed based on number of utility connections, or whether the renovated area is heated, cooled, or electrically lit.

**Major Renovations of Limited Scope Guideline Applicability:**

Major renovations projects with limited scope may request that the B3 Guidelines Administrators review the applicability of guidelines unrelated to project work. If approved, an outside-of-scope determination waives these unrelated guidelines. Adequate justification for this determination requires that guidelines are unrelated to project scope: e.g. an interior renovation may request stormwater-related guidelines be considered out-of-scope. Adequate justification does not include projects in which guidelines were simply not included in project scoping.

**Not-Applicable versus Not Compliant Status:**

Any construction project receiving relevant funds but which fails to meet either of the applicability criteria listed above may apply for a Non-Applicable designation. This is done by complete a Non-Applicability Request Form (available from the B3 Project Website). This request process is used to determine whether the B3 Guidelines apply to a project. Submission of this form is not needed if a project is following the B3 Guidelines. Projects receiving relevant funding which are not following the guidelines and have submitted a Non-Applicability Request Form but have not yet received a Not Applicable designation will be noted as "pending" until status can be determined. If the B3 Guidelines Administrators determines that the B3 Guidelines do apply to a project but the project is not following B3 Guidelines, that project will be listed as Not Compliant on the B3 Case Studies Database.

The table below distinguishes requirements for New Buildings from requirements for Major Renovations, while allowing reference to a common master set of guidelines. The table also lists which guidelines are required for different types of renovations.

| | Guideline | New Buildings | Major Renovations |
|---|---|---|---|
| | **Performance Management** | | |
| P.1 | Design and Construction Process | Required | Required |
| P.2 | Operations Process | Required | Required |
| | **Site and Water** | | |
| S.1 | Site and Water Connections | Required | Required for Minimum Site Scope (See Guideline) |
| S.2 | Site Water Quality and Efficiency | Required | Required for Minimum Site Scope (See Guideline) |
| S.3 | Soil | Required | Required for Minimum Site Scope (See Guideline) |
| S.4 | Vegetation | Required | Required for Minimum Site Scope (See Guideline) |
| S.5 | Animal Habitat Support | Required | Required for Minimum Site Scope (See Guideline) |
| | **Energy and Atmosphere** | | |
| E.1 | Energy Efficiency | Required | Required |
| E.2 | Renewable Energy | Required | Required for Minimum Project Scope (See Guideline) |
| E.3 | Efficient Equipment and Appliances | Required | Required |
| E.4 | Atmospheric Protection | Required | Required for new equipment |
| E.5 | EV-Ready | Required | Required for Minimum Project Scope (See Guideline) |
| | **Indoor Environmental Quality** | | |
| I.1 | Low-Emitting Materials | Required | Required for Newly Installed Materials |
| I.2 | Moisture and Water Control | Required | Required if Exterior Envelope is in Scope |
| I.3 | Ventilation | Required | Required |
| I.4 | Thermal Comfort | Required | Required |
| I.5 | Lighting and Daylighting | Required | Required |
| I.6 | Effective Acoustics | Required | Required |
| I.7 | View Space and Window Access | Required | Required |
| I.8 | Ergonomics and Physical Activity | Required | Required |
| I.9 | Wayfinding and Universal Access | Required | Required |
| | **Materials and Waste** | | |
| M.1 | Life Cycle Assessment of Materials | Required | Required (Partial - See Guideline) |
| M.2 | Environmentally Preferable Materials | Required | Required |
| M.3 | Waste Reduction and Management | Required | Required |
| M.4 | Health | Required | Required |

Further detail on applicability criteria is listed under individual guidelines. Renovation projects may still request exemption from specific guidelines if they relate to work outside the project scope: Contact B3 Guidelines Administrators for more detail.

**B3 Guidelines Small Buildings Method Applicability Criteria:**

Projects considered "Small Buildings" are eligible to use a streamlined path through the B3 Guidelines, in which some guidelines are not required and others have alternative compliance paths available. "Small Buildings" are defined as those that include less than 20,000 gross square feet (gsf) of conditioned space[1]. Upon approval from the B3 Guidelines Administrators, several other space types may be eligible for exclusion from the building area calculation, including:

- Spaces that are not regularly occupied and are indirectly conditioned, or semiheated spaces[2]
- Spaces that are not regularly occupied and are primarily used to enclose industrial or similar processes
- Spaces that are not regularly occupied and are primarily used to provide inactive storage

These exclusions are for the sole purpose of determining eligibility for the B3 Guidelines Small Buildings Path; spaces that qualify for exclusion from this building area calculation are not exempt from meeting applicable guideline requirements. Additionally, some spaces that may be excluded from the area calculation for the B3 Guidelines Small Buildings Path may be required to be included when determining eligibility for the SB 2030 Small Buildings Method. The table below outlines which spaces may contribute to each program's determination. Note that there are spaces that may contribute to a project's qualifying B3 Guidelines Area but not toward consideration under SB 2030 (for example, a space in which the HVAC systems will not be modified but which will undergo other renovations). Further details on determination of applicability of the SB 2030 Small Building method can be found at www.b3mn.org/2030energystandard/ or by contacting program support.

| **Which spaces need to be included in the building area calculations to determine applicability of the B3 Guidelines Small Buildings Method and the SB 2030 Small Buildings Method?** | | | |
|---|---|---|---|
| | **Regularly occupied** | **Not regularly occupied** | **Not regularly occupied, and primarily inactive storage/industrial process** |
| Conditioned space | Include for both B3, SB 2030 | Include for both B3, SB 2030 | Include for SB 2030, potentially excluded from B3* |
| Indirectly conditioned | Include for both B3, SB 2030 | Include for SB 2030, potentially excluded from B3* | Include for SB 2030, potentially excluded from B3* |
| Semiheated space | Include for both B3, SB 2030 | Include for SB 2030, potentially excluded from B3* | Include for SB 2030, potentially excluded from B3* |
| Unconditioned space | Do not include for B3, SB 2030 | Do not include for B3, SB 2030 | Do not include for B3, SB 2030 |

*Spaces noted as "potentially excluded" above must be approved by the B3 Guidelines Administrators.

[1] Conditioned Space is defined per ASHRAE: https://www.energycodes.gov/resource-center/faqs/what-are-space-conditioning-types
[2] Semiheated Space is defined per ASHRAE: https://www.energycodes.gov/resource-center/faqs/what-are-space-conditioning-types

The table below outlines guidelines affected by the Small Buildings Method:

| | Guideline | B3 Guidelines Small Buildings Path |
|---|---|---|
| | **Performance Management** | |
| P.1 | Design and Construction Process | |
| | P.1A - Develop Owner's Project Requirements (OPR) Document | Simplified path or documentation available for small buildings |
| | P.1B - Commissioning Plan (Cx Plan) | Simplified path or documentation available for small buildings |
| | P.1C - Develop Basis of Design (BOD) Document | Simplified path or documentation available for small buildings |
| | P.1D - Safety Risk Assessment of indoor air quality issues | Simplified path or documentation available for small buildings |
| | P.1E - Construction & Warranty Period Air Quality Management Plans | Simplified path or documentation available for small buildings |
| P.2 | Operations Process | |
| | P.2A - Energy Efficient Operations Manual | ~~Not required for small buildings~~This program has been sunset |
| | P.2B - Post -Occupancy Evaluation | Buildings with fewer than 25 occupants are currently exempt. |
| | **Site & Water Guidelines** | |
| S.1 | Site and Water Connections S.1 | |
| | S.1A – S.1C | Determined based on site scope not building size |
| S.2 | Site Water Quality and Efficiency | |
| | S.2A – S.2C | Determined based on site scope not building size |
| | S.2D - Building water consumption reduction | Required |
| S.3 | Soil | |
| | S.3A – S.3J | Determined based on site scope not building size |
| S.4 | Vegetation | |
| | S.4A – S.4F | Determined based on site scope not building size |
| S.5 | Animal Habitat Support | |
| | S.5A - Bird-safety Whole Building Threat Factor | S.5O may be available as path for small buildings |
| | S.5B - Bird-safety Non-Enclosure Threat Factor | S.5O may be available as path for small buildings |
| | S.5C - Bird-safety High Risk Surfaces | S.5O may be available as path for small buildings |
| | S.5D - Bird-safety Traps | S.5O may be available as path for small buildings |
| | S.5E - Bird-safety Lights Out Management Procedures | S.5O may be available as path for small buildings |
| | S.5F - Bird-safety First Year Monitoring | S.5O may be available as path for small buildings |
| | S.5G – S.5I | Determined based on site scope not building size |
| | S.5O - Bird-safety Small Buildings Path - Average Glazing Threat Factor | S.5O can be used instead of S.5A through S.5F for small buildings which don't include any "traps" |

| | Guideline | Small Buildings |
|---|---|---|
| | **Energy & Atmosphere Guidelines** | |
| E.1 | Energy Efficiency | |
| | E.1A - Meet SB 2030 Energy & Carbon target | SB 2030 Small Buildings Method available |
| | E.1B - Document energy consumption by energy type | Required |
| | E.1C - Submetering and load disaggregation | Not required for small buildings |
| E.2 | Renewable Energy | |
| | E.2A - 2% of project's total energy use supplied w/renewables | ~~Required~~This guideline has been sunset in lieu of the SB 2030 framework |
| | E.2B - Renewable Energy-Ready Roof or Site | Simplified path or documentation available for small buildings |
| E.3 | Efficient Equipment and Appliances | |
| | E.3A - Equipment & appliances meet Energy Star criteria | Required |
| | E.3B - Process load equipment efficiency (FEMP) | Not required for small buildings |
| E.4 | Atmospheric Protection | |
| | E.4A - Refrigerant selection using EPA SNAP guidelines | Likely limited applicability based on equipment size |
| | E.4B - Refrigerant leakage | Likely limited applicability based on equipment size |
| E.5 | EV Ready | |
| | E.5A - Electric Vehicle Supply Equipment (EVSE) infrastructure | Guideline based on number of parking spots provided |
| | **Indoor Environmental Quality** | |
| I.1 | Low-Emitting Materials | |
| | I.1A - Interior Materials (green certifications) | Simplified path or documentation available for small buildings |
| | I.1B - Wet Applied Materials (VOC limits and chemical restrictions) | Required |
| | I.1C - Composite Wood Products (formaldehyde restrictions) | Not required for small buildings |
| | I.1D - New furniture and furnishings (green certifications for VOC limits) | Not required for small buildings |
| I.2 | Moisture and Water Control | |
| | I.2A - Bulk water management | Required |
| | I.2B - Moisture-safe design (qualitative & quantitative moisture analysis) | Not required for small buildings, but strongly recommended for projects incorporating high R-value assemblies (above code) |
| | I.2C - Moisture safe construction (blower door test/building enclosure consultant) | Required |
| I.3 | Ventilation | |
| | I.3A - Outdoor air ventilation rate minimums per ASHRAE 62.1 or 62.2 | Required |
| | I.3B - Ventilation rate monitoring or yearly measurement | Not required for small buildings |
| | I.3C - Ventilation requirements for printer/copier & chemical storage rooms | Not required for small buildings |
| | I.3D - Minimum filtration requirements | Required |
| | I.3E - Permanent entryway dust/dirt control systems | Not required for small buildings |
| | I.3F - Outdoor air intake minimum separation distances | Required |
| | I.3G - ANSI CC-1000 Soil Gas Control Systems and radon testing | Required |
| I.4 | Thermal Comfort | |
| | I.4A - Passive thermal comfort (window properties and shading) | Required |
| | I.4B - Active thermal comfort | Simplified path or documentation available for small buildings |
| I.5 | Lighting and Daylighting | |
| | I.5A - Meet IES lighting level and contrast guidelines | Not required for small buildings |
| | I.5B - Bulbs provide CRI >/= 80 and RoHS compliant | Not required for small buildings |
| | I.5C - Daylighting levels | Simplified path or documentation available for small buildings |
| I.6 | Effective Acoustics | |
| | I.6A - ANSI Design Requirements for classrooms / learning spaces | Required |
| | I.6B - Exterior source noise control | Not required for small buildings |
| | I.6C - Internal source noise control | Simplified path or documentation available for small buildings |

| | | |
|---|---|---|
| | I.6D - Audio induction loops in gathering spaces | Required |
| | I.6E - Sound masking for spaces requiring additional sound privacy | Required |

| | Guideline | Small Buildings |
|---|---|---|
| | **Indoor Environmental Quality (continued)** | |
| I.7 | View Space and Window Access | |
| | I.7A - Focal relief | Not required for small buildings |
| | I.7B - Access to vision glazing in 75% of regularly occupied spaces | Required |
| I.8 | Ergonomics and Physical Activity | |
| | I.8A - Adjustable height workstations for 25% | Required if furniture part of the project scope |
| | I.8B - Fully Adjustable chairs for all workstation seating | Required |
| | I.8C - Bike storage | Not required for small buildings |
| | I.8D - Easily visible and accessible staircase | Not required for small buildings |
| I.9 | Wayfinding and Universal Access | |
| | I.9A - Lighted exterior signs for parking and building entrances | Not required for small buildings |
| | I.9B - Lighted interior signs and route design for visitors | Not required for small buildings |
| | I.9C - Universal design principles (equitable and flexible use) | Required |
| | I.9D - Quiet use/lactation room | Required |
| | **Materials and Waste** | |
| M.1 | Life Cycle Assessment of Materials | |
| | M.1A – Whole-building life cycle assessment (LCA) GWP reduction | Simplified path or documentation available for small buildings |
| | M.1B - Product Life Cycle Assessments | Not required for small buildings |
| M.2 | Environmentally Preferable Materials | |
| | M.2A - Salvaged, recycled, bio-based, regional, responsibly sourced | Simplified path or documentation available for small buildings |
| M.3 | Waste Reduction and Management | |
| | M.3A - Material Conservation and Waste Management Plan | Not required for small buildings |
| | M.3B - Construction waste reduction | Required |
| M.4 | Health | |
| | M.4A - Materials free of likely hazardous materials | Not required for small buildings |
| | M.4B - Mercury limits in compact fluorescent lamps | Required |

# Process

Compliance with the B3 Guidelines involves the coordination of several project team members across several phases. The primary guideline management roles, the guideline management process and the variance process are outlined below. This process must be completed through the B3 Guidelines Tracking Tool (at trackingtool.b3mn.org).

## Guideline Management Roles

Project Team: The project team is the team responsible for advancing a project through the B3 Guidelines during each phase. Depending on the phase, the project team may include the planning team, predesign team, design team, construction team, or operations team. This team works toward achieving the guideline performance criteria appropriate to their phase. The project team is also responsible for completing all required documentation in the B3 Guidelines Tracking Tool at the end of each phase (and annually during ongoing occupancy for 10 years).

Guideline Leader: The guideline leader coordinates the completion and documentation of tasks to comply with the sustainable building guidelines. Different project team members may fill the role of guideline leader for each phase. The guideline leader may work within the organization contractually responsible for a specific phase, or they may be a consultant hired by that organization. The guideline leader is the primary contact person for guideline compliance. If an agency does not designate this role, a representative from the project team fulfills the guideline leader's tasks.

The guideline leader's duties include:

- Coordinating and supporting the Guideline Management Process.
- Maintaining continuity as the guideline leader's position transfers across phases and responsible organizations.
- Supporting an interdisciplinary, participatory team approach.

The guideline leader should possess the following characteristics:

- Be familiar with B3 Guidelines and with sustainable building practices in general.
- Have good facilitation and communications skills.

Appropriated Agency and Agency Contact: The appropriated agency is the agency that received funding from the capital bond proceeds on behalf of the project and is responsible for compliance review. The Agency Contact role is the representative of the appropriated agency and includes the following responsibilities:

- The appropriated agency is responsible for reviewing completion of the project teams phase submission with B3 Guidelines, according to the Compliance Review Process.
- The appropriated agency reviews and decides whether to accept variance applications, according to the Variance Review Process.

CSBR and the B3 Guidelines Administrators: The Center for Sustainable Building Research (CSBR) at the University of Minnesota leads the B3 Guidelines Administrators. Project teams submit relevant project information to the B3 Guidelines Tracking tool in order to document compliance with the B3 Guidelines. Submitted data may be posted on the B3 Guidelines Case Study Database and for selected audits, to improve the usability and effectiveness of the B3 Guidelines, and to translate building performance into state economic, human, and environmental outcomes. CSBR also reports project compliance to relevant State agencies.

All project information is submitted through the online B3 Tracking Tool. The Tracking Tool is an online project file that helps to collect information at each phase of the guidelines from team members and manages the submission process. Each guideline is assigned to an individual role in the tool, the individual assigned to that role should complete the required information in order to document compliance with the B3 Guidelines. Once all information has been submitted for a phase, the guideline leader submits this information to be reviewed by the Agency Contact (at all phases) and by the SB 2030 Reviewer (at the Design and Final Design phases).

Project Planning & Work:

- At the start of each phase (or year of operation), the guideline leader should review the B3 Guidelines and required documentation and plan the tasks to be completed for that phase and future phases. Work should be distributed to relevant team members and any questions on process or schedule addressed in order to clarify and understanding of the B3 Guidelines, and to ensure adequate coordination.
- If variances to the B3 Guidelines are sought, the guideline leader or assigned design team member requests a variance from the appropriated agency through the B3 Guidelines Tracking Tool. Variance requests should be identified prior to the Design phase of the B3 Guidelines Tracking Tool and are subject to review by CSBR for adequate rational.

Documentation:

- The project team completes the appropriate documentation via the B3 Guideline Tracking by the end of each phase. The team should archive relevant documentation for that phase (or for each year) for future reference.
- The guideline leader submits online documentation to the appropriated agency for compliance review at the end of each phase. Review of the project relative to the SB 2030 Standard also occurs at the time of phase submissions.

Review and Tracking:

- The appropriated agency reviews the level of compliance reported by the project team. The agency also reviews and decides whether to approve variance requests.
- CSBR tracks the status of compliance, variances, documentation, and performance outcomes and summarizes these for the state.

## Compliance Review Process

The Compliance Review Process is designed to provide regular checkpoints for reviewing compliance with the guidelines from the project's 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 Phase Summary Report from the guideline leader, submitted online using the B3 Guidelines Tracking Tool.
- The appropriated agency reviews the extent and nature of compliance as documented by the project team and submitted by the guideline leader. The appropriate agency confirms the submission is accurate to the best of their knowledge.
- The appropriated agency then either approves the extent of compliance for that phase, or directs the guideline leader to revisit compliance measures with the project team. This is done in part by the Variance Review Process.

- After completion of the project, data from each year of occupancy will be reported through the B3 Guidelines Tracking Tool for a period of at least 10 years.

## B3 Guidelines Phases and Submission Timeline

The following is a comparison of the phase submissions under the B3 Guidelines program and common design phase names—note that this includes the phase names used for B3 Guidelines projects prior to version 3.0.

| B3 Guidelines Phases | Description | Common phase names (includes phase names under previous versions of B3) |
|---|---|---|
| **Predesign** | Agency/owner must set up project in Tracking Tool, become familiar with B3 Guidelines (including calculating a preliminary SB 2030 Energy Standard), and establish a budget and select a design team based on B3/SB 2030 requirements. Guideline Leader transitions to member of design team once selected. An early Owner's Project Requirements (OPR) document should be drafted at this phase. | Agency Planning |
| | | Predesign – Programming |
| | | Predesign – Site Selection |
| **Design** | Guideline leader must check in to make sure design is on track to meet B3/SB 2030 requirements. | Schematic Design |
| **Final Design** | Guideline leader must check compliance of construction documents. | Design Development |
| | | Construction Documents |
| **Closeout** | Guideline leader must verify that constructed building meets B3/SB 2030 requirements; Guideline leader transitions to Owner once documentation of closeout is complete. | Construction/Construction Administration<br><br>Correction Period |
| **Occupancy** | Owner is responsible for annual submission confirming B3/SB 2030 compliance in operations. Some information is only collected during the first year of occupancy. | Occupancy/Operations |

These phases were selected to optimize the potential for impact on the final design, while also providing the documentation needed to determine B3/SB 2030 compliance (i.e., at final design and project closeout).

Complete guideline documentation is required immediately upon completion of each phase. When applicable, B3 Guidelines submissions should be integrated into other owner submission requirements so the agency and SB 2030 review process occurs in conjunction with the owner review of the documents. At the Final Design phase, this may entail submitting B3 documentation based on the 95–99% Owner Review Set of construction documents, rather than the bid or permit set, so that any required changes can be incorporated before bidding.

## Variance Review Process

The B3 Guidelines differ from other rating systems in that it primarily consists of a set of required measures for all projects rather than a menu of optional sustainability strategies.[3] Due to the variability of B3 projects, some may require adaptations to the performance thresholds and/or documentation schedule. Under certain circumstances, the B3 Guidelines allows variances to provide this accommodation.

Variances should be used sparingly. For best results, project teams should review the full list of applicable guidelines during early design to identify requirements that may be difficult to achieve. This should be followed by conversations about strategies to pursue compliance and identification of any guidelines that may require a variance.

Two types of variances may be requested:

- Provisional Variance:
  A provisional variance can be considered a "free pass" to the next phase in the Tracking Tool. It may be granted for guidelines for which there is not yet enough information to determine compliance. Provisional variances only apply to the phase in which they are submitted; the guideline must be addressed in later phases by submitting compliant documentation, submitting another variance request, or designating the guideline as noncompliant. If the project's ability to meet the guideline is unknown, provisional variances should be used as long as possible before requesting a full variance or noncompliance designation, with the goal of achieving compliance in a later phase. A provisional variance may not be requested during the last phase in which a guideline is required; at that point, all noncompliant or undocumented guidelines must either request a full variance or be designated noncompliant.
- Full Variance:
  Full variances are intended for cases where guidelines conflict with the project's program (intended use), either by direct conflict or due to the limits of available approaches. If the building program cannot accommodate a specific guideline, a variance for that guideline may be requested. For example, a prison may not be able to meet a guideline related to light levels at the site boundary because security requirements demand higher lighting levels. Technological limitations constitute another acceptable justification for a full variance, when available technologies or methodologies do not permit the project to meet the B3 Guidelines performance threshold. For example, a project in Greater Minnesota may not have sufficient construction and demolition waste recycling facilities in the region to fully meet guideline requirements. When requesting a full variance, the design team is expected to pursue creative solutions to meet the intent of the guidelines to the extent feasible.

The following conditions are not considered grounds for a full variance:

- Variances will not be considered if alternative design strategies have not been evaluated, including consideration of creative solutions that maintain the intent of the guidelines.
- Variances will not be considered based on budgetary or project schedule constraints.
- Variances will not be considered for requirements missed by the project team that cannot be addressed at later phases (e.g., neglecting to document construction waste diversion rates or neglecting to specify appropriate low-VOC finishes).
- Meeting the B3 Guidelines may require adjustments to the standard design and construction processes used by the project team. This is not an accepted justification for a variance.

[3] In addition to the required measures, the B3 Guidelines also offers recommended measures for projects that seek an elevated level of performance.

- Small or irregular sites are not an automatic justification for a variance.
- Variances should not be used for guidelines unrelated to the project scope. Instead, these should be communicated to the B3 Guidelines Administrators upon project set-up so as to be removed from the project. For example, an interior renovation project with no sitework may request the removal of site-related guidelines.
- Variances are not required for "recommended" guidelines.
- SB 2030 requirements are not eligible for variances. There are several pathways built into that program to accommodate unique project types and considerations related to cost-effectiveness.

A guideline is designated as "Not Compliant" if the project team cannot document compliance, and there is not adequate justification for a variance. This designation is reserved for the last phase in which a guideline is required, so as to maximize the project team's opportunity to find a compliant solution. "Not Compliant" designations are displayed publicly as part of the B3 Case Studies Database.

Variance requests are made within the Tracking Tool by the project team and are included in the Phase Summary Reports. Upon phase completion, each variance request is first seen by the project's guideline leader when they approve the Phase Summary Report and is then reviewed by the B3 Guidelines Administrators to ensure it meets the program's minimum variance requirements. The final determination of approval or rejection is made by the Agency Contact, who may further specify a compromise, equivalency, or conditions. If the Agency Contact is not able to make a determination on a variance request, it will be referred to B3 Guidelines Administrators.

## B3 Guidelines Tracking Process

The B3 Guidelines Tracking Process consists primarily of updating and maintaining the project information. Related activities may include posting data from the project on the B3 Case Studies Database, using project information to improve the usability and effectiveness of the B3 Guidelines, and translating reported building performance into economic, human, and environmental outcomes for use by the State of Minnesota. This process consists of the following elements:

- Agency completes required approval process for each phase using the B3 Guidelines Tracking Tool. Depending on the phase, outcome documentation may also call for attachment of commissioning or other reports. These attachments will be included in the online submission.
- B3 Guideline Administrators receive compliance and outcome information from the agency, via the Tracking Tool.
- B3 Guideline Administrators use the information received to update and maintain project information.
- B3 Guideline Administrators provide preliminary review of variances to ensure appropriate justification and sufficient information.
- B3 Guideline Administrators use project information at the discretion of the State of Minnesota.

## References to Other Guidelines and Rating Systems

Whenever possible, the B3 Guidelines has been brought into alignment with other guidelines and rating systems. This includes some incorporation of guidelines thresholds from LEED v.4, the International Green Construction Code (IGCC), the WELL Building Standard, and Fitwel. There are several benefits to the alignment:

- It leverages associated work in guideline development.
- It provides projects seeking dual compliance a more straightforward documentation path.

- For those project teams familiar with other guideline submission requirements, compliance with the B3 Guidelines is more easily verified.

Compliance with relevant portions of other guidelines or rating systems does not impart compliance with any portion of the B3 Guidelines. Portions of the B3 Guidelines that are similar thresholds as other guidelines and green building rating system have been noted in the footnotes.

# Performance Management Guidelines

## Intent

The following performance management guidelines assist project teams in gathering necessary information and coordinating the design, construction, and operations processes in order to ensure that each project successfully meets key performance criteria, including those of the B3 Guidelines. Successful implementation of appropriate processes, including integrative design, can minimize risk and improve outcomes.

**General Performance Management and Project Information:**

The following information is collected in the Performance Management section of the B3 Guidelines Tracking Tool, under Section P.0:

**Predesign:**

- Project schedule
- Project budget
- Anticipated building information – building gross square footage

**Design:**

- Updated project schedule
- Updated project budget
- Building information – occupancy, building gross square footage, number of stories

**Final Design:**

- Updated project schedule
- Updated project budget
- Updated building information – occupancy, building gross square footage, number of stories
- Performance strategies used, including narrative

**Closeout:**

- Updated project schedule
- Actual project cost
- Updated building information – occupancy, building gross square footage, number of stories
- Updated performance strategies used, including narrative

**Occupancy – Submitted annually for ten years:**

- Updated building information – occupancy, building gross square footage, number of stories

# Guideline P.1: Design and Construction Process

## Intent

To support the compliance and outcome tracking process by facilitating the creation and communication of relevant project goals and information.

## Required Performance Criteria

Guidelines are required for New Construction and Major Renovation projects.

A. Develop an Owner's Project Requirements (OPR) document, beginning at the Predesign or equivalent phase. This document is developed in coordination between the owner, commissioning authority, architect, engineer, and any other relevant stakeholders. A commissioning authority must be established at the Predesign phase to complete the early-phase goal setting. The OPR includes:
   1. A list of the authors who developed the document and assisted in early team kickoff and goal-setting meeting(s).
   2. All sections listed in Section 6, Appendix D of ASHRAE 202-2013.
   3. A preliminary SB 2030 Energy Standard, as created through the SB 2030 Energy Standard Tool.
   4. Regular updates and developments as the owner's requirements change and project details become available.
   5. The requirement that trend data is able to be saved for major equipment for a minimum of two months if a building automation system is requested.

   Projects that include less than 20,000 gsf of conditioned space may elect to complete the B3 Guidelines Small Buildings OPR to satisfy this guideline, using Appendix P-1a as a template. Projects must meet the B3 Guidelines requirements noted in this OPR/BoD template, and may use it to document compliance with Guidelines P.1A, P.1C, and the thermal comfort requirements of I.4B part 2.

B. Develop a Commissioning Plan (Cx Plan) from the OPR with the assistance of the architect, engineer, commissioning authority, and owner. The Cx Plan shall follow Section 7 and Appendix E in ASHRAE 202-2013. The scope of commissioning shall follow the process outlined in Appendix P-1b1 and P-1b2 and include all of the following, if within project scope:
   1. Mechanical HVAC systems, including testing, adjusting, and balance.
   2. Energy (including renewable) systems.
   3. Power and electrical systems, including lighting and daylighting controls.
   4. Indoor air quality elements and systems.

   Projects that include less than 20,000 gsf of conditioned space are only required to commission HVAC systems and lighting controls.

C. Develop a Basis of Design document (BoD) from the OPR with the assistance of the architect, engineer, commissioning authority, and owner. The BoD shall follow Section 8 and Appendix F of ASHRAE 202-2013. Projects that include less than 20,000 gsf of conditioned space may submit a completed OPR/BoD template following Appendix P-1a to comply with this guideline.

D. Develop a safety risk assessment of indoor air quality issues for projects that are attached to occupied buildings ("new construction" additions or "major renovations" only). Projects must submit a completed B3 Guidelines IAQ Safety Risk Assessment template to comply with this guideline, available in Appendix P-1e.

E. Develop indoor air quality procedures according to a Construction Air Quality Management Plan and Warranty Period Air Quality Management Plan templates, available n Appendix P-1e. These plans must address at a minimum the sections outlined in Appendix P-1e, although projects that include less than 20,000 gsf of conditioned space are only required to document and pursue a subset of the listed procedures. These are noted in the appendix.

## Recommended Performance Criteria

F. Assemble an appropriate stakeholder team that includes representation from every discipline involved in the project, including: the owner's decision-making team, users, occupants, operations and maintenance representatives, at least one representative from the community, and at least one agency "client" or visitor representative. An owner representative and commissioning agent must also be included, if applicable. Members must make a commitment through post-occupancy.

G. Facilitate planning/review workshops at key phases with all team members.
   1. In Predesign:
      i. Comprehensive planning workshop
      ii. Programming workshop
   2. In Design:
      i. Conduct facility performance workshop within the first 2–3 weeks of the design phase.
      ii. Convene a multidisciplinary team at least once per design phase for integrated progress review toward guidelines.
      iii. Convene a stakeholder team for regularly integrated progress reviews. Stakeholder team to meet a minimum of once per phase.
      iv. Convene general contractor and subcontractors for preconstruction kickoff meeting to review the B3 Guidelines goals and objectives.
      v. Discuss progress toward project outcomes during construction meetings.
   3. After occupancy:
      i. Convene facility operations manager, human resources manager, and others who offer cross-disciplinary points of view on facility operations for annual meetings to review operation practices, complaints, and building maintenance issues.

H. Additional Commissioning Scope. Incorporate into the commissioning of the project one or more of the following:
   1. Plumbing Systems
   2. Interior materials
   3. Physical measurement of vibrations/acoustics/noise

## Meeting the Guidelines

Note that Guideline P.1 includes several sub-guidelines, including P.1A and P.1B, which are typically performed by a commissioning agent. The remainder of the guidelines under P.1 are not typically within the scope of the commissioning agent and are instead usually assigned to the mechanical engineer or contractor because they relate to developing the design response (the BOD) or planning specific construction and warranty period air quality. Sub-guideline P.2A may fall under the scope of the commissioning agent, design mechanical engineer, or other team members, according to the owner’s needs. Sub-guideline P.2A involves capturing specific operation parameters essential to optimal building operation. Support for this process may be available from the SB 2030 Operations Team.

To meet the guidelines, an owner must engage a commissioning agent as early as a potential project is identified during the predesign of the project to assist the owner in developing the Owner's Project Requirement (OPR) document. The creation of this document outlines the goals and requirements of the owner. It is useful to have the assistance of the commissioning agent in its creation, as they will be verifying the design and construction against these requirements. The OPR document lays out several key requirements of a building's design and operation.

The OPR also creates a set of fundamental requirements that the commissioning agent can check the completed project against, rather than relying on the plans and specifications for validating the success of the design and construction process.

The Basis of Design document (BoD) is developed after the OPR and consists of information related to the specific design of the project in order to create a common understanding of how the OPR is being achieved by the design of the project. This document may also serve as a reference for owner input and approval of design decisions as needed.

The Commissioning Plan (Cx Plan) document provides an outline and documentation of measuring how the design, construction, and operation of the building meet the OPR.

Each of these documents should be edited and developed as the design and the project requirements evolve.

## Submittal Requirements

**Predesign:**

- P.1A: Owners Project Requirements (OPR). Small Building projects may submit the completed OPR/BoD template, Appendix P.1a.
- P.1B: Commissioning scope and commissioning budget.
- P.1D: IAQ Safety Risk Assessment, if work is to be done to an existing building (either a renovation or addition). Projects shall submit a completed template, available in Appendix P.1e.
- P.1G: Meeting minutes of goal setting workshops.

**Design:**

- P.1A: Updated OPR.
- P.1B: Draft Cx Plan.
- P.1C: Draft Basis of Design (BoD). Small Building projects may submit the completed OPR/BoD template in Appendix P.1a.
- P.1D: Updated IAQ Safety Risk Assessment, in Appendix P.1e.
- P.1F: Members of stakeholder team.

**Final Design:**

- P.1A: Final OPR. Small Building projects may submit the completed OPR/BoD template.
- P.1B: Final Cx Plan.
- P.1C: Updated BoD. Small Building projects may submit completed OPR/BoD template.
- P.1D: Final IAQ Safety Risk Assessment, submitted as completed template in Appendix P.1e.
- P.1E: Specifications Requiring Construction Air Quality Management Plan.
- P.1F: Updated members of stakeholder team.
- P.1G: Dates and attendees of design planning and review workshops.

**Closeout:**

- P.1B: Commissioning report, including system manual and training plan.
- P.1E: Construction Air Quality Management Plan, submitted as completed template in Appendix P.1e.
- P.1E: Warranty Period Air Quality Management Plan, submitted as completed template in Appendix P.1e.
- P.1F: Updated members of stakeholder team.
- P.1G: Updated meeting minutes of planning and review workshops.

**Occupancy:**

- P.1B: Cx Report (only for year 1 if not captured at closeout).
- P.1G: Meeting minutes of occupancy workshops (only for year 1).

## Additional Resources

Appendix P-1a Small Buildings OPR and BoD Template

Appendix P-1b1 Design and Construction Commissioning Scope

Appendix P-1b2 Design and Construction Commissioning Responsibilities

Appendix P-1e_ IAQ Safety Risk Assessment Template, Design & Construction Phase Air Quality Management Plan Template, and Warranty Period Air Quality Management Plan Template

ASHRAE Standard 202-2013: http://www.techstreet.com/standards/ashrae-202-2013?product_id=1862482

Federal Energy Management Program Building Program: energy.gov/eere/femp/federal-energy-management-program

LBNL Study *Building Commissioning: A Golden Opportunity for Reducing Energy Cost and Greenhouse Gas Emissions*: http://cx.lbl.gov/documents/2009-assessment/lbnl-cx-cost-benefit.pdf

# Guideline P.2: Operations Process

## Intent

To ensure that buildings perform optimally.

## Required Performance Criteria

Guidelines are required for New Construction and Major Renovation projects.

~~A. Develop and implement an~~ Note that as of July 2025 the SB 2030 Energy Efficient Operations program has temporarily ceased operations, the development of an Energy Efficient Operations Manual ~~(EEOM). The EEOM defines tasks to ensure that each significant energy consuming device uses only as much energy as needed to serve its intended function. An EEOM~~ is currently not required for ~~all~~B3 projects ~~meeting the following criteria, subject to the listed exclusions.~~

~~1. Applicable buildings meet any of the following criteria:~~

~~i. Over 100,000 gross square feet (gsf) in size.~~

~~ii. Between 50,000 and 100,000 gsf with an EUI above 100 kBtu/sf.~~

~~iii. Fails to meet SB 2030 target during their second year of operation.~~

~~2. Exclusions:~~

~~i. Buildings in which the EEOM program does not support the HVAC system types.~~

~~ii. Buildings under 50,000 gsf that meet their SB 2030 target in their second and subsequent years of operation.~~

~~iii. Buildings that include less than 20,000 gsf of conditioned space.~~

~~Buildings operated by agencies or organizations with substantially similar or more robust energy management procedures to the EEOM. These plans and procedures must be reviewed and approved by the B3 Guidelines Operations Team. These procedures are not required to be building specific~~.

B. Facilitate the completion of at least one post-occupancy evaluation (POE) of the project after the first 12 months of occupancy.
   1. The Scan-Level Post-Occupancy Evaluation is required for available space types present in the project. This process is supported by the B3 Post-Occupancy Evaluation (B3 POE) process.
   2. Buildings without supported space types at six months post-occupancy are exempt from this requirement. Projects may also be exempt if they do not meet the minimum required number of occupants or residents; more details are available at the B3 POE website.

## Recommended Performance Criteria

C. Reserve 0.25% of total construction cost for contingency in order to meet the SB 2030 Energy Standard in Operations. As compliance with the SB 2030 program is required through ten years of operation, 0.25% of total construction cost is required to be set aside for efforts related to evaluating and remediating noncompliance in SB 2030 projects. This budget includes professional services over and above the services originally contacted for and additional construction costs that may be incurred to meet the SB 2030 Energy Standard if the project fails to meet the SB 2030 standard after the first year.

## Meeting the Guidelines

**P.~~2A:~~**

~~For more information on completing and using the EEOM please visit: http://www.b3mn.org/operations/. The B3 Operations Team may be able to facilitate the creation of the EEOM for projects subject to the requirement. This facilitation and support will require availability and coordination of design and operation team members. To ensure the maximum available level of support is available to a project, please contact operations@b3mn.org no later than 60 days prior to the completion of construction.~~

**~~P.~~2B:**

There are three (3) levels of sustainable POE surveys (SPOES): Scan, Core, and Advanced. The required Scan survey is available for select building types and is free for state-funded projects adhering to B3 Guidelines. Complete details can be found at www.b3mn.org/poe/. Buildings with space types with no supported SPOES at 6 months post-occupancy are exempt from this requirement. Projects may also be exempt if they do not meet the minimum required number of occupants or residents. A contact will need to be established who will serve as the primary contact for the survey collection process will need to be established.

The goal of these evaluations is to standardize the methodology for studying a building's performance from the occupant's point-of-view, to provide feedback to the owners and operators, and to understand how the building performs in practice.

## Submittal Requirements

**Predesign:**

- P.2C: Budget showing compliance with contingency.

**Design:**

- P.2C: Budget showing compliance with contingency.

**Final Design:**

- P.2C: Budget showing compliance with contingency.

**Closeout:**

- P.2A: Draft SB 2030 Energy Efficient Operations Manual (created online)
- P.2C: Budget showing compliance with contingency.

**Occupancy – Submitted annually for ten years:**

- P.2A: Use of SB 2030 Energy Efficient Operations Manual (managed online)
- P.2B: (One time during occupancy) Sustainable Post-Occupancy Evaluation report.

## Additional Resources

ASHRAE Standard 100-2015: https://www.ashrae.org/resources--publications/bookstore/standard-100

ASHRAE Guideline 4-2008: http://www.techstreet.com/standards/guideline-4-2008-ra-2013-preparation-of-operating-and-maintenance-documentation-for-building-systems?product_id=1852923

B3 POE Site (including library of prior POE results): http://b3mn.org/poe/index.html

SB 2030 Energy Efficient Operations: http://b3mn.org/operations/

# Site and Water Guidelines

## Intent

To support the design and maintenance of project sites, to promote ecological integrity, and to support healthy, biodiverse plant, animal, and human communities by restoring soil, habitat, and water quality. Current development practices can lead to damaging stormwater runoff, degraded water and soil quality, depletion of water, soil, and valuable vegetated areas, and can result in habitat destruction. These guidelines help to create sites that reduce water and energy consumption; reduce and improve stormwater runoff; minimize pollutant contributions related to transportation; and support, protect, and restore native species habitat and landscapes.

**Objectives:**

- To improve the ability of the soil present on a project site to maintain its biotic and abiotic structure against adverse impacts of development.
- To restore and/or enhance the site's hydrologic capacity to improve the soil, vegetative and animal habitats, and to mitigate adverse onsite and downstream water impacts.
- To reduce consumption of potable water and fossil fuel-based energy ~~demand~~ with appropriate site design and use of local vegetative materials.
- To reduce the amounts of toxic materials and salts used on project sites that contribute to air and water pollution.
- To reduce the negative effects of runoff on municipal stormwater systems by reducing runoff volume and improving the quality of stormwater leaving B3 project sites.
- To enhance and reinforce site biodiversity and surrounding networks of flora and fauna.
- To ensure that building sites provide habitat for local native and endangered species.
- To restore/improve the outdoor environmental quality (OEQ) of the site, which enhances occupant productivity and building performance while offering other community benefits.

**General Site and Water Information:**

The following information is collected in the Site and Water section of the B3 Guidelines Tracking Tool, Section S.0:

**Predesign:**

- Site information: existing site areas of various conditions (e.g., wetland, woodland, building footprint~~).~~, soil type, existing vegetation, etc.).

**Design:**

- Updated site information: existing and proposed site areas of various conditions (e.g., wetland, woodland, building footprint).

**Final Design:**

- Updated site information: existing and proposed site areas of various conditions (e.g., wetland, woodland, building footprint).
- Site and water strategies used, including narrative.

**Closeout:**

- Updated site information: existing and proposed site areas of various conditions (e.g., wetland, building footprint, woodland).
- Updated site and water strategies used, including narrative.

## Applicability and Project Size

Many of the site and water guidelines are triggered by the size of the soil disturbance; the B3 program looks at both the amount of soil disturbance counting the area within the building footprint and the amount of soil disturbance not counting the building footprint when determining which guidelines apply. Site area related solely to ADA improvements, other accessibility-related improvements, or utility connections may be excluded from the total area(s) of disturbance when determining if the guidelines are triggered. Each guideline has the applicability criteria listed, please reference that for additional detail. The chart below provides a high-level summary of which types of guidelines apply under these different areas of disturbance. The table below does not apply to guidelines related primarily to the scope of the building, such as bird-safety, exterior lighting, albedo, or interior plumbing.

| | **Less than 1,000ft2 of soil disturbance and less than 10 cubic yards of cut and fill excluding the building footprint** | **At least 1,000ft2 of soil disturbance or at least 10 cubic yards of cut and fill excluding the building footprint** | **At least 5,000 disturbance or 50 cubic yards of of cut and fill excluding the building footprint** |
|---|---|---|---|
| **Less than 5,000ft2 of soil disturbance and less than 50 cubic yards of cut and fill including the area within the building footprint** | No site-related Site and Water guidelines are triggered; building-related Site and Water guidelines may apply. | Some site-related Site and Water guidelines apply, excluding S.2: Stormwater and S.3: Soil, building-related Site and Water guidelines may apply. | NA |
| **At least 5,000ft2 of soil disturbance or at least 50 cubic yards of cut and fill including the area within the building footprint** | Stormwater-related Site and Water guidelines are triggered; building-related Site and Water guidelines may apply. | Site and Water guidelines are triggered excluding S.3: Soil, building-related Site and Water guidelines may apply. | All site and water guidelines are triggered; building-related site and water guidelines may apply. |

## Definition of Project Site

Defining the project site can be accomplished using one of the two following methods:

1. Use property lines to determine the project site area and boundaries.
2. Include at least the area disturbed as a result of the construction activities of the project if the project is part of a larger campus. ~~This~~Only the disturbed area will be considered the primary project site. This could include but is not limited to: planted areas, turf, parking, utility corridors, building footprints, areas for stockpiling, etc.).

Secondary Sites:

On sites ~~using the second method,~~that are part of a larger campus more flexible site considerations can be used in meeting the site and water requirements~~.~~, particularly those related to stormwater, vegetation, and habitat. Projects utilizing one or more secondary sites may meet ~~the~~these requirements ~~of the primary project site~~ by interventions ~~on~~or utilization of existing facilities within the larger campus outside of the primary site area (including in areas separated by

a public right-of-way). The area used to meet the B3 Guidelines will be considered a "secondary ~~project~~ site ~~(or sites)~~(s)" and must be owned by the same entity as the primary project site~~.~~ or must provide a written agreement that demonstrates it can be utilized in perpetuity in the manner that allows the project to meet the requirements by utilizing a secondary site. Different secondary project sites may be defined as necessary to meet different guidelines~~.~~ (e.g. one area of a larger campus could be used to meet the stormwater requirements whereas a different area of that campus could be utilized for habitat or vegetation requirements).

These interventions on secondary project sites must ~~(i) satisfy~~:

1. Satisfy the requirements for the primary project site area and consist of a modification performed as part of the project and documented as a permanent modification~~,~~.

   or ~~(ii) consist~~

2. Consist of a well-documented use of a regional or campus resource (e.g., the use of a regional stormwater facility ~~for~~to meet the stormwater requirements for the primary site) that is filed with an appropriate authority with jurisdiction (e.g., the watershed, county, city) that has adequate capacity to meet the B3 Guidelines requirements in addition to all other obligations.

~~A modification of a secondary project site is not required for existing animal habitats that meet the B3 habitat requirements and that are immediately adjacent to the primary project area.~~ The secondary site area may not contribute to meeting any of the B3 requirements if it is also used to satisfy other preexisting or planned regulatory requirements. The secondary site area, if utilized to satisfy any regulatory requirement for any area outside of the primary project site (e.g., the portion of a secondary site area which contributes to meeting stormwater runoff requirements for an area outside of the primary project site), may only consider the capacity above what is otherwise utilized in order to meet the B3 Guidelines.

A modification of a secondary project site is not required for existing animal habitats that meet the B3 habitat requirements and that are immediately adjacent to the primary project area.

Interventions may include, but are not limited to, regional stormwater management, pollinator habitat locations, animal habitat, or local vegetation; each can be located on a portion of the campus that would be best suited for such a use. In most cases, when combining stormwater and ecological enhancements, larger ecological areas and district stormwater systems are preferable to scattered, smaller systems.

# Guideline S.1: Site and Water Connections

## Intent

To create sites that are resilient, healthy, and sustainable, and to ensure connections between the surrounding environment and the site through vegetation selection, provision of animal habitats, and connections to human-made systems.

## Required Performance Criteria

Guidelines S1A, S1B, and S1C are required for New Construction and Major Renovation projects that include at least 1,000 square feet of land disturbance, or at least ten cubic yards or more of cut and fill of the site, excluding the land disturbance and cut and fill within or below the building footprint. ~~Exterior scope~~Site area related ~~only~~solely to ADA improvements, other accessibility-related improvements, or utility connections may be excluded from ~~contribution toward these amounts~~total area of disturbance when determining if the guidelines are triggered, more detail on this is included at the beginning of the Site and Water Guidelines.

A. Plant network connections: Establish plant selection to reinforce existing plant networks and to support and expand existing conservation, natural, and native species networks.
   1. The greater of either 25% of the project site area (excluding the building footprint), or 70% of the project site area (excluding the building footprint and code-minimum parking) shall be planted using native species listed in the class factsheet for the applicable class~~.~~ that either:
      i. Replicate/Reinforce a nearby SNA or MBS site (As defined by the MN DNR) if there is an appropriate ecosystem type to replicate given the project site's soil conditions, surrounding ecological connections, existing vegetation regime, and other factors that could influence applicability.

      or

      ii. Attempt to reinforce or rehabilitate native species that are appropriate for the project site's ecological sub region as defined by the Ecological class fact sheet(s) for the area. The vegetation selections for the site shall be determined from the province, section, and subsection of the site listed under the Minnesota Department of Natural Resources (DNR) Ecological Classification System (ECS).

      Native is defined as a plant originating from within a 200-mile radius of the site prior to artificial intervention, ~~which is~~ considered to be 1840 in Minnesota. Cultivars (CVs) of native species may be used if they do not appear on the Minnesota Native Plant Society, the Minnesota Invasive Terrestrial Plants and Pests Center's ~~prioritized list~~Prioritized List of ~~terrestrial invasive plants~~Terrestrial Invasive Plants, or on the Minnesota Department of ~~Agriculture~~Transportation's Noxious Weeds List.

      ~~ii. Ecological class shall be determined from the province, section, and subsection of the site listed under the Minnesota Department of Natural Resources (DNR) Ecological Classification System (ECS).~~

      ~~iii. The most advantageous plant species prevalent in the listed ecological class of the site shall be determined for use in revegetation.~~

   ~~2. If the project site is within ten miles of a DNR Scientific and Natural Area (SNA), plant selection shall be used to match, connect, and reinforce the conservation area. If the project site is within 1 mile of a DNR Scientific and Natural Area (SNA), vegetative and plant selections shall be selected to also replicate the natural area's conditions.~~

Note: Other vegetation requirements are also listed under S.4: Vegetation.

~~B.~~ Animal network connections: Include in the project design-appropriate habitats, including both food and shelter, of relevant species if any of the following criteria are met. ~~Project teams shall reference the relevant resources provided in the "Meeting the Guidelines" section if the project meets one of the following:~~

~~1. If project is~~ Food should ~~within ten miles of major bird migratory flyways, nesting habitat, or stopover feeding areas.~~

~~2.~~1. ~~If project site is within ten miles of a Wildlife Management Area. If project site is within ten miles of a National Wildlife Refuge or National Wetland Management District.~~

~~3. If project site is within one mile of an existing or planned animal movement corridor.~~

~~4. If project site is within one mile of the terrestrial habitats of rare, threatened, or endangered reptiles / amphibians of Minnesota.~~

~~5. If project site is within one mile of the habitats of rare, threatened, or endangered insects / arthropods of Minnesota.~~

~~6. If project site is within one mile of known important bird habitats and nesting areas of rare, threatened, or endangered birds of Minnesota.~~

~~7. If project site is adjacent to the aquatic habitat of rare, threatened, or endangered fish of Minnesota.~~

~~A.~~B. ~~Note: Other animal habitat requirements are listed under S.5: Light Pollution Reduction. Food shall~~ be of quality and quantity that would be normally found in the area created by natural food-bearing trees, shrubs, and other vegetation. Project teams must reference the relevant resources provided in the "Meeting the Guidelines" section to help determine if the project site is within one or more of the following buffers:

1. within ten miles of major bird migratory flyways, nesting habitat, or stopover feeding areas.
2. within ten miles of a Wildlife Management Area.
3. within ten miles of a National Wildlife Refuge or National Wetland Management District.
4. within one mile of an existing or planned animal movement corridor.
5. within one mile of the terrestrial habitats of rare, threatened, or endangered fish, reptiles, amphibians, birds, insects, or arthropods of Minnesota as determined using the county-scale MBS maps developed by the MN DNR.

Note: Other animal habitat requirements are listed under S.5: Light Pollution Reduction.

C. Human system connections: The project design shall include appropriate connections to any of the relevant systems if any the following criteria are met:

1. If project is within one mile of an existing or planned bike path, local government officials shall be consulted to assist in the creation of bike connections between site and existing routes.
2. If project is within one mile of an existing or planned walking path, local governmental officials shall be consulted to assist in the creation of a safe walking connection between site and existing routes.
3. If project is within one mile of an existing or planned future DNR water trail, local governmental officials shall be consulted to assist in the creation of a connection to existing or future water trails.
4. If project is within one mile of an existing or planned birding trail, county and governmental officials shall be consulted to assist in the creation of a connection to existing or future planned DNR or MN Audubon birding trails.
5. If the project is within 0.25 miles of an existing or planned transit stop, local transit officials shall be consulted to assist in the creation of a pedestrian path and waiting shelter at the stop (if none exist).

~~Systems~~Human systems can be considered "planned" if they are in a community master plan, small area plan, comprehensive plan, ~~or~~ a 5-year capital budget, or other equivalent, planning-level formats.

## Recommended Performance Criteria

D. Project site plans shall be coordinated with municipal, regional, county, and state planning agencies.
E. Historical context: Available historical context ~~shall~~should be incorporated into the design of the project site:
   1. Historical land survey or historical maps.
   2. Landview and/or historical photos, including historical aerial photos.
   3. Historical topography, land-use, vegetation, and ~~hydological~~hydrological conditions.

## Meeting the Guidelines

For vegetation-specific requirements, the determination of the Ecological Classification System (ECS) is made by referencing the DNR Ecological Classification System maps: ~~http://www.dnr.state.mn.us/ecs/index.html.~~ http://www.dnr.state.mn.us/ecs/index.html. and using the DNR's Conservation Explorer Tool: https://mce.dnr.state.mn.us

To determine the ~~provinces, sections~~province, section, and ~~subsections~~subsection of the project site: Access the MN DNR website~~.~~ at the link below and locate your project in each: https://www.dnr.state.mn.us/ecs/index.html

To make vegetative connection determinations for conservation and natural areas~~:~~ ~~http://www.dnr.state.mn.us/snas/map.html.~~, determine if there are any Scientific Natural Areas (SNA) or Minnesota Biological Survey (MBS) species within the required buffers (2 miles) and replicate, reinforce, or reference the appropriate vegetation that is best suited to the project site's soil, topography, and ecological characteristics. http://www.dnr.state.mn.us/snas/map.html.

To determine the required plant ~~community~~communities of a project site, use the DNR Native Plant Community Classification, located at ~~http://www.dnr.state.mn.us/npc/classification.html.~~

http://www.dnr.state.mn.us/npc/classification.html. Class fact sheets that include allowable plant selections for each class are located at the following ~~locations~~links:

- Upland Forests and Woodlands: ~~http://www.dnr.state.mn.us/npc/uplandforest.html.~~http://www.dnr.state.mn.us/npc/uplandforest.html.
- ~~Wetland Forests: http://www.dnr.state.mn.us/npc/wetforest.html.~~
- Wetland Forests: http://www.dnr.state.mn.us/npc/wetforest.html.
- Upland Grasslands, Shrublands, and Sparse Vegetation: ~~http://www.dnr.state.mn.us/npc/uplandgrassland.html.~~http://www.dnr.state.mn.us/npc/uplandgrassland.html.
- Wetland Grasslands, Shrublands, and Marshes ~~http://www.dnr.state.mn.us/npc/wetlandgrassland.html.~~http://www.dnr.state.mn.us/npc/wetlandgrassland.html.

~~For determining~~To determine the location and adjacency of existing or planned animal corridors~~,~~ and to cater the ~~project~~ site ~~shall be located in reference to the~~ habitat requirements to the most appropriate target species for a project, reference the following resources~~:~~

- ~~Wildlife Action Network Maps: http://www.dnr.state.mn.us/mnwap/mnwap_resources.html.~~

~~Statewide Map~~ and provide a site plan indicating the location and characteristics of ~~the Wildlife Action Network with County Boundaries:~~ ~~http://files.dnr.state.mn.us/assistance/nrplanning/bigpicture/mnwap/mndnr_wildlife_action_network_county.pdf.~~each habitat specifically designed for targeted species:

- ~~Prairie Corridors: https://www.dnr.state.mn.us/prairieplan/index.html~~
- ~~Metropolitan~~MN Conservation ~~Corridors~~Explorer Tool: https://~~arcgis~~mce.dnr.state.mn.us~~/portal/apps/instant/basic/index.html?appid=a74ce8dcc819434588a4fc5204187dee~~
- ~~Regionally Significant Natural Resource Areas: http://www.dnr.state.mn.us/rsea/map.html.~~
- ~~Mammals of Minnesota: http://www.dnr.state.mn.us/mammals/index.html.~~
- ~~At a minimum, the proposed site location shall be checked against the applicable resources relative to~~Minnesota Biological Survey

Identify major migratory flyways, nesting habitat, and stopover feeding areas and if within 1 mile of the flyway, provide appropriate habitat for threatened species identified in the resource reports linked below:

- Birds of Minnesota: ~~http://www.dnr.state.mn.us/birds/index.html.~~http://www.dnr.state.mn.us/birds/index.html.
- Important Bird Areas in Minnesota: ~~http://mn.audubon.org/conservation/minnesota-important-bird-areas.~~http://mn.audubon.org/conservation/minnesota-important-bird-areas.
- Bird Trails:
    - Northshore Birding Trail: http://audubon.maps.arcgis.com/apps/MapTour/index.html?appid=016293823ced4b7f9cb79389ecdd5a3c&webmap=0f48989d6fdd4584b8528628710a7846.
    - Minnesota River Valley Birding Trail: http://gis.audubon.org/Minnesota/MRVT/#.
    - Pine to Prairie Birding Trail: ~~https://mnbirdtrail.com/.~~https://mnbirdtrail.com/.
    - The Great River Birding Trail ~~https://gis.audubon.org/Minnesota/birdtrails/~~https://gis.audubon.org/Minnesota/birdtrails/
    - St. Cloud, MN map, from Little Falls, MN to Anoka, MN (River Mile 970 to 870): http://experiencemississippiriver.com/10states/wp-content/uploads/2016/04/Binder4.pdf.
    - Minneapolis and St. Paul, MN map (River Mile 870 to 823): http://experiencemississippiriver.com/10states/wp-content/uploads/2016/04/Binder5.pdf.
    - Red Wing, MN map, from Cottage Grove, MN to Kellogg, MN (River Mile 823 to 755): http://experiencemississippiriver.com/10states/wp-content/uploads/2016/04/Binder6.pdf.
    - La Crosse, WI map, from Kellogg, MN to New Albin, IA (River Mile 755 to 674): ~~http://experiencemississippiriver.com/10states/wp-content/uploads/2016/04/Binder7.pdf.~~http://experiencemississippiriver.com/10states/wp-content/uploads/2016/04/Binder7.pdf.

Animal connections shall be determined by referencing, ~~at a minimum,~~ each of the ~~following~~applicable resources listed below. Please note some of these resources may not be applicable to your particular site. Adjacencies and specified buffers for wildlife connections but are included for reference:

- MN Conservation Explorer Tool: https://mce.dnr.state.mn.us

- Wildlife Management Areas: ~~http://www.dnr.state.mn.us/wmas/index.html.~~http://www.dnr.state.mn.us/wmas/index.html.
- Terrestrial Habitats of Reptiles / Amphibians of Minnesota: ~~http://www.dnr.state.mn.us/reptiles_amphibians/index.html.~~http://www.dnr.state.mn.us/reptiles_amphibians/index.html.
- Habitats of the Mammals of Minnesota: ~~http://www.dnr.state.mn.us/mammals/index.html.~~http://www.dnr.state.mn.us/mammals/index.html.
- Habitats of the Fish of Minnesota: ~~http://www.dnr.state.mn.us/fish/index.html.~~http://www.dnr.state.mn.us/fish/index.html.
- Habitats of the Mussels of Minnesota: ~~http://www.dnr.state.mn.us/mussels/index.html.~~http://www.dnr.state.mn.us/mussels/index.html.
- Habitats of the Insects / Arthropods of Minnesota: ~~http://www.dnr.state.mn.us/insects/index.html.~~http://www.dnr.state.mn.us/insects/index.html.
- Known Important Bird Habitats and Nesting Areas for the Birds of Minnesota: http://www.dnr.state.mn.us/birds/index.html.
- National Wildlife Refuge or National Wetland Management District: https://www.fws.gov/our-facilities?type=%5B%22National%20Wildlife%20Refuge%22%5D&state_name=%5B%22Minnesota%22%5D

Human systems connections ~~shall~~should be determined by, at a minimum, referencing each of the following resources and coordinating with your local officials to determine what, if any, human systems need to be considered within the project design:

- US or Minnesota State Highways: ~~http://www.dot.state.mn.us/statemap/2017/map-front.pdf.~~http://www.dot.state.mn.us/statemap/2017/map-front.pdf.
- Mass Transit Routes: ~~http://www.dot.state.mn.us/transit/riders/.~~http://www.dot.state.mn.us/transit/riders/.
- Existing Bicycle Trails: ~~https://www.dot.state.mn.us/bike/state-bike-map.html~~https://www.dot.state.mn.us/bike/state-bike-map.html
- Walking and Hiking Trails and Routes: ~~https://www.traillink.com/stateactivity/mn-walking-trails/~~https://www.traillink.com/stateactivity/mn-walking-trails/ and ~~http://www.dnr.state.mn.us/state_trails/index.html.~~http://www.dnr.state.mn.us/state_trails/index.html.
- Water Trails, under Minnesota State Water Trails: ~~http://www.dnr.state.mn.us/watertrails/index.html and http://www.dnr.state.mn.us/watertrails/az.html.~~http://www.dnr.state.mn.us/watertrails/index.html and http://www.dnr.state.mn.us/watertrails/az.html.
- Minnesota Birding Trails and Maps: ~~https://www.traillink.com/stateactivity/mn-birding-trails/.~~https://www.traillink.com/stateactivity/mn-birding-trails/.

~~Ensure that all new impervious areas included as part of the human systems connections are included in infiltration calculations for Guideline S.2.~~

- Historical resources available for reference include:
- ~~Historic Topography: http://www.lib.utexas.edu/maps/topo/minnesota/, http://libguides.mnhs.org/maps/topographic and https://nationalmap.gov/historical/.~~
- Historic Topography: http://www.lib.utexas.edu/maps/topo/minnesota/, http://libguides.mnhs.org/maps/topographic and https://nationalmap.gov/historical/.

- Original General Land Office Plats: ~~http://www.mngeo.state.mn.us/glo/index.html.~~http://www.mngeo.state.mn.us/glo/index.html.
- ~~The DNR Landview: http://www.dnr.state.mn.us/maps/landview/index.html?layers=lakes+roads+cent_popplpt1~~The DNR Landview: http://www.dnr.state.mn.us/maps/landview/index.html?layers=lakes+roads+cent_popplpt1 includes information that may supplement other historic site information.
- Minnesota Historical Aerial Photographs: ~~https://www.lib.umn.edu/apps/mhapo/.~~https://www.lib.umn.edu/apps/mhapo/.

## Submittal Requirements

**Predesign:**

- S.1A: Documentation of the province, section, and subsection of the site, any identified conservation or natural areas within the distance specified in the guidelines, and the designated native plant communities of the site.
- S.1B: Documentation of ~~the determination of~~ animal communities within the listed distances.
- S.1C: Identified roads, transit, trails, and walking paths within the listed distances.

**Design:**

- S.1A: Narrative on the response to native and conservation areas and a list of relevant plant species selected for the site from the ~~class factsheet~~various resources listed in the "meeting the guidelines" section above.
- S.1B: Site plan ~~that documents~~documenting planned animal habitat nesting, breeding, food, and shelter areas, for each selected species, as required for the project site given the buffer distances outlined in this guideline.
- S.1C: Site plan ~~that documents~~documenting the required human network connections.
- S.1E: Site plan demonstrating incorporation of historic site information into design of site.

**Final Design:**

- S.1A: List of vegetation selected demonstrating compliance, including the class fact sheet; narrative on the project response to native and conservation areas; list of species selected from the class factsheets for site and area of site planted with listed species.
- S.1B: Final site plan documenting ~~animal habitat as required~~all required animal habitat areas provided including: proposed vegetation, habitat structures, targeted species, anticipated ecosystem services, and rationale for the design.
- S.1C: Final site plan documenting required human network connections.
- S.1D: Documentation of coordination with municipal, regional, county, and state planning agencies.
- S.1E: Final site plan demonstrating incorporation of historic site information into design of site.

## Additional Resources

Ecological System Summaries and Class Fact Sheets – Upland Forests and Woodlands: ~~http://www.dnr.state.mn.us/npc/uplandforest.html;~~http://www.dnr.state.mn.us/npc/uplandforest.html; Wetland Forests: http://www.dnr.state.mn.us/npc/wetforest.html; Upland Grasslands, Shrublands, and Sparse Vegetation:

http://www.dnr.state.mn.us/npc/uplandgrassland.html; Wetland Grasslands, Shrublands, and Marshes: http://www.dnr.state.mn.us/npc/wetlandgrassland.html.

~~Eco-Regions for Minnesotahttps://gaftp.epa.gov/EPADataCommons/ORD/Ecoregions/mn/mn_map.pdf~~

Eco-Regions for Minnesota https://gaftp.epa.gov/EPADataCommons/ORD/Ecoregions/mn/mn_map.pdf

Description of Eco-Regions: https://gaftp.epa.gov/EPADataCommons/ORD/Ecoregions/mn/mn_eco_desc.pdf

Ecological Classification System: http://www.dnr.state.mn.us/ecs/index.html.

Floodplain: Elevation Requirements: http://www.dnr.state.mn.us/waters/watermgmt_section/floodplain/rfpe.html.

~~Flood Plan Maps by County: https://www.dnr.state.mn.us/waters/watermgmt_section/floodplain/access-flood-maps.html~~

Flood Plan Maps by County: https://www.dnr.state.mn.us/waters/watermgmt_section/floodplain/access-flood-maps.html

Gridded Soil Survey Geographic (gSSURGO) Database: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/geo/?cid=nrcs142p2_053628.

Minnesota Department of Agriculture Noxious Weeds: https://www.mda.state.mn.us/plants-insects/minnesota-noxious-weed-list, PDF at https://www.mda.state.mn.us/sites/default/files/inline-files/noxiousweeds2018.pdf

Minnesota Association of Watershed Districts, Inc.: http://www.mnwatershed.org/.

Minnesota Scientific and Natural Areas Find by Map: http://www.dnr.state.mn.us/snas/map.html.

Model My Watershed Technical Documentation: https://wikiwatershed.org/documentation/mmw-tech/#layers-viewable-mapped-data.

Minnesota Invasive Terrestrial Plants and Pests Center Prioritized list of terrestrial invasive plants: http://www.mitppc.umn.edu/.

NOAA Atlas 14-Point Precipitation Frequency Estimates: https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=mn.

Natural Features of Minnesota: http://www.dnr.state.mn.us/maps/compass.html.

Nongame Wildlife – South Region: http://www.dnr.state.mn.us/eco/nongame/south.html.

Nongame Wildlife – Northwest Region: http://www.dnr.state.mn.us/eco/nongame/nw.html.

Nongame Wildlife – Northeast Region: http://www.dnr.state.mn.us/eco/nongame/ne.html.

Nongame Wildlife – Central Region: http://www.dnr.state.mn.us/eco/nongame/central.html.

Soil Hydrology of the United States: http://resources.arcgis.com/en/communities/soils/02ms00000008000000.htm.

# Guideline S.2: Site Water Quality and Efficiency

## Intent

To restore the natural water cycle of Minnesota biomes in order to support natural hydrology, soils, vegetation, and animals; reduce and limit the amount of chemicals and soil leaving the site; reduce potable water usage; recharge local aquifers, and respond to the ecological factors of the project site as a part of its larger watershed.

## Required Performance Criteria

Guidelines other than S.2D are required for New Construction and Major Renovation projects that include at least 5,000 square feet of land disturbance, or at least 50 cubic yards or more of cut and fill including the land disturbance, and cut and fill within or below the building footprint. ~~Exterior scope~~Site area related ~~only~~solely to ADA improvements, other accessibility-related improvements, or utility connections may be excluded from ~~contribution toward these amounts~~total area of disturbance when determining if the guidelines are triggered, more detail on this is included at the beginning of the Site and Water Guidelines. Guideline S.2D applies to projects that include renovation or replacement of plumbing fixtures. Major Renovation projects must upgrade or install all ~~faucets~~faucet aerators and showerheads in renovated areas to low-flow products~~. Major Renovation projects~~ but may otherwise limit the application of performance criteria to ~~the non-showerhead and faucet~~only the fixtures included in the renovation scope.

~~A.~~ Stormwater Quantity and Watershed Connections:

~~B.~~A. Water leaving the project site is subject to the following:

1. Site water cycle requirements: The catchment area of the entire project site is required to manage rain water and stormwater ~~to meet~~falling within the ~~required~~defined site area at the percentage ~~of annual onsite management according~~relative to its hydrological soil ~~types, as evaluated using~~ group (HSG) type(s). High infiltration soils (A type soils) area required to manage a higher percentage than low infiltration capacity soils (D type soils). Project teams must determine the site's HSG (or multiple HSG percentages across the site) and use either the appropriate Atlas 14 storm event (for sites with A or B soils) or the 1.1" default storm event (for sites with C or D soils or other accepted infiltration constraint) in the Minnesota Impact Design Standard (MIDS) calculator~~.~~ to calculate and report the volume managed on site. Project teams must calculate their HSG in Predesign using soil boring interpretation and/or a ring infiltrometer test. More information on these is found in "Meeting the Guidelines" section below.
2. Projects with A and B soils are also required to ~~locate~~determine the ~~site~~site's elevation in the watershed. Project sites are either located in the "uplands" or "lowlands" of the watershed ~~and to meet storm event-based onsite management targets equivalent~~as sites higher in the watershed have more opportunity to ~~the annual onsite management targets. Uplands~~improve aquifer recharge and lessen impacts on lower receiving waterbodies. Each elevation has slightly different requirements (see the table below for additional information). Sites are considered to be ~~sites that are at least a specific elevation~~in the uplands of a watershed if the lowest point of the site is 10' or more above the Ordinary High Water Mark (OHWM) elevation of the nearest receiving waterbody; sites with a lower elevation are considered to be in the "lowlands" of the watershed~~.~~ and have different (less stringent) requirements. Specific elevation requirements are listed under the "Meeting the Guidelines" section below. Projects are required to use a 25-year 24-hour storm for projects located in the uplands and a ten-year 24-hour storm for projects located in the lowlands.

3. Once project teams have determined the HSG and position in the watershed of their site, the volume of water required to be managed on-site is subject to the following limits:

| Hydrological Soil Groups | Projects in ~~Lowlands[1]~~Lowlands of Watershed | Projects in ~~Uplands[1]~~Uplands of Watershed | Runoff Not to Exceed | *Required Total Onsite Managed—for both annual evaluation and for A and B soils for event-based performance target in MIDS* |
|---|---|---|---|---|
| **A Soils 1.63–0.8 in./hr.** | Evaluate both: MIDS annual and ATLAS14 25-year 12-hr event | Evaluate both: MIDS annual and ATLAS14 25-year 24-hr event | 2% | ***98%*** |
| **B Soils: 0.45–0.3 in./hr.** | Evaluate both: MIDS annual and ATLAS14 25-year 12-hr event | Evaluate both: MIDS annual and ATLAS14 25-year 24-hr event | 5% | ***95%*** |
| **C Soils: 0.2 in./hr.** | Use MIDS Default | Use MIDS Default | 8% | ***92%*** |
| **D Soils~~:~~ (and those areas prohibited from infiltration): 0.006 in./hr.** | Use MIDS Default | Use MIDS Default | 15% | ***85%*** |

~~[1]Additional~~Additional detail about the definitions of uplands or lowlands of a watershed can be ~~determined using the definitions~~ found in the Meeting the Guideline section below. Applicable ATLAS14 storm event volume can be found at the NOAA Web Explorer ~~located here: https://hdsc.nws.noaa.gov/pfds/?bkmrk=mn This~~. If your project has type A or B soils the listed event volume (in inches) shall be input into MIDS instead of the 1.1" default ~~if your site has Type A or B soils~~. Event-based metrics relative to Atlas14 events are listed within MIDS under "Performance goal requirements," and annual metrics are listed as "Post development annual runoff volume" and "Annual runoff volume removed by BMPs.". The percentages required to be managed on site shall use the Performance goal metrics in the MIDS report. These limits are subject to the following:

~~Subject to the following:~~

i. Allowable on-site Infiltration ~~rates and location~~capacity to meet the requirements in the table above shall ~~be subject~~not contradict other local infiltration restrictions including but not limited to ~~both~~:
   - ~~-~~Water Table Vulnerability ~~(https://gisdata.mn.gov/dataset/water-aquifer-vulnerability) and~~

- and Ground Water Contamination Susceptibility (~~https://mnag.maps.arcgis.com/apps/webappviewer/index.html?id=47a342afe6654640b935c8e76023da92)~~links for these can be found in the Meeting the Guideline Section Below).
- ~~Sites~~Wellhead Protection Zones

~~ii.~~ Project sites, or areas of sites prohibited from infiltration per the NPDES Permit Application Requirements or another applicable local rule/regulation that does not allow infiltration within the project site boundaries are permitted to satisfy the total onsite managed requirements using other listed means~~.~~

~~It is recommended (though in this revision no longer required) that the following minimum annual infiltration,~~ (evapotranspiration~~, and onsite~~ + capture/storage/reuse ~~percentages~~), and are ~~met:~~

| ~~Hydrological Soil Groups~~ | ~~Recommended Infiltrate at Least~~ | ~~Recommended Evapo-Transpirate at Least~~ | ~~Recommended Onsite Reuse at Least~~ |
|---|---|---|---|
| ~~A Soils 1.63–0.8 in./hr.~~ | ~~80%~~ | ~~5%~~ | ~~0%~~ |
| ~~B Soils: 0.45–0.3 in./hr.~~ | ~~50%~~ | ~~25%~~ | ~~5%~~ |
| ~~C Soils: 0.2 in./hr.~~ | ~~30%~~ | ~~40%~~ | ~~10%~~ |
| ~~D Soils: 0.006 in./hr.~~ | ~~0%~~ | ~~50%~~ | ~~20%~~ |

iii. ~~Onsite roof~~ , like all sites, allowed to meet on-site management requirements with a “secondary site”. Onsite rainwater collected ~~rainwater~~ directly from a “clean” roof may be used to offset infiltration requirements at a ~~rate~~ratio of 1:1~~, subject to the guidance~~.5 or 150% multiplier for every acre (or portion thereof) of roof catchment area that is utilized as part of a storage/reuse system. For example, if a one-acre roof is utilized for storage/capture it is treated as a 1.5-acre roof catchment area on site. Use the EPA definition of “Clean Roof,” a link is available in the Meeting the Guideline section below~~:~~.

~~iii.~~iv. Roof-collected rainwater can be employed without treatment when “first-flush” technology is utilized. Ensure compliance with local plumbing codes.

~~iv.~~v. Roof-collected rainwater shall be prioritized to supplement the site’s ~~water holding~~storage/reuse requirements and used for one of the approved onsite ~~designated~~ uses in the following order (Note that some of these uses may require additional purification~~).~~ or treatment. Ensure compliance with local plumbing codes~~.~~.)

- ~~For~~ Utilize storage and reuse options that also serve the project’s animal habitat requirements per S.1 and S.5: Water ~~shall~~should be held in locations on site to which ~~site~~ animals ~~can~~ have ~~continual~~access to open water ~~access~~in non-winter months.

- For ~~subsurface~~ irrigation of ~~the~~ site planting and vegetation.
- For evaporative cooling on flat roofs (roof-collected rainwater only~~, from "blue roofs").~~)
- For cooling towers (roof-collected rainwater only).
- For ~~nonpotable~~non-potable water ~~usage~~uses within the site/building (depending on re-use may be roof-collected rainwater only or may need to be cleaned to a potable standard).
- For toilet flushing (roof-collected rainwater cleaned to a potable standard).

vi. Evapotranspiration can be calculated with select BMPs in MIDS (ex. tree trenches, green roofs, and vegetated swales, among others). For non-MIDS BMP areas that contribute additional evapotranspiration volume to baseline MIDS calculations, project teams can estimate the ET contributions for vegetated areas of common planting types utilizing the evapotranspiration calculator within Appendix S4f: Site Albedo + Evapotranspiration Calculator.

~~3.~~2. Localized Flood ~~prevention~~Prevention: If it is required by the project's building program or typology, the Minnesota State Predesign Process, or another non-negotiable site selection constraint to construct within a floodplain, the project shall follow the Federal Emergency Management Agency (FEMA) regulatory flood protection elevation requirements. Building in a floodplain is ~~prohibited unless essential to the program of the project. Where construction is added to the floodplain, it is recommended (and likely to be required under future versions of this guideline) to excavate and remove a 1:1 ratio volume of soil from floodplain equal to the volume of added structures.~~otherwise prohibited by the B3 Guidelines.

vi. All projects are encouraged to complete a flood hazard risk management assessment to determine the optimal siting, orientation, size/massing of the project.

vii. If it is technically or logistically infeasible to construct outside of the floodplain, projects are encouraged to document the flood prevention design strategies in a narrative and/or annotated site plan.

~~4.~~3. Runoff ~~rate~~Rate: The site shall be designed to not exceed the pre-settlement runoff rate for native soil and vegetation conditions as evaluated for a 2- and 10-year storm event, and to not exceed the pre-development runoff coefficient as evaluated for a 100-year storm event.

vi. MIDS does not calculate runoff rate/coefficient. Therefore, project teams must document compliance through the use of HydroCAD, P8, or other hydrological modeling software and upload results to the B3 tracking tool under this guideline.

~~C.~~B. Stormwater Quality:

1. Provide treatment systems designed to remove 80% of the post-development Total Suspended Solids (TSS) and 60% of the post-development Total Phosphorus (TP). The design of the retention of TSS and TP shall be accomplished with best management practices (BMPs) and calculated/reported using the MIDS calculator and the MIDS summary page in PD.
2. The reduction of chlorides shall be accomplished by all of the following to the maximum amount feasible:

~~i.~~vi. Reducing the area of ~~ongrade~~ impervious walking/driving surfaces requiring the use of chlorides by ~~20%.~~employing one or more of the low salt design strategies. Project teams are encouraged to document low salt design strategies in an annotated "low salt design" site plan early in the design process and update throughout Design and Final Design phases.

~~ii.~~vii. Reducing the amount of chlorides required on the remaining impervious surfaces by employing the ~~Minnesota Pollution Control Agency (~~MPCA~~)~~ Smart Salting Assessment tool (SSAt), formerly called the Winter Maintenance Assessment tool (or WMAt) as minimum low salt operational practice.

~~iii.~~viii. ~~Developing~~Project teams must coordinate with owner's maintenance representatives before the end of Design phase submissions to develop a chloride management plan for site-specific or campus-specific

operations to ensure ongoing chloride-use limits. Project teams should include this plan in the project OPR document and should update it throughout Design and Final Design phase submissions.

~~iv.~~ix. Inclusion of planning of alternative measures to de-ice (e.g. utilization of sand, incorporation of snow-melt systems).

C. ~~No~~Limit Water use for Irrigation

Demonstrate a reduction or elimination in potable water ~~shall be~~ used for irrigation ~~after a 5-year plant establishment period except for~~during non-drought periods ~~when actual rainfall for the month is less than 30%~~. This guideline shall be met by documenting water reduction by one of the ~~average rainfall for that month. Collected roof rainwater and graywater may be used for subsurface plant~~three listed compliance paths.

1. Irrigation Water Reduction Paths:

i. Irrigation Water Reduction Path 1: Planting selection + no permanent irrigation ~~at any time though not for spray or flood~~system

Demonstrate a 100% reduction in annual potable water demand for landscape irrigation compared to an irrigation demand baseline through planting selection documented in Appendix S-2c: Outdoor Water Calculator. The proposed irrigation demand value is based on plant selection only (not the irrigation system efficiency) and the baseline assumes all planting areas are turf grass in microclimate site areas matching those of the project as-designed. Turf grass integral to the program of the site, such as athletic fields or school recreational fields, are excluded from the reduction calculation for this requirement.

No permanent irrigation system may be installed on-site except for those serving turf grass integral to the program of the site. A temporary irrigation system using potable water is permitted during the 5-year establishment period and after the 5-year plant establishment period during times of drought when actual rainfall for the month is less than 30% of the historic average rainfall for that month. During times of drought irrigation with potable water shall not exceed 0.25" per week during the growing season for the designed landscape.

ii. Irrigation Water Reduction Path 2: Planting selection + permanent high-efficiency irrigation system

Demonstrate a reduction of 80% of annual potable water demand for landscape irrigation compared to an irrigation demand baseline through planting selection documented in Appendix S-2c: Outdoor Water Calculator. The proposed irrigation demand value is based on plant selection only (not the irrigation system efficiency) and the baseline assumes all planting areas are turf grass in microclimate site areas matching those of the project as-designed. Plants with similar water requirements shall be grouped into the same irrigation zone. Turf grass integral to the program of the site, such as athletic fields or school recreational fields, are excluded from the reduction calculation for this requirement.

A permanently installed high-efficiency irrigation system using potable water is only permitted during the establishment period (as defined under part 1) and during times of drought. During times of drought irrigation with potable water shall not exceed 0.25" per week during the growing season for the designed landscape. High efficiency irrigation system requirements are found under section 2 below.

iii. Irrigation Water Reduction Path 3: Planting selection + high-efficiency irrigation system + alternative water source use.

Demonstrate a reduction of 70% of annual potable water demand for landscape irrigation compared to an irrigation demand baseline through planting selection documented in Appendix S-2c: Outdoor Water Calculator. The proposed irrigation demand value is based on plant selection only (not the irrigation system efficiency) and the baseline assumes all planting areas are turf grass in microclimate site areas matching those of the project as-designed. Plants with similar water requirements shall be grouped into the same

irrigation zone. Turf grass integral to the program of the site, such as athletic fields or school recreational fields, are excluded from the reduction calculation for this requirement.

A permanently installed high-efficiency irrigation system using potable water is only permitted during the establishment period (as defined under part 1) and during times of drought. During times of drought irrigation with potable water shall not exceed 0.25" per week during the growing season for the designed landscape. High efficiency irrigation system requirements are found under section 2 below.

Under Path 3, irrigation demand after the establishment period and outside of times of drought can be provided only if supplied by eligible alternate water sources identified in Section 3.

2. High efficiency irrigation system requirements: Permanently installed irrigation systems installed for program required turf grass under path 1 and all irrigated areas under paths 2 and path 3 shall be subject to the following:
   i. Irrigation system types other than drip or subsurface drip shall only be used after sunset and before sunrise.
   ii. Overhead irrigation systems shall not be used on areas apart from turf grass integral to the program of the site unless demonstrated to be technically infeasible.
   iii. Pressure regulating devices shall be included to maintain irrigation system operating pressures within the manufacturer's recommended operating range unless the project team can demonstrate that operating pressures remain within those ranges without pressure regulation.
   iv. When pumps are used, variable frequency drive (VFD) or equivalent high efficiency controls are required.
   v. WaterSense-labeled smart controllers shall be installed and shall utilize soil moisture sensing, rainfall sensing, evapotranspiration-based scheduling, or a combination thereof to automatically adjust irrigation operation.
   vi. Systems shall be designed to achieve a minimum distribution uniformity (DUlq) of at least 0.70 for overhead systems, and at least 0.80 for drip irrigation systems.
   vii. Flow sensors with automatic leak detection shall be installed.
   viii. Irrigation systems shall be designed and installed to prevent overspray onto impervious surfaces and to minimize runoff.
3. Alternate water sources: Under Path 3 collected roof rainwater and graywater (where permitted by code) stored in a cistern shall be used to meet irrigation needs outside of the establishment period and times of drought.

~~E.~~D. Building Water Use: Municipal potable water or harvested groundwater use in the building shall be reduced by 50% compared to a baseline established in the 1992 Energy Policy Act requirements~~, including water-consuming appliances for all uses associated with fixture types referenced by those requirements.~~ and documented in Appendix S-2d: Building Water Calculator. The criteria may be met by any combination of the following: selection of low- or no-flow fixtures, use of recycled rainwater, or other strategies.

1. Renovation portions of projects may limit performance criteria application to the number of fixtures included in the renovation scope subject to the following exemption:
   ~~i.~~vi. Faucets in the renovated area shall be upgraded with low-flow faucet aerators, and showerheads shall be upgraded with low-flow showerheads even if other plumbing fixtures are not upgraded.
2. Recycled rainwater can also be used to offset the percentage of potable water usage, if allowed in the local jurisdiction.
3. To verify compliance with this guideline during operation of the building, it is necessary to submeter indoor water consumption separately from irrigation.

## Recommended Performance Criteria

~~F.~~E. No potable water shall be used for irrigation after a two-year plant establishment period except for periods when actual monthly rainfall is less than 30% of the average rainfall for that month. Graywater may be used for plant irrigation if allowed in the local jurisdiction.

~~G.~~F. Municipal potable water or harvested groundwater use in buildings shall be reduced by 70% compared to code (1992 Energy Policy Act requirements) for all uses associated with fixture types referenced by those requirements. The criteria may be met by any combination of the following: selection of low- or no-flow fixtures, use of alternatively sourced water, or other strategies. Major Renovation Path projects may limit performance criteria application to the number of fixtures included in the renovation scope.

## Meeting the Guidelines

~~Employ the Minnesota's Minimal Impact Design Standard calculator (https://stormwater.pca.state.mn.us/index.php/MIDS_calculator) to design the Best Management Practices (BMPs) for the project site to meet the amount of rainwater required to infiltrate project site, amount of rainwater required to evapotranspirate on the project site, and amount of rainwater allowed to run off project site.~~

~~Storm events are listed under NOAA ATLAS 14: https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=mn.~~

~~Use the Soil Survey Geographic Data Base (SSURGO), Minnesota at https://gisdata.mn.gov/dataset/geos-ssurgo to determine the hydrological soil group(s) for project site. Employ the MIDS calculator located at https://stormwater.pca.state.mn.us/index.php/MIDS_calculator to design a site that meets the rainwater retention requirements with BMPs.~~

**S2A – Stormwater Quantity**

Determine the composition of site Hydrologic Soil Groups (HSG) from soil boring interpretation or an infiltrometer ring test. Input into the B3 tracking tool and use as the site soils composition for MIDS.

Hydrological Soils Group Determination: as described by the following:

- Use the soil boring reports obtained for the project and make a determination using the table at this link: (https://stormwater.pca.state.mn.us/index.php?title=Design_infiltration_rates)
  Or
- Perform soil infiltration test(s) on project site using a ring infiltrometer ( https://pubs.usgs.gov/wsp/1544f/report.pdf) or one of the approved methods listed in the Minnesota Stormwater Manual to determine soil infiltration rate and Hydrologic Soil Group of the site: (https://stormwater.pca.state.mn.us/index.php?title=Determining_soil_infiltration_rates)

Determine the MIDS "Performance Goal" storm event size relative to the site HSG(s). For C and D type soils, use the 1.1" MIDS Default. For A and B type site soils, first determine the elevation of the project site in the watershed (uplands or lowlands) and then find the corresponding ATLAS14 event size and input as the "Performance Goal" in MIDS. NOAA ATLAS 14 event sizes can be found at: (https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=mn) Find your site location and find the relative storm event in the resulting table (ex. 12hr – 25yr Storm for A soils in the lowlands of the watershed).

*Water Networks:*

Water network connections can be determined by using the following resources:

- Watershed and lakeshed location:
    - Hydrologic units (HU) level 6: sub-watersheds (10,000–40,000 acres), minor watershed (3,000 acres) or HU (100 acres) DNR catchments level 09 are listed here: http://www.dnr.state.mn.us/watersheds/map.html.
    - More detail is available under the following:
        - www.dnr.state.mn.us/watersheds/lakeshed_project.html.
        - http://www.mngeo.state.mn.us/chouse/water_watersheds.html
        - https://streamstats.usgs.gov/ss/.
        - http://www.dnr.state.mn.us/watersheds/lakeshed_project.html.
    - ~~https://gisdata.mn.gov/dataset/water-aquifer-vulnerability.~~
        - https://gisdata.mn.gov/dataset/water-aquifer-vulnerability.
- The US EPA's Surf Your Watershed program provides detailed information on watersheds: ~~https://cfpub.epa.gov/surf/state.cfm?statepostal=MN.~~https://cfpub.epa.gov/surf/state.cfm?statepostal=MN.
- Watershed Management Districts and Watershed Management Organizations of Minnesota: ~~https://www.mnwatersheds.com/maps and https://bwsr.state.mn.us/watershed-districts~~and https://bwsr.state.mn.us/watershed-districts

~~Note: If the project is in a designated area, contact the appropriate organization for other specific requirements.~~

~~Soil hydrology is determined using the Soil Hydrology of the United States page: http://resources.arcgis.com/en/communities/soils/02ms00000008000000.htm.~~

~~Determine which of the following drain classes are contained on the site:~~

1. ~~Excessively Drained~~
2. ~~Somewhat Excessively Drained~~
3. ~~Well Drained~~
4. ~~Moderately Well Drained~~
5. ~~Somewhat Poorly Drained~~
6. ~~Poorly Drained~~
7. ~~Very Poorly Drained~~

~~Based on the drainage designation at ATLAS 14 rainfall estimates (available at https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html).~~

~~The site's floodplain designation shall be based on FEMA mapping (listed using FEMA's National Flood Hazard Layer viewer at https://msc.fema.gov/portal/home which includes the following designations:~~

- ~~1% Annual Chance Flood Hazard (under consideration)~~
- ~~Regulatory Floodway~~
- ~~Special Floodway~~
- ~~Area of Undetermined Flood Hazard~~
- ~~0.2% Annual Chance Flood Hazard~~
- ~~Future Conditions 1% Annual Chance Flood Hazard~~
- ~~Area with Reduced Risk Due to Levee~~

If the site is designated as any of the previous categories, contact the county flood plan maps by county at https://arcgis.dnr.state.mn.us/ewr/lfeo/lat/46.4055/lng/-94.2779/z/6 to verify FEMA designation. Any sites or portion of sites in designated floodplain areas shall not include building construction unless it is essential to the building program. If a building is necessary, it must meet the regulatory flood protection elevation, as listed at http://www.dnr.state.mn.us/waters/watermgmt_section/floodplain/rfpe.html.

Perform soil infiltration test(s) on project site using methods listed in the Minnesota Stormwater Manual, determining soil infiltration rates located at https://stormwater.pca.state.mn.us/index.php?title=Determining_soil_infiltration_rates. Use the infiltration test(s) to compare with the infiltration rates of the hydrological soil group(s) located at https://stormwater.pca.state.mn.us/index.php?title=Design_infiltration_rates. Use the more restrictive infiltration estimate for project site design.

The onsite retention of total suspended solids (TSS), phosphorus, and nitrogen can be calculated by applying the selected design strategies via the MIDS calculator and reporting the results.

A 20% reduction in the impervious areas that need chlorides may be accomplished through design; the remainder may be removed by the following strategies[4]:

- Hire a Smart Salting Certified contractor, Levels 1 and 2: https://www.pca.state.mn.us/water/salt-application-training.
    - Track and document annual salt use in total pounds and square footage of applied areas.
- Develop and follow a snow and ice policy: https://www.pca.state.mn.us/sites/default/files/p-tr1-51c.pdf.
- Utilize the Winter Maintenance Assessment tool (WMAt) to track and improve BMPs. Within three years, all BMPs shall reflect the highest level of management: https://stormwater.pca.state.mn.us/index.php/Winter_Maintenance_Assessment_tool_(WMAt).
- Follow the salt application rate guidelines in the MPCA's Winter Parking Lot and Sidewalk Maintenance Manual: https://www.pca.state.mn.us/sites/default/files/p-tr1-10.pdf.
    - Use liquid deicers where and when possible.
    - Create regular assessments in the WMAt with 10% or less poor practices (red).
    - Educate/inform employees and guests of the building about Smart Salting.

A chloride management plan with the goal of creating a chloride-free site in ten years (https://stormwater.pca.state.mn.us/index.php?title=Chloride_Management_Plan) may include the following:

- Use of sand substitution (from first-year occupancy).
- Use of alternate salts, such as magnesium chloride (after two years of occupancy).
- Use of substitute alternatives to reduce chloride, such as beet juice (after four years of occupancy).

The irrigation water use shall be metered and recorded for at least five years after building occupancy or until site planting is fully established. No potable water shall be used for outdoor use such as sidewalks, driveways, or vehicle washings. In addition, no potable water shall be used to irrigate or water after five years of plant establishment except during periods of drought. During periods of drought, potable water irrigation and watering is permitted to ensure plant survival. It is recommended that 90% of plant materials are drought tolerant and that decorative plants only require

[4] MPCA – Chloride reduction strategies

~~irrigation for nonsevere droughts. Periods of severe drought are defined as months in which monthly rainfall is 70% less than average. Captured rainfall can be used anytime for irrigation and watering of plant materials.~~

~~Worksheet S-2 Building Water Calculator shall be used to calculate building water use for base and design. This also calculates the base-case condition for Energy Policy Act required flow and flush fixture rates and provides example fixture performance values for uses associated with those fixtures. Annual water consumption must be submitted to the B3 Guidelines Tracking Tool for a period of ten years after building occupancy through the B3 Benchmarking program.~~

~~The proposed graywater treatment system shall meet the environmentally feasible, acceptable soil infiltration condition, and the onsite graywater wetland treatment system or the manufactured graywater treatment system shall be cost effective. The volume of graywater and the required size of the graywater treatment train or manufactured systems shall meet the NSF/ANSI 350 and 350-1, Onsite Water Reuse Treatment Systems standards for the intended final use. If blackwater onsite water treatment is pursued, then a qualified professional shall be employed to meet the NSF/ANSI 350 and 350-1, Onsite Water Reuse Treatment Systems standards. Treated blackwater shall not be reused but can be used to supplement a site's infiltration requirements if the treated blackwater is infiltrated through underground drainage fields.~~

- The watershed in which the project site is located can be found using the website ~~https://app.wikiwatershed.org/ and~~https://app.wikiwatershed.org/ and
    - For boundary: select US Geological Survey (USGS) Subwatershed Unit (HUC-12), then selecting the "free draw" area.
    - For delineate watershed: select the Continental US Medium Resolution under the Layers subheading.
    - For streams: select Continental US Medium Resolution Stream Network.
    - For coverage grid: select Hydrologic Soil Groups from gSSURGO.
    - For boundary: select USGS Subwatershed Unit (HUD-12).
    - For observation, select EPA Permitted Point Sources.
    - For base map: select Terrain.

~~If the project site has soils in Hydrologic Soil Group A: High Infiltration or Hydrologic Soil Group B: Moderate Infiltration, plans shall include at least 10% higher infiltration of all rainfall events.~~

If a project is in a designated area, contact the appropriate organization for specific requirements that may be more restrictive than the B3 requirements. The more restrictive of either shall be followed. Project teams should include contradiction of local vs. B3 requirements in the notes section of the PD or D phase tracking tool submission.

Input the upland/lowland determination in the B3 tracking tool.

*Determination of uplands and lowlands of watersheds:*

To simplify calculations as to whether a site is in the lower or upper part of a watershed, Minnesota has been divided into seven major watershed basins. The map showing these watershed basins can be found at: https://www.dnr.state.mn.us/watersheds/map.html. Once the major watershed basin for the project site is found, the project team shall determine the OHWL (ordinary high water level) and NWL (normal water level) for the nearest receiving body of water. Data on Minnesota rivers and streams is accessible by the Cooperative Stream Gaging (CSG) on the MN DNR CSG web (https://www.dnr.state.mn.us/waters/csg/index.html) for the

most current water elevation readings. “Ordinary high water level” (OHWL) of Minnesota Lakes can be determined by contacting a local area hydrologist (listed here: https://www.dnr.state.mn.us/waters/surfacewater_section/hydrographics/ohw.html).

Then using the project site elevation in feet above the OHWL/NWL, the project team can determine the status of the project site relative to the heights listed in the below list of watersheds. B

Sites or portions of sites located at a higher elevation than the lower watershed limit (as defined below) shall be considered in the *upper* watershed.

Lake Superior & Rainey River Watershed basins: Lower watershed is defined as within 20 feet elevation of OHWL/NWL of nearest relevant receiving water body.

- Lake Superior or Rainey River.

Minnesota River & Red River of the North Watershed basins: Lower watershed is defined as within five feet elevation of OHWL/NWL of nearest relevant receiving water body:

- Minnesota River Watershed source south and east to MSP Metropolitan Watersheds.
- Red River Valley Watershed source north to Canadian border.

Upper/North Mississippi River Watershed Basin: Lower watershed is defined as within 15 feet elevation of OHWL/NWL of nearest relevant receiving water body within:

- Mississippi River from Lake Itasca source south to West Metropolitan MSP Watershed Organizations.

St. Croix River Watershed Basin: Lower watershed is defined as within 25 feet elevation of OHWL/NWL of nearest relevant receiving water body:

- St. Croix River along Minnesota/Wisconsin border and its tributaries within Minnesota (Sunrise, Snake, Kettle Rivers, etc.).

West Metropolitan MSP (Minneapolis/St. Paul) Watershed organization basins: Lower watershed is defined as within ten feet elevation of OHWL/NWL of nearest relevant receiving water body. The following stream, creek, and lake watershed organizations are included:

- Bassett Creek Watershed Management Organization
- Black Dog Watershed Management Organization
- Carver County Watershed Management Organization
- Coon Creek Watershed District
- Elm Creek Watershed Management Commission
- Lower Minnesota River Watershed District
- Minnehaha Creek Watershed District
- Mississippi River Watershed Management Organization
- Nine Mile Creek Watershed District
- Pioneer-Sarah Creek Watershed Management Commission
- Prior Lake/Spring Lake Watershed District
- Richfield-Bloomington Watershed Management Organization
- Riley-Purgatory-Bluff Creek Watershed District
- Scott County Watershed Management Organization

- Shingle Creek and West Mississippi Watershed Management Commission

East Metropolitan MSP (Minneapolis/St. Paul) Watershed organization basins: Lower watershed is defined as within 15 feet elevation of OHWL/NWL of nearest relevant receiving water body. The following stream, creek, and lake watershed organizations are included:

- Browns Creek Watershed District
- Capitol Region Watershed District
- Carnelian-Marine-St. Croix Watershed District
- Comfort Lake-Forest Lake Watershed District
- Eagan-Inver Grove Heights Watershed Management Organization
- Lower Mississippi River Watershed Management Organization
- Lower Rum River Watershed Management Organization
- Lower St. Croix River Watershed Management Organization
- Northern Canon River Watershed Management Organization
- Ramsey-Washington Metro Watershed District
- Rice Lake Watershed District
- South Washington Watershed District
- Upper Rum River and Sunrise River Watershed Management Organization
- Vadnais Lake Area Watershed Management Organization
- Valley Branch Watershed District
- Vermillion River Watershed Joint Powers Organization

Lower/South Mississippi River Watershed basins: Lower watershed is defined as within 25 feet elevation of OHWL/NWL of nearest relevant receiving water body within:

- Mississippi River south of East Metropolitan MSP Watershed organizations to Iowa border.
- Southeast Minnesota Driftless Geological Area west of Mississippi River and north of Iowa border.

Employ the Minnesota Pollution Control Agency's Minimal Impact Design Standard (MIDS) calculator (https://stormwater.pca.state.mn.us/index.php/MIDS_calculator) to design the Best Management Practices (BMPs) for the project site and the required performance goal. The summary sheet from MIDS must show that the BMPs meet the required volume to infiltrate project site, amount of rainwater required to be evapotranspired on the project site, and amount of rainwater allowed to run off project site.

The table below outlines recommended minimum annual infiltration, evapotranspiration, and onsite reuse percentages that may be useful in planning for stormwater infrastructure early in the project design phase. This demonstrates a rough guide for the minimum amounts of each type of management practice that should be implemented within a project site of various soil types to design a feasible system of BMPs in MIDS to deal with the projected storm size.

| Hydrological Soil Groups | Recommended Infiltrate at Least | Recommended Evapo-Transpirate at Least | Recommended Onsite Reuse at Least |
|---|---|---|---|

| | | | |
|---|---|---|---|
| **A Soils**<br>**1.63–0.8 in./hr.** | 80% | 5% | 0% |
| **B Soils:**<br>**0.45–0.3 in./hr.** | 50% | 25% | 5% |
| **C Soils:**<br>**0.2 in./hr.** | 30% | 40% | 10% |
| **D Soils:**<br>**0.006 in./hr.**<br>**or no infiltration allowed on site**<br><br>**(This recommended minimum mix of volume reduction strategies could also be used to address other rules/regulations that prevent infiltration on site)** | 0% | 50% | 20% |

Account for additional evapotranspiration due to non-BMP vegetation contributions using the B3 Site Albedo and Evapotranspiration Calculator found at the following link: (B3 Site Albedo + Evapotranspiration Calculator) and add this to the overall on-site volume reduction. Calculate the total performance goal reduction from MIDS + Evapotranspiration from the B3 Calculator and record in the B3 tracking tool. The table below is utilized within the calculator and was based on the FAO Penman-Monteith equation to obtain a Local Reference Evapotranspiration (ETo) value. This value is then multiplied by a plant factor (turfgrass, deciduous tree cover, coniferous tree cover, shrubs, grasses, and others) and further modified utilizing a multiplier to incentivize vegetative site area over hardscape for albedo.

*Evapotranspiration Calculations*

If a project team is pursuing taking credit for vegetation not included in default MIDS BMPs these calculations should be made using a method following this formula: ETC = ET0 × KC (included in the B3 Guidelines Albedo and Evapotranspiration calculator)

- ETC is the ET for the specific land cover of interest, (please refer to the linked table to find a suitable proxy for your vegetation of interest.)
  - https://watereuse.org/salinity-management/ew/ew_8a_table-2.html
- ET0 is the local reference ET value calculated using the closest local weather station data (or future weather predictions), and
- KC is the appropriate plant adjustment factor (crop factor)
- For plants other than turf grass, KC needs to be adjusted for planting densities and microclimate variables of species other than continuous ground coverage. The KC can be estimated using the equation: KL = ETC × KD × KMC
  - ETC from above
  - KD is the vegetative density factor

        - Low density = .5
        - Medium density = .8
        - High density = 1.1
    - KMC is an appropriate microclimate adjustment factor
        - Low value (0.5)
            - if shaded for a substantial part of the day, especially in the afternoon—for example, on the north or northeast side of a building or under a building's overhang
            - if protected from wind by a building, structure, or other plants—for example, located in a courtyard or on the north side of a slope
        - Medium value (1.0)
            - if not exposed to atypical winds or atypical inputs of heat, as might be caused by nearby buildings or by reflective surfaces such as a building's windows
        - High value (1.2)
            - if exposed to atypical winds—for example, inside a "wind tunnel" formed by buildings or by hilly terrain
            - if surrounded by heat-absorbing surfaces—for example, located in a parking lot or next to the south- or southwest-facing wall of a building
            - if exposed to high amounts of light reflected by nearby windows, automobiles, or other reflective surfaces
- Lastly, that evapotranspiration rate is multiplied by the % area of the site where that target species is planted.

This methodology was adapted and simplified for use in the MN B3 program from the FAO Penman-Monteith equation and the WateReuse Foundation's online calculation guidelines. The simplified method is contained within the Site Albedo and Evapotranspiration Calculator.

| **Vegetative Cover Type** | **Estimated ET Values (Listed in inches relative to the % of total site area in this vegetative type)[5]** |
|---|---|
| **Turf Grass** | 0.1" of required storm event x % of total acreage in this vegetative cover type |
| **Non-Turf Ground Cover** | .15" of required storm event x % of total acreage in this vegetative cover type |
| **Shrubs + Low Plantings** | .25" of required storm event x % of total acreage in this vegetative cover type |

[5] In order to create standardized values for projects across Minnesota, the above values were calculated utilizing an adjusted average ET0 for Minnesota and adjusted averages/combinations of plant reference ET values for common native landscape plantings in Minnesota. https://www.fao.org/land-water/databases-and-software/eto-calculator/en/

| | |
|---|---|
| **Grasses/Sedges** | .25" of required storm event x % of total acreage in this vegetative cover type |
| **Deciduous Tree Canopy at maturity**[6] | .25" of required storm event x % of total acreage in this vegetative cover type |
| **Coniferous Tree Canopy at maturity** | .25" of required storm event x % of total acreage in this vegetative cover type |

The ET reductions are taken after the MIDS calculation and should be converted to acre inches and treated as a non-filtration BMP outside of the MIDS calculations to get a total volume reduction. (i.e. Total event size x acreage - MIDS filtration/volume BMPs reductions – ET calculator reductions = total volume managed on site)

Water Table Vulnerability can be found at https://gisdata.mn.gov/dataset/water-aquifer-vulnerability, Ground Water Contamination Susceptibility can be found at https://mnag.maps.arcgis.com/apps/webappviewer/index.html?id=47a342afe6654640b935c8e76023da92.

The EPA's guidelines on "Clean Roofs" can be found at: https://www.epa.gov/waterreuse/summary-minnesotas-water-reuse-guideline-or-regulation-onsite-non-potable-water-reuse.

*Floodplain Designation:*

The site's floodplain designation should be based on FEMA mapping (listed using FEMA'a National Flood Hazard Layer viewer at https://msc.fema.gov/portal/home which includes the following designations:

- 1% Annual Chance Flood Hazard (under consideration)
- Regulatory Floodway
- Special Floodway
- Area of Undetermined Flood Hazard
- 0.2% Annual Chance Flood Hazard
- Future Conditions 1% Annual Chance Flood Hazard
- Area with Reduced Risk Due to Levee

If the site is designated as any of the previous categories, contact the county flood plan maps by county at https://arcgis.dnr.state.mn.us/ewr/lfeo/lat/46.4055/lng/-94.2779/z/6 to verify FEMA designation. Any sites or portion of sites in designated floodplain areas should not include building construction unless it is essential to the building program. If a building is necessary, it must meet the regulatory flood protection elevation, as listed at http://www.dnr.state.mn.us/waters/watermgmt_section/floodplain/rfpe.html.

**S2B – Stormwater Quality**

[6] Tree cover area (for both deciduous and coniferous) is measured at anticipated size after 10 years. Mature tree canopy area cannot be counted if it overlaps hardscape (i.e. a tree canopy that overlaps sidewalk or drive aisle is counted as hardscape only).

Using the MIDS summary report, record the Total Suspended Solids (TSS) and Total Phosphorus (TP) reductions achieved through the site's MIDS BMPs in the B3 Tracking Tool and assure they meet the required reductions of 80% TSS removal and 60% TP removal.

Develop a low salt design site plan, narrative (from the BOD and OPR documents) that describes the low salt design strategy and graphicly shows the areas where those design strategies are used. Upload the site plan and the specific language from the OPR/BOD to the B3 Tracking Tool. The Smart Salting Assessment tool (SSAt) can be found at https://www.smartsaltingtool.com (requires registration).

*Chloride Management Plan*

Submit a Low Salt Design Site Plan at each phase submission (PD, D, FD, CO): This plan should identify the areas where the 3 primary low salt design strategies are utilized on site to minimize the need for salting and preventing unsafe ice conditions. Note that if considering installing a snow melt system that the energy used by these systems falls under the SB 2030 program and the resulting energy use would need to be accounted for under that program.

The 3 primary means are:

- Utilize the sun to melt snow on primary pedestrian and automotive routes. (Vegetation and other obstructions installed on the northern side of primary pedestrian and automotive routes)
- Grading plan drains snow melt away from primary pedestrian and automotive routes and prevents ponding/pooling of melt in shaded areas along pedestrian and vehicular routes.
- Utilize snow fences and other breaks if there are long distances (fetches) of unobstructed open space (Fetches greater than 500' is a typical length that would require a snow fence or other break)

This low salt site plan should highlight primary public pedestrian routes that would likely be saltable surfaces and show how the above 3 strategies for low salt management strategies are being integrated into the design.

Achieve a 20% reduction in the impervious areas that require the application of chlorides may be accomplished through design; the remainder may be removed by the following strategies :

- Hire a Smart Salting Certified contractor, Levels 1 and 2: https://www.pca.state.mn.us/water/salt-application-training.
- Track and document annual salt use in total pounds and square footage of applied areas.
- Develop and follow a snow and ice policy: https://www.pca.state.mn.us/sites/default/files/p-tr1-51c.pdf.
- Utilize the Winter Maintenance Assessment tool (WMAt) to track and improve BMPs. Within three years, all BMPs shall reflect the highest level of management: https://stormwater.pca.state.mn.us/index.php/Winter_Maintenance_Assessment_tool_(WMAt).
- Follow the salt application rate guidelines in the MPCA's Winter Parking Lot and Sidewalk Maintenance Manual: https://www.pca.state.mn.us/sites/default/files/p-tr1-10.pdf.
- Use liquid deicers where and when possible.
- Create regular assessments in the WMAt with 10% or less poor practices (red).
- Educate/inform employees and guests of the building about Smart Salting.

A chloride management plan with the goal of creating a chloride-free site in ten years (https://stormwater.pca.state.mn.us/index.php?title=Chloride_Management_Plan) may include the following:

- Use of sand substitution (from first-year occupancy).
- Use of alternate salts, such as magnesium chloride (after two years of occupancy).
- Use of substitute alternatives to reduce chloride, such as beet juice (after four years of occupancy).

**S2C – Irrigation**

Project teams are encouraged to calculate current and future rainfall projections for their site using the MN CliMAT tool and ATLAS14 storm event sizing (and the forthcoming ATLAS15) to establish baseline values for normal monthly rainfall averages in the near term and a 30% reduction from baseline and include this information in the BOD/OPR documents early in the predesign phase. This provision allows both design teams and owners/operators to understand and design for B3's irrigation protocol.

Potable or rainwater harvested irrigation water use shall be metered and recorded for at least five years after building occupancy until site planting is fully established. Projects using Path 1 potable water shall be used to irrigate or water after the monitored five years of plant establishment except during periods of drought where the rainfall is an estimated 30% less than average and this irrigated establishment period should not exceed the calculated baseline irrigation demand in gallons. It is recommended that 90% of plant materials are drought tolerant and that decorative plants only require irrigation for non-severe droughts. Periods of severe drought are defined as months in which monthly rainfall is 70% less than average. Captured rainfall can be used anytime for irrigation and watering of plant materials.

Building Water Calculations: Worksheet S-2 Building Water Calculator (hyperlink) should be used to calculate building water use for a base case and design case scenario. This also calculates the base-case condition for the Energy Policy Act requirements for low flow and flush fixture rates and provides example fixture performance values for uses associated with those fixtures. Annual water consumption must be submitted to the B3 Guidelines Tracking Tool for a period of ten years after building occupancy through the B3 Benchmarking program.

If a graywater treatment system is pursued, the volume of graywater and the required size of the graywater treatment system shall meet the NSF/ANSI 350 and 350-1, Onsite Water Reuse Treatment Systems standards for the intended final use.

If onsite blackwater water treatment is pursued, a qualified professional must be employed to meet the NSF/ANSI 350 and 350-1, Onsite Water Reuse Treatment Systems standards. Treated blackwater shall not be reused but can be used to supplement a site's infiltration requirements if the treated blackwater is infiltrated through underground drainage fields. Project teams electing to pursue a blackwater system should consult with a qualified professional engineer familiar the requirements for this type of system in Minnesota.

In the B3 Tracking Tool, include the specific sections of the BOD, OPR, and specifications that restrict the use of potable water for irrigation after the 5-year establishment period.

The MN-CliMAT tool can be found here: https://climate.umn.edu/MN-CliMAT.

**S2D – Building Water Reduction**

Use the B3 Building Water Use Calculator to establish the baseline values for building water use.

Use the B3 Building Water Use Calculator to design a 50% reduction from baseline values in the Design Case scenario.

Upload the Calculator and record the results in the B3 tracking tool.

## Submittal Requirements

**Predesign:**

- S.2A: Submit a map of the watershed with the project site located within the watershed boundaries. Note the Hydrological Soil Group of the site, the required ATLAS14 storm event size, and preliminary list of BMP types, sizes, and locations on site anticipated to handle volume and quality as defined in S2.

**Design:**

- ~~S.2A: Submit the requirements for infiltration, evapotranspiration, and runoff derived from MIDS calculation. Provide the identification of watershed or lakeshed of the project, drainage class(es) of the site, watershed organization jurisdiction, and identified watershed location (uplands or lowlands per guidance in Meeting the Guidelines section) if Soil Groups A or B is present, including planned rainfall infiltration if site soils include Soil Group A or B and are in the uplands or lowlands of watershed. Note the floodplain designation of the site. Submit completed Excel document demonstrating compliance with infiltration and other onsite managed criteria. Provide additional calculations as necessary to document evapotranspiration contribution to meeting guideline criteria.S.2B: Upload the completed MIDS calculator demonstrating intended removal systems for required TSS and phosphorus reductions. Also submit map of the watershed with the project site located within the watershed boundaries with slopes (percent of each gradation on site 0%, 1%, 2%, etc.), hydrological classification of the soils by gSSURGO legends (percent of each soil type, A, B, C, etc.). Submit a site plan with identified micro-catchments or buffers, if required per guideline.~~
- Submit the required items listed in the tracking tool for this category. There are submissions from multiple tools that are linked in the "Meeting the Guidelines" section.
- S.2C (and S.2E, if pursuing): Submit base and design case outdoor water consumption, any alternatively sourced outdoor water used, updated completed Outdoor Water Calculator documenting required reduction from base case, and confirmation that drought-tolerant plants that will require no potable water used for irrigation after the establishment period have been selected for the proejct.
- S.2D (and S.2F, if pursuing): Submit base and design case indoor water consumption, any alternatively sourced indoor water used, updated completed Building Water Calculator documenting required reduction from base case, and verification that site contractor understands the requirements and intents of this guideline.

**Final Design:**

- S.2A: Provide documentation of final project site design demonstrating conformance with the project site requirements concerning infiltration, evapotranspiration, storage/reuse and runoff. List of significant watershed features incorporated into the final project site design, and indication of compliance with additional rainfall infiltration if site soils include Soil Group A or B and are in the uplands or lowlands of watershed.
- S.2B: Upload the completed MIDS Excel sheet documenting design's removal systems for required TSS and phosphorus reductions.
- S.2B: Provide narrative of chloride reduction methods.
- S.2C (and S.2E if pursuing): Updated base and design case water use. Submit verification that all plant materials are either drought tolerant or can live without potable water after plant establishment period.
- S.2D (and S.2F if pursuing): Submit updated base and design case indoor water consumption, any alternatively sourced indoor water used, and updated completed Building Water Calculator documenting required reduction from base case.

**Closeout:**

- S.2B: Submit the Watershed Organization Inspection Report on the stormwater system's installation.
- S.2C: Confirmation that the site contractor and building operator understand the intent of this guideline.
- S.2D (and S.2G if pursuing): Provide updated base and design case indoor water consumption, any alternatively sourced indoor water used, updated completed Building Water Calculator documenting required reduction from base case, and verification that site contractor understands the requirements and intents of this guideline.

**Occupancy – Submitted annually for ten years:**

- S.2A: As required by the installation manual, document any required inspection and monitoring at prescribed intervals the onsite graywater wetland treatment system or the manufactured graywater treatment system to ensure proper functioning and water quality safety.
- S.2B: Conduct annual inspection of stormwater infrastructure and BMPs to ensure proper functioning. This inspection could be coordinated with the expertise and resources of the local watershed district. Submit bi-year inspection report on BMPs structures. For the first, second, fourth, seventh, and tenth year, submit chloride management plan reports on incremental elimination of chloride loading onsite.
- S.2D: Report on potable or harvested groundwater indoor water consumption.

## Additional Resources

Model My Watershed Technical Documentation: https://wikiwatershed.org/documentation/mmw-tech/#layers-viewable-mapped-data.

Description of Gridded Soil Survey Geographic (gSSURGO) Database: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/geo/?cid=nrcs142p2_053628.

Soil Hydrology of the United States: http://resources.arcgis.com/en/communities/soils/02ms00000008000000.htm.

Web Soil Survey (WSS): https://websoilsurvey.nrcs.usda.gov/app/.

Minnesota Soil Survey Status by County: https://stormwater.pca.state.mn.us/index.php?title=File:Minnesota_soil_survey_status.png.

Minnesota River and Stream Surface Elevations: https://www.dnr.state.mn.us/waters/csg/index.html.

Minnesota Lakes Ordinary High Water Level may be found at https://www.dnr.state.mn.us/lakefind/index.html or by contacting area hydrologists: https://www.dnr.state.mn.us/waters/surfacewater_section/hydrographics/ohw.html.

Natural Vegetation of Minnesota at the Time of the Public Land Survey 1847–1907: http://files.dnr.state.mn.us/eco/mcbs/natural_vegetation_of_mn.pdf or http://www.mngeo.state.mn.us/chouse/land_use_historic.html or https://gisdata.mn.gov/dataset/biota-marschner-presettle-veg.

Marschner Maps: https://files.dnr.state.mn.us/eco/mcbs/natural_vegetation_of_mn.pdf

Digital Soil Mapping in Minnesota: http://www.mngeo.state.mn.us/chouse/soil.html.

Soil Survey Geographic Database (SSURGO), Minnesota: https://gisdata.mn.gov/dataset/geos-ssurgo.

Soils and Landscapes of Minnesota by James Anderson, Jay Bell, Terry Cooper, and Dave Grigal: https://conservancy.umn.edu/bitstream/handle/11299/211988/Soils%20And%20Landscapes%20of%20Minnesota.pdf?sequence=1&isAllowed=y

Average Annual Precipitation in Minnesota Cities: https://www.usclimatedata.com/climate/minnesota/united-states/3193.

Minnesota's Minimal Impact Design Standard Overview: https://stormwater.pca.state.mn.us/index.php/Overview_of_Minimal_Impact_Design_Standards_(MIDS).

Minnesota's Minimal Impact Design Standard Calculator: https://stormwater.pca.state.mn.us/index.php/MIDS_calculator.

Minnesota Stormwater Manual Design infiltration Rates: https://stormwater.pca.state.mn.us/index.php?title=Design_infiltration_rates.

Minnesota Stormwater Manual, Minnesota Pollution Control Agency: https://stormwater.pca.state.mn.us/index.php/Main_Page.

Glossary of Soil Survey Terms, Natural Resources Conservation Service (NRCS): https://www.nrcs.usda.gov/sites/default/files/2022-08/A_Glossary_of_Terms_Used_in_Soil_Survey_and_Classification.pdf

Glossary of Soil Science Terms, Soil Science Society of America (SSSA): https://www.soils.org/publications/soils-glossary/.

Winter Maintenance Assessment Tool: https://stormwater.pca.state.mn.us/index.php/Winter_Maintenance_Assessment_tool_(WMAt).

Smart Salting Training Website: https://www.pca.state.mn.us/water/training.

Chloride Management Plan: https://stormwater.pca.state.mn.us/index.php?title=Chloride_Management_Plan.

Road Salt and Water Quality Website: http://www.pca.state.mn.us/programs/roadsalt.html.

Winter Parking Lot and Sidewalk Maintenance: https://www.pca.state.mn.us/sites/default/files/p-tr1-10.pdf.

Winter Maintenance Assessment Tool (WMAt): https://stormwater.pca.state.mn.us/index.php?title=Winter_Parking_Lot_and_Sidewalk_Maintenance_Factsheet.

Winter Parking Lot and Sidewalk Maintenance Factsheet: https://stormwater.pca.state.mn.us/index.php?title=Winter_Parking_Lot_and_Sidewalk_Maintenance_Factsheet.

The Real Cost of Salt Use for the Winter: https://www.pca.state.mn.us/sites/default/files/wq-iw11-06bb.pdf.

Smart Salting Certified Contractors: https://www.pca.state.mn.us/sites/default/files/p-tr1-01.xlsx.

MPCA Smart Salting Level 1 Certification: Buildings and Sidewalks https://www.pca.state.mn.us/water/salt-application-training.

MPCA Smart Salting Level 2 Certification: Road Maintenance Organizations: https://www.pca.state.mn.us/water/salt-application-training.

Snow Removal: Do It Better, Cheaper, and Pollution-Free: https://www.pca.state.mn.us/living-green/snow-removal-do-it-better-cheaper-and-pollution-free.

Improved Winter Maintenance: Good Choices for Clean Water Mississippi Watershed Management Organization: https://www.youtube.com/watch?v=qc8Y-_Nmfmo.

Drought Tolerate Plants: https://stormwater.pca.state.mn.us/index.php?title=Minnesota_plant_lists.

Minnesota Native Plant Encyclopedia: https://www.dnr.state.mn.us/rys/pg/encyclopedia.html

Rainwater Harvesting: https://rainwaterharvesting.tamu.edu/rainwater-basics/.

How to Use Native Plants for Landscaping and Restoration in Minnesota: https://files.dnr.state.mn.us/assistance/backyard/gardens/native_plant/nativelandscaping.pdf.

MN DNR Native Plant Suppliers and Landscapers Listing: https://www.dnr.state.mn.us/gardens/nativeplants/suppliers.html.

DNR Restore Your Shore Program: https://www.dnr.state.mn.us/gardens/nativeplants/suppliers.html.

MN DNR Invasive Species Listings: https://www.dnr.state.mn.us/invasives/index.html.

MN DNR Prescribed Fire Information: https://www.dnr.state.mn.us/firewise/prescribed.html.

MNTaxa Vascular Plants of Minnesota: https://www.dnr.state.mn.us/eco/mcbs/plant_lists.html.

DNR Information on Transplanting Lady's-Slipper Orchids: http://files.dnr.state.mn.us/assistance/backyard/gardens/native_plant/orchidtransplanting.pdf.

Minnesota Board of Water and Soil Resources, Native Vegetation/Seed Mixes: https://bwsr.state.mn.us/seed-mixes

University of Minnesota Extension – Native Plants for Sustainable Landscapes: https://files.dnr.state.mn.us/assistance/backyard/gardens/native_plant/nativelandscaping.pdf.

Minnesota's Pollinators: https://www.dnr.state.mn.us/pollinators/index.html.

References for Plant Identification and Minnesota Ecology: http://files.dnr.state.mn.us/eco/nhnrp/annotated_bibliography.pdf.

Library of Rainwater Collection System Designs: http://www.rainharvest.com/library-of-rainwater-collection-system-designs.asp.

Design Criteria for Stormwater and Rainwater Harvest and Use/Reuse in Minnesota: https://stormwater.pca.state.mn.us/index.php?title=Design_criteria_for_stormwater_and_rainwater_harvest_and_use/reuse.

National Stormwater Calculator: https://www.epa.gov/water-research/national-stormwater-calculator.

Sample Specification for a Rainwater Catchment System: http://www.harvesth2o.com/adobe_files/ARCSA_Rainwater%20Code.pdf.

The Texas Manual on Rainwater Harvesting 2005: http://www.harvesth2o.com/adobe_files/ARCSA_Rainwater%20Code.pdf.

EPA Graywater Treatment Using Constructed Wetlands: https://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryId=246852.

Constructed Wetlands for the Treatment of Grey Water in Campus Premises: https://link.springer.com/content/pdf/10.1007%2F978-3-319-11961-8_25.pdf.

NSF/ANSI 350 and 350-1, Onsite Water Reuse Treatment Systems: http://www.nsf.org/services/by-industry/water-wastewater/onsite-wastewater/onsite-reuse-water-treatment-systems.

Small-Scale Constructed Wetlands for Graywater and Total Domestic Wastewater Treatment: https://www.sswm.info/sites/default/files/reference_attachments/WAFLER%202008%20Small%20scale%20Constructed%20Wetlands.pdf.

Graywater Works: www.grayworks.com.

Englehardt, James D., Wu, Tinnting, and Tchobanoglus, George. 2013. "Urban Net-Zero Water Treatment and Mineralization: Experiments, Design." *Water Research*, 47. https://watersewerchallenge.alaska.gov/docs/Urban_NetZero_water_treatment_mineralization.pdf.

Guo, Tianjiao and Englehardt, James D. 2015. "Principles for Scaling of Distributed Direct Potable Water Reuse Systems: A Modeling Study." *Water Research*, 75. http://www.sciencedirect.com/science/journal/00431354/75 Or file:///C:/Users/stron081/AppData/Local/Packages/Microsoft.MicrosoftEdge_8wekyb3d8bbwe/TempState/Downloads/Urban_NetZero_water_treatment_mineralization.pdf

Steiner, Lynn. *Landscaping with Native Plants of Minnesota*. Voyageur Press, 2011: https://www.amazon.com/Landscaping-Native-Plants-Minnesota-2nd/dp/0760341184.

Wester, Julia, Timpano, Kiara R., Cek, Demet, Lieberman, Debra, Fieldstone, Shaina C., and Broad, Kenneth. 2015."Psychological and Social Factors Associated with Wastewater Reuse Emotional Discomfort." *Journal of Environmental Psychology*, 42. https://pdfs.semanticscholar.org/3b84/1faeb402047056d71694c22032f9f1a0b9aa.pdf.

## Glossary

**Graywater Treatment:**

Treatment of graywater must employ a sub-surface flow, preferred natural reed bed/wetland treatment and infiltration system or a reed bed/wetland treatment and recapture system for all onsite use where there is site space available, or, for tight urban spaces, treatment of graywater can employ an onsite manufactured treatment system for infiltration.

**Environmentally Feasible:**

If sufficient infiltration is feasible on the site (not an MPCA contaminated soils site), the treatment wetland is part of the required area for the animal and vegetative habitat and an asset to the design of the site.

**Acceptable Soil Infiltration Conditions:**

Natural or engineered soil must be able to treat and infiltrate or treat graywater onsite at the required rate during winter conditions.

**Cost Effective:**

Applies to situations in which the treatment of graywater per gallon is less expensive on a total cost basis (initial cost, operating cost over 20 years based on a discounted cash flow) than a potable water option.

**Wetland Type Descriptors:**[7]

- **Precipitation-Dominated Wetlands**
    - **Bogs:** Bogs obtain water primarily from precipitation and are characterized by sphagnum mosses dominating the floor of the bog and creating waterlogged, acidic conditions with low nutrient levels (USEPA 2010). Bogs prevent downstream flooding by absorbing precipitation. Because of the acidic, waterlogged conditions and low nutrient levels, only species that are specifically adapted to such conditions are able to live in bogs, resulting in many unique plant and animal species (USEPA 2010).
    - **Pocosins:** Pocosins are shrub- and tree-dominated landscapes with little standing water located at a slightly higher elevation than the surrounding landscape. Precipitation is the main water source, and although there is little standing water, the soil is saturated much of the year, resulting in waterlogged, nutrient-poor, and acidic soils. Fires typically occur in pocosins every ten to 30 years during the spring or summer dry periods, and pocosins play a key role in maintaining a diverse tree and shrub population (USEPA 2010).
    - **Vernal Pools, Playas, Prairie Potholes, Wet Meadows, and Wet Prairies**: Because of many similarities, these wetland types are sometimes categorized as marshes; however, unlike marshes, they receive water predominately from precipitation. Because these wetlands are isolated from surface waters, they do not typically discharge to surface waters, but many recharge groundwater (North Carolina State University [NCSU] Water Quality Group n.d.).
- **Surface Water-Dominated Wetlands:**
    - **Marshes:** Marshes are generally defined as wetlands frequently or continually inundated by water. All types of marshes receive most of their water from surface water; some are also fed by groundwater. Their vegetation is characterized by emergent soft-stemmed plants adapted to saturated soil conditions. Marshes are home to an abundance of plant and animal life due to high nutrient levels and neutral pH (USEPA 2010). They play an important role in recharging groundwater supplies, moderating stream flow, and settling pollutants to improve water quality (NCSU Water Quality Group n.d.).
    - **Riparian Forested Wetlands:** These wetlands receive water from rivers, streams, and lakes and are located across the United States. Standing water is present in the winter and spring, with little to no standing water during the summer and fall (NCSU Water Quality Group n.d.). Riparian forested wetlands act as a sink for pollutants from nonpoint sources (USEPA 2010). They also receive alluvial soil from floods, and as a result, they are very productive and are important ecologically as they serve as habitat for plant and animal species (NCSU Water Quality Group n.d.).
    - **Fens:** Fens are very similar to bogs, the main distinction being that fens receive water from groundwater (NCSU Water Quality Group n.d.). Fens are groundwater charged peat-forming wetlands. Bogs—in contrast—-are precipitation fed with very acidic soil conditions. Fens have much higher nutrient levels than bogs. Fens are geologically derived from dislodged alkaline bedrock (pH7.0 to 14.0) transported by glaciers. Fens are then fed by groundwater from these glacial features: till, moraines, eskers, and kames, which they then discharge down gradient. Fens are located in northern regions characterized by low temperatures and

[7] EPA Region 5 Wetlands Supplement: Incorporating Wetlands into Watershed Planning, March 2012.

short growing seasons (USEPA 2010). They can contribute to downstream waters and stabilize water tables by recharging groundwater at local aquifers (NCSU Water Quality Group n.d.).

# Guideline S.3: Soil

## Intent

To ensure the maintenance and restoration of healthy soils ~~by~~on project sites. This is accomplished by: documenting existing soil conditions, utilizing appropriate vegetation, preserving and protecting ~~benefits of existing~~intact soil~~,~~ horizons through Site Soil Protection Zones (SSPZ), minimizing the impacts of construction~~, repairing~~ on non-building site areas, keeping excavated soils ~~to return to supportive conditions~~on the project site, and ~~documenting soil maintenance practices to ensure ongoing optimal soil conditions~~understanding the dominant Hydrological Soil Group (HSG) of the site in coordination with stormwater infiltration requirements.

## Required Performance Criteria

Guidelines are required for New Construction and Major Renovation projects that include at least 5,000 square feet of land disturbance, ~~or at least~~ 50 cubic yards or more of cut and fill, excluding the land disturbance and cut and fill within or below the building footprint. ~~Exterior scope~~Site area related ~~only~~solely to ADA improvements, other accessibility-related improvements, or utility connections may be excluded from ~~contribution toward these amounts.~~total area of disturbance when determining if the guidelines are triggered, more detail on this is included at the beginning of the Site and Water Guidelines.

A. The soil conditions of the nonbuilding area of the project site shall ~~reference data gathered from the~~ be determined and documented using following sources:

~~0.~~1. National Resources Conservation Service (NRCS) Web Soil Survey (WSS~~) (websoilsurvey.nrcs.usda.gov) and shall be described. This description must include:~~).

2. Soil borings from geotechnical analysis.

3. Determination of the Hydrological Soil Group (HSG) of the site and more importantly, in the areas where infiltration stormwater BMPs are planned as determined by one of the approved infiltration testing methods.

~~1.~~4. A Site Soil Inventory Map (SSIM).

~~2. A listing of which of the eight soil orders, 1,000 soil series, and seven slope classes that occur in Minnesota are present on the subject site based on the NRCS WSS.~~

~~3. A listing of any soil-based limiting constraints for organic, wetland, or expansive clay soils (shrink/swell) for the project site's proposed uses.~~

~~4.~~5. A listing of which of the three stages (as defined by this B3 ~~Guideline~~Guidelines) currently apply to the state of the project site's soils: natural, agricultural, or urban.

~~5. A determination of whether the project is considered a greenfield (see definition below).~~

~~6. A listing of specialized DNR-defined native plant communities (NPCs).~~

~~7. A mapping of any naturally occurring atypical soils (see definition below).~~

~~8.~~6. Results from NPK soil fertility and composition testing for topsoil, using the following rates, at a minimum, for the following human soil stages:

i. Natural: (Never plowed, often containing O or E horizons and/or A, B, or C horizons.) No test ~~shall~~should represent more than five acres of a site with a different soil type and/or different usage history. A minimum of two soil tests are required for any site classified as "natural~~ site.~~".

ii. Agricultural: (Standard cultivation practices with one or more A, B, C horizons present.)No test ~~shall~~should represent more than four acres of a site with a different soil type and/or different usage history. A minimum of three soil tests are required for any "agricultural" site.

iii. ~~Urban: No test shall~~Urban: (Buried horizons; missing major horizons, such as A, B, C, or E or R horizons within 30 inches of existing surface plane.) No test should represent more than one acre of a site with a different soil type and/or different usage history. A minimum of four soil tests are required for any "urban" site.

~~iv. Testing~~ Topsoil testing must be performed prior to construction and is recommended to be ~~included in the geotechnical report. Additional testing at three and ten years after construction is recommended.~~

~~These soil~~completed during predesign. Topsoil tests do not require boring or heavy equipment and should be carried out when soil is ~~not frozen~~fully thawed. These tests can be met by using the University of Minnesota Soil Testing Laboratory Soil Analysis ~~(https://soiltest.cfans.umn.edu/testing-services/professionalcommercial-lawn) or equivalent.~~ Equivalent testing may also be accepted if done by a different laboratory. Test results must include Nitrogen-Phosphorous-Potassium (NPK) fertility composition, soil texture classification, percentage of organic matter in the sample, soil pH, and recommended strategies for fertilization and/or cropping, depending on the state of the project soil. These tests provide landscape architects a better idea of what plant species and stormwater BMPs will be most suitable to soil conditions/composition present on the project site. Topsoil tests should be taken in areas planned for planting.

~~B.~~ For projects developing on a greenfield site, ~~the following shall be submitted:~~

~~1. A written rationale of the need to develop a greenfield site rather than a previously developed site.~~

~~2.~~7. ~~A~~a plan for minimizing the disruption of existing, native, noninvasive vegetation~~.~~ shall be submitted.

~~C.~~B. Soil disturbance should be minimized on all sites. Disturbance is defined as; grading, compacting, piling~~,~~ (excluding cut and fill vegetated areas of the site), tilling, scraping, or storing. Disturbances of this kind shall be limited and the removal of soil within natural and agricultural human soil development spectrum areas shall be ensured by the following and included in the Stormwater Pollution Protection Plan (SWPPP) for the project:

1. Protecting intact soil with intact soil horizons using Site Soil Protection Zones (SSPZ); these areas shall be delineated using exclusion barriers to ensure soil protection during construction.
2. Soil in the following areas shall not be disturbed:
   i. 40 feet beyond the building perimeter.
   ii. 15 feet beyond the primary roadway curbs, parking lots, main utility branch trenches, or impervious areas.
   iii. ~~Five~~10 feet beyond/beside walkways.
   iv. Any area under ~~or closer than one foot of~~ existing tree driplines or at a ratio of 1 foot per one inch of trunk diameter at breast height (DBH) ~~trunk diameter~~ (e.g., 12-inch DBH will require tree protection fence at least 12 feet from the trunk).
   v. Areas within any ~~identified~~existing or planned stormwater ~~management features~~BMPs.
   vi. Retaining walls within these areas may be employed as needed to maintain necessary grades.
3. ~~Trees~~Individual trees shall be protected ~~as individuals~~ with ~~the tree~~a protection fence located at least 1 foot outside of the drip line~~, as defined above in C.2.iv,~~ prior to ~~site~~any construction activities. Trees may be protected as groups if their canopies are within ten feet of each other~~, with tree fence~~ and/or if this simplifies soil protection ~~zone distances as defined above in C.2.iv~~fencing logistics. Please note other tree requirements are listed in S.4B.

~~D.~~C. Soil management and erosion control plans ~~shall~~should be created and implemented to protect the soil profile of the current site before, during, and after construction and a copy of the SWPPP submitted for the project should reflect these strategies.

~~E.~~D. ~~The bulk density of all unpaved pervious surfaces intended for seeding and planting shall have the following maximum bulk densities, obtained via testing:~~

~~0.~~1. ~~Clays and silts: 1.25 g/cm3~~

~~0.~~1. ~~Loams: 1.40 g/cm3~~

~~0.~~1. ~~Sands: 1.60 g/cm3~~

~~D.~~E. A 50-foot minimum of perennially rooted vegetated buffer for delineated wetland boundaries shall be maintained, established, or enhanced.

~~D.~~F. Topsoil from the project site shall not be sold or exported until all landscaped areas (tree, shrub, perennial, annual, or lawn plantings) have received an average 12-inch deep respread using soil from the project site. Existing site topsoil shall be stockpiled and protected, or topsoil ~~shall~~should be imported for an average respread depth of 12 inches in all proposed planting and seeding areas. No topsoil ~~shall~~should be screened with less than a 3-inch screen. Minimum respread depth is not required for green roofs. Assure contractors are aware of this requirement as early as possible, preferably in the predesign phase to assure adequate provisions are provided in the site plan and construction logistics.

~~D.~~G. ~~At~~If soil fertility tests show low organic material, at least 3.5% organic material by soil weight ~~shall~~should be ~~achieved~~added in planting and seeding areas ~~by adding sufficient organic matter~~ to ~~soil~~ existing or respread soils below this threshold.

~~D.~~H. Amended urban soils: If urban soils (defined as ~~soils~~soil profiles missing major horizons within 30 inches of existing surface plane) are present, ~~in-site~~ landscaped areas ~~soil shall~~should be amended to mimic the physical and biological capabilities of natural and agricultural soils in the project areas (see the WSS and other testing to determine the appropriate soil amendments) to achieve the following metrics:

~~0.~~1. Soil texture: Determine which of the 12 soil classes are present on the site.

~~0.~~2. pH between 5.0 and 8.5.

~~0.~~3. NPK fertility greater than medium, as tested by using the University of Minnesota Soil Testing Laboratory Soil Analysis. Equivalent testing of NPK fertility may also be accepted if performed by a different laboratory.

~~0.~~4. Bulk density requirements for the listed soil types:

~~.~~i. Organics: less than 1.0 g/cm$^3$

~~.~~ii. Clays: less than 1.25 g/cm$^3$

~~.~~iii. Loams: less than 1.4 g/cm$^3$

~~.~~iv. Silts: less than 1.25 g/cm$^3$

~~.~~v. Sands: less than 1.6 g/cm$^3$

~~0.~~5. Organic matter content at a minimum of 3.5% by weight through the incorporation of Class A Biosolids, US Compost Council Certified Compost, and activated biochar (as defined in this B3 Guideline) in the following depths for the following soils:

~~.~~i. Post-development treatment for all soils with all soil disturbance types: incorporated (e.g., V-ripper or Paraplow) into site soils to a minimum depth of 24 inches.

~~.~~ii. Pre-development treatment for soils with continuous pasture cover: incorporated (e.g., V-ripper or Paraplow) into site soils to a minimum depth of 12 inches.

~~.~~iii. Pre-development treatment for soils with continuous forest cover: Minor modification amendments: applied as topdressing or incorporated into site soils to a minimum depth of six inches.

0.6. Soil modification to achieve the following NRCS infiltration rate for the following soil state conditions (calculated infiltration rates for each soil group can be found at https://stormwater.pca.state.mn.us/index.php/Design_infiltration_rates):

- i. Natural stage soils improved to have a higher infiltration rate than Group A.
- ii. Agricultural stage soils improved to have a higher infiltration rate than Group B.
- iii. Urban stage soils improved to have a higher infiltration rate than Group C.
- iv. Stormwater infiltration stage soils improved to have a higher infiltration rate than Group A.

0.7. A cation exchange capacity (CEC) of at least 15.

0.8. A base saturation percentage of at least 30%.

0.9. A mycorrhizae count of at least two Glomus species per ounce of soil.

D.I. Naturally-occurring atypical soils: If the project has atypical soils or substrates for a specialized Native Plant Community (NPC), these shall be preserved in the landscaped areas of the site according to the following:

0.1. All naturally Naturally-occurring atypical soils (ege.g. Spodosols, Histosols, Psamment, Entisols, and Sodic soils) of an area greater than 5,000 square feet shall be preserved as required to support NPCs in seeps, fens, bogs, bedrock outcrops, sand blow-outs, and sand dunes (as defined by MN DNR).

0.2. The boundaries of these atypical soils and substrates shall be field mapped, marked, and delineated the same way as other Site Soil Protection Zones (SSPZ) on the project site. This NPC delineation prohibits entry of any vehicles with tires before, during, or post construction. These soils or substrates shall not be disturbed, buried, blasted, or removed from their original location onsite.

0.3. The MBS Sites of Biodiversity Significance from the DNR and the DNR Native Plant communities layers (viewable at Minnesota Conservation Explorer) shall be consulted to create and execute the following:

- i. A specialized, NPC planting plan with a conservation status rank (S-ranks) of S1 or S2 that most appropriately matches the site's atypical soils and substrates.
- ii. Guidance on site preparation (weed and erosion control), site drainage, and revegetation (seeding, planting, etc.), and long-term maintenance (fire management, weed control, etc.) for that specialized NPC.
- iii. Operations and maintenance plan to ensure that this restored vegetation and naturally occurring atypical soil is rigorously protected and maintained.

0.4. Upon complete installation of this specialized NPC, a perimeter exclusion fence shall be installed.

Note that atypical soil definition is included in the glossary. Specialized planting areas may count against local open space ordinances at a 3:1 ratio (i.e., one square foot of specialized, NPC will equal three square feet of local open space). Also note that other vegetation requirements are listed under S.1 and S.4.

## Recommended Performance Criteria

D. The bulk density of all unpaved pervious surfaces intended for seeding and planting shall have the following maximum bulk densities, obtained via testing:

1. Clays and silts: 1.25 g/cm3
2. Loams: 1.40 g/cm3
3. Sands: 1.60 g/cm3

K. If the soils are NRCS-defined Udorthents or Udipsamments, then the results of a Modified Philip-Dunn Infiltrometer measurements of saturated hydraulic conductivity with at least four tests taken per acre shall be included in the descriptions of the site soils.

J. Project teams are required to test, report, understand, and design appropriate systems for the soil conditions of the project site. Project teams must make complex design decisions based on the various soil, vegetative, stormwater, and protection constraints in the site. To understand soil conditions, project teams must submit the results of a Modified Philip-Dunn Infiltrometer test (in the number of test sites required for the project site per S3A9). This must include at a minimum, the saturated hydraulic conductivity at each test location and the resulting HSG for each testing location. Report the site's Hydrologic Soil Group(s) (HSG) in percentages of total site area (HSG areas relative to overall site area is required for MIDS calculations) and show each testing site with anticipated boundaries of each HSG in a site plan that is updated throughout the design process with testing sites, areas of each HSG, planned stormwater BMPs, Site Soil Protection Zones (SSPZs), paved areas and building buffer zones required to meet the guidelines of this section.

~~I.~~K. Maintenance of a CEC of more than 15.

~~I.~~L. Maintenance of a pH factor between 5.5 to 8.5 of the soil by amending existing soils outside of the acceptable range.

## Meeting the Guidelines

The SSIM should be developed using an engineering scale typical to a development of site size (e.g., 1 inch = 30 feet, but no coarser than 1 inch = 100 feet), and labeled with a bar scale and north arrow. An interpretive legend of symbols, colors, shades, hatched markings, etc. and current NRCS soil terms should be used. The SSIM as a layer on the site's legal land survey should be mapped with topographical controls, benchmarks, etc. The NRCS WSS (https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm) ~~should be used~~is available for project teams' use to determine ~~the following~~:

- The eight soil orders, 1,000 soil series, and seven slope classes present on the project site.
- The soil limiting constraints for organic, wetland, or expansive clay soils for the proposed development uses (buildings, roads, parking, trails, and landscapes).
- The three stages that currently apply to the state of the site's soils: natural (never plowed, often containing O or E horizons), agricultural (standard cultivation practices with A, B, C horizons), or urban (buried horizons, missing major horizons, such as A or B or C; C or R horizons at the surface plane).

Additional information on using the NRCS WSS is listed under Appendix S-3.

The National Resources Conservation Service (NRCS) Web Soil Survey (WSS) can be found at websoilsurvey.nrcs.usda.gov.

University of Minnesota Soil Testing Laboratory Soil Analysis can be found at https://soiltest.cfans.umn.edu/testing-services/professionalcommercial-lawn.

The SSIM should identify where one or more of the state's soil orders are encountered intact, as these areas will need to be actively protected from disturbance, filling, or compaction per guideline S.3B. Existing natural soil horizons (A, B, C, R or O, A, E, B, C, R or A, E, B, C, R) should be preserved. The site's damaged soils should be mapped, classified, ~~and~~ protected from further damage, and~~/or mitigated.~~ remediated if possible. The SSIM should inform other B3 Guideline site requirements, particularly S.2 Stormwater Requirements and S.4 Vegitation

Site Soil Protection Zones (SSPZs): All areas required to be protected per guideline S3B (intact horizons, tree driplines, buffers from sidewalks, buildings, roadways, etc.) must be mapped on a site plan and submitted to the tracking tool.

Exclusion barriers for any identified SSPZ should be installed prior to site mobilization to ensure soil protection during the construction process. Access by vehicles with tires should be prohibited and a perimeter exclusion fence, with a minimum of 42 inches in height, implemented.

Atypical, naturally occurring soils, as well as substrates greater than 5,000 square feet in area on subject site should be identified, mapped, delineated, and preserved. These soils and substrates are required to support specialized (S1 and S2 rank) NPCs found in Minnesota's seeps, fens, bogs, bedrock outcrops, sand blow-outs, and dunes.

The specialized NPC and atypical soils may necessitate the use of other strategies to increase site biomass to match the ecosystem province in which the subject site occurs. In those cases, the use of green walls (vines on trellis), green roofs (extensive), and tree canopies over impervious surfaces that do not increase the building footprint but do increase overall site biomass are encouraged.

**Three stages of soil impacts**

Soil management and erosion control plans must list activities used to protect the soil profile of the current site before, during, and after construction. The following definitions should be used:

- Natural: never plowed, often containing O or E horizons, and/or A, B, C horizons.
- Agricultural: standard cultivation practices containing A, B, C horizons.
- Urban: buried horizons; missing major horizons, such as A or B or C or E or R horizons within 30 inches of the existing ground surface plane.

Raising or maintaining the percentage of organic material content in the existing or imported site soil will help build the site's natural mycorrhizae and microbial population and enhance the health of the soil. The soil in planting and seeding areas should be tested and amended with organic material as needed to achieve at least 3.5% organic material by soil weight.

**Determining the presence of pre- or post-development soils**

Post-development and pre-development soils refers to the presence or absence of significant human activities or disturbance via machine of/on site soil. Determining whether soils are in a pre-development or post-development condition necessitates the digging of exploratory test pits prior to any disturbance of the site because exposure of the soil horizons is needed for the evaluation. Exploratory test pits are not needed for soil areas that will be built on—e.g., under buildings, roads, parking lots, walkways/trails, and curbs. However, exploratory test pits are needed for all future lawn, landscaping, and garden areas; and for all future stormwater management areas, e.g. rain gardens, swales, bio-infiltration, etc., at a rate of one test pit per 1,000 square feet for areas less than one acre in size, or one test pit per 2,000 square feet for areas larger than one acre in size.

Post-development soils consist of human machine soil disturbances comprising anything larger than ten cubic yards in volume or 500 square feet in area. Post-development soil disturbance applies when the natural horizons of a site's soil have been removed, displaced, or mixed prior to any disturbance of the project's site. Post-development disturbance also refers to soil compaction in which large machinery (e.g., semi-tractor trailers, dump trucks, one-ton pick-ups, pan-scrapers, bulldozers, tractors, skid-steers, backhoes, rollers, and others) have traveled over unprotected soils for haulage

or vehicle access more than three times. If exploratory soil test pits reveal that none of the four natural soil horizons, O, A, E, B, are visible as distinct layers, one on top of the other and in order, then the area is considered post-development.

Pre-development soils are generally found in locations where the following vegetation cover exists: continuous grazing land or ~~old~~ meadow that has been in that condition for at least 25 years; continuous forest cover in which 70% of tree stems are greater than 10 inches in diameter at breast height (DBH). If exploratory test pits reveal any one or all of the following intact soil horizons (O, A, E, B) are present as distinct layers, one on top of the other and in order, then this area is considered pre-development.

~~**Minnesota soil background**~~

~~Of the 12 soil orders in the United States, Minnesota contains eight: 32% Mollisols (prairie); 27% Alfisols (deciduous forest); 9% Inceptisols (mixed forest); 18% Entisols (boreal forest or river floodplains); 5% Histosols (peat marshes or blanket bogs); 1.0% Vertisols (Glacial Lake Agassiz/Red River Valley); 0.2% Spodosols, (sandy saturated coniferous boreal forest). These soil orders are inextricably linked to the state's parent material climate and the vegetation of its dominant ecosystem provinces.~~

~~Surface-transported glacial parent materials of the Wisconsin Ice Age have been the most influential factor in forming Minnesota's soils. The dominant surface glacial parent materials are till, outwash, and moraines from the Des Moines and Superior Lobes. The shale-rich (Canadian sedimentary bedrock) Des Moines Lobe entered Minnesota from the northwest and terminated in Des Moines, Iowa and has an alkaline pH (7.0 to ~14.0). The Superior Lobe that scraped the Canadian Shield bedrock was iron-rich, igneous rock (basalt, granite) with an acidic pH (~3.0 to 6.9). The Superior Lobe entered Minnesota from the northeast and ended its journey in north central Minnesota.~~

~~During Minnesota's most recent glaciation, the Wisconsin Ice Age (about 10,000 BP), the Laurentian Ice Sheet covered about 90% of Minnesota for thousands of years, with ice anywhere from hundreds to thousands of feet thick. The state's soils are geologically young and extremely fertile. Much of the state's Entisols and Inceptisols (27% of the state) are less than a thousand years old. Mollisols, the state's dominant soil order, covers about one-third (32%) of Minnesota. Minnesota's Mollisols, formed under prairie, are among the richest soils on earth and approximately 5,000 to 10,000 years old. One acre of Minnesota Mollisols yield on a per-acre basis three to five times the agricultural lands of the southern and southeastern United Stated, and ten times more than ancient tropical soils. It is strongly discouraged to develop or disturb current Minnesota farmland.~~

~~Ancient or Glacial Lake Agassiz was located in the northwestern portion of Minnesota, now called the Red River Valley. At its maximum, Glacial Lake Agassiz covered most of Ontario and Manitoba, dwarfing the Great Lakes in size. The Minnesota River Valley (the Glacial River Warren) was the outlet channel for Glacial Lake Agassiz. The fluvial force of emptying Lake Agassiz carved a mile wide canyon, hundreds of feet deep. After this glacial meltwater formed Lake Agassiz, fine lacustrine parent material precipitated in the lake, depositing rich soils. Thus, the Red River Valley has fertile clays, with abundant illite, smectite, and vermiculite. Because of high moisture content in these very fine clays, these Vertisols are much harder to cultivate than Mollisols. However, these Vertisols of the Red River Valley are as exceptionally fertile as Minnesota's Mollisols. As these Vertisols are both poorly drained with high shrink/swell prone clays on a planar flat landscape, they are generally not well-suited for construction activities and are only recommended for row crop agriculture.~~

## Submittal Requirements

**Predesign:**

- S.3A: Submit a Site Soils Inventory Map (SSIM) Submit soil testing results ~~as~~ of the infiltration tests in the required ~~by~~number for the project site as detailed in these guidelines ~~and~~. Submit a listing of which of the three stages of human soil impacts ~~of the site~~the site is characterized by. Submit a preliminary site plan that identifies the infiltration testing locations, the resulting Hydrologic Soil Group (HSG) for each testing location, the anticipated areas/boundaries of each HSG, a schematic of planned stormwater BMP zones/types to deal with the required onsite retention and quality requirements in S2A and S2B, and identifying all Site Soil Protection Zones.

**Design:**

- ~~S.3A: Submit description of site soils, including the following: a SSIM, test results, and sampling locations; which of the eight soil orders, 1,000 soil series, and seven slope classes are present onsite; the soil development limiting constraints for organic, wetland, or expansive clay soil; which of the three stages of human soil impacts apply to the current state of the subject site's soils; whether the site is considered a greenfield; and a listing of NPCs identified onsite.~~
- ~~S.3C: Submit identified SSPZ and delineated exclusion barriers/zones.~~
- S.3A: anything?
- S.3C: Update the Site Soils Inventory Map (SSIM) with added detail and information.
- S.3I: Submit urban soil restoration amendment plan of future landscaped area in 1,000 square-foot units.
- S.3J: Include ~~results of preliminary coordination with Minnesota Biological Survey staff for NPC restoration, including~~ preliminary planting list, details of site preparation, drainage, and revegetation.
- ~~S.3K: If soils are Udorthents or Udipsamments, submit saturated hydraulic conductivity test results.~~

**Final Design:**

- S.3B: If project is developing on a greenfield site, submit rationale for developing on site and a site plan documenting minimization of the disruption of existing, native, noninvasive vegetation.
- S.3C: Submit a final Site Soils Inventory Map site plan ~~delineating limits of soil disturbance during development, including SSPZ.~~
- S.3D: Submit a soil management and erosion control plan.
- S.3E: Submit contract documents section with specifications for bulk density requirements for all unpaved pervious surfaces.
- S.3F: If wetlands are present on site, submit site plan noting 50-foot vegetated buffer for delineated wetland boundaries.
- S.3G: Submit contract documents, which ~~prohibit~~prohibits selling or exporting any topsoil from project site, and delineate onsite plan storage areas for site's topsoil that will be reused. Provide a respread plan for up to 12" depth across non paved areas of the site.
- S.3H: Submit contract documents specifying that the ~~soil~~final soil conditions after construction must have a minimum of 3.5% organic material by soil weight.
- S.3I: Submit contract documents with specifications for urban soil restoration amendment: Soil texture, pH, NPK fertility, bulk density, organic matter, infiltration rate, CEC, base saturation, and mycorrhiza count requirements for each 1,000 square feet of site landscape area.
- S.3J: Submit NPC restoration plan for atypical soils, including planting list, details of site preparation, drainage, revegetation; and management (O&M) manual to vigorously protect and maintain restored vegetation on these atypical soils.

- ~~S.3L: Submit contract documents requiring CEC of at least 15.~~
- S.3M: Submit contract documents requiring ~~pH factor~~ final soil conditions to have a pH between 5.0 and 8.5.

**Closeout:**

- S.3A: Submit updated soil reports ~~as required~~and SSIM.
- S.3C: Note any incursions into the SSPZ and remedies employed to mitigate soil damage.
- S.3J: Site O&M manual for restored NPCs on atypical soils.

**Occupancy – Submitted annually for ten years:**

- S.3A: Submit ongoing soil sampling as required at least every three years.

## Additional Resources

DeepRoot tree and stormwater products: http://www.deeproot.com/.

MN DNR Minnesota Biological Survey. Conservation Status Ranks for Native Plant Community Types and Subtypes (S-ranks): http://www.dnr.state.mn.us/npc/classification.html.

MN Board of Water & Soil Resources Wetland Delineation Guidance: https://bwsr.state.mn.us/wetland-delineation

MN DNR County Biological Survey, County Maps: http://www.dnr.state.mn.us/eco/mcbs/maps.html.

MN PCA - Brownfields: https://www.pca.state.mn.us/waste/brownfields.

MN PCA - Dominant soil orders: https://stormwater.pca.state.mn.us/images/e/e6/Minnesota_dominant_soil_orders.jpg.

MN Geospatial Commons (MBS Sites of Biodiversity Significance and the DNR Native Plant Communities are available here): https://gisdata.mn.gov

USDA Web Soil Survey (WSS): https://stormwater.pca.state.mn.us/images/thumb/b/bd/Minnesota_dominant_soil_suborders.jpg/300px-Minnesota_dominant_soil_suborders.jpg.

UMN Soil Testing. (select the Lawn and Garden Soil Analysis Request Sheet): http://soiltest.cfans.umn.edu/testing-services.

United States of America Department of Agriculture (USDA) Web Soil Survey: http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm.

## Glossary

**Activated Biochar:**

Activated biochar is biomass (e.g., woodchips) produced via pyrolysis (400–500 degrees Celsius) and activated to allow immediate application.

**Landscaped Areas:**

Nonbuilding or paved areas on which plants will be grown in soil (trees, shrubs, perennials, annuals, turf) or prairie, wetland, woodland, buffers.

**NRCS**:

Natural Resource Conservation Service, within the USDA.

**Soil Orders**:

Coarsest resolution of soil taxonomic nomenclature, defined by NRCS. Twelve found worldwide; eight found in Minnesota.

**Soil Series**:

Finest resolution of soil taxonomic nomenclature. >19,000 found in the USA; >1,000 found in Minnesota, defined by NRCS.

**Slope Classes**:

Classification of the slopes present on a project site based on percentage grade (slope A, B, C, D, E, F, G, where A is shallowest <2%. G is steepest >35%).[8]

**Three Stages of Human Soil Impacts**:

- Natural: never plowed, often containing O or E horizons and/or A, B, or C horizons.
- Agricultural: standard cultivation practices with one or more A, B, and/or C horizons present.
- Urban: buried horizons; missing major horizons, such as A, B, C, or E or R horizons within 30 inches of existing surface plane.

**Soil Texture Classes & Triangle**:

Twelve classes representing percentage ratios of the fine earths (<2 mm) or mineral portions of soil: sand, silt, clay. For example, in the case of sandy loam, the first word is a modifier (sandy) of the dominant mineral portion (loam).[9]

**Soil Infiltration Rate:**

The rate of infiltration of water into soil. The Infiltration rate scale uses NRCS Infiltration Rate Scale, which is based on the speed, measured in inches per hour, at which gravity water passes through soil. Listed as A, B, C or D. A is the fastest (>1.1 in./1 hr.); D is the slowest (<0.05 in./1 hr.).[10]

**Bulk Density**:

Soil compaction rate is measured in grams of density within a fixed volume of cubic centimeters.[11]

**Cation Exchange Capacity (CEC)**:

Capacity of a soil to retain macro- and micronutrients during standard weathering. Zero is an exhausted, deeply weathered soil; 15 is an adequate soil; >25 is a fertile soil.[12]

**Pre-Development and Post-Development Soils:**

Refers to the presence or absence of significant human activities or disturbance via machine of/on the soil of sites.

[8] https://www.agry.purdue.edu/soils_judging/review/slope.html
[9] http://passel.unl.edu/pages/informationmodule.php?idinformationmodule=1130447039&topicorder=2&maxto=10
[10] http://www.bwsr.state.mn.us/outreach/eLINK/Guidance/HSG_guidance.pdf
[11] http://www.deeproot.com/blog/blog-entries/the-most-important-factor-for-growing-healthy-trees-2
[12] http://www.extension.umn.edu/agriculture/nutrient-management/soil-and-plant-sampling/soil-cation-ratios/

Post-development soil disturbance describes the removal, displacement, or mixing of that site's soil's natural horizons prior to any disturbance of that project's site; Post-development disturbance also refers to soil compaction in which large machinery have traveled over unprotected soils, e.g. for haulage or vehicle access.

Pre-development soils are locations where the following vegetation cover exists: continuous grazing land or old meadow in that condition for at least 25 years, or continuous forest cover in which 70% of tree stems are greater than ten inches in diameter at breast height (DBH).

**Base Saturation Percent**:

Anion elements (calcium, sodium, magnesium) as a percentage of nutrient fertility: >35% is a young fertile soil; <20% is a weathered acidic nutrient-poor soil.[13]

**Topsoil**:

Defined as an A horizon with a Munsell soil color darker than 10YR 4/3.

**Atypical Soils:**

Naturally occurring atypical soils are soils with any of these characteristics:

- Greater than 40% clay fraction by volume.
- Greater than 30% organic matter by weight.
- Greater than 80% sand fraction by volume.
- Bedrock within 15 inches of the original ground surface elevation.
- Hydric soils as defined by 1987 Wetland Conservation Act.



[13] http://www.cbxproducts.com/3_1Soil_CationExchange.html

# Guideline S.4: Vegetation

## Intent

To optimize the ecological function of project sites by restoring Minnesota's native vegetation, protecting natural areas, conserving existing site features, and selecting vibrant and appropriate vegetation to ensure the optimum functioning of ecosystems and human uses on the project site.

## Required Performance Criteria

Guidelines are required for New Construction and Major Renovation projects that include at least 1,000 square feet of land disturbance, or at least ten cubic yards or more of cut and fill of the site, excluding the land disturbance and cut and fill within or below the building footprint. ~~Exterior scope~~ Site area related ~~only~~solely to ADA improvements, other accessibility-related improvements, or utility connections may be excluded from ~~contribution toward these amounts.~~total area of disturbance when determining if the guidelines are triggered, more detail on this is included at the beginning of the Site and Water Guidelines.

A. Site Selection: New construction projects shall not select sites containing any of the following critical site characteristics as defined by the Natural Resources Conservation Service (NRCS) Web Soil Survey (WSS), site history, or conservation easement status:
   1. Prime farmland ~~(as defined by the NRCS WSS).~~.
   2. Farmland of state significance ~~(as defined by the NRCS WSS).~~.
   3. Former municipal, township, or county parkland.
   4. Former federally protected lands.
   5. Areas covered by a conservation easement.

B. Trees: The following tree conditions shall be established:
   1. ~~Minimum~~Through preservation of existing trees and provision of new trees, provide minimum combined trunk areas of all trees (~~including~~ deciduous ~~and~~+ coniferous) as detailed in the table below as evaluated at 10-year estimated maturity post-construction and measured by calculating the trunk area at 4.5 feet above the ground (~~(~~i.e.~~,~~. diameter at breast height (DBH) for the site's tree plant community. ~~Tree trunk area must follow the minimum guidelines below:~~Large trees are considered those with 12-inch DBH (0.66 square feet); medium trees are considered those with 7-inch DBH (0.39 square feet); small trees are considered those with 3-inch DBH (0.20 square feet).
      ~~i. Tallgrass aspen parkland and savanna: two square feet. of trunk area per acre minimum.~~
      ~~ii. Southern and southeastern hardwood deciduous: four square feet. of trunk area per acre minimum.~~
      ~~iii. Northern deciduous: three square feet of trunk area per acre minimum.~~
      ~~iv. Boreal conifers: four square feet of trunk area per acre minimum.~~
   2. Required minimum of tree diameter per acre as evaluated in DBH to trunk area at ten years maturity, and number of large, medium, and small trees needed to achieve this requirement. ~~Note that the maximums shown below are suggested only.~~ Landscape Architect shall determine appropriate maximums.

| Type of Tree Plant Community | ~~Sq. Ft. (144~~Minimum sq. ~~in./1 sq. ft.).~~ Trunk Area per acre | ~~Number of Large Trees Only (0.66 sq. ft. ea/12 in. DBH)~~Minimum number of large trees per acre | ~~Number of Medium Trees Only (0.39 sq. ft. ea/7 in. DBH)~~Minimum number of medium trees per acre | ~~Number of Small Trees Only (0.20 sq. ft. ea/3 in. DBH)~~Minimum number of small trees per acre |
|---|---|---|---|---|
| Prairie | 0 sf/ac | 0/ac | 0/ac | 0/ac |
| Tallgrass Aspen Parkland & Prairie Savanna | 2~~–4~~ sf/ac | 3~~–6~~/ac | 5~~–11~~/ac | 10~~–20~~/ac |
| South & Southeast Hardwood Deciduous | 4~~–7~~ sf/ac | 6~~–11~~/ac | 11~~–18~~/ac | 20~~–35~~/ac |
| Northern Deciduous | ~~3–6sf~~3sf/ac | 5~~–10~~/ac | 8~~–16~~/ac | 15~~–30~~/ac |
| Boreal Coniferous | ~~4–7sf~~4sf/ac | 6~~–11~~/ac | 11~~–18~~/ac | 20~~–35~~/ac |

Type of tree plant community shall be established based on the ~~DNR Ecological Provinces Map.~~ site's MN DNR Class Fact Sheet "Vegetation Structure and Composition" section. DNR Class Fact Sheets for each site should be sourced by the project team.

i. Sample Ratios of Trunk Areas at DBH

| DBH Inches | Area Square Inches | Area Square Feet |
|---|---|---|
| 10" | 78 sq. in. | 0.55 sq. ft. |
| 15" | 177 sq. in. | 1.23 sq. ft. |
| 20" | 314 sq. in. | 2.19 sq. ft. |
| 25" | 491 sq. in. | 3.41 sq. ft. |

ii. Annual Tree Growth Diameter Increase in Inches DBH with trees planted at ~1-in. DBH/2.5-in. Caliper:

| Tree Type Size | Annual Rate Increase in Inches of DBH | DBH in Inches at Ten Years | Area of Trunk at Listed DBH in Square Inches at Ten Years | Area of Trunk at DBH in Square Feet at Ten Years |
|---|---|---|---|---|
| Large | >1" | ~11" | 95 sq. in. | 0.66 sq. ft. |
| Medium | >3/4" | ~8 1/2" | 57 sq. in. | 0.39 sq. ft. |

| Tree Type Size | Annual Rate Increase in Inches of DBH | DBH in Inches at Ten Years | Area of Trunk at Listed DBH in Square Inches at Ten Years | Area of Trunk at DBH in Square Feet at Ten Years |
|---|---|---|---|---|
| Small | >1/2” | ~6” | 28 sq. in. | 0.20 sq. ft. |

3. Adequate tree soil volumes ~~shall be achieved. Where~~: where trees are surrounded by hard surfaces (e.g., sidewalks, patios, driveways, car parks, plazas, parking islands), suspended pavement techniques, structural soils, or other comparable methods such as larger tree openings to provide adequate rootable soil volumes shall be ~~used~~provided. Minimum volume of rootable soil volume per tree shall follow the requirements below:
   i. Small trees (e.g., Serviceberry, *amelanchier*): 400 cubic feet
   ii. Medium trees (e.g., Ironwood, *ostyra*): 800 cubic feet
   iii. Large trees (e.g., Hackberry, *celtis*): 1,200 cubic feet

   If using structural soils, multiply the total soil volumes above by five (x5) to obtain equivalent volume of soil usable by the tree. If above soil volumes cannot be met, trees species requiring smaller soil volumes shall be selected. Where applicable, suspended pavement or comparable methods shall be utilized to allow tree roots under hard surfaces to access adjacent open space.
4. ~~For the minimum~~Minimum number and variety of trees ~~required on a site,~~per acre: adequate tree diversity shall be achieved to limit susceptibility of site to disease and increase ecological resilience: Tree genera of like form shall be planted in large single species tree plantings, such as allees or formal groupings. For example, Kentucky coffeetree (Gymnocladus), honey locust (Gleditsia), and black locust (Robinia) are similar in form, structure, and leaf texture but are three different genera not susceptible to the same pests and diseases. The following minimum numbers of tree ~~generas~~genera shall be achieved:
   i. Three genera on sites less than two acres.
   ii. Five genera or more on sites of two to five acres.
   iii. Seven genera or more on sites of five to ten acres.
   iv. Nine genera or more on sites of ten to 15 acres.
   v. Twelve genera or more on sites of 15 to 20 acres.
   vi. Fifteen genera or more on sites of 20 to 40 acres.
   vii. Eighteen genera or more on sites of 40 to 100 acres.
   viii. Twenty genera or more for sites of greater than 100 acres.
5. Tree planting requirements: The planting specifications in the project manual or within the planting sheets of the construction documents should provide the following criteria. At time of tree planting, the following criteria ~~shall~~must be met:
   i. All soil/mulch/media covering trunk flare shall be removed.
   ii. Point of stem/root union shall be exposed at original ground surface elevation ~~(see UMN Extension).~~.
   iii. Caliper size of all trees limited to 2.5 inches at planting.
   iv. All stem girdling roots (SGR) on trees rejected or removed ~~(see UMN Extension).~~.
   v. Metal baskets and burlap removed from balled-and-burlapped (B&B) root balls to 12 inches below soil level.
   vi. Trees shall not be planted deep in the planting hole to stabilize them.
   vii. Mulch shall not be placed against tree trunk deeper than 1-inch deep; tree stem/root union shall be planted one to three inches higher than surrounding ground plane elevation.

viii. Newly planted trees shall be watered at a rate of 1.5 gallons per caliper inches per three calendar days from May through September, at the following intervals. Watering bags are recommended.
   (1) Year 1: At least every three days.
   (2) Year 2: At least weekly.
   (3) Year 3: At least every two weeks.
   (4) Year 4+: Watering after the initial 3 year establishment period should only be provided if drought conditions exist or in order to restore tree health.
ix. See soil section for acceptable drainage and bulk density rates for soils in planting areas.
x. Crowns shall not be pruned at planting to balance root and crown volumes.
xi. Broken branches shall be pruned and removed to develop a single central leader. Codominant branches that exceed half of tree trunk diameter at branch/trunk attachment point shall be removed.
xii. Trees in containers that are rootbound shall be box cut (see UMN Extension).

The following shall be evaluated and implemented if feasible:

xiii. Contracting growing trees for orders exceeding 20 trees total.
xiv. Growing bare root stock in Missouri gravel bed nursery for half the growing season prior to planting out to create a large vigorous tree root system (see UMN Extension).
xv. Using arborist's wood chips, mulch to a depth of up to six inches deep, over tree root systems but not against trunks. If trees are unstable in their planting hole reject trees or require one year of tree staking.
xvi. Grade all landscaped areas to slope towards tree plantings.

C. The vegetation selected shall be subject to the following and selected in coordination with the animal and vegetation requirements listed under S.1 and animal habitat requirements listed under S.5:

1. Existing, noninvasive, nonnative vegetation shall not be removed solely in order to achieve the amount of native vegetation required under S.1A.
2. The selection of herbaceous plantings for prairies, wetlands, savannas, parklands, and forests shall use the methodology (steps 1–5) found in MnDOT's Native Seed Mix Design for Roadsides (2014): ~~www.dot.state.mn.us/environment/erosion/pdf/native-seed-mix-dm.pdf~~www.dot.state.mn.us/environment/erosion/pdf/native-seed-mix-dm.pdf and should reference and reinforce the "Vegetation Structure and Composition" and "Species Frequency & Cover" matrix sections of the site's MN DNR Class Factsheet.

~~3. The required strata are a ground layer less than 48 inches tall and a tree canopy greater than 78 inches tall.~~

~~4.~~3. Keystone species shall be selected according to the following restoration goals:

i. Where savanna, south and southeastern hardwood deciduous, and northern deciduous are being restored, one of the selected trees in the cohort population shall be burr oak (Quercus *macrocarpa*).

ii. Where prairie and savanna are being restored, one of the selected trees in the cohort population shall be American hazelnut (Corylus *Americana*) or beaked hazelnut (Corylus *cornuta*).

iii. Where prairie, tallgrass aspen parkland, and savanna are being restored, two of the selected grasses in shall be selected from the following two cohorts (one from each):

(1) dry/xeric grasses: little bluestem (Schizachurium *scoparium*) and side oats gramma (Bouteloua *curtipendula*);

(2) medium/mesic grasses: big bluestem (Andropogon *gerardii*) and Indian grass (Sorgastrum *nutans*); wet/hydric grasses: switch grass (Panicum *virgatum*) and prairie cord grass (Spartina *pectinata*).

iv. Where south and southeastern deciduous hardwood and northern deciduous and boreal conifers are being restored, one of the selected trees in the cohort population shall be serviceberry (Amelanchier *canadensis*).

v. Where boreal conifers are being restored, one of the selected trees in the cohort population shall be white pine (Pinus *strobus*).

~~5. The coefficient of conservancy for all B3 sites with wetland hydrology at planting must be greater than four as calculated by the floristic quality assessment (FQA) method (per Wilhelm 1977). In areas adjacent to water bodies or wetlands or rivers or streams, a series of exploratory holes 12 inches deep shall be dug between April and November. If water appears and persists in the hole for more than two hours after excavation, an FQA must be performed.~~

~~6.~~4. Invasive species on site shall be determined using ~~the *Invasive Species County Weed Guideline*.~~guidelines provided by Minnesota Department of Agriculture (MDA) and the Minnesota Department of Natural Resources (DNR) provided in the "Meeting the Guidelines" section below. If the site does contain invasive species, a mitigation and maintenance plan as defined by the ~~Minnesota Department of Agriculture~~ MDA and DNR shall be created or implemented.

~~7.~~5. All vegetation must be selected in accordance with the correct local USDA hardiness zones.

D. Pollinator-friendly vegetation:
   1. Neonicotinoid-free sites: All project plantings must use a written chain of custody method within project specifications and proven by greenhouse/sale receipt to verify neonicotinoid-free ~~claims. Reject plants that have been neonicotinoid treated, or that do~~vegetation. Various formats are acceptable for this requirement and if greenhouse/nursery documentation is not ~~have a clear, verifiable chain of custody indicating that they~~possible, provide alternative format reporting certifying the plantings are neonicotinoid-free~~. This requirement also applies to trees, shrubs, and vines~~.
   2. Site plantings shall be selected so that at least 50% by quantity of all trees, shrubs, groundcovers, vines, and herbaceous perennials are insect pollinated, and rich in pollen and/or nectar.
   3. Blooming pollinator plants shall be provided for all three seasons of blooms (spring, summer, fall), with at least two different species blooming during each season.
   4. Coincidently blooming pollinator plants shall be clustered in large groupings to reduce expended energy of insect pollinators.
   5. Abundant human and natural structural enhancements shall be provided for insect pollinators (e.g., dead tree snags, downed tree logs, sand baths, bee skeps, solitary beehives, mason bee houses, green roofs, and green walls).
   6. Cultivars with double and triple petal flowers that do not produce pollen or nectar shall be minimized.

~~Note: This guideline has been developed in response to Minnesota Executive Order 16-07, which also outlines requirements of specific state agencies, departments, boards, and committees not listed here.~~

~~E.~~F. Site ~~shall~~Albedo: The project site should be designed so that the entire site albedo measured as an non-vegetated or non-planted area is at least 0.25 as evaluated using the ~~B3~~Appendix S.4f Site Albedo and Evapotranspiration Calculator. 1.0 represents a perfectly reflective surface/material and 0.00 represents a perfectly absorptive surface/material. Note that the inputs in Appendix S.4f Site Albedo and Evapotranspiration Calculator is now divided into hardscape and vegetative area with weighted albedo contributions that encourage tree cover and pervious vegetative site area in favor of hardscape.

## Recommended Performance Criteria

E. Achieve biomass target according to major ecosystem of site, as measured in biomass per area of vegetated site area, estimated at ten years post-occupancy according to the major ecosystem characterization from DNR:
   1. Prairie: 1.1 kg per square meter or 2.03 pounds per square yard.
   2. Tallgrass aspen parkland and savanna: 0.9 kg per square meter or 1.66 pounds per square yard.
   3. South and southeastern hardwood deciduous forest: 0.7 kg per square meter or 1.29 pounds per square yard.
   4. Northern deciduous and boreal conifer: 0.6 kg/per square meter or 1.11 pounds per square yard.

   These biomass targets do not apply to the restoration of specialized NPCs installed pursuant to S.3K: Atypical Soils.

G. Use a diversity of native plants to express multiple design styles (do not exceed 500 of any single herbaceous perennial species or cultivar; 50 of any single shrub species or cultivar; ten of any single tree species or cultivar). DNR's 49 designated terrestrial invasive plants shall not be planted.

H. Subject sites with existing NPCs shall be protected from development, and DNR regional ecologists consulted for restoration of existing native plant areas.

I. Achieve an entire site albedo of at least 0.3, as evaluated using the B3 Albedo Calculator.

## Meeting the Guidelines

In the predesign and early design of the project, determine ideal spatial needs for existing or new development~~. Critical sites for preservation or restoration on the project site as defined by the B3 Guidelines should be identified, and the type of buildings and related infrastructure that will be required for the developed areas and their spatial requirements should be determined. After a site has been selected, create potential spatial footprints that preserve any critical sites identified during the project's Predesign Phase (PD).~~ and assure adequate site area for vegetation to meet the vegetation requirements of this section, soil requirements of S3, and the stormwater requirements of S2, among others.

Class Fact Sheets for each site should be sourced by the project team and can be found at the following link: https://www.dnr.state.mn.us/npc/wetforest.html.

Select a site where the proposed building and infrastructure will have minimal disturbance on the existing vegetation and on the supporting soil and hydrologic conditions. Areas of vegetation or high-quality areas for restoration should be identified for protection or restoration during the design and construction process.

~~Through the design process, techniques should be used to minimize negative impacts on soil, water, and vegetation on the site and on adjacent sites that are to be preserved or restored. Develop details and specifications that support the use of native plantings, maintain existing biodiversity, and promote enhancement of site conditions per the B3 Guidelines.~~

A preconstruction meeting ~~should~~between landscape architects, architects, civil engineers, owners, and other relevant parties must be held to identify requirements for protection/preservation of vegetation during and after the construction process~~.~~ and to allocate adequate site area to meet or exceed vegetative requirements. During this meeting, the overlapping requirements of vegetation, stormwater, habitat, and soil requirements should be coordinated and recorded. Submittals should be monitored for compliance with plans and details. Bidders should be made aware of specific responsibilities for integrating the onsite vegetation management with connections to vegetation on adjacent sites. Existing plants and trees that will remain should be protected, and soil and water conditions maintained or improved to promote and improve vegetation growth.

An O&M manual should be created to protect and maintain onsite vegetation. The existing conditions of the vegetation should be documented, as should the reason the vegetation was preserved or enhanced, and its ability to function in its current capacity. The necessary enhancements needed to accommodate a different building type in the future should be noted, as well as what the enlargements or reductions in spatial area would be.

Pollinator-friendly plantings should be selected from the lists below for compliance with S.4H:

DNR Pollinator BMPs and Habitat Restoration Guidelines: ~~http://files.dnr.state.mn.us/natural_resources/npc/2014_draft_pollinator_bmp_guidelines.pdf.~~http://files.dnr.state.mn.us/natural_resources/npc/2014_draft_pollinator_bmp_guidelines.pdf.

University of Minnesota Bee Lab, Plants for Minnesota Bees: https://beelab.umn.edu/plants-mn-bees

To calculate the site albedo: On the project site plan, measure all areas in square footage that are exposed to sun during noon on June 22nd and determine the albedo value of the area according to its color. For living plants, use expected growth in ten years after the project is completed for square footage.

Calculate the total proposed site albedo using Appendix S-4: Site Albedo Calculator. The total site albedo as determined by this calculation must be at least 0.3 (or 0.25 if pursuing S.4N). Submit a site plan with each site material and albedo values identified and the completed Appendix S-4.

~~Using https://www.pca.state.mn.us/water/floristic-quality-assessment~~Using https://www.pca.state.mn.us/water/floristic-quality-assessment and the available FQA calculator and instructions, ensure that the site achieves at least a score of 4.0.

## Submittal Requirements

**Predesign**

- S.4A: Identification of any critical site conditions.
- S.4C: Submit a Predesign (PD) matrix for all vegetation areas and proposed types to reinforce the site's MN DNR Class Fact Sheet.

**Design:**

- S.4B: Verification of intended compliance and preliminary calculations of tree trunk areas, tree soil volumes, tree soil diversity and preliminary specifications outlining tree planting methods.
- S.4C: Verification of intended compliance and preliminary calculations for all required vegetation conditions, including planting plan for each plant category identified in the Predesign (PD) matrix for genera, species, and structural diversity of planting guidelines, updated as needed.
- S.4D: Verification of preliminary selection of pollinator-friendly plantings.
- S.4E: Identification of major ecosystem and preliminary intended method of compliance of ~~biomass target~~vegetation requirements.
- S.4F (and S.4I if pursuing): Completed preliminary Appendix S-4 Albedo Calculator demonstrating anticipated design compliance with albedo limits.

**Final Design:**

- S.4B: Verification of language mandating compliance in construction documents and specifications for tree trunk areas, tree soil volumes, tree soil diversity, and specifications outlining tree planting methods.
- S.4C: Verification of compliance method in construction documents for all required vegetation conditions, including planting plan for each plant category identified in the predesign matrix for genera, species, and structural diversity of planting guidelines, updated from prior iterations.
- S.4D: Verification of selection of pollinator-friendly plantings and specifications prohibiting using neonicotinoid products during the establishment, maintenance, and operation of the site.
- S.4E: Identification of major ecosystem and construction documents requiring compliance with biomass target.
- S.4F (and S.4I if pursuing): Completed Appendix S-4 Albedo Calculator demonstrating compliance with albedo limits. A site plan showing the location and size of areas with different reflective characteristics and their assigned albedo values should be included.
- S.4G: Planting plan demonstrating diversity of native plant species.
- S.4H: Documentation of NPCs, including site plan and documentation of correspondence and implementation of recommendations of DNR Regional Ecologists.

**Closeout:**

- S.4B: Verification of language mandating compliance in construction documents and guidelines requirement compliance if trees are surrounded by hard surfaces. Final planting plan for each plant category identified in the final design matrix for genera, species, and structural diversity of planting that meet required genera diversity, updated as needed and verifying that substitutes were not implemented for more than 5% of trees, shrubs, vines, or perennials.

## Additional Resources

Appendix S-4 Site Albedo Calculator

Coffin, Barbara and Pfannmuller, Lee. 1988. *Minnesota's Endangered Flora and Fauna*. Minnesota: University of Minnesota Press.

Dirr, Michael. 2009. *Manual of Woody Plants*. Illinois: Stipes Pub.

Hightshoe, Gary. 1988. *Native Trees, Shrubs, and Vines for Urban and Rural America: A Planting Design Manual for Environmental Designer*. New York: Van Nostrand Reinhold.

International Society of Arboriculture: www.isa-arbor.com/publications/tree-ord/ordprt3d.aspx.

MacDonagh, L. Peter, 2005. *Minnesota Soil Bioengineering Handbook*. Minnesota: MnDOT.

Minnesota Department of Agriculture, Invasive Species: https://directives.sc.egov.usda.gov/viewerFS.aspx?hid=21429.

MN DNR, Invasive Species: http://dnr.state.mn.us/invasives/terrestrialplants/index.html.

MacDonagh, L. Peter, Nathalie Shanstrom. MnDOT Native Seed Mix Design for Roadsides, May 2010. www.dot.state.mn.us/environment/erosion/pdf/native-seed-mix-dm.pdf.

Smith, Welby. 2008. *Trees and Shrubs of Minnesota: The Complete Guide to Species Identification*. Minnesota: University of Minnesota Press.

Wilhelm, Gerould and Rericho, Laura. 2017. *Flora of the Chicago Region: A Floristic and Ecological Synthesis.* Indiana Academy of Science.

Sutton, Richard K., ed. et al. 2015. *Green Roof Ecosystem.* Springer International Publishing. (See Chapter 11, MacDonagh, Shanstrom.)

Urban, James. *Up by Roots*, International Society for Arboriculture 2008: http://www.jamesurban.net/up-by-roots/.

## Glossary

**Albedo:**

Exterior surface reflectivity index, or the capacity of a surface to reflect back light as evaluated across a specified range of frequencies.

**Biomass**:

The standing dry weight of all vegetation, typically measured in kilograms per square meter.

**Coefficient of Conservancy/Floristic Quality Assessment (FQA):**

An ecological integrity evaluation tool for NPCs, pioneered by Wilhelm (1977) and later refined by Swink and Wilhelm (1979, 1994). Currently, all 50 states use FQA systems. All plants within a subject community are scored from 0–10, from most to least invasive (e.g., in Minnesota: common buckthorn Rhamnus *cathartica* = 0; pink and white ladyslipper orchid Cypripedium *reginae* = 10).

**Cultivar or CV:**

Named variety of a hybrid plant species e.g., Iris "Caesar's Brother" is an Iris *siberica* crossed Iris *sanguinea* hybrid. CVs are generally more vulnerable to pest infestations and usually lack pollen or nectar in their flowers.

**Ecosystem Provinces**:

Major ecosystem zones with distinctive physical structures and groupings of plants (trees, shrubs, vines, herbaceous) with unique soil orders, precipitation, climate, and specific stochastic disturbance regimes, such as winds, fire, or floods.

**Historical Context or European Presettlement:**

Refers to native landcovers in Minnesota prior to 1840.

**Tree Sizes**:

Large, medium, and small refer to the ultimate mature dimensions of that tree species, not tree size at time of planting. For example, hybrid elm, burr oak, hackberry, American linden, white pine, etc. are considered large trees.

**Tree Species**:

Primary taxonomic classification, ranking below genus.

**Tree Genera**:

Second-level of scientific species classification, (e.g., maples: Acer, oak: Quercus, elms: Ulmus are all tree genera). Note that because multiple species (cultivars) may be of the same genera, if multiple species or cultivars belonging to a single genera are selected for a site, only a single genera is represented by those selections.

# Guideline S.5: Animal Habitat Support

## Intent

To provide appropriate animal habitats within project sites that protect, restore, and ~~support site animal habitat resilience by~~reinforce Minnesota's native flora and fauna while reducing the negative impact of ~~the built environment~~construction on ~~animal~~targeted species ~~and providing supportive environments for at-risk native species essential to ecosystem health.~~.

## Required Performance Criteria

Guidelines S.5A through S.F are required for New Construction and Major Renovation projects that include new or renovated glazing within project scope. Projects that include less than 20,000 gross square feet of conditioned space that do not include any traps (e.g., skyways, corner windows, or other see-through condition less than 20 feet across) may opt to meet guideline S.5O in lieu of Guidelines S.5A through S.5F. Guidelines S.5G and S.5H are required for New Construction and Major Renovation projects that include at least 1,000 square feet of land disturbance, or at least ten cubic yards or more of cut and fill of the site, excluding the land disturbance and cut and fill within or below the building footprint. ~~Exterior scope~~Site area related ~~only~~solely to ADA improvements, other accessibility-related improvements, or utility connections may be excluded from ~~contribution towards these amounts.~~total area of disturbance when determining if the guidelines are triggered, more detail on this is included at the beginning of the Site and Water Guidelines. Guideline S.5I is required for projects that include new or ~~updated~~modified exterior building or site lighting within the project scope. When selecting vegetation, project teams should pay close attention to the requirements in both S.4 and S.5 as there is some overlap in their scope; when providing native vegetative habitat under S.4: Vegetation may help satisfy the needs of S.5: Animal Habitat Support.

A. Bird safety: Whole Building Threat Factor (WBTF)
   The WBTF must be less than or equal to WBTF 45 for sites not designated critical. The WBTF must be less than or equal to 15 for critical sites. The WBTF is calculated through the B3 Guidelines Bird-Safe Design Calculator (Appendix S-5a). This calculator also assists in determining compliance with S.5B, S.5C, S.5D, and S.5I (when pursued).
B. Bird safety: Non-Enclosure Threat Factor (NETF)
   The NETF must be less than or equal to 45. The NETF is calculated through the B3 Guidelines Bird-Safe Design Calculator to determine NETF for non-enclosure surfaces.
C. Bird safety: High Risk Surfaces
   The portion of the building considered a High Risk Surface may not include a material with a threat factor of 75 or greater in more than 15% of its surface area. A High Risk Surface is defined as:
   a. Any condition that offers a view from exterior to exterior greater than 20 feet across, such as a large atrium or glazed corners.
   b. A surface within 50 feet or less of attractants such as trees, shrubs, prairie, grassland, or open water (including green roofs with this type of vegetation).
D. Bird safety: Traps
   No portion of the building considered a trap may include any glazing with a threat factor (TF) greater than 25: For the purposes of these guidelines, the following conditions are considered traps:
   a. Transparent exterior railings where all surfaces are exposed to exterior.
   b. Transparent-sided walkways (e.g., skyways, covered walks with glass on two sides).

c. Any condition that offers a view from exterior to exterior 20 feet or less across, such as a small atrium or glazed corners.

E. Bird safety: Lights Out management procedure

Follow the Lights Out light management program, which addresses operation of lights at night for specified times and dates of bird migrations. Note that this procedure is also required by law for state-owned and managed buildings~~.~~ per Minnesota Statute 16B.2421. The program advises turning off building lighting including but not limited to: architectural lighting at top of building; uplighting; interior lighting, especially on upper floors; and lobby or atrium lighting during times and dates listed below.

a. Dates: between March 15 and May 31 and between August 15 and October 31 each year.
b. Times: between midnight and dawn.
c. Exception: Lights that have been documented as necessary for normal use of the building between midnight and dawn may be operated.

F. Bird safety: First-year monitoring

For one year after construction/occupancy, the perimeter of the building(s) shall be walked and all accessible setbacks and roof areas observed at least twice per week. Activity and findings shall be surveyed and documented as listed in Appendix S-5f Bird-Safe Monitoring Worksheets.

G. Protection of rare, threatened, or endangered species:

If the project site is within one mile of a Minnesota state rare plants, animals, native plant community, or other rare feature as determined by ~~a Natural Heritage Review, the~~the use of the Minnesota DNR's Conservation Explorer tool. The project team must create and execute a protection plan to mitigate the impact of development on those identified species within the project site, including the measures listed in the Natural Heritage Review letter and at least the following:

a. An ~~O&M~~operations & maintenance manual with site-specific provisions and maintenance procedures designed to ~~vigorously~~specifically protect targeted species~~, with instructions on how to enhance the vigor of the subject species until delisting~~.
b. Supportive habitat for the noted species, aggregated into the largest possible single units with ~~least~~a minimum perimeter.
c. Management practices for the subject site designed to protect and enhance the viability of rare, threatened, or endangered species ~~until that species is delisted.~~ Requirements may include avoidance, buffers, management with fire, elimination of fertilizers and invasive species, and/or artificial drainage.

H. The following provisions for animal habitat shall be included in design:

a. Water features with the following characteristics are required for all B3 sites subject to the listed exclusions:

~~i. At least partially open year-round (e.g., a heater, aerator, or fountain, or waterproof liner may be required to ensure that at least 10% of the water feature is accessible year-round) to maintain continual freshwater access for wildlife.~~

~~ii.~~i. Gently sloped (<10% grade) access for a 5-foot horizontal distance.

~~iii. Sites with limited ledges and sharp drop-offs.~~

ii. For water features, the ~~primary~~ water balance source ~~shall~~should be ~~roof~~prioritized as follows:

1. Roof-collected rainwater~~, supplemented by treated~~.
2. Treated greywater ~~and potable~~
~~0.~~3. Potable water only as necessary to maintain the water feature.

~~v.~~iii. Water features are not required for sites within 500 feet of an existing natural water body of at least one acre in size or a stream at least ten feet in width.

~~vi.~~iv. If the site or greater contiguous campus of the site's location has an existing, perennial freshwater feature (natural or manmade) such as a fen, river, wetland, stream, creek, pond, lake, NURP basin (stormwater retention or detention basin) with freshwater at least three inches in depth, which wildlife can access via land, it is considered to have fulfilled the necessary requirement for a wildlife freshwater source. ~~However, to maintain year-round freshwater access for wildlife during the coldest months, a heater or bubbler or fountain shall be run to maintain an ice-free freshwater source.~~

~~vii.~~v. Size requirements for water features relative to the listed nonbuilding site area are as follows:

| Size of Site | Size of Freshwater Feature (in Square Feet) | Maximum Depth of Freshwater Feature (in Inches) | Size of Freshwater Feature with depths of ~2" Depth (in Square Feet) | Percent of Perimeter with Gently Sloped (Under 10% Grade) Access |
|---|---|---|---|---|
| **Less than 1 Acre** | not required | n/a | n/a | n/a |
| **1 to 3 Acres** | 300 | 12 | 100 | 50% |
| **3 to 5 Acres** | 500 | 24 | 200 | 40% |
| **5 to 10 Acres** | 2,000 | 24 | 200 | 30% |
| **10 to 20 Acres** | 8,000 | 36 | 1000 | 30% |
| **20 to 40 Acres** | 16,000 | n/a | 2000 | 30% |
| **More than 40 Acres** | 5% of site area | n/a | 5% of freshwater water feature area | 10% |

b. Bat Habitat: If the project site is either greater than three acres in size or adjacent to or adjoining a permanent surface water body, natural bat habitat enhancement shall be installed and maintained, including implementation of the following:
   i. Multiple standing snags (>10" DBH) and downed logs in all wooded areas of subject site.
   ii. Bat boxes to provide roosting area for 80 colony roosting bats per acre of surface water and 40 colony roosting bats per acre of nonsurface water areas.
   iii. Bat boxes within 100 feet of permanent site water feature, facing south or southeast.
   ~~iv. During the fifth growing season following project opening, the number of bats on subject site shall be observed and recorded. Bat habitat should be remediated if at least 50% of the bat boxes have not been used by at least one species of bat that season.~~

c. Reptile and amphibian habitat: If the project site is one acres in size or larger feeding, nesting, and breeding sites shall be created with natural and human-made structures to achieve at least one amphibian and one reptile ~~by~~habitat area within the ~~fifth growing season~~site plan. Provide acceptable reptile and amphibian enhancement structures on a year-round basis, including implementation of the following:
   i. Natural options: standing snags, brush piles, piles of leaf litter, downed logs, haul-out logs in water bodies, large flat sunning stones in full sun, wood and rock mulches, sand and gravel baths on south slopes and in shallow water.
   ii. Human-made options: stone snake or reptile hibernaculum; fabricated buried wood, stone or concrete reptile and amphibian dens; submerged Christmas tree reefs; wooden stream-bank lunkers.

iii. ~~Any other reptile and amphibian habitat enhancement structures may be acceptable if they have been listed in peer-reviewed literature and approved by the B3 Guidelines Administrators.~~

iv. ~~Limiting area of mown lawn to increase available reptile and amphibian habitat.~~

v. ~~Avoiding use of pesticides that harm animals.~~

vi. ~~Verifying the presence of reptile and amphibians during the fifth growing season following the project opening and during the monitoring period of March to November, for a period not to exceed 24 hours. A 48-hour bio-blast monitoring protocol is an acceptable methodology. Animals may be captured for monitoring purposes only, but limit time of handling to avoid stressing, injuring, or killing these temporarily captured animals. Remediate reptile and amphibian habitat if at least one reptile and one amphibian have not been observed.~~

d. Insect pollinator habitat shall be created so that during the fifth growing season following the project opening, at least one butterfly, one bee, and one other insect pollinator shall be found on site using monitoring protocols during a 24-hour search. If insect pollinators are not found during monitoring, the site design should be remediated as necessary to achieve this.

I. The aggregate illumination level outlined under the most recent International Dark-Sky Association (IDA) IES Model Lighting Ordinance (MLO) shall not be exceeded for the project's lighting zone.

## Recommended Performance Criteria

J. A WBTF of less than or equal to 15 (see S.5A for more details).

K. Enhanced bird-safe building monitoring, implementing one or more of the following:
   a. Continued monitoring performed under S.5F by one or more additional years.
   b. More surveys per week for the first or more years.
   c. Ongoing work with an organization such as Audubon Minnesota to collect and catalog birds found.

L. Bird-safe lighting design.
   a. Lighting levels listed below are not exceeded for the listed environmental lighting zone.[14]

| Environmental Lighting Zone | Description | Maximum Vertical Illuminance Levels [fc] at Property Line | Achieve the Following Light Distribution Characteristics |
|---|---|---|---|
| E1: Intrinsically Dark | Parks and residential areas where controlling light pollution is a high priority | 0.1 | Use luminaires with light distribution that meets IES's Full Cutoff Fixtures. |
| E2: Low Ambient Brightness | Outer urban and rural residential areas | 0.1 | Use luminaires with light distribution that meets IES's Cutoff Fixtures. |
| E3: Medium Ambient Brightness | Urban residential areas | 0.2 | Use luminaires with light distribution that meets IES's Semi-Cutoff Fixtures. |

[14] Adapted from Illuminating Engineering Society of North America (IES) RP-33-99, using "post curfew" recommendations for all values to ensure that light trespass is minimized for each environmental zone.

| Environmental Lighting Zone | Description | Maximum Vertical Illuminance Levels [fc] at Property Line | Achieve the Following Light Distribution Characteristics |
|---|---|---|---|
| E4: High Ambient Brightness | Urban areas having both residential and commercial use and experiencing high levels of nighttime activity | 0.6 | Use luminaires with light distribution that meets IES's Cutoff Fixtures. |

i. For façade, display, sculptural, and sign lighting:
   1. For luminaires of 3500 or more lumens, objects lit from above.
   2. For luminaires of less than 3500 lumens, objects may be lit from below. An effort is made to minimize nontarget light (and to maximize the percentage of uplight that falls on the target).

b. Create lighting control zones and provide lighting control devices for parking lot, security, and decorative and façade lighting so that each type of lighting can be controlled independently and can be turned off or reduced in response to reduced lighting needs during low-use or nonuse periods. Clearly relate decisions to the Lights Out program.

c. Document bird-safe lighting design measures undertaken.

M. Bird-safe building narrative: A Bird-Safe Case Study Narrative Report documents and shares bird-safe efforts. (Use Appendix S-5m Bird-Safe Building Narrative Template or include a writeup with similar content.)

N. ~~Limited~~Eliminate the use of pesticides ~~site-wide, specifically eliminated~~ within 300 feet of the site's required permanent water feature and all other surface waters within 1,000 feet of the site.

## Small Buildings Path

Projects that include less than 20,000 gross square feet of conditioned space and that do not include any traps (e.g., skyways, corner windows, or other see-through condition less than 20 feet across) may opt to meet guideline S.5O in lieu of Guidelines S.5A through S.5F.

O. Demonstrate that the average threat factor of glazing included in the project is less than the value listed below relative to the project's window-to-wall ratio (WWR):

| Project's window-to-wall ratio | Average glazing threat factor—maximum allowed value: not critical bird habitats | Average glazing threat factor—maximum allowed value: critical bird habitats |
|---|---|---|
| **Less than or equal to 25%** | 100 (clear glass) | 40 |
| **Greater than 25%, up to 35%** | 80 | 30 |
| **Greater than 35%, up to 45%** | 60 | 25 |
| **Greater than 45%, up to 55%** | 45 | 20 |
| **Greater than 55%, up to 65%** | 40 | 15 |
| **Greater than 65%, up to 75%** | 30 | 13 |
| **Greater than 75%, up to 85%** | 28 | 10 |

| | | |
|---|---|---|
| **Greater than 85%, up to 100%** | 25 | 10 |

When calculating the window-to-wall ratio and the average glazing threat factor, also include glazing and vertical surfaces of the building which are not part of the enclosure if present, such as glazed railings.

## Meeting the Guidelines

In predesign and early design, the impact of glazing percentage on bird safety should be considered and evaluated. If the building use is likely to be associated with large, glazed areas, consider if increased risk/adjustments are needed on highly vegetated sites. Additionally, an ecological assessment of the site that includes an evaluation of bird species, habitat, and migration patterns should be considered.

Through the design process, identify attractant areas for birds on the site, plan deterrents for facades adjacent to attractants, and keep glazed areas of buildings greater than 50 feet away from attractants. Configure building to minimize bird collision traps. Traps can include clear barriers, transparent railings, or other glazed see-through conditions. See guideline for complete conditions deemed to be traps.

Early designs should be evaluated with the Bird-Safe Calculator (Appendix S-5a), and designs should be adjusted to meet bird-safe criteria. ~~Design~~As the design of the project progresses it should be ~~checked against bird-safe criteria and the WBTF~~ regularly updated in the Bird-Safe Building Calculator ~~update~~ to confirm continued compliance. Note that the WBTF as calculated by the Bird-Safe Calculator weights the lower three floor more than the upper floors so the relative areas of the surfaces of those portions of the building are input separately.

Using the Bird-Safe Calculator early in design will assist in matching requirements to the project's glazing needs, as more treatment is generally needed for higher window-to-wall ratios.

Bird-safe film, which is applied to the exterior surface of glazing has increasingly become available from a variety of manufacturers and provides an alternative means to reduce glazing threat factors. These films generally achieve a lower threat factor for the same visibility as frit, as exterior applied measures are believed to be more visible to birds. An additional benefit noted in some projects is the increased availability of glazing options when separately procuring the glazing and the bird-safety measures.

Renovation projects replacing only a portion of glazing must include adjacent opaque assemblies on the same surface in the Bird-Safe Calculator. If only some windows on a surface are being replaced and some are remaining, the opaque area included in calculations must be pro-rated by the percentage of glazing area replaced.

As the construction documents are developed, continued compliance with all required and pursued recommended bird-safe criteria should be confirmed, adjusting documentation and design as needed.

Contract documents should include those features needed for bird-safe compliance, as calculated using the Bird-Safe Calculator (Appendix S-5a). Bidders should be made aware of specific requirements for sustainable construction according to the B3 Guidelines. Substitutions that would change the bird-safe performance of the building should be monitored, and any material substitutions should meet bird-safe performance criteria. Correct implementation of features affecting bird-safe performance should be confirmed according to drawings and specifications. Bird-safe first-year monitoring and Lights Out program criteria should also be implemented in the project documentation. A lighting engineer should be consulted regarding controls for lights to accommodate Lights Out program compliance.

Required first-year bird-safe monitoring should be performed, as should any recommended ongoing monitoring that was pursued, using Appendix S-5f for First-Year Building Monitoring. If pursuing Bird-Safe Case Study Narrative, coordinate with lighting engineer on documentation of lighting benefits anticipated from Lights Out program. Documentation of recommended bird-safe lighting design under S.5L Bird-Safe Lighting Design should also be considered.

As early as possible during the design process and preferably prior to any physical site activities including inspections, disturbance, or mobilization of the project site, a National Heritage Review should be performed to identify potential impacts to rare plants, animals, native plant community and other rare features. This review is requested by creating an account in the Minnesota Conservation Explorer, defining an area of interest, and clicking the *Natural Heritage Review* button. As part of this process, the DNR provides a Natural Heritage Review letter identifying the rare features within the search radius and measures to avoid or minimize impacts, which should be incorporated into the design and management of the project.

If bat boxes are required, they should be located so that the largest surface of the bat box has a south, west, or southeast aspect during the growing season (April–October), so that sun exposure on the bat box is a minimum of six hours per day. Bat boxes should not be mounted in shade and should be seasonally mounted and ready for use by bats no later than April 1. Bat boxes should be located on solid structures with a minimum distance of 30 feet from trees (do not mount on poles or trees, and do not mount on or adjacent to windmills). The bottom of bat box should be elevated a minimum of 15 feet above the ground, or at least 12 feet above the top of nearest vegetation. Bat boxes should be sheltered from prevailing winds during the growing season. They should not be illuminated from above or below. They should not be located immediately above an asphalt road or parking lot. Fabricate larger (>24 in. x >24 in. x 8 in.) bat boxes from natural, dark-colored untreated wood with rough surfaces throughout (cedar, cypress, redwood, juniper). Do not use polished or planed surfaces in the construction of bat boxes, and do not attach wires or hardware mesh. Do not paint interiors or exteriors of bat boxes. Use closely spaced (~1/2 in.) multi-chambered bat boxes accessed by bats from below (see Bats Conservation International guidance). Provide a vertical landing pad immediately beneath bat box access point. Use black roofing, maintain waterproofing throughout, and tightly seal. Thoroughly caulk all site buildings adjacent to bat boxes to close openings smaller than a dime to eliminate accidental bat infestation. At year five, post-occupancy, monitor bat boxes to ensure at least 50% of bat boxes are occupied with bats. Report any incidences of white-nose syndrome on bats to DNR Nongame Wildlife. Clean bat boxes annually per Bat Conservation International bat box maintenance guidelines.

Insect-pollinated trees, shrubs, vines, and groundcovers which may be used to create insect pollinator habitats include:

- Spring and summer: cherries, plums, peaches (Prunus spp.), apples, crabapples (Malus spp.), pears (Pyrus spp.), persimmon (Diospyros spp.), hawthorns (Craetagus spp.), serviceberries (Amelanchier spp.), nannyberries (Viburnum spp.), honeysuckle (Lonicera spp.), holly (Ilex spp.), linden (Tilia spp.), catalpa (Catalpa spp.), dogwoods (Cornus spp.), willows (Salix spp.), redbud (Cercis spp.), hackberries (Celtis spp.), locusts (Gleditsia and Robinia spp.), elderberries (Sambucus spp.), magnolia (Magnolia spp.), tupelo (Nyssa spp.), tulip tree (Liriodendron spp.), horse chestnut (Aesculus spp.), hop tree (Ptelea spp.), mountain ash (Sorbus spp.), golden rain tree (Koelreuteria spp.), pagoda tree (Sophora/Styphnolobium spp.), silverbell (Halesia spp.), buttonbush (Cephalanthus spp.), New Jersey tea (Ceanothus spp.), lead plant (Amorpha spp.), grape vine (Vitis spp.), kiwi fruit (Actinidia spp.), trumpet creeper (Campsis spp.), raspberries (Rubus spp.), roses (Rosa spp.), blueberries, cranberries (Vaccinium spp.), strawberries (Fragaria spp.), prickly pear cactus (Opuntia spp.), stonecrop (Sedum spp.).

Insect-pollinated herbaceous perennials which may be used to create insect pollinator habitat include:

- Spring: lupine (Lupinus spp.), bloodroot (Sanguinaria spp.), buttercups (Ranunculus spp.), Dutchman's breeches (Dicentra spp.), columbine (Aquilegia spp.), Virginia bluebells (Mertensia spp.), spiderwort (Tradescantia spp.), lobelias (Lobelia spp.), golden alexanders (Zizia spp.).
- Summer: prairie clovers (Petalostemum spp.), milkweed (Asclepius spp.), wild bergamot (Monarda spp.), giant hysopp (Agastache spp.), beard tongue (Penstemon spp.), bush clovers (Lespedeza spp.), Canada milk-vetch (Astragalus spp.), Culver's root (Veronicastrum spp.), evening primrose (Oenothera spp.), ironweed (Vernonia spp.), false indigo bush (Baptisia spp.), tickseed (Coreopsis spp.), Canada tick trefoil (Desmodium spp.), obedient plant (Physostegia spp.), mountain mint (Pycnanthemum spp.), partridge pea (Chamaecrista spp.), yellow coneflower (Rudbeckia spp.), cup plant (Silphium spp.), Joe Pye weed (Eupatorium/Eutrochium spp.), blazing stars (Liatris spp.).
- Fall: asters (Aster spp.), sneezeweed (Helenium spp.), gentian (Gentian spp.), boneset (Eupatorium spp.), goldenrods (Solidago spp.), sunflowers (Helianthus spp.).

The lighting zone for the project can be determined by referencing the Joint IDA IES MLO dated June 15, 2011. Lighting zones include the following:

- LZ-0: No ambient lighting.
- LZ-1: Low ambient lighting, or for other uses.
- LZ-2: Moderate ambient lighting.

The determination of the lighting zone and the calculated total site lumens for the site should be recorded. Site lighting requirements should be designed in accordance with the performance method allowed for the lighting zone and a project site plan submitted complying with the total site lumens for the selected light zone.

## Submittal Requirements

**Predesign:**

- S.5G: Submit Natural Heritage Review letter from the Minnesota DNR and identified potential impacts to rare features from the DNR (obtained by submitting a NHIS Data Request).

**Design:**

- S.5A (and S.5J if pursuing): Submit WBTF (as calculated by Appendix S-5a) and preliminary version of Appendix S-5a.
- S.5B: Submit NETF (as calculated by Appendix S-5a), and submit preliminary version of Appendix S-5a.
- S.5C: Submit if the project includes new high risk Surfaces, input the area of the enclosure that is considered a high risk surface and note the areas of that surface with a TF greater than 75 not to exceed 15%.
- S.5D: Submit traps TF (as calculated by Appendix S-5a), and upload preliminary version of Appendix S-5a.
- S.5G: If the project's Natural Heritage Review letter identifies rare features, submit draft protection plan listing measures to mitigate the impact of those identified species on the project site, including the measures listed in the Natural Heritage Review letter and all measures listed in guideline requirements.
- S.5H: Submit preliminary site plan outlining guide requirements, including water feature, bat habitat, reptile and amphibian habitat, pollinator habitat, and identified endangered plant species listed from DNR Designated Natural Heritage Review letter.
- S.5I: Submit a plan of lighting zones that most represent the surrounding site conditions of the project site and note identified anticipated aggregate illumination level.
- S.5O: Submit elevations and calculations identifying the window-to-wall ratio of project and required area-weighted threat factor (TF).

**Final Design:**

- S.5A (and S.5I if pursuing): Submit WBTF (as calculated by Appendix S-5a) and final version of Appendix S-5a.
- S.5B: Input NETF (as calculated by Appendix S-5a), and upload final version of Appendix S-5a.
- S.5C: Submit if the project includes new high risk Surfaces, input the area of the enclosure that is considered a high risk surface and note the areas of that surface with a TF greater than 75 not to exceed 15%.
- S.5D: Submit traps TF (as calculated by Appendix S-5a), and upload final version of Appendix S-5a.
- S.5G: If the project's Natural Heritage Review letter identifies rare features, submit final protection plan listing measures to mitigate the impact of those identified species on the project site including the measures listed in the Natural Heritage Review letter, in addition to those measures listed in guideline requirements. Include final plans and specification sections referencing design and installation of a perimeter exclusion fence and sign per guideline requirements; as well as plans and specifications for site preparation (weed and erosion control), site drainage, and revegetation (seeding, planting, etc.) related to the impact mitigation of rare features.
- S.5L: Submit site plan outlining designed light levels demonstrating compliance with the guideline limits. Include narrative of lighting design and lighting control zones.
- S.5M: Submit Bird-Safe Case Study Narrative Report based on Appendix S-5m or using similar content.
- S.5O: Submit elevations and calculations of final design identifying the window-to-wall ratio of project, required area-weighted threat factor (TF), and documentation of the selection of glazing meeting area-weighted threat factor.

**Closeout:**

- S.5A (and S.5J if pursuing): Ensure WBTF of installed condition meets guideline limits (as calculated by Appendix S-5a) and Appendix S-5a, updated as needed.
- S.5B: Submit NETF of installed condition (as calculated by Appendix S-5a), and upload final version of Appendix S-5a, updated as needed.

- S.5C: Submit if the project includes new High Risk Surfaces, note that the area of that surface of installed condition with a TF greater than 75 is less than guideline limits and Appendix S-5a. Update this as needed to reflect installed conditions.
- S.5D: Submit plans for traps TF of installed condition. UpdateAppendix S-5a as needed.
- S.5E: Provide verification of a Lights Out management program in place.
- S.5F: Provide verification that the facility operations team is aware of first-year monitoring requirements.
- S.5I: Submit a plan showing lighting zones that most represent the surrounding site conditions and designed aggregate illumination level.
- S.5O: Provide verification of installation of compliant glazing identified in Final Design submission.

**Occupancy – Submitted annually for ten years:**

- S.5E: Verification of adherence to Lights Out management program.
- S.5F: (Year one only): Verification of first-year monitoring.
- S.5J: Documentation of enhanced bird-safe building monitoring.
- S.5H: Annual inventory, condition, and recovery rate of endangered species. At year five submit inventory of bat, reptile and amphibian, and pollinated populations to meet required performance criteria. Ensure at least 50% of bat boxes are occupied with bats. Remediate habitat if requirements are not met. Report any incidences of white-nose syndrome on bats to DNR Nongame Wildlife.
- S.5M: Documentation of operations pesticide limits and methods of ensuring compliance.

## Additional Resources

Appendix S-5a Bird-Safe Calculator

Appendix S-5f Bird-Safe Monitoring Worksheets

Appendix S-5m Bird-Safe Case Study Narrative Template

Bat Conservation International (BCI): http://www.batcon.org/.

Bird-Safe Building Guidelines by Audubon Minnesota and Project Birdsafe: http://mn.audubon.org/conservation/birdsafe-buildings.

Henderson, Carrol. 2010. *Woodworking for Wildlife*. Minnesota: MN DNR.

Henderson, Carrol. 1987. *Landscaping for Wildlife*. Minnesota: MN DNR.

Holm, Heather. 2014. *Pollinators of Native Plants: Attract, Observe, and Identify Pollinators and Beneficial Insects with Native Plants*. Minnesota: Pollination Press.

Holm, Heather. 2017. *Bees: An Identification and Native Plant Forage Guide*. Minnesota: Pollution Press.

International Dark-Sky Association (IDA): www.darksky.org, International Dark-Sky Association Joint IDA IES Model Lighting Ordinance: http://www.darksky.org/wp-content/uploads/bsk-pdf-manager/16_MLO_FINAL_JUNE2011.PDF, Recommended Lighting Zones: https://darksky.org/resources/guides-and-how-tos/lighting-zones/

IDA Mapping Earth's Night One Picture at a Time: http://www.darksky.org/mapping-earths-night-one-picture-at-a-time/.

MN DNR, Ecological Classification System (select applicable ecosystem provinces, sections, subsection to download the complete plant lists): http://www.dnr.state.mn.us/ecs/index.html.

MN DNR, CBS Maps of Minnesota (now outdated): http://www.dnr.state.mn.us/eco/mcbs/maps.html.

MN DNR, Natural Heritage Information System: https://www.dnr.state.mn.us/nhnrp/nhis.html.

MN DNR, Natural Heritage Review: https://www.dnr.state.mn.us/nhnrp/natural-heritage-review.html.

MN DNR, Invasive Species: http://dnr.state.mn.us/invasives/terrestrialplants/index.html.

MN DNR Pollinator BMPs and Habitat Restoration Guidelines: http://files.dnr.state.mn.us/natural_resources/npc/2014_draft_pollinator_bmp_guidelines.pdf.

Minnesota Biological Survey: www.dnr.state.mn.us/mbs/index.html.

Pollinator Garden: About Plants, Pollinating Insects and Gardening: http: www.foxleas.com.

Sheppard, C. 2011. *Bird-Friendly Building Design*. American Bird Conservancy, The Plains, VA: http://collisions.abcbirds.org/.

State of Minnesota Lights Out Management Program: http://www.revisor.leg.state.mn.us/laws/?id=101&doctype=Chapter&year=2009&type=0.

United States Dept. of Agriculture, Natural Resources Conservation Service, Engineering Field Handbook: https://directives.sc.egov.usda.gov/viewerFS.aspx?hid=21429.

Xerces Society Pollinator Conservation: http://xerces.org/pollinator-conservation/.

## Glossary

**Beaver Deceiver:**

Installation of trapezoid protective fence upstream of culvert pipes and road embankments to eliminate flooding and road washouts from beaver damming.

**Brush Piles:**

Approximately 2–3 feet-tall piles of tree toppings/trimmings and/or broken branches on the ground in order to promote critical insect-feeding bird habitat; typically discreetly sited.

**Christmas Tree Reefs:**

Human-made underwater structure built of sunken, anchored, and attached discarded formerly live Christmas trees to promote aquatic habitat in non-flowing freshwater bodies, including lakes, ponds, reservoirs and stormwater retention basins.

**Critical Bird Habitats:**

Critical bird habitats include all of the following:

- Any land within a conservation easement or existing municipal, county, state parkland.
- Any land within global or state Important Bird Areas, listed at https://www.audubon.org/important-bird-areas/state/minnesota.

- Any land within an intact natural community as shown on Minnesota Biological Survey maps (or identified through a NHIS Data Request response) https://www.dnr.state.mn.us/eco/mcbs/maps.html.

**Downed Tree Log:**

A length of trunk or large limb of felled tree to promote insect-feeding bird habitat and discourage unregulated mountain biking.

**Gravel/Sand Baths:**

A shallow depression filled with evenly graded sand or gravel, above the toe of the slope to aid birds and small mammals in parasite removal, and aid bird digestion by providing grit for their gizzard/crop.

**High Risk Surfaces:**

High Risk Surfaces are those surfaces within 50 feet or less of attractants such as trees, shrubs, prairie, grassland, or open water, or any other condition where multiple transparent or translucent surfaces on the exterior of the project are separated by 20 feet or more and which can be seen through simultaneously (e.g., a small atrium or glazed corners).

**Permanent Surface Water Body:**

Lake, pond, river, creek, or stormwater pond.

**Solitary/Mason Bees:**

Untreated wooden drilled blocks with holes diameter ranging from 2–10 mm x 80–100 mm deep, a waterproof roof, and mounted on a solid surface 48 inches (1,200 mm) above ground. Blocks replaced every 2 years.

**Stream-Bank Lunkers:**

Three-sided, open-framed wooden fish crib installed directly into stream banks, anchored with steel rods, stone slabs, and earth to create artificial cut bank for fish shelter/protection.

**Hibernaculum:**

Underground shelter occupied during winter by a cold-blooded dormant animal, typically three to five feet deep, and backfilled with approximately basketball-sized boulders and fine brush.

**Threat Factor (TF):**

Threat factor (TF), a property of a building material related to likelihood of bird collision, found in the TF Table (See Appendix S-5a). Consult the B3 Guidelines Administrators if you have questions on which TF should be used for a particular material. Table of threat factors available as defaults in the Bird-Safe Calculator.

**Traps:**

Traps are glazed conditions particularly likely to produce bird strikes. These are defined in the B3 Guidelines as any of the following: transparent exterior railings (e.g., a glass or plexiglass panel in an exterior railing system), transparent-sided walkways (e.g., skyways with both sides glazed, covered walks with glazing on both sides), or any other condition where multiple transparent or translucent surfaces on the exterior of the project are separated by 20 feet or less and which can be seen through simultaneously (e.g., a small atrium, or glazed corners).

**Tree Snag:**

A standing dead or dying tree often missing a top or most of the smaller branches, promoting insect-feeding bird habitat.

# Energy & Atmosphere Guidelines

## Intent

**Goal**

To promote the design and operation of energy-efficient buildings to reduce expenditures on imported fuel, reduce the impacts associated with greenhouse gas emissions, minimize negative impacts of refrigerant selection, and ensure readiness for next-generation energy infrastructure.

**Overview**

Projects meeting these guidelines reduce negative impacts of nonrenewable energy consumption through a combination of energy efficiency and onsite renewable energy generation. Projects meeting the SB 2030 Standard and two percent renewable-energy production requirement also help satisfy project energy demand through an increase in renewable energy generation. A minimum performance standard is implemented for installed equipment, including equipment associated with process loads that may fall outside the SB 2030 project scope. Ozone-depleting and environmentally-damaging refrigerants are avoided through the specification of lower-impact alternatives. Preparation for future rooftop or site-based renewable energy systems and electric transportation energy infrastructure allows projects to prepare for later integration by leveraging opportunities available to new construction and major renovation projects.

**Objectives**

- Design, construct, and operate projects designated New Buildings and Major Renovations to meet the energy targets of the SB 2030 program.
- Provide building performance data sufficient for benchmarking building performance.
- Ensure that actionable performance data is available during occupancy so that long-term operations meet or exceed as-designed operating parameters and the project's programmatic needs.
- Reduce plug loads and process energy through energy-efficient purchasing practices.
- Design New Buildings and Major Renovations to source at least two percent of energy use from onsite renewable energy sources.
- Encourage development of additional renewable energy generation capacity.
- Encourage implementation of resilient energy capacity.
- Encourage balanced consideration of ozone depletion potential (ODP), global warming potential (GWP), exposure, and toxicity assessments in selection of refrigerants.

**General Energy and Atmosphere Information:**

The following information is collected in the Energy and Atmosphere section of the B3 Guidelines Tracking Tool, under Section E.0:

**Final Design:**

- Energy and atmosphere strategies used, including narrative of measures taken to achieve objectives outlined above.

**Closeout:**

- Updated energy and atmosphere strategies used, including narrative of measures taken to achieve objectives outlined above.

## Availability of Campus-Scale Approaches

If needed to meet the SB 2030 Energy and Carbon Standard, renewable energy (RE) generation shall be evaluated per guidance listed in the SB 2030 Program Requirements.

As it is aligned with existing Minnesota legislation, the two-percent renewable energy requirement under E.2A is currently limited to the building site.

# Guideline E.1: Energy Efficiency

## Intent

To establish and meet the building energy and carbon performance standard in design and operation in order to significantly reduce carbon dioxide emissions and lower energy use.

## Required Performance Criteria

Guidelines E.1A and E.1B are required for New Construction and Major Renovation projects. Guidelines E.1C is required only for New Construction projects that include 20,000 gsf or more of conditioned space and Major Renovation projects that include 20,000 gsf or more of conditioned space and include construction, replacement, or alteration of relevant systems or assemblies.

A. Meet the MN SB 2030 Energy and Carbon Standard, information on which can be found at www.b3mn.org/2030energystandard. Project submissions, results, and compliance are tracked through the B3 Guidelines Tracking Tool.
B. Document aggregate totals by energy type for predicted and actual energy use.
C. Implement submetering and end-load disaggregation.

   Separately meter and separately report the following:

   1. HVAC system electrical energy use.
   2. Energy use for at least one of the following space conditioning loads: heating, cooling, or ventilation. Metered energy may include natural gas, steam, chilled water, or electricity.
   3. Interior lighting energy use.
   4. Exterior lighting energy use.
   5. Plug loads energy use.
   6. At least one nonregulated load.

   Nonregulated loads may include the following: cooking equipment, compressed air systems, specialized equipment in laboratories, hospitals, and manufacturing plants, or nonrefrigeration related process loads. If no such nonregulated loads exist, submeter and report one additional regulated load to fulfill item six above. Regulated loads may include: heating, cooling, ventilation, service water heating, motors, transformers, vertical transportation, refrigeration equipment, computer room cooling equipment and other systems, and other components and processes described in ASHRAE 90.1 sections 5 through 10.[15]

   Metering requirements for whole-building electrical use, whole HVAC system, interior and exterior lighting, and plug loads are aligned with ASHRAE 90.1 2013 and ASHRAE 90.1 2016, which are under consideration for the Minnesota State Energy Code in 2020. Going beyond ASHRAE 90.1, compliance with Guideline E.1 requires metering and reporting two additional energy loads—one specifically from the HVAC system(s) and a second regulated or nonregulated load. Meters installed must be capable of reporting data that enable building operators to track energy consumption over time (kWh, BTU, etc.).

[15] ASHRAE 90.1 2016

This guideline outlines a metering approach intended to permit projects to have actionable data on their energy consumption. The SB 2030 Program has related requirements intended to parallel this metering approach and permit the project to be tracked against its SB 2030 Standard in operation. The requirements under the SB 2030 program include the development of a metering plan and a consideration of how to meter any process loads that are outside of the SB 2030 project boundary. Consult the SB 2030 Metering Requirements listed on the SB 2030 project website for specifics, including the metering-plan format.

## Recommended Performance Criteria

D. Advanced submetering
   1. Install permanent meters capable of recording and transmitting data to a remote location at one-hour intervals (or less), sufficient to either:[16]
      i. Meter and report any individual end-use that represents more than 10% of the predicted annual total energy consumption.
      ii. Meter and report separate energy loads, which together account for at least 90% of predicted annual energy consumption by end-use.[17]

E. Display real-time energy metering information to building occupants.[18]

## Meeting the Guidelines

Please refer to the SB 2030 project website, at http://www.b3mn.org/2030energystandard, for more guidance on SB 2030 compliance, including submittal requirements.

During Schematic Design, determine which loads will be submetered and reported separately, and ensure that this list is regularly updated and communicated to the electrical system designers to enable compatibility between electrical distribution and metering layouts.

During the Schematic Design and Construction Document phases, the design team should determine the extent and scope of energy metering, which generally includes the building and any external associated loads (such as lighting). Main end-uses and their percentages of the total consumption should be identified through energy modeling. From this list of end-uses, the project team may also determine the compliance path (if they are pursuing Recommended Criteria D), and the uses to be metered. Appropriate meters for each item should be selected, and installation points identified. At this point, the metering strategy should be reviewed for completeness, usability, cost effectiveness, and contribution to the building's operational goals. The submetering plan should be documented in a written report or on plan drawings during the Design phase and as part of the as-built set. Operational guidance should be provided for the building operator, and any others who may access or analyze the metered results data. Ensure that this is coordinated with the metering plan requirements of the SB 2030 program and included in the final design submittal.

Metering and reporting building and individual loads makes real-time energy consumption information available for facility managers and operators. This data can be used in efforts to reduce energy use, reduce energy costs, improve

[16] This guideline is aligned with portions of USGBC, "Energy and Atmosphere Credit: Advanced Energy Monitoring," *LEED Building Design and Construction v.4* and BREEAM, ENE02a.
[17] End-use may include more detailed energy use categories than included under Part C or the metering of additional large building loads sufficient to capture 90% predicted energy consumption.
[18] This guideline is aligned with BREEAM, ENE02b: Energy Monitoring.

overall building operation, and improve equipment operation. The collection of data also allows for verifying utility bills, properly allocating energy costs and budgets, demand-response or load-shedding opportunities, measuring and verifying energy performance, benchmarking building and individual load energy use, identifying efficiency improvement opportunities, and developing annual energy reports.[19] All of these reports and efforts are in support of the goal to reduce greenhouse gas emissions generated by Minnesota's built environment.

The submetering plan should include the following:[19,20]

- Goals and objectives, such as verifying, benchmarking, optimizing performance, identifying failing equipment, monitoring occupant awareness and behavior change, or ongoing commissioning.
- Resources required, including appropriate staff time and training, equipment, and budget during design, construction, and operations phases.
- Security requirements for metered data.
- End-uses to be metered.
- Equipment that best supports metering objectives.
- SB 2030 metering requirements,[21] including:
    - Schematic metering diagram and narrative.
    - Metered/monitored value list.
    - Any calculations used to convert utility and/or submetered data into values that can be directly compared to the project's SB 2030 Energy and Carbon Standard.

If pursuing Recommended Guideline D, use whole-building energy modeling to determine which end-uses will be metered. The selection of metered uses and the appropriate compliance path will vary depending on the building's scale, program, equipment, and systems.

The intent of this recommended criteria is to ensure the building is operating as designed, and to identify potential additional energy savings. The selection of end-uses should support this goal and enable building operators to identify and correct anomalies. Some typical loads to meter include heating, cooling, hot water, lighting, ventilation and pumps, office equipment, in-building transportation, and controls and telecommunications. Special energy uses may also be useful to monitor, including items such as catering kitchens and restaurants, sports facilities, and covered and/or conditioned parking areas.

## Submittal Requirements

**Predesign:**

- E.1C: Preliminary metering plan containing elements listed in "Meeting the Guidelines" (this document will also be submitted at later phases as part of the SB 2030 submission).
- E.1D: Preliminary advanced submetering plan, including breakdown of anticipated loads to be metered based on whole-building energy simulation.
- E.1E: Designated system parameters for real-time display, and preliminary location of display.

**Design:**

[19] Derived from Metering Best Practices: A Guide to Achieving Utility Resource Efficiency, 3.0. PNNL, DOE. 2015.
[20] The Energy Program at Washington State University, a Short Guide to Submetering.
[21] Full SB 2030 metering requirements available under www.b3mn.org/2030EnergyStandard

- E.1C: Metering plan identifying each metered load, each meter type, and methods for sharing meter data.
- E.1D: Advanced submetering plan identifying compliance path chosen, loads included in metering, and methods for sharing meter data.
- E.1E: Plan indicating location of energy information display and updated display parameters.

**Final Design:**

- E.1C: Final metering plan identifying each metered load, meter type, methods for sharing meter data, and meter manufacturer cut sheets.
- E.1D: Final advanced submetering plan identifying compliance path chosen, loads included in metering, methods for sharing meter data, and meter manufacturer cut sheets.
- E.1E: Plan indicating location of energy information display and manufacturer cut sheets from informational and display system.

**Closeout**

- E.1C: Verification of installation and operation of metering equipment and reporting.
- E.1D: Verification of installation and operation of advanced submetering equipment and reporting.
- E.1E: Verification of installation and operation of energy information display.

## Additional Resources

US Department of Energy: Metering Best Practices: A Guide to Achieving Utility Resource Efficiency, Release 3.0 https://www.energy.gov/sites/prod/files/2015/04/f21/mbpg2015.pdf

General Services Administration: Submetering Business Case: How to Calculate Cost Effective Solutions in the Building Context https://www.gsa.gov/cdnstatic/Energy_Submetering_Finance_Paper_Knetwork_2012_11_269%28508%29.pdf

General Services Administration: Sustainable Facilities Tool – Submetering Wizard https://sftool.gov/plan/submetering

# Guideline E.2: Renewable Energy

## Intent

To facilitate the implementation of onsite renewable energy and promote the development of offsite renewable generation to satisfy project energy demand. Greater use of renewable energy reduces atmospheric pollution from fossil fuel-derived energy and can provide a stimulus to the state's economy through investments in local energy jobs and manufacturing. Greater use of renewable energy also reduces the state's expenditures on imported fuel and power.

The language of E1A guideline was aligned with previous Minnesota legislation, which required an economic analysis of onsite solar- and wind-derived renewable energy systems sufficient to offset two percent of predicted energy demand (MN Statute §16B.32, Subd 1a). In 2023 this statute was changed in order to align with the SB 2030 program and as part of revision 2 of version 3.2 of the B3 Guidelines program this was modified from a required guideline to a recommended guideline.

## Required Performance Criteria

E.2B is required for New Construction projects and for Major Renovation projects where the scope of the renovation aligns with the scope of the guideline requirements (e.g., if roof replacement is in the project scope). Guideline E.2A was previously required for New Construction projects but is now noted as a recommended guideline per change in statute. Note that renewable energy development may still be required to meet the SB 2030 Standard and that the modification of E2A from required to recommended does not indicate a waiver of potential renewable energy development under the rules of the SB 2030 program. Also note the order has been modified below to group required and recommended guidelines separately.

B. Ensure project design is renewable-energy ready:
   Solar-Ready Roof Requirements
   The building must be designed and built to facilitate future installation of solar systems on the building's rooftop. Solar-ready roof planning begins with consideration for location, orientation, height, and massing of the building on the site, with the goal of maximizing exposure for solar systems mounted on the roof. At a minimum, a solar-ready building shall include:
   1. Space on the roof that has unrestricted solar access to the south, is free of obstructions such as rooftop equipment, utility poles, plumbing vents, or other shading elements, and is structurally designed with attachment points, if necessary, to accommodate the weight, wind, and additional snow loads imposed by the system.
   2. Roof material with sufficient durability and lifespan to withstand later solar installation and maintenance activities. Ensure that the warranty of the selected roof system will not be voided by future installation of a typical solar system.
   3. An internal chase (or chases) with rated conduit and/or other means for connecting solar panels on the roof to the components and controls located within the building.
   4. Space within the building that is conveniently located, readily accessible, and reserved for the installation of controls and components such as electric inverters, meters, disconnects, and hot-water storage tanks.

5. Solar-Ready Roof Plan, documenting location and extent of area dedicated for panels, chase location(s), electrical interconnection availability, roof structural capacity, and pertinent roofing product or system information.

In some cases, these solar-ready roof requirements may be replaced with requirements for a renewable energy-ready site. Please contact B3 Guidelines Administrators at guidelines@b3mn.org to determine if project constraints permit this alternative. The following project constraints are permissible reasons to pursue the alternative renewable energy-ready site requirements:

1. Shading: If the project's roof area is substantially shaded and reasonable massing and siting options for the building cannot remediate this condition.
2. Prohibitions against solar panels: If the project is located in a historic district or other zone that prohibits the use of solar panels on the building rooftop.
3. If project funding included proceeds from bonds that restrict the use of the building's rooftop for third-party solar leases and the two-percent renewable requirement (part A) is met with onsite ground-mounted renewable energy.
4. Projects that include less than 20,000 gsf of conditioned space may opt to pursue a renewable energy-ready site as an alternative to a renewable-ready roof if site area is available.

Alternative Renewable Energy-Ready Site Requirements

The project's site must be designed and built to facilitate future installation of renewable energy systems. At a minimum, a renewable energy-ready site shall include:

1. A designated area on the site that stays clear of required setbacks and planned building expansions, and has unrestricted solar access to the south, and/or unrestricted access to the prevailing wind directions.
2. Buried conduit sized sufficiently to conduct power from the designated area to components and controls located within the building.
3. Space within the building conveniently located, readily accessible, and reserved for the installation of controls and components such as electric inverters, meters, disconnects, and hot-water storage tanks.
4. Renewable-ready site plan, documenting location and extent of area dedicated for renewable systems, the unrestricted solar or wind access window, buried conduit location, and electrical interconnection availability.
5. Verification that local zoning regulations permit the construction and use of renewable energy systems on the building grounds.

If both the building roof and nonbuilding site area are substantially shaded, not conducive to wind turbine placement, or prohibited from constructing renewable energy systems, please contact B3 Help at guidelines@b3mn.org to determine if these renewable energy-ready requirements (roof and/or site) can be considered out-of-scope.

## Recommended Performance Criteria

A. Provide at least two percent of the project's energy needs with onsite solar or wind renewable sources (note that the development of renewable energy may also be triggered by E.1A if needed to meet the SB 2030 Standard): Eligible wind and solar renewable sources may include:
   1. Photovoltaic (PV) solar panels
   2. Wind turbines

3. Transpired solar collectors for heating air
4. Solar thermal systems for heating water

Analyze at least two scenarios that include the environmental and economic impacts of supplying two percent of the project's anticipated total energy use with onsite renewable generation systems. This is coordinated with Minnesota Statute §16B.32, which states in part that this analysis "must include an explicit cost and price analysis of complying with the two-percent requirement compared with the present and future costs of energy supplied by a public utility from a location away from the building site and the present and future costs of controlling carbon emissions. If the analysis concludes that the building should not meet at least two percent of its energy needs from renewable sources located on the building site, the analysis must provide explicit reasons why not."[22] The feasibility of meeting this requirement for B3 Guidelines projects shall be determined using the B3 Levelized Cost of Energy (LCOE) Calculator to determine if the levelized cost of wind or solar is less than the combined price of grid and/or fossil fuel-supplied energy and carbon. The tool includes several default values for costs at the Predesign phase (including the accepted social cost of carbon) to streamline evaluation. These costs are refined at later phases. Installation of a system meeting two percent of the project's anticipated energy need is required if the evaluation determines that the LCOE from a proposed system is less than the combined price of grid and/or fossil fuel-supplied energy and carbon.

C. Achieve 2025 SB 2030 target with additional renewable energy:
Provide sufficient renewable energy to achieve the building's SB 2030 Energy and Carbon Standard for the year 2025. The renewable energy provided to meet this criteria may be supplied using any combination of the following approaches:
   1. Onsite or on-campus systems.
   2. Offsite directly owned "portfolio"-based systems.
   3. Offsite renewable energy purchases including, but not limited to:
      a. Community solar gardens
      b. Renewable energy investment funds
      c. Utility renewable energy programs
   4. Purchase of Renewable Energy Credits (RECs)

   Note that the SB 2030 program requires prioritization of renewable energy resources in the order listed above. Once the required SB 2030 target is met, compliance with this recommended guideline permits any of the above to be used. Note also that offsite purchases including RECS must meet minimum contract requirements set forth in the Meeting the Guidelines section below.

D. Achieve net-zero energy with additional renewable energy:
Provide adequate renewable energy to achieve net-zero energy use for the building's energy consumption using any of the resources outlined under E.2C.[23]

E. Achieve net-zero energy with additional onsite renewable energy:
Provide additional onsite renewable energy to achieve net-zero energy use for the building's energy consumption using only onsite or on-campus systems.[24]

[22] Minnesota Statute §16B.32, Subd. 1a. www.revisor.mn.gov/statutes/?id=16B.32
[23] Compliance with this guideline is similar to meeting National Renewable Energy Lab Net Zero Options 1-4.
[24] Compliance with this guideline is similar to meeting National Renewable Energy Lab Net Zero Options 1 or 2.

F. Provide resilient power infrastructure capacity by installing either: [25]

1. Grid disconnection capability and photovoltaic system with battery storage.
2. Grid disconnection capability and permanently installed efficient dual-fuel or cleaner-fuel generator and fuel storage.
3. Grid disconnection and electrical connection point to permit portable generator use.

These systems should be sized to provide emergency power for the project's identified critical loads for a period of three days. If the building is located within the 500-year flood plain, resilient power infrastructure and equipment above the flood elevation should be installed, if building height permits. Also note that if generators are deployed, dual-fuel or cleaner-fuel (such as natural gas) generators are recommended to reduce airborne pollution.



[25] These requirements are aligned with RELI, HA Requirement 2 and Enterprise Community Foundation, 2015 Green Communities Criteria 5.8a and 5.8b.

## Meeting the Guidelines

**Implementation in the Design Process:**

Project teams should be aware that there is a distinction between the allowable locations for renewable energy installed to meet the SB 2030 Energy Use Intensity (EUI) targets (discussed as part of the SB 2030 Energy and Carbon Standard), and the allowable installation locations to meet the requirements of Guideline E.2A discussed here. This is due to the different legislation that governs each set of requirements. To fulfill the SB 2030 Energy and Carbon Standard, onsite and on-campus renewable energy installations are considered equivalent. Either location is acceptable, and together they form the first tier in a hierarchy of installation locations that can be used to meet the SB 2030 Energy Standard. However, only renewable energy that is installed on the building site may be used to comply with Guideline E.2A. This guideline requires that two percent of the predicted total project energy consumption (including space heating, water heating, and natural gas consumption) must be met by renewable energy generated onsite.

Furthermore, Guideline E.2B requires that all new projects constructed under the B3 program are "renewable ready," in support of E.2A. Solar-ready roofs are prioritized, but a solar-ready site may achieve compliance as well under certain circumstances.

Therefore, project teams may find themselves in a scenario where installing or acquiring renewable energy from an on-campus renewable energy system is the most cost-effective way to meet the SB 2030 Energy and Carbon Standard for the building, but an installation on the building's solar-ready roof or site is still required by the legislation referenced in this guideline. In that case, the project team may decide to provide all of the renewable energy on the building site, or install just enough renewable energy onsite to meet the two-percent requirement, while providing the rest with a campus-based (or even portfolio-based) approach.

Meeting the two-percent renewable energy requirement mandated by this guideline is only necessary if it is found to be cost effective. The cost effectiveness must be determined using the B3 LCOE Calculator. Two options must be investigated using the LCOE calculator to achieve compliance with E.2A: a solar photovoltaic (PV) option, and either a solar hot water or small wind option. Each of these three technologies has its own tab in the LCOE tool. Note that ground source (geothermal) heat pumps, air source heat pumps, and passive solar energy may be desirable for the project, but do not qualify to meet the requirements of E.2A. Also, transpired solar thermal collectors may be evaluated as a second option, but are not supported by the LCOE calculator. If the design team wishes to pursue transpired solar collectors as a second option, please consult the B3 Guidelines Administrators at guidelines@b3mn.org to assist in calculating levelized cost.

During Predesign, the LCOE calculator requires a small number of inputs to perform the levelized cost of energy calculation. These inputs typically include the required yearly energy production (of at least two percent of predicted total project energy use as determined by the SB 2030 Energy Standard Tool (E.1A)) and the yearly average fuel/electricity costs at the site (including any demand charges, delivery charges, surcharges, and fees). All other necessary inputs are generally provided as either defaults or assumptions built into the calculation cells. Input cells with default values should not be adjusted unless there is documented justification. Calculation cells are locked so users cannot inadvertently adjust them.

If in the Predesign phase, the LCOE calculator shows that solar or wind may be cost effective, then project teams must advance to the Design phase calculator. At this phase, the LCOE calculator requires cost inputs from a contractor estimate. Note that for new projects, the additional structural costs for a solar-ready roof should not be included in the

cost estimate since solar-ready roofs are required regardless of whether renewable energy is immediately installed. Using the refined costs from the contractor estimate, upload outputs from the Design phase LCOE calculator to the B3 Guidelines Tracking Tool. If the calculator shows that renewable energy is cost effective at this phase, then a renewable energy system capable of providing at least two percent of the building's projected total energy consumption must be installed. Identification of the installed system will be verified at project closeout.

For renovation projects that are not renovating the roof, the solar-ready roof requirements are considered optional, as is the installation of a renewable energy system to meet the two-percent requirement. However, renovation projects that do require renovation or replacement of the roof will be required to make the roof solar-ready, to the extent made possible by the scope of work. For those projects, the addition of a renewable energy system is still optional but is recommended. A site is required to be made renewable-ready only when a solar-ready rooftop is not viable—determined in coordination with the B3 Guidelines Administrators as discussed above—and the renovation scope significantly impacts the site.

Because photovoltaic system pricing has achieved cost-parity with utility-generated electricity for many systems and throughout most of the state, and because solar-ready roofs are required for most B3 projects, project teams should budget for these expenses for all new construction projects.

**Resilient Power Infrastructure**

If pursuing recommended guideline E.2F, the project team should consider how the facility could function during a disaster event that disrupts grid electrical supply, above and beyond any code-mandated emergency power systems. When selecting the critical loads that will be supplied during a disaster event, first determine the intent of the facility's operation and assess which installed systems will be crucial in supporting the operation during a disruption. These may include: heating, cooling, ventilation, in-building transportation, lighting and/or emergency lighting, communications, appliances or equipment, and miscellaneous plug loads for things like charging cell phones. When evaluating disaster scenarios, it is important to consider the needs of vulnerable populations, such as those who may not have the capacity to evacuate or who are dependent on building systems such as refrigeration for medication. The energy demands of the selected loads should be determined by energy modeling, and the resilient power infrastructure should be sized to accommodate these loads for a period of at least three days.

**Requirements for Offsite Renewable Energy Purchases:**

Offsite renewable energy is not permitted to be used to meet the requirements of E.2A. However, a variety of options including the purchase of RECs are available to meet the E.2 Recommended Guidelines E.2C and E.2D. In order for the offsite renewable energy procurement methods to offset the annual energy consumption of the building, they need to meet the following minimum requirements:[26]

1. The building owner shall contract to procure qualifying offsite renewable energy with a term of not less than 10 years.

2. RECs and other environmental attributes associated with the procured offsite renewable energy shall be assigned to the building project for the duration of the contract. (Note that this may prohibit renewable energy purchases from most types of community solar gardens as these often separate RECs from produced energy).

3. The renewable energy generating source shall be photovoltaic systems, solar thermal power plants, geothermal power plants, and/or wind turbines.

[26] These requirements are generally aligned with the Architecture 2030 Zero Code for Off-Site Procurement of Renewable Energy

4. The offsite renewable energy producer shall maintain transparent accounting that clearly assigns production to the building. Records on power sent to or purchased by the building shall be retained by the building owner.

**Related Legislation:**

There may be implications resulting from Minnesota Statute §16B.323, which states in part that, "a project for the construction or major renovation of a state building, after the completion of a cost-benefit analysis, may include installation of solar energy systems of up to 300 kilowatts capacity on, adjacent to, or in proximity to the state building." Additionally, "The capacity of a solar energy system must be less than 300 kilowatts to the extent necessary to match the electrical load of the building," and "The cost of the solar energy system must not exceed five percent of the appropriations from the bond proceeds fund for the construction or renovation of the state building."

Minnesota Statute §16B.326 also states that "when practicable, geothermal and solar thermal heating and cooling systems must be considered when designing, planning, or letting bids for necessary replacement or initial installation of cooling or heating systems in new or existing buildings that are constructed or maintained with state funds. The Predesign review must include a written plan for compliance with this section from a project proposer. For the purposes of this section, "solar thermal" means a flat plate or evacuated tube with a fixed orientation that collects the sun's radiant energy and transfers it to a storage medium for distribution as energy for heating and cooling."

This section does not provide a comprehensive list of potentially relevant legislation or the full text of those statues cited. Please reference the Revisor of Statues of the State of Minnesota for full legislation text.

## Submittal Requirements

**Predesign:**

- E.2A: Predesign plan for projects using state Predesign process; Predesign LCOE calculator documenting two systems evaluated (including at least one PV) for meeting two percent of annual energy demand.
- E.2B: Site plan delineating areas with the most feasible solar (or wind) access, accounting for planned site and building development.

**Design:**

- E.2A: Design phase LCOE calculator documenting two systems evaluated for supplying at least two percent of annual energy demand, including contractor estimates of performance, yearly energy production, and cost.
- E.2B: Documentation of renewable-ready design features included in the project design.
- E.2C: Documentation of project's predicted 2025 SB 2030 EUI target and yearly total energy consumption.
- E.2D: Documentation of project's predicted yearly total energy consumption, showing guideline met.
- E.2E: Documentation of project's predicted yearly total energy consumption, showing guideline met.
- E.2F: List of identified critical electric loads to be served and their associated power demand (kW), and 3-day energy consumption estimate (kWh).

**Final Design:**

- E.2A: Updated Design phase LCOE calculator documenting two systems evaluated for supplying at least two percent of annual energy demand, including updated contractor estimates of performance, yearly energy production, and cost, and selection of the final system for installation.
- E.2B: Documentation of renewable-ready design features included in the project including the Solar-Ready Roof Plan or Renewable-Ready Site Plan.

- E.2C: Documentation of onsite renewable energy system and energy production estimate or offsite renewable energy purchase to achieve the 2025 SB 2030 EUI target.
- E.2D: Documentation of onsite renewable energy system and energy production estimate or offsite renewable energy purchase to achieve net-zero energy.
- E.2E: Documentation of onsite renewable energy system and energy production estimate to achieve net-zero energy.
- E.2F: Documentation of resilient power system to be installed, including any dual- or cleaner-fuel generators and fuel storage, and grid disconnect. Updated list of critical electric loads to be served and their associated power demand (kW) and three-day energy consumption estimate (kWh).

**Closeout:**

- E.2A: Verification of installed renewable energy system and final yearly energy production estimate.
- E.2B: Verification of installed renewable-ready design features included in project.
- E.2C: Verification of installed renewable energy system and final yearly energy production estimate, or contract for purchase of offsite renewable energy adequate to achieve 2025 SB 2030 EUI target. Contract must specify minimum quantity and type of renewable energy, term of contract (years), location of renewable energy source, and must clearly assign associated RECs to the B3 project.
- E.2D: Verification of installed renewable energy system and final yearly energy production estimate, or contract for purchase of offsite renewable energy adequate to achieve net-zero energy. Contract must specify minimum quantity and type of renewable energy, term of contract (years), location of renewable energy source, and clearly assign associated RECs to the B3 project.
- E.2E: Verification of installed renewable energy system and final yearly energy production estimate adequate to achieve net-zero energy.
- E.2F: Verification of installed resilient power systems, including any dual- or cleaner- fuel generators and fuel storage, and grid disconnect.

## Additional Resources

Minnesota Renewable Legislation: MN Statute §16B.32, Subd 1a: www.revisor.mn.gov/statutes/?id=16B.32

Minnesota Legislation: Solar Energy in State Buildings: §16B.323 Solar Energy In State Buildings: www.revisor.mn.gov/statutes/?id=16B.323

Minnesota Legislation: Geothermal Energy in State Buildings: §16B.326 Heating And Cooling Systems; State-Funded Buildings: www.revisor.mn.gov/statutes/?id=16B.326

The Database of State Incentives for Renewable Energy (DSIRE): http://www.dsireusa.org/

RETScreen Software: www.retscreen.net

The Minnesota Department of Commerce Guidance Documents and Model Solar-Ready Specifications: http://mn.gov/commerce-stat/pdfs/solar-ready-building.pdf and http://mn.gov/commerce-stat/pdfs/solar-ready-construction.pdf

US Green Building Council (USGBC) Rules of Thumb for Solar Readiness: https://www.usgbc.org/articles/making-all-buildings-solarready-7-rules-thumb

National Renewable Energy Laboratory Solar-Ready Technical Considerations: https://www.nrel.gov/state-local-tribal/blog/posts/solar-ready-building-design-a-summary-of-technical-considerations.html

Energy Trust of Oregon Solar-Ready Commercial Design and Construction Requirements: https://insider.energytrust.org/wp-content/uploads/nb_solarready_comm_design_construction_req.pdf

National Renewable Energy Laboratory—Valuing the Resilience Provided for Solar and Battery Energy Storage Systems: https://www.nrel.gov/docs/fy18osti/70679.pdf

# Guideline E.3: Efficient Equipment and Appliances

## Intent

To reduce energy use associated with equipment and process loads in buildings.

## Required Performance Criteria

Guidelines E.3A applies to New Construction projects and Major Renovation projects that include the procurement of equipment and appliances that have Energy Star Certified Product Categories. Guidelines E.3B is required only for New Construction projects that include 20,000 gsf or more of conditioned space, and for Major Renovation projects that include 20,000 gsf or more of conditioned space and include construction, replacement, or alteration of relevant systems or assemblies.

A. All equipment and appliances provided as part of the project that have Energy Star Certified Product Categories shall meet Energy Star criteria.
B. Equipment relating to process loads which are excluded from the SB 2030 project shall either:
    1. Meet or exceed the Federal Energy Management Program (FEMP)-designated energy efficiency level.
    2. Document that efficient equipment options have been selected such that no more-efficient alternatives with a 15-year or less simple payback were available.

## Recommended Performance Criteria

C. Select new appliances and equipment that are within the top quartile of efficiency in the corresponding Energy Star Certified Product Category.
D. In-building transport: When elevators, escalators, or moving walkways are specified:[27]
    1. Perform analysis of the transportation demand and usage pattern to determine the optimum size, number, and placement of elevators, escalators, and moving walkways.
    2. Estimate the annual energy use for in-building transportation for at least two options for each transport type under consideration. Document that efficient equipment has been selected such that no more-efficient options with a 15-year or less simple payback exist.
    3. Specify in-building transportation with energy saving measures, including:
        i. Elevators
            (1) Operate in standby mode during off-peak times.
            (2) Use a drive controller capable of variable speed, variable frequency control, and variable frequency control of the drive.
            (3) Use of machine room-less traction systems with regenerative drives.
        ii. Escalators and Moving Walks
            (1) Use a load-sensing device that synchronizes motor output to passenger demand.
            (2) Uses a passenger-sensing device for automated operation and standby mode.

[27] This guideline is aligned with BREEAM Ene 06

## Meeting the Guidelines

**Implementation in the Design Process:**

List anticipated equipment types in the project planning and early design phases that are covered under Energy Star Certified Product Categories. Some large process loads may be eligible to exclude from the SB 2030 project scope. If any such loads exist, contact the SB 2030 Review Team at SB2030@b3mn.org.The team will review all requests to exclude specific process load(s) from consideration under SB 2030. Note that any energy consumption excluded from the SB 2030 project scope must be separately metered to permit adequate energy tracking under SB2030 requirements. Ensure that Energy Star and process load systems meeting E.3B are budgeted as part of the project.

If project teams pursue the 15-year payback path to document non-SB 2030 efficiency measures, each piece of equipment or system should list the following for all alternatives examined:

- Equipment type
- Equipment cost
- Runtime estimates
- Expected annual energy use
- Expected annual energy cost
- O&M costs (if costs vary between options)
- Any other information required to calculate the simple payback

During the construction documents phase, provide drawings, cut sheets, and specifications highlighting compliance of equipment and appliances with Energy Star requirements. Document efficiency ratings of motors and drives, water service equipment, and other electrical load components. During construction administration, review shop drawings to assure compliance with energy-efficient equipment specifications.

Ensure that all alternatives permitted as part of the project meet the requirements for the relevant guideline and monitor final equipment selection and purchasing to ensure compliance is achieved.

## Submittal Requirements

**Predesign:**

- E.3A: Identify and list Energy Star appliance types expected to be used in the project.

**Design:**

- E.3A: Update Energy Star appliance types expected to be used in the project.
- E.3B: List any identified process load requested to be excluded from the SB 2030 project scope and identified method of compliance (FEMP or payback period).
- E.3D: Document system type(s), number(s), and location(s) of optimized in-building transport systems and identify system options with anticipated energy use.

**Final Design:**

- E.3A: Upload specifications mandating selection of Energy Star appliances or equipment for available appliance types. Submit list of identified appliance types covered under the Energy Star program.

- E.3B: Identification of process loads requested and approved by SB 2030 Review Team to be removed from SB 2030 project scope. List related equipment and method of compliance, including calculations of payback periods for alternatives.
- E.3C: List identified appliance types and document selection of top-quartile options.
- E.3D: Submit specifications section and equipment schedule for in-building transport systems and identify which of the measures outlined in the guideline were implemented.

**Closeout:**

- E.3A: Verification of selection of Energy Star appliances for available appliance or equipment types.
- E.3B: Identification of final equipment selected for non-SB 2030 process loads and final method of compliance.

## Additional Resources

Federal Energy Management Program: https://www.energy.gov/eere/femp/federal-energy-management-program

SB 2030 Program: https://www.b3mn.org/2030energystandard/

BS EN ISO 25745 – Energy Performance of Lifts, Escalators, and Moving Walks: https://www.iso.org/standard/60951.html

DOE ENERGY STAR Program: www.energystar.gov

# Guideline E.4: Atmospheric Protection

## Intent

To select refrigerants that reduce environmental impacts, including harm to the environment, risk to human health, and ozone depletion potential.

## Required Performance Criteria

Guidelines are required for New Construction and Major Renovation projects for all new equipment procured for a project and are recommended for the retrofit of existing equipment.

A. When selecting equipment, choose refrigerants used in new and repaired equipment not designated "unacceptable" for current application under the Environmental Protection Agency (EPA) Significant New Alternatives Program (SNAP) in order to limit ozone depletion, human health, and Global Warming Potential (GWP) impacts.
B. Design, maintain, and operate mechanical equipment to reduce refrigerant leakage over the life of the building following updated Clean Air Act Section 608 requirements and guidelines. This is achieved by adhering to the following:
    1. Equipment containing 2,000 lbs. or more of refrigerant with a GWP of 150 or greater must include an automatic leak detection (ALD) device.
    2. Facilities shall conduct quarterly leak inspections or use ALD devices for equipment containing more than 50 lbs. of refrigerant.
    3. For equipment containing more than 50 lbs. of refrigerant, leaks must be repaired, subject to a plan for repair, or retired within 30 days of leak detection or refrigerant recharge for thresholds listed in Section 608.
    4. For equipment containing between five and 50 lbs. of refrigerant, refrigerant recovery recordkeeping requirements must be met per Section 608. For equipment of this size with annual leakage rates of 10% or greater, equipment operators must implement leak reduction measures sufficient to identify and minimize future leaks. Repaired systems must be monitored at least quarterly to ensure leak reduction is maintained.

## Recommended Performance Criteria

C. At the time of equipment selection, refrigerants used in new and repaired equipment may not be listed as "unacceptable," for *any* future implementation date, under the EPA SNAP in order to limit ozone depletion, human health, and GWP impacts.
D. GreenChill Certification: Document reduced impact of refrigeration used in food retailing by achieving a platinum, gold, or silver level in the EPA's GreenChill Partnership program.

## Meeting the Guidelines

Early in the design process, communicate the requirements of this guideline to the project team members, consultants, and contractors that will select equipment with refrigerants.

If the project is relocating an existing facility and will move existing equipment, document what equipment will be repaired and retained as part of the project. Evaluate if low-impact refrigerants such as ammonia or carbon dioxide are compatible with the needed equipment. Ensure that refrigerants used in this process are listed as acceptable under the

SNAP program. Use compliant alternatives as needed. For transitioning existing equipment to SNAP-compliant refrigerants, ensure that any existing refrigerant is recovered and appropriately disposed of according to EPA reporting and disposal requirements.

As the design progresses, ensure that the list of refrigerant-containing equipment is up-to-date. During project closeout, ensure that any alternatives permitted are also compliant with this section's requirements. If any refrigerant selected is slated for a future SNAP phase-out, evaluate possible alternative refrigerants.

At project's substantial completion, ensure that equipment operators are familiar with installed leak detection equipment and that any required monitoring schedules are in place. Ensure that facility operators are aware of all Section 608 requirements, including ongoing operations and maintenance requirements.

## Submittal Requirements

**Design:**

- E.4A: List the equipment types with refrigerant that are part of this project.

**Final Design:**

- E.4A: Submit equipment list and selected refrigerants specified for the project, including confirmation that all are SNAP approved for use at the time of installation.
- E.4B: List all refrigerant leak detection methods specified for the project for equipment with 50 lbs. or more refrigerant. Document process for ensuring EPA recordkeeping standards are met during operation, including remediation measure for smaller equipment.
- E.4C: List all SNAP-approved refrigerants used in the project showing no phase-out date listed.

**Closeout:**

- E.4A: Submit equipment list and selected refrigerants installed in the project, including confirmation that all are SNAP approved for use at the time of installation.
- E.4B: List all refrigerant leak detection methods or processes for equipment with 50 lbs. of refrigerant or greater. Document process for ensuring EPA record keeping standards are met during operation, including remediation measure for smaller equipment.
- E.4D: Provide certification of platinum, gold, or silver certification from the GreenChill program.

## Additional Resources

EPA Significant New Alternatives Policy, Reducing Hydrofluorocarbon Use and Emissions in the Federal Sector: https://www.epa.gov/snap/reducing-hydrofluorocarbon-hfc-use-and-emissions-federal-sector

Section 608 Stationary Refrigerant Leak Repair Requirements: https://www.epa.gov/section608/revised-section-608-refrigerant-management-regulations

California Air Resource Board High-GWP definition: https://ww2.arb.ca.gov/resources/documents/high-gwp-refrigerants

## Glossary

**High Global Warming Potential (High-GWP) Refrigerant**

A high-GWP refrigerant is a refrigerant that has a global warming potential of 150 or greater.

**Natural Refrigerant**

A natural refrigerant is a naturally occurring substance that can act as a refrigerant, such as ammonia or carbon dioxide. Chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) are not considered natural refrigerants. Note that some natural refrigerants may be toxic or flammable.

# Guideline E.5: EV-Ready

## Intent

To enable and encourage a transition to lower-carbon transportation infrastructure.

## Required Performance Criteria

Guidelines are required for New Construction and Major Renovation projects.

A. For New Construction and Major Renovation projects that include new or renovated parking areas, provide Electric Vehicle Supply Equipment (EVSE) infrastructure to permit future electric vehicle charge stations based on the number of long-term parking spaces. Long-term parking is defined here as parking spaces where typical users are expected to stay more than four hours; short-term parking is defined as parking spaces where typical users are expected to stay for fewer than four hours.
   - If the project includes five or fewer total long-term parking spaces, EVSE infrastructure must be provided for at least one space.
   - If the project includes between five and 50 long-term parking spaces, EVSE infrastructure must be provided for at least 20% of long-term parking spaces.
   - If the project includes more than 50 long-term parking spaces, EVSE infrastructure must be provided for 10 spaces plus additional spaces equal to 10% of the number of long-term spaces above of 50.

   EVSE infrastructure shall be sufficient to support "Level 2" or higher charging technology. EVSE infrastructure shall consist of:

   - Dedicated space for future electrical distribution equipment to support EVSE.
   - Raceway or equivalent distribution capacity of at least 1 inch diameter, connecting each future EVSE parking space to dedicated electrical distribution location.

   Accessible parking spaces shall be given consideration when determining access to charging equipment. Projects designated Major Renovations that do not disturb parking surfaces, modify electric distribution to parking areas, or modify electrical equipment in walls or other assemblies adjacent to parking areas may be exempted from this requirement. One DC-fast charging EVSE (including full installation of the equipment) can be used in place of five Level 2 EVSE-ready spaces. If used to replace Level 2 EVSE spaces, this DC-fast charging option shall be installed in short-term parking areas, if such areas are included in the project.

## Recommended Performance Criteria

B. For New Construction and Major Renovation projects, provide EVSE infrastructure for future electric vehicle charging for all of parking areas included in the project. EVSE infrastructure shall consist of the elements outlined under E.5A.

C. Install EVSE for at least 10% of all spaces. EVSE must be at least Level 2 to meet this guideline.

D. Install sufficient renewable energy capacity to supply EVSE by installing or enlarging an onsite or on-campus system or by installing additional solar canopy in parking areas. Note that meeting this recommended guideline requires renewable energy capacity in addition to the renewable energy requirements of other guidelines.

## Meeting the Guidelines

During the Predesign phase, determine the project's parking needs and the number of spaces devoted to long-term parking. Calculate the required number of spaces by using the following formulas:

If the number of long-term spaces is less than or equal to 50:

$$Spaces\ required = (number\ of\ long\ term\ spaces) * (0.2), \text{ rounding up}$$

If the number of long-term spaces is greater than 50:

$$Spaces\ required = 10 + ((number\ of\ long\ term\ spaces) - 50) * (0.1), \text{ rounding up}$$

If the parking requirements change as the project progresses, update these calculations as needed. The number of spaces contributing to meeting this requirement are provided by the following:

$$Spaces\ contributing\ to\ meeting\ this\ requirement =$$

$$(Number\ of\ ESVE\ Ready\ Spaces) + 5 * (Number\ of\ installed\ DC\ Fast\ Charging\ Points)$$

Note that the *Number of ESVE Ready Spaces* in the above formula excludes those spaces contributing to the *Number of installed DC Fast Charging Points*.

Ensure that team members responsible for planning parking areas are aware of this requirement and that access to future EVSE is provided for accessible parking. Ensure that electrical distribution capacity or utility interchange locations have been identified and sized appropriately for the anticipated load.

Document location of future EVSE and EVSE infrastructure in site and electrical design documents, including identifying future panel locations in mechanical spaces. Label this future panel location and reserve for future installation. Label raceway terminals in mechanical spaces to facilitate future installation. Provide electrical and site plan diagrams listing parking areas, noting long-term parking and highlighting locations of EVSE infrastructure.

Larger diameter raceways may be used to provide equivalent electrical distribution capacity to multiple spaces according to electrical code capacity calculations.

## Submittal Requirements

**Design:**

- E.5A: Site plan identifying preliminary location of EVSE-ready spaces and calculation of number of required spaces.

**Final Design:**

- E.5A: Site plan identifying final location of EVSE-ready spaces, calculation of number of required spaces and electrical drawings identifying raceway layout and future panel or other electrical distribution location.
- E.5B: Site plan demonstrating all spaces are EVSE-ready (the same documentation may be uploaded under E.5A).
- E.5C: Documentation of purchase of charging infrastructure sufficient to supply 10% of spaces identified under E.5A.
- E.5D: Site plan and electrical diagram documenting renewable energy supply to EVSE location and documentation of anticipated EVSE load and estimate of renewable energy generation.

# Glossary

**Level-2 Parking**

Level-2 parking is EVSE supplied through 240V service, typically in the range of 16 to 30 amps.

**Long-Term Parking**

For the purposes of this guideline, long-term parking is used to define parking spaces which the typical user will stay in excess of four hours. If the parking area serves several user types, those with the lengthiest stay shall be considered.

# Indoor Environmental Quality Guidelines

## Intent

To provide high quality indoor environmental conditions to promote occupant health, well-being, and productivity. This is achieved through both the reduction of the conditions that contribute to negative outcomes, and support for the conditions associated with increased health, comfort, and productivity.

**General Indoor Environmental Quality information:**

The following information is collected in the Indoor Environmental Quality Section of the B3 Guidelines Tracking Tool, under Section P.0:

**Final Design:**

- Indoor environmental quality strategies used, including narrative.

**Closeout:**

- Updated Indoor environmental quality strategies used, including narrative.

# Guideline I.1: Low Emitting Materials

## Intent

To minimize occupant exposure to volatile organic compounds.

## Required Performance Criteria

Guidelines I.1A and I.1B are required for New Construction and for Major Renovation projects. Guidelines I.1C and I.1D are required only for New Construction projects that include 20,000 gsf or more of conditioned space and for Major Renovation projects that include 20,000 gsf or more of conditioned space and include construction, replacement, or alteration of relevant systems or assemblies.

A. All newly installed interior materials must comply with California Department of Public Health (CDPH) Standard Method v1.1–2010 or v1.2–2017. Interior materials are defined as all materials and finishes interior to the enclosure's least vapor-permeable and continually air-sealed barrier system. This includes but is not limited to flooring adhesives, sealants, carpets, resilient flooring, paints, acoustical insulation products, gypsum board, acoustical ceilings, acoustic wall panels, casework, composite wood subflooring, and furnishings.[28] Projects that include less than 20,000 gsf of conditioned space are required only to document that the five most prevalent interior materials by surface area (that are not subject to a listed exception) meet this requirement.
   1. Exceptions:
      i. Inherently non-emitting sources: Products that are inherently non-emitting sources of volatile organic compounds (VOCs) (stone, ceramic, powder-coated metals, plated or anodized metal, glass, concrete, clay brick, and unfinished or untreated solid wood flooring) are considered fully compliant without any VOC emissions testing if they do not include integral organic-based surface coatings, binders, or sealants.
      ii. Salvaged and reused architectural millwork more than one year old at the time of occupancy is considered compliant, provided it meets the requirements for any site-applied paints, coatings, adhesives, and sealants. Newly installed finishes and components are not exempt from I.1A or I.1B.
      iii. Product types with two or fewer compliant manufacturers available from the combination of all databases listed below at the point of product selection are exempt from this requirement.[29]
      iv. Structural building products as excluded from CDPH Standard Method v1.1 under part 1.1.4.
      v. Composite wood products covered under Guideline I.1C.
      vi. Furnishings covered under Guideline I.1D. Onsite applied furniture coatings are not exempt from the requirements of I.1A.
   2. Approved databases of materials recognized as compliant with the most current CDHP standard:
      ~~i. Collaborative for High Performance Schools (CHPS) Low Emitting Materials (which includes several of the other third-party certifications below).~~
      ~~ii.~~i. Carpet and Rug Institute (CRI) Green Label Plus™ Certification (for carpet, cushion, and adhesive products).
      ~~iii.~~ii. Scientific Certification Systems (SCS) Indoor Advantage Gold™ Certification.
      ~~iv.~~iii. Resilient Flooring Institute (RFI) FloorScore™ Certification.

[28] This guideline is aligned with the USGBC, "Indoor Environmental Quality Credit: Low-Emitting Materials," *LEED Building Design and Construction v.4*, though with a different definition of interior materials and a different threshold for compliance.
[29] Allowable exclusions differ from LEED v.4.

~~v.~~iv. Underwriters Laboratory (UL) GREENGUARD Gold™.
~~vi.~~v. Intertek ETL Environmental™ VOC+.
~~vii.~~vi. Materials Analytical Services, LLC (MAS) Certified Green™ (for Building Materials).
~~viii.~~vii. NSF/ANSI 332 (for Resilient Floor Coverings).
~~ix.~~viii. Berkeley Analytical Associates ClearChem (for Interior Building Products).
~~x.~~ix. Coatings Research Group, Incorporated (CRGI) Green Wise Gold (for Paints).

B. Wet-applied materials: All onsite wet-applied materials must meet the applicable requirements below. Interior onsite wet-applied materials also must meet the general requirements for VOC emissions under I2A.
   1. All paints and coatings wet-applied onsite must meet the applicable VOC limits of the California Air Resources Board (CARB) 2007, Suggested Control Measure (SCM) for Architectural Coatings, or the South Coast Air Quality Management District (SCAQMD) Rule 1113, effective June 3, 2011.
   2. All adhesives and sealants wet-applied onsite must meet the applicable chemical content requirements of SCAQMD Rule 1168, July 1, 2005, Adhesive and Sealant Applications, as analyzed by the methods specified in Rule 1168.
   3. Paints, coatings, adhesives and sealants wet-applied onsite may not include any intentionally added methylene chloride or perchloroethylene.

C. Composite Wood Products: Newly installed composite wood must meet the California Air Resources Board ATCM for formaldehyde requirements for ultra-low-emitting formaldehyde (ULEF) resins or no added formaldehyde resins.

D. New furniture and furnishing items not tested under I.2A must be tested in accordance with ANSI/BIFMA Standard Method M7.1–2014. Comply with ANSI/BIFMA e3-2014 Furniture Sustainability Standard, Section 7.6.1 or 7.6.2.
   1. Furniture listed in the following databases or providing the following certifications are considered compliant with this guideline:[30]
      i. Scientific Certification Systems (SCS) Indoor Advantage (furniture)
      ii. Scientific Certification Systems (SCS) Indoor Advantage Gold (furniture)
      iii. Underwriter Laboratories (UL) Greenguard Certified
      iv. Underwriter Laboratories (UL) Greenguard Gold Certified
      v. Intertek ETL Environmental VOC (furniture)
      vi. Intertek ETL Environmental VOC+ (furniture)
      vii. Materials Analytical Services, LLC (MAS) Certified Green

## Recommended Performance Criteria

E. After construction and before occupancy, conduct air-testing to ensure that the contaminant levels listed in the USGBC document “Maximum Concentration Levels, by Contaminant and Testing Method” are not exceeded using the test methods listed in that document. If excessive levels of contaminants are found in the building, develop a mitigation plan to reduce these and retest until acceptable thresholds are reached. Conduct testing in spaces representing typical airflow conditions and interior finishes.

## Meeting the Guidelines

During Predesign and early design, identify all applicable product types to be used in the project. All interior materials on interior assemblies must be included (though some materials in these may be subject to the listed exclusions). For

[30] Allowed furnishings differ from LEED v.4.

exterior assemblies this is done by determining which continuously sealed material or set of materials is least vapor-permeable and including all materials interior of that boundary. Note that there may be materials (such as metal cladding) that are the least vapor-permeable layer but which are not continually sealed, and should not be considered as the boundary of interior materials.

The recommended method for tracking this guideline is for an assigned team member or members to keep a running list of products and their VOC content compliance information, complete with manufacturer's documentation. If a product category has been identified but a complaint product has not yet been selected, products may be found in the list of approved databases in the guideline requirements. Communication with manufacturers and product representatives may aid in the discovery of compliant products.

Through the design process, compile required documentation and maintain and update the list of materials. Review project documents to identify all applicable products and specify them as low- or non-emitting. Track and report all interior materials in the B3 Guidelines Tracking Tool, even those that are excluded from VOC content requirements.

For bid and construction documents preparation, verify continued selection of compliant interior materials and products to reflect guideline requirements. Provide contractor with detailed specifications to ensure that the team has the information needed to meet the B3 Guideline requirements. The design team should specifically call out compliant products and only specify allowable substitutions that also meet the guideline requirements.

Input compliant products into the B3 Tracking Tool by uploading a list of all interior materials used in the product and their method of achieving compliance or qualifying for an exemption. Note that compliance with I.2B may be documented through a Certificate of CARB Compliance from the Hardwood Plywood and Veneer Association or the Composite Panel Association. The absence of added methylene chloride and perchloroethylene may be determined from the MSDS for a material.

Coordinate reviews of the construction submittals to ensure that selected products meet the guideline requirements and do not exceed the allocated VOC emissions limits. All review submittals, substitution requests and changes to the construction contract should be carefully reviewed by the design team and contractor for compliance with guideline requirements.

Because meeting these guideline requirements is not typical for all construction teams and suppliers, conducting a B3 Guideline-specific preconstruction meeting to review the requirements in detail and stress their importance will aid in successful product procurement.

**A Note for Suppliers, Contractors, and Subcontractors:**

During construction, interior paints and coatings applied onsite represent the largest source of VOC emissions. Awareness of VOC levels in paints and coatings is a key step in ensuring the building project is sustainable, and selecting an approved paint, primer or stain is as easy as finding a compliant certification mark as listed in the guideline text. Similarly, awareness of interior adhesives and sealants applied onsite (including flooring adhesives) is also a key factor in compliance.

Carpet installation requires that the carpet, carpet cushion, and carpet adhesive all be compliant with this guideline. Installation of other floorings such as tile, masonry, cut stone, concrete, and wood require that any the flooring product and any finishes or sealers meet the same requirements as paints.

During closeout, monitor submittals and construction site to ensure that materials, products, and systems are being correctly installed to preserve project goals and objectives. Review substitutions based on performance criteria to ensure consistency and compliance with goals as represented in the drawings and specifications.

Document changes to requirements for construction that occur that may impact the provision or installation of materials, products, or components that were intended to ensure indoor air quality standards are achieved.

It is also recommended to use low- or noVOC emitting materials for products including cleaning supplies, pest management applications, minor remodeling, and maintenance associated with "churn" or standard product replacement of furnishings and finishes and to see the full benefit of lowered VOC emissions.

Retain final product compliance documentation as part of the B3 records.

## Submittal Requirements

**Design:**

- I.1A: List the material categories needed to meet the guideline.

**Final Design:**

- I.1A: List all interior materials specified to meet the guideline in the required material categories, including method of compliance and compliant specifications. Small Building projects only need to submit the 5 most prevalent.
- I.1B: List all wet-applied products specified in the project, including method of compliance and relevant specifications.
- I.1C: List all composite wood products specified including method of compliance, compliant specifications, and product documentation.
- I.1D: List all furniture specified including method of compliance, compliant specifications, and product documentation.

**Closeout:**

- I.1A: List all interior materials installed in the required material categories, including method of compliance.
- I.1B: List all wet-applied products installed in the project including method of compliance.
- I.1C: List all composite wood products installed in the project including method of compliance.
- I.1D: List all furniture installed including method of compliance.
- I.1E: List testing protocols used in the project and results of testing, including levels of listed contaminants and locations tested.

**Occupancy – Submitted annually for ten years:**

- I.1E: Submit any testing results, whether remediation was necessary and performed remediation methods (if any).

## Additional Resources

California Department of Public Health (CDPH), "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers," Version 1.1, February 2010:

http://www.cdph.ca.gov/programs/IAQ/Documents/cdph-iaq_standardmethod_v1_1_2010%20new1110.pdf, Version 1.2, January 2017: https://berkeleyanalytical.com/sites/default/files/CDPH-IAQ_StandardMethod_V1_2_2017.pdf

AQMD Rule 1113: http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/r1113.pdf?sfvrsn=17

OEHHA Acute, 8-hour and Chronic Reference Exposure Level (REL) Summary: https://oehha.ca.gov/air/general-info/oehha-acute-8-hour-and-chronic-reference-exposure-level-rel-summary and chRELs as of June 2016: http://oehha.ca.gov/air/allrels.html

~~Collaborative for High Performance Schools (CHPS) High Performance Products Database: http://www.chps.net/dev/Drupal/node/445~~

Carpet and Rug Institute (CRI) Green Label Plus Certification for carpet, cushion, and adhesive products: http://www.carpet-rug.org/CRI-Testing-Programs/Green-Label-Plus.aspx

EPA Indoor air PLUS: https://www.epa.gov/indoorairplus

UL SPOT: https://spot.ulprospector.com/en/na/BuiltEnvironment

LEED v.4 EQ Credit Low-Emitting Materials Third Party Certification and Labels: http://www.usgbc.org/resources/low-emitting-materials-third-party-certification-table

Low-Emitting Materials Calculator LEED v.4: http://www.usgbc.org/resources/low-emitting-materials-calculator

South Coast Air Quality Management District Rule 1168 - Adhesive and Sealant Applications: http://www.aqmd.gov/docs/default-source/rule-book/reg-xi/rule-1168.pdf

## Glossary

**Interior Materials**

Interior materials and finishes are defined as all materials interior to the enclosure's least vapor-permeable and continually air-sealed barrier system. For most enclosure systems this definition will encompass all materials interior and exclusive of the vapor barrier/retarder, though for some assemblies with several systems providing vapor impermeability a further determination will need to be made.

**Continually Air-Sealed Barrier System**

A continually air-sealed barrier system refers to the set of air-sealed building materials that is intended to prevent air-flow through a wall assembly. This may consist of a continually sealed vapor barrier or a set of materials that when combined provide the least vapor-permeable system. Note that some materials have low vapor permeability but may not be part of a continually sealed system and should not be considered as the boundary of the building's interior.

**Volatile Organic Compounds (VOCs)**

Volatile organic compounds (VOC) refers to any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, that participates in atmospheric photochemical reactions, except those designated by EPA as having negligible photochemical reactivity. VOCs are

organic chemical compounds the composition of which makes it possible for them to evaporate under normal indoor atmospheric conditions of temperature and pressure.[31]

**Sealants**

A sealant has adhesive properties and is formulated primarily to fill, seal, or waterproof gaps or joints between two surfaces. Sealants include sealant primers and caulks.[32] Sealants are used on wood, fabric paper, corrugated paperboard, plastic foam, and other materials with tiny openings, often microscopic, that may absorb or discharge gas or fluid.

**Composite Wood Products:**

Composite wood products includes hardwood plywood, particleboard, and medium density fiberboard. Composite wood excludes hardboard, structural plywood, structural composite, oriented strand board, glued laminated timber, prefabricated wood I-joists, and finger-jointed lumber.[33]

# Guideline I.2: Moisture and Water Control

## Intent

Ensure a moisture-safe building envelope.

## Required Performance Criteria

Guidelines I.2A and I.2C are required for New Construction and Major Renovation projects with an exterior envelope included in the project scope. Guidelines I.2B is required for projects that include 20,000 gsf or more of conditioned space with an exterior envelope included in the project scope. Guideline I.2B is recommended for smaller projects, particularly those with high R-value enclosures.

A. Bulk water management:

Implement the following to ensure adequate control of bulk water on the site:

1. Site grading at building perimeter: Ensure 5% slope away from the building for a minimum of 10 ft. in unpaved and nonpedestrian areas.
2. Use downspout leaders, trench drains, and/or other methods to direct runoff from the building away from the perimeter.
3. Ensure irrigation systems do not spray on the building enclosure.

B. Moisture-safe design:

Design the building envelope to manage moisture flow and maintain all layers of wall and roof assemblies at safe moisture levels by implementing items (1) and (2) below.

1. *For above-grade walls*: Project teams must demonstrate safe moisture design by conducting a qualitative moisture analysis, and by conducting one of two quantitative moisture analysis options. Analysis must be

[31] United States Environmental Protection Agency, "Technical Overview of Volatile Organic Compounds," March 17, 2016.
[32] South Coast Air Quality Management District Rule 1168.
[33] Definition based on California Air Resource Board rules, www.arb.ca.gov.

performed for at least two wall assemblies or one wall assembly if it comprises 60% or more of the total wall area. Wall types following the principles of the "Perfect Wall" with all control layers (water, air, vapor, thermal) outboard of the sheathing (i.e. no cavity insulation) do not require the quantitative moisture analysis.

Qualitative moisture analysis:

This analysis shall be guided by the B3 Qualitative Moisture Analysis Worksheet for walls, discussing how the assembly manages liquid water, capillary drive, air leakage, and vapor diffusion, including location and type of each control layer: water, air, vapor, and thermal.

Quantitative moisture analysis:

Option 1: Static temperature and vapor pressure profile calculation (Glaser method):

Project teams are encouraged to use the B3 Glaser Calculator Tool. Results must show each surface layer through the wall section remains below the saturation vapor pressure. Test conditions for this analysis must use the average exterior winter temperature and humidity (average of the coldest three months) at or near the project site. Different buildings and space types will have varying interior temperature and humidity levels. To create a safety margin, this analysis shall use challenging conditions; the highest interior temperature and humidity the exterior wall is likely to experience on a regular basis.

Option 2: Dynamic moisture simulation (i.e., WUFI software):

An analysis following American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) 160 must show the wall's total moisture content achieves a declining or stable moisture content pattern over three years while the sheathing meets the mold growth criterion of ASHRAE 160-2009. This criterion verifies that the highest 30-day running average surface relative humidity in the sheathing is below 80% when surface temperatures are between 41°F and 104°F

C. Moisture-safe construction:

Air leakage and resulting condensation is one of the primary causes of moisture damage in buildings. Construct the building to control air leakage. Compliance with this guideline can be achieved using one of the two following methods:

1. Whole-building air tightness test:

   Test the building thermal envelope for air tightness using the Air Barrier Association of America (ABAA) Standard Method for Building Enclosure Airtightness Compliance Testing "operational enclosure test." A pressurization test is not required, but may be performed in addition to the required depressurization test. The maximum air leakage rate allowed is 0.25 cubic feet per minute (cfm) per square foot enclosure area (6-sided) at 75 Pascal (Pa).[34] If the rate falls above this level, a diagnostic evaluation to find the primary sources of air leakage is required using smoke tracer or infrared imaging, followed by nondestructive remediation steps to reduce air leakage. A final air tightness test is required following remediation efforts. If the final leakage rate achieved is below 0.4 cfm per sq. ft. at 75 Pa, the building is considered compliant with this guideline.

2. Third-party building enclosure consultant:

[34] This threshold is similar to US Army Corps of Engineers and GSA Requirements

The building enclosure must be designed and constructed with assistance from a third-party building enclosure consultant. This scope of work must include, but is not limited to:

i. Regularly scheduled meetings and consultations with the design and construction team during each phase (Predesign through construction and project completion).

ii. Review of all technical plans, specifications, shop drawings, and material submittals relating to the building enclosure.

iii. Coordination, observation, and documentation of preconstruction training for enclosure contractors and construction managers, focused on proper installation methods for air and water barrier continuity. (The training may be conducted by a qualified third party such as a manufacturer/product representative.)

iv. Coordination, observation, and documentation of air and water leakage performance testing on window installation mockup and/or field installations. This performance testing may be conducted by a third-party testing agency.

v. Field observation of critical enclosure details for quality assurance during construction.

If compliance is achieved through a third-party building enclosure consultant, whole-building airtightness testing is not required as part of the process, though smaller scale assembly or panel testing may be appropriate as determined by the building enclosure consultant. Note that the building enclosure consultant may also perform the work required under Section B, Moisture-Safe Design. Note that a certified building enclosure consultant is preferred, though not required.

## Meeting the Guidelines

Moisture control is one of the most important functions provided by a building enclosure. It is vital to building durability and longevity, energy performance, and occupant health. Yet it remains one of the most challenging aspects of building design.

There are four key pathways for moisture to move through a building enclosure. Arranged in order of significance, these are 1) bulk water leakage, 2) capillary movement, 3) air leakage, and 4) diffusion. In general, the building industry has learned to control bulk water leakage using a large variety of materials and products, but relying on a few basic principles such as slope and drainage gaps, redundancy, and proper overlap of layers. Capillary movement can generally be controlled with rainscreens, drainage gaps, and capillary breaks installed in key locations.

Often failure to control bulk water and capillary drive is quickly evident, which is one reason why the building industry has been able to learn adequate methods of control for these wetting pathways. However, diffusion-driven wetting and especially air leakage remain difficult for the building industry to properly control. Modern enclosures incorporate less moisture storage and higher insulation values, which translate into less available heat to drive off excess moisture. Increasingly moisture-sensitive materials may also be selected. As they become less tolerant to moisture, modern enclosures need to be paired with improved methods of air leakage and diffusion control. Better approaches to enclosure design, accessing enclosure expertise, setting air leakage targets, and testing performance have all been shown to improve enclosure durability, energy performance, and moisture safety.

A preferred method to control all four wetting pathways is through the use of an enclosure scheme called the Perfect Wall. This design approach can be safely used in any climate and for any part of the enclosure (wall, roof, slab on grade),

as well as above or below grade. It also lends itself to easier installation and quality assurance inspections for the four essential control layers: water control, air control, vapor control, and thermal control. The Perfect Wall approach requires that all of these control layers be positioned outboard of the structure regardless of whether that structure is concrete, wood frame, steel frame, or other. Conveniently, the water, vapor, and air control layers can often be provided with a single product installed on the outside face of the sheathing or outermost structural surface. In this position, it can be installed continuously and inspected more easily than enclosure approaches using multiple layers installed variously inside, outside, and/or within the structure. The thermal control layer is applied outboard of these control layers, protecting them from damage functions and keeping them and the structure warm and dry as well. This outboard system may also be easier to repair or replace during the building's lifespan. More information on the Perfect Wall is listed below under Additional Resources.

This Perfect Wall design approach is known as an inverted or protected membrane roof when applied to the top of the building. The waterproof roofing membrane is placed on top of the roof deck, providing air, vapor, and water control in a single layer. All of the insulation is placed on top of this, typically as rigid foam board, and weighed down and protected with gravel ballast or pavers. Although the roofing membrane is more difficult to inspect and access after construction is complete, it is also longer lasting because it is protected from sun, heat, ice, and physical damage. This type of roof design doesn't create a cold side vapor barrier or double vapor barrier as most other roof designs do, leading to much greater drying potential and moisture safety. It also eliminates common air leakage pathways and associated moisture issues in truss roofs with dense pack insulation. Building enclosure consultants have found dense-packed truss roofs especially problematic due to the difficulty of creating a continuous, robust air barrier in the ceiling plane.

Adopting the Perfect Wall approach to enclosure design eases the requirements for conducting qualitative and quantitative moisture analysis, as these are considered less likely to have moisture issues. It will also help achieve the demanding air leakage requirement of 0.25 cfm/sq. ft. at 75 Pa, though use of this scheme is just one step toward achieving that target.

Project teams may wish to hire a building enclosure consultant as well, particularly if the project team or contractor has never designed a building that has to achieve this level of airtightness. Building enclosure consultants can help project teams design and construct an air barrier system that maintains continuity even at locations that have traditionally been problematic, such as parapets, windows, and projections like balconies and overhangs. They can suggest products, materials, and approaches that have been proven to perform better in the field or are easier to install in an air- and watertight manner. Building enclosure consultants may also suggest conducting preliminary performance tests around installed components such as windows and doors, or testing the tightness of certain wall sections or building zones. Finding and remediating discontinuities in the air barrier is easier and cheaper early in the construction process (rather than during or after the final blower door test).

Mechanical engineers and contractors also should be aware of the air leakage requirements of these guidelines. Specifying higher quality louvers and dampers that can close fully during normal operation has been shown to significantly improve commercial-scale buildings' air tightness results. A reduced level of air leakage may also impact heating and cooling load calculations and improve mechanical air distribution and pressure management.

WUFI modeling for compliance with the quantitative moisture analysis should be done by experienced professionals. Currently, there are no widely-followed certifications for this particular modeling skill, though many building enclosure

consultants and firms do employ people with WUFI modeling experience. It is highly recommended to follow expert guidance for WUFI modeling techniques. Thorough guidance can be found in the Building Technologies Office Strategy Guideline: Modeling Enclosure Design in Above-Grade Walls, 2016.

## Submittal Requirements

**Predesign:**

- I.2C: Determination of which method the project is pursuing. If the project team is using a third-party building enclosure consultant, add the consultant to the B3 Project Team in the B3 Tracking Tool and submit a description of the consultant's contractual scope of work.

**Design:**

- I.2B: Complete and submit the B3 Qualitative Moisture Analysis Worksheets for the proposed primary roof and exterior above-grade wall assemblies. Submit either 1) completed B3 Glaser Calculator Tool with calculations for the proposed wall assembly, or 2) WUFI simulation results for the proposed wall assembly including documentation of the modeled wall materials and properties, simulation settings, and moisture content or relative humidity graphs at the sheathing surfaces, showing compliance with ASHRAE 160-2009.
- I.2C: If project team has determined to use a third-party building enclosure consultant, submit minutes and/or reports from the Design Development-phase meetings with the enclosure consultant.

**Final Design:**

- I.2A: Submit site plans documenting proper slope next to the building and location and direction of water flowing through downspout leaders and/or trench drains. Submit an irrigation plan identifying location and coverage of spray irrigation or sprinkler heads.
- I.2B: If changes have been made to the primary roof and exterior above-grade wall assemblies, complete and re-submit the B3 Qualitative Moisture Analysis Worksheets and Glaser calculation or WUFI simulation documentation.
- I.2C: If the project team has determined to use a third-party building enclosure consultant, submit minutes and/or reports from the Construction Documents-phase meetings with the enclosure consultant.

**Closeout:**

- I.2A: Confirmation that site grading provides proper slope next to the building. Confirmation that installed downspout leaders and/or trench drains lead water away from the building perimeter. Confirmation that all spray irrigation or sprinkler heads do not spray on the building enclosure.
- I.2C: Submit results of the depressurization air leakage test, done in accordance with listed standards and given in terms of cfm/sq. ft. enclosure area at 75 Pa. If the test results are above 0.25 cfm/sq. ft. at 75 Pa, submit documentation from the diagnostic evaluation, air leakage remediation efforts, and the final test results following remediation. If the project team selected to use a third-party building enclosure consultant, submit minutes and reports from the Construction Administration-phase meetings with the enclosure consultant as well as results from the window performance air and water leakage testing.

## Additional Resources

ABAA Standard Method for Building Enclosure Airtightness Compliance Testing: http://www.airbarrier.org/technical-information/whole-building-air-tightness-testing-2/.

Building Enclosure Consultant Certification and Training Programs: http://rci-online.org/pro-registrations/registered-building-envelope-consultant-rbec/ and http://besinstitute.com/besi-certifications/.

Building Science Corporation (BSC) Explains the Perfect Wall Concept: https://buildingscience.com/documents/insights/bsi-001-the-perfect-wall.

Dynamic Moisture Modeling Guidance from the Department of Energy (DOE) Building Technologies Office, Strategy Guideline: Modeling Enclosure Design in Above-Grade Walls: https://www.nrel.gov/docs/fy16osti/65479.pdf.

# Guideline I.3: Ventilation

## Intent

To promote good indoor air quality by implementing appropriate outdoor air ventilation and exhaust systems and limiting the ingress of particulates and soil gases into the building.

## Required Performance Criteria

Guidelines I.3A, I.3D, I.3F, and I.3G are required for New Construction projects and to Major Renovation projects that include replacement or alteration of relevant systems. Guidelines I.3B, I.3C, and I.3E are required only for New Construction projects that include 20,000 gsf or more of conditioned space, and Major Renovation projects that include 20,000 gsf or more of conditioned space and include construction, replacement, or alteration of relevant systems.

A. Ventilation baseline: Design mechanical systems to meet the minimum outdoor air ventilation rates for all mechanically ventilated zones as specified in the current ASHRAE Ventilation Standard 62.1 (or Standard 62.2 for residential buildings).

B. Monitor outdoor airflow rates or perform checks annually to verify ventilation rates are meeting the ASHRAE minimums in all large spaces (1,000 sq. ft. or more) which are high occupancy (25 people or more). Small ventilation systems serving a total of 5,000 sq. ft. or less are exempt from this requirement.

C. Meet ASHRAE 62.1 Air Class (1–4) requirements for recirculation of indoor air and enclose and negatively pressurize the following spaces:

   1. Chemical storage rooms or other areas with identified risk of airborne hazard.

   2. Printer/copier rooms with high volume laser printers, copiers, and multifunctional device (MFDs), (i.e., printing equipment with dry toner). Air from these rooms shall be treated as Air Class 4. Laser printers/copiers meeting Blue Angel low emission criteria RAL-UZ 171 are exempted from these requirements and are permitted to be located in an open-office space without triggering exhaust requirements.

D. All mechanical ventilation equipment designed to deliver outdoor air must be equipped with minimum efficiency reporting value (MERV) 11 filters or better. Equipment designed to recirculate only indoor air must be equipped with MERV 11 filters or better.

E. Install permanent entryway systems such as walk-off mats or grille or grate systems at least 10 ft. long in the primary direction of travel at all regularly used entrances.

F. Meet the Outdoor Air Intake Minimum Separation Distances as specified in ASHRAE 62.1, Section 5.5 and Chart 5.5.1.

G. Control radon and other hazardous soil gas:

1. For new non-residential buildings and additions, control radon and other harmful soil gas by meeting the requirements of ~~ANSI~~the most recent version of ANSI/AARST CC-1000: Soil Gas Control Systems in New Construction of Building. ~~This is required~~For new residential buildings and additions, follow building code requirements for ~~all projects in Minnesota, both EPA Zone 1 and Zone 2~~radon resistant new construction (RRNC) according to MN Rules 1303.2400-1303.2403. This includes but is not limited to:

   i. Creation of a soil gas collection plenum (this plenum is often a sub-slab gravel or crushed stone bed into which soil gas infiltrates).

   ii. Creation of a continuous sealed barrier between occupied space and the soil gas collection plenum.

   iii. Soil gas vent piping that has the capability to, at minimum, passively vent soil gas from the collection plenum through the roof of the building.

   Testing of radon levels after construction is required~~; if~~. A radon measurement professional, licensed by the Minnesota Department of Health, must conduct the radon testing, according to the requirements of the MN Radon Licensing Act (Statute 144,4961) and MN Rules 4620.7000-4620.7950. If radon levels are found to be above 2 picocuries per liter (pCi/L) the project must install an Active Soil Depressurization System (ASD) per ~~ANSI CC-1000~~either ANSI/AARST CC-1000 for non-residential projects or per building code requirements for residential projects.

2. For all remodeled buildings and remodeled portions of buildings regardless of type, testing and remediation must be performed as directed in the most relevant of the following standards:

   ~~i. For schools and large buildings: American National Standards Institute Radon~~ANSI/AARST SGM-MFLB-2023 (or successor standard): Soil Gas Mitigation ~~System~~Standards for ~~Schools and Large~~Existing Multifamily, School, Commercial and Mixed-Use Buildings ~~(ANSI RMS-LB).~~

   ~~ii.~~i. . For Multifamily Buildings: American National Standards Institute Radon Mitigation System for Multifamily Buildings (ANSI RMS-MF).

   ii. ANSI/AARST MA-MFLB-2023 (or successor standard): Protocol for Conducting Measurements of Radon and Radon Decay Products in Multifamily, School, Commercial and Mixed-Use Buildings

3. If mitigation is required a radon mitigation professional, licensed by the Minnesota Department of Health, must conduct the radon mitigation, according to the requirements of the MN Radon Licensing Act (Statute 144,4961) and MN Rules 4620.7000-4620.7950:
   i. In non-residential new construction and additions, when RRNC is activated or altered to reduce radon.
   ii. In residential new construction and additions, after the certificate of occupancy is issued, when RRNC is activated or altered to reduce radon.
   iii. In all remodeled projects.

## Recommended Performance Criteria

H. Implement a demand-controlled ventilation system.

I. Develop and implement a green cleaning protocol using products that comply with EPA Safer Choice or Green Seal labels.

## Meeting the Guidelines

In almost all settings, ventilation with outdoor air is critical to ensure proper indoor air quality. Research has shown that occupant health, cognition, and productivity all benefit from the introduction of fresh air and the exhaust of polluted indoor air. Determining the proper outdoor air ventilation rate is the primary topic of ASHRAE Guideline 62. ASHRAE 62.2 should be used for residential buildings; ASHRAE 62.1 should be used for all others. Below, the most recent version is referred to simply as ASHRAE 62.

In the early design stage, work with the owner to identify the expected occupancy and activity type in all areas of the building, and use these or ASHRAE design occupancy levels to begin ventilation rate calculations. Determine the appropriate ASHRAE procedure for calculating these, either 1) the Ventilation Rate Procedure (VRP), 2) the Indoor Air Quality Procedure (IAQP), or 3) the Natural Ventilation Procedure (NVP). If using the standard VRP, it is recommended to adopt an air distribution configuration such as displacement ventilation that improves the zone air distribution effectiveness and reduces the total zone outdoor airflow. This may also result in reduced energy consumption and help meet SB 2030 energy targets.

Early in the design phase, determine a strategy for controlling emissions from printers, copiers, and MFDs. If these devices will use dry toner, emissions to the air must be contained within an enclosed room and exhausted directly to the outdoors. Alternatives to this approach include using inkjet printers rather than laser printers, or requiring laser printers to meet the emission certification of Blue Angel RAL-UZ 171. Such printers could be dispersed in an open-office setting, for example.

Throughout mechanical design, the mechanical design team should coordinate with the energy analysis team so that ventilation rates are consistent in both processes. Update the design ventilation rate as any changes are made to the occupancy levels planned for the building. Communicate these changes to the parties evaluating energy performance so that ventilation rates compliant with these guidelines can be taken into account in energy calculations. The SB 2030 program considers ventilation rates in the creation of the SB 2030 Energy Standard; ensuring that these rates are noted allows an appropriate standard to be created.

The mechanical design team should consider using strategies that provide the opportunity to reduce energy use associated with ventilation. The list of recommendations includes but is not limited to:

- Use of $CO_2$ sensors or other types of occupancy sensors to reduce ventilation in spaces when they are unoccupied.
- Use of ventilation strategies that increase ventilation efficiency such as displacement ventilation.
- Use of economizer cycles where possible.
- Use of heat recovery strategies in the ventilation design chosen.

For many building types, use of these strategies can significantly reduce total energy consumption and help the building achieve challenging SB 2030 energy targets.

For ventilation systems serving over 5000 sq. ft., determine how outdoor airflow will be monitored. Yearly spot checks are allowed, but if continuous monitoring is desired, ensure that air flow can be measured for all large spaces that are high occupancy and that these values are reported to the Building Automation System (BAS) or other tracking and recording device. These systems should be shown on the HVAC plans.

All new buildings, regardless of type or location, must protect against hazardous soil gases, including radon, using at least the passive measures found in the ANSI ~~CC-1000 standard.~~/AARST CC-1000 standard (for non-residential new construction) or the building code requirements for residential new construction. Radon is a soil gas, and typically enters buildings through air leaks at or below grade. Therefore, passive measures such as the creation of a robust air barrier between the building's at/below grade space and the ground is critical and effective. Further control is offered by passively venting the ground below the building's floor slab. This is typically done with a sub-slab layer of crushed stone and perforated drain tile, which can collect soil gases migrating through the stone layer. These gases are safely routed through a vertical ventilation stack and released above the roof of the building. The ANSI/AARST CC-1000 ~~Standards~~Standard and building codes guide engineers on the design, layout, and venting requirements of the sub-slab collection plenum and vent system. Be aware that each vertical ventilation stack can vent only a limited area, and may require space for a powered fan.

Following construction, testing radon levels is also required for all buildings, regardless of type or location. Testing ~~should~~must be performed ~~per CC-1000 Annex D, and be performed~~by a licensed radon measurement professional for radon and any other hazardous soil gas identified as a risk for the building. If radon levels are found above 2 piC/L, the passive stack ventilation system must be retrofitted with fans to provide a powered ventilation assist. These fans will require extra space for installation and access in case of replacement or maintenance. They will also require a source of electrical power since they must run continuously. Take these issues into consideration at the design stage to minimize expenses if radon testing shows fans are required.

## Submittal Requirements

**Design:**

- I.3E: Submit preliminary building plans showing the location of all primary entrances including space for permanent entryway systems.

**Final Design:**

- I.3A: ~~Submit~~Upload full ASHRAE 62.1 procedure or input ASHRAE 62 calculations for each zone, showing the required and planned ventilation rate in each.
- I.3B: Identify the chosen method for monitoring outdoor airflow rates during operations (permanent monitoring system or annual spot checks) and, if appropriate, submit an HVAC plan identifying the monitoring equipment.
- I.3C: Submit HVAC plans identifying the ASHRAE Air Class of each ventilation zone, along with the ventilation and/or dedicated exhaust systems that will serve them.
- I.3D: Submit HVAC specifications or plans detailing the level of filtration on all mechanical ventilation equipment.
- I.3E: Submit building plans showing the location of all primary entrances and the type and placement of permanent entryway systems.
- I.3F: Submit HVAC plans showing the location of all outdoor air intakes relative to the nearest pollutant or other contaminant sources with notes indicating the distance between them.
- I.3G: Submit building plans showing all critical components of the soil gas control system, including the design and details of the sub-slab collection plenum, air barrier, and size, location, and area served by each vent stack.
- I.3H: Submit HVAC plans and specifications detailing the location and type of equipment and operating parameters of the demand-controlled ventilation system.

**Closeout:**

- I.3G: Submit results from radon tests within one year of occupancy. If radon levels are measured above 2 piC/L, submit documentation showing installation of fans and/or other components of the ASD and submit documentation showing subsequent testing was completed and radon is under 2 pCi/L.
- I.3A, I.3C, I.3D, and I.3H (Submitted under P.1): Ensure that the mechanical system has been commissioned and documented according to the requirements of Guideline P.1.
- I.3I: Submit a Green Cleaning Protocol that specifies the types of cleaning products and outlines the procedures that will be used to clean the premises.

**Occupancy – Submitted annually for ten years:**

- I.3B: Annually submit outdoor airflow rates measured for each high occupancy zone (>25 people/1000 sq. ft.) along with the associated ASHRAE 62-calculated minimum rate.

## Additional Resources

ASHRAE Standards 62.1 and 62.2: https://www.ashrae.org/resources--publications/bookstore/standards-62-1--62-2.

Current ANSI/AARST Radon Standards, including ANSI/AARST CC-1000 Soil Gas Control Systems in New Construction of Buildings: ~~https://aarst-nrpp.com/wp/store/rrnc-for-larger-buildings-cc-1000/, Previous public draft available for review: http://aarst-nrpp.com/wp/wp-content/uploads/2016/09/CC-1000-09-16PubReview.pdf.~~https://standards.aarst.org/

MN Rules for Radon Control Systems in New Residential Structures (1303.2400-1303.2403): https://www.revisor.mn.gov/rules/1303.2400/

Blue Angel-certified laser printer/copier/MFD product listings: https://www.blauer-engel.de/en/products/electric-devices/drucker-und-multifunktionsgeraete and http://h22235.www2.hp.com/hpinfo/globalcitizenship/environment/productdata/lpblueangeluseng.html.

EPA Radon Information: https://www.epa.gov/radon.

EPA Radon Resistant Construction: https://www.epa.gov/radon/radon-resistant-construction-basics-and-techniques#rrct.

Minnesota Radon Testing Kits: http://www.health.state.mn.us/divs/eh/indoorair/radon/radontestresults.html.

~~US EPA, Radon Zone Map: https://www.epa.gov/radon/epa-map-radon-zones.~~

MDH Radon Information: mn.gov/radon

Minnesota Radon Measurement Professionals: https://www.health.state.mn.us/communities/environment/air/radon/findprof.html

Minnesota Radon Mitigation Professionals: https://www.health.state.mn.us/communities/environment/air/radon/mitigation.html

# Guideline I.4: Thermal Comfort

## Intent

To promote occupant thermal comfort through active and passive means, and to provide occupants with the ability to control the conditions in their space.

## Required Performance Criteria

Guidelines are required for New Construction projects and for Major Renovation projects that include replacement or alteration of relevant assemblies.

A. Passive thermal comfort

1. Avoid high solar heat gains.

   For regularly occupied spaces with at least one exterior wall facing within 45 degrees of due east or west, limit susceptibility to solar heat gains by employing one or more of the following on at least 95% of glazing:

   i. Specify low solar gain glazing (solar heat gain coefficient [SHGC] of glass < 0.4).

   ii. Employ frit patterns that achieve SHGC equivalent no greater than 0.4.

   iii. Implement exterior operable shading systems or southern horizontal and easterly and westerly vertical louvers.

2. Avoid radiant temperature asymmetry

   i. For regularly occupied spaces above grade with at least one exterior wall, maintain an area-weighted average U-value for the exterior wall no greater than 0.2, including fenestration and doors.[35] The opaque wall and fenestration/door component U-values can be no greater than those listed in the prescriptive enclosure requirements section of the current version of the applicable energy code (International Energy Conservation Code [IECC] or ASHRAE 90.1).

3. For naturally-ventilated spaces (i.e., without mechanical ventilation equipment), meet the design, operating, and performance criteria of the Adaptive Comfort Model from the current version of ASHRAE 55 Standard.

[35] The U-0.2 limit follows ASHRAE 55 guideline that specifies the U-value at which radiant asymmetry from an exterior wall becomes negligible, and air temperature may be used rather than operative temperature in the comfort calculations.

B. Active thermal comfort[36]

1. Mechanical systems: New Construction projects that include 20,000 gsf or more of conditioned space and Major Renovation projects that include 20,000 gsf or more of conditioned space and include construction, replacement, or alteration of relevant systems shall document compliance with part i. below. Part ii is required for all New Construction and for Major Renovation projects that include construction, replacement, or alteration of relevant systems.

   i. All mechanically ventilated spaces must have mechanical systems designed to meet the comfort criteria of the current version of ASHRAE 55 during operating hours. Provide documentation of ASHRAE 55 calculations for summer, fall, winter, and spring conditions in a range of spaces, including different space types and occupant activity levels. As long as I.4A Part 2i is met, the mean radiant temperature calculation is not necessary for these spaces. Garages, warehouses, vehicle maintenance and repair, ice rinks, and pools are exempted from this requirement.

   ii. Ensure that the mechanical system, including ventilation, heating, cooling, and distribution systems, are commissioned as required under Guideline P.1, and the requirements of this section are included in the Basis of Design documentation.

~~2.~~ Occupant controls[37]

2. : Provide locally adjustable thermal comfort controls for at least 50% of all single occupant spaces and a control for all shared multi-occupant spaces. Thermal comfort controls must allow occupants to adjust at least one of the following: air temperature, radiant temperature, air speed, or humidity. Projects that include less than 20,000 gsf of conditioned space may document compliance with this requirement by documenting compliance using the B3 Guidelines Small Buildings OPR rather than submitting under this guideline. Projects may demonstrate local control of a space through either of the following:

   i. Thermostats or other controllers permitting direct adjustment to air temperature, radiant temperature, air speed, or humidity.

   ii. Easy-to-locate signage in all single occupant spaces and shared multi-occupant spaces with instructions for directly contacting building management staff who have the ability to immediately control space temperatures and/or airflow. Signage should also include information about the occupant's location, for example, building and room number, or identify the VAV or other piece of mechanical equipment that regulates thermal conditions in the occupant's space. At a minimum, building management staff must be available to make these adjustments during all normal business hours of the building.

   Note that for either option there is no requirement that each space operates independently (as systems may be shared between spaces).

## Meeting the Guidelines

Post-occupancy evaluations of existing B3 buildings have identified occupant thermal comfort as an area in need of significant improvement. High thermal performance enclosures are the first step to improving this comfort with minimal

[36] This guideline is aligned with credits available under the USGBC LEED Building Design and Construction v.4 (LEEDv4), The WELL Building Standard, and the Collaborative for High Performance Schools (CHPS).
[37] This guideline is aligned with credits available under LEEDv4.

use of additional energy. Better design of mechanical systems to increase occupant control over thermal conditions is also necessary, combined with enhanced commissioning to ensure those controls and systems are working properly.

Early in the design phase, begin evaluating the appropriate window-to-wall area ratio (WWR) abutting regularly occupied spaces. Achieving a WWR above 40% to 50% in those spaces while meeting the area-weighted average U-value requirement under 0.2 will be difficult without using fenestration that surpasses code-level thermal performance. Fixed and operable windows, storefront, and curtainwall systems are available that can achieve U-0.2, but they remain a more expensive option compared to limiting the WWR.

Identifying or calculating the U-value of opaque wall assemblies and fenestration can be difficult in some cases. A simple center-of-cavity or center-of-glass U-value is not adequate to determine thermal comfort because of the strong influence of thermal bridging. In the early design stages, it may be more helpful to use code-prescribed U-values for calculations since actual assemblies and fenestration products may not yet be known. Code U-values for Climate Zones 6 and 7 are provided in the Design-Stage B3 Enclosure Thermal Comfort worksheet. For the final design-stage submission, actual whole-assembly or whole-window U-values must be calculated or provided for the specific assemblies and components which have been selected. Both ASHRAE 90.1 and the IECC Energy Conservation Code contain tables listing the U-values for a range of different opaque wall assemblies and insulation thicknesses. These values are particularly important to use for walls incorporating steel framing elements.

It's important to note that while the ASHRAE 90.1 and IECC tables account for thermal bridging between steel studs, they generally assume any exterior insulation is perfectly continuous. In practice, exterior insulation installed outboard of the sheathing is rarely continuous since the cladding needs attachment points to transfer wind and gravity loads to the structure. Often, attachment is provided via a system of metal girts or clips or both, with very significant impacts on the R-value of the exterior insulation. For example, a typical system of horizontal z-girts installed 24 in. on center may reduce the additional R-value of exterior insulation by more than 50%. If exterior insulation is used, the impact of such thermal bridges must be accounted for in the U-value calculations as well. In some cases, manufacturers of proprietary cladding mount systems will have methods or tables to help calculate the R-value reduction due to their girts or clips. If such resources are not available for a particular project, use the Steven Winter Associates Cladding Attachment Thermal Bridging Guide to find the appropriate degradation factor for the exterior insulation (see Additional Resources section, below).

Whole-window U-values for storefront and curtainwall products can also be difficult to provide since they depend strongly on the spacing of the mullions and resulting frame-to-glass ratio. High amounts of window frame tend to drive up the window U-value and decrease the thermal performance of storefront and curtainwall systems since they act as thermal bridges. Some manufacturers will provide a range of U-values representing a range of frame-to-glass ratios. In that case, it is the responsibility of the design team to determine an appropriate U-value from that range, given their fenestration design, or to ask the manufacturer for assistance. Other manufacturers may only provide a single U-value based on a specific window test size and frame-to-glass ratio. In that case, an adjustment to the U-value may be appropriate using experience, judgement, and/or recommendations from the manufacturer. Special, project-specific U-value calculations are possible and encouraged but not required.

Compliance with I.4A Part 2 is verified by submission of a calculation performed for each regularly occupied space with one or more exterior walls. Nonregularly occupied spaces (e.g., hallways, stairways) are exempted from this requirement. Below grade spaces and spaces with less than 30% window and door area can be omitted from the

calculations, as long as walls, windows, and doors meet the minimum U-values prescribed in the applicable energy code. A group of identical spaces, or nearly identical spaces, require only one calculation demonstrating compliance for the group. If design values for the opaque wall and fenestration are already known in the design stage, they can be used in conjunction with the Final Design-Stage B3 Enclosure Thermal Comfort Worksheet and submitted in place of the design-stage calculator.

Improving passive thermal comfort with a high quality enclosure is the first step to achieving thermal comfort for occupants. Mechanical systems must be well designed and commissioned in order to maintain comfortable conditions. Anticipated compliance with ASHRAE 55 comfort zones should be verified for a range of representative spaces in summer, fall, winter, and spring conditions. The Center for the Built Environment (CBE) Thermal Comfort Tool, hosted by the University of California, Berkeley, may be used to set desired operating conditions, activity levels, and clothing levels within a space to check for compliance with ASHRAE 55 comfort requirements. As long as Guideline I.4A Part 2 is met, the mean radiant temperature of all regularly occupied space will be sufficiently close to the indoor air temperature. In this case, the indoor air temperature can be used as the operative temperature, eliminating the need to calculate mean radiant temperature. A link to the CBE Tool is provided in the Additional Resources section.

Since thermal comfort is subjective and dynamic, a mechanical system that can provide the conditions to satisfy ASHRAE 55 is not a guarantee of thermal comfort for all occupants all the time. Research studies have shown that occupants feel more comfortable and satisfied with their space when given the means to control at least some of the factors that influence thermal comfort. These include air temperature and radiant temperature, air speed, and humidity. Ideally, every occupant should be given thermal comfort controls allowing them to adjust at least one of these factors, but this may be cost-prohibitive or not feasible given some types of mechanical systems. However, every mechanical system should be designed to either 1) provide locally adjustable comfort controls for every shared multi-occupant space and at least 50% of individual occupant spaces~~.~~, or 2) provide signage in all regularly occupied spaces instructing occupants how to do so (via contacting building management staff, for example). Individual occupant spaces are enclosed or nearly enclosed spaces occupied most regularly by a single person. These requirements are best considered early in the design of the mechanical systems of the project.

## Submittal Requirements

**Design:**

- I.4A2: Submit building elevations showing the preliminary window and opaque wall surface areas. Submit the Design-Stage B3 Enclosure Thermal Comfort Worksheet, documenting the area-weighted average U-value of each exterior wall abutting a regularly occupied space and assuming code-compliant wall attributes.
- I.4A3: For all naturally-ventilated zones, submit preliminary building plans showing the planned airflow paths through each space.

**Final Design:**

- I.4A1: Submit documentation from the glazing manufacturer listing the SHGC value of the glass used on east- and west-facing exposures is less than or equal to 0.4. If shading devices are used to meet this requirement, submit building elevations showing shading devices instead of SHGC values.

- I.4A2: Submit building elevations showing the window and opaque wall surface areas. For window, door and spandrel components, submit manufacturer literature documenting the U-value for each of these components. Submit Final-Design B3 Enclosure Thermal Comfort Worksheet, documenting compliant wall assemblies.
- I.4A3: Submit ASHRAE 55 Adaptive Comfort Model calculations for all naturally-ventilated zones or sufficient representative spaces.
- I.4B1: Verify that the mechanical system can meet the comfort requirements of ASHRAE 55 for summer, fall, winter, and spring conditions in a range of different space types with different occupant activity levels using the CBE Thermal Comfort Tool, and document using the "LEED Documentation" option. Small Building projects are not required to document ASHRAE 55 comfort requirements.
- I.4B2: Submit building plans showing the location of all local thermal comfort controls, individual occupant spaces, and shared multi-occupant spaces~~, indicating which of the individual occupant spaces contain thermal comfort controls and identifying the thermal comfort control for all shared multi-occupant spaces~~. If the signage option is used, also provide construction specification language discussing the format, content, and location of these signs.

## Additional Resources

CBE Thermal Comfort Tool for Use with ASHRAE 55: http://comfort.cbe.berkeley.edu/.

IECC 2015 U-value Requirements for Opaque Walls and Fenestration:
https://codes.iccsafe.org/public/document/IECC2015/chapter-4-ce-commercial-energy-efficiency and
https://codes.iccsafe.org/public/document/IECC2015/chapter-4-re-residential-energy-efficiency.

Morrison Hershfield – Thermal Bridging in Exterior Insulated Steel Stud Assemblies:
http://blog.morrisonhershfield.com/insights/solutions-mh-thermal-bridging-in-exterior-insulated-steel-stud-assemblies.

Parallel Paths Method Wall U-value Calculator, for Wood-Framed Walls Only:
https://www.appliedbuildingtech.com/fsc/calculator.

RDH Technical Bulletin – Cladding Attachment Solutions for Exterior Insulation Commercial Walls: http://rdh.com/wp-content/uploads/2015/12/TB-11-Cladding-Attachment-Solutions-Dec-16-15-FINAL.pdf.

Steven Winter Associates – Cladding Attachment Thermal Bridging Guide for Exterior Insulation:
https://www.b3mn.org/swa-cladding-attachment-thermal-bridging-guide-for-exterior-insulation/

## Glossary

**Regularly Occupied Space:**

Any space that is occupied by one or more persons for more than one hour during days the building is in use. Note that this includes spaces which may be irregularly occupied but, when occupied, a typical occupant would spend more than one continual hour in the space. Excluded from calculation of continuously occupied spaces are:

- Spaces with uses that only require minimal lighting and in which the primary activity intended for the space would be harmed by daylight (this exclusion does not apply to spaces with ultraviolet light concerns) – note that this only applies to the calculation of regularly occupied spaces with respect to the daylighting requirements.

- Spaces that do not meet the minimum occupancy outlined above during daylight hours) – note that this only applies to the calculation of regularly occupied spaces for the daylighting criteria with respect to the daylighting requirements.
- Spaces where no individual occupant spends at least one continual hour during days the building is in use.

# Guideline I.5 Lighting and Daylighting

## Intent

To promote occupant comfort by providing sufficient levels of natural and artificial light for tasks being performed. Quality lighting should also support cognitive function, mental health, and social interaction while being aesthetically pleasing and complementing the design of the space.

## Required Performance Criteria

Guideline I.5C applies to New Construction projects and Major Renovation projects that include replacement or construction of relevant systems and assemblies. Guidelines I.5A and I.5B are required only for New Construction projects that include 20,000 gross square feet or more of conditioned space and Major Renovation projects that include 20,000 gross square feet or more of conditioned space and include construction, replacement, or alteration of relevant systems or assemblies.

A. Light levels[38]:

1. In all Regularly Occupied Floor Area, provide adequate light levels according to Illuminating Engineering Society (IES) guidelines, not including daylighting contributions. These light levels must:

   i. Be measured at the task plane.

   ii. Maintain contrast levels by demonstrating one of the following:

      (1) Average wall surface to average work surface illuminance level does not exceed a ratio of 1:3.

      (2) Average ceiling surface to average work surface illuminance level does not exceed a ratio of 1:10.

B. Lamp specifications[39]:

1. Use light sources with a color rendering index (CRI) of at least 80, unless a different CRI is necessary for special use.

2. All light sources should be Restriction of Hazardous Substances (RoHS)-compliant following the most current European RoHS requirements.

C. Daylighting:

1. On facades facing within 45 degrees of east, south, or west, provide glare control devices with manual operation (or automatic with manual override) for 90% of all Regularly Occupied Floor Area.

2. Demonstrate daylight utilization with one of the following:

   i. Spatial daylight autonomy in at least 50% of Regularly Occupied Floor Area (sDA30fc/50%); i.e., at least 50% of the Regularly Occupied Floor Area must achieve a minimum of 30 foot-candles for at least 50% of operating hours per year.

[38] This guideline is aligned with credits available under LEEDv4.

[39] This guideline is aligned with credits available under LEEDv4, The WELL Building Standard, and CHPS.

ii. Daylight factor (DF) of at least 1.0% in at least 50% of Regularly Occupied Floor Area. Evaluation is performed using the percentage of Regularly Occupied Floor Area meeting the 1% threshold—not with a simple average daylight factor. Compliance is evaluated by using a percentage of floor area, not a percentage of the number of spaces.

iii. Projects that include less than 20,000 gross square feet of conditioned space may demonstrate adequate daylight utilization by complying with Option i or ii as described above, or by documenting a window-to-wall area ratio (WWR) of the portion of exterior walls bounding all Regularly Occupied Floor Area of at least 35%, and a minimum visible transmittance (VT) of 0.65 for all exterior glazing in all Regularly Occupied Floor Area.

## Recommended Performance Criteria

D. Use light sources with a CRI of at least 90.

E. Light direction and glare: Use direct-only overhead lighting for 25% or less of total connected lighting load in all Regularly Occupied Floor Area.[40]

F. Interior surface reflectance: Specify interior surfaces (walls, floors, ceilings, permanently installed furniture) for all Regularly Occupied Floor Area that meet or exceed the following area-weighted average reflectance values to maximize lighting efficiency and to increase the perceived brightness of spaces:

1. Ceilings: at least 85% average surface reflectance.
2. Walls: at least 60% average surface reflectance.
3. Floors: at least 25% average surface reflectance.
4. Furniture:
    i. At least 45% average surface reflectance for work surfaces.
    ii. At least 50% average surface reflectance for movable partitions.

## Meeting the Guidelines

**Electric Lighting:**

During the schematic design phase, work with owner/client to understand electric lighting needs and develop a strategy to meet needs while conserving energy and maintaining a high environmental quality. For each regularly occupied interior space, document the light levels recommended for primary (and secondary) use type using B3 Electric Lighting Spreadsheet. This spreadsheet requires a room name, area, and program to be entered for all Regularly Occupied Floor Area, listed by room or space.. If the exact program is not included in the drop-down list, select the most similar available or the IES category space type that aligns with the room's use (IES space type descriptions can be found in the spreadsheet tab, IES Reference Categories). After the program is selected, the IES recommended light level (in foot-candles [fc]) will auto-populate.

[40] This guideline is aligned with credits available under LEEDv4.

**Representative Spaces for Electric Lighting:**

Projects containing spaces that are significantly similar in size, program, and electric lighting design can make use of the *representative space* designator in the B3 Electric Lighting Spreadsheet. The entry should be indicated as a *representative space* with the total square footage included in the spaces and the rooms listed by number or name. For these spaces, the simulated electric lighting levels of a single room can be applied to the entire represented area.

As design progresses, computer simulations should be performed to determine the amount of light provided by electric lighting at the work plane, walls, and ceiling. As the results are entered in the spreadsheet, the compliance metrics will be calculated and indicated for each space. Because the contrast ratios are based on the light level at the work surface, this value must be entered first; then, the target light levels for both the walls and ceiling will be calculated and populated in the spreadsheet.

For contrast ratios between work surfaces and wall surfaces (excluding fenestration), the spreadsheet relies on the following calculation ratio:

$$1:\left(\frac{Average\ work\ surface\ illuminance}{Average\ wall\ surface\ illuminance}\right)$$

For example, if the target average work surface illuminance is 40 foot-candles, the target wall surface illuminance will be, at most, 13 fc, so as to maintain the desired 1:3 ratio.

For contrast ratios between work surfaces and ceiling surfaces (excluding fenestration), the spreadsheet uses the following calculation ratio:

$$1:\left(\frac{Average\ work\ surface\ illuminance}{Average\ ceiling\ illuminance}\right)$$

For example, if the target average work surface illuminance is 40 fc, the target ceiling surface illuminance will be, at most, 4 fc, so as to not exceed the desired 1:10 ratio.

When selecting and/or specifying light fixtures, ensure that the CRI and RoHS compliance criteria are mandated in the specifications and met by product purchases. This information can typically be found on manufacturer cutsheets.

**Daylighting:**

Glare control: During the schematic design phase, identify those façades that face within 45 degrees of east, south, or west, and the Regularly Occupied Floor Area adjacent. In 90% of Regularly Occupied Floor Area, glare control should be designed and specified with manual operation, or with automatic operation with manual override. Acceptable glare control devices are those that are operable by building occupants to address unpredicted glare and include interior window blinds, shades, curtains, moveable exterior louvers, movable screens, and movable awnings.[41]

During the schematic design phase, list all Regularly Occupied Floor Area, listed by room or space, using B3 Daylighting Worksheet.

[41] This guidance aligns with credits available under LEED v4.1

**Representative Spaces for Daylighting:**

Projects containing spaces that are significantly similar in size, window-to-wall ratio, window-to-floor area ratio, and orientation can make use of the *representative space* designator in the B3 Electric Lighting Spreadsheet. Entries should include the area totals for the entire group of spaces represented and should list the included rooms by number and/or name. For these spaces, the simulated daylight utilization of a single room can be applied to the entire represented area.

During schematic design and design development, the daylight utilization for each regularly occupied (and/or representative) space should be simulated. Ensure that daylight models accurately reflect room size, height, window placement, glazing properties, interior surface reflectance, and permanently installed furnishings. Some software uses default values for interior surface reflectance; if these values are significantly higher than the design conditions (i.e., if there are a lot of dark surfaces), a different software with adjustable values must be used. Enter simulation results for sDA and/or DF in the B3 Daylighting Spreadsheet. As results are entered, the spreadsheet will automatically calculate the weighted average spatial daylight autonomy, or the percentage of floor area with a daylight factor of 1.0 or higher, and indicate compliance or noncompliance with the guideline.

Two daylighting metrics that may be used to comply with the B3 Guidelines are available as outputs from daylight modeling software:

- Spatial daylight autonomy ($sDA_{30fc/50\%}$) is an annual measure that determines the percentage of the floor area that receives the minimum light level (30 fc) for at least 50% of the occupied hours during which daylight is available. Occupied hours vary by space use type and can generally be programmed into daylight simulation software.
- Daylight factor is the ratio of the illumination available inside a structure to the illumination outside, calculated or measured using an overcast sky condition. When calculating daylight factor for compliance with B3 Guidelines, note that the required result is the *percentage of floor area with a daylight factor of 1.0 or higher***.** This is different from the average daylight factor in the space, which is what most simulation programs report. This value can be found in each of the software programs listed below, but may require specific settings for the simulation or a separate calculation from the results provided by the software. For further guidance on calculating the percentage of floor area meeting the requirement in the listed software tools, please reference guidance documents in the Additional Resources section of the guidelines or guidelines website.

Software tools capable of performing daylight analysis for B3 compliance include:

| Software Name | Spatial Daylight Autonomy Analysis Capability | Daylight Factor Analysis Capability | Surface Reflectance Settings |
|---|---|---|---|
| Sefaira for Sketchup or Revit | Yes | Yes – manual calculation of floor area above threshold | Ceilings – 80%<br>Walls – 50%<br>Floors – 20% |
| Insight for Revit | Yes | Yes – automatically reports floor area above threshold | Adjustable – set in Revit Model |
| Lightstanza | Yes | Yes – automatically reports floor area above threshold | Adjustable – set in web application |

| | | | |
|---|---|---|---|
| Andrew Marsh Tools – Dynamic Daylighting | Yes, with upload of weather file | Yes – automatically reports floor area above threshold | Adjustable – set in web application |
| Cove Tool | Yes | No | Ceiling/Roof – 70%<br>Interior Walls – 50%<br>Floors – 20% |

Other software tools may be used, provided the tool is capable of reporting sDA or percentage of floor area within a specific daylight factor range.

These calculations should be updated during the final design phase to match construction documents and represent the as-built condition as closely as possible.

**Considerations for Buildings under 20,000 Gross Square Feet Conditioned Space:**

Projects under 20,000 square feet that are considered small buildings under the B3 Guidelines program[42] can simulate their spatial daylight autonomy or daylight factor as described above, or can use the Small Buildings Method tab in the B3 Daylighting Worksheet. During the schematic design phase, list all Regularly Occupied Floor Area by room or space in the B3 Daylighting Worksheet. Representative spaces (described above) may be used when appropriate.

For the Small Buildings Method (WWR), enter the exterior window area, the exterior wall area, and the interior floor area for each area designated a Regularly Occupied Space. *Window Area* refers to the area of the entire window unit(s), including the frame(s). *Exterior Wall Area* refers to the interior finished face area of the exterior wall(s) in the space. *Floor Area* refers to the interior finished floor area for the space. The worksheet will automatically calculate the ratio of window-to-wall area and indicate compliance with the required threshold for the window-to-wall ratio. If the project includes any Regularly Occupied Floor Area that has no exterior wall area (a fully interior room), these spaces and floor areas should be listed in the B3 Daylighting Worksheet, Small Buildings Method tab, with 0s in the Window Area and Exterior Wall Area columns. These spaces are important for a more comprehensive understanding of the daylight conditions but are not included in the calculated ratios.

Update these calculations during the final design phase to match construction documents and represent the as-built condition as closely as possible.

Windows that are specified and installed in regularly occupied spaces should meet the visible transmittance (VLT) requirement of 0.65 or greater. Submit manufacturer's cutsheets or other supporting documentation to meet this requirement. If the VLT requirement is in conflict with other glazing requirements (e.g., bird-safe requirements), please reach out to guidelines@b3mn.org to discuss an alternative compliance option.

If pursuing Recommended Guideline I.5-D, when selecting and/or specifying light fixtures, ensure that the criteria of Color Rendering Index of 90 is listed in specifications. This information can typically be found on manufacturers' cutsheets.

If following Recommended Guideline I.5E, evaluate lighting plans and identify spaces with direct-only overhead lighting. Calculate the total connected lighting load in areas served by the direct-only overhead lighting, and if direct-only overhead lighting exceeds 25% of the total connected load, select different fixtures to meet the criteria.

[42] Defining a small building under the B3 Guidelines program is noted earlier in this document in the Applicability section.

If following Recommended Guideline I.5F, select or specify interior surfaces with reflectance to meet or exceed the values listed. This information can be found on manufacturer specifications, typically listed as a fraction of percentage light reflectance or light reflectance value. If the manufacturer's data does not include reflectance, use the methodology described in the IES Lighting Handbook to calculate the surface reflectance with a product sample or installed product.

## Submission Requirements

**Design:**

- I.5A: Submit B3 Electric Lighting Worksheet with all regularly occupied spaces listed, and with results of electric lighting simulation entered.
- I.5C: Provide building plans with facades subject to glare control indicated, and information about the glare control system under consideration.
- I.5C: Submit B3 Daylighting Worksheet with all regularly occupied spaces listed, and results of daylight calculations for chosen metric entered.

**Final Design:**

- I.5A: Submit updated B3 Electric Lighting Worksheet with all regularly occupied spaces listed, and with results of lighting simulation entered.
- I.5B: Submit lighting schedule and specifications including a requirement for CRI of 80 and RoHS compliant fixtures.
- I.5C: Provide building plans with facades subject to glare control indicated, and detailed information about the glare control system selected.
- I.5C: Submit updated B3 Daylighting Worksheet with all regularly occupied spaces listed and results of daylight simulation for chosen metric entered.
- I.5C: Submit reports and or screenshots of daylight analysis results from the simulation software. Screenshots should be clearly labeled and assembled into one file (i.e., multi-page PDF or zipped file).
- I.5C – Small Building Projects: Submit specifications indicating compliant glazing VT. Complete required inputs in B3 tracking tool, including: compliance method, daylight simulation metric and assessment tool, and daylighting simulation result.
- I.5D: Submit lighting schedule and specifications, including requirement for CRI 90.
- I.5E: Submit a narrative describing location and amount of direct-only overhead lighting.
- I.5F: Submit a narrative describing interior surface reflectance for each item listed.

**Closeout:**

- I.5B: Provide documentation of installed light fixtures and compliance with RoHS.
- I.5C: Complete required inputs in B3 tracking tool

## Additional Resources

Architecture 2030 Palette – Daylighting Patterns and Guidance: http://2030palette.org/.

Efficient Windows Collaborative (contains references, resources and simulation tools for window design and specification for daylighting): www.efficientwindows.org.

IES Lighting Handbook, 10th Edition – Electric Light Level Recommendations, Surface Reflectance Guidance: https://www.ies.org/store/lighting-handbooks/lighting-handbook-10th-edition/.

Radiance Lighting Engine: https://www.radiance-online.org/ and https://www.energy.gov/eere/buildings/downloads/radiance.

Velux Daylight Visualizer: https://www.velux.com/what-we-do/digital-tools/daylight-visualizer.

## Glossary

**Regularly Occupied Floor Area:** The total floor area within regularly occupied spaces, as defined below.

**Regularly Occupied Space:** Any space that is occupied by one or more persons for more than one hour during the days the building is in use. This includes spaces which may be irregularly occupied but, when occupied, a typical occupant would spend more than one continual hour in the space. Excluded from calculation of regularly occupied spaces are:

- Spaces with uses that only require minimal lighting and in which the primary activity intended for the space would be harmed by daylight (this exclusion does not apply to spaces with ultraviolet light concerns). This exemption only applies when meeting the requirements of I.5C – Daylighting. These spaces should be included in the B3 Electric Lighting Spreadsheet if they meet the general criteria above.
- For spaces that do not meet the minimum occupancy outlined above during daylight hours, this exemption only applies when meeting the requirements of I.5C – Daylighting. These spaces should be included in the B3 Electric Lighting Spreadsheet if they meet the general criteria above.
- Spaces where no individual occupant spends at least one continual hour during days the building is in use.

# Guideline I.6: Effective Acoustics

## Intent

To promote productive, supportive, and comfortable acoustic environments for all occupants and to control unwanted noise. Effective acoustics enable effective speech communications at normal speaking voice while providing for local speech privacy.

## Required Performance Criteria

Guidelines I.6A, I.6C, I.6D, and I.6E are required for New Construction projects and for Major Renovation projects that include replacement or alteration of relevant assemblies. Guideline I.6B is required only for New Construction projects that include 20,000 gsf or more of conditioned space and Major Renovation projects that include 20,000 gsf or more of conditioned space and include replacement or construction of relevant assemblies.

A. Newly constructed and renovated classrooms and other education facilities, including both spaces classified as occupancy group[43] E and other learning spaces and facilities for students above the 12th grade must follow ANSI S12.60–2010 Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools, Part 1: Permanent Schools.

B. Exterior-source noise control: All buildings or spaces not covered under I.6A must meet at least one of the following:

   1. A-weighted exterior-source background noise in regularly occupied spaces of the building shall be no greater than 45dBA, as evaluated after construction but prior to occupancy and tested per Annex A of ANSI S12.60–2010 Part 1.

   2. Average Outdoor-Indoor Transmission Class (OITC) rating of facades and roof assemblies shall be at least 30, or at least 40 for sites with identified risk of significant exterior-source noise. These sites include:

      i. Sites within mapped 60 dBA Day-Night Level (DNL) area for airports listed below.

      ii. Sites with an identified A-weighted outdoor noise level of 65dBA or greater as surveyed during planned occupied times and evaluated as equivalent energy level (Leq) for a period of one hour during loudest time of the day.

      iii. If the project includes residential use and the site has a DNL or Community Noise Equivalent Level (CNEL) of 45dBA or greater.

[43] Occupancy groups listed here are defined in the most recent version of the International Code Council's International Building Code.

C. Internal-source noise control: For buildings or spaces not covered under I.6A:

Projects that include 20,000 gsf or more of conditioned space and Major Renovation projects that include 20,000 gsf or more of conditioned space must meet the following requirements.[44] Projects that include less than 20,000 gsf of conditioned space and Major Renovation projects with less than 20,000 gsf of conditioned space must meet parts 2 and 3 only:

1. Air-distributed noise level from mechanical system must not exceed the following Noise Criteria (NC) levels, as estimated through the most current version of HVAC Applications HVAC Handbook, Chapter 48, Noise and Vibration Control; Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 885-2008 methodology; or ANSI S12-60 Part 1 Annex A.1.
    i. Gymnasia, circulation spaces, lobbies, service areas, and sports facilities with or without seating areas: maximum of NC 45.
    ii. Meeting, lecture halls not part of occupancy type E, offices of less than 300 sq. ft., and conference rooms: maximum of NC 35.
    iii. All other spaces: maximum of NC 40.
2. Reduce interior noise transfer through the following:
    i. Wall and floor/ceiling assemblies between occupancies achieves a Sound Transmission Class (STC) of at least that listed in the table below. If Apparent Sound Transmission Class (ASTC) ratings are used, subtract 5 from the listed STC minimums to determine ASTC minimums. If Normalized Noise Isolation Class (NNIC) is used for field verification, subtract 3 from the listed STC minimums.

    Note that Group E occupancies and other learning spaces are covered under I.6A above.

    Minimum STC ratings for regularly occupied portions of adjacent occupancy groups:

| | A | B | F | I | M | R |
|---|---|---|---|---|---|---|
| **A** | 60 | 60 | 60 | 60 | 60 | 60 |
| **B** | 60 | 50 | 60 | 50 | 50 | 50 |
| **F** | 60 | 60 | 60 | 60 | 60 | 60 |
| **I** | 60 | 50 | 60 | 50 | 50 | 50 |
| **M** | 60 | 50 | 60 | 50 | 50 | 50 |
| **R** | 60 | 50 | 60 | 50 | 50 | 50 |

    Assemblies adjacent to circulation spaces may reduce the STC requirements by 5. Spaces not regularly occupied are exempt from this requirement.

[44] This guideline is generally aligned with the method proscribed by the 2015 International Green Construction Code, though it differs on the threshold for open floor offices.

Adjacent regularly occupied spaces within occupancies shall meet the following minimums:

| | Minimum STC for assemblies within occupancy group |
|---|---|
| **A** | 55 |
| **B** | 45 |
| **F** | 50 |
| **I** | 45 |
| **M** | 45 |
| **R** | 45 |

Assemblies separating occupied spaces from storage, including Group A-4 and Group S, are exempt from this requirement.

ii. Impact Isolation Class (IIC) of floor and ceiling assemblies separating sleeping areas or dwelling units from other sleeping areas or dwelling units or other occupancies is at least 50. Assemblies separating sleeping areas or dwelling units from storage, including Group A-4 and Group S are exempt from this requirement.

iii. Ensure the following are included in the design and verified during construction:

(1) Walls continue and are sealed to bottom of floor/ceiling structure for those assemblies serving as acoustic barriers

(2) Other penetrations of intended sound barriers are limited.

(3) Consideration of other equipment or noise that will be present in the space and will be active during occupied hours. Consider separation of equipment likely to interfere with productive and comfortable acoustic environments.

iv. Ensure that wall, floor/ceiling assemblies separating mechanical rooms from other areas of the building achieve at least an STC rating of 50. If the mechanical space includes a generator, compressor, or other similar noise source, achieve an STC of at least 60 in surrounding wall and floor/ceiling assemblies. Ensure that mechanical equipment is adequately isolated to limit structure-borne sound and vibration transmission. Ensure that plumbing equipment has been adequately isolated from spaces to prevent noise transmission and noise production.

3. Room acoustics: All regularly occupied spaces must meet one of the three paths listed below subject to the noted exceptions:

i. Calculated reverberation time as evaluated for the 500 Hz, 1000 Hz, and 2000 Hz octave bands must be no less than 0.2 seconds and no greater than 0.7 seconds. This calculation may include furnishings if included in the project.

ii. The average area-weighted noise-reduction coefficient (NRC) of all of the interior surface materials or assemblies of the space is greater than 0.45. This calculation may include furnishings if included in the project.

iii. The average area-weighted NRC of all interior surface materials or assemblies of the space is greater than 0.35 for spaces with volumes less than 30,000 cu. ft. This calculation may include furnishings if included in the project.

Exceptions:

- Concert halls or other music performance auditoria, laboratory spaces, aquatic facilities, and gymnasia are exempt from this requirement.
- Open-office floor plans may have a reverberation time of up to 0.8 seconds or an area-weighted NRC as low as 0.30.

D. Adequate acoustic conditions of gathering spaces and accommodation for hard-of-hearing: This is coordinated with Minnesota Statute §16C.054. For all spaces which accommodate and are intended for gatherings of 15 or more people and where audible communications is integral to the use of the space:

1. Include audio-induction loops to provide an electromagnetic signal for hearing aids and cochlear implants if a permanent audio amplification system is present in the space.
2. The space must meet the American National Standards Institute Acoustical Performance Criteria, Design Requirements and Guidelines for Schools for:
   i. Maximum background noise
   ii. Reverberation times

E. Implement sound masking if any of the following condition are met:[45]

1. Internal-source noise control: Projects which are not compliant with I.6A, I.6B, or I.6C where other sound-privacy measures have not been met. It is not necessary or advisable to implement sound masking in all spaces not compliant with listed guidelines, though shall be implemented in noncompliant open-plan office areas, libraries, and other areas where the need for speech privacy and masking exceeds the need for speech intelligibility.
2. Spaces which have been identified as requiring additional sound privacy, or where the productivity benefits of sound masking are desired in areas that are anticipated to be over-quiet.

Sound masking system shall not exceed 45dBA and shall be broad spectrum.

## Recommended Performance Criteria

F. Confirm performance under I.6A for educational facilities by performing noise measurement as outlined under ANSI/ASA S.12.60-2010 Annex A.

G. Articulation Index (AI) must be less than 0.30 for open offices, where speech privacy is desired, and greater than 0.70 for enclosed offices or other spaces where a high level of speech intelligibility is desired. Compliance with this requirement involves:
   1. Identification of at least two areas of indented speech privacy and areas of desired communicability.
   2. Documentation that the design meets the AI for these identified spaces.

[45] Similar to credit available under LEEDv4.

## Meeting the Guidelines

Indoor acoustic environments have been identified as an area many surveyed occupants find dissatisfactory. Improving the indoor acoustic condition is generally done by the consideration of controlling noise (i.e., unwanted sound) and by supporting the transfer or reverberation of desired sound. As the appropriate level of these criteria varies with different outdoor conditions, occupancy types, noise source and space types, there are an array of strategies necessary to help ensure a productive, supportive, and comfortable indoor environment.

Early in the design process identify which of the guidelines will be required for each room and wall/room assembly. Develop a list of occupancy types if more than one occupancy type is present in the project. In particular, note that education spaces (occupancy type E) and other classroom and learning environments must meet the listed ANSI Standard, which includes requirements for core learning spaces (under 20,000 cu. ft.) and ancillary learning spaces. List specific room criteria for each of the space types (i.e., classrooms, conference rooms, etc.) and verify that the anticipated schedule of finishes, wall, and floor/ceiling types will be anticipated to meet these criteria. Adjust design as necessary to meet criteria, including reverberation time, AI (if pursuing I.6G), and sound insulation requirements of interior and exterior wall and floor/ceiling assemblies. List anticipated wall types expected to be used in the project and ensure that they meet the sound insulating requirements laid out in I.6A through I.6C.

The noise present on the site may be evaluated by use of an integrating-averaging sound level meter, which can record and evaluate sound on the site. This measurement can be used both for the evaluation of Leq levels and DNL levels to determine if OITC ratings must be addressed. Currently, the Minneapolis-Saint Paul International Airport (MSP) is the only available airport with DNL mapping, and it is listed below under Additional Resources. The United States Department of Housing and Urban Development (HUD) DNL calculator may also be used if there are no other significant external noise sources other than road and rail; this calculator is also listed below under Additional Resources. When OITC ratings are unavailable for an assembly under evaluation, the OITC may be estimated by reducing the STC by 11:

$$estimated\ OITC\ =\ STC\ -\ 11$$

Calculation of airborne noise from HVAC systems may be done per the AHRI 885 methodology using the spreadsheet-based calculator listed below (under Additional Resources) for air terminal units or by using the ASHRAE Handbook - Fundamentals methodology listed for other system types. Here the source noise and effect of duct size, characteristics and distribution is used to calculate the NC in the resulting space. This additionally permits designs that test with NC over the allowable limit to quickly evaluate potential remedies that would bring the receiving space into compliance. Use of this calculation method may influence duct sizing and layout and as such is best done as early as feasible in the design and mechanical layout process to avoid redesign. Projects may evaluate compliance with I.6C.1 based on representative spaces rather than calculating each room in the project.

Limiting undesirable long reverberation times in larger, more “live” spaces may necessitate additional consideration of interior finishes and furnishings. Projects may evaluate the design of representative spaces for reverberation times if their interior finish materials are predominately the same and square footages and ceiling heights are within 20%. Areas with different floor or ceiling finish types may not be considered to be acoustically representative. Smaller spaces may be able to meet the reverberation time requirements with a lower average NRC through a calculation of reverberation time than they can through the prescriptive approach through I.6C Part 3ii. A simple reverberation time calculator is listed below under Additional Resources.

Include performance criteria necessary to meet guideline requirements in the construction drawings and specifications of the project. Ensure that details have been developed that avoid sound transmission. Note that uncontrolled sound transfer can easily occur at the joint of wall/ceiling assemblies if not properly detailed, and at the connection of interior to exterior wall assemblies.

## Submittal Requirements

**Predesign:**

- I.6B: Identification of whether the project is a high risk outdoor noise environment.

**Design:**

- I.6A: Identification of spaces required to meet guideline, if any. Provide list of spaces identified as core learning spaces and ancillary learning spaces with background noise level, reverberation time, and other room and assembly acoustic criteria as defined in ANSI Standard. List the A-weighted outdoor noise level as measured under Part 5.4.1.1 of the guideline and the resulting OITC requirement.
- I.6B: Identification of whether the project is high risk outdoor noise environment, included documentation of selected method of compliance, including enclosure OITC rating.
- I.6C: List preliminary wall types and wall/ceiling assemblies in project compliant with STC rating requirements. List rooms in project and preliminary assessment of reverberation times and NC. List spaces identified as exempt from reverberation time requirements. If multiple spaces have generally equivalent size, wall assemblies, and finishes, then representative calculations can serve in lieu of calculation of every space in the project.
- I.6D: List gathering spaces of project which trigger guideline requirements and preliminary planning for required system and noise control.

**Final Design:**

- I.6A: Identification of spaces required to meet guideline, if any. Provide list of spaces identified as core learning spaces with background noise level, reverberation time and other room and assembly acoustic criteria as defined in ANSI Standard. List the A-weighted outdoor noise level as measured under Part 5.4.1.1 of the guideline and the resulting OITC requirement.
- I.6B: Identification of whether the project is a high risk outdoor noise environment, included documentation of selected method of compliance, including enclosure OITC rating.
- I.6C: List wall types and floor/ceiling assemblies in project compliant with STC rating requirements. List rooms in project and assessment of reverberation times (or NRC if used) and NC. Determination of NC levels is not required for Small Building projects. List spaces identified as exempt from reverberation time requirements. If multiple spaces have generally equivalent size, wall assemblies, and finishes, then representative calculations can serve in lieu of calculation of every space in the project.
- I.6D: List gathering spaces of project which trigger guideline requirements. Describe design of induction loop system and evaluation of reverberation time and outdoor noise control for required spaces.
- I.6G: List open and enclosed office spaces and anticipated AI.

**Closeout:**

- I.6A: Verification of installed condition meets requirements for core and ancillary learning spaces.

- I.6B: Verification of final enclosure OITC rating(s).
- I.6C: Verification that installed wall types and wall/ceiling assemblies in project compliant with STC rating requirements. Verification or updating of calculated reverberation times based on installed condition.
- I.6D: Verification of installation of required systems.
- I.6F: Documentation of verification of conformance with ANSI/ASA S.12.60 per Annex A.
- I.6G: List open and enclosed office spaces and measured AI (if documenting compliance through measurement).

## Additional Resources

AHRI 885 Calculator (calculates the discharge, radiated, and room sounds for various duct sizes and arrangements using AHRI 885 methodology):
http://www.ahrinet.org/App_Content/ahri/files/standards%20pdfs/EXCEL%20Docs/AHRI%20Standard%20885-2008%20Duct%20Discharge%20Calculation%20Spreadsheet.xls.

AHRI Standard 885:
http://www.ahrinet.org/App_Content/ahri/files/STANDARDS/AHRI/AHRI_Standard_885_2008_with_Addendum_1.pdf

IRCAM (French research project with useful publications and free software): www.ircam.fr.

HUD DNL Calculator: https://www.hudexchange.info/programs/environmental-review/dnl-calculator/

SARA (Spatial Audio & Room Acoustics Project from the Academy of Finland):
www.acoustics.hut.fi/~vpv/projects/sara.htm.

The Engineering Toolbox Architectural Acoustic Calculator: http://www.engineeringtoolbox.com/room-absorption-sound-d_69.html.

Minneapolis-Saint Paul 2017 International Airport (MSP) 2017 Annual Noise Contour Report:
https://www.macnoise.com/pdf/final-msp-2017-annual-noise-contour-report-web.pdf.

ODEON Room Acoustics Modeling Software: www.odeon.dk.

## Glossary

**Regularly Occupied Space:**

Any space that is occupied by one or more persons for more than one hour during days the building is in use. Note that this includes spaces which may be irregularly occupied but, when occupied, a typical occupant would spend more than one continual hour in the space. Excluded from calculation of continuously occupied spaces are:

- Spaces with uses that only require minimal lighting and in which the primary activity intended for the space would be harmed by daylight (this exclusion does not apply to spaces with ultraviolet light concerns) – note that this only applies to the calculation of regularly occupied spaces with respect to the daylighting requirements.
- Spaces that do not meet the minimum occupancy outlined above during daylight hours) – note that this only applies to the calculation of regularly occupied spaces for the daylighting criteria with respect to the daylighting requirements.
- Spaces where no individual occupant spends at least one continual hour during days the building is in use.

# Guideline I.7 View Space and Window Access

## Intent

To provide focal relief and promote a connection the outdoor environment. A distant interior focal point-of-view to the outdoors can help reduce eyestrain and dry eyes from computer-based work, and building occupants who can connect to the outdoors experience greater productivity, attentiveness, and satisfaction. Outdoor views also provide a connection to environmental cues that support natural circadian rhythms.

## Required Performance Criteria

Guideline I.7A is required only for New Construction projects that include 20,000 gsf or more of conditioned space and Major Renovation projects that include 20,000 gsf or more of conditioned space and include construction, replacement, or alteration of relevant systems or assemblies. Guideline I.7B is required for New Construction and Major Renovation projects that include replacement or construction of relevant assemblies.

A. For focal relief, provide a direct line of sight to vision glazing or interior focal point for 75% of all regularly occupied floor area. Area contributing to the 75% requirement shall include a view of objects at least 25 ft. from occupant location.

B. To foster a connection to the outdoor environment, provide direct or borrowed access to vision glazing in 75% of all regularly occupied spaces. Vision glazing must have a clear and unobstructed view to the exterior and include at least one of the following:

   1. Movement (may be vehicular or human movement outside of subject area)
   2. Flora
   3. Fauna
   4. Sky
   5. Water

## Recommended Performance Criteria

C. Foster a connection to the outdoor environment by providing direct or borrowed access to vision glazing in all regularly occupied spaces. Vision glazing must have a clear and unobstructed view to the exterior and include at least one of the following:

   1. Movement (may be vehicular or human movement outside of subject area)
   2. Flora
   3. Fauna
   4. Sky
   5. Water

D. Provide operable windows:

   1. In offices, all workstations shall be within 30 ft. of an operable window.
   2. Provide operable windows in all dwelling units.

## Meeting the Guidelines

During Predesign and schematic design, work with client to identify desirable outdoor views. If no desirable views are possible, consider an interior courtyard space. As design progresses, consider the placement of program spaces as they relate to views to the exterior or to an interior courtyard. As floorplans are developed, note the floor areas in regularly occupied spaces and the corresponding requirements for access to vision glazing. Map sightlines and floor area with view access. Include permanently installed furniture in consideration of sightlines and views. If following recommended performance criteria, identify which facades or window areas can be operable, and arrange program spaces to provide access to operable windows from workstations and in dwelling units.

## Submission Requirements

**Design:**

- I.7A: Submit preliminary floor plans for regularly occupied floor area, with identified sight lines to focal points at least 25 ft. from occupant location(s).
- I.7B and I.7C: Create preliminary plan indicating floor area served, vision glazing contributing to compliance, and view availability of at least one of the listed items.

**Final Design:**

- I.7A: Submit final design floor plans for regularly occupied floor area, with identified sight lines to focal points at least 25 ft. from occupant location(s).
- I.7B and I.7C: Create final design plan indicating floor area served, vision glazing contributing to compliance, and view availability of at least two of the listed items.
- I.7D: Create plan demonstrating workstation distance to operable windows for regularly occupied spaces and in dwelling units if provided.

## Glossary

**Borrowed Views:**

Exterior view achieved through another interior space, particularly through transparent or partial height workstation and room partitions.

**Regularly Occupied Space:**

Any space that is occupied by one or more persons for more than one hour during days the building is in use. Note that this includes spaces which may be irregularly occupied but, when occupied, a typical occupant would spend more than one continual hour in the space. Excluded from calculation of continuously occupied spaces are:

- Spaces with uses that only require minimal lighting and in which the primary activity intended for the space would be harmed by daylight (this exclusion does not apply to spaces with ultraviolet light concerns) – note that this only applies to the calculation of regularly occupied spaces with respect to the daylighting requirements.

- Spaces that do not meet the minimum occupancy outlined above during daylight hours) – note that this only applies to the calculation of regularly occupied spaces for the daylighting criteria with respect to the daylighting requirements.
- Spaces where no individual occupant spends at least one continual hour during days the building is in use.

**Vision Glazing:**

Vision glazing refers to glazing which permits an unobstructed view to the exterior. Typical vision glazing does not have perceptible tint or other modification that would impede these views and is installed between 2.5 ft. and 7.5 ft. above the floor height.

# Guideline I.8: Ergonomics and Physical Activity

## Intent

To promote spatial conditions conducive to incidental physical activity. Movement helps maintain cardiovascular fitness, mental alertness, and encourages interactions that improve morale and well-being. Quality ergonomic design reduces the risk of workplace-related injury and increases productivity.

## Required Performance Criteria

Guideline I.8A and I.8B are required for New Construction projects and for Major Renovation projects that include relevant project scope. Guidelines I.8C, and I.8D are required only for New Construction projects that include 20,000 gsf or more of conditioned space and Major Renovation projects that include 20,000 gsf or more of conditioned space and include relevant project scope.

A. If workstation furniture is included as part of the project, provide sit-stand desks that are available to all employees and in at least 25% of workstations. Workstations may be height adjustable or equipped with height adjustment stands.

B. Provide workstation seating with adjustable chair height, seat depth, and at least one of the following: adjustable seat angle, adjustable backrest angle, fully or partially adjustable armrests, or adjustable lumbar support.

C. On project sites with access to existing nonmotorized transportation infrastructure, provide the following secure nonmotorized vehicle storage:

   1. Nonmotorized vehicle storage within 650 ft. of main building entrance for at least 5% of regular building occupants.

   2. Nonmotorized vehicle storage within 650 ft. of main building entrance for at least 2% of building visitors.

D. Promote the use of stairs by providing at least one staircase that is easy to locate for building occupants and visitors, accesses all regularly occupied floors and building main entrance, and is aesthetically pleasing. This staircase may be an enclosed egress stair.

## Recommended Performance Criteria

E. In buildings with more than ten regular occupants, provide showers, changing facilities, and lockers for a minimum of 1% of all regular building occupants.[46]

F. Provide outdoor recreation area/open space greater than or equal to 30% of total site area that is accessible to all regular occupants of building.

G. To foster connection to neighborhood, select sites:[47]

   1. With a building site Walk Score of at least 70.

[46] This guideline is aligned with credits available under the Fitwel Certification Program, LEEDv4, and The WELL Building Standard.
[47] This guideline is aligned with credits available under the Fitwel Certification Program, CHPS, and The WELL Building Standard.

2. Located within a maximum of one-third mile from at least five basic services, such as a supermarket, hardware store, bank, and food establishments.
3. Where sidewalks and bike lanes can be extended from building to edge of site to connect to existing and planned pedestrian paths.

H. Signage and education:[48]

1. Provide point-of-decision prompts promoting use of stairs rather than elevator.
2. Provide signage of walkable and bikeable attractions nearby.

## Meeting the Guidelines

During design, work with owner to establish goals and priorities for ergonomics of workspaces within the project. Identify the number of adjustable workstations required, where they will be located, and who will use them.

Identify the number of regular building occupants and anticipated visitors, calculate nonmotorized vehicle parking requirements, and locate nonmotorized vehicle parking in secure area.

If project has multiple levels, establish a staircase to be visible and enticing. This stairway may also function as egress stair. Design and document features of stairwell.

If pursuing Recommended Criteria I.F, identify need for showers and changing facilities in the project and establish space and fixtures required.

If pursuing Recommended Criteria I.G, calculate required outdoor recreation area and locate the recreation area on the site. Provide accessible routes to recreation area.

If pursuing Recommended Criteria I.H, during site selection, compare potential project sites on https://www.walkscore.com and map nearby basic services. During design, establish site setbacks or other limitations on sidewalks and bike lanes, document site circulation strategy as it relates to general public circulation.

If pursuing Recommended Criteria I.H, create visually appealing and clearly understandable graphics promoting use of stairs rather than elevator for those able. Create visually appealing and clearly understandable graphic showing nearby attractions, particularly those in the walkable (.25–.5 mile) and bikeable (2.5 miles) area.[49]

## Submission Requirements

**Design:**

- I.8A: Planned standing height desk selection and number available to occupants.
- I.8B: Planned workstation seating selection.
- I.8C: Preliminary site or building plan indicating location(s) for nonmotorized vehicle parking.

[48] This guideline is aligned with credits available under the Fitwel Certification Program.

[49] Distances listed derived from "Creating Walkable and Bikeable Communities" US Department of Housing and Urban Development – Office of Policy and Research. Dec 2016

- I.8D: Preliminary building plan indicating stair location, narrative description of measures implemented to improve visibility and desirability.
- I.8E: Preliminary building plan indicating location of showers, changing facilities, and lockers meeting guideline requirements.
- I.8F: Preliminary site plan indicating outdoor recreation area.
- I.8G: Documentation of connection to neighborhood, including Walk Score, diagram of nearby services, site plan indication connections achieved and outdoor recreation area meeting minimum site percentage requirements.

**Final Design:**

- I.8A: Description of standing height desk selected and number available to occupants, including specifications or purchasing requirements listed.
- I.8B: Description of workstation seating selected, including specifications or purchasing requirements listed.
- I.8C: Final site or building plan indicating location(s) for nonmotorized vehicle parking.
- I.8D: Final building plan indicating stair location, narrative description of measures implemented to improve visibility and desirability.
- I.8H: Narrative describing site signage and image of signage to be installed.

**Closeout:**

- I.8A: Description of installed standing height desk mechanism and number available to occupants, including specifications or purchasing requirements listed.
- I.8B: Description of workstation seating, including specifications or purchasing requirements listed.
- I.8C: Final site or building plan indicating location(s) for nonmotorized vehicle parking.
- I.8D: Final building plan indicating stair location, narrative description of measures implemented to improve visibility and desirability.
- I.8I: Narrative describing site signage.

## Additional Resources

Creating Walkable and Bikeable Communities. US Department of Housing and Urban Development: https://www.huduser.gov/portal/sites/default/files/pdf/Creating-Walkable-Bikeable-Communities.pdf.

University at Texas at Austin Physical Specifications for Lactation/Quiet Rooms: https://hr.utexas.edu/sites/hr.utexas.edu/files/LQR_PhysicalRoomSpecs.pdf.

Walk Score: https://www.walkscore.com/cities-and-neighborhoods/.

# Guideline I.9 Wayfinding and Universal Access

## Intent

To ensure that buildings can be used by all regular occupants, visitors, and other users regardless of age, gender, culture, or ability level. Wayfinding enhances users' experience with the building and facilitates movement to and within it, thereby reducing stress and supporting safety and security. This guideline supports the social and equitable aspects of sustainable design that ensure all people have access to high quality and high performance projects.

## Required Performance Criteria

Guidelines I.9C and I.9D are required for New Construction projects and for Major Renovation projects that include relevant project scope. Guidelines I.9A and I.9B are required only for New Construction projects that include 20,000 gsf or more of conditioned space and Major Renovation projects that include 20,000 gsf or more of conditioned space and include relevant project scope.

A. Exterior wayfinding:

   1. Provide signage (including verbal and pictorial communication) to identify parking areas (including for human powered vehicles), buildings, and entrances.
   2. Provide signage to clearly delineate accessible parking and access routes.
   3. Provide lighting on exterior including sign elements.

B. Interior wayfinding: For projects with public access or for which the program includes regular visitors to the site:[50]

   1. Establish clear routes to common destinations, particularly destinations sought by visitors to the building.
   2. Identify all destinations using consistent language, color, or other cues.
   3. Use symbols and icons to bridge language barriers.
   4. Provide clear, concise, and consistent signs that have strong contrast and visibility.
   5. Provide adequate lighting for interior signs.
   6. Provide signs at decision points (places in which the navigator must make a decision such as whether to continue straight or turn).
   7. Identify spaces, groups of spaces, linking, and organization of spaces, and communicate with building users.

[50] Adapted from *International Health Facility Guidelines,* Part W, "Wayfinding." 2017.

C. Universal Design Principles: Implement at least three of the following in the design and operation of the project:[51]

1. Equitable use: Ensure the building and site are useful and marketable to people with diverse abilities.
2. Flexibility in use: Ensure the building and site accommodate a wide range of individual preferences and abilities.
3. Simple and intuitive use: Ensure the use of the building and site is easy to understand, regardless of user's experience, knowledge, language skills, or current concentration level.
4. Perceptible information: Ensure the building and site communicate necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities.
5. Tolerance for error: Ensure the building and site minimize the hazards and the adverse consequences of accidental or unintended actions.
6. Low physical effort: Ensure the building and site can be used efficiently and comfortably and with a minimum of fatigue.
7. Size and space for approach and use: Ensure appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility.

D. Provide at least one dedicated, reservable, lockable, private room that is accessible to all regular building occupants for lactation or other quiet use. The lactation room must include:[52]

1. A comfortable chair with an accessible outlet.
2. A sink.
3. Counter space, waste receptacle, and hand cleaning supplies.

This is only required for buildings with nonresidential, regularly occupied space, and is assumed to be satisfied for building occupants with access to residential units on premise.

## Meeting the Guidelines

During Predesign and concept development, work with owner to establish wayfinding needs and strategy. Identify user groups who may rely on wayfinding when visiting or occupying the building. Develop and document a wayfinding strategy that works within project scope, budget, and design intent and can be applied consistently across the project.

Work with owner to establish universal design goals and select universal design principles that will be addressed in the project. Review strategies (see Additional Resources) that contribute to universal and inclusive design and select approaches that work within project scope, budget, and design intent.

During schematic design, document and describe strategies employed in project for at least three universal design principles. Document wayfinding strategy and implementation including design and placement of signage and other wayfinding cues.

[51] Adapted from *Inclusive Design in the Built Environment,* Sandra Manley. 2016

[52] This guideline is aligned with credits available under the Fitwel Certification Program.

Work with owner to determine number of and characteristics of lactation/quiet room(s). These spaces should be easily accessible and adaptable, and pleasant to use.

If post-occupancy evaluations are conducted, address issues that arise regarding wayfinding and universal access.

## Submittal Requirements

**Design:**

- I.9A: Preliminary site plan indicating signage location for all parking areas, building entrances, handicap parking and access routes.
- I.9B: Preliminary description of wayfinding strategies and execution.
- I.9C: Preliminary description outlining intended project compliance method and identification of at least three criteria project is expected to meet.
- I.9D: Preliminary building plan indicating location of LQR meeting guideline requirements.

**Final Design:**

- I.9A: Final site plan indicating signage location for all parking areas, building entrances, accessible parking, and access routes. Provide images of project signage and electrical plan for providing lighting as necessary.
- I.9B: Final description of wayfinding strategies and execution, including annotated floor plan indicating location of implemented strategies.
- I.9C: Description outlining project compliance method and identification of at least three criteria included in project design.
- I.9D: Final building plan indicating location of lactation rooms meeting guideline requirements.

## Additional Resources

AIA Best Practices for Lactation Room Design:
https://www.aia.org/best-practices/17116-recommendations-for-designing-lactationwelln.

Design Resources: DR-01 Architectural Wayfinding. Center for Inclusive Design and Environmental Access, University of Buffalo School of Architecture and Planning:
https://udeworld.com/documents/designresources/pdfs/ArchitecturalWayfinding.pdf.

Health Facility Guidelines, Part W, “Wayfinding Design Principles”:
http://healthfacilityguidelines.com/Guidelines/ViewPDF/iHFG/iHFG_part_w_wayfinding_design_principles.

Inclusive Design in the Built Environment. Design Commission for Wales: https://s3-eu-west-1.amazonaws.com/dcfw-cdn/InclusiveDesign_traininghandbook.pdf.

Inclusive Design Standards. London Legacy Development Corporation:
http://www.queenelizabetholympicpark.co.uk/~/media/qeop/files/public/inclusivedesignstandardsmarch2013.pdf.

Wayfinding Design Guidelines, Cooperative Research Centre for Construction Information:
http://www.hpw.qld.gov.au/sitecollectiondocuments/wayfindingdesignguidelines.pdf.

# Material and Waste Guidelines

## Intent

To reduce embodied environmental impact and toxicity in the building materials.

**Which products relate to which guidelines?**

Different products contribute to compliance in different guideline categories. The table below lists which guidelines are related to only *interior materials* and which guidelines may be met using any product selected for the project. This includes Guideline I.1 as it relates to product selection.

| | I.1: Low Emitting Materials | M.1B: Product Life Cycle Assessments | M.1: Environmentally Preferable Materials | M.4: Health |
|---|---|---|---|---|
| **Interior Materials (see definition under I.1)** | All interior materials in project must comply with I.1 | | | 10 materials required (if one of most common it may be double counted) |
| **Any Materials in Project** | | 5 materials required~~, may be any used in project~~ at a minimum, see Guideline M.1B for reporting requirements for specific material categories | 55% of all materials are required, some may contribute in multiple categories, so actual % of contributing materials may be lower | |

**General Material Information:**

The following information is collected in the Materials section of the B3 Guidelines Tracking Tool, under Section M.0:

**Final Design:**

- Material strategies used, including narrative.

# Guideline M.1: Life Cycle Assessment

## Intent

To use life cycle analysis to quantify and minimize the environmental impact of building materials, which have significant effects on global warming, air pollution, water pollution, energy consumption, and waste.

## Required Performance Criteria

Guideline M.1A applies to New Construction projects, including additions. Guidelines M.1B is required only for New Construction and Major Renovation projects that include 20,000 gsf or more of conditioned space.

A. Whole-Building Life Cycle Assessment (LCA):
Demonstrate a reduction in life cycle Global Warming Potential (GWP) of the building's construction materials through building massing, structural design, dematerialization, and alternative assembly and material selection. This credit shall be met by documenting GWP reduction using one of the three listed compliance paths and by using one of the approved whole-building LCA software tools to complete a whole-building LCA model. A whole-building LCA model representing the final design of the project is required regardless of the chosen GWP reduction compliance path.

1. GWP Reduction Documentation Paths:
   i. GWP Reduction Path 1: Whole-Building LCA Approach
   This path may be used for any building scenario and will provide a basis for comparing the impact-reduction strategies with the most potential. These include whole-building strategies such as changes to the building plan to optimize shape, layout, and surface area of assemblies. Impacts from assembly and material selections may also be documented by using this path.
   Following this path, use whole-building LCA models to document a 10% reduction in GWP. The basis for this reduction is a comparison between the Selected Building Design (the design of the building at the end of the CD phase, representing the final design of the building) and the Reference Building, developed by the end of the SD phase and updated as needed. There are several methods for creating the Reference Building discussed in more detail below.[53]
   ii. GWP Reduction Path 2: Assembly-Level LCA Approach
   This path requires the utilization of an LCA model of a representative portion of the building to document a 10% reduction in GWP. This approach is fundamentally similar to Path 1, but a smaller functional unit based on structural bays or another representative unit is modeled in lieu of the whole building. The basis for this 10% reduction is a comparison between the Selected Design - Partial (the final design of the selected structural bays) to the Reference Model - Partial, developed by the end of the SD phase and updated as needed.
   This compliance path provides a basis for comparing assembly-level and material-level impact reduction strategies but cannot be used with building-level strategies such as massing and layout. Projects using this path that include more than 20,000gsf of conditioned space must also complete and submit a whole-building LCA model at the completion of design.

[53] This compliance path closely follows the requirements of USGBC, "Materials and Resources Credit: Building Life-Cycle Impact Reduction," *LEED Building Design and Construction v.4*, with several key changes.

iii. GWP Reduction Path 3: Material-Level LCA Approach

Use the B3 LCA Material Selection Calculator to document that the building's primary construction materials achieve an Impact Score of 1.6 or less. Projects following the B3 Guidelines Small Building Path may show compliance by achieving an Impact Score of 1.75 or less.

This compliance path may be used when the design team is only evaluating material substitutions to reduce GWP (e.g., exchanging one type of cladding for another). It does not compare impacts of broader building-level or assembly-level impact reduction strategies. This compliance path is limited to building projects that utilize one dominant structural and enclosure type, which must make up at least 60% of the building's structural volume and exterior surface area respectively. This compliance path is additionally limited to projects utilizing assemblies and materials that are well approximated by the assemblies and materials contained in the B3 LCA Material Selection Calculator. Projects using this path that include more than 20,000gsf of conditioned space must also complete and submit a whole-building LCA model at the completion of design.

2. Whole-Building LCA Model:

New Construction projects, including additions, that include 20,000 gsf or more of conditioned space shall submit a whole-building LCA model representing the final design of the project. This LCA building model must be completed using Approved Whole-Building LCA Software Tools. This model should be submitted at the end of the CD phase and represent the final design of the building. If Path 1, Whole-Building LCA Approach was selected to document GWP reduction, the Selected Building Design LCA model from that approach fulfills this requirement. Whole-building LCA models must follow the requirements as listed in Meeting the Guidelines: M.1A Section below.

B. Product Life-Cycle Assessments[54]

Use at least 5 different permanently installed products sourced from at least five different manufacturers that meet one of the disclosure criteria below:

1. Product-specific declaration.
   i. Products with a publicly available, critically reviewed life-cycle assessment conforming to ISO 14044 that report impacts from at least cradle to gate.
2. Environmental Product Declarations (EPD) which conform to ISO 14025, 14040, 14044, and EN 15804 or ISO 21930 and have at least a cradle-to-gate scope.
   i. Industry-wide (generic) EPD – Products with third-party certification (Type III), including external verification, in which the manufacturer is explicitly recognized as a participant by the program operator are valued as one-half (½) of a product for purposes of compliance.
   ii. Product-specific Type III EPD – Products with third-party certification (Type III), including external verification, in which the manufacturer is explicitly recognized as the participant by the program operator are valued as one whole product for purposes of compliance.
   iii. Beginning on February 1, 2026, projects will be required to submit third-party verified EPDs for all materials/products listed Table M1b-2 in the Meeting the Guidelines section and submit a completed EPD Reporting Template, available as Appendix M-1b. If a valid EPD is not available for a material/product, material data and quantity information will still be required to be submitted, with additional notation either in a separate written statement or within the EPD Reporting Template, detailing the reasoning and the steps

[54] This guideline is aligned with the International Green Construction Code and ANSI/ASHRAE/USGBC/IES Standard 189.1, "9.4.1.4 Multiple-Attribute Product Declaration or Certification," some language also shared with LEED v.4.

that the project team has taken in an effort to obtain an EPD. EPD disclosure for these material categories will remain voluntary until the date specified above, at which time EPD disclosure will become mandatory to align with any/all requirements of the State of Minnesota's Buy Clean policy.

## Meeting the Guidelines: M1A

**Approved Whole-Building LCA Software Tools**

- Tally
- Athena Impact Estimator
- One Click LCA

For other methods, please contact guidelines@b3mn.org to request evaluation of additional methods of whole-building LCA evaluation. This list will be updated if other methods are approved.

**Allowable GWP Impact Reduction Strategies by Path.**

The strategies that can be used to reduce environmental impacts vary by path; below is a summary of the options available under the three compliance paths:

| Impact Reduction Strategies | Path 1<br>Whole-Building | Path 2<br>Assembly Level | Path 3<br>Material Level |
|---|---|---|---|
| Building size (floor area) | no | no | no |
| Building service life | no | no | no |
| Building shape (layout, surface area) | yes | no | no |
| Building structural spacing (grid layout) | yes | no | no |
| Assembly substitutions (swap types) | yes | yes | no |
| Assembly design changes (thicknesses and layers of materials) | yes | yes | no |
| Window-to-wall area ratio changes | yes | yes | no |
| Floor-to-floor height changes | yes | yes | no |
| Structure design changes (type and sizing of beams + columns) | yes | yes | no |
| Material substitutions | yes | yes | yes |

**Whole-Building LCA Model Requirements:**

Requirements of the whole-building LCA model:[55]

1. Building service life shall be 60 years.

[55] These whole-building LCA requirements are aligned in part on USGBC, "Materials and Resources Credit: Building Life-Cycle Impact Reduction," *LEED Building Design and Construction v.4*, with some changes noted.

2. The scope of the assessment must include EN15978 Phases A1–A5, B1–B5, and C1–C4 (cradle to grave) but omit phase D (beyond building life). Building operational energy and water use (Phases B6, B7) are not included for this requirement though both the Selected Building Design and the Reference Building must meet current B3 and SB 2030 requirements.
3. The LCA models must include the complete building enclosure from the interior to the exterior layer, structural elements (posts, beams, bearing walls), including the intermediate floors and foundation and any attached parking structures.
4. All interior finishes shall be omitted with the exception of those on exterior above and below grade walls.
5. The LCA models shall omit electrical and mechanical equipment including elevators, pipes, plumbing fixtures, and control systems, as well as items exterior to the building such as landscaping and surface parking lots.
6. The Selected Building Design and Reference Building must be functionally equivalent. They must serve the same program, same gross floor area, and the same operational energy and water efficiency. The operational energy and water use for both the Selected Building Design and the Reference Building must meet current B3/SB 2030 requirements.[56]

**GWP Reduction Documentation Options:**

Documenting a 10% GWP reduction for a building's construction materials often requires early-phase design changes, which necessitate a start to LCA evaluation in the schematic design phase. Substantial changes to a building's structure, envelope, or building plan may be necessary. This often requires coordination between multiple team members – architects, structural engineers, and building owners.

**GWP Reduction Path 1 – Whole-Building LCA Approach**[57]

Defining the Reference Building:

The Reference Building LCA model should be completed early in the SD phase so it can be used as a benchmark for comparing design cases and gauging GWP reductions. For Path 1, the total area of exterior walls, floors, and roofs may differ between the Reference Building and the design cases to account for optimization in building shape, layout, and surface area. The Reference Building and Selected Building Design must remain functionally equivalent, with equal floor area and space use types. Water and energy consumption must be approximately equal and meet current SB 2030 standards.

There are a variety of valid approaches for defining the Reference Building.[58] The design team performing the LCA analysis may choose from the following options to best meet their needs:

1. Early design case – an early design for the building under study.
2. Existing building – a real-world benchmark, modified to match the floor area and energy efficiency of the project.

~~[56] Differs from LEED v.4 credit: Interior nonstructural walls and assemblies should be omitted from the LCA models.~~

~~[57] Differs from LEED v.4 credit: For compliance with this requirement (M.1a), a 10% reduction is required for GWP only. Impacts in other environmental indicator categories such as eutrophication potential and acidification potential should be monitored, but performance improvements are not required in those areas. Compliance options 1, 2, and 3 of USGBC, "Materials and Resources Credit: Building Life-Cycle Impact Reduction," *LEED Building Design and Construction v.4* will not be considered as a compliance paths for this credit.~~

~~[58] Reference Building options and descriptions follow LEED v.4 credit requirements.~~

3. Building archetype – a design similar to an existing building modified to match the floor area and energy efficiency of the project.
4. Alternative design – a design based on the project design but that is more reflective of industry-standard materials and practices.

**GWP Reduction Path 2 – Assembly-Level LCA Approach**

The functional unit used in this path to document GWP reduction is a representative slice through the building incorporating the most common construction assemblies. It must extend from exterior wall to the opposite exterior wall and from the foundation to the roof. For buildings with structural bays this should incorporate at least two bays. For buildings without structural bays, project teams should contact B3 Guidelines Support to ask for guidance on selecting and sizing an appropriate functional unit for modeling. All applicable whole-building LCA modeling requirements (as listed in Meeting the Guidelines Part 1a–g) should be applied to the LCA models.

**GWP Reduction Path 3 – Material-Level LCA Approach**

To use this path, the building design and design team must comply with the following requirements.

1. The project must have one dominant structural and enclosure type, comprising at least 60% of the building's structural volume and exterior surface area respectively.
2. This method only documents GWP reductions from material substitutions.
3. The building project is limited to the selection of materials that are well approximated by the assemblies and materials contained in the Path 3 B3 LCA Material Selection Calculator.

**Using B3 LCA Material Selection Calculator:**

The calculator contains a database with GWP impacts for ten different categories of material, such as cladding and roofing. Only one material type may be selected per category, and it must make up 60% or more of the material used by the building in that category (i.e., it must be the primary material type). If a building does not contain material in a particular category, that category must be entered as NA.

Within the calculator's database, specific materials are ranked by their GWP impact. The lowest GWP materials are assigned a material Impact Score group number of 1 or 2. Materials with medium GWP impact are assigned a material Impact Score of 3. High GWP materials are assigned a material Impact Score of 4 or 5. The building's Impact Score (averaged) across all categories must be 1.6 or lower to achieve compliance using this documentation path. If the building's Impact Score is greater than 1.6, Paths 1 and 2 may be used instead to allow the design team more flexibility to apply additional impact reduction strategies not available under Path 3. A series of graphs comparing the GWP impact of functionally equivalent building materials is provided to assist the practitioner in selecting materials that will help achieve compliance. These may be useful for guiding structure and envelope decisions in the early design phases.

## Submittal Requirements: M.1A

**Design:**

- M.1A: Documentation of either Path 1, Path 2 or Path 3 and Upload Supporting Documents:
  - Architectural and Structural Drawings (PDF)
  - Architectural and Structural Specifications (Word or PDF)

- Architectural and Structural BIM Models (Revit files) [59]

GWP Reduction Path 1 – Whole-Building LCA Approach

- Upload the Reference Building LCA model and selected reports showing GWP impact. These reports should show impacts for life-cycle phases A–C ~~only~~ and must include total whole-building GWP impact as well as a breakdown of GWP by assembly type. Total GWP for the Reference Building must also be input separately~~.~~ into the Tracking Tool (life-cycle phases A-C only, excluding biogenic carbon).
- Upload an iteration of the whole-building LCA model and reports that show reduction in GWP impact compared to the submitted Reference Building LCA model. Total GWP reduction must also be input into the Tracking Tool~~.~~ (life-cycle phases A-C only, excluding biogenic carbon).
- Required submittal files for Athena users:
  - Athena IE base files (Reference Building and current design iteration)
  - Reports:
    - Exported Project Reports (PDF and Word files), obtained by clicking *"File" → "Export" → "Project Report to PDF and Word (Selected Project)"* (reports for both Reference Building and current design iteration)
    - "Detailed LCA Results by Assembly Group Embodied Effects" in table format Excel files (reports for both Reference Building and current design iteration)
- Required submittal files for Tally users:
  - Revit model files (both Arch and Struct) [60] with included Tally specifications (Reference Building and current design iteration)
  - Reports: "Full Building Summary" (reports for both Reference Building and current design iteration) include both PDF and Excel files
- Required submittal files for One Click LCA users:
  - If Revit was used upload Revit model files[61] used to output One Click LCA model (Reference Building and current design iteration). Include PDF of "Building Materials" tab showing building materials and mapping.
  - Reports: Excel outputs "detailReport" (reports for both Reference Building and current design iteration)

GWP Reduction Path 2 – Assembly-level LCA Approach

- Upload the Reference Model structural bay model (Athena IE or Tally) and selected reports showing GWP impact. These reports should show impacts for life cycle phases A–C ~~only~~, and must include total whole-building GWP impact as well as a breakdown of GWP by assembly type. Total GWP for the Reference Model must also be input into the Tracking Tool~~.~~ (life-cycle phases A-C only, excluding biogenic carbon).
- Upload an iteration of the structural bay model (Athena IE or Tally) and reports that show reduction in GWP impact compared to the submitted Reference Model structural bay model. Total GWP for this model iteration must also be input separately~~.~~ into the Tracking Tool (life-cycle phases A-C only, excluding biogenic carbon).

[59] To reduce model file sizes for upload, it is recommended to exclude any/all worksets that are not included in the scope of the LCA.
[60] To reduce model file sizes for upload, it is recommended to exclude any/all worksets that are not included in the scope of the LCA.
[61] To reduce model file sizes for upload, it is recommended to exclude any/all worksets that are not included in the scope of the LCA.

- Required submittal files for Athena users:
  - Athena IE base files (Reference Model and current model iteration).
  - Reports:
    - Exported Project Reports (PDF and Word files), obtained by clicking "*File*" → "*Export*" → "*Project Report to PDF and Word (Selected Project)*" (reports for both Reference Building and current design iteration)
    - "Detailed LCA Results by Assembly Group Embodied Effects" in table format Excel files (reports for both Reference ~~Case~~Building and current ~~model~~design iteration~~).~~)
- Required submittal files for Tally users:
  - Revit model files (both Arch and Struct) [62] with included Tally specifications (Reference Model and current model iteration)
  - Reports: "Full Building Summary" (reports for both Reference Model and current model iteration) include both PDF and Excel files
- Required submittal files for One Click LCA users:
  - If Revit was used upload Revit model files[63] used to output One Click LCA model (Reference Building and current design iteration). Include PDF of "Building Materials" tab showing building materials and mapping.
  - Reports: Excel outputs "detailReport" (reports for both Reference Building and current design iteration)

GWP Reduction Path 3 – Material-Level LCA Approach

- Upload a preliminary version of the completed Path 3 Compliance Calculator demonstrating selection of compliant assemblies. The Impact Score computed by the calculator must be 1.6 or lower to achieve compliance. Also input the Impact Score to the Tracking Tool.

**Final Design:**

- M.1A: Whole-Building LCA Model (not required for Small Building projects~~) and~~), Documentation of either Path 1, Path 2 or Path 3~~.~~, and Upload Supporting Documents (updated from previous phase):
  - Architectural and Structural Drawings (PDF)
  - Architectural and Structural Specifications (Word or PDF)
  - Architectural and Structural BIM Models (Revit files) [64]

Whole-Building LCA Model

- Regardless of the compliance path chosen, all projects except Small Building projects must upload a final whole-building LCA model and selected reports showing GWP impact at the end of the construction documents (CD) phase. These reports should show impacts for life cycle phases A–C ~~only~~, and must include total whole-building GWP impact as well as a breakdown of GWP by assembly type. The model should represent the closest available approximation of the building as it will be built. If the design team selected GWP Reduction Path 1 to demonstrate compliance, the final Selected Building Design LCA model satisfies this requirement.

GWP Reduction Path 1 – Whole-Building LCA Approach

[62] To reduce model file sizes for upload, it is recommended to exclude any/all worksets that are not included in the scope of the LCA.
[63] To reduce model file sizes for upload, it is recommended to exclude any/all worksets that are not included in the scope of the LCA.
[64] To reduce model file sizes for upload, it is recommended to exclude any/all worksets that are not included in the scope of the LCA.

- If there has been changes to the Owner's Project Requirements (OPR) (established in P1), confirm that the Reference Building model uploaded at the end of the Design phase still meets the updated OPR. If not, the Reference Building model ~~may~~will need to be updated.
- Upload the final Selected Design whole-building model and reports that show 10% reduction in total building GWP impact compared to the submitted Reference Building. The Selected Building Design should represent the closest available approximation of the building as it will be built.
- Required submittal files for Athena users:
  - Athena IE base files (Reference Building and Selected Building Design)
  - Reports:
    - Exported Project Reports (PDF and Word files), obtained by clicking "*File*" → "*Export*" → "*Project Report to PDF and Word (Selected Project)*" (reports for both Reference Building and Selected Building Design)
    - "Detailed LCA Results by Assembly Group Embodied Effects" in table format Excel files (reports for both Reference Building and Selected Building Design)
- Required submittal files for Tally users:
  - Revit model files (both Arch and Struct) [65] with included Tally specifications (Reference Building and Selected Building Design)
  - Reports: "Full Building Summary" (reports for both Reference Building and Selected Building Design) include both PDF and Excel files
- Required submittal files for One Click LCA users:
  - If Revit was used upload Revit model files[66] used to output One Click LCA model (Reference Building and Selected Building Design). Include PDF of "Building Materials" tab showing building materials and mapping.
  - Reports: Excel outputs "detailReport" (reports for both Reference Building and Selected Building Design)

GWP Reduction Path 2 – Assembly-Level LCA Approach

- If there has been changes to the Owner's Project Requirements (OPR) (established in P1), confirm that the Reference Model structural bay model uploaded at the end of the schematic design phase still meets the updated OPR.
- Upload the final Selected Design Model structural bay model and reports that show 10% reduction in GWP impact compared to the submitted Reference Model structural bay model. The Selected Design Model should represent the closest available approximation of the building as it will be built.
- Required submittal files for Athena users:
  - Athena IE base files (Reference Model and Selected Design Model)
  - Reports:
    - Exported Project Reports (PDF and Word files), obtained by clicking "*File*" → "*Export*" → "*Project Report to PDF and Word (Selected Project)*" (reports for both Reference Model and Selected Design Model)
    - "Detailed LCA Results by Assembly Group Embodied Effects" in table format Excel files (reports for both Reference Model and Selected Design Model)

[65] To reduce model file sizes for upload, it is recommended to exclude any/all worksets that are not included in the scope of the LCA.
[66] To reduce model file sizes for upload, it is recommended to exclude any/all worksets that are not included in the scope of the LCA.

- Required submittal files for Tally users:
  - Revit model files (both Arch and Struct)[67] with included Tally specifications (Reference Model and Selected Design Model)
  - Reports: "Full Building Summary" (reports for both Reference Model and Selected Design Model) include both PDF and Excel files

GWP Reduction Path 3 – Material-Level LCA Approach

- Upload a final version of the completed Path 3 Compliance Calculator. The Impact Score computed by the calculator must be 1.6 or lower to achieve compliance. Also input the Impact Score to the Tracking Tool.

**Closeout:**

- If there are significant design changes or material changes from the previous phase, or if additional/modified LCA documentation/inputs are required to meet the guidelines, please update LCA inputs and file uploads in the Tracking Tool to reflect the as-built condition. Note that inputs from the Final Design phase will automatically carry forward into the CO phase, but can be updated by the team as needed.

## Meeting the Guidelines: M.1B

Select which product option(s) to pursue. Identify any materials from Table M1b-2 that will be utilized on the project. Early product research can help the project team capitalize on opportunities for products contributing to multiple credits and options. Individual products may contribute under either Option 1 or Option 2 but not be counted toward both.

The required scope of this guideline is for permanently installed building products, excluding mechanical, plumbing, electrical (MEP), and specialty equipment and items purchased for temporary use on the project. Furniture is not considered permanently installed and is not required to be included in the submission.

Option 1 is for projects with permanently installed products that have a product-specific declaration adhering to third-party certification programs to ensure that they conform to ISO 14044, which defines how LCAs are critically reviewed.

Option 2 is for projects with products with either product-specific or Environmental Product Declarations (EPDs) or industry-wide EPDs. Products must be sourced from multiple manufacturers, as indicated in the Required Performance Criteria. Various thresholds are available to accommodate stages of EPD development in different industries.

[67] To reduce model file sizes for upload, it is recommended to exclude any/all worksets that are not included in the scope of the LCA.

~~The table~~**Table M1b-1** below compares different EPD formats to product-specific declarations:

| | Product-Specific Declaration | Industry-Wide EPD | Product-Specific EPD |
|---|---|---|---|
| Data are critically reviewed | x | x | x |
| Data are specific to product | x | | x |
| Data are reported according to product category rules (PCR) | | | x |

Reference Guide for Building Design and Construction. Washington, DC: US Green Building Council, 2013. Print.

Starting on February 1, 2026, projects will be required to submit third-party verified EPDs for all materials/products listed Table M1b-2 below and submit a completed EPD Reporting Template, available in Appendix M-1b. If a valid EPD is not available for a material/product, material data and quantity information will still be required to be submitted, with additional notation either in a separate written statement or within the EPD Reporting Template, detailing the reasoning and the steps that the project team has taken in an effort to obtain an EPD. EPD disclosure for these material categories will remain voluntary until the date specified above, at which time EPD disclosure will become mandatory. Material disclosure and EPD reporting requirements will be updated to align with any/all requirements of the State of Minnesota's Buy Clean policy.

**Table M1b-2: Material Categories, CSI Specification Sections, and Subcategories/Products**

| Material Category | CSI Specification Section | Subcategory / Product Description |
|---|---|---|
| Asphalt | 02 25 00 | Asphalt Paving Mixtures |
| Concrete | 03 30 00 | CIP Ready Mix Concrete |
| | 03 30 00 | CIP Ready Mix Concrete Paving |
| | 03 41 00 | Precast Concrete - Structural |
| | 03 45 00 | Precast Concrete - Architectural |
| Masonry | 04 22 00 | Concrete Masonry Unit (CMU) |
| Steel | 03 20 00 / 03 21 00 | Concrete Reinforcing Steel Bars |
| | 05 12 00 | Hot-Rolled Structural Sections |
| | 05 12 00 | Plate |
| | 05 12 00 | HSS (Hollow Structural Sections) |
| | 05 20 00 | Open Web Steel joists |
| | 05 31 10 | Steel Decking |
| | 05 40 00 | Cold-Formed Metal Framing |
| | 05 00 00 | Aluminum Extrusions |
| | 07 74 12 | Metal Wall Panels |
| Glass | 08 80 00 | IGUs (Insulating Glass Units) |
| | 08 81 00 | Panes |

| | | |
|---|---|---|
| Insulation | 07 21 00 | Thermal Insulation |

**Suggested Implementation in the Design Process:**

In Predesign and early design, refer to Additional Resources section below for information on product-specific declarations, EPDs, and how to obtain them.

Use the databases listed in Tools & Resources to search for common building product categories with disclosed EPDs. Material categories that are likely to have EPDs are wood products and interior finishes.

If, at this stage, a particular manufacturer and/or product is intended as a partner, contact manufacturer and learn about their current product life-cycle assessments. Refer to Tools and Resources section of M.1B for information on how to create a product-specific declaration or an Environmental Product Declaration.

Establish an initial list of products or building materials for the project. Review and update this list at each stage of the project. This will be useful for the Design phase in order to research compliant products. Also track whether the products or product categories identified are anticipated to meet option 1 (product-specific declaration) or option 2 (EPD).

Through the design process, refine selection of products and/or materials and establish a list of potential manufacturers. Review online resources for available product-specific declarations or EPDs that match the specified products or building materials for the project. Contact manufacturers and inquire about their current product life-cycle assessments. If needed, provide information on how to create a product-specific declaration and/or an EPD. Create specifications ensuring that this guideline can be met. Some additional information on specifying compliant products can be found under Additional Resources below.

Begin collecting documentation on compliant products by compiling product-specific declarations and/or EPDs and upload to the B3 Guidelines Tracking Tool. Declarations are typically in the form of a PDF document. If a product-specific declaration or EPD is in the process of being created for a particular product or building material, a PCR may be submitted in the Design phase and replaced by the completed documentation at the Final Design phase in the B3 Guidelines Tracking Tool.

In the construction documents phase of the project, establish final selection of compliant products and/or materials, ensuring that at least five meet the criteria here. It is recommended that the design team have researched and specified more than five products anticipating that some may not be eventually installed in the product due to requested changes or product availability. In the Tracking Tool submit at least five final product-specific declarations or EPDs~~.~~ or as many as are necessary to document all materials in Table M1-2. If necessary, make appropriate updates to products where only a PCR was submitted in the previous phase. Keep all documentation pertaining to specified products or materials.

During construction check in periodically with team members (contractors, subcontractors, and suppliers) to verify progress toward guideline achievement and address any gaps in credit compliance.

Continually track substitutions and change orders to ensure replacement products comply with the guidelines. Any product and/or building material substitutions or submittals should be carefully reviewed by the design team for compliance with the guidelines. Compile documentation to verify environmental claims for each product. Retain product data for all materials that contribute to guideline compliance.

**Documentation of Product-Specific Declarations:**

Declarations based on a life-cycle assessment of a product but not constituting a full EPD: To document this claim, the project team must provide the following information:

- Name (declaration holder or producer, typically the manufacturer)
- Contact information
- Product type
- Product name
- Product description
- Summary of impact categories measured and overall values
- Functional unit
- Standards met
- Independent review body name, including a review statement.

**Documentation of Environmental Product Declarations (EPDs)**

Documentation of an EPD (this includes Industry-wide or "generic" declarations, and product-specific Type III declarations). The project team must provide the following:

- Declaration holder (the company, usually the manufacturer, that the EPD is attributed to).
- EPD program operator (the entity that creates and registers the EPD).
- LCA verifier (the third-party entity that verifies the life cycle assessment).
- PCR reviewer (the third-party entity that has reviewed the product category rules).
- During the selection of products with EPDs, identify two items about the document: the type of EPD, and the summary that will be uploaded for guideline compliance.

Note that similar products from the same manufacturer can be counted as separate products if they have distinct formulations, but not if they are just aesthetic variations or reconfigurations. For example: Paints of different gloss levels are separate products, but different colors of the same paint, or different colorways of the same carpet, are not. During collection of EPDs ensure that EPD documentation includes a summary sheet of measured impacts.

## Submittal Requirements: M.1B

**Design:**

- M.1B: Submit at least five different Product Declarations or Environmental Product Declarations that comply with the guideline requirements. Starting on February 1, 2026, projects will be required to submit EPDs for all materials/products listed Table M1b-2 in the Meeting the Guidelines section and submit a completed EPD Reporting Template, available in Appendix M-1b.

**Final Design:**

- M.1B: Submit at least five different Product Declarations or Environmental Product Declarations that comply with the guideline requirements. Starting on February 1, 2026, projects will be required to submit EPDs for all materials/products listed Table M1b-2 in the Meeting the Guidelines section and submit a completed EPD Reporting Template, available in Appendix M-1b.

**Closeout:**

- If there are significant material changes from the previous phase, or if additional/modified documentation/inputs are required to meet the guidelines, please update inputs and file uploads in the Tracking Tool to reflect the as-built condition. Note that inputs from the Final Design phase will automatically carry forward into the CO phase, but can be updated by the team as needed.

## Additional Resources

Appendix M-1b: EPD Reporting Template

Standard EN15978: "Sustainability of construction works – Assessment of environmental performance of buildings – Calculation method" https://www.en-standard.eu/csn-en-15978-sustainability-of-construction-works-assessment-of-environmental-performance-of-buildings-calculation-method/

Building Transparency's EC3 Tool (Embodied Carbon in Construction Calculator) – EPD Database: https://www.buildingtransparency.org/tools/ec3/

Environmental Product Declarations: The International EPD® System: www.environdec.com/

Healthy Building Network and Pharos: www.healthybuilding.net/content/pharos-v3

Thinkstep: www.thinkstep.com

Underwriter's Laboratory (UL) SPOT database: www.ul.com and https://spot.ulprospector.com/en/na/BuiltEnvironment

ICC Evaluation Service: ICC-ES technical evaluations: www.icc-es.org

NSF International: www.nsf.org

Declare Products: www.living-future.org/declare-products

Cradle2Cradle: www.c2ccertified.org

Greenguard: UL Environment's GREENGUARD Certification program: www.greenguard.org/

Ecoinvent: http://www.ecoinvent.org/

Athena Sustainable Materials Institute: http://www.athenasmi.org/our-software-data/lca-databases/

openLCA Nexus: https://nexus.openlca.org/database

ISO Standards: http://www.iso.org/iso/home.htm

## Glossary

**Reference Building**

A base-case whole-building LCA model used to compare performance with design cases. Embodied global warming potential (GWP) reductions for compliance Path 1 are measured by comparing embodied GWP of the design cases to the embodied GWP of the Reference Building. There are four accepted methods of determining the design of the Reference Building, discussed in the Meeting the Guidelines section.

**Selected Building Design**

The final design case whole-building LCA model, representing the building as it is expected to be built. The final global warming potential (GWP) reduction for compliance Path 1 is measured by comparing embodied GWP of the Selected Building Design to the embodied GWP of the Reference Building.

**Reference Model**

A base-case structural bay LCA model used to compare performance with design cases. Embodied global warming potential (GWP) reductions for compliance Path 2 are measured by comparing embodied GWP of the design cases to the embodied GWP of the Reference Model. The exact contents of the structural bay model are discussed in the Meeting the Guidelines section.

**Selected Design Model**

The final design case structural bay LCA model, representing the building as it is expected to be built. The final global warming potential (GWP) reduction for compliance Path 2 is measured by comparing embodied GWP of the Selected Design Model to the embodied GWP of the Reference Model.

# Guideline M.2: Environmentally Preferable Materials

## Intent

To improve the environmental ~~impacts~~performance of construction projects through the selection of environmentally preferable materials and products.

## Required Performance Criteria

Guidelines are required for New Construction and Major Renovation projects.

A. At least 55% of the total building materials used in the project must have one of the following attributes: salvaged or reused, recycled content, recyclable, bio-based, responsibly sourced or regional as defined in Sections 1 through 6 below. The combined calculation is based on mass, volume or cost. Where a material has more than one attribute, the material value will be multiplied by its number of qualifying attributes.[68]

1. Salvaged or reused materials and components:
   i. The salvaged material content will be determined based on the actual mass, volume, or cost of the salvaged material or the cost of a comparable alternative component material. Portions of a building retained and reused in a renovation may contribute in this category.[69]
2. Recycled content or recyclable:
   Recycled content building materials must comply with one of the following:
   i. Contain not less than 25% combined postconsumer and/or pre-consumer recovered material, and be recyclable (see definition in ~~3~~iii below).
   ii. Contain not less than 50% combined postconsumer and/or pre-consumer recovered material.
   iii. Recyclable[70]: Building materials and building components that can be recycled into the same material or another material with a minimum recovery rate of not less than 30 percent through recycling and reprocessing or reuse, or building materials which are recyclable through an established, currently active closed loop manufacturer's take-back program.
3. Bio-based:
   Bio-based materials are materials that comply with one or more of the following:
   i. The bio-based content is not less than 75% as determined by testing in accordance with ASTM D6866.
   ii. The requirements of USDA 7CFR Part 2902.
4. Responsible sourced:
   Responsibly sourced materials are materials that comply with the following:
   i. Wood and wood products labeled in accordance with the following standards:[71]
   ii. If wood comes from a North American source, it is certified using SFI, FSC, CSA, or ATF.
   iii. If wood comes from a source outside North America, it is certified using FSC or PEFC.

[68] This section is aligned with International Green Construction Code (IGCC) and ANSI/ASHRAE/USGBC/IES Standard 189.1, Section "505.1 Material selection and properties." Areas that differ are noted in subsequent footnotes. ~~Recycleable materials contribute to the IGCC guideline but do not contribute to meeting this guideline~~

[69] Salvaged or reused category differs from the IGCC requirements.

[70] Recyclable materials definition is aligned with 2012 IGCC Section 505.2.3, but without requiring a "nationally available" take-back program.

[71] Wood product requirements differ from the IGCC.

~~iv.~~ Other approved standards for extraction of raw materials (see Additional Resources in Meeting the Guidelines below).

5. Regional:

   Regional materials or components must be composed of resources that are recovered, harvested, extracted, and manufactured within a 500-mile radius of the building site~~.~~, subject to the following:

   i. Where only a portion of a material or product is recovered, harvested, extracted, and manufactured within 500 miles, only that portion can be included.

   ~~i.~~ii. Portions of cast-in-place (CIP) concrete mix constituents, such as fine aggregate/sand, coarse aggregate/gravel, cement, and supplemental cementitious materials (SCMs) may be included in the calculation of regional material quantities only if they are originally sourced/extracted from within the 500-mile radius. Quantities of potable water and other additives/ingredients added to the CIP concrete mixture at the ready-mix plant or at the project site may not be counted in the quantity calculations for this category. Additionally, the ready-mix plant location cannot be used to calculate the distance to the project site (distance from extraction/harvest site for each individual material constituent must be utilized for calculating applicable quantities). Other products that are composed of multiple material constituents shall be treated similarly, such that only the qualifying portion attributable to the constituents meeting the regional sourcing material requirement may be counted.

   ~~ii.~~iii. Where resources are transported by water or rail, the distance to the building site must be determined by multiplying the distance that the resources are transported by water or rail by 0.25, and adding that number to the distance transported by means other than water or rail.

Projects that include less than 20,000 gsf of conditioned space may opt to demonstrate compliance with this guideline by evaluating only the most prevalent materials of the project, subject to the following:

i. The most prevalent materials shall be evaluated by mass, volume, or cost.
ii. At least five materials must be included in this calculation.
iii. Additional materials may be included in the calculation—e.g., the 7 or 10 most prevalent materials may be used.
iv. Materials of lower prevalence may not be included unless all materials of higher prevalence are included—e.g., the tenth most prevalent material cannot be used unless the first through ninth most prevalent materials are also included in this evaluation.

## Recommended Performance Criteria

B. At least 75% of the total building materials combined to be used in the project must have one of the following attributes: salvaged or reused, recycled content, recyclable, bio-based, responsibly sourced, or regional as defined in the preceding section.

## Meeting the Guidelines

**Implementation During the Design Process:**

During Design, make initial selection of building materials and products with the following attributes: salvaged or reused, recycled content, recyclable, bio-based, responsibly sourced, or regional.

During the construction documents phase, represent chosen materials from Guideline M.2 in drawings and specifications. Ensure that 55% compliance level for environmentally preferable materials is met. Through construction, monitor submittals to ensure project includes selected materials; review substitutions based on selected criteria to ensure consistency and compliance with goals and objectives.

**Other Approved Responsible Sourcing Standards:**

There are no additional approved responsible sourcing standards at this time.

## Submittal Requirements

**Design:**

- M.2A and M.2B: Selection of preliminary calculation method (mass, volume, or cost), total anticipated material mass, volume or cost, a list of building materials anticipated to achieve compliance with this guideline. This will include the material name, manufacturer (if known at this phase) and the percent contribution of each attribute category (salvaged or reused, recycled content, recyclable, bio-based, responsibly sourced, or regional).

**Final Design:**

- M.2A and M.2B: Selection of calculation method (mass, volume, or cost), total anticipated material mass, volume or cost, a list of building materials anticipated to achieve compliance with this guideline. This will include the material name, manufacturer (if known at this phase) and the percent contribution of each attribute category (salvaged or reused, recycled content, recyclable, bio-based, responsibly sourced, or regional).

**Closeout:**

- M.2A and M.2B: Verification of calculation method (mass, volume, or cost), total anticipated material mass, volume or cost, a list of installed building materials used to achieve compliance with this guideline. This will include the material name, manufacturer (if known at this phase) and the percent contribution of each attribute category (salvaged or reused, recycled content, recyclable, bio-based, responsibly sourced, or regional).

## Additional Resources

2015 International Green Construction Code: https://www.iccsafe.org/codes-tech-support/international-green-construction-code-igcc/international-green-construction-code/

ANSI/ASHRAE/USGBC/IES Standard 189.1-2014, Standard for the Design of High Performance Green Buildings: https://www.ashrae.org/resources--publications/bookstore/standard-189-1

ASTM D6866: https://www.astm.org/Standards/D6866.htm

SFI Standard: http://www.sfiprogram.org/sfi-standard/

FSC STD-40-004 V2-1 EN: https://us.fsc.org/preview.fsc-std-40-004-v3-0-chain-of-custody-certification.a-561.pdf

CSA Standard: http://www.csasfmforests.ca/

PEFC Council Technical Document: https://www.pefc.org/resources/technical-documentation/pefc-international-standards-2010

USDA 7CFR Part 2902: https://www.gpo.gov/fdsys/granule/CFR-2010-title7-vol15/CFR-2010-title7-vol15-part2902

# Glossary

**Bio-Based Material**

A commercial or industrial material or product, other than food or feed, that is composed of, or derived from, in whole or in significant part, biological products or renewable domestic agricultural materials, including plant, animal, and marine materials, or forestry materials (IGCC 2015).

**Post-Consumer Recycled Content**

The proportion of recycled material in a product generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product that can no longer be used for its intended purpose. This includes returns of material from the distribution chain (IGCC 2015).

**Pre-Consumer (Post-Industrial) Recycled Content**

The proportion of recycled material in a product diverted from the waste stream during the manufacturing process. Pre-consumer recycled content does not include reutilization of material such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it (IGCC 2015).

**Raw Material**

The basic substance from which products are made, such as concrete, glass, gypsum, masonry, metals, recycled materials (e.g., plastics and metals), oil (petroleum, polylactic acid), stone, agrifiber, bamboo, and wood (LEED v.4).

**Reuse**

To divert a material, product, component, module, or a building from the waste stream in order to use it again (IGCC 2015). Reuse includes the recovery and reemployment of materials recovered from existing building or construction sites. Also known as salvage (LEED v.4).

**Total Building Materials**

Includes all building materials except electrical, mechanical, plumbing, security and fire detection, and alarm equipment and controls, automatic fire sprinkler systems, elevators and conveying systems (IGCC 2015).

**Wood**

Plant-based materials that are eligible for certification under the FSC and other programs. Examples include bamboo and palm (monocots) as well as hardwoods (angiosperms) and softwoods (gymnosperms) (LEED v.4).

# Guideline M.3: Waste Reduction and Management

## Intent

To minimize use of resources and negative environmental impacts through design decisions and careful reduction and management of waste generated during the construction process and building occupancy.

## Required Performance Criteria[72]

Guideline M.3B is required for New Construction and Major Renovation projects. Guideline M.3A is required only for New Construction and Major Renovation projects that include 20,000 gsf or more of conditioned space.

A. Material Conservation and Waste Management Plan[73]

Create a material conservation and waste management plan that includes the sections outlined below:

1. A plan to adaptively reuse an existing structure or salvage and reuse materials from an existing structure being demolished or deconstructed onsite.
2. A plan to select materials with appropriate durability for service life. In many cases, state-funded buildings are intended to have a 50–100 year service life for the structure and envelope.
3. A plan to specify the use of prefabricated products, preassembled products, and/or modular building units to minimize construction waste onsite.
4. A plan that addresses both partial deconstruction (for renovations) and total deconstruction (for end-of-life removal) of the building to maximize the reuse and recycling of building components and materials. Indicate specific strategies to facilitate disassembly.
5. A construction waste management plan that includes the following:
   i. Specification of materials to be diverted from disposal by efficient usage, recycling, reuse, manufacturer's reclamation, or salvage for future use, donation or sale.
   ii. Specification of the percentage of materials to be diverted ; calculate by weight or volume, but not both. Include separate average percentages for those materials collected by construction and demolition materials processing facilities that end up as alternative daily cover and incineration.
6. An operational waste plan that includes the following:
   i. Description of waste streams and discuss how waste will be minimized and diverted from disposal (recycled, composted, reverse distribution).
   ii. Description of the collection plan including a collection plan for consumables and durables (this can be done at a campus or organization scale).

B. Construction Waste Reduction

At least 75% of nonhazardous construction and demolition waste must be diverted from landfill. The percentage of materials diverted can be calculated by weight or volume, but not both.[74] Project teams shall report this using Appendix M-3b3: Construction and Demolition Waste Reporting Calculator.

For the purposes of this section, construction materials and waste include, but are not limited to (1) all materials delivered to the site and intended for installation prior to the issuance of the certificate of occupancy, including

[72] This section is aligned with International Green Construction Code (IGCC) and ANSI/ASHRAE/USGBC/IES Standard 189.1, Section "1006.1 Deconstruction and demolition material and waste management plan." Areas that differ are noted in subsequent footnotes.
[73] Differs from the IGCC requirements.
[74] Differs from the IGCC requirements.

related packaging; (2) construction materials and waste removal during demolition or razing. For the purposes of this section, construction and waste materials do not include land-clearing debris (including trees, rocks, and vegetation), excavated soils, and fill and base materials such as topsoil, sand, and gravel. Waste used as alternative daily cover or in waste-to-energy incineration will not be counted as diverted material.

## Recommended Performance Criteria

C. Additional Construction Waste Reduction
At least 90% of nonhazardous construction and demolition waste must be diverted from landfill. The percentage of materials diverted can be calculated by weight or volume, but not both.

## Meeting the Guidelines

During Predesign, ensure that adequate space is planned for dedicated recycling areas, processing and holding space, and reverse distribution space in the building. Begin to draft a Material Conservation and Waste Management Plan.
At site selection, evaluate the potential for adaptive reuse of an existing structure or salvage and reuse materials from an existing structure being demolished onsite.
Ensure that products are selected and specified that have appropriate durability. Specify the use of prefabricated products, preassembled products, and/or modular building units to minimize construction waste onsite. Incorporate design for disassembly and deconstruction that addresses both partial deconstruction (for renovations) and total deconstruction (for end of life removal). Verify that recycling areas are included in plans.
As the construction documents are being developed, incorporate details and specifications that support the minimization of material use and clearly require construction waste management that meets project requirements. Include specification language mandating compliance with the pursued level of construction waste landfill diversion. Request reduced, reused, or eliminated material packaging. Develop detailing and construction recommendations that minimize material use and maximize performance of materials to support intended goals of durability, disassembly, and use of prefabricated products, preassembled products, and/or modular building units. Compile material and product documentation from the manufacturer, declaring life cycle and warranty recommendations indicating durable life cycle projections for building components. Provide specifications that require contractor submittals highlighting service life of materials installed.
During construction administration monitor submittals to ensure project construction waste diversion meets requirements. Review revisions to program to ensure consistency and compliance with goals and objectives.

## Submittal Requirements

**Design:**

- M.3A: Material conservation plan.

**Final Design:**

- M.3A: Material conservation report (on execution of the material conservation plan), specification mandating waste management plan, and draft of operational waste management plan.

**Closeout:**

- M.3A: Operational waste management plan and waste management report

- M.3B and M.3C: ~~A waste management report~~Completed Appendix M-3b3: Construction and Demolition Waste Reporting Calculator documenting actual construction waste disposal and recycling rates of at least 75% diversion (90% if pursuing M.3C), including receipts or other documentation related to diversion through the course of construction.

## Additional Resources

Project Manager's Guide to Building Material Reuse on Commercial Projects: https://msrdesign.com/resources/project-managers-guide-to-building-material-reuse-on-commercial-projects/

2015 International Green Construction Code: https://www.iccsafe.org/codes-tech-support/international-green-construction-code-igcc/international-green-construction-code/

ANSI/ASHRAE/USGBC/IES Standard 189.1-2014, Standard for the Design of High Performance Green Buildings: https://www.ashrae.org/resources--publications/bookstore/standard-189-1

Living Building Challenge includes standards on net positive waste: https://living-future.org/lbc/

## Glossary

**Deconstruction:**

The process of systematically disassembling a building, structure, or portion thereof, so that the materials, products, components, assemblies, and modules can be salvaged for repurpose, reuse, or recycling (IGCC 2015).

# Guideline M.4: Health

## Intent

To minimize potentially hazardous materials used in B3 projects.

## Required Performance Criteria

Guideline M.4B is required for New Construction and Major Renovation projects that include fluorescent lamps. Guideline M.4A is required for New Construction and Major Renovation projects with 20,000 gsf or more of conditioned space.

A. Demonstrate that the chemical inventories of at least ten permanently installed interior materials from at least five different manufacturers do not contain likely hazardous materials by one of the following screening methods:[75]
    1. GreenScreen List Translator: Qualifying materials must demonstrate, based on a full chemical inventory to 100 ppm, that they are free of List-Translator-1 (LT-1) or List-Translator Possible 1 chemicals (LT-P1) as defined by the most current version of GreenScreen.
    2. Full GreenScreen Assessment: Qualifying materials must demonstrate, based on a full chemical inventory to 100 ppm that they are free of Benchmark-1 (BM-1) chemicals as defined by the most current version of GreenScreen. A GreenScreen label indicating the product is free of BM-1 chemicals is sufficient for this method.
    3. Products certified under Cradle to Cradle v2 Gold or Platinum or Cradle to Cradle v3 Silver, Gold or Platinum.
    4. Products certified as meeting Declare Label Declaration Status of LBC Red List Free

    Qualifying materials that are among the ten most prevalent by area may be double-counted. If a project team is unable to find adequate available compliant materials, documentation of letters to manufacturers requesting GreenScreen BM-1, List Translator results for products not currently reporting GreenScreen hazard assessment will be accepted. The team may also document the request for materials that have identified BM-1 chemicals to remove these chemicals from the product. Each documented requests for product evaluation may contribute as one material under this guideline. Compliance is determined by identification and specification of compliant products. Manufacturers may report qualification under Part 1 or Part 2 above by inclusion in a Health Product Declaration (HPD).

[75] This section is aligned with in part on USGBC, "Materials and Resources Credit: Building product disclosure and optimization, Option 2: Material Ingredients," *LEED Building Design and Construction v.4*, though with different required numbers of materials submitted for compliance and with different available methods of chemical inventory verification.

B. Mercury content in fluorescent lamps. The mercury content in straight fluorescent lamps and compact fluorescent lamps must comply with the limitations stated below.[76]

1. Straight fluorescent lamps.
    i. Non-preheat straight, double-ended fluorescent lamps less than 70 inches (1800 mm) and greater than 21 inches (550 mm) in length and containing a medium bi-pin base or miniature bi-pin base must comply with the following:
    ii. T-5 lamps with a rated lifetime of less than 25,000 hours at 3 hours per start must not contain more than an average of 3 milligrams of mercury per lamp.
    iii. T-8 lamps with a rated lifetime less than 25,000 hours at 3 hours per start on an instant start ballast must not contain more than an average of 4 milligrams of mercury per lamp.
    iv. All other T5 or T8 lamps must not contain more than an average of 5 milligrams of mercury per lamp.
2. Compact fluorescent lamps.
    Single-ended pin- base and screw-base compact fluorescent lamps must not contain more than an average of 5 milligrams of mercury per lamp, and must be listed and labeled in accordance with UL 1993.
    Exception: Mercury content is not limited for lighting integral to equipment or instrumentation and installed by the manufacturer, or for lamps with a high color-rendering index that is greater than or equal to 87.

## Recommended Performance Criteria

C. Demonstrate that the chemical inventories of all permanently installed interior materials do not contain any Benchmark-1 chemicals as defined by the most current version of GreenScreen.

D. Demonstrate that the chemical inventories of at least ten different permanently installed interior materials from at least five different manufacturers do not contain any Benchmark-2 chemicals as defined by the most current version of GreenScreen.

## Meeting the Guidelines

**Implementation in the Design Process:**

**For M.4A, M.4C and M.4D:**

In Predesign and early design, determine likely product categories that will contribute to compliance with this requirement. Early product research should be conducted to evaluate opportunities specific to project needs. This may be done by searching for approved products in databases or by contacting product reps and manufacturers. GreenScreen certification marks compliant with LEED v.4 are acceptable as documentation for B3 compliance. Health Product Declarations (HPDs) may also demonstrate GreenScreen results.

Through the design process refine contributing product list and look for opportunities to add contributing products as the design changes. A product may contribute toward M.4A, M.4C or M.4D if that product has been evaluated as

[76] This section is aligned with International Green Construction Code (IGCC) and ANSI/ASHRAE/USGBC/IES Standard 189.1, Section "506.1 Mercury Content in Fluorescent Lamps."

defined in GreenScreen v1.2 Benchmark, has received a Cradle to Cradle (C2C) v2 Gold or Platinum or Cradle to Cradle v3 Silver, Gold or Platinum certification, or are certified as meeting Declare Label Declaration Status of LBC Red List Free.

Under GreenScreen products that have fully inventoried chemical ingredients to 100 ppm that have no LT-1, LT-P1 or BM-1 (Benchmark 1) hazards are:

- Any materials that have all its ingredients assessed with the GreenScreen List Translator and have been found to be free of LT-1 chemicals.
- Any materials for which all ingredients have undergone a full GreenScreen Assessment and have been found to be free of BM-1 chemicals.
- Any materials referenced in the Pharos or Portico databases and vetted for use in B3 Guidelines documenting either no LT-1 or no BM-1 chemicals.

**For M.4B:**

As in early design, evaluate opportunities for reduction in fluorescent fixtures to reduce the need for low-mercury bulbs. In construction documents specify any fluorescent lamps that fall under this guideline meet the limits specified above.

## Submittal Requirements

**Design:**

- M.4A, M.4C, and M.4D: Submit list of identified product types anticipated to comply with this guideline.
- M.4B: Submit list of fluorescent lighting fixtures or systems expected to fall under this guideline.

**Final Design:**

- M.4A, M4C, and M4D: Submit specified materials list compliant with this guideline, including documentation of: GreenScreen compliance at one of the listed allowable levels or documentation of product manufacturer requests.
- M.4B: Submit list of fluorescent lighting fixtures or systems falling under this guideline and compliant specifications.

**Closeout:**

- M.4A, M.4C, and M.4D: Submit documentation of final product selection and any received responses from product manufacturers in response to requests for information.
- M.4B: Submit documentation that relevant lighting fixtures comply with this guideline.

## Additional Resources

How to Use GreenScreen for LEED v.4: http://www.greenscreenchemicals.org/practice/leed

Full GreenScreen Chemical Hazard Assessment Procedure: http://www.greenscreenchemicals.org/learn/full-greenscreen-method

GreenScreen Assessment Report Template: https://www.pharosproject.net/uploads/files/gs/1405445287.pdf

GreenScreen Information Sources :~~https://chemicalprofiler.wiki.zoho.com/List-of-Lists.html~~https://chemicalprofiler.wiki.zoho.com/List-of-Lists.html

GreenScreen List Translator: http://www.greenscreenchemicals.org/method/greenscreen-list-translator

Understanding GreenScreen and List Translator Benchmarks: https://www.buildinggreen.com/primer/understanding-greenscreen-and-list-translator-benchmarks

GreenScreen Store: http://www.greenscreenchemicals.org/gs-assessments

Cradle to Cradle Certified Products Registry: http://www.c2ccertified.org/products/registry

Interstate Chemicals Clearinghouse: http://www.theic2.org/hazard-assessment

Declare Label: https://living-future.org/declare/declare-about/

## Glossary

**Interior Materials**

Interior materials are defined as all materials interior to the enclosure's least vapor-permeable and continually air-sealed barrier system. For most enclosure systems, this definition will encompass all materials interior and exclusive of the vapor barrier. For some assemblies with several systems providing vapor impermeability, a further determination will need to be made.

**Continually Air-Sealed Barrier System**

A set of air-sealed building materials that is intended to prevent air-flow through a wall assembly. This may take the form of a continually sealed vapor barrier or a set of materials that when combined provide the least vapor-permeable system. Note that some materials have low vapor permeability but may not be part of a continually sealed system and would not be considered to be the boundary of the building's interior.