COLLABORATIVE FOR HIGH PERFORMANCE SCHOOLS

Better buildings. Better students.

2020

US-CHPS Criteria 2.0

Criteria & Implementation Guide for New Construction & Major Renovation of School Buildings

Republished June 2022

US-CHPS Criteria

Version 2.0

This version has minor corrections and clarifications from US-CHPS 2.0 Member Copy 2, which was in Soft Release from 10/15/2020-6/1/2022

Cover: Longfellow Elementary School, Salida, CO

Photo courtesy of: CannonDesign

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INTRODUCTION

We are pleased to offer the second edition of our US-CHPS Criteria™. US-CHPS is based on our national Core Criteria and is the edition usable by design and construction teams seeking to create high performance school buildings. This edition of US-CHPS continues the CHPS tradition of integrating national standards and best practices for the design, construction, and operation of healthy, high performance schools.

Best of Both Worlds

US-CHPS can be used off the shelf without customization or public comment in school districts and school projects in any region or district in the 38 states that do not currently have a customized version of the CHPS Criteria. Alternatively, US-CHPS can be used with limited customization in these 38 states.

States without a CHPS adaptation may adopt US-CHPS for K-12 schools as is or may work with CHPS to add code requirements and/or additional relevant resources without an intensive development process or additional public review. US-CHPS is also a great way to pilot test or evaluate the CHPS Criteria against any state green building/school requirements or incentives.

Similarly, existing CHPS states or regional authorities can opt to adopt US-CHPS as is or as a starting point to replace or complement their previous CHPS Criteria.

However, US-CHPS may not be used for projects in states covered by a locally adopted CHPS Criteria -- currently Hawaii, Washington, California, Texas, New York, Massachusetts, New Hampshire, Rhode Island, Connecticut, Vermont, and Maine. As of publication, project teams in Virginia have the option to use VA-CHPS 2011 or the new edition of US-CHPS.

System-Wide Approach

Most of the CHPS programs including CHPS Criteria, CHPS Verified™ and CHPS Designed™ are intended for school system-wide use. Public school districts, charter schools and private/independent schools (with an independent governing board) may become CHPS members for free and adopt a CHPS resolution committing to use US-CHPS Criteria for all of their schools.

Projects

US-CHPS may be used for individual public, charter and private construction projects. Projects must meet or exceed applicable code requirements for school construction projects within that particular state or local jurisdiction, i.e. covered by US-CHPS. For more details, see Eligible Project Types below.

What Has Changed in This Version

US-CHPS Version 2.0 is the regular, comprehensive revision to the Criteria. This edition is based on the comprehensive revisions made to the National Core Criteria v3.0 in 2019 with the addition of a new credit for Biophilic & Responsive Design and other clarifications and corrections made in 2020. For a complete list of changes from the last version, please contact us at info@chps.net or 415-957-9888.

Effective Date

US-CHPS v2.0 (2020 edition) became available for use effective October 15, 2020. The concurrency period for registering projects under either US-CHPS 2014 (v1.1) or US-CHPS v2.0 is March 17, 2021.

Future Editions

CHPS has adopted a five-year cycle for comprehensive revisions to our criteria, with a 2-year cycle for interim updates as necessary. Changes during these cycles are made by the CHPS National Technical Committee with the approval of the CHPS Board of Directors in accordance with our consensus process. All major revisions are subject to two public comment periods prior to Board approval. Substantial changes to conform with changes to statutes or regulations may not be subject to public review.

Unless stated otherwise in the approval, the revised edition will take effect upon approval by the CHPS Board of Directors. A summary of substantive changes will be available by contacting CHPS at info@chps.net.

Non-Substantive Changes and Interpretations

Corrections, clarifications, editorial changes, additional compliance pathways, and interpretations to the criteria and supporting documentation may be made at any time by CHPS. An errata sheet will be posted on the Core Criteria webpage and in the document, and the document may be renumbered n.1, n.2, etc. Minor changes go into effect immediately. Changes to the supporting documents will be posted on the Core Criteria webpage. CHPS Criteria Interpretations (CCIs) will be posted in the CCI Library https://chps.net/criteria-interpretations-and-errata.

ERRATA

Effective May 6, 2021.

General minor corrections to formatting, scoring; clarification of intent statements and documentation.

II C6.1 – Guidance on low-GHG refrigerants updated.

EQ P1.0 – References to ASHRAE 62.1-2016 updated to ASHRAE 62.1-2019.

EQ P1.0 - Changes made to previous language requiring ducted returns to encouraging, but not requiring, ducted returns.

EQ C2.1.2 - Minor clarification of documentation.

EQ P7.0-C7.1 – Significant clarification of documentation.

EE P2.0 - Minor clarification of documentation.

EE P2.0 - Minor clarification of implementation.

SS P1.0 - Minor clarification of documentation.

SS C7.1.2 - Minor clarification of documentation.

SS C8.1 - Minor clarification of documentation.

MW C3.1 – Significant clarification of documentation.

PRINCIPLES, FRAMEWORK AND CHPS RECOGNITION

Guiding Principles of US-CHPS

CHPS has established our criteria based on evidence and best practices that form the foundation of every healthy, high performance school. Our criteria are structured around three priority outcomes:

1. Maximize the health, well-being, and performance of students, educators, and staff.
2. Conserve energy, water, and other resources to minimize greenhouse gas emissions and reduce operating costs.
3. Practice good environmental stewardship within schools to achieve community social and environmental goals.

Framework and Organization

US-CHPS is divided into seven categories in order to streamline the implementation process: Integration (II), Indoor Environmental Quality (EQ), Energy (EE), Water (WE), Site (SS), Materials & Waste (MW), and Operations (OM). Each category is comprised of prerequisites and credits (formerly called "mandatory offerings"). Prerequisites are required to be implemented in every project unless non-applicable due to project type or other allowed exemption. CHPS assigns points to prerequisites and credits. This allows us to demonstrate the importance of the prerequisites on the same scale as credits.

US-CHPS contains 250 points available for recognition.

Point Assignments in US-CHPS

Category	% (Points)
Integration (II)	14% (35)
Indoor Environmental Quality (EQ)	32.5% (81)
Energy (EE)	23% (57)
Water (WE)	8% (20)
Site (SS)	9% (23)
Materials & Waste (MW)	6.5% (16)
Operations (OM)	7% (18)
TOTALS	100% (250)

Each prerequisite and credit includes the following sections:

- **Intent**: The fundamental goal of the strategy or feature. Nested prerequisites and credits share the intent.
- **Background description**: The context for and helpful information about the strategy or feature. Nested prerequisites and credits share the background description.

- **Prerequisite or Credit:** Identification of whether the item is required or optional.
- **Applicability**: What types of projects can use the prerequisite or credit.
- **Verification Review Stage**: Indicates which review stages are required: Design Review prior to construction and/or Construction Review shortly after substantial completion or occupancy.
- **Scoring:** Guidance on how to calculate the points for multi-part items.
- **Related Criteria:** If applicable, a list of CHPS prerequisites and credits that are substantially related to the item.
- **Requirement**: Describes what is required to achieve compliance and receive points for the prerequisite or credit.
- **Implementation**: Describes in more detail strategies for implementing the requirements of the prerequisite or credit.
- **Documentation**: Describes how to appropriately document compliance for the purposes of participating in the CHPS Verified recognition program. Documentation guidance may be included in the text of CHPS adaptations or may be contained in a separate document.
- **Resources**: Publications, websites, and other sources of additional information for support for compliance.

CHPS Verification

CHPS began as a self-certifying building rating program, referred to as CHPS Designed™. Later, CHPS introduced CHPS Verified™, a full technical review by a third party, in order for schools to have a more rigorous option, which is sometimes required by a funding entity or regulatory authority. The two levels of recognition under CHPS Verified are *Verified* and *Verified Leader*. CHPS offers both the CHPS Designed and CHPS Verified programs to schools in order to allow flexibility in compliance.

Further details on the options are provided here:

CHPS Designed is a semi-self-certification recognition system with a narrative reviewed by CHPS. Full documentation is not required. It is ideal for school districts or design teams with extensive internal capabilities and experience in using the CHPS Criteria and limited need for an independent project review. The program relies on a project scorecard that helps design teams manage the points they are claiming and can be used to designate responsible team members and track compliance with credits. Teams provide CHPS with a brief narrative for each prerequisite and credit they are claiming describing how they complied, and no additional documentation is reviewed. The primary accountability rests on the school administration and design team for ensuring compliance with the CHPS Criteria. CHPS Designed is available for a low registration fee.

CHPS Verified combines project management, the CHPS Criteria, and a third party assessment to ensure that the school project is designed and built to the highest performance standards. A school that is recognized as CHPS Verified is healthier, more environmentally efficient, and more cost-saving than standard schools, and has been verified by an independent third party. Participation in this program helps ensure that the school project has the required high performance features to realize all the benefits associated with high performance schools, including improved student and worker health, increased productivity of personnel, improved student performance, decreased operating costs through energy and resource savings, and reduced environmental impact. CHPS Verified helps design teams manage the design and documentation process with tools for project oversight, plan review and other resources. The Verification Program User Guide is available online and outlines design and construction review requirements and what each registered project will receive. CHPS Verified is ideal for school districts or design teams seeking to verify their project's performance. Accountability rests not only on the school district and design team but also on CHPS and an assigned independent reviewer.

CHPS Verified Leader is a higher level of recognition for school projects that perform well beyond minimum eligibility requirements. CHPS Verified Leaders exceed CHPS Verified and have inspirational designs that incorporate their high performance features into architectural expression. A Verified Leader school must be an image of environmental and social responsibility and must be balanced in providing benefits to student health and student performance, resource conservation and the environment.

More information on the available programs, costs, processes and documentation requirements are outlined on the CHPS website https://chps.net/verification-programs.

Eligible Project Types

While any building project involving a school may follow the CHPS Criteria for guidance, only the following project types are eligible for recognition under CHPS Verified or CHPS Designed:

- New School Construction (new site)
- New Buildings on Existing Campus (classroom or non-classroom)
- Major Renovations/Modernizations with or without Additions (classroom or non-classroom)
- Combined Scope (new construction + major renovation)

Note: For the remainder of this manual, when references are made to a new building on an existing campus and renovations, these terms include both classroom and non-classroom buildings unless specified otherwise in the applicability section. CHPS uses the terms "renovation" and "modernization" interchangeably.

New Schools and New Building(s) on Existing Campus (Classroom Buildings)

Verification thresholds:

	CHPS Designed/Verified	CHPS Verified Leader
New Building	**110**	**160**

Note: For new buildings on existing campuses, all prerequisites apply with the exception of EQ P15.0 Acoustical Performance for buildings without classrooms. See Non-Classroom Projects below for more discussion.

Major Renovation/Modernization Projects (Classroom Buildings)

To qualify for CHPS recognition, the scope of the renovation must meet our threshold for Major Modernization, which is defined by a substantial improvement to a building of at least two of the following systems: lighting, HVAC, building envelope, interior surfaces, and/or site. A substantial improvement is when more than half the system or surfaces are being replaced or upgraded. The method for quantifying the amount varies by system.

	CHPS Designed/Verified	CHPS Verified Leader
Major Modernization	**85**	**135**

Appendix A, Table A shows the applicability of US-CHPS v2.0 prerequisites for Major Modernizations.

Note: For Modernizations that include Additions, the building must pass the EE P1.0 prerequisite to be eligible. In other words, the addition's systems must be independent of the main building and pass on their own or the whole building's systems must be modeled and pass the prerequisite.

Non-Classroom Projects

Non-Classroom Buildings, both new and renovated, as a stand-alone project type are now eligible for CHPS Designed and CHPS Verified/Verified Leader recognition. Taking into consideration the wide range of building uses and project scopes for non-classroom spaces, we have established the following point thresholds:

	CHPS Designed/Verified	CHPS Verified Leader
New Building	**83**	**120**
Major Renovation	**64**	**101**

Appendix A, Table B contains guidance on applying the prerequisites to non-classroom scopes. The only prerequisite that absolutely does not apply is EQ P15.0 Acoustical Performance. Even so, some non-classroom spaces may be well served by the same acoustical practices used in classrooms; similarly, most other prerequisites and credits apply based on the project scope and the goals of the project team. Many criteria that were originally intended for classrooms translate to non-classroom spaces quite readily. The lower point thresholds are an acknowledgement of the range of possibilities for this project type.

CHPS and Historic Preservation

CHPS supports the reuse and preservation of historic buildings for schools as a community and national interest. While we recognize that local, state, or federal rules for historic structures may limit the scope of a project in terms of alterations, CHPS does not offer automatic exemptions from prerequisites because in many cases some achievement is possible. This approach allows us to balance the values of historic preservation with the core principles of our criteria. The CHPS National Technical Committee has determined in recent CCIs pertaining in historic spaces that those teams did not have to follow the prerequisite to the letter but were asked to do what they can.

Teams working on projects in a historic structure may submit a waiver request to CHPS once the project is registered. CHPS reviews waiver requests on a case-by-case basis and may issue a determination of full exemption, partial exemption, or no exemption.

ACKNOWLEDGEMENTS

Thank you to the US-CHPS 2020 Working Committee:

CHPS Members:
Arnel Catalan, Mount Vernon Group Architects
Ryan Baumgart, Branch Pattern Consultancy
Carrie Havey, Green Engineer Inc
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INTEGRATION & INNOVATION (II)

II P1.0 INTEGRATED DESIGN
II C1.1 ENHANCED INTEGRATED DESIGN

> **Intent**
>
> Establish the district's high performance goals early in the conceptual design phase and work collaboratively as a team to ensure these goals are incorporated. Goals identifying building efficiencies, site impacts, indoor environmental health and well-being should be captured in this early planning process.

Integrated design is the consideration and design of all building systems and components together. It brings together the various disciplines involved in designing a building to develop and review their recommendations as a whole. It recognizes that each discipline's recommendations have an impact on other aspects of the building. For example, the HVAC system selection and design should take into consideration the building envelope and other building systems such as lighting and daylighting. A lack of teamwork can result in oversized systems or systems that are optimized for non-typical conditions. Integrated design allows professionals working in various disciplines to take advantage of efficiencies that are not apparent when they work in isolation. The earlier the integration is introduced into the design process, the greater the benefit for both new construction and renovation/modernization projects.

II P1.0 INTEGRATED DESIGN

PREREQUISITE

1 point

APPLICABILITY: All Projects

VERIFICATION: Design Review, Construction Review

RELATED CRITERIA: All

II P1.0 REQUIREMENTS

1 point

Conduct a minimum of three integrated design team workshops that identify the project's high performance goals, ensure the incorporation of all CHPS prerequisites, and target the appropriate CHPS credits and best practices as part of an ongoing programming and design decision-making process. The outcome shall be a plan, scorecard matrix, or checklist of how each prerequisite and credit will be implemented, the person(s) responsible, and a timeline of key deliverables or implementation procedures.

The first workshop must take place at the point at which the project team is making design decisions, and preferably in the programming or first conceptual or Schematic Design phase meeting.

The second workshop must occur sometime during the Design Development phase, prior to the mid-point (50%) of the construction documentation phase and should coordinate with the owner's project requirements and any other district or project specific CHPS guidelines or environmental performance requirements. This integrated design workshop should include a quality check of the documents for high performance features and continued achievability of the earlier identified prerequisites and credits with an emphasis on maintenance and operational aspects of the building systems. School staff in charge of HVAC controls, maintenance, lighting, cleaning, landscaping, recycling, trash collection, and consumables purchasing are required to attend.

The third workshop must occur during the early part of construction, preferably in concert

with the construction kick-off meeting, where all parties review the CHPS scorecard goals, schedule of deliverables, and expectations of respective responsible parties, especially contractors, school site and maintenance and operations staff. Discuss implementation issues and confirm continued achievability of design intent, CHPS scorecard prerequisites and targeted credits.

Set any remaining deadlines for respective CHPS design and construction review, prerequisites, and credit documentation to be uploaded to the CHPS project account in Basecamp.

The following groups must be represented at least once in the process to speak to their responsibility for a CHPS prerequisite or credit:

- *Owner Representatives Group* – owner's project manager, facilities maintenance representative, district or school capital project staff, utility representative, commissioning agent, and any sustainability officer or green schools staff.
- *Design Consultants Group* – architect, interior designers, engineers (mechanical, electrical, civil, and plumbing), food service, acoustic and energy consultants, lighting designer, landscape architect, and green building/CHPS consultant.
- *Construction Representatives Group* – construction manager, general contractor, and major subcontractors. For projects that are Design-Bid-Build-Delivery, the contractor may not yet be under contract until the Construction Phase.
- *School Occupants Representatives Group* – principal, teachers, special education representatives, students, parents, operations staff, and community members.

II C1.1 ENHANCED INTEGRATED DESIGN

CREDIT

2 points

APPLICABILITY: All Projects

VERIFICATION: Design Review

SCORING: 2 points for completing one of the 3 options: 1.1.1, 1.1.2, 1.1.3

RELATED CRITERIA: All

II C1.1 REQUIREMENTS

II C1.1.1 *Energy Modeling Variations*

2 points

During the Design Phase, perform at least three iterations or variations of whole building energy analysis and document how the models responded to synergistic issues raised during the first two CHPS workshops and/or Interim Design Phase to improve overall high performance (see Prerequisite above).

OR

II C1.1.2 *Advanced Design Modeling*

2 points

Utilize an advanced BIM decision-making tool for integrated sustainable design; whole building life cycle assessment (WBLCA); or environmental impact modeling tool such as Tally, Athena, One Click, or Skanska's Embodied Carbon in Construction Calculator (EC3); or others that facilitate calculation of embodied and/or operating carbon emissions.

OR

II C1.1.3 *Cross-Category Workshops*

2 points During CHPS integrated design workshops, set aside time to specifically discuss design opportunities to improve multiple high performance outcomes by identifying criteria across categories (Materials & Waste, Indoor Environmental Quality, Site, Water, Energy) that contribute to the achievement of other category credits and/or design strategies that also promote human health, nutrition, or wellness.

II P1.0 - C1.1 IMPLEMENTATION

Assign a facilitator to oversee the integrated design workshops. The most likely candidates are the school project manager, if familiar with CHPS, a district/owner's green building program or sustainability manager/officer or the project's CHPS/sustainability consultant. While the design architect can be the facilitator, it is recommended that the lead design architect not be the facilitator, in order to minimize any situations where they might be required to serve dual roles and to maximize their open participation as a key member of the project team.

Invitation to the workshops of additional relevant stakeholders is encouraged. These stakeholders may positively contribute to the discussion by providing a unique perspective. This is especially true of those who will be impacted by or responsible for the selected green building strategies long-term. The workshop minutes shall include high performance project goals, implementation procedures, topics needing further investigation or research, and team members responsible for each prerequisite and targeted credit.

Planning documents (education specifications and owner project requirements) and procurement documents (requests for proposals and contracts) should reference project team member participation in these workshops where possible to ensure associated costs are covered for participation and ensure attendance of appropriate consultants. Participation via telephone or videoconference can assist with minimizing consultant travel expenses. The CHPS Scorecard is an efficient tool to record the results.

Although an integrated workshop is an important first step in achieving the benefits of high performance schools, it is important to carry out a collaborative team process through continual interdisciplinary dialogue throughout the completion of construction and into post-occupancy. Although only three integrated design workshops are required, more workshops may be beneficial to ensure optimum results, depending on the district and team's experience with high performance schools and/or the complexity of the project.

It is encouraged, but not required, that additional workshops are held after construction and post-occupancy to discuss lessons learned for future projects and to highlight any pertinent maintenance and operations issues. Consider scheduling these to cover both the heating and cooling seasons.

II P1.0 - C1.1 DOCUMENTATION

DESIGN REVIEW

II P1.0 For the first two workshops: agendas, attendee lists, and workshop minutes including at least one example of how different participants contributed in the integrated design process to co-create/innovate some part of the design that contributed to a credit. Note: the third workshop occurs during the construction phase kick-off, thus is a Construction Review

submittal.

II C1.1.1-2 Submit a signed letter or narrative from the project lead stating which model/tool was used and what purpose the model served, i.e. a description of how the team used the model or what the team got out of it. The narrative should explain the improvements made to each successive model, any synergies between achievements of two or more prerequisites or credits, and the intended beneficial outcomes of those integrated design decisions.

OR

II C1.1.3 Provide a brief signed narrative from the project lead of how the intentional design approaches discussed in the integrated design workshops were incorporated into the project, identifying prerequisites or credits involved across categories and combined outcomes, such as health or wellness benefits.

CONSTRUCTION REVIEW

II P1.0 Submit the final integrated design workshop report: agenda, attendee list, and workshop minutes including at least one example of how different participants contributed to a credit.

II P1.0 - C1.1 RESOURCES

1. American Institute of Architects (AIA) Center for Integrated Practice: https://network.aia.org/projectdelivery/home/integratedpractice
2. ANSI/MTS 1.0 Whole Systems Integrated Process Guide (WSIP)-2007 http://mts.sustainableproducts.com/Capital_Markets_Partnership/DueDiligence/15/15%20IP%20Standard%20Guide%20-%20FINAL%20APPROVED%202-1-12.pdf
3. The Integrative Design Guide to Green Building: Redefining the Practice of Sustainability, by Group 7, and Bill Reed, April 2009.
4. The National Institute of Building Science's Whole Building Design Guide (WBDG): www.wbdg.org/
5. US Department of Energy: Office of Renewable Energy and Energy Efficiency and Renewable Energy High-Performance Buildings Initiative & the National Renewable Energy Laboratory: www.nrel.gov/docs/fy09osti/44051.pdf

II P2.0 CENTRAL EDUCATIONAL DISPLAY
II C2.1 SCHOOL AS A LEARNING TOOL

Using the school and grounds as a learning tool, students, staff, and the community can benefit by having an educational display to illustrate the healthy, efficient, environmentally sustainable features of the school.

Intent

Promote environmental awareness and eco-literacy by utilizing the high performance features of the school to demonstrate the basics and benefits of sustainable, healthy buildings.

High performance features offer excellent opportunities to teach students about the specific ideas and technologies incorporated into the school. Demonstrating these features in the architecture of the school provides a hands-on experience for students, teachers, and staff.

School gardens and campus landscape can provide a richly engaging learning environment, as well as a beautiful respite from the demands of the school day. Gardens promote learning about the social and environmental systems and healthy foods. Students who are not engaged by traditional learning methods often find the experience of working in the garden and campus landscape a welcome path to experiential-based learning.

II P2.0 CENTRAL EDUCATIONAL DISPLAY

PREREQUISITE

1 point

APPLICABILITY: All Projects

VERIFICATION: Design Review, Construction Review

RELATED CRITERIA: All

II P2.0 REQUIREMENTS

Provide a permanent educational display, such as signage, kiosk, showcase, or digital device, in a central location on the school site that describes the high performance features that are part of the building and site.

The permanent educational display must be located in a prominent location at the school, such as the main lobby. The display shall include a list of all CHPS high performance features with a statement of the intent and an explanation of each feature. Visual aids or drawings may be used to illustrate features as needed. If demonstration areas are established in II C2.1, the display shall include a map identifying their locations.

II P2.0 IMPLEMENTATION

The display may be electronic and interactive but must be physically present at the school site and dedicated for this purpose. It may not be a virtual display only accessible via computer, unless that computer is permanently located as described above. In any case, the software and content must be permanently accessible to the school community and public. We recommend the display be designed so that it can be updated periodically and easily modified for future phased renovation/modernization projects.

II P2.0 DOCUMENTATION

DESIGN REVIEW

CDs must include the prominent location and details of the educational display, describing all main high performance features, as well as material specifications of any permanent display. If available, graphics of the signage, including text, should be submitted. If graphics are not available, then a narrative describing the plan for the sign must be submitted.

CONSTRUCTION REVIEW

Submit one to two photos of the installed educational display. At least one photo must show the context/location of the display and at least one photo must show readable details of the content of the display. Explain any deviations from Design Review submittals.

II C2.1 SCHOOL AS A LEARNING TOOL

CREDIT

1-5 points

APPLICABILITY: All projects

VERIFICATION: Design Review, Construction Review

SCORING: 1 point each for 2.1.1 and 2.1.3, 3 points for 2.1.2

RELATED CRITERIA: All

II C2.1 REQUIREMENTS

II C2.1.1 *Demonstration Areas*

1 point

Create at least two demonstration areas for any of the school's high performance features on: indoor environmental quality, energy, water, site, materials & waste, or climate resilience. The demonstration areas are in addition to the central educational display.

Within the demonstration sites, at least one feature of a high performance category must be showcased. The demonstration area must explain how the high performance feature works, its environmental and economic benefits, and how it exemplifies a holistic and integrated approach to sustainable design.

II C2.1.2 *Educational Integration/Environmental Curriculum*

3 points

Create an educational plan, program, or activity that utilizes the school's high performance features in teaching and learning to contribute to environmental awareness and/or eco-literacy. If the plan or program is obtained through a third party, it must address the school's high performance features. Include a letter of commitment from the school principal, teacher(s), or governing board stating that the sustainability education will occur on a yearly basis. The educational program should consist of the following primary components:

- Science, technology, environmental arts, or math (STEM/STEAM) hands-on learning that explores high performance design features.
- A core group of learners, or CHPS Champions, who will be responsible for educational outreach within the school community. The number of CHPS

Champions will vary from school to school but is preferably at least 2 students per grade.

- Support staff, preferably 2, who will administer the program and mentor the CHPS Champions.

Educate entire student community (100% of student population) on high performance design. Each student should be exposed to at least one design feature, exposing them to level appropriate learning-outcome relevant information.

Educational integration should incorporate the central educational display and/or demonstration areas.

II C2.1.3 *School Gardens*

1 point

Provide a site on campus for one or more school gardens with a minimum of 200 ft^2 for a student enrollment of 499 or fewer students, and a minimum of 500 ft^2 for student enrollment equal to or greater than 500 students. At a minimum, the garden(s) must provide for learning about the social and environmental systems of the local natural systems and about healthy foods, in the case of an edible garden. The garden(s) shall have a permanent source of water through an irrigation system or by access to a tap and hose and/or access to a rain collection system. There must also be dedicated storage space for garden maintenance supplies and tools. Informal seating or gathering space for instruction within the garden or nearby is encouraged, but not required.

Provide signage to designate the area as a school garden and to differentiate it from the surrounding grounds. Develop a long-term ecologically sustainable operations and maintenance plan to ensure the garden is implemented and continues to thrive; update the plan as-needed.

For existing school sites (major renovations/modernizations or new building on existing campus project) the soil must be tested to ensure there are no harmful contaminants. New school sites are covered under SS P1.0 site requirements.

II C2.1 IMPLEMENTATION

II C2.1.1 *Demonstration Areas*

A demonstration area identifies a feature of the building where the feature occurs and provides an explanation of the feature and its benefits. Each demonstration area will showcase a minimum of one feature that was utilized in the design of the school. The design of the demonstration areas may include but is not limited to, signage, kiosks, cut-aways, meters, graphic illustrations, artistic murals, videos, real-time displays, or other elements. For example, a demonstration area could be a meter of resource flows/usage or a visual display of electrical generation provided by photovoltaics.

Demonstration areas in joint use portions of the building are an excellent way to educate the broader community beyond students. For safety and security reasons, it may not be desirable to allow the public to access the demonstration areas outside of joint use areas; however, the demonstrated features can be identified and summarized as part of the central educational display.

When choosing materials or media to portray a high performance feature, ensure that they align with the other intents of a high performance school. For example, a kiosk made of on-site recycled materials, or an electronic display labeled ENERGY STAR®.

II C2.1.2 *Educational Integration/Environmental Curriculum*

Educational integration considers people, lesson plans, educational outreach, and documentation.

Personnel

- Identify the CHPS Champions group and determine their roles and level of involvement. Roles and involvement should be grade-appropriate.
- Create a support team on the side of educators and staff (minimum 2 people). The support team should have at least one educator. It is preferred, but not required, that facilities staff is involved in technical support of the curriculum.
- Together, the CHPS Champions and the support staff will be responsible for educating the entire school community (100% of student population).

Lesson Plans

- Review mission of CHPS and all high performance features. It is encouraged that the educational display and demonstration areas be incorporated in the overview.
- Select or design age-appropriate standards-based lesson plans covering at least one of four high performance design topics (see resources). Instruction can include classroom work, outdoor instruction, engagement at demonstration areas, educational event, homework, and/or tours or a site visit. Educational lesson plans can be from established or third party curriculum or developed by site-project team.

Educational Outreach

- The goal of outreach is to connect every student with knowledge about high performance design and how it benefits the school and/or the local community from social, economic and performance perspectives. CHPS Champions are encouraged to be creative. Outreach can range from an educational assembly to publication of educational materials that includes a discussion (see Resources).

II C2.1.3 *School Garden*

To earn this point, the project shall designate an area(s) appropriate for gardening by the school community. Examples of acceptable uses of garden space include a vegetable garden, pollinator or butterfly habitat, or for animal husbandry, such as raising turtles, fowl (ducks, geese, chickens), rabbits, fish amphibians or other animals.

Indicate on the plans the location of the garden and its components. A school garden can come in many different forms. It can be fenced off, or physically separated from buildings, making it easily accessible to the school and to community members, or it can be integrated onto the school site in multiple areas or planters. Unique gardens, such as roof gardens, can also be considered for credit.

It is highly recommended that school community members, including staff and parents, be involved with the school garden and its development. When school is closed during summer months, for example, the garden will still need care, and community support is essential for this purpose.

The garden must have:

- A prominent entrance that is easily accessible and/or identified by signage.
- A long-term maintenance plan to ensure the garden is implemented and continues to thrive.

- Soil that has been tested (for existing school sites or redeveloped sites) to ensure there are no contaminants.
- Permanent irrigation or water source.

Gardens and campus landscapes can be integrated across the curriculum, including natural sciences, social sciences and humanities, as well as place-based and project-based curriculum.

Consistent with best science-based practices to conserve or restore biodiverse ecosystem function, use native seeds or plants (or locally adapted native seeds or plants). The school garden(s) and campus landscape should promote ecologically sustainable practices such as building healthy soil, using organic compost instead of chemical fertilizers, planting locally adapted native seeds and plants, and using integrated pest management without chemicals. School gardens can also be the site of school-wide composting programs. Agroecology can provide a model approach for the planning and design of school gardens and campus landscape.

II C2.1 DOCUMENTATION

DESIGN REVIEW

II C2.1.1 CDs must contain all the pertinent details of the demonstration areas. These include location and details of all three areas and the actual content of the signage (describing how the high performance features work, the environmental and economic benefits, and how the project exemplifies a holistic and integrated approach to sustainable design).

II C2.1.2 Present an educational plan and letter of commitment or governing board-level resolution, if appropriate, stating that the sustainability education will occur on a yearly basis. Include a narrative of the district or school's intent to implement this educational integration with a proposed typical timeline and identification of the CHPS Champion(s) and any educators or staff involved.

CONSTRUCTION REVIEW

II C2.1.1 Submit one to two photos of each of the demonstration areas with a brief description of each. One of the required photos must show the Demonstration Area in context and the other required photo must be a close- up and/or show readable detail of any signage.

II C2.1.3 Submit a photo(s) of the completed garden(s). Submit the long-term maintenance plan for the garden spaces. For existing schools, submit proof that the garden site soil has been tested and no harmful contaminants are present or that new soil is being installed.

II C2.1 RESOURCES

1. California Environmental Protection Agency, Education and the Environment Initiative: www.californiaeei.org/
2. Minnesota Department of Natural Resources, Environmental Education Resources: www.dnr.state.mn.us/education/ee/examples.html
3. North American Association For Environmental Education, Excellence in Environmental Education: Guidelines for Learning (K-12): resources.spaces3.com/47edc444-7bd4-4093-918b-7964644cce75.pdf

4. Energy Coalition, PEAK curriculum: energycoalition.org/peak/
5. Alliance to Save Energy, PowerSave Schools: www.ase.org/programs/powersave-schools
6. Green Schoolyard Network: greenschoolyardnetwork.org/
7. Hedgerows Enhance Beneficial Insects: ucanr.org/repository/cao/landingpage.cfm?article=ca.v065n04P197&fulltext=yes
8. Native American Plant Hedgerow Resource Establishment: www.plant-materials.nrcs.usda.gov/pubs/capmctn7882.pdf
9. Square Foot Gardening: www.squarefootgardening.org
10. The Edible Schoolyard: www.edibleschoolyard.org

II C3.1 DISTRICT LEVEL COMMITMENT

Intent

Integrate high performance goals into district planning.

School and district leaders who institutionalize high performance programs are not just building better schools; they are protecting student and staff health, improving student performance, and lowering the district's operating expenses. Institutionalizing high performance schools allows districts to leverage suppliers and vendors for products and services that comply with high performance school standards, standardize specifications and building strategies to minimize time and expenses, and maximize the benefits of high performance schools on a district-wide basis.

II C3.1 DISTRICT LEVEL COMMITMENT

CREDIT

3 points

APPLICABILITY: All Projects

VERIFICATION: Design Review

SCORING: 1 point for 3.1.1 and/or 2 points for 3.1.2

RELATED CRITERIA: All

II C3.1 REQUIREMENTS

II C3.1.1 *CHPS Membership & Construction Resolution*

1 point

The administration must maintain an active CHPS membership and pass a board or trustee-level resolution that mandates compliance with CHPS Criteria across construction project types to formalize district-wide commitment to high performance schools, as follows:

Meet or exceed the CHPS qualifying threshold using the CHPS Criteria for:

- New Schools
- Major Renovation/Modernization Projects
- New Buildings on an Existing Campus, including Non-Classroom Buildings
- Additions to an Existing Building
- Prefabricated/Modular Classrooms

OR

II C3.1.2 *Benchmarking Resolution*

2 points

The governing board must pass a resolution that mandates annual monitoring and benchmarking of building performance (see OM C4.1 High Performance Operations) district-wide.

II C3.1 IMPLEMENTATION

II C3.1.1 *Membership & Construction Resolution*

The CHPS website has membership information, sample board or trustee level resolutions, and other resources. The district must be a CHPS member in good standing at the time of project review. The resolution must be passed by the governing body by the time of submittal for Design Review. Commitments to become a member or adopt a resolution are not allowed for a point.

Where applicable, state or other jurisdiction (county, city or district, as in the case of the District of Columbia) green/high performance building legislation requiring CHPS compliance, or CHPS as an equivalent rating system to LEED where specifically legislated, for all school facility projects may accompany local board or trustee-level resolutions as additional evidence of formalized commitment.

The requirement for prefabricated/modular classrooms does not apply to temporary housing used during construction.

II C3.1.2 *Benchmarking Resolution*

Benchmarking and monitoring over time are excellent ways to assess the performance of school buildings and to guide the continuous high performance of the buildings. The resolution should state a commitment to conduct benchmarking using any of the tools identified in OM C4.1 on an annual basis. For non-public schools, a letter of commitment from the administration or a policy adopted by the governing board are acceptable. An equivalent form of commitment is acceptable.

II C3.1 DOCUMENTATION

DESIGN REVIEW

Provide a PDF of approved governing board-level resolution(s). CHPS membership will be verified by the reviewer through the CHPS online Member Directory. Note: Benchmarking commitment may be submitted during Construction Review.

CONSTRUCTION REVIEW

N/A unless benchmarking resolution or equivalent submitted.

II C3.1 RESOURCES

1. CHPS sample resolutions: https://chps.net/school-district-resolutions
2. CHPS School Membership Program: https://chps.net/join-us

II C4.1 SCHOOL MASTER PLAN & ENHANCED PLANS

While a school is being designed or renovated it is important to consider future needs and how those needs may be met while keeping high performance principles in mind. It is also important to have a master plan in place to ensure that the intent of the design or renovation/modernization is carried out when the school is renovated and maintained in the future.

Intent

Ensure high performance measures are implemented throughout the life of the school. Plan for and take meaningful actions to measure and reduce GHG emissions over time.

Climate action planning provides a roadmap for schools and districts to reduce greenhouse gas (GHG) emissions. Electricity use and combustion of fuels for heating in buildings contribute to nearly 40 percent of national GHG emissions. High performance design and construction of new schools as well as sustainable operation and renovation of existing schools offers great potential to reduce GHG emissions.

II C4.1 SCHOOL MASTER PLAN & ENHANCED PLANS

CREDIT

3-7 points

APPLICABILITY: All Projects

VERIFICATION: Construction Review

SCORING: 3 points for 4.1.1, 5 points for 4.1.2, 6 points for 4.1.3, 7 points for 4.1.4

RELATED CRITERIA: EE C1.1 Superior Energy Efficient Design, OM P3.0 Energy & GHG Performance Benchmarking, OM C8.1 Green Power

II C4.1 REQUIREMENTS

Create a written, actionable master plan with goals for continuous implementation and improvement of the high performance elements of the school over at least a 10 year period from occupancy/project completion. Enhanced plans contain goals for significant additional steps towards sustainability over the baseline performance of the building, such as zero net energy or zero waste. Enhanced plans should cover 50-80 years.

II C4.1.1 *School Master Plan or Commitment to Complete Sustainable Plan*

3 points

Do either of:

School Master Plan

The administration shall develop a school master plan for the site and facilities in collaboration with school board members and community stakeholders covering 10-15 years from occupancy that:

- Supports continued compliance with high performance strategies followed in these Criteria.
- Is consistent with the district-wide facilities master plan, if applicable.
- Assesses and plans for future transportation impacts on the school and offers flexibility for alternative forms of transportation.

- Assesses and plans for the possibility of increased or decreased student enrollment.
- Assesses use of the school for emergency preparedness such as a shelter or for climate adaptation and resilience.
- Assesses and plans for future high performance upgrades and renovations/modernizations by documenting:
  1) Life expectancy of major systems and materials.
  2) Opportunities for high performance replacement such as reuse or recycle.
- Identifies current and future opportunities for pedestrian and bike connections to surrounding neighborhoods, community services, and bike paths.
- Considers protecting outdoor spaces for school gardens, landscaping, permeable paving, and ideal solar orientation.

OR

Commitment to Enhanced Plan

The administration shall make a written commitment to complete any one of the following sustainable/climate action plans (4.1.2-4.1.4), including the GHG Emissions Inventory. The commitment must include the timeframe for completion of the plan and identification of the responsible individuals.

II C4.1.2 *ZNE School Master Plan*

5 points

Exceed the school master plan above to create a zero net energy (ZNE or ZE) plan. The ZNE plan should address all of 4.1.1 as well as include goals and actions to achieve the following over time:

- Zero net energy for the whole site/all buildings using the criteria in EE C1.1 Superior Energy Efficiency Design
- Energy resiliency using the criteria in II C7.1 Design for Adaptation & Resilience or other criteria appropriate to the local climate and conditions

II C4.1.3 *Sustainable School Master Plan*

6 points

Exceed the above plans by doing all of 4.1.2 plus:

- At least 40% water use reduction using strategies including but not limited to those in WE C2.1 & C3.1; “water neutral” or “zero water” goals are encouraged
- Additional waste reduction measures beyond those in MW P1.0 and MW C1.1; “zero waste” is encouraged
- Provide for ZEV/carpool preferred parking and electric vehicle charging facilities
- Coordinate with district-wide sustainability planning, if applicable
- Integrate education on all the above into curriculum

II C4.1.4 *Sustainable School Climate Action Plan or Low/Zero Carbon School Master Plan*

7 points

Do all of 4.1.3 plus either of:

Sustainable School Climate Action Plan

Develop and implement an administration-approved climate action plan that includes a goal for annual reporting of GHG emissions to raise awareness of the school community’s carbon

footprint and engage students, staff, and the community in reducing the footprint. The plan must establish a baseline year, identify measures that will lead to reduction in GHG emissions by at least 25% from the baseline year within 10 years and 80% by 2050. The climate action plan shall address Scopes 1 and 2 emissions (see Implementation) at a minimum and may also include Scope 3 emissions.

OR

Low/Zero Carbon School Master Plan

The Low/Zero Carbon plan is eligible for an additional point in II C8.1 Innovation.

Complete the Climate Action Plan above plus:

- Commit to no fossil fuels used on-site for space heating, water heating, cooking, or other small process loads.
- Address GHG emissions from transportation related to school district employee/teacher/student commute or pick-up/drop-off through performing a baseline survey and developing a plan for minimum 25% reduction by 2030 and 80% reduction by 2050.

II C4.1 IMPLEMENTATION

This credit applies to major renovation/modernization projects if the school master plan is developed for the entire school site, not just the portion of the school being renovated or built.

The basic master plan should cover 10 to 15 years from the school opening or a major renovation being completed. Enhanced plans should cover 50 to 80 years to capture changes in climate. Some school districts may already have a master plan, so a new plan may not be needed. The existing plan can be reviewed for compliance with the above requirements.

The school may use a district-wide Facilities Master Plan that contains the site-specific information required by this criterion.

If pursuing the commitment option, the school/district governing body must adopt and sign a written statement of intent, resolution or equivalent. The commitment must be specific as to who, when, and what will be accomplished.

For plans that include the GHG Emissions Inventory, the plan should identify who will be responsible for monitoring the GHG measurements.

GHG Emissions Inventory and Monitoring

CHPS projects that complete Portfolio Manager®/Target Finder™ in EE P1.0 and OM P3.0 will have an automatic GHG baseline projected for them. GHG emissions inventory, calculation, and reporting of the school's carbon footprint can also be completed using the Climate Registry Information System (CRIS) tool or other appropriate calculator. Once the GHG emissions baseline is established, the methodology is same as other types of monitoring: gather 12 continuous months of data for direct (on-site) and indirect (utility generated) emissions. [9] A school may additionally address Scope 3 emissions (other indirect sources), per the Greenhouse Gas Protocol. [10] All three categories of emissions provide a complete accounting of measuring and reducing GHG emissions. Then calculate the percentage reduction, if any, from the baseline GHG inventory, to track and report annually or in the chosen period.

II C4.1 DOCUMENTATION

DESIGN REVIEW

N/A

CONSTRUCTION REVIEW

Submit a copy of the plan or written commitment.

II C4.1 RESOURCES

1. A4LE, *Creating Connections: The CEFPI Guide for Educational Facility Planning*, available for purchase: http://creatingconnections.a4le.org/
2. The Climate Action Registry: www.theclimateregistry.org/
3. Climate Registry Information System: http://cris4.org/(S(e3cxw11z3wfmzlrca5ea0wix))/frmLILogin.aspx
4. The Campus Carbon Calculator, now SIMAP, housed at the University of New Hampshire, Sustainability Institute: https://sustainableunh.unh.edu/calculator
5. Eco-Schools USA Handbook: http://www.ecoschools.global/ecoschools-ehandbook/
6. The Whole-School Sustainability Framework: https://www.centerforgreenschools.org/sites/default/files/resource-files/Whole-School_Sustainability_Framework.pdf
7. Sample Climate Action Plan: The New School Climate Action Plan: https://issuu.com/newschool/docs/2017-tns-climate-action-plan
8. Sample Sustainability Plan: San Diego Unified School District Sustainability Plan: https://www.scribd.com/document/272746917/San-Diego-Unified-School-District-Sustainability-Plan
9. EPA's Portfolio Manager Technical Reference on GHG Emissions: https://portfoliomanager.energystar.gov/pdf/reference/Emissions.pdf
10. The Greenhouse Gas Protocol: https://ghgprotocol.org/sites/default/files/standards_supporting/FAQ.pdf

II C5.1 SAFER SCHOOLS BY DESIGN

The design of learning environments can dramatically affect behavior, feelings, and attitudes towards one another. While schools in the United States remain relatively safe, it is imperative to increase feelings of safety and reduce opportunities for violence. Crime Prevention Through Environmental Design (CPTED) principles focus on reducing crime opportunities, and promoting positive social behavior. The CPTED Principles are:

Intent

Ensure school grounds, buildings, and interiors incorporate proven design strategies that foster a sense of safety, community and connectedness to improve the quality of the life for students.

- Natural surveillance – Integrate themes of openness and transparency for all to see and be seen.
- Natural access control – Direct the flow of people towards entrances that are most visible.
- Territorial reinforcement – Create a sense of place and ownership to deter crime.
- Maintenance and management – Well-maintained spaces feel safer and are proven to deter crime.

There are strong overlaps and synergies among the four CPTED principles. In practice, it may be useful to recognize that the principles can meet other design goals as well, like Responsive Design (II C8.1 Biophilic and Responsive Design). The implementation of strategies should create a warm and welcoming environment, foster a sense of physical and social connection, increase a sense of place, and provide more opportunities for natural surveillance.

To incorporate CPTED Principles effectively, schools must involve those responsible for design, use, and maintenance. Key stakeholders include school officials, teachers, designers, students, community members, and local emergency response agencies. The most effective CPTED strategies are those that improve the quality of the learning environment and that bring communities closer. This is in contrast to implementing visually affronting security or hardening measures such as armed security patrols or harsh fencing materials. Effective CPTED strategies include:

- Increasing visibility between interior rooms and circulation spaces.
- Adequate site lighting at drop-off/pick-up areas, trash enclosures, and along pedestrian paths.
- Directing the flow of people toward proper and visible entrances.
- Eliminating unnecessary doors or gates, such as at restrooms.
- Promoting land use mix to encourage activities during critical time periods.
- Creating a sense of ownership and placemaking through design, maintenance, and management.

II C5.1 SAFER SCHOOLS BY DESIGN

CREDIT

1 point

APPLICABILITY: All Projects

VERIFICATION: Design Review

RELATED CRITERIA: II C8.1 Biophilic & Responsive Design, Most Site criteria, MW P1.0 Storage & Collection of Recyclables

II C5.1 REQUIREMENTS

Conduct a CPTED workshop with key project stakeholders and a CPTED professional at the outset of, or before, schematic design to identify site, building and interior issues, and define strategies aligned with CPTED principles for addressing them in a CPTED Plan. Key project stakeholders must include representatives of the designers, users, students, community members, and emergency responders.

The CPTED Plan must articulate strategies categorized by CPTED Principles.

The design team must incorporate these strategies in the project design. The CPTED professional shall review the design prior to construction and provide comments as necessary to align the design with CPTED Principles.

II C5.1 IMPLEMENTATION

The requirement includes a minimum list of potential strategies. Design teams are encouraged to develop a broader list of strategies taking into account district needs and site-specific research, especially in consideration of placemaking, social equity, and responsive or trauma-sensitive design. The CPTED Plan will be provided to the CHPS review team, along with the review comments that align the originally proposed strategies with the actual design response.

II C5.1 DOCUMENTATION

DESIGN REVIEW

Provide meeting agenda, list of attendees, and meeting minutes from CPTED workshop.

Provide a written narrative, articulating the CPTED Plan strategies for the project, referencing any plans or other construction documentation that will demonstrate the incorporation of CPTED principles.

Provide a letter from the CPTED professional with comments related to the review of the plan and meeting of the intent of the narrative above.

CONSTRUCTION REVIEW

N/A

II C5.1 RESOURCES

1. A4LE Safe Schools Planning Guide: https://www.a4le.org/pdf/knowledgecenter/SchoolSafetyGuide.pdf?hkey=8cc99e62-7d45-4db6-9cce-f6e1f5015a6f
2. International CPTED Association: www.cpted.net/
3. *Sandy Hook Elementary School was rebuilt after the shooting – and it hides high security in beautiful design*: https://www.businessinsider.com/new-sandy-hook-elementary-design-2016-8

II C6.1 LOW/ZERO GHG SCHOOLS

> **Intent**
>
> Avoid the use of fossil fuels, promote all-electric facilities that use 100% renewable energy and low embodied carbon materials to reduce school contributions to GHG emissions.

Zero Net Energy (ZNE) schools are not zero GHG or zero carbon emission schools. If ZNE schools use natural gas or other fossil fuels, they are a major source of direct GHG emissions in buildings, even if offset by renewable energy. Low carbon schools avoid use of natural gas or other fossil fuels for space heating, water heating, cooking, and other process loads, are energy efficient, all-electric facilities that use 100% renewable energy. Low carbon schools are on track to becoming zero emission schools when they also ensure that environmentally preferable refrigerants are incorporated into equipment and building material selection.

Embodied carbon is another climate impact when carbon dioxide or other GHG is emitted during the extraction, manufacture, transport and construction of building materials, together with end of life emissions. The Carbon Leadership Forum quantified GHG emissions of embodied carbon as an order of magnitude greater than operational energy. Initial design and construction of an efficient new building is equal to 20 years of carbon emissions from its operational energy. Serious consideration to minimize embodied carbon is becoming increasingly important in the near term between now and 2030.

II C6.1 LOW/ZERO GHG SCHOOLS

CREDIT

1-5 points

APPLICABILITY: All projects

VERIFICATION: Design Review, Construction Review

SCORING: 1 point each for 6.1.1, 6.1.2, and 6.1.4; 3 points for 6.1.3

RELATED CRITERIA: EE C1.1 Superior Energy Efficient Design & Zero Net Energy, OM C7.1 Green Power, II C1.1 Enhanced Integrated Design, II C7.1 Design for Adaptation & Resilience

II C6.1 REQUIREMENTS

II C6.1.1 *Energy Efficient, All-Electric*

1 point

Design a highly efficient, all-electric building using one of the following options:

1. Passive House approach;
2. Achieve a minimum of 35% savings beyond ASHRAE 90.1-2016; or
3. Achieve a site-based Energy Use Intensity (EUI) of less than 30 kBtu/sf/yr.

II C6.1.2 *100% Renewable Energy*

1 point

Achieve the zero net energy level in EE C1.1 where on-site renewable energy systems produce as much energy on an annual basis as is used by the sum of all the building systems;

OR

100% of purchased electricity to power the building, whether through the local grid, a Community Choice Aggregator (CCA), or through a Power Purchase Agreement (PPA), is

from 100% renewable sources.

II C6.1.3 *Low Embodied Carbon Materials*

3 points Select low carbon structural and other major materials through an assessment of embodied carbon using whole-building life-cycle assessment (WBLCA) or other appropriate calculator. Install low carbon materials from at least 3 of the following categories:

- Concrete
- Steel
- Timber
- Metal Framing
- Glazing
- Insulation
- Interior Materials: Gypsum Board, Wall & Ceiling Panels, Carpet, Flooring

II C6.1.4 *Environmentally Preferable Refrigerants*

1 point Use no CFC-based refrigerants in building heating, ventilating, air conditioning, & refrigeration (HVAC&R) systems.

HFC refrigerants are allowed and preference should be given to specifying HVAC, refrigeration, and water heating equipment that utilizes low GWP refrigerants, including carbon dioxide (CO_2) refrigerant.

II C6.1 IMPLEMENTATION

For the purposes of this criterion, natural gas also includes propane and similar fuels.

II C6.1.3 *Low Embodied Carbon Materials*

WBLCA is a process to evaluate multiple impacts of building materials over the entire life cycle of the material. Since structural systems contribute to approximately 80 percent of the embodied carbon in a building, projects can earn three points by completing WBLCA using calculator tools such as the Athena Impact Estimator, or Tally, and selecting low carbon structural and other major materials, sourced as locally as possible. As tool and methods for accounting of embodied carbon in construction materials may progress rapidly, other appropriate calculators may be submitted to CHPS for pre-approval prior to utilization. (See Resources.)

II C6.1.4 *Environmentally Preferable Refrigerants*

The following table may be used as a quick reference in choosing refrigerants. For a full guide of acceptable refrigerants, refer to EPA's SNAP list, see Resource 7. All CFC production has stopped. HCFC-123 is allowed for existing equipment until 2030. Districts and schools should implement exceptional maintenance and operation practices so that refrigerant is not lost from the system. This will reduce replacement costs, help maintain energy efficiency, and protect the reliability of the equipment.

Table II6-1: Refrigerants and Environmental Performance (Not Exhaustive)

Refrigerant	ODP	GWP	Common Building Applications
Hydrofluorocarbons (HFC) Refrigerants **permitted in new equipment** (not an exhaustive list)			
HFC-134a	0	1,430	Air conditioning, centrifugal chillers, refrigerators, vending machines
HFC-245fa	0	1,030	
R-407A	0	2,110	Low-temperature refrigeration
R-507A	0	3,990	
Carbon Dioxide	0	1.0	Air conditioning, low-temperature refrigeration, water heating, vending machines
HFC-32	0	675	Air conditioning (under R&D)
R-1233zd	0	7	Centrifugal chillers
R-1234ze	0	6	Centrifugal Chillers
R-1234ze	0	4	Centrifugal Chillers

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II C6.1 DOCUMENTATION

DESIGN REVIEW

II C6.1.1 Identify and submit the plan sheets/detail numbers and specification section(s) in the construction documents indicating electric systems for heating/HVAC, water heating equipment, all cooking equipment or appliances, and any science labs.

II C6.1.2 Provide documentation verifying all-electric design to ZNE with provision for on-site renewable energy. If the project is a modification of an existing facility with natural gas or other fossil-fuel building uses, identify and submit the demolition plans and/or specification sections showing safe shut off and removal of gas supply-distribution lines through to removal of gas meter. The documentation in EE P1.0 will cover the energy analysis requirement.

II C6.1.3 Provide documentation of WBLCA of structural and major materials systems.

II C6.1.4 Provide specifications showing the refrigerants and that equipment has no CFC-based refrigerants.

CONSTRUCTION REVIEW

II C6.1.1-2 Submit statement on letterhead confirming “No natural gas or other fossil-fuel use in the completed project,” and “All electricity provided to the project is from 100% renewable sources”, citing sources and signed by both the architect-of-record and the district facilities officer. If project is a modification of an existing facility served by natural gas or other fossil-fuel building uses, include a statement attesting to the safe shut off and removal of gas supply-distribution lines including removal of gas meter.

II C6.1.3 Include a statement confirming the project utilized the “low embodied carbon building materials” listed in the WBLCA submitted in the Design Review without substitution.

II C6.1.4 N/A

II C6.1 RESOURCES

1. New Buildings Institute, ZNE Schools: https://newbuildings.org/?s=ZNe+schools

   And https://newbuildings.org/hubs/zero-net-energy/#case-studies

2. The Carbon Leadership Forum's LCA Practice Guide http://carbonleadershipforum.org/lca-practice-guide/
3. Athena Impact Estimator: https://calculatelca.com/software/impact-estimator/download-impact-estimator/
4. Tally: https://choosetally.com/
5. *Life Cycle Assessment*, by Kathrina Simonen, c 2014
6. U.S. EPA Refrigerant Guidelines and Regulations: www.epa.gov/Ozone/title6/608/index.html
7. U.S. EPA Significant New Alternatives Policy (SNAP) list of acceptable substitute refrigerants: https://www.epa.gov/snap/snap-substitutes-sector
8. NREL's *A Guide to Zero Energy and Zero Energy Ready K-12 Schools* https://www.nrel.gov/docs/fy19osti/72847.pdf

II C7.1 DESIGN FOR ADAPTATION & RESILIENCE

A well maintained building designed today should last 60-100 years, at least in terms of its building shell and foundation. High performance school facilities may perform well on paper, but the design is often based on outdated climate data that does not reflect changes in weather data, let alone future changes in climate. Changing climate is already contributing to increased overheating and other weather-related hazards at schools, and is expected to worsen through this century and beyond. Due diligence should be taken to assess and mitigate the vulnerability of school facilities to climate change.

Building designers around the world have been designing buildings in recent years to perform well under future climate conditions and during power outages. This life cycle approach will increase the long-term durability and performance of buildings, and help avoid unnecessary and perhaps catastrophic impacts on facilities and their occupants. It will also help state-level adaptation, mitigation and resilience planning, such as in New York, California, Massachusetts, and others, in meeting goals for energy efficiency, emergency disaster planning, and GHG reductions in their schools, despite a changing climate.

Intent

Encourage building design practices that assess climate change vulnerability and that plan for changing climatic conditions over the building lifespan, in order to avoid excessive energy costs, repair costs, carbon emissions, and liability risks; while preserving access to safe water, sanitation, life safety, and minimizing health and student performance impacts. This approach of planning now for ***future*** changing conditions and disruptive events, particularly when combined with related CHPS Criteria, can allow schools to serve as sustainable centers of community resilience.

II C7.1 DESIGN FOR ADAPTATION & RESILIENCE

CREDIT

1-5 points

APPLICABILITY: All projects. For renovations/major modernizations, see Implementation for details.

VERIFICATION: Design Review

SCORING: 1 point each for 7.1.1-7.1.2, 1-2 points for 7.1.3, 1 point for 7.1.4

RELATED CRITERIA: All Integration, EQ P1.0 Ventilation & IAQ, EQ C10.1 Thermal Comfort, EQ C12.1 Daylight Availability, All Energy, All Water, SS P1.0 Environmental Site Assessment, SS C5.1 Sedimentation & Stormwater Management, SS C4.1 Joint Use, SS C7.1 Reduce Heat Islands, OM C6.1 Indoor Environmental Management and C8.1 Green Power

II C7.1 REQUIREMENTS

II C7.1.1 *Climate Vulnerability Assessment*

1 point

If no recent climate risk assessment exists for the site, conduct an assessment of the location's vulnerability to significant weather events. Assume at least 60-100 years of service life for the building shell, foundation, and other major structural components. Use the most recent and most localized (local, regional, and/or state, and/or national) climate change vulnerability assessments, maps, and/or adaptation plans to assess the magnitude and likelihood of climate change hazards at the school site and district wide, if applicable. Consider potential hazards such as, extreme heat event/overheating, wildfires, power

outages, extreme drought/water shortage, air pollution, extreme wind, sea level rise, winter storms, tornadoes, and episodic flooding or storm surge. State and federal (USGCRP, EPA, NOAA, or DOE) online resources, databases, or tools may be utilized, if no local climate risk assessments have been done recently.

Identify the top one to two hazards from the vulnerability assessment above based on the likelihood and potential magnitude of impacts on human health and safety and on economic impacts. For the top hazard(s), identify potential actions, design strategies, and opportunities to adapt the school building project, site, and district design standards (if applicable), operational policies, and school site activities and address future emergency events and climate conditions. Outreach and partnering with the local community, state, and regional agencies is highly recommended.

II C7.1.2 *Design for Climate Adaptation*

1 point

Design the building to meet the EE C1.1 criteria for zero energy and:

For the top hazards identified above, incorporate all feasible adaptation measures in the project design. Assess the feasibility, scheduling, and cost-effectiveness of the measures. Evaluate the potential benefits in terms of energy, water, and cost savings, disruption of service and other cost avoidance, improved staff and student performance, health, and safety, and reduced liability. Seek to identify and leverage other community benefits, both short and long term.

If integration of climate adaptation measures is not feasible under the current project budget or other constraints, provide the school administration with a recommendation for how to assess and implement the measures in the future, such as by designing and preparing construction alternates. Phasing the measures in over time is allowed if necessary, but plan for any necessary infrastructure or preparations in the initial construction phase, e.g., brackets for external shades, substructure for green roofs, and electrical transformer/panel/wiring for more electrification, PV panels, internet of things, EV charging, and microgrids. These recommendations can be used in the plan in II C4.1 School Master Plan.

II C7.1.3 *Energy Resilience*

1-2 points

Meet the criteria for zero net energy in EE C1.1. and design the building to meet at least two of the following measures for 1 point or all four measures for 2 points:

1. No less than 75% of the floor area is located within a daylit zone as defined by the IECC-2015, ASHRAE 90.1-2016 or the Spatial Daylight Autonomy methodology.
2. No less than 75% of the floor area is located in a space provided with an operable fenestration area to the exterior of at least 5% of the floor area of the space. Operable fenestration area shall be capable of manual operation.
3. All power systems are divided into primary/critical and secondary/non-critical sub-systems so that no more than 50% of the building loads are on the primary subsystem and the secondary sub-system can be disconnected from energy sources.
4. It contains an on-site energy storage system sized to serve the loads on the primary subsystem for no less than 4 days without any interaction with energy supply infrastructures such as the electricity grid or is connected to renewable backup power with the same capacity. A microgrid or renewable district energy system is acceptable for this criterion.

   Critical energy systems such as HVAC equipment, energy distribution systems for the primary energy sub-system, onsite renewable energy systems and energy

storage systems are built and located to protect them from the most likely disturbances or natural disasters. For example, in tornado-prone areas, these systems would be built in accordance with, or located in portions of the building built in accordance with, tornado-resistant standards. Or in flood-prone areas, these systems would be located above the flood level. In areas prone to high wind, especially tornadoes and hurricanes, it is especially important that onsite renewable systems be built to withstand high wind loads.

Include the systems in training and O&M Manual in OM P1.0 and in the Systems Maintenance Manual in OM C4.1, if applicable.

II C7.1.4 *Passive Habitability/Survivability*

1 point

If/when the school/district establishes readiness for emergencies by working with the Red Cross or other local lead agency, then comply with the criteria below. It is not required that the school achieve formal designation as an emergency shelter.

- Using dynamic thermal modeling such as EnergyPlus or Passive House certification, design and construct the facility, first maximizing energy efficiency and passive strategies, with 100% renewable energy systems including energy storage that can safely support the maximum occupancy for a 4-day power outage, at minimum.
- Meet the energy storage/backup power criterion in 7.1.3 to cover critical services such as access to sanitation facilities, potable water, refrigeration of medicines and food, cooking, charging of cell phones and other essential communication and electronic devices, shade/cooling and fresh air/exhaust fans, and perhaps portable air cleaners, as well as others identified in the vulnerability assessment above.
- Take additional measures as needed if the quality of potable water may also be affected, such as having backup filtration or a backup source. Coordinate with lead public agencies and plan with local community around other needs such as food supplies.
- Include details on all passive features in the O&M Manual in OM P1.0 and in the Systems Maintenance Plan in OM C4.1. Provide a brief User's Guide to designated emergency personnel on the operation of the features.

II C7.1 IMPLEMENTATION

For additions and major modernizations/renovations, the credit is based on the whole building. While portions of buildings can meaningfully pursue energy resiliency, the intent of this criterion is to achieve resiliency for the whole building.

II C7.1.1 *Vulnerability Assessment and Adaptation*

Research and/or contact regional, state, or federal programs and green building programs for the latest climate change modeling results, future weather files, local or regional climate vulnerability assessments or online resources (see CHPS Resources below) with data that may already be analyzed and applicable to your project as well as examples and case studies of future climate adaptation. A growing number of state and regional agencies have researched and published useful reports, online tools, or guidance on vulnerabilities, climate assessments, and adaptation and mitigation resources. Please refer to latest versions of these documents pertinent to your project locale first.

Method for Conducting Overheating Analysis:

Estimate mid- and late-century climate conditions for the site(s). Use the High Emission Scenarios in the climate models (e.g., RCP 8.5 or A2 scenarios) and 90th percentile or higher estimates of impacts. Climate projections should use 20- year averages if possible. Use the most spatially resolved climate predictions available for the project site.

For modeling energy and thermal comfort performance, two alternate approaches are available:

1) Use TMY weather files from a city with a current climate similar to that predicted for future conditions at the site (the "climate analog city" approach"), as characterized by Cooling and Heating Degree Days, Max and Min temperatures, and humidity. If local or regional climate model results are not available for the site, use the Climate Central website to identify a "climate analog city". Current weather files for major cities in the U.S. are available at the Energy Plus website.

2) Use future weather files with hourly data that are adjusted ("morphed") to reflect projected climate changes. These files are available commercially, e.g.: http://www.weather-shift.com/. They can also be created at no cost using the online CC WorldWeatherGen tool. In addition, consider the incremental effects of urban heat islands (UHI); consult local and regional groups for mapping and estimates of UHI impacts.

For prioritizing the hazards and identifying potential adaptation measures, consider the most recent federal, state, and local plans for climate adaptation and resilience or climate change modeling results. Some of these sources may be outdated or limited in analysis, but they are good starting points.

II C7.1.2 *Design for Adaptation*

Give preference to measures that have been tested or modeled for their effectiveness in the type of climate and region for the project. Consider case studies as well.

Facility Planning

Identify future building and modernization projects where adaptation and resilience measures could be incorporated and provide these recommendations to the school administration. This step can be used toward credit in II C4.1 School Master Plan.

II C7.1.3 *Energy Resilience*

Resiliency in the energy systems of buildings is achieved in two ways. The first is by designing the building so that it has passive systems that can meet certain building needs without any energy-consuming active systems. This aligns with the energy efficiency loading order of maximizing demand reduction, including building envelope insulation, prior to relying on highly energy efficient systems. The second is by designing active systems to be resilient. This criterion includes requirements for both kinds of resiliency.

Resiliency that incorporates passive systems is important for a couple of reasons. Even resilient active systems can be damaged, either by a disruptive event itself or by overtaxing those systems in the aftermath. Passive systems allow the load on the active systems to be reduced, especially when buildings are running on limited onsite energy storage or being served by potentially damaged or limited energy infrastructure systems. Passive systems also ensure that the building can continue to be usable even if onsite supplies of energy run out.

Daylighting & Operable Fenestration:

Daylighting and operable fenestration allow a building to continue to be usable even when all of the active systems have failed. They ensure that the building has lighting and ventilation without the use of active systems. Items #1 and #2 are not intended to require systems that are sufficient for substantially daylit or naturally ventilated spaces in day-to-day operation; a properly designed daylighting or natural ventilation system requires more design attention. These basic requirements are meant to merely provide minimum levels of lighting and ventilation to maintain usability during or after a disruptive event.

Zero Energy:

Energy resiliency requires a combination of both energy efficient systems and onsite energy production. For this reason, the Zero Energy criterion is a good standard to meet to ensure both of these. A resilient energy design requires the onsite production of energy even when the energy infrastructure fails or is only limited. Onsite renewable energy systems fill that role without the need to store or input consumable fuel sources. However, reducing energy consumption is also important. It maximizes the utility of both the onsite energy production and the onsite energy storage. Criterion EE2.2 includes a set of requirements that ensures that a design includes these important elements.

Primary/Secondary Energy Systems:

In an emergency situation, many normal loads are not essential. However, many loads are difficult to turn off or disconnect. Many plugged-in devices continue to draw power when in standby and even off mode. Turning off loads one by one is also a task that is likely to be a low priority in an emergency situation. Separating non-critical loads onto a secondary subsystem that can be disconnected from power sources ensures that none of the limited on-site energy supply is wasted on non-essential or “phantom” loads. This is a well-established practice in building types like hospitals, which are often designed so that only certain building loads are served by backup generators.

Onsite Energy Storage:

Many onsite renewable systems are “grid-tied” systems. These systems feed their power production back into the grid instead of into on-site storage. These systems are often less costly, simpler, and more efficient (the grid is a more efficient storage medium than onsite storage options like batteries). Many onsite renewable systems actually won’t even operate if they are not connected to a working power grid.

However, resiliency requires onsite energy storage so that energy is available if the utility services fail. No onsite renewable system – especially not photovoltaic systems, which are the most ubiquitous type of system – has a constant production. Loads aren’t constant either. Onsite storage allows a buffer to manage the mismatches that occur between onsite energy production and onsite energy demand. (This is why even some generator-based systems utilize batteries, which allows the generators to always run at peak efficiency regardless of load.) Onsite storage ensures that there is energy available regardless of the production levels on the onsite renewable energy system.

Critical System Location:

When Hurricane Katrina hit New Orleans, the Superdome was used as a refuge of last resort. Unfortunately, the generators were located in the basement of the building. As flooding worsened and water infiltrated the basement, the generators failed, and with them the lighting and HVAC systems that were keeping the superdome habitable. This illustrates that an important part of energy resiliency is ensuring that critical parts of the energy system are protected.

How this is done will vary depending on the disruptions that the building is most likely to face. For example, if flooding is the primary concern, then critical equipment should not be located anywhere in the building below the anticipated flood level. But if high winds from a source like a tornado are the anticipated danger, a basement location could be very appropriate. In seismic zones, critical equipment would need to be located in a seismically reinforced portion of the building. Hurricanes can pose particular challenges since they often include both high winds and flooding.

Another issue is protecting systems that cannot be located within the building. Most onsite renewable energy systems will be located outside the building, so this is a critical issue. Photovoltaic systems, by far the most common onsite renewable energy system, are particularly vulnerable to high winds. High winds can detach panels from mountings and blowing debris can damage panels. It is important, therefore, to design and install these systems to withstand the conditions that could occur during the disruption such as wind loads, seismic loads, snow loads, flooding, etc.

II C7.1.4 *Passive Habitability/Survivability*

Utilizing the approach for identifying and designing for primary and secondary systems in 11.1.3 Energy Resiliency, identify a facility or portion thereof, that can provide emergency shelter for a large number of students and adults. Model the thermal comfort performance of the designated space at full occupancy during a 4-day power outage. Use the worst recorded weather episodes for heat waves and cold waves; for heat waves, also select those that have the highest nighttime temperature. Estimate the time until the facility goes outside the Standard Effective Temperature (SET) target range of 54 - 86°F, and the number and percent of total hours it would be outside the target ranges.

Create a brief classroom User's Guide for teachers and administrative staff. This guide shall explain policies and procedures for ensuring human safety during heat waves, cold spells, power outages, and other weather related hazards. Guidance should include warning and actions levels, and when and how to evacuate the building or move to a "cool room" or other shelter in place. Incorporate the use of the OSHA-NIOSH Heat Safety Tool app (https://www.cdc.gov/niosh/topics/heatstress/heatapp.html) for obtaining real-time, hourly forecasts of the local outdoor Heat Index.

Coordinate with school community/parents, local health and safety officials on the location and capacity of cool rooms and/or emergency shelters in the district, FEMA, the Red Cross, and other relevant agencies.

II C7.1.3 & 4 Be sure the resilient features and systems are included in the O&M Manual and training and the Systems Maintenance Plan, as applicable. Be sure the occupant User's Guide includes any pertinent information.

II C7.1 DOCUMENTATION

DESIGN REVIEW

II C7.1.1 Provide a short narrative that cites the outside assessment used, if any, or describes the approach taken and includes top hazards and the rationale for selecting them.

II C7.1.2 Provide a short narrative of all feasible adaption measures that will be included in the project design and construction. The zero energy requirement will be fulfilled under EE C1.1.

Or, if the adaptation will occur in the future, provide a copy of the recommendations to the administration and a description of features included in the current design.

II C7.1.4 Identify the shelter space(s) on the CDs. Provide a description of the features that provide habitability.

CONSTRUCTION REVIEW

II C7.1.2 & 4 Provide a signed letter of confirmation from the primary architect, engineer, or commissioning agent that systems and any passive features have been installed as designed.

Documentation for OM P1.0 and OM C4.1 will cover the training and manuals.

II C7.1.3 Documentation from the following related credits will suffice for this credit as long as the calculations and other evidence demonstrate compliance with the above requirements:

EQ C12.1 Daylight Availability

EQ C13.1 Views

EQ C11.1 Controllability of Systems (operable windows)

EE C1.1 Superior Energy Efficient Design-Zero Net Energy Bonus

For the primary and secondary subsystems, onsite energy storage, and critical system location, submit a signed letter from the engineer stating how the project complies.

II C7.1 RESOURCES

1. ARCC Network (Adaptation and Resilience to Climate Change Network). Extremes and other Project types. U.K. Climate Impacts Programme. Tools; demonstration and research projects http://www.arcc-network.org.uk/extremes/overheating/. See Overheating and Flooding topics.
2. Houghton et al., 2017. Design Strategies and Community Resilience to Urban Flooding: A Systematic Review of the Evidence. Int J Environ Res Public Health. 2017 Dec; 14(12): 1519. DOI: 10.3390/ijerph14121519.
3. ICLEI, 2012. ICLEI's Adaptation Work: Local and Global Resources. http://resilient-cities.iclei.org/resilient-cities-hub-site/resilience-resource-point/resilience-library/methodologies-and-tools/
4. Imhoff et al., 2010. Remote sensing of the urban heat island effect across biomes in the continental USA. Remote Sensing of Environment, Volume 114, Issue 3, Pages 504-513. https://www.sciencedirect.com/science/article/pii/S0034425709003174.
5. New York City, April 2017. Preliminary Climate Resiliency Design Guidelines. OneNYC Initiative, Mayor's Office of Recovery and Resiliency, New York, NY. http://www1.nyc.gov/office-of-the-mayor/news/271-17/mayor-new-resiliency-guidelines-prepare-city-s-infrastructure-buildings-for.
6. Sustainable Energy Research Group. CCWorldWeatherGen. University of Southampton, U.K. Online tool for creating future weather files by morphing historical weather files. http://www.energy.soton.ac.uk/ccworldweathergen/.
7. UKCIP (United Kingdom Climate Information Programme), 2013. Adaptation Wizard Tool. University of Oxford, UK. A 5-step tool for vulnerability assessments and climate adaptation plans for communities plus case studies. U.S. weather and climate information can be used. https://www.ukcip.org.uk/wizard/. *See also:* https://www.ukcip.org.uk/designing-a-climate-resilient-school/

8. USGCRP (US Global Change Research Program), 2017. “Fourth National Climate Assessment.” Assessments of climate change impacts by U.S. region, plus various resources, and forthcoming risk assessments and other updates. https://www.globalchange.gov/nca4.
9. Resilient Design Institute: http://www.resilientdesign.org. Search for LEED, RELi, thermal, and other resilient design topics.
10. RELi (http://c3livingdesign.org/?page_id=5110)
11. City Resilience Index (https://www.arup.com/perspectives/themes/cities/city-resilience-index)
12. FEMA resources: https://www.fema.gov/media-library/assets/documents/177480?utm_source=gd&utm_medium=ces&utm_campaign=BSBRiskMAPFlyers032619
13. EnergyPlus modeling tool: https://energyplus.net/
14. Passive House Institute US: https://www.phius.org/home-page

II C8.1 BIOPHILIC & RESPONSIVE DESIGN

As we spend increasing amounts of time inside, we create a disconnect between our day to day experiences and the natural world. Biophilic design aims to recreate that connection to nature by activating the senses with natural elements or mimics of natural systems, such as daylight, natural patterns, fresh air, moving water, and plant life.

Intent

To contribute to occupant health and wellness by providing an experience that is grounded in place, connected to nature, and promotes a sense of calmness and wellbeing.

Biophilic design principles are organized into three categories: nature in the space, nature of the space, and natural analogues. Nature in the space is the direct presence of nature. Nature of the space is about mimicking or replicating the feelings that natural spaces give us. Natural analogues use indirect methods to reflect nature, such as the use of patterns, shapes, textures, and numerical arrangements found in nature. The key to biophilic design principles is to integrate these forms in a way that feels natural.

Responsive design is the term we use to encompass design features that create safe and calming spaces, contribute to a sense of community, and allow for students of all abilities, backgrounds, and perspectives to learn together. Responsive design features support equitable education by making all children feel safe, welcome, and engaged.

Contact with nature and feeling connected is essential to the human experience. Schools should be designed and planned in ways that connect us with nature and with each other, something that we know produces numerous benefits including improved focus, awareness, social interactions, sense of wellbeing, and reduced absenteeism.

II C8.1 BIOPHILIC & RESPONSIVE DESIGN

Credit

1-3 points

APPLICABILITY: All projects

VERIFICATION: Design Review

SCORING: 1 point each for 8.1.1, 8.1.2, 8.1.3

RELATED CRITERIA: II P1.0 Integrated Design, II P2.0 Central Educational Display, II C2.1 School as a Learning Tool, II C5.1 Safer Schools by Design, EQ C13.1 Views, SS C2.1 Sustainable Site Use & Sensitive Lands Conservation, OM P1.0 Facility Staff and Occupant Training

II C8.1 REQUIREMENTS

II C8.1.1 *Biophilic Design*

1 point

Incorporate a minimum of six biophilic features, with at least two elements in each of the three categories: Nature in the Space (physically experiencing nature), Nature of the Space (spatial configurations), Natural Analogues (nature-inspired elements).

II C8.1.2 *Responsive Design*

1 point

Provide a minimum of two interior or exterior features that create safe and calming spaces, provide sensory input, or contribute to a sense of community. Features may include the sites' cultural, spiritual, archeological, or architectural history.

II C8.1.3 *Educational Curriculum Integration*

1 point

Provide educational materials for students and teachers that document the successful biophilic and responsive design strategies in C8.1.1 or C8.1.2. These could include but not be limited to signage indicating the benefits of a biophilic element, or a user guide highlighting the biophilic patterns included in the building, or a curriculum that further explores a responsive feature.

II C8.1 IMPLEMENTATION

Conduct an integrated biophilic and responsive design charrette with key stakeholders early in the design process. Identify opportunities to incorporate features into the project that respond to Biophilic and Responsive Design principles. Teams may target either Biophilic or Responsive Design, or both.

Biophilic features bring nature into the space, replicate the feelings that natural spaces give us, and use materials, elements and symmetries that reflect and remind us of nature.

Responsive features may be targeted to classrooms or grade levels and may vary throughout the building.

Employ targeted engagement tools such as:

- Develop narratives describing strategies available for incorporation.
- Engage the greater community in the responsiveness conversation.
- Document building user group ideas.
- Draft building and site drawings highlighting spaces available and installation locations.
- Solicit ideas for curriculum integration and grade appropriate project-based learning assignments.
- Consider signage around the building that discusses the biophilic or responsive elements and why they are important. This tool can be counted towards one of the Demonstration Areas in II C2.1 School As A Learning Tool.

II C8.1 DOCUMENTATION

DESIGN REVIEW

II C8.1.1 *Biophilic Design*

Provide the list of proposed and selected strategies generated from the integrated design charette. Identify within the project specifications or the construction drawings the six features that have been incorporated into the project.

II C8.1.2 *Responsive Design*

Provide a written explanation of the features that have been included in the design and how these features serve as calming spaces, provide sensory input, or create a sense of community.

II C8.1.3 *Educational Curriculum Integration*

Provide a written statement from the district or school administration reflecting their commitment to incorporate the concepts of biophilic and responsive design into the educational curriculum, including how that will be achieved.

CONSTRUCTION REVIEW

N/A

II C8.1 RESOURCES

1. 14 Patterns of Biophilic Design, Improving Health & Well-Being in the Built Environment: https://www.terrapinbrightgreen.com/report/14-patterns/
2. AIA-funded study led by Craig Gaulden Davis Architects: https://cgdarch.com/wp-content/uploads/2019/12/The-Impact-of-Biophilic-Learning-Spaces-on-Student-Success.pdf
3. International Living Future Initiative, Biophilic Design Initiative: https://living-future.org/biophilic-initiative

II C9.1 INNOVATION

The purpose of this criterion is to encourage school project teams to be creative and take advantage of and/or test new technologies or strategies for improving the health and performance of students, schools, and the environment. The innovation may take an existing CHPS criterion to a significant new height or address a topic or practice not currently offered within the CHPS Criteria. Users are encouraged to refer to the CHPS Criteria Library for potential Innovation credit strategies.

Intent

Test, understand, and implement innovative approaches to improving the health of school occupants and performance of school facilities.

II C9.1 INNOVATION

CREDIT

1-2 points

APPLICABILITY: All projects, does not apply to CHPS Designed recognition

VERIFICATION: Design Review, Construction Review

SCORING: Reviewers will determine whether a submission warrants 1 or 2 points. Two submissions may be awarded 1 point each or a single submission may be awarded 2 points.

II C9.1 REQUIREMENTS

Implement new technologies or strategies that do at least one of the following not currently offered in the CHPS rating program:

- Improves the health and performance of students and staff.
- Improves the performance and efficiency of school facilities, or operation of those facilities.
- Improves the natural environment and/or addresses GHG reductions.

OR

Demonstrate exceptional performance in an existing criterion area through submission of a narrative explaining how the intent was exceeded by a significant amount.

II C9.1 IMPLEMENTATION

The point value of the criterion will be determined during the CHPS Verified review process by the CHPS Verified review team. A maximum of 2 points will be awarded per strategy, technology, or for exceptional performance beyond an existing threshold. Points will be awarded based on the technology or strategy's ability to address the three priorities under Requirements.

The CHPS Criteria are designed to be a comprehensive guide to high performance design, but as new technologies and creative designs evolve, there is a responsibility to support and encourage them. These points are also offered for communities that go beyond what is required by the Criteria and push to achieve exceptional performance, health,

educational, and environmental benefits, place-based novel solutions, and excellent policies.

As innovation points are achieved by projects, they will be catalogued by CHPS and made available on request.

Ideas for innovation points:

- Produce a surplus of energy on a net annualized basis, which exceeds Zero Net Energy School per EE C1.1.
- Implement a recycling program where there is no existing infrastructure per MW P1.0.
- Divert 95% or more of construction and demolition waste per MW C2.1 for 1 additional point.
- Provide a published Health Product Declaration (HPD) with a disclosure level of 1,000 ppm for at least 40 permanently installed products from at least five manufacturers in accordance with EQ C7.1 for 1 point.
- Design for Adaptability, Durability and Disassembly -- Provide the school owner, builder and records management systems with a Disassembly Plan that has the method of disassembly of major systems during renovations and end-of-life, and the properties of major materials and components for 1 point. Design major systems with differing functions and lifespans to promote disentanglement for 1 point, or provide access to and types of connections for one major system that allows disassembly for 1 point.
- Install a school farm or indoor garden.
- Retro-commissioning – For existing schools, commission all retained systems that have not been commissioned within the past three years. Systems to retro-commission are lighting and lighting controls, HVAC, domestic hot water, and energy management systems.
- Implement a responsibly permitted 100% non-potable on-site water reuse system with periodic water quality testing and management.
- Implement a program for district/staff/fleet Zero Emissions Vehicles and/or install charging stations in school parking areas.
- Create outdoor classrooms or design for local cultural sensitivity.
- Reduce outdoor water use in arid climates beyond the water use prerequisite and credits.

For each new credit attempted:

1) Define the action or feature and its purpose. For example, “School Farm, to provide fresh fruit and vegetables to the cafeteria and to provide students with the opportunity to learn about farming.”
2) Describe the proposed criteria for compliance including any applicable standards. Cite the source of any third-party guidelines or standards.
3) Identify documentation requirements that verify compliance with the proposed credit. Examples: photos, plan, written policy, signed letter, proof of purchase.

If the Innovation point is for exceptional performance in an existing criterion, then prepare a narrative of the design approach, including an explanation of how the original intent was

exceeded by a significant amount.

II C9.1 DOCUMENTATION

DESIGN REVIEW

For each new innovation attempted:

1) Submit a narrative describing how the action or feature reflects sustainable or environmental health and safety practices.
2) Submit documentation identified to support narrative.

For claiming credit for exceptional performance in an existing credit area, submit a narrative of the design approach, including an explanation of how the original credit was exceeded by a significant amount.

CONSTRUCTION REVIEW

If the innovation has a physical component (i.e.it is not purely performance-based), submit photographs that best highlight the high performance aspects of the innovation. Possible examples: photos of a large photovoltaic array(s), an urban school farm next to a culinary academy, or details of the construction of a building designed for disassembly.

II C9.1 RESOURCES

None

INDOOR ENVIRONMENTAL QUALITY (EQ)

EQ P1.0 VENTILATION & IAQ
EQ C1.1 ENHANCED VENTILATION, FILTRATION, AND DEDICATED OUTDOOR AIR SYSTEM

Establishing a minimum level of indoor air quality positively impacts student and teacher performance, may reduce absenteeism, and reduces the potential for long- and short-term health problems. The criteria in this prerequisite and credit are used to achieve excellent indoor air quality, which starts during construction with preventative measures to keep pollutants out of the building and includes good filtration and ventilation during building operation. [1]

Intent

Provide a foundation for providing clean, breathable air to protect student and staff health and increase potential for better performance and attendance.

EQ P1.0 VENTILATION & IAQ

PREREQUISITE

5 points

APPLICABILITY: All projects.

VERIFICATION: Design Review, Construction Review

RELATED CRITERIA: All of EQ and EE, SS P1.0 Environmental Site Assessment, OM C4.1 Systems Maintenance Plan, OM C5.1 Indoor Environmental Management

EQ P1.0 REQUIREMENTS

Design and construct the HVAC system to provide continuous outdoor air (OA) ventilation to each space during occupied hours, including all full- and part-load conditions. Follow ASHRAE 62.1-2019 unless a local equivalent is more stringent. Comply with all of the following:

1. The design shall ensure the ventilation system is not readily defeated. Assume no windows are open.
2. Ventilation rates during occupied hours including all full-and part-load conditions in all school areas shall be no less than required by the outdoor ventilation rate calculated according to the outdoor air ventilation rate procedure in ASHRAE 62.1-2019 §6.2 or §6.4 if natural ventilation is used.
3. The ASHRAE 62.1 Mechanical Ventilation Calculation Worksheet shall be completed in full and included in the project drawings and design documentation. The table shall list for each room: HVAC system ID number and HVAC type, minimum outdoor air flow rate, room air classification, and all exhaust fans.
4. HVAC systems and equipment shall meet the requirements of ASHRAE Standard 62.1-2019 §5.
5. Design of condensate pans shall meet all requirements in ASHRAE Standard 62.1-2019 §5.10.
6. Outdoor air intakes shall meet all requirements in ASHRAE Standard 62.1-2019 §5.5. All intakes must be 6 feet above landscaped grade including soil, lawn, shrubs, or any plant life within 1.5 ft. horizontally of intake. Intakes near Class 2

exhaust sources shall be a minimum of 2 feet below the exhaust and 10 feet horizontally from the nearest edge of the intake to the nearest edge of the Class 2 exhaust.

7. The particulate matter filters or air cleaners shall meet all requirements in ASHRAE Standard 62.1-2019 §5.8, §6.2.1.1 and §6.2.1.2. In addition, filtration media shall have a Minimum Efficiency Reporting Value (MERV) of 13 or higher for all new HVAC systems, excluding unit ventilators, which can have MERV 8. All HVAC f@ailtration media must be replaced immediately prior to occupancy.
8. Mold resistance of air stream surfaces shall meet all requirements in ASHRAE Standard 62.1-2019 §5.4.
9. All in-room plug in Air Cleaning Devices used in the school classrooms shall be models that are Certified and Labeled in accordance with California Air Cleaning Device regulation California Code of Regulations, Title 17, Section 94804. [1]
10. The school shall be in compliance with ASHRAE 62.1-2019 §6.2.1.3, as applicable.

For multiple spaces served by variable air volume (VAV) systems, this means that the minimum supply setting of each VAV box should be no less than the design outdoor ventilation rate calculated for each space. The box must be controlled so that the minimum required airflow is maintained at all times when the space is occupied, even when the fan has modulated to its minimum capacity. Additionally, for art classrooms, darkrooms, kitchens and kitchenettes, locker rooms, copy printing rooms, science lab classrooms, woodwork shops and any other rooms with significant pollutant sources, the pollutants shall be exhausted directly to the outside and not recirculated. Local contaminate exhaust in rooms such as fume hoods may meet this requirement. The exhaust airflow rates shall be no less than required in ASHRAE 62.1-2019 §6.5. Occupancy or CO_2-based demand control ventilation shall be in compliance with ASHRAE 62.1-2019 §6.2.7.

To avoid particulate accumulation and/or mold in the ductwork, duct liners must meet the American Society for Testing and Materials (ASTM) standards C 1071 or UL 181 for surface erosion resistance and ASTM standards C 1104 or C 209 (at <0.5% absorption by volume) for water vapor sorption.

To minimize dust and microbial growth, this prerequisite encourages all regularly occupied spaces in the school to be served by a ducted HVAC Return. This prerequisite allows plenum returns at schools with limited plenum space and encourages best practices to minimize any negative impacts on the facility's indoor environmental quality.

EQ C1.1 ENHANCED FILTRATION, VENTILATION, AND DEDICATED OUTDOOR AIR SYSTEM

CREDIT

1-11 points

APPLICABILITY: All projects except 1.1.1 not applicable to those with unit ventilators.

VERIFICATION: Design Review, Construction Review

SCORING: 1 point for 1.1.1; 5 points for each of 1.1.2 and 1.1.3

RELATED CRITERIA: All of EQ and EE, SS P1.0 Environmental Site Assessment, OM C4.1 Systems Maintenance Plan, OM C5.1 Indoor Environmental Management

EQ C1.1 REQUIREMENTS

EQ C1.1.1 *Enhanced Filtration Media*

1 point Filtration media shall have a Minimum Efficiency Reporting Value (MERV) of 15 or higher.

EQ C1.1.2 *Enhanced Ventilation Rate*

5 points The outdoor airflow shall be no less than 130% of the value determined in accordance with the ASHRAE 62.1 ventilation rates.

EQ C1.1.3 *Dedicated Outdoor Air System*

5 points Provide a dedicated outdoor air ventilation system (DOAS) that serves classrooms with the ability to efficiently process and manage ventilation down to the individual room level.

EQ P1.0-C1.1 IMPLEMENTATION

EQ P1.0 *Ventilation & IAQ*

CDs shall include design details and control sequences presented in a manner allowing that compliance with the prerequisite may be verified. In addition to information on the contract documents, calculations used to determine the most stringent outdoor air ventilation rate shall be signed by the project engineer. ASHRAE 62.1-2019 Mechanical Ventilation Calculation Worksheet shall be completed by the project engineer documenting that each space meets the minimum outdoor air quantities according to ASHRAE 62.1-2019 calculations. The spreadsheet shall show that the outdoor air quantity in each room served by an HVAC system meets the minimum outdoor air quantity for the space. For multiple spaces the spreadsheet shall show that the minimum outdoor air quantities are met in each space including during times when all VAV boxes are turned down to their minimum flow positions. A completed table shall be compiled by the project engineer and included in the project drawings and design documentation.

The table shall list for each room:

- the HVAC system ID number,
- HVAC type,
- the minimum outdoor air flow rate,
- the room's air classification, and
- all exhaust fans.

Minimum outdoor air quantities for all spaces shall be verified during HVAC system Testing and Balancing and included in minimum Commissioning requirements when all VAV boxes are turned down to their minimum flow positions.

Throughout this criterion, ventilation air means the designed outdoor air flow rate for maximum occupancy.

Controls shall be specified that operate the HVAC fans to provide outdoor air ventilation continuously during occupied hours, whether or not there is a need for heating or cooling. Thermostats with an "automatic" setting do not meet this requirement, since in this mode, the fans cycle on and off according to demands for heating or cooling.

The HVAC shall be operated continuously during working hours except during scheduled maintenance and emergency repairs, or during periods in which the district can demonstrate that the quantity of outdoor air supplied by non-mechanical means meets the outdoor air supply rate required by ASHRAE Standard 62.1-2019, §6.2 (i.e., climate is suitable and an acceptable means for natural ventilation is provided).

Natural ventilation systems must be engineered to demonstrate sufficient outdoor air ventilation and thermal comfort and shall adhere to natural ventilation guidelines, including:

- Maximize wind-induced ventilation by siting the ridge of a building perpendicular to the summer winds.
- Generally, naturally ventilated buildings should be narrow.
- Generally, each room should have two separate supply and exhaust openings. Locate exhaust high above inlet to maximize stack effect. Orient windows across the room and offset from each other to maximize mixing within the room while minimizing the obstructions to airflow within the room.
- Provide ridge vents.
- Consider the use of clerestories or vented skylights.
- Consider the use of fan-assisted cooling strategies.
- Consider open staircases that provide stack effect ventilation, but observe all fire and smoke precautions for enclosed stairways.
- Doors are not acceptable natural ventilation openings.

ASHRAE Standard 62.1-2019 §5 has a number of requirements to improve the effectiveness of outdoor air ventilation systems. Some of these requirements apply to the design of equipment and manufacturers. The design engineer shall check with manufacturers to verify that the specified equipment complies with the requirements of §5. Some manufacturers label their product lines or equipment as complying with Standard 62.1 but not all do; when in doubt check with the manufacturer. Specifications shall specify that the HVAC system provides a slope in condensate pans so that water does not stand, provides access for cleaning coils and other components, and makes sure that air stream surfaces are not porous including the requirement that insulation is not placed on internal air stream surfaces except for sound attenuation insulation that may be placed selectively on the inside of HVAC ducts if it is certified to meet ASTM C 1071 and ASTM C 1104 for surface erosion resistance and water vapor sorption.

Some jurisdictions may also be required to submit to the county.

Locating air intakes away from sources of potential air pollution will ensure that indoor air quality is not compromised by diesel fumes or exhaust air from ventilation, cooling towers, kitchen, or HVAC systems. Be particularly careful to locate air intakes away from areas where school buses and other vehicles may be idling. Where intake openings front on a street or public way, measure the horizontal distance from the centerline of the street or public way to the air intake.

EQ C1.1.1 *Enhanced Filtration Media*

It is important to select a filter that is designed for the specific application and to make sure that the HVAC filter enclosures are designed to perform with the filter in place without leakage around the filter. This rating is conducted by ASHRAE standard 52.2 MERV scale range from 1 to 20. For this credit, it is not necessary to provide filters for equipment that provides in-room circulation, although it is recommended.

Filters rated MERV 15 or higher will block up to 90% of fine particulates and most allergens. Schools located near areas with elevated outdoor particulate matter during one or more seasons of the year, in areas with high wildfire risk, and near high-volume roadways should use high efficiency filters of MERV 15 or higher. At the federal level, high-volume roadways are defined as an excess of 50,000 annual average daily traffic (AADT). Each state may set a different threshold, and design teams should consult the state's Department of Transportation to determine the applicable threshold and AADT for the road(s) in question.

For new construction or renovations/modernizations that replace HVAC equipment, specify systems that accept the required filter efficiency without a loss of operating efficiency. Filters rated at MERV 13 and higher will help ensure very good quality ventilation air by blocking some fine particles and allergens. A MERV 13 filter has the ability to filter more than 90% of particles 1.0 to 3.0 microns or larger in size, which includes lead dust, humidifier dust, mold spores, sand dust, fabric fibers, pollen.

Labels on filter entry doors of all HVAC Systems shall list the date that the filter was last changed on and the date for scheduled replacement. The Systems Maintenance Plan, OM C4.1, and/or the Indoor Environmental Management Plan, OM C5.1, should include a filter schedule that includes all air handling units, roof top units, unit ventilators, etc. and the rating of filters used for each piece of equipment.

EQ C1.1.2 *Enhanced Ventilation Rate*

The minimum occupied rate of outdoor air ventilation to be provided should equal the minimum rate of ventilation required to satisfy ANSI/ASHRAE Standard 62.1-2019 for the applicable category of space computed using the Ventilation Rate Procedure. IAQ procedure demand control methods employing contaminant sensing may not be employed. The maximum amount of outdoor air is to be provided.

Project engineers shall provide engineering documentation on the drawings in tabular format demonstrating compliance with ANSI/ASHRAE Standard 62.1-2019 using the Ventilation Rate Method. Show and describe how the dedicated outdoor air HVAC system designs seeking credit: 1) Delivers 130% fresh outdoor air directly into each space without first mixing it with any recirculated building air (i.e. variable volume, displacement ventilation dual duct, etc.); and 2) Integrates an adequate energy recovery strategy to meet ANSI/ASHRAE/IESNA Standard 90.1-2016 air-to-air energy recovery requirements.

EQ C1.1.3 *DOAS*

Dedicated outdoor air systems (DOAS) can take multiple forms but must be able to independently deliver heating, cooling, and ventilation where, and only when, it is needed. The practice of recirculation in traditional HVAC systems does not save energy; it compromises ventilation. Recirculated air may contain toxins from materials found within the built environment as well as higher levels of carbon dioxide, both of which can affect student and teacher health and performance. A DOAS consistently delivers the required amount of outside ventilation air to each space and can provide higher indoor air quality to combat harmful particulate matter.

Shut-off variable-air-volume delivery systems can be used with DOAS systems to control, measure and monitor ventilation in real time, permitting these systems to actively manage ventilation by delivering the precise amount of fresh outdoor air directly to each space without recirculating contaminants or pathogens generated in other spaces. Furthermore, VAV air terminal unit controls can be integrated with occupancy sensing devices to not only assure that appropriate levels of ventilation are provided when spaces are occupied, but to also turn off ventilation to those spaces when they are not occupied.

For dedicated outdoor air systems to comply with energy efficiency requirements or ASHRAE 90.1, they must utilize energy recovery to reduce the energy used to condition outdoor air a minimum of 50%, measured as enthalpy, at design conditions. DOAS systems that effectively employ two-stage air-to-air heat exchangers maximize the performance characteristics of energy recovery and energy avoidance equipment like heat wheels and indirect evaporative coolers. These configurations have demonstrated the ability to reduce annual ventilation cooling energy as much as 85% and heating energy requirements as much as 97%.

DOAS best serve classrooms and may be installed in only portions of the building, i.e.

classroom floors or wings.

EQ P1.0-C1.1 DOCUMENTATION

DESIGN REVIEW

EQ P1.0 Certification by the Mechanical Engineer that the mechanical system design meets these requirements. Provide drawings showing all air intake openings. Clearly identify hazardous and noxious contaminant sources on the drawings and bubble each air intake with a 10 ft radius circle on the drawings. Additionally, provide drawings showing ducted returns. Indicate the horizontal and vertical distances from the contaminant source.

EQ P1.0-C1.1.1 CDs must clearly specify the correct type of filter. Designate the CSI number, section, and page number that highlight compliance with this criterion.

EQ C1.1.2 CDs must include calculations showing that the design can supply 130% of outdoor air as determined in accordance with the ASHRAE 62.1 ventilation rates.

EQ C1.1.3 CDs must include the required components of the DOAS. Provide the ASHRAE 62 MZ Calc spreadsheet or equivalent. Show that the system provides 100% fresh air without mixing with recirculated air; show integrated energy recovery strategy.

CONSTRUCTION REVIEW

EQ P1.0-C1.1.1 Photos of a sample installed filter or approved submittal.

EQ P1.0-C1.1 RESOURCES

1. Read-only version of ASHRAE 62.1-2019: https://ashrae.iwrapper.com/ASHRAE_PREVIEW_ONLY_STANDARDS/STD_62.1_2019
2. CARB Certified Air Purifiers: https://www.arb.ca.gov/research//indoor/aircleaners/certified.htm
3. Davanagere, B.S., Shirey, D.B. III, Rengarajan, K., & Colacino, F. (1997). Mitigating the impacts of ASHRAE Standard 62-1989 on Florida schools. United States: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., Atlanta, GA (United States).
4. Fisk, W. (1999). Estimates of Potential Nationwide Productivity and Health Benefits from Better Indoor Environments: An Update. Indoor Air Quality Handbook
5. Fisk, W. J. (2017). The ventilation problem in schools: literature review. Indoor Air, 27(6), 1039-1051.
6. Kajtár, L. & Herczeg, L. (2012). Influence of carbon-dioxide concentration on human well-being and intensity of mental work. Idojaras, 116(2), 145-169.
7. MacNaughton, P., J. Pegues, U. Satish, S. Santanam, J. Spengler, and J. Allen. (2015). Economic, Environmental and Health Implications of Enhanced Ventilation in Office Buildings. International Journal of Environmental Research and Public Health 14709-14722.
8. Maddalena, R., Mendell, M. J., Eliseeva, K., Chan, W. R., Sullivan, D. P., Russell, M., Satish, U., & Fisk, W. J. (2015). Effects of ventilation rate per person and per floor

area on perceived air quality, sick building syndrome symptoms, and decision-making. Indoor Air, 25(4), 362-370.

9. Satish, U., Mendell, M. J., Shekhar, K., Hotchi, T., Sullivan, D., Streufert, S., & Fisk, W. J. (2012). Is CO_2 an Indoor Pollutant? Direct Effects of Low-to-Moderate CO(2) Concentrations on Human Decision-Making Performance. Environmental Health Perspectives, 120(12), 1671-1677.
10. Seppänen, O. A., Fisk, W. J., & Mendell, M. J. (1999). Association of Ventilation Rates and CO_2 Concentrations with Health and Other Responses in Commercial and Institutional Buildings. Indoor Air, 9(4), 226-252.

EQ P2.0 OFF-GASSING
EQ C2.1 POLLUTANT & CHEMICAL SOURCE CONTROL

Intent

Achieve good indoor air quality to protect student, educator, and staff health and increase the potential for improved performance and attendance.

Good indoor air quality includes preventing potential air-borne contaminants from being released into occupied spaces and reduces the building's overall environmental footprint. Volatile organic compounds (VOCs) are contributors to health problems in humans and are widely believed to cause low-level ecosystem damage. For example, VOCs from construction materials, cleaning products and plug-in or spray fragranced air fresheners can cause smog, causing disruption to human breathing and to the ecosystem surrounding the building. This section includes an array of best practices to prevent or eliminate pollutants and chemicals releases.

EQ P2.0 OFF-GASSING

PREREQUISITE

2 points

APPLICABILITY: All projects.

VERIFICATION: Design Review, Construction Review

RELATED CRITERIA: EQ P1.0 Ventilation and C1.1 Enhanced Ventilation, OM C4.1 High Performance Operations

EQ P2.0 REQUIREMENTS

EQ P2.0

Where use of chemicals with likely VOCs occurs, including housekeeping areas, chemical mixing areas, copying/print rooms, photography labs, and vocational spaces, use deck-to-deck partitions with dedicated mechanical exhaust to the outdoors (no air recirculation, and negative pressure) at a rate of at least 0.50 cubic feet per minute per square foot, and adequate make up air. These spaces must have negative air pressure when the doors are closed. Negative air pressure is defined as mechanical exhaust to the outdoors at a rate of at least 0.50 cubic feet per minute per square foot. The spaces must maintain a negative pressure of at least 5 Pa (0.02 inches of water gauge) to a minimum of 1 Pa (0.004 inches of water) compared to their immediate environment and when their doors are closed. In photo labs, specify table vents to draw chemical vapors away from the breathing zone of dark room users.

Doors to areas where hazardous materials are stored and used must be secured with self-locking and closing mechanism.

EQ C2.1 POLLUTANT & CHEMICAL SOURCE CONTROL

CREDIT

6 points

APPLICABILITY: All projects.

VERIFICATION: Design Review, Construction Review

SCORING: 6 points for any three of 2.1.1-2.1.6

EQ C2.1 REQUIREMENTS

EQ C2.1.1 *Walk Off Mats*

1. Provide a minimum of a 20 foot walk off mat system with a combination of scraper, absorption mat, and finisher mat at every major outside common entryway to school buildings. These areas do not include entryways to kitchens and loading docks. Mat systems must be appropriate to the region, and the length of each segment may vary accordingly. Vacuuming of mats should be done with a HEPA vacuum that meets or exceeds the CRI Seal of Approval standards. The mat system must consist of one of the following:
   - Non-Permanent Mats: The district must have at least a two-year signed contract for non-permanent mats to be cleaned as seasonally appropriate. It is expected that maintenance staff will provide regular cleaning in between.

     OR

   - Permanent Mats: Shall consist of a grate or grill 4-6 feet long exterior of every major entry or within an entry vestibule that scrapes and provides water drainage, an interior absorption mat at least 6 feet long that traps and hides dirt and water, and a finisher mat at least 8 feet long to clean and dry any residual dirt and moisture. Mats must be permanently installed. Any recessed grates, grills, or slotted materials must be designed to be lifted for cleaning. Specify daily cleaning and periodic maintenance of walk off mat systems.
2. Finger-Plan Schools with Outdoor Circulation: Provide a walk off mat system at the entrance to all classrooms with primary exterior entrances. Mat systems must be at least 6 feet in length and width and appropriate to the region. Roll-out mats may only be used if they are maintained at least weekly. Alternately, provide permanent exterior grates 4-6 feet long at every classroom entry where there is a continuous covered walkway.

EQ C2.1.2 *Surface Dust Control*

Control surface dust by providing hard-surfaced paving not less than eight feet by eight feet at all outside entrances or doorways to any school room (concrete or equivalent), together with covered walkways or entry canopies covering the entire 8'X8' area to keep rain from the walkway surface.

EQ C2.1.3 *Electric Ignitions for Gas-Fired Equipment*

Specify electric ignitions for the following gas-fired equipment: water heaters, boilers, air-handling units, and cooking stoves.

EQ C2.1.4 *No Mobile Fossil Fuel Powered Equipment Indoors*

Do not acquire fossil fuel-powered machinery that is mobile and whose specific function is for use inside the building. This is to prevent accumulation of exhaust inside the building from equipment such as polishers and burnishers. This criterion does not include stationary equipment such as gas stoves, chemistry equipment, and vocational equipment.

EQ C2.1.5 *Carbon Monoxide (CO) Sensors*

Install a carbon monoxide monitor in occupied spaces served by gas fired appliances, and/or adjacent to parking areas where cars may idle to prevent unhealthful exposures to carbon monoxide and other combustion gasses. These sensors are intended for life safety

purposes. Sensors capable of detecting very low concentrations of CO are not required.

EQ C2.1.6 *Electronic Product Environmental Assessment Tool (EPEAT)*

All school electronic devices including computers, imaging devices, and TV/AV systems shall meet the requirements of the EPEAT rating system, Silver or Gold level. See EPEAT website for a comprehensive list of current Silver and Gold-rated products.

EQ P2.0-C2.1 IMPLEMENTATION

EQ P2.0 Design to physically isolate activities associated with chemical contaminants from other locations in the building and provide dedicated exhaust systems to contain and remove chemical pollutants from source emitters at source locations. Eliminate or isolate high hazard areas and design all housekeeping chemical storage and mixing areas (central storage facilities and janitors' closets) to allow for secure product storage. Design copier or print rooms with structural deck-to-deck partitions and dedicated outside exhaust systems.

EQ C2.1.1 Because cleaning of walk off mats is so important, select mats that are appropriate to the weather of the region and are readily maintained. Daily vacuuming of the interior mats is absolutely necessary, and regular washing may be necessary in snowy or muddy seasons. Particles tracked into the school on shoes are one of the chief sources of contamination of floors and carpets. Research shows that pesticides, heavy metals, and soil are tracked in on students' shoes. The best way to keep the school free of dust, dirt, and contaminants is to prevent these unwanted items from entering the building in the first place. It is especially important to protect young school children since they are more likely to sit and play on classroom floors and be more directly exposed to contaminants. [2]

EQ C2.1.2 Control surface dust by providing hard-surfaced paving not less than eight feet by eight feet at all outside entrances or doorways to any school room (concrete or equivalent), together with covered walkways or entry canopies to keep rain from the walkway surface.

EQ C2.1.3 The purpose of this criterion is to prohibit standing pilot lights in gas-fired equipment. Under certain conditions, the accumulation of carbon monoxide from standing pilot lights can cause dangerous air quality conditions for staff and students. Therefore, electric ignitions are required for the equipment listed in this prerequisite.

Reference specification sections for gas-fired equipment that uses electric ignitions to light gas burners.

EQ C2.1.4 The school/district may adopt a resolution or policy indicating compliance.

EQ C2.1.5 Provide plans with locations of CO sensors highlighted. Include specifications for CO sensors.

EQ C2.1.6 The school/district may adopt a resolution or policy indicating compliance.

EQ P2.0-C2.1 DOCUMENTATION

DESIGN REVIEW

EQ P2.0 Provide a letter from the engineer certifying that the spaces stated in the prerequisite are ventilated to maintain a 1-3 Pa negative pressure, compared to their immediate environment, and are exhausted at a rate of 0.50 cfm/ft2. List the specific spaces in the project that comply.

EQ C2.1.1 Reference sheet numbers identifying walk-off mats, or equivalent track-off mitigation

measures, and their lengths at all high volume entrances.

EQ C2.1.2 Reference sheet numbers identifying paved areas outside entrances or doorways as well as covered walkways or canopies.

EQ C2.1.3 Reference specifications and subsections for gas-fired equipment that uses electric ignitions to light gas burners.

EQ C2.1.4 Provide the signed resolution, policy, or equivalent stating that no indoor mobile fossil fuel burning equipment will be used in the new or renovated facility.

EQ C2.1.5 Reference CD sheet numbers identifying required carbon monoxide monitors. Provide drawings that show all air intake openings and clearly identify hazardous and noxious contaminant sources on the drawings.

EQ C2.1.6 Provide a copy of the purchasing policy, signed resolution, or equivalent regarding purchasing of equipment that complies with EPEAT Silver or Gold.

CONSTRUCTION REVIEW

EQ C2.1.1 Where removable mats are specified, provide photo(s) of walk-off mats or equivalent track-off mitigation at required areas.

EQ P2.0-C2.1 RESOURCES

1. Carpet & Rug Institute certified vacuums: https://www.carpet-rug.org/certified-vacuums.html
2. US Environmental Protection Agency, *Resuspension and Tracking of Particulate Matter From Carpet Due to Human Activity Final Report*, November 2007: http://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P1005V2Y.PDF
3. US Environmental Protection Agency, Controlling Pollutants and Sources, Preventing the Entry of Pollutants from Outside the Building: https://www.epa.gov/iaq-schools/controlling-pollutants-and-sources-indoor-air-quality-design-tools-schools#EntryMatBarrier

EQ C3.1 OUTDOOR MOISTURE MANAGEMENT

Due to health risks associated with mold and microbial growth and the damage caused to buildings by water infiltration, all surface grades, drainage systems, and HVAC condensate must be designed to move water away from buildings and their foundations.

Intent

Achieve good indoor air quality to protect student and staff health and increase the potential for improved performance and attendance.

EQ C3.1 OUTDOOR MOISTURE MANAGEMENT

CREDIT

2 points

APPLICABILITY: All projects.

VERIFICATION: Design Review, Construction Review

RELATED CRITERIA: WE P2.0 & C2.1 Outdoor Water Use Reduction

EQ C3.1 REQUIREMENTS

Drainage

Design surface grades to slope away from the building and the building foundation to drain away rainwater, snowmelt, and HVAC condensate and to prevent ponding, pooling or otherwise saturating the building envelope or foundation. Rain leaders, or downspouts, must be directed to infiltration structures, on site storage, rain gardens, or daylight provided that surface drainage moves water well away from the building and does not result in unintended ponding or pooling. HVAC systems that use evaporation drip pans for condensate removal are prohibited.

Lawn Irrigation Systems

Design to prevent spray on building walls.

EQ C3.1 IMPLEMENTATION

Condensate removal systems that rely on gravity drainage are strongly preferred to systems that use pumps due to the reduced maintenance associated with gravity systems.

The following should be submitted to adequately show compliance:

- Site plan showing grading plan
- Diagram of condensate system. A signed statement indicating that it is an integral part of the HVAC system if such a diagram is not available.
- Typical detail of condensate drains showing drain trap and gravity drainage system
- Project team sign-off that the drain trap and gravity drainage systems have been tested to show that water flows out and neither is blocked nor flows into the building.

Permanent irrigation systems that spray on buildings can cause structural damage and mold growth. Do not install irrigation systems in locations where they may spray directly onto buildings. *Note:* This requirement only applies to schools with permanent irrigation

systems. Submit a plan of irrigation system showing that sprinkler ranges do not intersect with buildings.

EQ C3.1 DOCUMENTATION

DESIGN REVIEW

Reference site plan showing required drainage. Diagrams and details of condensate systems must show drain tap and gravity drainage system.

CDs must include irrigation plans showing that sprinkler ranges do not intersect with buildings.

CONSTRUCTION REVIEW

Submit photos of installed measures, minimum of one photo for each measure.

EQ C3.1 RESOURCES

None.

EQ C4.1 CONSTRUCTION IAQ MANAGEMENT

Good indoor air quality starts during design, is implemented during construction, and is maintained during operation. Cleanliness during construction is especially important to reduce the chance of dust settling in the building and causing problems during occupancy. Protecting building materials from moisture and removing water-damaged materials are important practices to prevent mold growth in the building.

Intent

Achieve good indoor air quality to protect student and staff health and increase the potential for improved performance and attendance.

EQ C4.1 CONSTRUCTION IAQ MANAGEMENT

CREDIT

5 points

APPLICABILITY: 4.1.1 applies to renovations only. 4.1.2 applies to any project involving a new HVAC system. 4.1.3 and 4.1.4 apply to all projects.

VERIFICATION: Design Review, Construction Review

SCORING: 1 point each for 4.1.1, 4.1.2, & 4.1.4, 2 points for 4.1.3

RELATED CRITERIA: OM C4.1 High Performance Operations, OM C5.1 Indoor Environmental Management

EQ C4.1 REQUIREMENTS

EQ C4.1.1 *SMACNA Guidelines for Occupied Renovations*

1 point

During construction, meet the recommended Design Approaches of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) *IAQ Guideline for Occupied Buildings Under Construction*, 2007, Chapter 3. Include the erosion and sedimentation control measures to minimize site dust during occupied renovations. [4]

EQ C4.1.2 *SMACNA Guidelines for Duct Cleanliness – New Ducts Only*

1 point

If installing a new duct system, follow the SMACNA guidelines for “Duct Cleanliness for New Construction Guidelines” according to Advanced Levels of cleanliness. Of specific importance are the following:

- Specify that ductwork be sealed when transported to the construction site.
- Store ductwork in clean, dry conditions and keep sealed while it is stored.
- Wipe down internal surfaces of ductwork immediately prior to installation to remove dust.
- Seal open ends on completed ductwork and overnight work-in-progress.
- During installation, protect ductwork waiting to be installed with surface wrapping, etc.
- During construction, seal HVAC supply and return openings to protect them from construction dust infiltration (e.g., from drywall installation or wood floor sanding).

EQ C4.1.3 *Building Flush-Out*

2 points

The project team shall develop a plan, and include it in the specifications, to flush out the building with outdoor air (no return air) based on the requirements and recommendations in the specifications to remove indoor pollutants prior to occupancy. The information should also be detailed in the projects TAB and control sequence of the specifications or project manual.

The specifications at minimum must state that the maximum amount of outdoor air (the design outdoor air flow rate for maximum occupancy) must be provided during and after installation of VOC emitting materials for the maximum amount of time feasible, but not less than continuously (i.e. 24 hrs.) for seven days. It should be noted that the maximum amount of ventilation provided by an HVAC system may be limited not only by the system's capacity but also by the temperature and humidity of the outdoor air.

After substantial completion, conduct the flush out for 24 hours a day continuous ventilation for 7 days with all supply fans at their maximum rate and position. Internal temperatures are maintained at the most energy efficient level above 60°F; relative humidity is maintained no higher than 60%. Under conditions where the heating cannot be met (60°F) at that fan speed, then adjust the fan to achieve 60°F.

All air handling unit dampers are at their maximum outdoor air position during the 7-day flush out. If the 60% relative humidity level cannot be achieved with maximum outdoor air position, reduce fan speed and/or outdoor air position as needed, but extend flush-out period beyond 7 days to accomplish roughly the same amount of total air throughput that would have occurred at maximum outdoor air position.

After flush-out, replace air filters with new filters and provide two sets of additional replacement filters prior to occupancy.

Occupied Flush-Out:

For the case where a project has fallen behind schedule, the contractor may alternatively conduct the flush-out while the building is occupied according to the requirements below or conduct air testing to identify classrooms that exceed the limits below and remedy any non-compliant rooms.

1. Conducting Occupied Flush-Out

   Conduct the flush-out for 24 hours a day with continuous ventilation for the total number of days identified in the plan with all supply fans at their maximum rate and position. Thermal comfort must be maintained during occupied hours, per the criteria in ASHRAE Standard 55. Internal temperatures must be maintained at the most energy efficient level above 60°F; relative humidity must be maintained no higher than 60% during non-occupancy hours.

   All air handling unit dampers are at their maximum outdoor air position during the flush-out. If the 60% relative humidity level cannot be achieved with maximum outdoor air position, reduce fan speed and/or outdoor air position as needed, but extend flush-out period beyond the established period to accomplish roughly the same amount of total air throughput that would have occurred at maximum outdoor air position. Classrooms shall not be “baked out”. The temperature in the building space shall not be increased to attempt to bake out contaminants. (If continuous ventilation is not possible, flush-out must total the equivalent of 14 days of maximum outdoor air.)

2. Air Testing

The square root of the total number of all classrooms must be tested for compliance with the following criteria. Any non-compliant rooms must be remedied and re-tested until they are compliant. Two additional classrooms per non-compliant classroom must also be tested in all items below in the event of non-compliance. Conduct IAQ testing using protocols consistent with the methods listed in Table EQ4-1. Use current versions of ASTM standard methods, EPA compendium methods, or ISO methods, as indicated. Laboratories that conduct the tests for chemical analysis of formaldehyde and volatile organic compounds must be accredited under ISO/IEC 17025 for the test methods they use. Demonstrate that contaminants do not exceed the concentration levels listed in Table EQ4-1.

Remedies may include spot ventilation or flush-out.

Table EQ4-1. Maximum Concentration Levels* by Contaminant and Testing Method

Contaminant	Maximum concentration	ASTM and U.S. EPA Methods	ISO method
Formaldehyde	27 ppb	ASTM D5197; EPA TO-11 or EPA Compendium Method IP-6	ISO 16000-3
Particulates (PM10 & PM2.5)**	PM10: 20 µg/m3 PM2.5: 12 µg/m3	EPA Compendium Method IP-10	ISO 7708
Total volatile organic compounds (TVOCs)	500 µg/m3	EPA TO-1, TO-15, TO-17, or EPA Compendium Method IP-1	ISO 16000-6
Target chemicals listed in CDPH Standard Method v1.2, Table 4-1, except formaldehyde	CDPH Standard Method v1.2, Allowable Concentrations, Table 4-1	ASTM D5197; EPA TO-1, TO-15, TO-17, or EPA Compendium Method IP-1	ISO 16000-3, 16000-6
Carbon monoxide (CO)	9 ppm; no more than 2 ppm above outdoor levels	EPA Compendium Method IP-3	ISO 4224

*ppb = parts per billion; ppm = parts per million; µg/m3 = micrograms per cubic meter
**Only required if located in an EPA non-attainment area.

Post-Occupancy Ventilation

When the contractor is required to perform touch-up (including furniture after occupancy) work involving products with chemical emissions, provide temporary construction ventilation during application and extend the building flush-out by a minimum of 4 days after touch-up application, with 100% tempered outdoor air for 24 hours each day. [1]

EQ 4.1.4 *Mold Prevention/Moisture Management*

1 point Building materials, especially gypsum wallboard, wood, porous insulation, paper, and fabric, should be kept dry to prevent the growth of mold and bacteria. Cover these materials to prevent rain damage, and if resting on the ground, use spacers to allow air to circulate between the ground and the materials. Water damaged materials shall be dried within 24 hours. Due to the possibility of mold and bacterial growth, materials susceptible to moisture that are damp or wet for more than 24 hours must be discarded. Immediately remove materials showing signs of mold and mildew, including any with moisture stains, from the site and properly dispose of them. Replace moldy materials with new, undamaged materials.

EQ C4.1 IMPLEMENTATION

EQ C4.1.1 For new schools constructed next to occupied schools, the construction process (and demolition process if applicable) will create dust, fumes, and exhaust from activities such as site grading, pouring of the foundation, framing, enclosing the walls and roof, landscaping, installation of stormwater and utility systems, and paving. The construction team must have a communications plan in place to alert school occupants to potential exposures. Additionally, there must be an occupant complaint system in place when construction activities are creating nuisance dust, fumes, and exhaust. Furthermore, if warranted, the construction team should consider protecting the occupied school's outdoor air intakes to prevent entrainment of pollutants.

Prepare a communication plan between the construction team and building occupants regarding complaints, concerns, and predicted changes to IAQ and include the plan in the specifications. The plan must consider communications from occupants as well as to occupants. In addition, the plan must consider whether protection of outdoor air intakes is necessary for the project. Designate the CSI number, section, and page number that highlight compliance with this requirement.

For occupied renovations, applicants must implement containment procedures for dusts, gases, fumes, and other pollutants created as part of any planned construction, addition to, or renovation/modernization of a school building. Containment procedures must follow the SMACNA *IAQ Guidelines for Occupied Buildings Under Construction.* All bids received for school construction or renovations/modernizations must include the cost of planning and execution of containment of construction pollutants consistent with the SMACNA guidelines.

Specifications must include an Indoor Air Quality Management Plan that addresses SMACNA control measures for maintaining good indoor air quality on the job site. The specifications should indicate who is responsible for implementing the IAQ management plan, and the plan should address depressurizing work areas, ongoing housekeeping, scheduling of construction activity to lower impacts of IAQ problems on workers and building occupants, and the method of communication between construction team and building occupants regarding complaints, concerns, and predicted changes to IAQ. In addition, the plan must consider whether protection of outdoor air intakes is necessary for the project.

EQ C4.1.2 This construction practice will improve indoor air quality by minimizing the amount of indoor pollutants that are distributed and retained by the surface materials and ventilation systems during construction.

Prepare specification sections for the SMACNA guidelines for duct protection including specific references to SMACNA Duct Cleanliness Guidelines Advanced Levels. Designate the CSI number, section, and page number showing compliance with this requirement.

Provide photographs taken at various times during construction, with a narrative for each photo describing compliance with SMACNA Duct Cleanliness advanced levels.

Duct insulation should be located on the outside of ductwork, unless it is being installed for the purpose of attenuating sound and there is no other means of attenuating sound. Duct liners have been known to deteriorate over time and absorb moisture, leading to the release of particles in the ducts that can be blown into classrooms and offices. Ensure that the duct liners used for sound attenuation meet the ASTM standards for surface erosion resistance and water vapor sorption.

Specifications must include the requirements for ASTM standards C 1071 or UL 181 for surface erosion resistance and ASTM standards C 1104 or C 209 (at <0.5% absorption by volume for ASTM C 209) for water vapor sorption.

EQ C4.1-C4.2 DOCUMENTATION

DESIGN REVIEW

EQ C4.1.1-C4.1.2 Construction drawings must include specifications for: 1) SMACNA guidelines for IAQ which should include sedimentation and erosion control measures, 2) duct cleanliness, 3) building flush-out, 4) post-occupancy ventilation requirements when touch-ups are required. Designate the CSI number, section, and page number that highlight compliance with each requirement.

EQ C4.1.4 Provide specification sections for protection of building materials from water damage and identify the CSI number, section, and page number showing compliance.

CONSTRUCTION REVIEW

EQ C4.1.1-C4.1.2 Submit photos, taken at various times during construction, with a narrative for each photo describing compliance with the various requirements.

For occupied renovations/modernizations, provide photographs and a description for each as follows:

- Construction areas that were isolated from adjacent non-construction areas using temporary walls, plastic sheeting or other vapor retarding barriers.
- Construction areas that were maintained at a negative air pressure compared to surrounding non-construction areas.
- Recirculating air ducts that were temporarily capped and sealed (appropriate filters may be used if nuisance particulates are the only contaminant of concern).
- Supply air systems that were operated with filters in place.

EQ C4.1.3 Submit a narrative describing implementation of the flush-out option chosen, photos and sign-off from the contractor or Inspector of Record that it took place.

EQ C4.1.4 Submit photos taken at various times during construction, with a narrative for each photo describing techniques for protecting building materials from mold and moisture damage.

EQ C4.1 RESOURCES

1. ANSI/ASHRAE Standard 62.1-2016, Ventilation for Acceptable Indoor Air Quality
2. ANSI/ASHRAE Standard 62.1-2016 User's Manual: https://www.techstreet.com/ashrae/standards/standard-62-1-user-s-manual-based-on-standard-62-1-2016-ventilation-for-acceptable-indoor-air-quality?gateway_code=ashrae&product_id=1937128

3. ANSI/ASHRAE Standard 62.1-2016 Mechanical Ventilation Calculation Worksheet
4. ASHRAE Standard 62.1 Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guideline for Occupied Buildings Under Construction, 2008.
5. Sheet Metal and Air Conditioning Contractors' National Association, Inc., (SMACNA) Duct Cleanliness for New Construction Guidelines; ©SMACNA 2000 https://www.smacna.org/docs/default-source/technical-resources/duct-cleanliness-for-new-construction-guidelines.pdf?sfvrsn=c921fda5_2

EQ C5.1 POST-CONSTRUCTION INDOOR AIR QUALITY

Carpet and other soft surfaces and ventilation systems are susceptible to the accumulation of construction dust. Effective vacuuming will reduce the accumulation and distribution of particulates.

Intent

Improve indoor air quality by minimizing the amount of indoor pollutants that are distributed and retained by the surface materials and ventilation systems during construction.

EQ C5.1 POST-CONSTRUCTION INDOOR AIR QUALITY

CREDIT

1 point

APPLICABILITY: All projects.

VERIFICATION: Design Review, Construction Review

EQ C5.1 REQUIREMENTS

Vacuum carpeted and soft surfaces with a certified vacuum or high-efficiency particulate air (HEPA) filter vacuum that meets or exceeds the CRI Seal of Approval program after construction is complete and prior to occupancy. For phased, occupied renovations, HEPA vacuum the carpet daily in occupied areas and in areas adjacent to those affected by construction activities. [1]

For hard surfaces, either use a HEPA vacuum that meets the above criteria with a brush or hard floor attachment, or use microfiber mops, cloths, and sponges that will capture the dust.

EQ C5.1 IMPLEMENTATION

Reference specifications for vacuuming of carpeted floors prior to full building occupancy using a certified vacuum or high efficiency particulate air (HEPA) filter vacuum that meets or exceeds the CRI Seal of Approval. For phased, occupied renovations, or adjacent areas that may be affected by construction activities, submit a signed letter from the superintendent or designee stating that:

- Carpeting in occupied areas of the school shall be vacuumed on a daily basis.
- Only certified Carpet & Rug Institutes Seal of Approval (CRI SOA) Program vacuums with manufacture model identification numbers listed on the Carpet & Rug Institutes Seal of Approval (CRI SOA) Program website list will be permitted to be used for daily vacuuming of carpet in the school.
- All maintenance and cleaning staff shall keep a written log reviewed by the schools Facility Manager annually verifying that each vacuum used in the school operated at all times with the proper filter defined for the specific vacuum in the Carpet & Rug Institutes Seal of Approval (CRI SOA) Program.
- Tracking labels shall be included and used documenting date of all past and next filter replacements.

EQ C5.1 DOCUMENTATION

DESIGN REVIEW

Reference specifications for vacuuming of carpeted floors prior to full building occupancy using a certified vacuum or high efficiency particulate air (HEPA) filter vacuum that meets or exceeds the CRI Seal of Approval program and for phased, occupied renovations adjacent areas that may be affected by construction activities. Provisions for cleaning hard surfaces must also be specified.

CONSTRUCTION REVIEW

Submit a signed letter from the Superintendent, or designee, stating that carpeting in occupied areas of the school shall be vacuumed on a daily basis, and only certified CRI SOA vacuums with manufacture model identification numbers listed on the CRI SOA website list will be permitted to be used for daily vacuuming of carpet in the school.

EQ C5.1 RESOURCES

1. List of vacuums certified by the The Carpet and Rug Institute (CRI) Seal of Approval Program: https://www.carpet-rug.org/certified-vacuums.html

EQ P6.0 LOW EMITTING MATERIALS
EQ C6.1 ADDITIONAL LOW EMITTING MATERIALS

Intent

Minimize air concentrations of harmful volatile organic compounds that derive from building products and building materials used indoors.

Many common building products and building materials used indoors in the construction of educational facilities and other buildings are sources of volatile organic compounds (VOCs). When emitted to indoor air, these pollutants are inhaled by occupants. Such inhalation exposures can result in adverse health effects, including sensory and upper respiratory irritation, pulmonary irritation, asthma, damage to organ systems and neurological and reproductive systems, and increased risk of cancer. Exposure to airborne VOCs is an especially important issue for schools as children may be more susceptible than adults. In order to reduce the potential for adverse effects due to inhalation exposures to VOCs, it is important to specify and utilize products and materials in the construction of the interiors of classrooms and other educational buildings that have low emissions of VOCs know to be harmful.

EQ P6.0 LOW EMITTING MATERIALS

PREREQUISITE

2 points

APPLICABILITY: All projects.

VERIFICATION: Design Review, Construction Review

RELATED CRITERIA: MW C3.1 and C5.1 for material environmental attributes, EQ C7.1 Material Health Disclosures, OM C5.1 Indoor Environmental Management, all ventilation prerequisites and credits

EQ P6.0 REQUIREMENTS

EQ P6.0 *Paints & Coatings*

Applicable to all paints and coatings that are applied onsite in the project's interior. The affected products include but are not limited to sealers, stains, clear wood finishes, floor sealers and coatings, waterproofing sealers, primers, flat paints and coatings, non-flat paints and coatings, and rust preventative coatings. 90%, or more, of the total volumes of such products shall meet the applicable VOC content requirements 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, amended February 5, 2016.

EQ P6.0 *Flooring Systems*

Applicable to all resilient flooring and carpet systems installed in the project's interior. Seventy-five percent or more of the installed area of such products shall be shall be tested for emissions of VOCs of concern with respect to chronic inhalation exposures following the specifications of the CDPH Standard Method V1.2, dated January 2017, and shall be compliant with the Standard Method when modeled to the school classroom scenario described therein.

EQ P6.0 *Composite Wood*

Applicable to all composite wood panels and building products with composite wood cores that are installed onsite in the project's interior. Composite wood is defined in the California Air Resources Board (CARB) Airborne Toxic Control Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products (California Code of Regulations, Title 17, Sections 93120-93120.12). Affected materials are composite core and veneer core hardwood plywood (HWPW, particleboard (PB), medium density fiberboard (MDF), and thin MDF. 90 percent or more of the total area of composite wood panels and the composite wood cores of finished building products (e.g. engineered wood floors, doors, trim/molding, cabinetry, and counter tops) shall meet the applicable ATCM Phase 2 formaldehyde emission standards.

EQ C6.1 ADDITIONAL LOW EMITTING MATERIALS

CREDIT

6 points APPLICABILITY: All projects.

VERIFICATION: Design Review, Construction Review

SCORING: 1 point each

EQ C6.1 REQUIREMENTS

Meet the requirements in up to four of the following six categories of materials:

EQ C6.1.1 *Adhesives & Sealants*

1 point Products in this category include but are not limited to carpet and resilient and wood flooring adhesives; base cove adhesives; ceramic tile adhesives; drywall and panel adhesives; aerosol adhesives; adhesive primers; acoustical sealants; fire stop sealants; HVAC duct sealants, sealant primers; and caulks. Note that structural adhesives are excluded, and sealers including concrete floor sealers and other waterproofing sealers are treated under C6.1.5 for Paints & Coatings.

All adhesives and sealants used on the project in quantities of 2.5 gal (10 liters) or more and totaling 90% or more of the total volumes of such products applied onsite in the project's interior shall meet the VOC content requirements in the applicable category of South Coast Air Quality Management District (SCAQMD) Rule 1168, Adhesive and Sealant Applications, amended January 2005.

Further, 90% or more, by volume, of the flooring, wall covering and wall base adhesives and sealants covered under this criterion shall be tested for emissions of VOCs of concern with respect to chronic inhalation exposures following the specifications of the CDPH/EHLB Standard Method V1.2, 2017. The test results shall be compliant with the Standard Method when modeled to the school classroom scenario as follows: Flooring adhesives and sealants shall be modeled using the manufacturer's specified coverage and the classroom flooring area. Wall applied adhesives and sealants shall be modeled using the manufacturer's specified coverage and the classroom wall paint and wall coverings area. Wall base adhesives shall be modeled similarly using the wall base area.

EQ C6.1.2 *Flooring Systems*

1 point Flooring systems include but are not limited to: carpet with or without an integral cushion, carpet with an integral adhesive system, and separate cushion; resilient flooring; wood

flooring with the exception of solid wood flooring; ceramic tile flooring; other mineral-based flooring (either natural or manmade) without any organic component, and concrete flooring. For the purposes of this option, it is assumed that ceramic tile, organic-free mineral-based flooring, and concrete flooring are negligible sources of VOCs and are available for credit without any testing requirements. Site applied flooring adhesives are treated under Option 1 for Adhesives & Sealants, and site applied flooring stains, sealers and coatings are treated under Option 2 for Paints & Coatings.

All flooring systems installed in the project's interior totaling 90% or more of the total floor area shall be tested for emissions of VOCs of concern with respect to chronic inhalation exposures following the specifications of the CDPH Standard Method V1.2, 2017 (CDPH Standard Method). The test results shall be compliant with the Standard Method when modeled to the school classroom scenario using the classroom flooring area. For systems consisting of more than one distinct layer (e.g., carpet with separate cushion), all layers shall individually meet the requirements of the CDPH Standard Method.

Selected flooring shall not require the use of heavy-duty strippers and finishes.

Solid wood flooring is exempt, although adhesives and sealants used with it must comply.

EQ C6.1.3 *Composite Wood & Agrifiber Products*

1 point

Composite wood is defined in the California Air Resources Board (CARB) Airborne Toxic Control Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products (California Code of Regulations, Title 17, Sections 93120-93120.12). The affected materials are composite core and veneer core hardwood plywood (HWPW, particleboard (PB), medium density fiberboard (MDF), and thin MDF.

Agrifiber products are composite boards produced from agricultural/biobased materials and a chemical binder system. At least 90%, by area, of the composite wood and the composite wood cores of finished building products (e.g., engineered wood floors, doors, trim/molding, cabinetry, and counter tops) installed onsite in the project's interior shall either 1) be manufactured with no-added formaldehyde (NAF) based resins, or 2) be manufactured with ultra-low emitting formaldehyde (ULEF) resins and shall meet the appropriate emission requirements established by the ATCM for NAF and ULEF products.

Additionally, at least 90%, by area, of all agrifiber products installed onsite in the project's interior shall be manufactured with NAF based resins.

Structural plywood, structural panels, oriented strand board, structural lumber, glue laminated timber, prefabricated wood joists, and finger jointed lumber, are excluded from this option and these requirements.

EQ C6.1.4 *Furniture & Furnishings*

1 point

This option is only available if 75% or more of the total number of individual stations (defined as a chair and associated work surface, i.e., either a desk or a desk/chair combination) are new and/or newly remanufactured/refurbished. All such furniture totaling 90% or more of new individual stations (e.g., combined classroom and administrative stations) shall meet this requirement.

The furniture, both classroom and administrative, shall be tested for VOC emissions following the procedures in ANSI/BIFMA M7.1-2011. Workstations and seating, both classroom and administrative, shall be tested individually except a pupil desk/chair combination is treated as a single unit. Administrative area and teacher workstations and seating shall be evaluated for VOC emissions using the parameters for an open plan workstation and seating as defined in M7.1. Pupil classroom workstations and seating shall be evaluated for emissions using parameters defined for the classroom in CDPH Standard Method V1.2, 2017. The furniture modeling parameters are listed in f., below. The furniture

shall meet the VOC emissions guidelines defined in ANSI/BIFMA X7.1-2011 (reaffirmed 2016), *FES Test Method*, and ANSI/BIFMA e3-2014, *Furniture Sustainability Standard*, as specified in Table EQ6-1.

Table EQ6-1: Modeling Parameters and VOC Emission Guideline Requirements

	Admin Area & Teacher		Classroom Pupil	
Modeling Parameters	Workstation	Seating	Workstation	Seating
Number of units	1	1	27[a]	27[a]
Air Flow rate, m^3/h	15.01[b]	24.84[b]	191[c]	191[c]
Total workstation area, m^2	21.75[d]	n/a[e]	n/a[e]	n/a[e]
VOC Emission Guidelines				
Meet ANSI/BIFMA X7.1-2011	Yes	Yes	n/a	n/a
Meet ANSI/BIFMA e3-2014, Section 7.6.1[f]	Same as X7.1	Same as X7.1	Yes	Yes
Meet ANSI/BIFMA e3-2014, Section 7.6.2[f,g]	Yes	Yes	Yes	Yes
Meet ANSI/BIFMA e3-2014, Section 7.6.3[h]	Not required	Not required	Yes	Yes

a. CDPH Standard Method specifies 27 occupants per classroom.
b. Air flow rates specified in M7.1 for open plan workstations and seating.
c. Classroom air flow rate from CDPH Standard Method.
d. Total open plan workstation area (work surface + storage + panel) as defined in M7.1.
e. Not applicable. Modeling of seating is performed on a per unit basis, not area.
f. Administrative workstations shall meet the requirements using either the concentration or the emission factor approach defined in M7.1. For the latter, use the open-plan workstation emission factor requirements. Classroom furniture (either workstations, seating, or combined desk seating units) shall meet the concentration limits for a workstation system as specified in the e3 standard.
g. Workstation individual VOC concentration limits and open-plan workstation emission factor limits are defined in the e3 standard, Annex C.
h. The formaldehyde concentration limit is 9 µg/m3.

EQ C6.1.5 *Paints & Coatings*

1 point

See EQ P6.0 for the description of the paints and coatings covered under this criterion. 90%, or more, by volume of all interior paints and coatings normally applied to walls, ceilings, floors or trim shall be tested for emissions of VOCs of concern with respect to chronic inhalation exposures following the specifications of the CDPH Standard Method V1.2, January 2017. The test results shall be compliant with the Standard Method when modeled to the school classroom scenario as follows. Flooring sealers and paints shall be modeled using the manufacturer's specified coverage and the classroom flooring area. Wall applied paints and coatings shall be modeled using the manufacturer's specified coverage and the classroom wall paint and wall coverings area. Ceiling applied paints and coatings shall be modeled similarly using the ceiling area. Wood stains and finishes

and trim applied paint shall be modeled similarly using the area of the classroom door plus the area of the wall base (i.e., 125 ft^2 or 11.6 m^2).

EQ C6.1.6 *Ceiling & Wall Systems*

1 point

Ceiling and wall systems include but are not limited to ceiling insulation installed within the structural envelope, wall insulation, acoustical ceiling panels, gypsum board wall panels, tackable wall panels, and wall coverings. Ceramic tile and other organic-free, metal-, or mineral-based wall coverings are available for credit without any testing requirements. Site applied adhesives and sealants are treated under EQ C6.1.1 Adhesives & Sealants, and site applied paints and coatings associated with ceiling and wall systems are treated under EQ C6.1.5 Paints & Coatings.

All ceiling and wall systems installed in the project's interior totaling 90% or more of the total areas of such products shall be tested for emissions of VOCs of concern with respect to chronic inhalation exposures following the specifications of the CDPH Standard Method V1.2, January 2017. The test results shall be compliant with the Standard Method when modeled to the school classroom scenario using the classroom ceiling area and/or wall area as appropriate. For systems consisting of more than one distinct layer (e.g., walls comprised of insulation, wall panel and wall covering), all layers shall individually meet the requirements of the CDPH Standard Method.

EQ P6.0-C6.1 IMPLEMENTATION

For the purposes of these requirements, indoor products and materials are defined as materials installed or applied on site inside of a building. The building interior is defined as everything within the waterproofing membrane. The building exterior is defined as everything outside and inclusive of the primary and secondary weatherproofing system, such as waterproofing membranes and air- and water-resistive barrier materials. Low emitting materials within a selected option shall be used throughout the project including all classroom areas, teaching laboratories, administrative and staff areas, indoor circulation areas, restrooms, and multipurpose areas such as gymnasiums. Shops or other areas requiring specialty finishes may be excluded. Ninety percent (90%) or more of the combined surface area or quantity measure of an entire system (e.g., floor, ceiling, furniture) or the individual components of a system (e.g., wall assembly consisting of three components – insulation, wall panel, and wall covering) shall be comprised of low emitting materials in order to receive credit for an option. Unless otherwise specified below, low emitting materials shall meet the testing and VOC emission requirements of the California Department of Public Health's (CDPH) *Standard Method for the Testing and Evaluation of Volatile Organic Emissions from Indoor Sources Using Environmental Chambers, Version 1.2* (2017). The school classroom shall be used as the exposure modeling scenario for evaluating the acceptability of VOC emissions as described in the Standard Method, Tables 4-2 and 4-3. For wet applied products, additional content criteria are specified.

There are three options for selecting products:

- Pre-approved products from the CHPS Pre-Approved Product listings at zerodocs.com. Products under this option do not require documentation.
- Acceptable third party labeling or certification programs listed on the CHPS website at https://chps.net/products.
- Products tested by an independent laboratory as prescribed by CHPS. See the CHPS product site for information.

Construction Documents shall specify the low emitting products to be used on the project and that these meet the requirements defined herein.

EQ P6.0 - C6.1 DOCUMENTATION

DESIGN REVIEW

EQ P6.0 Specification sections for each category of products with the maximum allowed VOC concentration levels per product and certifications as required.

EQ C6.1.1-.2, & 6.1.5-.6 Specification sections for each product requiring emissions testing to CDPH Standard Method.

EQ C6.1.3 Specification sections for each product requiring no-added formaldehyde (NAF) based resins or be manufactured with ultra-low emitting formaldehyde (ULEF) resins and meeting the appropriate emission requirements established by the ATCM for NAF and ULEF products.

EQ C6.1.4 Specification sections for each product requiring testing for VOC emissions following the procedures in ANSI/BIFMA M7.1-2011.

CONSTRUCTION REVIEW

For all products, complete CHPS Low Emitting Materials worksheet or custom sheet to show compliance with quantity thresholds.

If CHPS Pre-Approved products are selected, provide a list of the products. Submittals are not required for these materials.

EQ P6.0 Submit cut sheets or equivalent showing VOC content.

EQ C6.1 Provide test reports or proof of labeling/certification with cover sheet.

EQ P6.0-C6.1 RESOURCES

1. State of California Department of Public Health, Standard Method for the Testing and Evaluation of Volatile Organic Emissions from Indoor Sources Using Environmental Chambers, Version 1.2, January 2017 (CDPH/EHLB/Standard Method, V1.2): https://www.cdph.ca.gov/Programs/CCDPHP/DEODC/EHLB/IAQ/CDPH%20Document%20Library/CDPH-IAQ_StandardMethod_V1_2_2017_ADA.pdf
2. CHPS Pre-Approved Products listings: zerodocs.com
3. CHPS approved list of independent laboratories and third party certifiers of low-emitting material products: https://chps.net/products
4. California Air Resources Board: Suggested Control Measures: http://www.arb.ca.gov/coatings/arch/docs.htm
5. South Coast Air Quality Management District: Rule 1113. Architectural Coatings: http://www.arb.ca.gov/DRDB/SC/CURHTML/R1113.PDF

EQ C7.1 MATERIAL HEALTH DISCLOSURES

Demand for transparency in environmental and health impacts of products has resulted in multiple options for identifying products that have disclosed the health hazards of their contents. It is important for specifiers to look for these products to ensure that everything that goes into a school building is free from hazardous materials.

Intent

Specify products and materials with publicly available health related information of their ingredients.

EQ C7.1 MATERIAL HEALTH DISCLOSURES

CREDIT

1-2 points

APPLICABILITY: All projects.

VERIFICATION: Design and Construction Review

SCORING: 2 points for Performance Approach, 1-2 points for Prescriptive Approach

EQ C7.1 REQUIREMENTS

The following programs are approved for use in this credit, using either the Performance or Prescriptive Approach below:

- Health Product Declaration (HPD): the product has a published HPD with full disclosure of known hazards in accordance with the HPD Standard. [1]
- Cradle to Cradle Product Certification Standard (C2C): the product has been certified at the C2C v2 Silver Level or above or the C2C v3 Bronze Level or above. [2]
- Cradle to Cradle Material Health Certificate (MHC): the product has an MHC at the Bronze level or above
- Declare: the product has a Declare label. [3]
- Manufacturer Inventory: the product has a published list of ingredients identified by name and CAS number and a GreenScreen Benchmark and/or GreenScreen List Translator Benchmark. [4,5]
- UL Product Lens: the product has been certified to Product Lens for materials transparency and disclosure. [6]
- Other CHPS approved certification program meeting the criteria.

EQ C7.1 *Performance Approach*

2 points

Use at least 20 permanently installed products from at least five different manufacturers that use any of the approved programs to demonstrate the material health and inventory of a product down to 1000 ppm (0.1%).

OR

EQ C7.1 *Prescriptive Approach*

2 points Specify the use of at least 50% (by cost) of two or more of the following major interior finish or structural materials categories demonstrating the material health and inventory of a product down to 1000 ppm (0.1%) using the approved programs. Two-three categories earns 1 point; four-five categories earns 2 points.

- Paints & Coatings
- Flooring Systems
- Composite Wood and Agrifiber Products
- Furniture & Furnishings
- Ceiling & Wall Systems

EQ C7.1 IMPLEMENTATION

EQ C7.1 Designers and specifiers may collect disclosure certificates from identified third party programs, from the manufacturer, or from the certificate website, if applicable. In order to meet the requirements of this credit, the documentation must be publicly available--either published by the manufacturer on the manufacturer website with other technical data and/or in a registry (ex. Pharos, GreenWizard, etc).

For each of the programs, the following requirements shall apply:

- Health Product Declarations (HPDs): the HPD shall be published and disclose, at a minimum, all hazards down to 1000ppm.
- Cradle to Cradle Product Certification Standard (C2C): the product shall be certified at the C2C v2 Silver level or above, or at the C2C v3 Bronze level or above.
- Cradle to Cradle Material Health Certificate (MHC): the product has a Cradle to Cradle Material Health Certificate at the Bronze level or above.
- Declare: the product has a Declare label at any of the 3 levels (Declared, LBC Compliant, LBC Red List Free).
- Manufacturer Inventory: the product has a published list of ingredients identified by name, percentage of ingredient found in product, and Chemical Abstracts Service Registry (CAS) number, disclosed to at least 1000 ppm. In addition, the manufacturer shall provide a GreenScreen Benchmark or GreenScreen List Translator Benchmark for each disclosed ingredient. Where IP concerns are an issue, a manufacturer may choose to not disclose the chemical name/CAS number, but shall still be required to disclose the GreenScreen Benchmark or GreenScreen List Translator Benchmark, as well as the role of the chemical. Also, manufacturers may disclose percent ranges where appropriate.
- The product has a Product Lens label.

If a team collects only third party certificates, the team should consider applying for an Innovation credit.

Full disclosure of known hazards means that the documentation discloses the role and hazard traits of each ingredient but may mask the identity of certain ingredients that are restricted by IP and/or trade secret policies.

Full disclosure of intentional ingredients means that the documentation discloses the role and hazard traits of every ingredient in the product. This is a much higher standard that is not required by this credit, but its use is encouraged where appropriate.

EQ C7.1 DOCUMENTATION

DESIGN REVIEW

CDs must include notes for specifiers and designers regarding which of the various product categories are covered, where product templates may be found, and what the credit requirements are.

CONSTRUCTION REVIEW

Completed CHPS Materials Worksheet and approved submittal with cover sheet and applicable materials. Provide cut sheets and completed HPD templates for materials claimed to meet this credit.

If pursuing the prescriptive path, provide schedule of values for the project. All products from the pursued categories must be grouped together, and all qualifying products must clearly be indicated. Provide a total value for all products in the category and a subtotal for all qualifying products.

EQ C7.1 RESOURCES

Current valid versions of programs:

1. Health Product Declaration Standard and Templates for Manufacturers: http://www.hpd-collaborative.org/
2. Cradle to Cradle Product Certification Standard and Cradle Material Health Certificate: http://www.C2ccertified.org/
3. Declare product certification program: http://www.declareproducts.com
4. CAS Registry: https://www.cas.org/content/chemical-substances
5. GreenScreen Benchmark Program: http://www.greenscreenchemicals.org/method
6. UL Product Lens: https://industries.ul.com/environment/certificationvalidation-marks/product-lens-certification

Free product searches, non-exhaustive list:

7. Sustainable Minds Transparency Catalog*: http://www.transparencycatalog.com/
8. ZeroDocs Product & Specification Resource*: zerodocs.com

*Official CHPS' product listing partner

EQ C8.1 DRINKING WATER: TOXIN-FREE PLUMBING

Intent

Ensure that drinking water is lead-free and free of other potential contaminants that leach from plumbing fixtures and materials.

Children, particularly younger ones, are especially susceptible to poisoning from water-borne contaminants because of their physiology and age. The impacts of lead poisoning are acute and life-long. As a consequence, there is no safe amount of lead ingestion for children. However, EPA allows for some amount of lead in plumbing fixtures (no more than 0.25% of weighted average). Until 2014, it was optional for products to be tested to meet this standard. Since 2014, plumbing products have to be tested and labeled according to the National Sanitation Foundation (NSF) standards, known as NSF/ANSI 61 and NSF/ANSI 372. Additionally, all new plumbing installed for potable use must meet the standard.

EQ C8.1 DRINKING WATER QUALITY: TOXIN-FREE PLUMBING

CREDIT

1-3 points

APPLICABILITY: 8.1.1 applies to Renovation/Modernization projects only; 8.1.2 applies to all projects

VERIFICATION: Design and/or Construction Review

SCORING: 2 points for 8.1.1 and/or 1 point for 8.1.2

EQ C8.1 REQUIREMENTS

EQ C8.1.1 *Plumbing System Components*

2 points

In Renovation/Modernization projects with or without Additions, for the potable water system, specify and install only components that are certified to meet the NSF/ANSI 61 requirements for low-lead content and chemical extraction. If the plumbing system is not part of the scope of work, the project may alternatively apply for 1 point under 8.1.2. The list of covered components includes but is not limited to:

- Pipes, fittings, and related products
- Drinking fountains, faucets, and other end-point devices
- Mechanical parts such as meters, valves, and filters
- Protective barriers, including paints, coatings, and cements
- Joining/sealing materials
- Process media such as sand, ion exchange resins, and filter media

AND/OR

EQ C8.1.2 *District Resolution to Test Drinking Water*

1 point

For all projects, adopt a school or district resolution to test drinking water for lead annually and publish results for the community. Commit to implement mitigation measures, if warranted, including replacement of plumbing components in compliance with 8.1.1. Testing procedures should follow EPA's 3Ts program for lead sampling and remediation or an equivalent state or local program. [3]

EQ C8.1 IMPLEMENTATION

Not all renovation projects touch the plumbing; however, all existing schools with plumbing over a certain age are at risk for lead leaching into the drinking water. All renovation projects are strongly encouraged to pursue this credit either by replacing potable water components or by adopting a resolution to test drinking water annually.

EQ C8.1.1 NSF/ANSI 61 establishes standards for the health effects of materials and products that come into contact with drinking water. NSF/ANSI 61 addresses both the content of the material/product and any leachate that may arise from water coming into contact with the surface of the product and references the 0.25% limit for lead content under the SDWA. The associated standard, NSF/ANSI 372, covers the testing procedure for lead content only, again referencing the 0.25% limit. Products meeting the requirements may have one or multiple NSF marks, pursuant to NSF's system. [2]

Use the NSF search feature at http://info.nsf.org/Certified/PwsComponents/ to find products meeting NSF/ANSI 61 and/or NSF/ANSI 372. Products certified to NSF/ANSI 61 meet both the lead-free content and leachate standards. Products certified to NSF/ANSI 372 meet the lead-free content standard.

Fixtures and products involving wastewater, such as toilets and urinals, or outdoor irrigation do not have to comply with the standard.

For further information and guidance, refer to the NSF web page on lead in schools in the first bullet under Resources.

EQ C8.1.2 The resolution or policy can be adopted at the governance or facilities management level and must identify the testing protocol to be used. It is good practice to ensure that testing is included in the annual budget.

EQ C8.1 DOCUMENTATION

DESIGN REVIEW

EQ C8.1.1 Provide specifications showing that the following components are required to meet NSF/ANSI 61:

- Pipes, fittings, and related products
- Drinking fountains, faucets, and other end-point devices
- Mechanical parts such as meters, valves, and filters
- Protective barriers, including paints, coatings, and cements
- Joining/sealing materials
- Process media such as sand, ion exchange resins, and filter media

CONSTRUCTION REVIEW

EQ C8.1.1 Provide a statement signed by the plumbing contractor or general contractor certifying that all installed components have met the NSF/ANSI 61 standard.

EQ C8.1.2 Provide a copy of the resolution or policy identifying the responsible party and the protocol that will be followed.

EQ C8.1 RESOURCES

1. NSF has a very informative page for lead in school drinking water: http://www.nsf.org/consumer-resources/water-quality/faucets-plumbing/lead-schools?pane=water-school-lead.
2. For a list of the various NSF marks and what they apply to, see http://www.nsf.org/newsroom_pdf/water_nsf_ansi_61_your_answer_lead-free.pdf
3. US EPA 3Ts for Reducing Lead in Drinking Water Toolkit for schools: https://www.epa.gov/ground-water-and-drinking-water/3ts-reducing-lead-drinking-water-toolkit

EQ C9.1 LOW RADON

Intent

Build with radon-reducing features and test for radon to determine whether mitigation is necessary to reduce health effects.

This credit encourages schools to assess their radon levels and to ensure that the levels are low. Radon in schools presents a significant health risk, and thousands of schools are affected. Approximately 20% of schools have high radon, and 41% of those schools are located in known high radon areas. Radon is a human lung carcinogen and is the largest source of radiation exposure and risk to the public. Radon is the second leading cause of lung cancer; even small exposures to radon can result in lung cancer. According to the US EPA, the only way to know if elevated radon levels are present is to conduct testing. Mitigation measures should be pursued during design, construction, and renovation.

EQ C9.1 LOW RADON

CREDIT

1 point

APPLICABILITY: All projects

VERIFICATION: Design Review, Construction Review

EQ C9.1 REQUIREMENTS

For new construction, institute radon reduction measures specifically, *but not limited to*: soil gas barrier, gas permeable layer, and vent pipes for fan-activated radon removal systems (should testing warrant system activation). Designs and strategies depend on the types of building foundations and other factors. See *CC-1000 Soil Gas Control Systems in New Construction of Buildings* by ANSI/AARST for radon reduction measures that work best for different construction types and scopes

Radon reduction measures are not deemed effective until testing verifies radon levels below 4 pCi/L. Test for radon according to *MALB Protocol for Conducting Measurements of Radon and Radon Decay Products in Schools and Large Buildings*.

For renovations/modernizations, perform post-renovation radon testing and make necessary mitigations should radon levels meet or exceed 4 pCi/L. Test for radon after HVAC systems are commissioned and performing as intended prior to occupancy. If mitigation is warranted, such as HVAC manipulations or sub-slab depressurization, procedures must follow *RMS-LB Radon Mitigation Standards for Schools and Large Buildings* as soon as possible. If radon levels are near 100 pCi/L or greater, school officials should call their State Radon Contact and consider relocating from affected rooms until the levels can be reduced. All radon testing must follow the *MALB Protocol for Conducting Measurements of Radon and Radon Decay Products in Schools and Large Buildings.*

EQ C9.1 IMPLEMENTATION

New school buildings have a unique opportunity to prevent radon gas from entering the interior of a school at the USEPA action level of greater than or equal to 4 pCi/L. Design and construction methods for radon reduction should follow *CC-1000 Soil Gas Control Systems in New Construction of Buildings.* Additionally, the USEPA regional office or state radon program and professionals certified in radon testing and mitigation should be

consulted. If hiring measurement and mitigation consultants, ensure that they are certified through the National Radon Proficiency Program (NRPP) or National Radon Safety Board (NRSB). Also ensure that projects comply with applicable codes, regulations and certification rules within the project jurisdiction.

Once measures have been incorporated into the construction of the school and HVAC systems have been commissioned and are operating as intended, then test that levels of radon are less than 4 pCi/L. Post-construction radon testing best practices are found in *MALB Protocol for Conducting Measurements of Radon and Radon Decay Products in Schools and Large Buildings.* Where radon testing indicates high radon (4 pCi/L or greater), the radon system can be activated with a fan and/or HVAC can be modified to reduce radon in accordance with *CC-1000 Soil Gas Control Systems in New Construction of Buildings.*

Renovations/modernizations also have opportunities to successfully mitigate radon levels in school projects. Depressurization systems which pull air from below the slab or crawl spaces or changes to ventilation are examples of proven measures that reduce radon. These changes should be made once HVAC systems have been commissioned and are operating as intended. At that point, testing can be conducted to determine presence of radon and whether airflow adjustments are needed. Projects must consult *RMS-LB Radon Mitigation Standards for Schools and Large Buildings and MALB Protocol for Conducting Measurements of Radon and Radon Decay Products in Schools and Large Buildings* for guidance on mitigation and testing measures and, as above, USEPA regional office or state radon program and professionals certified in radon testing and mitigation should be consulted.

To maintain low radon environments, a school should be tested at least every five years unless the school previously tested with high levels. In such schools, those rooms or buildings should be mitigated and then retested every two years. Retesting is done to ensure that the mitigation system remains effective and that common building changes are not causing a change in radon levels from previously known levels. The need for retesting is triggered by the following types of events:

- Renovation work that includes energy upgrades
- HVAC equipment that is added, removed, replaced, operated incorrectly or differently, or improperly maintained
- New additions/significant renovations

EQ C9.1 DOCUMENTATION

DESIGN REVIEW

The Project Team must provide a statement to CHPS stating that radon prevention and active mitigation systems (if needed) have been designed according to the following standards, and include descriptions of any deviations from best practices:

- For new construction*: CC-1000 Soil Gas Control Systems in New Construction of Buildings,* ANSI/AARST*.*
- For renovation/modernizations: *RMS-LB Radon Mitigation Standards for Schools and Large Buildings,* ANSI/AARST*.*

Provide specifications and construction documents delineating radon prevention measures and active mitigation systems in order to support the statement above.

CONSTRUCTION REVIEW

Submit a statement from the Project Team that summarizes the following: whether radon testing was completed, when it was completed, test duration, and the radon levels detected. Indicate whether further mitigation was needed.

Statement must indicate that testing was performed in accordance with *MALB Protocol for Conducting Measurements of Radon and Radon Decay Products in Schools and Large Buildings*, ANSI/AARST

EQ C9.1 RESOURCES

1. CC-1000 Soil Gas Control Systems in New Construction of Buildings, ANSI/AARST
2. RMS-LB Radon Mitigation Standards for Schools and Large Buildings, ANSI/AARST
3. MALB Protocol for Conducting Measurements of Radon and Radon Decay Products in Schools and Large Buildings, ANSI/AARST
4. EPA Radon in Schools Webinar: https://www.epa.gov/iaq-schools/forms/webinar-radon-schools-what-you-need-know-properly-manage-radon-your-school
5. American Association of Radon Scientists and Technologists (AARST) Mitigation and Certification Courses: http://aarst-nrpp.com/wp/entry-level-courses/
6. Schools and Daycares testing: https://www.certi.us/cms/component/virtuemart/courses/continuing-education/c-16-108-addressing-radon-in-daycare-facilities,-schools-and-large-buildings-certi-323-detail?Itemid=0
7. Western Regional Radon Training Center courses: http://kansasradonprogram.org/courses
8. Eastern Regional Radon Training Center courses: http://www.cpe.rutgers.edu/programs/radon_indoor_air_quality.htmlNational Radon Proficiency Program (NRPP) http://aarst-nrpp.com/wp/certification/
9. National Radon Safety Board (NRSB) http://www.nrsb.org/

EQ C10.1 THERMAL COMFORT – ASHRAE 55

Thermal comfort is controlled by six factors: air temperature, relative humidity, radiant temperature, air movement, occupant activity and clothing. Design the building envelope and mechanical systems to provide optimal comfort and energy efficiency.

Intent

To provide a high level of thermal comfort to support optimum health, productivity, and comfort.

EQ C10.1 THERMAL COMFORT – ASHRAE 55

CREDIT

2 points

APPLICABILITY: All projects.

VERIFICATION: Design Review

RELATED CRITERIA: II C7.1 Design for Adaptation & Resilience, EE P1.0 Energy Efficient Design

EQ C10.1 REQUIREMENTS

Comply with the latest edition of the ASHRAE Standard 55 for thermal comfort. [1]

EQ C10.1 IMPLEMENTATION

Indoor design temperature and humidity for general comfort applications shall be determined in accordance with the latest edition of the American National Standards Institute ANSI/ASHRAE 55. The standard specifies conditions in which a specified fraction of the occupants will find the environment thermally acceptable. Comfort conditions for naturally ventilated buildings are included in the standard. Provide a summary that identifies each thermally controlled zone and the temperature and humidity control ranges and method of control used for each zone.

The design should also consider other important factors such as minimizing temperature differences between exterior surfaces and interior walls, decreasing the temperature variation between floors and ceilings, the impact on air speed by ceiling fans, radiant temperature, and decreasing the velocity of air flow such as drafts. Energy modeling tools can provide outputs on some of these factors.

EQ C10.1 DOCUMENTATION

DESIGN REVIEW

CDs must include a table with seasonal temperatures and humidity design criteria, and metabolic rates for each space. Provide supporting documentation with PMV/PPD calculations, and/or ASHRAE Comfort Tool results that standards have been met.

CONSTRUCTION REVIEW

N/A

EQ C10.1 RESOURCES

1. ANSI/ASHRAE Standard 55-2010 Thermal Environmental Conditions for Human Occupancy: www.ashrae.org/resources--publications/bookstore/standard-55

EQ C11.1 CONTROLLABILITY OF INDOOR ENVIRONMENT

Temperature and Ventilation Controls: A high performance school is a comfortable place to learn. Temperature and humidity are important factors in maintaining occupant comfort. A comfortable and healthy indoor environment increases productivity and learning and reduces absenteeism.

Intent

Enable teachers to have reasonable control of the thermal environment within classrooms.

Operable windows are important for personal comfort and have been shown to improve student performance.

EQ C11.1 CONTROLLABILITY OF INDOOR ENVIRONMENT

CREDIT

2 points

APPLICABILITY: All projects; in renovations, applies if new HVAC is part of scope

VERIFICATION: Design Review, Construction Review

RELATED CRITERIA: EE P1.0 Energy Efficient Design, EE P2.0 Commissioning, OM P1.0 Facility Staff & Occupant Training, OM C6.1 Indoor Environmental Management

EQ C11.1 REQUIREMENTS

Temperature Controls

Provide an individual temperature control for each classroom with an independent temperature sensor.

AND

Operable Windows

Ninety percent (90%) for new schools and new school buildings, and seventy five percent (75%) for major renovations, of all classrooms shall have a minimum of one operable window per classroom that is reasonably accessible to the occupants. This precludes the use of ladders to adjust the window opening. If external shading devices are included, controls for their use and management must be made accessible to teachers and staff.

EQ C11.1 IMPLEMENTATION

Temperature Controls

Individual classrooms will vary in temperature depending on their orientation, glazing apertures, occupancy, and the effectiveness of the heating or cooling systems. Provide individual systems to allow teachers to regulate the lighting and temperature of classrooms.

Operable Windows

Provide at least one operable window in each classroom. Provide either an educational signage or a guide and train teachers how to properly use the HVAC controls in their rooms and on how opening doors and windows affects the HVAC system and the acoustical environment in a classroom. Operable windows are important for both personal comfort and operation if for example, power loss occurs, and mechanical ventilation cannot be

provided.

For the purposes of this part of this criterion, classrooms are:

- General classrooms
- Art rooms
- Music rooms
- Science rooms
- Computer rooms
- Special needs, remedial, and collaborative space
- Industrial technology spaces
- Work and family studies spaces

Other Considerations

Temperature control systems should not give teachers free range to adjust the temperature to whatever they desire. It is possible to install systems that allow teachers to adjust the temperature in a room to within 1-2 degrees of the standard setting for the season (e.g. 70° in winter) that will improve comfort while not having a significant adverse impact on the building's energy efficiency. Establishing a standard temperature setting for the entire building is an important corollary action.

EQ C11.1 DOCUMENTATION

DESIGN REVIEW

Provide specifications and drawings for separate temperature controls for each classroom.

Provide specifications for operable windows. Identify the CSI number, section, and page number that highlight compliance with this requirement. Drawings must show operable windows in each classroom - 90% for new schools and new school buildings, and 75% for major renovations of classrooms need to comply. This is based on numbers of classrooms not square footage.

CONSTRUCTION REVIEW

Provide approved submittal with cover sheet and applicable materials and/or operation of temperature and ventilation sensors and controls.

EQ C11.1 RESOURCES

None.

EQ P12.0 DAYLIGHT: GLARE PROTECTION
EQ C12.1 DAYLIGHT AVAILABILITY

Daylighting is fundamentally important to high performance design and should be the primary source of light in classrooms. Daylighting has a number of advantages, including improved occupant productivity, improved connection to the outdoors, improved health, energy savings, and quality of light.

Intent

Provide high quality daylighting in classrooms to enhance student performance, improve student productivity through quality daylighting designs that minimize glare and direct sunlight penetration, promote health and wellness, and ensure energy savings.

EQ P12.0 DAYLIGHT: GLARE PROTECTION

PREREQUISITE

4 points

APPLICABILITY: All projects.

VERIFICATION: Design Review

RELATED CRITERIA: EQ C11.1 Controllability of Indoor Environment, EQ C14.1 Electric Lighting Performance

EQ P12.0 REQUIREMENTS

Design regularly occupied spaces to optimize daylight while preventing glare by controlling direct sunlight ingress with blinds, shades, overhangs, light shelves, translucent material, or other effective means. Use either of the following two metrics to document achievement of this criterion, and refer to the implementation section for documentation requirements:

- No direct sunlight incident on the teaching surfaces or the workplane at 9:00am, 12:00pm and 3:00pm on the winter and summer solstice and the equinox.

  OR

- The ratio of maximum to average illuminance measured on the workplane cannot exceed 15 at 9:00am, 12:00pm and 3:00pm on the winter and summer solstice and the equinox.

EQ C12.1 DAYLIGHT AVAILABILITY

CREDIT

1-5 points

APPLICABILITY: All projects. To earn these points for major renovations/modernizations, it may be necessary to add skylights or modify the size and location of windows.

VERIFICATION: Design Review

SCORING: 1-3 points for 12.1.1 and 1-2 points for 12.1.2

EQ C12.1 REQUIREMENTS

For **all** **regularly occupied** spaces, a daylight responsive electric lighting control system or control plan must be implemented for the daylit spaces. In renovation/modernization projects that do not modify lighting systems, this requirement does not apply.

AND

Comply with the Multiple Point in Time Approach or the Daylight Saturation (DS) Approach as shown below:

EQ C12.1.1 *All Classroom Spaces*

1-3 points *Daylight Sufficiency – Multiple Point in Time Approach*

1 Point	Achieve >20fc annual average daylight illuminance for >75% of classroom area
2 Points	Achieve >35fc annual average daylight illuminance for >75% of classroom area
3 Points	Achieve >50fc annual average daylight illuminance for >75% of classroom area

OR

Daylight Sufficiency - Daylight Saturation (DS) Approach

1 Point	Achieve >40% DS_{30} for >75% of classroom area
2 Points	Achieve >60% DS_{30} for >75% of classroom area
3 Points	Achieve >80% DS_{30} for >75% of classroom area

EQ C12.1.2 *All Support Spaces*

1-2 points *Daylight Sufficiency - Multiple Point in Time Approach*

1 Point	Achieve >20fc average daylight illuminance for >75% of administration office area
1 Point	Achieve >35fc average illuminance for >75% of library, cafeteria, gymnasium, and multi-purpose/commons area

OR

Daylight Sufficiency - Daylight Saturation (DS) Approach

1 Point	Achieve >40% DS_{30} for >75% of administration office area
2 Points	Achieve >40% DS_{50} for >75% of library, cafeteria, gymnasium, and multi-purpose/commons area

- Any spaces where daylight would have an adverse impact on the use of the space are excluded. Provide documentation illustrating impact.
- Spaces can use a design illuminance different than the target illuminance used in Daylight Saturation calculation (30fc for classroom/admin, 50fc for other) provided good reasoning. Provide documentation justifying variance.

EQ P12.0-C12.1 IMPLEMENTATION

EQ P12.0 *Daylight: Glare Protection*

Direct sunlight penetration shall be verified by one of the following methods. In all cases, indicate if window treatments are used to meet the requirement and the intended window treatment operation:

- A physical model should be placed on a heliodon or otherwise positioned so that the sun angles represent the dates and times specified in EQ P12.0. Verify by photograph that the 9 conditions do not have any direct sunlight on the workplane or teaching wall.
- Manually calculate the sun profile angles and show that the criteria are satisfied for the dates and times specified in EQ P12.0. Illustrate how the shading strategies provide complete direct sunlight control for the 9 conditions specified.
- A computer-simulation that can calculate sunlight or daylight illuminance on interior surfaces. Verify with rendering images and/or task plane illuminance calculations that the 9 conditions do not have any direct sunlight on the workplane or teaching wall or comply with the illuminance ratio requirements.
- Using a computer simulation, perform a Daylight Excess calculation using 300fc, 500fc or other recommended target illuminance x 10.

EQ C12.1.2 *Daylight Availability in Classrooms and Support Spaces*

Calculations for this requirement must be made with a qualified computer simulation tool.

Multiple Point in Time Approach

- The annual average illumination should be determined by either with a 9am-3pm annual calculation or with a point-in-time formula. The point in time formula should be determined by first calculating the workplane average illuminance for 10 design sky conditions: 9am, 12pm, and 3pm for winter and summer solstice and equinox under a CIE clear sky and 12pm on the equinox under a cloudy sky condition. Use information from the National Oceanic and Atmospheric Association's (NOAA) National Climatic Data Center, or from a TMY weather file to determine the percentage of cloudy and sunny days. The annual average illuminance is calculated with this formula:

$$E_{avg} = [(W9 + W12 \times 2 + W3 + (E9 + E12 \times 2 + E3) \times 2 + (S9 + S12 \times 2 + S3) \times 0.5)/14] \times Sunny\% + EC12 \times Cloudy\%$$

Where:

E_{avg} = estimated annual average illuminance
WX = Sunny winter solstice condition at 9am, 12pm, and 3pm
EX = Sunny equinox condition at 9am, 12pm and 3pm
SX = Sunny summer condition at 9am, 12pm, and 3pm
EX12 = Cloudy equinox condition at 12pm
Sunny % - percent of year with opaque cloud cover <50%
Cloudy % - percent of year with opaque cloud cover >50%

- Include window treatments in the 10 design sky conditions as prescribed by the window treatment operation.

Daylight Saturation Approach

The daylight saturation calculations must meet the following criteria:

- Using a computer model, perform an annual Daylight Saturation calculation using 30fc, 50fc or other recommended target illuminance. Describe and document the window treatment operation used to achieve the requirement.
- The school occupancy schedule and a representative weather file should be used for the annual Daylight Saturation and Daylight Excess calculations. 7am to 3pm should be used as a standard school schedule. Schools with schedules that vary from this standard should provide documentation of their operation hours.

Window Treatment Operation: Window treatments should comply with one of the following three control schemes:

1) Fixed (Passive manual) control – for windows where occupants do not have direct access to the window treatment control or spaces with no occupant education efforts the window treatment should be included in all modeling.
2) Manual control – for windows where occupants have easy and intentional access to window treatment control and occupant education efforts have been taken, the window treatment should be modeled to be engaged when there is a glare event and open after a delay period. The glare event is defined as anytime the center-of-glass daylight exitance (illuminance x normal glazing transmittance) is greater than 500fc. After the glare event passes, it is to be checked hourly during the duration, there is a 4 hour delay period before the shades will be opened.
3) Automatic control – for windows with automatic window treatment control, simulate the window treatment as accurately to the automatic controller's method as possible. Document control system algorithm and simulation approach. Alternatively, the Blinds/Shades Operation protocol described in section 2.2.6 of IES document LM-83-12 can be used to model automatic blinds.

Window treatment (manual control) Occupant Education: Describe in a building manual or classroom operation manual that can be provided and explained to teachers/staff, the intentional control and benefit of operating of window treatments throughout the school, namely ensuring they are not left down when there is available glare-free daylight.

EQ P12.0-C12.1 DOCUMENTATION

DESIGN REVIEW

EQ P12.0 *Daylight: Glare Protection*

If window treatments are implemented, provide plans or specification sections for all regularly occupied spaces that indicate the window treatment types and placement. Provide PDF results of a daylight simulation model, a computer based simulation model, a physical model, or manually calculated sunlight penetration in the classrooms to illustrate no direct sunlight on teaching surfaces and work planes.

If submitting a computer simulation, submit a screenshot of the input values for each model and the results for each classroom type for each of the nine conditions or a report showing the Daylight Excess (DE) calculations for the space.

If submitting a physical model, submit a photo of the model and picture of each of the nine lighting conditions.

EQ C12.1.1-2 *Daylight Availability*

CDs must identify spaces that qualify as daylit, and the overall percentage of daylit classrooms. Plans and sections will be used for verification. For each classroom group identified on the CHPS Verified Workbook worksheet, provide the required simulation results including point-by-point illuminance or daylight saturation calculations as appropriate.

- For photosensor based control systems; provide documentation showing location of sensors, lighting zones, setpoints, and commissioning information for the system.
- For strategic switching and occupant education approaches; provide documentation showing the switching and zones and a brief manual to be provided to the building occupants describing the daylighting intent of the space and the recommended function of all daylighting, lighting, and shading devices.

Construction Review

N/A

EQ P12.0-C12.1 RESOURCES

1. IES TM-83-13 “IES Spatial Daylight Autonomy (sDA) and Annual Sunlight Exposure (ASE)”: https://www.ies.org/product/ies-spatial-daylight-autonomy-sda-and-annual-sunlight-exposure-ase/
2. Free tool from NBI, *Daylighting Pattern Guide*: http://patternguide.advancedbuildings.net
3. AGI32 Lighting Design Software: www.agi32.com/
4. DAYSIM Daylighting Analysis Software: http://daysim.ning.com/
5. DOE-2 Building Energy Use and Cost Analysis Software: http://doe2.com/
6. EnergyPlus Building Energy Simulation Program: https://energyplus.net/
7. Equest: http://www.doe2.com/equest
8. SPOT Pro: www.daylightinginnovations.com/spot-home
9. Radiance: radsite.lbl.gov/radiance/
10. DIVA-for-Rhino: www.diva4rhino.com
11. Open Studio: http://openstudio.nrel.gov
12. Sefaira: http://sefaira.com/
13. Insight 360: https://insight.autodesk.com/oneenergy
14. LightStanza: http://lightstanza.com

EQ C13.1 VIEWS

View windows are essential to areas where students and staff will be working for extended periods of time. Ample and interesting views have consistently been found to increase student performance. Distant views enable the room occupants to relax their eyes, which is especially beneficial to computer users and younger children who are still developing visual capabilities.

Intent

Provide a connection between indoor spaces and the outdoor environment through the introduction of sunlight and views into the occupied areas of the building.

EQ C13.1 VIEWS

CREDIT

1-3 points

APPLICABILITY: All projects.

VERIFICATION: Design Review

SCORING: 1 point for 70%, 2 points for 80%, 3 points for =/>90%

RELATED CRITERIA: EQ C12.1 Daylight Availability

EQ C13.1 REQUIREMENTS

To qualify, a space shall have view glazing area equal to or greater than 7% of the floor area. View glazing shall be transparent, but not translucent, and only include window area above 2.5 ft. and below 7.5 ft. from the floor. The total width of view windows shall be greater than 1% of the floor area. Exception: For school buildings that share at least two sides with other buildings, shared walls are exempted from this requirement. Every effort shall be made to meet the view glazing requirement on walls not shared with other buildings.

EQ C13.1 Provide direct line of sight to view glazing from at least 70% of the combined floor area of classrooms, library reading rooms, and administration areas. Points are awarded by threshold as shown in the table. Percentages between thresholds are implied.

Percent Area with Access to Views	Points
70%	1
80%	2
>=90%	3

EQ C13.1 IMPLEMENTATION

EQ C13.1.1 This criterion applies to all classrooms and administration areas. Renovation/modernization projects that involve window replacement can earn this criterion by modifying existing window configurations that do not conform to the requirements to configurations that do meet the requirements for this criterion.

Determine the total floor area of spaces for which this requirement applies by creating a table listing the classrooms, library reading rooms and administrative areas. Like spaces may be listed just once. A like space is one with the same physical configuration, including

windows.

For each space in the list determine how much of the floor area qualifies for the view criterion. Two considerations come into play: the view window area and the total width of the view windows. Each of these considerations limit how much of the area qualifies, as explained below:

- To determine the maximum qualifying area based on the view window area, divide the view window area by 7%.
- To determine the maximum qualifying area based on the width of the view windows, divide the total width of view windows by 1%.

For each space the qualifying floor area is the lesser of the total floor area, the maximum floor area based on view window area, or the maximum floor area based on view window width. Sum the qualifying area and compare to the total area. If it is greater than 70%, then the school project qualifies, otherwise it does not.

Line of sight may be drawn through interior glazing, and qualifying area in these zones may be included, assuming the interior glazing allows for a line of sight though exterior view glazing.

Example Calculation

Question:

A new school has 30 like classrooms each with a floor area of 960 ft². Each classroom has view windows with a total area of 60 ft² and a total width of 9 ft. The school also has six larger 1,040 ft² classrooms with 70 ft² view windows with a total width of 10.5 ft. The 2,600 ft² library reading area has 200 ft² of view windows with a total width of 25 ft. The 2,000 ft² administration area has 150 ft² of view windows with a total width of 18 ft. Does this school qualify for the view windows criterion, and how much of the floor area qualifies as having view windows?

Answer:

The total floor area of classrooms, administration areas and library reading rooms is 39,640 ft² (see column D in Table EQ13-1). To meet the criterion, at least 70% of the floor area of these spaces shall have view windows, or a total of 27,748 ft². The qualifying floor area must be determined for each space based on the total view window area and the total width of the view windows. For the smaller classrooms, the maximum qualifying floor area based on view window area is 857 ft² or 60 ft² divided by 7%. The maximum qualifying floor area based on window width is 900 ft. or 9 ft. divided by 1%/ft. The qualifying area is the smaller of these numbers or 857 ft². For the larger classrooms, the qualifying area is 1,000 ft²; 2,500 ft² for the library reading area; and 1,800 ft² for the administration areas. The total qualifying area is 36,010 ft² or 91%. See Table EQ13-1 for details of the calculation.

Table EQ13-1: Example Calculation of View Window Criterion

A	B	C	D	E	F	G	H	I	J
				For each space					
Space	Size (ft²)	Number of spaces	Total area (ft²)	View window area (ft²)	Maximum Floor Area based on view window area (ft²)	Total width of view windows (ft.)	Maximum floor area based on view window width	Qualifying floor area per space (ft²)	Total qualifying floor area (ft²)
Classroom type 1	960	30	28,800	60	857	9	900	857	25,710
Classroom type 2	1040	6	6,240	70	1,000	10.5	1,050	1000	6,000
Library reading room	2600	1	2,600	200	2,857	25	2,500	2500	2,500
Administration	2000	1	2,000	150	2142	18	1,800	1800	1,800
Totals			39,640						36,010
Percent									91%

EQ C13.1 DOCUMENTATION

DESIGN REVIEW

CDs must include required calculations for view windows. Reference interior elevations to confirm dimensions.

CONSTRUCTION REVIEW

N/A

EQ C13.1 RESOURCES

1. The Daylighting Collaborative is a clearinghouse of best practices and resources about daylighting: www.daylighting.org

EQ C14.1 ELECTRIC LIGHTING PERFORMANCE & CIRCADIAN LIGHTING

The classroom is one of the focal points for preparing students for today's high tech, postindustrial world. New teaching tools such as affordable A/V systems, smart boards, tablets and web-based learning tools have turned the classroom into a dynamic place of learning. As the rate of adoption of these new technologies increases, it is important to give the teacher easy-to-use control of lighting. This will enhance learning by letting the teacher tailor high quality lighting to the type of teaching taking place.

Intent

Integrate high performance electric lighting with daylighting to promote the health and well-being of the occupants while maximizing energy efficiency. Reduce hazardous substances commonly found in electric products. Provide high quality and flexible classroom lighting with teacher controls tailored to new teaching methods.

While the use of LED-based lighting systems is not required, the selection criteria included here will help progressive schools select LED-based luminaires that provide high quality, long-lasting and energy efficient lighting for the classroom

EQ C14.1 ELECTRIC LIGHTING PERFORMANCE & CIRCADIAN LIGHTING

CREDIT

2-7 points

APPLICABILITY: This criterion applies to all new classrooms and can also be earned in renovation/modernization projects when classroom lighting is included in the scope of work.

VERIFICATION: Design Review, Construction Review

SCORING: 2 points each for 14.1.1 and 14.1.2, 1 point each for 14.1.3-14.1.5

RELATED CRITERIA: EQ C12.1 Daylight Availability, EE P1.0 Energy Efficient Design

EQ C14.1 REQUIREMENTS

EQ C14.1.1 *High Performance Lighting*

2 points

Achieve the following:

1. *Illuminating Engineering Society (IES) TM-30-15: Method for Evaluating Light Source Color Rendition* [3]: All luminaires shall have light sources with a Fidelity (Rf) of 80 or greater and a Gamut Area (Rg) of between 80 and 100.
2. *Restriction of Hazardous Substances (RoHS) Requirements* [2]: All luminaires shall be RoHS compliant following the most current European RoHS regulations, including all applicable exemptions.
3. *LED Lighting:* If an LED-based system used, all LED-based luminaires shall meet the ENERGY STAR criteria in the latest ENERGY STAR Luminaires Specification or be listed by the Design Lights Consortium (DLC). [4] Exceptions may be accepted for specialty fixtures not listed by either source.

EQ C14.1.2 *Illumination Levels & Multimodal Systems*

2 points Achieve the following:

1. Provide multi-scene indirect/direct lighting systems for all classrooms, with the exception for specialty classrooms where multi-scene lighting is not required.
2. At a minimum, the lighting system shall work in at least two modes: General and Audio Visual (AV). The modes shall be recalled through a preset lighting control system via dimming the fixtures to meet required light levels for each mode. Daylight sensors shall be used to dim the lighting system in response to available daylight. A 3-minute fade shall be used to slow the daylight system to prevent distracting changes in the electric lighting. The daylighting system shall not dim the electric lighting below 10% initial output.
3. In general illumination mode, achieve the average illumination at the desk level based on the classroom type in the *IES Lighting Handbook, Tenth Edition*, or its most recent update.
4. In A/V mode the average illumination levels shall be 10 to 30-foot candles, not including contribution from the teaching wall light, for any point in the room greater than 3-feet from the side walls, or 10-feet from the front wall. Limit vertical illumination on the AV screen to no more than 7-footcandles at any point on the screen.
5. *Whiteboard Illumination:* Provide a separately switched lighting system that provides whiteboard vertical illumination of at least 30-footcandles average with a maximum-to-minimum illuminance ratio of 8:1 or better for all points on the whiteboard.

EQ C14.1.3 *Lighting Controls*

1 point Achieve the following:

1. All lighting must be dimmable by users in all regularly occupied spaces.
2. Enhanced Teacher Controls: Provide teacher control at the front of the classroom for general/AV mode and whiteboard control.
3. Advanced Classroom Controls: Link the on/off occupancy signal into a school-wide management system.

EQ C14.1.4 *Superior Performance Lighting Systems*

1 point Achieve the following:

1. All luminaires shall have light sources with Fidelity (Rf) of 85 or greater and a Gamut Area (Rg) of between 90 and 105.
2. If LED-based systems are used, they must meet the following criteria for flicker and performance:

   Flicker

   In all school classrooms and educational learning spaces, the measured Percent Amplitude Modulation (flicker percent and frequency) from LED integrated systems (include driver, LED array, dimming controls, daylight sensor) shall be less than 30% at greater than 200 Hz across the entire dimming range or meet IEEE PAR1789. (8, 9, 10)

   Performance

   LED-based luminaires shall maintain at least 80% of their initial light output (L80) at

60,000 projected hours of operation. [7]

EQ C14.1.5 *Circadian Lighting*

1 point Achieve the following:

1. For **all classrooms and regularly occupied support spaces**:
    - Proposed lighting program shall account for latitude and provide adequate light in winter months.
    - Proposed lighting program shall adjust to age group category for population being served (i.e. majority of occupants in that space). A ratio of brightness based upon age where as younger than 25 years old = 0.5, 25-65 = 1, and older than 65 years = 2; meaning that children and young adults need half the brightness of middle age and elderly need 2 times that of middle age. Reference Table 3 of IES-ANSI RP-3-13.
    - Baseline light intensity and color temperature schedule must be programmed into lights.
2. For **all classroom** spaces:
    - Lighting model shall demonstrate that the appropriate EML or CS is present at 75% or more of desks (may include daylight) on a vertical plane facing the primary teaching wall 4 ft above finished floor (to simulate the view of the student). This light level to be present for at least 4 hours per day for each day of scheduled instruction.
    - Manual override or pedagogical programming for lighting fluctuations to support learning (e.g. dim after lunch to calm, increase light intensity for exams) shall be demonstrated as beneficial and not disrupt circadian entrainment by more than 1 hour per day.
3. For regularly occupied **support** spaces:

    Lighting model shall demonstrate that 75% or more of workstations and regularly utilized work surfaces receive at least 200 EML or equivalent CS measured on a vertical plane 4’ above finished floor for workstations and at 5’6” above finish floor standing access work surfaces (to simulate the view of occupants). This light level is to be present at least between the hours of 9am and 1pm for each day of regular occupancy (may include daylight).

EQ C14.1 IMPLEMENTATION

EQ C14.1.1-4 Many renovation/modernization projects include the installation of new lighting systems, providing an excellent opportunity to install high quality, energy efficient electric lighting that is integrated with the available daylight. Lighting technology in particular, is changing rapidly.

- TM-30-15 is an Illuminating Engineering Society (IES) technical standard that uses Fidelity (Rf) and Gamut Area (Rg) to describe how LEDs function in color space. The lighting industry is moving away from the CRI standard and using the IES TM-30-15 as the reference standard.
- ENERGY STAR’s criteria for standards from the IES TM-21 addresses all evolving aspects of the industry and is used as the main regularly updated reference for this document. Design Lights Consortium (DLC) is used as a complementary standard. If a luminaire is specified that is not listed by either, justification must be made.

- Restriction of Hazardous Substances (RoHS) is a European standard with no applicable third party certification or labeling. It is up to producers to self-declare that their products comply with RoHS legislation. Design teams may ask manufacturers to show that due diligence has been used and they have taken reasonable steps to comply.

- Manual override for occupancy sensors is no longer recommended due to advances in lighting technology and to the relatively higher cost. Occupancy sensors are available as motion, audio, and dual-technology hybrid solutions or equivalent. Current motion sensor technology can detect even minor movement now and will not shut off lights during times of classroom stillness.

Lumen maintenance is the amount of light produced from a light source or from a luminaire when it is brand new to the amount of light output at a specific time in the future.

During audio visual presentations, an average as low as 10-foot candles is acceptable to allow the teacher to "see" the students' faces and allow them to take notes. An average as high as 30-foot candles is acceptable to keep the contrast level of light at the desk and the screen at desired levels.

Special Consideration:

Flicker, both perceptible and imperceptible to the human eye, has effects on human performance and comfort and impacts different populations with varying sensitivity, particularly children, those individuals with Autism Spectrum Disorder, and those who suffer from migraines. These responses include headaches, seizures, eyestrain, and more. Addressing flicker issues can aid in classroom and school building performance and comfort. IEEE PAR1789 has not been finalized or adopted yet; however, it is robust and comprehensive compared to the Title 20 of the 2016 California Building Energy Efficiency Standards Code, which sets the 30% at 200Hz threshold. (8, 9, 10)

EQ C14.1.5 *Circadian Lighting*

Select measurement (EML or CS). The choice of metrics will impact the simulation process and should be consistently applied through the entirety of the process. Gather occupancy schedules and identify potential pedagogical uses that will impact circadian entrainment. Circadian entrainment should be preferenced over pedagogical applications.

If the space will serve multiple occupant age groups, such as in a joint use space, design for the needs of the occupants who require the highest light levels. For instance if the space will be used for both children and seniors, design for the lighting needs of the seniors, and use dimming to assure that the space is not overlit for children.

Choose locations for points of measurement that are representative of variability in space type, view, and orientation.

You may use a full color or neutral color simulation tool.

Full Color:

These tools demonstrate as CS value of .03 or a ML value of 250 or greater through simulation. The design intent simulation results must be met or exceeded, with onsite measurements that correlate with simulated locations and views.

Lark Spectral Lighting and Alfa/DIVA are currently the only simulation tools that take into account the spectral content of light, the spectral reflectance of materials and the interaction of the two. If this path is chosen, then materials palettes can be viewed as suggestions rather than prescriptive.

Neutral Color:

These tools may render in color but do not analyze the interaction of the color (spectral content of light) of light and the color (spectral reflectance) of materials. Light is assumed to be white and materials are neutral, with changes in reflectance and surface roughness being the only modifiers. If these tools are used, the impact of material color is ignored and results may not correlate with onsite measurements.

Spot checking is recommended to confirm desired light levels. For classrooms, check five locations in two typical classrooms: front center of classroom desks, center of room, center rear, center right, and center left. Check at 10am, 1pm, and 3pm. For other work areas, spot check sufficient locations based on usage.

Vertical Measurements for Circadian Lighting:

The circadian resource must be understood at the occupant's eye. All measurements are to be taken perpendicular to the occupant's eye rather than perpendicular to the work plane. The height of the measurement should be representative of occupant characteristics and should be adjust according to age.

Potential modeling/calculation tools:

- Lark Spectral Lighting – Rhino
- Diva – Alfa
- Fidelity
- Circadian Stimulus Calculator
- Melanopic Luminance Calculator

EQ C14.1 DOCUMENTATION

DESIGN REVIEW

EQ C14.1.1-3 Submit specifications and subsections and/or drawings that confirm compliance.

EQ C14.1.4 CDs, particularly the electrical plans must include point-by-point lighting calculations for each classroom type. CDs, ideally the electrical schedule must include the required lighting and system features, particularly Enhanced Teacher Controls and Advanced Classroom Controls. Also reference specifications and sub-sections that confirm compliance.

CONSTRUCTION REVIEW

EQ C14.1.1-3 Submit approved submittal with cover sheet and applicable materials that contain the required specifications from the manufacturer and show Fidelity (Rf) of 80 or greater, a Gamut Area (Rg) of between 80 and 100, Restriction of Hazardous Substances (RoHS) certification, and LED Performance that meets Energy Star Luminaires specification or is listed by Design Lights Consortium.

EQ C14.1.4 Provide submittals that meet the Fidelity (Rf) or 85 and a Gamut Area of between 90 and 105. Show that LED-based luminaires retain 80% of their initial light output (L80) and explain how flicker standards are met.

EQ C14.1.5 Provide a narrative that describes the lighting design approach as it relates to circadian system regulation, including highlights of the color and materials palette, a draft sequence of operations for lighting, and a list of the spaces targeted for circadian lighting.

EQ C14.1 RESOURCES

1. Advanced Lighting Guidelines: 2003 Edition: http://www.iesna.org/handbook/

3. Restriction of Hazardous Substances (RoHS) Guidelines: http://www.rohsguide.com/
4. IES link to worksheet for converting CRI to TM-30-15 is available from CHPS. Contact us at info@chps.net.
5. ENERGY STAR Luminaires Specification Version 2.1 (published March 15, 2018): https://www.energystar.gov/products/spec/luminaires_specification_version_2_0_pdf
6. Design Lights Consortium: https://www.designlights.org/
7. IES Maximum TM-21 Testing: 60,000 hours represents the mean of tested lifetimes for LEDs.
8. 2016 Nonresidential Compliance Manual Title-24 Part 6; Flicker Requirements Section 7.2.3 Section B. #5. Effective until 12/31/19; the 2019 update effective 1/1/20 does not change flicker requirements. https://www.energy.ca.gov/2015publications/CEC-400-2015-033/chapters/chapter_07_sign_lighting.pdf
9. US DOE slides on understanding IEEE PAR1789: https://www.energy.gov/sites/prod/files/2015/05/f22/miller%2Blehman_flicker_lightfair2015.pdf
10. Further reading on flicker: https://www.energystar.gov/sites/default/files/01-Bullough-FlickerOverview-2017-09-22.pdf
    https://www.energy.gov/sites/prod/files/2015/05/f22/miller%2Blehman_flicker_lightfair2015.pdf
11. Lighting Patterns for Healthy Buildings, http://lightingpatternsforhealthybuildings.org/welcome/select_room/5
12. Circadian Stimulus Calculator, http://www.lrc.rpi.edu/programs/lightHealth/
13. Melanopic Lux Tool Kit http://personalpages.manchester.ac.uk/staff/robert.lucas/Lucas%20et%20al%202014%20workbook.xls

EQ P15.0 ACOUSTICAL PERFORMANCE
EQ C15.1 ENHANCED ACOUSTICAL PERFORMANCE

Student learning and teacher health suffer in acoustically poor environments. Excessive noise and long sound reverberation negatively affect speech communication, forcing teachers to talk louder than normal thereby straining their vocal cords and forcing students to strain to hear or to try to cope with noisy distractions. Students who are hearing impaired particularly suffer.

Intent

Provide classrooms with adequate acoustical environments.

EQ P15.0 ACOUSTICAL PERFORMANCE

PREREQUISITE

7 points

APPLICABILITY: All classroom projects. Renovation/modernization projects must meet the acoustics prerequisite according to Table A: Renovation/Modernization Requirements at the front of the document.

VERIFICATION: Design Review, Construction Review

EQ P15.0 REQUIREMENTS

Note on Definitions in ANSI 12.60

For the purpose of this criterion, general terms and definitions are the same as those found in Section 3 of ANSI/ASA Standard S12.60-2010/Part1, with the introduction of the following amendments and additional categories:

Amendments:

a. The Core Learning Spaces category does not include special education rooms, libraries, music instruction and practice rooms. For the purpose of this criterion, these spaces are re-categorized as shown below.

b. The Ancillary Learning Spaces category does not include corridors. CHPS exempts corridors from acoustical requirements.

Additional Categories:

c. Inter-Classroom Workspaces (ICWS) include: small spaces in between two or more classrooms where student groups from any of the classrooms can gather for separate activities. For the purposes of the present criteria, Inter-Classroom Workspaces shall not be treated as regular classrooms, except where the district designates the ICWS as a core learning space.

d. Special Education Rooms (SER) include classrooms for special needs students.

e. Confidential Speech Privacy Rooms (CSPR) are rooms for which confidential speech privacy, as defined by Appendix X1 of ASTM standard E1130, is required for conversations held at normal voice levels, such as educational council offices and therapy rooms.

f. Performance Arts Spaces (PAS) include: music and choir classrooms, ensemble rooms, practice rooms, dance classrooms, drama classrooms, auditoria and theaters.

g. Audio/Video Production Spaces (APS) include: audio/video recording or production studios and control rooms, and audio/video editing suites.

h. Large Assembly Spaces (LAS) include: multipurpose rooms, libraries, and gymnasia when the school program requirements include the use of any of these rooms as group instruction rooms or assembly spaces where good understanding of speech (amplified or unamplified) is important.

EQ P15.0.1 *Criteria for Sound Reverberation*

Comply with either the performance or prescriptive option listed below. The prescriptive and performance methods may be used interchangeably within a single project. While each room shall comply with one method, compliance with both methods is not required for any one space.

Performance Method:

The maximum reverberation times in the one-octave frequency bands centered at 500 Hz, 1,000 Hz and 2,000 Hz shall be:

- Core learning spaces with volume less than 10,000 ft^3: 0.60 seconds
- Core learning spaces with volume between 10,000 ft^3 and 20,000 ft^3: 0.70 seconds
- Core learning spaces with volume greater than 20,000 ft^3: 1.0 seconds

In spaces designated as ICWS and SER (see Implementation), the ideal reverberation times depend on the specific program for each space. The design team shall submit a narrative stating the Basis of Design for reverberation times for each of these spaces and calculations showing achievement of such Basis of Design.

Prescriptive Method:

Provide the following minimum finishes:

- Core learning spaces with volume less than 10,000 ft3: Ceiling finish with a minimum NRC of 0.70, covering minimum 95% of ceiling area (excluding lights, diffusers and grilles).
- Core learning spaces with volume between 10,000 ft3 and 20,000 ft3: Ceiling finish with a minimum NRC of 0.70, covering minimum 85% of ceiling area (excluding lights, diffusers and grilles).

For core learning areas greater than 20,000 ft^3 and/or spaces designated as ICWS and SER, follow the performance method.

EQ P15.0.2 *Criteria for Background Noise*

In Core Learning Spaces and in spaces designated as ICWS and SER, the total background noise from the combination of building HVAC systems and exterior noise shall not exceed 40 dBA.

- The metric for HVAC and exterior noise shall be the Equivalent Sound Level (L_{eq}).
- For exterior noise sources, the maximum hourly L_{eq} during instructional hours shall be used.

Acoustical modeling or measurement shall be conducted to determine the interior sound levels from exterior sources.

- For HVAC noise, the L_{eq} when the HVAC system is in operation continuously shall be used. Acoustical calculation or measurement shall be conducted to determine the interior sound levels from HVAC.
- The total background noise level shall be defined as the energy sum of the maximum hourly L_{eq} from exterior sources and the HVAC system noise L_{eq}.

For background noise requirements, Section 5.2.3 of ANSI/ASA Standard S12.60-2010/Part1 does not apply. Sections 5.2.2.2 and 5.2.4 of ANSI/ASA Standard S12.60-2010/Part1 apply.

EQ P15.0.3 *Criteria for Sound Isolation*

1. *Outdoor-to-Indoor Attenuation of Airborne Sound:* Refer to background noise criteria.
2. *Indoor-to-Indoor Attenuation of Airborne Sound:*
   a. Wall and floor-ceiling assemblies shall be designed to achieve the minimum STC ratings specified in Table EQ15-1.
   b. The STC rating requirements of Table EQ15-1 also shall apply to the design of temporary full-height partitions that subdivide a learning space into smaller enclosed areas. The ratings in Table 6 apply to wall construction only.
   c. Design according to Section 5.4.2.2 of ANSI/ASA Standard S12.60-2010/Part1.
   d. Table EQ15-1 requirements do not apply to toilets opening only into the receiving space and used only by occupants of the receiving space.
   e. In any wall between a classroom and a public restroom, no plumbing shall be rigidly attached to the classroom wall framing. The wall assembly shall not contain large penetrations such as for restroom supply dispensers or disposals and shall not support rigidly attached electric hand dryer devices.
   f. The isolation between mechanical equipment rooms and Core Learning Spaces, ICWSs or SERs shall have a STC rating of 60 or greater unless it is shown that the sound level in the mechanical equipment room combined with a lower STC rating can achieve the required background noise level from building services in the core learning space. In no case shall the design STC between such spaces be less than 45.
   g. Operable partitions shall have same minimum STC rating as the wall they replace.
   h. Interior glazing in walls with STC ratings of 40 or higher shall have the same minimum STC requirement as the wall.
   i. Doors shall be selected to achieve the minimum requirements specified in Table EQ15-2.
   j. A minimum sound rating is not required for doors between classrooms and corridors. The absence of such requirement assumes that noise generated by corridor traffic can be controlled administratively by school staff.
   k. Vestibules functioning as a sound lock may be provided as an alternate to sound-rated door assemblies.

Table EQ15-1 - Minimum STC Ratings for Wall and Floor-Ceiling Assemblies

Source Room	Receiving Room	Minimum STC Rating
Classroom, ICWS, SER	Classroom, ICWS, SER	43
Public Restrooms	Classroom, ICWS, SER	53
Corridor	Classroom, ICWS, SER	38
Staircase	Classroom, ICWS, SER	40
Mechanical Equipment Room	Classroom, ICWS, SER	60
Administration Office	Classroom, ICWS, SER	40
Conference Room	Classroom, ICWS, SER	50
PAS	Classroom, ICWS, SER	60
LAS	Classroom, ICWS, SER	60
CSPR	Classroom, ICWS, SER	53

Table EQ15-2 - Minimum STC Ratings for Doors

Source Room	Receiving Room	Minimum STC Rating
Classroom, SER	Classroom, SER	40
Conference Room	Classroom, ICWS, SER	45
PAC, APS	Classroom, ICWS, SER	40
CSPR	Classroom, ICWS, SER	45
ICWS	Classroom, SER	35
CSPR	Any other space	35

3. *Isolation from Structure-Borne Sound:*

   Design according to Section 5.4.3 of ANSI/ASA Standard S12.60-2010/Part1, with the exception that carpeting is allowed to contribute to the assembly IIC rating when used as a permanent finish.

EQ P15.0.4 *Criteria for Classroom Audio Distribution Systems*

Where installed, design according to Section 5.5 of ANSI/ASA Standard S12.60-2010/Part1.

EQ C15.1 ENHANCED ACOUSTICAL PERFORMANCE

CREDIT

1-5 points

APPLICABILITY: All projects.

VERIFICATION: Design Review, Construction Review

SCORING: 1 point for 15.1.1 and/or 2 points for 15.1.2 and/or 2 point for 15.1.3

EQ C15.1 REQUIREMENTS

EQ C15.1.1 *Reverberation Time*

1 point

In spaces designated as PAS, APS, and LAS, the ideal reverberation times depend on the specific program for each space. The design team shall submit a narrative stating the Basis of Design for reverberation. (1 point)

EQ C15.1.2 *Background Noise*

2 points

In Core Learning Spaces and in spaces designated as ICWS, SER and CSPR, the total background noise from the combination of building HVAC systems and exterior noise shall not exceed 35 dBA.

In Ancillary Learning Spaces and in spaces designated as LAS, the total background noise from the combination of building HVAC systems and exterior noise shall not exceed 40 dBA.

In spaces designated as PAS and APS, the ideal background noise levels depend on the specific program for each space. The design team shall submit a narrative stating the Basis of Design for background noise levels for each of these spaces and calculations showing achievement of such Basis of Design. (2 points)

EQ C15.1.3 *Noise Isolation*

2 points

Wall and floor-ceiling assemblies shall be upgraded to achieve the minimum STC ratings specified in Table EQ15-3. Doors shall be upgraded to achieve the minimum requirements specified in Table EQ15-4. (2 point)

Table EQ15-3 - Minimum STC Ratings for Wall and Floor-Ceiling Assemblies

Source Room	Receiving Room	Minimum STC Rating
Classroom, ICWS, SER	Classroom, ICWS, SER	48
CSPR	Classroom, ICWS, SER	48

Table EQ15-4 - Minimum STC Ratings for Doors

Source Room	Receiving Room	Minimum STC Rating
Classroom, SER	Classroom, SER	45
ICWS	Classroom, SER	40

EQ P15.0-C15.1 IMPLEMENTATION

General Guidance

Additional specific implementation steps are included under Documentation.

The acoustical testing agency shall have a minimum of ten (10) years' experience conducting architectural acoustical measurements in accordance with the applicable standards. The testing agent shall have a Bachelor's or higher degree in acoustics, physics, or engineering and a minimum of five (5) years' experience completing architectural acoustical measurements.

Consider employing a testing agency that is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) or equivalent organization for the applicable test method.

EQ P15.0.1 & C15.1.1 *Reverberation Time*

Design guidelines for controlling sound reverberation are available in Annex C of ANSI/ASA Standard S12.60-2010/Part1. Verification of conformance to reverberation time requirements is required for rooms utilizing the performance method only. Measurements shall be conducted according to ISO 3382-2:2008, utilizing the Survey method.

The acoustical testing agent shall select the classrooms to be tested. One classroom per classroom group shall be tested.

A measurement result is considered compliant when it does not exceed the required value by more than 10%, which is the nominal accuracy to be expected when applying the Survey method of the ISO 3382-2:2008 Standards. Octave-band measurement results shall be provided in the 500 Hz, 1,000 Hz and 2,000 Hz bands. Each band is required to comply with the criteria.

Measurements shall be conducted when construction in the space being measured is complete. Rooms may be measured with or without furnishings in place and shall be unoccupied.

EQ P15.0.2 C15.1.2 *Background Noise*

Design guidelines for controlling background noise and vibration are available in the 2007 (or most recent version) HVAC Applications ASHRAE Handbook, Chapter 47 on Sound and Vibration Control.

- Interior background noise levels due to building HVAC and exterior noise shall be measured in a sampling of spaces.
- Interior background noise levels due to building HVAC and exterior noise may be measured simultaneously or sequentially in a sampling of spaces.
- When measured sequentially, the total background noise level shall be defined as the sum of the maximum hourly L_{eq} from exterior sources and the maximum L_{eq} when the HVAC system is in operation continuously.
- A measurement result is considered compliant if it does not exceed the criteria, when rounded to the nearest whole decibel. When measurements of building HVAC and exterior noise are completed sequentially, their results shall be summed using the energy method before rounding and comparing to the criteria.

- When measurements are conducted simultaneously, the timing of the measurement shall be chosen so that both sources simultaneously represent the worst-case condition at the time of the measurement (i.e. maximum L_{eq} for HVAC and maximum hourly L_{eq} for exterior noise).

Exterior Noise:

- For any rooms/facades where the maximum exterior hourly L_{eq} is less than or equal to 57 dBA, a verification measurement of exterior-to-interior noise is not required.
- Exterior noise within classrooms shall be verified in sufficient rooms to document compliance with the background noise criteria at all facades.
- Only the criteria that apply to the specific project are required to be measured.
- The acoustical testing agency shall submit a narrative describing the verification measurement paradigm and results. The acoustical testing agency shall provide a statement of engineering judgment regarding the sufficiency of the surveyed rooms to verify compliance across the entire building.
- The length of each measurement and the sound level measurement metric shall be determined by the acoustical testing agency and shall be appropriate to document compliance with the criteria.
- Ideally, the verification measurement should be performed at the time of occurrence of the maximum exterior hourly L_{eq}. However, the acoustical testing agency may use the results of the exterior noise evaluation to adjust/offset verification measurement results to accommodate for changes in weekday or time of day.

Building HVAC:

- HVAC noise within classrooms shall be verified in sufficient rooms to document or infer compliance with criteria.
- Only the criteria that apply to the specific project are required to be measured.
- The acoustical testing agency shall submit a narrative describing the verification measurement paradigm and results. The acoustical testing agency shall provide a statement of engineering judgment regarding the sufficiency of the surveyed rooms to verify compliance across the entire building.
- The length of each measurement and the sound level measurement metric shall be determined by the acoustical testing agency and shall be appropriate to document compliance with the criteria.
- The building HVAC system shall be in operation during the entire length of each the measurement to document compliance. Any measurement with HVAC system cycling on/off will not be accepted.

EQ P15.0.4 *Audio System*

A classroom that meets the reverberation time and dBA requirements set for in this criterion should not require enhanced classroom audio systems. However, there may be circumstances, such as the health of the teacher that may require sound amplification. If installing sound amplification systems, consider the new levels of noise that may be transmitted between classroom walls, ceilings and floors and necessary improvements or upgrades to ensure the noise does not affect neighboring classes. Also consider the maintenance and user training of such systems. Improperly maintained systems can lead to poorer speech communication between teacher and student than without the system.

EQ P15.0-C15.1 DOCUMENTATION

DESIGN REVIEW

EQ P15.0.1 & C15.0.1 *Reverberation Time Requirements*

Performance Method:

1. Provide narrative(s), as applicable, for selection of design criteria.
2. Provide calculations showing compliance with the reverberation time requirements for each classroom group.

Prescriptive Method:

1. Provide acoustical test reports for specified ceiling finishes.
2. Provide drawings and specifications as necessary to verify compliance with minimum surface area requirement.

EQ P15.0.2 & C15.1.2 *Background Noise Requirements*

1. Provide a statement that the design will achieve the minimum requirements for background noise from building services, utilities, and exterior sources. Provide calculations and specification sections supporting the statement. Specifically:
2. Provide results of exterior noise measurements or exterior noise calculations showing the predicted maximum exterior hourly L_{eq} at all school facades during regular school hours. A narrative and site plan must be submitted.
    a. For facades where the maximum exterior hourly L_{eq} is less than or equal to 57 dBA, further analysis/documentation for exterior noise is not required.
    b. For facades where the maximum exterior hourly L_{eq} is greater than 57 dBA:
        - Provide analysis and supporting documentation, such as laboratory test reports with sound transmission loss (TL) values, showing the required exterior building shell construction to meet the required level indoors (i.e., exterior wall construction and minimum window/door STC ratings).
        - Provide calculation results for the expected interior noise levels due to exterior noise sources.
3. Provide results of HVAC noise measurements or HVAC noise model calculations showing the predicted interior HVAC noise levels when all HVAC systems are operating under anticipated conditions. Heating and cooling modes shall be submitted separated for systems that provide both operational modes.

EQ P15.0.3 & C15.1.3 *Noise Isolation Requirements*

Indoor-to-Indoor Attenuation of Airborne Sound

1. Provide documentation of compliance with the requirements of Table EQ15-1. Provide independent laboratory test reports showing the specified interior wall construction's STC rating.
2. Provide documentation of compliance with the requirements of Table EQ15-2. Provide independent laboratory test reports showing the specified door's STC rating. Such minimum specified sound ratings shall be for door/door hardware/ door frame systems and not for door panels alone.

3. Where vestibules are included as an alternate for a sound-rated door, design team shall submit a narrative regarding vestibule design compliance with sound isolation requirement at door.

Structure-Borne Impact Sound Isolation

Provide documentation of conformance to the IIC requirements of Section 5.4.3 of ANSI/ASA Standard S12.60-2010/Part1.

CONSTRUCTION REVIEW

EQ P15.0.1 & C15.0.1 *Reverberation Time Requirements*

Performance Method:

1. Submit evidence for qualification of the acoustical testing agency to perform Construction Review verification services.
2. Submit a narrative from the acoustical testing agency describing the verification measurement paradigm and results.

Prescriptive method:

Provide construction submittals, shop drawings and acoustical test reports for acoustical products demonstrating compliance with design requirements.

EQ P15.0.1 & C15.1.1 *Background Noise Requirements*

1. Submit evidence for qualification of the acoustical testing agency to perform Construction Review verification services.
2. Submit a narrative from the acoustical testing agency describing the verification measurement paradigm and results. The testing agency shall provide a statement of engineering judgment regarding the sufficiency of the surveyed rooms to represent compliance across the entire building, for both HVAC noise and exterior noise.

EQ P15.0.3 & C15.1.3 *Noise Isolation Requirements*

A report from the acoustical testing agency covering the following:

Indoor-to-Indoor Attenuation of Airborne Sound:

1. Wall and Floor-Ceiling Assemblies: A minimum of one of each of the following partition types shall be tested for airborne sound attenuation. If there are multiple assemblies used for a single adjacency type within the project, measurement of more assemblies may be required.
   - Classroom/classroom wall
   - Classroom/public restroom wall
   - Classroom/classroom floor-ceiling assembly
2. The acoustical testing agency shall select the specific partitions to be tested. The verification shall be performed in accordance with ASTM standard E336-09. The measured NIC shall not be more than 3 points below the laboratory STC rating criteria to be considered compliant.
3. Operable Partitions: Verification of airborne sound attenuation field performance (NIC) is required for all operable partitions. The verification shall be performed in

accordance with ASTM standard E336-09. The NIC shall not be more than 5 points below the laboratory STC criteria to be considered compliant.

4. Doors: Verification of airborne sound attenuation field performance (NIC) is required for all classroom partitions that include doors for which there is a requirement for minimum STC rating. The verification shall be performed in accordance With ASTM standard E336-09. The NIC shall be not be more than 3 points below the required minimum laboratory STC rating criteria of the door to be considered compliant.

Structure-Borne Impact Sound Isolation:

Verification of conformance to the structure-borne impact sound isolation requirements shall be conducted according to Section A.3.2 of ANSI/ASA Standard S12.60-2010/Part1, except that the metric used shall be ISR. The resultant ISR shall not be more than 5 points below the required minimum IIC rating criteria to be considered compliant. The verification shall be conducted in the same room(s) for which the airborne floor-ceiling sound attenuation is verified.

EQ P15.0-C15.1 RESOURCES

1. National Clearinghouse for Educational Facilities: www.edfacilities.org/
2. Acoustical Society of America: asa.aip.org/
3. American National Standards Institute: www.ansi.org/
4. American Speech-Language-Hearing Association: www.asha.org

ENERGY (EE)

EE P1.0 ENERGY EFFICIENT DESIGN
EE C1.1 SUPERIOR ENERGY EFFICIENT DESIGN & ZERO NET ENERGY

Operating dollars are precious to schools. Clean air and a clean environment are precious too. High performance schools incorporate energy efficient design features, equipment, and systems to save money on operating costs and reduce the environmental impact of using fossil fuels, including the emission of atmospheric and land-based pollutants. Superior performing schools incorporate renewable energy resources and strive to become zero net energy buildings.

Intent

Minimize environmental impacts and operational costs associated with consuming energy and encourage the school to produce as much energy as it consumes on an annual basis.

Extra points are available for schools that are designed to achieve zero net energy or are designed to be capable of achieving zero net energy without building modification.

EE P1.0 ENERGY EFFICIENT DESIGN

PREREQUISITE

5 points

APPLICABILITY: All Projects

VERIFICATION: Design Review

SCORING: 5 points total for either Prescriptive or Performance Compliance.

EE P1.0 REQUIREMENTS

Projects shall design for energy efficiency and greenhouse gas emissions reduction by demonstrating compliance with one of the following:

Prescriptive Compliance Options

1. The prescriptive requirements of ASHRAE Standard 90.1-2016
2. The prescriptive requirements of the 2018 edition of the *International Energy Conservation Code* (IECC)
3. The base requirements of Tier 2 of the *Advanced Buildings New Construction Guide* from the New Buildings Institute (NBI).
4. The 50% ASHRAE *Advanced Energy Design Guide* for Schools

Performance Compliance Options

1. Demonstrate the project's energy performance is more efficient on a source energy basis than the Budget Building Design, using the procedures in ASHRAE Standard 90.1-2016, Appendix G.
2. Achieve an ENERGY STAR score of at least 75 using Target Finder or Portfolio Manager. This option may be used with any baseline, but additional points in C1.1 are not available without modeling against ASHRAE 90.1-2016 or following zEPI.

EE P1.0 IMPLEMENTATION

Performance Compliance - ASHRAE Option

On a new site or campus, designs for a single new building shall comply on a whole-building basis, and designs for multiple new buildings shall comply based on the entire campus.

On an existing site, designs for a single new building shall comply on a whole-building basis. Multiple new buildings may comply on a whole-building or combined basis, depending on scope.

For renovation/modernization or additions, projects may comply either on the basis of the whole building or the scope of work. Projects that include a mix of new construction and renovation may calculate the performance on a combined basis or on a separate basis, depending on the nature of the scope.

For multiple buildings where each building has its own model, combined efficiency shall be calculated as a weighted average:

Weight of Building n
= % area of n (decimal) = area n / total area

Combined Savings
= (savings 1*weight 1)+(savings 2*weight 2)+(savings 3*weight 3)+…*100

Energy Metric

The baseline and proposed site energy predicted from the energy model simulations and renewable energy system designs shall be converted to source energy using the Source Energy Conversion factors from Table EE1-1 below. Note that the procedures in the 90.1-2016 PRM require the use of energy cost as the metric, but for CHPS purposes, source energy is required.

Table EE1-1: Source Energy Multipliers [1]

Energy Type	Source Energy Conversion
Electricity (Grid Purchased)	2.8
Exported Electricity (exported On-Site renewable)	1.00
Natural Gas	1.05
Fuel Oil	1.01
Propane & Liquid Propane	1.01
Steam	1.20
Hot Water	1.20
Chilled Water	0.91
Wood	1.00
Coal/Coke	1.00

Other	1.00

The source energy conversion factors in the table are used in the ENERGY STAR Portfolio Manager and Target Finder tools; updated August 2018. [1]

To determine source energy generally, multiply the energy consumed on site for each energy type by its source energy conversion factor. Then add together all of the source energy conversions.

For example, if 100 kBtu of electricity from the grid is used in a month. The grid electricity would use a conversion factor of 2.8 and the calculation would be:

$$100 \text{ kBtu Grid Electricity} \times 2.8 = 280 \text{ kBtu Source}$$

Consider that the example school also consumes 100.0 kBtu of natural gas. The conversion factor for natural gas is 1.05, so the calculation would be:

$$100 \text{ kBtu Grid Electricity} \times 2.8 + 100 \text{ kBtu Natural Gas x } 1.05 = \text{Total Source Energy}$$

If natural gas and electricity are the only two energy types used at the school, its total source energy would be:

$$\mathbf{280} \text{ Source kBtu Grid Electricity} + \mathbf{105} \text{ Source kBtu Natural Gas} = \mathbf{385} \text{ Total Source kBtu}$$

If the school also includes renewable energy, the total electricity consumed will need to be divided between the onsite renewable electricity consumed and the grid electricity consumed since they have different source conversion factors. For a modeled building, this would mean calculating the total production capacity of the renewable energy system and subtracting it from the total electricity consumption calculated by the building energy simulation to find the grid electricity consumed.

Take for example a school design whose energy model shows 100 kBtu total electricity consumption, and whose renewable energy system will produce 80 kBTU. 80 kBtu of the total electricity consumption will be renewable electricity and the remaining 20 kBtu would be grid electricity consumption. So, the calculation would be:

80 kBtu Renewable Electricity × 1.0 + 20 kBtu Grid Electricity x 2.8 = Total Source Energy

$$\mathbf{80} \text{ Source kBtu Renewable Electricity} + \mathbf{56} \text{ Source kBtu Grid Electricity}$$

$$= \mathbf{136} \text{ Total Source kBtu}$$

If a school has excess renewable energy production, then that can be used to offset the source energy of other sources. So, if a school has 100 kBtu of electricity consumption, 20 kBtu of natural gas consumption, and 120 kBtu of renewable electricity production, the calculation would be:

$$100 \text{ kBtu Renewable Energy Consumption x } 1.0 + 20 \text{ kBtu Natural Gas Consumption x } 1.05 - 20 \text{ kBtu excess renewable energy } \mathbf{production} = \text{Total Source Energy}$$

$$\mathbf{100} \text{ Source kBtu Renewable Electricity} + \mathbf{21} \text{ Source kBtu Natural Gas} - \mathbf{20} \text{ kBtu Source Renewable Electricity} = \mathbf{101} \text{ Total Source kBtu}$$

Renewable energy and natural gas do not have the same conversion factors, so the excess renewable energy production does not completely offset the source value of the same quantity on on-site natural gas consumption.

Non-Regulated Energy Use:

Under this criterion, school districts may use the procedures documented in the COMNET MGP to take credit for reductions in plug load and other components of energy use that are not regulated by Standard 90.1-2016. The magnitude of the credit depends on the length

of the commitment, per COMNET procedures.

Naturally Ventilated Spaces:

School districts in appropriate climates are encouraged to design classrooms and other school spaces to use natural ventilation to control overheating of the spaces. Credit for natural ventilation is offered through the COMNET modeling rules when the school has fewer than 300 unmet cooling load hours.

Naturally Ventilated Spaces as referenced in this section are not intended to be for control of contaminants in the spaces.

Building Schedules:

Building daily operating schedules and annual operating schedules (e.g. number of vacation days) should match the actual expected schedule. Schools typically operate on very different schedules than other building stock and this should be accounted for in the energy modeling.

Performance Compliance – ENERGY STAR Option

Once minimum code compliance is established, obtain an ENERGY STAR 1–100 design score from EPA's Target Finder or Portfolio Manager online tools. The inputs to receive a score for the estimated energy use shall account for all energy associated for the school's assets, intended operations, including all process and non-process loads as well as building use characteristics. The project must create a Statement of Energy Design Intent (SEDI) and through this attain an ENERGY STAR score of at least 75. The score can also be used to establish the baseline for energy performance benchmarking in OM P3.0. Other metrics from the SEDI report from Target Finder/Portfolio Manager can be used toward baselines and monitoring too, including the GHG emissions in II C5.1 Low/Zero GHG School and water savings in OM P3.0.

For multiple buildings in a project scope, each building must achieve an ENERGY STAR score of at least 75.

Note: If a design project is saved in Portfolio Manager, the same project record can be used to add metered energy data to meet OM P3.0. The tool will show a comparison of design and operating energy data for the school.

EE C1.1 SUPERIOR ENERGY EFFICIENT DESIGN & ZERO NET ENERGY

CREDIT

1-34 points

APPLICABILITY: All projects.

VERIFICATION: Design Review

SCORING: 1-30 points for 1.1.1 (see tables below) and 1 or 4 points for 1.1.2

RELATED CRITERIA: all of EE, OM C7.1 Green Power, II C8.1 Innovation, II C6.1 and C7.1 for low GHG and climate resiliency

EE C1.1 REQUIREMENTS

EE C1.1.1 *Superior Energy Efficient Design*

For overall energy performance, achieve energy reductions beyond the energy pre-requisite. Additional requirements are listed below.

Performance Compliance Option

Energy reductions shall be calculated utilizing the protocol from EE P1.0 and this section. Points are awarded as shown in the table in accordance with the following equation for percentage improvement or a zEPI score.

$$\text{Percentage Improvement} = \frac{\sum \text{Baseline Buildings Source Energy} - \sum \text{Proposed Buildings Source Energy}}{\sum \text{Baseline Buildings Source Energy}}$$

Points	Percentage Improvement	Optional zEPI Equivalent [9]
1	2%	51
2	4%	50
3	6%	49
10	20%	42
15	30%	37
20	40%	31
25	50%	26
30	>=60%	21

Interpolation between the values in the above table is permitted.

Prescriptive Compliance Options

Projects may demonstrate energy reductions by complying with the requirements of the *Advanced Buildings New Construction Guide* from the New Buildings Institute (NBI). Points shall be awarded according to the following table:

Points	Requirement	Optional zEPI Equivalent
1	Base requirements of Tier 2	51
2	Tier 2 + Criterion 2.18: Enhanced Envelope	50

3	Tier 2 + Criteria 3.2: Advanced Envelope	49
7	Tier 2 + Criteria 3.6: Variable Capacity Heat Pump (VRF)	46

EE C1.1.2 *Zero Net Energy*

For 1-or 4 additional points, design the building to produce as much renewable energy as it consumes per year. There are two options:

1 point *Zero Net Energy Capable*

For schools that aspire to achieve zero net energy at a future date, design the building with a low enough energy usage metric that it could be 100% powered by on-site renewable systems and include features that make it ready to add the renewable systems without modification.

4 points *Zero Net Energy*

For schools that will install renewable systems as part of the project scope, show through the energy modeling required for EE P1.0 that on-site renewable energy systems produce as much energy on an annual basis as is used by the sum of all the building systems. Alternatives to on-site systems, such as renewable district energy or microgrid, will be considered case-by-case. Purchase of green power from the grid does not count as zero net energy.

EE C1.1 IMPLEMENTATION

There are significant opportunities to reduce energy use beyond the prerequisite level. Providing a more energy efficient building saves money for the school district, reduces environmental impacts and has a number of other long-term benefits. Up to 30 additional points are offered for schools designed to exceed the prerequisite level.

Performance Modeling Path

Demonstrating compliance with this criterion requires energy modeling following the procedures of ASHRAE/IES Standard 90.1-2016 Energy Standard for Buildings Except Low-Rise Residential Buildings Appendix G and Criterion EE P1.0.

zEPI Option

Projects may optionally establish their zEPI rating in lieu of performance above ASHRAE 90.1. There is a direct correlation between ASHRAE 90.1-2016 performance and the zEPI scale. zEPI provides a more stable scale that will not vary with future code updates. zEPI scores must be calculated using source energy values.

More information about zEPI and the conversion process can be found in *Rethinking Percent Savings – The Problem with Percent Savings* and *zEPI: The New Scale for a Net Zero Energy Future* by Eley et al., see Resources. [9]

Projects that do not pursue the zEPI option may still find the zEPI conversion chart above useful for comparing future projects that use a baseline that differs from ASHRAE 90.1-2016.

On-Site Renewables:

On-site renewable energy sources may be used to offset the consumption of non-renewable fuels and contribute to superior energy performance.

Similarly, the use of community renewable energy systems is allowed if both of the following requirements are met:

- The school district owns the system or has signed a lease agreement for a period of at least 10 years
- The system is located within the same utility service area as the facility claiming the use

Renewable Energy Sources include:

- Photovoltaics
- On-site wind
- On-site hydropower
- On-site Geothermal
- On-site Solar Thermal

Source Net Energy Calculations for Zero Energy Buildings having Mixed Energy Types with On-Site Renewables:

If the school were to produce electricity on site, the site production will first offset what is consumed as electricity. If the production is greater than the on-site consumption it would then count as exported energy and could offset other energy consumption on site, like natural gas.

Consider the first case, a school that produces less electricity than it uses:

The school uses 100 kBtu of natural gas, 100 kBtu of electricity, and produces 80 kBtu of electricity from a photovoltaic system. Using the example above, the annual source energy balance would be:

$$(\mathbf{100}\ \text{kBtu N.G.}) \times 1.05 + (\mathbf{100}\ \text{kBtu Electricity Consumed} - \mathbf{80}\ \text{kBtu Produced}) \times 2.8 = \mathbf{161}\ \text{kBtu Source}$$

Consider the second case, a school that produces more electricity on site than it uses:

The school uses 100 kBtu of natural gas, 100 kBtu of electricity, and produces 120 kBtu of electricity from a Photovoltaic System:

$$(\mathbf{100}\ \text{kBtu N.G.}) \times 1.05 + (\mathbf{100}\ \text{kBtu Consumed} - \mathbf{100}\ \text{kBtu Produced}) \times 2.8 - (\mathbf{20}\ \text{kBtu Exported}) \times 1 = \mathbf{85}\ \text{kBtu Source}$$

EE C1.1.2 *Zero Net Energy*

Energy modeling using the procedures specified in EE P1.0 and above shall be used to demonstrate this criterion. Full zero net energy schools are eligible for an additional point in II C8.1 Innovation.

Zero Net Energy Capable

When demonstrating compliance with this criterion, the location of planned renewable systems shall be identified on the site or building and modeled using typical performance characteristics.

Examples of features that make a building zero energy capable:

- Roof can accommodate additional weight of a PV system.
- There is sufficient area to accommodate the PV needed; a rule-of-thumb is to plan for generation of 110% of energy usage to cover contingencies.
- No additional roof or wall penetrations will be needed for electrical wiring.
- Electrical or mechanical rooms are sufficient to accommodate the inverter(s) and other electrical system components.

Boundary for Determining Zero Net-Energy:

In determining whether a school is zero net energy or capable of zero net energy, only renewable energy sources located on the school site shall be considered with the exception that if the project is designing for resiliency in II C7.1, off-site renewable systems will be allowed. Biomass and liquid biofuels are not renewable energy sources.

Zero-Code Calculator:

The Zero-Code (zero-code.org) calculator can be used to demonstrate compliance. [11]

EE P1.0-C1.2 DOCUMENTATION

DESIGN REVIEW

EE P1.0

Prescriptive Path

Provide a narrative from the design team identifying the option used and how the design complies with each of the prescriptive requirements. The narrative must be stamped by a design professional.

Performance Path

Provide a short narrative identifying the energy efficient performance target and a description of the building systems and features that accomplish this target or a set of construction documents showing all energy efficiency features and equipment used.

Then:

- For the ASHRAE option, provide the summary report from the model used, such as the certificate of compliance, as a pdf. If needed to confirm compliance, the entire energy model may be requested. Make this file available as needed.
- For the ENERGY STAR option, provide a Statement of Energy Design Intent (SEDI) report from Target Finder; or create an account in Portfolio Manager and save and print the SEDI to document the ENERGY STAR design score. If needed to confirm compliance, backup documentation, such as the inputs and baseline may be requested.

EE C1.1.1

For projects that follow the performance path, the summary report used in EE P1.0 covers the requirement, if used. If the ENERGY STAR option was used in EE P1.0, then submit a copy of the summary report from the modeling software as described above for documentation in the prerequisite.

For projects that follow the prescriptive path, provide a narrative describing the additional measures taken per the table.

For projects using the zEPI scale, provide documentation showing the calculations.

EE C1.1.2 Provide output reports from the energy model simulation showing the predicted annual energy consumption of the proposed building. Include both the utility consumption (kwh and therms) and the overall energy consumption (BTUs). Provide a report showing both the site and source energy consumption. Provide a narrative that clearly outlines all deviations from the standard compliance model and the justification for such deviations. Provide a projection of the annual energy generation of the renewable energy systems.

CONSTRUCTION REVIEW

N/A

EE P1.0-C1.1 RESOURCES

1. 2015 International Energy Conservation Code® published jointly by ICC and ASHRAE:
2. ANSI/ASHRAE/IES Standard 90.1-2016 Energy Standard for Buildings Except Low-Rise Residential Buildings
3. ENERGY STAR: www.energystar.gov/
4. EPA ‘s energy performance tools for calculating the 1 -100 ENERGY STAR score
   - Target Finder: https://www.energystar.gov/buildings/service-providers/design/step-step-process/evaluate-target/epa%E2%80%99s-target-finder-calculator?s=mega
   - Portfolio Manager: https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager?s=mega
5. The Consortium for Energy Efficiency (CEE) provides information on high performance equipment: www.cee1.org
6. The ASHRAE Advanced Energy Design Guide for K-12 School Buildings: www.ashrae.org/publications/page/1604
7. Commercial Energy Services Network (COMNET)
8. Renewable Energy Rebates: www.dsireusa.org/
9. The Problem with Percent Savings and zEPI: The New Scale for a Net Zero Energy Future by Eley et al. http://www.eley.com/sites/default/files/pdfs/ASHRAE-D-ML-11-029-20110922.pdf
10. NREL 2007. Assessment of the Technical Potential for Achieving New Zero-Energy Buildings in the Commercial Sector, B. Griffith, N. Long, P. Torcellini, and R. Judkoff, NREL/TP-550-41957, December 2007: www.nrel.gov/docs/fy08osti/41957.pdf
11. Zero-Code Calculator: https://zero-code.org/ENERGY%20CALCULATOR/

EE P2.0 COMMISSIONING
EE C2.1 ENHANCED COMMISSIONING

Commissioning is vitally important to the performance of the school and is the key to achieving and maintaining energy efficiency. Commissioning involves a rigorous quality assurance program that ensures the building and its systems are built and operated as designed and that the school district receives the proper training and documentation needed to operate and maintain the building. No building can perform optimally without adequate maintenance.

Intent

Verify that building elements and systems are designed, installed, and calibrated to operate as intended, and provide for the ongoing accountability and optimization of building energy performance over time.

Buildings, even simple structures, are complex systems of electrical, mechanical, and structural components. High performance buildings are healthy, efficient, environmentally sensitive structures whose performance can be significantly affected if the building has not been designed following the owner's project requirements or constructed according to the designers' specifications.

Commissioning is a rigorous quality assurance program administered by a knowledgeable third party that ensures the building performs as expected.

EE P2.0 COMMISSIONING

PREREQUISITE

4 points

APPLICABILITY: All projects.

VERIFICATION: Design Review, Construction Review

RELATED CRITERIA: OM P1.0 Occupant Training, WE C3.1 Irrigation Systems Commissioning

EE P2.0 REQUIREMENTS

This prerequisite requires a commissioning process to be in place early in the design process and carries through to the post-occupancy 10-month warranty review and subsequent completion of a commissioning report.

ALL of the fundamental best practice commissioning procedures must be implemented:

Engage an independent, third-party commissioning agent (CxA). The commissioning agent will be responsible for commissioning the following critical building systems [1]:

1. Electrical Systems
   - Lighting systems and lighting controls (daylight, occupancy, timing switches, etc.)
   - On-site renewable solar electric or wind systems
2. Mechanical Systems [2]
   - HVAC systems (such as hot water systems, chilled water systems, central air systems, ventilation systems)
   - Domestic hot water systems

- Energy management system
- Renewable energy heating systems

3. Plumbing Systems
   - Flow control devices
   - Pumping systems
   - Special hazardous waste treatment systems (e.g. for lab wastes)
   - Domestic hot water systems
   - Graywater systems (if applicable)

EE P2.0 The commissioning scope of services shall include:

- Review Owners Project Requirements (OPR) (formerly known as Design Intent. documentation) and Basis of Design (BOD) documentation.
- Conduct a focused review of the design prior to the Construction Documents (CDs) phase.
- Issue Design Review Comments and conduct [1] back check review prior to submitting Permit Set to the Building Department / AHJ.
- Review commissioning requirements for inclusion in the specifications / CDs.
- Develop and utilize a commissioning plan.
- Conduct a selective review of contractor submittals of commissioned equipment.
- Develop and track Pre-Functional Checklists (PFC) and pre-functional testing
- Review the Operations & Maintenance manual.
- Verify installation, functional performance testing (including off-season testing), training, and operations and maintenance documentation. A minimum 20% sampling strategy for testing terminal units and repetitive units is permissible. All major systems must be tested.
- Participate in training of facility, teaching, and admin staff in accordance with the training plan (OM P1.0).
- Complete a commissioning report.
- Conduct a 10-month, post occupancy warranty review.

EE C2.1 ENHANCED COMMISSIONING

CREDIT

1-3 points APPLICABILITY: All projects.

VERIFICATION: Design Review, Construction Review

SCORING: 1 point for 2.1.1; 2 points for 2.1.2

EE C2.1 REQUIREMENTS

This criterion is intended to allow project managers to think beyond the typical scope of a commissioning authority into other useful system testing, including building envelope commissioning, and to seek out a highly skilled professional commissioning agent.

EE C2.1.1 *Certified Commissioning Professional*

1 point The commissioning professional is third party ANSI certified with at least five years' experience in the state where s/he practices.

AND/OR

EE C2.1.2 *Building Envelope Commissioning*

2 points Commission the building envelope(s) using ASTM E2813, the National Institute of Building Sciences (NIBS) Guideline 3 or an equivalent approach.

EE P2.0-C2.1 IMPLEMENTATION

This full scope of commissioning applies to a new school. For major renovations/modernizations and a new building on an existing campus this commissioning scope is required based on the scope of the project. The scope of commissioning services for major renovations/modernizations will depend on whether the building envelope is being upgraded.

Qualifications of Commissioning Authority

The CxA should satisfy the qualifications of, and perform in accordance with, the Building Commissioning Association's (BCA) Essential Attributes of Building Commissioning. [3]

The CxA must have experience commissioning schools in accordance with this standard. The CxA may be a qualified employee of the school district. An additional point is available per EE C2.1.1 for hiring a CxA with professional certification/recognition.

Commissioning Scope

The following list describes each of the commissioning steps listed above in greater detail.

- Engage a commissioning agent. The commissioning agent (CxA) directs the commissioning process and should be hired in time for the design development phase. The commissioning services must be performed by an independent third party, i.e. not part of the design or construction management of the project. The CxA may be hired by the owner, the owner's project manager, or the design firm as long as the CxA is not an employee of the design firm and reports to both the school district and the design firm. Review design intent and basis of design documentation. The architect and the design engineer are the most appropriate people to create this document, which should list the owner's project requirements and design intent for each of the systems or features to be commissioned. The CxA will review this document, and a copy of the review shall be provided to the owner.
- Conduct a focused review of the design prior to the Construction Documents (CDs) phase. This review early in the design process should be focused on an assessment of how well the design meets the owner's design intent. Assessment should be made as to how the design meets the functionality, utility performance, maintainability, sustainability, cost, and indoor environmental quality requirements

outlined in the design intent. Evidence of the review is to be documented in the commissioning report.

- The Back Check Review should answer these questions:
    - Does the design meet the owner's design intent?
    - Does the design allow for proper maintenance access?
    - Do the construction documents clearly detail the construction requirements?
    - Do the construction documents clearly define the commissioning requirements?
- Include commissioning requirements in the CDs. All commissioning requirements must be integrated into the CDs to clearly specify the responsibilities and tasks to be performed. Of particular importance are the delineation of the contractors' responsibilities regarding documentation, functional performance testing, occupant and operator training, and the creation of the operations and maintenance manuals.
- Develop commissioning plan. The commissioning plan includes a list of all equipment and systems to be commissioned, delineation of roles for each of the primary commissioning participants, and details on the scope, timeline, and deliverables throughout the commissioning process.
- Conduct a selective review of contractor submittals and shop drawings related to the commissioned systems. Contractor submittals for the systems included in the commissioning scope shall be reviewed by the CxA in conjunction with the designer's review. The review shall focus on the ability of the submitted product to meet the owner's requirements and review comments shall be provided to the owner and the design team.
- Review Operations & Maintenance manual. The Contractor compiles the O&M Manuals prior to commencement of training and the CxA reviews them for completeness, organization and readability. [2]

The CxA shall review the O&M Manuals for the following items:

- As-built sequences of operations for all equipment as provided by the design professionals and contractors, including time-of-day schedules and schedule frequency, and detailed point listings with ranges and initial set points.
- Ongoing operating instructions for all energy- and water-saving features and strategies.
- Seasonal operational guidelines.
- Recommendations for recalibration frequency of sensors and actuators by type and use.
- Guidelines for continuous maintenance of the owner's project requirements (operational requirements) and basis of design (basis of operation).

- Verify Pre-Functional Testing The CxA shall provide the Contractor with the Pre-Functional Checklists (PFC) that include a list of items to inspect and elementary component tests to conduct to verify proper installation of equipment. PFCs are primarily static inspections and procedures to prepare the equipment or system for

initial operation. The CxA shall observe, at minimum, the startup procedures for each piece of primary equipment, unless there are multiple units, (in which case a sampling strategy may be used). Extent of CxA observation of Pre-Functional Testing will be at the discretion of the CxA, though spot checking of items on the lists will be performed prior to Functional Testing. PFC's are separate and in addition to the manufacturer's installation and start-up forms and shall be reviewed by the CxA and included in the Commissioning Report. Contractor shall certify that installation, prestart, and startup activities have been completed prior to commencing Functional Testing. Certification shall include completed PFC's, manufacturer installation and startup checklists and the final TAB report approved by the A/E.

- Functional Testing. The CxA shall develop the functional test procedures in a sequential written form, coordinate, oversee and document the actual testing. Functional Performance Tests (FPT) are performed after Prefunctional testing and startup are complete. FPT Test the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Systems shall be tested under various modes and run through all the control system's sequences of operation while components are verified to be responding as the sequences state. Checklists will be completed during the testing process, deficiencies will be added to the Commissioning Issues Log and each included in the Commissioning Report.
- Participate in training of facility, teaching, and admin staff in accordance with the training plan (OM P1.0). The CxA may be charged with reviewing the training plan, developed by the Construction Manager/General Contractor, for adequacy. The CxA may additionally be charged with participating in the training itself. This task is related to OM P1.0 Facility Staff & Occupant Training.
- Complete a commissioning report. The report must show that the building's systems have met the design intent and specifications, have been properly installed, are performing as expected, and that proper O&M documentation and training have been provided. The report should include a compilation of all commissioning documentation described in this criterion, including complete functional testing results and forms and should note any items that have not been resolved at the time the report is issued.
- Ten month warranty, post-occupancy review. The commissioning contract shall contain provisions for a 10-month warranty and post-occupancy review. The review is intended to bring the design, construction, commissioning, and facility staff together to solicit facility staff's comments, suggestions, and areas of concern regarding the systems in their first year of operation. Warranties on any commissioned systems should be reviewed and deficient equipment should be identified and a plan for resolution developed.

Testing Sampling Criteria

Contractors shall submit to the CxA documentation that they have performed installation and functional performance verification in accordance with the commissioning plan for all equipment components and systems. The functional performance test may be demonstrated to the CxA for a sample of systems that comply with all of the following criteria

- Equipment or systems have similar components and configurations. For component testing, sampling may apply where there are many identical component types with similar applications.

- The systems or equipment have identical sequences of operation, which are implemented using identical control software programming or firmware settings.
- The components and systems to be included in the demonstrated samples shall be chosen by the commissioning authority at the time of demonstration.
- Building Automation System mapping of component to the operators graphic shall be demonstrated for all components.
- The trend logging portions of all functional performance tests shall be completed for 100% of the systems or components.

Failure Testing

The Commissioning Plan must also identify retesting protocols for components and systems that fail initial testing

Cross-Category and Other Considerations

This prerequisite relates to all prerequisites and credits that involve operable building systems, including HVAC, windows, and room controls. Good training is critical for good operations, and good operations are critical for good building performance. The prerequisite also relates to the required Systems Maintenance Plan in OM C4.1. The operations & maintenance manual described here will be part of the plan, along with the inventory and schedule of maintenance.

It is recommended that the owner consider using the commissioning process and provider for additional services including acoustic testing and irrigation commissioning. Qualified commissioning authorities can provide quality control on a range of high performance school systems and strategies.

EE C2.1.1 *Certified Commissioning Professional*

An individual certified by an ANSI/ISO/IEC 17024:2012 accredited organization to lead, plan, coordinate and manage commissioning teams and implement commissioning processes. The individual's accredited certification required by the referenced standard provides a measured level of experience and competence with the various whole building commissioning processes and the ability to deliver quality service. Accredited organizations include, but are not limited to:

- AABC Commissioning Group (ACG) Certified Commissioning Agent ll: www.commissioning.org/
- ASHRAE CPMP (Commissioning Process Management Professional) certification: https://www.ashrae.org/professional-development/ashrae-certification/certification-types/bcxp-building-commissioning-professional-certification
- Building Commissioning Association (BCA) certification: www.bcccbonline.org
- Educational certification from University of Wisconsin: cx.engr.wisc.edu/
- NEBB Qualified Commissioning Administrator: www.nebb.org/certified/nebbs_certification_program/
- TABB Certified Commissioning: Supervisorhttps://www.icbcertified.org/site/certifications/index.php

EE C2.1.2 When commissioning the envelope, follow ASTM E2813, the National Institute of Building Sciences (NIBS) Guideline 3 or an equivalent method that at minimum includes drawing review, field inspection (construction checklist) and testing for thermal breaks and water leaks, as relevant to the climate. Testing should be done on a completed portion of the building in accordance with ASTM E1186, ASTM E1105, and AAMA 501.2.

EE P2.0-C2.1 DOCUMENTATION

DESIGN REVIEW

EE P2.0 Provide the project's commissioning specifications, commissioning plan and owners project requirements (OPR). Provide a copy of the commissioning agent's contract. CDs must include the project's commissioning specifications documenting that commissioning is required, at what stages and where the commissioning plan may be found for more information.

EE C2.1.1 Provide documentation showing the Commissioning Agent's ANSI certification and experience.

EE C2.1.2 Highlight in the commissioning specification where they require building envelope commissioning and identify NIBS Guidelines or equivalent.

CONSTRUCTION REVIEW

EE P2.0 Provide the final commissioning report.

EE C2.1.2 Provide final commissioning report including a summary of building envelope commissioning.

EE P2.0–C2.1 RESOURCES

1. ASHRAE Guideline 1.1-2007: HVAC&R Technical Requirements for The Commissioning Process: www.techstreet.com/ashrae/cgi-bin/detail?product_id=1573306
2. ASHRAE Guideline 4-2019: Preparation of Operations & Maintenance Documentation for Building Systems: https://www.techstreet.com/ashrae/standards/guideline-4-2019-preparation-of-operations-and-maintenance-documentation-for-hvac-r-systems?product_id=2033699
3. The Building Commissioning Association, Essential Attributes of Building Commissioning, April 2018: https://www.bcxa.org/membership/essential-attributes/
4. ASHRAE Standard 202-2013 The Commissioning Process: https://www.techstreet.com/ashrae/standards/ashrae-202-2013?gateway_code=ashrae&product_id=1862482
5. The National Clearinghouse for Educational Facilities includes a bibliography on commissioning: http://www.ncef.org/resource-lists/building-commissioning
6. National Institutes of Building Sciences, NIBS Guideline 3-2012, Building Enclosure Commissioning Process BECx: http://www.wbdg.org/FFC/NIBS/nibs_gl3.pdf
7. ASTM E2813-18: https://www.astm.org/Standards/E2813.htm

8. AAMA 501.2 from the Fenestration & Glazing Industry Alliance: https://pubstore.aamanet.org/pubstore/ProductResults.asp?cat=0&src=501.2

EE C3.1 ENERGY MANAGEMENT SYSTEMS & SUBMETERING

Energy Management Systems (EMS) are important systems for controlling, monitoring and understanding patterns of energy use in schools. Nowadays, an EMS or any number of equivalent systems are standard practice, and schools have choices among proprietary systems developed by the HVAC manufacturer or off-the-shelf products.

Intent

Provide a mechanism to assist school operators to monitor and control the building's energy systems remotely, make adjustments quickly and easily, and control costs.

EE C3.1 ENERGY MANAGEMENT SYSTEMS & SUBMETERING

CREDIT

3-9 points

APPLICABILITY: All Projects

VERIFICATION: Design Review

SCORING: 3 points each subcredit

RELATED CRITERIA: OM P1.0 Training, OM C4.1 Systems Maintenance Plan, EE P2.0 Commissioning, OM P3.0 Benchmarking

EE C3.1 REQUIREMENTS

EE C3.1.1 *Systems Control*

3 points

Install a base level Energy Management System (EMS) or equivalent Building Automation System (BAS) or Building Management System (BMS) to control the operating schedule of HVAC systems throughout the building including terminal units, packaged units, air handling units, make-up air units, centralized hydronic heating and cooling systems, pumps, and fans including fume hoods. Fractional horsepower fans, fractional horsepower pumps and units providing air conditioning to spaces requiring continuous 24/7 cooling such as computer server rooms, network equipment rooms, or walk-in refrigerators and freezers are excluded. The base level EMS shall provide the following energy saving features:

- Schedule unoccupied setback temperature control so that units can heat during unoccupied modes should the space temperature fall below the setback temperature. Setback temperature settings shall be no higher than 60 degrees F.
- Scheduled control of all ventilation outdoor air fans, exhaust fans and outdoor air dampers so that fans are turned off and dampers are closed during unoccupied periods.

- Zoning of systems so that major building areas (i.e. gymnasium, cafeteria, library, classrooms, and administrative offices) can be independently scheduled during non-school hours.
- An override system to temporarily change a unit or zone from unoccupied to occupied mode locally is permitted provided that it is timed and will automatically revert back to the normal operating schedule after no more than four hours. A local override switch that is not on a timer is not permitted. Ventilation outdoor air shall be set to occupied mode if the local override is used.

A centrally located scheduling interface shall be provided so that the operator can schedule the EMS operating mode for weekdays, weekends, and holidays. The scheduler shall be capable of independently scheduling each major building area or zone. If the facility management staff that sets the operating schedule is located at another site, the EMS shall have a web-based interface so that the schedule can be set remotely. Any system – including but not limited to Building Automation System or Building Management System – that includes the above features shall meet this requirement.

EE C3.1.2 *Automated Demand Management.*

3 points

Install an advanced energy management system (EMS) capable of supporting Automated Demand Management functions. System shall be capable of:

- Storing pre-programmed demand management control strategies for specific controlled equipment and/or systems that will, in a safe and controlled manner, increase or decrease electrical demand, (e. g., change cooling setpoints, turn equipment on or off, rotate loads to avoid simultaneous/stacked demand) when triggered.
- Store pre-conditions for triggering and releasing discrete demand control strategies, such as approaching user defined demand thresholds, applicable electricity pricing points, etc.
- Respond to external signals as triggers for implementing and releasing demand management control strategies such as a contracted demand response event. The facility shall either demonstrate compliance with Open ADR 2.0 or demonstrate similar functionality via automated triggers using other communications protocols.
- Support automated notification of a demand response event scheduled, threshold met, strategies scheduled for triggering, strategies executed and strategies released to normal control.
- Allow for remote access opt out or cancellation of any demand control strategy scheduled or currently in force.
- Allow for remote access user triggering of any demand control strategy not currently in force as well as scheduling triggering any demand control strategy for future triggering and release.
- Energy models should be used to determine appropriate setback temperatures during unoccupied hours.

EE C3.1.3 *Submetering/Data Acquisition and Storage*

3 points

Install a meter data acquisition and storage system for all electrical power used within the building. The system can use the main utility meter as a data source or an owner-supplied submeter provided that all electrical power used in the building is recorded. Data from the system shall at a minimum record and store every 1 minute and shall be available to the operator with no less than 1 hour of the time the energy was consumed. The system shall

include a user interface to trend and analyze stored data. Using the EMS, a separate stand-alone system, or a system provided by the local utility company are all acceptable provided that the system meets the requirements described herein. Provide metering at all panelboards.

EE C3.1 IMPLEMENTATION

EE C3.1.1 While energy management systems (EMS) are typically installed with new HVAC and heating systems, care must be taken to specify and install an appropriate system for the district and its maintenance staff. The best EMS for a district is the simplest system that still addresses the school's energy management needs. Increased complexity does not always mean increased value for the district.

Energy management systems can potentially save significant energy, but only if the staff understands how to operate them. With EMS installation, proper training of district staff is absolutely critical. The district must be prepared to budget for staff training and for training new staff when those knowledgeable about the EMS leave employment.

EE C3.1.2 The following are considered exempt from this criterion:

- Unit heaters, cabinet heaters, radiation and convectors located in vestibules, storage rooms, janitor closets, and other unoccupied areas.
- Natural gas and heating oil demand sensors are not required on buildings less than 50,000 ft^2.

Monitoring capabilities of the EMS should allow for comparison between various types of building loads throughout all spaces of the school. This information is valuable and can be used to manage and optimize energy use. By trending and monitoring the building operation, any deviation from the design operation can be identified and corrected before an impact on occupant comfort and energy performance of the building is created. Building performance can also be optimized by longer-term trending, observation of performance characteristics, and benchmarking performance against expected operation.

The EMS should include:

- Sensors to trend outdoor air temperature.
- Sensors to monitor and trend equipment status for all equipment with motors greater than ½ hp.
- Indication and trending of damper and valve commanded position.
- Sensors to monitor building electrical, natural gas, and heating oil demand and consumption.
- Sensors to monitor indoor and outdoor CO_2.
- Sensors to monitor and *trend* (create trend logs) controlled variables at the operator interface. Control variables may include air and/or water flow, temperature, pressure, CO_2, and pump or fan speed. Relevant multiplexed data from microprocessors located in chillers, boilers, humidifiers, VAV box controllers, variable speed drives, and other HVAC equipment with multiplexing capabilities may be used in lieu of specifying separate sensors.
- Wells and other ports shall be specified for the installation of calibration devices to facilitate calibration of sensors.

- Points Matrix: A points matrix including all hardwired input and output devices connected to the automation system, all set points, upper and lower control limits.
- Trend Capabilities: Trend requirements including a trend point list and preprogrammed sample of point (performed by controls contractor), sample rate, storage interval, upload interval, custom trend abilities, alarms, and automated trend data review and notification (automated diagnostics).
- System Architecture: A system architecture capable of allowing sampling of these points to facilitate building commissioning and diagnostics without significantly affecting system performance.
- Data Storage: A data storage system with adequate capacity to record trend data for use by building operators. Data export requirements must facilitate user-friendly data access and manipulation.
- Operator Interface: An operator interface designed for remote/web access, monitoring requirements, trend-log reporting and diagnosing building problems through a user-friendly interface. This includes providing a visual (non-text based) operations and reporting interface to facilitate rapid system assessment that utilizes color coding, diagrams of floor plans and graphing capabilities.

EE C3.1 DOCUMENTATION

DESIGN REVIEW

Reference the portions of the CDs that include the required Energy Management System features. CDs must include a System Architecture Diagram highlighting metering of all systems.

CONSTRUCTION REVIEW

N/A

EE C3.1 RESOURCES

1. *Advanced Buildings Benchmark Version 1.1*, by the New Buildings Institute, Inc. pp. 3839

EE C4.1 ADVANCED VENTILATION STRATEGIES

Natural ventilation is an effective energy design strategy for schools in many climates. This credit offers a bonus for natural ventilation above what is credited in EE C1.1 Superior Energy Efficient Design.

Intent

Provide a bonus for school designs that incorporate natural ventilation, mixed mode, or demand control ventilation. Provide an incentive to install interlocks on doors and windows.

EE C4.1 ADVANCED VENTILATION STRATEGIES

CREDIT

2 points

APPLICABILITY: New schools, a new building on an existing campus, additions and major renovations/modernizations based on the scope of the project.

VERIFICATION: Design Review

SCORING: 1 point for C4.1.1 and/or 1 point for C4.1.2

RELATED CRITERIA: EE C1.1 Superior Energy Design, II C7.1 Design for Adaptation & Resilience

EE C4.1 REQUIREMENTS

EE C4.1.1 *Natural Ventilation*

1 point

Design schools such that at least 75% of the classrooms are designed to provide comfort conditions with no mechanical cooling according to the comfort conditions defined in ASHRAE Standard 55-2017 [3].

Naturally ventilated classrooms (with no mechanical cooling) shall meet the classroom ventilation requirements of ASHRAE Standard 62.1-2016 §5.1 or demonstrate that engineered natural ventilation systems satisfy the requirements. [2]

EE C4.1.2 *Energy Conservation Interlocks*

1 point

For hybrid systems that use natural ventilation in combination with mechanical cooling, install interlocks or an equivalent mechanism, to prevent heating and cooling equipment from operating when exterior windows or doors are open.

EE C4.1 IMPLEMENTATION

While this criterion applies to modernization projects, the cost of installing interlocks on existing windows can be prohibitive. A good opportunity to install interlocks occurs when the windows are being replaced as part of the project.

Natural Ventilation

Computer labs, media closets, science labs, or art/ceramic rooms are exceptions, and may install mechanical air-cooling systems.

Comply with ASHRAE 62.1-2016 § 6.4 requirements for classroom natural ventilation or include an engineered natural ventilation system that meets ASHRAE 62.1-2016 requirements. The former requires a minimum operable area in comparison to the classroom size, that openings are unobstructed, and that a means to open the required operable windows or doors is readily accessible, in addition to other requirements. Adequate amounts of ventilation must be supplied to occupied classrooms at all times.

Possible Approach:

Exfiltration by means of low pressurization is sometimes a preferred strategy to passive infiltration to achieve occupant sensible ventilation in locations with poor air quality or relatively high airborne particulate matter (dust storms, proximity to faming or mining operations). An economizer cycle does require parasitic fan energy but provides evenly distributed filtered outside in exchange. Effective passive ventilation requires an air pressure differential across the occupied space to provide sensible and effective ventilation benefits to the occupants. This is difficult to achieve without at least two operable openings (one could be an operable skylight(s) on opposite sides of the space to induce airflow).

Interlock Switches

Each year, significant amounts of energy are lost when teachers or staff members open exterior doors or windows while the HVAC heating and cooling equipment dedicated to that space continues operating. Interlocks installed on windows and doors can be used to shut off this equipment when windows and doors are opened for extended periods. If the heating or cooling equipment provides conditioned air to multiple rooms, the equipment should only be shut down when all related rooms have a window or door open. Interlocks must not turn off supply air fans that are used for ventilation, only equipment that is used to condition the air such as furnaces, heat-pumps, air-conditioner compressors and coil valves. Adequate amounts of ventilation must be supplied to the classroom at all occupied times.

For hybrid spaces, specify and install interlock switches on all densely occupied (greater than 25 people per 1,000 sf) classroom's and non-classroom's operable windows and doors. Consider including a strategy (such as a red light/green light system) to notify staff when the air temperature outside is appropriate for opening windows.

Controls that use some form of time delay must be included so that normal use of doors does not cause the HVAC equipment to cycle on and off unnecessarily. Teachers must be educated on how the system works and why it is needed. The energy savings for natural ventilation are included in the calculations for EE P1.0 Energy Efficient Design and EE C1.1 Superior Energy Efficient Design.

EE C4.1 DOCUMENTATION

DESIGN REVIEW

Submit CDs, including mechanical and architectural plans and specifications, that provide the required system details.

CONSTRUCTION REVIEW

N/A

EE C4.1 RESOURCES

See next page.

EE C4.1 RESOURCES

1. ASHRAE Advanced Energy Design Guide for K-12 School Buildings: https://www.ashrae.org/search?q=Advanced%20Energy%20Design%20Guide%20for%20K-12%20School%20Buildings
2. ASHRAE 62.1-2016: https://www.techstreet.com/ashrae/standards/ashrae-62-1-2016?product_id=1912838
3. ASHRAE 55-2017: https://www.techstreet.com/ashrae/standards/ashrae-55-2017?gateway_code=ashrae&product_id=1994974

WATER (WE)

WE P1.0 INDOOR POTABLE WATER USE REDUCTION
WE C1.1 ENHANCED INDOOR WATER USE REDUCTION

The growing value of potable water in the United States underscores the importance of lowering demand. Efficient water consumption naturally reduces the amount of water pumped from the ground or transported from reservoirs to cities and towns. In addition, water efficiency reduces the cost and amount of sewage needing treatment after use. Because water-efficient devices can vary in quality and performance, specify only durable, high performance fixtures.

Intent

Maximize water efficiency within buildings to reduce the burden on municipal water supply, aquifers, and wastewater treatment systems.

There is opportunity to achieve additional potable water savings through selection of fixtures with higher efficiency than required in WE P1.0 and/or efficient appliances. Additionally, for flushing, there may also be opportunity to use rainwater, reclaimed water (tertiary treated wastewater) from the municipality, or graywater, among others. These options are subject to what local code allows and what may be available through municipal water treatment, Note that manufacturers may have minimum water quality requirements and that fixture warranties may be voided if water quality fails to meet their specifications.

WE P1.0 INDOOR POTABLE WATER USE REDUCTION

PREREQUISITE

4 points

APPLICABILITY: All Projects

VERIFICATION: Design and Construction Review

WE P1.0 REQUIREMENTS

This prerequisite is prescriptive; no calculations are needed. All indoor water fixtures listed in Table WE 1-1: Fixture Performance Requirements must comply with the listed maximum water consumption figures. These requirements are not averages–every fixture must comply.

WE P1.0 IMPLEMENTATION

Use Table WE 1-1 to identify the maximum consumption rate and other requirements for each fixture. Where applicable, CHPS follows EPA's WaterSense standards, and products with the WaterSense label must be specified. [1] If no WaterSense or national equivalent is available, CHPS has adopted a relevant state standard, such as California Title 24, Part 11 (CALGreen).

Table WE 1-1: Fixture Performance Requirements

Fixture/Fitting Type	Maximum Water Consumption	Other Requirements & Notes
Showerheads	2.0 gpm @ 80 psi	Must be WaterSense labeled.
Commercial lavatory faucets	0.5 gpm @ 60 psi	Source: Section 5.4.1 and Table 1 of ASME A112.18.1/CSA B125.1–Plumbing Supply Fittings
Metering faucets (self-closing)	0.20 gallons/cycle @ 60 psi	Source: CALGreen 5.303.3.3.4 There is no WaterSense standard.
Kitchen faucets	2.2 gpm	No WaterSense standard.
Water closets	1.28 gallons/flush	Tank-type and flushometer water closets must be WaterSense labeled.
Urinals	0.5 gallons/flush	Flushing urinals must be WaterSense labeled.
Commercial pre-rinse spray valves	1.3 gpm @ 60 psi	No WaterSense standard.

WE C1.1 ENHANCED INDOOR POTABLE WATER USE REDUCTION

CREDIT

2-7 points

APPLICABILITY: All Projects, see Implementation for specifics.

VERIFICATION: Design and Construction Review

SCORING: 2-5 points for 1.1.1 and/or 2 points for 1.1.2

WE C1.1 REQUIREMENTS

WE C1.1.1 *Calculated Water Savings*

2-5 points

Reduce potable water consumption beyond the savings achieved in WE P1.0 per the following thresholds. Use any combination of high efficiency fixtures and appliances in Table WE 1-2, water shut-off, or site-collected water. Points will be awarded based on total calculation of percentage reduced. Percentages between thresholds are implied.

- 20% (2 points)
- 25% (3 points)
- 30% (4 points)
- 35% (5 points)

Table WE 1-2: Enhanced Fixture Performance Targets*

Fixture/Fitting Type	Target Maximum Water Consumption
Showerheads	1.5 gpm @ 80 psi
Water closets – flush valve	1.1 gallons/flush
Urinals	0.125 gallons/flush
Commercial pre-rinse spray valves	1.15 gpm @ 60 psi
Commercial washing machines	Must meet ENERGY STAR (<=4.0 gpc/ft3)

*Not exclusive. Any fixture with a higher efficiency than in WE P1.0 is acceptable. Note that faucets lower than .5 gpm, while available on the market, have not been proven viable for handwashing.

AND/OR

WE C1.1.2 *Efficient Appliances*

2 points Specify and install ENERGY STAR or Consortium for Energy Efficiency (CEE) labeled appliances per the following table:

Water-Efficient Appliance Standards*

Appliance	Standard
Dishwashers	ENERGY STAR [6]
Food Steamers	CEE [7]
Ice Machines	ENERGY STAR or CEE

* Other efficient appliances, such as combination ovens, may be available and are strongly encouraged but are not required for this point.

WE C1.1 IMPLEMENTATION

Applicability

This credit applies to all new schools and major renovations/modernizations. It applies to new buildings (classroom/non-classroom) on an existing campus and additions if enough fixtures are provided within the building to meet the occupant load. In cases

where compliance with the occupant load ratio is determined on a campus wide basis the calculations should be performed for the entire school site.

WE C1.1.1 *Calculated Water Savings*

To quantify water use reductions, use the CHPS water use spreadsheet to determine baseline and design water consumption. Use any of the following techniques alone or in combination to achieve the target savings.

1. Specify fixtures meeting the maximum water consumption limits in Table WE 1-2. The list is not exhaustive but any product must have an identifiable baseline in order to be counted. Use of aerators or recalibration (self-closing faucets) is allowed where complying products are not available. Products should be WaterSense labeled, as applicable.
2. Provide shut-off capabilities for water supply to all urinals and water closets to prevent water leakage when unoccupied.
3. Use rainwater, reclaimed municipal water, or other non-potable water for flushing.
4. Other techniques with prior approval from CHPS.

Considerations for Rainwater Catchment & Storage

For some schools, installation of a rainwater catchment system with underground storage tanks is a cost-effective option to provide water for flushing water closets (toilets) and urinals as well as for supplemental irrigation. Catchment systems can decrease some irrigation water demand depending on the size of the fields being irrigated. However, they are unlikely to contribute much to schools with many playing fields and large irrigation demands.

A rainwater catchment system should be designed with a water storage capacity for sewage conveyance and/or irrigation in typical years under average conditions. Oversizing water storage to meet drought conditions will be costly and under sizing storage may simply result in a system that is too small to significantly offset potable water consumption. In addition, rainwater collection and storage systems should be designed to avoid stagnation that could lead to mold growth and accumulation of bacteria. It will be important to check with your plumbing inspector early in the process if you pursue a catchment system.

The underground storage tanks and cisterns could at times run dry during drought conditions. Therefore, it is acceptable for tanks and cisterns to connect to wells or municipal water supplies.

WE P1.0-C1.1 DOCUMENTATION

DESIGN REVIEW

WE P1.0 CDs must include a plumbing fixture schedule showing compliance with flow requirements.

WE C1.1.1 Complete the CHPS Water Savings worksheet.

CDs must identify shut-off capabilities for restroom facilities, if applicable.

CDs must include a plumbing fixture schedule showing flow rates lower than the prerequisite.

If site-collected water is used, identify the location on the CDs and provide a narrative describing the system, including justification for the volume collected. Alternatively,

highlight in the specifications where the system is contained. Documentation from SS C5.1 Stormwater & Sedimentation Management may apply.

WE C1.1.2 Specifications or an appliance schedule showing the required labels/certifications.

CONSTRUCTION REVIEW

WE P1.0-C1.1 Provide approved submittal with cover sheet and applicable materials for the water-efficient products purchased.

WE C1.1.1 Provide a photo of the rainwater catchment system or non-potable water recycling system, if applicable.

WE P1.0-C1.1 RESOURCES

1. High-efficiency fixture and fitting standards are available through the American National Standards Institute (ANSI) as published by the American Society of Mechanical Engineers (ASME): www.asme.org/kb/standards#des=A112
2. Maximum Performance (MaP) tested toilet fixtures: www.map-testing.com
3. US EPA WaterSense® program for efficient fixtures and sensors: www.epa.gov/watersense/
4. California utility-sponsored information, Food Service Technology Center (FSTC), including a list of tested pre-rinse spray valves: https://fishnick.com/equipment/sprayvalves/
5. Alliance for Water Efficiency: http://www.allianceforwaterefficiency.org/Green_Building_Introduction.aspx
6. US EPA ENERGY STAR Products: https://www.energystar.gov/products/appliances
7. Consortium for Energy Efficiency (CEE): https://www.cee1.org/content/cee-program-resources

WE P2.0 OUTDOOR WATER USE REDUCTION
WE C2.1 ENHANCED OUTDOOR WATER USE REDUCTION

Intent

Reduce and optimize potable water use for irrigating recreational and non-recreational landscaping areas.

The use of potable water for irrigation of landscaped areas and playing fields can be an expensive undertaking and can cause significant stress on water bodies, potentially leading to water shortages. A typical natural turf recreation field needs up to 5,000 gallons of water/acre/day during the peak of the irrigation season and in many locations exceeds 7,000 to 8,000 gallons/acre/day. Irrigation systems should only be provided if necessary and should be designed with efficiency in mind.

Irrigation--when necessary--should be limited to early morning hours to minimize evaporation. Potable water use can also be minimized by specifying drought tolerant plants and considering the soil composition to support the plants. New technologies to measure the amount of moisture in soil can be used to alert grounds staff to provide only the quantity of water, and only at the time it is necessary to sustain species life on recreational fields. The US Environmental Protection Agency claims that water savings of 10-20% can be achieved through such technologies. A water budget is a reasonable estimate of the amount of irrigation water required for a specific landscape over a given time interval. Local governments may have a different ordinance from the state model for calculating a water budget.

WE P2.0 OUTDOOR WATER USE REDUCTION

PREREQUISITE

3 points

APPLICABILITY: All Projects

VERIFICATION: Design and Construction Review

SCORING: 3 points for either 2.0.1 or 2.0.2

WE P2.0 REQUIREMENTS

WE P2.0.1 *Landscape Irrigation Controls & Water Budget*

3 points

Any irrigation systems used for campus landscape, gardens, or recreational areas must have sensors (soil moisture and/or rain sensors) and weather-based irrigation controllers (WBIC) meeting or exceeding WaterSense criteria to manage operation of irrigation systems when there is adequate ambient moisture.

And develop a water budget for landscape (both non-recreational and recreational) and ornamental water use to conform to the local water efficient landscape ordinance. If no local ordinance is applicable, then use the landscape and ornamental budget developed by the California Department of Water Resources.

OR

WE P2.0.2 *No Permanent Landscape Irrigation*

3 points Install no permanent irrigation for landscaped areas: non-recreational areas are required, school gardens and recreation fields are optional. Project must specify drought resistant plants or grasses in these areas so that irrigation is not needed beyond plant establishment.

WE C2.1 ENHANCED OUTDOOR WATER USE REDUCTION

CREDIT

1-5 points APPLICABILITY: All Projects installing irrigation systems

VERIFICATION: Design and Construction Review

SCORING: 1-3 points for 2.1.1 as indicated and/or 1-2 points for 2.1.2

WE C2.1 REQUIREMENTS

WE C2.1.1 *Non-Recreational Irrigation*

1-3 points Meet or exceed the following thresholds for reduction of water consumption (potable water, natural surface water, groundwater, captured rain, or reclaimed water) for irrigation of non-recreational areas over landscape budget baselines.Use best science-based practices to conserve or restore biodiverse ecosystem function with the use of native seeds or plants (or locally adapted native seeds or plants). Note: The landscape budget baseline is calculated based on current best practices and/or standards from the California Department of Water Resources.

- 20% (1 point)
- 35% (2 points)
- 50% (3 points)

AND/OR

WE C2.1.2 *Recreational Irrigation*

1-2 points As in 2.1.1, meet or exceed the following thresholds for irrigation on recreational areas.

- 20% (1 point)
- 50% (2 points)

WE P2.0-C2.1 IMPLEMENTATION

Recreational areas include athletic fields, playing fields, practice fields, etc.

WE P2.0.1 *Water Budget*

Develop a water budget for landscape and ornamental use in accordance with the project's local ordinance. If a local ordinance is not available use the California Department of Water Resources Model Water Efficient Landscape Ordinance (WELO) [1], however if you are using the California WELO, substitute the evapotranspiration rates in your location for the California ones. (See Resources section for local evapotranspiration sources).

The Model Water Efficient Landscape Ordinance requires that estimated applied water use

cannot exceed the Maximum Applied Water Allowance (MAWA). MAWA means, for design purposes, the upper limit of annual applied water for the established landscaped area as calculated using the procedures below. It is based upon the area's reference evapotranspiration, the ET Adjustment Factor, and the size of the landscaped area.

Estimated applied water use may be the sum of the water recommended through the irrigation schedule.

Calculate the MAWA first for non-recreational areas and then for recreational areas.

A project's MAWA can be calculated using the following formula:

$$MAWA = ET_o \times 0.8 \times LA \times 0.62$$

Where,

MAWA Maximum Applied Water Allowance (gallons per year).

ET_o Reference Evapotranspiration (inches of water per year). Evapotranspiration means the quantity of water evaporated from adjacent soil surfaces and transpired by plants during a specific time.

0.8 ET Adjustment Factor. This factor, when applied to evapotranspiration, adjusts for plant factors and irrigation efficiency, two major influences upon the amount of water that needs to be applied to the landscape.

LA Landscaped Area (square foot).

0.62 Conversion Factor. This converts the MAWA from acre-in. per acre per year, to gallons per square foot per year.

Portions of landscaped areas such as parks, playgrounds, athletic fields, or schoolyards where turf provides a playing surface, or serves other recreational purposes, are considered recreational areas and may require water in addition to the MAWA. A statement should be included with the landscape design plan, designating the location and size of recreational areas to be used for such purposes and specifying any needed amount of additional water above the MAWA for non-recreational uses.

The water budget should be reflected in the school landscaping plan and in specifications for efficient irrigation equipment.

Example Calculation

Question:

What is the annual water use budget in gallons for a 50,000 ft² landscaped area in Charlottesville?

Answer:

The ETo for Charlottesville is 30.98 in., so the MAWA is about 768,304 gallons per year, as calculated below:

$$MAWA = ETo \times .08 \times \text{Landscaped Area} \times 0.62$$

$$= 30.98 \times .8 \times 50{,}000 \times 0.62$$

$$= 768{,}305 \text{ gallons per year}$$

WE P2.0.2 *No Permanent Irrigation*

Provide a letter signed by the landscape architect certifying that permanent irrigation systems have not been specified for non-playing field areas AND that only drought resistant plants and grasses have been specified for these areas. Letter must clearly state that no irrigation, manual or otherwise, will be needed in these areas after plants are established. Letter must also indicate the species of drought resistant plants and grasses that have been specified.

WE C2.1.1 *Non-Recreational Landscape Irrigation*

Establish a Landscape Design Plan and an Irrigation Design Plan then calculate project water requirements for irrigation of non-recreational areas.

Irrigation needs for the designed landscape areas must be calculated and compared to the Maximum Applied Water Allowance (MAWA) required by WE C2.0. Use the following procedure to calculate the irrigation requirements of the designed landscape non-recreational areas.

Step 1: Determine the Landscape Coefficient (KL):

The Landscape Coefficient consists of three elements; Species Factor (ks), Microclimate Factor (kmc) and Density Factor (kd).

$$KL = ks \times kmc \times kd$$

The Species Factor (ks) is used to account for differences in species' water needs. In established landscapes, certain species are known to require relatively large amounts of water to maintain health and appearance while others are known to need very little water. For a sample of Species Factors, use http://www.salinitymanagement.org/Salinity%20Management%20Guide/ew/ew_8.html.

The Microclimate Factor (kmc) is used to account for differences in environmental conditions specific to the landscape. Natural and man-made features can affect temperature, wind speed, light intensity and humidity, which can vary considerably among landscapes. The microclimate factor ranges from 0.5 to 1.4, and is divided into three categories:

Low 0.5 - 0.9

Average 1.0

High 1.1 - 1.4

The average situation refers to conditions where the landscape evapotranspiration rate is not significantly affected by nearby buildings, pavements, reflective surfaces and slopes. When site features increase evaporation potential, a higher condition exists, such as exposed areas, or areas surrounded by heat absorbing materials (e.g. parking lots). Lower conditions exist in shaded areas and areas protected from wind, such as courtyards or north sides of buildings.

The Density Factor (kd) is used to account for differences in vegetation density, or leaf area, among landscape plantings. These differences lead to differences in water loss. The density factor ranges in value from 0.5 to 1.3. This range is divided into three categories:

Low 0.5 - 0.9

Average 1.0

High 1.1 - 1.3

Immature and sparsely planted landscapes typically have less leaf area than mature or densely planted landscapes, and thus lose less water. These plantings are assigned a kd value in the low category. Plantings with mixtures of vegetation types (trees, shrubs, and groundcovers) typically have greater collective leaf areas than plantings with a single vegetation type, and thus will lose more water. These plantings are assigned a density factor value in the high category. Plantings that are full but are predominantly of one vegetation type, are assigned to the average category.

Step 2: Determine how much irrigation water is required.

$$ETL = KL \times ETO$$

ETL is the estimated water needed for the planting in inches. KL is the landscape coefficient (see step 1).

ETO is the evapotranspiration rate in inches

Step 3: Calculate Water Applied (WA):

$$WA = A \times 0.62 \times ETL / IE$$

A is area in ft^2.

0.62 is the conversion factor to convert to gallons.

ETL is the estimated water required in inches (see step 2).

IE is the irrigation efficiency: Sprinkler 0.625, Drip 0.90.

Step 4: Perform the above calculations for each specific landscape area.

Step 5: Sum the Total Water Applied (TWA) for each specific area to determine the subtotal in gallons.

Step 6: Subtract the number of gallons of harvested rainwater**,** graywater, or recycled water used for irrigation to determine the actual volume of potable water required**.**

Step 7: Use the following formula to determine the reduction in potable water over the landscape budget baseline:

$$\text{Potable Water Reduction (\%)} =$$

$$1 - (\text{actual volume of potable water (gal)} / \text{MAWA (gal)} \times 100$$

WE C2.1.2 *Recreational Landscape Irrigation*

Soil Types

The best types of soil for playing fields are 3% to 7% organic content and fall into the US Department of Agriculture soil categories:

Soil Type	Watering Requirements
Loamy sand	1 in. per week
Sandy loam	1 in. per week
Loam	1 in. per week

Artificial Turf

Artificial sports turf can be installed, but no credit will be given for water savings because fields tend to require watering for maintenance and heat control.

WE P2.0-C2.1 DOCUMENTATION

DESIGN REVIEW

WE P2.0.1 CDs must include complete landscape drawings identifying irrigation system components and soil moisture meters if required and all outputs of the model/budgeting tool. The outputs should reflect the landscape plans provided.

WE P2.0.2 If there is no permanent irrigation, provide the letter described under Implementation.

WE C2.1 Provide the full calculations.

CONSTRUCTION REVIEW

WE P2.0.1 & C2.1.1-2.1.2 Provide approved submittal with cover sheet and applicable materials, photos or other supporting documents that show compliance.

WE P2.0.2 N/A

WE P2.0 - C2.1 RESOURCES

1. California Department of Water Resources, Model Water Efficient Landscape Ordinance (WELO): www.water.ca.gov/wateruseefficiency/docs/MWELO09-10-09.pdf
2. For information on local evapotranspiration rates, see lists provided by the Irrigation Association: https://www.irrigation.org/IA/Resources/Tools-Calculators/ET-Resources/IA/Resources/ET-Resources.aspx?hkey=576c5d0f-fee5-415f-b325-2ea2a95083f
3. Local water utility staff, water efficient landscape consultants, Certified Irrigation Designers (www.irrigation.org), and Master Gardeners are good resources for helping achieve C2.1.

WE C3.1 IRRIGATION SYSTEMS COMMISSIONING

Irrigation system testing and training is a rigorous quality assurance program administered by a knowledgeable party that ensures the irrigation systems perform as expected. Irrigation system testing can help to ensure that water efficiency measures are working properly, and design water savings are achieved.

Intent

Verify that the site's irrigation systems and controls are operating as intended and that effective training has been provided.

WE C3.1 IRRIGATION SYSTEMS COMMISSIONING

CREDIT

1 point

APPLICABILITY: All projects that include irrigation systems.

VERIFICATION: Design and Construction Review

WE C3.1 REQUIREMENTS

Create an irrigation systems commissioning plan to manage operation and maintenance of irrigation systems. Complete irrigation systems commissioning review during construction and performance testing after installation. Provide documentation for ongoing operations and maintenance. Post the irrigation schedules for each station for each month at the irrigation controller. Based on best science-based practices to conserve or restore biodiverse ecosystem function, adaptively update the operations and maintenance plan, as needed.

WE C3.1 IMPLEMENTATION

Include the irrigation commissioning plan in the specifications. Designate the CSI number, section, and page number. State that irrigation commissioning plan must include:

- Identification of which entity will prepare the irrigation commissioning plan and who will perform the commissioning tasks.
- Review of irrigation system installation during construction, with record of deficiencies found and corrected.
- Performance testing and documentation of results (as compared to specified performance) at least once during the first year of installation.
- Site-specific documentation detailing maintenance requirements and frequency, and operation procedures including a recommended irrigation schedule to apply appropriate water per week to athletic fields.

Acceptance testing shall be included in the specifications and performed on the following, if applicable:

- Irrigation pipes and fittings. Under static conditions the system pressure loss shall not exceed 3 psi over a one-hour time period.

- Irrigation heads and coverage. The system shall have a measured distribution uniformity (lower quarter) of no less than 65%.
- Back-flow devices.
- Automatic sensors, timers and other controls.

For equipment not listed, the design team shall provide acceptable test results, and the contractor shall certify that the tests were performed and the equipment performs as specified.

WE C3.1 DOCUMENTATION

DESIGN REVIEW

Provide a PDF of the Irrigation Commissioning Plan showing items listed in the Implementation section as well as who will be responsible for the commissioning and when it will occur.

CONSTRUCTION REVIEW

Provide final commissioning report.

WE C3.1 RESOURCES

1. The Irrigation Association has resources on conducting an irrigation audit: https://www.irrigation.org/IA/Resources/Technical-Resources/Irrigation-Auditing/Audit-Guidelines/IA/Resources/Audit-Guidelines.aspx?hkey=d3af0807-efe0-4779-a31f-c6011b23c6d

SITE (SS)

SS P1.0 ENVIRONMENTAL SITE ASSESSMENT

Intent

Select sites that are a safe and healthy environment for students and staff and that protect topsoil.

Federal guidelines and some state laws and regulations for school siting were created to prevent schools from being constructed on sites containing pollutants known to be hazardous to student and staff health. The primary tool for reviewing the quality of the site is an Environmental Site Assessment (ESA), following EPA guidelines; however, a state or locality may have additional rules or guidance. A variety of factors, from hazardous materials in the soil to airborne pollutants from nearby sources, are included in the site review process. At existing facilities, an assessment should be undertaken to determine whether there are legacy environmental and health problems on site or in the building prior to modernization.

SS P1.0 ENVIRONMENTAL SITE ASSESSMENT

PREREQUISITE

3 points

APPLICABILITY: All projects.

VERIFICATION: Design Review

RELATED CRITERIA: II C7.1 Design for Adaptation & Resilience

SS P1.0 REQUIREMENTS

SS P1.0 *New Buildings on New Sites*

Complete a Phase I Environmental Site Assessment (ESA) in accordance with ASTM E1527-13. If a Phase II ESA is necessary based on the results of Phase I, follow ASTM E1903-11. The ESA must include:

- Identification of facilities within ¼ mile that might reasonably be anticipated to emit hazardous air emissions, or handle hazardous or acutely hazardous material, substances or waste. A determination shall be made (following ASTM 1527-13) that such facilities will not adversely affect the health of students, staff or teachers.
- A risk assessment and implementation of appropriate mitigation measures or the establishment of appropriate “buffer zones” to ensure that the proposed school site would not expose school occupants to significant health or safety risks from rail lines, hazardous material pipelines, high power transmission lines, toxic air emissions from stationary sources, or other sources of pollution including those identified under ASTM 1527-13.
- Written findings verifying that the site is not currently or formerly a hazardous, acutely hazardous substance release, or solid waste disposal site or, if so, that the wastes have been removed in a manner that meets the referenced standard. Also, the written findings must state that the site does not contain pipelines, which carry hazardous wastes or substances other than a natural gas supply line to the school or neighborhood. If hazardous air emissions are identified, the written findings must state that the health risks do not, and will not, constitute an actual or potential danger of public health of students or staff. If corrective measures of chronic or accidental hazardous air emissions are required under an existing order by another

jurisdiction, the governing board shall make a finding that the emissions have been mitigated prior to occupancy of the school.

- Identification of train tracks, freeways, or traffic corridors within 500 feet of the site and analyses that neither short-term nor long-term exposure to air pollutants poses significant health risks to students.

SS P1.0 *Additional Requirements*

The ESA must also include all of the following:

- Site the school with at least the following distances from the edge of respective power easements above ground; 100 feet for 50-133 kV lines, 150 feet for 220-230 kV lines, and 350 feet for 500-550 kV lines.
- The site shall be self-draining, including detention ponds or other engineered systems (lakes) to control and direct water, and free from depressions in which water may stand and be allowed to stagnate. The site shall be kept free from refuse, weed overgrowth, and other hazards. Livestock or poultry shall be located more than fifty (50) feet from food service areas, offices, or classrooms except those offices and classrooms associated with animal husbandry activities.
- The site shall not be located near an above-ground water or fuel storage tank or within 1500 feet of the easement of an above ground or underground pipeline that can pose a safety hazard as determined by a risk analysis study, conducted by a competent professional, which may include certification from a local public utility commission.
- If the site is located in an agricultural area, identify drift problems throughout the year from highly toxic and volatile pesticides. Pesticides under concern are listed as “Restricted Use Products” by the US EPA. If highly toxic and volatile pesticides are identified and not mitigated, the school will not meet this prerequisite.
- If the school drinking water source is an on-site private well, the well water must be tested by the local health department or authority having jurisdiction to ensure the water is free of harmful contaminants prior to occupancy. The local jurisdiction may require further testing during occupancy.
- The site must not be within 1,000 feet of an active landfill.

SS P1.0 *New Buildings on Existing Sites and Major Renovations/Modernizations*

If a prior ESA was completed when the site was first developed, that ESA should be reviewed for any relevant changes and for completeness of all of the above requirements. If the ESA did not address all of the above requirements, the missing ones must be completed, and mitigation may be necessary. The requirement to be at least 1,000 feet from an active landfill does not apply to existing sites; however, if the new building is proximate to an active landfill, mitigation may be necessary. If no prior ESA was performed, a Phase I ESA should be done meeting all of the above requirements, and a Phase II ESA completed if any hazards are found.

Furthermore, identify facilities within ¼ mile that might reasonably be anticipated to emit hazardous air emissions or handle hazardous or acutely hazardous material, substances, or waste. A determination shall be made (following ASTM 1527-13) that such facilities will not adversely affect the health of students, staff, or teachers.

SS P1.0 IMPLEMENTATION

If state laws or regulations or funding authority rules require additional considerations, those should be included in the ESA. To determine if the site is within 500 feet of a freeway, refer to the state's definition of "freeway" available through the state's department of transportation. Other types of roadways may also be relevant to the analysis, depending on the site and the amount and type of traffic, for example a high volume roadway as defined by the state or a trucking corridor.

CHPS has adopted the Massachusetts standard for minimum distance from an active landfill of 1,000 feet. [7] If the site is in a state with a shorter allowable distance and it would be a hardship to meet the 1,000 feet, the ESA should contain an explanation of the circumstances and the mitigation steps that will be taken to minimize pest and pollution exposure at the school.

SS P1.0 DOCUMENTATION

DESIGN REVIEW

Provide a copy of the Phase I Environmental Site Assessment (and the Phase II assessment, if applicable) or equivalent in accordance with the requirements above. If hazards or potential hazards are identified in the report, provide documentation of remedial action, mitigation, or other measures undertaken as a result and/or a signed statement clarifying how the hazards noted do not pose a risk to the project site.

CONSTRUCTION REVIEW

N/A

SS P1.0 RESOURCES

1. ASTM Phase I Environmental Assessment Requirements: www.astm.org/Standards/E1527.htm
2. ASTM Phase II Environmental Assessment Requirements: https://www.astm.org/Standards/E1903.htm
3. US EPA School Siting Guidelines: https://www.epa.gov/sites/production/files/2015-06/documents/school_siting_guidelines-2.pdf
4. US EPA Restricted Use Product List: https://www.epa.gov/sites/production/files/2017-10/documents/rup-report-oct2017.pdf
5. US EPA Travel and Environmental Implications of Schools Siting: https://www.epa.gov/smartgrowth/travel-and-environmental-implications-school-siting
6. Massachusetts School Building Authority regulations on school construction, see 2.05 (4) for the landfill reference: http://www.massschoolbuildings.org/sites/default/files/edit-contentfiles/Documents/Stats_Regs/MSBA_Regs_Program_April-10.pdf

SS C2.1 SUSTAINABLE SITE USE & SENSITIVE LANDS CONSERVATION

The availability of open areas with natural ecosystems preserves species and habitat and can help keep the environment cleaner. It also offers opportunities for teaching biological and natural sciences and recreation outside of defined play spaces.

Intent

Preserve as much open space as possible to save existing ecosystems and provide natural learning and recreation spaces.

This criterion is intended to mitigate negative impacts on existing ecosystems. Reducing a building footprint, reducing parking and prioritizing emissions-free vehicles, and maximizing open space can reduce disturbance to these systems. Multi-story schools decrease the amount of land used in construction and help preserve existing open space. Reduced parking spaces discourages automobile use, reduces urban heat island effects, and can reduce pollution from stormwater runoff. Prioritizing parking for shared rides and Zero Emissions Vehicles (ZEV) lowers the impact of air pollution on people and wildlife. Combined, these strategies for reducing the footprint of buildings and limiting parking and paving while encouraging alternate means of transportation can minimize the effects on existing ecosystems.

SS C2.1 SUSTAINABLE SITE USE & SENSITIVE LANDS CONSERVATION

CREDIT

1-3 points

APPLICABILITY: All projects

VERIFICATION: Design Review

SCORING: 1 point each for 2.1.1-2.1.3

RELATED CRITERIA: SS C4.1 Central Location & Near Public Transit

SS C2.1 REQUIREMENTS

SS C2.1.1 *Sustainable Site Use*

1 point

Do any two of the following:

- Building Footprint: Design the building to minimize the footprint by having a ratio of gross square footage to footprint square footage of at least 1.4.
- Parking: Do not exceed minimum local parking requirements. Comply with the following, unless they result in more parking than local minimums:

  New Construction and Additions:

  - Size parking capacity not to exceed 2.25 spaces per classroom for elementary and middle schools and 2.25 spaces per classroom plus spaces for 30% of students for high schools.
  - If event parking is provided, it must be permeable.

- Provide preferred parking spaces and signage for 10% of total parking spaces for carpools, vanpools, and Zero Emission Vehicles (ZEVs).

Major Renovations/Modernizations:

- Add no new parking compared to existing conditions.
- Provide preferred parking spaces and signage totaling 10% of total parking spaces for carpools or vanpools and for Zero Emission Vehicles (ZEVs).

- Open Space: Limit total site development so that open space is 25% more than zoning open space requirements. If no zoning ordinances apply to open space, provide a minimum of 50% vegetated open space. If a school is located in a densely populated area (SS 6.1: Central Location), provide a minimum of 25% vegetated open space.

SS C2.1.2 *Sensitive Lands Conservation*

1 point

Do not develop buildings or impervious surfaces on portions of sites that meet any one of the following classifications:

- Land which prior to acquisition for the project was public parkland, conservation land, or land acquired for water supply protection.
- Greenfields, which for the purposes of this criterion, are defined as undeveloped land or lands that are used for agriculture, forestry, or park purposes. Undeveloped lands are defined as lands that have not been in use for a period of 50 years or more and cannot be identified, by visual inspection, as having been developed.
- Land specifically identified as habitat for any species on the federal or state threatened or endangered list.
- Land that is prime farmland, unique farmland, or farmland of statewide importance as defined by the US Department of Agriculture (USDA) Natural Resources Conservation Services NRCS.

SS C2.1.3 *Additional Sensitive Lands Conservation*

1 point

Do not develop buildings or impervious surfaces on portions of sites that meet any one of the following classifications:

- Land whose elevation is lower than 5 feet above the elevation of the 100-year flood as defined by FEMA and as shown on the FEMA Flood Insurance Rate Map (FIRM) for the site.
- Land that is within 100 ft. of any wetland as defined by 40 CFR (Code of Federal Regulations) Part 230.3, or within setback distances from wetlands prescribed in state or local regulations, whichever is more stringent.
- Previously undeveloped land that is within 50 feet of a water body, defined as seas, lakes, rivers, streams and tributaries that support or could support aquatic life, recreation or industrial use, consistent with the terminology of the Clean Water Act.

SS C2.1 IMPLEMENTATION

SS C2.1.1 *Sustainable Site Use*

For a new building, addition or major renovation/modernization project to earn these points, calculations must be based on the entire campus, not the individual building or building(s) being modernized. A major modernization project, a new building on an existing campus,

and an addition can also claim these points if the existing campus already satisfies the requirement.

Demonstrate that the design meets this requirement through the following equation:

$$\frac{\text{Total Floor Area of Building (ft}^2\text{)}}{\text{Total Square Footage of the Building Footprint (ft}^2\text{)}} \geq 1.4$$

Calculate the ratio by dividing the school facility's footprint by the facility's entire square footage including all stories. Said another way, achieving a ratio of 1.4 requires at least 40% of the total building square footage needs to be above the first floor. The building footprint is defined as the ground surface occupied by the structure and excludes awnings, overhangs and projections from the building.

Excess parking spaces encourage increased automobile use, contribute to urban heat island effects, and can increase pollution from stormwater runoff. Design parking so as not to exceed listed amounts, and include clearly marked, preferred parking areas for carpools, vanpools, and Zero Emission Vehicles (ZEVs). If electric charging stations are included, you may apply for an Innovation credit. For the purposes of making calculations for this criterion, classrooms include:

- General classrooms
- Art rooms
- Music classrooms
- Computer labs
- Science labs
- Special needs collaborative and remedial classroom space

For new construction, provide a site plan showing parking layout (indicate total number of parking spaces). Highlight preferred parking spaces and provide a signage schedule or other graphic highlighting Preferred Parking signage. Indicate number of classrooms (as defined for this criterion) and total number of students.

Zero Emission Vehicles (ZEV) are designated by the California Air Resources Board.

For major renovation/modernization, provide an existing site plan showing existing parking conditions (indicate total number of parking spaces) and a site plan of the new parking layout (indicate total number of parking spaces). Highlight preferred parking spaces and provide a signage schedule or other graphic highlighting Preferred Parking signage.

If event parking is provided, it must be permeable (gravel, permeable paving or concrete grid with drainage).

Calculate building and paving areas to determine open space remaining within the site boundary. Calculate building footprint as listed above. Only vegetated areas will be considered open space.

Where state or local zoning ordinances specify open space requirements, open space must measure a minimum of 25% greater than required open space. Where no state or local zoning ordinances apply to open space, vegetated open space must measure a minimum of 50% of total site area.

Where project complies with SS C4.1: Central Location and no state or local zoning ordinances apply to open space, open space must measure a minimum of 25% of total site area.

When reducing the floor area to footprint ratio, a careful balance must be achieved between the energy benefits and costs of the building envelope, the footprint of the building, and daylighting best practices. Tuck-under parking and sharing of off-site parking facilities can minimize site disturbance.

SS C2.1.2 *Sensitive Lands Conservation*

A new building on an existing campus or additions to existing buildings can earn this point if the site for the new building or addition is not on environmentally sensitive land. For major renovations/modernizations, this point may be earned if it can be verified that the site is not environmentally sensitive land as defined by this criterion.

Protect environmentally sensitive site features, such as wetlands and tree stands, and encourage landscaping and architecture that responds to and includes the school's immediate environment. Provide a current site survey with the school site property boundaries marked in bold.

Greenfields:

During the site selection process, use previously developed sites instead of greenfields. Redevelopment reduces environmental impacts by utilizing established infrastructure and preserving the open space of undeveloped lands.

Habitat: Verify that the proposed site is not habitat to any species on the federal or state, threatened or endangered list. Provide the excerpt of the document indicating that the site is not habitat to any species on the federal or state, threatened or endangered list.

Prime Farmland:

Verify that the proposed site is not prime farmland, unique farmland, or farmland of statewide importance as defined by the US Department of Agriculture (USDA). The Natural Resources Conservation Services (NRCS) division of the USDA maintains the definitions and soil surveys that designate areas as "prime farmland, unique farmland, or farmland of statewide importance." Provide NRCS map indicating site location.

SS C2.1.3 *Additional Sensitive Lands Conservation*

A new building on an existing campus or additions to existing buildings can earn this point if the site for the new building or addition is not on environmentally sensitive land. For major renovations/modernizations, this point may be earned if it can be verified that the site is not environmentally sensitive land as defined by this criterion.

Flood Plain

Do not construct permanent buildings, or structures to support buildings within the 100-year flood plain. Both federal and state agencies have worked together over the last several decades to prevent construction of buildings in 100-year floodplains to achieve two important results: 1) significant decrease in building damage and liability and 2) restoration of functional floodplains to absorb flood waters and minimize impacts to downstream communities.

"Above the floodplain" means that the building footprint must be above the 100-year flood plain, but the requirement does not apply to non-building areas of the site.

Consult with FEMA to determine the 100-year floodplain for the school site. Verify that the proposed building footprint is located at an elevation five feet or higher than the 100-year floodplain. Provide the site plan indicating site is located five feet or higher than the 100-year flood plain.

Wetlands

Do not build on sites which are within 100 ft. of a wetland as defined below. Site development includes the school facilities, playing fields and parking lots and construction operations that are not related to wetlands improvement. Survey the site to determine if wetlands exist on, or near the site. Verify that all construction activity, including parking lots, playgrounds or any structures are located more than 100 feet from wetlands. Consult with federal regulations 40 CFR § 230, or local, or state rule to determine if an area qualifies as a wetland. Depending on state law, the owner may need to get a determination from a local jurisdiction, such as a conservation commission. If more than one definition exists, use the one that is more stringent. The term wetlands is defined in 40 CFR § 230 as "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas." During construction, protect all wetlands with a fence or other physical barrier that cannot be easily moved (wildlife-permeable barrier, if appropriate) that protect the wetland from equipment parking and traffic, storage of materials, and other construction activities. All construction and maintenance personnel shall be educated about the location and protective measures of the wetlands. In Construction Documents, outline consequences to the contractor if wetland boundaries are not respected.

Water Bodies

Do not build on sites which are within 50 ft. of a water body as defined below. Site development includes the school facilities, playing fields, parking lots and construction operations that are not related to water body improvement. Survey the site to determine if water bodies exist on or near the site. Verify that all construction activity, including parking lots, playgrounds or any structures are located more than 50 feet from water body.

Water bodies include navigable waters, waters of the contiguous zone, the oceans and adjoining shorelines as well as wetlands and watersheds that feed the water bodies listed. For further guidance, see https://www.epa.gov/wotus-rule/about-waters-united-states.

SS C2.1 DOCUMENTATION

DESIGN REVIEW

SS C2.1.1 *Building Footprint:* CDs, ideally the title page and the code page, must include both the building's gross square footage and the building footprint square footage.

Parking: provide a site plan showing parking layout (indicate total number of parking spaces). Highlight preferred parking spaces and provide a signage schedule or other graphic highlighting preferred parking signage. Indicate number of classrooms (as defined for this criterion) and total number of students.

Open Space: CDs, ideally the title page and the code page, must include the square footage of open space.

SS C2.1.2 *Parkland/Protected Land:* Provide a current site survey with the school site property boundaries marked in bold confirming that there are no former parks, conservation lands, or water protection lands on the site.

Greenfield: Provide evidence of historical property use through submittal of aerial photographs, environmental assessment or similar verification that property is not a greenfield.

Habitat: Provide the excerpt of document indicating that the site is not habitat to any species

on the federal or state, threatened, or endangered list.

Prime Farmland: Provide NRCS map indicating site location.

SS C2.1.3 Provide one or more site plans with the building footprint that:

Flood Plain: Includes the 100-yr flood plain and a line indicating 5' in elevation above the flood line if it crosses the site (use a map from the FEMA web site to identify 100-yr flood plain).

Wetlands: Shows that the site is located more than 100 feet from wetlands. Show location of fencing to mitigate grading impacts on construction site plan or grading plan.

Water Bodies: Shows that the site construction is located more than 50 feet from water bodies.

CONSTRUCTION REVIEW

N/A

SS C2.1 RESOURCES

1. California Air Resources Board, Zero Emission Vehicles (ZEV): www.arb.ca.gov/msprog/zevprog/zevprog.ht
2. Lists of Prime and Statewide Important Farmland Soils are maintained for each soil survey area and may be obtained from the Field Office Technical Guide (FOTG) located in each NRCS field office. County and state offices of the NRCS keep maps showing the status of lands within their jurisdiction. County offices can be located at: offices.sc.egov.usda.gov/locator/app. Maps are also available at websoilsurvey.nrcs.usda.gov/app/HomePage.htm (main page) and websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx (actual map page).
3. EPA wetlands information: https://www.epa.gov/wetlands. Many wetlands are digitally mapped and downloadable from the National Wetlands Inventory, www.fws.gov/wetlands/ or from state, county, or municipal GIS departments or Natural Resources Conservation Service offices.
4. Federal Clean Water Act can be found at and https://www.epa.gov/laws-regulations/summary-clean-water-act
5. Federal Emergency Management Agency (FEMA) Regions: https://www.fema.gov/fema-regional-contacts
6. FEMA Flood Maps: https://msc.fema.gov/portal/home

SS C3.1 STORMWATER & SEDIMENTATION MANAGEMENT

Erosion results when wind and precipitation carry away soil that has not been protected during site clearing and earth moving operations. This leads to degradation of property and sedimentation of local waterways. Mitigation measures to protect soil during construction reduce negative impacts to water and air quality. Best management practices (BMPs) are an established means for reducing runoff and preventing pollution both during construction and during building operation. [1]

Intent

Reduce erosion and negative impacts on water and air quality during construction.

SS C3.1 STORMWATER & SEDIMENTATION MANAGEMENT

CREDIT

2-6 points

APPLICABILITY: All projects located near water bodies; for 3.1.1 additional applicability is contained under Implementation.

VERIFICATION: Design and Construction Review

SCORING: 2 points for 3.1.1; 4 points for 3.1.2

SS C3.1 REQUIREMENTS

SS C3.1.1 *Erosion & Pollutant Control During Construction*

2 points

Control erosion and the transport of soil and other pollutants off the site during construction. Design and implement a site-specific plan that incorporates the use of best management practices (BMPs) consistent with part 2.2 of the US EPA's National Pollutant Discharge Elimination System (NPDES) 2017 Construction General Permit. [2]

The plan shall meet the following objectives:

- Prevent soil loss by wind and water erosion, including protecting topsoil by stockpiling for reuse.
- Prevent transport of sediment and particulate matter to storm sewers or receiving waters and/or to air.
- Eliminate or reduce off-site discharge of construction waste.
- Establish maintenance commitments on post-construction pollution control measures.

SS C3.1.2 *Stormwater & Pollutant Control Post-Construction*

4 points

Do all of the following:

Stormwater Runoff Rate:

For sites with an existing imperviousness of less than or equal to 50%, limit the post-development peak stormwater runoff discharge rate so that it does not exceed the estimated pre-development rate.

For sites with an existing imperviousness of more than 50%, implement a stormwater management plan that results in a 25% reduction in the rate and quantity of stormwater runoff.

Drainage at Trash Storage Areas:

For all sites, design trash storage areas to provide appropriate drainage from adjoining roofs and pavement to divert stormwater runoff around the trash storage areas. The trash container areas must be screened or walled to prevent off-site transport of trash.

Stormwater Management:

Provide post-construction treatment control best management practices (BMPs). Incorporate either a volumetric or flow-based treatment control design standard, or in combination, as identified below to mitigate (infiltrate, filter or treat) stormwater runoff:

Volumetric Treatment Control BMP

One of the following:

- The 95th percentile 24-hour runoff event determined as the maximized capture stormwater volume for the area, using procedures recommended in https://owl.cwp.org/mdocs-posts/post-construction-manual-managing-stormwater-in-your-community/.
- The volume of runoff produced from a historical-record based reference 24-hour rainfall criterion for "treatment" that achieves approximately the same reduction in pollutant loads achieved by the 95th percentile 24-hour runoff event.

OR

Flow Based Treatment Control BMP

The flow of runoff produced from a rain event:

- equal to at least two times the 95th percentile hourly rainfall intensity for the area; or
- that will result in treatment of the same portion of runoff as treated using volumetric standards above; or
- the intensity-duration-frequency method, with a hydrograph corresponding to a 50-year storm; or
- 0.2 inches per hour.

SS C3.1 IMPLEMENTATION

SS C3.1.1 *Erosion & Pollutant Control During Construction*

This point applies only to sites where there is potential for runoff to reach a stream, wetland, pond, lake, etc. either directly or by entering a storm sewer. On sites where there is no surface water body in proximity or where all rain or snowmelt will enter a sanitary sewer or be absorbed directly into the ground, construction BMPs are not needed.

For sites over 1 acre in size, the contractor must develop and implement a site-specific Stormwater Pollution Prevention Plan (SWPPP) that includes specific controls for preventing water and air-borne soils from being carried off-site. Controls must stay in place and be maintained throughout the period of construction. Provide specification language requiring filing of a SWPPP to the agency having jurisdiction. Additionally, the contractor must submit a Notice of Intent (NOI) to the jurisdictional agency. The contractor shall verify with the agency whether any additional requirements apply to the project site.

For sites under 1 acre in size, BMPs must be utilized, and the contractor should prepare a plan similar to a SWPPP to document where and how the BMPs will apply. Provide specification language requiring preparation of the BMPs.

Note: EPA is currently revising the CGP https://www.epa.gov/npdes/proposed-modification-2017-construction-general-permit-cgp.

SS C3.1.2 *Stormwater & Pollutant Control Post-Construction*

Design the project to maintain natural stormwater flows by promoting infiltration, using alternative surfaces (e.g., green roofs or permeable paving materials) and sustainable design strategies. Show BMPs on site plans, civil drawings and specifications. Include calculations to verify required levels are met. Schools should consider using organic, natural turf fertilizers during operation to improve water quality.

If the new project results in an alteration of more than 50% of the impervious surface of a previously existing development, and the existing development was not subject to stormwater treatment measures, then the entire project must be included in the treatment measure design.

If the new project results in an alteration of less than 50% of the impervious surface of a previously existing development, and the existing development was not subject to stormwater treatment measures, then only the new and replaced impervious surface must be included in the treatment system design. In order to earn a point under this criterion, the area of site altered must be greater than 25% of the site area.

For a new school on a greenfield site, the entire project must be included in the treatment measure design.

For the purpose of verifying compliance, the peak stormwater discharge rate is assumed to be directly proportional to the imperviousness of the site. For example, a 25% reduction in imperviousness is assumed to equate to a 25% reduction in the peak stormwater runoff discharge rate.

Provide fully enclosed trash areas or garbage containers with self-closing lids. Drains in this area must go to the sewer conveyance system and not to the storm sewers. Fully enclosing trash areas prevents feral animal intrusion and contamination of stormwater.

The impervious site area is the sum of the area of each surface multiplied by its runoff coefficient, and the imperviousness of the site is the impervious site area divided by the total site area. Use the runoff coefficients for typical surfaces in the statewide Stormwater Management Handbook or as recommended by US EPA stormwater resources. Other surfaces or systems not listed may be considered if proper documentation is shown for runoff coefficients. Use the manufacturer's information or a "best estimate" for surfaces not included in the table. Calculate the imperviousness of the site both before and after development using the following equations. Note that many sites have vegetated surfaces but are underlain with high clay content soils that do not percolate. For these sites, runoff coefficients for the existing site should be adjusted to reflect higher runoff rates and care should be taken to develop methods for reducing the rate of runoff and increasing infiltration, if possible.

$$\text{ImperviousSiteArea} = \text{SurfaceArea} * \text{RunoffCoefficient}$$

$$\text{Imperviousness} = \text{ImperviousSiteArea} \,/\, \text{TotalSiteArea} * 100$$

This calculation should be completed for the proposed development and pre-development conditions. For sites with an existing imperviousness of less than 50%, the post-development imperviousness must be equal to, or less than, the pre-development

conditions. In cases where the existing imperviousness is greater than 50%, the post-development imperviousness must be 25% less than the existing conditions.

Example Calculations
Question:

What is the imperviousness of an approximately ½ acre site (20,787 ft²) before and after development? The site is being converted from a *gravel* parking lot (11,420 ft²) to a new school.

Answer:

As calculated in Example 17, the site has an existing imperviousness of 49%. After the site is developed, it is estimated to have an imperviousness of 43%. The post-development site has imperviousness less than the pre-development site, therefore, the peak stormwater runoff may be assumed to be lower and the criterion may be earned.

Example 17: Existing Imperviousness

Surface type	Runoff coefficient	Area (sqft²)	Impervious area (ft²)
Pavement, gravel	0.75	11,420	8,565
Vegetation, flat	0.10	2,332	233
Vegetation, average	0.20	7,035	1,407
Total		20,787	10,205
Imperviousness			49%

Example 17: Developed Imperviousness

Surface type	Runoff coefficient	Area (sqft²)	Impervious area (ft²)
Pavement, pervious	0.60	4,128	2,477
Pavement, brick	0.85	1,072	911
Roof, conventional	0.95	4,020	3,819
Roof, rainwater collection	0.0	3,400	0
Turf, flat	0.25	3,542	886
Vegetation, average	0.20	4,625	925
Total		20,787	9,018
Imperviousness			43%

Question: What is the imperviousness of an approximately ½ acre site (20,787 ft²) before and after development? The site is being converted from a *paved* parking lot (11,420 ft²) to a new school.

Answer: As calculated in Example 18, the site has an existing imperviousness of 60%. After the site is developed, it is estimated to have an imperviousness of 43%.

60% x 25% = 15%.

60% - (60% x 25%) = 45% > 43%

The site's imperviousness is at least 25% less than it was before development.

Example 18: Existing Imperviousness

Surface type	Runoff coefficient	Area (sqft²)	Impervious area (ft²)
Pavement, gravel	0.95	11,420	10,849
Vegetation, flat	0.10	2,332	233
Vegetation, average	0.20	7,035	1,407

Total		20,787	12,489
Imperviousness			60%

Example 18: Developed Imperviousness

Surface type	Runoff coefficient	Area (sqft^2)	Impervious area (ft^2)
Pavement, pervious	0.60	4,128	2,477
Pavement, brick	0.85	1,072	911
Roof, conventional	0.95	4,020	3,819
Roof, rainwater collection	0.0	3,400	0
Turf, flat	0.25	3,542	886
Vegetation, average	0.20	4,625	925
Total		20,787	9,018
Imperviousness			43%

SS C3.1 DOCUMENTATION

DESIGN REVIEW

SS C3.1.1 For all sites, the site plan must show the storm sewer/s or water body affected and CDs must include the site runoff control measures (BMPs). For sites over 1 acre, include a copy of the Notice of Intent or the SWPPP if completed

SS C3.1.2 Complete the CHPS Stormwater worksheet to calculate imperviousness of surfaces. Surfaces identified will be crosschecked with plans.

Drawings must identify trash storage areas, how water is diverted from this area, and measures taken to ensure the trash is not transported off-site (walls, screens).

Calculations must include the total volume of runoff and the total volume of runoff treated. In addition, drawings must call out where Best Management Practices (BMPs) are located and details where appropriate.

CONSTRUCTION REVIEW

SS C3.1.1 Provide evidence of the SWPPP or equivalent plan, such as the table of contents or summary list of BMPs utilized. Provide photos identifying measures taken throughout construction.

SS C3.1.2 Provide photo(s) of the primary trash storage areas showing appropriate drainage from adjoining roofs, pavement diverting stormwater runoff and screen or wall preventing transport of trash. Provide photos of at least one implemented BMP.

SS C3.1 RESOURCES

1. Best Management Practices (BMPs): www.bmpdatabase.org/
2. NPDES Construction General Permit: https://www.epa.gov/sites/production/files/2017-06/documents/2017_cgp_final_permit_508.pdf
3. To verify if your state administers the NPDES program: https://www.epa.gov/npdes/npdes-program-authorizations

4. Stormwater Pollution Prevention Plan: https://www.epa.gov/npdes/developing-stormwater-pollution-prevention-plan-swppp
5. To determine exactly when BMPs are needed: https://www.epa.gov/sites/production/files/2017-07/documents/cgp_flow_chart_do_i_need_a_permit2.pdf
6. US EPA Best Management Practices Guide: https://www.epa.gov/npdes/national-menu-best-management-practices-bmps-stormwater#edu
7. Center for Watershed Protection (CWP): https://www.cwp.org, and CWP's Online Watershed Library (OWL): https://owl.cwp.org

SS C4.1 CENTRAL LOCATION & NEAR PUBLIC TRANSIT

Over the lifetime of the building, schools and parents invest significant amounts of time, energy, and money transporting students to and from school. Cars driven by parents, guardians, or the students themselves are one of the largest resource users and sources of pollution. Centrally located sites allow more students to walk or bike to school or take public transportation, while reducing the distance cars must travel.

Intent

To make the school more accessible to its occupants and to promote smart growth through centrally locating new schools close to dense, mixed-use areas to encourage alternatives to automobile use.

SS C4.1 CENTRAL LOCATION & NEAR PUBLIC TRANSIT

CREDIT

1-3 points

APPLICABILITY: All projects

VERIFICATION: Design Review

SCORING: 2 points for 4.1.1 and/or 1 point for 4.1.2

RELATED CRITERIA: SS C4.1 Central Location, SS C5.1 Joint Use of Facilities, SS C6.1 Human-Powered Transportation

SS C4.1 REQUIREMENTS

SS C4.1.1 *Proximity to Students & Community Services*

2 points

Comply with any of the following 4 options:

1. Site is centrally located in which 50% of students are within the following distances: 1 mile for elementary schools, 2 miles for middle and high schools.
2. The school's location is within ½ mile of at least eight basic resident services, such as: supermarket, commercial office building, convenience grocery with fresh food, day care, fitness center, hardware store, pharmacy, laundry or dry cleaner, public library, medical/dental services, senior care facility, public park, post office, bank, community center (for recreation or community education), place of worship, fire station, police station, beauty salon, restaurant, and theater.
3. If the project is in a rural school district as defined by the National Rural and Small Schools Consortium (the district inhabitants number is fewer than 150 per square mile or if the district is located in a county where 60% or more of the population lives in communities of 5,000 or fewer), the school's location meets at least one of the following criteria:
    - Located within ¼ mile of the historic central main street business district. Provide a direct pedestrian connection between the school and the business district that includes walking paths and bicycle paths; or
    - Located on the grounds of a historic schools: one that is or has been the site of the school building(s) constructed before 1940.
4. If there are long-term energy use or transportation circumstances that make it more efficient to site the school in a centralized location to serve multiple districts, or between

schools, submit your own proposal showing why it is more transportation and/or energy efficient.

SS C4.1.2 *Availability of Public Transit System*

1 point Locate building within ¼ mile of a commuter rail, light rail or subway station, or within ⅛ mile of one bus line.

SS C4.1 IMPLEMENTATION

This criterion applies to new schools, a new building on an existing campus, additions and to major modernizations. A major modernization project and a new building on an existing campus may claim this criterion if the existing campus already satisfies the requirement, or if the site is expanded and satisfies the requirement.

For all cases, base calculations must include the total school population, not just the population of the new building, addition or the building(s) being renovated/modernized.

SS C4.1.1 *Proximity to Students & Community Services*

To earn this criterion, calculations must be based on the estimated school population when the school opens or when a new building on an existing campus opens. Develop a site map that identifies the school site and the location of the student population that the school supports. Draw a circle centered on the school using the mile requirement by school level listed in SS.6.1 as the radius.

Schools located near busy arterials or highways are encouraged to develop Walking School Bus programs – see also 6.1.2.

Verify that at least 50% of the school's students are within the circle.

Provide a map showing the ½ mile perimeter around the school and indicating the names and location of eight of the basic services listed in the criterion text box. The ½ mile radius may be drawn from EITHER the front entrance of the school, where the school driveway meets the public way, or from the front door of the school. The front door of the basic service identified on the map must fall within the ½ mile radius. Online tools such as MapQuest® or Google Maps™ may also be submitted as documentation of the ½ mile radius.

Submit a proposal showing why a particular school siting is more transportation and/or energy efficient than other locations.

SS C4.1.2 *Availability of Public Transit System*

The energy use and pollution associated with transportation often dwarfs the total lifetime energy used by the school itself. Locating the site close to public transportation, encouraging use of public transportation and carpooling by minimizing parking, and creating bike facilities and safe walking/biking access, all reduce the automobile-related pollution (see SS C6.1). Some school districts offer reduced or subsidized fares for students and staff using public transportation. If sufficient capacity exists, schools can use public transportation to replace district-provided bus service.

SS C4.1 DOCUMENTATION

DESIGN REVIEW

SS C4.1.1 Provide an explanation or methodology, and appropriate back up for the option chosen.

Provide a map showing the required features and distance to the school.

If an alternative analysis was completed during the environmental review process, this document can provide basis for school site selection.

SS C4.1.2 Provide an area map locating transportation lines within the distance to school as noted. Measure from the main entrance of the school building (i.e. front door), and mark bus stops or stations for commuter rail, light rail, or subway lines.

CONSTRUCTION REVIEW

N/A

SS C4.1 RESOURCES

1. US EPA's Smart Growth site: www.epa.gov/smartgrowth
2. US Census Bureau Population Information: https://www.census.gov/cps/data/cpstablecreator.html
3. Center for Cities and Schools: http://citiesandschools.berkeley.edu/

SS C5.1 JOINT USE OF FACILITIES

Intent

Allow for more community and neighborhood integration within the school facility and grounds.

Community common-pool resources such as school facilities and grounds, park and recreation space (for example, habitat areas, playgrounds and athletic fields), parking lots, gardens and libraries are shared with the community. Joint-use of school facilities is a growing trend. Increasingly, schools are making their facilities available to community groups during and/or outside school hours, providing mutual benefits to both the school and the community. [1, 2]

The benefits of sharing community common-pool resources have been well documented (Elinor Ostrom, et al), and include social benefits such as communication, trust, cooperation, security, ecological benefits and cost sharing (resource costs such as energy and water use, capital and operating costs).

In planning for shared community common-pool resources, care must be taken to provide for programmatic and operational needs. For example, a school campus shared with joint-use programs must be able to maintain separate access and security between the main campus student areas and the after-hours community joint-access areas. Another example would be a parking lot that could well serve multiple community needs on a 24/7 basis. Similarly, a school garden could be made accessible to qualified community members.

Joint-use facilities may be owned and/or maintained by other organizations or agencies, but be available for school use. If so, the contractual agreement(s) must clearly provide for the long-term benefit to the school community.

SS C5.1 JOINT USE OF FACILITIES

CREDIT

1 point

APPLICABILITY: All projects

VERIFICATION: Design

SCORING: 1 point for either 5.1.1 or 5.1.2

SS C5.1 REQUIREMENTS

SS C5.1.1 *Interior Joint Use*

1 point

With community involvement, design one or more interior spaces totaling at least 2,500 sf for use by the community-at-large or appropriate organizations but still owned and maintained by the school. The plans shall designate this area as the "Joint Use Area." Design of the Joint Use Area must include features to keep the rest of the building and occupants separated and secure and must provide access to toilet facilities without compromising security of the non-public portions.

AND do any of the following:

- Provide a separate, independently secured entrance for the Joint Use Area.
- If the Joint Use Area is operated by a non-school entity, provide a separate entrance and bathroom facilities independent of the school use portions of the facility. To qualify, the third party must use the facility on a regular (at least weekly) basis.

- Share at least 75% of library space, based on total availability, with the community as a community library. There are no additional security requirements for this option. The 75% of library space may count towards the 2,500 sf.

OR

SS C5.1.2 *School Grounds Joint Use*

1 point Do any two of the following:

- Share at least 75% of school grounds based on total square feet of availability with the community.
- Share at least 50% of parking spaces, based on total availability, with the community and make those spaces available outside school hours.
- Share at least 75% of garden space, based on total availability, with the community and make that space available to community members.

SS C5.1 IMPLEMENTATION

A new building on an existing campus can claim this criterion only if the building is designated as a "Joint Use Area" and the above requirements are satisfied for the whole campus. A renovation/modernization project can claim this criterion if new measures are taken or if the existing campus already satisfies the requirements. Schools with special needs facilities may request a variance based on circumstances.

SS C5.1.1 *Interior Joint Use*

The most successful schools have a high level of parent and community involvement, but there is a need to control access for security reasons. Therefore, this involvement can be enhanced if a school is designed so that neighborhood meetings, recreation activities, and other community functions can take place at the school in a safe and secure fashion.

Building or renovating a school provides an opportunity for the community to incorporate community programs and services into the building program. During the planning stages, school districts should give careful thought to the types of programs, services, and facilities they may wish to offer via the future school building (e.g., library services, recreation services, meeting space, space for special events, etc.).

Other strategies that contribute to shared use of the school building include designing separate entrances for spaces likely to be shared, adjusting building orientation and layout to separate classroom and administration areas from shared spaces, planning for shared kitchen and toilet facilities, and designing special features into the school that the community can use.

Alternately, the school can incorporate spaces owned and operated by other entities, but make them available for direct access from the school during school hours. These spaces must incorporate separate security and may include separate toilet facilities if school-site facilities are not directly available.

To earn this criterion, the physical design must incorporate measures to facilitate joint-use while providing security for the school. Provide doors or security gates to close off portions of the school that are used during non-school events.

If the joint use facility is administered by another entity, provide a copy of the formal agreement between the school district and outside entity on joint use of facilities, including any operations/maintenance provisions and provide copies of applicable insurance policies for use of the facilities by the school if the spaces are owned and maintained by others.

Joint-use facilities owned by other entities will be considered for this criterion only if use by the school occurs on a regular (at least weekly) basis. Provide a description of contractually approved use pattern by the school.

Share at least 75% of library space based on total availability, with the community, and make that space available during normal library operating hours as a community library.

Joint use of library space provides both social and ecological benefits. Socially, it provides a place for community social interaction, communication, and building relationships of mutual trust and cooperation. Furthermore, it provides for a node for local information resource sharing. Ecologically it mitigates climate change by reducing redundant facilities.

SS C5.1.2 *Joint Use of School Grounds*

Joint use of school facilities and grounds is a growing trend across the country. This criterion is intended to encourage schools to share their outdoor space with the community at large or vice versa – to encourage municipalities to allow schools to use local parks, in lieu of having the school construct separate facilities. Either arrangement allows the community to optimize resources dedicated to community common pool needs.

Urban schools lacking adequate outdoor space may consider use of off-site public park and recreation space to comply if such space is within a safe, walkable 1/8 mile route.

Joint use of parking facilities provides both social and ecological benefits. Socially, it provides a node for safe interaction. Ecologically it limits disruption of the landscape, reduces heat island effects and reduces stormwater runoff by minimizing construction of impervious paving.

Joint use parking facilities will only be considered if 50% of a school's parking lot capacity is used by an outside organization on a regular basis, or 50% of the school's parking requirement is satisfied by use of another organization's parking lot.

Share at least 75% of garden space (based on total availability) with the community, and make that space available on a 24/7 basis to qualified community members.

Joint use of garden space provides both social and ecological benefits. Socially, it provides a place for community social interaction, communication, and building relationships of mutual trust and cooperation. Furthermore, it provides for local food security. Ecologically it mitigates climate change by protecting soil fertility, biodiversity, water management, and so forth.

Joint-use garden space will only be considered if 75% of a school's garden space is shared (based on total availability) with the community, and that space is made available to community members. Provide a calculation and a schedule of use substantiating this requirement.

SS C5.1 DOCUMENTATION

DESIGN REVIEW

Provide a letter signed by the project architect and school superintendent, indicating features of the school that enhance its shared use with the community.

SS C5.1.1 CDs must include a site plan that identifies the "Joint Use Area" and the bathroom facilities that can be accessed without compromising the security of the non-joint-use portions of the facility.

Provide a copy of the formal Joint Use agreement between the school district and the other entity and copies of applicable insurance policies for use of the space, if relevant. Include maintenance and operations provisions in any agreement.

SS C5.1.2 CDs must include a site plan that identifies the area of recreation space available for joint-use. A calculation must be provided on the sheet that includes the total amount of recreation and park space available, and the percentage of that space available for joint-use.

Provide a copy of the agreement between organization(s) and school district, school principal, or school board to provide joint use, if relevant. The agreement should be signed by both parties and state the facilities/parks to be used and for what purpose. Alternatively, provide copies of applicable insurance policies governing use of the parks or recreational space by the municipality or by the school if the spaces are municipally owned.

CONSTRUCTION REVIEW

N/A unless anything not provided at Design Review.

SS C5.1 RESOURCES

1. US EPA SMART Growth, benefits of Smart Growth provisions: www.epa.gov/dced/basic_info.htm
2. New Schools Better Neighborhoods offers information on the benefits of joint-use facilities, examples of join-use projects, joint-use analysis, recommendations, and policies: www.nsbn.org/case/jointuse/.

SS C6.1 HUMAN-POWERED TRANSPORTATION

Walking, biking, and using scooters and skateboards are a popular and pollution-free form of transportation. When encouraging the use of bicycles, it is important to encourage the safety of pedestrians and bicyclists by providing bike lanes and sidewalks.

Intent

Encourage alternative transportation methods to and from school that increase physical activity, improve health, and reduce dependence on fossil fuels.

SS C6.1 HUMAN-POWERED TRANSPORTATION

CREDIT

1-2 points

APPLICABILITY: All projects

VERIFICATION: Design and Construction Review

SCORING: 1 point for 6.1.1, an additional point for 6.1.2 or 6.1.3

RELATED CRITERIA: SS C4.1 Central Location

SS C6.1 REQUIREMENTS

SS C6.1.1 *Bike Accommodation*

1 point

Provide sidewalks or walkways, and bike lanes that extend at least from the school entrance to the end of the school property.

Provide suitable means for the short-term securing of bicycles and scooters outside the school and for skates, skateboards and helmets indoors (including lockers and/or cabinets). The storage must be safe, convenient, and at accessible locations at the following ratio:

- Grades 4-12: 1.5 spaces for every 10 students planned capacity (2 spaces minimum)

For an additional point, do either 9.1.2 or 9.1.3:

SS C6.1.2 *Community Bike Lanes*

1 point

In addition to requirements of 9.1.1, collaborate with local organizations and the municipality to provide safe bike lanes that extend appropriately from the school site at least one mile into neighboring communities or access ways.

OR

SS C6.1.3 *Walking School Bus/Safe Routes to School*

1 point

Walking School Bus/Safe Routes to School: for elementary schools that also comply with SS C5.1 Central Location, provide an active Safe Routes to School Program involving parents, students, school and city traffic officers and transportation planners. Program can include walking school buses, bike trains, bike and walk skills training, bike helmet promotion and other active transportation encouragement events.

SS C6.1 IMPLEMENTATION

For a new building, addition or major modernization project to earn these points, the calculations must be based on the number of occupants for the entire campus, not the individual building or building(s) being modernized. A major modernization project, a new building on an existing campus, and an addition can also claim these points if the existing campus already satisfies the requirement.

Calculations must be based on the number of occupants for the entire campus.

SS C6.1.1 *Bike Accommodation*

The purpose of this criterion is to provide safe access to the school by students and staff who choose to walk or ride their bicycles to school.

To earn these points:

- Bike storage area must be in a prominent location that is easily viewable from a main administrative location or within 100' of a main entrance and accessible from the bicycle lane or route.
- Bike storage area must have sufficient electric lighting.
- Half of bike rack area must be protected from precipitation for schools in areas with more than 20 inches of annual precipitation. Projects are encouraged to employ photovoltaic panels as the roof structure.
- Racks must be fixed in place and must provide for locking of wheel and frame. Additionally, projects are encouraged to provide supplemental bike racks for visitors near the main entrance.

To earn these points, safe bicycle lanes must extend from the school entrance to the ends of the school property to protect and encourage cyclists. There should be no barriers (e.g., fences) on school property line at cycling routes/access points, unless gates that can be locked open during appropriate hours are provided. Work with the local authorities to extend the bike lanes beyond the project limits and across busy roads. Illustrate how site bike lanes relate to neighborhood use patterns. Bike lanes should be designed to accommodate significant traffic (lane width established by the local jurisdiction) and be separated from pedestrian sidewalks and parking.

As a supplement to encouraging bicycle use, projects are encouraged to provide skateboard lockers, racks, or other means of separately and safely storing skateboards, scooters, roller skates, and helmets. Where individual lockers or lockable racks are provided, reduce the required number of bike racks by the count of lockers or skateboard racks provided.

Grades K-3 are not included in the ratio. Long-term bicycle/scooter parking, such as indoor lockers or storage rooms, for staff and faculty is eligible for an Innovation point.

SS C6.1.2 *Community Bike Lanes*

In addition to the requirements of SS C6.1.1, provide a map showing the relationship of the school to existing or new bike lanes that extend at least one mile from the school site into neighboring communities.

SS C6.1.3 *Walking School Bus/Safe Routes to School*

Provide a description of a Walking School Bus / Safe Routes to School program including a map indicating route(s) and a statement of participant levels and school population. Provide a map indicating routes and showing the relationship of the school to existing or

new sidewalks that extend at least one mile from the school site into neighboring communities. Include organizational description listing how program will be implemented and maintained. Provide a written confirmation from the school district that they will institute at least a yearlong program.

SS C6.1 DOCUMENTATION

DESIGN REVIEW

Drawings must show the location and number of racks and storage and show bike lanes or bike paths to edge of school property. Complete the CHPS Human Powered Transportation worksheet.

CONSTRUCTION REVIEW

SS C6.1.1 Provide photo(s) of the features.

SS C6.1.2 Provide a map showing the relationship of the school to existing or new bike lanes that extend at least one mile from the school site into the neighboring community.

SS C6.1.3 Provide the Safe Routes to School Plan (SRTS). Include photos of strategies implemented to provide safe bike lanes or a network that extends appropriately from the school site at least one mile into neighboring communities or access ways.

SS C6.1 RESOURCES

1. Safe Routes to Schools http://www.saferoutesinfo.org/
2. Walking School Bus www.walkingschoolbus.org/

SS C7.1 REDUCE HEAT ISLANDS

Intent

Reduce heat islands to minimize impact on microclimate and human and wildlife habitat.

Heat islands raise temperatures and can impact school communities by increasing peak energy demand, air pollution levels, air conditioning costs, and heat-related illness. Note that the "heat island effect" is largely an urban phenomenon. Dark surfaces, such as pavement, cladding, and roofing absorb heat and radiate it back to surrounding areas. In a city, where there are many dark, heat absorbing surfaces, infrared radiation can easily boost temperatures by 10˚F or more. The heat island effect increases the need for air conditioning (and therefore electricity consumption) and is detrimental to site plantings, local wildlife, and maintaining comfortable temperatures.

Cool roofs and cool walls can significantly reduce school cooling loads and urban heat island effects by reflecting the sun's energy, instead of absorbing, retaining, and radiating it into the occupied spaces below. This criterion is most beneficial for schools with significant cooling loads.

SS C7.1 REDUCE HEAT ISLANDS

CREDIT

1-3 points

APPLICABILITY: All projects

VERIFICATION: Design Review

SCORING: 2 points for 7.1.1; 1 point for any option in 7.1.2

SS C7.1 REQUIREMENTS

SS C7.1.1 *Non-Roof & Impervious Surfaces*

2 points

Provide shade (within five years) on at least 50% of non-roof, impervious surfaces on the site, including parking lots, walkways, plazas, etc.

OR

Use light-colored/ high-albedo materials (a Solar Reflectance Index* (SRI) of at least 29) for 50% of the site's non-roof, impervious surfaces.

OR

Use a combination of shading and high-albedo materials for 50% of the site's non-roof surfaces.

*SRI or Solar Reflectance Index is calculated according to ASTM E 1980. Reflectance is calculated according to ASTM E 903, ASTM E 1918 or ASTM C 1549. Emittance is calculated according to ASTME E 408 or ASTM C 1372.

SS C7.1.2 *Roofs & Walls/Trellises*

1 point

One point for any of the following options:

Cool Roof

Use roofing materials that have a Solar Reflectance Index (SRI) as listed below for roof type for a minimum of 75% of the roof surface. See Resources for an SRI calculator. [4]

Roof Type	Slope	SRI
Low-Sloped Roof	≤2:12	78
Steep-Sloped Roof	>2:12	29

OR

Vegetated Roof

Install a green or vegetated roof equal to at least 25% of the roof surface. Develop a guide and maintenance plan for the green roof. Vegetated Roofs using potable water or reclaimed water or using an in-ground irrigation system shall not be eligible for any points.

OR

Vegetated Wall/Trellis

Provide vegetated wall surface, shading from trees or other landscaping (within 5 years) or exterior shading device shading 30% or more of glazed surfaces that are not north facing, at 9:00am and 3:00pm at the equinox. Vegetated wall/trellis using potable water or reclaimed water for an irrigation system shall not be eligible for any points.

SS C7.1 IMPLEMENTATION

SS C7.1.1 *Non-Roof & Impervious Surfaces*

Employ design strategies, materials, and landscaping designs that reduce heat absorption of exterior materials. Note Solar Reflectance Index (SRI) requirements in the drawings and specifications. Provide shade using native or climate-tolerant trees and large shrubs, vegetated trellises, or other exterior structures supporting vegetation. Substitute vegetated surfaces for hard surfaces. Explore elimination of blacktop and the use of new coatings and integral colorants for asphalt to achieve light colored surfaces.

Where artificial turf is provided, provide turf with light aggregate to reduce heat island effect caused by black aggregate. Artificial turf will be considered impervious for the purposes of this criterion.

A site plan or landscaping plan should show trees that contribute to shade and/or highlight light-colored, non- roof impervious surfaces. Consider the latest recommendations and updates for climate ready trees and vegetation for the site(s) from such sources as the USDA and state university extensions in order to reduce the climate vulnerability of vegetation to heat, drought, pests, flooding, etc.

Calculations:

Shading:

- Identify all non-roof impervious surfaces on the project site and sum the total area.
- Identify all trees that contribute shade to non-roof impervious surfaces. Highlight these trees on the plan you submit.
- Calculate the shade coverage provided by these trees after five years of growth on the non-roof impervious surfaces on June 21 at solar noon to determine the maximum shading effect.

- Determine the total area of shade provided for non-roof impervious surfaces. To calculate the percentage of compliant hardscape surfaces, divide the non-roof impervious surface area that is shaded by the total hardscaped area.

Light-colored/High-Albedo Materials:

- Identify all non-roof impervious surfaces on the project site and sum the total area.
- Calculate the total area of non-roof impervious surfaces designed with light-colored/high-albedo materials. Divide by total—result must be 50%.
- If light-colored/ high-albedo materials are used to achieve this criterion, provide specifications showing an SRI of 29 or better.

Note: Projects may achieve 50% coverage by adding together areas of shading and areas of light-colored/high-albedo materials to total 50%.

SS C7.1.2 *Cool Roofs*

Cool roofs can significantly reduce school cooling loads and urban heat island effects by reflecting the sun's energy, instead of absorbing, retaining, and radiating it into the occupied spaces below. Both the reflectivity and emissivity are important characteristics of cool roofs. A solar reflectance of 0.0 means that all the solar energy hitting the surface is absorbed and none is reflected. Emissivity is the ability of a material to shed infrared radiation.

Schools that do not have significant cooling loads (i.e. schools that do not have significant summer use), are not located in urban areas, or are in areas dominated by winter heating (northern plains) may not wish to pursue this criterion. In these cases, a cool roof can actually result in more energy use in the heating season than it will offset in cooling loads during the summer. Energy modeling can help predict which facilities would be likely to experience an energy benefit by installing a cool roof. To find qualifying roof products, see the Cool Roof Rating Council website at www.coolroofs.org.

While some solar panel systems shade roofing surfaces and decrease heat transmission through the roof, they differ in their emissivity. Projects that wish to earn credit for roof areas covered with solar panels in lieu of cool roofing materials must show reflectance and emissivity properties to assess overall SRI of roof + solar panel assembly.

Vegetated Roofs

Vegetated roofs have been found to significantly reduce both the heating and cooling loads of buildings on which they are implemented. While they may significantly reduce the urban heat island effect by not using traditional building materials, they can also provide increased insulation and help reduce heating costs in the winter months, unlike cool roofs, which can possibly increase a building's energy use during the winter. In addition to improving the insulation of a roof, green roofs greater than 3-inch soil thickness have also been found to considerably lengthen the lifespan of a roof and reduce stormwater runoff. In some cases, implementing a vegetated roof has been found to more than double the lifespan of a roof.

Green roofs may be difficult to implement on existing structures due to limitations on the weight load of the existing roof. Retrofitting roofs with certain types of green roofs may not be possible because the substrate and vegetation placed on the roof will exceed permitted static loading. In addition to issues concerning weight load, waterproofing the existing roof structure can potentially be an obstacle because of the amount of water retained on the roof and the potential for roots to penetrate the waterproof membrane. For an informational database containing more information on the implementation and different kinds of green roofs that exist, see http://www.greenroofs.com/.

Vegetated Walls

Green walls, shading from trees or other landscaping or exterior shading device can shade glazed areas and prevent intrusion of sunlight into spaces that experience cooling loads. Like cool roofs, care should be taken to assess cooling vs. heating loads in order to determine the overall effect of planting on building energy use. Provide plans and sections to calculate the shading effect of green walls, landscape trees or vegetated trellises on glazing. Provide information about yearly duration of vegetation if deciduous and indicate expected growth within 5 years of planting.

SS C7.1 DOCUMENTATION

DESIGN REVIEW

SS C7.1.1 CDs, likely the landscaping plans, must provide the calculations described under the implementation section.

SS C7.1.2 Construction drawings, including a roof plan or landscaping plan, must include the square footage of total roof surface (including any existing roofs within the project boundaries) and the total surface covered by cool roof, or the size of green wall. For cool roofs, the specifications must include the CRRC Product ID#, emissivity and reflectance. For vegetated roofs and/or walls, details should be provided on the Construction Review.

CONSTRUCTION REVIEW

SS C7.1.2 Provide photo(s) of the installed cool roof(s), vegetated roof(s) and/or green wall(s).

SS C7.1 RESOURCES

1. US EPA Heat Island resources and strategies: www.epa.gov/heatisland/
2. Cool Roof Rating Council (CRRC): www.coolroofs.org
3. Solar Reflectance Calculator (SRI): coolcolors.lbl.gov/assets/docs/SRI%20Calculator/SRI-calc10.xls
4. US EPA ENERGY STAR reflected roof products: www.energystar.gov/index.cfm?c=roof_prods.pr_roof_products
5. Lawrence Berkeley National Laboratory (LBNL), Heat Island Group resources: https://heatisland.lbl.gov/resources/guides
6. LBNL Winter heating penalty map: heatisland.lbl.gov/coolscience/cool-science-cool-roofs
7. Database of green roofs: www.greenroofs.com

SS C8.1 LIGHT POLLUTION PREVENTION

Night lighting represents a significant source of energy use on campuses and can adversely affect the nighttime environment, while well-designed lighting can ensure safety, security, and beneficial use of properties. Avoidance of unnecessary lighting reduces resource use and minimizes the potential adverse environmental effects on the nighttime environment. Approaches may range from “dark campus” programs to careful controls on direction, intensity, duration, and spectrum of lighting.

Intent

Reduce or eliminate uses of artificial night lighting that are not needed or contribute to light pollution.

SS C8.1 LIGHT POLLUTION PREVENTION

CREDIT

1-2 points

APPLICABILITY: All projects.

VERIFICATION: Design and Construction Review

SCORING: 1 point each for 8.1.1 and 8.1.2

RELATED CRITERIA: EE P1.0 Energy Efficient Design, II C7.1 Safer Schools by Design

SS C8.1 REQUIREMENTS

SS C8.1.1 *Auto Controlled Outdoor Lighting*

1 point

All outdoor non-emergency lighting will be automatically controlled to turn off after hours. Provide manual override capability for after-hours use with timed automatic shut-off (dark campus scenario).

AND/OR

SS C8.1.2 *Outdoor Lighting Specifications*

1 point

All outdoor lighting for general illumination and color rendition shall be fully shielded, except decorative lamps, which may be partially shielded if less than 2000 fixture lumens or unshielded if less than 20 fixture lumens.

Total outdoor light output per acre shall not exceed 50,000 lumens per acre, of which only 5,000 lumens may be partially shielded or unshielded in rural or park settings or 100,000 lumens per acre of which only 10,000 lumens may be partially shielded or unshielded in all other settings. Sports fields are considered separately. See below.

Sports fields shall be considered Sports Class IV as defined by the illuminating Engineering Society of North America (IESNA) [1] and lighting of them considered Class 1 (Color Rendition) lighting. Illumination of sports fields is exempt from the lumens per acre limits, but shall be designed to achieve no more than the minimum illumination levels defined for Sports Class IV by the IESNA and use only fully shielded fixtures that permit no light to be emitted above the horizontal and be extinguished within 30 minutes of the end of play.

Except for areas requiring color rendition (e.g., sports fields), outdoor lighting for general illumination shall not have a color temperature exceeding 3200 K.

SS C8.1 IMPLEMENTATION

Light pollution will be moderated by the prerequisite EE P1.0 that requires controls to automatically turn off unnecessary interior and exterior lighting after hours.

SS C8.1 *Definitions*

Emergency Lighting

"Emergency Lighting" is considered any lighting required for occupants' safety in and around the building. Examples include:

1. Lighting providing the minimum required for the means of egress that must be maintained at all times any space served by the means of egress is occupied, and may not be controlled by motion sensors.

2. Lighting in areas designated as security or emergency areas. Parking lot lighting is not considered security lighting.

3. Emergency lights upon activation during loss of power.

4. Lighting in spaces where an automatic shutoff would endanger occupant safety or security.

Fully Shielded (Light Fixture)

A light fixture constructed in such a manner that all light emitted by the fixture, either directly from the lamp or a diffusing element, or indirectly by reflection or refraction from any part of the fixture, is projected below the horizontal. Any structural part of the light fixture providing this shielding must be permanently affixed, and part of the fixture, not part of any surrounding building or architectural elements.

Partially Shielded (Light Fixture)

A light fixture constructed and mounted such that most light emitted by the fixture, either directly from the lamp or a diffusing element, or indirectly by reflection or refraction from any part of the fixture, is projected below the horizontal. Light emitted at or above the horizontal direction (sideways or upwards) arises only from decorative elements or strongly colored or diffusing materials such as "honey" or colored glass or plastic. Fixtures using spot or flood lamps are considered partially shielded if the lamps are aimed no higher than 45 degrees above straight down (half-way between straight down and straight to the side).

SS C8.1 DOCUMENTATION

DESIGN REVIEW

SS C8.1.1 Specification section containing auto-control requirements.

SS C8.1.2 The plan should indicate the location and mounting height of all site building mounted exterior fixtures clearly indicated by fixture type designations relating to the lighting fixture schedule.

Fixture schedule with manufacturers and model numbers, and manufacturers spec sheets, with a clear description of the specified lamps, wattage, (Illuminating Engineering Society of North America) IESNA cutoff classification and shielding accessories for each fixture.

Provide site plan indicating all exterior lighting with different fixtures referenced. Provide exterior light fixture data indicating lumens, CRI, cutoff & color temperature, as appropriate. Provide calculation of lumens per acre.

Provide documentation that the total outdoor light output per acre does not exceed criteria requirements.

CONSTRUCTION REVIEW

SS C8.1.1 N/A

SS C8.1.2 Provide approved submittal with cover sheet and applicable materials or photos of installed fixtures.

SS C8.1 RESOURCES

1. IDA approved lighting fixtures: www.darksky.org/outdoorlighting/74-manufacturers
2. Illuminating Engineering Society (IES): www.iesna.org/
3. International Dark Sky Association: www.darksky.org/
4. Lighting Handbook, 10th Edition, by IES: www.ies.org/handbook/pdf/

MATERIALS & WASTE (MW)

MW P1.0 STORAGE & COLLECTION OF RECYCLABLES AND ORGANIC WASTE

Providing easily accessible recycling and composting to students, teachers and staff ensures a significant portion of solid waste can be diverted from landfills and incineration/transformation facilities. Diverting paper, cardboard, metals, plastics and organics diminishes the need to extract virgin materials and reduces the generation of greenhouse gases (GHG).

Intent

Facilitate the separation and collection of materials for recycling and composting.

MW P1.0 STORAGE & COLLECTION OF RECYCLABLES AND ORGANIC WASTE

PREREQUISITE

2 points

APPLICABILITY: All Projects

VERIFICATION: Design and Construction Review

SCORING: 2 points total for one of the three conditions below.

MW P1.0 REQUIREMENTS

MW P1.0 *Condition 1: Local Recycling/Composting Ordinance*

School jurisdiction has a local recycling and/or composting ordinance.

The school building site must meet or exceed the requirements of the lawfully enacted local ordinance for recycling space.

For this section, recycling also includes the composting, anaerobic digestion, chipping, grinding, etc. of organic waste. “Organic waste” means green waste, landscape and pruning waste, and nonhazardous wood waste. For the purpose of the criterion, food waste is not included in the definition of organics. Food waste is covered in MW C1.1.

Provide easily accessible areas serving the entire school that are dedicated to the collection and storage of materials for recycling. There must be at least one centralized collection point (e.g. loading dock or other common area where waste is typically collected), and ability for separation of recyclables and organic waste where waste is disposed of for classrooms and common areas such as cafeterias, landscaped areas, gyms or multi-purpose rooms. The team must provide a copy of the ordinance.

Provide means for recycling inside each classroom. Administration areas must have one central recycling station set up per 20 employees.

When local waste service providers have ability to divert food waste, provide means for collection of organic waste in food preparation and dining areas.

MW P1.0 *Condition 2: Recycling Services Without Ordinance*

School jurisdiction does not have a local recycling and/or composting ordinance but local recycling or composting services are available to the school district.

For this section, recycling also includes the composting, digestion, chipping, grinding, etc.

of organic waste. “Organic waste” means green waste, landscape and pruning waste, and nonhazardous wood waste. For the purpose of this section, food waste is not included in the definition of organics unless food waste recycling collection is available within the school’s region.

Provide easily accessible areas serving the entire school that are dedicated to the collection and storage of materials for recycling. There must be at least one centralized collection point (e.g. loading dock or other common area where waste is typically collected), and ability for separation of recyclables and organic waste where waste is disposed of for classrooms and common areas such as cafeterias, landscaped areas, gyms or multi-purpose rooms.

Provide means for recycling inside each classroom. Administration areas must have one central recycling station set up per 20 employees.

When local waste service providers have ability to divert food waste, provide means for collection of organic waste in food preparation and dining areas, wherever applicable. Credit for food waste composting on-site or off-site given in MW C1.1.

MW P1.0 *Condition 3: No Ordinance or Services*

School jurisdiction does not have a local recycling and/or composting ordinance and no recycling or composting services are available to the school district.

If there is no recycling or composting infrastructure within the boundaries of the school district, or if the diversion of waste is economically infeasible given the school district’s budget, then the project is exempt from this prerequisite. If a recycling and/or a composting program is established for this project, then the project should consider applying for an innovation credit.

MW P1.0 IMPLEMENTATION

For sizing guidelines on spaces for storage and handling of recyclable and organic material, CHPS has adopted CalRecycle’s *Recycling Space Allocation Guide.* [1] The school may follow state or local guidelines or ordinances, if applicable.

Early in the design phase, be sure to reserve space for recycling functions and show areas dedicated to the collection of recyclable and organic materials on floor plans. Consider the question of how recyclable materials will be collected and removed from classrooms, teachers’ prep rooms, and offices. When recycling bins are used, they should be able to accommodate a 75% diversion rate (from normal waste basket contents) and be easily accessible to students and staff as well as custodial staff. Consider bin designs that allow for easy cleaning to avoid health issues. Consider how custodial or food service daily or weekly operations can be utilized for an organic waste program for landscape waste and food.

MW P1.0 DOCUMENTATION

DESIGN REVIEW

Site and classroom plans must include the centralized collection point and recycling bins/dumpsters/areas in classrooms and common areas such as cafeteria or multi-purpose room. Identify if there is a local ordinance.

For Condition 3, provide documentation that specific services do not exist to justify why space for the material is not provided.

CONSTRUCTION REVIEW

Provide photos of the centralized recyclables and organic wastes collection point and typical classroom/common area recycling bins/dumpsters.

MW P1.0 RESOURCES

1. CalRecycle Recycling Space Allocation Guide: https://www2.calrecycle.ca.gov/Publications/Details/832
2. US EPA School Recycling: https://archive.epa.gov/wastes/conserve/tools/localgov/web/html/school.html
3. US EPA List of Common Recyclables: www.epa.gov/recycle/how_recycle.html
4. US EPA Food Waste: https://www.epa.gov/sustainable-management-food
5. Grasscycling: www.calrecycle.ca.gov/organics/grasscycling/
6. US EPA Toolkit for Starting a Recycling Program

   https://archive.epa.gov/region4/rcra/mgtoolkit/web/html/improving.htmll
7. Foam Recycling Information for Schools: https://www.homeforfoam.com/schools

MW C1.1 FOOD WASTE REDUCTION AND PREVENTION

Food waste is the single largest component of waste disposed in landfills, where it generates methane--a greenhouse gas that is 72 times more potent than CO_2. [1] Preventing food waste is not only the best way to keep edible food from being thrown away but it is also the best way to reduce the damaging environmental impacts food waste has on our world.

Intent

Reduce the amount of edible and non-edible food waste going to the landfill.

MW C1.1 FOOD WASTE REDUCTION AND PREVENTION

CREDIT

1-3 points

APPLICABILITY: All Projects

VERIFICATION: Design Review and Construction Review

SCORING: 1 point each for any of 1.1.1-1.1.3

MW C1.1 REQUIREMENTS

MW C1.1.1 *Share Table*

1 point

Reduce the amount of edible food wasted by providing a space within the eating area for a "share table" or other space for students to place and remove unwanted packaged or pre-portioned food. This area may include both refrigerated and non-refrigerated space where the contents are visible from the outside and readily accessible to students. (1, 2)

MW C1.1.2 *Storage & Donation*

1 point

Provide adequate space for the collection and storage of uneaten, edible food for recovery and donation to charitable organizations such as food banks, pantries, or other food recovery organizations, either on-site or to be backhauled to a central kitchen for consolidated collection. For schools serving food prepared at a central location, space should be large enough to hold several collection bins. Refrigerated space should be included to maintain freshness until collection.

MW C1.1.3 *Composting*

1 point

Provide adequate interior and exterior space for the collection and processing of food waste through an on-site or off-site composting system. Collection and processing systems should be sized to divert all food waste from the landfill by composting all scraps from food preparation and uneaten plated food.

MW C1.1 IMPLEMENTATION

Use the EPA's Food Recovery Hierarchy [7] to prioritize actions to take to prevent wasted food and to divert food waste from ending up in a landfill. This is a school-wide endeavor that involves students, teachers, school staff, nutrition, local health department, waste haulers and the community.

All non-edible food waste should be diverted from the landfill. According to the US EPA's Food Recovery Hierarchy, animal feed is the next best use, but may not be possible in

many areas. Composting on or off school grounds is a viable solution.

Food compost facilities on school grounds must be properly constructed and managed. Composting is the decomposition of organic materials, in this case food scraps from food preparation in the kitchen and left over food on plates. Composting food waste helps to keep the organic materials out of the landfill and turns the wasted food into a product that can be useful as a soil amendment.

On-site composting facilities can reduce the cost of hauling materials and are usually exempted from solid waste regulations. Consult state and local jurisdiction authorities for composting regulations and guidance on permit requirements prior to beginning a compost project. Or contract with a local food waste hauler. [8]

Preventing Edible Food from Being Wasted

Schools across the nation are educating students about preventing food from being wasted. This starts by taking only what they will eat and understanding what edible food can be shared with other students or donated to local food banks or pantries.

Successful implementation of an edible food recovery program though sharing and donation hinges on several factors, including:

1) health department approval

2) school district approval and commitment

3) providing adequate space for collection

4) distribution to recipient organizations

5) education

6) staff input

Providing adequate, accessible space is best provided in the design phase of the project. Both USDA and StopWaste (5,6) provide tips on where to place share tables. Support staff responsible for managing the program should be consulted. Local food banks and pantries can explain any requirements they have for providing adequate space for collection of food to be donated.

Considerations should be made early in the design phase for the varying eating habits of the grades being served by the school.

MW C1.1 DOCUMENTATION

DESIGN REVIEW

Provide drawings showing the location of share table or recycling infrastructure.

CONSTRUCTION REVIEW

Provide up to 3 photos showing composting spaces, collection bins, or share table, etc.

MW C1.1 RESOURCES

1. Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report 2007: Working Group I: The Physical Science Basis: https://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html

2. US EPA Guide to Conducting Student Food Waste Audits: A Resource for Schools: https://www.epa.gov/sustainable-management-food/guide-conducting-student-food-waste-audits-resource-schools
3. US EPA Sustainable Management of Food: https://www.epa.gov/sustainable-management-food
4. US EPA How to Prevent Wasted Food Through Source Reduction: https://www.epa.gov/sustainable-management-food/how-prevent-wasted-food-through-source-reduction
5. USDA The Use of Share Tables in Child Nutrition Programs: https://www.fns.usda.gov/use-share-tables-child-nutrition-programs
6. StopWaste: HELPING SCHOOLS SAVE FOOD: Food Share Table http://www.stopwaste.org/resource/food-share-table-guide
7. US EPA Food Recovery Hierarchy: https://www.epa.gov/sustainable-management-food/food-recovery-hierarchy
8. US EPA Reducing the Impact of Wasted Food by Feeding the Soil and Composting: https://www.epa.gov/sustainable-management-food/reducing-impact-wasted-food-feeding-soil-and-composting

MW C2.1 CONSTRUCTION SITE WASTE MANAGEMENT

Intent

Divert construction and demolition waste from landfills.

This criterion is very feasible in many parts of the United States. Even if there are limited recycling facilities or waste management recycling companies in the project area, construction waste management can still take place through a sub-contractor sorting the waste into multiple dumpsters. The cost is then associated with the dumpster costs and hauling charges. Recycling construction and demolition (C&D) materials reduces demand for virgin resources and diminishes the need for landfill space. Meet local ordinance requirements concerning C&D materials at construction sites, if applicable; and develop and implement a C&D waste management plan, quantifying material diversion by weight.

MW C2.1 CONSTRUCTION SITE WASTE MANAGEMENT

CREDIT

1-4 points

APPLICABILITY: All Projects

VERIFICATION: Design and Construction Review

SCORING: 1-3 points for 2.1.1 or 4 points for 2.1.2

MW C2.1 REQUIREMENTS

MW C2.1.1 *Recycle, Reuse, Salvage*

1-3 points

Recycle, reuse, and/or salvage at least 50% (by weight) of non-hazardous construction and demolition waste, not including land clearing and associated debris. Points are awarded according to the table. Percentages between thresholds are implied.

Percent Recycled/Salvaged	Points
50%	1
75%	2
90%	3

OR

MW C2.1.2 *Waste Recovery Plan*

4 points

Develop a comprehensive Waste Recovery Plan such that a minimum of 50% (by weight) of non-hazardous construction and demolition waste, not including land clearing and associated debris, is reused or salvaged by donating or selling to a reuse organization within 1000 miles.

MW C2.1 IMPLEMENTATION

Successful salvage, recycling, and diversion of construction and demolition materials is usually the result of a well thought out waste management plan and on-site training for contractors and subcontractors.

Compliance calculations for this criterion must be based on weight. Many recycling and landfill facilities weigh incoming materials. Shipments that cannot be weighed can be estimated based on their volume and density.

$$\text{Recycle Rate (\%)} = [\text{Recycled Waste [Tons]} \,/\, (\text{Recycled Waste [Tons]} + \text{Garbage [Tons]})] \times 100$$

Note: DO NOT include materials classified as hazardous wastes in these calculations. The Construction Waste Management Plan should detail the following components:

- The diversion percentage goals for C&D wastes, e.g., 75%. A 90% recycling rate will receive additional points.
- Recycling/reuse strategies and processes for onsite recycling, deconstruction and salvage, e.g., scheduling of different stages of deconstruction to best remove recyclable or salvageable materials intact.
- On-site communication: the general contractor will detail communication strategies for construction workers and subcontractors about the recycling program and goals.
- Waste management documentation: The construction waste management plan will specify documents needed to show waste diversion—e.g., weight tickets for all wastes removed from the site including recycled and salvaged materials.
- Recycling summary: Recycling and waste data will be collected into a summary document for construction documentation.

For projects pursuing MW C2.1.2, include a section called "Waste Recovery Plan" in the Construction Waste Management Plan. Identify reuse organizations within 1000 miles that will purchase or accept the donation of construction waste for reuse. The identified organization must intend to reuse the waste as-is or sell the material for the intent of re-use.

During construction, collect the receipts from the reuse organization that shows the donated or sold items and weight of the donated or sold items form construction & demolition recycling waste.

MW C2.1 DOCUMENTATION

DESIGN REVIEW

MW C2.1.1 CDs must include general notes to the Contractor to implement a Construction Waste Management Plan. The notes should specify the required diversion rate through recycling, composting or salvage, compliant and preferred facilities to receive the debris, and that they are responsible to maintain documentation (weight tickets / receipts) for all debris leaving the site to be summarized and submitted after construction as a diversion summary.

MW C2.1.2 Provide a copy of the plan. May be submitted at Construction Review.

CONSTRUCTION REVIEW

MW C2.1.1 Provide a diversion summary and back up documentation for where debris was taken.

MW C2.1.2 A copy of the plan, if not submitted at Construction Review.

MW C2.1 RESOURCES

1. Whole Building Design Guide, *Construction Waste Management*, 10/17/2016: https://www.wbdg.org/resources/construction-waste-management

2. US EPA C&D: https://www.epa.gov/smm/sustainable-management-construction-and-demolition-materials

MW C3.1 CERTIFIED WOOD & RECYCLED CONTENT MATERIALS

Sustainably sourcing materials is an important component of healthy, green schools. Wood grown and harvested in an ecological manner is a truly sustainable material that is renewable, biodegradable, energy efficient and recyclable. The Forest Stewardship Council (FSC) guidelines help to ensure wood is grown and harvested with responsible forest management practices. [5]

Intent

Reduce the environmental impacts associated with harvesting or extraction and processing of wood and virgin materials.

The number and variety of products using recycled-content materials expands every year. Using these materials closes the recycling loop by creating markets for materials collected through recycling programs across the country. It also reduces the use of virgin materials and landfill waste. Recycled-content alternatives exist for all major building materials and surfaces. Recycled content may contain hazardous materials, however. Products with recycled content, including crumb rubber, must not contain lead, other heavy metals, or other contaminants.

MW C3.1 CERTIFIED WOOD & RECYCLED CONTENT MATERIALS

CREDIT

1-3 points

APPLICABILITY: All Projects

VERIFICATION: Construction Review

SCORING: 1 point for 3.1.1 and/or 1-2 points for 3.1.2

MW C3.1 REQUIREMENTS

MW C3.1.1 *Certified Wood*

1 point

Use a minimum of 50% of wood-based materials, by cost, certified in accordance with one of the following programs. This includes, but is not limited to, framing, flooring, finishes and built in cabinetry.

- Forest Stewardship Council (FSC) [5]
- NWFA Responsible Procurement Program (RPP) for flooring products only [6]

MW C3.1.2 *Recycled Content*

1-2 points

Select one of the following approaches to identify materials specified with recycled content:

Prescriptive Approach:

For 1 point, specify and install at least four major materials from Table MW3-1, Minimum Recycled Content Levels. For 2 points, specify and install at least eight major materials.

OR

Performance Approach:

The weighted average recycled-content value by cost is at least 10% (post-consumer + ½ pre-consumer) for 1 point or at least 20% for 2 points.

MW C3.1 IMPLEMENTATION

Compliance for this credit may be demonstrated by selecting a CHPS Pre-Approved product, as applicable, listed in the CHPS product database at ZeroDocs.com. [2]

MW C3.1.1 *Certified Wood*

Refer to one of the wood certification programs listed above for wood building components that comply with the requirements and incorporate them into the material selection for the project.

The National Wood Flooring Association [4] has developed the Responsible Procurement Program that provides a management structure for wood sources to transition over time to meet the Forest Stewardship Council (FSC) standards. CHPS encourages other wood industries to develop similar improvement plans.

To perform the calculation for this criterion, determine the cost of total new wood-based products and the cost of certified wood-based products. Exclude all labor costs, project overhead and fees. Divide the total cost of certified wood products by the total cost of all new wood products that are incorporated into the permanent construction. Multiply this result by 100 to determine the percentage of wood products that are certified. Be sure to use the total wood products cost for the project in the denominator of the calculation equation.

$$\text{Certified Wood Material Portion [\%]} =$$

$$\text{Certified Wood Products Cost [\$] / Total New Wood Based Products Cost [\$] x100}$$

MW C3.1.2 *Recycled Content*

Recycled content is either a post-consumer (collected from end users) or secondary material. Pre-consumer, also known as post-industrial or secondary, waste is collected from manufacturers and industry. The objective of this criterion is to maximize post-consumer recycled content; therefore, pre-consumer recycled content is discounted 50% for the calculations.

Recycled content claims must be in accordance with the International Organization for Standardization document ISO 14021:2016 – Environmental labels and declarations.

A "major" material is defined as those materials covering more than 50% of a major building surface (such as parking areas, floor, roof, partitions, walls) or serving a structural function throughout the majority of the facility or area. For example, credit would not be issued if tackable wall panels were used in only one classroom. Recycled content products with minimum recycled content levels must be used throughout the project.

Fly ash generated from municipal solid waste incinerators is not an acceptable recycled content material under this criterion, nor is fly ash generated as a coal combustion by-product where the coal plant is fired with hazardous waste, medical waste or tire-derived fuel.

Mercury concentration should not be more than 5.5 ppb (0.0055 mg/L) as determined by a Toxic Characteristic Leaching Procedure (TCLP) following EPA 7470A. Most US fly ash has mercury content of 2 ppb or less. This is a level that is deemed acceptable for drinking water in the US and is safe for use in construction. Furthermore, when this mercury is bound in the matrix of construction materials, the scientific literature indicates that it does not leach out, even when subjected to more aggressive conditions than anticipated in real life. Certain combinations of coal types and power plant combustion may produce fly ash with higher mercury content, though this appears to be rare.

Specifications should include that products must not contain lead or other heavy metals. Crumb rubber should be avoided in playgrounds and in turf fields because of the risk of lead content. Recycled cork is an available and preferable option.

Note: If tire derived products are used indoors, they must also meet EQ C6.1 standards for low-emitting materials.

Prescriptive Approach:

Use Tab MW3-1 to identify the minimum required recycled content level for specified products. Either use the value to select products or calculate the recycled content of already selected products to determine if they meet the minimum.

Asterisked products must meet their minimum total recycled content level entirely with post-consumer content.

For all other products, pre-consumer content may count as half credit toward the minimum total recycled content required. For example, the 30% total recycled content requirement for acoustical ceiling tiles could be met by a product with 60% secondary content or one with 10% post-consumer content and 40% secondary recycled content.

$$\text{Total Recycled Content} = \text{Post-Consumer Recycled Content} + \tfrac{1}{2}\,\text{Pre-Consumer Recycled Content}$$

TABLE MW3-1: Minimum Recycled Content Levels[1]

Category	Product	Total Recycled Content	Post-Consumer Recycled Content
Building Insulation	Fiberglass Insulation	30%*	30%
	Cellulose Insulation (Including Cotton and Denim)	75%*	75%
Flooring	Nylon Carpet (Total) Weight	10%*	10%
	Polyester Carpet Fiber Face	25%*	25%
	Plastic	40%	0%
	Linoleum	40%	0%
	Vinyl	40%	0%
	Rubber (non-tire-derived)	40%	0%
	Tire-derived Rubber	50%*	50%
	Glass	50%*	50%
	Ceramic	45%	0%
Acoustical Ceiling Tiles and Wall Panels	Glass	30%	0%
	Recycled Newspaper, Slag Wool, Aluminum	30%	0%
Countertops	Paper	30%*	30%
	Glass	50%*	50%
	Ceramic Tile	45%	0%
Cabinetry	Medium Density Fiberboard	80%	0%
Wall Coverings	Tackable Wall Panels	100%*	100%
	Paint	50%*	50%

Aggregate Base and Subbase	Recycled Aggregate	50%	0%
Structural Concrete	Fly Ash, Rice Hull Ash, or other Pozzolanic Materials (See credit restrictions on claiming credit for fly ash.)	25%	0%
Structural Steel	Basic Oxygen Furnace (BOF) Produced Steel	25%*	25%
	Electric Arc Furnace (EAF) Produced Steel	56%*	56%
Shower/Restroom Partitions	Plastic	20%	0%
	Steel	25%	0%
Windows	Fiberglass Frame	15%	0%
Roofing Materials	Steel	25%	0%
	Aluminum	20%	0%
	Fiber (Felt) or Fiber Composite	50%*	0%
	Tire-derived Products	50%*	50%
	Plastic or Plastic/ Rubber Composite	100%*	100%
Playground Equipment	Plastic	90%	90%
	BOF Steel, EAF Steel	25%, 56%	25%, 56%
	Aluminum	25%*	25%
Playground Surfaces	Plastic	10%*	10%
	Tire-derived	100%*	100%
Landscaping Products	Compost, Co-compost, and Mulch	80%*	80%
Plastic Lumber and Timbers	Plastic	10%*	10%
Parking Stops	Plastic	10%*	10%
	Tire-derived Products	100%*	100%
Products not listed here but included in EPA Comprehensive Procurement Guidelines		per EPA CPG	per EPA CPG
Products not listed by EPA (To receive credit, products must have a life cycle assessment to ensure there are no environmental or health tradeoffs and must be worth at least 5% of total project material cost).		25%	0%

[1]Table MW3-1 is adapted from the US EPA Comprehensive Procurement Guidelines and from readily available industry information.
*Denotes products for which only post-consumer content is allowed in the calculation.

Performance Approach:

Another method to verify compliance with this criterion is to use the performance approach. The weighted average of recycled-content value is calculated using the following equations:

- Recycled Content Value (RCV): Calculate the Recycled Content Value of each product by multiplying the cost of the product by the percent of post-consumer recycled content and then adding the cost of the product multiplied by ½ of the percent of pre-consumer recycled content. Material Cost is the construction cost of each individual material excluding all labor costs, project overhead, and fees.

$$\text{RCV} = (\%\ \text{postconsumer recycled content x material cost}) +$$

$$(0.5 \times \% \text{ pre-consumer recycled content}) \times \text{material cost})$$

- Total Recycled Content Value: Total Recycled-content Value is the sum of the postconsumer and pre- consumer recycled-content value of all recycled-content products.

$$\sum \text{RCV} = \text{RCV Product A} + \text{RCV Product B} + \text{RCV Product C, etc.}$$

- Verify RCV of each recycled product DOES NOT exceed 25% of ∑RCV: If RCV of Product A is greater than 25% of ∑RCV, then 25% (∑RCV) must be substituted for the value of Product A in the Total Recycled Content Value equation. This step must be repeated for each product to verify that no one material accounts for more than 25% of the ∑RCV.

$$\text{RCV Product A} \leq (25\%)\ (\sum \text{RCV})$$

(If RCV of Product A is greater than 25% of ∑RCV, then 25% (∑RCV) must be substituted for the value of Product A in the Total Recycled Content Value equation. Repeat equation for each product.)

Weighted Average Recycled Content Value (%): The Weighted Average Recycled Content Value is calculated by dividing the Total Recycled-Content Value (∑RCV) by the Total Project Material Cost. The Total Project Material Cost is the construction cost of all materials excluding all labor costs, project overhead, and fees. A default value of 35% of the total construction costs can be used for the Total Project Material Cost.

$$\text{Weighted Average Recycled Content Value } [\%] =$$

$$\text{Total Recycled Content Value } [\$]/\text{Total Material Cost } [\$] \times 100$$

MW C3.1 DOCUMENTATION

DESIGN REVIEW

N/A

CONSTRUCTION REVIEW

If the product has a CHPS Pre-Approved Certificate, no submittals are necessary. Include the product in the CHPS Materials Worksheet provided after project registration and check the column marked *Pre-Approved*. Then complete all other relevant columns.

For all products, complete the CHPS Materials Worksheet and provide the following:

MW C3.1.1 Provide cut sheets for materials with the required recycled content. If the product has a CHPS Pre-Approved certificate, use the approved recycled content amount in the calculation.

MW C3.1.2 Provide proof of purchase and evidence of certification such as chain-of-custody or FSC or NWFA label for installed products.

MW C3.1 RESOURCES

1. For life cycle evaluations (EPDs and HPDs), see Scientific Certification Systems (SCS) Global Services: www.scsglobalservices.com/certified-green-products-guide or Sustainable Minds Transparency Catalog: http://www.transparencycatalog.com/

2. Free product search for CHPS Pre-Approved products on Zerodocs.com: https://zerodocs.com
3. US EPA's Comprehensive Procurement Guideline (CPG) Program: https://www.epa.gov/smm/comprehensive-procurement-guideline-cpg-program
4. Information about recycled content in steel: www.recycle-steel.org
5. Forest Stewardship Council Website at: www.fscus.org
6. National Wood Flooring Association – Responsible Procurement Program www.nwfa.org/rpp.aspx

MW C4.1 BUILDING REUSE

Some states have banned the disposal of construction materials from landfills, which forces schools to consider other ways of dealing with demolition waste, including whether to reuse any elements. [1] Reusing parts of the building can save significant money and resources while greatly reducing the amount of construction waste.

Intent

Reduce waste and costs by reusing the building envelope.

Care must be taken to ensure that any environmental hazards such as toxins, lead, and asbestos have been identified and addressed. The impact of the existing building envelope on many important high-performance areas such as space programming, energy performance, opportunities for daylighting, and indoor air quality must be considered too. Develop a list of benefits and tradeoffs, and make the decision to reuse exterior elements, interior materials, or salvaged materials based upon the overall, integrated design tradeoffs.

MW C4.1 BUILDING REUSE

CREDIT

1-2 points

APPLICABILITY: All projects that reuse the building shell.

VERIFICATION: Design and Construction Review

SCORING: 1-2 points for percentage reused

MW C4.1 REQUIREMENTS

Reuse large portions of existing structures during renovation or redevelopment projects. Maintain at least 25% of existing building structure and shell (exterior skin and framing, excluding window assemblies). Hazardous materials that are remediated as part of the project scope AND elements requiring replacement due to unsound material condition must be excluded from the calculation of the percent maintained. Points are allocated as follows:

- Maintain 25%-49% of existing structure and shell – 1 point
- Maintain at least 50% of existing structure and shell – 2 points

MW C4.1 IMPLEMENTATION

For new schools to satisfy this criterion, the new school must be in an existing (previously non-school) facility. For new buildings on an existing campus, this criterion would apply in the instance of an existing building, for instance a maintenance shed, being converted into conditioned space for classrooms, administration, or other school functions. In addition, this criterion pertains to a case where a building next to an existing school is purchased by the school district and converted into classrooms or other school space.

Percentage of reused structural materials (foundation, slab on grade, beams, floor and roof decks, etc.) and shell materials (roof and exterior walls) should be estimated in square feet. Average together the structural and shell reuse percentages. The average will be used to determine the overall reuse percentage for the building.

$$\text{Building Reuse (\%)} =$$

$$100 \times [\text{Reused (floor+ roof area + ground floor/slab) + Reused (exterior wall area excluding window assemblies)}] / [\text{Total (floor+ roof area + ground floor/slab) + Total (exterior wall area excluding window assemblies)}].$$

Note: This criterion will be subject to review if design changes are made affecting the amount of existing structure and shell that are retained.

MW C4.1 DOCUMENTATION

DESIGN REVIEW

Drawings or equivalent instructions to Contractor indicating demolition plans and features to remain.

CONSTRUCTION REVIEW

Maintain photos taken before and after of major or large reuse of structural or shell elements.

MW C4.1 RESOURCES

1. Massachusetts 310 CMR 19.017 prohibits certain construction and demolition materials (asphalt pavement, brick, concrete, metal and wood) from disposal, transfer for disposal, or contracting for disposal. Other states may have similar prohibitions.
2. US EPA information on reducing construction waste: https://www.epa.gov/smm/sustainable-management-construction-and-demolition-materials

MW C5.1 ENVIRONMENTAL PRODUCT DECLARATIONS

Environmental product declarations (EPDs) help manufacturers and specifiers make better decisions when selecting materials so that the materials used provide minimal impact on the environment and human health throughout their lifecycles.

Intent

Specify materials that have been evaluated for their lifecycle impacts on the environment.

Manufacturers and specifiers that are committed to understanding their products' impact on the environment and on human health should be recognized for their efforts.

MW C5.1 ENVIRONMENTAL PRODUCT DECLARATIONS

CREDIT

2 points

APPLICABILITY: All projects

VERIFICATION: Construction Review

MW C5.1 REQUIREMENTS

Select 10 products that contain a third party certified Environmental Product Declaration conforming to the requirements of ISO 14025 on Type III environmental declarations and/or ISO 21930 on environmental declarations of building products. The EPD must justify the omission of any impact category in narrative form within the document. Products may have an EPD to the European standard EN 15804 or an equivalent LCA for embodied carbon.

MW C5.1 IMPLEMENTATION

ISO 14025 Environmental Labels and Declarations -- Type III Environmental Declarations -- Principles and Procedures

ISO 14025 establishes the principles and procedures for developing Type III environmental declarations (EPD). [1] It specifically establishes the use of the ISO 14040 series of standards on life-cycle assessment in the development of these declarations. Type III environmental declarations prepared in accordance with this standard are intended to present quantified environmental life cycle product information to enable comparisons between products fulfilling the same function.

ISO 21930 Sustainability in Building Construction -- Environmental Declaration of Building Products

Building on the framework and requirements described in ISO 14025, ISO 21930 contains specifications and requirements for Type III environmental declarations (EPD) of building products. The standard recommends that Type III declarations for building products account for all life cycle stages of the product. Omission of life cycle stages must be justified.

ISO 21930 Requirements for At Least Three Life Cycle Stages:

- product stage (raw material supply, transport to production, manufacturing: "cradle to gate")

- building stage (transport to building site, building installation, use, maintenance and repair, replacement)
- end of life stage (demolition, transport, disposal / recycling)

ISO 21930 Minimum Requirements for VerifierCompetence (ISO 19011:2002, clause 3.14) including:

- Knowledge of relevant industry, product and product-related environmental matters
- Process and product knowledge of the product category
- Expert on LCA and methodology for LCA work
- Knowledge of the relevant standards in the field of environmental labeling and declarations, and life cycle assessment
- Knowledge of the regulatory framework in which requirements for environmental declarations have been prepared
- Knowledge of the program for Type III environmental declarations

Embodied Carbon – EN 15804 and Equivalent

Understanding the embodied carbon in construction materials is an important step toward reducing the climate footprint of buildings. EN 15804 is a European standard that may not be in wide use in the U.S.; however, it provides a path for selecting and specifying products. [7] Other methods for whole building life cycle analysis (WBLCA) may also be used in an EPD. EPDs that disclose embodied carbon are allowed here and in II C6.1 Low/Zero GHG School.

MW C5.1 DOCUMENTATION

DESIGN REVIEW

N/A

CONSTRUCTION REVIEW

Completed CHPS Materials Worksheet and approved submittal with cover sheet and applicable materials. Provide cut sheets for materials claimed to have the required environmental product declarations. Provide the environmental product declarations.

MW C5.1 RESOURCES

1. ZeroDocs Product & Specification Resource*: zerodocs.com
2. Sustainable Minds Transparency Catalog*: http://www.transparencycatalog.com/
3. Library of common chemicals and products, Pharos: https://www.pharosproject.net/
4. EPD International AB: https://www.environdec.com
5. Article explaining EN 15804 and embodied carbon: http://www.greenspec.co.uk/building-design/embodied-energy/

*Official CHPS' partner for pre-approved product listings

OPERATIONS (OM)

OM P1.0 FACILITY STAFF & OCCUPANT TRAINING

The design and construction of the school may incorporate all the latest high performance features, yet problems after occupancy can occur simply because important information is not transferred from the design and construction teams to the school facilities and maintenance staff or to the building occupants. Training for facilities and maintenance staff is essential to the performance of the building but is often not performed or is hastily completed.

Intent

Training is the foundation of effective maintenance programs and is an essential tool to maintain and receive the high performance benefits such as protecting indoor air quality, thermal and visual comfort and maintaining superior energy performance.

Training the teachers and administration staff in how they can control their room environments provides them with an important understanding that will also help the facilities staff keep the building performing optimally and help maintain good air quality and comfort in the classrooms.

OM P1.0 FACILITY STAFF & OCCUPANT TRAINING

PREREQUISITE

2 points

APPLICABILITY: All Projects

VERIFICATION: Construction Review

RELATED CRITERIA: EE P2.0 Commissioning, EQ C11.1 Controllability of Indoor Environment, WE P2.0 Outdoor Water Use Reduction, OM C5.1 Indoor Environmental Management

OM P1.0 REQUIREMENTS

Facility Staff Training and Operations & Maintenance Manual

Facility staff must receive training and operation & maintenance (O&M) documentation on all building systems included in the commissioning scope of work under the EE P3.0 Commissioning Prerequisite as well as systems related to high performance – lighting and shading controls, maintenance of finishes, green cleaning, etc., depending on the scope of the project.

Teacher & Administrative Staff Training and User's Guide

Teachers, administrators, and support staff must be provided with training on operations of lighting, heating, and cooling systems in classrooms, offices, gymnasiums, auditoriums etc. When the school opens, or the modernization is completed, provide training and a brief and easy to understand manual, kiosks, educational display, or demonstration area for school occupants on the high performance aspects of the school. A User's Guide, explaining basic systems operations, shall be developed and available either electronically for download or in a central school location.

OM P1.0 IMPLEMENTATION

Facility Staff Training and Operations Manual

Provide Operations & Maintenance training for facilities and maintenance staff on all major building systems from bulleted list in EE P3.0 Commissioning. It is typical to specify training requirements in the construction contract and subsequently, the general contractor arranges for equipment vendors, controls contractors etc. to teach building operators how to use and maintain their new equipment. The training may be overseen by the commissioning agent to ensure that the facilities staff receives the materials and hours of training stipulated in the construction contract. It is vital that facility and maintenance staff attend these training sessions.

Compile an Operations & Maintenance Manual. The manual should provide detailed O&M information for all equipment and products installed. It should be specifically written for maintenance and facility staff. The construction contractor typically furnishes the O&M manuals and the commissioning agent reviews the completed O&M Manual for completeness and clarity.

Teacher & Administrative Staff Training and User's Guide

Create a brief and concise (1-2 page) classroom "User's Guide" for teachers and administrative staff (see Appendix for example) explaining how to operate their room lighting and HVAC systems. It is ideal if the temperature settings are included in this users guide so that when occupants understand the limits of the HVAC system, they may file fewer complaints. A User's Guide should be posted in every room of the school.

Use the staff user's guide to conduct facility operations training for staff. Provide a short introduction for all school staff explaining how classroom systems work, such as lighting and temperature controls, particularly if classrooms that have operable windows and air conditioning systems and daylight harvesting. Include the process for requesting repairs or creating work orders for maintenance staff to keep the building functioning optimally.

Training should also address other ways the teachers and staff can maintain air quality, such as outfitting spaces with low emitting furniture, using green products for cleaning and activities, and utilizing natural ventilation when available.

OM P1.0 DOCUMENTATION

DESIGN REVIEW

N/A

CONSTRUCTION REVIEW

For facility and maintenance staff training, submit a copy of the O&M Manual and a written report that demonstrates completion of the training. The report shall include: the date of training, list of attendees, and a summary of what was covered. Meeting minutes, if any, may be submitted in lieu of a separate report.

For teacher and admin staff training, submit a copy of the User's Guide and a written report containing: the date of training, list of attendees, and a summary of what was covered. Meeting minutes, if any, may be submitted in lieu of a separate report.

OM P1.0 RESOURCES

1. ASHRAE Guideline 16: The HVAC Commissioning Process
2. ASHRAE Guideline 4: Preparation of Operations & Maintenance Documentation for Building Systems.
3. On-Demand Indoor Air Quality Training Webinars: https://www.epa.gov/iaq-schools/demand-training-webinars
4. Indoor Air Quality Master Class Professional Training Webinar Series: https://www.epa.gov/iaq-schools/indoor-air-quality-master-class-webinar-series-calendar#register
5. Indoor Air Quality Knowledge-to-Action Webinar Professional Training Series: https://www.epa.gov/iaq-schools/indoor-air-quality-knowledge-action-webinar-series-calendar

OM C2.1 POST-OCCUPANCY TRANSITION

Numerous post occupancy studies over the past decade have shown that a key cause of underperforming buildings is a lack of communication. Post-Occupancy Transition requirements aim to address this weakness by capturing feedback from users and operators and using that feedback to better communicate design intent and operation in a three-part process.

Intent

To ensure that facilities actually perform to design expectations and meet the Owner's operations requirements, by both obtaining user feedback and transferring design knowledge during the critical handoff phase after construction.

Reach Out – with a brief Post Occupancy Survey to obtain feedback shortly after training is complete.

Engage – in an integrated post-occupancy transition meeting 3 months after substantial completion. Review the results of the survey and ensure that the occupants understand how to control and best use their buildings, are comfortable, can work effectively, and have realistic expectations. The goal is to confirm that operators are efficiently running systems and meeting the needs of the users and that the entire group balances saving energy and staying comfortable, noise versus ventilation, daylight and shading devices versus the impact on energy use and technology systems, plug load and energy conservation.

Enhance - the feedback gained through this interaction helps the design team, school, and district facilities staff better understand users' needs and experience of the building to fine tune, de-bug, and correct systems and record lessons learned. This is an opportunity to create a virtuous circle to encourage the development of a body of knowledge and a process that helps the users into the future maintain a high performance environment and institutional knowledge, in spite of the usual obstacles of change of personnel, change of programs and the like.

OM C2.1 POST-OCCUPANCY TRANSITION

CREDIT

2 points

APPLICABILITY: All Projects

VERIFICATION: Construction Review

OM C2.1 REQUIREMENTS

Do both of the following:

Post-Occupancy Survey (POS)

Conduct a brief Post Occupancy survey for the project after the prerequisite (Facility Staff and Occupant Training) process is complete but within 3 months of occupancy. Survey must be given to all staff and faculty. Prepare the results for distribution at the Post-Occupancy Transition meeting.

Post-Occupancy Transition Meeting & Action Items

Conduct an integrated design and operations meeting 3 months after occupancy. Ensure the required representatives attend. Distribute the results of the POS for discussion; determine action items for adjustments to building systems and/or further education for occupants. The school or district must commit to complete the action items as determined the Post-Occupancy Transition Meeting within 9 months of occupancy to fine tune and correct systems.

OM C2.1 IMPLEMENTATION

The post-occupancy evaluation survey may be accomplished by using the CHPS occupancy survey template or a tool like the Center for the Built Environment's IEQ online surveys. [1, 2] The survey may also be developed in-house to conform to the needs of the project. The survey should be distributed to all staff and faculty.

The integrated design and operations meeting attendees should include design team, maintenance and operations staff representatives, user representatives – teachers and school staff representatives, school administration representatives, school custodian, and preferably student representatives.

Reference the Usable Building Trust website for talking points regarding effective approaches to post-occupancy surveys, user behavior, and transition for design and construction to operations. [3]

OM C2.1 DOCUMENTATION

DESIGN REVIEW

N/A

CONSTRUCTION REVIEW

Submit a copy of the Post-Occupancy Survey, Post-Occupancy Transition meeting notes and list of attendees.

Submit written confirmation that transition action items will be addressed within 9 months of occupancy.

OM C2.1 RESOURCES

1. CHPS Sample Occupancy Survey: provided on request
2. University of California, Berkeley, Research on Indoor Environmental Quality: https://www.cbe.berkeley.edu/research/research_ieq.htm
3. Usable Buildings Trust has guidance on occupancy surveys and using the feedback. A password is required for free downloads: https://usablebuildings.co.uk/
4. Energy Savings Plus Health Guide: https://www.epa.gov/iaq-schools/protecting-iaq-during-school-energy-efficiency-retrofit-projects-energy-savings-plus

OM P3.0 ENERGY & GHG PERFORMANCE BENCHMARKING

Intent

Track energy and water use and GHG emissions over time to ensure continued high performance, maximize savings, and monitor the climate impact of the building.

Benchmarking school energy use can be one of the most straightforward and simple methods available to help keep a school operating efficiently and equitably. Energy benchmarking typically shows how a school is operating compared to its peers or to itself—with multiple years of utility data—and shows how well a school operates from year to year. Good benchmarking systems account for yearly changes in weather and track energy use per square foot per year. Tracking water use is a companion to tracking energy use because of the inherent energy savings from water efficiency. GHG emissions are also easy to piggyback on energy tracking using standard multipliers. Some benchmarking tools calculate GHG emissions automatically.

OM P3.0 ENERGY & GHG PERFORMANCE BENCHMARKING PREREQUISITE

4 points

APPLICABILITY: All Projects

VERIFICATION: Design Review

RELATED CRITERIA: EE P1.0/C1.1 Energy Efficient Design

OM P3.0 REQUIREMENTS

The school must 1) adopt a policy of benchmarking to track its energy and water use and GHG emissions over time and 2) commit to conducting a post-occupancy analysis of the school's energy performance and water use after 1-2 years or perform recommissioning after 2-5 years.

OM P3.0 IMPLEMENTATION

Benchmarking

There are two options for benchmarking. The school/district must adopt a written policy identifying which option will be used and what the baseline year is. An additional point is available in II C4.1 School Master Plan for creating a GHG emissions baseline according to the protocol.

Benchmarking must be done at a minimum annually but can be done more frequently, such as seasonally.

Option 1: Portfolio Manager:

Use EPA's Portfolio Manager. Portfolio Manager generates an ENERGY STAR score from 1-100 using data on energy usage, space attributes, and operating hours. A school that achieves at least a 75 achieves the ENERGY STAR level. Schools using Portfolio Manager will need to go to the website, create an account, and follow the instructions for inputting data and generating reports. Portfolio Manager also tracks water and waste usage as well as GHG emissions. These elements are not required for this prerequisite but can be used towards the credit in OM C4.1.

Note: If a design project was saved in Portfolio Manager, the same project record can be used to add metered energy data. The tool will show a comparison of design and operating energy data for the school. For Renovations/Modernizations, use the first* year of metered data as the baseline year.

*The baseline year for the facility should be established after the start-time or commissioning phase has been completed to ensure that all equipment and systems are operating as intended.

Option 2: Self-Benchmarking or Other Benchmarking Tool:

2a.) Use the school's own energy model created at design of the building. If a model was done according to the guidelines contained in EE P1.0 and contains information on plug load and operating hours, it will provide the most suitable benchmark for the school. Utility data, including kWh, therms, and costs, must be tracked annually by the school, normalized using heating degree days, and organized in a way that allows them to be analyzed against the model, i.e. total costs over time must be calculated. Under this option, the school would need to use a different tool to track water usage and calculate GHG emissions.

2b.) If the school's utility, a state agency, municipality, or other local entity offers a benchmarking tool or service, use it in accordance with its provisions. Other third party tools are also allowed as long as they offer the ability to run comparisons over time and normalize data by space and heating degree days. Again, if water and GHG tracking is not included, the school will need to come up with its own system or identify a different third party system.

Post-Occupancy Study and Recommissioning

Committing to perform a post-occupancy analysis or to recommission the school years after it is designed and built to the CHPS Criteria helps ensure the high performance features of the school continue to provide benefits over the life of the school.

A post-occupancy analysis of resource use essentially combines recommissioning and benchmarking to evaluate the building's performance. Systems are typically checked to see how they are working and utility bills are recorded and evaluated against a baseline. The post-occupancy analysis must include, at a minimum, an evaluation of energy and water use and may include occupant or end-user surveys regarding thermal comfort, air quality, and acoustical comfort. The post-occupancy study should cover at least one full heating and one full cooling season.

Recommissioning involves having a commissioning agent re-check the systems after a couple years of operation. Recommissioning can be done by the original commissioning agent or by a different one, but should be performed by someone meeting the same qualifications described in EE P2.0. The scope of recommissioning should follow the original commissioning scope for testing and balancing and any other aspects that might be appropriate.

OM P3.0 DOCUMENTATION

DESIGN REVIEW

For all options, submit 1) a letter from the district identifying which benchmarking program will be used and commit to tracking energy performance after 1-2 years or perform recommissioning after 2-5 years and 2) a screenshot of the school's Portfolio Manager account or of the other tool used. For Option 2b, a brochure or other evidence will be accepted.

For Option 1, provide a screenshot showing the project registered in Portfolio Manager.

For Option 2a, identify the person who will be responsible.

For both 2a and 2b, identify how water usage will be tracked.

CONSTRUCTION REVIEW

N/A

OM P3.0 RESOURCES

1. US EPA Portfolio Manager: https://www.energystar.gov/benchmark
2. California Energy Commission, Bright Schools program: http://www.energy.ca.gov/efficiency/brightschools

OM C4.1 HIGH PERFORMANCE OPERATIONS & SYSTEMS MAINTENANCE PLAN

One of the prime methods to maintain, enhance or promote high performance operation is to monitor and benchmark the ongoing performance of existing schools once occupied. There are eight key metrics that should be tracked: energy efficiency, thermal comfort, visual comfort, indoor air quality, acoustics, waste reduction, water conservation, and greenhouse gas emissions.

Intent

Ensure that the school project meets its design intent in providing a healthy, efficient, and environmentally responsive place to learn and work. Keep key building systems properly maintained over time and ensure on-going performance and system life.

Other highly effective techniques to sustain high performance is by designation of key positions in a school system: A district wide manager to oversee energy and water usage, performance targets and coordinate efficiency policies and foster behavioral change; and, at the school site level, the designation of an advocate to promote these policies.

The Systems Maintenance Plan is one of the most important features of a high performance school since it establishes the practices that will continue to ensure the school is operated according to its high performance intent. The Systems Maintenance Plan is a key part of commissioning and has a strong connection to other energy efficiency performance items such as energy benchmarking.

OM C4.1 HIGH PERFORMANCE OPERATIONS & SYSTEMS MAINTENANCE PLAN

1-4 points

APPLICABILITY: All Projects

VERIFICATION: Construction Review

SCORING: 1 point each for 4.1.1 - 4.1.4

RELATED CRITERIA: EE P2.0 Commissioning, OM P3.0 Energy Benchmarking, OM C5.1 Indoor Air Quality Management

OM C4.1 REQUIREMENTS

OM C4.1.1 *Monitoring & Benchmarking*

1 point

Commit to monitor at least three metrics beyond energy efficiency and GHG (OM P1.0) for a minimum of 3 years post-occupancy. See Implementation for guidance.

AND/OR

OM C4.1.2 *Designated Resource Manager*

1 point

The school administration must designate a permanent energy and water manager(s) to set performance targets, monitor usage, and coordinate and support school level advocates.

AND/OR

OM C4.1.3 *Designated Advocate*

1 point

Designate a school-based advocate to provide education and awareness on energy and water reduction programs and targets to promote behavioral change.

AND/OR

OM C4.1.4 *Systems Maintenance Plan*

1 point

The administration must create a school Systems Maintenance Plan that includes an inventory of all equipment in the new or renovated school with a schedule of all preventative and routine maintenance needed. The plan should clearly define who is responsible for performing the task, as well as the overall management of maintenance activities. The inventory and plan should cover the following systems:

1. Electrical Systems
   - Lighting fixtures and controls (daylight, occupancy, timing switches, etc.)
   - On-site renewable solar electric or wind systems
   - Telecommunication systems
   - Electrical distribution systems
   - Life and safety systems
2. HVAC Systems
   - HVAC systems (such as hot water systems, chilled water systems, central air systems, ventilation systems)
   - Domestic hot water systems
   - Energy Management system
   - Renewable energy heating systems (if applicable)
3. Plumbing Systems
   - Flow control devices
   - Pumping systems
   - Special hazardous waste treatment systems (e.g. for lab wastes)
   - Domestic hot water systems
   - Graywater systems (if applicable)
4. Building Envelope and Roofing Systems (particularly acid management)
5. Significant Plug Loads
6. Other High Performance systems as applicable.

OM C4.1 IMPLEMENTATION

OM C4.1.1 *Benchmarking*

The benchmarking metrics to target are: thermal comfort, indoor air quality, acoustics, visual quality (lighting), waste generation, and and water usage. The following tools may be used:

A number of alternative tools may be acceptable and can be proposed to CHPS in advance. Thermal Comfort: Some manufacturers of ventilation systems and energy services companies are offering their own a) Manufacturer-provided building monitoring products, which sometimes come free of charge with installation of the system; b) Occupant survey; c) Manual or automated data collection and analysis.

Indoor Air Quality (IAQ):. a) EPA also has an IAQ mobile monitoring app: https://www.epa.gov/iaq-schools/school-iaq-assessment-mobile-app and a walk-through checklist; b) Occupant survey; c) Manufacturer-provided monitoring product, often offered

by ventilation systems manufacturers; d) Manual data collection and analysis..

Acoustics: a) Manual data collection and analysis; b) Occupant survey.

Visual Quality (Lighting): a) Lighting companies may also offer products or services; b) Manual measurement and analysis; c) Occupant survey.. Note that alternative tools will not provide all the functionality of the ORC and may require additional work by school staff to create a complete package.

Waste Generation: a) Portfolio Manager; b) Manual waste audit.

Water Efficiency: a) Portfolio Manager; b) Manual fixture audit.

The metrics to target are: thermal comfort, indoor air quality, acoustics, visual quality (lighting), waste generation, and water usage.

OM C4.1.2-3 *Designated Individuals*

Designated individuals who can focus on monitoring performance and assist others with implementing behavioral or operational changes are important for high performance maintenance of the school. Programs do not need to be created from scratch; EPA and others have tools and programs that schools can use. See Resources.

OM C4.1.4 *Systems Maintenance Plan*

Like conventional schools, all high performance schools and their systems require preventive and routine maintenance. The Systems Maintenance Plan encourages districts to plan for preventive and routine maintenance tasks and invest adequate funds in the maintenance of their school facilities. Preventive and routine maintenance tasks include cleanings, calibrations, component replacements, and general inspections. Operations and maintenance manuals and commissioning reports developed during the commissioning process should be used as references for developing the maintenance plan. The plan must clearly define who is responsible for performing the task, its frequency, as well as the overall management of maintenance activities.

The plan can be in the form of a spreadsheet, manual, calendar or any other printed or electronic document that is conducive to a list of equipment and maintenance tasks with dates.

OM C4.1 DOCUMENTATION

DESIGN REVIEW

N/A

CONSTRUCTION REVIEW

OM C4.1.1 Provide a copy of a resolution, written policy, or similar commitment.

OM C4.1.2-3 Provide signed confirmation from the administration that a designated, permanent energy and water manager(s) has been hired and a school-based advocate has been hired or volunteered. The confirmation should include the name(s) but does not need to include contact information.

Submit program outline or plan for your behavior-based energy and/or water conservation program as applies to this project, baseline, and any interim results or energy savings reporting.

OR

Submit a copy of the district MOU with Alliance to Save Energy for the PowerSave Schools Program, or equivalent documentation for a similar established program.

OM C4.1.4 Provide a copy of the Systems Maintenance Plan that includes an inventory of building system components and all regularly scheduled preventative and routine maintenance tasks and their frequency over the lifetime of the building systems or equipment.

OM C4.1 RESOURCES

1. CHPS sample occupant survey available on request; email info@chps.net.
2. EPA Portfolio Manager: https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager
3. PowerSave Schools, Alliance to Save Energy: www.ase.org/projects/powersave-schools
4. Alliance for Climate Education: www.acespace.org
5. Center for Green Schools, Powering Down: www.centerforgreenschools.org/Libraries/Resources_Documents/Behavior-based_Efficiency.sflb.ashx
6. EPA's Indoor Air Quality Tools for Schools: https://www.epa.gov/iaq-schools/indoor-air-quality-tools-schools-action-kit
7. EPA's Energy Savings Plus Health : Indoor Air Quality Guidelines for School Building Upgrades: https://www.epa.gov/iaq-schools/protecting-iaq-during-school-energy-efficiency-retrofit-projects-energy-savings-plus, and Interactive Air Quality Planner: https://www.epa.gov/iaq-schools/technical-resources-energy-savings-plus-health
8. Northeast Energy Efficiency Partnerships (NEEP): http://www.neep.org/initiatives/energy-efficient-buildings/high-performance-schools
9. Useful information on O&M planning for schools, *NE-CHPS Operations & Maintenance Guide:* https://neep.org/sites/default/files/resources/omg%20update_dec%202018%20final.pdf

OM C5.1 INDOOR ENVIRONMENTAL MANAGEMENT

According to the US Environmental Protection Agency (US EPA), the indoor environment may contain levels of air pollutants that are 2-5 times higher, and occasionally 100 times higher, than outdoor levels. Poor indoor air quality (IAQ) can cause headaches, fatigue, asthma attacks, and ultimately absenteeism. Asthma can be a leading cause of school absenteeism due to chronic illness (US EPA).

Intent

Protect student and staff health and the environment by monitoring and correcting indoor air quality problems, reducing the risk of exposure to hazardous cleaning products and practices, and reduce the risk of pesticide exposure.

Cleaning practices, response protocols when a problem is reported, and pest management all contribute to good indoor air and environmental quality. An Indoor Environmental Management Plan guides staff in preventing and addressing issues. The use of green cleaning products and practices supports the goal of maintaining a healthy, safe, and clean environment for students, faculty, and staff. Integrated pest management focuses on using effective, least-toxic methods to prevent pests and the health hazards they may bring with them as well as reduces the potential exposure of occupants to pesticides.

OM C5.1 INDOOR ENVIRONMENTAL MANAGEMENT

CREDIT

1-4 points

APPLICABILITY: All Projects

VERIFICATION: Design Review and Construction Review

RELATED CRITERIA: All of EQ

SCORING: 1 point for each of 5.1.1 and 5.1.3; 2 points for 5.1.2

OM C5.1 REQUIREMENTS

OM C5.1.1 *Indoor Environmental Management Plan*

1 point

Develop and adopt an indoor environmental management plan using the US EPA's Tools for Schools Program [1] or equivalent indoor health & safety program at the school district level [4]. Assign staff to the program and commit to take significant action within a two-year period, such as staff training, policy implementation, development of personnel infrastructure for problem solving and reporting issues, or IAQ assessment activities such as school walk-throughs, data collection, mapping, and/or action plans.

OM C5.1.2 *Green Cleaning*

2 points

Do either of the options:

For schools that do their own cleaning:

At the district or governing body level, establish a resolution or policy including the following green cleaning and maintenance requirements:

- At least 75% of cleaning products used will be environmentally preferable and safer cleaning products that are certified by Green Seal or EcoLogo programs. If no third party certification is available for a specialty product, then EPA's Safer Choice (formerly Design for the Environment) label may be used. [5,6,7]
- Prohibition of aerosol and plug-in air fresheners.

- Use of only CRI certified vacuums or other HEPA vacuums. [8]
- Prohibition of teachers and staff bringing in their own products.

As applicable, create an audit of current product inventory (if any) and purchasing practices to identify where green items or approaches can be used as replacements. If a green product policy already exists, review it and update it for references to current or new product certifications.

For schools that use a cleaning service:

Ensure that the contract requires the use of green cleaning supplies meeting nationally recognized standards and requires training for custodial staff. Alternatively, the vendor can be certified by the International Janitorial Cleaning Services Association (IJCSA) [11].

OM C5.1.3 *Integrated Pest Management*

1 point

Develop and support an Integrated Pest Management (IPM) Plan [12] that emphasizes a least-toxic approach to IPM.

AND

Design the project's exterior walls, foundation, attics, roofs, interior partitions and ceilings in food storage areas, food preparation and disposal areas, utility chases and penetrations, for integrated pest management by making it difficult for pests to enter the building including, as applicable [13]:

- Blocking openings in the enclosure larger than 1/4" by 3/8".
- Use mesh or screens on openings required for airflow.
- Caulk all cracks larger than 1/16".
- Any landscape planting must be located at least two feet from buildings.
- Facades should be designed to discourage birds from roosting.
- Select dumpsters that seal tightly and are easy for people to open and close, and enclosure designed to discourage pest infestation in buildings.
- Make all kitchen surfaces easy to degrease.

OM C5.1 IMPLEMENTATION

OM C5.1.1 *Indoor Environmental Management Plan*

EPA's Tools for Schools is not a plan per se. It is a set of resources and best practices that school staff can use to implement an IEQ management plan. The Tools for Schools Action Kit [1] contains several checklists by department that can readily be turned into a plan. Typical plans also identify the responsible staff people, reporting and response requirements, remediation and corrective action requirements, and may include dispute resolution. The Wisconsin Department of Public Instruction has created a model IEQ management plan available online. It includes many of the features of Tools for Schools and is set up to be easily adopted by any school. [4]

OM C5.1.2 *Green Cleaning*

Environmentally preferable and safer cleaners are those that are currently certified to any of the following standards:

Green Seal, GS-37 Cleaning Products for Industrial and Institutional Use, 2013, or other related Green Seal product standard. Product must be certified to display the Green Seal mark.

EcoLogo, UL Global Network, Janitorial & Janitorial Products standards (relevant product category standard). Product must be certified to display the EcoLogo mark.

Vacuum cleaners must carry certification from the Carpet and Rug Institute (CRI) or contain a HEPA filter.

Janitorial staff should try to limit cleaning activities performed during school hours to protect vulnerable occupants.

The green cleaning policy should include proper procedures for the safe handling and storage of cleaning chemicals, and an overview on staff training requirements.

OM C5.1.3 *Integrated Pest Management*

An appropriate IPM plan, specified to be a least-toxic approach, reduces the need to apply chemical sprays or deploy bait traps in order to control pest populations. A successful plan eliminates food, water, and shelter for pests, thereby decreasing the likelihood that pests will enter school facilities. The control of food and its restriction to appropriate locations in the facility decreases pest problems and increases Indoor air quality through the elimination of pest contaminants and chemical control agents.

Consider also designing school fencing and turf/landscape bed margins to prevent weed encroachment and the need for herbicides, including:

- Installing weed barrier mow strips under fencing that is ½ inch beneath final mow height of adjacent turf, that extends at least four inches from the widest part of the fence on both sides, and that will support the deck of a mechanical mower.
- Installing curbing between turf and other porous landscape features (landscape beds, gardens, mulch or sand play boxes, mulched paths, etc.) that extends vertically a minimum of six inches below grade and extends four inches horizontally at the turf margin.

OM C5.1 DOCUMENTATION

DESIGN REVIEW

OM C5.1.1 N/A

OM C5.1.2 N/A

OM C5.1.3 Provide a copy of the IPM plan, if ready. Drawings must show the measures, such as location of plantings and screening/blocking of openings, selected to improve pest management.

CONSTRUCTION REVIEW

OM C5.1.1 Provide evidence of the plan, such as the executive summary or table of contents or minutes or vote documenting adoption of the plan, or provide a written commitment to develop the plan within 9 months of occupancy. The plan or the commitment must identify the person responsible and show that significant implementation of the plan will begin within a two-year period.

OM C5.1.2 Submit the green cleaning policy or resolution covering the required areas. Submit the completed audit, if any. Or provide a copy of the contract with the cleaning vendor highlighting the appropriate sections.

OM C5.1.3 Submit the Integrated Pest Management (IPM) plan, if not provided at Design Review.

OM C5.1 RESOURCES

Indoor Environmental Management

1. US EPA's IAQ Tools for Schools Action Kit: www.epa.gov/iaq/schools/actionkit.html
2. To identify state-specific requirements and other applicable approaches to IAQ management, see the Environmental Law Institute's list of IAQ laws and regulations by state:https://www.eli.org/sites/default/files/docs/greenbuilding/schools_2018.pdf
3. US EPA's IAQ mobile app is a tool for measuring air quality: https://www.epa.gov/iaq-schools/school-iaq-assessment-mobile-app
4. Wisconsin Department of Public Instruction has developed a model IEQ Management Plan for schools using many of the Tools for Schools approaches: https://dpi.wi.gov/sms/facilities/indoor-environmental-quality-plan

Green Cleaning

5. Green Seal: www.greenseal.org
6. UL Environment, EcoLogo: https://spot.ul.com
7. US EPA Safer Choice: https://www.epa.gov/saferchoice/products
8. Carpet and Rug Institute (CRI) certified vacuums: https://carpet-rug.org/testing/seal-of-approval-program/certified-vacuums/
9. ASTM E1971-05(2011), Standard Guide for Stewardship for the Cleaning of Commercial and Institutional Buildings http://www.astm.org/cgi-bin/resolver.cgi?E1971
10. Sustainable Jersey Schools cleaning audit information: http://www.sustainablejerseyschools.com/actions-certification/actions/?type=1336777436&tx_sjcert_action%5BactionObject%5D=76&tx_sjcert_action%5Baction%5D=getPDF&tx_sjcert_action%5Bcontroller%5D=Action&cHash=d6c4bc0e520dee0b2b32259f07fbc52f
11. International Janitorial Cleaning Services Association (IJCSA): http://www.ijcsa.org/green-cleaning-certification
12. Green Seal Commercial & Institutional Cleaning Standard: https://www.greenseal.org/green-seal-standards/gs-42/

Integrated Pest Management

13. US EPA IPM in Schools: https://www.epa.gov/safepestcontrol/integrated-pest-management-ipm-principles
14. Beyond Pesticides: www.beyondpesticides.org
15. For general information and several tools, including a model IPM plan: https://ipminstitute.org/projects/school-ipm-2020/resources/
16. People with a LEED User account can assess an IPM template here: https://leeduser.buildinggreen.com/credit/EBOM-2009/SSc3#tab-docs

OM C6.1 ANTI-IDLING MEASURE

According to the US Environmental Protection Agency (US EPA) [1] and others, exposure to vehicle exhaust, even at low levels, is a serious health hazard and can cause respiratory problems such as asthma and bronchitis. Diesel emissions are well-documented asthma triggers and may increase the severity of asthma attacks. Other types of air pollution, including ultrafine particles, can impact heart and brain health [2] and (3). Such particles can make their way indoors in buildings near busy roadways.

Intent

Reduce the health and environmental effects of vehicle exhaust and decrease use of fuel by preventing unnecessary vehicle idling.

OM C6.1 ANTI-IDLING MEASURE

CREDIT

1 point

APPLICABILITY: All Projects

VERIFICATION: Design Review, Construction Review

RELATED CRITERIA: SS C2.1 Sustainable Site Use

OM C6.1 REQUIREMENTS

- Adopt a no idling policy that applies to all school buses operating in the school district and all vehicles operating in the school grounds. The policy must include the following provisions: School bus drivers will shut off bus engines upon reaching destination, and buses will not idle for more than five minutes while waiting for passengers. This rule applies to all bus use including daily route travel, field trips, and transportation to and from athletic events. School buses should not be restarted until they are ready to depart and there is a clear path to exit the pick-up area.
- Post signage expressly prohibiting the idling of all vehicles for more than five minutes in the school zone.
- Transportation operations staff will evaluate and shorten bus routes whenever possible, particularly for older buses with the least effective emissions control.
- All school district bus drivers will complete a “no idling” training session at least once. All bus drivers will receive a copy of the school district’s No Idling Policy at the beginning of every school year.

OM C6.1 IMPLEMENTATION

The term “school grounds” shall mean in, on or within 100 feet of the school, including any athletic field or facility and any playground used for school purposes or functions which are owned by a municipality or school district, regardless of proximity to a school building, as well as any parking lot appurtenant to such school, athletic field, facility or playground.

Establish the length of time an operator on school grounds may idle an engine before such idling becomes prolonged, and the limited circumstances under which the prolonged idling of an engine shall be permitted, including periods necessary to operate defrosting, heating

or cooling equipment to ensure the health or safety of a driver or passengers or to operate auxiliary equipment and to undergo inspection or during maintenance.

Prohibit an operator of a school bus from idling a school bus engine while waiting for children to board or exit a bus on school grounds and from starting a school bus engine for any unnecessary period of time in advance of leaving the school grounds, unless the registrar determines that a school bus engine must be fully engaged in order to operate safety devices or that such idling prohibition would otherwise compromise the safety of children boarding or exiting a bus. Such regulations shall further prescribe templates for "no idling" signage to be posted by schools.

OM C6.1 DOCUMENTATION

DESIGN REVIEW

Provide a copy of the adopted anti-idling policy. Provide drawings showing the locations of anti-idling signage to be installed.

CONSTRUCTION REVIEW

Provide photo(s) of the installed anti-idling signage.

OM C6.1 RESOURCES

1. US Environmental Protection Agency: Diesel Exhaust and Your Health https://www.epa.gov/mobile-source-pollution/research-health-effects-exposure-risk-mobile-source-pollution
2. Tufts University has a study on ultrafine particles from vehicles and their impacts on health: https://sites.tufts.edu/cafeh/
3. AirNow is the home of EPA's information on air quality and health: https://www.airnow.gov/air-quality-and-health

OM C7.1 GREEN POWER

School districts and municipalities have the opportunity to purchase green power in multiple forms, including Renewable Energy Certificates (RECs) or Power Purchase Agreements (PPAs). These mechanisms allow schools to use green power without constructing an on-site renewable power system. CHPS has adopted the Zero-Code approach for quantifying off-site generation and applying it toward school usage. [2]

Intent

Reduce the use of fossil fuel energy sources.

OM C7.1 GREEN POWER

CREDIT

1 point

APPLICABILITY: All Projects

VERIFICATION: Design Review

RELATED CRITERIA: EE P1.0/C1.1 Energy Efficient Design, II C4.1 School Master Plan, II C6.1 Low/Zero GHG School

OM C7.1 REQUIREMENTS

Contract for (or commit to) off-site renewables, green power and/or RECs for 15 years, at an adjusted annual quantity equal to or greater than 75% of estimated building energy consumption. Purchased energy quantities shall be adjusted by weighting factors derived from the "Zero Code Off-site Procurement of Renewable Energy Technical Support Document" (April 2018), as follows:

Class 1 (Self Owned Off-Site, Community Solar, Virtual PPA, REIFs) = 0.75

Class 2 (Direct Access, Green Retail Tariffs) = 0.55

Class 3 (Unbundled RECs) = 0.20

Alternative approaches are allowed with CHPS approval.

Calculation:

$$\text{Purchased Renewables} \times \text{Adjustment Factor} = \text{Adjusted Purchased Renewables}$$

$$\text{Adjusted Purchased Renewables} / \text{Total Building Energy Usage} = \%\ \text{off} - \text{site renewables}$$

Purchased Renewables must meet all other requirements of Zero Code.

If green power is purchased at the district level, it must be allocated to the project to achieve the point. If the electricity utility provides green power at no additional cost, school can claim this credit.

OM C7.1 IMPLEMENTATION

RECs

For each megawatt-hour of power generated and supplied to the electric grid through renewable electricity generation (solar, wind, ocean thermal, wave, tidal, landfill gas and

"low emission" bio-energy sources), a REC is issued for trade on the open market. Both new and old RECs can be purchased by retail electricity suppliers or renewable electricity suppliers for resale to customers. Consumers can purchase RECs through programs or companies across the country. When a consumer purchases RECs, the RECs are effectively retired and taken out of circulation, which contributes to the increased demand for generation and sale of additional renewable electricity.

An interesting characteristic of renewable energy certificates is that they can be purchased from any location in the country, however, purchasing RECs from local generation sources means that the environmental benefits are experienced locally.

PPAs

Power Purchase Agreements are a contractual means for a site-owner and a renewable energy installer to work together to provide green power on-site when the site-owner does not wish to outright own the system. In a PPA, the system is owned and maintained by the installer (ownership may also be by a third party investor), and the site-owner purchases the power generated by the system for the contracted price. Typically, PPAs are structured so that the site-owner eventually has the right to own the system. The benefits of a PPA to a site- owner are that the upfront capital costs of installation and the ongoing maintenance costs are borne by the installer. Theoretically, a PPA allows the installer to build a larger system at the site than might otherwise be possible (site conditions are still the primary determinants of system size), therefore offsetting a larger portion of the site's fossil fuel use.

OM C7.1 DOCUMENTATION

DESIGN REVIEW

Provide a copy of a written commitment by the district or school governing body to purchase at least 75% of annual electricity needs as green power through Green-e Energy certified RECs or a renewable energy system through a PPA. The document must specify at least a 2-year period.

CONSTRUCTION REVIEW

N/A

OM C7.1 RESOURCES

1. Article on where to buy RECs: https://www.energysage.com/alternative-energy-solutions/renewable-energy-credits-recs/where-to-buy-renewable-energy-credits-recs/
2. Zero-Code: https://zero-code.org/wp-content/uploads/2018/04/Zero-Code-TSD-OffSiteRenewables.pdf

APPENDIX A

TABLE A: MAJOR MODERNIZATION REQUIREMENTS

Prerequisite	Systems and Surfaces Substantially Improved	Requirement
II P1.0 Integrated Design		Always Required; flexibility in timing of meetings allowed
II P2.0 Central Educational Display		Required only in gut rehab or building conversion
EQ P1.0 Ventilation & IAQ	HVAC	Required, some exceptions may apply
EQ P2.0 Off-Gassing	Interior Surfaces	Always Required
EQ P6.0 Low Emitting Materials	Paints & Coatings Flooring Composite Wood	Required for each category that is substantially improved
EQ P12.0 Glare Protection	Envelope	Required only if impacts at least 70% of classrooms, libraries & administrative spaces. Exceptions: Structural constraints, physical constraints, i.e., HVAC or electrical conduit systems, rooms without exterior access or site obstructions, but must still meet 50% threshold.
EQ P15.0 Acoustical Performance	Interior	Reverberation time; if includes windows/doors/walls then noise transmission within scope
	HVAC	Background noise
	Envelope	Background noise and exterior noise if includes windows/doors/walls
EE P1.0 Energy Efficient Design	HVAC, Envelope, Lighting	Performance or prescriptive parts of ASHRAE 90.1 are triggered by specific scope; always required for additions
EE P2.0 Commissioning		Always Required
WE P1.0 Indoor Potable Water Use Reduction	Interior Systems	Required if plumbing fixtures are in scope
WE P2.0 Outdoor Water Use Reduction	Site	Required only if irrigation is in scope
SS P1.0 Environmental Site Assessment	Site	Always Required
MW P1.0 Storage & Collection of Recyclables and Organic Waste	Envelope, Interior	Always Required
OM P1.0 Facility Staff & Occupant Training	All	Required for facility staff on systems within scope
	HVAC, Lighting, Interior	Required for teachers & admin staff on systems with which they interact
OM P3.0 Energy & GHG Performance Benchmarking	HVAC, Lighting, Envelope	Required when more than 50% of school is within pertinent scope of work

TABLE B: NON-CLASSROOM REQUIREMENTS

Prerequisite	Requirement
II P1.0 Integrated Design	Always Required
II P2.0 Central Educational Display	Required for buildings with student use
EQ P1.0 Ventilation & IAQ	Always Required
EQ P2.0 Off-Gassing	Always Required
EQ P6.0 Low Emitting Materials	Always Required
EQ P12.0 Glare Protection	Required if admin spaces or libraries are part of scope
EQ P15.0 Acoustical Performance	Not required except that ancillary spaces >20,000 ft^3 must ensure reverberation time <= 1.0
EE P1.0 Energy Efficient Design	Always Required
EE P2.0 Commissioning	Always Required
WE P1.0 Indoor Potable Water Use Reduction	Required if plumbing fixtures are in scope
WE P2.0 Outdoor Water Use Reduction	Required if irrigation is in scope
SS P1.0 Environmental Site Assessment	Always Required
MW P1.0 Storage & Collection of Recyclables and Organic Waste	Required based on scope
OM P1.0 Facility Staff & Occupant Training	Required based on scope
OM P3.0 Energy & GHG Performance Benchmarking	Required based on scope