JOHNS HOPKINS UNIVERSITY

High-Performance and Healthy Buildings Requirements

CONTENTS

INTRODUCTION

About These Requirements

Johns Hopkins University (JHU) buildings are at the heart of our campus community and provide secure spaces to work, live, and learn. Innovation and an integrative approach throughout the design and construction process is essential to making our buildings more efficient and to improving occupant health and well-being.

The High-Performance and Healthy Buildings (HPHB) Requirements were endorsed along with JHU's Climate Action and Sustainability Plan (Plan) in June of 2024 by the Board of Trustees. They include best practices to guide project teams in meeting the university's ambitious sustainability, health, and well-being goals and are intended to be a living document that will be updated periodically.

The requirements apply to all JHU-owned buildings and will be phased in as facilities teams integrate the requirements into their capital plans and design and construction processes. **Teams are expected to implement these standards to the best extent possible within the scope of each project's financial and technical constraints.** In addition to owned buildings, teams are also encouraged to apply these standards wherever possible to leased space in buildings not owned by the university. Project teams are expected to verify all current applicable codes and regulatory standards, and where a difference may arise between these requirements and code, follow the more stringent of the two.

Highlights of this document include:

- **LEED Gold certification as a minimum** for new construction and major renovations, or an approved alternative.
- **Emphasis on decarbonization** in alignment with Maryland's Climate Solutions Now Act and electrification goals.
- **Supporting health and well-being** for all building occupants.

The HPHB Requirements are separated into two sections:

- **New construction and major renovations**, where major renovations are defined as "extensive alteration work in addition to work on the exterior shell of the building and/or primary structural components and/or the core and peripheral mechanical, electrical, and plumbing (MEP) and service systems and/or site work. Typically, the extent and nature of the work is such that the primary function space cannot be used for its intended purpose while the work is in progress and where a new certificate of occupancy is required before the work area can be reoccupied."[1]
- **Modifications** refer to renovation scopes that do not meet the standard for major renovation (i.e., projects that do not require a new certificate of occupancy) such as a fit-out of a floor or a finish upgrade. Modification projects of all sizes must follow any requirements that are applicable to the project scope.

  Note that different campuses use different terminologies to describe their projects. Please consult the Office of Sustainability if the above definitions are unclear.

How the HPHB Requirements Fit into JHU's Sustainability Goals

JHU has committed to ambitious sustainability goals through its Plan that address climate action, the built and natural environment, responsible consumption, mobility and transportation, and research, teaching and scholarship. This document includes standards and expectations for building projects at all JHU locations whether large or small to support these overarching goals and represents the priorities of JHU for the built and natural environment.

The following table highlights goals and objectives from the Plan that are most relevant to building projects:

Goals of 2030 Climate Action & Sustainability Plan	Plan Objectives	How the HPHB Requirements Support the Plan
Boldly act to reduce greenhouse gas emissions	Achieve net zero scope 1 and 2 greenhouse gas emissions by 2040	Significant emphasis on reducing operational emissions from buildings (e.g., all-electric, high efficiency projects)
	Establish a scope 3 greenhouse gas emissions reduction initiative by 2030	Focus on reducing embodied carbon of materials in design and emissions from construction
	Accelerate deep decarbonization and energy efficiency in existing buildings	Accelerate energy efficiency and fuel-switching in existing buildings
Improve health through the increased use of sustainable transportation options	Increase the use of sustainable transportation to reduce emissions and improve health and well-being	Enable sustainable transportation options through bike storage, reduced parking, and multi-modal transportation networks
Enact policies, practices, and behavior change solutions towards zero waste	Increase waste stream diversion to 50% by 2030	Reduce waste generated by construction and provide operational waste infrastructure to encourage zero waste practices
Plan, design and operate campuses and buildings to safeguard environmental and human health	Design and renovate buildings to reduce emissions and exemplify best practices in environmental and human health	The HPHB Requirements are the first implementation tool to help meet this objective
	All building provide healthy environments in which to work, learn, and thrive	Include health and well-being in design features and materials selection
Design and steward ecologically-beneficial landscapes that enhance biodiversity, health, and community connections	Protect local water resources through conservation and stormwater management best practices	Reduce potable water use and manage stormwater onsite through green infrastructure where possible
	All campuses have accessible greenspace to enhance biodiversity, support well-being, and increase climate resilience	Integrate biophilic design features into buildings and providing access to greenspace around, on and in buildings

How the HPHB Requirements Fit into Regional Commitments and Policy Landscape

On June 1, 2022, the State of Maryland passed the Climate Solutions Now Act requiring a 60% reduction in GHG emissions by 2031 and net zero GHG emissions by 2045. The legislation requires the development of Building Energy Performance Standards (BEPS) for buildings 35,000 square feet or larger, GHG and energy use intensity (EUI) reporting, and the development of recommendations for a statewide all-electric building code. The HPHB Requirements are intended to support the Maryland BEPS efforts while also working to align with the 2045 carbon neutrality commitments set by the City of Baltimore and District of Columbia.

How to Use this Document

All projects are required to establish sustainability goals during planning and/or feasibility phases and report on progress to the JHU Project Manager at the end of each phase as noted in the requirements.

New construction and major renovations are required to achieve **LEED Gold certification minimum.** LEED Platinum, International Living Future Institute (ILFI) Core Green Building Certification, ILFI Living Building Challenge Petal Certification, and ILFI Living Building Challenge Certification can be pursued as an alternate to LEED Gold. **Projects must also meet performance requirements** as specified. Performance requirements are **in addition** to certification requirements.

Modifications must meet requirements as specified here in as appropriate to scope and project scale and at the determination of the Design and Construction Unit Director (with signature authority) and Project Manager in the project planning phase.

The HPHB Requirements are broken out into six priority areas: Energy and Carbon, Climate Resilience, Water, Site, Health and Well-Being, and Responsible Consumption. Each category includes performance requirements as well as expected deliverables and responsible parties. Projects are also encouraged to pursue any *best practices* that are listed alongside the requirements. These best practices reflect industry-leading guidance, support JHU's aspirational goals, and may inform potential requirements included in future updates to this document.

These requirements are to be updated at least every two years by a committee representative of JHU divisions.

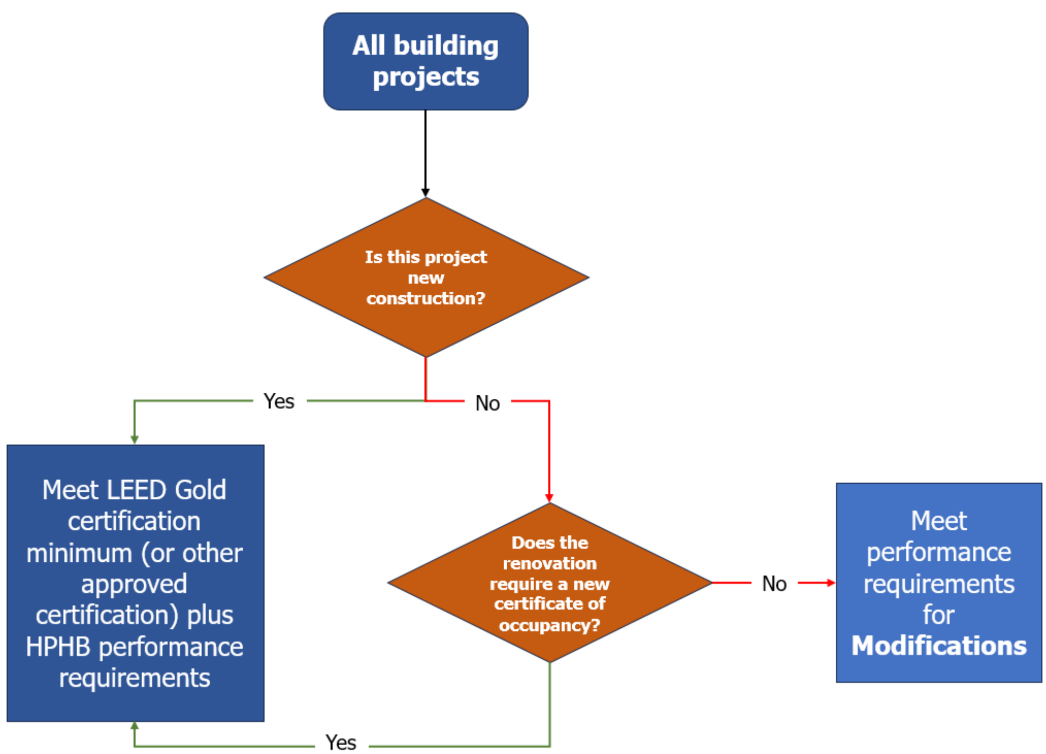

Figure 1: Decision tree for application of the High Performance and Healthy Buildings Requirements

Project Team – Roles and Responsibilities

Note that different campuses use different terminologies to describe their project teams. The document below uses standard industry terminologies, that should be adjusted as needed to reflect the roles and governance of different JHU campuses. Please consult the Office of Sustainability if any of the below roles are unclear.

JHU Project Manager

The JHU Project Manager works closely with the JHU Project Architect and the Design Team and is accountable for the implementation of the HPHB Requirements by advocating for strategies that will help meet JHU sustainability goals and by reviewing HPHB deliverables throughout design and construction. The JHU Project Manager is also responsible for the development and maintenance of the Owner's Project Requirements (OPR) in consultation with the JHU Project Architect, the Design Team, and Commissioning Agent. The JHU Project Manager is inclusive of other roles which may vary by division, scope/budget of project, etc. For modification projects that do not have a dedicated project manager, a member of the operations team responsible for the project can serve as the JHU Project Manager on the project.

JHU Project Architect

The JHU Project Architect serves as an in-house authority on planning efforts and architectural design solutions (e.g., aesthetics, materials, systems, products, etc.). They work with JHU representatives, JHU project managers and outside consultants to ensure work conforms to the intended program, project scope and budget, industry best practices, design compatibility with respect to JHU, university standards (including the HPHB Requirements), and sound architectural practice.

JHU Office of Sustainability (or divisional sustainability representative, if applicable)

The Office of Sustainability lends support, advocacy, and expertise to project teams in their efforts to follow the HPHB Requirements. It acts as a resource on sustainable project planning and current sustainability initiatives underway on campus. The Office of Sustainability participates in Sustainability Workshops and other meetings as needed. The Office of Sustainability coordinates with appropriate stakeholders to update the Requirements every other year as needed.

Design Team

The Design Team is comprised of the Architect, Structural Engineer, MEP Engineers, Landscape Architect, Civil Engineer, Sustainability Consultant, and others as applicable. The whole of the Design Team is expected to review these requirements and advise the JHU project team as to the best cost-effective strategies to meet the requirements using analysis, research and documentation to support decision-making.

> A Sustainability Consultant is expected to be part of the Design Team for all new construction and major renovation projects and is recommended for modifications. They are expected to facilitate goal-setting, optioneering and decision-making throughout the design and construction process as well as end-of-phase progress reporting and LEED administration.

Commissioning Agent

The Commissioning Agent helps the JHU Project Manager develop the OPR and reviews the Basis of Design (BOD) and all other design document submissions for compliance with the OPR as part of the commissioning process.

Contractor

The Contractor ensures that these Requirements are met as included in the contractual documents. The Contractor is also expected to advise the owner and Design Team on cost effectiveness of different strategies as appropriate to scope and depending on the contractual relationship (e.g., General Contractor vs. Construction Manager).

Compliance and Reporting

Compliance and reporting are key elements to the success of the HPHB Requirements and will help ensure that projects are meeting JHU sustainability goals. Ultimately, it is the responsibility of the JHU Project Manager to manage the reporting process and hold project teams accountable for the implementation of the HPHB Requirements.

Actions and deliverables as well as responsible parties are indicated in each section. **These are in addition to other project deliverables including local jurisdictional requirements as Green Building Certification (e.g., LEED)**. If a project cannot meet any of the requirements specified herein, the project team is expected to clearly document why in writing and submit to the JHU Project Manager for review.

The Primary Responsibility column lists those project team members who are expected to lead the action/deliverable but other project team members will likely also need to be involved. At the end of each design phase (e.g., Schematic Design, Design Development, Construction Documents), project teams shall provide the JHU Project Manager with the analysis and written documentation requested herein to explain progress towards sustainability goals including at minimum the following elements:

- Updated LEED (or other approved rating system as listed in Green Building Certification) scorecard for New Construction and Major Renovations only
- Updated Appendix E. JHU Green Building Checklist and LEED Gold Scorecard
- Updates to the project narrative and BOD describing how the project is meeting all requirements of this guideline by section. See each section for specific deliverables:
    - Green Building Certification (for New Construction and Major Renovations only)
    - Building Performance (for New Construction and Major Renovations only)
    - 1.0 Energy and Carbon
    - 2.0 Climate Resilience
    - 3.0 Water
    - 4.0 Site
    - 5.0 Health and Well-Being
    - 6.0 Responsible Consumption

Table 1: Example of deliverables table

Phase	Deliverable	Primary Responsibility
Concept	◻ Site-wide renewable energy feasibility study to assess power supply, availability and renewable energy and storage options.	▶ Electrical Engineer
All design phases	◻ Identify on plans solar ready roof area and future battery locations and related infrastructure needs per 2021 IECC Appendix CB Solar-Ready Zone.	▶ Electrical Engineer and Architect

NEW CONSTRUCTION AND MAJOR RENOVATIONS REQUIREMENTS AND GUIDELINES

Integrative Design Process (IDP)

IDP is a holistic process by which a design team and the client align around shared project goals and use a collaborative approach to inform decision-making that understands the building as an interconnected whole rather than separate parts. The following IDP activities are expected of all project teams.

Project Scoping Workshop

A project scoping workshop is to be held prior to development of a Request for Proposals (RFPs) to establish preliminary sustainability goals and define needed design team roles, scope, and deliverables to be included in any RFP. At minimum, attendees are to include JHU Project Manager, and representatives from Design and Construction, Planning and Architecture, Operations, Office of Sustainability or divisional sustainability representative, and Building End User.

Sustainability Visioning Workshop

A Sustainability Visioning Workshop is to be held prior to the commencement of each project to review opportunities and constraints and identify strategies to meet the goals and targets of the project. The workshop will also clarify roles and responsibilities for implementing and tracking progress through the course of the project.

The workshop is to be facilitated by the Sustainability Consultant. The sustainability stakeholder group should include representatives of the full design team, construction manager, university/school project managers, maintenance, custodial, energy and engineering staff, sustainability staff, research faculty and key stakeholders. Agenda topics must include all areas of this guideline and other key topics as applicable:

- Energy and Carbon
- Climate Resilience
- Water
- Site
- Health and Well-Being
- Responsible Consumption
- Campus as a Living Lab (i.e., research and academic opportunities)
- Community Engagement
- Green Labs (if applicable)
- Green Building Certifications

Outcomes of the workshop must include project-specific strategies to meet the sustainability goals and targets of the project. The design team must report on progress towards these goals and targets at the end of each phase (see

Compliance and Reporting).

Sustainability Meetings

A Sustainability Meeting is to be held at the beginning of each of the following phases, as applicable per campus and scope of project:

- Schematic Design
- Design Development
- Construction Documents
- Construction

The meeting should include at minimum the sustainability stakeholder group and cover the agenda topics listed in the Sustainability Visioning Workshop and be used to review project progress towards sustainability goals; key challenges and decision points for the next phase; and specific analysis that needs to occur to inform decision-making.

In addition, every design progress meeting should include sustainability and green building certification tracking as an agenda item.

Construction Kick-Off and Progress Meetings

As part of the kick-off meeting at the beginning of construction, sustainability goals for the project should be reviewed as well as green building certification documentation and compliance. Agenda items should include:

- Sustainability and performance goals
- Commissioning plan
- LEED and other (if applicable) certification requirements
- Waste management plan
- Low-carbon construction plan
- Contractors and sub-contractor responsibilities to meet sustainability goals and document compliance including frequency of reporting

At minimum attendees should include the JHU Project Manager, Office of Sustainability or divisional sustainability representative, General Contractor or Construction Manager and other subject matter experts as appropriate, as well as the architect and sustainability consultant. Other consultants are invited as appropriate.

In addition, every construction progress meeting should include sustainability and green building certification tracking as an agenda item.

Building Performance Analysis

All new construction and major renovation projects are to employ building performance analysis throughout the design process to inform decision-making. The following outlines energy modeling and other related activities by phase. Results are to be reported at the end of each design phase per the

Compliance and Reporting section and include at minimum updates on the following:

1. Project performance against energy use targets for Thermal and Cooling Energy Demand Intensity (TEDI/CEDI), peak heating and cooling load, and total building EUI
2. Operational GHG emissions per SF
3. Renewable energy
4. Thermal comfort
5. Daylighting
6. LEED EAc2 Optimize Energy Performance estimated points

Analysis to be performed as follows:

Concept

- Determine climate categorization for project site, including typical and peak weather conditions for current climate, 2050 climate (equipment) and 2080 climate (envelope) using RCP8.5[1].
- Establish targets and stretch targets for TEDI/CEDI, peak heating and cooling load, and total building EUI. See Energy and Carbon section for how to develop target EUI, TEDI, and CEDI by building type.
- Conduct solar photovoltaic (PV) and/or solar hot water feasibility study of building site, including roof tops, building canopies, parking, and building facades to assess annual renewable energy generation. Assess feasibility of site to offset building energy use and include up to three different scenarios to meet all or part of building energy demand.
- Run shoebox[2] parametric models to evaluate the impact of architectural massing, orientation, and envelope design on TEDI, CEDI, peak load, and EUI and compare to target EUI.
- Include description of project goals and results of analysis in 100% Concept Report.

Schematic Design

- Create simple shoebox LEED baseline energy model to compare against proposed design iterations.
- Assess performance of three or more envelope design parameters, including glazing, shading, insulation, window-to-wall ratio and window operability with metrics of TEDI, peak load, thermal comfort and system size.
- Assess performance of three or more HVAC design parameters, including but not limited to heating equipment, cooling equipment, distribution equipment, ventilation equipment and DHW equipment with metrics of EUI, life-cycle cost and LEED points. Compare design EUI with target building EUI (see Energy and Carbon section).
- Based on digital 3D geometry, highlight opportunities to maximize natural daylight potential while minimizing glare and thermal discomfort through exterior solar insolation analysis, annual illuminance diagrams and analysis of direct sunlight and glare potential. This analysis shall help refine building massing, façade fenestration and internal layout and serve to benchmark performance relative to LEED Daylight credit thresholds. For details on modelling spatial daylight autonomy, refer to the IES LM-83 Standard.

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[1] Weather files for future climate data to be sourced from WeatherShift.

[2] Shoebox energy models are basic energy models that reflect simple geometries to assess energy use implications of early design decisions such as massing, orientation and zoning.

- Evaluate 100% SD building design for any potential energy code compliance issues.
- Include update in final SD project narrative.

Design Development

- Update the daylight analysis and LEED Daylight credit benchmarking. Provide detailed recommendations for façade design and program layout. For spaces receiving relatively high solar gains/daylight during the summer, identify potential for thermal discomfort and advise on solar control strategies.
- Update BOD full building model to reflect latest design changes.
- Evaluate final envelope design options (up to three iterations) with metrics of TEDI, peak load, thermal comfort and system size.
- Evaluate final HVAC design options (up to three iterations) with metrics of EUI, life-cycle cost and LEED points. Conduct a life-cycle cost assessment of the final HVAC design options including the social cost of carbon in the analysis (see JHU tool). Compare design EUI with target building EUI (see Energy and Carbon section).
- Update PV generation estimates and evaluate potential for on-site battery storage with metrics of cost savings, energy savings and reduction of carbon emissions.
- Determine LEED compliance method for EAc2 Optimize Energy Performance. Calculate LEED points estimate in three categories (Yes, Maybe, No) of 100% DD building design.
- Make a determination if the project complies with the prescriptive compliance path of International Energy Conservation Code (IECC), current edition, or shall follow the performance compliance path. If the performance path is followed, create an IECC baseline model to check performance against and report the percent savings the project is achieving relative to code.
- Include update in 50% and 100% DD Report.

Construction Documents

- Update BOD full building model to reflect latest design changes.
- Determine total building energy consumption, total on-site renewable energy generation, and total GHG emissions (accounting for emissions from a central plant if connected). Calculate off-site renewable energy generation needed to achieve net zero carbon. Compare design EUI with target building EUI (see Energy and Carbon section).
- Complete final LEED energy model and documentation for credit EAc2 Optimize Energy Performance.
- Update LEED daylight analysis at 50% CD and prepare final LEED Daylight credit calculations.
- If the performance path is followed for energy code compliance, update IECC baseline model and report the percent savings the project is achieving relative to code. Complete a performance report in accordance with IECC requirements for inclusion in the project permit set.
- Include update in 50% and 95% and final CD Report.

Green Building Certification

In additional to meeting local jurisdictional requirements, all new construction and major renovations are to be certified LEED BD+C Gold minimum (see Appendix E. JHU Green Building Checklist and LEED Gold Scorecard) or alternative green building certification as listed below and meet the following specific certification requirements in addition to the

Performance Requirements. Accepted alternative certifications include:

- LEED Platinum
- International Living Future Institute (ILFI) Core Green Building Certification, Living Building Challenge (LBC) Petal certification, or Living Building Challenge Certification

The following certifications can be pursued **in addition to**, but not in place of, LEED or LBC:

- WELL Building Standard (WELL)
- Passive House Institute US (Phius) (Passive House)
- ILFI Zero Carbon

The sample scorecard also highlights those LEED credits that align with WELL. **JHU requires all projects to pursue the following credits in addition to the standard LEED prerequisites.** These credits have been selected to align with JHU's sustainability goals. Where more than one point is available, the minimum number of required points is indicated.

All credits are v4 unless otherwise noted. If a new version is released before a regularly scheduled update to the HPHB Requirements, then project teams are expected to perform a crosswalk to compare these required credits to the new version.

- **IPc1 Integrative Process**
    - The Integrative Process credit requires teams to analyze energy and water strategies early in design to help make informed decisions. This credit aligns with the Building Performance Analysis section and with the water balance required in 3.1 Potable Water Reduction.
- **SSc4 Rainwater Management** (1 of 3 pts min)
    - The Plan requires JHU campuses to develop a campus stormwater management plan and to focus on using green infrastructure (e.g., infiltration, bioswales) to manage stormwater onsite as much as possible and help avoid overloading storm systems. This is of particular importance as climate change continues to bring more intense storms (see 2.0 Climate Resilience for additional requirements).
- **SSc5 Heat Island Reduction** (2 of 2 pts min)
    - Urban temperatures can be up to 10 degrees hotter than that of suburban or rural areas due to the predominance of materials such as concrete and pavement that absorb and retain heat. Extreme heat events will continue to exacerbate these effects as the climate changes. Reducing the amount of hardscape and using reflective materials such as white roofs not only limit the effects of the urban heat island effect but also help to reduce energy use in buildings. Meeting this credit helps to support JHU's goals of reducing energy use and increasing resilience to climate change (see 2.0 Climate Resilience for additional requirements).
- **SSc6 Light Pollution Reduction**
    - Light pollution from exterior fixtures and interior fixtures left on at night not only waste energy but also obscure the night sky and interfere with the natural rhythms of plants, birds and animals. JHU prioritizes protecting and enhancing natural systems. Meeting this credit also aligns with performance requirement 4.2 Bird-Safe Buildings.
- **WEc1 Outdoor Water Use Reduction** (1 of 2 pts min)
- **WEc2 Indoor Water Use Reduction** (3 of 6 pts min)
- **WEc3 v4.1 Optimize Process Water Use** (if applicable, 1 of 2 pts min)
- **WEc4 Water Metering** (submeter irrigation if appliable, and one other use)

- Climate change will increase the frequency of drought and stress available potable water supplies. JHU is committed to reducing potable water use through efficiency and leveraging alternative water sources such as rainwater and condensate. All four of these credits will help JHU meet its goal (see section 3.0 Water for additional requirements).

- **EAc1 Enhanced Commissioning** (all 6 pts min)
- **EAc2 Optimize Energy Performance** (8 of 18 pts min)
- **EAc3 Advanced Energy Metering**
- **EAc4 v4.1 Grid Harmonization** (1 of 2 pts min)
- **EAc6 Enhanced Refrigerant Management**
    - Reducing energy use is a cornerstone of JHU's roadmap to net-zero GHG emissions. Meeting all 5 of these credits will help JHU develop and maintain its high performance buildings as well as reduce GHG emissions.
- **MRc1 v4.1 Building Life-Cycle Impact Reduction** (2 of 5 pts min)
- **MRc2 v4.1 BPDO Environmental Product Declarations** (1 of 2 pts min)
- **MRc3 v4.1 BPDO Sourcing of Raw Materials** (1 of 2 pts min)
- **MRc4 v4.1 BPDO Material Ingredients** (1 of 2 pts min)
    - JHU recognizes the impacts materials have on the environment and on occupant health. Meeting these four credits in addition to section 6.0 Responsible Consumption and Appendix B. Material Requirements will help JHU reduce the embodied carbon of new construction, improve indoor air quality and increase the use of toxin free materials.
- **MRc5 Construction & Demolition Waste Management** (all 2 pts min)
    - The Plan commits JHU to increasing waste diversion. Section 6.2 Waste Reduction – Construction requires projects to achieve a minimum of 75% construction and demolition waste diversion in alignment with this goal.
- **IEQc1 Enhanced IAQ Strategies** (all 2 pts min)
- **IEQc2 Low Emitting Materials** (all 3 pts min)
- **IEQc3 Construction IAQ Management Plan**
- **IEQc4 Indoor Air Quality Assessment** (1 of 2 pts min)
- **IEQc6 Interior Lighting** (1 of 2 pts min)
- **IEQc7 Daylight** (1 of 3 pts min)
- **IEQc9 Acoustic Performance**
    - These seven credits reflect JHU's desire to support the health and well-being of the JHU community through the design and operation of its buildings in addition to the performance requirements of section 5.0 Health and Well-being.

Innovation credits in LEED offer projects an opportunity to showcase pioneering approaches to sustainability. JHU has pre-selected Innovation credits that best align with overall Plan goals. Projects are required to select three from the following pilot credits and a minimum of one from the Innovation catalog credits. If a new version is released, then project teams are expected to perform a crosswalk to compare these credits to the new version.

- Pilot Credits (choose 3):
    - IPpc98 – Assessment and Planning for Resilience
    - IPpc99 – Design for Enhanced Resilience
    - EApc152 GridOptimal Building ACP
    - IPpc108 Integrative Process for Health Promotion
    - SSpc55 Bird collision deterrence

    - IPpc100 Passive Survivability and Back-up Power During Disruptions
    - SSpc75 Clean Construction
    - EQpc105 Lead Risk Reduction
    - One or more of the WELL Features eligible for LEED Innovation credits
- Innovation catalog credits (minimum 1):
    - Design for active occupants
    - Green Building Education
    - Community outreach and involvement
    - Occupant comfort survey

	Project Scoping	Concept	SD	DD	CD	Construction	Post-Occupancy
Integrated Design Meetings	Project Scoping Workshop	Sustainability Visioning Workshop	Sustainability Meeting	Sustainability Meeting	Sustainability Meeting	Construction Kick-Off	
Building Performance		Future climate categorization Establish energy performance targets Solar feasibility study Shoebox models	Shoebox LEED baseline model Envelope design analysis HVAC design analysis Daylight analysis Energy code compliance	Update energy model Envelop design analysis HVAC design analysis Update daylight analysis Update solar potential and evaluate onsite battery potential Update LEED compliance for energy credits Energy code compliance check	Update energy model Determine energy performance metrics Complete LEED energy model and documentation Update LEED daylight analysis documentation Complete energy code documentation		
Deliverables	Sustainability goals	Owner's Project Requirements including sustainable design goals LEED (or other) scorecard HPHB Requirements Checklist Updated Basis of Design and Project Narrative	LEED (or other) scorecard HPHB Requirements Checklist Updated Basis of Design and Project Narrative	LEED (or other) scorecard HPHB Requirements Checklist Updated Basis of Design and Project Narrative	LEED (or other) scorecard HPHB Requirements Checklist Updated Basis of Design and Project Narrative	LEED (or other) scorecard HPHB Requirements Checklist	Final certified LEED (or other) scorecard and credit documentation Final HPHB Requirements Checklist

Figure 2: Integrated design process timeline for New Construction and Major Renovation projects

Performance Requirements

New construction and major renovations are required to meet the following as applicable to scope and as indicated. Performance requirements are additional requirements that must be met in addition to LEED required credits (if applicable). Best practices are recommended optional strategies for consideration.

1.0 Energy and Carbon

Climate action is a signature priority of JHU's Climate Action and Sustainability Plan and aligns with the City of Baltimore's Climate Action Plan[3] and Maryland's Climate Solutions Now Act.[4] JHU is committed to achieving net-zero GHG emissions with an emphasis on direct emissions reductions. Building energy use plays a significant role in the institution's ability to achieve this goal. All new construction and major renovation projects are expected to reduce energy and carbon impacts in design and operation through the following required measures.

1.1 Electrification

Minimum Requirements

In order to meet JHU's net-zero goal, it is imperative that campus buildings, infrastructure and fleet transition off of fossil fuels to low-carbon energy sources. Over 80% of JHU's procured electricity is already purchased from renewable sources with a goal to increase this to 100% by 2030. As such, all standalone[5] new construction and major renovations shall be all-electric,[6] including space heating, domestic hot water, and commercial kitchens. All new construction and major renovations connected to a central plant shall build in capacity to accept low-temperature hot water in place of steam (e.g., 125°F supply, 10°F differential).

LEED and Best Practice

Related required LEED credit	Related optional LEED credit	Best Practice
• N/A	• EApc152 GridOptimal Building ACP	Eliminate fossil fuel use entirely including but not limited to dryers, fireplaces, barbeques, and emergency backup power (where viable – see footnote).

Deliverables

Phase	Deliverable	Primary Responsibility
All design phases	☐ Include description of how project is meeting requirement in BOD.	▶ Mechanical Engineer

Resources

- ▶ Maryland Climate Solutions Now Act of 2022

[3] The City of Baltimore has committed to reducing GHG emissions by 60% by 2030 and to zero by 2045: https://bit.ly/3UN57nJ

[4] The Climate Solutions Now Act of 2022 requires the State to reduce statewide greenhouse gas emissions 60% by 2031 and to zero by 2045 and sets energy efficiency and emission reduction requirements for certain buildings: https://mgaleg.maryland.gov/mgawebsite/Legislation/Details/sb0528

[5] "Standalone" buildings are those not connected to a central plant or connected to a central plant that does not yet have plans to decarbonize.

[6] Exception for backup power if no other feasible low-carbon solution is viable (e.g., facilities where power outage presents a life safety risk).

1.2 Energy Efficiency

Energy efficiency is critical to reducing GHG emissions and ongoing utility costs. These requirements set out specific energy targets for different building types. All new construction and major renovations are to reduce energy use as much as is feasible through passive design strategies and building system efficiency. At minimum, projects are expected to meet the energy performance targets outlined per the following decision matrix (see Figure 3: Energy target setting requirements) and validated per the

Building Performance integrative design process section.

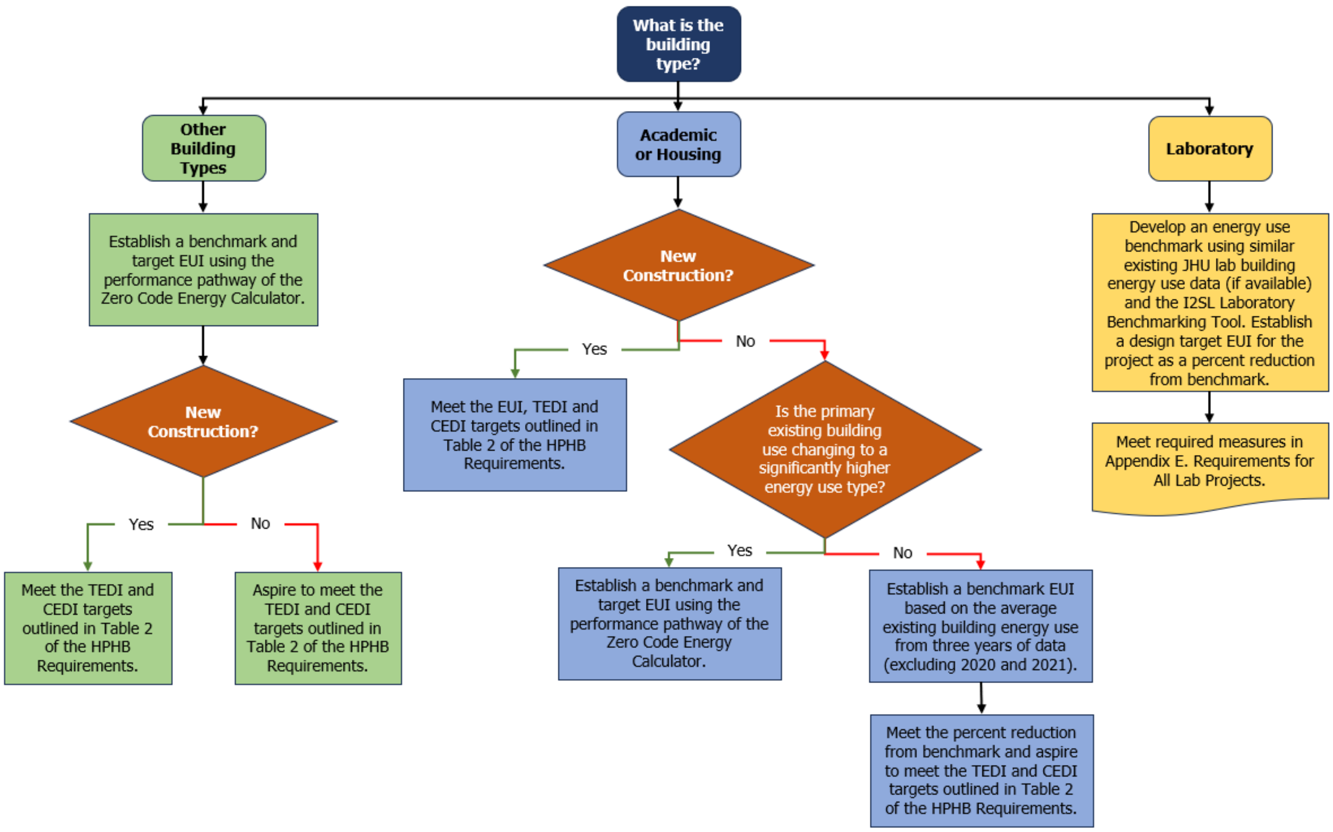

Figure 3: Energy target setting requirements

Table 2: Energy Requirements for Academic and Housing Building Types provides EUI targets for new construction and major renovations as well as TEDI and CEDI targets. Laboratory projects shall meet the performance requirements outlined in Appendix A. Requirements for All Lab Projects. Mixed use projects shall follow the target setting as described in Figure 3: Energy target setting requirements.

Table 2: Energy Requirements for Academic and Housing Building Types

Building Type	Major Renovation (% Reduction from Benchmark)[7]	New Construction EUI Target (kBtu/SF)[8]	TEDI[9] (kBtu/h-ft2-yr)	CEDI[10] (kBtu/h-ft2-yr)
Academic[11]	60%	25	1.9	13.2
Housing[12]	45%	30	1.3	6.7

LEED and Best Practice

Related required LEED credit	Related optional LEED credit	Best Practice
• IPc1 Integrative Process (1 pt) • EAc2 Optimize Energy Performance (8 of 18 pts min) • EAc1 Enhanced Commissioning (all 6 pts min) • EAc3 Advanced Energy Metering • EAc4 v4.1 Grid Harmonization (1 of 2 pts min)	• N/A	Provide sufficient onsite renewable energy to meet the annual energy demand of the building.

Deliverables

Phase	Deliverable	Primary Responsibility
All design phases	☐ See ☐ Building *Performance* section for analysis requirements by phase and include description of how project is meeting requirement in BOD at the end of each phase.	▶ Mechanical Engineer / Energy Modeler

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7 Existing building projects maintaining a similar primary building use are to establish a benchmark EUI based on the average existing building energy use from three years of data (excluding 2020 and 2021).

8 Buildings connected to a central plant must model existing plant efficiencies.

9 TEDI = Thermal Energy Demand Intensity. TEDI is the modeled heating demand of the building, which is driven by building envelope and airtightness as well as the ventilation system.

10 CEDI=Cooling Energy Demand Intensity. CEDI is the modeled cooling demand of the building, similar to TEDI.

11 Academic buildings refer to classrooms, office, and other low-energy intensive building types. Assumes no large area of lab spaces. For projects with large loads such as lab space, develop a project specific blended EUI and follow lab requirements in Appendix A. Requirements for All Lab Projects.

12 Housing refers to dormitory and apartment style student housing without a dining hall. For projects with large loads such as a dining hall, develop a project specific blended EUI.

Resources

- Zero Code
-
- Building Performance requirements
- JHU life-cycle cost assessment and social cost of carbon tool

1.3 Refrigerants

Refrigerants can have a very high global warming potential (GWP) depending on the type. In alignment with JHU's climate action goal and state legislation, no HFC, CFC, or HCFC refrigerants are allowed. Project teams should consider factors such as flammability, odor, and efficiency in their evaluation of low GWP alternatives. If ultra-low GWP refrigerants are not available or feasible, do not go over GWP 700 unless it can be proven that the volume is very low and the GWP of the whole system is under 750.[13]

LEED and Best Practice

Related required LEED credit	Related optional LEED credit	Best Practice
• EAc6 Enhanced Refrigerant Management	• N/A	Use natural/hydrocarbon refrigerants with ultra-low GWP <10 (e.g., Ammonia, CO2, Propane, HFOs).

Deliverables

Phase	Deliverable	Primary Responsibility
All design phases	☐ Include description of how project is meeting requirement in BOD.	▶ Mechanical Engineer

Resources

- EPA AIM Act

1.4 Embodied Carbon

In alignment with meeting JHU's climate action goals, all new construction and major renovations must strive to reduce their embodied carbon emissions. Projects must also strive to reduce the embodied carbon of new materials by meeting the material specifications in Appendix B. Material Requirements and endeavor to use salvaged materials wherever possible. Projects must also reduce emissions during construction (see requirements under Deliverables below).

LEED and Best Practice

Related required LEED credit	Related optional LEED credit	Best Practice
• MRc1 v4.1 Building Life-Cycle Impact Reduction (2 of 5 pts min)	• SSpc75 Clean Construction (Pilot Credit)	Do not exceed total embodied carbon emissions of 500 kg-CO_{2e}/m^2 for foundations, structure, enclosure, and interior of the project.

[13] Use the LEED methodology for calculation for refrigerant impact.

	Consider end of life and circular economy principles in all materials selection in line with Section 6.0 Responsible Consumption

Deliverables

As part of meeting the LEED NC v4.1 MRc1: Building Life-Cycle Impact Reduction credit and to support JHU's commitment to reducing GHG emissions, a building life-cycle assessment is required at each phase of design. In addition, the contractor is to develop and implement a low-carbon construction plan to reduce emissions from construction.

Phase	Deliverable	Primary Responsibility
Concept	☐ Develop a life-cycle assessment of the building structure and enclosure and MEP systems to set a baseline and target for embodied carbon. ☐ Include exposure to carbon offset pricing in analysis. ☐ Include description of how project is meeting requirement in 100% Concept report. ☐ Conduct outreach with manufacturers to request product-specific Environmental Product Declarations (EPDs) to refine the model and assessment.	▶ Architect or Sustainability Consultant, MEP Engineer
Schematic Design	☐ Compare at minimum three structural, three enclosure, and three MEP design options. Include exposure to carbon offset pricing in analysis and decision-making. ☐ Include description of how project is meeting requirement in 100% Schematic Design report.	▶ Architect or Sustainability Consultant, MEP Engineer
All other design phases	☐ Update the baseline and target model at each design milestone to track design changes and compare options, including offset pricing in analysis and decision-making. ☐ Include description of how project is meeting requirement in final report at each phase.	▶ Architect or Sustainability Consultant
Construction	☐ At time of bid, contractor to develop a Low-Carbon Construction Plan[14] and report on it as part of regularly occurring construction progress meetings.	▶ Contractor

Resources

- Carbon Leadership Forum
- Mircrosoft's "Reducing Embodied Carbon in Construction"

1.5 Renewable Energy and Battery Backup

Conduct a site-wide renewable energy feasibility study to assess power supply, availability and renewable energy options. At a minimum meet the provisions of 2021 IECC Appendix CB Solar-Ready Zone for both future rooftop solar and energy storage systems.

LEED and Best Practice

[14] Adapted from Microsoft's "Reducing Embodied Carbon in Construction," 2021. https://query.prod.cms.rt.microsoft.com/cms/api/am/binary/RWGtgl. See pg. 28 for Sample Construction Activity Carbon Reduction Plan (CACRP).

Related required LEED credit	Related optional LEED credit	Best Practice
• N/A	• EAc5 Renewable Energy • EApc152 GridOptimal Building ACP (Pilot Credit)	Install onsite renewable energy paired with battery backup day one.

Deliverables

Phase	Deliverable	Primary Responsibility
Concept	◻ Site-wide renewable energy feasibility study to assess power supply, availability and renewable energy and storage options.	▶ Electrical Engineer
All design phases	◻ Identify solar ready roof area, future battery locations, and related infrastructure needs on plans per 2021 IECC Appendix CB Solar-Ready Zone.	▶ Electrical Engineer and Architect

Resources

- 2021 IECC Appendix CB Solar-Ready Zone

1.6 Electric Vehicle Charging Infrastructure

For projects with 5 or more parking spaces, 10% of all parking spaces associated with the building to be EV-Ready. See definitions and guidance from the International Code Council, "Electric Vehicles and Building Codes: A Strategy for Greenhouse Gas Reductions": "EV-READY SPACE. A designated parking space which is provided with a dedicated branch circuit that is not less than 40-ampere and 208/240-volt assigned for electric vehicle supply equipment terminating in a receptacle or junction box located in close proximity to the proposed location of the EV parking space. For two adjacent EV-Ready spaces, a single branch circuit is permitted."

LEED and Best Practice

Related required LEED credit	Related optional LEED credit	Best Practice
• N/A	• V4.1 LTc8 Electric Vehicles	Install electric vehicle charging equipment for 10% of all parking spaces associated with the building day one.

Deliverables

Phase	Deliverable	Primary Responsibility
All design phases	◻ Indicate EV-Ready parking spaces on plans including related wiring and capacity.	▶ Electrical Engineer

Resources

- International Code Council, "Electric Vehicles and Building Codes: A Strategy for Greenhouse Gas Reductions"
- Washington, D.C. code: "Electric vehicle make-ready parking spaces in new multi-unit residential and commercial buildings."

2.0 Climate Resilience

Climate change will continue to impact the mid-Atlantic region with greater severity over the coming years including increasing extreme heat and storm events. A Climate Risk Assessment was conducted in 2022 to identify climate hazards, related risks and prioritized adaptation strategies. Project teams are encouraged to review this assessment to help inform strategies to mitigate future impacts from climate change.

2.1 Climate Risk Assessment and Resilience Plan

Project teams are expected to review the 2022 JHU Climate Adaptation Report and conduct a project and site-specific risk assessment to evaluate at minimum the impacts of extreme heat, poor air quality, flooding, and storms. Assessment and narrative should address the following:

- Management of stormwater accounting for increased storm intensity. Strive to limit post-development 10-year flow rate from on-site discharge to the off-site storm sewer such that it will be no greater than the 10-year pre-development flow rate, with pre-development flow rate based on 2014 IDF curves and post-development flow rate based on 2100 IDF curves to account for climate change. Ensure that capacity of design (infiltration, capture, and conveyance systems) accounts for adjusted climate projections based on 100-year IDF curves for end of facility life. Where site-specific updated future IDF curves do not exist, add 20% to rainfall intensity for a nominal factor of safety. Include the following specific measures in design:
    - Ensure to limit conveyance of sediment and contamination to neighboring sites.
    - Account for future climate projections in the design of roof drainage and rainwater leaders. Capacity of design should be increased by an additional 20% above current requirements. Require design teams to calculate and document the capacity required for roof drainage system and demonstrate 20% capacity increase.
    - Proper site drainage so that rain, snowmelt and freeze/thaw is prevented from entering the building and from pooling on site (e.g., increasing infiltration, decreasing impervious surfaces, and adding retention tanks).
- Site-level flood risk either from overland and/or sea level rise (as applicable) under current, 2050, and 2080 climate change projections (RCP8.5). Detail types of flooding and projected risk as well as sources of information used in the assessment and mitigation measures if needed including:
    - Provide detailed narrative on approach to basement and foundation waterproofing in flood prone areas in the BOD
    - Location and protection of sensitive building systems and program (e.g., mechanical and electrical rooms, backup power, elevator pits, vivarium etc)
    - Specific materials in areas subject to flooding that are easy to clean, repair and replace
- Impact of extreme heat on cooling demands. See the
- Building Performance section for how project teams are expected to assess building energy use with future climate data. Assess the following mitigating strategies in design, noting that these strategies should also serve to further the energy efficiency objectives outlined in these requirements:
    - Size and design facility cooling systems (i.e. chiller plant and ventilation air handling unit equipment and plants) to maintain required thermal comfort using weather files (RCP8.5) for the year that is 30 years from building occupancy date. If equipment design life is less than modeled future conditions, provide flexibility in the design to replace, upgrade or retrofit systems including allowing additional space for shafts, mechanical rooms, rooftop penthouses, etc.
    - Incorporate passive strategies such as shading, high performance envelope and appropriate window-to-wall ratios as informed by energy modeling to reduce building overheating.
- Impact of extreme heat on outdoor comfort. Prioritize the reduction of the impact of urban heat island effect through shading of hardscape, ideally from tree canopy, PV, or green roofs, based on site conditions

and scope. Design sites to encourage airflow and thermal comfort (e.g., avoid down drafts) and include drought-resistant planting.

- Need for backup power based on potential interruptions. Evaluate emergency and non-emergency backup power needs and develop a plan to assess options to deliver backup power with batteries. At minimum, supply life safety emergency power with batteries where feasible (e.g., emergency lighting and elevators). In addition to other non-emergency backup power needs (e.g., IT, research requirements etc), consider other potential loads such as cooling and air quality refuge spaces as determined by OPR.

LEED and Best Practice

Related required LEED credit	Related optional LEED credit	Best Practice
• SSc5 Heat Island Reduction (2 pts min) • IEQc1 Enhanced IAQ Strategies (2 pts min) • SSc4 (v4.1) Rainwater Management (1 pt min)	• IPpc98 – Assessment and Planning for Resilience • IPpc99 – Design for Enhanced Resilience • IPpc100 Passive Survivability and Back-up Power During Disruptions	Conduct a microclimate analysis considering future climate conditions and design landscape to maximize exterior comfort. Incorporate a cooling and/or air quality refuge space into the design that is accessible to community members. Incorporate passive strategies such as shading and window treatments to improve thermal performance.

Deliverables

Phase	Deliverable	Primary Responsibility
All design phases	☐ Provide a narrative describing assessed climate risks and mitigation measures considered and incorporated to the project. Update the narrative at each end-of-phase.	▶ Architect, Civil, MEP and Landscape Architect

Resources

- JHU Climate Adaptation Report
- Climate Positive Design tool
- U.S. Climate Resilience Toolkit
- City of Baltimore Disaster Preparedness and Planning Project
- Climate Change Projections for the District of Columbia

3.0 Water

Climate change will further stress potable water resources in Baltimore and beyond. Maintaining potable water quality is also a key priority to protect the health and well-being of the JHU community. JHU already has implemented alternative water sources for non-potable uses in some projects (e.g., condensate for toilet flushing) and is exploring other opportunities.

3.1 Potable Water Reduction

Conduct a water balance accounting for all potable and non-potable indoor and outdoor water uses and evaluate alternate water sources including rainwater, greywater, and condensate at a minimum. Assess feasibility of using alternative water sources for non-potable uses such as toilet flushing and irrigation.

LEED and Best Practice

Related required LEED credit	Related optional LEED credit	Best Practice
• IPc1 Integrative Process (1 pt) • WEc1 Outdoor Water Use Reduction (1 pt min) • WEc2 Indoor Water Use Reduction (3 pts min) • WEc3 Optimize Process Water Use (1 pt min) • WEc4 Water Metering (irrigation plus one other use)	• N/A	Dual-plumb the building and meet all non-potable water uses (e.g., toilet flushing, irrigation and cooling tower makeup) with non-potable water. Install water meters for non-potable system to track long-term operational benefits.

Deliverables

Phase	Deliverable	Primary Responsibility
Schematic Design	◻ Water balance and narrative describing potable water reduction strategies.	▶ Plumbing Engineer

Resources

- EPA WaterSense

3.2 Access to Clean Drinking Water

For all spaces, meet WELL prerequisite W01 Water Quality Indicators for water delivered to the project and intended for human contact (e.g., drinking, cooking and dishwashing, handwashing, showering or bathing):

- Turbidity is less than or equal to 1.0 NTU, FTU or FNU (nephelometric turbidity, formazin turbidity or formazin nephelometric units, respectively).
- Coliforms are not detected in any 100 ml sample.

Install drinking water dispensers and bottle fillers within 100 ft of all regularly occupied areas. Install water filters on all dispensers to remove chemicals, organic contaminates, and pesticides.[15]

[15] See WELL W02 Drinking Water Quality and W06 Drinking Water Promotion for recommended guidelines.

LEED and Best Practice

Related required LEED credit	Related optional LEED credit	Best Practice
• N/A	• N/A	Provide drinking water that meets the quality outlined in WELL credit W02 Drinking Water Quality. Implement protocols to reduce risk of Legionella colonization as outlined in WELL SA3 Develop Legionella Management Plan. Do not refrigerate drinking water dispensers and bottle fillers.

Deliverables

Phase	Deliverable	Primary Responsibility
Schematic Design	☐ Water quality test results and mitigation measures if quality does not meet requirements. ☐ Identify locations for drinking water dispensers on plans.	▶ Plumbing Engineer
All other design phases	☐ Identify locations for drinking water dispensers on plans and include in specifications water dispensers and bottle fillers capable of delivering water quality as described.	▶ Plumbing Engineer

Resources

- WELL W01 Water Quality Indicators
- WELL SA3 Develop Legionella Management Plan

4.0 Site

JHU recognizes the benefit of enhancing campus greenspace to provide ecosystem services (e.g., stormwater management through bioswales and others) and respite for the community. Project teams are expected to focus on designing climate resilient landscapes that utilize native species, enhance biodiversity, infiltrate stormwater, sequester carbon, and minimize water use.

4.1 Increase greenspace and tree canopy

Assess opportunities for the addition of greenspace and tree canopy throughout the project. Where site constraints limit the ability to add vegetation, include at least one biophilic design element[16] within the building (e.g., natural materials, water feature, images of nature etc). The vegetation strategy must consider the following:

- Locations and areas of greenspace to maximize accessibility, use and comfort
- Protection of existing sensitive ecological areas
- Elimination of invasive species[17]
- Use of native species adaptive to climate change

[16] See Terrapin Bright Green's "14 Patterns of Biophilic Design": https://www.terrapinbrightgreen.com/reports/14-patterns/

[17] Non-native plants, animals, or other organisms that thrive in areas where they don't naturally live and degrade, change, or displace native habitats and cause economic or environmental harm.

- Increase in biodiversity and habitat
- Protection of existing native trees
- Opportunities to increase tree canopy as much as is feasible with native species adaptive to future climate conditions
- Opportunities to include vegetation on terrace or roof areas that can accommodate green roof installations and/or be accessible to buildings occupants.

LEED and Best Practice

Related required LEED credit	Related optional LEED credit	Best Practice
• N/A	• SSc2 Site development – protect or restore habitat • SSc3 Open Space	Provide tree canopy for 40% of site area excluding the building footprint (measured at tree maturity). Replace specimen trees at a 1.5:1 ratio wherever vegetation is removed as part of construction.

Deliverables

Phase	Deliverable	Primary Responsibility
Concept	☐ Identify greenspace and tree canopy goals and targets and include in project narrative.	▶ Landscape Architect
All other design phases	☐ Identify ecological features on drawings and describe in project narrative how design meets intent including percent of tree canopy and native species as well as area of accessible greenspace and/or biophilic design strategies.	▶ Landscape Architect

Resources

- WELL Prerequisite W01 Water Quality Indicators

4.2 Bird-Safe Buildings

According to experts in the field, up to one billion birds are killed in collisions with glass across the US each year (Loss, et al, 2014). JHU projects are required to evaluate bird-friendly materials (not just glass) uniformly on facades, above green roofs, and at all glass railings and other hazardous elements, regardless of how high they are located on a building's exterior. Projects are also required to limit light pollution and turn out lights visible from outside as much as possible. See New York's Int. 1482/Local Law 15 and NYC Audubon for more information and design guidance.[1]

LEED and Best Practice

Related required LEED credit	Related optional LEED credit	Best Practice
• SSc6 Light Pollution Reduction	• Innovation Credit: SSpc55 Bird collision deterrence	Work with an ornithologist, biologist, or specialist with a background in collision issues to help the design team assess existing conditions and develop architectural and landscape design strategies to reduce bird collisions and implement bird-safe regulations. The ornithologist/biologist/specialist can help develop a post-construction monitoring plan to monitor the effectiveness of implemented measures.

	Establish a contingency for dealing with any emerging problematic sections of the building.

Deliverables

Phase	Deliverable	Primary Responsibility
Concept	☐ Map existing surrounding landscape features (e.g., stands of trees, water bodies) that may influence bird movement and identify facades likely to need most careful attention. Establish goals for bird collision deterrence and include in project narrative.	▶ Architect and Landscape Architect
Schematic Design / Design Development	☐ Evaluate opportunities for façade design to reduce transparency and reflectivity of glass as well as consider proximity of vegetation to glass. Provide interior and exterior lighting plans and glass specifications. Include description of approach to reducing bird strikes in project narrative.	▶ Architect and Landscape Architect

Resources

- Bird-Friendly Building Design [American Bird Conservancy]

4.3 Climate Positive Landscape

Landscape projects must demonstrate that they will be climate positive[18] within 5 years for projects with greenspace that account for 50% or more of the site area (excluding building footprint) or within 10 years for sites with greenspace that account for less than 50%. Climate positive means that GHG emissions generated from the materials used in and construction of the landscape will be offset by the carbon sequestered by the planting.

Identify areas with high-value soils and develop a soil management strategy that retains reusable soil and amends in place rather than importing new soil. Minimize soil disturbance to prevent soil carbon release. Consider using a cover crop on disturbed soils that will be exposed for an extended length of time. Avoid high maintenance landscapes (e.g., lawn and hedges, non-native plants). In addition, use compost or organic fertilizers to eliminate the need for chemical fertilizers, particularly those containing Nitrous Oxide.

LEED and Best Practice

Related required LEED credit	Related optional LEED credit	Best Practice
• N/A	• SSc2 Protect or Restore Habitat	20% of landscape materials (including planting but excluding soil) by cost to be salvaged or reused.

[18] See Climate Positive calculator and design toolkit: https://climatepositivedesign.com/

Deliverables

Phase	Deliverable	Primary Responsibility
Concept Design	☐ Establish project goals for climate positive landscape strategies and describe in project narrative.	▶ Landscape Architect
Schematic Design	☐ Compare a minimum of two design options using the Climate Positive Design Pathfinder tool and use results to evaluate design direction. Update strategies and approach in project narrative.	▶ Landscape Architect
All other design phases	☐ Update Pathfinder tool and project narrative at end of each phase.	▶ Landscape Architect

Resources

- Climate Positive Design Pathfinder Tool
- Climate Positive Design Toolkit

4.4 Mobility and Sustainable Transportation

The Plan focuses on reducing GHG emissions from commuting through the promotion of alternative transportation options. In support of this goal, projects are expected to carefully consider and design for pedestrian, bike and other forms of micromobility (e.g., scooters, skateboards etc.). Provide sufficient short and long-term bicycle parking as appropriate to project use and available surrounding infrastructure. Housing must include secure long-term bicycle storage.

LEED and Best Practice

Related required LEED credit	Related optional LEED credit	Best Practice
• N/A	• LTc5 Access to Quality Transit • LTc6 Bicycle facilities	Provide covered and secure bicycle parking for at least 5% of building occupants.

Deliverables

Phase	Deliverable	Primary Responsibility
Concept	☐ Evaluate opportunities to increase pedestrian and micromobility access and safety. Include description in project narrative.	▶ Architect and Landscape Architect
All other design phases	☐ Update approach to mobility and sustainable transportation in project narrative.	▶ Architect and Landscape Architect

Resources

- LEED for Cities, Transportation and Land Use, Walkability and Bikeability

5.0 Health and Well-being

JHU is committed to developing and maintaining buildings to support the health and well-being of all occupants. In addition to the materials requirements in Appendix B. Material Requirements, projects are expected to address indoor air quality, contagion management, drinking water quality, diverse user needs, daylighting and quality views, and acoustic performance.

5.1 Indoor Air Quality

Air quality is fundamentally important for the health and well-being of the JHU community. Projects are expected to design ventilation systems to optimize air quality and manage contaminants in the building through careful selection of materials (see Appendix B. Material Requirements), cross-contamination prevention and air quality monitoring.

Design air handling units and HVAC systems to accommodate MERV 14 filtration at a minimum. Provide ASHRAE 52.2 Appendix J MERV A rating test report for filtration. Develop operations and maintenance protocol for filter storage, inspection & replacement.

Limit exfiltration and infiltration of air, fine particulate matter (<2.5PM) and other air pollutants through materials of the assembly, joints in the assembly, joints in components of the wall assembly, and junctions with other facility elements, including the roof.

Locate air intakes in protected locations to minimize intake of contaminants (i.e. avoid pollutants near air intake locations, including plantings, parking areas, garbage disposal bins, and others).

Conduct whole building air leakage testing prior to occupancy to ensure leakage is under 0.25 cfm/SF. In conjunction with this test, conduct an infrared scan to identify potential leakages.

Complete duct leakage testing.

LEED and Best Practice

Related required LEED credit	**Related optional LEED credit**	**Best Practice**

• IEQc1 Enhanced IAQ Strategies (2 pts min)
• IEQc2 Low Emitting Materials (3 pts min)
• IEQc3 Construction IAQ Management Plan
• IEQc4 Indoor Air Quality Assessment (1 pt min)
• IEQc2 v4.1 Low Emitting Materials for the following categories:
    ○ Interior-Applied Paints, Coatings, Adhesives, and Sealants
    ○ Ceilings
    ○ Wall Panels
    ○ Insulation
    ○ Flooring
    ○ Furniture
	• IPpc108 Integrative Process for Health Promotion	Increase breathing zone outdoor air ventilation rates for 95% of all occupied spaces by at least 30% above the minimum rates as determined by LEED IEQ prerequisite Minimum Indoor Air Quality Performance.[19]
		
		Install permanent air quality monitoring per WELL A08 Air Quality Monitoring and Awareness.

Deliverables

[19] Base on strategy 6 in LEED IEQc1 Enhanced Indoor Air Quality Strategies as well as WELL A06 Enhanced Ventilation Design.

Phase	Deliverable	Primary Responsibility
Concept Design	☐ Establish goals for indoor air quality and include in project narrative.	▶ Mechanical Engineer
Design Development	☐ Review envelope details at 75% DD.	▶ Envelope Consultant
Construction Documents	☐ Review envelope details at 75% CD.	▶ Envelope Consultant
All other design phases	☐ Update project narrative with approach to meeting requirements.	▶ Mechanical Engineer
Construction	☐ Provide ASHRAE 52.2 Appendix J MERV A rating test report for filtration. ☐ At the end of construction and prior to occupancy, conduct building flush out or air quality testing per LEED requirements.	▶ Contractor

Resources

- WELL A06 Enhanced Ventilation Design
- WELL A08 Air Quality Monitoring and Awareness
- Building Evidence for Health: The 9 Foundations of a Healthy Building [Harvard]

5.2 Contagion Management

Health and safety are paramount considerations for JHU. Project teams are expected to address contagion management through improved air quality (see 5.1 Indoor Air Quality) and access to handwashing. Projects to consider providing stairwells with ventilation based on occupancy sensors and assess feasibility of adding air cleaning devices (such as UV-C) to elevators and HVAC equipment.

LEED and Best Practice

Related required LEED credit	Related optional LEED credit	Best Practice
• IEQc1 Enhanced IAQ Strategies (2 pts min)	• IPpc108 Integrative Process for Health Promotion	Meet WELL A14 Microbe and Mold Control

Deliverables

Phase	Deliverable	Primary Responsibility
All design phases	☐ Include contagion management strategies in BOD.	▶ Mechanical Engineer

Resources

- WELL A14 Microbe and Mold Control

5.3 Meeting Diverse Needs

JHU is deeply committed to the dignity and equality of all persons—inclusive of sex, gender, marital status, pregnancy, race, color, ethnicity, national origin, age, disability, religion, sexual orientation, gender identity or expression, and veteran status. As such, projects are encouraged to consider the variety of needs for visitors and building occupants. All projects are to consider universal design strategies.[20] New construction projects are to include all-gender restrooms for 100% of all required fixture count equitably distributed between floors. For major renovations, all-gender restrooms should be included (e.g., converting existing single room facilities) as much as feasible as applicable to scope. In addition, for each building project with regular occupants (e.g., at least 1 full-time occupant), provide at least one designated lactation room meeting the requirements outlined in Appendix D. Lactation Room Requirements, unless a lactation room is readily accessible in a neighboring facility within 500 feet. The lactation room cannot be used for other purposes.

LEED and Best Practice

Related required LEED credit	Related optional LEED credit	Best Practice
• N/A	• N/A	Provide a designated indoor space available to all regular occupants to support restorative practices. See WELL M07 Restorative Spaces for more guidance.

Deliverables

Phase	Deliverable	Primary Responsibility
Concept	☐ Identify goals for meeting diverse needs and include in project narrative.	▶ Architect
All other design phases	☐ Identify rooms on plans and describe approach to meeting diverse needs in project narrative.	▶ Architect

Resources

- WELL C13 Accessibility and Universal Design
- WELL M07 Restorative Spaces
- Appendix D. Lactation Room Requirements

5.4 Daylighting and Quality Views

JHU is committed to providing lighting environments that support productivity, reinforce circadian rhythms, promote mental health, and reduce the use of electrical lighting by introducing daylight into the space. JHU also recognizes the importance of connecting building occupants to the outdoors and natural environment by providing quality views. All projects must complete LEED Daylight credit benchmarking and provide manual (or automatic with manual override) glare-control devices for all regularly occupied spaces.

LEED and Best Practice

Related required LEED credit	Related optional LEED credit	Best Practice
• IEQc7 Daylight (1 of 3 pts min)	• IEQc8 Quality Views	Provide occupants with a view to the outdoors for 75% of all regularly occupied floor area[21], excluding auditoriums, video conference rooms, and gymnasiums.

[20] See WELL C13 Accessibility and Universal Design for suggestions.

[21] Views to interior atria may account for up to 30% of regularly occupied floor area.

Deliverables

Phase	Deliverable	Primary Responsibility
Concept	☐ Establish goals for daylighting and quality views and include in project narrative.	▶ Architect
Schematic Design	☐ Highlight opportunities to maximize natural daylight potential while minimizing glare and thermal discomfort through exterior solar insolation analysis, annual illuminance diagrams and analysis of direct sunlight and glare potential. Use analysis to benchmark performance relative to LEED Daylight credit thresholds.	▶ Architect
Design Development	☐ Update the daylight analysis and LEED Daylight credit benchmarking. Provide detailed recommendations for façade design and program layout.	▶ Architect
Construction Documents	☐ Update the daylight analysis at 50% CD and prepare final LEED Daylight credit calculations.	▶ Architect

Resources

- IES LM-83-12 Spatial Daylight Autonomy and Annual Sunlight Exposure

5.5 Acoustic Performance

Acoustic performance is essential for the health and well-being of the JHU community and an equally important consideration for meeting the diverse needs of visitors and buildings occupants. Noise can interfere and distract from normal work and communications, contribute to hearing loss, and increase the risk of other negative health impacts. Projects are to pursue effective acoustic design that promotes occupant well-being and productivity. Projects with spaces intended for instruction and public address should consider providing audio devices that improve hearing accessibility.

LEED and Best Practice

Related required LEED credit	Related optional LEED credit	Best Practice
• IEQc9 Acoustic Performance	• N/A	Provide occupants with devices that support enhanced speech intelligibility and bolster hearing accessibility in classrooms, lecture halls, and other learning spaces. See WELL S08 Enhanced Audio Devices for more guidance.

Deliverables

Phase	Deliverable	Primary Responsibility
Concept	☐ Establish goals for acoustic performance and include in project narrative.	▶ Architect
All other design phases	☐ Update project narrative with approach to meeting requirements.	▶ Architect
Construction	☐ At the end of construction and prior to occupancy, calculate or measure HVAC background noise, sound isolation, reverberation time, and sound reinforcement and masking per LEED requirements.	▶ Contractor

Resources

- ASHRAE Handbook – Chapter 48 Noise and Vibration Control
- WELL S08 Enhanced Audio Devices
- Building Evidence for Health: The 9 Foundations of a Healthy Building [Harvard]

6.0 Responsible Consumption

The materials we use and what we do with them at the end of life have significant environmental and health impacts. JHU prioritizes using materials that reduce impacts on the health of people and the planet. All projects are expected to evaluate material selections for life-cycle environmental impacts, toxicity, durability, and reuse or recycling potential. JHU follows standard procurement protocols that encourage the selection of businesses and haulers that are owned and operated within Baltimore City, with an emphasis on Minority Business Enterprises (MBE) in line with JHU's HopkinsLocal commitment.

6.1 Healthy Materials and Resource Efficiency

For all projects, strive to specify products free from Red List materials, chemicals, and elements[22] as much as is feasible based on availability and budgets and specifically based on the requirements by Appendix B. Material Requirements. Demonstrate compliance through one of the following forms of documentation:

1. Health Product Declaration (HPD)
    a. Published and complete HPD in compliance with the Health Product Declaration Open Standard
2. International Living Future Institute Declare Label (status: Red List Free)
3. Cradle to Cradle Certification
    a. Material Health Certification, Bronze or higher
    b. Cradle to Cradle full certification, Bronze or higher

In addition, prioritize the following criteria for materials selection and see specific criteria in Appendix B. Material Requirements:

- Locally-salvaged materials
- Locally-sourced materials (extracted and/or manufactured from within 100 miles)
- High-recycled content
- Low-embodied carbon
- Durability

[22] Refer to the Living Building Challenge Red List: https://living-future.org/lbc/red-list/

- End-of-life disposal

LEED and Best Practice

Related required LEED credit	Related optional LEED credit	Best Practice

• MRc2 v4.1 BPDO: Environmental Product Declarations (1 point min)
• MRc3 v4.1 BPDO: Sourcing of Raw Materials (1 point min)
• MRc4 v4.1 BPDO: Material Ingredients (1 point min)
• IEQc2 v4.1 Low Emitting Materials for the following categories:
  o Interior-Applied Paints, Coatings, Adhesives, and Sealants
  o Ceilings
  o Wall Panels
  o Insulation
  o Flooring
  o Furniture
	• EQpc105 Lead Risk Reduction (Pilot Credit)	Avoid Red List chemical classes or 90% of the project's new materials by cost.[23]

[23] See Living Building Challenge Materials Imperative 13, Red List.

Deliverables

Phase	Deliverable	Primary Responsibility
Concept	☐ Identify material goals for the project and include in project narrative. ☐ The Project Manager or contractor shall assess and identify all built-in equipment, appliances, fixtures and furniture for deconstruction, reuse, or donation where feasible and depending on location and manage accordingly. This can include reuse on the existing project, donation to the Hop Reuse Hub and/or nonprofit, or sale to an outside vendor.	▶ Architect / Contractor
Design Development	☐ During Project Scoping Workshop, review sustainability goals and related materials requirements as well as how to select and document compliance. Discuss at minimum the following: • Material selection criteria and process including tips and resources for finding compliant products and documentation • Embodied carbon and Environmental Product Declarations • Healthy materials (toxicity, low VOCs etc) • Locally available materials including salvage and reused At minimum attendees should include design team, JHU Office of Sustainability or divisional sustainability representative, JHU project staff and key stakeholders, and General Contractor/Construction Manager (if onboard).	▶ Sustainability Consultant

Resources

- Healthy Building Network
- BuildingGreen
- Carbon Leadership Forum

6.2 Waste Reduction – Construction

Project teams are expected to emphasize waste reduction wherever possible. New construction and major renovations are expected to achieve minimum 75% diversion of construction waste from landfill/incineration and submit recycling and disposal tonnage reports. Project Managers will collect and submit tonnages to the Office of Climate and Sustainability using Appendix F. C&D Waste Reporting log.

LEED and Best Practice

Related required LEED credit	Related optional LEED credit	Best Practice
• MRc5 Construction & Demolition Waste Management (all 2 pts min)	• N/A	Achieve 75% construction and demolition waste diversion.

Deliverables

Phase	Deliverable	Primary Responsibility
Bidding	☐ General Contractor or Construction Manager is to provide a Waste Management Plan, which should include, at a minimum, the following elements: • Project overview • Diversion goal (75% or greater) • Anticipated waste streams • Diversion methods and strategies • Site logistics for comingling or sorting • Communication plan for employees and subcontractors • Hazardous materials • Hauler/ waste removal vendor	▶ Contractor
Construction	☐ Contractor to provide updated Construction Waste Management Plan (see above Waste Management Plan) and conduct mandatory preconstruction onsite training for all subcontractor key field personnel. ☐ Contractor to submit monthly recycling and disposal tonnage reports to JHU Project Manager. Project Managers will utilize PM Web to track tonnages.	▶ Contractor

Resources

- Appendix F. C&D Waste Reporting Log
- JHU Responsible Consumption
- USGBC Defining Waste Streams

6.3 Waste Reduction – Building Operations

JHU is committed to waste diversion and zero waste practices. Projects must design building infrastructure to support JHU's zero waste efforts in collaboration with JHU Divisional Facilities and Custodial teams and the Office of Sustainability to ensure adequate and consistent waste collection. See Appendix C. JHU Waste Infrastructure Standards.

LEED and Best Practice

Related required LEED credit	Related optional LEED credit	Best Practice
• N/A	• N/A	Achieve 50% waste stream diversion.

Deliverables

Phase	Deliverable	Primary Responsibility
Schematic Design	☐ Identify needed waste infrastructure (e.g., collection locations) and allocate sufficient space inside the building for receptacles and outside the building for staging or disposal. Include description in project narrative.	▶ Architect
Construction Documents	☐ Include in drawings and specifications University approved waste collection receptacles and signage. Include description in project narrative.	▶ Architect

Resources

- JHU Responsible Consumption

MODIFICATIONS

All projects regardless of scale have the opportunity to improve the overall sustainability of JHU operations and occupant health and well-being. **Modifications[24] are required to meet the following as applicable to scope and project scale and at the determination of the Design and Construction Unit Director (with signature authority) and Project Manager in the project planning phase.** All modification projects are encouraged to explore a green building certification (e.g., LEED for Commercial Interiors) as appropriate to project type and scale.

Integrative Design Process (IDP)

IDP is a holistic process by which a design team and the client align around shared project goals and use a collaborative approach to inform decision-making that understands the building as an interconnected whole rather than separate parts. The following IDP activities are expected of all project teams.

Project Scoping

Project scoping is to occur prior to development of a Request for Proposals to establish preliminary sustainability goals and define needed design team roles, scope, and deliverables. Project Scoping can occur during a project scoping workshop for larger modification projects or during a regularly occurring meeting for smaller projects. This meeting should include a walkthrough of the HPHB requirements that are applicable to the modification scope. At a minimum, attendees are to include the JHU Project Manager and representatives from Design and Construction, Planning and Architecture, Operations, and Office of Sustainability or another divisional sustainability representative.

Sustainability Visioning

Sustainability Visioning is to occur at the beginning of each project to review opportunities and constraints and identify the goals and targets for the project. Sustainability Visioning can occur during a specific sustainability visioning workshop or a regularly occurring meeting depending on the size of the project. This meeting should also clarify roles and responsibilities for implementing and tracking progress through the course of the project.

This Sustainability Visioning is to be organized and facilitated by the design prime. The sustainability stakeholder group should include representatives of the full design team, sustainability consultant (recommended for larger modification projects) construction manager, university/school project managers, maintenance, custodial, energy and engineering staff, sustainability staff, research faculty, and key stakeholders as applicable to scope. Agenda topics must include all areas of these requirements that have been determined to be applicable to scope per Project Scoping.

Outcomes of the Sustainability Visioning must include project-specific sustainability goals and targets to be added to the OPR. The design team must report on progress towards these goals and targets at the end of each phase (see

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[24] Modifications refer to renovation scopes that do not meet the standard for major renovation (i.e., projects that do not require a new certificate of occupancy) such as a fit-out of a floor or a finish upgrade.

Compliance and Reporting).

Sustainability Meetings

A Sustainability Meeting is to be held at the beginning of each of the following phases, as applicable to campus and scope of modification project:

- Schematic Design
- Design Development
- Construction Documents
- Construction

The Sustainability Meeting can be a standalone meeting or take place during a regularly occurring meeting depending on the size of the project. The meeting should include at minimum all participants and agenda topics listed in the Sustainability Visioning and be used to review project progress towards sustainability goals; key challenges and decision points for the next phase; and specific analysis that needs to occur to inform decision-making.

In addition, every design progress meeting should include sustainability as an agenda item.

Construction Kick-Off

Conduct a meeting at the beginning of construction to review sustainability and resiliency goals for the project as well as green building certification documentation and compliance. Topics should include:

- Sustainability and performance goals
- Commissioning plan
- LEED and other certification requirements (if applicable)
- Waste management plan
- Low-carbon construction plan
- Contractors and sub-contractor responsibilities to meet sustainability goals and document compliance, including frequency of reporting

At minimum attendees should include the JHU Project Manager, sustainability representative, General Contractor or Construction Manager and other subject matter experts as appropriate, as well as the architect and sustainability consultant (as applicable). Other consultants are invited as appropriate.

	Project Scoping	Concept	SD	DD	CD	Construction	Post-Occupancy
Integrated Design Meetings	Project Scoping	Sustainability Visioning	Sustainability Meeting	Sustainability Meeting	Sustainability Meeting	Construction Kick-Off	
Deliverables	✓ Sustainability goals	✓ Owner's Project Requirements including sustainable design goals ✓ HPHB Requirements Checklist ✓ Updated Basis of Design and Project Narrative	✓ HPHB Requirements Checklist ✓ Updated Basis of Design and Project Narrative	✓ HPHB Requirements Checklist ✓ Updated Basis of Design and Project Narrative	✓ HPHB Requirements Checklist ✓ Updated Basis of Design and Project Narrative	✓ HPHB Requirements Checklist	✓ Final HPHB Requirements Checklist

Figure 4: Integrated design timeline for Modifications

Performance Requirements

1.0 Energy and Carbon

Climate action is a signature priority of JHU's Sustainability and Climate Action Plan and aligns with the City of Baltimore's Climate Action Plan[25] and Maryland's Climate Solutions Now Act.[26] JHU is committed to achieving net-zero GHG emissions by 2040 through direct emissions reductions. Building energy use plays a significant role in the institution's ability to achieve this goal. All new construction and major renovation projects are expected to reduce energy and carbon impacts in design and operation through the following required measures.

1.1 Electrification

In order to meet JHU's net-zero goal, it is imperative that campus buildings, infrastructure and fleet transition off of fossil fuels to low-carbon energy sources. Over 80% of JHU's procured electricity is already purchased from renewable sources with a goal to increase this to 100% by 2030. As such, all projects involving modifications to or replacements of fossil-fuel burning equipment (e.g., DHW, space heating, cooking equipment, dryers) shall transition equipment to all-electric. For projects connected to a central plant, build in capacity to accept low-temperature hot water in place of steam (e.g., 125°F supply, 10°F differential).

Related CSI Divisions and Best Practices

Related CSI Divisions	Best Practice
• 11 Equipment • 22 Plumbing • 23 HVAC • 26 Electrical	Electrify all fossil-fuel burning equipment and appliances if part of the project.

Deliverables

Phase	Deliverable	Primary Responsibility
All design phases	☐ Include description of how project is meeting requirement in project narrative.	▶ Mechanical and/or Plumbing Engineer

Resources

▶ [Maryland Climate Solutions Now Act of 2022]

1.2 Energy Efficiency

Energy efficiency is critical to reducing GHG emissions and ongoing utility costs. All modifications involving HVAC, DHW, and/or lighting systems shall incorporate at least one energy efficiency measure as applicable to project scope. For example, retro-commissioning, upgrading to more efficient equipment, or incorporating lighting controls.

Related CSI Divisions and Best Practices

25 The City of Baltimore has committed to reducing GHG emissions by 60% by 2030 and to zero by 2045: https://bit.ly/3UN57nJ

26 The Climate Solutions Now Act of 2022 requires the State to reduce statewide greenhouse gas emissions 60% by 2031 and to zero by 2045 and sets energy efficiency and emission reduction requirements for certain buildings: https://mgaleg.maryland.gov/mgawebsite/Legislation/Details/sb0528

Related CSI Divisions	Best Practice
• 11 Equipment • 22 Plumbing • 23 HVAC • 26 Electrical	Increase HVAC energy efficiency through measures such as ventilation setbacks for unoccupied hours and energy recovery ventilation.

Deliverables

Phase	Deliverable	Primary Responsibility
Schematic Design	☐ Audit existing building equipment and performance and assess energy use to help identify energy efficiency goals and strategies for the project. Include goals and priority strategies in BOD.	▶ MEP Engineers
All remaining design phases	☐ Describe energy efficiency measures and estimated savings in BOD.	▶ MEP Engineers

Resources

- Zero Code

1.3 Refrigerants

Refrigerants can have a very high global warming potential (GWP) depending on the type. In alignment with JHU's climate action goal and state legislation, no HFC, CFC, or HCFC refrigerants are allowed. Existing equipment being replaced as part of project scope using CFCs or HFCs must refer to requirements for new construction/major renovations. All modifications involving equipment using refrigerants shall evaluate the feasibility of upgrading equipment with a low-GWP refrigerant.

Related CSI Divisions and Best Practices

Related CSI Divisions	Best Practice
• 11 Equipment • 22 Plumbing • 23 HVAC • 21 Fire Suppression	Use natural/hydrocarbon refrigerants with ultra-low GWP <10 (e.g., Ammonia, CO_2, Propane, HFOs).

Deliverables

Phase	Deliverable	Primary Responsibility
Schematic Design	☐ Identify equipment with refrigerants to be replaced and describe how project will address any existing HFC, CFC, OR HCFC refrigerants in BOD.	▶ Mechanical Engineer
All remaining design phases	☐ Confirm in BOD project approach to refrigerants and replacements made.	▶ Mechanical Engineer

Resources

- EPA AIM Act

1.4 Embodied Carbon

In alignment with meeting JHU's climate action goals, all modifications must strive to reduce the embodied carbon of new materials by meeting the material specifications in Appendix B. Material Requirements and endeavor to use salvaged materials wherever possible.

Related CSI Divisions and Best Practices

Related CSI Divisions	Best Practice
• 03-10 • 12 Furnishings	20% of materials by cost have one or more of the following attributes: are reused/salvaged, contain 10% or greater recycled content, or are made of sustainably sourced natural materials (e.g., wood, stone etc.).

Deliverables

Phase	Deliverable	Primary Responsibility
Schematic Design	☐ Identify project material goals and salvage opportunities to reduce embodied carbon and describe in project narrative.	▶ Architect
All remaining design phases	☐ Update project narrative with strategies to reduce embodied carbon in materials.	▶ Architect
Construction	☐ Provide documentation with submittals supporting environmental claims (e.g., percent of recycled content) and complete materials tracking spreadsheet.	▶ Contractor

Resources

- Carbon Leadership Forum
- Healthy Building Network
- BuildingGreen

2.0 Climate Resilience

Climate change will continue to impact the mid-Atlantic region with greater severity over the coming years including increasing extreme heat and storm events. JHU is committed to planning to mitigate against future impacts including in existing buildings.

2.1 Climate Resilience Planning

Assess scope of project in the existing building for vulnerability to extreme heat and flooding. If building has had flooding in the past or has been identified as being at risk of future flooding, assess opportunities to mitigate flood risk (e.g., material selection, equipment location, program location, program type). Where feasible and depending on scope of modification, address any building overheating concerns through passive and low energy strategies (e.g., adding window films, ceiling fans, etc) as well as upgrade old and undersized ventilation equipment to run efficiently with MERV 14 filtration.

Related CSI Divisions and Best Practices

Related CSI Divisions	Best Practice
• 10 Specialties • 11 Equipment • 22 Plumbing • 23 HVAC • 26 Electrical • 32 Exterior Improvements • 33 Site Utilities	Design and size cooling systems using climate projections for at least 30 years in the future, considering the lifespan of building components. Incorporate flexibility for future systems, including providing added space for future equipment expansion. Monitor indoor air quality in select spaces (e.g., key residences, classrooms, research labs, or gyms) for pollutants and air conditions such as PM2.5, volatile organic compounds, relative humidity, and carbon dioxide.

Deliverables

Phase	Deliverable	Primary Responsibility
Schematic Design	☐ Assess existing building for vulnerabilities to climate impacts and identify project goals to increase resilience. Include description of vulnerabilities and potential mitigation strategies in project narrative.	▶ Design Team
All remaining design phases	☐ Update project narrative with mitigation strategies.	▶ Design Team

Resources

- JHU Climate Adaptation Report
- Climate Positive Design tool
- U.S. Climate Resilience Toolkit
- City of Baltimore Disaster Preparedness and Planning Project
- Climate Change Projections for the District of Columbia

3.0 Water

Climate change will further stress potable water resources in Baltimore and beyond. Maintaining potable water quality is also a key priority to protect the health and well-being of the JHU community. JHU already has implemented alternative water sources for non-potable uses in some projects (e.g., condensate for toilet flushing) and is exploring other opportunities.

3.1 Potable Water Reduction

For any modification or replacement of a water using fixture, new fixture must be EPA WaterSense labeled. If project includes irrigation, reduce potable water use by a minimum of 30% from baseline for peak watering month using the EPA WaterSense Water Budget tool.

Related CSI Divisions and Best Practices

Related CSI Divisions	Best Practice
• 22 Plumbing	Assess opportunities to collect and reuse alternative water sources for non-potable uses. For example, collect condensate or reverse osmosis discharge for irrigation and/or toilet flushing.

Deliverables

Phase	Deliverable	Primary Responsibility
Schematic Design	☐ Identify water reduction goals for the project and include in project narrative. Use LEED Water Use Reduction Calculator to estimate water savings.	▶ Plumbing Engineer
All remaining design phases	☐ Update water calculator and project narrative with water reduction strategies and estimated savings.	▶ Plumbing Engineer

Resources

- LEED v4 Indoor Water Use Reduction Calculator
- EPA WaterSense Water Budget Tool

3.2 Access to Clean Drinking Water

For all modifications >$5M, ensure there is at least one water dispenser and bottle filler within 100 ft of all regularly occupied spaces and meet WELL prerequisite W01 Water Quality Indicators for water delivered to the project and intended for human contact (e.g., drinking, cooking and dishwashing, handwashing, showering or bathing):

- Turbidity is less than or equal to 1.0 NTU, FTU or FNU (nephelometric turbidity, formazin turbidity or formazin nephelometric units, respectively).
- Coliforms are not detected in any 100 ml sample.

Install water filters on all dispensers to remove chemicals, organic contaminates, and pesticides.[27]

Related CSI Divisions and Best Practices

Related CSI Divisions	Best Practice
• 22 Plumbing	Provide drinking water that meets the quality outlined in WELL credit W02 Drinking Water Quality. Implement protocols to reduce risk of Legionella colonization as outlined in WELL SA3 Develop Legionella Management Plan. Do not refrigerate drinking water dispensers and bottle fillers.

Deliverables

[27] See WELL W02 Drinking Water Quality and W06 Drinking Water Promotion for recommended guidelines.

Phase	Deliverable	Primary Responsibility
Schematic Design	☐ Water quality test results and mitigation measures if quality does not meet requirements. ☐ Identify locations for drinking water dispensers on plans.	▶ Plumbing Engineer
All other design phases	☐ Identify locations for drinking water dispensers on plans and include in specifications water dispensers and bottle fillers capable of delivering water quality as described.	▶ Plumbing Engineer

Resources

- WELL W01 Water Quality Indicators
- WELL SA3 Develop Legionella Management Plan

4.0 Site

JHU recognizes the benefit of enhancing campus greenspace to provide ecosystem services (e.g., stormwater management through bioswales) and respite for the community. Project teams are expected to focus on designing climate resilient landscapes that utilize native species, enhance biodiversity, infiltrate stormwater, sequester carbon, and minimize water use.

4.1 Increase greenspace and biophilic design elements

Assess opportunities for the addition of greenspace and biophilic design elements. Where site constraints limit the ability to add vegetation, include at least one biophilic design element[28] within the building (e.g., natural materials, water feature, images of nature etc).

Related CSI Divisions and Best Practices

Related CSI Divisions	Best Practice
• 09 Finishes • 10 Specialties • 31 Earthwork • 32 Exterior Improvements	Incorporate five biophilic design elements based on Terrapin Bright Green's "14 Patterns of Biophilic Design."

Deliverables

[28] See Terrapin Bright Green's "14 Patterns of Biophilic Design": https://www.terrapinbrightgreen.com/reports/14-patterns/

Phase	Deliverable	Primary Responsibility
Concept / Schematic Design	☐ Establish goals for increasing vegetation and/or integrating biophilic design elements and include in project narrative.	▶ Architect
All other design phases	☐ Update project narrative with approach to increasing greenspace and/or integrating biophilic elements.	▶ Architect

Resources

- 14 Patterns of Biophilic Design [Terrapin Bright Green]

4.2 Bird-Safe Buildings

According to NYC Audubon, up to one billion birds are killed in collisions with glass across the US each year. JHU modifications are required to assess bird strike risk and retrofit existing conditions as appropriate to project scope using bird-friendly materials (not just glass) Projects are also required to limit light pollution and turn out lights visible from outside as much as possible. See New York's Int. 1482/Local Law 15 and NYC Audubon for more information and design guidance.

Related CSI Divisions and Best Practices

Related CSI Divisions	Best Practice
• 05 Metals • 06 Wood, Plastics, and Composites • 07 Thermal and Moisture Protection • 08 Openings • 10 Specialties • 32 Exterior Improvements	Use fully shielded and full cutoff fixtures for all exterior lighting and incorporate strategies into existing glazing to breakup reflections (e.g., adding patterns using window films).

Deliverables

Phase	Deliverable	Primary Responsibility
Concept / Schematic Design	☐ Assess existing building for bird strike risk and develop plan for retrofit solutions as appropriate to scope of project and bird strike risk.	▶ Architect
All other design phases	☐ Update project narrative with approach to bird friendly design.	▶ Architect

Resources

- Bird-Friendly Building Design [American Bird Conservancy]

4.3 Climate Positive Landscape

Landscape projects must demonstrate that they will be climate positive[29] within 5 years for projects with greenspace that account for 50% or more of the site area (excluding building footprint) or within 10 years for sites with greenspace that account for less than 50%. Climate positive means that GHG emissions generated from the materials used in and construction of the landscape will be offset by the carbon sequestered by the planting.

Identify areas with high-value soils and develop a soil management strategy that retains reusable soil and amends in place rather than importing new soil. Minimize soil disturbance to prevent soil carbon release. Consider using a cover crop on disturbed soils that will be exposed for an extended length of time. Avoid high maintenance landscapes (e.g., lawn and hedges, non-native plants). In addition, use compost or organic fertilizers to eliminate the need for chemical fertilizers, particularly those containing Nitrous Oxide.

Related CSI Divisions and Best Practices

Related CSI Divisions	Best Practice
• 32 Exterior Improvements	20% of landscape materials (including planting but excluding soil) by cost to be salvaged or reused.

Deliverables

[29] See Climate Positive calculator and design toolkit: https://climatepositivedesign.com/

Phase	Deliverable	Primary Responsibility
Concept Design	☐ Establish project goals for climate positive landscape strategies and describe in project narrative.	▶ Landscape Architect
Schematic Design	☐ Compare a minimum of two design options using the Climate Positive Design Pathfinder tool and use results to evaluate design direction. Update strategies and approach in project narrative.	▶ Landscape Architect
All other design phases	☐ Update Pathfinder tool and project narrative at end of each phase.	▶ Landscape Architect

Resources

- Climate Positive Design Pathfinder Tool
- Climate Positive Design Toolkit

4.4 Mobility and Sustainable Transportation

The Plan focuses on reducing GHG emissions from commuting through the promotion of alternative transportation options. In support of this goal, projects are expected to carefully consider and design for pedestrian, bike and other forms of micromobility (e.g., scooters, skateboards etc.) where applicable to scope (e.g., landscape projects and projects involving changes to pedestrian and bike infrastructure).

Related CSI Divisions and Best Practices

Related CSI Divisions	Best Practice
• 34 Transportation	Provide covered and secure bicycle parking for at least 5% of building occupants.

Deliverables

Phase	Deliverable	Primary Responsibility
Concept	☐ Evaluate opportunities to increase pedestrian and micromobility access and safety. Include description in project narrative.	▶ Architect and Landscape Architect
All other design phases	☐ Update approach to mobility and sustainable transportation in project narrative.	▶ Architect and Landscape Architect

Resources

- LEED for Cities, Transportation and Land Use, Walkability and Bikeability

5.0 Health and Well-Being

JHU is committed to developing and maintaining buildings to support the health and well-being of all occupants. In addition to the materials requirements in the Responsible Consumption section, projects are expected to address indoor air quality and diverse user needs.

5.1 Indoor Air Quality

Air quality is fundamentally important for the health and well-being of the JHU community. Projects are expected to design ventilation systems to optimize air quality and manage contaminants in the building through careful selection of materials (see Appendix B. Material Requirements), cross-contamination prevention and air quality monitoring.

Design air handling units and HVAC systems to accommodate MERV 14 filtration at a minimum. Provide ASHRAE 52.2 Appendix J MERV A rating test report for filtration. Develop operations and maintenance protocol for filter storage, inspection & replacement.

Limit exfiltration and infiltration of air, fine particulate matter (<2.5PM) and other air pollutants through materials of the assembly, joints in the assembly, joints in components of the wall assembly, and junctions with other facility elements, including the roof.

Locate air intakes in protected locations to minimize intake of contaminants (i.e. avoid pollutants near air intake locations, including plantings, parking areas, garbage disposal bins, and others).

Conduct whole building air leakage testing prior to occupancy to ensure leakage is under 0.25 cfm/SF. In conjunction with this test, conduct an infrared scan to identify potential leakages.

Complete duct leakage testing.

Related CSI Divisions and Best Practices

Related CSI Divisions	Best Practice
• 11 Equipment • 23 HVAC	Install permanent air quality monitoring per WELL A08 Air Quality Monitoring and Awareness.

Deliverables

Phase	Deliverable	Primary Responsibility
Concept Design	☐ Establish goals for indoor air quality and include in project narrative.	▶ Mechanical Engineer
All other design phases	☐ Update project narrative with approach to meeting requirements.	▶ Mechanical Engineer
Construction	☐ Provide ASHRAE 52.2 Appendix J MERV A rating test report for filtration. ☐ At the end of construction and prior to occupancy, conduct building flush out or air quality testing per LEED requirements.	▶ Contractor

Resources

- WELL A06 Enhanced Ventilation Design
- WELL A08 Air Quality Monitoring and Awareness
- Building Evidence for Health: The 9 Foundations of a Healthy Building [Harvard]

5.2 Meeting Diverse Needs

JHU is deeply committed to the dignity and equality of all persons—inclusive of sex, gender, marital status, pregnancy, race, color, ethnicity, national origin, age, disability, religion, sexual orientation, gender identity or expression, and veteran status. As such, projects are encouraged to consider the variety of needs for visitors and building occupants. All projects are to consider universal design strategies.[30] When modifications involve

[30] See WELL C13 Accessibility and Universal Design for suggestions.

existing restrooms, the conversion to all-gender facilities should be evaluated on a case by case basis. Where feasible and appropriate to project scope, strive to add a lactation room if one is not yet available in the building. Lactation room should meet the requirements outlined in the Appendix D. Lactation Room Requirements.

Related CSI Divisions and Best Practices

Related CSI Divisions	Best Practice
• 10 Specialties • 11 Equipment • 22 Plumbing • 23 HVAC • 26 Electrical	Provide a designated indoor space available to all regular occupants to support restorative practices. See WELL M07 Restorative Spaces for more guidance.

Deliverables

Phase	Deliverable	Primary Responsibility
Concept	☐ Identify goals for meeting diverse needs and include in project narrative.	▶ Architect
All other design phases	☐ Identify rooms on plans and describe approach to meeting diverse needs in project narrative.	▶ Architect

Resources

- WELL C13 Accessibility and Universal Design
- WELL M07 Restorative Spaces
- Appendix C. Lactation Room Requirements

6.0 Responsible Consumption

The materials we use and what we do with them at the end of life have significant environmental and health impacts. JHU prioritizes using materials that reduce impacts on the health of people and the planet. All projects are expected to evaluate material selections for life-cycle environmental impacts, toxicity, durability, and reuse or recycling potential. JHU follows standard procurement protocols that encourage the selection of businesses and haulers that are owned and operated within Baltimore City, with an emphasis on Minority Business Enterprises (MBE) in line with JHU's HopkinsLocal commitment.

6.1 Healthy Materials and Resource Efficiency

For all projects, strive to specify products free from Red List materials, chemicals, and elements[31] as much as is feasible based on availability and budgets and specifically based on the requirements by Appendix B. Material Requirements. Demonstrate compliance through one of the following forms of documentation:

1. Health Product Declaration (HPD)
   a. Published and complete HPD in compliance with the Health Product Declaration Open Standard

[31] Refer to the Living Building Challenge Red List: https://living-future.org/lbc/red-list/

2. International Living Future Institute Declare Label (status: Red List Free)
3. Cradle to Cradle Certification
    a. Material Health Certification, Bronze or higher
    b. Cradle to Cradle full certification, Bronze or higher

In addition, prioritize the following criteria for materials selection and see specific criteria in Appendix B. Material Requirements:

- Locally salvaged materials
- Locally sourced materials (extracted and/or manufactured from within 100 miles)
- High recycled content
- Low embodied carbon
- Durability
- End of life disposal

Related CSI Divisions and Best Practices

Related CSI Divisions	Best Practice
• See Appendix B. Material Requirements	Avoid Red List chemical classes or 90% of the project's new materials by cost.[32]

Deliverables

Phase	Deliverable	Primary Responsibility
Concept	☐ Identify material goals for the project and include in project narrative ☐ The JHU Project Manager shall assess and identify all built-in equipment, appliances, fixtures and furniture for deconstruction, reuse, or donation feasibility and manage accordingly. This can include reuse on the existing project, donation to the Hop Reuse Hub and/or donation to an outside vendor.	▶ Architect / Contractor
Design Development	☐ During Project Scoping, review sustainability goals and related materials requirements as well as how to select and document compliance. Discuss at minimum the following: • Material selection criteria and process including tips and resources for finding compliant products and documentation • Embodied carbon and Environmental Product Declarations • Healthy materials (toxicity, low VOCs etc) • Locally available materials including salvage and reused At minimum attendees should include design team, JHU Office of Sustainability or divisional sustainability representative, JHU project staff and key stakeholders, and General Contractor/Construction Manager (if onboard).	▶ Sustainability Consultant

Resources

- Healthy Building Network
- BuildingGreen
- Carbon Leadership Forum

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32 See Living Building Challenge Materials Imperative 13, Red List.

6.2 Waste Reduction – Construction

All modifications to send waste material to a C&D waste facility that practices source separation for recycling and submit recycling and disposal tonnage at the end of the fiscal year. Project Managers will collect and submit tonnages to the Office of Climate and Sustainability using C&D Waste Reporting log.

Related CSI Divisions and Best Practices

Related CSI Divisions	Best Practice
• All	Source separate waste streams.

Deliverables

Phase	Deliverable	Primary Responsibility
Bidding	☐ General Contractor or Construction Manager is to provide a Waste Management Plan, which should include, at a minimum, the following elements: • Project overview • Diversion goal • Anticipated waste streams • Diversion methods and strategies • Site logistics for comingling or sorting • Communication plan for employees and subcontractors • Hazardous materials • Hauler/ waste removal vendor • General contractor or Construction Manager is to send waste material to a C&D waste facility that practices source separation for recycling	▶ Contractor
Construction	☐ Contractor to provide updated Construction Waste Management Plan and conduct mandatory preconstruction onsite training for all subcontractor key field personnel. ☐ Contractor to submit monthly recycling and disposal tonnage reports to JHU Project Manager. Projects managed by JHFRE PMs will utilize PM Web to track tonnages. All other projects can complete and submit the JHU C&D Waste Reporting Log.	▶ Contractor

Resources

- Appendix E. C&D Waste Reporting Log
- JHU Responsible Consumption
- USGBC Defining Waste Streams

6.3 Waste Reduction – Building Operations

JHU is working hard to increase waste diversion and implement zero waste practices. Where applicable to scope, projects must design building infrastructure to support JHU's zero waste efforts in collaboration with JHU Divisional Facilities and Custodial teams and the Office of Sustainability to ensure adequate and consistent waste collection. See Appendix C. JHU Waste Infrastructure Standards as applicable to project location.

Related CSI Divisions and Best Practices

Related CSI Divisions	Best Practice
• All	Work to achieve 50% waste stream diversion.

Deliverables

Phase	Deliverable	Primary Responsibility
Schematic Design	☐ Identify needed waste infrastructure (e.g., collection locations) and allocate sufficient space inside the building for receptacles and outside the building for staging or disposal. Include description in project narrative.	▶ Architect
Construction Documents	☐ Include in drawings and specifications University approved waste collection receptacles and signage. Include description in project narrative.	▶ Architect

Resources

- JHU Responsible Consumption

TERMS AND ACRONYMS

Basis of Design (BOD)

A technical narrative that describes the design team's approach to meeting the Owner's Project Requirements. Typically includes the design rationale and assumptions for how the project will meet the expressed needs as described in the OPR. Updated throughout the design process and a critical document for commissioning.

Biophilic Design

Design that connects people with nature. Example strategies include providing access to views and daylight, living walls or other planting interior to the building, water features, natural materials (e.g., wood, stone), and patterns mimicking nature (e.g., honeycomb patterns).

Carbon Offsets

A financial instrument that represents a reduction in greenhouse gas (GHG) emissions and is used by the purchaser to counterbalance the emissions resulting from an organization's own activities. Types of offsets include renewable energy, carbon sequestration (e.g., avoided deforestation or reforestation), regenerative agriculture, or landfill methane capture.

Cooling Energy Demand Intensity (CEDI)

Cooling Energy Demand Intensity. CEDI is the modeled cooling demand of the building, similar to TEDI.

Embodied Carbon

Measurement of the greenhouse gas emissions associated with a material or product's life-cycle from extraction to disposal.

Energy Use Intensity (EUI)

Indicator of the energy efficiency of a building measured as kBtu per square foot. Similar to miles per gallon for vehicles.

Greenhouse Gas Emissions (GHGs)

GHGs are gases that trap heat in the atmosphere. These gases include carbon dioxide, methane, nitrous oxide, and fluorinated gases.

International Energy Conservation Code (IECC)

Building energy code adopted by the state of Maryland.

Integrative Design Process (IDP)

A holistic process by which a design team and the client align around shared project goals and use a collaborative approach to inform decision-making that understands the building as an interconnected whole rather than separate parts.

Life-Cycle Assessment (LCA)

A process of assessing a product or material's environmental impact at each stage from extraction to disposal (i.e. cradle to grave).

Life-Cycle Cost Assessment (LCCA)

A process of evaluating the financial performance of a building or infrastructure project over its lifespan including capital and operating costs. Useful for comparing different system options during design.

Optioneering

The in-depth evaluation and consideration of design options.

Owner's Project Requirements (OPR)

A document that provides direction to the design and construction teams as to a building's functional requirements as well as client expectations for its use and operation. Often includes goals, performance criteria, schedules of use, measurement of success and other supporting information. Updated throughout the design process and a critical document for commissioning.

Leadership in Energy and Environmental Design (LEED)

A green building certification developed by the US Green Building Council to assess a project's environmental performance in multiple areas including site, energy, indoor air quality, water, and materials.

Living Building Challenge (LBC)

A green building certification developed by the International Living Future Institute.

Net-Zero Greenhouse Gas (GHG) Emissions

Net-zero GHG emissions refers to the reduction of greenhouse gas emissions such that the remaining amount of carbon released into the atmosphere is balanced by an equivalent amount being removed on an annual basis. Emissions reduction strategies include energy efficiency and fuel switching (e.g., renewable electricity instead of natural gas). Carbon offsets may then be used to reduce any remaining emissions.

Shoebox Energy Model

Shoebox energy models are basic energy models that reflect simple geometries to assess energy use implications of early design decisions such as massing, orientation and zoning.

Social Cost of Carbon

An estimate of the economic damages resulting from greenhouse gas emissions measured in dollars per ton of carbon.

Solar-Ready

Per IECC 2021, a solar-ready zone is "a section or sections of the roof or building overhang designated and reserved for the future installation of solar photovoltaic or solar thermal system."

Thermal Energy Demand Intensity (TEDI)

Thermal Energy Demand Intensity. TEDI is the modeled heating demand of the building, which is driven by building envelope and airtightness as well as the ventilation system.

WELL Building Standard (WELL)

A green building certification focused on promoting the health and well-being of building occupants through design and operation.

APPENDICES

Included in this document:

Appendix A. Requirements for All Lab Projects

Appendix B. Materials Requirements

Appendix C. JHU Waste Infrastructure Standards

Appendix D. Lactation Room Requirements

To be found in SharePoint:

Appendix E. JHU Green Building Checklist and LEED Gold Scorecard

Appendix F. C&D Waste Reporting Log

Appendix A. Requirements for All Lab Projects

All new lab projects are expected to set an energy benchmark and target for the design per the

Building Performance requirements section. Projects are expected to meet the following requirements[33] as applicable to scope. Project teams are encouraged to refer to the following resources: the Smart Labs Toolkit and the Lab Ventilation Risk Assessment.

NEW CONSTRUCTION AND MAJOR RENOVATIONS

1.0 Commissioning

All projects must have proper commissioning completed to meet the building requirements write-up.

Requirements	Related Best Practice
• Refer to Building Requirements – New Construction and Major Renovations	N/A

2.0 Ventilation

2.1 Ventilation – Air Quality Monitoring

Installation of real-time demand-based ventilation controls for ACH based on occupancy and measured air quality. Zone-by-zone ACH varies from a defined minimum during unoccupied/occupied times, up to a defined maximum when threshold levels of VOCs, CO2, or particulates are detected. Carbon monoxide sensing is added as needed.

Requirements	Related Best Practice
• Maximum and minimum values shall be defined based on the results of the LVRA (Lab Ventilation Risk Assessment) • BOD for this system to be Aircuity	• Where laboratories are not able to achieve energy savings with the use of air quality monitoring, follow the LVRA minimum airflows, and if the team believes air quality monitoring offers benefits from a safety monitoring perspective, it can be used

2.2 Ventilation – Chemical/Hazardous Exhaust

Variable-air volume manifolded exhaust fans with heat recovery

Requirements	Related Best Practice
• Heat recovery systems will be dependent on central plant where possible (i.e. either use a heat recovery heat pump to inject heat into the building if possible,	N/A

[33] Requirements are based on best practices as outlined by the University of California, Irvine Smart Lab requirements.

otherwise use high efficiency run-around coil designed for greater than or equal to 50% effectiveness)	

2.3 Ventilation – High Plume Exhaust Design

Commission an exhaust dispersion study - typically taking three months once the contract is in place. Based on this study, exhaust stack discharge airspeeds are reduced by:

a) Closing bypass dampers and/or
b) Extending stack heights and/or
c) Running manifolded fans in parallel

If the dispersion study indicates re-entrainment problems under specific wind conditions, exhaust stack discharge airspeed may be anemometer-controlled. Anemometer control shall be as designed through the wind tunnel study.

Requirements	Related Best Practice
• Dispersion study is required, apply energy saving strategies based on results of the study	N/A

2.4 Ventilation – Fume Hood Selections

Requirements	Related Best Practice
• Low-flow, high-performance fume hoods where hood density warrants	• Automatic sash closers – based on safety assessment • Consider motion detectors to modulate airflow based on occupancy

2.5 Ventilation – Fume Hood Minimum Rates

Fume hood standby ventilation is reduced to conform to the new AIHA/ANSIZ9.5 standard.

Requirements	Related Best Practice
• Following a hazard evaluation, qualifying hoods to be reduced from approximately 375 to 200-250 internal air-changes per hour	N/A

3.0 HVAC[34]

3.1 HVAC – Design; Central Air Handling Systems

[34] AIHA/ANSIZ9.5 standard

Requirements	Related Best Practice
• Size air handlers with no more than 350 ft/min max air speed through filters and include bypass around coils for when there are cooler temperatures and treatment of the air is not needed	N/A

3.2 HVAC – Design; Central Air Handling Systems Pressure Drop

Requirements	Related Best Practice
• Design the systems with a total pressure drop for the air systems (TSP) <5" wg	N/A

3.3 HVAC – Design; Separation of Ventilation from Heating and Cooling

Where process heat loads are higher than minimum ventilation rates would cool at a 20-degree temperature difference.

Requirements	Related Best Practice
• Separate ventilation from the heating/cooling loads within labs through the use of fan coils, active chilled beams, etc.	N/A

3.4 HVAC – Design; Noise Attenuation Mitigation

Because lower fan speeds and duct airspeeds reduce HVAC noise significantly, duct noise attenuators are removed where feasible. Attenuators are often found upstream of exhaust fans and both upstream and downstream of supply fans. Sometimes it is feasible to remove resistive elements while leaving their exterior casings intact.

Requirements	Related Best Practice
N/A	• If resultant noise is higher than acceptable, duct liner can be installed with a minor energy penalty compared to that of a typical duct attenuator

3.5 HVAC – Design; Passive Strategies

Where possible, utilize natural ventilation to provide make-up air to corridors and adjacent spaces to laboratories to reduce overall energy and fan power.

Requirements	Related Best Practice
N/A	• Utilize mixed mode ventilation strategies through the use of detailed natural ventilation designs following CIBSE natural ventilation design requirements

3.6 HVAC – Process Cooling Water

No single-pass or once-through water for process cooling of laboratory equipment.

Requirements	Related Best Practice
• There shall be no domestic water connections made available for process cooling applications	N/A

4.0 Controls – DDC

Trim and respond control for heating water temperature and air system static pressure.

Requirements	Related Best Practice
• Controls must be direct digital controls (DDC) in-lieu of pneumatics and must tie into central building control systems	N/A

5.0 Equipment Sharing

Requirements	Related Best Practice
N/A	• Where possible, consider centralized locations for freezers or fume hoods to encourage sharing of lab infrastructure that has a higher energy demand

MODIFICATIONS

1.0 Commissioning

All projects must have proper commissioning completed to meet the building requirements write-up.

Requirements	Related Best Practice
• Refer to Building Requirements – Modifications	N/A

2.0 Ventilation

2.1 Ventilation – Air Quality Monitoring

Installation of real-time demand-based ventilation controls for ACH based on occupancy and measured air quality. Zone-by-zone ACH varies from a defined minimum during unoccupied/occupied times, up to a defined maximum when threshold levels of VOCs, CO2, or particulates are detected. Carbon monoxide sensing is added as needed.

Requirements	Related Best Practice
N/A	• Maximum and minimum values shall be defined based on the results of the LVRA (Lab Ventilation Risk Assessment) BOD for this system to be Aircuity

2.2 Ventilation – Fume Hood Selections

Requirements	Related Best Practice
• Low-flow, high-performance fume hoods where hood density warrants	• Automatic sash closers – based on safety assessment • Consider motion detectors to modulate airflow based on occupancy

2.3 Ventilation – Fume Hood Minimum Rates

Fume hood standby ventilation is reduced to conform to the new AIHA/ANSIZ9.5 standard.

Requirements	Related Best Practice
• Following a hazard evaluation, qualifying hoods to be reduced from approximately 375 to 200-250 internal air-changes per hour	N/A

3.0 HVAC

3.1 HVAC – Design; Central Air Handling Systems

Where air handlers are replaced in modification projects.

Requirements	Related Best Practice
• Size air handlers with no more than 350 ft/min max air speed through filters and include bypass around coils for when there are cooler temperatures and treatment of the air is not needed	N/A

3.2 HVAC – Design; Central Air Handling Systems Pressure Drop

Where air handling systems are replaced or added in modification projects.

Requirements	Related Best Practice
• Design the systems with a total pressure drop for the air systems (TSP) <5” wg	N/A

3.3 HVAC – Process Cooling Water

No single-pass or once-through water for process cooling of laboratory equipment.

Requirements	Related Best Practice
• Conduct an Engineering assessment of existing once through process cooling, providing options for adding recirculated process cooling systems • Implement the best option for the project being considered	• Where implementation is not within the project budget, utilize air cooled systems where possible and ensure that new systems are compatible with closed loop cooling connections for future implementation if water cooled equipment is the only option

4.0 Controls – DDC

Trim and respond control for heating water temperature and air system static pressure.

Requirements	Related Best Practice
• Controls must be direct digital controls (DDC) in-lieu of pneumatics and must tie into central building control systems • Replace any pneumatic controls that are within renovated areas with low voltage control systems	N/A

5.0 Equipment Sharing

Requirements	Related Best Practice
N/A	• Where possible, consider centralized locations for freezers or fume hoods to encourage sharing of lab infrastructure that has a higher energy demand

Appendix B. Material Requirements

Aggregates (CSI Division 03 + 32)

- Source within 100 miles of project site
- Include minimum 15% recycled content

Aluminum (CSI Division 05,07 + 08)

- Include minimum 25% recycled content
- Require Industry-wide Type III EPD

Asphalt (CSI Division 31 + 32)

- Include minimum 15% recycled content
- Require Industry-wide Type III EPD

Carpet (CSI Division 09)

- No backings containing fly ash, PVC or polyurethane backing
- No products with antimicrobials above 100 ppm
- Manufacturer has a take-back program
- CRI Green Label Plus
- No product coated with PFAS
- Require Product-specific Type III EPD

Ceiling Systems (CSI Division 09)

- Red List Free
- Include recycled content
- Have a light reflectance greater than 0.85
- FSC certified (wood products)
- Meet the VOC criteria of LEED IEQc2 v4.1 Low Emitting Materials

Composite Wood (CSI Division 06, 07, 08, 10, 12 + 27)

- 100% FSC wood
- Require Industry-wide Type III EPD
- No added urea formaldehyde (NAUF) or ultra-low emitting formaldehyde (ULEF)

Concrete Masonry Units (CSI Division 04)

- Include minimum 15% recycled content

Concrete (CSI Division 03, 31 + 32)

- Reduce the embodied carbon of concrete by using performance specifications, replacing Portland Cement with Supplementary Cementitious Materials, minimizing below-grade structure, optimizing structural systems, and lengthening cure times.[35]
- Require Product-specific Type III EPD for each mix type

Furniture

[35] See Rocky Mountain Institute's Concrete Solutions Guide: https://rmi.org/insight/concrete-solutions-guide/

- No PFAS treatments on upholstery fabrics
- No fabrics or foams with halogenated flame retardants
- No composite wood components with high-emitting formaldehyde binders
- Encouraged to meet one of the following standards: Indoor Advantage Gold, Cradle to Cradle Silver or higher, ANSI/BIFMA Furniture Emissions Standard and Level Credits 7.6.1, 7.6.2, 7.6.3

Glass / Glazing (CSI Division 08)

- Require Industry-wide Type III EPD
- Align glazing with bird-safe design guidelines per 4.2 Bird-Safe Buildings

Gravel / Crushed Stone (CSI Division 31 + 32)

- Require sourcing within 100 miles of project site
- Include reused material where possible

Gypsum Board (CSI Division 09)

- Contain natural gypsum
- Have lower than industry average embodied carbon (<277 kg CO2eq)
- No paper-faced drywall with biocides
- Red List Free
- Require Industry-wide Type III EPD

Interior Paints and Coatings (CSI Division 09)

- VOC less than 50 g/L after tinting (excluding fireproofing and high-performance coatings)
- Meet MPI X-Green Performance Standards or similar performance metrics

Insulation, Fiber (CSI Division 07)

- Glass or mineral fiber insulation with formaldehyde-free binder or sprayed or dense-pack cellulose insulation

Insulation, Foamed-in-Place (CSI Division 07)

- Acrylic spray air-sealing products for "flash-and-batt" applications
- No formaldehyde-based foamed insulation or spay polyurethane foam (neither open- nor closed-cell)

Insulation, Rigid (CSI Division 07)

- Mineral wool, cellular glass, or wood fiber boardstock requiring no flame retardants and/or halogen-free polyisocyanurate (Polyiso)
- No extruded polystyrene (XPS) or expanded polystyrene (EPS), except in below-grade applications
- In addition, meet one of the following standards: Greenguard Gold or Indoor Advantage Gold (for Polyiso)

Metal Decking (CSI Division 05)

- Include minimum 50% recycled content
- Require Industry-wide Type III EPD

Metal Duct (CSI Division 23)

- Include minimum 25% recycled content

Misc. Metals (CSI Division ALL)

- Include minimum 25% recycled content

Mulch & Soils (CSI Division 31 + 32)

- Source from within 100 miles of project site
- Source reused materials

Plants (CSI Division 32)

- Source from within 100 miles of project site
- Support producers that have publicly committed to sustainable production practices such as reducing potable water use, composting green waste, using integrated pest management, prevent distribution of invasive species, use renewable energy, or provide safe and fair working conditions.[36]

Plumbing Piping (CSI Division 22)

- Include minimum 25% recycled content

PV (CSI Division 26)

- Require a Product-specific Type III EPD

Resilient Flooring (CSI Division 09)

- PVC-free
- Require a Product-specific Type III EPD
- Certified Greenguard Gold or equivalent per LEED IEQc2 v4.1 Low Emitting Materials

Steel Rebar (CSI 03)

- Include minimum 90% recycled content
- Require Product-specific Type III EPD

Structural Steel (CSI Division 05)

- Include minimum 75% recycled content
- Require Industry-wide Type III EPD

Wood (CSI Division ALL)

- FSC certified or equivalent certification
- No wood treated with chromated copper arsenate (CCA), copper azole, or ammoniacal copper quaternary compound (ACQ)
- Require Industry-wide Type III EPD

Wood Flooring (CSI Division 09)

- FSC certified or equivalent or reclaimed wood without biocides

[36] See SITES, Section 5; Site Design, Materials Section, Credit 5.10: Support sustainability in plant production.

Appendix C. JHU Waste Infrastructure Standards

University-wide Goals

JHU's Climate Action and Sustainability Plan commits the university to establishing a pathway to zero waste, which includes a goal to create university-wide waste management infrastructure standards. Consistent waste infrastructure across the institution – including receptacle placement, type, and signage – helps people sort materials properly, resulting in higher diversion and less contamination and should be incorporated into all design projects. Additionally, providing equal convenience for all waste streams is essential to ensuring material diversion is maximized. The standards outlined in this document aim to provide designers, project managers, and facilities teams with the necessary guidance for establishing uniformity across JHU's campuses to support our institutional sustainability goals.

Interior Waste Infrastructure

Interior infrastructure for waste collection should be determined by the type of use, how much material is expected to be generated, and how frequently the receptacles will be serviced. Except in limited areas like copy rooms and restrooms, all waste stations should include co-located compost, recycling, and trash receptacles.

Placement of the waste stations will be design-dependent but should be located at a minimum within line of sight of interior building entrances, on every floor along an accessible and convenient path of travel for building occupants, and in areas where food is prepared and/or consumed. The location of the receptacles should not impede circulation or access to adjoining rooms and functions. The location of the receptacles should not impede circulation or access to adjoining rooms and/or functions. Receptacles should be placed with waste in a consistent order (e.g. compost, recycle, incinerate). For divisions with dual stream recycling (paper & cardboard collected separately), both blue recycling bins should be placed next to each other.

Waste receptacles are not recommended for individual desks (see centralized waste stations below), classrooms, or conference rooms with an occupancy of less than 10.

JHU Standard Waste Receptacles and Requirements

The following free-standing receptacle styles are recommended and have university negotiated pricing. Contact the Office of Climate and Sustainability for company information.

Busch Systems Waste Watchers Series

Busch Systems Spectrum Series (cube style)

Discretion is allowed per building aesthetics for free-standing receptacles or built-in cabinet style waste stations; however, the following standard criteria should be adhered to with all standard and non-standard waste receptacles:

Color

The following waste streams colors must be used for receptacles, signage, or both:

- Recycling (single stream, paper, and bottles and cans) – Blue
- Compost – Green
- Trash – Grey

Signage

All waste receptacles must include standard university signage and should be attached above the bin. Contact the Office of Climate and Sustainability for access to division-specific signage. It is recommended that signage be placed above the receptacles. If casework is being used, signage should be mounted on the wall. Standard signs are portrait 8 ½ x 11.

Receptacle openings

Restrictive openings should be used with free-standing waste receptacles to reduce contamination as follows:

- Single stream recycling: “Mixed” opening that accommodates paper and bottle/cans
- Paper recycling: "Slot” opening that accommodates only paper
- Bottles and cans recycling: “Circle” opening that accommodates bottles and cans only

- Compost: “Full” rectangle opening that accommodates a minimum of 6”x10” opening
- Trash: “Full” rectangle with a minimum 6”x10” opening

The same restrictive openings are preferred for casework but are not required. Waste receptacles inside casework should be “slim jim” style (20” x 11” x 30”) and colors should follow requirements above. Additionally, openings in front of casework need adequate clearance for receptacles to slide in and out easily either without a toe kick or with a toe kick attached to the door.

Icons

If icons are used on waste receptacles or casework, the following images should be used:

- Single stream recycling: paper, bottle, and can
- Paper recycling: paper
- Bottles and cans recycling: bottle and can
- Compost: apple core 
- Trash: trash bin

Staff Engagement

It is important that the staff who maintain and service the waste receptacles daily have a chance to provide feedback on the selection and placement of waste receptacles. Their expertise and the impact on their work should always be integrated into the final decision. Consult with the appropriate staff before finalizing the design, placement, and purchase of receptacles.

Centralized waste stations

Removing individual deskside waste receptacles in lieu of centralized waste stations and offering all waste stream diversion options has been shown to increase waste diversion potential and reduce plastic liner waste, cost, and pests. Numerous JHU departments have piloted this system with success and adoption university-wide is recommended. (See Guidance)

Exterior waste collection

Each building should have space designated for consolidated waste collection with appropriately sized containers (compactor, dumpster, toters) *or* a staging area that is safely accessible by waste handling personnel and vehicles to collect and transport waste to a centralized container

Appendix D. Lactation Room Requirements

Lactation Room Requirements

JOHNS HOPKINS
UNIVERSITY & MEDICINE

U.S. Department of Labor's Break Time for Nursing Mother's Provision:

"An employer shall provide a reasonable break time for an employee to express breast milk for her nursing child for 1 year after the child's birth each time such employee has a need to express the milk; and a place, other than a bathroom, that is shielded from view and free from intrusion from coworkers and the public, which may be used by an employee to express breast milk."

The space can be as small as 4 feet by 5 feet, though the size of an accessible restroom stall, 7 feet by 7 feet, is ideal.

REQUIREMENTS:

These guidelines are for establishing a permanent lactation room, temporary room location information can be found on our website.

- Cannot be a bathroom or closet; Cannot be used for storage
- Must be able to be locked from the inside of the space
- Must have at least 1 electrical outlet
- Plumbing (sink with running hot/cold water) ideally placed in the room, but within close proximity (a few steps away) is also acceptable
- Chair with small shelf or table for personal items; Multi-station rooms, each must have its own chair, shelf/table and outlet
- Additional shelf/counter (and/or cabinet) for supplies
- Trashcan, coat hook, bulletin board or space to post announcements; Mirror
- Adequate lighting
- Temperature regulation/air circulation
- Small refrigerator for milk storage
- Exterior room signage

OPTIONAL CONSIDERATIONS:

- Key pad or card swipe for room access
- Vacant/Occupied door lock for single –use rooms is ideal but not required
- Single or multi-station room
- Options for storage (accessory kits, parts, supplies)
- White noise machines
- LSP will provide framed artwork; Some buildings may wish to add additional decoration
- Speak to LSP for more information about a Lacstation Vending Machine

State-of-the-art, 4-station Lactation Room @ Bloomberg Children's Center. Room includes all requirements and optional considerations. Additional pictures of simpler, smaller rooms are on our website.

Office of Benefits & Worklife | hr.jhu.edu/lactation-support | 410-516-2000 | worklife@jhu.edu