18 10 00 SCOPE & ADMINISTRATION

18 10 10 SCOPE & APPLICATION of STANDARDS – Reserved for future.

18 10 20 ADMINISTRATION and ENFORCEMENT – Reserved for future.

18 10 30 DEFINITIONS

Biodiversity – The biological variety of life on a landscape.

Cultural & Historic Natural Landscapes: Natural areas of cultural or historical significance. These can be areas with importance to The Ohio State University or areas that are recognized nationally or locally as cultural or historic sites. Cultural and historical landscapes are often considered the "iconic" landscapes and are typically parks or memorials. Existing sites on the Columbus campus include Legacy Park, Spirit of Women Park, The Oval, Mirror Lake Hollow & South Oval, Ohio Field, Chadwick Arboretum, and Buckeye Grove. These sites may include areas that are not natural such as sidewalks, paths, or patios.

Developed land: Areas of buildings, parking lots, streets, or other man-made structures of a permanent nature.

Ecosystem: A biological community of organisms and the physical environment interacting as a system

Ecosystem Services: The benefits people obtain from ecosystems. These include provisioning services such as food, water, timber, and fiber; regulating services that affect climate, floods, disease, wastes, and water quality; cultural services that provide recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling.

Ecosystem Services Assessment (ESA): Assessment tool for scoring construction projects in accordance with The Ohio State University's Building Design Standards "Ecosystem" section.

Embodied Carbon Analysis (ECA): ECA, known as Lifecycle Carbon Analysis or LCA, is a method of analysis that allows project teams to understand the energy use and other environmental impacts associated with all life cycle phases of the building. Definition for future reference.

Farmland: Areas of crop production, pastures, and grassy/natural areas adjacent to known agricultural areas, such as continuous lands at Waterman Farm. This can include small garden plots used for research and instruction.

Floodplains: Area of flat land adjacent to river and typically designated by FEMA as "Flood Hazard".

Forested Areas: Areas that are primarily covered by trees that are or have the potential to be in a mature state. Forested areas are typically significant in size (> 1 acres) however the University will review smaller landscapes of the same nature on a case-by-case basis. Tree plantings adjacent to existing forested areas may be considered forest.

Green Infrastructure: The range of measures that use plant or soil systems, permeable pavement or other permeable surfaces or substrates, stormwater harvest and reuse, or landscaping to store, infiltrate, or evapotranspirate stormwater and positively affect quantity and quality to sewer systems or to surface waters.

Heritage Tree: Trees that have a single stem with a Diameter at Breast Height (dbh) of 30" or more, or any multi-stemmed tree with a dbh on the largest trunk of 24" or more Or trees with a special significance to the university due to historical, cultural, or characteristic value and shall be in good to fair condition.

Life Cycle Cost Analysis (LCCA): LCCA is a process of evaluating the economic performance of a building over its entire life. Sometimes known as "whole cost accounting" or "total cost of ownership," LCCA balances initial monetary investment with the long-term expense of owning and operating the building.

Living Labs: Academic projects that use campus lands and buildings for research, teaching and learning.

Multimodal Transportation: Refers to transportation and land use planning that considers diverse transportation options, typically including walking, cycling, micro-mobility, public transit and automobile (private and rideshare), and accounts for land use factors that affect accessibility.

Micro-mobility Networks: Transit networks and infrastructure to support a range of small, lightweight vehicles operating at speeds typically below 15 mph and driven by users personally. Micro-mobility devices include bicycles, e-bikes, electric scooters, electric skateboards, shared bicycles, and electric pedal assisted bicycles

Non-Developed land: Areas that are mostly natural in their state. Sometimes referred to as green spaces or open spaces. Certain man-made features such as trails, sidewalks or other amenities are acceptable in these areas.

Recreational greenspaces: Areas with a primary land use of recreation to support mental restoration, physical activity, or social connection. These are generally classified as active recreation areas (i.e. sport fields) and passive recreation areas (i.e. quads/cultural parks). These sites may include areas that are not natural such as artificial turf, sidewalks, paths, or other supporting hardscape elements.

Restoration Sites: Areas that have seen efforts that aim to recreate, initiate, or accelerate the recovery of an ecosystem that has been disturbed.

Rideshare programs: Refers to services that connects drivers with passengers that need transportation. Passengers use smartphone apps to book rides, and get updates on the driver's location, and pay. The app uses phone locations to find the closest driver to help arrange pick-up.

Soil Health: The continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans.

Total Cost of Ownership (TCO): Total cost of ownership is an estimate of all the direct and indirect costs involved in acquiring and operating a product or system over its lifetime.

Tree Canopy: The amount of ground that is covered by trees' leaves, branches, and stems from a top-down view. This can be thought of as how much shade a tree provides.

Urban Heat Island Effect: Increased temperatures in areas of dense buildings, roads, and other infrastructure due to a higher absorption and re-emittance of the sun's heat compared to natural landscapes.

Urban Meadows: Managed, prairie areas which may consist of low mow or no mow species with an emphasis on native or adaptive prairie plant species.

Vegetation: Plant life/plant cover on a surface such as areas covered in grass, shrubs, trees, or plant beds.

Waterbodies: Areas that are covered with surface water for most of the year such as rivers, streams, lakes, ponds, or other areas that of hold significant surface water for most of the year.

Water Quality: Describes the condition of the water, including chemical, physical, and biological characteristics, usually with respect to a suitability for a particular purpose such as drinking or swimming.

Wetlands: Areas where water covers the soil or is present either at or near the surface of the soil all year or for varying periods of time during the year (ie swamps, marshes, bogs), including during the growing season, at a frequency which supports vegetation typically adapted for life in saturated conditions.

18 20 00 COMMISSIONING & SUSTAINABILITY REVIEW

18 20 10 SCOPE

The standards in this section specify requirements for and services to be provided by Commissioning Agent (CxA) for new construction and improvements to the existing buildings and the built environment.

18 20 20 COMPLIANCE

All projects shall utilize the Sustainability Applicability Matrix (SAM) (SAM ≤ $75,000 construction budget or SAM > $75,000 construction budget) to identify which Commissioning requirements below are applicable to the project based on project type, scope, and budget. Additionally, the provisions of the Commissioning standards will be followed based on project type in 18 20 60 COMMISSIONING APPLICABILITY. These are also summarized below:

.1 Existing Buildings, Additions, Repairs, and minor Renovations shall be commissioned in accordance with applicability per the applicability identified in 18 20 60.

.2 New Buildings shall perform full Building Systems Commissioning and Water Systems Commissioning (Cx), and Building Enclosure Commissioning (BECx).

.3 Envelope renovations to existing buildings shall perform Building Enclosure Commissioning (BECx) per the applicability identified in 18 20 60.

.4 All Projects shall verify if any building(s) have had Ohio State Energy Partners (OSEP) install any equipment intended to lower the building's energy usage as part of the Program of Requirement. If so, the project team will work with Ohio State's Energy Services and Sustainability department to address any impacts and/or costs that may affect said equipment and its intended functionality.

.5 Mission Critical buildings and systems – including but not limited to Medical, Research/Laboratory, and Data Centers – shall perform full Building Systems Commissioning.

18 20 25 SUSTAINABILITY CHARRETTE (see 00 00 17.1.3)

18 20 30 COMMISSIONING OVERVIEW

Commissioning proposals for the services below shall be requested during Schematic Design and the Commissioning Agent (CxA) shall be engaged throughout the design process. Cx and BECx to be independent third-party from Schematic Design through at least the 12-month warranty period with exact end date to be determined.

18 20 40 BASIC SERVICES

Cx and BECx shall adhere to the following requirements:

.1 Cx

Basic Services to be provided shall consist of the activities and stages set forth in Article 2 of *Exhibit B1* – *Consultant Scope of Services(Commissioning).* Basic Services include developing an on-going commissioning plan and providing Monitoring based commissioning. Additional services performed by the CxA shall be followed; see 18 20 50.

.2 BECx

Basic Services to be provided shall consist of the activities and stages set forth in Article 2 of *Exhibit B2* – *Consultant Scope of Services(Building Enclosure Commissioning)* in compliance with NIBS Guideline 3-2012 Building Enclosure Commissioning Process BECx., ASTM_E2813_Standard Practice for Building Enclosure Commissioning and ASTM E2947-14 Standard Guide for Building Enclosure Cx.

18 20 50 ADDITIONAL SERVICES

In addition to the basic services outlined in *Exhibit B1 and Exhibit B2*, Cx and BECx shall act as the 3rd party verification for sustainability compliance by reviewing and confirming the project's sustainability standards from Division 18 as identified below.

.1 ENERGY (Section 18 30 00)

.1.1 Confirm assumptions, parameters, and output for energy modeling during design stages.

.2 WATER (Section 18 40 00)

.2.1 Confirm assumptions, parameters, fixture types, and output used in Water Use Intensity calculation.

.3 USER EXPERIENCE (Section 18 70 00)

.3.1 Confirm background noise levels from HVAC equipment and sound transmission class ratings through measurement.

.3.2 Confirm lighting levels through measurement.

.4 LIFE CYCLE COST ANALYSIS (Section 18 80 00)

.4.1 Confirm assumptions, parameters and output used in Life-Cycle Cost Analyses (LCCA) for energy systems comparison, water systems comparison, and material selection comparison.

.4.2 Confirm assumptions, parameters and output used in Life-Cycle Cost Analyses (LCCA) for the Total Cost of Ownership calculation for energy systems, water systems, and material selection.

.5 PLANNING FOR RESILIENCY (Risk and Functional Performance Assessment) (Section 18 20 70)

.5.1 Conduct Risk and Functional Performance Assessment to identify site-specific hazards, vulnerabilities, and resilient strategies.

18 20 60 COMMISSIONING APPLICABILITY

.1 BUILDING SYSTEMS COMMISSIONING APPLICABILITY

Type of Project	Dollar Limit By Division						Fundamental Cx	Enhanced Cx	Notes
	22	23	25	26	27*	28*			
Mission Critical (Medical, Research/Lab, Data Center, Food Service, etc.)	Any	Any	Any	Any	N/A	N/A	**Yes**	**Yes**	Recommend pre-design and post-construction TAB, if applicable
Controls Only (Non-Critical Facilities)	N/A	<$200k	<$200k	<$200k	N/A	N/A	**Yes, Limited**	**No**	
Controls Only (Non-Critical Facilities)	N/A	>$200k	>$200k	>$200k	N/A	N/A	**Yes**	**Yes**	
Non-Critical, Equipment Replacement (Like for Like Replacement)	<$200k	<$500k	N/A	<$200k	N/A	N/A	**No**	**No**	Recommend pre-design and post-construction TAB, if applicable
Non-Critical, Equipment Replacement (Like for Like Replacement)	$200k < $500k	$500k < $1M	N/A	$200k < $1M	N/A	N/A	**Yes, Limited**	**No**	Recommend pre-design and post-construction TAB, if applicable
Non-Critical, Equipment Replacement (Like for Like Replacement)	$500k < $4M	$1M < $4M	N/A	$1M < $4M	N/A	N/A	**Yes**	**No**	Recommend pre-design and post-construction TAB, if applicable
Non-Critical, Equipment Replacement (Like for Like Replacement)	> $4M	> $4M	N/A	> $4M	N/A	N/A	**Yes**	**Yes**	Recommend pre-design and post-construction TAB, if applicable
Non-Critical, New System	<$200k	<$500k	N/A	<$200k	N/A	N/A	**No**	**No**	
Non-Critical, New System	$200k < $500k	$500k < $1M	N/A	$200k < $500k	N/A	N/A	**Yes, Limited**	**No**	
Non-Critical, New System	$500k < $1M	$1M < $4M	N/A	$500k < $1M	N/A	N/A	**Yes**	**No**	

Type of Project	Dollar Limit By Division						Fundamental Cx	Enhanced Cx	Notes
	22	23	25	26	27*	28*			
Non-Critical, New System	> $1M	> $4M	N/A	> $1M	N/A	N/A	**Yes**	**Yes**	

Note: * refers to divisions below:
Division 22 - Plumbing
Division 23 - Mechanical
Division 25 - Controls / Integrated Automation Network Equipment
Division 26 - Electrical
Division 27 - Communications *Not typically commissioned by CxA
Division 28 - Electronic Safety and Security Fire Alarm *Not typically commissioned by CxA

Specialized systems shall be evaluated outside of this matrix on a case-by-case basis. Specialized systems may include, but not be limited to agricultural industrial equipment, rainwater harvesting, etc.

.2 BUILDING ENCLOSURE COMMISSIONING APPLICABILITY

Building Enclosure Commissioning (BECx) Applicability Matrix									
Project Scope	**Construction Cost**				**Level of BECx Activity**				**Notes**
	<$500K	**$500K-$1M**	**$1M-$4M**	**>$4M**	**Full 3rd-Party BECx***	**Documents Peer Review****	**Site Observation ****	**System Testing****	
New Building			X	X	Yes	-	-	-	
Building Addition $$$				X	Yes	-	-	-	
Building Addition $$			X		No	Yes	Yes	Yes	
Building Addition $		X			No	Yes	Yes	Yes	Testing requirement varies with enclosure systems chosen
Major Renovation w/ Re-Skin				X	Yes	-	-	-	
Major Renovation - Interior Only	X	X	X	X	No	No	No	No	
Window / entryway replacements					No	Yes	Yes	Yes	
Roof Replacement					No	Yes	Yes	Yes	
Building foundation work					No	Yes	Yes	No	
Enclosure maintenance (sealants, joints, etc.)					No	No	Yes	No	

Note:

* Full 3rd-Party BECx includes all the services covered by Documents Peer Review, Site Observation, and Systems Testing

**These services need to be provided by qualified professionals, but on a case-by-case basis may be determined to be 3rd-party consultants or a member of the design team. For instance, the enclosure maintenance or even small addition scope, could be observed by an architect well versed in that work.

.3 BUILDING ENCLOSURE TESTING

ENCLOSURE SYSTEM	TEST	STANDARD	
Glazed assemblies (includes windows, doors)	Water Penetration Chamber Test	ASTM E783	Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors
Glazed assemblies (includes curtain walls, windows, doors, skylights)	Air Infiltration Chamber Test	ASTM E1150	Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference

ENCLOSURE SYSTEM	TEST	STANDARD	
Glazed assemblies - System interfaces and joints (includes storefronts, curtain walls and sloped glazing systems)	Water Hose Test	AAMA 501.2	Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems
Air barriers	Air Barrier Adhesion Test	ASTM D4541	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
Air barriers	Air Barrier Leakage Detection Test	ASTM E1186	Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems
Roof	Roof (Conventional) Infrared Survey	ASTM C1153	Standard Practice For Location Of Wet Insulation In Roofing Systems Using Infrared Imaging
Roof	Roof (IRMA) Electric Field Vector Mapping (EFVM)	ASTM D7877	Standard Guide for Electronic Methods for Detecting and Locating Leaks in Waterproof Membranes
Roof	Roof (IRMA) Flood Test	ASTM D 5957	Standard Guide for Flood Testing Horizontal Waterproofing Installation
Joints	Field Sealant Adhesion Test	ASTM C1521	Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints
Joints	Field Sealant Adhesion Test	ASTM C1193	Standard Guide for Use of Joint Sealants

18 20 70 PLANNING FOR RESILIENCY APPLICABILITY

18 20 71 SCOPE
Projects $4M and above shall conduct a Risk and Functional Performance Assessment.

18 30 00 ENERGY EFFICIENCY

18 30 10 SCOPE
Energy consumption in buildings accounts for most of the energy consumed on campus. The standards in this section specify requirements for energy efficiency

within new construction and improvements to the existing buildings and the built environment.

18 30 20 COMPLIANCE

All projects shall utilize the Sustainability Applicability Matrix (SAM ≤ $75,000 construction budget or SAM > $75,000 construction budget) to identify which energy efficiency requirements below are applicable to the project based on project type, scope, and budget. Additionally, the provisions of these Energy Efficiency standards shall be followed based on project type as identified below:

.1 Existing Buildings, Additions, Repairs, and Renovations shall comply with ASHRAE 90.1-2016.

.2 In addition to complying with ASHRAE 90.1-2016, New Buildings shall model the building performance as determined in sections 18 30 40 and 18 30 50. Existing buildings where the mechanical systems and building enclosure are being renovated may be required to follow sections 18 30 40 and 18 30 50 depending on the extent of the renovation.

18 30 30 AUTOMATED DEMAND RESPONSE

Building projects shall contain automatic control systems that have the capability to reduce building equipment loads to lower electric peak demand of the building. The building controls shall be designed with automated demand-response (DR) infrastructure capable of receiving DR requests from the university's Building Automation Shop and automatically implementing load adjustments to the HVAC and lighting systems. Systems shall be installed and programmed for Automated Demand Response following university standards.

Exception: All facilities and/or equipment classified as critical may be exempt from this demand response requirement. For FOD, critical is defined as lab, museum, art/book storage and medical/veterinary facilities. **All medical center** facilities are classified as critical, therefore they are exempt from this demand response requirement. Any changes to this will require written approval from the Wexner Medical Center Facilities Engineering team.

.1 HVAC SYSTEMS ZONE SET POINTS

The project's HVAC systems shall be programmed to allow centralized demand reduction in response to a signal from a centralized contact or software point in accordance with the following:

.1.1 Upon receiving notification of a Demand Response event, an Ohio State - BAS technician places buildings in Demand Response Mode from the BAS Operator Interface

.1.2 When the Demand Response signal is sent to the buildings, the following changes will occur at the Air Handlers. This increase shall only occur if the AHU chilled water coil or Dx cooling is actively cooling the supply air:

a. The Supply Air Setpoint shall be increased 5 degrees from current setpoint

b. The Supply Air Static Pressure Setpoint shall be reduced by 50% from current setpoint.

.1.3 When the Demand Response signal reaches the room level VAV boxes, the temperature setpoints shall be reset as follows. Note: If the VAV controller is in unoccupied mode, no changes are made.

a. Active Heating Setpoint 68 Deg. F.

b. Active Cooling Setpoint 78 Deg. F.

.1.4 Upon receiving notification, the Demand Response event is ended, an Ohio State BAS technician shall take the buildings out of Demand Response mode via BAS Operator Interface. All setpoints at the Air Handlers and VAVs shall be set back to normal.

18 30 35 ENVIRONMENTAL CONTROLS

.1 AUTOMATIC CONTROL OF ZONE LEVEL HVAC AND LIGHTS
Automatic controls for the lighting and HVAC equipment serving each room shall be configured with overhead occupancy sensors per Appendix A requirements. Sensors must be placed to sense all occupants within the controlled area. Within 20 minutes of all occupants leaving the room, power for lighting shall be automatically turned off and the airflow shall be set to minimum and unoccupied set points shall be in effect. The project teams shall coordinate with the project's respective operations group (e.g. FOD's Building Automation Shop for academic buildings) to determine which spaces shall adhere to the automatic control of HVAC and lighting. Project Teams shall also reference Division 26 58 00 LIGHTING CONTROL for additional standards for occupancy and vacancy sensors.

Exception: Medical Center Facilities shall require a list of each space with proposed setbacks and sensor details to be approved by Medical Center Engineering. All medical center spaces are required to follow most current FGI guidelines and ASHRAE 170.

.2 AUTOMATIC CONTROL OF SYSTEM LEVEL HVAC
Automatic controls for system level HVAC (air handlers, roof top units, makeup air units) shall use scheduled ventilation for non-critical areas. Schedules shall be developed in consultation with FOD's Building Automation Shop and the building

stakeholders. System controllers shall use Optimum Start algorithms to maintain occupied building temperatures.

18 30 40 SITE ENERGY USE INTENSITY (EUI) TARGETS

Site EUI Targets are used as energy performance target metrics during energy modeling and LCCA with variation for building type and square footage. Site EUI Targets are identified by building type and may be calculated in one of two ways:

.1 SITE EUI TARGET CALCULATION OPTIONS

.1.1 Single-Use Building Type – Site EUI Target is identified in section 18 30 40.2 based off the primary building type of the project. Building must be at least 75% single building type, otherwise use Mixed-Used area-weighted average.

.1.2 Mixed-Use Facilities – Site EUI Target is calculated as an area-weighted average of building types by square footage as identified in the calculation below:

Mixed-Use Facility Site EUI $_{target}$ = x / s

x = ∑ (Building type 1 sq. ft. * building type 1 EUI) +
(Building type 2 sq. ft. * building type 2 EUI) +
(Building type 3 sq. ft. * building type 3 EUI) +
… + (Building type n sq. ft * building type n EUI)

s = gross floor area (square feet) as defined in ASHRAE 90.1-2016

.1.3 EUI TARGET CALCULATION NOTES:

.1.3.1 Building types that make up less than 10% of the gross floor area may be combined with the building type that it is most similar to in the Mixed-Use Facilities calculation.

.1.3.2 Support/common spaces for mixed-use facility calculation (i.e. restrooms, wellness, lobby, etc.) shall be proportionally divided by square footage among the building types chosen. Other support/common space areas, such as storage, and equipment and mechanical spaces shall be proportionally divided unless these spaces are specifically related to one of the specific building types chosen (e.g. mechanical space required specifically for a portion of a building, such as additional HVAC equipment for a laboratory).

.1.3.3 If the project contains a building type(s) that does not match the building types within section 18 30 40.2, the A/E shall identify the closest building type from the Commercial Building Energy Consumption Survey (CBECS). The A/E will then use that building type to identify the 25th

percentile Site EUI performance within the DOE Building Performance Database (BPD) and the BPD search criteria identified below. The recommended EUI Target will be approved by the Project Sustainability Stakeholders Group and the Project Team:

BPD Search Criteria

1. Site EUI shall be used.
2. Climate zone set to match ASHRAE 90.1 – 2016 for the location of the project.
3. Year built set to 10 years from date. If the BPD website indicates insufficient data is available for that timeframe or search criteria, increase year built to no more than 15 years.
4. If expanding the search timeframe results in insufficient data, the A/E shall research the building type and provide a recommendation for consideration and approval by the Project Sustainability Stakeholders Group.

.2 SITE EUI TARGETS BY BUILDING TYPES

Building Types match the definitions found in the Commercial Building Energy Consumption Survey (CBECS). The Site EUI Targets per building type are identified in the table below:

Site EUI Targets by Building Types		
	Building Type	**EUI (kBtu/sq. ft./yr.)**
1	Lodging	50
2	Education (Lab/Research)	200
3	Education (Academic)	75
4	Office	60
5	Wexner Medical Center - Outpatient	125
6	Wexner Medical Center - Inpatient	150
7	Public assembly	75
8	Food Service (Restaurant/Cafeteria)	325
9	Warehouse and storage	20

.3 DISTRICT PLANT CONVERSION FACTORS

For buildings served by district energy systems, the building calculated energy consumption (e.g., computer simulation) shall be converted to site EUI using district thermal plant conversion factors based on the energy required at the plant to generate and distribute the district utility. If district chilled water, steam, or hot water is used to serve the building, site energy for comparison with EUI targets shall be calculated using the following Plant-to-Site district plant efficiencies conversion factors. To ensure the designers are utilizing the most current plant efficiency

conversion factors, the A/E shall contact Ohio State Energy Partners representative on the Project Sustainability Stakeholders Group for the project.

.3.1 District Chilled Water from McCracken Power Plant
Proposed Building Chilled Water Energy Use (ton-hrs) * 0.81 (kW/ton) = Building Site Cooling Energy Input (kWh)

.3.2 District Chilled Water from South Campus Central Chiller Plant
Proposed Building Chilled Water Energy Use (ton-hrs) * 0.74 (kW/ton) = Building Site Cooling Energy Input (kWh)

.3.3 District Chilled Water from East Regional Chilled Water Plant
Proposed Building Chilled Water Energy Use (ton-hrs) * 0.76 (kW/ton) = Building Site Cooling Energy Input (kWh)

.3.4 District Steam from McCracken Power Plant
Building Steam Energy Use (Btu) / 0.68 (Btu delivered/Btu input) = Building Site Heating Energy Input (Btu)

.3.5 District Hot Water
Building Heating Water (Btu) / TBD (Btu delivered/Btu input) = Building Site Heating Energy Input (Btu)

.4 TARGET EUI AND LIFE CYCLE COST EFFECTIVENESS

If there is no life-cycle cost effective combination of energy conservation measures that allows the Target EUI to be met, modify the design of the proposed building system(s) to achieve an energy consumption level at the highest level of energy efficiency that is life-cycle cost-effective. In cases where the Target EUI is not met, the A/E shall submit documentation for review by the Project Sustainability Stakeholders Group (defined in 00 00 17), and will be considered by the university engineer, in collaboration with the university architect, university landscape architect and senior director, sustainability and strategic services.

.5 PROCESS LOADS

For projects unable to meet the Target EUI due to a process load(s) that is unusual to a specific building type, a request for a modified Target EUI Calculation shall be submitted to the Project Sustainability Stakeholder Group for their approval. If approved, this process load(s) and systems that serve them shall be the same for both the modified Target EUI Calculation and the proposed design. Documentation showing the analysis of the energy system chosen for the process load equipment shall be submitted to the Project Sustainability Stakeholder Group for their approval; if requested, the A/E shall perform a LCCA comparison of alternative design options. The building area containing this process load(s) shall also be defined and shall be utilized as a separate building type in the Mixed-Use Facility Calculation.

.6 DESIGN STRATEGIES

For New Construction and Major Renovation projects, the following shall be studied as design strategies in concept design to support the EUI targets.

Exception: Medical Center Facilities are not required to study any of the following strategies.

.6.1 Component Performance Alternative

The building thermal envelope shall study compliance with IECC 2021 Section C402.1.5, with the following correction to Equation HR-1:

1. Under the definition of "A" in Equation 4-2, the "Area" of vision glazing for "UA Table" shall be either 30% or 40% of the gross wall area. 40% shall only be used if the requirements of IECC 2021 C402.4.1.1 (daylight zone) are met. The opaque wall area shall make up the remaining 70% or 60% in the calculation.
2. The value of "D" in Equation 4-2 shall be zero.

.6.2 Air leakage – thermal envelope

The building thermal envelope shall study compliance with IECC 2021 Sections C402.5.1 through Section C402.5.11.1, , AND shall study compliance with the building envelope testing requirements in accordance with IECC 2021 Section C402.5.2 or C4,2.5.3. In addition, the building shall study compliance with IECC 2021 Sections C402.5.7, C402.5.8, and C402.5.9.

C402.5.3 Building thermal envelope testing.
Performance modification: The measured air leakage shall not exceed 0.25 cfm/ft2 of the building thermal envelope area at a pressure differential of 0.3-inch water gauge (75Pa).

.6.3 Energy Recovery Systems

Energy recovery ventilation systems shall study compliance with IECC 2021 Section C403.7.4. In addition, energy recovery ventilation systems shall study compliance with the following:

Application. All mechanical ventilation systems shall include an energy recovery system, regardless of the minimum fan system supply airflow rate and percent outdoor air. Exceptions listed in IECC 2021 shall be eliminated and replaced with the exceptions listed below.

Energy Recovery Effectiveness. The weighted average sensible energy recovery ratio of the building ventilation systems shall not be less than 1.0, in accordance with Equation HR-1. The sensible energy recovery ratios used in the equation shall be the values listed in Table HR-1. All values and

calculations shall be based on the winter design condition. IP or SI units shall be used consistently.

Exempt Exhaust is defined as exhaust where energy recovery systems are prohibited by 780 CMR or the International Mechanical Code. This includes exhaust from commercial kitchen hoods used for collecting and removing grease vapors and smoke.

Class 4 Exhaust is defined as exhaust meeting the definition of Class 4 air in ASHRAE/ASHE Standard 62.1-2019, including laboratory fume hood exhaust, exhaust where energy recovery is not allowed by ASHRAE/ASHE Standard 170 for use in energy recovery systems with leakage potential, and systems exhausting toxic, flammable, paint or corrosive fumes or dust. The Class 4 Exhaust system must be capable of reducing exhaust and makeup airflow rates to 50% of the zone design values or the minimum required to maintain pressurization relationship requirements. Excludes exempt exhaust.

Class 3 Exhaust is defined as exhaust meeting the definition of Class 3 air in ASHRAE/ASHE Standard 62.1-2019, including air with significant contaminant concentration, significant sensory-irritation intensity, or offensive odor. The Class 3 Exhaust system must be capable of reducing exhaust and makeup airflow rates to 50% of the zone design values or the minimum required to maintain pressurization relationship requirements.

Other Exhaust is defined as any exhaust that does not fall under the categories of Exempt Exhaust, Class 4 Exhaust, or Class 3 Exhaust.

Sensible Energy Recovery Ratio is defined as the change in the dry-bulb temperature of the outdoor air supply divided by the difference between the outdoor air and entering exhaust air dry-bulb temperatures, expressed as a percentage.

Table HR-1 **Exhaust Type**	**Sensible Energy Recovery Ratio**
EXH.EFOTHER	75%
EXH.EFCLASS-4/3	50%
EXH.EFEXEMPT	0%

Equation HR-1

$SENSIBLE.RATIO_{PROPOSED} / SENSIBLE.RATIO_{REQUIRED} \geq 1.0$

where:
$SENSIBLE.RATIO_{PROPOSED} = [(VENT.\Delta T_1 \times VENT.CFM_1) + (VENT.\Delta T_2 \times VENT.CFM_2) + (VENT.\Delta T_3 \times VENT.CFM_3) + \ldots) / VENT.CFM_{TOTAL}]$

and:
$SENSIBLE.RATIO_{REQUIRED}$ = [(($EXH.\Delta T_{OTHER}$ x $EXH.CFM_{OTHER}$ x $EXH.EF_{OTHER}$) + ($EXH.\Delta T_{CLASS\text{-}4/3}$ x $EXH.CFM_{CLASS\text{-}4/3}$ x $EXH.EF_{CLASS\text{-}4/3}$) + ($EXH.\Delta T_{EXEMPT}$ x $EXH.CFM_{EXEMPT}$ x $EXH.EF_{EXEMPT}$)) / $EXH.CFM_{TOTAL}$]

where:

Variable	Equals
$SENSIBLE.RATIO_{PROPOSED}$	Weighted average sensible energy recovery ratio of all mechanical ventilation systems.
$SENSIBLE.RATIO_{REQUIRED}$	Minimum average sensible energy recovery ratio required by code.
$VENT.\Delta T_X$	Change in the dry-bulb temperature of each individual mechanical ventilation system, calculated by subtracting the outdoor air dry-bulb temperature from the ventilation air temperature leaving the heat recovery device. This value shall be based on the change in dry-bulb temperature achieved by the heat recovery system alone, not including heat input from return air, fans, heat pumps, or active heating systems.
$VENT.CFM_X$	Ventilation rate in cubic feet per minute of each individual mechanical ventilation system.
$VENT.CFM_{TOTAL}$	Total volume of mechanical ventilation in cubic feet per minute.
$EXH.CFM_{TOTAL}$	Total volume of mechanical exhaust in cubic feet per minute.
$EXH.\Delta T_{OTHER}$	Dry-bulb temperature difference between the exhaust air and the ambient outdoor air, calculated by subtracting the ambient outdoor air temperature from the exhaust air temperature. The exhaust air temperature shall be based on the weighted average exhaust air temperature of all exhaust sources other than exempt exhaust and Class 4 exhaust. The value shall be based on the exhaust air temperature prior to exhaust heat recovery.
$EXH.\Delta T_{CLASS\text{-}4/3}$	Similar definition as EXH.ΔTOTHER except limited to Class 4 and Class 3 exhaust.
$EXH.\Delta T_{EXEMPT}$	Similar definition as EXH.ΔTOTHER except limited to exempt exhaust.
$EXH.CFM_{OTHER}$	Exhaust rate in total cubic feet per minute of all exhaust sources other than exempt exhaust and Class 4 exhaust.

$EXH.CFM_{CLASS-4/3}$	Exhaust rate in total cubic feet per minute of all Class 4 and Class 3 exhaust sources.
$EXH.CFM_{EXEMPT}$	Exhaust rate in total cubic feet per minute of all exempt exhaust sources.
$EXH.EF_{OTHER}$	Sensible energy recovery ratio requirement for ventilation air associated with all exhaust sources other than exempt exhaust and Class 4 exhaust. See Table AA104.3.2.2-1.
$EXH.EF_{CLASS-4/3}$	Sensible energy recovery ratio requirement for ventilation air associated with all Class 4 and Class 3 exhaust sources. See Table AA104.3.2.2-1.
$EXH.EF_{EXEMPT}$	Sensible energy recovery ratio requirement for ventilation air associated with all exempt exhaust sources. See Table AA104.3.2.2-1.

18 30 50 ENERGY MODELING

The site EUI calculation shall be derived from the proposed building performance model utilized in the life cycle cost analysis and Building energy use shall be modeled following *ASHRAE 90.1-2016 Appendix G – Performance Rating Method* with the following conditions:

.1 INPUT CRITERIA

The A/E firm shall simulate the performance of the whole building and shall include the following:

.1.1 Utility costs – See section 18 80 60.3.

.1.2 Use typical meteorological year (TMY3) weather data and full-year (8760 hr) analysis using The Ohio State University (WMO #724288) weather data from the National Renewable Energy Laboratory User's Manual.

.2 DOCUMENTATION REQUIREMENTS

The A/E shall provide all documentation requirements outlined in *ASHRAE 90.1-2016 Appendix G – Performance Rating Method,* including the following information shall be required:

.2.1 Provide all schedules utilized, including but not limited to schedules for modeling hourly variations in occupancy, lighting power, plug equipment,

service hot water, miscellaneous equipment power, thermostat set points and HVAC system operation.

.2.2 Anticipated building population data.

18 40 00 WATER USE EFFICIENCY

18 40 10 SCOPE

The standards in this section specify requirements for water use within new construction and improvements to the existing buildings and the university's-built environment.

18 40 20 COMPLIANCE

All projects shall utilize the Sustainability Applicability Matrix to identify which water use efficiency requirements below are applicable to the project based on project type, scope, and budget. Additionally, the provisions of the water use efficiency standards will be followed based on project type as identified below:

.1 Existing Buildings, Additions, Repairs, and Renovations shall comply with the applicable standards below.

.2 In addition to complying with the applicable standards below, New Buildings shall model the building water performance as determined in section 18 40 40 .11 WUI.

18 40 30 SITE WATER USE REDUCTION

.1 LANDSCAPE DESIGN

A minimum of 60% of the planted area, excluding lawn areas, shall consist of native and adaptive plants that can survive without irrigation after the first season. Plant selection shall be right plant, right place selections. The designer shall engage with the ecosystem services team during design. Landscaped areas irrigated with alternative non-potable cold water are exempt from these requirements.

Exception: lawn areas, athletic fields, golf courses, and areas dedicated to the production of food for human consumption.

.1.1 Maximize use of green infrastructure for stormwater management and stormwater harvesting. Potential resilient landscaping strategies include, but are not limited to, stormwater capture and reuse, flow attenuation, infiltration, retention, and detention (see 18 50 40).

.2 IRRIGATION

.2.1 GOLF COURSES

Only well water, stormwater, or other alternate onsite sources of water shall be used to irrigate the landscape.

.2.2 LANDSCAPE AREAS

No more than one-third of the improved landscape area may be irrigated using potable water. If more than one-third of the improved landscape area is to be irrigated, an alternate onsite water source must be used. The landscape establishment period shall not exceed one year, with the exception of tree plantings needing an additional watering for a period of one year per caliper of tree.

Exception: Potable water may be temporarily used on such newly installed landscape for the landscape establishment period.

.2.3 IRRIGATION SYSTEM DESIGN

The design of the irrigation system shall be in accordance with Section 32 80 00 and shall be performed by an accredited or certified irrigation professional. The irrigation system design shall meet or exceed the requirements of USEPA's WaterSense® Specification for Weather-Based Irrigation Controllers.

.2.3.1 Irrigation sprinklers shall not spray on buildings or hardscape areas and shall be prohibited on landscape areas less than 4 feet in area. They shall not have a popup height greater than 4 inches.

.2.3.2 Irrigation systems shall be based on hydrozones. They shall have a flow sensor and monitoring equipment that will shut off the control valve if the flow exceeds normal flow from an irrigation station. They shall prevent piping from draining between irrigation events.

.2.4 CONTROLS

The system shall be controlled by a qualifying smart controller that uses evapotranspiration (ET) and weather data to adjust irrigation schedules. Alternatively, the system shall be controlled by an onsite rain or moisture sensor that automatically shuts off the system after a predetermined amount of rainfall or sensed moisture in the soil. Qualifying smart controllers shall be labeled according to the USEPA WaterSense Specification for Weather-Based Irrigation Controllers.

Exception: A temporary irrigation system used exclusively for the establishment of new landscape shall be exempt from this requirement. Temporary irrigation shall be removed when the landscape vegetation becomes established or after one year, whichever is shorter, with the exception of tree plantings needing an additional watering for a period of one year per caliper of tree.

18 40 40 BUILDING WATER USE REDUCTION

.1 PLUMBING FIXTURES AND FITTINGS
Plumbing fixtures and fittings shall comply with the requirements of ASME A112.18.1 and A112.19.2, and NSF/ANSI Standard 61, as applicable, using the following flow/volume requirements listed in 22 40 00.

.2 APPLIANCES

.2.1 ELIGIBLE CLOTHES WASHERS shall comply with the ENERGY STAR® Program requirements.

2.2 DISHWASHERS shall comply with the ENERGY STAR® Program requirements.

2.3 ICE MACHINES shall comply with the requirements of the ENERGY STAR® Program for Commercial Ice Makers.

.3 HVAC SYSTEMS AND EQUIPMENT

.3.1 Once-through cooling with potable water is prohibited.

.3.2 The water being discharged from cooling towers for air-conditioning systems such as chilled water systems shall be limited in accordance with method 3.2.1 or 3.2.2

.3.2.1 For makeup waters having less than 200 ppm (200 mg/L) of total hardness expressed as calcium carbonate, by achieving a minimum of 5 cycles of concentration.

.3.2.2 For makeup waters with more than 200 ppm (200 mg/L) of total hardness expressed as calcium carbonate, by achieving a minimum of 3.5 cycles of concentration.

Exception: Where the total dissolved solids concentration of the discharge water exceeds 1500 mg (1500 ppm/L) or the silica exceeds 150 ppm (150 mg/L) measured as silicon dioxide before the above cycles of concentration are reached.

.3.3 Cooling towers shall be equipped with efficient drift eliminators that achieve drift reduction to a maximum of 0.002% of the recirculated water volume for counterflow towers and 0.005% of the recirculated water flow for crossflow towers.

.4 ROOFS

The use of potable water for roof spray systems to thermally condition the roof is prohibited.

.4.1 Maximize use of green infrastructure for stormwater management and stormwater harvesting. Potential resilient roof strategies include, but are not limited to, green roof, blue roof, and cool roof.

.5 COMMERCIAL FOOD SERVICE OPERATIONS.

.5.1 HIGH-EFFICIENCY PRE-RINSE SPRAY VALVES shall meet the requirements of Section 22 40 00.

.5.2 DISHWASHERS shall comply with the requirements in Section 18 30 20.2.2

.5.3 COMBINATION OVENS shall not consume more than 10 gal/h (38 L/hr) in the full operation mode.

.5.4 ICE MACHINES shall comply with the requirements of the Energy Star Program for Commercial Ice Machines 18 40 40.2.3.

.6 WEXNER MEDICAL CENTER AND LABORATORY/RESEARCH FACILITIES

.6.1 Once-through cooling with potable water is prohibited

.6.2 Use only water efficient steam sterilizers that

.6.2.1 have water-tempering devices that allows water to flow only when the condensate discharge exceeds 140°F (60°C)

.6.2.2 VACUUM STERILIZERS that use mechanical processes and not venturi-type vacuum systems.

.6.3 Use a dry-hood scrubber system if possible. If a wet-hood scrubber system is required, the scrubber shall be equipped with a water recirculation system.

.6.3.1 For perchlorate hoods and other applications where a hood wash down system is required, the hood shall be equipped with self-closing valves on those wash-down systems.

.6.4 Use only dry vacuum pumps unless fire and safety codes require a liquid ring pump.

.6.5 WATER TREATMENT SYSTEMS

.6.5.1 For all filtration processes, pressure gages shall determine and display when to backwash or change cartridges.

.6.5.2 For all ion exchange and softening processes, recharge cycles shall be set by volume of water treated or based on conductivity or hardness.

.6.5.3 For reverse osmosis and nanofiltration equipment with capacity greater than 27 gal/h (100 L/h), reject water shall not exceed 60% of the feed water.

.7 SPECIAL WATER FEATURES

.7.1 ORNAMENTAL FOUNTAINS
Ornamental fountains and other ornamental water features shall be supplied either by alternate on-site sources of water. Fountains and other features equipped with automatic water refilling valves shall be equipped with (1) makeup water meters (2) leak detection devices that shut off water flow if a leak of more than 1.0 gal/h (3.8 L/h) is detected, and (3) equipment to recirculate, filter, and treat all water for reuse within the system.

Exception: Where alternate on-site sources of water are not available within 500 ft (150 m) of the building project site, potable water is allowed to be used for water features with less than 10,000 gal (38,000 L) capacity.

.8 WATER UTILITY METERING refer to Section 33 12 33.

.9 WATER SOFTENERS

.9.1 DEMAND INITIATED REGENERATION
Water softeners shall be equipped with demand-initiated regeneration control systems. Timer-based control systems shall be prohibited.

.9.2 WATER CONSUMPTION
During regeneration, water softeners shall have a maximum water consumption of 4 gal (15.1 L) per 1000 grains (17.1 g/L) of hardness removed, as measured in accordance with NSF 44.

.9.3 EFFICIENCY AND LISTING
Water softeners that regenerate in place, that are connected to the water system they serve by piping not exceeding 1¼ in. (31.8 mm) in diameter, or that have a volume of 3 ft^3 (0.085 m^3) or more of cation exchange media shall have a rated salt efficiency of not less than 4000 grains of total hardness exchange per pound of salt (571 grams of total hardness exchange per kilogram of salt), based on sodium chloride equivalency, and shall be listed and labeled in accordance with NSF 44. All other water softeners shall have a rated salt efficiency of not less than 3500 grains of total hardness exchange

per pound of salt (500 grams of total hardness exchange per kilo- gram of salt), based on sodium chloride equivalency.

.10 REVERSE OSMOSIS WATER TREATMENT SYSTEMS

Reverse osmosis systems shall be equipped with an automatic shutoff valve that prevents the production of reject water when there is no demand for treated water. Point-of-use reverse osmosis treatment systems for drinking water shall be listed and labeled in accordance with NSF 58.

.11 WATER USE INTENSITY (WUI)

.11.1 WUI TARGET

Site Water Use Intensity (WUI) is used as water performance target metric with variation for building type square footage. The project WUI *anticipated* performance shall be calculated and be equal to or less than the WUI Target per calculation in 18 40 20.11.2.

.11.2 WUI DESIGN CALCULATION

The WUI design calculation shall be broken down as follows and summarized as a site WUI design calculation in the units of (gal/sq. ft./yr.) where sq. ft. is the gross building square footage.

A. Site Irrigation
B. Water Softeners
C. Reverse Osmosis Systems
D. Plumbing Fixtures
    a. Water Closets
    b. Urinals
    c. Lavatories
    d. Sinks
    e. Showers
    f. Miscellaneous
E. Appliances
    a. Clothes Washers
    b. Dishwashers
F. HVAC
    a. Total Cooling Tower Use (onsite or remote plant)
    b. Hydronic System Make-up Water
    c. Boiler Blowdown
    d. Steam Production/makeup Water (onsite or remote plant)
    e. Humidifiers
G. Process Equipment
H. Medical or Research Devices
I. Pools/Spas
J. Water Features
K. Other water consuming equipment

.11.3 WATER USE INTENSITY DESIGN TARGET (WUI_{target})
Project WUI_{target} are identified by building type. The WUI design target may be calculated in one of two ways, Single-Use and Mixed-Use Building Types and Areas shall match those used in the Site EUI target calculation:

.11.3.1 Single-Use Building Type – For facilities that only contain one building type identified in the Section 18 40 20.11.3.3, the WUI design target is determined by identified the Site WUI design target in Section 18 40 20.11.3.3 corresponding to the building type of the project.

.11.3.2 Mixed-Use Facilities – Mixed use buildings may reflect the uses/types of the space with weighted WUI numbers to reflect mixed space footprints. Each project shall combine WUI targets where large sections of the building area fall into different use types. For facilities containing more than one of the building types identified in Table 18 30 20.11.3.3, the WUI is calculated as an area-weighted average of building types by square footage as identified in the calculation below:

$$\mathbf{WUI_{target} = x/s}$$

$\mathbf{x} = \sum$ (Building type 1 sq. ft. * building type 1 WUI) +
(Building type 2 sq. ft. * building type 2 WUI) +
(Building type 3 sq. ft. * building type 3 WUI) +
… + (Building type n sq. ft * building type n WUI)

s = gross building area (square feet) as defined in ASHRAE 90.1-2016

Note:

a. Support/common spaces for mixed-use facility calculation (i.e. restrooms, wellness, lobby, etc.) shall be proportionally divided by square footage among the building types chosen. Other support/common space areas, such as storage, and equipment and mechanical spaces shall be proportionally divided unless these spaces are specifically related to one of the specific building types chosen (e.g. mechanical space required specifically for a portion of a building, such as additional HVAC equipment for a laboratory).

b. If one of the top 3 building types of a mixed-use facility does not match the building types within section 18 30 20.11.3.3, the A/E shall identify the closest building type from the Commercial Building Energy Consumption Survey (CBECS). The A/E will then use that building type to identify the WUI performance *Consumption per square foot (gallons)* from the

CBECS Water Index. The recommended WUI Target will be approved by the Project Sustainability Stakeholders Group and the Project Team.

.11.3.3 WUI TARGET BY BUILDING TYPE

Building Types match the definitions found in the Commercial Building Energy Consumption Survey (CBECS). The WUI Targets per building type are identified in the table below:

	Building Type	Site WUI Target (gal / sq. ft. / yr.)
1a	Lodging w/o Dining	21
1b	Lodging w/Dining	42
2	Education (Lab/Research)	21
3	Education (Academic)	7
4	Office	8
5	Wexner Medical Center – Outpatient	11
6	Wexner Medical Center – Inpatient	25
7	Public assembly	17
8	Food Service (Restaurant/Cafeteria)	27
9	Warehouse and storage	4
10	Sterilizers/Autoclave	41
11	Laundry in Building	42

18 30 30 TARGET WUI AND LIFE CYCLE COST EFFECTIVENESS

Alternative design concepts shall be provided that allows the Target WUI to be met. These alternative designs shall be shown to be cost effective thru life cycle cost analysis (LCCA), refer to 18 80 00 Life Cycle Cost Analysis. In cases where the Target WUI is not met, the A/E shall submit documentation for review by the Project Sustainability Stakeholders Group (defined in 00 00 17), and will be considered by the university engineer, in collaboration with the university architect, university landscape architect and senior director, sustainability and strategic services.

18 40 50 INTEGRATED WATER RESILIENCE

As a result of the Risk and Functional Performance Assessment (Section 18 20 70) on projects $4M and above, resilient site and/or resilient building strategies shall be considered in response to extreme water-related weather events such as riverine flooding, heavy precipitation, and drought.

18 50 00 ECOSYSTEM SERVICES

18 50 10 SCOPE

The standards in this section specify requirements for Ecosystem Services within new construction and improvements to the existing buildings and the university's-built environment.

18 50 20 COMPLIANCE

All projects shall utilize the Sustainability Applicability Matrix (Links to SAM ≤ $75,000 construction budget or SAM > $75,000 construction budget) to identify when these ecosystem services requirements are applicable to the project based on project type, scope, and budget. Applicable projects shall conduct an Ecosystem Services Assessment (ESA) as identified below and achieve a passing score which shall result in a net positive impact to the university's ecosystem services goal. The project can increase their score by funding any of the ecosystem services strategies in other campus locations; contact the university Ecosystem Services Team for more information. for more information.

18 50 30 ECOSYSTEM SERVICES ASSESSMENT (ESA)

Projects shall complete an Ecosystem Services Assessment with review and approval from the university Ecosystem Services Team, which consist of the University Landscape Architect, Planning Architecture and Real Estate, Sustainability Institute, and Facilities Operations and Development. The assessment shall calculate the impact of the project on the university's Ecosystem Services Sustainability Goal based on the natural assets provided by the existing site compared to the site design. Project teams shall provide the additional deliverables below with the ESA to the Project Manager and the university Ecosystem Services Team.

Regional campuses and off-campus university locations (locations not within the contiguous boundary of the Columbus campus) shall complete the Regional Ecosystem Services Assessment.

.1 Ecosystem Services Assessment

.1.1 Project teams shall complete the ESA with information on the existing site conditions and the proposed site plans.

.1.2 Project team shall provide a site plan (PDF, JPEG, GIS or CAD data, etc.) identifying the impact of the proposed design on the existing Ecosystem Services attributes (e.g. illustrating the loss/gain in vegetated acreage) provided by the Ecosystem Services Team upon request.

18 50 40 ECOSYSTEM SERVICES IMPROVEMENT STRATEGIES

Projects should consider the improvement strategies identified below separated into four major categories. Please note the list is not all inclusive of strategies.

.1 Protection and Conservation of Core Ecosystems

.1.1 Limit development on farmland

.1.2 Limit development in floodplains

.1.3 Limit development on wetlands

.1.4 Limit development on forested areas

.1.5 Preserve Heritage trees (large, old trees) (https://fod.osu.edu/files/heritage-and-specimen-trees)

.1.6 Preserve cultural, historic, and/or restoration sites

.1.7 Limit development on recreational areas

.1.8 Limit development on water bodies

.1.9 Limit development on urban meadows

2. Stormwater Management and Water Quality
Designs shall meet or exceed the requirements within the Ohio Environmental Protection Agency (EPA) Stormwater General Permit and the City of Columbus Stormwater Drainage Manual (current editions). A/E may utilize Storm Water Master Plan Best Management Practices (BMP) toolkit to identify best strategies for site. Credit under the Ecosystem Services Index shall only be given for the following best management practices that promote the spirit of ecosystem services.

.2.1 Bioretention

.2.2 Swales and Filter Strips

.2.3 Green Roofs

.2.4 Pervious Pavement

.2.5 Constructed Wetlands

3. Vegetation, Soil, & Biodiversity

.3.1 Preserve Heritage trees on site (https://fod.osu.edu/files/heritage-and-specimen-trees)

.3.2 Plant trees/increase Tree Canopy on site or on campus.

.3.3 Green Roofs

.3.4 Bioretention

.3.5 Swales and Filter Strips

.3.6 Use native or adapted plantings or plantings that have a purpose for research

.3.7 Soil amendments .3.8 Build up not out. Create a balance on site between built and natural areas.

.3.9 Wetland Mitigation

.3.10 Utilizing locally sourced trees and plantings

4. Quality of Life

.4.1 Create areas for passive or active recreation on site or on campus

.4.2 Create opportunities for Living Labs on site or on campus, which could include but is not limited to sites for outdoor classrooms, natural areas that could lead to research or learning opportunities

.4.3 Create spaces that reduce the heat island effect on campus, which could include but is not limited to increased tree canopy, green roofs, or water features.

.5 Innovation (Possible examples include)

.5.1 Improve Water Quality beyond City of Columbus requirements

.5.2 Increase Biodiversity

.5.3 Rainwater Harvesting and reuse

.5.4 Blue or Cool Roofs

.5.5 Utilizing locally sourced trees and plantings

18 60 00 MATERIALS

18 60 10 SCOPE

The standards in this section specify requirements for Materials within new construction and improvements to the existing buildings and the built environment. Materials sustainability guidance covers material sourcing, construction and demolition waste and materials management planning.

18 60 20 COMPLIANCE

.1 All projects shall utilize the Sustainability Applicability Matrix to identify which Materials requirements below are applicable to the project based on project type, scope, and budget.

18 60 30 SUSTAINABLE VALUE OF MATERIALS

Projects with a construction cost exceeding $4 million must procure at least 50% (by cost) of the building materials which meet sustainability criteria based on content, sourcing and/or carbon impacts as calculated using the Sustainable Materials Calculator. A narrative of the material sourcing approach and requirements shall be provided in the Basis of Design (BoD).

Projects with a construction cost below $4 million must meet the prescriptive materials requirements as outlined using the Prescriptive Materials Matrix by applicable CSI division.

.1 LIFE CYCLE COST ANALYSIS

Life cycle cost analysis (LCCA) shall be used to illustrate the relative cost effectiveness of comparable materials options for the following product categories: roofing, façade, flooring, exterior pavers, and counters.

Additionally, LCCA shall be used to determine the total cost of a project over a defined period of time once the building materials and finishes are selected. The LCCA shall follow the standards in section 18 80 00.

18 60 40 CONSTRUCTION AND DEMOLITION

The project shall follow the standards below to create a Construction and Demolition Waste Management Plan (CWM Plan) and to achieve a minimum total diversion of 85% of construction and demolition waste (by weight) from the landfill. The CWM Plan shall be provided with the Basis of Design (BoD).

.1 Construction and Demolition Waste Management Planning – General Contractor shall complete the university's Construction Waste Management Plan (CWM Plan) which shall identify the approach and methods to achieve the project's diversion targets.

.2 Diversion Thresholds – The university requires any project with a total cost above 1 million dollars to achieve a minimum total diversion of 85% of construction and

demolition waste (by weight) from the landfill. All dumpsters used for construction debris shall be located on concrete locations (Refer to Sections 32.13.10 Rigid Paving and 32.13.13 Concrete Paving). The General Contractor shall complete the Construction and Demolition Tracking spreadsheet to record the total waste, hauling and disposal cost, and end market information for each material type landfilled or diverted. Additionally, the General Contractor shall provide weight tickets, receipts, and invoices containing the dates and weight of the material diverted and landfilled. Hazardous materials and land-clearing debris are excluded from the calculation

18 60 50 MATERIALS MANAGEMENT PLANNING

A/E shall create a Materials Management Plan (MM Plan) identifying the materials management infrastructure and the management approach to maximize diversion from the landfill for all daily materials streams anticipated from the project once the space is operational. The MM Plan shall include a site/building plans indicating the space and layout for the storage of waste materials and shall have a narrative describing waste collection, storage, and removal following the guidelines below. Depending on which parties are responsible for the waste/recycling collection services of the building, the A/E shall consult with one or more of the following groups during the design process: Ohio State Recycling and Refuse Services, Athletics Sustainability Coordinator, Wexner Medical Center Director of Environmental Services, and/or Office of Student Life, Energy Management & Sustainability. A narrative of the material management approach and requirements shall be provided in the Program of Requirements (POR).

.1 RECYCLING

A/E shall design the project to allow for adequate recycling collection and storage for the entire space. Recycling storage shall be adjacent to solid waste storage and occupy the same room within a building, or the same enclosure if solid waste storage is located outside of a building. Right sizing the dedicated space shall consider increases in recycling storage needs and decreases in the number of pick-ups per week, thereby reducing vehicle air emissions, wear and tear on collection vehicles, and collection costs.

.2 ORGANICS

A/E shall provide adequate storage space for the collection and landfill diversion of non-hazardous organic material including but not limited to food waste from food preparation or food sales locations, animal bedding from research locations, and organic matter from greenhouse operations. Collection and storage options will include but not be limited to 45-gallon rolling carts, food waste disposer and storage tank accessible by university vacuum truck, or biodigester unit(s).

.3 HAZARDOUS AND UNIVERSAL WASTE

The project shall be designed to allow for adequate collection and storage of hazardous and universal wastes for the entire building. Project teams shall

coordinate with FOD's Environmental Health and Safety group on the requirements for collection, storage, and disposal options.

.4 SPECIALTY WASTE STREAMS
The project shall identify any specialty waste streams that are capable of being diverted and provide a narrative of how adequate collection and storage of these materials is being provided.

18 70 00 USER EXPERIENCE

18 70 10 SCOPE
User Experience/Indoor Environmental Quality (IEQ) sustainability requirements and guidance provide project teams with direction on how to optimize the indoor environment for building occupants' health and wellness. The standards in this section specify requirements for IEQ within new construction and improvements to the existing buildings and the built environment.

18 70 20 COMPLIANCE
All projects shall utilize the Sustainability Applicability Matrix (Links to SAM ≤ $75,000 construction budget or SAM > $75,000 construction budget to identify which of the User Experience/Indoor Environmental Quality (IEQ) sustainability requirements below are applicable to the project based on project type, scope, and budget.

18 70 30 INDOOR AIR QUALITY (IAQ)

.1 VENTILATION AND IAQ REQUIREMENTS
Projects shall incorporate the requirements of the following standards based on building type:

.1.1 All buildings shall comply with *ASHRAE Standard 62.1-2016, Ventilation for Acceptable Indoor Air Quality*.

.1.2 **Exception:** Residence Halls not in the scope of ASHRAE 62.1-2016 shall comply with *ASHRAE Standard 62.2-2016, Ventilation and Acceptable Indoor Air Quality in Residential Buildings*.

.1.3 **Exception:** Wexner Medical Center patient facilities shall comply with most recent *ASHRAE Standard 170, Ventilation of Health Care Facilities*.

.2 IAQ MANAGEMENT PLAN
See Division 01 51 23.

.4 BUILDING ENTRANCES
New construction or major renovation projects shall include entry vestibules at all main entrances. Vestibules shall be equipped with walk-off carpet tiles or mats at all main building entrances. The Vestibule depth from the exterior of the building is not greater than 10 feet and the length is not greater than 30 feet. Building Entrances design shall be approved by university stakeholders including university Technical Services Group (TSG).

Wexner Medical Center patient facilities require an additional 5'-0" allocated in the interior beyond the vestibule in the primary direction of travel for accommodating permanently installed entrance grilles. WMC building entrances to be approved by WMC Planning, WMC Engineering Team, and TSG.

.4.1 BUILDING ENTRANCE MATS AND CARPETING
A/E shall work with the project team to identify the appropriate type of entry vestibule flooring, see sections 12 48 13 for information on entrance floor mats and section 09 68 00 for information on carpet tiles.

Wexner Medical Center buildings shall use carpet tiles at main entrance vestibules as specified in section 09 68 00.

.5 INTERIOR MATERIALS AND FINISHES
The following materials and finishes used inside the weatherproofing system shall be low-emitting and should comply with California Department of Public Health (CDPH) Standard Method v1.1–2010 or v1.2–2017. Compliance shall be based on cost of products, as indicated below. Compliance with CDPH Standard Method v1.1-2010 or v1.2-2017 includes the following certifications: GREENGUARD Gold certification,

Cradle to Cradle (C2C) Gold certification, FloorScore certification, CRI Green Label Plus certification, Indoor Advantage Gold certification.

.5.1 75% by cost of interior paints and coatings

.5.2 75% by cost of interior adhesives and sealants

.5.3 75% by cost of wall assemblies

.5.4 90% by cost of ceiling finishes

.5.5 90% by cost of flooring products

.5.6 75% by cost of thermal and acoustic insulation

.5.7 75% by cost of furniture systems

18 70 40 THERMAL COMFORT

Projects shall comply with *ASHRAE Standard 55, Thermal Comfort Conditions for Human Occupancy*, and demonstrate 80% acceptability with thermal comfort (Predicted Mean Vote (PMV) levels within +/- 0.5; PPD ≤ 10%). Projects shall perform thermal comfort analysis using the CBE Thermal Comfort Tool.

Exception: Excludes research/laboratories, Wexner Medical Center patient facilities, residence halls, commercial kitchens, and arts/theater stage or areas where Metabolic Rate (MET) rate exceeds 2.0.

.1 DESIGN STRATEGIES

.1.1 Ensure spaces at risk for discomfort (e.g., locations close to entrances prone to drafts or west-facing walls that may retain heat) have been addressed.

.1.2 When designing for thermal comfort, consider providing variation in indoor thermal conditions or natural conditioning, thermal zoning, and individual controls (e.g. thermostats, ceiling fans, adjustable underfloor diffusers, task-mounted controls such as plug-in desktop fans, humidifiers, or dehumidifiers)

.1.3 Consider placement of return and supply vents in the furniture plans.

.1.4 Address building orientation and motorized shades (light sensors) as a design element that supports overall thermal comfort.

.1.5 Encourage the use of natural ventilation where applicable. This strategy and its feasibility shall be assessed on a case-by-case basis. In general, common areas should be automatically controlled, while windows in individual spaces could be manually controlled, provided that the adequate sensing technology

to shut down HVAC functions as needed. It is recommended that natural ventilation design is based on a no-wind condition.

.1.6 Consider winter comfort implications when making decisions with respect to glazed façade design: often times using triple pane glass can eliminate the need for perimeter heating, and may prove to be first cost effective, or neutral.

18 70 50 ACOUSTICAL PERFORMANCE

A/E shall provide a design narrative to describe how the project addresses exterior noise, mechanical rooms/equipment, levels of speech intelligibility needed, levels of speech privacy, etc. Additionally, A/E shall follow the standards below:

.1 Maximum background noise levels for HVAC equipment shall not exceed those outlined in the *current ASHRAE Handbook - HVAC Applications on Noise and Vibration Control* and *ANSI Standard S12.2, Criteria for Evaluating Room Noise*. Specified criteria shall be in NC.

Exception: patient treatment areas in Wexner Medical Center patient facilities; Wexner Medical Center to follow Facility Guidelines Institute (FGI) *Guidelines for Design and Construction of Hospitals*.

.2 Achieve minimum sound transmission class (STC) ratings in compliance with the Ohio State Acoustical Design. Classroom spaces shall achieve minimum STC ratings for classroom spaces and comply with standards as outlined in the current *ANSI Standard S12.60, Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools*.

Exception: patient treatment areas in Wexner Medical Center patient facilities; Wexner Medical Center to follow Facility Guidelines Institute (FGI) *Guidelines for Design and Construction of Hospitals*, residence halls shall follow local building codes for acoustical separation of dwelling units, commercial kitchens, and arts/theater spaces with specialized acoustic design.

.3 Achieve maximum reverberation time requirements in compliance with the Ohio State Acoustical Design.

18 70 55 EQUIPMENT VIBRATION PERFORMANCE

.1 Vibration isolation of equipment shall be designed to achieve acceptable vibration levels for the building occupants, other sensitive equipment in the building and to properly protect the vibrating equipment and its attachments. Vibration isolation design shall be as required but shall at least include the recommendations provided in the current ASHRAE handbook – HVAC applications chapter on Noise and Vibration Control.

18 70 60 DAYLIGHTING AND LIGHTING QUALITY

A/E shall evaluate daylight and electric lighting needs on a space-by-space basis. A/E shall provide a Lighting & Daylighting Plan and design narrative to describe how the project addresses program and project-specific tasks, architectural style, light levels, potential for glare, and lighting quality - including color rendering index (CRI), correlated color temperature (CCT), etc. The Lighting Plan shall demonstrate how light levels and daylighting have been designed for the various tasks and activities within the project, including height of work plane, as well as how glare is being addressed. The extent of the analysis (i.e. spaces to be studied – the whole floorplate or key areas) shall be determined and justified by the OSU project manager and A/E. A report or presentation shall be provided outlining key questions and goals, analysis methodology, analysis results, and key findings and recommendations. This deliverable shall be provided at each project phase up to the discretion of OSU project manager and the A/E (e.g. Concept/Schematic Design, 50% Design Development, 100% Design Development, 100% Construction Documents), with the level of detail in line with the design progression. A/E shall follow the standards below.

.1 METRICS

.1.1 DAYLIGHT AUTONOMY

A/E shall evaluate daylight sufficiency using Daylight Autonomy (DA) for all spaces where daylight is beneficial. Projects shalltarget achievement of DA 55 – 85%. Excluded project/space types shall provide a narrative explaining why daylight would be detrimental to the function of the space.

Exception: Any space in which daylight would be detrimental to the use of the space (e.g. auditorium / arts / theater stage, media lab, etc.). In Wexner Medical Center, DA requirements apply only to patient rooms and typical visitor spaces. In Residence Halls, DA requirements apply only to living and bedroom spaces.

.1.2 GLARE

A/E shall evaluate potential for glare using one of the following metrics, or similar: DA > 3,000 lux, UDImax (> 2,000 lux), Daylight Glare Probability (DGP), or a glare proxy such as seasonal direct sunlight hours or contrast ratios with luminance falsecolor renderings.

.1.3 DESIGN STRATEGIES

.1.1.1 Consider exterior shading that minimizes solar heat gain and glare while admitting daylight. Consider high albedo materials, including but not limited to roof areas.

.1.1.2 Explore interior space layouts to ensure adequate daylight in all regularly occupied spaces.

.1.1.3 Explore the impact of interior finish surface reflectances on the daylight environment for regularly occupied spaces

.1.2 DEFINITIONS

.1.2.1 Daylight Autonomy (DA) - An illuminance (grid-based, view independent) measure of daylight sufficiency, reporting a percentage of time (annual occupied hours) that achieves the target illuminance (e.g. 28 fc, or 300 lux) for a specified percentage of the analysis period (source: Illuminating Engineering Society (IES)). Spaces shall use the IES handbook, or related recommended practice, to guide target illuminance levels and target achievement of DA of 55 – 85% for annual occupied hours. The metric can also be used with a higher illuminance threshold (e.g. 3,000 lux) to understand potential for glare.

.1.2.2 Useful Daylight Illuminance Maximum (UDImax) - An illuminance (grid-based, view independent) measure of potential for glare, reporting a percentage of time (annual occupied hours) that exceeds 2,000 lux, indicating potentially high brightness and therefore glare.

.1.2.3 Daylight Glare Probability (DGP) - A luminance (view-dependent) measure of glare, expressed as both point-in-time or annual, reporting a percentage associated with glare (imperceptible, perceptible, disturbing, and intolerable) for a given viewpoint.

.1.2.4 Seasonal Direct Sunlight Hours – A grid-based proxy for glare, reporting the number of hours seasonally that a space receives direct sunlight. This metric is equivalent to “shade down” areas for spaces where program involves focused work and/or non-flexible viewpoints.

.1.2.5 Contrast Ratios & Luminance Falsecolor Renderings – A luminance (view dependent) proxy for glare, reporting the contrast between a task area and glare instance (window opening) using luminance renderings for a given viewpoint at selected times of year and sky conditions.

.1.2.6 Color Rendering Index (CRI) - A measure of the degree of color shift that objects undergo when illuminated by the light source, as compared with the color of those same objects when illuminated by a reference source of comparable color temperature. (source: Illuminating Engineering Society) Ex: High color rendering (CRI ≥ 80) shows color (and therefore, objects and surroundings) more realistically and helps differentiate between objects.

.2 LIGHTING LEVELS

All indoor and outdoor spaces (including transition areas) shall comply with the lighting levels outlined in the Illuminating Engineering Society (IES) *The Lighting Handbook, Current Edition,* or related recommended practice.

.2.1 In regularly occupied spaces, electric lighting shall have color-rendering index (CRI) > 80 (excluding decorative fixtures and emergency lights).

.3 CONTROLS AND TASK LIGHTING

.3.1 For educational spaces and office spaces, projects shall provide dimmable lighting controls with a low-end trim of 1% for at least 90% of individual occupant spaces. For office spaces, projects shall provide task lighting for individual workstations.

.3.2 Projects shall employ vacancy sensors in meeting rooms and classrooms rather than occupancy sensors. The vacancy sensors shall meet the requirements of the FOD Building Automation Shop (or the Building Automation group of the project owner) and follow the AUTOMATIC CONTROL OF HVAC AND LIGHTS within 18 30 00 Energy Efficiency section.

.3.3 All fixtures in public spaces shall be dimmable. General lighting and accent/art lighting shall be separately controlled.

.3.3.1 For educational spaces and conference spaces, projects shall provide dimmable lighting controls with a low-end trim of 1% for at least 90% of individual occupant spaces. For office spaces, projects shall provide task lighting for individual workstations.

.4 EXTERIOR LIGHTING

Exterior lighting strategies shall consider landscaped areas as well as general pathway illumination for safety and to enhance views from the interior after daylight hours to allow for a connection with nature. Landscape/accent lighting shall be controlled separately from general exterior illumination.

.5 CORRELATED COLOR TEMPERATURE (CCT)

A/E shall design lighting fixtures with a color temperature range between 3000K – 4000K. Final color temperature to be approved by the project team.

18 70 70 CONNECTION TO NATURE

A/E team shall explore and implement at least three (3) distinct design strategies related the biophilic design elements below to enhance building occupants' connection with the natural environment. A/E shall complete the Biophilic Design Checklist, indicating biophilic strategies selected. Biophilic design strategies shall be implemented according to OSUWMC and OSU approved brand standards .

Exception: Excludes research/laboratories, commercial kitchens, and arts/theater stage or performance areas.

Note: Additional guidance can be found in: *14 Patterns of Biophilic Design: Improving Health and Well-Being in the Built Environment*, *Biophilic Design Guidebook*, or *Biophilic design: the theory, science and practice of bringing buildings to life* by Stephen R. Kellert, Judith Heerwagen, and Martin Mador.

18 80 00 LIFE-CYCLE COST ANALYSIS

18 80 10 SCOPE

LCCA shall be used: 1) for comparing alternative design concepts, and 2) to estimate the Total Cost of Ownership for the final design. LCCA for comparing alternatives shall include all relevant costs form making a valid comparison. LCCA for determining Total Cost of Ownership shall determine the reasonably expected costs of facility ownership, operation, and maintenance including labor and materials for the economic life of the facility.

18 80 20 COMPLIANCE

The A/E shall submit life-cycle cost analyses as identified below:

.1 As required by the State of Ohio under Sections 123.001, 153.01, 153.04, and 153.10 of the Ohio Revised Code and in accordance with rules adopted under Chapters 3781 and 4101.

.2 As requested by Project Manager or Project Owner.

18 80 60 LIFE-CYCLE COST ANALYSIS

LCCA shall be used for comparing design concepts that affect utility consumption (e.g., energy and water), but may also be used for material selection. LCCA shall use Building Life-Cycle Cost (BLCC5) software for Department of Energy's Federal Energy Management Program (FEMP), Energy Projects. Input reports, output reports and digital BLCC5 file shall be provided as part of design review process. Annual utility cost between alternatives shall be determined by following *ASHRAE 90.1-2016 Appendix G – Performance Rating Method.* A/E shall include the required inputs below:

.1 LENGTH OF ANALYSIS
The study period shall be 40 years.

.2 DISCOUNT RATE INFORMATION
LCCA shall be performed using each of the Discount Rates below as a sensitivity analysis.

.2.2 Discount Rate = 3% and 5.25%

.3 UTILITY CONSUMPTION RATES
The utilities rates utilized for LCCA will vary depending on the location of the project, cost center, and the delivery of the utility:

.3.1 Projects for facilities located in the contiguous Columbus campus that will be billed at the direct billed or POM rates for utilities and served by Columbus campus utilities shall perform the LCCA using the rates in the Ohio State Utility Rates for LCCA document.

.3.1.1 Utility rates can be found in the *Ohio State Utility Rates for LCCA* document. Access is restricted.

To request access, please complete a SIMS/Archive access request form through: https://go.osu.edu/guest-accounts.You will receive an email from OSU's IT Service Desk to complete the guest account process. Please respond to this email promptly. Once the guest account is created, your access to SIMS/Archive will be granted. If you already have access, login.

.3.2 Projects for facilities located outside of the contiguous Columbus campus or served by non-Ohio State utilities shall use the Department of Energy (DOE) recommended utility rates on EIA's website: http://www.eia.gov

.4 UTILITY ESCALATION RATES
Projects shall use the escalation rates provided through the BLCC5 software.

.5 MAINTENANCE COST
The AE shall provide documentation for maintenance and other costs, upon request

.6 INFLATION RATE
LCCA shall not include inflation. This is consistent with LCCA for FEMP Energy Projects.

.7 REQUIRED INFORMATION
Costs in LCCA shall include but not be limited to the following: energy, other utilities, initial investment, maintenance, replacement, and residual value.

18 90 00 ACCESS AND CONNECTIVITY

18 90 10 SCOPE

The standards outlined in this section, provide design guidelines, incentives and metrics that support the University's commitment to ***Access and Connectivity*** with a focus on sustainability. This commitment has been fundamental in recent planning documents and initiatives including Framework 2.0 (2017) and CTPP3 (2020).

These guidelines acknowledge the evolving nature of the region, the OSU campus and corresponding transportation and parking networks. The goal of the Division 18 standards is to encourage project teams to reference relevant university strategies related to transportation, parking, and mobility and further encourage the use of fuel efficient and multi-modal transportation.

Additionally, these guidelines define project specific requirements but also promote a proposed projects contextual relationship within the university and surrounding communities that may exist beyond individual project boundaries.

18 90 20 COMPLIANCE

Reference SAM document to determine which Access and Connectivity requirements are applicable. Additionally, the provisions of these standards shall be followed based on project type as identified below:

- Building type / size / location for projects $4M and above.

.1 Documents Referenced

The following reference documents should be utilized in creation of mobility plan:

.1.1 OSU Framework 2.0

.1.2 OSU Comprehensive Transportation and Parking Plan 3 (CTTP3)

.2 Mobility Plan

The A/E shall submit a "Mobility Plan" to address how the project will consider issues of Access and Connectivity relative to university goals. The mobility plan submittal shall occur as part Programming of Requirements or Schematic Design process. The Mobility Plan shall include a study and survey of existing bike parking / amenities within a 200' radius and shall address how the project supports campus wide Access and Connectivity goals including a minimum of 4 of the below:

.2.1 Connections to existing connectivity networks

.2.2 Regional multimodal and alternative transportation strategies

.2.3 University based bike networks & micro mobility systems

.2.4 CABS, COTA and BRT transit and shuttle services

.2.5 Rideshare programs

.2.6 Pedestrian circulation routes

.2.7 ADA access routes and accommodations

18 90 40 DESIGN STRATEGIES

The following guidelines relate to specific requirements related to Access and Connectivity.

.1 Bike Facilities and Infrastructure

Design considerations shall address bicycle infrastructure in conjunction with landscape and site design elements and be incorporated into a cohesive plan that meets the goals of the project program, responds to the surrounding campus.

.2 Bike Parking Requirements

.2.1 The bike parking requirements per building type are identified in the table below

```Required Bike parking per Building Type:

| Building Type | Required Bike Parking Quantities |
|---|---|
| Residence Halls / Residential | 1 space per 1.5 beds |
| Education / Academic | 1 space per each 5 seats in classroom OR 1 space per each 250 gross SF whichever is greater |
| Office | 1 space per each 10 employees |
| Public Assembly (lecture hall, theater, auditorium) | 1 space per each 40 seats or 1 space per 500sf (whichever is greater) |
| Food Service (Restaurant / Cafeteria) | 1 space per 20 seats + 1 space per 15 employees on largest shift |
| Warehouse & Storage | 2.5% of peak users. Min of 4 |
| Wexner Medical Center | Bike parking for 2.5% of peak visitors AND 5% of building occupants |
| Retail | 1 space per 1500 gross SF |
| Parking Structures | 2 bikes spaces per 200 vehicular parking spaces |

.3 Bike Facility Design Requirements

The following requirement applies to bike parking facilities

.3.1 Parking Garages

Bike parking should be utilized in “dead” spaces and corner spaces within parking structures. Parking structure provide opportunities to include covered areas for repair stations, bicycle pumps, first aid kits, and e-bike charging areas.

.3.2 Proximity to Entries:
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Bicycle facilities should be conveniently located to destinations and should be sited to correspond with specific destination entrances and screened with landscape plantings to better integrate them into the campus environment. Bicycle parking shall not clutter building entrances, impede upon other site amenities, or restrict circulation routes. This requirement should be balanced with site security, including lighting accommodations, in the creation of the final layout and design. Primary bike parking should be no more than 100 feet walking distance from the main entry.

When a building is located close to a parking garage and/or open lot, *(within 200 yards of a building entrance)* racks may be located at the parking facility closest to the building entrance in lieu of installation near the building entrance.

.3.2.1 Electric Scooters
Designated space for E scooter parking should be provided in conjunction with bike parking facilities. Such spaces should be sized to accommodate e-scooters for at least 2.5% of peak visitors to the building.

.3.2.2 Covered Parking
Covered bike parking should be considered for 2% of regular building occupants and 5% of visitors

.3.2.3 Pavements
Paving materials in bike parking areas should be permeable where possible.

.3.2.4 Bike Racks
Ohio State Univ standard bike rack “U” rack (See 12 93 13 Bicycle Racks).

.3.4.5 Lighting
All sidewalks, bike parking areas and plazas shall be lit to OSU standards or as otherwise required for safety (See Division 26 56 00). Only light areas where exterior lighting is clearly required for safety and security.

.4 Bike Shelters / Repair Stations
Bike Shelters / Repair Stations should be considered and located across campus and distributed in locations to maximize use and convenience and consider proximity to indoor shower facilities. These shelters may include the following:

- Indoor bike parking
- First aid kits
- Benches / seating areas
- Scooter parking
- Bicycle pumps
- e-bike & scooter charging areas
- BikeShare docking stations
- Benches / seating

.5 Shower Facilities

.5.1 Indoor shower facilities shall be provided in areas where more than 40 bikes are required for new buildings and major renovations.

.6 Bike Parking Removal

If the project requires removing bike parking spaces, it must add at least the equivalent number of spaces within this project or show proof of a plan to add them within another project, or provide parking study showing transportation needs.

.7 Electric Vehicle Infrastructure

Projects should consider preferential parking and infrastructure for Electronic Vehicles. Project teams (A/Es in conjunction with OSU Planning Departments) should develop survey information to identify participants who own electric cars, as well as the current locations and usage of EV charging stations on campus. Projects which are impacting parking will provide at minimum spots that are “EV Ready”, because adding the infrastructure in the future can be challenging and costly.

Additionally, project teams should consider requirements based on LEED v4.1 as a general guideline when determining required EV infrastructure:

LEED v4.1:
Install electrical vehicle supply equipment (EVSE) in 5% of all parking spaces used by the project or at least two spaces, whichever is greater. Clearly identify and reserve these spaces for the sole use by plug-in electric vehicles.

OR

Make 10% of all parking spaces or at least 6 spaces EV Ready, whichever is greater. An EV ready parking spot is defined as having enough electrical capacity installed at the panel to support future EV charging spots. Additionally, there is a dedicated branch circuit to make sure enough power is available for future charging stations without overloading the system and raceway to future charging spots. Finally, wiring and junction box or 240 outlet is provided.

.8 Rideshare Programs

Projects should be encouraged to support OSU TTM in the development and promotion of rideshare programs. This would include creating designated pick-up and drop-off zones, complete with safe waiting areas in areas that support campus wide goals. Such pick up zones are not desired in the campus core.

END OF DIVISION 18 SUSTAINABILITY