





result of and/or to accommodate adjacent primary construction work such as replacement or installation of new mechanical equipment, or similar.

*Annual benchmarking report* – The report provided each year to the Office of Climate Action, Sustainability and Resiliency (“CASR”) to meet the requirements of Chapter 10, Article XIV “HIGH-PERFORMANCE EXISTING BUILDINGS PROGRAM,” or Section 403 “Benchmarking and Reporting”.

*All-electric property* means a property that contains no permanently installed equipment or appliances that utilize combustion, plumbing for fuel gas or fuel oil or fuel gas utility connection, installed within the building(s) or site, except for emergency power systems and standby power systems

*Building* - Means any structure used or intended for supporting or sheltering any use or occupancy. The boundary of any single building is defined by its surrounding exterior walls. Party walls as constructed in accordance with the International Building Code shall create separate buildings.

*Building Official* - Means the person authorized and directed to act on behalf of the Building Permitting and Inspections Services in the interpretation and enforcement of the Building Code of the City and County of Denver, and appointed by the Executive Director of Community Planning and Development.

*Campus* - Means a tract of contiguous property with one or more owners and that contains or will contain more than one building, that is planned, developed and operated as an integrated facility for a number of individual uses with special attention to coordinated circulation, parking, utility needs, aesthetics and compatibility. For purposes of this definition, the presence of public rights-of-way shall not destroy contiguity of land area. A campus may contain only existing buildings, existing buildings and proposed new buildings, or only proposed new buildings.

*Character defining roof* – Means a *visible roof* where the roof’s relationship to the overall shape of the building, as well as the roof’s distinctive materials, craftsmanship, and/or decorative details are important to the overall visual character of the building; if the materials, color or shape of the roof were to change, it would impact the visual character of the building.

*Cool roof* – Means a roof or portion of a roof containing roof covering material meeting any of the solar reflectance values in Table 1 in order to mitigate or assist in reducing urban heat island effect.

*Denver Building Code* - Has the same meaning as in Section 10-16, DRMC.

*Denver Fire Code* – Has the same meaning as in Section 10-16, DRMC.

*ENERGY STAR Portfolio Manager* – Means the online tool created by the U.S. Environmental Protection Agency used to measure and track a building's energy use, water consumption, and greenhouse gas emissions.

*Energy Use Intensity (EUI)* – Means the energy used (kbtus) per square foot per year.

*Green space* - Means any area that is proposed to contain trees, groundcover, shrubs, urban agriculture, natural grass/turf, or vegetated roofs.

*Greenhouse* -Means a structure or a thermally isolated area of a building that maintains a specialized sunlit environment exclusively used for, and essential to, the cultivation, protection or maintenance of plants, that sells its commodities for a profit, or on behalf of a non-profit, and is constructed or planned to be constructed as either an F-1 occupancy or a U occupancy.

*Gross floor area* – Means the floor area within the inside perimeter of the exterior walls of the building under consideration, exclusive of vent shafts and courts, without deduction for corridors, stairways, ramps, closets, the thickness of interior walls, columns, or other features. The floor area of a building, or portion thereof, not provided with surrounding exterior walls shall be the useable area under the horizontal projection of the roof or floor above. The gross floor area shall not include shafts with no openings, interior courts, or areas used exclusively for the storage or parking of vehicles.

*Individual roof section (or roof section)* - Means a portion of roof bounded on all sides by one or more of the following features: a wall or parapet; the roof edge; an expansion joint; or a roof divider.

*International Building Code (IBC)* - Means the 2021 International Building Code, as amended by the 2022 Denver amendments and all subsequent amendments and reenactments to form the 2022 Denver Commercial Building Code (DCBC).

*International Fire Code (IFC)* - Means the 2021 International Fire Code, as amended by the 2022 Denver amendments and all subsequent amendments and reenactments to form the 2022 Denver Fire Code (DFC).

*International Energy Conservation Code (IECC)* - Means the 2021 International Energy Conservation Code, as amended by the 2022 Denver amendments and all subsequent amendments and reenactments to form the 2022 Denver Energy Code (DEC).

*International Plumbing Code (IPC)* - Means the 2021 International Plumbing Code, as amended by the 2022 Denver amendments and all subsequent amendments and reenactments to form the 2022 Denver Plumbing Code (DPC).

*Low-sloped roof* – Means a roof having a slope less than 2 units vertical in 12 units horizontal.

*Net Zero Energy Building* - Means an energy-efficient building where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy.

*Owner* - Means any person, agent, operator, entity, firm, or corporation having any legal or equitable interest in the building or property; or any person authorized to act on the owner's behalf.

*Registered Roof Consultant* – Means a current Registered Roof Consultant (RRC), as provided by the International Institute of Building Enclosure Consultants (IIBEC).

*Renewable energy device* - Means a device that obtains energy derived from solar radiation, wind, landfill gas, biomass, the internal heat of the earth, or another source with the approval of the departments of community planning and development and climate action, sustainability, and resiliency.

*Residential building* - Means a building where more than sixty percent (60%) of the gross floor area of the building is used, designed or intended to be used for a household living use type as defined in the Denver Zoning Code, including accessory residential uses; however, a residential building shall not include a residential care use, or a lodging accommodation use, all as defined in the Denver Zoning Code.

*Roof* – Means the overhead structural component of a building which functions primarily to shelter the interior of the building from the effects of weather and the infiltration of water.

*Roof covering materials* – Means the exposed covering or coating of a roofing system or roof structure protecting the building.

*Roof recover* – Means the process of installing an additional layer of roof covering over a prepared existing roof covering without removing the existing roof covering.

*Roof repair* - The reconstruction or renewal of any part of an existing roof for the purposes of correcting damage or restoring pre-damage condition.

*Roof replacement* – Means the process of removing the existing roof covering, repairing any damaged substrate, and installing a new roof; or the reconstruction or renewal of any part of an existing roof for the purposes of its maintenance.

*Solar reflectance* – Means the reflective properties of roofing materials and coatings as tested and rated by the Cool Roof Rating Council or as otherwise approved by the Building Official for any of the following values: Initial solar reflectance, 3-year-aged solar reflectance, initial solar reflectance index (SRI) and 3-year-aged solar reflectance index (SRI).

*Steep-sloped roof* – Means a roof having a slope equal to or greater than 2 units vertical in 12 units horizontal.

*Total roof area* - Means the square footage of all roofs and roof sections located on a building. Roofs covering a story or stories below grade, as determined in accordance with the International Building Code as adopted in the Denver Building and Fire Code, shall not be included in the calculation of total roof area of a building.

*Urban agriculture* - Means the process of cultivating and processing herbs, fruits, flowers and or vegetables.

*Vegetated roof* - Means an assembly of interacting components designed to waterproof and normally insulate a building's top surface that includes, by design, vegetation and related landscape elements. A vegetative roof shall meet requirements as set forth in rules and regulations. Another term for vegetated roof is a green roof.

*Visible roof* – Means a *roof section* that is at least partially visible from a person of average height in a public vantage point such as a city park, public street, campus grounds, or a private street with a public access easement.

#### **Section 1.04 Green Buildings Ordinance Compliance Options.**

The Green Buildings Ordinance contains various compliance options and the requirements associated with those options.

### **ARTICLE II: GENERAL ADMINISTRATION**

#### **Section 2.01 Applicability of the Green Buildings Ordinance.**

The Building Official shall have the sole responsibility for determining whether a project must comply with the Green Buildings Ordinance or if the project is subject to an applicable exemption as outlined in the ordinance. The Building Official shall also be responsible for verifying the owner's selected compliance path, and that it meets all applicable code requirements in consultation with other agencies.

All measurements shall be in conformance with the methods used in the Denver Building and Fire Code except where otherwise noted. Stories and height of residential buildings shall be measured per the Denver Building and Fire Code.

#### **Section 2.02 Permit Issuance.**

The Building Official shall not issue any building or roofing permits for a project subject to the provisions of the Green Buildings Ordinance, except for permits such as those for shoring, preparatory demolition, phased construction, or foundation permits, prior to a project documenting compliance with the Green Buildings Ordinance.

#### **Section 2.03 Permitting Requirements.**

- (a) The Building Official is delegated the authority to establish submittal requirements to document compliance with the Green Buildings Ordinance. These requirements will be available on CPD's webpage and at CPD's offices, which are in addition to any requirements contained within these regulations. Regardless of compliance option, each building permit submittal that includes a roof replacement or a new roof must provide the building's total roof area on the roof plan.
- (b) Buildings or additions 25,000 square feet or greater in gross floor area, including those who must only comply with the provision of a cool roof, must submit required documents

for review when constructing either a new roof or a roof replacement, or seeking to document compliance as a Campus as outlined in Article V. Owners seeking a character defining roof determination shall submit the required documentation as outlined in Section 3.04. Renewable energy devices being used to fulfill a Green Buildings Ordinance requirement shall also be submitted for review, regardless of the size of the system.

- (c) The owner of a building subject to the Green Buildings Ordinance shall submit to CPD a Green Building Declaration Form for either a new or existing building. This form will be available on CPD's website.
- (d) Depending on the compliance method chosen, required permits are subject to change, but are summarized below. Any new construction, additions, or roof replacement that includes compliance with the Green Buildings Ordinance, shall follow the procedures for permit issuance in the administrative section of the Denver Building and Fire Code. Owners are required to comply with all other applicable City regulations and permit requirements.
- (e) Any new construction, addition, or roof replacement that includes a vegetated roof must receive a separate permit for the vegetated roof (a commercial construction permit for a green roof), in addition to a roof permit for the underlying roof/waterproof membrane of the building. The permit for the vegetated roof must be issued to a Denver licensed green roof installer.
- (f) For vegetated roofs, the following additional permits are required:
  - (i) A plumbing permit for irrigation on the vegetated roof which may include a backflow preventer so long as the permit is issued to a licensed plumber. If an irrigation contractor obtains the permit, then a separate plumbing permit shall be required for the backflow preventer and associated equipment.
  - (ii) Fire prevention for extension of any standpipes on existing buildings.
- (g) A separate electrical permit is required for any renewable energy device. A zoning permit will also be required for all solar panels that do not meet the definition in the Denver Zoning Code for "solar panels, flush-mounted".
- (h) A site development plan (SDP) or amendment/modification to an existing site development plan and resulting zoning permit, if applicable, is required for at-grade green space.
- (i) As required by the Denver Building Code and Denver Fire Code and associated policies, and the zoning code of the City and County of Denver, additional permits or approvals shall be obtained for related work, including, but not limited to:
  - (i) General Construction;
  - (ii) Roofing;
  - (iii) Fire Protection systems;
  - (iv) Mechanical systems;
  - (v) Plumbing systems;

- (vi) Electrical systems;
- (vii) Irrigation systems;
- (viii) Zoning permits;
- (ix) Office of the City Forester approval; and
- (x) Landmark approval as needed.

**Section 2.04 Inspection Requirements.**

The following inspection requirements are in addition to any other required inspections of issued permits, including but not limited to, final roof inspection and final building inspection for vegetated roof.

- (a) Pre-construction meeting required: Upon issuance of a roofing permit and vegetated roof permit (under a commercial construction permit for a green roof), the roofing contractor and green roof installer must schedule a pre-construction meeting with the appropriate construction inspector prior to beginning construction on the building's roof.
- (b) Leakage testing report for a vegetated roof: Prior to installation of the vegetated roof, an inspection for the roofing permit must be requested in order to verify that the membrane and other aspects of the roofing system have been installed per the approved plans. Additionally, the owner must provide a signed and stamped leakage testing report by a Colorado licensed architect or engineer, or a registered roof consultant, showing a successful leakage test.
- (c) Vegetated roof irrigation inspection: An inspection will be required of the backflow preventer, verification of the control system, water test of the irrigation system, and connection to the irrigation main.
- (d) Any green space not on the roof shall be inspected by CPD's Zoning/Neighborhood Inspections to ensure compliance with the site development plan and/or zoning permit that documents compliance with the green space requirements.

**ARTICLE III: COOL ROOFS**

**Section 3.01 In General.**

The Green Buildings Ordinance requires new buildings or additions containing 25,000 square feet or more of gross floor area, and existing buildings containing 25,000 square feet or more of gross floor area upon a roof replacement or roof recover for more than 5% of either the total roof area or individual roof section(s) to provide a cool roof. See Appendix A for reference.

**Section 3.02 Coverage Requirements.**



- (a) New Buildings or applicable additions. Must provide a cool roof, except as specifically exempted in Section 3.04 below.
- (b) Existing Buildings. Only that portion of total roof area or roof section being replaced or recovered must provide a cool roof, except as specifically exempted in Section 3.04 below.

**Section 3.03 Roof Covering Material Requirements.**

- (a) **Applicability.** Roof covering materials shall contain a minimum solar reflectance in accordance with Table 1 for a new roof, roof replacement, or roof recover of new or existing buildings containing 25,000 square feet or greater of gross floor area. Roof covering materials shall meet at least one of the values identified in Table 1; materials do not have to meet all four values.

Owners may apply for administrative approval when proposing specific roof materials not itemized or included in the below table by following the process in Section 106 of the Denver Building Code.

- (b) **Requirements**

Table 1.

	Initial Minimum Reflectance	3-Year Minimum Reflectance	Initial SRI Minimum	3-Year SRI Minimum
<b>Low Sloped Roofs</b> Slope less than 2:12				
Low Slope roofs (except materials specified below).	0.70	0.55	78	64
Low Slope metal roofs	0.50	not available	not available	not available
Low Slope concrete pavers or a concrete surface or stone roofs	0.20	not available	not available	not available
Character defining roof	See Section 3.04(a)	See Section 3.04(a)	See Section 3.04(a)	See Section 3.04(a)
<b>Step Sloped Roofs</b> Slope 2:12 or steeper				
Step Slope roofs (except materials specified below)	0.25	0.15	39	32
Clay or Concrete roof tile installed on elevated battens	None Required	not available	not available	not available
Character defining roof	See Section 3.04(a)	See Section 3.04(a)	See Section 3.04(a)	See Section 3.04(a)

- (i) Where a roof recover or roof replacement project introduces a cool roof where none previously existed, the roof shall be demonstrated, or modified, to meet one of the following designs:
  - (1) Steep sloped roofs shall be designed and installed to meet IBC 1202.2 or 1202.3 Ventilation Requirements.
  - (2) Low sloped roofs shall be designed and installed to include at least a Class III vapor retarder at the roof deck in addition to an air barrier at the roof deck, a single layer may be used to provide both preventative measures. The roof shall also be installed with insulation on top of the roof deck that exceeds the R-value of any interior insulation by a minimum of R-18 thermal insulating value, and all other requirements of the International Energy Conservation Code, as amended.
  - (3) The roofing system shall be designed by a professional roofing consultant, architect, or engineer who must submit an analysis of the existing roofing system. The analysis shall calculate and identify the dew point, and include a section-detail of the roofing system documenting the vapor retarder, air barrier and other roof components used to minimize condensation within the roof system.

**Section 3.04 Exceptions.**

- (a) Character defining roof: Where approved by the Building Official, the solar reflectance of roof covering materials for use on a character-defining roof may be reduced as is technically and financially feasible to allow the use of materials and colors in keeping with the visual character of the building.
  - (i) A submission requesting a character defining roof determination shall include the following, though the Building Official may ask for additional information:
    - (1) Roof plan (new buildings only or existing buildings if a roof plan exists)
    - (2) Photographs of the building and roof from public vantage points (existing buildings only)
    - (3) Elevations (new buildings only – as photographs would not exist)
    - (4) Demonstration of at least one of the following criteria:
      - a. The roof is or will be highly visible and contributes to the architectural identity of the building or its context.
      - b. There are certain roof features important to the profile of the building against the sky or its background, such as cupolas, multiple chimneys, dormers, cresting, or weathervanes.
      - c. The roofing material, color or patterns (such as patterned slate tile) are distinctive.

- d. The roof is identified as being an integral part of the building's character and an identified feature for any historically designated building in its designation materials. Such historical designation may be local, state or national.
    - (5) The application shall also include general information about the proposed roofing materials, color and finish, the materials' solar reflectance, and the importance of the roof in context of the building or its location.
    - (6) Any other information the Building Official requests in order to make a determination.
  - (ii) The Building Official will use the following process to determine whether a roof is a character defining roof:
    - (1) CPD staff shall review all submitted materials to determine if the above criteria are applicable and if the definition of character defining roof is met.
    - (2) The review team shall, at minimum, consist of at least three staff: a member of the Landmark Preservation team, an architectural/structural plan reviewer, and a member of the urban design team. Other staff may be consulted as deemed necessary. The team shall prepare a recommendation to the Building Official who shall have the final determination if the roof may or may not be characterized as a character defining roof.
    - (3) Upon a determination that the roof is a character defining roof, then a roofing permit may be issued using the information provided by the customer.
    - (4) Upon a determination that the roof is not a character defining roof, then the owner shall be notified and must make a resubmittal to provide roofing materials that comply with the cool roof provisions identified above before a roofing permit may be issued.
    - (5) The determination of the Building Official shall be appealable to the Board of Appeals per the Denver Building Code.
- (b) In the case of a roof recover of a non-cool roof, where the roof system analysis (item 3.03(b)(i)(3) above) determines that the existing roof would need to be replaced to control condensation, the roof section analyzed is exempt from meeting cool roof requirements.
- (c) The following roofs and portions of roofs are exempt from the requirements of Table 1:
  - (i) Portions of the roof that include or are covered by the following:
    - (1) Photovoltaic systems or components.
    - (2) Solar air or water-heating systems or components.
    - (3) Vegetated roofs.

- (4) Above-roof decks or walkways. The roof below the deck or walkway need not be a cool roof, but the deck and walkways themselves must be made of materials meeting the cool roof standard.
- (5) HVAC systems and components, and other opaque objects mounted above the roof.
  - (ii) Roof covering materials that are swimming pools, sport surfaces (such as tennis courts) and glazing.
  - (iii) Portions of the roof shaded during the peak sun angle on the summer solstice by neighboring buildings or other portions of the same building.
  - (iv) Portions of roofs that are ballasted with a minimum stone ballast of 15 pounds per square foot or, in the case of an existing ballasted roof, the weight of ballast for which the roof was originally designed.
  - (v) Up to 30% of a low sloped roof if covered by wood roof tiles certified by the Forest Stewardship Council (FSC) or by an equivalent alternative forest product certification program approved by the Building Official.
  - (vi) The solar reflectance of roof covering materials for use on a visible roof, as defined in Section 1.03 may be reduced for no more than 10% of the total roof area unless a roof is determined to be a character defining roof.
  - (vii) A roof section, as defined in Section 1.03, where not less than 75 percent of the roof covering materials comply with this Section.
- (d) Low sloped roof replacements and roof recovers over semiheated spaces as defined in ASHRAE 90.1-2022 are not required to include an air barrier or vapor retarder, but must comply with all requirements of the Denver Energy Code.
- (e) *Ancillary roof construction* up to 20% of the total roof area.

## ARTICLE IV: COMPLIANCE OPTIONS

### Section 4.01 In General.

The Green Buildings Ordinance requires new buildings and additions containing 25,000 square feet or more of gross floor area, and existing buildings containing 25,000 square feet or more of gross floor area upon a new roof or roof replacement for more than five percent (5%) of either the total roof area or individual roof section(s), to select one of the compliance methods listed in this Article IV. See Table 2 and for reference. The sections provided in this Article IV set forth the requirements associated with each compliance option. Owners may apply for administrative approval when proposing an alternate material, design or method of construction by following the process in Section 106 of the Denver Building Code.

Table 2. Compliance Options Summary

	<u>New Buildings</u>	<u>Existing Buildings</u>
Green Space Option (4.02)	X	X
Renewable Energy Option (4.03)	X	X
Energy Cost Savings Option (4.04)	X	
Building Certification Option (4.05)	X	X
Combination Options(4.06)	X	
Payment to the Green Building Fund Option (4.07)	X	X
Energy Program for Existing Buildings Option (4.08)		X

**Section 4.02 Green Space Option Requirements for New and Existing Buildings.**

(a) Coverage Requirements When Green Space Solely Provided

(i) New Buildings.

- (1) Owners who choose to provide solely either a vegetated roof or at-grade green space must provide one of the following amounts of green space:
  - a. 10% of the gross floor area of the building; or
  - b. 60% of the total roof area of the building.

(ii) Existing Buildings.

- (2) Owners who choose to provide solely either a vegetated roof or at-grade green space may choose to replace either the total roof area or an individual roof section. If the owner chooses to replace the total roof area then he/she must provide one of the following amounts of green space:
  - a. 2% of the gross floor area of the building; or
  - b. 18% of the total roof area on the building.

If the owner chooses to replace an individual roof section, then he/she must provide one of the following amounts of green space:

- a. 2% of the gross floor area of the building multiplied by the area of individual roof section being replaced; divided by the total roof area of the building; or
- b. 18% of the individual roof section being replaced.

(b) General Administration Requirements

- (i) Owners may provide required green space either with a vegetated roof, and/or at-grade green space.
- (ii) Buildings are allowed to provide more than the required green space and to allow that to count towards a future building's compliance only if that green space is located on the same zone lot or parcel, unless seeking compliance through the campus approach. Owners cannot use existing green space at their site at the time of permit for a new roof or roof replacement, unless specifically allowed in these rules and regulations.
- (iii) At-grade green space must be designed by a licensed landscape architect, or certified arborist as appropriate, who shall be responsible for ensuring that the at-grade green space is designed per the requirements of these rules and regulations.
- (iv) Vegetated roofs must be designed by a licensed landscape architect or an accredited green roof professional, unless the vegetated roof system is an approved manufactured system.
- (v) For at-grade green space, plans shall be submitted for review through the site development plan (SDP) process. Submissions shall include, at a minimum, a cover sheet including the building area calculation, site plan, and a landscape plan. Other sheets may be required to document compliance. If new lighting is being installed, then the SDP must also include a photometric plan. This SDP shall follow the typical SDP process as outlined in the zoning code. The SDP must contain the following note when green space is chosen as a compliance method for this ordinance.

At-grade green space is shown on this site development plan for compliance with Article XIII of Chapter 10, DRMC, it must be maintained, and cannot be used for purposes other than that shown on this site development plan. Should a future amendment change the amount or location of this at-grade green space, then additional at-grade green space must be provided to document compliance with Article XIII of Chapter 10, DRMC, or another compliance option must be selected.

- (vi) Landscape and vegetated roof plans shall be submitted through the site development plan and the building permitting process. Landscape and irrigation construction documents shall be submitted through the building permitting process.
  - (vii) All green space installed for compliance with this ordinance must be maintained for the life of the building. If it dies, it must be replaced or another compliance option must be chosen.
- (c) All green space must be in an outdoor space; vegetation inside a building will not count as required green space coverage.

- (d) Vegetated roofs
  - (i) General Requirements –
    - (1) Permitting:
      - a. All vegetated roofs on commercial buildings (i.e., buildings constructed to meet the International Building Code) shall require a Green Roof Construction Permit issued to a licensed Green Roof contractor.
      - b. As required by the Denver Building Code and Denver Fire Code and adopted policies, additional permits shall be obtained for related work, including, but not limited to:
        - i. General Construction
        - ii. Roofing
        - iii. Fire Protection systems
        - iv. Plumbing systems
        - v. Irrigation systems
    - (2) Code Compliance:
      - a. The design and construction of vegetated roofs shall comply with Denver Building Code and Denver Fire Code provisions and with these regulations. Where a vegetated roof is intended for occupancy, Denver Building Code and Denver Fire Code requirements for occupied roof decks shall apply in addition to the requirements for vegetated roofs.
      - b. Adopted Denver Building Code and Denver Fire Code provisions governing vegetated roofs include, but are not limited to, the following current sections and standards, which are subject to change through code adoption cycles:
        - i. IBC Sections 1503, 1505.10, 1507.16, 1507.16.1, 1607.12.3, & 1607.12.3.1
        - ii. IFC Sections 304.1.2, 317 & 905.3.8
        - iii. IPC Sections 1106 & 1108
        - iv. ANSI/SPRI VF-1 2010, ANSI/SPRI RP-14, ASCE 7, ASTM E108, ASTM E2397, ASTM E2396M-15 & ASTM E2788M-18
    - (3) Design Considerations:
      - a. Vegetative roofing systems shall be either extensive, intensive, or semi-intensive systems, and shall include:
        - i. Vegetation,
        - ii. Growing medium,

- iii. Filter fabric,
  - iv. Drainage layer,
  - v. Root barrier,
  - vi. Waterproofing membrane, and
  - vii. Other elements as required by the Denver Building Code and Denver Fire Code or this standard (insulation, tie-downs, irrigation etc.).
- b. For new buildings, where vegetated roofs are covered by renewable energy devices, the overlapping coverage areas of the vegetated roof and the renewable energy devices shall be allowed to count twice when calculating green roof coverage.
  - c. Existing vegetated roofs on existing buildings may be deemed compliant with the Green Buildings Ordinance if they meet the standards of this section.

(ii) Fire Protection

(1) Construction Materials:

- a. The fire-resistance of the structural frame and roof construction supporting the vegetative roof shall comply with the IBC. The roofing covering material shall be as required by the IBC and ANSI/SPRI VF-1 2010 (tested to ASTM E108).
- b. Vegetated roofs on buildings of Type V, IV, III, or II-B construction without a tray system shall include permit submittal design information demonstrating the alternative means for providing building ventilation during firefighting efforts and post-fire salvage & overhaul operations. Some examples of recognized methods include mechanical smoke control systems and fixed smoke/heat vents as outlined in IFC 910. An owner seeking this approval must submit an administrative modification request to the Denver Fire Department's Fire Prevention Division.

(2) Vegetated Roof Layout:

- a. Area Dividers, Firebreaks & Border Zones shall be provided as required by the IFC and ANSI/SPRI VF-1 2010.
- b. The roof shall include the following clearance zones:
  - i. For all vegetative roofing systems abutting combustible vertical surfaces, a Class A (per ASTM E108 or UL790) rated roofing system for a minimum 6-ft wide continuous border placed around rooftop structures, all rooftop equipment, and penetrations.



- ii. A 6 ft-wide area that meets Class A fire classification requirements shall divide vegetated roofs into areas not exceeding 15,625sf or 125ft in length or width.
  - iii. In buildings less than 4-stories in height, a minimum 8-foot-wide clear perimeter around the edges of the roof when exit stairways and fixed permanent ladders are not provided.
  - iv. In buildings 4-stories and greater in height, all roofs containing vegetated areas shall be afforded access via exit stairways and fixed permanent ladders to upper roofs. Access points shall be separated by minimum of 10 feet from the vegetated areas.
  - v. Vegetation shall be separated from or permitted to abut glazed building openings in accordance with Chapter 3 of the IFC.
- c. Required clearance zones shall not count towards required green roof coverage.

(3) Fire Protection Systems:

- a. Fire Protection Systems shall comply with the IFC as amended.
- b. Where the building requires a standpipe system, it shall extend to the roof. The standpipe hose outlet shall be located within 230 feet of all vegetated areas and located within the access point.
- c. In high rise buildings, activation of rooftop manual pull stations shall not activate building vertical pressurization systems.

(4) Maintenance:

- a. Maintenance shall be provided as required by the IFC. The requirement for maintenance shall be conveyed by the designer to the building owner, and it shall be the building owner's responsibility to maintain the vegetative roof system.
- b. A maintenance plan shall be submitted as part of the Vegetated Roof permit application and shall include:
  - i. A description of the maintenance and care necessary for the survival of the specified vegetation in the specified growing-media and how it will be provided.
  - ii. A plan for maintaining the design depth of the growing-medium.
  - iii. A plan for replanting the vegetated roof, in the event replanting becomes necessary.

- iv. A plan for the removal of overgrown, dead and decaying vegetation at regular intervals, not less than two times per year.
- v. A plan for the storage of combustible materials for the maintenance of the roof and compliance with the IFC for such storage.
- vi. A plan for the winterization and maintenance of irrigation systems.
- vii. Identification of IBC-compliant access to the vegetated roof and fall protection where the vegetated roof is within 10ft of a roof edge.

(5) Supplemental Irrigation:

- a. An irrigation system is required. Irrigation plans shall be submitted as part of the Vegetated Roof permit application. The system shall be designed as described in the maintenance plan as necessary for the survival of the specified vegetation in the vegetative roofing system.
- b. The vegetative roofing system shall be irrigated with an appropriate automatic system as needed. The irrigation system must include an automatic system that is controlled either by evapotranspiration controls or soil moisture sensor responsive controls.
- c. Plumbing connections shall meet Denver Building and Fire Code requirements including applicable IPC requirements.

(6) Vegetation:

- a. Vegetation shall be specified on plans and coordinated with the maintenance plan.

(iii) Waterproofing

(1) Code requirements:

- a. The roof covering materials shall be designed in accordance with the Denver Building Code, Denver Fire Code, the IBC and ANSI/SPRI VF-1 2010.

(2) Testing:

- a. When the roof cover is not impervious to root penetration, a root barrier shall be installed.
- b. Prior to the installation of the vegetative roof system, the roof's water-tightness shall be tested and a report documenting a successful test, signed by a registered roofing consultant or licensed architect or engineer, shall be provided to the building inspector for approval.

- c. Testing shall follow ASTM Standards and utilize one of the following methods:
  - i. Flood test
  - ii. Electrified field vector mapping
  - iii. Impedance test
  - iv. Infrared thermal imaging
  - v. Low voltage testing
  - vi. High voltage testing
  - vii. Moisture sensors

(iv) Roof Drainage

- (1) Code requirements: The roof-drainage system shall be designed to meet the IBC and IPC requirements and the requirements of this standard.
- (2) Design considerations:
  - a. The reference point for overflow scuppers and drains shall be clearly indicated on drawings to be the roof membrane and not the vegetated roof surface or other layer above the waterproofing.
  - b. The root barrier, vegetation, and border materials shall be designed to limit debris and to prevent the blockage of roof drains.
  - c. The roof drainage layer of the vegetative system shall be designed to improve the ability of plants in the system to survive.
    - i. Systems designed to detain water utilizing geocomposite drainage layers shall meet ASTM E2398-05.
    - ii. Systems designed to detain water with a moisture retention mat and granular drainage layer shall meet ASTM E2396M-15.

(v) Structural Design

- (1) Submittal requirements: Structural design shall comply with the IBC and the submittal requirements shall be as required for commercial construction projects.
- (2) Gravity loads:
  - a. The roof structure and deck shall be engineered to support the load of fully-hydrated growing media, the vegetative roof system, and all other design loads.
  - b. Live loads and vegetative roof loads shall be computed as follows:
    - i. The weight of all landscaping materials shall be considered as dead load and shall be computed on the basis of

saturation of the soil as determined in accordance with ASTM E2397.

- ii. The uniform design live load in unoccupied landscaped areas on roofs shall be 20psf.
- iii. The uniform design live load for occupied landscaped roofs shall be determined in accordance with IBC Table 1607.1.

- (3) Wind loads: The roofing system and the additional vegetative roof system shall be structurally designed to resist wind loads as follows:
  - a. Design meeting ANSI/SPRI RP-14 Wind Design Standard and utilizing ASCE 7 shall be considered to comply with the IBC.
  - b. Documented manufacturer testing of wind resistance for proprietary systems may be accepted by the reviewer in lieu of structural engineering, as appropriate.
  - c. For buildings over 150ft in height, the submittal shall include design by a wind design engineer or the results of a wind tunnel study.
- (4) Existing structures: Existing structures shall be demonstrated as capable of supporting added loads and, where unable to support a vegetated roof, shall be modified as required by the Denver Building Code and Denver Fire Code.

(vi) Vegetative Roofing System

- (1) Submittal Requirements: The vegetative system shall be fully specified, including the growing media and vegetation.
- (2) Growing media:
  - a. Growing media shall be specifically designed for use in vegetative roofing systems and may be composed of a combination of organic and inorganic materials complying with ASTM performance standards.
  - b. Growing media or equivalent shall be a minimum 5-inch depth. Except where demonstrated to meet Denver's vegetated roof performance criteria and approved by the Building Official.
- (3) Vegetation:
  - a. Vegetation shall be coordinated with the growing media, drainage mat, root barrier and maintenance plan.
  - b. Vegetation shall not include any noxious weeds as defined by the Colorado Department of Agriculture.
  - d. Vegetation shall be designed to cover 80% of the vegetated roof within 3 years of issuance of certificate of occupancy (TCO or CO), or be used and maintained for the purpose of urban agriculture.

- e. For roof slopes greater than 2:12, a licensed design professional experienced in vegetative roof design shall submit a vegetative system design that incorporates anti-shear measures for evaluation and approval by the Building Official.
- (4) Irrigation: Design of irrigation systems shall consider the waterproofing membrane, roof drainage systems, vegetation, growing media, drainage system and the maintenance plan.
- (vii) Additional Standards –
  - (1) The Building Official and the Green Building Technical Advisory Committee shall develop guides and performance criteria for industry use and for the evaluation of vegetated roof designs and specifications.
- (e) At-grade green space.
  - (i) Location of at-grade green space. At-grade green space may be located anywhere on the zone lot except for the roof of a building.
    - (1) New Buildings:
      - a. At-grade green space coverage provided must be above and beyond the required landscaping area as identified in the Zoning Code of the City and County of Denver or other applicable rules and regulations, unless otherwise allowed below.
      - b. For projects subject to a zoning requirement for publicly accessible open space, all or a portion of that open space requirement can be used to fulfill the green space requirement so long as it complies with the at-grade green space standards below.
      - c. Areas designed to provide water quality treatment of storm water as required by Public Works may be used to fulfill the green space requirement as long as all water quality treatment is met through a vegetated water quality facility and in conformance with UDFCD’s *Stormwater Criteria Manual* (Volume 3, Chapter 4, Factsheets T-3), and/or Public Works’ *Ultra Urban Green Infrastructure Guidelines* criteria for vegetated bioretention facilities, or current versions of these documents
      - d. Areas in the right of way will not be considered unless they can meet the following standards, and so long as the vegetation does not reduce sidewalk width below the minimum required by the Department of Transportation and Infrastructure.
        - i. A vegetated water quality facility and in conformance with UDFCD’s *Stormwater Criteria Manual* (Volume 3, Chapter 4, Factsheets T-3), and/or the Department of Transportation and Infrastructure’s *Ultra Urban Green Infrastructure Guidelines* criteria for vegetated bioretention facilities, or current versions of these documents.

- (2) Existing Buildings. Generally, at-grade green space currently in existence on the zone lot, improvements to at-grade green space currently in existence, or vegetation in the right-of-way will not count towards required green space coverage with the following exceptions:
  - a. Conversion of current green space to a new vegetated water quality facility that is in conformance with UDFCD's *Stormwater Criteria Manual* (Volume 3, Chapter 4, Factsheets T-3), and/or the Department of Transportation and Infrastructure's *Ultra Urban Green Infrastructure Guidelines* criteria for vegetated bioretention facilities, or current versions of these documents.
  - b. Trees on the zone lot added to the existing green space or provided with improved planting space to meet a level in Table 2 shall count.
- (ii) Soil. All projects shall demonstrate that they have met the following soil remediation and irrigation standards:
  - (1) Soil analysis from a local credited soil analysis laboratory with experience in local urban soils shall be required when plants are to be installed in green space. All soil remediation shall be based on the soil analysis.
    - a. Minimum soil analysis must determine soil texture and structure, pH balance, soil salinity, free lime, organic matter (OM) content, plant available nutrients, and compaction.
    - b. Depth of landscape soil analysis shall be 24in for trees and 18in for all other areas.
  - (2) Grades shall be set to allow for proper drainage away from structures. Grades shall maintain smooth profiles and be free of surface debris, bumps, and depressions.
  - (3) Shrub bed/planting areas shall be mulched to a depth of 2-4in. Perennials and groundcover areas shall be mulched with a 3in layer. No weed barrier shall be installed over top of tree root balls.
    - a. Mulch shall be an organic shredded wood mulch certified pathogen, weed and chemical free;
    - b. Surface coverage shall be a minimum 3ft radius from the trunk for trees where possible; and
    - c. Mulch shall be kept a minimum of 4-6in away from tree trunks and not touching the base of other woody landscape plants.
- (iii) Irrigation.
  - (1) All landscape plant material and grass shall be irrigated with an appropriate automatic system as needed. If applicable, then the irrigation system must meet the following:

- a. Automatic system that is controlled either by evapotranspiration controls or soil moisture sensor responsive controls; and
    - b. Shrubs and trees shall be installed on a separate zone from turf.
  - (2) Specific characteristics of available water supply including salinity shall be understood and accounted for during landscape plant material selection, particularly if reclaimed and/or graywater will be present. Salt tolerant plants shall be selected if the project team identifies conditions warranting this.
- (iv) At-grade green space options. An owner may choose any of the options below in order to satisfy green space requirements. The option must be documented within the Site Development Plan. Owners must maintain the green space.
- (1) Trees.
    - a. Projects installing trees must demonstrate on the site development plan how they will be planted with the appropriate supporting infrastructure or provide a tree protection plan detailing how existing trees will be successfully retained. Projects proposing to use trees for at-grade-green space must use green building qualified trees from the Office of the City Forester approved street tree list found at [www.denvergov.org/forestry](http://www.denvergov.org/forestry). Ornamental/columnar trees require approval from the Office of the City Forester.
    - b. All trees shall be provided with soil at least 2 feet deep, the full width of the tree planting area, extending a clear minimum of 15 feet measured horizontally in two opposing directions from the tree trunk.
    - c. All trees shall have a soil area with a minimum depth of 2 feet, with a maximum 80% proctor density compacted soil that promotes healthy root growth, meeting one of the following soil volumes or horizontal areas (when applicable) detailed in Tables 3A and 3B (depths beyond 2 feet shall not count towards volume minimums for trees planted without structural cells; depths beyond 3 feet shall not count towards volume minimums for trees planted with structural cells). Trees shall receive square footage coverage credit towards compliance in accordance with Tables 3A and 3B.

Table 3A: Tree Standards for Trees without Structural Cells

	Soil Volume per tree (Cubic Feet)	Horizontal Area of Soil per tree meeting above soil standard (Square Feet)	Coverage Credit per Shade tree (Square Feet)	Coverage Credit per Ornamental / Columnar tree (Square Feet)	Additional Requirements
Level 1	>500	>250	150	150	Not applicable
Level 2	>700	>350	300	300	Not applicable
Level 3	>1000	>500	450	-	Not applicable
Level 4	1000+	>500+	600	-	provide soil distance for root extension equal to a minimum of 15' in a minimum of three perpendicular directions from trunk

Table 3B: Tree Standards for Trees with Structural Cells

	Soil Volume per tree (Cubic Feet)	Depth of Soil per tree meeting above soil standard (Linear Feet)	Coverage Credit per Shade tree (Square Feet)	Coverage Credit per Ornamental / Columnar tree (Square Feet)	Additional Requirements
Level 1	>500	2'-3'	150	150	Not applicable
Level 2	>700	2'-3'	300	300	Not applicable
Level 3	>1000	2'-3'	450	-	Not applicable
Level 4	1000+	2'-3'	600	-	provide soil distance for root extension equal to a minimum of 15' in a minimum of three perpendicular directions from trunk

- d. Additional requirements for existing trees are as follows:
  - i. Existing canopy cover of established trees may be used instead of Tables 3A & 3B when existing trees are used for new building compliance.



- ii. An existing tree may only count towards at-grade green space if approved by the City Forester as a qualified tree (factors include: desirable species, in fair or better condition of health with sound structure for the species, free of communicable insect and disease, in a location capable of supporting the mature size of the tree, etc.) Projects seeking to use existing trees must submit supporting documentation with the site development plan to allow the City Forester to determine if the tree can qualify.
  - iii. In order for existing trees to be approved and counted towards at-grade green space, a tree protection plan shall be submitted including the following: tree location, species, trunk diameter at 4.5 feet above ground, surveyed drip line of existing tree canopy edge, and a maintenance plan to protect tree health during construction which must include continued irrigation of the tree.
  - iv. Projects proposing to use existing trees for at-grade green space must follow the City Forester tree retention and protection specifications found at [www.denvergov.org/forestry](http://www.denvergov.org/forestry).
- (2) Groundcover, Shrubs, and Xeric Grasses. In order to comply with required at-grade green space using groundcover, shrubs, or urban agriculture, the proposed vegetation must be included in one of the following resources:
  - a. “Plant Select” lists. <https://plantselect.org>
  - b. <https://conps.org/home-2/resources/gardening-with-native-plants/>;  
or
  - c. For xeric grasses see Table B-3 of UDFCD’s Urban Storm Drainage Criteria Manual (Volume 3, Chapter 4, Fact Sheet T-3) or current versions of these documents.
- (3) Turfgrass. Turfgrass may be installed in the following amounts.
  - a. 25% of the green space requirement may be met with turfgrass.
  - b. An additional 25% of the green space requirement may be met with a turfgrass, if the grass areas also provide pollution removal and volume reduction from adjacent impervious areas per UDFCD’s Urban Storm Drainage Criteria Manual (Volume 3, Chapter 4, Fact Sheet T-1 –Grass Buffer), or current versions of these documents
- (4) Areas for Urban Agriculture. The area must contain protected plant beds with soils appropriate for plants meeting the definition of urban

















method as required by the City & County of Denver: Other requirements can be found at the following URL:

[Denver Building Code and Denver Fire Code - City and County of Denver \(denvergov.org\)](http://denvergov.org)

- (iii) Additional energy savings or exceptional calculations for loads or efficiency measures that are not already addressed by the methods above, may only be claimed with prior approval by the Building Official.
- (iv) New construction projects other than additions and alterations shall be all-electric properties.

**Section 4.07 Payment to the Green Building Fund Option for New and Existing Buildings.**

- (a) An owner whose building is subject to the requirements of the Green Buildings Ordinance may choose to comply by paying an amount to the Green Building Fund. Upon the owner's request to comply through payment to the Green Building Fund, the owner must calculate the amount of green space required, and CPD shall calculate the appropriate fee to be paid to the fund. The owner must pay the applicable fee at the same time as payment of building and/or roofing permits. CPD will not issue any building permit for a new building or addition, or a roof permit for an existing building until the owner has paid the applicable fee to the Green Building Fund. Payment of a fee to the green building fund is a one-time payment, and shall be valid for compliance for the life of the building.
- (b) In cases where an owner chooses to provide required green space, or required on-site solar panels, or both, but is unable to provide the entirety of the requirement, the owner may pay the applicable amount for no more than twenty-five (25) percent of the combined green space required, or on-site solar panel coverage required, or both, but not provided, and must provide at least seventy-five (75) percent of the combined required green space coverage, or required on-site solar panel coverage, or both.
- (c) Revenue received through payments to the fund will offset the cost undertaken by the City in providing new or improved green space within the City. In selecting projects for funding, the City will strive to give priority or preference to the following:
  - (i) Low income areas that currently have less green space and trees;
  - (ii) Highest impact projects. Prioritize projects that will make substantial impacts in alignment with the uses and purposes outlined in the Green Building Ordinance; and
  - (iii) Green spaces located near the buildings that paid into the fund where feasible.

**Section 4.08 Energy Program for Existing Buildings.**

- (a) The Energy Program for Existing Buildings only applies to existing buildings for which project teams are requesting a roof replacement permit. The program provides flexible energy efficiency and renewable energy options and allows building owners to take









those projects will generate as much energy as if individual buildings on the campus had complied.

- (iii) Commitment to a deadline by which each project will be complete by and who is responsible for completing it and reporting its completion to CASR.
  - (iv) Identification of interim project steps that will be reported to track progress and deadlines by which each step will be complete and submitted to CASR.
  - (v) Plan for how the projects will be funded and financed; and
  - (vi) A protocol for continuing to monitor energy production to ensure the energy generation is realized.
- (d) CASR shall be responsible for reviewing and approving the energy master plan as well as enforcing compliance with the plan.

## **ARTICLE VI: REPORTING**

Every twelve (12) months, CPD and CASR shall prepare a written report of the activities related to, and an assessment of outcomes of, this article, and report their findings and any recommendations to the city council.

- (a) The report shall include information about the number of buildings that have selected each compliance option and the total number of cool roofs, square footage of vegetated roofs and at-grade green spaces, solar capacity installed on-site and purchased off-site, and efficiency improvements made.
- (b) The report will also characterize the effects those installations have had on improving the urban heat island, adding green space to the City, improving water and storm water management, and reducing greenhouse gas emissions.