

Denver Green Roofs – Full Text of Measure

Be it enacted by the City and County of Denver:

Section 1: The Denver, Colorado Code of Ordinances, Title I, Chapter 10, is hereby amended to include a new Article XIII:

ARTICLE XIII. DENVER GREEN ROOFS

Sec. 10-300. Definitions.

The following terms shall have the meanings indicated:

APPLICANT -The owner of a building or property who applies for a permit or any person authorized by the owner to apply for a permit on the owner's behalf.

AVAILABLE ROOF SPACE - The total roof area of the building or building addition excluding:

- A. Areas designated for renewable energy devices;
- B. Private terraces no greater in area than the floor of the abutting residential unit at the roof level; and
- C. In the case of a residential building or a building addition to a residential building, the Required Outdoor Amenity Space.

AVERAGE GRADE - The average elevation of the ground surface measured at the street property line.

BASEMENT - The portion of a building between the first floor and any floor below the first floor.

BUILDING CODE, DEVER BUILDING CODE or DBC - Means or refers to the Denver Building and Fire Code as established through the Revised Municipal Code, Chapter 10, Article II.

COMMUNITY PLANNING AND DEVELOPMENT DEPARTMENT - The Community Planning and *Development Department as established through the Revised Municipal Code, Chapter 12, Article II, Division 1.*

COMPLETE BUILDING PERMIT APPLICATION - An application submitted to The Community Planning and Development Department for an above grade building permit which complies with all technical requirements, and includes the payment of all applicable fees.



Section 0001

COMPLETE SITE PLAN APPLICATION - An application submitted to The Community Planning and Development Department for site plan approval, and includes the payment of all applicable fees and the submission of all supporting documentation as may be required.

COOL ROOFING MATERIALS - With reference to an Industrial Building or building addition, means roofing materials with a minimum Solar Reflectance Index ("SRI") of 78.

DENVER GREEN ROOF CONSTRUCTION STANDARD - The minimum mandatory standards for construction of a green roof as set out in Section 10-303 of this Article.

DENVER PLANNING BOARD - The Planning Board as established through the Revised Municipal Code, Chapter 12, Article II, Division 2.

FIRST FLOOR - The floor of a building closest to average grade.

FLOOR PLATE AREA - The total area of a floor of a building, measured from the exterior of the main wall of the floor level, including voids at the level of the floor, such as an atrium, mezzanine, stairwell, escalator, elevator, ventilation duct or utility shaft.

GRADE - The finished ground level of the land upon which the building is located.

GREEN ROOF - An extension of an above grade roof, built on top of a human-made structure, that allows vegetation to grow in a growing medium and which is designed, constructed and maintained in accordance with the Denver Green Roof Construction Standard.

GROSS FLOOR AREA - The total area of each floor level of a building, above and below average grade, measured from the exterior of the main wall of each floor level, including voids at the level of each floor, such as an atrium, mezzanine, stairwell, escalator, elevator, ventilation duct or utility shaft, but excluding areas used for the purpose of parking or loading.

HEIGHT - The vertical distance measured between a horizontal line drawn from the average grade to the highest point on the building, but shall not include the following elements located on a roof of the building:

- A. Equipment used for the functional operation of the building, such as electrical, utility, mechanical and ventilation equipment;
- B. Structures or parts of the building that are used for the functional operation of the building, such as enclosed stairwells, roof access, maintenance equipment storage, elevator shafts, chimneys, vents and water supply facilities;
- C. Structures that enclose, screen or cover the elements listed in Subsections A and B above;

Section 0001

- D. A flagpole;
- E. An antenna; and
- F. A satellite dish, provided that no part of such element shall exceed a vertical distance of 80 feet measured from average grade, and further provided that in the case of the elements listed in Subsections A, B and C above, the total area of all of those elements together shall not over more than 30 percent of the area of the roof.

HOTEL - A commercial establishment offering temporary accommodations on a daily or weekly rate to the public, and where all rooms, suites, apartments or similar forms of accommodation are owned by a single owner or entity.

INDUSTRIAL BUILDING - A building or a building addition exclusively used or designed or intended for use for or in connection exclusively with the manufacturing, producing or processing of goods, warehousing or bulk storage of goods, self-storage facility, distribution center, truck terminal, research and development in connection with manufacturing, producing or processing of goods, and:

- A. Includes office uses and the sale of commodities to the general public where such uses are accessory to and subordinate to an industrial use;
- B. Does not include:
 - 1. A building used exclusively for office or administrative purposes unless it is attached to an industrial building as defined above; or
 - 2. Warehouse clubs and retail warehouses, including commercial establishments which have as their principal use the sale of goods and merchandise in a warehouse format.

NURSING HOME FACILITY - Shall have the same meaning as that set forth in section 25-1-1002, C.R.S., and shall include nursing care facilities, whether proprietary or nonprofit, which are licensed under section 25-1.5-103 (1) (a) (I), C.R.S., or pursuant to the rules for nursing homes promulgated by the department of public health and environment.

PODIUM - The base of a building consisting of a base and a tower above the base where the base is two stories or greater.

PRIVATE TERRACE - Outdoor amenity area on a roof that is available exclusively for use by the occupants of an abutting residential unit for recreational or social activities.

RENEWABLE ENERGY - Energy obtained from solar energy or wind energy.

Section 0001

REQUIRED OUTDOOR AMENITY SPACE - An area located on the roof of a building, intended for recreational use by the residents of the building.

RESIDENTIAL BUILDING - A building or building addition where more than 60 percent of the gross floor area of the building or building addition is used, designed or intended to be used for one or more dwelling units, including accessory uses naturally and normally incidental in purpose and exclusively devoted to the residential use, but does not include a nursing home facility, retirement home or lodge, or hotel.

RETIREMENT HOME OR LODGE - A building or portion of a building which provides room and board accommodation for senior citizens.

REVISED MUNICIPAL CODE – The Revised Municipal Code of the City and County of Denver, Colorado.

ROOF - The overhead structural component of a building or a part of a building supported by walls or columns and which functions primarily to shelter the interior of the building from the effects of weather and the infiltration of water.

SOLAR ENERGY - Energy from the sun that is converted to produce electrical or thermal energy.

SOLAR REFLECTANCE INDEX - With reference to an Industrial Building or building addition, is a measurement of a roof's ability to reject solar heat, where a reference black roof (solar reflectance 0.05, thermal emittance 0.90) is 0 and a reference white roof (solar reflectance 0.80, thermal emittance 0.90) is 100.

STORY - The portion of a building, other than a basement, between any floor level and the floor, ceiling or roof immediately above it.

STREET - A public highway.

TOWER - The portion of a building above the podium of the building, where the tower portion of the building is at least 12 stories.

URBAN AGRICULTURE – The practice of cultivating and processing, herbs, fruits, flowers, and/or vegetables in a city and distributing those goods in or around the same city.

VEGETATION - Plants selected in accordance with the plant selection criteria of the Denver Green Roof Construction Standard.

WIND ENERGY - Energy from the wind that is converted to produce electrical energy.

Section 0001

Sec. 10-301. Requirements for Green Roofs.**A. Green roofs required**

1. Every building with a gross floor area of 25,000 Square feet or greater or a building addition that causes the building to become 25,000 square feet or greater constructed after January 1, 2018, shall include a green roof with a coverage of available roof space in accordance with the following chart:

Gross Floor Area (Size of Building)	Coverage of Available Roof Space (Size of Green Roof)
25,000 – 49,999 f ²	20%
50,000 – 99,999 f ²	30%
100,000 – 149,999 f ²	40%
150,000 – 199,999 f ²	50%
200,000 f ² or greater	60%

and no person shall construct a green roof or cause a green roof to be constructed unless a permit therefor has been issued by the Community Planning and Development Department. Notwithstanding the foregoing, where a development consists of two or more buildings under a Complete Site Plan Application and the buildings are to be constructed on a phased basis, the first phase of the development shall comply with the Green Roof requirements of this article for the building permit being issued and any Green Roof area provided in excess of the minimum Green Roof area required may be applied to subsequent phases of the development.

2. A combination green roof and Solar Energy collection may be used to fulfill the requirements of the Coverage of Available Roof Space as defined in Subsection A (1) so long as the combination is no less than 30% green roof and retains or collects for re-use at least the first .25 inches from each rainfall or 50 percent of annual rainfall volume falling on the roof through systems that incorporate roof surfaces.
3. Every building or building addition consisting of a tower above a podium, where no story in the tower above the podium level has a floor with a floor plate area exceeding 8,000 f², shall be permitted to provide the required green roof area on available roof space at the podium roof level or levels and the roof area of the tower shall not be considered as part of the available roof space for a green roof.
4. When an existing building or building addition with a gross floor area of 25,000 square feet or greater requires roof replacement the roof shall be built to include a combination of green roof and solar energy collection in accordance with Subsection A (2) or the maximum amount of coverage possible so that major structural alterations are not required.

Section 0001

5. In the case of an Industrial Building or a building addition to an Industrial Building with a Gross Floor area of 25,000 f^2 or greater, the provisions in Subsection A (1) shall not apply, but the building or addition shall include:

(a) a Green Roof with a minimum coverage of Available Roof Space that is equal to the lesser of 25,000 f^2 or 10 percent of the Available Roof Space of the building or addition; or;

(b) a roof that uses Solar Energy Collection for 80% of the Available Roof Space and retains or collects for re-use at least the first .25 inches from each rainfall or 50 percent of annual rainfall volume falling on the roof through systems that incorporate roof surfaces.

B. Maintenance of green roofs and health of vegetation.

Every green roof required to be constructed pursuant to this chapter shall be maintained in accordance with the maintenance plan required in the Denver Green Roof Construction Standard.

C. Permit required.

1. No person shall construct, or cause to be constructed, a green roof required pursuant to this chapter unless a permit has been obtained from the Community Planning and Development Department in accordance with the requirements of this chapter.
2. No person shall materially alter, or cause to be materially altered, a green roof required pursuant to this chapter unless a permit has been obtained from the Community Planning and Development Department in accordance with the requirements of this chapter.
3. Where a green roof is constructed in conjunction with a building or building addition, the Community Planning and Development Department may issue a single permit for the building or building addition and for the green roof.
4. Where a green roof is proposed although not required under this chapter no person shall construct a green roof or cause a green roof to be constructed unless a permit has been obtained from the Community Planning and Development Department in accordance with the Denver Green Roof Construction Standard.

D. Exemption.

1. Section 10-301(A) does not apply to a building or building addition if:
 - a. A complete building permit application has been submitted for the building or building addition prior to January 1, 2018; or

Section 0001

- b. A complete site plan application has been submitted for the building or building addition prior to January 1, 2018.
2. Section 10-301(A) does not apply to a residential building or building addition to a residential building with a height less than or equal to the greater of four stories or 50 feet.
 3. Section 10-301(A) does not apply to commercial greenhouses located at grade, temporary structures and air supported structures

Sec. 10-302. Application and Fees.**A. Application for approval.**

An application for a permit for construction of a green roof shall be made to the Community Planning and Development Department on forms, including a "Green Roof Declaration Form," that may be prescribed by the Denver Development Services from time to time. The "Green Roof Declaration Form" may require information including, but not limited to: structural design; intended use of the roof and whether or not it will be accessible to the public; and fire safety provisions.

B. Fees and charges.

1. Where an application for a required green roof is made in conjunction with an application for a permit for construction of a building or building addition there shall be no additional fee for the green roof.
2. Where an application for a permit is made for an alteration or renovation to construct a green roof, the fee for the application shall be the same as for the building permit classification.

Sec 10-303. Denver Green Roof Construction Standard**A. Purpose of Denver Green Roof Construction Standard.**

1. The purpose of the Denver Green Roof Construction Standard is to set out minimum requirements for the construction and maintenance of green roofs. The design and construction of a green roof shall meet the City's minimum requirements for green roof construction while also meeting the Denver Building Code (DBC) requirements. The Denver Green Roof Construction Standard does not replace or alter any existing DBC requirements, or define a singular code-compliant green roof design.

Section 0001

2. A designer of a green roof shall apply the measures described in this article with reference to the principles governing the DBC requirements related to each measure.
3. This article is considered an acceptable solution for the design and construction of a green roof. Designs shall meet the DBC objectives to demonstrate compliance with the DBC; however a design that complies with the provisions of Section 10-303(B) shall be deemed to comply with such objectives.
4. A green roof designed to the Denver Green Roof Construction Standard may be constructed on both combustible and non-combustible buildings.

B. Denver Green Roof Construction Standard: mandatory provisions.

The following standards shall be met in the design and construction of a green roof:

1. Green roof assembly.

A green roof assembly shall, as a minimum, consist of a root repellent system, a drainage system, a filtering layer, a growing medium and plants, and shall be installed on a waterproof membrane of an applicable roof.

2. Gravity loads.

- (a) The applicant shall calculate green roof gravity loads following the protocol provided by the ASTM standard: "ASTM E2397.05 — Standard Practice for Determination of Dead Loads and Live Loads Associated with Green Roof Systems."
- (b) The density of the growing media shall be determined:
 - i. In accordance with "ASTM E2399.05 — Standard Test Method for Maximum Media Density for Dead Load Analysis of Green Roof Systems"; or alternatively
 - ii. The designer may use an un-factored, saturated density of the growing media of 125 lb/ft³.
- (c) The applicant shall include design loads definition as part of the "Green Roof Declaration" form which shall be required as part of an application for building permit.

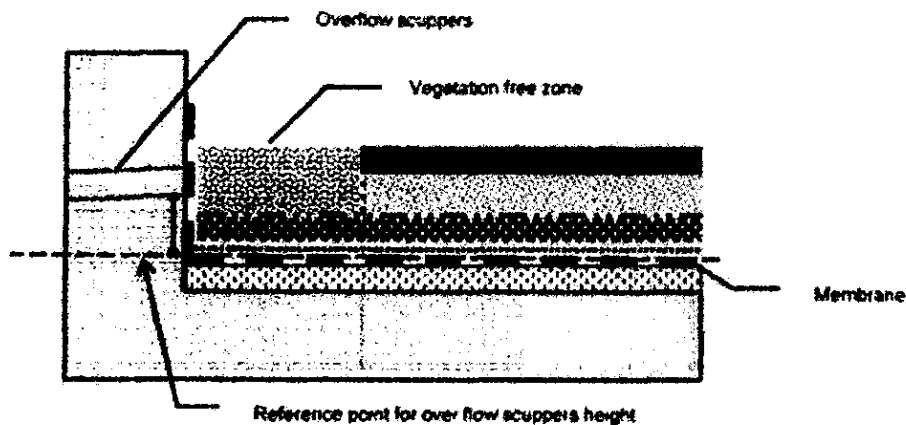
3. Slope stability.

Section 0001

All roofs with slopes in excess of 10° (17%) that support green roof assemblies shall incorporate anti-shear measures.

4. Parapet height and/or overflow scupper locations.

- (a) Parapets and scuppers shall be specified in the design, as required, to limit retained rain water loads to within structural limits in the event of obstructed internal drains.
- (b) Analysis shall be done in conformance with DBC.
- (c) The referenced point for the overflow scuppers height must be clearly indicated to avoid the possibility of confusing the overflow scupper height as being measured above the finished green surface or other layer above the waterproofing resulting in higher water load than accounted for by the design as indicated in the sketch below.



5. Wind uplift.

The applicant shall provide a report, stamped by an engineer, providing wind uplift pressures being designed for (including a description of how the pressures were determined), and describing how the design addresses these pressures.

6. Fire safety.

Where roof penetrations, intersecting walls, parapets, upturns or mechanical equipment are clad with combustible materials the design shall include a vegetation-free border zone abutting such features and the vegetation-free border shall be equal to the vegetation height at maturity but in no case be less than 1.5 ft.

Section 0001**7. Occupancy and safety.**

The applicant shall state, in a green roof declaration form and the green roof application, the use of the roof and whether or not it will be accessible to the public.

8. Waterproofing.

- (a) The design and construction shall include the installation of a root barrier in all vegetated roofing systems.
- (b) Immediately prior to installation of the green roof, the applicant shall cause to be conducted one of the following leakage testing protocols:
 - i. Flood test;
 - ii. Electric field vector mapping;
 - iii. Impedance test;
 - iv. Infrared (IR) thermal imaging;
 - v. Low voltage testing;
 - vi. High voltage testing;
 - vii. Moisture sensors;

and a report documenting a successful test, signed by an architect or engineer, shall be provided to the Community Planning and Development Department.

9. Drainage.

- (a) The design hydraulic load shall be evaluated assuming that the green roof system is fully saturated prior to the maximum fifteen-minute rainfall.
- (b) Positive slope to drain shall be provided at the level of the waterproofing membrane.
- (c) The system shall permit effective drainage beneath the growth media.
- (d) Vegetation-free zones shall be provided around all drains.

Section 0001**10. Water retention.**

- (a) Water retention mats or equivalent materials shall be employed as required to promote vegetation growth.
- (b) The drainage layer shall be appropriate for storm water retention and must be selected following "ASTM E2398-05 Standard Test Method for Water Capture and Media Retention of Geo-composite Drain Layers for Green Roof Systems."

11. Vegetation performance.

In order to support plant survivability:

- (a) When structurally possible, the growing media shall be at a minimum 4 inches; or
- (b) The applicant shall provide a report confirming that the engineered system as designed provides plant survivability comparable to that of an un-irrigated system with growing media at minimum 4 inches.

12. Plant selection.

- (a) Vegetation on a green roof shall not include any noxious weeds as defined by the Colorado Department of Agriculture.
- (b) The plant selection and design shall be:
 - i. Used and maintained for the purpose of Urban Agriculture, or;
 - ii. That within three years of the planting date the selected plants shall cover no less than 80% of the vegetated roof;

13. Irrigation.

Adequate measures shall be provided to permit irrigation necessary to initiate and sustain the vegetation during the service life of the green roof.

14. Maintenance plan.

- (a) The applicant shall develop a maintenance plan for the green roof as per which shall define programs of routine maintenance and inspection sufficient to ensure that the green roof components perform their required functions for the duration of their design service lives.

Section 0001

- (b) The maintenance plan shall address the requirements of the specified growth media and vegetation for vegetation survival.
- (c) The maintenance plan shall address re-planting, in the event that re-planting should become necessary.
- (d) The maintenance plan shall be submitted with the application for a permit for a green roof.

Sec. 10-304. Approval of Application.**A. Approval by Community Planning and Development Department.**

The Community Planning and Development Department shall approve an application for construction of a green roof that conforms to this chapter by issuing a permit in accordance with Denver Building Code, in conjunction with an application for construction of a building or structure that includes a green roof.

B. Exemption or variation of coverage requirement for a green roof by the Denver Planning Board.

1. If an applicant is unable to provide the green roof coverage as required in this chapter, application may be made to the Denver Planning Board for either a complete exemption to the requirement to provide a green roof or to provide a smaller green roof area than would otherwise be required, provided that a cash-in-lieu payment is made in accordance with this chapter, and the Denver Planning Board shall approve such application and shall notify the appropriate parties of the decision.
2. Where an application for a reduced green roof requirement is made to the Denver Planning Board, no alteration or variance to the technical standards for construction of green roofs as provided in the Denver Green Roofs Construction Standard shall be permitted.
3. Where the Denver Planning Board has approved an exemption or variance and the cash-in-lieu payment is made, the Community Planning and Development Department may issue a permit for the related building or building addition as though the applicant was in compliance with this chapter.

C. Cash in lieu of construction of a green roof.

1. Where less than the required green roof coverage than otherwise would be required by this chapter is provided, either because of a variance or exemption approved by the Denver Planning Board, the applicant shall make a payment of cash-in-lieu of

Section 0001

- construction of a green roof for the reduced or exempted area based on the average actual cost of construction of a green roof which this time shall be deemed to be \$25.00/ft.
2. The Denver Planning Board shall from time to time, and at least bi-annually, report to Denver City Council on the cost of construction for a green roof and shall recommend changes to the base sum in Sec. 10-304(C)(1) to ensure that it reflects the prevailing average actual cost of construction of a green roof.
 3. All of the funds collected as cash in lieu of construction of a green roof shall be segregated and directed to the Denver Office of Sustainability.

Sec. 10-305. Green Roof Technical Advisory Group.**A. Green Roof Technical Advisory Group.**

1. The Mayor of Denver shall appoint a chair and 10 members of the Green Roof Technical Advisory Group.
2. The Chair and members of the Green Roof Technical Advisory Group shall be appointed for a term of three years, and may be re-appointed for an additional term of three years.
3. The Community Planning and Development Department shall provide staff support, including secretariat duties, for the Green Roof Technical Advisory Group.

B. Qualifications for Chair and members of the Green Roof Technical Advisory Group.

1. Persons appointed as the Chair or as a member of the Green Roof Technical Advisory Group shall possess expert knowledge and professional qualification concerning green roof technology and have a working familiarity with the building code.
2. Membership in the Green Roof Technical Advisory Group shall be representative of various sectors including the following:
 - (a) Enforcement of regulations and administration of the building code sector including but not limited to members from the Community Planning and Development Department;
 - (b) Design sector;
 - (c) Material and component manufacturers and suppliers sector;
 - (d) Construction sector;

Section 0001

- (e) Research sector including but not limited to persons involved in green roof research and testing in a professional academic institution, school of engineering or architecture; and
- (f) Green roof industry sector being individuals working in the green roof industry.

C. Purpose of the Green Roof Technical Advisory Group.

1. The Green Roof Technical Advisory Group shall make recommendations for consideration by the Denver Planning Board with respect to:
 - (a) Technical issues relating to the creation, implementation and development of the City of Denver Green Roof Construction Standard;
 - (b) Possible amendments to the Denver Green Roof Construction Standard; and
 - (c) Take part in periodic review of the Denver Green Roof Construction Standard.

D. Recommendations of the Green Roof Technical Advisory Group.

1. The Green Roof Technical Advisory Group shall consider and comment upon the following matters in making recommendations for consideration by the Denver Planning Board:
 - (a) Policy directions from Denver City Council related to requiring and constructing green roofs;
 - (b) The City's green roof strategy;
 - (c) Consultations with stakeholders from government, industry, and the community at large;
 - (d) Technical viability of existing or proposed standards for green roofs;
 - (e) Consistency of the green roof standards with objectives of the building code;
 - (f) Impacts of the green roof standard on the interests of stakeholders and the economic feasibility of the recommendation; and
 - (g) The enforceability of the recommendation if implemented as part of the green roof standard.

E. Meetings of the Green Roof Technical Advisory Group.

Section 0001

1. The Green Roof Technical Advisory Group shall meet at the call of the Denver Planning Board and the meeting shall consider the matters set out in a meeting agenda prepared by Denver Planning Board.

Sec. 10-306. Changes to the Technical Standards.**A. Changes to technical standards.**

1. The Denver Planning Board shall periodically review the Denver Green Roof Construction Standard and, after consultation with the Green Roof Technical Advisory Group, recommend amendments to Denver City Council to reflect the City's experience with green roofs and new construction techniques and materials.

Section 10-307. Denver Planning Board to Publish Guideline.**A. Denver Planning Board to publish guideline.**

1. The Denver Planning Board shall, after consulting with the Green Roof Technical Advisory Group, periodically develop and publish green roof construction guidelines and best practices to assist designers and others to design and construct green roofs in accordance with the Denver Green Roof Construction Standard.

Section 10-308. Enforcement, Violations, and Penalties**A. Enforcement**

1. This article shall be enforced by the deputy director of the development services division of the community planning and development agency or the deputy director's designee (collectively referred to as "enforcement official"). The enforcement official is hereby empowered to enter into and cause any building, other structure or tract of land to be inspected and examined and to order in writing the remedy of any condition found to exist in violation of any provision of this article. Service of the order shall be by personal service upon the owner, authorized property management agent, agent, occupant or lessee or, alternatively, service may be made upon such persons by certified mail. If such persons are not found, the order may be served by posting in a conspicuous place on the premises, in which event service shall be deemed complete as of the moment of posting.

Section 0001

2. No oversight or dereliction on the part of the enforcement official or on the part of any other official or employee of the city shall legalize, authorize or excuse any violation of any provision of this article.

B. Violations and Penalties

1. Any person or any officer, agent, member, servant or employee thereof, or any lessee or occupant of premises who violates the provisions of this article, shall be guilty of violation thereof; and every omission, neglect or continuance of the thing commanded or prohibited for twenty-four (24) hours shall constitute a separate and distinct offense; provided, however, without affecting any penalty for a violation, no proceedings shall be instituted hereunder against an occupant who is not the owner, or against an agent, servant, employee or lessee for any violations hereof until after the expiration of ten (10) days from the date of the service of a notice by the enforcement official to cease and desist such violation, such notice to be served as provided in 10-308 (A)
2. Any person who shall be convicted of a violation of any such section shall, for each offense, be fined in a sum not more than nine hundred ninety-nine dollars (\$999.00) or imprisoned not to exceed one (1) year, or both so fined and imprisoned. Each day an offense and violation continue shall constitute a separate offense and violation. In addition to any penalty the city or any person aggrieved by any violation of this article may maintain any appropriate action to prevent and restrain the violation including an action for injunctive relief and may apply for a temporary restraining order without posting bond.

