

Late Backup

GREEN ROOF ADVISORY GROUP



INTERIM REPORT

PRESENTED TO:
THE CITY COUNCIL OF THE
CITY OF AUSTIN

MARCH 25, 2010

BY ORDER OF RESOLUTION #20090827-057

March 9, 2010

From: Green Roof Advisory Group

To: Mayor Lee Leffingwell

Mayor Pro Tem Mike Martinez

Council Member Sheryl Cole

Council Member Bill Spelman

Council Member Laura Morrison

Council Member Randi Shade

Council Member Chris Riley

Re: Green Roof Advisory Group (GRAG) Interim Policy Report

Dear Mayor and Members of the City Council:

The Green Roof Advisory Group (GRAG) is pleased to provide you our Interim Policy Report regarding credits and other incentives to promote Green Roofs in the city for your review and comment. Since your resolution on August 27, 2009 creating the stakeholder group we have developed a membership from the fields of design, development, and green building as well as local green roof organizations and the University of Texas Lady Bird Johnson Wildflower Center. Staff from Watershed Protection and Austin Energy Green Building has admirably provided group support and sponsoring council policy aides have offered direction and guidance.

Our group has explored how green (vegetative) infrastructure offers the opportunity to soften the environmental impacts of a building. Green roofs have been adopted worldwide as an innovative way to introduce important green infrastructure into urban areas. A few of the long list of potential benefits to the City of Austin Green roofs include: reduce urban heat island, reduce building energy use in both summer & winter, reduce stormwater and provide wildlife habitat. Green roofs also have a long history of improving the quality of life among urban workers and residents. Converting "dead" rooftops to living roofs provides an amenity not only for those who can access it, but also to those who can view it. Casting a blanket of green infrastructure over the rooftops of Austin could be another important element in becoming the "Emerald City."

The stakeholder group determined to divide our overall tasks into two phases. In Phase I we have been valuing green roofs within COA policy. Our efforts have included articulation of the multiple benefits of Green Roofs, research into policy initiatives of other cities, research by staff into existing incentives and credits for green roofs in city code, and efforts to promote the inclusion of Green Roofs as a Public Benefit option in the Downtown Density Bonus Plan. The Interim Report documents these efforts.

In Phase II we will determine best practices for Green Roofs in Austin. We will develop implementation priorities such as targeting areas where green roofs might make a demonstrable impact; seeking tools that will increase the available knowledge about appropriate green roofs for Austin, and encouraging appropriate technologies that support water conservation.

The **Final Report** will be presented to council in August of 2010 including a 5-year plan and policy recommendations with the goal of increasing green roofs throughout Austin. We will also make recommendations for future demonstrations and measurement of impacts to provide policy makers information on the benefits of green roofs in Central Texas.

Thank you for your commitment and support for Green Roofs in Austin. We look forward to receiving your feedback and direction for our next phase.

Sincerely,



Eleanor McKinney, ASLA, GRP
Chair



Brian Gardiner, Roofing Consultant
Co-Chair

Stakeholders

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I. Austin's Environmental Values & Green Roofs

The City of Austin strives to be the most livable city in the country. Built on a strong environmental culture, we also pride ourselves on being one of America's greenest cities. Ours is a community keenly committed to enhancing and protecting the region's quality of life. For decades, Austin's citizens and political leaders have worked to manage and direct growth and customize building standards to minimize damage to the environment associated with the built environment.

Green roofs address a broad range of issues across multiple scales, from building to site to urban infrastructure, and as such, offer unique cumulative public and private benefits in a single technology. Effectively reconstituting open green space within the building footprint, planted roofs augment the city's green infrastructure, lessen stormwater runoff, cool ambient temperatures to counteract the urban heat island effect, increase energy conservation, sequester carbon, offer an aesthetic amenity, provide wildlife habitat, and provide an opportunity to connect with nature in the heart of the city.

Green roofs are one of the most compelling ways to literally green a city, offsetting acres of hardscape given over to hard surfaces such as parking lots and streets. When linked and combined with rain gardens, green walls and screens, water features and collection, urban trees, and planted space at grade, green roofs add breadth and depth to a functioning green infrastructure system. The impact of green roofs in Austin, especially as encouraged and applied in greater numbers with appropriate local technology, stands to be far-reaching.

The Green Roof Advisory Group (GRAG) was formed in August of 2009 under the sponsorship of City Council members Chris Riley and co-sponsorship of Mayor Pro Tem Mike Martinez and council member Randi Shade to investigate policy opportunities in the City of Austin to promote and encourage green roofs. GRAG is composed of stakeholders from the design and development communities, City of Austin staff, a local green roof organization, the University of Texas, the Lady Bird Johnson Wildflower Center, the Center for Maximum Potential Building Systems, and members with diverse specialties within the field of green building. GRAG will produce a report that includes recommendations for policies, including incentives, to advance green roofs in Austin. The stakeholder group is to provide City Council with an interim progress report by February 2010, and will present a final report to City Council in August of 2010.

II. Expected Impacts

Air Quality

Green roofs prevent and absorb urban heat that can lead to increased energy-related emissions, ground level ozone formation, and CO₂ production, as well as actively absorbing carbon dioxide through the natural processes plants go through to live. Researchers estimate that a 1,000-square foot green roof can remove about 40 pounds of particulate matter (PM) from the air in a year, while also producing oxygen and removing carbon dioxide (Peck and Kuhn 2003). Forty pounds of PM is roughly the equivalent to what 15 passenger cars will emit in a year of typical driving (Highway Statistics 2004)¹. While ground level vegetation might produce a similar environmental result, green roofs take advantage of the space available in dense urban areas.

Carbon Dioxide Reduction

Green roofs have the potential to reduce building energy use, which has a massive impact on greenhouse gas emissions: Commercial buildings generate 17%, industrial facilities 28%, and residences 22% of all greenhouse gases, according to the US EPA. According to Austin Energy data, the average single family residence in Austin consumes an annual 14,900 kWh, with HVAC responsible for 4,426 kWh of use, the equivalent of 6,957 lbs. of CO₂; a green roof that reduced HVAC load by 10% would be responsible for a CO₂ emissions reduction of 695 lbs. Care should be taken to acknowledge the embodied energy and CO₂ impact of manufacturing components, transporting materials, and installing, irrigating, and maintaining green roofs. A recent Michigan State University study showed that green roof vegetation has the potential to sequester carbon dioxide, with an estimated 375 g C · m⁻² of CO₂ found to be sequestered by the study's low profile sedum green roof of 141 square feet. However, considering the number of potential variables in green roof design and context, the technology's indirect contribution to greenhouse gas reduction—through a reduction in building energy use—is more significant.

Energy Use

According to the US Energy Information Administration buildings are responsible for 48 percent of all energy used in the US

¹ This comparison assumes each car will produce 0.1g of PM per mile (based on new federal standards that would limit PM emissions to this level or lower in passenger vehicles), and that each car is driven 12,500 miles (20,000 km) in a year, which was the average mileage for a car in America in 2004.

(Architecture2030 2009), and the HVAC system (heating, ventilating, and air conditioning) in commercial and residential buildings accounts for 40 to 60 percent of that energy used (US Department of Energy 2009). Green roofs facilitate building energy efficiency by providing increased insulation and by actively cooling the air above a building through evapo-transpiration, the process by which plants process water. This natural process creates a cooling buffer of air that mitigates the transference of solar energy between the exterior and interior of a building, limiting the need for mechanical cooling, a major use in Austin's climate.

Green roofs can offer the greatest energy efficiency boost when used to replace dark roofs on large existing low-rise buildings with low insulation values and less efficient HVAC systems—buildings constructed under earlier codes with more lenient energy efficiency standards. Under more recent building codes, new buildings and replacement roofs are required to conform to higher energy efficiency standards relative to insulation and roof reflectivity, so are more likely to perform competitively with green roofs in terms of energy performance.²

Extended Roof Life

Green roofs have been demonstrated to have double to triple the lifespan of conventional roofs, a benefit that increases in areas where high summer temperatures can damage roofing materials. Materials installed above the green roof waterproofing membrane (vegetation, growing media, etc.) protect it from the effects of heat, ultraviolet radiation, foot traffic, hail and other damaging effects. Extending the useful life of a roof means that a smaller quantity of raw material is expended, landfill space is spared (roofing waste is reported to account for approximately 10 million tons of waste annually), and potential disruptions and damage due to reroofing are minimized.

² Energy use reduction is directly proportional to temperature reduction. A recent Austin study reported summer temperatures of 167°F for a black roof, 118°F for a "cool" reflective roof, and 106°F for a green roof. Heat gain is defined as

$$Q = kA \frac{\Delta T}{\Delta X}$$

where Q = heat flux, k = conductivity, A = area, T = temperature, and X = distance. As a result, highly insulated buildings have low conductivity (k) and consequently less efficiency to gain from the addition of a green roof.

Sound Attenuation

Research suggests that green roofs can prevent sound from both entering and leaving a building. Specific decibel reductions depend upon the decking used under the green roof—concrete offers the most sound attenuation value—as well as the density of the growing medium. Unlike materials such as dense concrete, wood, or drywall, green roofs are dynamic and their properties change with the addition of water. Static materials carry a constant Sound Transmission Class (STC)—a measure of the overall sound transmission loss of a layer of material—but a green roof STC (in the absence of as-built tests) is estimated based on the system's known properties (density, weight, etc.) under various moisture conditions. (Plant matter is thought to make little measurable difference in attenuating the sound frequencies of concern.) Green roofs of 10-14 inch depth (comparable to the American Hydrotech monolithic type) have been calculated to have an STC of around 50; a higher STC means less sound escapes, and green roofs have higher STCs when wet. While not necessarily applicable to all projects, research indicates that a green roof system with a 2-4 inch-thick drainage layer and 8-10 inches of soil (above membrane but not including plants) installed over a 3" thick concrete deck might have similar sound attenuation properties to a 4" concrete deck alone.

Stormwater Detention

While green roofs as they are currently conceived are not considered stormwater detention systems, testing and modeling in a variety of climates has demonstrated that green roofs can significantly retain and detain rainfall for smaller storm events—less than a 2-year storm (about 3.4 inches in 24 hours in Austin)—especially when the soil is dry. An EPA study has shown that green roofs retain about 50% of annual precipitation and an even higher percentage during summer months. The potential for this additional function over conventional roofs is promising and calls for additional experimentation with green roof designs. They might also be used as a design component to address larger storms and thus receive full or partial credit as flood detention controls for a development. Concerns remain about the lack of hydrologic control that might result from over-saturation of soils from irrigation.

Urban Amenities

Open space: As urban areas become denser, people have less access to nearby green space. With less available space, high land values and ground-level programmatic needs leave rooftops over occupied space or plazas over underground parking garages as some of the few urban areas still available to be vegetated. Accessible green roofs (both

public and private) increase the actual and perceived availability of open green space in dense urban districts.

Uses and activities: The more uses and activities a green roof can support, and the more beautiful it is, the more value it brings to a building, making it a more viable investment over the long term. Worldwide, green roofs that improve views, offer accessible areas with hardscape or furniture, or provide the potential for edible gardening have been demonstrated to increase the value, interest, and profile of their buildings. Furthermore, the more a green roof offers opportunities for use, the greater the sense of ownership gained, and the more likely an owner and users will be to care about and contribute to its health and longevity.

Real Estate Value: Most of the green roofs installed in the United States have been justified by building owners on the basis of the amenity value they provide, with the recognition that tenants value green space and are often willing to pay more for access. Property value also accrues with the presence of a distinctive building attribute that gives the building character; a green roof, well-designed and integrated into a building's program and use, offers enhanced property identity.

Urban Heat Island Mitigation

The urban heat island effect, recognized by a City Council resolution in 2001, causes city temperatures to range from 18°F to 20°F above temperatures in the surrounding countryside, and 9°F to 18°F at night (EPA – Urban Heat Island Basics). The dark impervious surfaces that have replaced vegetation in urban areas absorb and hold the sun's heat during the day, then re-radiate it at night as the surrounding air cools, raising the city's temperature along with ozone levels, energy bills, and carbon production (Akbari 2002)³. Green roofs impact the Urban Heat Island effect in several ways. Much like planting trees next to sidewalks and cemented areas, they reduce solar uptake and heat absorption, reducing the problematic re-radiation that occurs in the evening making it hotter for longer. Through the natural process of evapotranspiration, plants release water from the soil into the air resulting in temperatures that can be 4°F to 11°F cooler than the surrounding ambient air (Taha 1997). This is considerably cooler than highly reflective 'cool' roofs which range from 10°F to 20°F above

³ For each 2°F increase in temperature, Akbari (2001) states that there is a 2 to 4% rise in peak summer urban electric demand.

ambient temperature, and dark or black roofs which range from 55°F to 85°F above ambient temperature (EPA – Cool Roof Compendium).

Water Conservation/Use

With outdoor irrigation already accounting for more than 50 percent of Austin's peak-day water use, green roofs must be designed and constructed with water conservation in mind. Some municipalities institute design guidelines to ensure appropriate design of all green roofs; whether or not Austin develops such measures, for green roofs with irrigation systems, provisions for alternative water sources as well as guidelines on appropriate soil depth, native/adapted plant species, and efficient irrigation standards will be vital to ensure support of the City's water conservation efforts. Considerations should include:

1. alternative water sources (collected rainwater, air conditioner condensate, gray water),
2. growth media depth and type to increase water retention,
3. native/adapted plant species and shade-providing vegetation, and
4. efficient irrigation systems, such as drip irrigation systems which waste little water to evaporation or wind drift.

Water Quality

Green roofs are frequently assumed to provide stormwater quality benefits. Research, however, has shown that concerns remain with the export of pollutants, such as nitrogen, from the soil and fertilizers used on green roofs. Their promise as a component of water quality control likely lies in the fact that they can absorb and slow rainfall runoff better than conventional, impervious roofs, better replicating natural runoff patterns. A 2009 EPA study showed that green roofs can retain about 50% of annual precipitation, and an even higher percentage during summer months. The study concluded that to address nutrient and other potential concerns, "the green roof as a stormwater BMP should probably be integrated with other treatment techniques" rather than relied upon as a stand-alone approach. In such a system, runoff could be reduced by the green roof and any remaining nutrients or other pollutants removed by landscaped controls such as biofilters or rain gardens. In addition, over-saturation of soils significantly reduces green roofs' ability to retain rainfall, an issue that should be considered in design and maintenance. Further experimentation with soil media depth and composition; plant selection; and runoff capture and re-irrigation all hold promise to enable green roofs to help with water quality. Issuance of stormwater credit for green roofs will ultimately depend on the development of

systems that document the detention capabilities of the roofs in Austin's climate.

Well-being

Aesthetics: The current vision of Austin as a “green” city reflects the sparkling Colorado River, the shaded creek corridors, the squares, parks and open spaces, and the increasingly tree-lined Great Streets. Green roofs can add significant value to this green vision. Imagine flying into Austin over a multitude of green roofs in place of expanses of dark, hot rooftops. This is the view that some European cities now have after 25 years of concentrated effort to promote green roofs. The roof plane is a ripe opportunity for architectural and landscape design, and green roofs can enhance the visual and sensorial experience of a building. A well-designed and maintained green roof also provides welcome views from adjacent higher buildings.

Biophilia and Human Health: Biophilia, or the “the connections that human beings seek with the rest of life,” is well supported by green roofs, which capitalize on the human tendency to be drawn toward and appreciate open green spaces, adding tangible and intangible value to buildings. Studies increasingly demonstrate measurable links between humans’ access to nature and improved physical and emotional health; productivity; and childhood development of creativity. Multiple studies have shown shorter patient recovery times for those who have views or access to vegetated areas.

Wildlife Habitat

On the ground, wildlife seek food, water, places to hide, and safe places to raise young. Green roofs can help provide such habitat for wildlife that are able to access them, particularly in areas where at-grade habitat is scarce. A growing body of research suggests that the more diverse microclimates (including sunny, shady, windy, and sheltered areas and varied topography), native plant species, and local soil types and depths that are represented on a roof, the more opportunities that roof will provide for wildlife to thrive. Roofs can be designed to mimic ground-level habitats and encourage specific species to settle; conservationists are beginning to investigate the potential for green roofs to provide targeted habitat for specific types of threatened wildlife. A recent Swiss study indicates that green roofs may be able to provide food habitat and breeding habitat for ground-nesting birds, while Canadian research has shown that green roofs may encourage threatened bee species to rebound. Indirectly, the proliferation of green roofs benefits wildlife by slowing the rise of

urban ambient temperatures, improving air quality, and helping slow climate change.

III. Policy Objectives, Considerations & Recommendations

Phase I: Valuing Green Roofs within City of Austin Policy

As the above impacts show, in aggregate the effect of multiple green roofs has the potential to provide broad public benefit, particularly when considered in tandem with other green and vegetated technologies and with provisions to address water quality and conservation goals. With the formation of the Green Roof Advisory Group, the beginning steps are being taken to value green roofs within overall city policy.

In our first phase of work for this Interim Report, we have identified ways to increase the visibility within city policy of green roofs as a tool to mitigate the effects of the urban environment, as well as avenues that merit further research. Table 1 presents the group's research into ways to incentivize and otherwise encourage the use of green roofs in Austin and details the advantages, disadvantages, and City staff input for each. Some would require changes to the Land Development Code and/or to Criteria Manuals; others simply require additional clarification and education. Still others are likely more appropriate for future consideration due to the current economic climate and need for further technical data collection.

In our first step towards incentives and credits for green roofs, we have reviewed the DAP Density Bonus Plan and have recommended inclusion of Green Roofs as a Public Benefit Option (see Appendix B: Letter to City Council Advocating Addition of Green Roofs to Density Bonus Program Public Benefit Options). Currently, the Planning Commission Density Bonus Stakeholder Group is reviewing this recommendation for possible inclusion in the Density Bonus Plan.

In our Final Report, the Advisory Group will recommend policy initiatives, including incentives, with the goal of increasing the use of green roofs throughout Austin within the larger context of enhancing the effectiveness of the City's green infrastructure.

Although green roofs appear in various parts of the city code, there is no one place for a developer, planner, or homeowner to seek information about implementing the technology locally. Green roofs can, for example, contribute to achievement of an Austin Energy

Green Building rating, provide required open space, and assist in meeting flood detention requirements. However, this information is not currently emphasized. While other North American cities have instituted incentives to promote green roofs, Austin lags behind.

Phase II: Determining Best Practices

The second phase of the GRAG's efforts will be to determine implementation priorities, to include:

1. Targeting areas where green roofs might make a demonstrable impact, whether downtown, old commercial corridors, big box developments, etc. We intend to employ GIS maps and thermal imaging to support our conclusions and recommendations.
2. Seeking tools that will increase the available knowledge about and support the appropriate use of green roofs in our region, such as a dedicated city website, brochures, frontline staff education and coordination, etc.
3. Encouraging appropriate technologies and discouraging strategies inappropriate to our climate or that conflict with municipal conservation goals. Appropriate technologies might include native and adapted low water use plants, suitable soil depth, mulch, irrigation, nonpotable water sources, etc. Minimum design, construction and maintenance requirements to achieve performance goals will be considered.

Phase III: Demonstrating and Measuring Impacts

While the proposed third phase of demonstrating and measuring impacts is not within the scope of the GRAG, we will recommend methodologies to continue to monitor and provide feedback to policy makers of the benefits of green roofs in Central Texas on such items as temperature reduction, decreased run-off, increased water quality, etc.

IV. Conclusion & Next Steps

In summary, Phase I tasks during the first six months have been directed at valuing green roofs within City of Austin policy. We have defined the expected impacts of green roofs positive and negative, discovered the existing places in the code that already support green roofs, reviewed ways to modify the code to bring green roofs forward, evaluated the need for data collection on the performance of green roofs in Austin, and highlighted opportunities for making information on green roofs more accessible to the public.

In Phase II, we will direct our activities toward the following tasks:

- 
- Provide outreach to the community for information and feedback
 - Develop proposals for advancing the implementation of green roofs
 - Perform a targeting/land use study of locations and building types suited to green roofs. We will review existing tree canopy, green open space, roof availability and square footage, watershed adjacencies, and urban creek issues, among others.
 - Select types of policy to move forward, such as City of Austin planning and development policies, Austin Energy programs, and Watershed Protection and Water Conservation initiatives.
 - Develop performance-based green roof design standards appropriate to our region
 - Recommend a process for the development of construction and maintenance standards for building and site
 - Develop policy administration goals and objectives for political support, advocacy support, and marketing information.
 - Develop a framework for future standards to ensure compliance and the measurement and verification of performance.

Our goal is to bring forward a Final Report to Council in August of 2010 that includes recommendations regarding credits and other incentives to promote green roofs in Austin.

TABLE 1: Green/Vegetated Roofs vs. Reflective “Cool” Roofs

Building Attributes

Attribute	Green/Vegetated Roof	Reflective “Cool” Roof
1. Cooling Season Energy Use	Most efficient due to shading, thermal mass, evapotranspiration, water storage	More efficient than conventional roof, depending on clean roof surface
2. Requires Cleaning	No cleaning necessary.	Yes – reflectivity can be reduced significantly depending on pollutants and product discoloration. Water used in cleaning roof may need to be prevented from flowing into watershed, expense to clean roof may not be cost effective depending on roof insulation value
3. Heating Season Energy Use	Most efficient, growing media adds thermal mass and possible R value if dry	Least efficient – reflective roof has heating season penalty
4. Peak Summer Energy Load	Most efficient – peak temperature is lower than cool roof and peak temperature is delayed due to roof’s thermal mass	More efficient than conventional roof, depending on clean roof surface
5. Roof Longevity	Most efficient – waterproofing membrane is protected from direct sunlight (heat & UV), foot traffic, hail, etc.	Least efficient – cool roofs, depending on formulation and ability to withstand climate, foot traffic, hailstorms, etc.
6. Urban Heat Island	Most efficient – vegetation keeps itself cool via transpiration and shade	More efficient than conventional roof, although reflection of sunlight to other building surfaces can be detrimental
7. Aesthetics	Can be used as an amenity	Reflective roof can be obtrusive, especially if viewed from above, can be a hazard in low altitude aircraft approaches
8. Sound Attenuation	Vegetation can be designed to help with exterior urban noise reduction, mass of growing media reduces sound into the building from above	None, actually can be noisy if single-ply roof that “flutters”, thin membrane sheets reverberate sound during rainfall
9. Tax Base	Can be used as an amenity, raising tax base and increasing usable space, enhances urban landscapes and quality of life	No benefit to tax base
10. Water Needs	Needs supplemental moisture	None needed, except for

	during dry periods	periodic membrane cleaning
11. Initial Cost	Green roofs more costly	Less costly
12. Life Cycle Cost	Long-term performance of waterproofing membrane helps reduce life cycle costs, although more costly to maintain vegetation	Roof membrane life expectancy is less than protected green roof membrane

Site Attributes

Attribute	Green/Vegetated Roof	Reflective "Cool" Roof
1. Stormwater Retention/Detention	Most efficient, can be optimized for stormwater retention	Least efficient – cool roof surface actually contributes more to stormwater runoff than hotter conventional roof that evaporates moisture
2. Air Quality	Can filter particulates, help reduce certain pollutants, most efficient at cooling surrounding air	Main benefit is cooling of air, which is dependent on a clean membrane surface
3. Water Quality	Dependent on growing media, type and amount of fertilizer and water storage capacity	Water quality dependent on membrane type, could be affected by cleaning activities (see above)
4. Water Quality Events	Most green roofs capture low intensity rainfall events – those that can contain concentrated pollutants	Least efficient – cool roof can contribute runoff in low-intensity rain events, morning dew, more so than conventional roof
5. Wildlife Habitat	Vegetation can be chosen to address specific insects and birds	None

Developed by Brian Gardiner

Table 2: Potential Incentives

Potential Option	Description of Current Status/Concern	Potential Improvement	Anticipated Impacts	
			Advantages	Disadvantages
ZONING				
Planned Unit Development (PUD) Requirements: CHAPTER 25-2 Division 5				
§2.3.1.C Open Space Required (Tier 1)	Must be 10-20% of project area. Many designers are not aware this may be met using green roof.	Better educate potential development applicants that green roof may be used to meet 20% open space requirement.	Green roofs may contribute attractive, functional open spaces if designed correctly & accessible.	If green roof not accessible, then open space benefits will be lost.
§2.3.1.D PUD 2-Star Green Building Rating Required (Tier 1)	Projects with green roofs may contribute to up to 4 points on the rating scale. But many designers are not aware of this fact.	Better educate potential development applicants that green roof is means of achieving many points for one system.	Small effort to increase awareness might result in more green roof projects.	None.
		Grant additional points to and/or create additional categories for green roofs.	Further incentivize green roofs for Green Building projects.	Green roofs already given multiple points. More would be disproportionate.
§2.3.1.H Landscaping (Tier 1)	PUD must exceed standard landscaping requirements. Many designers are not aware this "over and above" landscaping may be met using green roof.	Better educate potential development applicants that green roof may be used to meet additional landscaping requirement.	Green roofs create landscapes in areas normally devoid of them.	Need to ensure that ground-level landscaping is provided per code.
§2.4 Tier 2 Options	Green roofs not explicitly part of the current tier 2 options, although they could already be counted under "other creative or innovative [environmental] measures."	Explicitly add green roof to Tier 2 list.	Further incentivize green roofs in PUDs.	Not all green roofs will provide net environmental benefits. Need to ensure minimum standards for water quality & conservation met.
§2.5 Development Bonuses ("Tier 3")	Tier 3 currently only allows affordable housing contributions in exchange for exceeding baseline for max height, FAR, and/or building coverage. Green roofs not included in section.	Add green roof to Tier 3 list.	Further incentivize green roofs in PUDs.	Bonuses at present geared toward affordable housing, not environmental or design enhancements.
Zoning Impervious Cover Limits				

Table 2: Potential Incentives

Potential Option	Description of Current Status/Concern	Potential Improvement	Anticipated Impacts	
			Advantages	Disadvantages
§25-1-23 <i>Impervious Cover Measurement</i>	Green roofs are currently counted as "impervious" and as "building cover" by code. Yet they act and perform as pervious for many social and environmental functions.	Allow increased building cover (BC) and/or impervious cover (IC) if a green roof of a certain size were provided. Increase Floor-to-Area Ratio (FAR) proportionately. [Note: NOT referring to IC as defined for water quality protection purposes. See Watershed IC below for this discussion.]	Acknowledges that green roof provides the aesthetics, open space, and social benefits sought by the zoning BC & IC limits. Would allow more site IC or BC and significantly encourage more green roofs.	Could result in heavy "massing" of buildings and IC on site. Need to ensure that intent of requiring pervious/non-building areas respected.
	Subsurface parking structures considered "pervious" if avg. soil depth is 4 feet & min. depth is 2 feet.	Soil and landscaping above a garage is a form of green roof. Explore reduction of 4-foot depth to make more technically & financially feasible.	Reduction in soil depth to reduce cost & increase green roof project feasibility.	Must ensure pervious function of area maintained.
Downtown Density Bonus Program				
<i>Code under consideration</i>	Green roofs not explicitly part of the gatekeeper requirements, although they could already be counted under Green Building.	Explicitly add green roof to gatekeeper requirements. FAR bonuses are used in Portland.	Further incentivize green roofs downtown.	Too many options may hinder the effectiveness of the program.
Open Space Requirements				
§25-2-514 <i>Open Space Requirements for Multifamily</i>	Private and, in some cases public, open space is required for many multifamily zoning categories. But it is not widely known that §25-1-21(70) defines open space to potentially include roofs. Green roofs are rarely proposed to meet open space requirements.	Better educate potential development applicants that green roof is means of meeting open space requirements.	Small effort to increase awareness might result in more green roof projects.	If green roof not accessible, then open space benefits will be lost.
Parkland Dedication				

Table 2: Potential Incentives

Potential Option	Description of Current Status/Concern	Potential Improvement	Anticipated Impacts	
			Advantages	Disadvantages
<i>§25-1-603 Standards for Dedicated Parkland</i>	The Parks director determines whether land offered for parkland dedication complies with the standards for dedication. Green roofs have not been considered for PLD but could be, especially where other available public open space is limited.	Better educate potential development applicants that a green roof may potentially be used to meet privately-owned & maintained PLD requirements.	A green roof might be the only feasible means of providing parks in built-out areas with little or no existing parkland/open space.	Some green roofs will have access and/or accessibility barriers that will make them unsuitable for use as parks.
Green Roof Requirement				
<i>Mandatory Requirement</i>	Projects are not required to build a green roof.	Require green roofs for specific building types, geographic areas, or public projects. Some form of mandatory requirements used in Tokyo, Chicago (projects receiving public assistance), and Portland (city-owned facilities).	Ensure green roofs used in projects.	Green roofs not necessarily warranted or feasible for every project. Overly prescriptive.
ENERGY CONSERVATION, AIR QUALITY & CLIMATE PROTECTION				
<i>Energy Code</i>	Austin Energy Code requires a high reflectivity for flat roofs. Exception: vegetated roofs or rooftop pools.	Define vegetated roof.	Definition of what constitutes a vegetated roof will help plan reviewers assure high performance.	Difficult to strictly define.
<i>Austin Energy (AE) Rebates associated with Green Roofs</i>	Existing Roof rebate: AE rebates \$0.15/sq ft for applying reflective coating on an existing dark roof.	Provide the same \$0.15/sq ft rebate for replacing a dark roof with a green roof.	Potential reduction in consumption & peak energy demand.	When replacing an existing roof, the new roof must meet energy code by providing a high reflectivity or green roof and AE can not justify paying a rebate for meeting and not exceeding code requirements. \$0.15/sq ft is an insignificant incentive when considering the cost of green roofs.

Table 2: Potential Incentives

Potential Option	Description of Current Status/Concern	Potential Improvement	Anticipated Impacts	
			Advantages	Disadvantages
<i>AEGB ratings associated with Green Roofs</i>	All Austin Energy Green Building (AEGB) rating systems promote green roofs within the rating points: * BR3 Roofing to Reduce Heat Island * S6a Site Development Protect or Restore Open Areas * S6b Site Development Maximize Vegetated Open Area * S7b Additional Heat Island reduction - Roof	Grant additional points to and/or create additional categories for green roofs.	Further incentivize green roofs for Green Building projects.	Green roofs already effect multiple points. More would be disproportionate.
<i>AE Urban Heat Island Mitigation Program</i>	Urban Heat Island Mitigation funds for tree planting; not yet available for green roofs; community not aware green roofs can address rising urban temperatures.	Create educational outreach campaign & monetary incentives/rebates for green roofs.	Green roofs provide more urban heat island mitigation than other roof types. Increased cooling of surrounding environment benefits community and local ecosystem.	Cost-benefit ratio for funding green roof may not merit expenditure for developers or owners who are only concerned with their site and not its impact on the larger community environment.
<i>Air Quality</i>	Green roofs help lower urban temperatures & reduce occurrence of ground-level ozone; vegetation also reduces particulate matter in the air. But many developers & policymakers are not aware of this fact.	Create educational outreach campaign & monetary incentives/rebates for green roofs.	Increased energy use and higher urban temperatures increase the production and incidence of ground level ozone formation. Green roofs can reduce energy use & lower urban temperatures. They can also remove particulate matter from the air.	Cost-benefit ratio for funding green roof may not merit expenditure for developers or owners who are only concerned with their site and not its impact on the larger community environment.
<i>Austin Climate Protection Plan</i>	Carbon reduction achieved through energy savings, and carbon sequestration.	Direct carbon reducing funding from Green Fund to new green roof incentives and/or rebates for new and existing roofs.	Funding would help incentivize citizens to take that next step in energy conservation. Green roofs (on average) have been shown to reduce energy use and can sequester carbon.	Green roofs take energy to create and if poorly designed can consume large amounts of energy through its lifetime (i.e. potable water).

Table 2: Potential Incentives

Potential Option	Description of Current Status/Concern	Potential Improvement	Anticipated Impacts	
			Advantages	Disadvantages
WATERSHED PROTECTION				
Flood Control				
DCM 8.3.4.J Parking Lot Detention	Flood detention requirements may be met on a site using "parking lot detention." This method may not be widely known to design professionals and could be employed on a roof.	Better educate potential development applicants that parking lot detention is an option and could be used in conjunction with a green roof.	Saves space on the site to combine the detention footprint on the roof rather than have a separate roof and flood detention pond.	Additional weight of stored water on roof likely to dissuade use of this practice. But may be helpful for parking garages with heavy-duty structural supports.
Water Quality (WQ) Structural Control Requirements				
ECM 1.6.7 Innovative Water Quality Controls	Green roofs not considered an approved water quality control for use to meet on-site WQ requirements.	Develop criteria in ECM to allow use of green roof to meet WQ requirements.	Creates significant incentive to building green roofs: land and resources for separate WQ control reduced or not required.	Green roof technology not proven in Austin climate to perform as a stand-alone WQ management practice.
		Industry demonstrates that green roof technology can meet water quality requirements.	Same as above. But also does not require City resources.	None to City of Austin. Requires research expenditure on part of green roof industry.
	Green roof could be used as area for re-irrigation of captured stormwater. Not widely known in design community.	Allow green roof systems to be used for re-irrigation component of retention-irrigation systems.	Creates incentive to building green roofs: land and resources for separate WQ control reduced or not required. No further code or criteria modifications required. Re-irrigation systems help address water conservation concerns.	Potentially high export of nutrients and high use of potable water need to be prevented. Green roof area may not be large enough to accept all water, requiring supplemental irrigation area (e.g., other landscaping).
	Biofiltration or other water quality control could be integrated into green roof design. Not widely known in design community.	Incorporate a biofiltration or rain garden (or other approved) system into a green roof design.	Allows water quality requirements to be met in conjunction with green roof with no further code or criteria modifications.	May be more difficult to maintain and inspect a WQ control on a roof. Greater media depth may be structural or financial burden.
Watershed Impervious Cover (IC)				

Table 2: Potential Incentives

Potential Option	Description of Current Status/Concern	Potential Improvement	Anticipated Impacts	
			Advantages	Disadvantages
§ 25-8-63 <i>Impervious Cover Calculations</i>	Green roofs are considered "impervious" just like conventional roofs, despite their ability to absorb and retain rainfall.	Change code to make green roofs (with a minimum media depth) to be considered "pervious." Allow increased impervious cover (IC) if a green roof of a certain size were provided, e.g., allow 5% additional IC if a green roof with 10% of the site area were provided.	Creates significant incentive to building green roofs: increases functional level of impervious cover allowed.	Green roof technology not proven in Austin climate to perform as natural pervious soils. Issues: (1) typical Green roof soil depths result in more runoff than natural soil profiles; (2) irrigation leads to saturation & thus runoff more like a conventional roof; (3) fertilizers & other landscape products used to care for the Green roof may lead to increased pollutant loads; and (4) lack of connectivity with ground-level soils prevents contributions to groundwater & creek baseflow.
	Green roofs considered "impervious" just like conventional roofs; resulting calculations for water quality control sizing may overstate the amount of runoff and control size required.	Change code to discount a portion of the green roof area for purposes of sizing WQ & flood controls depending on the soil depth and system storage capabilities.	Resulting water quality controls will be smaller and less expensive and will reflect the reality of the site's hydrology.	Increases complexity of oversight to permit. May require monitoring and modeling to confirm assumptions granting discount are justified.
Drainage Utility Fee				
<i>Stormwater Drainage Fee Reduction</i>	Green roofs are considered "impervious" for purposes of calculating the Drainage Utility Fee.	Discount a portion of the green roof area for purposes of calculating the Drainage Utility Fee. Portland, Minneapolis, Seattle & Munster (Germany) use some form of stormwater drainage fee credit.	Further incentivize green roofs. City already provides a discount for proper maintenance of approved water quality controls.	Provides less funds for Drainage Utility. Green roofs need further design improvement to qualify as water quality components (see Innovative WQ Controls above).
FINANCIAL INCENTIVES				
<i>Subsidies, Grants, Low-Interest Loans</i>	City does not provide any funding for green roofs.	Provide funding (e.g., subsidies, grants, low-interest loans) for green roofs. Chicago, Montreal, Toronto, & cities in Germany & Switzerland provide some form of funding for green roofs. Portland provides up to \$5 per sq ft for green roofs that provide stormwater management as part of their Grey to Green initiative.	Further incentivize green roofs.	Economy in recession: funds not likely available at present. Need to justify why money to be spent on green roofs and not other options.

Table 2: Potential Incentives

Potential Option	Description of Current Status/Concern	Potential Improvement	Anticipated Impacts	
			Advantages	Disadvantages
<i>Development Process Incentives (Fee Waivers, Expedited Process, Design Support)</i>	City does not provide development process incentives for green roofs.	Provide development process incentives (fee waivers, expedited process, design support) for green roofs. Chicago & Washington D.C. offer expedited review & permit process. Chicago also provides a dedicated review team and fee waiver.	Further incentivize green roofs.	More complicated for Development Review while receiving less money through fees.
<i>Local Improvement Credits</i>	City does not provide local improvement credits (municipality offers loans for upfront improvement costs and is reimbursed through property taxes over time) for green roofs.	Provide local improvement credits for green roofs. Similar to City of Austin program currently proposed for solar panels.	Further incentivize green roofs. Shifts cost of green roof off of developer and onto owner (who is receiving long term benefits - e.g., energy savings).	Economy in recession: funds not likely available at present. Need to justify why money to be spent on green roofs and not other options.
<i>Property Tax Credit</i>	City does not provide property tax credits for green roofs.	Provide property tax credits for green roofs. New York City offers a one-year property tax credit of up to \$100,000.	Further incentivize green roofs.	City receives less property tax revenue. May be difficult to justify in time of economic recession. Need to justify why money to be spent on green roofs and not other options.
OVERALL CONSIDERATIONS				
In order to receive credits for the above (open space, zoning impervious cover, water quality, etc.), the following considerations must be adequately addressed:				
* Water Conservation/Potable Water Use * Integrated Pest Management (IPM) * Minimum soil depth * Minimum green roof size (building coverage) * Suitable plant species * Maintenance/assurance green roof continues to exist in adequate condition				

RESOLUTION NO. 20090827-057

WHEREAS, green roofs, as a component of green infrastructure, can conserve energy, mitigate stormwater runoff volume, provide wildlife habitat, and reduce the urban heat island effect; **NOW, THEREFORE**,

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF AUSTIN:

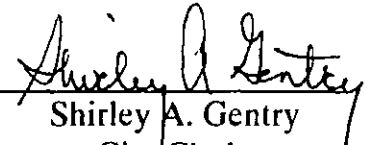
The City Manager is directed to convene and work with a green roofs stakeholder group to explore the feasibility of offering energy and stormwater credits and other incentives, based on performance, to encourage the creation of green roofs in the City.

1. The stakeholder group shall produce a policy report that includes recommendations regarding credits and other incentives to promote green roofs in the City.
2. The stakeholder group shall work with City staff.
3. The stakeholder group shall provide Council with an interim progress report on or before February 25, 2010 and shall present a final report to Council on or before August 26, 2010.
4. The stakeholder group shall be drawn from the fields of design, development, and green building, and include input from local

green roof organizations and the University of Texas at Austin's
Lady Bird Johnson Wildflower Center.

ADOPTED: August 27, 2009

ATTEST:


Shirley A. Gentry
City Clerk

APPENDIX B: Letter to City Council Advocating Addition of Green Roofs to
Density Bonus Program Public Benefit Options



City of Austin

Founded by Congress, Republic of Texas, 1839
P.O. Box 1088, Austin, Texas 78767

October 14, 2009

From: Green Roof Advisory Group

To: Mayor Lee Leffingwell

Mayor Pro Tem Mike Martinez

Council Member Sheryl Cole

Council Member Bill Spelman

Council Member Laura Morrison

Council Member Randi Shade

Council Member Chris Riley

**Re: Downtown Austin Plan – Density Bonus Program
Addition of Green Roofs to Density Bonus Program Public Benefit Options**

Dear Mayor and Members of the City Council:

The Green Roof Advisory Group (GRAG) requests that Council **add Green Roofs to the DAP Density Bonus Program Public Benefit Options**, as a separate option with its own criteria. This request is the outcome of the initial efforts of GRAG to research and develop a policy report that includes recommendations regarding credits and incentives to promote green roofs in the city. The group is working with Watershed Protection and Austin Energy to develop performance based standards for green roofs that would establish base lines for consideration.

Green Roofs address a broad range of issues across a breadth of scale, from building to site to urban design, and as such, offer a unique combined Public Benefit in a single technology. As downtown Austin becomes denser, green roofs mitigate the combined negative effects of the built environment. Effectively reconstituting open green space within the building footprint, planted roofs augment the City's green infrastructure, mitigate stormwater runoff, cool ambient temperatures to counteract the urban heat island effect, increase energy conservation, sequester carbon, offer aesthetic amenity, provide wildlife habitat and an opportunity to connect with nature in the heart of the City. The cumulative impact of green roofs in downtown Austin, especially as encouraged and applied in greater numbers with appropriate local technology, stands to be far-reaching.

The Density Bonus Program for the Central City of Portland includes options that incentivize Green Roofs for the benefit of publicly accessible on-site open space and for stormwater management. In Chicago's Density Bonus Program, Green Roofs are promoted to mitigate the effect of the urban heat island and air quality. GRAG is looking to these and other established density bonus programs for criteria and standards relating to green roof design and construction.

At this point, we propose the following Bonus Provisions for Green Roofs in the DAP Density Bonus Program comparable to Portland and Chicago:

- 3-5 s.f. of bonused floor area for each s.f. of green roof (planted roof is a min. of 50% of building footprint)

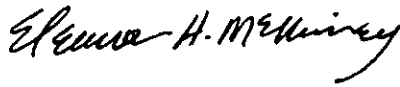
The current DAP Density Bonus Program proposes Publicly Accessible Open Space as a Public Benefit Option with 5 s.f. of Bonused Floor Area for each 1 s.f. of eligible open space with a 1200 s.f. minimum. However, non-publicly accessible green roofs that would mitigate the urban heat island and provide stormwater management would not fit under this option.

*The City of Austin is committed to compliance with the Americans with Disabilities Act.
Reasonable modifications and equal access to communications will be provided upon request.*

The Austin Energy Green Building (AEGB) one-star rating system has been proposed as a gatekeeper requirement and additional density may be obtained through projects achieving a two and three-star AEGB rating. While the AEGB currently offers points for vegetated roofs, costs associated with this option (with no added incentives) in comparison to a reflective roof or other green building measures effectively mean that the vegetated roof option is rarely chosen.

Therefore, we believe that a separate Green Roof Public Benefit Option is necessary to promote Green Roofs in the Downtown area for all of the reasons described above. Thank you for consideration of this request. We are willing to assist you in whatever manner is deemed appropriate to add Green Roofs as a Public Benefit in the DAP Density Bonus Program.

Sincerely,



Eleanor McKinney, Chair



Brian Gardiner, Co-Chair

cc:
City Manager Marc Ott
Asst. City Manager Sue Edwards
Asst. City Manager Rudy Garza
City Clerk, Shirley Gentry

APPENDIX C: Brief Overview of Green Roof Credits and Incentives in North America

Boston

- Rebate of \$5.00/sf up to \$100,000

Chicago

- Climate Action Plan for 6,000 green roofs by 2020. Over 2.5 million sf of green roofs installed to date in institutional / commercial arena.
- Green Roof Grant Program – up to \$5000 to residential and small commercial projects
- Density Bonus

Cincinnati

- Low interest loans for Green Roofs

Washington, D.C.

- Rebate of \$5.00/sf up to \$20,000

Minneapolis

- 50% stormwater credit for strategies that increase quality of runoff
- 50% to 100% credit for strategies that decrease quantity of runoff

New York

- Tax Credit Incentives

Philadelphia

- Tax credit of 50% discount on stormwater charges for residences and businesses

Portland, OR

- All new City-owned buildings must have a green roof that covers at least 70% of the roof.
- Density Bonus
- 100% discount of site fee or 35% of total stormwater discharge fee based in management of roof runoff

Tempe, AZ

- Green vegetated desert roof counted toward LEED. (While this is not a city program, the green roof was installed on a city building.)

Toledo, OH

- Maximum credit of 50% for non-residential

Toronto

- Eco-Roof Incentive Program provides funding for qualifying green roof projects of \$50 per square meter, up to a maximum of \$100,000.
- Green Roof By-law requires all new institutional and commercial buildings to have green roofs. Graduated coverage chart applies.

Vancouver

- Density Bonus
- Credit for reduction of stormwater if integrated into Stormwater Management Plans
- Sewer System Fee Reduction
- Mandated requirement on 25% of roof areas in new sustainable development area

Virginia

- Reduction in permit fees
- Rate incentive based on stormwater reduction

Prepared by Eleanor McKinney, RLA, GRP

APPENDIX D: Resources

Air Quality

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U.S. Department of Transportation Federal Highway Administration. "Annual Vehicle Distance Traveled in Miles and Related Data-2004." Highway Statistics 2004. October 2005. Retrieved October 19, 2007 from www.fhwa.dot.gov/policy/ohim/hs04/htm/vm1.htm.

Carbon Dioxide Impact

US EPA Fast Facts. Available from:

http://www.energystar.gov/ia/business/challenge/learn_more/FastFacts.pdf

Getter, Kristin L., Bradley Rowe, Phillip Robertson, Bertm Cregg, and Jeffery A. Andresen. Carbon Sequestration Potential of Extensive Green Roofs. Michigan: Michigan State University. 2009.

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Sound Attenuation

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Miller, Charlie. "Green Roof Benefits." Available from:

www.roofmeadow.com/technical/publications/Benefits.doc

Steve Skinner at American Hydrotech, personal communication 2.15.07 (800-877-6125)

Sky Garden Green Roof Systems, British Columbia.

http://www.greenrooftops.com/Planning_Sound.aspx

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through the CMHC website at: http://www.cmhc-schl.gc.ca/en/imquaf/himu/himu_002.cfm

Henderson, Beau, "Human-Driven Extensive Green roof Design." Masters Thesis, Landscape Architecture, Virginia Polytechnic Institute & State University, 2003.

Peck, Steven W. et al. "Greenbacks From Green Roofs: Forging A New Industry In Canada." Report for Canada Mortgage and Housing Corporation, March 1999.

Stormwater Detention

US EPA, *Green Roofs for Stormwater Runoff Control*, EPA/600/R-09/026, February, 2009.

Urban Amenities

Add Portland Hamilton West Condos and Vancouver Fairmont Waterfront hotel herb garden

Urban Heat Island Mitigation

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EPA – Urban Heat Island Basics Compendium.

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EPA – Cool Roof Compendium.

<http://www.epa.gov/heatisland/resources/pdf/CoolRoofsCompendium.pdf>

Water Quality

US EPA, *Green Roofs for Stormwater Runoff Control*, EPA/600/R-09/026, February, 2009.

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-- "The Nature of Human Nature," from *Biophilic Design* by Kellert, Stephen R., Heerwagen, Judith H. and Martin L. Mador, Wiley 2008, p. 23.

"Biophilia in Practice: Buildings that Connect People with Nature", *Environmental Building News* July 2006, reprinted with permission on AIA website:

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Valuing Green Roofs
Austin Energy Green Building
<http://www.austinenenergy.com/Energy%20Efficiency/Programs/Green%20Building/index.htm>