Decision Table E. Green Building Standards – Carryover from January 10, 2017

Comments on the Bird Safe Glazing Standard and Eco roof standard are grouped into this packet. Additional memos provide more context.

Contents of Decision Packet E:

- Decision Table E
- Memo E3 – Bird Safe Glazing
- Memo E5 – Ecoroofs

Items Marked for Discussion:

Items E3 and E5

Ref #	Comment #	Commenter(s)	Topic	Proposed draft	Request(s)	Staff recommendation	Staff rationale	Discuss?	PSC decision
E3 **and** **Memo E3**	20324, 20481, 20688, 21004, 21005, 21014	Staci Monroe-- Bureau of Development Services, Jeanne E Galick Bob Sallinger—Audubon Society of Portland Karina Adams Alan Armstrong Mary Coolidge- Audubon Society of Portland	Bird Safe Glazing standard	Standard requires bird safe glazing in the areas shown on Map 510-22. Ninety percent of windows on first four floors must be treated. A list of options for fritting, UV coating, films and screens are provided. **References**: Volume 2A, Part 1: Central City Plan District, Pages 142-144 and Map 510-22, Page 397-399.	1. Expand area where standard applies to entire Central City to align with Pacific Flyway and ease of implementation. Current map and rationale for selecting areas of high tree canopy makes for a very complicated map and tree canopy will change over time. 2. Calculating the bird-safe protections against the Ground floor windows requirements is cumbersome and conflicts with the standard. These regulations should only apply to the levels 2-4 above the ground floor. 3. Consider adding a drawing to the code to show types of patterns and dimension to eliminate some of the complex measurement language.	**Proposed Amendments:** **1. Apply standard to the entire Central City. This removes the need for a map in the zoning code. Add a threshold to the standard. Any building with more than 30% exterior glazing (per façade from 0 to 60 feet measured from the sidewalk) must meet the standard. See attached memo for more detail.** **2. Identify specific bird safe patterns for the ground floor to ensure transparency including a UV coated and lighter fritting pattern. BPS will create an Administrative Rule to update approved glazing patterns and types of glass.** **3. Add an illustration to the standard to show the minimum required spacing and types of patterns that may be used. Also clarify the patterns and measurements that are allowed.**	1. BPS Staff agrees that the proposed draft map may be challenging to implement and would need to be amended to allow for changes in tree canopy over time. Staff proposes to apply the standard Central City-wide and maintain some exemptions, including for historic or conservation resources and single family residential development. Based on discussion with bird safe experts, staff believes 30% is an appropriate threshold. Staff has chosen to recommend 30%, the higher end of the recommended range. See attached memo for more detail. 2. Staff proposes to limit the types of glass available for use on the ground floor to ensure that new development includes high-transparency ground floor windows that encourage a vibrant pedestrian experience. A new Administrative Rule will allow staff to update glazing standards and keep up with quickly changing technology. 3. Staff agrees that a drawing to show the dimensions will help clarify the complex language. Also, staff needs to clarify in the code which measurements apply to glass and what applies if alternatives such as netting, louvres or mullions are used.	☒	☐ Support staff rec. ☐ Other

Ref #	Comment #	Commenter(s)	Topic	Proposed draft	Request(s)	Staff recommendation	Staff rationale	Discuss?	PSC decision
E5 **and** **Memo E5**	 20466 20499 20506 20560 20663 20688 20698 20945 20950 20993 20994	BDS, BES, BPS Staff Tom Liptan NAIOP CEIC Land Use Committee GRIT Downtown Development Group Bob Salinger- Audubon Jonathan Malsin Brad Malsin Amy Chomowitz Susan Lindsay Elizabeth Hart	Ecoroof standard	Standard requires ecoroofs on new buildings in the CX, RX, EX, and IG1 with a net building area of at least 20,000 square feet. Sixty percent of the building's roof area must be covered by an ecoroof. **References**: Volume 2A, Part 1: Central City Plan District, Pages 154-155.	1. Strengthen language in purpose statement to include more benefits of an ecoroof. 2. Add stairwell enclosures to list of items exempt from the calculation of the roof area. 3. Update code language to require ecoroofs to cover 90% of roof tops and reduce threshold for standards to be based on a 5,000 sq.ft roof tops and higher. 4. Update code language to require ecoroofs on 10,000 sq ft roof top and 75% coverage. 5. Rooftops need to be for amenities such as trees, gardens, patio space. Stormwater can be addressed other ways. 6. Restore BES ecoroofs incentive program and keep the ecoroofs bonus. 7. Ecoroofs have considerable cost impacts at time of construction and on-going maintenance. White or cool roofs should be considered as an alternative to ecoroofs.	**Proposed Amendments:** **1. Add language to the purpose statement that identifies additional benefits including reducing urban heat island and improving air quality,** **2. Update list of items exempt from eco roof calculation to include stairwell enclosures.** **3 -7: Retain proposed draft version.** **See memo E5 for more detail on BES research on implementing the proposed requirement and a cost comparison between a conventional roof and an ecoroof**.	1-2. Staff agrees that the purpose statement should be strengthened by adding additional benefits. Staff is adding stairwell enclosures as part of the list of exemptions. These may be necessary as part of required building evacuation routes. 3-5. Staff is not proposing to increase the percent coverage on the rooftop because BPS and BES believe the 60% coverage requirement provides adequate space to meet some stormwater management requirements while also reducing urban heat island effects and providing habitat for birds, plants and pollinators. The remaining 40% of roof area may accommodate other uses such as patios, gardens and architectural details that are not suitable for ecoroofs. 6.The ecoroof FAR bonus and BES incentive program have already been eliminated. The Central City bonus system is now focused on affordable housing development. 7.Ecoroofs typically have higher up-front costs than conventional roofs, but provide multiple benefits to the property owner and the public over the life of the roof. In addition, ecoroofs extend the life of the roof membrane, protecting it from sun exposure and extreme temperatures. Staff research shows that white and cool roofs are not very effective in the wet and cool Pacific Northwest climate. Maintenance costs are high, with a need to remove moss and algae that accumulates during rainy months. Also, ecoroofs have multiple benefits whereas cool roofs and blue roofs typically only provide energy efficiency benefits.	☒	☐ Support staff rec. ☐ Other

CITY OF PORTLAND
ENVIRONMENTAL SERVICES

1120 SW Fifth Avenue, Room 1000, Portland, Oregon 97204 ▪ Nick Fish, Commissioner ▪ Michael Jordan, Director

TECHNICAL MEMORANDUM

Date: December 12, 2016

To: Sallie Edmunds, Rachael Hoy

From: David Helzer

CC: Marie Walkiewicz, Marc Asnis, Paul Ketcham, Kaitlin Lovell

Re: CC2035: Technical Elements of Proposed Bird Safe Standards

Collisions with windows are estimated to kill between 365 and 988 million birds per year in the United States. In terms of anthropogenic threats to birds, window collisions are second only to feral and free-ranging domestic cats as a cause of direct mortality. Local studies in Portland by Audubon Society of Portland and Environmental Services have documented the mortality threat is real here in the city's built environment. Songbirds are most at risk, as opposed to other avian species groups.

The proposed Bird Safe Exterior Glazing Standards in the CC 2035 Plan District address this threat to native bird populations, many species of which are in serious decline. It is estimated from 2% to 9% of the entire North American bird population dies annually due to collisions with windows. The highest risk occurs where vegetation is found adjacent to reflective glass.

This memorandum summarizes key findings and recommendations to inform the proposal. These are based on a literature review, local studies of bird window strikes, consultation with local and national experts, and best professional judgment. Key findings and recommendations are:

1. Neotropical migratory songbirds, such as warblers, thrushes, and vireos, are disproportionally affected by window collisions, and as a group are a priority for conservation locally and nationally.

2. Large surface areas of glass cause more strikes than smaller surface areas of glass.

3. The highest risk on a building façade is the first 60 vertical feet because the majority of bird activity (including migrating birds) occurs in this zone and due to the presence of adjacent vegetation (trees and shrubs). **Bird safe glass treatment should prioritize this 60-foot zone**, including the ground level.

4. BPS has identified a need to set the zoning standard based on a threshold for the percentage of glazing on a building façade. Façades that exceed that percent would be required to use bird safe glazing in the first 60 feet of height. Based on findings in peer reviewed studies and consultation with leading national experts, **there is a sound scientific basis for setting the trigger at 20-30% glazing** in the first 60 vertical feet.

    a. Borden et al. found a statistically significant increase in strikes on facades with >31% glazing (excerpt from paper attached).

    b. Dr. Daniel Klem, a leading national researcher, recommends 20% for CC 2035, based on his research (correspondence attached).

    c. Keith Russel, another expert, recommends 25% for CC 2035.

5. **The standard should apply to the entire CC 2035 Plan District**. Proposed map 510-22 is not a realistic representation of bird window collision risk in the CC 2035 District, for these reasons:

    a. The map is not based on location data for documented bird strikes, rather on existing vegetation (> 1 acre); its assumptions about the risk of bird window collisions are not consistent with bird behavior and distribution in the central city.

    b. Resident and migratory birds are found throughout urban landscapes and are not limited to areas with one acre or larger patches of vegetation. In fact, neotropical migrant songbirds, such orange-crowned warblers or yellow-rumped warblers, are conspicuous for their use of isolated, tiny, or unexpected vegetation patches. Examples includes downtown sidewalk landscaping or small street trees on a block dominated by impervious surfaces and glass.

    c. The map is based on existing tree canopy conditions. City of Portland policies, programs and regulations actively encourage an increase in the presence, size and canopy coverage of trees throughout the Central City. As a result, the location and extent of tree canopy coverage is expected to increase over the life of the CC 2035 Plan and over the expected life cycle of the buildings that will be constructed under the new zoning requirements.

ORNITHOLOGICAL LITERATURE REVIEWED (partial list, focused on research related to the correlation between the percentage of glazing and risk to birds):

Bayne, Erin M., Corey A. Scobie and Michael Rawson, 2012. Factors influencing the annual risk of bird–window collisions at residential structures in Alberta, Canada. Wildlife Research

Borden, W.C., O.M. Lockhart, A.W. Jones and M.S. Lyonn, 2010. Seasonal, taxonomic and local habitat components of bird-window collisions on an urban campus in Cleveland, OH. Ohio J Sci 110(3):44-52.

Collins, K. A. and D. J. Horn. 2008. published abstract. Bird-window collisions and factors influencing their frequency at Millikin University in Decatur, Illinois. . Bird-window collisions and factors influencing their frequency at Millikin University in Decatur, Illinois 101(supplement):50.

Cusa, Marine, Donald A. Jackson and Michael Mesure, 2015. Window collisions by migratory bird species: urban geographical patterns and habitat associations. Urban Ecosystems doi:10.1007/s11252-015-0459-3)

Gelb, Y. and N. Delacretaz. 2006. Avian window strike mortality at an urban office building. Kingbird 56(3):190-198.

Hager, S.B., H. Trudell, K.J. McKay, S.M. Crandall, L. Mayer. 2008. Bird density and mortality at windows. Wilson Journal of Ornithology 120(3):550-564.

Hager SB, Cosentino BJ, McKay KJ, Monson C, Zuurdeeg W, and B. Blevins, 2013. Window Area and Development Drive Spatial Variation in Bird-Window Collisions in an Urban Landscape. PLoS ONE 8(1): e53371. doi:10.1371/journal.pone.0053371

Kahle LQ, Flannery ME, Dumbacher JP (2016) Bird-Window Collisions at a West-Coast Urban Park Museum: Analyses of Bird Biology and Window Attributes from Golden Gate Park, San Francisco. PLoS ONE 11(1): e0144600. doi:10.1371/ journal.pone.0144600

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Klem, D. Jr., C. J. Farmer, N. Delacretaz, Y. Gelb and P.G. Saenger, 2009. Architectural and Landscape Risk Factors Associated with Bird-Glass Collisions in an Urban Environment. Wilson Journal of Ornithology 121(1): 126-134.

Loss, Scott R., Tom Will, Sara S. Loss and Peter P. Marra, 2014. Bird–building collisions in the United States: Estimates of annual mortality and species vulnerability. Condor 116:8-23. DOI: 10.1650/CONDOR-13- 090.1

Ocampo-Peñuela N, Winton RS, Wu CJ, Zambello E, Wittig TW, Cagle NL. (2016) Patterns of bird-window collisions inform mitigation on a university campus. PeerJ 4:e1652

Parkins, Kaitlyn L, Susan B. Elbin and Elle Barnes, 2015. Light, Glass, and Bird–building Collisions in an Urban Park. Northeastern Naturalist 22(1): 84-94.

Sloan, Allison, 2007. Migratory bird mortality at the World Trade Center and World Financial Center, 1997-2001: A deadly mix of lights and glass. Transactions of the Linnaean Society of NY 10:183-204.

From: Daniel Klem [mailto:klem@muhlenberg.edu]
Sent: Thursday, November 10, 2016 11:50 AM
To: Peter Saenger <PSaenger@muhlenberg.edu>; Helzer, David <David.Helzer@portlandoregon.gov>
Cc: Mary Coolidge (mcoolidge@audubonportland.org) <mcoolidge@audubonportland.org>
Subject: Re: inquiry on glass building facades and bird strike risk - City of Portland

10 November 2016, Thursday

Dear Environmental Specialist Helzer,

Thanks for your question. My most relevant study (conducted with others) to your question looked at architectural risk factors using proportional hazards models (Klem et al. 2009; attached). For the data we collected and analyzed for architectural features, these mathematical models revealed that % of glass was important in calculating the risk of a bird strike, as you justifiably identify. Using fall and spring migration data, our analyzes found that a 10% increase in % of glass increased the risk of a strike by 19% and 32%, respectively (see p. 129 in Klem et al. 2009 attached). This study conducted in New York City provides quantitative evidence and suggests to me that you should consider 20% or greater glazing as your trigger for your requirement. More generally, I, at least, believe this study offers you information to permit you to decide at what level of risk you are willing to accept to trigger your requirement. The paper by Borden et al. 2010 you provide highlights, at least for me, the importance of architectural and landscape context. Contrasting to those modest % of glass facades where many strikes were documented, the all or near all glass corridors (90% glass) that no strikes were recorded are far different than what occurs at other sites, many of which I have monitored and are part of other published works of mine. My interpretation and suggestion is a trigger point for your requirement should be below, legitimately far below the 50% level, not unreasonably at the 20% level.

Hope this helps you and your colleagues in assessing what is most relevant for your city and its part in trying to protect more bird lives from the windows. I continue to be sincerely and respectfully yours, Dan (D. Klem, Jr.)

Daniel Klem, Jr., Ph.D., D.Sc.
Professor of Biology, and
Sarkis Acopian Professor of Ornithology and Conservation Biology
Muhlenberg College, Allentown, PA 18104-5586 USA

Telephone: 484-664-3259
FAX: 484-664-3509
email: klem@muhlenberg.edu

Acopian Center for Ornithology, Website: http://ACO.muhlenberg.edu

morning descent birds appear most susceptible to collisions. This scenario may also suggest why building height is a poor predictor of bird mortality (DeCandido 2005, Klem and others 2009).

In urban and suburban areas such as metropolises bordering the Great Lakes, stopover sites increasingly take the form of residential neighborhoods, parks, and landscaped green spaces. Bird fatalities at CSU are clustered into a few hot spots (i.e., green spaces), characterized by large areas of sheet glass windows and adjacent vegetation taller than five meters. Sites where vegetation, glass windows, and permanent water converge and cause disproportionately high numbers of bird deaths are "migrant traps" (O'Connell 2001). These traits are consistent with campus hotspots (e.g., Fig. 2A, 2D) and help explain the variability of bird deaths among buildings. Our results support the tenet that local habitat characteristics can greatly exacerbate the prevalence of bird-window collisions (Klem 1990, O'Connell 2001, Klem and others 2004, 2009, Gelb and Delacretaz 2006, 2009, Hager and others 2008). Finally, the three extreme data points are informative and hint that building attributes not measured in this study (e.g., glass treatments, the area of contiguous glass surface rather than strictly the percentage of total glass) may be relevant parameters when assessing causative factors leading to bird-window collisions. For example, reflective glass yields more collisions (Klem and others 2009).

This year-long study is the first to investigate the association between local habitat and building factors with bird fatalities among a suite of low-rise buildings aligned within an important migratory pathway. Our results support many of the published temporal, taxonomic, and habitat patterns in deaths from bird-window collisions. More importantly, we demonstrate that low-rise buildings with adjacent green spaces are significant hazards to migrating birds, even when such buildings occur within a highly urbanized environment. The large number of dead migrants highlights their abilities to find small green spaces hidden within a city and emphasizes the biological value of fragmented green spaces to migrating birds. It also reinforces the urgency to mitigate the impact of architecture on the number of bird-window collisions. Additional studies that contrast urban coastal and urban inland sites and quantify the effect of site proximity to migration routes are needed.

Acknowledgments. We thank Jen Milligan for help with data collection. Birds were salvaged under Federal Fish and Wildlife Permit MB124772-0 and Ohio Division of Wildlife Wild Animal Permits 342 and 11-135 to A. W. Jones at the Cleveland Museum of Natural History. Robert Gibson, Tom Labedz, Bob Krebs, and several anonymous reviewers provided constructive critiques that greatly improved the manuscript. Since the completion of the study, four additional species have been documented as collision deaths on campus: Peregrine Falcon (*Falco peregrinus*), Belted Kingfisher (*Ceryle alcyon*), Fox Sparrow (*Passerella iliaca*), and Killdeer (*Charadrius vociferus*).

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Bonter DN, Gauthreaux SA Jr, Donovan TM. 2009. Characteristics of important stopover locations for migrating birds: remote sensing with radar in the Great Lakes basin. *Conserv Biol* 23:440-448.

Crawford RL. 1981. Weather, migration and autumn bird kills at a north Florida TV tower. *Wilson Bull* 93:189-195.

Crawford RL, Engstrom RT. 2001. Characteristics of avian mortality at a north Florida television tower: a 29-year study. *J Field Ornith* 72:380-388.

DeCandido R. 2005. Dancing in the moonlight: nocturnal bird migration from the top of the Empire State Building. *Winging It* 19:1-5.

Diehl RH, Larkin RP, Black JE. 2003. Radar observations of bird migration over the Great Lakes. *The Auk* 120:278-290.

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Gelb Y, Delacretaz N. 2006. Avian window strike mortality at an urban office building. *The Kingbird* 56:190-198.

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Hager SB, Trudell H, McKay KJ, Crandall SM, Mayer L. 2008. Bird density and mortality at windows. *Wilson J Ornithol* 120:550-564.

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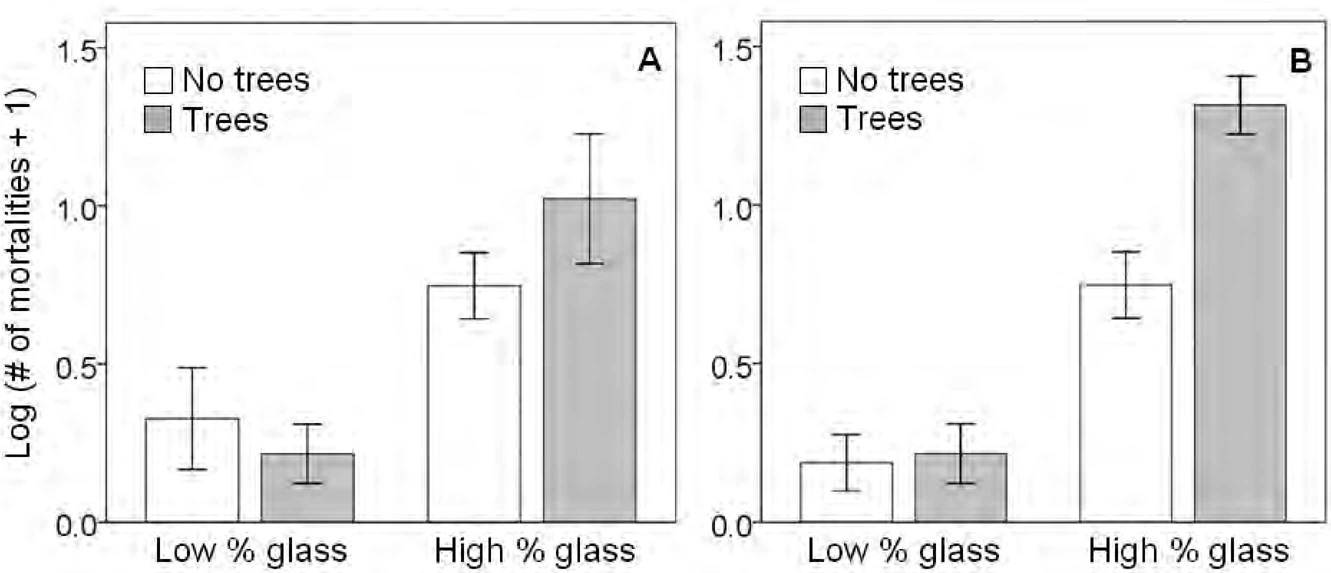

Figure 4. Effect of glass surface area and tree proximity on the frequency of bird mortality with the (A) inclusion and (B) exclusion of three data points greater than 5 SE from the mean (see text). Larger glass surfaces ($F_{1,26}$ = 67.25, P < 0.001), trees ($F_{1,26}$ = 8.70, P = 0.007), and the interaction between trees and glass ($F_{1,26}$ = 7.089, P = 0.013) were associated with statistically more bird deaths following the removal of three extreme outliers. Bars represent the mean number of deaths per building surface (log-transformed values) ± 1 SE.

Bureau of Planning and Sustainability
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MEMO E5

DATE: December 29, 2016

TO: Planning and Sustainability Commission

FROM: Rachael Hoy, BPS; Stephen Himes and Marie Walkiewicz, BES

SUBJECT: Central City Ecoroof Requirement

Background
The ecoroof development standard for the Central City is being proposed to meet multiple objectives including: managing stormwater in an urban setting; keeping urban areas cooler in the summer; providing habitat for birds, pollinators and other wildlife; reducing CO2 emissions by reducing energy use; and creating greenspaces in the dense urban core. In most of the Central City, stormwater enters the same pipes that carry sanitary waste. One acre of ecoroof (about 1 city block) manages about 980,000 gallons of water per year. By reducing the amount of stormwater entering the combined and stormwater sewers, we can avoid costly pipe and treatment projects and limit the incidence of combined sewer overflows to the Willamette River.

Since 2009, the City of Portland has required ecoroofs on new City-owned buildings over 20,000 square feet and/or with a budget over $5 million. The entire roof must be covered minus skylights, mechanical systems, and fire access routes.

The Planning and Sustainability Commission received testimony, both for and against an ecoroof requirement. Many letters in support of the requirement requested a higher percentage of the roof top be covered by an ecoroof. Other letters raised concerns about the cost and future maintenance of an ecoroof. Additional testimony requested maintaining an incentive to help offset the cost of an ecoroof, or allowing other types of rooftops, including white roofs or other reflective roofs to help meet energy efficiency goals.

Currently new development may access bonus floor area in the Central City with the installation of an ecoroof. Through CC2035, it was determined that the ecoroof bonus would be one of many eliminated. Instead the Central City bonuses would focus on creating affordable housing, protecting historic resources and creating open space along the Willamette River. Some of the reasons for eliminating the ecoroof bonus were:

1) The Stormwater Management Manual, adopted in 1999 and last amended in 2016, requires that all new development manage stormwater from impervious surfaces. In the Central City, where buildings are allowed and encouraged to develop lot-line-to-lot-line, ecoroofs are one of the primary tools used to comply with the manual.
2) The market in the Central City is resulting in many sustainable buildings that meet LEED standards. Ecoroofs are one of a suite of options used to meet the requirements of sustainable building design.
3) Development bonuses and financial incentives are meant to encourage innovative practices that have public benefits by offsetting the costs and uncertainties associated with their early adoption. For example, floor area bonuses and financial incentives supported, in part, the development of 35 ecoroofs in the Central City since 2001. Typically, as a practice is more commonly used, local technical expertise increases and costs go down, so incentives and bonuses are no longer needed.

The attachments provide additional information on the Bureau of Environmental Services (BES) research, BES cost analysis and alternative roof types in response to public testimony. Each topic is briefly described and has an associated attachment.

Attachment A

This attachment includes the BES research to assess the feasibility of implementing the ecoroof requirement. It also presents an understanding of its likely outcome and benefits, and the implications for other uses of roofs (for example, would the requirement make it difficult to provide outdoor areas for building tenants). The analysis looked at how the provisions would work if applied to several projects currently in building permit review.

Attachment B

Attachment B highlights a BES analysis comparing the costs of installing a conventional roof and an ecoroof and identifies the multiple benefits that accrue over time with the installation of an ecoroof.

Attachment C

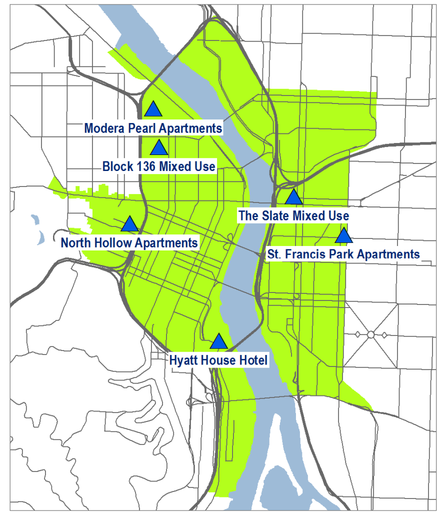
This attachment includes information from research on alternative roof types: cool roofs vs. ecoroofs, highlighting and comparing the potential benefits of each in Portland.

Attachment A

Application of Proposed CC2035 Ecoroof Requirement to Current Development

Summary

In Fall 2016, City staff from BES and BPS analyzed the Central City 2035 Proposed Draft ecoroof code by reviewing how it would apply to several development projects that had permits under review by BDS and other City agencies at the time. This exercise was completed for the purpose of determining the potential impact of the ecoroof standard on development and the net ecoroof area this requirement might yield for future development projects.



Given the illustrative nature of this analysis, projects were selected from a pool of projects that had sufficient source material readily available. Six projects were selected to represent geographic distribution across the Central City and, to the extent feasible, a diversity of project types. The six projects that were included in this analysis are shown at right.

Assumptions

In conducting this analysis, BES made the following assumptions in translating the proposed code language to implementation:

- Mechanical equipment was assumed to include mechanical units themselves, not pads or other associated features
- Mechanical units were assumed to sit directly on the roof surface even though some unit types can be raised on racks, thereby leaving adequate clearance to extend an ecoroof underneath them
- Areas internal to mechanical screens were not considered exempt from the proposed standard
- De minimis features such as vent pipe protrusions and fall protection tieback anchors were not included as mechanical equipment, nor were they subtracted from the ecoroof area even when located within the ecoroof
- Rooftop access points such as stairwells and elevator overruns were assumed to be components of required fire access routes and were therefore considered exempt from the code provisions
- Rooftops were measured to the outside building wall consistent with FAR calculation methods
- Incomplete rooftop mechanical plans were available for Block 136 (12th Ave Building), therefore the exemptions for that project are likely undercounted slightly.

CC2035 Ecoroof Requirement Applied to Current Development Projects

All measurements were hand scaled (square feet) and are therefore approximate

	North Hollow	St. Francis	Modera Pearl*	Block 136	The Slate	Hyatt House**
Gross Roof Area	19,321	18,829	33,664	27,596	13,737	27,685
Minus Exempted Area	*-938*	*-300*	*-1,864*	*-2,219*	*-1,095*	*-1,169*
Net Roof Area	18,383	18,529	31,800	25,377	12,642	26,517
Required Ecoroof Area (60% of Net Roof Area)	**11,030**	**11,117**	**19,080**	**15,226**	**7,585**	**15,910**
% of Gross Roof Area Covered by Required Ecoroof	*57%*	*59%*	*57%*	*55%*	*55%*	*57%*

** Modera Pearl included a 22,232 sf ecoroof on submitted permit plans, exceeding what the CC2035 plan would have required*
***Hyatt House included a 21,587 sf ecoroof on submitted permit plans, exceeding what the CC2035 plan would have required*

Conclusions

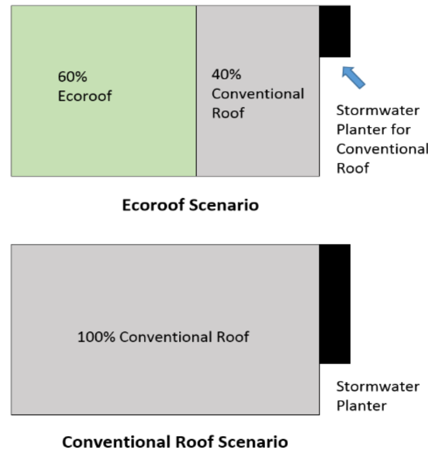
- From this analysis, we conclude that the proposed ecoroof requirement – had it been in place during the development of these six projects – would have yielded approximately 80,000 sf of gross ecoroof area (1.8 acres).
- Considering that the Modera Pearl and Hyatt House projects proposed 22,232 sf and 21,587 sf ecoroofs with their permit plans respectively, the *net gain* in ecoroof area under the CC2035 code as compared to existing conditions is 36,181 sf (0.83 acres).
- Across the six projects, the percentage of the total building roof area that would be required to be covered in ecoroof was fairly consistent, in the range of 55-60%.
- After subtracting out exemptible features and the required ecoroof area, each project was left with between 37-39% of the total roof area as flexible space to add features to respond to market forces (e.g. tenant/resident amenity spaces) or to regulations (e.g. maximize the ecoroof to contribute toward the project's overall stormwater management obligation).
- Two of the projects proposed outdoor amenity spaces with their permit plans, and in both instances the actual proposed amenity space could be accommodated in the flexible space that would remain after application of the CC2035 ecoroof requirement.
- All six projects met the City's Stormwater Management Manual by providing vegetated facilities to the maximum extent feasible. In addition to their ecoroofs, the Modera Pearl and Hyatt House projects are providing lined stormwater planters which are reduced in size because they manage only the non-ecoroof portions of developed impervious area. The other four projects are meeting their full stormwater obligation in a variety of ways, including 100% planters and a combination of planters with other BES-approved methods.

Rendering showing the Modera Pearl's ecoroof and outdoor amenity space

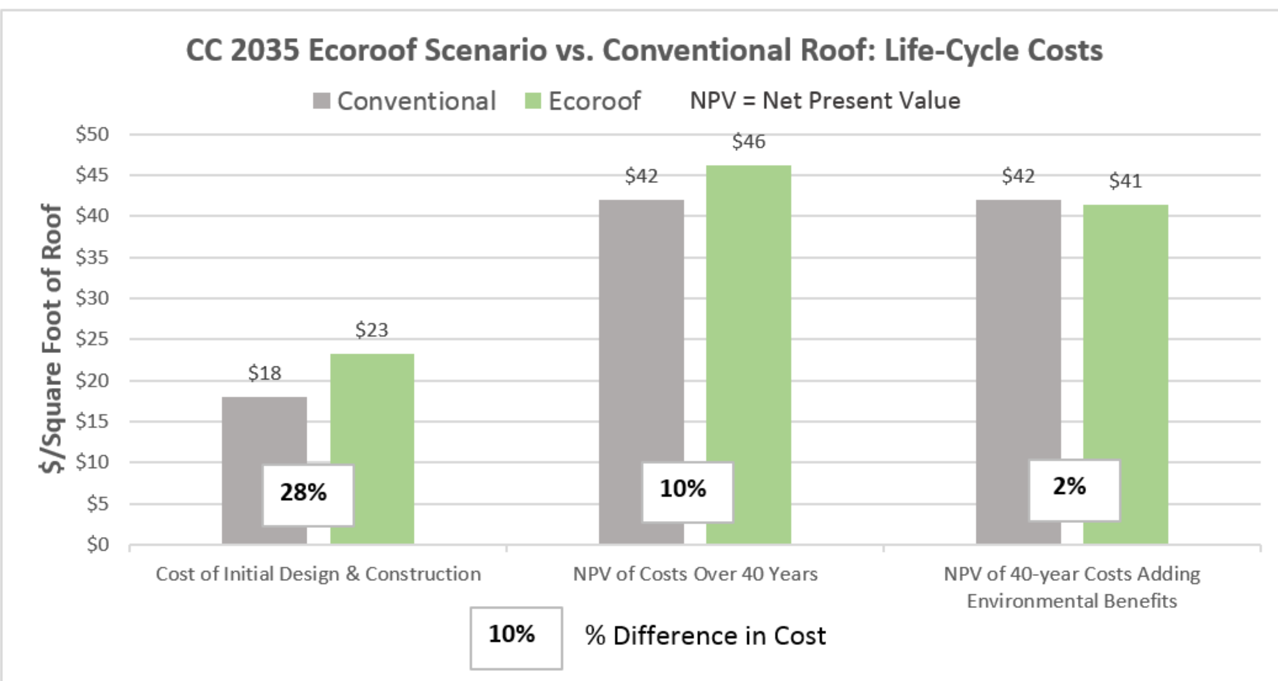
Attachment B
Comparison of the CC 2035 Ecoroof Scenario with a Conventional Roof

Summary

In November 2016, BES staff compared life-cycle costs for the CC 2035 ecoroof proposal with costs for conventional roofs. To be conservative, staff assumed in the ecoroof scenario that the green roof would cover 60% of the entire roof – as noted in Attachment A, in most cases a required ecoroof would cover less than 60% of the gross roof area, so the difference in initial costs between the scenarios would be smaller.



The evaluation followed the framework in the *San Francisco Living Roof Cost-Benefit Study* (ARUP, 2016) including assumptions about the life expectancy of the different roof types. Results are presented in the chart below: although initial costs for the ecoroof scenario are 28% more expensive, after 40 years the cost difference is only about 10%. With the addition of documented values for environmental benefits – air quality, heat island energy savings, habitat – the Net Present Values over 40 years are similar.



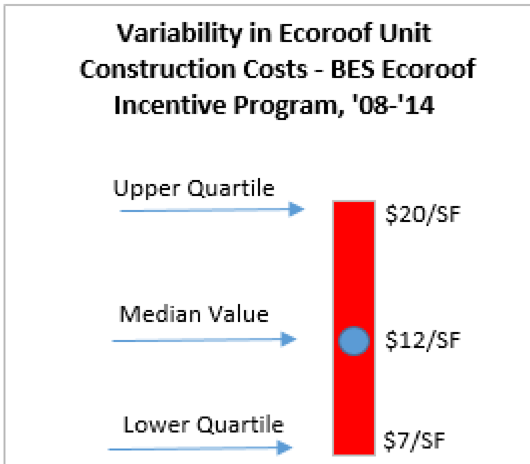
Assumptions

- A membrane is included in both scenarios;
- Discount rate = 2.5%, including inflation; term of the analysis = 40 years;
- Asset life: 20 years for the conventional roof; 40 years for the ecoroof; 30 years for the stormwater planter;
- Construction costs: conventional roof = $12/square foot; ecoroof = $24/square foot;
- Costs include design, construction, maintenance, replacement (demo, re-construction);

- Environmental benefits were calculated per the 2011 US GSA report *The Benefits and Challenges of Green Roofs on Public and Commercial Buildings,* adjusted for the lower cost of electricity in Portland.

Construction Costs – Sources

- Conventional roof and membrane: Green Roof info Think-Tank (GRiT)
- Green roof components: *Cost Analysis for the Portland Ecoroof Incentive*; Ecometrix, 2014. The median unit cost among the 36 projects with a land use type of commercial/multi-family/mixed use was $12/square foot.
- Stormwater planter costs: BES Private Retrofit Program



Cost data for the middle 50% of applicable incentive program projects (36 projects); Ecometrix report, 2016 $.

Ecoroof Benefits Not Included in the Analysis

- Potential increase in property values. A 2012 study, *Willingness to Pay for Ecoroofs in the Portland, Oregon Condominium Market,* concluded that ecoroofs and other eco-friendly building features increased condominium property values by 5.5%.
- Stormwater management value. BES' stormwater monitoring program has collected data confirming that ecoroofs provide a significantly higher level of stormwater retention than stormwater planters.
- Increase in developable area. Other types of stormwater management systems sometimes take up land or space that could be covered by a building, plaza or other type of development.

A more complex design with a stylized planting plan, adjacent to walkways

A simple design with an inexpensive planting plan (sedum cuttings)

Attachment C
Comparing Cool Roofs/Blue Roofs with Ecoroofs

Public testimony received on the Central City 2035 Plan asked whether white roofs, more typically called "cool roofs" in the building industry, might be a cheaper way to achieve the same results as requiring ecoroofs. At the hearing testifiers also asked the City to consider "blue roofs" as an alternative to requiring ecoroofs.

> **Cool roofs** are typically flat roofs covered with highly reflective surface materials (often white in color). Their purpose is to reflect sunlight into the atmosphere and away from the building where it would normally be absorbed, heating both the building and potentially increasing local Urban Heat Island effect by some amount.
>
> **Blue roofs** are non-vegetated roof treatments that detain and slowly release stormwater to reduce the surge of water going into the municipal stormwater system during a weather event. Like ecoroofs, the water collected by blue roofs can be utilized on-site for irrigation.

Staff reviewed academic research and spoke with building professionals to better understand this topic. As a result, staff propose maintaining the ecoroof requirement for the following reasons:

Cool roofs aren't very effective in our climate. Academic research and green building advocacy groups agree that cool roofs are most effective in warmer, dryer climates. In fact, the 2015 International Energy Conservation Code (IEEC) adopted by many states in the US including Oregon, does not require cool roofs in Portland's climate zone (climate zone 4c). In our climate, maintenance costs for cool roofs can be relatively high because wet non-summer months result in moss and algal growth that reduces its reflectance and must be removed. For large roofs, maintenance costs can be significant. For example, it costs $100,000 to clean the cool roof of New Orleans's Superdome.

Cool roofs and blue roofs would only provide a few of the many benefits of ecoroofs. Ecoroofs reduce the heat transferred to a building during the summer months through evaporating water stored in plants instead of reflecting sunlight. They have many other important benefits in urban environments, many of which offset other building costs. Ecoroofs:

- Treat much or all of the stormwater from the building,
- Insulate buildings during the majority of the year where heating buildings is desired,
- Provide habitat for birds and other animals, and
- Provide an amenity for the building's users while improving the visual environment for surrounding building users that look onto the ecoroof.