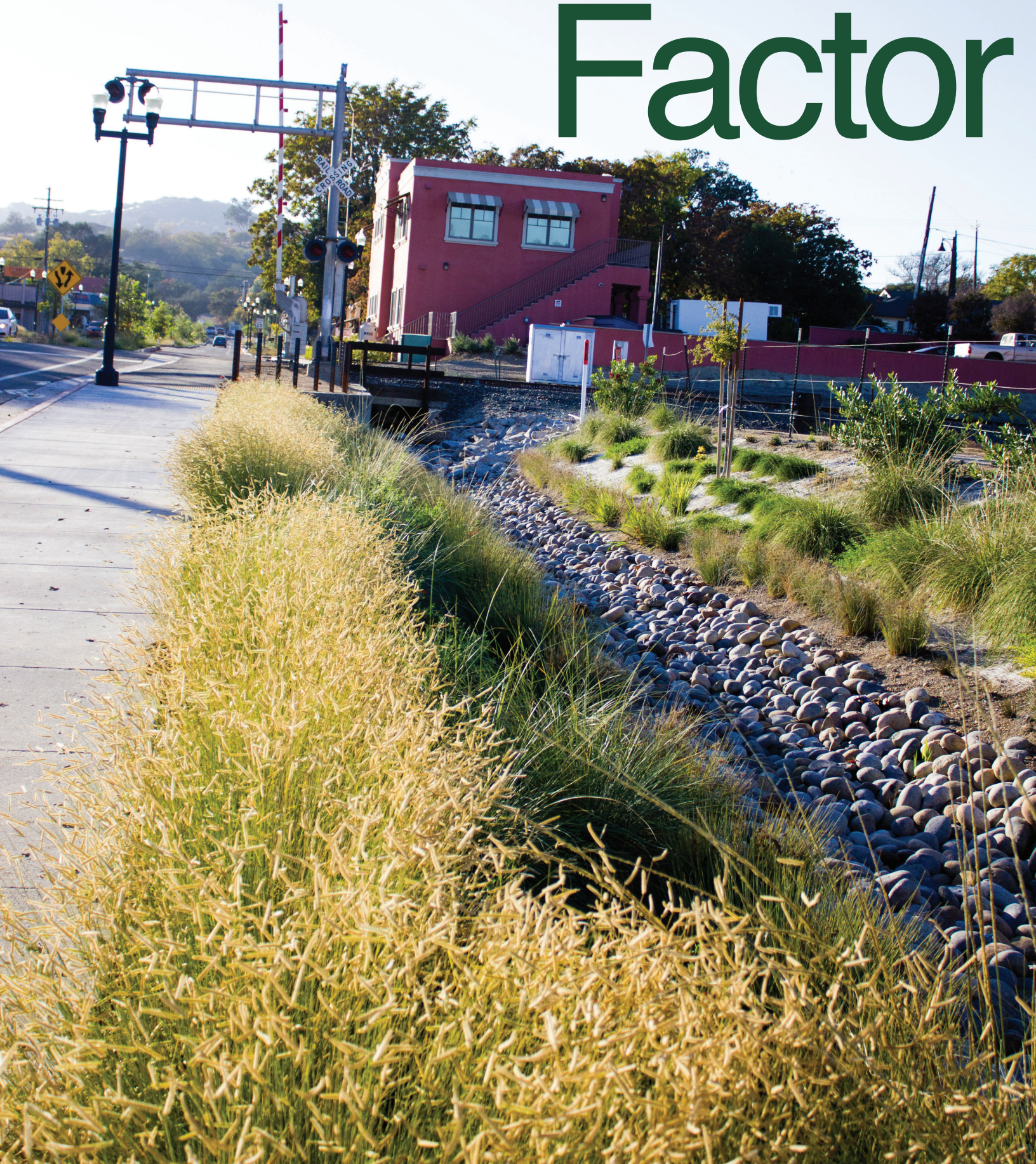
The Green Factor



The Green Factor

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Executive Summary

The Green Factor focuses on one main factor: covering a certain percentage of the parcel in vegetation. It forces developers that build in a certain zone, to cover their parcel with vegetation, not just pave over the environment. There are variations in Green Factors due to different cities having the ability to edit them based on the cities' weather and soil patterns.

Green Factors have different environmental elements that are considered, such as bioretention basins, green roofs, vegetated walls, permeable paves, and more. These components help specify and define different elements that a development can implement.

The establishment of Green Factors helps increase a social and environmental outcome through increased sidewalks and infiltration of stormwater into the groundwater. Numerous studies have established that those who are surrounded by landscapes and nature are generally happier than those who are not surrounded by them. One of the critical reasons that Green Factors were developed was to increase the amount of landscaping in areas that lacked landscape, such as downtown urban areas.

Green Factor Ordinance:

Ordinance _____: A Green Factor requires that newly constructed office and commercial buildings that exceed ____ shall vegetate ___% of the parcel of land in accordance to the Green Factor. The elements of a Green Factor include, but are not limited to: large trees, tree preservation, Green Roofs, Green Walls, rainwater harvesting,

low water use planting, bioswales, and bioretention basins. The benefit of increasing vegetation increases public health, aesthetic appeal, and sustainability.

The purpose of the blanks in the ordinance above is to allow for each city to choose when they shall implement the Green Factor as well as how much of the parcel of land they would like to see be green.

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Chapter 1: Background of the Green Factor

Introduction and Definition

Since the Industrial Era, rural and agricultural lands have been rapidly converted for urban uses. Dense cities are built to accommodate the factories as well as the families that work for the factories. In the United States, after World War II, the idea of single-family homes and the heavy use of vehicles lead to sprawl and urbanization. Population is pushing densely toward main cities as well as outward toward agricultural land. This makes it difficult to incorporate nature into parcels. Sprawl and dense urbanization lead to "loss of biodiversity, air pollution, reduction of natural function to absorb stormwater runoff, clean water, and loss of habitat"[1].

In the early 1960s, the environmental movement boomed and caused a series of acts to be passed in the United States. The Clean Air Act and the Endangered Species Act were some of first acts that were passed to allow further study and investment in technologies. The Santa Barbara Oil Spill and the Cuyahoga River Catching on fire lead to the environmental quality being questioned by the public. In 1970, Congress passed the National Environmental Policy Act[2].

[1] Environmental Services: City of Portland. March 2012. Portland Green Factor: Pilot Project Report. City of Portland.

[2] American Experience. n.d. Timeline: The Modern Environmental Movement. PBS: KQED. Retrieved from http://www.pbs.org/wgbh/americanexperience/features/timeline/earthdays/

Planners have been constantly trying to fix what was thought of as the traditional style of planning. Traditional zoning was very popular after World War II, and it resulted in “large-scale, single-use development, large-lot residential development”[3]. Planners have “developed and implemented ways to mitigate and eliminate those impacts through zoning, building setbacks, landscaping requirements and other development codes”[1].

One of these implementations is known as the Green Factor. There are a variety of different definitions for what exactly is a Green Factor. They vary due to different cities having the ability to edit their Green Factor based on the cities’ weather and soil patterns. However, most Green Factors focus on one main factor: covering a certain percentage of the parcel in vegetation. It forces developers that build in a certain zone, to cover their parcel with vegetation, not just pave over the environment.

Components

Green Factors have different environmental elements that are considered. These components help specify and define different elements that a development can implement.

Percentage of Parcel Covered in Landscape

Each city decides how much of their parcel needs to be covered in vegetation. This can vary due to the zoning of the parcel or specifically what the city desires. For example, if a city wants commercial and office buildings to be covered in vegetation, they must take into account parcels that are located in downtown areas versus lower density commercial zones or large office parks. The City of Seattle has decided that 30% of

[3] American Planning Association. n.d. PAS Quick Notes No. 6. APA. Retrieved from: https://www.planning.org/pas/quicknotes/pdf/QN6.pdf

most of their commercial zones be covered in vegetation; there are other zones that are required less or more[4].

Bioretention Facilities

One major development in the Green Factor is trying to keep all runoff water inside the parcel. This is done with the development of bioretention facilities such as bioretention basins (that are typically built in a more urban environment) and rain gardens (that are built in a suburban or rural area). This helps replenish the groundwater system and maintain landscape on the parcel as well as clean out contaminates that are in the runoff.

Figure 1: Bioretention basin in Paso Robles, California.

Plantings

There are different types of plantings that are required based on the city's preferences. Most of the time, a city would prefer the landscaper to use native plants. Especially for a Mediterranean climate, drought tolerant plants are desired for the reduction in water usage.

[4] LaClergue, Dave. n.d. Seattle Green Factor: Background. City of Seattle: Department of Planning and Development. Retrieved from: http://www.seattle.gov/dpd/cityplanning/completeprojectslist/greenfactor/background/default.htm

Tree Canopy

Having a tree canopy can provide a wide variety of benefits to public health as well as the environment. Trees feed off the greenhouse gases and produces oxygen for the environment. Trees also help reduce the heat island effect that could be occurring in surrounding areas. They help energy conservation by proving shade and windbreaks, which reduce air conditioning costs[5]. Although trees do take use a decent amount of water, urban forests help promote water quality and reduce stormwater management costs by slowing down rainfall and having the roots filter water.

Green Roofs

Although the general public typically cannot see green roofs, they are a great component to be placed on the parcel. This is usually beneficial for parcels of land that require the building to cover most of the parcel (ie: downtown buildings). Green roofs usually last longer than conventional roofs, they reduce energy costs, and act as natural insulation[6]. Green

Figure 2: Green roof located on the California Academy of Sciences building

[5] Canopy. n.d. The Benefits of Trees. Canopy: healthy trees, healthy communities. Retrieved from: http://canopy.org/about-trees/the-benefits-of-trees/

[6] Dowdey, Sarah. n.d. What is a Green Roof?. How stuff works. Retrieved from: http://science.howstuffworks.com/environmental/green-science/green-rooftop.htm

Roofs improve the air quality in the area as well as help reduce the Urban Heat Island Effect.

Vegetated Walls

Green walls can reclaim disregarded space by providing aesthetically appealing walls. They can help improve the reduction of the Urban Heat Island effect as well as improve the air quality of the surrounding area. Green walls also provide insulation, which reduces the energy costs related to air-conditioning and heating[7]. Many of the plants that are used in the creation of a green wall would need to be placed in planters that are then attached to the wall.

Figure 3 : Permeable paver sidewalk

Permeable Paving

Permeable paving provides many benefits for surface water management. Permeable pavers capture water runoff and allow it to infiltrate it into the ground water. This decreases the necessity for irrigation and helps replenish water back into the ground. There are both cheap and expensive designs for permeable paving - one design is the use of permeable pavers. Permeable paving requires a significant amount of maintenance, since the pavers need to be cleaned every year.

[7] Green Roofs. n.d. Green Wall Benefits. Green Roofs for Healthy Cities. Retrieved from: http://www.greenroofs.org/index.php/about/green-wall-benefits

Soil Systems

Soil systems are key when it comes to designing the landscaping of an area. A parcel may be placed on soil that prevents water from infiltrating into the ground water system. Knowledge of the capability of the type of soil helps a designer choose what green factor components they should use. Soil data can be easily found in the Web Soil Survey.

Policy Question

In the creation of a Green Factor, cities have a variety of goals that they try to accomplish. The purpose of the Green Factor is to require parcels in specified zones to have a certain percentage of their parcel covered in landscape. The establishment of Green Factors helps increase a social and environmental outcome through increased sidewalks and infiltration of stormwater into the groundwater.

Numerous studies have established that those who are surrounded by landscapes and nature are generally happier than those who are not surrounded by them[8]. One of the critical reasons that Green Factors were developed was to increase the amount of landscaping in areas that lacked landscape, such as downtown urban areas.

Another reason Green Factors were developed was to achieve a sustainable future through stormwater infrastructure. Stormwater has become increasingly important. In a natural environment, stormwater infiltrates into the groundwater. However, in urbanized areas, stormwater runs off, collecting contaminates, and flows straight to the nearest body of water.

The establishment of a green factor helps improve the environment of the surrounding buildings. The development of a landscaped area

[8] Illman, Sue. February 2014. Public health: how landscapes can improve the health of residents. The Guardian.

absorbs carbon and releases oxygen, which improves the air quality in the surrounding area. The presence of landscapes helps create habitat, increase property values, muffle sound, and clean out the surrounding air. The establishment of green roofs and green walls help cool the buildings with shade and help reduce the heat island effect. They also help insulate buildings, which decreases the need for heating and air-conditioning and therefore reduces energy usage.

Policy

Cities should implement a Green Factor that requires that a certain percentage of a certain zones of land be vegetated. Establishing the Green Factor helps encourage maximizing the potential of vegetation on the parcel, which helps public health and the environment.

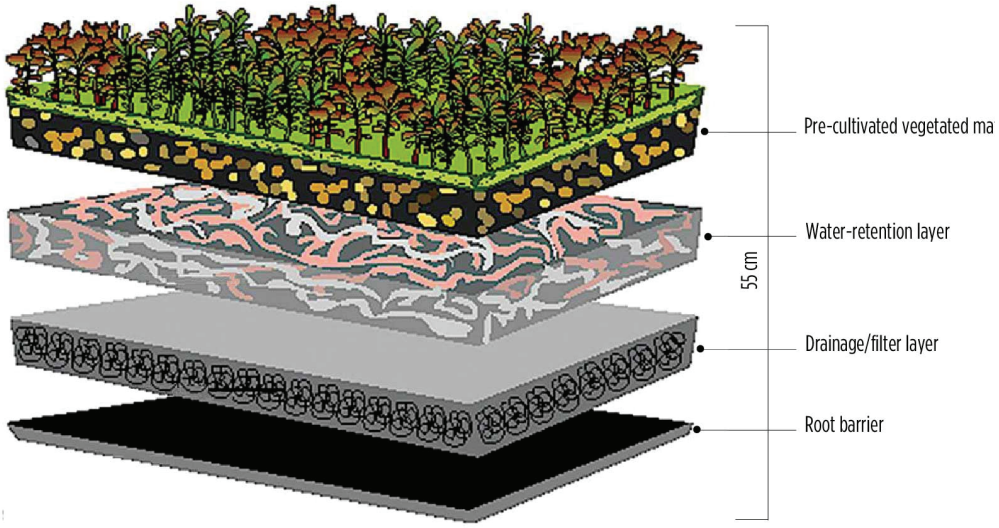
Issues

Although there are a numerous number of positive outcomes to implementing a Green Factor, one common issue with most environmentally friendly implementation plans is that they are too expensive up front. Retrofitting a building to have a green roof may be not possible due to the high costs.

Another issue is permitting. This requires participation with the city government as well as training on how to permit a green factor. Also, depending on what the city chooses, the program could be required or voluntary. It is recommended that the program be required for new buildings and voluntary for existing buildings.

Environmental Consequences

There are a few physical consequences that may come with the development of a green roof. Every reputable roofing company will guarantee the waterproofing integrity of a green roof. However, water leaks can come from drainage backups or root puncture which could lead



1 SCHEMATIC OF THE GREEN ROOF SYSTEM INSTALLED ON THE CRD BUILDING.

Figure 4: Layers of a green roof

to interior damage to the membrane system, root barrier, and the drainage layer. Another environmental issue comes from pesticide used in the roof materials. Roof materials have the potential to have iron and aluminum to run off and infiltrate into the ground water[9]. Another issue is the roofing support. Intensive green roofs with projected live loads higher than 17 pounds per square foot - consulting a structural engineer is required. Green roofs will only function if the vegetation is successful. This brings up the question of whether or not native plants are the best for the climate. Since green roofs are planned landscapes, the goal is to replicate the physical conditions of plants living in the ground, though it is difficult as the

[9] Green Roofs. n.d. Issues. The Green Roof. Retrieved from: http://www.greenroofs.com/Greenroofs101/issues.htm

plants endure much more harsh conditions when they are multiple stories up9. However, in a place with a hot, dry climate, it would not necessarily be environmentally friendly to have a green roof that requires extensive irrigation.

Conflicts with Traditional Planning

Traditional planning erupted after World War II where cities planned on creating large suburbs with high emphasis on automobiles. All different land uses of a city were separated, e.g. all housing being in one area, commercial in another, and industry existing in a separate area away from housing. Traditional planning does not have significant conflicts with green factor elements, however there is some trouble in trying to establish green factor ideas in locations that did not originally consider the environment as a priority. The idea of the Green Factor is for it to be implemented in areas where there are no significant amounts of open space, such as a downtown area of a city.

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Chapter 2: Case Studies

Berlin: Biotope Area Factor

Case studies are an essential part of the study of the Green Factor. There have been three implemented Green Factors and one that has yet to be developed. These case studies brought about different climates as well as issues that they have encountered in the process. Knowing the issues provides help with guiding other cities to develop Green Factors.

Germany has always had an ecological tradition in Europe; they have had a widespread appreciation of nature and making cities livable. Berlin had the opportunity to reconstruct their policies and infrastructure after the unification of East and West Germany in 1989[10]. There was a unique opportunity for the middle of the city to become a testing ground for innovative large-scale green infrastructure projects due to the high-density buildings located in the area. Planners were confronted with the challenge of potential growth in the area and a need for housing, commercial space, retail space, and offices.

The Landscape Programme for West Berlin (1984) was the beginning of the creation of the Biotope Factor. Political Parties in West Berlin focused on nature conservation and environmental protection in their electoral campaigns[11]. The four topics that the Landscape Programme covered was: the ecosystem and environmental protection, protection of biotopes

[10] Buehler, Jungjohann, Keeley, Mehling. October 2011. How Germany Became Europe's Green Leader: A Look a Four Decades of Sustainable Policymaking. The Solutions Journal.

[11] Kazmierczak, A. and Carter, J. 2010. Adaptation to climate change using green and blue infrastructure; Berlin: The Biotope Area Factor. The University of Manchester.

and species, the characteristic landscape, and the recreation and the use of open space[12]. The Biotope Area Factor fit into the nature and wildlife protection portion of the Landscape Programme.

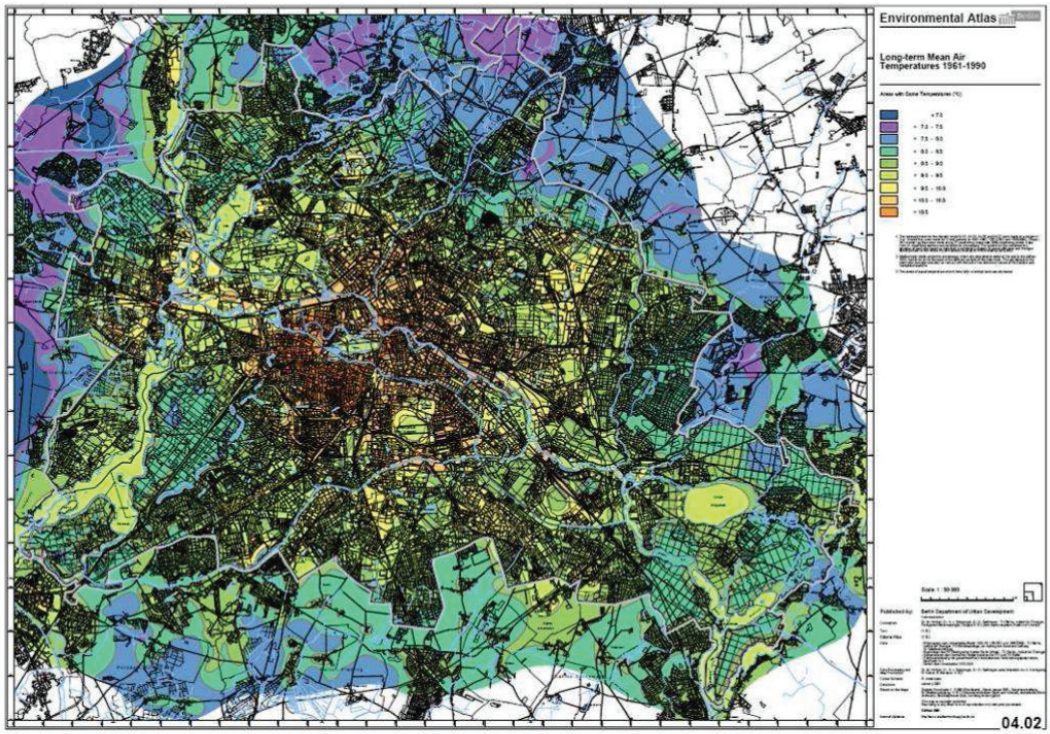


Figure 5: Climatic zones in Berlin

After the fall of the Berlin Wall, Berlin, Germany grew to become a high-density development. The large amount of development eventually resulted in a high degree of soil sealing and the inadequate replenishment of groundwater. The built environment of the City Centre also caused a heat island effect, where temperature was on average 4 degrees Celsius higher than the surrounding areas. A significant amount of research and public interest was put in the Urban Ecology of Berlin[13]. As a result, the Biotope Area Factor was implemented through the Landscape Plans and

[12] Cloos, Ingrid. 2009. A project celebrates its 25th birthday: The Landscape Programme Including Nature Conservation for the City of Berlin. Berlin: Senate Department for Urban Development and Environment.

[13] Stenning, Elizabeth. 2008. An Assessment of the Seattle Green Factor: Increasing and Improving the Quality of Urban Green Infrastructure pg. 19-20. University of Washington.

was formally established in the element of Landscape Plans in 1994. The Biotope Area Factor (BAF) is a legally binding force in selected parts of the city and it allows each neighborhood to establish different administration standards. The BAF formulate ecological minimum standards for structural changes and new development. The BAF is usually put into practice through building permits. The green area targets are set for different land uses for new development, such as residential, public facilities, and day centers having 60% coverage while commercial and technical infrastructure are allowed 30% coverage[12]. There are currently 21 BAF landscape plans in Berlin; they cover all forms of urban land use including residential, commercial, and infrastructure. Overall, many architects and property owners have given positive feedback regarding the BAF with its easy use and results in immediate visual improvements.

Seattle Green Factor

Seattle, Washington is already an innovator in implementing environmental aspects throughout its city. They have many different case

Figure 6: Display of Urban Greening 2007. The Seattle Green Factor [14]

studies where they analyzed parcels that had no vegetation coverage vs. parcels with large vegetation coverage. Originally, implementing LID and Green Infrastructure was highly recommended in the planning department, but was not always required. The City looked at previous projects that had started developing initiatives to increase landscaping and green all parcels. The planners knew that the changes for the urban, village, and commercial zones would dramatically increase in time, which would increase the density of buildings in Seattle, especially in downtown[1]. They began looking for cities that had combated the increase of density with the increase of landscaping. Berlin and Sweden had very similar issues and realized that landscapes are very important in influencing the health of those who live in an area along with keeping runoff in the parcel.

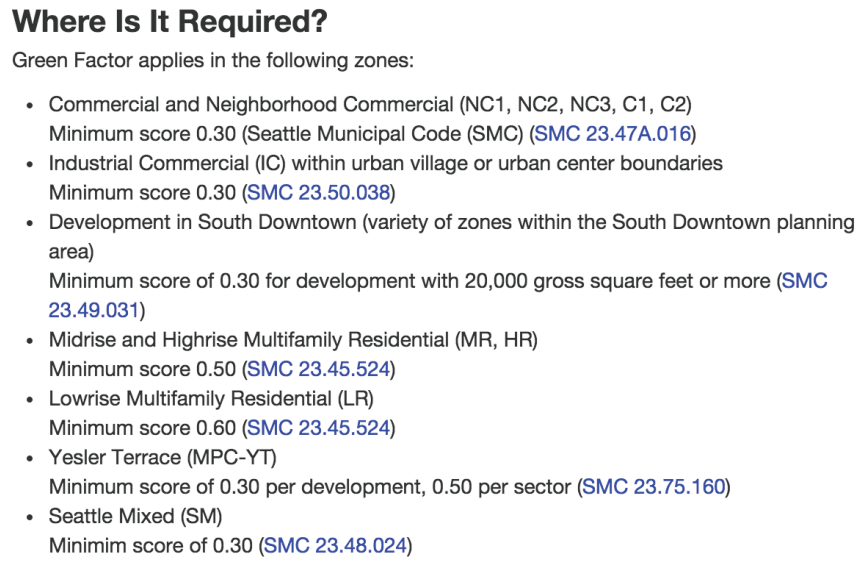
After reviewing the Berlin Biotope Factor, Seattle took the biotope calculations and did an example audit on the Seattle Central Library, which received a BAF of 0.12. Seattle took the Biotope Area Factor, modified it for their landscapes and soil, which developed the Seattle Green Factor. "The Seattle Green Factor is a menu of landscaping strategies that is required for all new development in the neighborhood business districts with more than 4 dwelling units, or than 4,000 square feet of commercial uses, or more than 20 new parking spaces. It is intended to increase the amount of quality of urban landscaping in dense urban areas while allowing increased flexibility for developers and designers to efficiently use their properties." [14]

The City of Seattle passed Ordinance 122311, which "requires the equivalent of 30% of a parcel in the commercial zones to be vegetated by using the Seattle Green Factor. The Green Factor encourages maximizing the 'vegetation potential' of the rights of way though planting of layers of vegetation and larger trees in areas visible to the public. There

[14] 2007. The Seattle Green Factor. City of Seattle. Retrieved from: http://www.seattle.gov/dpd/cs/groups/pan/@pan/documents/web_informational/dpds021348.pdf

are additional bonuses for rainwater harvesting and/or low water use plantings. Use of larger trees, tree reservation, green roofs, green walls, and water features are encouraged by this requirement."[13]

This implementation only required that new buildings in certain zones meet these requirements.



Where Is It Required?

Green Factor applies in the following zones:

- Commercial and Neighborhood Commercial (NC1, NC2, NC3, C1, C2)
  Minimum score 0.30 (Seattle Municipal Code (SMC) (SMC 23.47A.016)
- Industrial Commercial (IC) within urban village or urban center boundaries
  Minimum score 0.30 (SMC 23.50.038)
- Development in South Downtown (variety of zones within the South Downtown planning area)
  Minimum score of 0.30 for development with 20,000 gross square feet or more (SMC 23.49.031)
- Midrise and Highrise Multifamily Residential (MR, HR)
  Minimum score 0.50 (SMC 23.45.524)
- Lowrise Multifamily Residential (LR)
  Minimum score 0.60 (SMC 23.45.524)
- Yesler Terrace (MPC-YT)
  Minimum score of 0.30 per development, 0.50 per sector (SMC 23.75.160)
- Seattle Mixed (SM)
  Minimim score of 0.30 (SMC 23.48.024)

Figure 7: Where the Green Factor is required in Seattle

Since the adoption of the Seattle Green Factor, new development must now meet the requirements they laid forth. The factor was designed to be more stringent about landscape requirements; the policy was designed to still be flexible for the developers. The City of Seattle's staff believes that the Seattle Green Factor is a positive step and improvement of past codes. They believe that it is a "creative approach to help restore ecological function in the City"[15]. The Green Factor is currently set to be desired in commercial and office zones, however many of the city staff would like it to be industrial or all zones. The Green factor is currently required in specific zones shown in figure 7.

[15]Stenning, Elizabeth. 2008. An Assessment of the Seattle Green Factor: Increasing and Improving the Quality of Urban Green Infrastructure pg62. University of Washington.

The Seattle Green Factor increased the landscaping in the parcel, which improved the look and feel of the neighborhood while reducing stormwater runoff and providing habitats. It also helped cool the city during heat waves as well as support businesses and safety in the area. The Green Factor is viewed to help with public health with the increase of natural vegetation.

Portland Green Factor

The City of Portland in Oregon wanted to implement a very similar program to the Seattle Green Factor, which would result in more high quality landscaped areas with less impervious surfaces[1]. Developing a Portland Green Factor program would also provide and help integrate other planning goals such as the Portland Plan, Central City 2035, Healthy

Figure 8: The Portland Green Factor Pilot Project Report[1]

Connected Neighborhoods, Portland Water Shed Management Plan, and more. By integrating other planning goals with the Portland Green Factor, it is suggested that this would help create comprehensive and clearer landscaping requirements that are easier for developers and designers to understand and meet[1]. Development of the initiative would also make it easier on the city staff to review.

In order to see what the Portland Green Factor would contain and specify, the City decided to do example audits on recently completed projects within the city of Portland. This helped the city to determine which scoring factors potentially needed to be refined, added or deleted for Portland. After implementing the Green Factor Guidelines to the Four Pilot Projects, three had failed to meet Seattle's Green Factor minimum score, and one of them passed. The Portland Green Factor has yet to be implemented in the city as of now.

Malmö's Green Space Factor and Green Points System

An international housing exposition called Bo01 or "The Sustainable City of Tomorrow" was held in Malmö in 2011. Malmö is the third largest city in Sweden, and is transforming their industrial city into a knowledge city[16]. The exposition consisted of the development of a new housing district in a former industrial era. As a result of the geographical location of Malmö, it was built on former agriculture land with no hills, forests, or other natural obstacles to encourage a dense development, causing little green land available for recreation in Malmö. Due to this Malmö began to apply green planning instruments, which took place 10 years before another city in Sweden began to implement such techniques.

[16] Stenning, Elizabeth. 2008. An Assessment of the Seattle Green Factor: Increasing and Improving the Quality of Urban Green Infrastructure pg62. University of Washington.

Malmö's most important goal was to present an attractive healthy environment for people, to promote biodiversity, and to minimize stormwater runoff. Small creeks in the area had a problem where they

Figure 9: Bo01 Housing exposition in Malmö, Sweden

received more stormwater than they had capacity for, which lead to flooding and erosion problems. The development of Bo01 allowed the city to implement a large open stormwater system within a dense district. Bo01 contained an open stormwater system, which consisted of narrow concrete channels and ponds with or without vegetation[17].

The Green Space Factor was aimed to secure a certain amount of green coverage in each building lot, especially to minimize the amount of sealed or paved surfaces. Developers had to work with the city so that their development would be able to achieve a Green Space Factor of 0.5. The German Biotope Factor in Berlin adapted this system. The Green Points

[17] Kruuse, Annika. GRaBS Expert Paper 6: The Green Space Factor and the Green Points System. City of Malmö.

System consisted of different ways that the development could strive to achieve the 0.5 level coverage. A list of 35 different points was developed, from which developers had to select 10[17].

Since the development of Bo01, the area has become very popular to the citizens of Malmö. People have begun to visit the parks, lawns, and coastline. A common problem that they have faced is the lack of resources for the development of such places. For Bo01, an environmental program had helped finance an Ecologist, which helped with the green portions of the area[17]. However, most developers that are under the Green Factor had plans that showed that they would achieve a Green Space Factor of 0.5, which when developed, was actually lower.

Analysis and Comparison of Case Studies

After researching though the case studies mentioned above, each city had brought up different points that were important in establishing a new ordinance. The City of Malmö brought up the issue about making sure their parcels kept up with the 0.5 factor that they had promised to develop. Due to this issue, the city needed to require consistent inspection of the parcels. Berlin's Biotope factor allowed other cities to be able to follow in its footsteps. Although weather patterns are similar, the factor allowed for adaptability, which is very beneficial for establishing a Green Factor in a Mediterranean climate. The City of Berlin also mentioned that this factor should to be easy for the government and architects to work with to make this factor succeed. The City of Portland had an issue with the factors that were part of their Green Factor. They recommended refining the factors to be more specific and adaptable for their city.

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Chapter 3: Literature Review

Green Buildings and Public Health

Trowbridge, M. J., Huang, T. T.-K., Botchwey, N. D., Fisher, T. R., Pyke, C., Rodgers, A. B., et al. (2013). American Journal of Medicine. Retrieved from American Journal of Medicine: www.ajpmonline.org

One of the emerging practices in Urban Development is addressing public health, particularly as a component with the on-going increase of childhood obesity. Partnerships are recommended between cities and green companies to bridge public health and green buildings to create "Green Health". One of the recommended strategies is focusing on school environments for research. Schools are already a focus for obesity prevention and being environmentally friendly, so integrating green health into the mixture should be feasible. Schools also engage parents and communities, so teaching green health to students will bring back the information to the students' families and communities. Research and training will increase knowledge about the contribution of green health in schools and communities.

Under One Green Roof

Reid, Robert L. (March 2009). Under One Green Roof. Retrieved from the American Society of Civil Engineers.

One of the greenest museums in the world is the California Academy of Sciences, due to the building having a 2.5 acre vegetated roof. After 9 years of design and construction, the building opened in late September 2008, costing a total of $484 million. After popular and critical success, the museum received the platinum Leadership in Energy & Environmental Design (LEED) rating. The building earned 54 points in six categories:

sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and innovation and design process. The new building was built to dissipate the seismic forces in the event of a significant earthquake, since it is located 10 miles from the San Andreas Fault. The museum also features natural ventilation systems that help reduce the amount of energy consumed. Additionally, the museum uses recycled water that is provided through the City of San Francisco. Finally, the building was created using a high percentage of recycled materials.

New Methods and Technologies in the Construction Area of Urban Landscapes – Green Roofs

Firu, C. R. (2014). New methods and technologies in the construction area of urban landscapes—green roofs. Geopolitics, History, and International Relations, 6(1), 241+. Retrieved from http://go.galegroup.com/ps/i.do?id=GALE%7CA377530368&v=2.1&u=calpolyw_csu&it=r&p=AONE&sw=w&asid=2391c75f1814474a77c05c7ba2828183

Man does not build the same way that nature does - modern cities are built with a sea of rooftops with an artificial desert, which does not consists of an ecosystem. The first green rooftop in written history was the famous Hanging Gardens of Babylon, which was built around 500 B.C. In other parts of the world, roofs were made from vegetation in order to protect homes from cold and heat. In the 19th century, green roofs made a comeback, though only for rich clients. Currently, the trend continues with countries like Germany, Switzerland, and Austria due to the increasing factor of research and environmental group pressure. Countries like Great Britain and the United States are making progress in implementing green roofs. Countries such as Brazil are requiring new buildings with flat roofs to be able to sustain vegetation. Green roofs will start an invasion that will be beneficial to the urban landscape of today.

An Assessment of the Seattle Green Factor: Increasing and Improving the Quality of Urban Green Infrastructure

Stenning, Elizabeth. 2008. An Assessment of the Seattle Green Factor: Increasing and Improving the Quality of Urban Green Infrastructure. University of Washington.

In 2006, the City of Seattle adopted new regulations of the Seattle Green Factor, which requires adding ecological function and visible vegetation. Like with any new ordinance, the Seattle Planning Commission raised concerns to the City Council. They mentioned the potential impact on small businesses, responsibility for maintenance, and coordination with the Department of Transportation. The Green Factor was adopted on December 12, 2006, which would replace old landscaping requirements in January 2007. Elizabeth, the author of the thesis, had conducted research to determine how the Seattle Green Factor was doing for the environment and what designers and developers thought of the project. She conducted numerous face-to-face interviews regarding the multiple projects that were required to implement the SGF. For example, most of them tended to choose Lawn, Ground Cover as for one of their factors. The lowest one that is chosen is Water Features.

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Chapter 4: Green Factor Ordinance

Recall Past Projects

Green Stormwater Infrastructure and Low Impact Development have been continuing movements in Mediterranean and desert climates. Especially in the western part of the United States, reduced water usage is a major goal. Cities such as San Francisco and Paso Robles have taken on new building and street designs to help improve the aesthetic appeal of areas as well as incorporate landscape and allow water to infiltrate into the groundwater.

Paso Robles 21st Street Project

In 2012, for my Planning and Urban Ecology class, I had the opportunity to visit 21st street in Paso Robles to inspect the conditions of the street and understand why they decided to implement a green street.

Figure 10: The main detention basin to collect and slow down the flow of stormwater

The area of town was developed quickly in the late 1800s and did not take into account the natural drainageway from the 2,000 plus acres of watershed that flowed into the Salinas River[18]. The large storms flooded the street, which caused erosion and traffic hazards.

[18] David LaCaro, Personal Communication, November 7, 2014

In November 2014, I revisited 21st street right after they finished the green street. There were notable differences in the street since they had medians that helped with the flow of the stormwater, bike lanes, pervious sidewalks, park benches, and multiple shade trees. The street provided better safety features especially for the large number of visitors that walked through that area to get to the Mid State Fair.

Figure 11: A planter to help infiltrate water into the groundwater

Figure 10, it shows an example of one of the main medians that are located on site. The example contained a basin that would collect large amounts of rainwater. It had train tracks in the design, which helps slow down the flow of water.

Figure 12: Public benches that also second as a way to reduce the amount of runoff from parcels

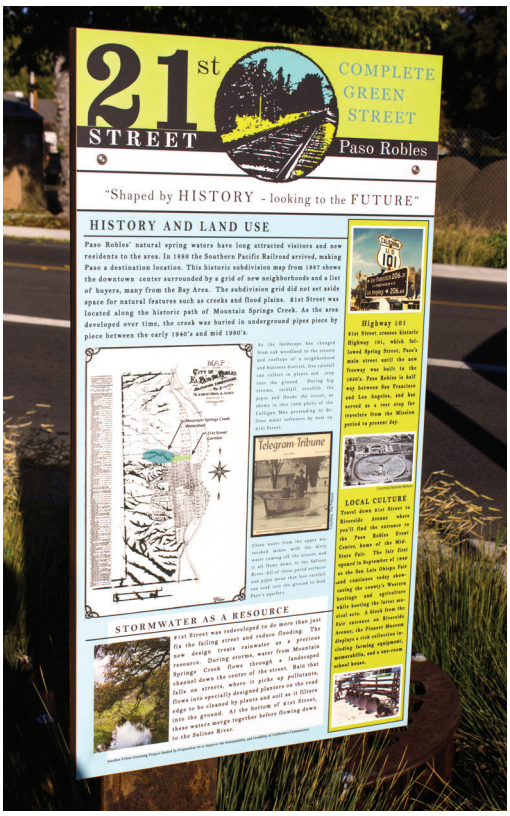

Figure 13: Signs posted around 21st street explaining the green street

The medians all contain wetland plants, which should be able to handle the large amount of water that is expected to come. However, as with other green infrastructure projects like this, it is expected to require approximately 3 years of maintenance and irrigation.

The city also implemented a variety of public benches, some of which are used both as a bench as well as a preventative measure to reduce the amount of runoff from parcels that would flow into the street during storms. These have been placed next to parcels that are currently vacant, under construction, or next to locations that have a large amount of dirt.

Another aspect of the new green street was public education on what the changes on 21st street is doing for the residents as well as the environment. In major intersections, two signs were posted giving out information to those who walk by and are interested in learning more. Paso Robles just recently experienced a rainstorm in the area. However, the rain occurred only at night, making it difficult for the city employees and residents to see how the green street was doing. After the rainstorm it looked like the street was doing well, however one issue that was noticed

Figure 14: After its first rainstorm, it had already started to collect sand in the planters

Figure 15: The city will need to maintain this, so that the planter is still effective in slowing the flow of runoff.

was the amount of sediment that had flowed into the some of the planters. One of the plants had so much sediment that the train tracks used to slow down the flow of water no longer worked.

The California Academy of Sciences Building

In 1999, a select few architects were invited to San Francisco to submit proposals for the new California Academy of Sciences building. Other architects had put together elaborate 3D models of what they had envisioned for the project. However, Renzo Piano, who had come up with some sketches, ultimately had his design selected[19]. A structural engineer, Arup, was chosen to help building the "living" roof that they had envisioned.

Since its opening in 2008, the building had received the highest certification, the Platinum LEED building. The 2.5 acre vegetated roof contains 1.7 million native California plants and plumbs recycled water, which helps reduce the water consumption by 20%. The building earned 54 points in sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and innovation and

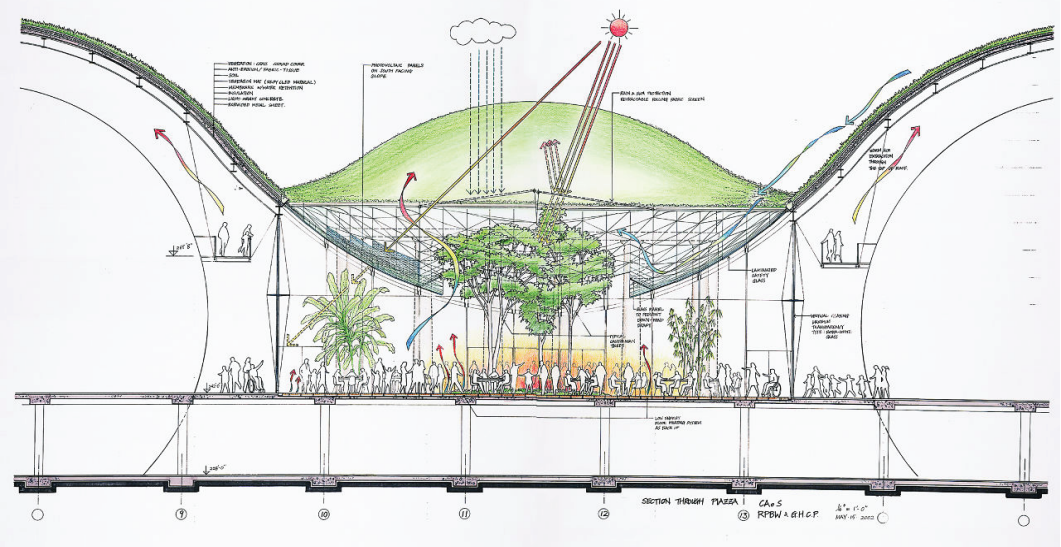

Figure 16: Sketch of California Academy of Sciences building by Renzo Piano

[19]Reid, Robert L. (March 2009). Under One Green Roof. Retrieved from the American Society of Civil Engineers.

design processes.

Since its grand opening, the Living Green Roof has been working quite well.

Green Streets L.A. Program

Contaminated runoff has always been the largest source of Ocean Pollution in Southern California. With the city of Los Angeles being paved over in order to build buildings and streets, all the pollutants and contaminates that are located on the street end up in the waterways that flow directly to the ocean. The Board of Public Works said that Los Angeles has an enormous opportunity to infiltrate, capture, and filter urban runoff to prevent continuous pollution of the waterways and recharge the groundwater[20].

The city developed the Green Streets Committee, which is compromised of representatives from certain city departments to work on related street infrastructure. A few streets have been converted into Green Streets. Oros Street is a residential road in Los Angeles and was the first to be converted into a green street. Runoff from the road drains directly into the Los Angeles River, so the city decided that the street should contain bio-retention areas along with a large infiltration basin[20].

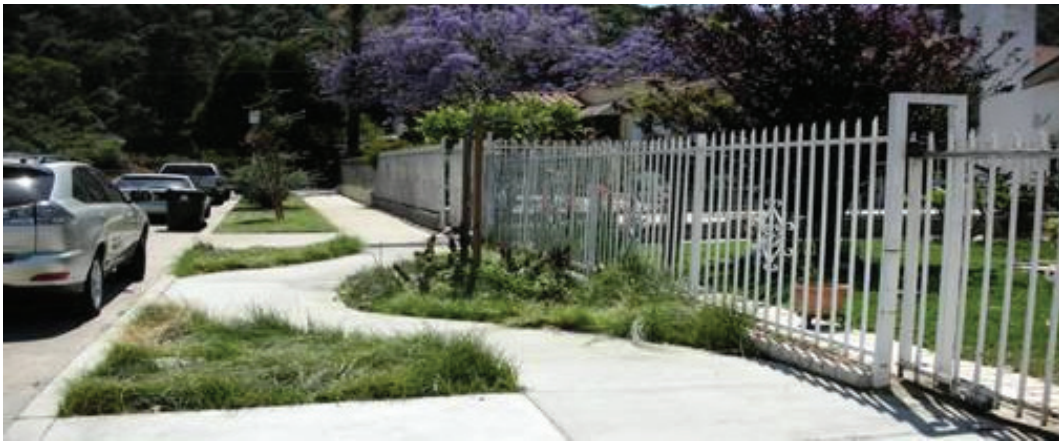

Figure 17: Bioretention planters installed on Oros Street in Los Angeles

[20] Chau, Haan-Fawn. April 2009. Green Infrastructure for Los Angeles: Addressing Urban Runoff and Water Supply Through Low Impact Development. California Water Board.

There were multiple green streets that were located around drainage areas. There was also a pocket park that the city built that was redesigned with LID principles. Native Plants and trees were selected and were maintained with a drip irrigation system. Los Angeles County oversaw testing to evaluate the BMP performance on reducing total suspended solids, oil, and grease. Testing was completed in 2005; with the limited testing that was performed, results seem to show that the BMP was effective in reducing oil, grease, and total suspended soils.

Mediterranean Climate Green Factor

Many of the Past Green Factors are in areas of high rain count. Seattle is located in a Temperate Rain Forest; Portland, Oregon is located in a Coniferous Forest biome. Berlin, Germany is located in a Temperate Deciduous Forest. All of these biomes have high rain count and have certain plants that are best suited for this environment. However, there are not many established Green Factors that are produced for biomes that do not have such a high rain count.

California is striving to become an environmentally friendly state and has already started to encourage the implementation of Low Impact Development (LID). Projects in San Luis Obispo County, San Diego County, Orange County, and the Bay Area have shown that LID is beneficial in increasing water infiltration as well as creating greener habitats[21]. Many of these projects are developed through voluntary or mitigation purposes. However, many developers are not willing to spend the money to develop these Green Factors unless they are to receive benefits or will be paid back in a timely manner.

[21] California State Water Resources Control Board. n.d. Low Impact Development (LID) Projects. California Environmental Protection Agency. Retrieved from: http://www.waterboards.ca.gov/water_issues/programs/grants_loans/low_impact_development/

Coastal California has a Mediterranean Climate, which has the characteristic of warm temperatures that vary from 30 degrees to 100 degrees Fahrenheit based on the season. This biome typically gets around 10 – 17 inches of rain, though it varies on the location of the biome. The Northern California typically gets more rain while areas in Southern California receive less.

Effective Project Components

Although established Green Factors have provided many different components of what can be incorporated into the Green Factor, many of the ideas will need to be rethought or edited so that they work with the climate of the area, such as the idea that native plants should be incorporated into the Green Factor. Green Walls may be more of an issue in areas of certain native plants as they may not be well suited for being hung from a wall, or the infrastructure to develop a Green Wall may be too costly and not beneficial enough.

Developing an Ordinance

Green Factor Ordinance

Ordinance _____: A Green Factor requires that newly constructed office and commercial buildings that exceed ____ shall vegetate ___% of the parcel of land in accordance to the Green Factor. The elements of a Green Factor include, but are not limited to: large trees, tree preservation, Green Roofs, Green Walls, rainwater harvesting, low water use planting, bioswales, and bioretention basins. The benefit of increasing vegetation increases public health, aesthetic appeal, and sustainability.

The purpose of the blanks in the ordinance above is to allow for each city to choose when they shall implement the Green Factor as well as how much of the parcel of land they would like to see be green. An example of variation in the implementation of the Green Factor is a downtown

commercial/business area vs. a business park area. A downtown area is already limited in open space. Unless the building has a Green Roof on top of the building, it is quite unlikely to be able to implement anything more than 10% of coverage. A business park area has the capability of implementing more than 30% of green coverage due to the greater area of open space.

Requirements and Restrictions

Cities are encouraged to choose the types of requirements and restrictions that they seem fit for their city. These are some example requirements - cities are encouraged, but not required, to use them. Cities are also not limited to use just these requirements.

-Required for new commercial and office building that exceed a certain size

-Requires the equivalent of ___% of a parcel in specified zones to be vegetated by using the Green Factor.

-The Green Factor encourages maximizing the “vegetation potential” of the rights-of-way through planting of layers of vegetation and larger trees in areas visible to the public. The use of larger trees, tree preservation, green roofs, and green walls are encouraged by this requirement[14]

- o All vegetation should be native species. No invasive species should be planted.

-The Green Factor encourages the use of rainwater harvesting and/or low water use plantings[14].

- o This includes the proper use of bioswales or bioretention basins.
- o All water run off is encouraged to stay on site.

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Chapter 5: Revamping the Mediterranean Climate Green Factor

This Green Factor has been developed in such a way that it should be easy to edit for different climates. One of the largest components of this Green Factor is the thought to use native plants rather than non-native plants. This helps reduce the water usage since native plants are used to the amount of water the environment usually gets, as opposed to non-native plants that may have higher water requirements.

To continue with the ability to edit the Green Factor to work in different areas, different climates in the United States were chosen to see what changes would need to be made in the green factor.

Midwest (Grassland Biome)

The Grassland Biome has a moderate amount of annual rainfall (averages about 20 inches of rainfall a year). Weather can be very extreme, with summer temperatures reaching up to 100 degrees Fahrenheit and dropping to as low as -40 degrees Fahrenheit in the winter . This means that the Mediterranean Green Factor should be easily adaptable in the Midwest[22].

[22] Webber, Charles. 2002. The grassland biome. University of California Museum of Paleontology.

Figure 18: Rain garden located in University of Nebraska - Omaha

Southwest (Desert Biome)

In the Desert Biome, the amount of rainfall that occurs is very limited - less than 19 inches of rain[23]. Cities located in deserts are already adapting themselves to create drought tolerant lawns. One of the main aspects that the cities in the desert should take into account is refining their factors. A desert lawn that is covered in “green” may not be similar to what Seattle considers as “green”.

Figure 19: Arizona reduces the amount of water they use on their lawns but using native plants.

[23] Webber, Charles. 2002. The desert biome. University of California Museum of Paleontology.

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Appendix B: Picture Citations

Figure 1
Personal photograph by Hillary Tung. 7 Nov 2014.

Figure 2
n.d. California Academy of Sciences. Photograph. Retrieved from: http://imk2dd.files.wordpress.com/2011/11/11-california-academy-of-sciences.jpg

Figure 3
Personal photograph by Hillary Tung. 7 Nov 2014.

Figure 4
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Figure 6
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Figure 8
Environmental Services: City of Portland. March 2012. Portland Green Factor: Pilot Project Report. City of Portland.

Figure 9
Yudell, Moore. n.d. Tango Bo01 Exhibition Housing. Retrieved from: http://www.moorerubleyudell.com/projects/tango-bo01-exhibition-housing

Figure 10
Personal photograph by Hillary Tung. 7 Nov 2014.

Figure 11
Personal photograph by Hillary Tung. 7 Nov 2014.

Figure 12
Personal photograph by Hillary Tung. 7 Nov 2014.

Figure 13
Personal photograph by Hillary Tung. 7 Nov 2014.

Figure 14
Personal photograph by Hillary Tung. 7 Nov 2014.

Figure 15
Personal photograph by Hillary Tung. 7 Nov 2014.

Figure 16
Piano, Renzo. n.d. Proposed sketch of California Academy of Sciences building. Retrieved from: http://buildipedia.com/images/masterformat/Channels/In_Studio/California_Academy_of_Sciences/Drawings/Renzo_Piano_California_Academy_of_Sciences_06.jpg

Figure 17
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Figure 18
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Figure 19
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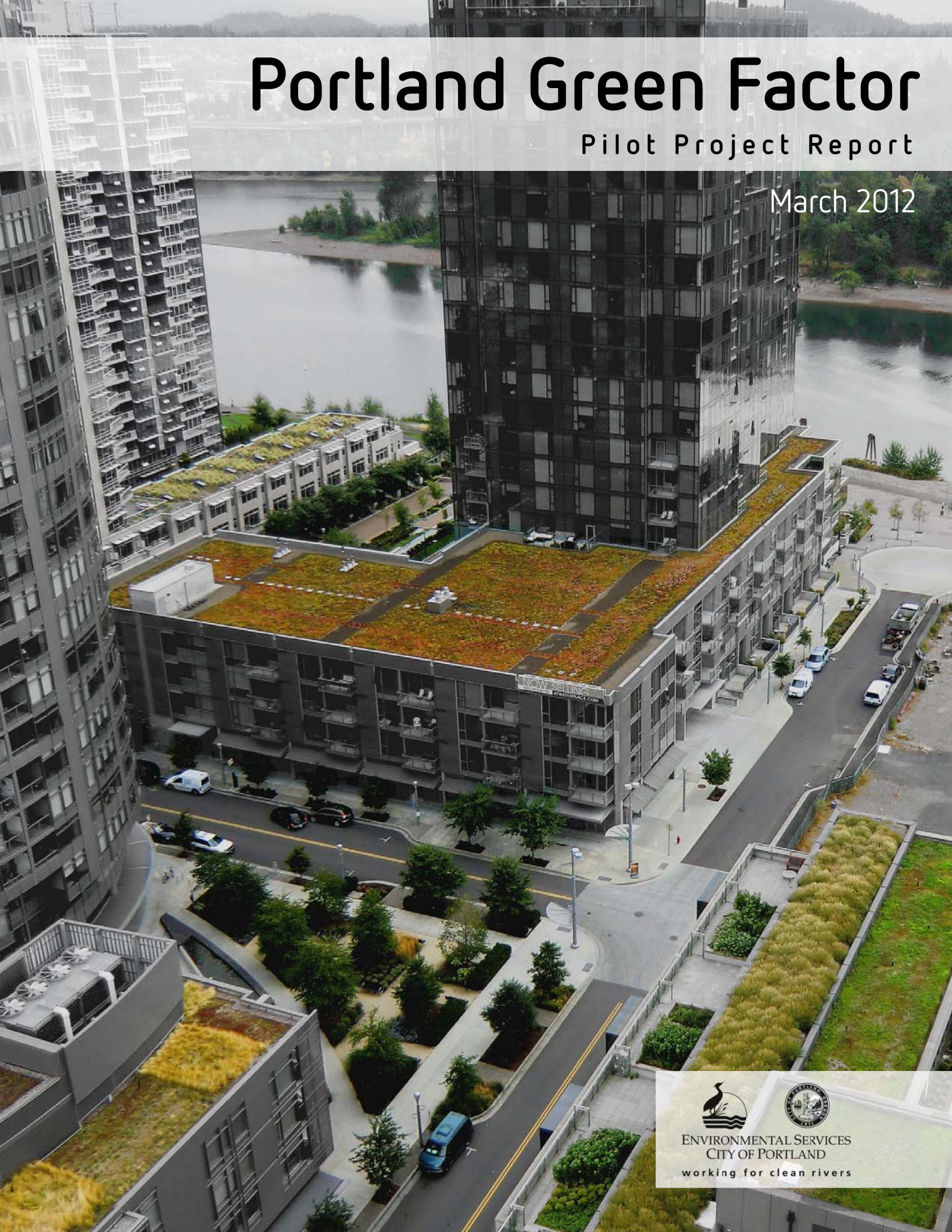
Appendix C: Portland Green Factor: Pilot Project Report

Portland Green Factor

Pilot Project Report

March 2012



ENVIRONMENTAL SERVICES
CITY OF PORTLAND
working for clean rivers

Portland Green Factor

Pilot Project Report

March 2012

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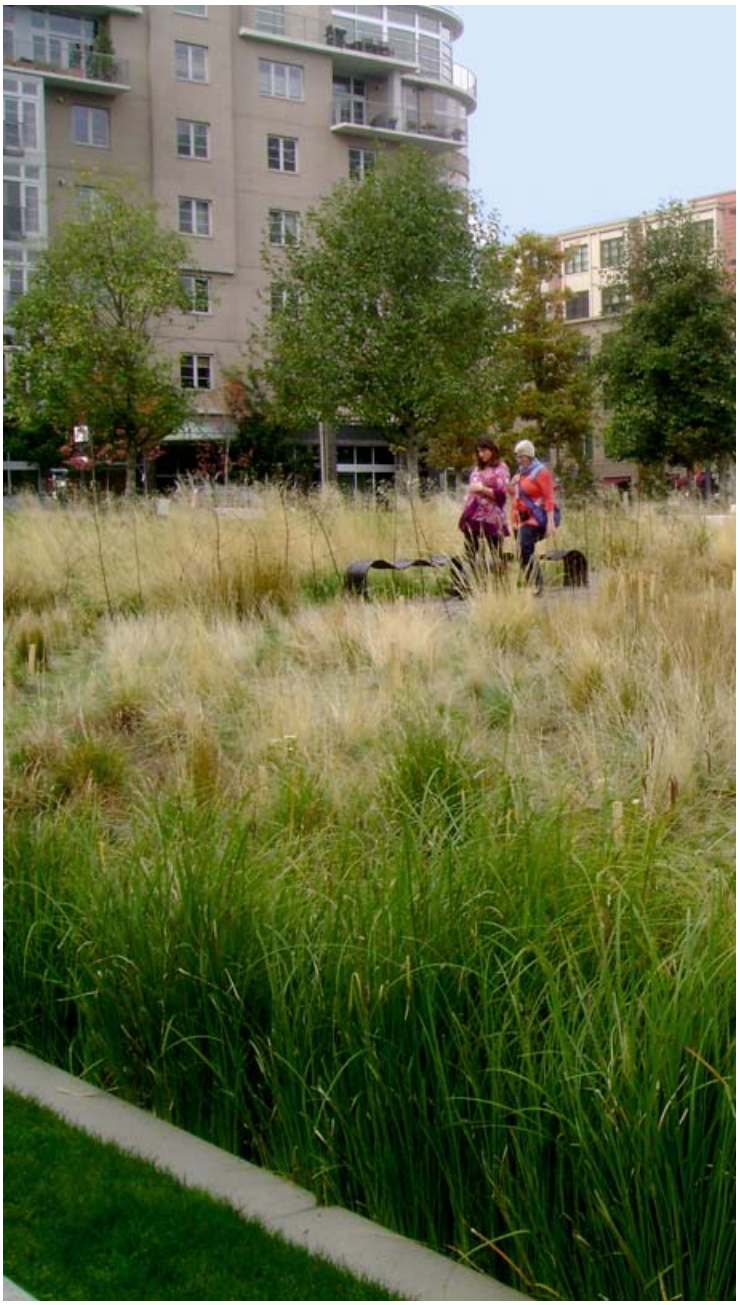
A 'Green Factor' for Portland, and Why it's Important



The more urban and technologically focused we as humans become, the more we have an intrinsic need to incorporate nature into our daily lives. We inherently seek a balance between mind, body, and nature for our physical and mental health. Nature is as essential to humans living in an urban environment as the streets, the buildings, and the variety of hardscapes that define the urban fabric of our cities. While nature is rarely treated as an afterthought in the development of our urban spaces, neither Is it often regarded as a key element.

The potential negative impacts of urban development on human health and well-being have been widely recognized. Planners have developed and implemented ways to mitigate and eliminate those impacts through zoning, building set backs, landscaping requirements, and other development codes. Although these approaches work, they do not assure healthy habitats for humans. The key to achieving a balance is the carefully and thoughtful integration of urban development and natural systems at all scales; from street level, to neighborhoods, communities, and throughout our region.

There is mounting evidence regarding the benefits that nature provides: patients who see trees from their hospital window recover faster and have fewer post-operative complications; children who can see trees from their classroom perform better on tests; residents who walk among trees and vegetation report a greater sense of belonging and well-being.

The type of nature that we need in our urban areas is not necessarily pristine or untouched by humans; it is close and accessible. It is as much the trees in the parking strip, vegetation on roofs, green street facilities, and pocket parks as it is large natural areas such as Forest Park. Providing even small, low-cost landscape areas will provide enormous benefits.

Seattle Washington, along with other forward-thinking cities in Europe and North America, has developed a Green Factor policy to provide broad community benefits by integrating nature into new development. Seattle's

Green Factor policy ensures more and higher quality landscaping is provided in conjunction with new development in more densely developed commercial and multi-family residential areas. The Seattle Green Factor was based on previous iterations developed in Berlin, Germany and Malmo, Sweden, and has since become a model used to develop a draft Green Factor for Washington, DC. Seattle's Green Factor couples an increased call for more and higher quality landscape areas with greater flexibility for designers and developers who are creating projects that are required to meet a variety of landscape codes. Implementing a similar program in Portland would result in more landscaped area, high quality landscape, and less impervious surfaces. Portland would reap a myriad of benefits, including;

- More overall landscape area which result in less paving and would also contribute to improved sustainable stormwater management for existing impervious area
- Additional green spaces for public enjoyment and improved health
- More, and higher quality, landscape areas for trees
- Increased vegetation for improved air and water quality
- Increased vegetation for mitigating climate change and reducing urban heat island
- Improved environmental health for the citizens of Portland

Developing a Portland Green Factor program would also provide an opportunity to integrate planning goals from other City planning efforts, such as: The Portland Plan, Central City 2035, Healthy Connected Neighborhoods, Portland Watershed Management Plan, the city's Climate Action Plan, Eco-district Planning, and others.

Implementing a Portland Green Factor provides an opportunity to review existing, prescriptive landscape code requirements and align them with Stormwater Management Manual and the new tree code. A collaboratively developed and comprehensive Portland Green Factor could result in clearer landscaping requirements that are easier for developers and designers to understand and meet. A Portland Green Factor may also provide a process for permit submittal that makes review by city staff easier and faster.

Additionally, a Portland Green Factor could provide instructions and guidance on how to ensure that a site is designed to meet aesthetic, environmental, stormwater, and sustainability goals. Aligning the goals of the various codes and stormwater requirements could help resolve conflicts while also improving the overall quality of the landscape in our urban environments.

In order to test the viability of a Green Area Factor for the City of Portland, it is useful to test the Seattle Green Factor scoring system against a small number of recently completed projects within the city of Portland. We selected four projects that are located in at least two different types of zoning to determine if the scoring factors are applicable to development within the city, and to help determine which scoring factors may need to be refined, added, or deleted in any early draft scoring systems for Portland. Before highlighting the results of our initial scoring, a brief history of the Green Factor scoring system may be helpful.

Seattle Green Factor – Seattle, Washington, USA

To combat sprawl and create thriving neighborhoods, Seattle's Comprehensive Plan identifies urban villages and directs growth to these areas. In 2006, the city revised standards for urban village commercial zones to strengthen business, improve walkability, and allow more residential uses. Because the changes would lead to greater density (and in some cases bigger or taller buildings), constituents wanted provisions to mitigate potential adverse effects. Planners began to explore options for a more robust landscaping requirement, which led to consideration of two European precedents; Berlin's Biotope Area Factor, and Malmo's Green Space Factor.

Code Development and Implementation

Starting with Berlin's scoring system and working in collaboration with private sector landscape architects and engineers, city staff developed a draft scoresheet adapted to the environmental, social, and regulatory context of Seattle. Throughout initial code writing and subsequent revisions, the three priorities of SGF have been:

- Livability. Use landscape amenities to create or maintain attractive, human-scale spaces in an increasingly dense urban environment.
- Ecosystem services. Encourage landscape elements that manage stormwater, improve air quality, increase energy efficiency in buildings, and provide habitat for birds and insects.
- Climate change adaptation. Build a more resilient city through landscapes that mitigate urban heat island effect and reduce flooding.

The scoresheet quantifies and tallies a range of landscape features, then divides the total by the parcel size to calculate approximate percent landscaped area. Thus, a score of 0.5 is roughly equivalent to 50 percent of a parcel being landscaped. The scoresheet includes conventional landscaping elements as well as green roofs and walls, permeable paving, tree preservation, and water features. Elements are weighted according to relative aesthetic and functional values, as determined through best available science and professional judgment. For example, canopy area of a preserved tree is multiplied by a factor of 0.8 while a newly planted tree would be multiplied by 0.4, and green roofs have a factor of 0.7 while permeable paving (lacking the same aesthetic, energy, and habitat benefits) is multiplied by 0.4.

In addition to credit weighting, SGF's structure creates two important incentives. First, it counts landscaping in the right-of-way the same as landscaping on private property, and provides a bonus credit for landscaping visible to the public. These provisions lead to greater investment in streetscape improvements. Second, designers maximize credits by layering vegetation—a tree with an understory of shrubs is worth more than a tree by itself. This leads to more lushly planted designs, which typically look better and provide greater ecological value.

To fine-tune the weighting and establish a minimum score for new development, case studies applied the scoresheet to projects built under conventional standards: How do average landscapes score? What other elements could they reasonably accommodate? It was found that commercial projects typically achieved scores between 0.05 and 0.15, but that a minimum score of 0.30 would lead to better results. Based on these findings, City Council adopted SGF into the Seattle Municipal Code with a minimum score of 0.30 for commercial zones in December 2006.

Implementation has required extensive collaboration between departments. Because SGF encourages planting in the right-of-way, it requires increased coordination between building and street use permit reviewers. Also, because it includes stormwater BMPs, it requires better alignment for the Land Use Code and the Stormwater Code, administered by different departments. This intra- and interdepartmental coordination continued over two years, and helped resolve other outstanding green infrastructure issues including unclear policies on permeable paving in rights-of-way and an outdated street tree list.

Branching Out

Approximately 200 projects have been permitted through SGF. Many are stalled due to the current recession, but about 30 are built or close to completion. Because SGF significantly raises the bar for landscaping in affected zones, landscape design now starts in the initial stages of site planning, allowing more collaboration between design professionals; the resulting landscapes are more attractive and better integrated into site programs and amenity areas.

The first generation of SGF projects also shows that the standard effectively encourages better streetscapes and use of new technologies. Two telltale signs identify SGF projects on paper and in the built environment: more vegetation in and adjacent to rights-of-way, and frequent use of green roofs, green walls, and permeable paving. Seventy-five percent of projects reviewed include green walls, fifty percent include green roofs, fifty percent include permeable paving, and every project has at least one of the three.

In 2009, the city updated SGF code language and issued a new policy paper clarifying the review process. Both actions were based on feedback from the design community and improved the ease of use for applicants and planners. The update also added new credits for food cultivation and structural soils, along with increased flexibility for green roofs and permeable paving. Further, the city expanded SGF to multifamily residential zones, and is considering further expansions.

Biotope Area Factor – Berlin, Germany

A "biotope" is defined as “an area of uniform environmental conditions providing a living place for specific plants and animals” , or in more direct terms it is habitat for a biological community of plants and animals. In urban settings biotopes have specific characteristics that provide ecological value that can be ranked and measured.

The Biotope Area Factor (BAF) is an innovative green urban infrastructure program that was developed, in part, in the 1980’s in West Berlin as part of an active green movement, reflecting national policies, such as the National Environmental Protection Law, that empowered local authorities to develop landscape plans for urban areas, including the Biotope Area Factor program. In 1994, the BAF was codified in Berlin and has become something of a template for similar programs in Malmo, Sweden and Seattle, Washington, USA.

The BAF is calculated for a development, and the individual landscape components of a site (biotopes) are weighted according to their value. According to the program an important goal of urban development in Berlin is the reduction of the environmental impact in the city center. Improving the ecosystem's function and promoting the development of biotopes, while maintaining the current land use, are central to this endeavor.

Similar to the urban planning approaches used in development planning, such as the gross floor area, the site occupancy index, and the floor space index, which regulate the dimensions of use structures, the BAF

expresses the portion of a plot of land that serves as a location for plants or assumes other functions for the ecosystem.

The BAF thereby contributes to standardizing and putting into concrete terms the following environmental quality goals:

- Safeguarding and improving the microclimate and atmospheric hygiene,
- Safeguarding and developing soil function and water balance,
- Creating and enhancing the quality of the plant and animal habitat,
- Improving the residential environment.

The BAF can be established with binding force in landscape plans for selected, similarly structured parts of the city.

The BAF is a simple performance based calculation that uses the following formula, along with weighting factors, to assign a value to all site areas:

$$BAF = \frac{\text{Ecologically-effective surface areas}}{\text{Total Land Area}}$$

Each plot of land can be designed in various ways. In principle, measures that lead to an expansion of the area of vegetation on the ground are given priority. Only then should additional possibilities, such as the replacement of asphalt and concrete with other surfaces, be utilized.

Green Space Factor – Malmo, Sweden

A Green Space Factor in Malmo Sweden was developed as part of a particular project, the Western Harbor. The first phase of the project, Bo01, developed a Green Space Factor that was adapted from the German model and refined to be more project specific. To give the developers some leeway in how they designed the projects, they created a Green Points system in addition to the Green Factor. They were given a list of 35 points and were required to choose 10 of them. Among the points, some focused on biodiversity while others focused on improving architectural qualities of the landscape or stormwater management.

After the first phase was completed, the city administration decided to revise the process due to widespread criticism of the lack of social achievements; The Bo01 development was so popular it was only affordable to a select few. The next phase of the Western Harbor district, Flagghusen, applied the Green Space Factor in a different way by making the minimum factor relative to the amount of building coverage; sites with 60% coverage had to achieve a .40 factor, whereas a building with 50% coverage had to achieve a .50 factor. The Green Points were also modified and only focused on biodiversity. The 35 points used in Bo01 were scrapped in favor of a list of biotopes, of which one type had to be selected for each project.

After the Flagghusen phase was completed, there was general disappointment in how the public spaces and courtyards were designed, which led to a third revision in 2009. A minimum factor was re-established, however many of the individual factors were lowered. For example, the factor for green roofs was lowered from 0.8 to 0.6 because the original phase of the project was designed to encourage the adoption of green roofs in Malmo.

While the factors and calculations required to meet the Malmo Green Space Factor are different from the Seattle Green Factor the overall intent and process is similar.

Green Area Ratio – Washington, DC

The Green Area Ratio (GAR) is an environmental site sustainability metric intended to set standards for landscape and site design that meet goals for stormwater runoff, air quality and urban heat island. The Green Area Ratio is based on achieving environmental performance by allowing a user to select from among optional elements in order to meet an overall GAR score. As of November, 2011, the GAR has not gone into effect, but it is currently going through the process of being tested and has been included in a 2012 draft of the zone code revisions.

The GAR is clearly based on the Seattle Green Factor, and uses a very similar scoring system, however there are a few major differences to be highlighted:

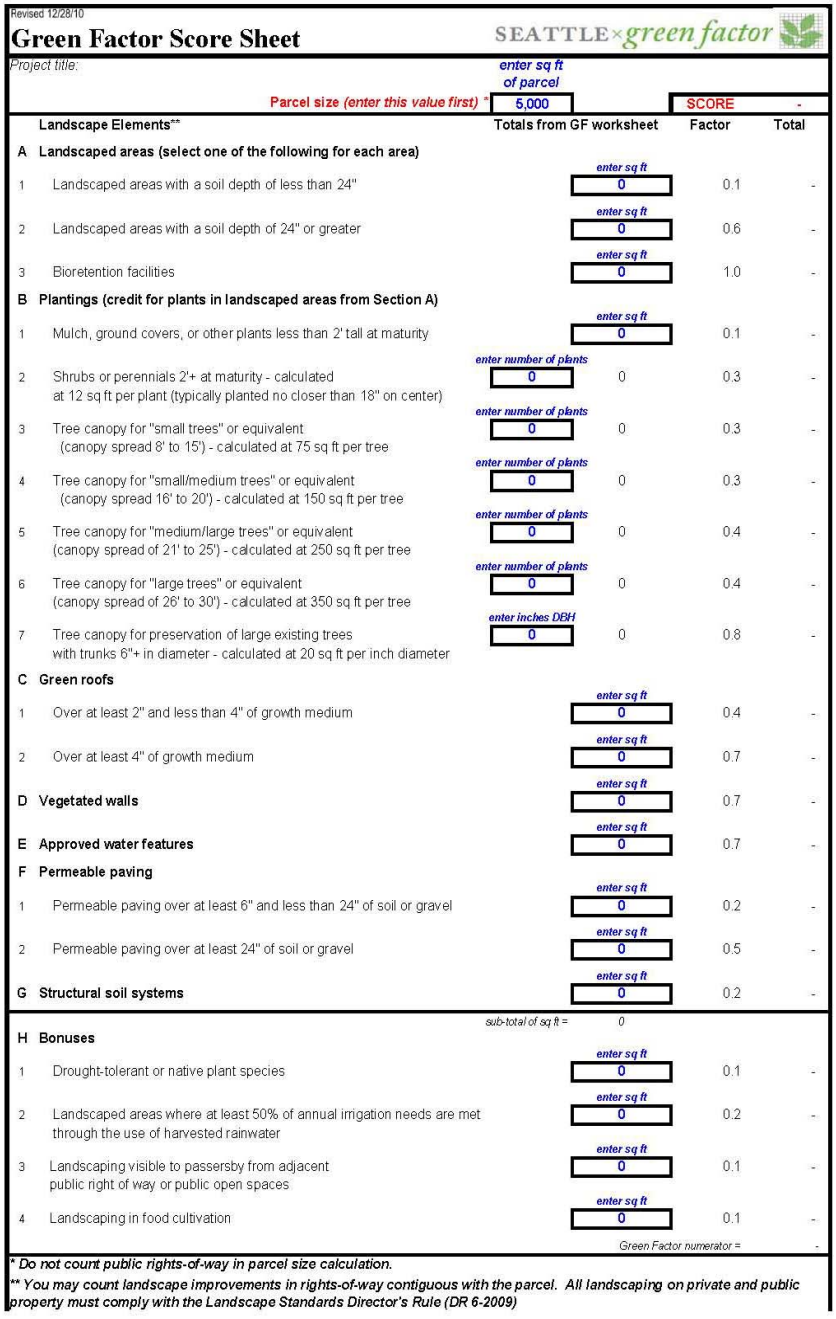
- The GAR does not allow the rights-of-way to be included in the calculations used for scoring
- Single Family homes have been specifically exempted from the GAR
- The values for most elements have changed slightly. Some of the key changes were:
    - higher values given to shallow soils in the landscape (less than 24-inches)
    - an increase in value given to mulch, groundcover, and other plants less than 2-feet at maturity;
    - an adjustment to all of the tree landscape elements to simplify the calculation by giving credit for caliper inches of the trunk vs. the mature size of the tree
    - reduced values for ecoroofs
    - higher values for permeable paving over shallow soils
    - reduced values for harvested rainwater

Another key difference is that each zoning type will have a green area ratio, whereas the SGF is only applied to a variety of multi-family residential or light commercial areas, rather than in the urban core.

Generally, it appears that the goal of the GAR is to encourage a higher amount of ground level landscape, although not necessarily focused on a higher quality. The higher values for deeper soils and low groundcover would allow for a site with less intensive, less mature landscape to achieve a passing score. Also, the reduction in values for vegetated roofs further focuses the need to have ground level landscape to achieve a passing score.

Understanding the Green Factor Scoring System

The Seattle Green Factor scoresheet quantifies and tallies a range of landscape features and then divides the total by the parcel size to calculate approximate percent landscaped area. Thus, a score of 0.5 is roughly equivalent to 50 percent of a parcel being landscaped. The scoresheet includes conventional landscaping elements as well as green roofs and walls, permeable paving, tree preservation, and water features. Elements are weighted according to relative aesthetic and functional values, as determined through best available science and professional judgment. For example, canopy area of a preserved tree is multiplied by a factor of 0.8 while a newly planted tree would be multiplied by 0.4, and green roofs have a factor of 0.7 while permeable paving (lacking the same aesthetic, energy, and habitat benefits) is multiplied by 0.4.



Revised 12/28/10

Green Factor Score Sheet SEATTLE×green factor

Project title:

		enter sq ft of parcel			
	Parcel size *(enter this value first)* *	5,000		SCORE	-
	Landscape Elements**	**Totals from GF worksheet**		**Factor**	**Total**
A	**Landscaped areas (select one of the following for each area)**				
1	Landscaped areas with a soil depth of less than 24"	enter sq ft: 0		0.1	-
2	Landscaped areas with a soil depth of 24" or greater	enter sq ft: 0		0.6	-
3	Bioretention facilities	enter sq ft: 0		1.0	-
B	**Plantings (credit for plants in landscaped areas from Section A)**				
1	Mulch, ground covers, or other plants less than 2' tall at maturity	enter sq ft: 0		0.1	-
2	Shrubs or perennials 2'+ at maturity - calculated at 12 sq ft per plant (typically planted no closer than 18" on center)	enter number of plants: 0	0	0.3	-
3	Tree canopy for "small trees" or equivalent (canopy spread 8' to 15') - calculated at 75 sq ft per tree	enter number of plants: 0	0	0.3	-
4	Tree canopy for "small/medium trees" or equivalent (canopy spread 16' to 20') - calculated at 150 sq ft per tree	enter number of plants: 0	0	0.3	-
5	Tree canopy for "medium/large trees" or equivalent (canopy spread of 21' to 25') - calculated at 250 sq ft per tree	enter number of plants: 0	0	0.4	-
6	Tree canopy for "large trees" or equivalent (canopy spread of 26' to 30') - calculated at 350 sq ft per tree	enter number of plants: 0	0	0.4	-
7	Tree canopy for preservation of large existing trees with trunks 6"+ in diameter - calculated at 20 sq ft per inch diameter	enter inches DBH: 0	0	0.8	-
C	**Green roofs**				
1	Over at least 2" and less than 4" of growth medium	enter sq ft: 0		0.4	-
2	Over at least 4" of growth medium	enter sq ft: 0		0.7	-
D	**Vegetated walls**	enter sq ft: 0		0.7	-
E	**Approved water features**	enter sq ft: 0		0.7	-
F	**Permeable paving**				
1	Permeable paving over at least 6" and less than 24" of soil or gravel	enter sq ft: 0		0.2	-
2	Permeable paving over at least 24" of soil or gravel	enter sq ft: 0		0.5	-
G	**Structural soil systems**	enter sq ft: 0		0.2	-
		sub-total of sq ft =	*0*		
H	**Bonuses**				
1	Drought-tolerant or native plant species	enter sq ft: 0		0.1	-
2	Landscaped areas where at least 50% of annual irrigation needs are met through the use of harvested rainwater	enter sq ft: 0		0.2	-
3	Landscaping visible to passersby from adjacent public right of way or public open spaces	enter sq ft: 0		0.1	-
4	Landscaping in food cultivation	enter sq ft: 0		0.1	-
				Green Factor numerator =	-

** Do not count public rights-of-way in parcel size calculation.*

*** You may count landscape improvements in rights-of-way contiguous with the parcel. All landscaping on private and public property must comply with the Landscape Standards Director's Rule (DR 6-2009)*

Through a number of case studies, Seattle planners determined a minimum score of .30 should be applied to commercial or dense mixed-use areas, and .40 or .60 to multi-family residential areas. These same minimums were used with the four pilot projects in this study.

The Scoring Sheet is broken into 8 main sections designated by letters (A through H). Each section addresses specific site landscape elements that can be calculated to achieve the overall target score. For example, Section A, Landscape Areas, has three landscape types that can be used to describe any landscape area that is not a vegetated roof or vegetated wall (calculated in sections C and D, respectively). Any landscape area on the plan can be calculated using only one of the types. For example, if a stormwater bioretention facility was calculated through section A.3, it could not also be included in section A.1, even if the facility was more than 24 inches deep. Section B, Plantings, is then used to calculate the quality of the landscape areas designated in Section A. Larger shrubs and trees are given higher scores, so more densely planted, larger shrubs will get a higher scoring factor than low, sparsely planted groundcover. Existing canopy trees that are preserved are more highly valued than planting large canopy trees, shown in Section B.7.

Section C, Vegetated roofs, is intended to be used to calculate extensive and shallow intensive roofs. Roof gardens, which can often have soils 12 to 18-inches deep, or deeper, can be calculated in either Section A, or Section C, but not both. If an applicant decides to score a garden roof in Section C, they cannot score points in Section B, Plantings. Therefore, there has been some confusion with the SGF by applicants on how to score a Garden Roof. This issue became apparent on two of the pilot projects in this report.

Portland Green Factor Pilot Projects

To illustrate both challenges and the potential benefits of a Green Factor policy for Portland, we scored four recently completed projects within the City of Portland with the Seattle Green Factor. The intent was to select a variety of project types and locations that could highlight both the benefits and the challenges of implementing a Green Factor in Portland. The four projects selected are:

Project Name	Project Type	Target Score	Score Achieved
1st & Main	Urban, Multi-story Commercial/Office	.30	.29
The Ramona	Urban, Multi-story, Multi-family	.30	.37
Tupelo Alley	Neighborhood, Multi-story, Mixed Use	.30	.19
SE Foster Housing	Neighborhood, Multi-family	.60	.45

The result of the four sample projects was that three failed to achieve enough points to pass the minimum score required. The following pages include aerial views, photographs, site plans, and some observations as to why each project may have passed or failed. Some of the reasons for failure highlight the opportunities to improve the quality of the landscape in Portland, as well as how we could design a scoring system to more closely align with our goals as a city as outlined in several of our most recent planning efforts.

Thoughts and conclusions on how the city can begin the process of developing a Portland Green Factor, and how it could benefit both existing and future policy and planning efforts are included after the projects.

For a complete spreadsheet of how the projects scored, see Appendix A on page 29.

The site plans and images for the following were collected from a number of sources, including Google Maps, Flickr, BES photo archives, and project designers. BES staff made every effort to be accurate in calculating the scores reflected on the spreadsheet shown in Appendix A, however many of the areas and plant counts had to be general in nature due to the source material. The goal was to get a general sense of how these projects would score on the SGF, but it is feasible that the scores reflected would be adjusted up or down slightly with more accurate data.

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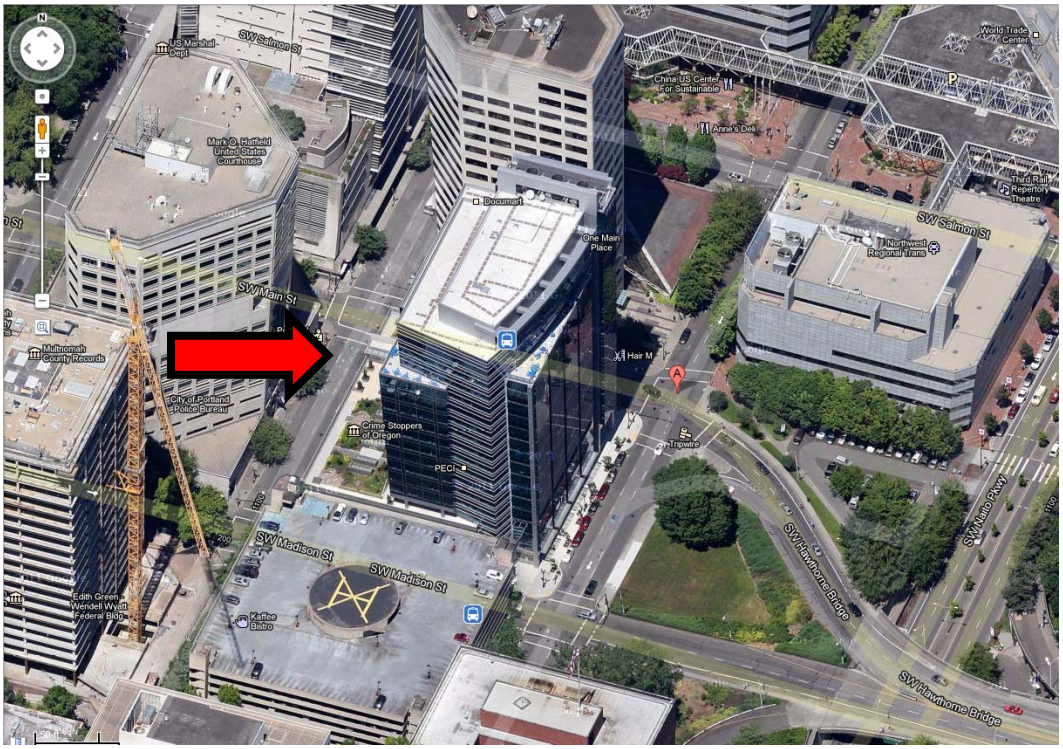
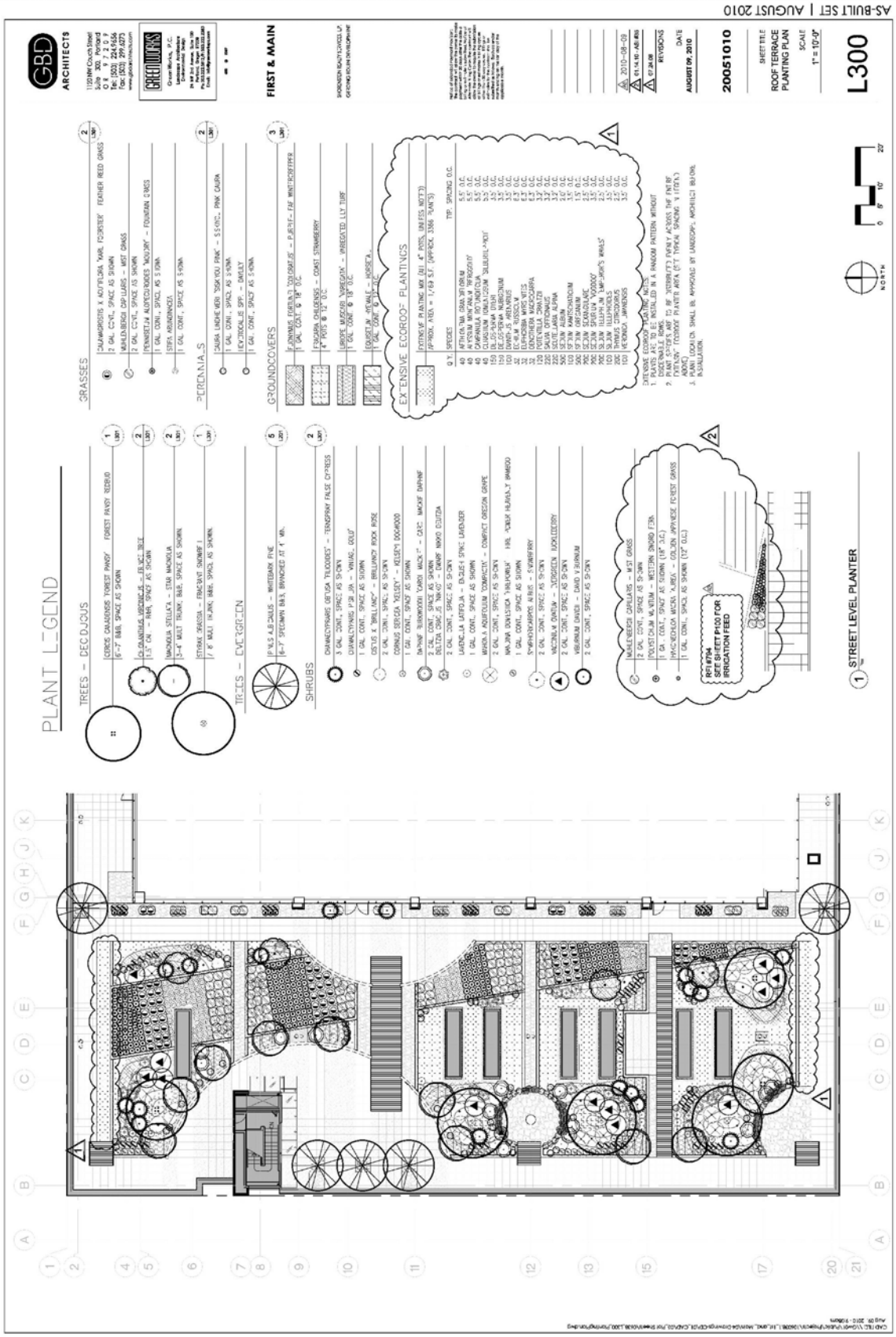
First & Main – 100 SW Main Street, Portland, Oregon

Parcel Size -	38,318 SF	SGF Target Score -	.30
Parcel Zone -	CX – Central Commercial	SGF Result Score -	.29 (See Appendix A for Complete Score)

This office/retail building was chosen because of its location in the downtown, urban core of Portland. The full-block building has an intensive ecoroof/roof-garden with minimal landscape at street level, including in the rights-of-way. The combination of minimal street-level landscape and a partial ecoroof is similar to many recent urban core buildings, leading us to conclude that this would be a good test project.



Roof Plan


AS-BUILT SET | AUGUST 2010
GBD ARCHITECTS
GREENWORKS
PLANT LEGEND
TREES – DECIDUOUS
TREES – EVERGREEN
SHRUBS
GRASSES
PERENNIALS
GROUNDCOVERS
EXTENSIVE ECOROOF PLANTINGS
FIRST & MAIN
L300
20051010
ROOF TERRACE PLANTING PLAN
AUGUST 09, 2010
STREET LEVEL PLANTER

Observations

The SW 1st & SW Main project very nearly meets the SGF minimum .30 score for a dense, urban environment. Because the scoring process allows designers the ability to count vegetated roofs in either categories A and B, or C (see pages 7 and 8 for explanation of the categories), the deeper soil areas with larger plant material could be counted in a similar manner as on-the-ground landscape areas. However, testing the roof scoring in both ways, more points were gained using category C in this case. This highlights the value of vegetated roofs in the scoring system.

Comparing this to the Tupelo Alley project, which scored better in categories A and B, the conclusion is that the lack of clarity in how to score an intensive vegetated roof in the SGF highlights the need to clearly define how vegetated roofs should be scored. This sentiment was echoed by the administrators of the Seattle Green Factor and is one of the items being considered for revision in the next iteration.

Additionally, this project highlighted the challenge in achieving a passing score in dense, urban sites that utilize 100 percent of the site area for buildings. Additional plantings in the tree wells, or on the ground plane, may have helped this project to pass.

Some potential design changes that would help this project to pass the SGF could be:

- Rather than use grated tree wells, plantings would have provided approximate 650 additional square feet of ground-level landscape.
- An extensive ecoroof on the top floor could have added approximately 15,000-20,000 SF of additional vegetated space.
- Less paving on the lower vegetated roof would provide more vegetated areas.

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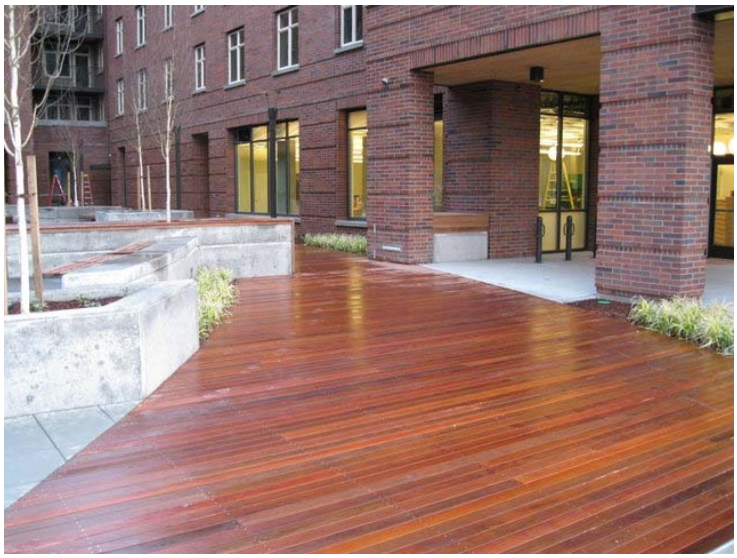
The Ramona – 1550 NW 14th Ave., Portland, Oregon

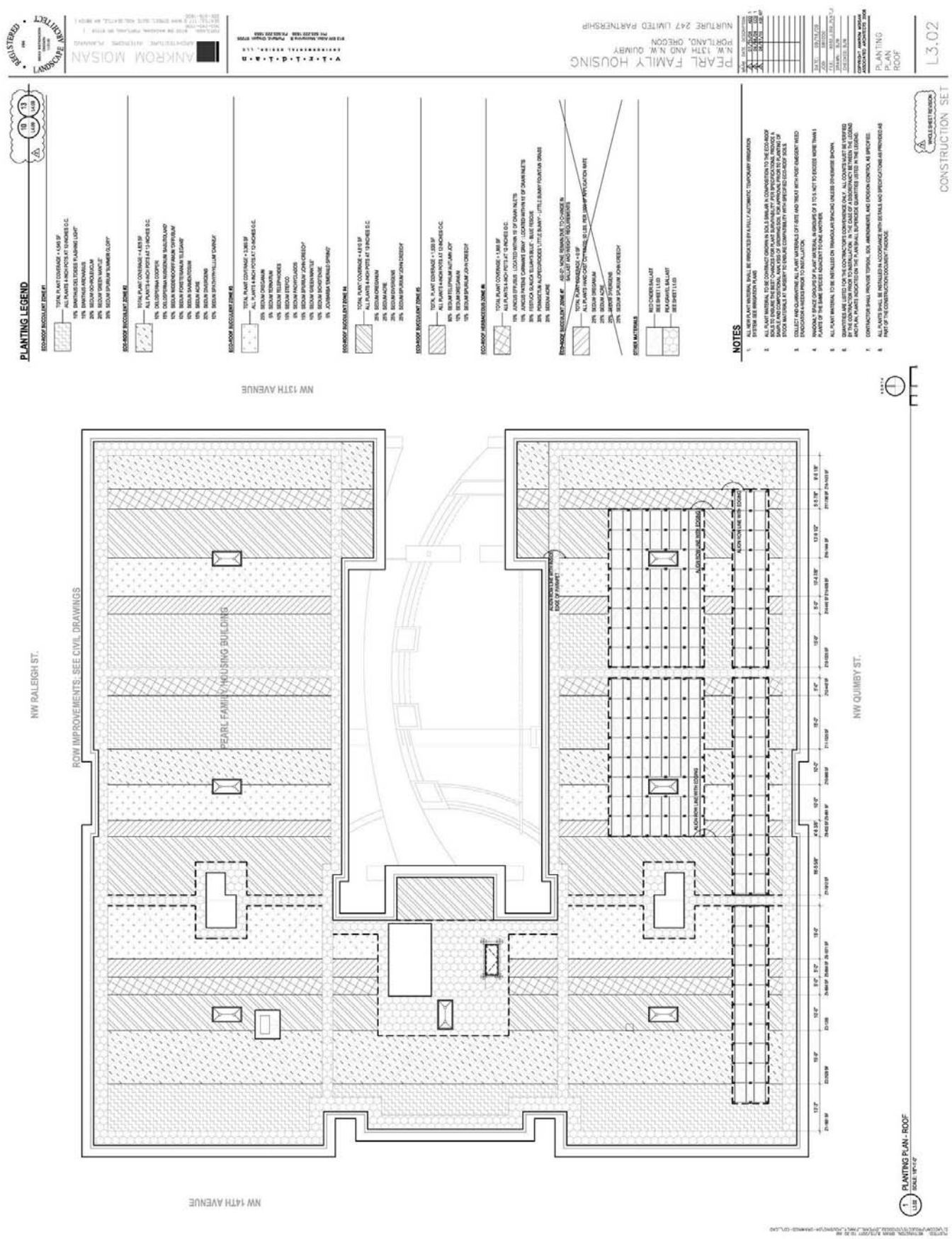
Parcel Size -	40,000 SF	SGF Target Score -	.30
Parcel Zone -	EX – Central Employment	SGF Result Score -	.37 (See Appendix A for Complete Score)

The Ramona is a six-story residential and community building located in the Pearl District of Portland. The development is located in an area similar to the IC zone (within an Urban Village) for the SGF, and is one of a mix of high-density residential buildings.

This project was selected because it is a full block building with an extensive vegetated roof, a stormwater courtyard that is accessible from the ground floor, and tree wells and a green street within the rights-of-way. Almost all of the 40,000 square feet of the project is covered in either extensive vegetated roof or intensive vegetated roof over parking deck. The project was built without a conventional mechanical stormwater treatment system.



Site Plan (Roof Plan)



Observations

The combination of the extensive vegetated roof, the stormwater treatment facilities and planted areas in the courtyard, and the trees and greenstreet facility with the right-of-way helped this project pass the Seattle Green Factor.

One of the interesting issues brought to light by scoring this project was the large amount of ballasted roof used for walking paths and under low-sloping photo-voltaic panels. Due to structural issues inherent on a wood-framed building, nearly 25% of the roof had to be designed with lighter-weight ballast. There is no accommodation in the Seattle Green Factor for the ballasted section of ecoroofs or how it should be accounted for in scoring. While ballast does not necessarily improve the visual quality of a site, it may be preferable to an exposed membrane roof.

Some issues raised from studying this site include:

- How should ballast on vegetated roofs be scored? On this roof, the ballasted area was excluded from the square footage calculations.
- How should pavers, or other pedestrian areas on roofs, be scored? Are they preferable, from a visual quality standpoint, to conventionally roofed buildings?
- Are there ways to utilize a Green Factor to encourage alternative stormwater treatment designs that can improve visual quality both on-site and in the rights-of-way?

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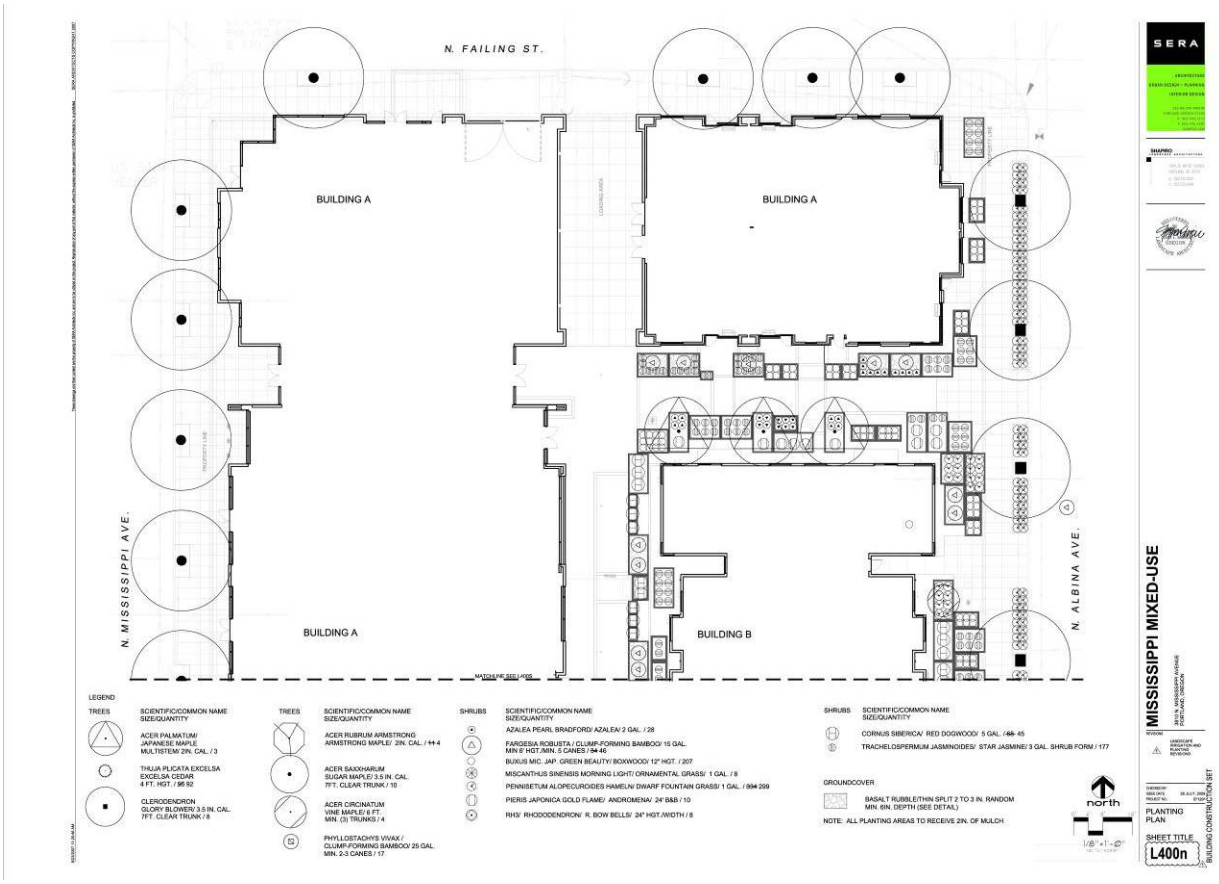
Tupelo Alley – 3850 N Mississippi Ave., Portland, Oregon

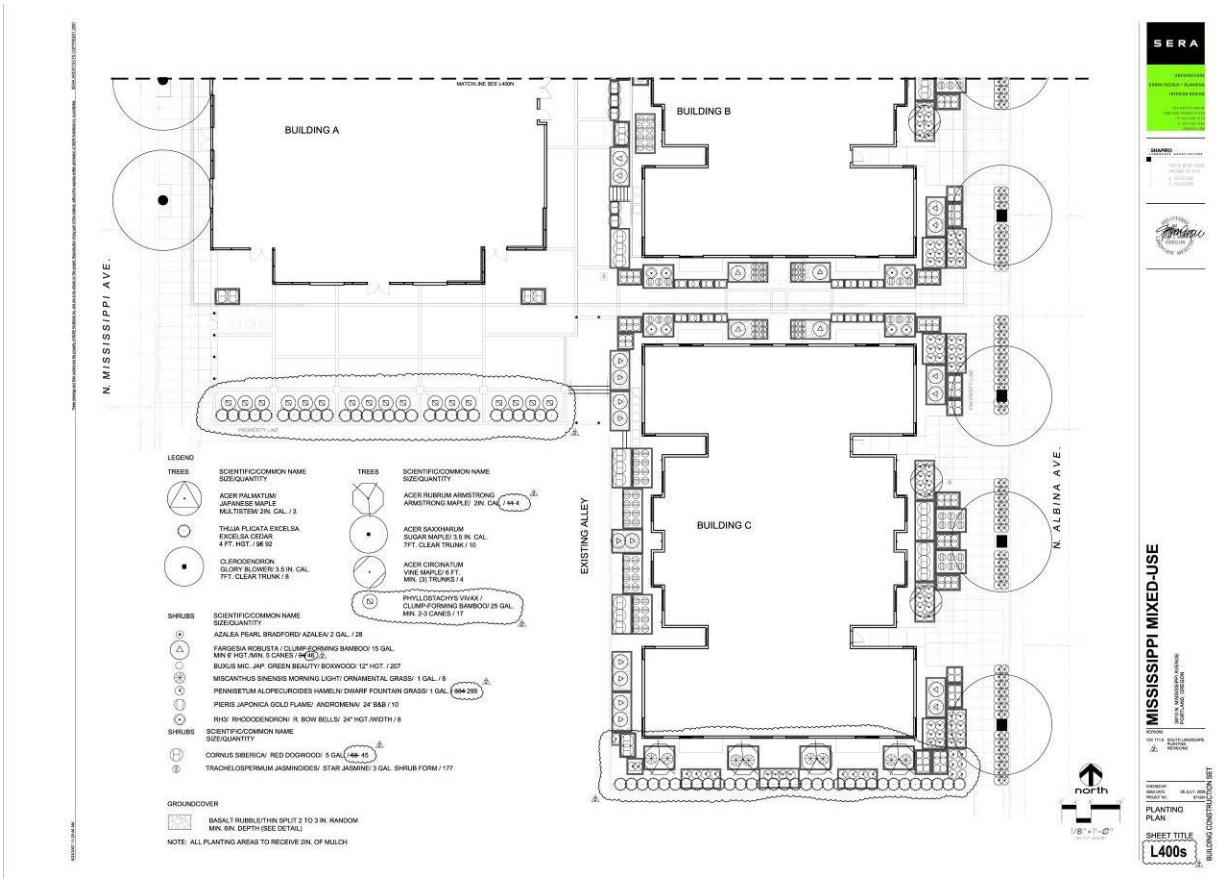
Parcel Size -	62,500	SGF Target Score -	.30
Parcel Zone -	CX – Central Commercial	SGF Result Score -	.19 (See Appendix A for Complete Score)

The Tupelo Alley project is a mix of one four story, mixed-use residential and retail building, and two smaller multi-family residential buildings located on N Mississippi Ave. in North Portland. The zoning is the same as The Ramona, although it is located outside of the downtown area of Portland, in an area that would be considered similar to the MR and HR zones in the SGF, or perhaps the IC zone within an Urban Village.

This project was selected because of its location in an actively developing area near downtown Portland and because it has a significant below-grade parking structure and ground-floor pedestrian and public areas.

Site Plans


N. FAILING ST.
BUILDING A
BUILDING A
BUILDING A
BUILDING B
N. MISSISSIPPI AVE.
N. ALBINA AVE.
MATCHLINE SEE L400S
LEGEND
TREES
SCIENTIFIC/COMMON NAME
SIZE/QUANTITY
ACER PALMATUM/
JAPANESE MAPLE
MULTISTEM/ 2IN. CAL. / 3
THUJA PLICATA EXCELSA
EXCELSA CEDAR
4 FT. HGT. / 96 92
CLERODENDRON
GLORY BLOWER/ 3.5 IN. CAL.
7FT. CLEAR TRUNK / 8
ACER RUBRUM ARMSTRONG
ARMSTRONG MAPLE/ 2IN. CAL. / 44 4
ACER SAXXHARUM
SUGAR MAPLE/ 3.5 IN. CAL.
7FT. CLEAR TRUNK / 10
ACER CIRCINATUM
VINE MAPLE/ 6 FT.
MIN. (3) TRUNKS / 4
PHYLLOSTACHYS VIVAX /
CLUMP-FORMING BAMBOO/ 25 GAL.
MIN. 2-3 CANES / 17
SHRUBS
AZALEA PEARL BRADFORD/ AZALEA/ 2 GAL. / 28
FARGESIA ROBUSTA / CLUMP-FORMING BAMBOO/ 15 GAL.
MIN 6' HGT./MIN. 5 CANES / 94 46
BUXUS MIC. JAP. GREEN BEAUTY/ BOXWOOD/ 12" HGT. / 207
MISCANTHUS SINENSIS MORNING LIGHT/ ORNAMENTAL GRASS/ 1 GAL. / 8
PENNISETUM ALOPECUROIDES HAMELN/ DWARF FOUNTAIN GRASS/ 1 GAL. / 93 299
PIERIS JAPONICA GOLD FLAME/ ANDROMENA/ 24" B&B / 10
RHS/ RHODODENDRON/ R. BOW BELLS/ 24" HGT./WIDTH / 8
SHRUBS
CORNUS SIBERICA/ RED DOGWOOD/ 5 GAL. / 48 45
TRACHELOSPERMUM JASMINOIDES/ STAR JASMINE/ 3 GAL. SHRUB FORM / 177
GROUNDCOVER
BASALT RUBBLE/THIN SPLIT 2 TO 3 IN. RANDOM
MIN. 6IN. DEPTH (SEE DETAIL)
NOTE: ALL PLANTING AREAS TO RECEIVE 2IN. OF MULCH
north
SERA
MISSISSIPPI MIXED-USE
PLANTING PLAN
SHEET TITLE
L400n
BUILDING CONSTRUCTION SET


MATCHLINE SEE L400N
BUILDING A
BUILDING B
BUILDING C
EXISTING ALLEY
N. MISSISSIPPI AVE.
N. ALBINA AVE.
LEGEND
TREES
SCIENTIFIC/COMMON NAME
SIZE/QUANTITY
ACER PALMATUM/
JAPANESE MAPLE
MULTISTEM/ 2IN. CAL. / 3
THUJA PLICATA EXCELSA
EXCELSA CEDAR
4 FT. HGT. / 96 92
CLERODENDRON
GLORY BLOWER/ 3.5 IN. CAL.
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ARMSTRONG MAPLE/ 2IN. CAL. / 44 4
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SUGAR MAPLE/ 3.5 IN. CAL.
7FT. CLEAR TRUNK / 10
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GROUNDCOVER
BASALT RUBBLE/THIN SPLIT 2 TO 3 IN. RANDOM
MIN. 6IN. DEPTH (SEE DETAIL)
NOTE: ALL PLANTING AREAS TO RECEIVE 2IN. OF MULCH
north
SERA
MISSISSIPPI MIXED-USE
PLANTING PLAN
SHEET TITLE
L400s
BUILDING CONSTRUCTION SET

Observations

Tupelo Alley was a challenging project to score because the majority of the project is on a parking deck over a garage. In the same way that the Ramona vegetated roof could either be scored in the A & B categories, or the C category, this site had to be scored in both ways to determine which approach would net the better score. Even with the alternative ways of scoring this project, it still failed by a significant amount.

The ground-level landscape is at the same grade as surrounding streets but because the pedestrian and planting areas are over a parking deck the depth of the soil was greatly limited. The landscape that was installed is of good quality, but because the soils are shallow a large number of concrete planters were used to create deeper planting areas. However, the relatively small dimensions of the planters limit the amount of square footage that could be used for planting.

An additional element that made this site interesting, from a pilot perspective, is the relatively large area of pervious paving on the west side of the site, along N Mississippi Ave. It did have a sizable contribution to the overall score while still allowing an open, pedestrian accessible area adjacent to a commercial/retail business.

It appears that one of the key reasons this project doesn't meet the SGF is the relatively small amount of landscape area given the overall footprint of the site. Of the sites that were studied, this one made the best use of the rights-of-way in terms of including shrubs and groundcover within the tree wells. The sizes of the tree wells are significantly larger than a typical urban site. However, even though the amount and quality of landscape greatly improved the aesthetics of the site over a more traditional zero-lot-line development, a reduction in the number of concrete planter walls and impervious hardscape could have helped the project achieve a better score.

Some potential design changes that would allow this project to pass the SGF could be:

- Reduce the number of walls by providing larger contiguous planters, allowing for more landscape area at a greater depth, and a higher number of larger shrubs and groundcover.
- Reduce the amount of hardscape paving between buildings, or convert it to pervious paving in a manner similar to the area along N Mississippi Avenue.
- Install an extensive vegetated roof on at least one of the buildings.
- If the raised planters had been used for stormwater treatment, they would have received a higher score. If any of the on-site landscape areas had utilized stormwater treatment, they would have received scoring for "bioretention" facilities in category .
- Unique to this site is a below grade parking garage, which more or less penalizes the project. Deeper soils would have allowed many of the on-grade landscape areas to score higher.

Some issues raised from studying this site include:

- Sites that utilize below grade parking, with intensive gardens above, are penalized to some degree. Because the developer is greatly reducing the visual impact of parking on a site, thereby making it much denser, there should be some benefit given to provide multiple sustainable/social benefits in a smaller footprint. Underground parking should be encouraged.

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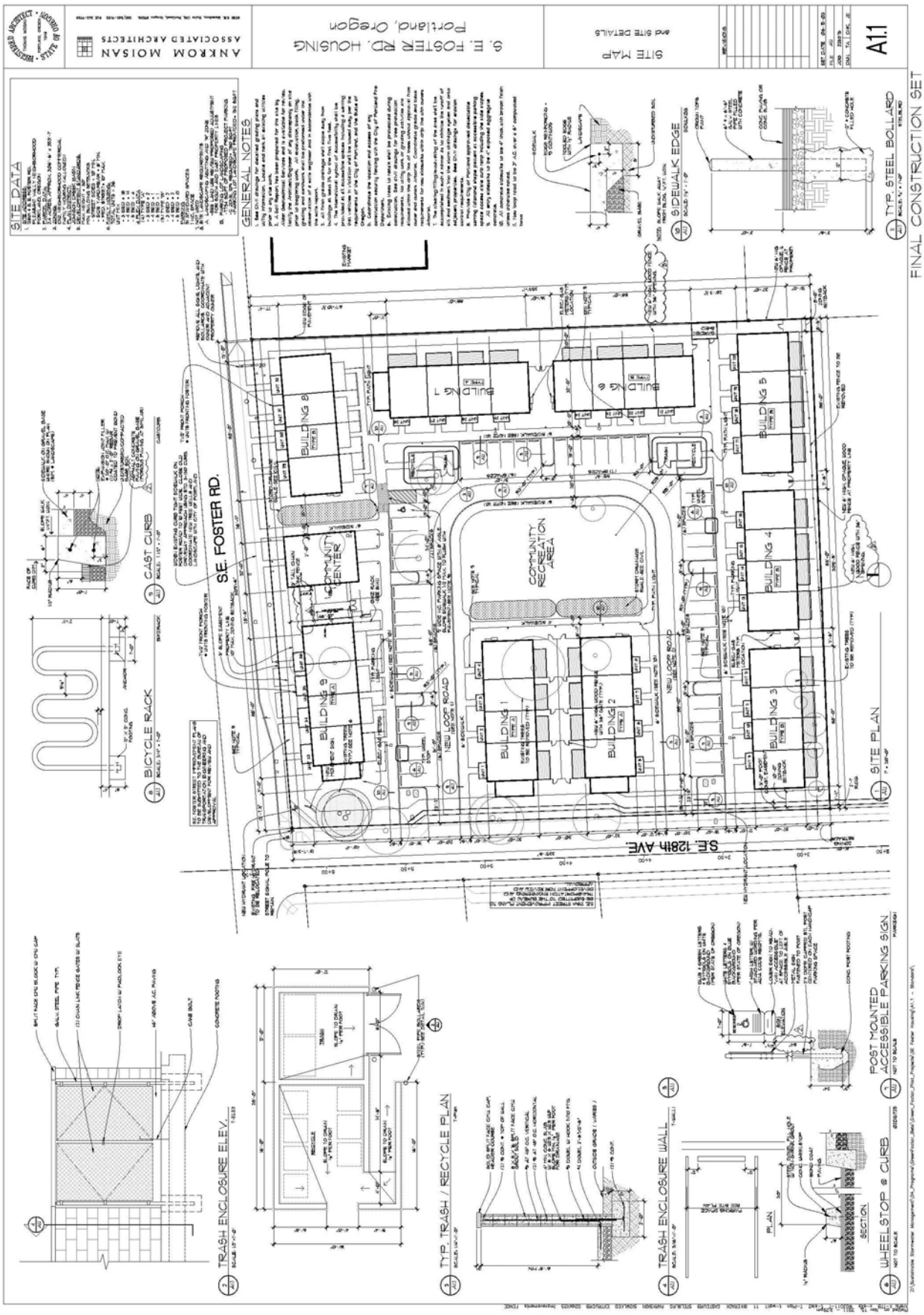
SE Foster Housing, SE 128th & SE Foster, Portland, Oregon

Parcel Size -	107,115 SF	SGF Target Score -	.60
Parcel Zone -	CN2 – Neighborhood Comm	SGF Result Score -	.40 (See Appendix A for Complete Score)

The SE Foster Housing project was included as a sample project because it is located in a mixed single family and multi-family residential community on the outskirts of Portland. The larger lot size and multiple-building layout around a parking lot is more typical of a development in the lower density residential areas. This project is an good example of a project with significantly more land area dedicated to landscape than the previous projects located in denser areas. Also, this project was developed recently enough to require compliance with current stormwater standards. The site is designed to convey water to swales and infiltration basins at the center of the site.

Site Plan


A1.1
SITE MAP
and SITE DETAILS
S. E. FOSTER RD. HOUSING
Portland, Oregon
ANKROM MOISAN
ASSOCIATED ARCHITECTS
SITE DATA
GENERAL NOTES
SE. FOSTER RD.
SE. 128th AVE.
NEW LOOP ROAD
COMMUNITY CENTER
COMMUNITY RECREATION AREA
BUILDING 1
BUILDING 2
BUILDING 3
BUILDING 4
BUILDING 5
BUILDING 6
BUILDING 7
BUILDING 8
BUILDING 9
SITE PLAN
CAST CURB
BICYCLE RACK
SIDEWALK EDGE
TYP. STEEL BOLLARD
TRASH ENCLOSURE ELEV.
TYP. TRASH / RECYCLE PLAN
TRASH ENCLOSURE WALL
POST MOUNTED ACCESSIBLE PARKING SIGN
WHEELSTOP @ CURB
FINAL CONSTRUCTION SET

Observations

The SE Foster Housing project is the only one of the group is be located in area that corresponds to Seattle's low-density area, therefore it would need to achieve a score of .60 to pass. The final score for the project was .40.

Current zoning requires that 15% of the site remain in landscape areas, however this site retains nearly 25% open space (green space), and yet still falls short of the minimum score. In review of the site, it appears that the developer chose to install less woody shrub and groundcover material and more lawn and bark-mulch. The abundance of low-quality groundcover contributed to a lower score. If they had installed a wider variety of larger landscape shrubs, less lawn, and included more on-site stormwater management facilities of a higher quality, they may have been able to achieve the .60 factor.

Some potential design changes that would allow this project to pass the SGF could be:

- Increase quantity and size of larger shrubs.
- Convert some impervious area, such as parking stalls or plaza spaces, to pervious paving.
- Reduce paved area in lieu of landscape area.

Some issues raised from studying this site include:

- Sites that are required to meet the .60 factor may have to significantly exceed minimum open space requirements currently called for in our development code, or rely on pervious paving and ecoroofs.
- Parking space requirements, and lot dimensional requirements, will likely be in direct conflict with the effort to reduce impervious areas.

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Thoughts & Conclusions

Overall, the choice of projects was meant to test current design and development practices in the more dense areas of Portland. The pilot projects show that some small changes to the design process to provide higher quality landscape could help future developments pass the Portland Green Factor. In the case of Tupelo Alley, it is clear that there are specific nuances and planning/zoning goals that would require us to revise the scoring factors to more closely fit the needs of Portland.

Additional Observations

1. Determining how a Portland Green Factor would provide benefits for local developers and property owners will be important. Seattle worked closely with the development community in creating and refining scoring factors that provided valuable landscape benefits while also helping developers to complete projects in an equitable manner.
2. Developing appropriate targets for each zone and building type, along with adjusting factor values to target landscape and planning goals, could help to ameliorate the challenges of applying a Green Factor in dense urban environments while still providing a tremendous benefit in terms of increased quality and quantity of landscape.
3. The BAF and Green Space Factor (Malmo) simplifies the vegetation factor by creating only 3 factors influenced by soils. Understanding the reasoning may help in designing a scoring system that is more simple than the Seattle Green Factor.
4. The SGF does not give credit for deeper soil or larger plantings on roofs because they want a higher quality ground-level landscape that is viewable to more people. As a result, vegetated roofs with deeper soils don't have any more value than a 4-inch, extensive roof. This may be desirable from a "quality" of landscape-at-ground-level approach, but does not necessarily benefit overall ecosystem and habitat health. If there is more emphasis desired to improve the overall quality of habitat, there could be more benefit given to high quality landscape on roofs or areas out of the public realm.
5. The SWMM started as a simplified prescriptive method to determining whether or not a site is responsibly managing stormwater and has become more complex over time. In a similar way, the SGF is based on the BAF and has become more complicated with additional factors meant to give credit to a wider variety of solutions.
6. A Portland Green Factor could be used to help the city achieve specific density goals in a more fined-grained manner than just through zoning and FAR ratios.
7. Would it be possible to create a factor/category for use in Industrial Zones? Is this desirable? It may be useful as a tool to encourage the development of vegetated roofs in industrial zones.

Some Potential Simple Changes, or Additions, to the SGF for use in the Portland Factor

1. Give Bonus Factors for percentage of open (or green) space in relation to overall parcel size (ie, 0-10% = .10, 10.1-25%=.20, 25.1%-50=.30, 50.1-100=.40, etc.)
2. Add factors that are aligned with the goals SWMM to give value to systems that provide multiple benefits.
3. Simplify the tree credits with mature canopy diameter (ie, 15-25 mature canopy spread instead of "medium"), or tie it directly to the Urban Forestry Portland plant/tree lists.
4. Add a bonus factor for complete vegetated coverage (as a way to encourage roofs dese areas).
5. Determine how ballast may be accounted for on vegetated roofs. There may structural or maintenance needs that require non-vegetated zones, but that still provide benefit over a membrane roof.
6. For new construction, include a separate ballast roof factor (very low, .05) in coordination with vegetation for roofs that have higher ballast-to-vegetation ratios (perhaps due to weight factors), or at least take into account that certain building types are less likely to have eco-roofs due to structural concerns.

7. Clarify points for landscape over below-grade parking structures, but still being visible and accessible at ground level.
8. Bonus points for providing public access to vegetated roofs.
9. Bonus points for multiple benefits within single spaces (ie, ecoroofs and solar applications).

Some Potential Complex Changes, or Additions, to the SGF for use in the Portland Factor

1. The SGF does not take into account the existing condition of the site prior to development. A method to develop a factor for more urban areas may include weighting a project based on pre-development conditions (ie. a highly degraded, or contaminated site, may get a higher credit for cleaning the site prior to development of a higher-quality landscaped site).
    a. The BAF does this by calculating an EEA (**E**cologically **E**ffective surface **A**rea) for both existing development and proposed development, although it doesn't appear to use the existing number in the calculation in any way.
2. Lower factor values for systems that require carbon-intensive widget, or systems to function.
    a. For example, vegetated walls get the highest .70 factor, but may require product-intensive systems, permanent irrigation, and high maintenance to remain functional. One solution may be to split into soil-based vegetated walls (keep at .70) and product-based walls (.40), or some variation thereof. Another solution would be to remove them from the alternatives.
3. Revise weighting factor values to reflect which factors are most important to the City of Portland; for instance, vegetated roofs and walls, and approved water features are all weighted as .70 for SGF.

Incorporating Title 33 and Title 17 Landscape Requirements into a Portland Green Factor

Currently, Title 33 of the Planning and Zoning code has a number of sections that include landscape requirements, most of which reference section 33.248, the Landscape and Screening section of the code. This code is prescriptive based in that it has clear requirements for "x" number of trees per liner foot of "y" or "n" number of shrubs per "z" square footage of parking. This section is also tightly integrated with section 33.266, Parking and Loading, due to interior and edge landscaping and screening requirements.

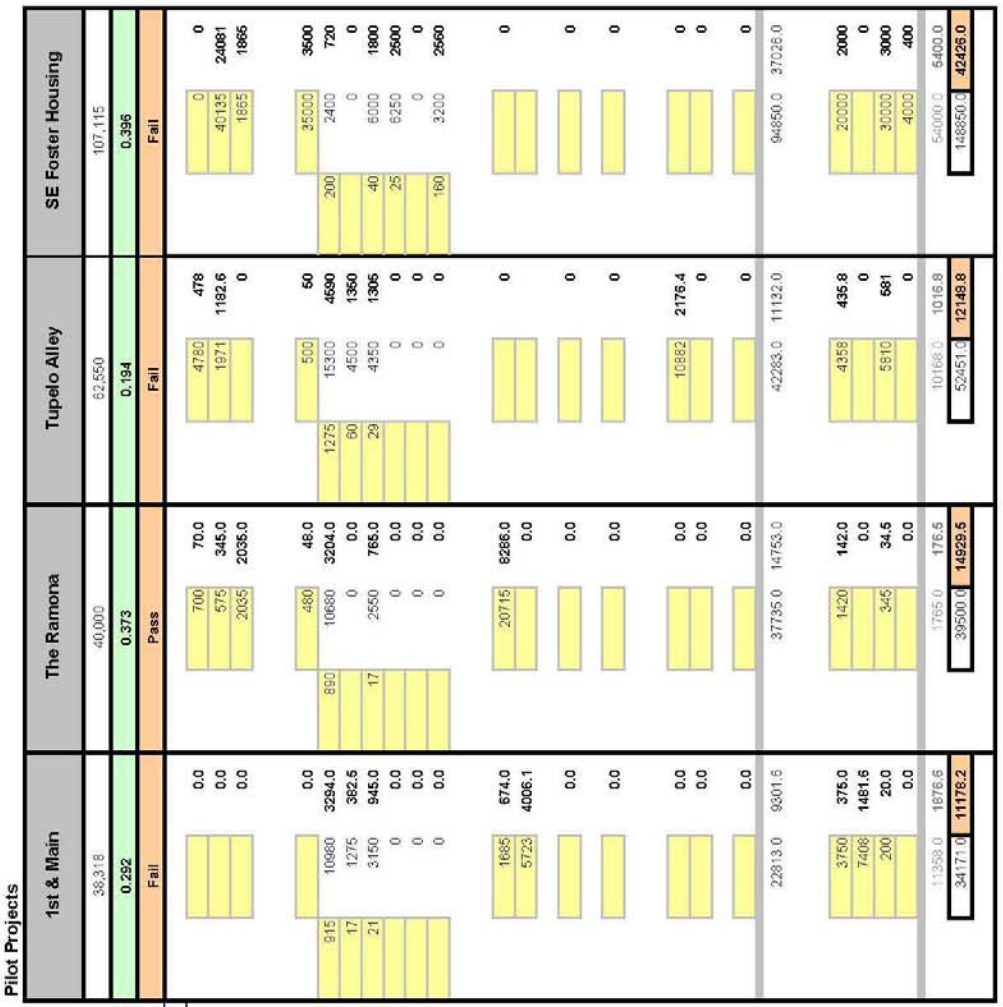
Title 17 of the Planning and Zoning code has other sections that could also either incorporate or support parts of a Portland Green Factor. Chapter 17.52 specifically references trees, and other chapters that reference work in the right-of-way may be affected by the creation of a Portland Green Factor.

There is also a great opportunity to incorporate some of the prescriptive goals in disparate parts of City of Portland code and policy requirements into performance goals that achieve multiple objectives and simplify the process for developers, city agencies, and development services. Some possible benefits;

1. Reduce documentation and complexity for designers and developers in determining code compliance by limiting calculations and documentation to a single document (with multiple pages and calculations).
2. Permitting documents are submitted with the documentation for easy reference and review by BDS for compliance. This would include standardization of the submittal documentation as part of permitting.
3. The calculations clearly require inclusion of stormwater management calculations (based on the SWMM).

The opportunity to reduce a burden on the development community, rather than to just add another layer of development requirement, while also improving the quality of the landscape, is one that should be pursued.

Appendix A - Scoresheet



Pilot Projects

			1st & Main			The Ramona			Tupelo Alley			SE Foster Housing		
		SF of Parcel	38,318			40,000			62,550			107,115		
		GF Score	0.292			0.373			0.194			0.396		
			Fail			Pass			Fail			Fail		
A	Landscaped Areas	Factor	Unit											
1	Landscaped Areas with a soil depth of less than 24"	0.10	SF			0.0			700	70.0		4780	478		0	0
2	Landscaped Areas with a soil depth of 24" or greater	0.60	SF			0.0			575	345.0		1971	1182.6		40135	24081
3	Bio-retention facilities	1.00	SF			0.0			2035	2035.0			0		1865	1865
B	Plantings (Credit for plants in landscape areas from Sec. A)															
1	Mulch, Ground Covers, or other plants less than 2-ft at maturity	0.10	SF			0.0			480	48.0		500	50		35000	3500
2	Shrubs or perennials 2-ft+ at maturity	0.30	# of Plants	915	10980	3294.0	890	10680	3204.0	1275	15300	4590	200	2400	720
3	Tree Canopy for "small" trees, or equivalent	0.30	# of Plants	17	1275	382.5		0	0.0	60	4500	1350		0	0
4	Tree Canopy for "small/medium" trees, or equivalent	0.30	# of Plants	21	3150	945.0	17	2550	765.0	29	4350	1305	40	6000	1800
5	Tree Canopy for "medium/large" trees, or equivalent	0.40	# of Plants		0	0.0		0	0.0		0	0	25	6250	2500
6	Tree Canopy for "large" trees, or equivalent	0.40	# of Plants		0	0.0		0	0.0		0	0		0	0
7	Tree Canopy for preservation of large existing trees	0.80	Inches DBH		0	0.0		0	0.0		0	0	160	3200	2560
C	Vegetated Roofs															
1	Extensive Vegetated Roof - >= 2-inches, <= 4-inches soil depth	0.40	SF		1685	674.0		20715	8286.0			0			0	
2	Intensive Vegetated Roof - > 4-inches soil depth	0.70	SF		5723	4006.1			0.0							
D	Vegetated Walls	0.70	SF			0.0			0.0			0			0	0
E	Approved Water Features	0.70	SF			0.0			0.0			0			0	0
F	Permeable Paving															
	Permeable paving over 6-inches and less than 24-inches of soil or gravel	0.20	SF			0.0			0.0		10882	2176.4			0	0
	Permeable paving over at least 24-inches of soil or gravel	0.50	SF			0.0			0.0			0			0	0
G	Structural Soil Systems	0.20	SF			0.0			0.0			0			0	0
			Sub-Total		22813.0	9301.6		37735.0	14753.0		42263.0	11132.0		94850.0	37026.0	
H	Bonus Factors															
1	Drought-tolerant or native plant species	0.10	SF		3750	375.0		1420	142.0		4358	435.8		20000	2000	
2	Landscape areas where 50% of annual irrigation from harvest rainwater	0.20	SF		7408	1481.6			0.0			0			0	
3	Landscape visible to passerby from adjacent ROW or public open space	0.10	SF		200	20.0		345	34.5		5810	581		30000	3000	
4	Landscaping in food cultivation	0.10	SF			0.0			0.0			0			4000	400	
			Sub-Total		11358.0	1876.6		1765.0	176.5		10168.0	1016.8		54000.0	5400.0	
			Total		34171.0	11178.2		39500.0	14929.5		52451.0	12148.8		148850.0	42426.0	