

For my son Ali Oso

“We can be absolutely sure of a few things about future cities. The cities will not be smaller, simpler or more specialized than cities of today. Rather, they will be more intricate, comprehensive, diversified, and larger than today’s, and will have even more complicated jumbles of old and new things than ours do. The bureaucratized, simplified cities, so dear to present-day city planners and urban designers, and familiar also to readers of science fiction and utopian proposals, run counter to the processes of city.”

— Jane Jacobs, *The Economy of Cities* [1]

ABSTRACT

Portland, Oregon does not have an urban climate change mitigation program to protect ecology, capture carbon, build resilience, and develop social equity in a single strategy. Local programs are siloed into one or two aspects of climate change mitigation and rarely overlap with broader initiatives. Meanwhile Portland has an array of liminal public lands that have no future use. This Masters Project aims to transpose the principles of regenerative design onto undevelopable liminal landscapes in urban Portland to test if these sites can contribute to climate change mitigation and if climate change mitigation is the highest and best use of interstitial public land.

Using a Research-by-Design methodology, eight experimental designs were developed to meet four regenerative design-based mitigation goals: 1) Enhance Social Equity, 2) Reduce Atmospheric Carbon/ Urban Heat Island, 3) Increase Ecosystem Services, and 4) Encourage Resilience. Then, using three site typologies across all eight experimental sites—Right of Ways, Underpasses, and Ghost Ramps—the design experiments were tested against case studies of similar design scope as well as existing city programs to determine each sites' aptitude for climate change mitigation using a regenerative design hub framework and calculator. Following the design experiment phase, each site received a regenerative hub score and was accompanied by an experimental design. The project concludes with projected climate change mitigation findings based on discoveries from the eight experimental designs and an analysis of how existing city programs can be unified to mitigate climate change on undevelopable public land.

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CHAPTER 1 - INTRODUCTION

REGENERATIVE DESIGN FOR LIMINAL LANDSCAPES

Climate change is impacting cities and cities are contributing to climate change. Local, national, and global programs are attempting to mitigate impacts but there are few urban mitigation tools that aim to protect ecology, capture carbon, build resilience, and develop social equity in a single framework. Local programs, in Portland, OR, for instance, tend to specialize in one solution for climate change mitigation but rarely cross-pollinate between programs. And there are no existing city programs that use a regenerative design framework.

Portland is “built out” because of Oregon’s proud legacy of smart growth, which aims to preserve Greenfields and densify urban infill. This leaves the city with few sites that can be maintained exclusively for climate change mitigation as the sole use. What remains available is undevelopable public lands throughout the city, sites that require low to zero maintenance but have no future use. Perhaps they could contribute towards climate change mitigation by overlapping existing city programs?

In the chapters that follow, you will see the problems cities face with climate change and some of the more common mitigation solutions. It will show that the concept of regenerative design can be applied to liminal landscapes for the sole purpose of climate change mitigation.

In Chapter 2 I outline a regenerative design tool kit for liminal landscapes that shows how small design interventions can lead to the following goals. I then breakdown how a regenerative hub framework can be calculated to qualify a series of design interventions that fall within these four goals, using the standards of existing city programs. The goals are:

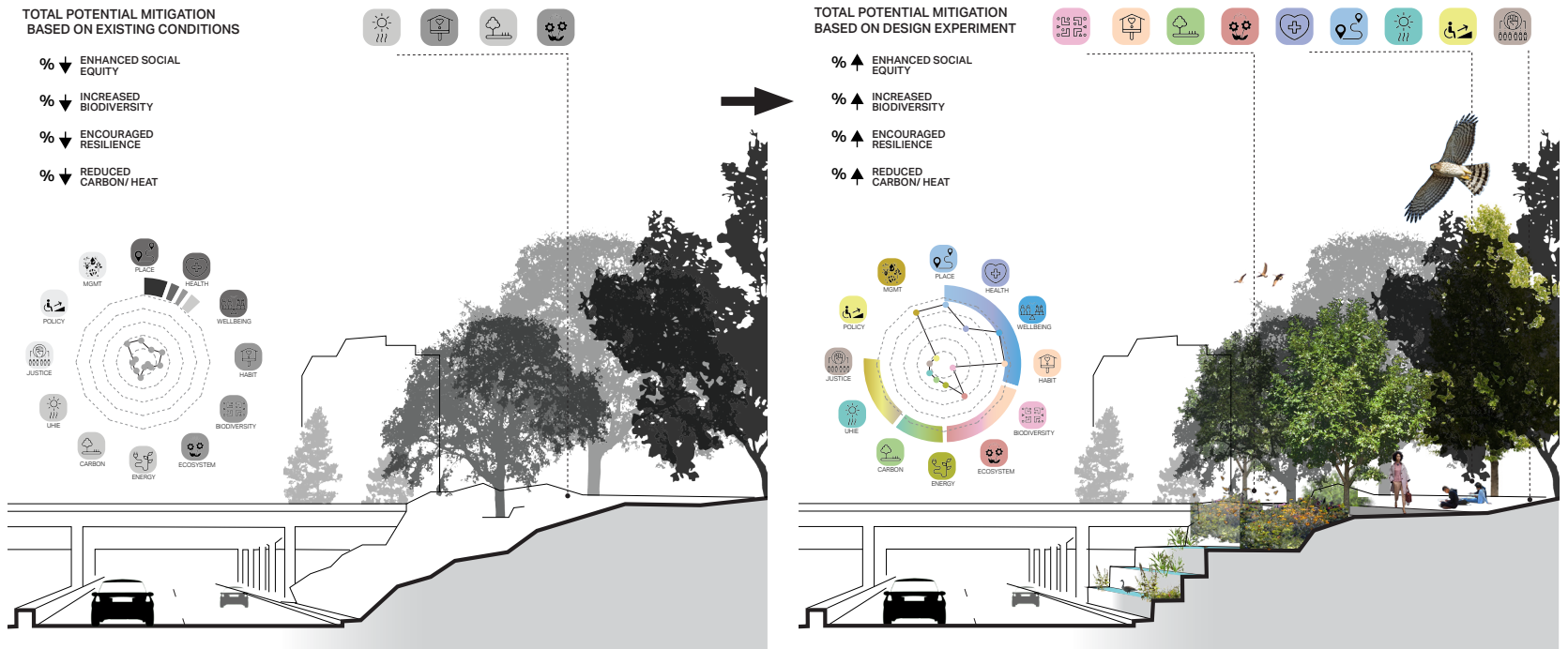
- Enhanced Social Equity
- Reduced Atmospheric Carbon/ Urban Heat Island
- Increased Biodiversity/ Ecosystem Service
- Encouraged Resilience

To ensure that liminal landscapes can be used this way objectively, they are then explored through three site typologies. Each typology possesses a unique set of constraints and opportunities for the experimental design process.

- Ghost Ramps
- Right-Of-Ways
- Underpasses

Chapter 3 studies eight sites chosen for research, comparing them against two case studies for each typology of to compare and contrast against the site typologies. Then, using the Research-by-Design approach developed by Nijhuis and Bobbink, [2] each of the eight design experiments are passed through a regenerative hub calculator – created for this project and are accompanied by an analysis. The project concludes with projected climate change mitigation findings and few recommendations.

This project is in no way attempting to assert that climate change can be mitigated with only small sites in cities. My personal belief is that climate change adaptation and resilience will require a continued push for global corporate and government accountability. However, this research shows that simple innovations can help us along the way.



Regenerative Hub Design Opportunities Experiment: Before and After

CHAPTER 2 - BACKGROUND

THE PROBLEM: CITIES NEED CLIMATE CHANGE MITIGATION

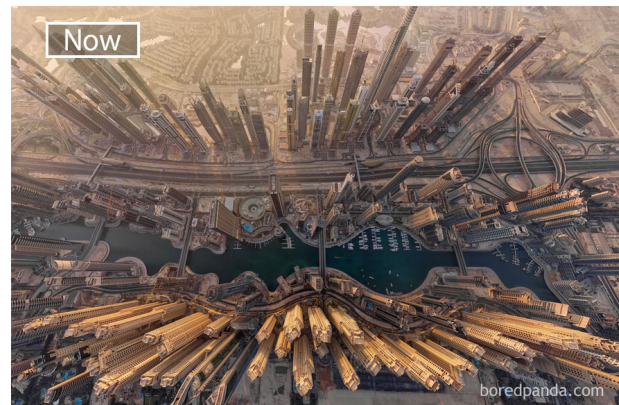
In cities we find jobs, support networks, housing, resources, and community. Cities are the result of human nature and are vital to human existence. Cities, however, alter the livability of other species in the regions they irreversibly transform. In many ways, urbanites live in the past, acutely aware of the lessons they are in the process of learning as urban heat island and smog from their own cars make their neighborhood less livable; and in other ways, live in the future, as the leaders of global policy for change. Man-made climate change, exacerbated by urban heat islands, ecological shifts are due to urbanization, and high levels of toxic atmospheric carbon due to economic need for human survival is pushing cities to the brink of reform. [3] Global and local leadership is anxiously pressed to pursue innovative solutions with a sense of urgency shared by the entire human race (well almost). Activists and politicians urgently push for new policies that are at odds with each other. The future is unclear, but it appears that cities of the future will be living experiments of high stakes and complicated adaptive mitigation solutions.

Despite these challenges, cities are growing because they offer the best resources for human survival. It is now widely accepted that the densification of cities using Smart Growth and Inclusionary Zoning policy is better than the damaging prospects of sprawl, which exacerbate climate change and livability for marginalized communities. [4] Estimates show the global population will reach 9.8 billion people by 2050, with lower fertility rates and longer life expectancy across most continents. [5] Despite the obvious need for rural food systems and less carbon dependent distributions, the global population will continue to dwell in cities – particularly in the United States where it is estimated that 88.5% of the population will be urban by 2050. [6]

More than half the global population is already urban and urban areas are responsible for 70% of the earth's carbon dioxide (CO₂). [7] By 2100 the estimated rise in near-surface temperature across the continental US will rise 1-2 °C. [8] The general consensus among scientists is that a 1°C temperature shift in certain climates alone will result in widespread impacts, particularly to human-life-sustaining marine biology. [9] In some ways it may already be too late for ecosystems as we know them, breeding seasons have changed as a result of warming weather and urbanization. [10] Many wildlife communities have already undergone re-assembly in order to adapt and tolerate warmer seasons and shifts in food webs. Phenological factors impacted by increasing temperature on plants in cities are further amplified by urban heat islands. Cities will continue to see earlier bloom times than rural communities. [11] These increased temperatures have huge consequences for human food systems. Among other eminent concerns is heat stress during heatwaves, mental issues, climate refugees, and pandemics. [12]

Urbanization (the rapid creep of urban uses sprawling into farm or natural areas) has increased exponentially since advent of the automobile. In fact, the pandemic itself is said to be a result of disrupting what should remain wild land due to urbanization. [13] But despite uncertainty climate change has created, and even the after the global pandemic, cities will continue to densify. Post pandemic real estate transactions in cities are still expected to rise. [14] In fact, densifying our cities has long been the harbinger of nearly every land use planner, urban designer, and landscape architects' practice

for decades now. Policies to protect farmland and conserve wildlife have pushed for denser cities to preserve threatened wildlife, healthy air, and food systems. [15] The result has been designer cities where people ride bikes, share cars, and live inside tiny apartments as part of a “Live/ Work/ Play” smart growth lifestyle intended to offset the consequences of modern civilization.



“Facing Climate Change,” Bloomberg

Korolkovaite, I. (2018) Dubia: Before-And-After, Board Panda

THE SOLUTION: CLIMATE CHANGE MITIGATION IN CITIES

Cities that practice Smart Growth are compelled to maximize the uses of every parcel of land. However, some pieces of land exist without of foreseeable use, and stand to offer a limited environmental public benefit. In some cases, these sites, perhaps clad in concrete or grass, can increase albedo and the urban heat island effect—among many other future negatives. Increasing efficiency of use of these spaces could be significant if they were to double as environmental resources by offering ecosystems services, storm water mitigation, and carbon sequestration (to name a few). It seems unlikely that every small public space can facilitate environment benefits, but this project argues that retrofitting underutilized public land on freeways (for instance) with biophilic design is in fact a low cost and effective strategy for climate change mitigation.

Cities can mitigate climate change. Research provides evidence that vegetation cools the built environment and can be particularly impactful in urban areas where the albedo can be reduced with vegetative adaptations. And in general, the research shows that greener areas provide localized cooling and that these approaches (cool roofs (highly reflective), green roofs (highly transpiring), and mix of both (green-albedo)) are effective in reducing temperatures. [16] Cities can adapt to climate change and urban heat island effect and even urban hot spots can be off-set with tree canopy requirements and walkability. [17] Connections have been made between positive economic impacts and biophilic urbanism to the extent that an economics case for biophilic urbanism can occur in different ways based on the biophilic services provided. Such “biophilic services,” which are manmade interventions in the built environment that provide ecosystem services, also have benefits for human welfare such as clean food and clean water, beyond economic indicators. [19] Air quality, for instance, through carbon sequestration or the delight of listening to a bird song on a sunny afternoon are simple factors of livability, relating to both social equity and community resilience.

City-based climate change responses must be as unique as their respective climates. Strategies and approaches must differ regionally based on climates and surface conditions. Adaptive strategies for the built environment should be implemented regardless of carbon emission policies and limits. Land-based built environment strategies can rework cities with a “dynamic landscape” in a “regional ecosystem,” promoting innovation towards increased equity for all social groups. And that innovation is needed to bolster resiliency where globalism has become a multidimensional aspect of survival in a system of cities. [20] The biophilic services framework reveals a case for biophilic urbanism strategies to encourage resilience and mitigate present impacts of climate change. [21]

Urban resilience—as defined as a city that can withstand “shocks” and “stressors” and a relatively quick return to normal—can benefit from any number of environment program strategies, a regenerative framework that provides a more wholistic approach to local climate change mitigation programs could guide cities past the realm of adaptation. While ecosystems are out of human control, adaptations to ecosystem changes can be wagered towards sustainability to increase equity for all social groups (including plants and animals). Similarly, urban hazards can be assessed by economic risks of shocks and stressors that create inequality and solutions can be considered through the lens of the “cost of doing nothing.” Lastly,

funding resiliency efforts should include diverse, widespread, and invested group of stakeholders to ensure innovation efforts remain targeted. [22] No parcel of land should go overlooked and a regenerative design theory can be used to frame a dynamic approach.



Image of Biophilic Urbanism, Singapore , Biophilic Cities Network

THE GAP: REGENERATIVE HUBS

The concept of regenerative design in the field of landscape architecture has many definitions, but its more about a regenerative design process. A process of introducing living system to restore a site's surroundings and inspire continued care. A regenerative landscape design in this project will systematically serve social equity, decarbonization, and ecosystem services in a way that builds sustained future resiliency goals without further adverse impacts. Those four goals can be used to design a framework for regenerative hubs on liminal landscapes.

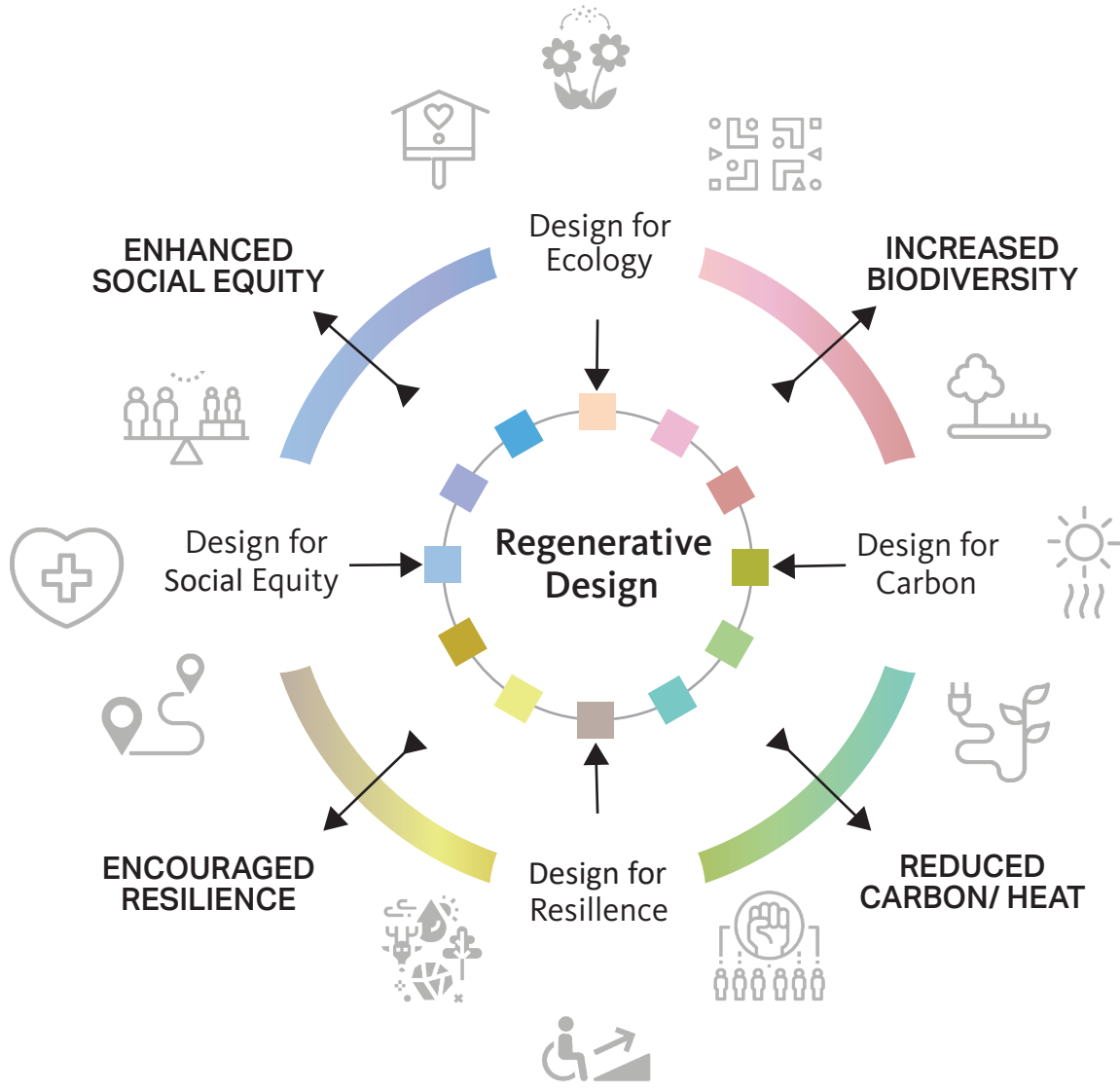
A “Regenerative Hub” means an urban node designed to maximize environmental conditions and mitigate climate change using design methods that promote all four regenerative design solutions:

- 1) Enhance Social Equity
- 2) Reduce Atmospheric Carbon/ Urban Heat Island Effect
- 3) Increase Biodiversity/ Ecosystem Services
- 4) Encourage Resilience

The regenerative hub framework will use four design goals to reveal how much a design can maximize climate change mitigation outputs on sites chosen for such experimentation. Each of the four goals is then further expanded into a “matrix of mitigation design solutions,” specifically geared towards public liminal landscapes.

For the purposes of this master’s project, once a design experiment’s site typology is compared to a successful case study of a similar type, the design experiment will then be contrasted against case studies by its own potential for improvement of existing conditions and design opportunities. The site will be analyzed for its context and then as many mitigation design opportunities as possible are applied in the design experiment.

Once the design is complete, the regenerative hub framework, intended to mix each of the four goals using an array of design opportunities, will measure the possible climate change mitigation of a liminal landscape. Following are the Regenerative Design Goals broken-down into possible Regenerative Design Opportunities, and the corresponding matrix used in the Regenerative Hub Calculator itself.



Regenerative Design Inputs and Outputs Diagram

REGENERATIVE DESIGN METRICS AND CALCULATOR

Four overarching indicators were used to categorize climate change goals. The list of design opportunities that fall below the overarching categories fall are then broken out into public benefit indicators. The public benefit indicators can then be peice out further into design interventions. And later into site specific designs.

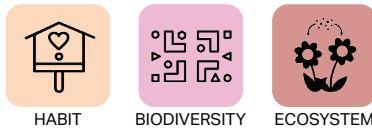
So, for example, an “accessible” design could trigger public benefits for “place, health, wellbeing, justice...etc.” giving it a particular indicator score. Each site was given an existing condition score and an opportunity score. These compared, I called the regenerative hub.

ENHANCED SOCIAL EQUITY



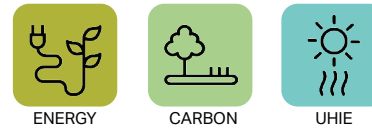
- Anti-gentrification measures
- Accessible Places
- Centralized Public Node
- Design Public Safety
- Employment Land Preservation
- Habitat Creation/ Conservation/ Restoration
- Historic Preservation
- Sense of Place
- Tourism

INCREASED BIODIVERSITY



- Bioswales
- Citizen Science Apps
- Civic Ecology
- Migration Design
- Native Plantings
- Noise Mitigation
- Pollinator Gardens
- Rainwater Features
- Placemaking/ Public Art
- Recreation Opportunities

REDUCED CARBON / HEAT



- Bioremediation / Toxic Cleanup
- Carbon Sequestration
- Constructed Wetlands
- Materials that Reduce Albedo
- Safe Bike/ Pedestrian Paths
- Job Creation/ Retention
- Reused/Recycled/ Local materials
- Smart Growth Urban Design
- Tree canopy/ Shade-Making

ENCOURAGED RESILIENCE

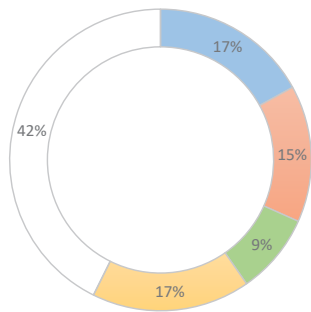


- Adaptive Reuse
- Bikes/ Scooter/ Car-Share Stations
- Decentralize Energy/ Microgrids
- Inclusive Streetscaping
- Local Business Preservation
- Increasing Public Transportation
- Rain Gardens
- Renewable Energy Infrastructure
- Urban Agriculture
- Urban Forest
- Stormwater Facilities
- Solar-Lit Bus Stops/ Kiosks

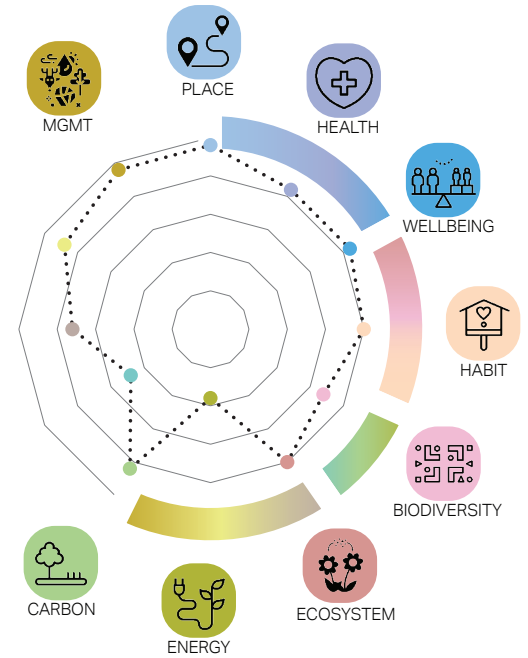
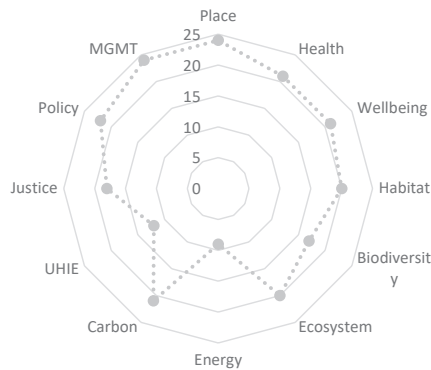
Development of Regenerative Metrics

Design No. 1	GOALS BEFORE					GOALS AFTER					DESIGN OPPORTUNITIES														
	Y/N	Equity	Ecology	Carbon	Resilience	None	Y/N	Equity	Ecology	Carbon	Resilience	None	Place	Health	Wellbeing	Habitat	Biodiversity	Ecosystem	Energy	Carbon	UHIE	Justice	Policy	MGMT	Sum
NW Regeneration Station		8	2	2	7		51	44	26	51	128	19	15	17	16	13	15	7	13	6	14	17	20	172	
Accessible Places	6	y	3	0	1	2	6	y	3	0	1	2	6	x	x	x				x		x	x		6
Adaptive Reuse	0	n						y	3	3	2	2	10	x	x	x	x	x	x	x		x		x	10
Anti-gentrification measures	0	n						y	3	1	1	1	6	x	x	x	x								6
Bikes/ Scooter/ Car-Share Stations	0	n						n																	0
Bioremediation / Toxic Cleanup	0	n						n																	0
Bioswales	0	n						n																	0
Carbon Sequestration	0	n						y	3	3	2	3	11	x	y	y	x	y		x	x	x	x	x	11

Example of Regenerative Hub Calculator



Equity Ecology Carbon Resilience None



Development of Regenerative Hub Graph

PORTLAND'S PROGRAM STANDARDS

The regenerative hub framework, which considers four goals related to carbon, ecology, social equity, and resilience can draw directly on existing city program standards where they align. Portland is the study area chosen for this project because it has an assortment of preexisting and established climate change mitigation programs. The city's sustainability values are shared with cities across the world but the programs are unique to Portland's terrain, culture, and environment. To keep the scope of work for the regenerative design framework relevant and local, this project gleans from a few program guidelines that have the best chances of overlap on liminal landscapes of Ghost Ramps, Right-Of-Ways, and Underpasses. And it should be mentioned that although fantastic national program elements from the SITES program or the Green New Deal were not used, their best practice inspired the pursuit of this concept in the first place.

The programs that informed the mitigation standards for the regenerative hub framework can be grouped into the following categories:

1) Enhance Social Equity

In my opinion Portland lacks existing programs that decriminalizing poverty, prevent gentrification, and de-marginalize vulnerable populations in the built environment. Portland, frankly, lacks social equity. So, it will be assumed that site construction is handled by an apprenticeship program between Ecotrust's Green Workforce Academy and an OMWESB contractor. [25] This relationship already exists but could be formalized using a First Source Hiring Agreement through Work Source Oregon for climate change mitigation specifically. [25] And of course, though many of the sites are not intended for public use, those that are will use the city's standard for universal design for maximum accessibility. [26]

2) Reduce Atmospheric Carbon/ Urban Heat Island Effect

For bioswales on site, I consulted Portland's Stormwater Management Manual. This manual has a short list of best practices and plants that are low maintenance and the municipality already has a protocol for maintaining. It is given that all rainwater systems used in my design experiments follow this checklist. [23] The design will follow the City of Portland tree canopy requirements for Mixed Use as well.

3) Increase Biodiversity/ Ecosystem Services

Backyard Bird Habitat program's platinum certification criteria. I added the exact criteria of this program to obtain a platinum level certification because its criteria is thorough and streamlined. For instance, the BBH Certification uses the Portland Plant list, a composite of native and non-invasive plants composed by the Bureau of Planning and Sustainability. The plant palettes for my design will be limited to the plants found in this catalogue. The BBH also uses a Watershed Approach to Landscape Design published by Green Gardens Group, for small gardens as resource for its program. This includes "contours for rain capture," which I found particularly helpful for small site design. And their Wildlife Stewardship component offers many tools and resources for wildlife in small urban spaces, such as snags, nurse logs, and bat boxes, among other things. [22]

4) Encourage Resilience

The resilience criteria ensures that any natural resource on site is used, such as rainwater capture for plants and wildlife and using solar or wind if energy is needed to light the space. This is a combination of urban forests, water reuse, tree canopy, and energy decentralization. The City of Portland's Climate Action does make an attempt to ensure these efforts are combined. [27]

Taking the best practices from these programs, a regenerative hub framework can enhance each design experiment by maximizing as many existing best practices as possible. While it was unlikely that each site was able to facilitate this much criteria, the exercise of trying to blend existing programs by assuming their level of care is assumed in each design opportunity to embolden the framework. [Appendix A – City of Portland Program Criteria Matrix]



Happy Backyard Bird Habitat Participants



Bureau of Planning and Sustainability
Innovation. Collaboration. Practical Solutions.



City of Portland, Oregon



THE HISTORY OF PORTLAND'S LIMINAL LANDSCAPES

Portland grew rapidly during World War II without adequate infrastructure to support its explosive wartime industry workforce population growth. After the war many left home back to their respective families in the eastern and southern parts of the US. Still, many stayed as transplants. There was a sudden and urgent need for urban planning to make up for inadequate housing and new infrastructure in nearly every far reach of the expanded city. Farmland had turned into housing and main streets were getting cramped with trolleys and cars. The last streetcar lines were converted to bus operation in 1950 as the affordable automobile became the more efficient and fashionable mode of transportation after the war. [28]



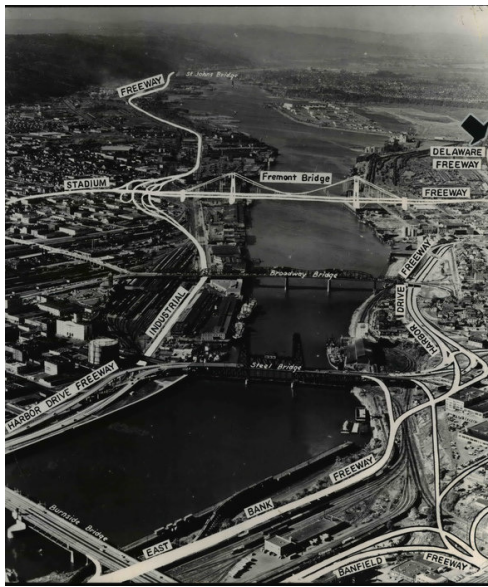
23rd St. Trolley Line on W. 18th, 1940s

By the late 1950s the city showed signs of segregation by class and race. Ethnic enclaves flourished in various parts of town. Vanport in the north and the Albina District in inner Northeast were where the primarily black and African American communities lived, worked, and thrived. Those neighborhoods had also been Red Lined, so despite the black and African American who served in the war's access to the GI Bill and FHA's home ownership programs, their homes were devalued by racist policy and their home loans were restricted to that geography. [29] Meanwhile, on the south side, the South Auditorium neighborhood was enclaves of Jewish, German, Russian, and Italian immigrants where merchants kept bustling storefronts and kosher delis that line the main streets. These neighborhoods known as "Little Italy" and "Little Russia" were rich with culture and were also systemically underserved by the city due to Portland's classist and xenophobic heritage. [29]

By the 1950s, schools were unequal and workforce discrimination by wealthy employers was rampant, despite years of plotting and planning to "reduce poverty" and renew the city. Originally through the use of Housing Act of 1949 and eventually Urban Renewal, city leadership aimed to take part in a Model Cities program as part of a national trend called

“slum clearance,” where ethnic communities were targeted and blamed by the growing affluent white populations for systemic poverty. But we now know that it was racism that kept residents stuck in those communities with economic constraints and unable to move. [30]

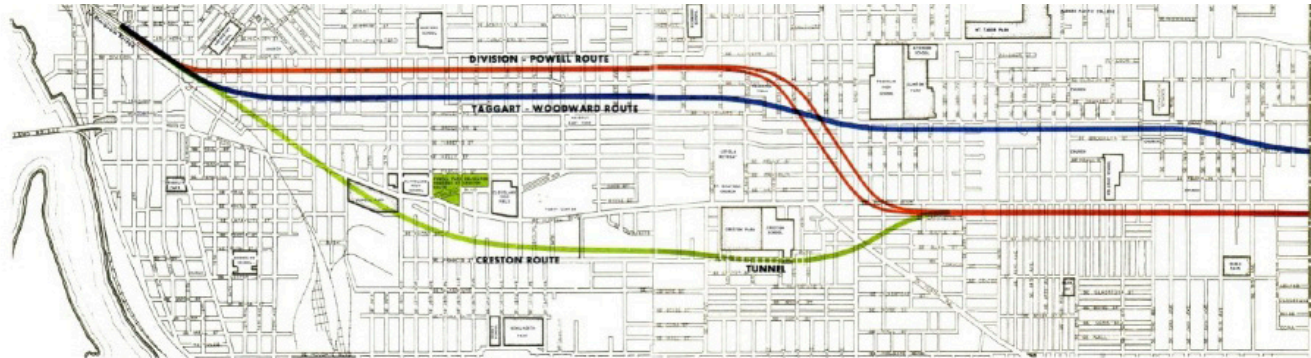
During these dark years of planning, the city invited Robert Moses the renown “power broker” from the east who had design freeway systems for many US cities, to design a system for Portland. [31] By 1958, the city voted to create the Portland Development Commission and shortly thereafter the neighborhoods were cleared or severely disrupted to make way for the new freeway system. Moses envisioned a network of freeways that would lead inner-city residents out of the city to surrounding suburbs, a car-centric urban design trend of the ‘50s and ‘60s that we now know as “urban sprawl.” [32] What is now considered a painful and regretful chapter in Portland’s history, the city demolished and destroyed vital neighborhoods to Portland’s most marginalized communities to install the I-405 and I-5 loop in the city center. The project was ongoing until the 1969 when the Moses plan was interrupted by a group of local advocates who protested the extension of the Mt Hood freeway through the inner Southeast neighborhood along where Clinton Street thrives today. [33] “Freeway Revolts” as they were called were not limited to Portland and began to emerge around the United States and other countries in response to severe displacement cause by massive freeway developments.



Moses Plan for Portland; Image of Portland Freeway Decay; Maps of Proposed Portland Freeway

THE HISTORY OF PORTLAND'S LIMINAL LANDSCAPES

The city's eventual refusal to further displace residents as well as its concerted attempt prevent sprawl was part of a larger smart growth mentality developed quickly in Oregon. In 1973 Senate Bill 100 codified the state's first anti-sprawl and conservation laws by implementing the Urban Growth Boundary and the 2040 plan, which limited commercial and residential zoning to metro areas in an attempt to preserve farmlands and habitat. The initiative to halt future displacement and reuse the federal transportation infrastructure for public buses, such as Portland's "Fairless Square," left a lasting legacy for the city as well as a number of physical relics known by locals as the Ghost Ramps (freeway exists that never materialized).



[Proposed Freeway Alternatives Through Portland, SOM 1972, ODOT

While there is no doubt that climate change in cities was made worse by freeways, in the case of Portland it drew together an early climate change mitigation alliance in smart growth. The poetic justice of responding to Moses' heavy-handed network of racist and sprawling freeways by reutilizing their remnant interstitial spaces for climate change mitigation would be an iconic opportunity for all who suffered environmental injustice in Portland (both through displacement and pollution). Though falling short of healing generational wounds, the circular reference is very much intended and continued acknowledgement of this suffering is needed. The notion of mitigating atmospheric carbon at its primary source and rectifying historic wounds for public health seems like a worthwhile antidote for urban designers to pursue because gestures of this sentiment have not yet been made so directly.



SF Bay Freeway Construction Revolt 1960

It should also be noted that Portland does have an emerging Green Loop that has the opportunity to use the regenerative hub framework at a large scale. While not on freeways, it can be viewed as an alternative to freeways.

The Green Loop, still in planning phase, will be a circular loop around the city to connect residents along a pedestrian path and create shared public space. And that is where Portland is putting its site-specific greenspace infrastructure efforts today. [34] The green loop will use some of the most challenging of the liminal landscape typologies, fractured easements on and inbetween uses of commercial, industrial, residential zoned land. If the Green Loop is the type of action Portland is willing to commit to as a method of stitching community back together and mitigating the impacts of climate change, perhaps other liminal landscape typologies could stand a chance in public policy for these reasons as well.



Green Loop

LIMINAL LANDSCAPE SITE TYPOLOGY

Portland's municipal and nonprofit programs show that ecological regeneration and climate change mitigation can be implemented in small liminal public spaces to improve environmental conditions at a relatively low cost to the public entity that maintains it. The Backyard Bird Habitat certifies small sites to increase biodiversity for pollinators, nocturnal species, and migratory species. And Portland's bioswales are small sites that decarbonize soil and air, localize storm water treatment with bioremediation, and reduce high albedo with shade to offset the urban heat island effect. And small parks, like Two Plumn Park in Portland, show how small spaces can be reclaimed to create human scaled place; fine textured nodes for public art, wayfinding, lunching, playing, or reading.

The following site typologies: Ghost Ramps, Right-Of-Ways, and Underpasses were selected because each of their site types are unique and offer separate sets of constraints and opportunities. These site are also relics rich in context, having been both the consquence of the darks years of Urban Planning and then the celebrated symbols of the utopian years that followed the Freeway Revolts. While there are more types of sites to choose from, these types are similar enough to create framework for which to reduce a set of recommendations. By identifying site typologies and developing a criterion for each typology, this project defines an approach for maximizing mitigation on small spaces using regenerative design. Each design experiment fell into one of three site typologies and each site typology-specific case study fueled both inspiration and comparison for the design experiment, making this research both iterative and projective.

For the experiment, sites were selected by a simple set of criteria: publicly owned or maintained, not slated for development, and have almost no existing or planned future use. These sites are blank slates, many of which have little to no environmental benefits and contribute to climate change with issues like Urban Heat Index with high albedo materials like concrete and metal. Most of these sites cannot facilitate stormwater with their impervious surfaces and/ or due to the nature of their proximity to automobiles and exhaust, must process high levels of toxic runoff. One could probably argue that they do provide ecological services and some habitat--as pollinators and birds tend to enjoy undisturbed areas that are not frequented--but as-is these services are marginal at best.



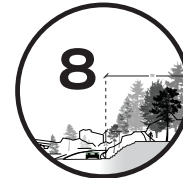
The Ghost Ramp Site Typology is defined as: “An unused highway or ramp that was partially or fully constructed but went unused or was later closed. An unused roadway or ramp may often be referred to as an abandoned road, ghost road, highway to nowhere, stub ramp, ghost ramp, ski jump, stub street, stub-out, or simply stub.” [35] Research compiled on the Ghost Ramp Typology in this project are from Design Experiment No.2 (Borthwick Ghost Ramp), No.3 (Eastbank Ghost Ramp), and No.5 (Esplanade Ghost Ramp).

GHOST RAMPS



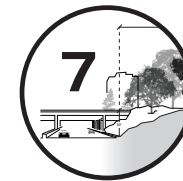
The Right of Way Site Typology (“ROW”) is defined as: “the legal right, established by usage or grant, to pass along a specific route through grounds or property belonging to another”, or “a path or thoroughfare subject to such a right”. [36] For this project, these sites are characterized as freeway medians or vegetated terrain that hug the off/ on ramp of freeways. Research compiled on the Right of Way Typology in this project are from Design Experiment No.4 (I-5 Island ROW) and No.8 (Halprin Path ROW).

RIGHT OF WAYS



The Underpass Site Typology is defined as: “a crossing of a highway and another way (such as a road or rail) at the lower level of such a crossing.” [37] In this project is often characterized as the site below a ghost ramp. Research compiled on the Underpass Typology in this project are from Design Experiments No.1 (Western Underpass), No. 6 (Esplanade Underpass), and No.7 (Naito Underpass).

UNDERPASSES



Experimental Design No 2, No 3, No 5; No 4, No 8; No 1, No 6, No 7

CASE STUDIES

Two case studies for each site typologies were compared. Nearly all case studies for this project were taken from the Landscape Architecture Foundation's Landscape Performance Series because it uses a boilerplate methodology to evaluate each project. Although I did not use their methodology, I found it helpful to have a consistent approach and I felt this made the case study comparisons to my experiments more scientific.

There are great precedents for ghost ramps, right-of-ways, and underpasses. As cities all over the world growing in density, a premium on liminal space has encouraged innovative and thoughtful projects. While the images on the right were not used for the project, they reveal the how landscape architecture has reimagined liminal landscapes in dense cities around the world.

1. Football at Bush, London
2. Housing at Bush, London
3. Stables at Bush, London
4. Art at Bahnhof, Tirol
5. Passage at Huangpu, Shanghai
6. Community Center at Liziba Main Street, Chongqing
7. Booth at Huangpu, Shanghai
8. Wetlands at Yuzhong, Chongqing
9. Lunch at Yuzhong, Chongqing
10. Trail at Yuzhong, Chongqing
11. Office at Zhabei, Shanghai
12. Promenade at Planeé, Paris
13. Wayfinding at Ink Park, Boston
14. Placemaking at Pheonix Park, Glasgow
15. Olafur Eliasson Waterfall Art, NYC
16. Ice Skating at Bentway Park, Toronto.



1. Football



2. Housing



3. Stables



4. Art



5. Passage



6. Community Center



7. Toll Booth



8. Wetlands



9. Cafe



10. Trail



11. Office



12. Promenade



13. Wayfinding



14. Placemaking



15. Olafur Eliasson Art



16. Ice Skating

GHOST RAMP CASE STUDY: HIGH LINE BY JAMES CORNER FIELD OPERATIONS/ PIET OUDOLF. NEW YORK - 2009

The High Line was an elevated railway that stretches over 20 blocks from the Meatpacking District to Chelsea in Manhattan, New York. Today, it sequesters 1.3 tons of atmospheric carbon and 24,340 gallons of stormwater annually. It attracts millions of visitors to NYC a year. It hosts community events and education opportunities. It generates an additional \$65 million in tax revenue per year. And it claims to be a catalyst for affordable housing development. [38]

Purpose: To connect neighborhoods, salvage a historic structure, and creates community space.

Approach: Adaptive reuse of abandoned structure. Initiated by community advocacy.

Implication: The highline is an inspiring example of what to do with abandoned places, what a public effort can do with an abandon structure, and the positive benefits of experimenting with plant diversity. However, the High Line did contribute to gentrification of the surrounding neighborhood.



High Line, Before and After, LAF Performance Series

GHOST RAMP CASE STUDY: KLYDE WARREN PARK BY THE OFFICE OF JAMES BURNETT, DALLAS TEXAS - 2012

Klyde Warren sequesters 18,500 lbs of carbon a year using trees and reduces the average temperature of the surrounding area by 1-9F. It claims to have “improved quality of life” by 90% as well as increased outdoor activity in the community. It has created jobs, generated \$12.7 million in tax revenue, and improved economic conditions for the surrounding neighborhoods. [39]

Purpose: As “the world’s largest suspended infrastructure park,” Klyde Warren connect two urban districts with pedestrian nodes and promenades. It centralizes what would be a fragmented space with public open space amenities.

Approach: Adaptive reuse of existing 8-lane freeway and epic example of landscape on structure.

Implication: The park is considered the “front lawn” of Dallas and is cherished locally. Though the park initially received over \$90 million in public funding, the park’s upkeep does cost up to \$2 million a year, which much now paid for in private donations. Many of the amenities in the park were implemented and only exit due to continued private funding and support.



Klyde Warren Park, Before and After, LAF Performance Series

RIGHT-OF-WAY CASE STUDY: GOODS LINE NORTH BY ASPECT STUDIOS, NEW SOUTH WALES - 2015

The Goods Line restored an old rail line to improve pedestrian and bike access that increased to surrounding neighborhoods. The project increase greenspace by 33% and has increased local social interaction in open space. [40]

Purpose: The project redeveloped rail lines into a very functional linage between two districts, and was built to integrate a rapidly growing commercial, residential, and education-sectored community.

Approach: Adaptive reuse of an industrial Greyfield. The design uses the post-industrial aesthetic and in keeping creates a very functional linage between tow districts.

Implication: No air quality improvements were detected despite the significant addition of greenspace, and it is thought that perhaps this is due to the overuse of lawns versus shrubs and trees. Nor did the vegetative uses increase the biodiversity of local birds. The redevelopment hasn't been tied to increased economic development, and in fact may gave led to gentrification and displacement of existing businesses.



Goods Line, Before and After, LAF Performance Series

RIGHT-OF-WAY CASE STUDY: TUJUNGA GREENWAY BY LOS ANELES COUNTY FLOOD CONTROL DISTRICT, LA - 2007

Tujunga Wash Greenway and Stream Restoration project filters about 118 million gallons of water run-off from Tujunga Wash back into the San Fernando groundwater on an annual basis. It has been praised for increasing open-space using native plants in an otherwise concrete area and for saving \$8-\$20,000 a year in stormwater processing costs using those same native plants. [41]

Purpose: Restore streams from concrete ditches to facilitate a natural process channelization in the LA river watershed.

Approach: Design an ecologically productive stream habitat and use native plants that can be enjoyed by pedestrians.

Implication: The stream channel changes seasonally, making it difficult to manage public use. Insufficient foresight was given to environmental monitoring and the beneficial ecological and environmental impacts are unknown. Data on habitat and hydrological performance would encourage more of similar projects and best practice, but it's not tracked.



Tujunga Wash, Before and After, LAF Performance Series

UNDERPASS CASE STUDY: THE UNDERLINE BY JAMES CORNER FIELD OPERATIONS, MIAMI - 2021

The Underline is still in construction, with Phase One (Brickell Backyard) open February, 2021. It has already received excellent feedback. The project will extend 10 miles of multimodal path under 120 acres of the elevated Metro Line, it estimated the project could take up to 5% of vehicular traffic off the streets. The project is projected to produce \$170 million in economic output, create 1,000 jobs (many temporary) and \$45 million in total compensation. [42]

Purpose: Designed to create a linear park with amenities that connect transportation corridors in the surrounding communities on county owned land, as well as catalyze new real estate investment and local equity and minimize crime.

Approach: Revitalization of the underutilized area below the metro. The projected included community outreach, private crowd funding, native plantings and outdoor public amenities.

Implication: The Underline was spurred by the Friends of the Underline and it is too early to know its impact, but so far, the project has gained a lot of interest and the organizers of the parks roll out have done well to create programming and facilitate events such as yoga and poetry. They even have a lost and found hotline and “park rules.”



Underline, Before and After

UNDERPASS CASE STUDY: UNDERPASS PARK BY PFS/ PLANNING PARTNERSHIP, TORONTO - 2014

Underpass Park repurposed a series of abandon sites under Toronto’s downtown freeway system for public recreation. It cost was inexpensive compared to other projects of this size, at about \$5 million. About 50% of the park is covered by the freeway providing covered areas for community activities. The designers were able to honor local history, local neighborhoods, and facilitate new commercial activity.

Purpose: The design intent envisioned a network of flexible social and recreation opportunities between neighborhoods and nearby parks to “animate the public realm.” [43]

Approach: The interventions vary from area to area but most of them have a light touch which consists of murals, public art, lighting, playgrounds, and low maintenance vegetation. A few nodes contain playgrounds or basketball courts.

Implication: The project transformed and reclaimed the areas below the underpasses in to a variety of urban outdoor amenities including many pop up spaces for the fine and performing arts. It won an ASLA Award of Excellence in 2016. Upon further inspection this is part of a much larger Urban Renewal project that connects a lot of new development.



Underpass Park, Before and After

CHAPTER 3 - RESEARCH PROJECT

THE RESEARCH QUESTION AND THEORETICAL FRAMEWORK

The question is: Can a Regenerative Design Framework Improve Environmental Conditions using Undevelopable Land?

Using a research by design approach, eight sites in Portland were used to modeled design experiments based on the analysis of best practices extracted from case studies and findings from reputable local programs. Then, using a regenerative hub calculator, created for the project, an analysis of how to maximize environmental benefits with underutilized land to combat climate change in cities was generated.

Methodology: This project used a “projective” research by design methodology, which is incremental and iterative because of the nature of these sites. Case studies revealed that design elements of biophilic design in urban areas, urban ecology, and designing for climate resilience and adaptation was possible but no standard approach was laid out for small liminal landscapes. The scope of this analysis required design experimentation and would be limited to small sites and their ability to maximizing beneficial environmental impacts with design.

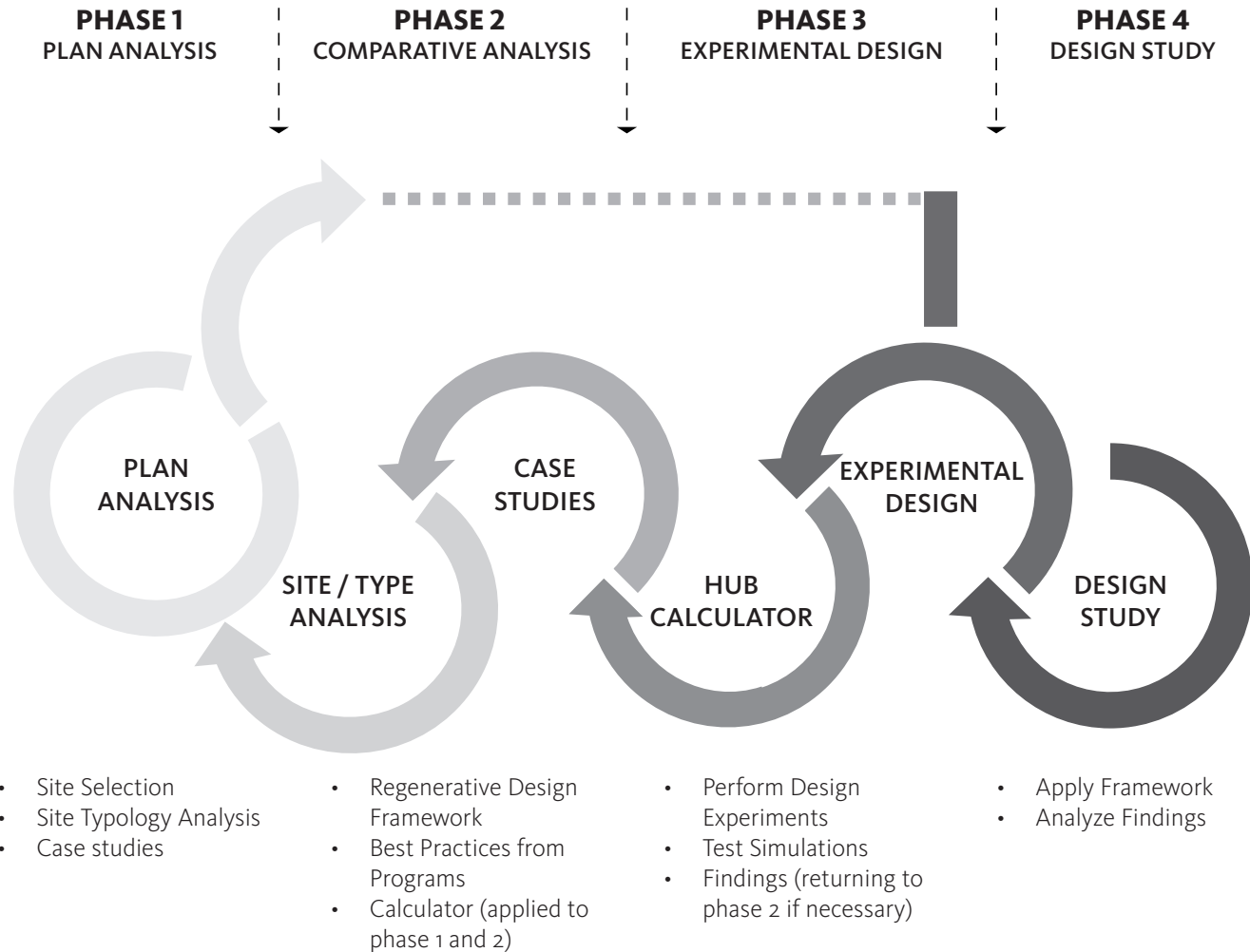
Phases of the Research Project: In Phase 1, using Nijhuis and Bobbink’s Design Research and Research-by-Design approach, the project started with the Plan Analysis phase where a method of compiling specific knowledge from case studies and mapping out typologies to deduce the relationships between the physical buildability and the potential for environmental benefits was applied. [44] The results included: identifying site typologies based on a set of criteria, selecting sites for design experiments through Google Earth instead of GIS, analyzing site dimensions and constraints (such as ecosystem services or existing programs) through site visits and Google Earth, and compiling case studies that match the goals and typology of the design experiments from the Landscape Performance Series and elsewhere.

In Phase 2, Comparative Analysis, the framework for Regenerative Hubs was developed and tested. Results included: what a regenerative hub is based on researching best practices in regenerative design and comparing those practices to existing city programs and to reveal meaningful information using the hub from my design experiment by plugging criteria into Excel spreadsheets. In this phase, generic knowledge of the qualitative, quantitative, and potential regenerative design process for mitigation was formalized by a calculator, where the process could be repeatable and objective.

In Phase 3, Design Experiment, design goals and opportunities were applied to each of the eight sites and design solutions from the case studies and best practices were retroactively considered to tweak designs that were scoring low. Results included: Findings about which design solutions work best for each of the three site typologies and how many solutions can be packed into a single site. This phase was mostly projective design and so documentation was both visual as well as analytical, using renderings and spreadsheets. The Regenerative Hubs calculator was used to test the hypothesis.

Phase 4, Design Study, was the process of analyzing the results of the Experimental Designs to parse out specific findings. Each experimental design was used as a simulation to explore all possible opportunities under the lens of the Regenerative

Hubs Framework. Here, the principals developed from the research against the experiments were turned into findings and recommendations by cataloguing all of the work into a presentation with visuals and graphs.



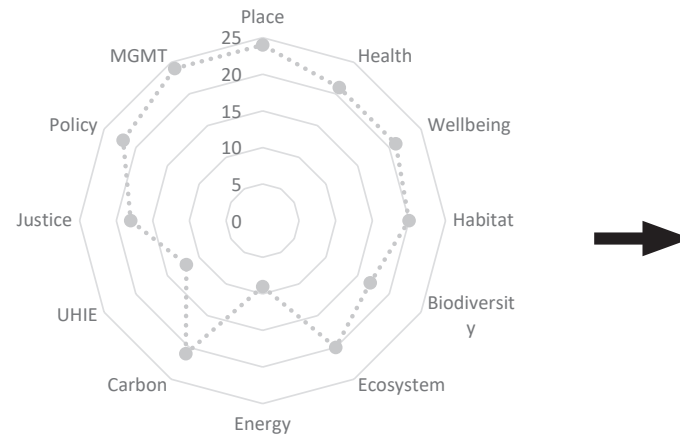
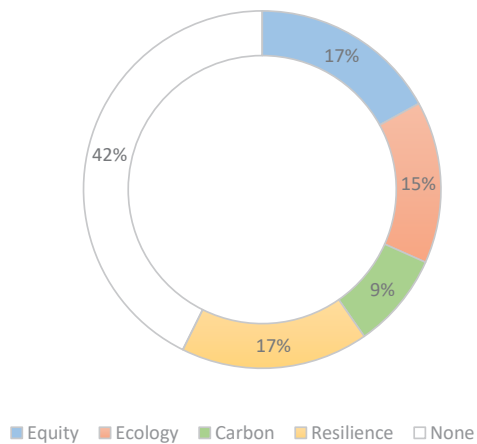
Design-Related Research in Landscape Architecture based on Nijhuis and Bobbink

METHODOLOGY

The Regenerative Hub Calculator, developed in Excel, determined the quantitative findings by comparing the score of existing conditions to the design experiments' opportunities. The total possible score is 200, which was unlikely. The calculator also tracked which goals scored higher than others and how much opportunity was not used.

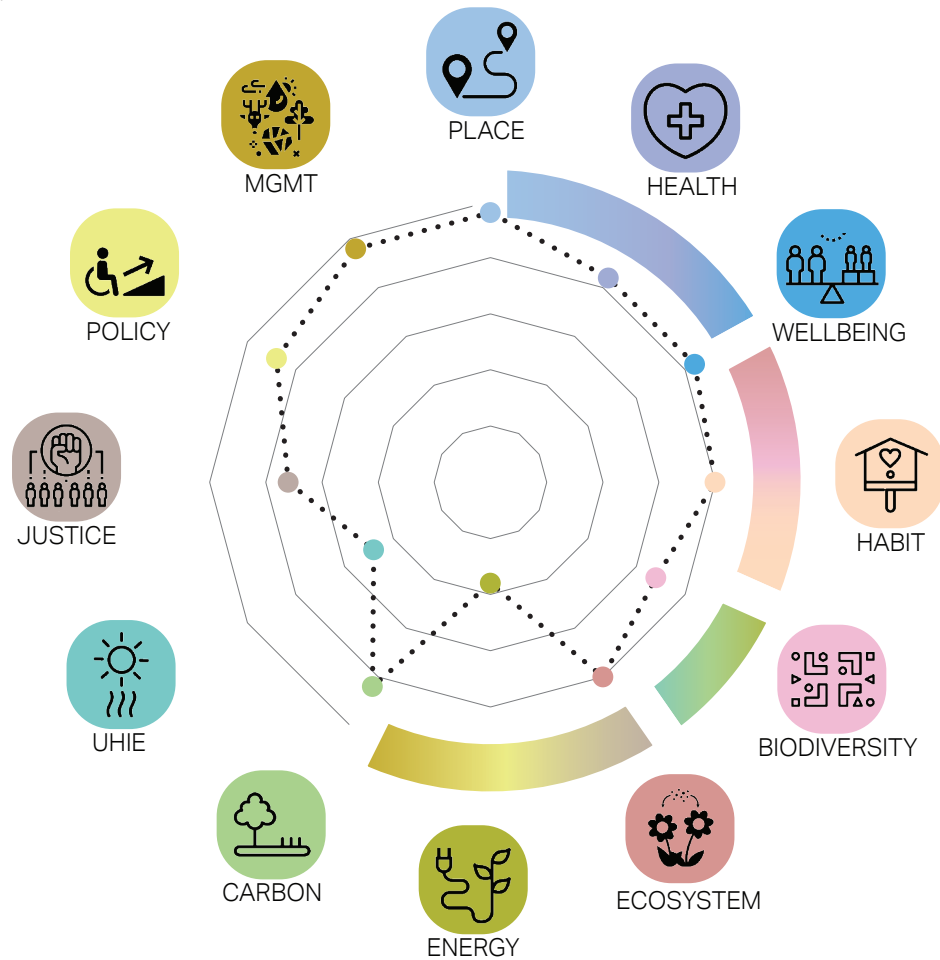
Design No. 1		GOALS BEFORE					GOALS AFTER					DESIGN OPPORTUNITIES													
		Equity	Ecology	Carbon	Resilience	None	Equity	Ecology	Carbon	Resilience	None	Place	Health	Wellbeing	Habitat	Biodiversity	Ecosystem	Energy	Carbon	UHIE	Justice	Policy	MGMT	Sum	
	NW Regeneration Station	Y/N	8	2	2	7		51	44	26	51	128	19	15	17	16	13	15	7	13	6	14	17	20	172
	Accessible Places	6 y	3	0	1	2	6	y	3	1	2	6	x	x	x				x		x	x			6
	Adaptive Reuse	0 n						y	3	3	2	10	x	x	x	x	x	x	x		x		x		10
	Anti-gentrification measures	0 n						y	3	1	1	6	x	x	x	x			x		x				6
	Bikes/ Scooter/ Car-Share Stations	0 n						n																	0
	Bioremediation / Toxic Cleanup	0 n						n																	0
	Bioswales	0 n						n																	0
	Carbon Sequestration	0 n						v	3	3	7	11	x	x	x	x	x	x	x	x	x	x	x	x	11

Example of Regenerative Hub Calculator



Development of Regenerative Hub Graph

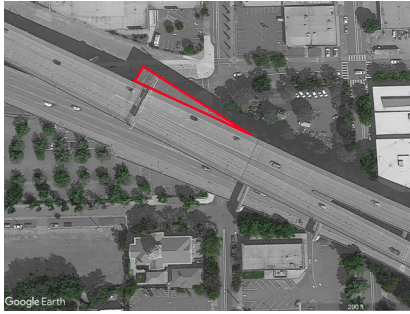
The goal of the design experiment was to maximize regenerative design on the site as much as possible. When one scored higher than others, data was checked on notes were taken following the hub analysis a qualitative approach was provided in the conclusion, summarizing what was learned by comparing the design experiments to their respective case studies and other discoveries made in through Nijhuis and Bobbink's Design Research and Research-by-Design approach. Once the data was processed, the two graphs were made for goals and opportunities, which were later combined to make the Regenerative Hub.



Regenerative Hub Graph

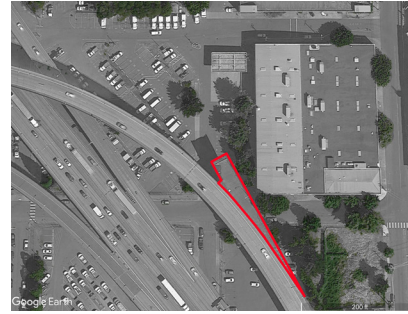
REGENERATIVE HUB DESIGN EXPERIMENT SITE LOCATIONS





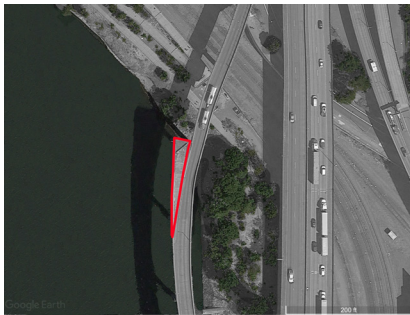
Design Experiment No. 3

Site: **Northwest Underpass**
 Typology: **Underpass**
 Longest Length: **225'**
 Shortest Length: **224'**
 Widest Width: **25'**
 Narrowest Width: **2'**
 Perimeter: **471'**
 Square Footage: **3,420**
 Highest Elevation: **40'**



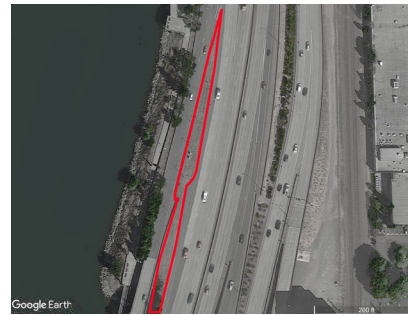
Design Experiment No. 2

Site: **Borthwick Underpass**
 Typology: **Underpass**
 Longest Length: **268'**
 Shortest Length: **264'**
 Widest Width: **19'**
 Narrowest Width: **2'**
 Perimeter: **576'**
 Square Footage: **5,021**
 Highest Elevation: **55'**



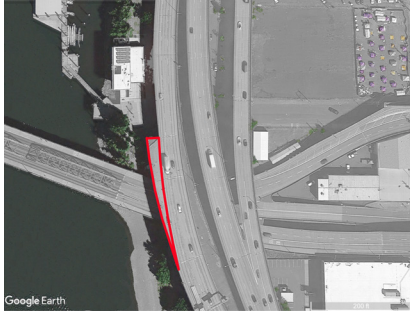
Design Experiment No. 3

Site: **Eastbank Ghost Ramp**
 Typology: **Ghost Ramp**
 Longest Length: **173'**
 Shortest Length: **145'**
 Widest Width: **30'**
 Narrowest Width: **2'**
 Perimeter: **376'**
 Square Footage: **2,806**
 Highest Elevation: **110'**



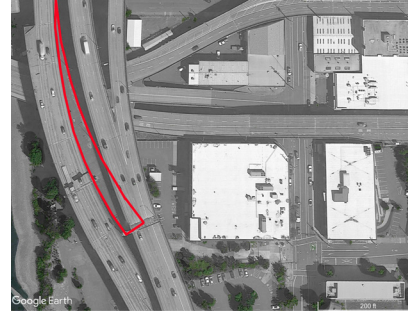
Design Experiment No. 4

Site: **I-5 Right of Way**
 Typology: **Right of Way**
 Longest Length: **560'**
 Shortest Length: **486'**
 Widest Width: **40'**
 Narrowest Width: **14'**
 Perimeter: **1,186'**
 Square Footage: **16,771**
 Highest Elevation: **3'**



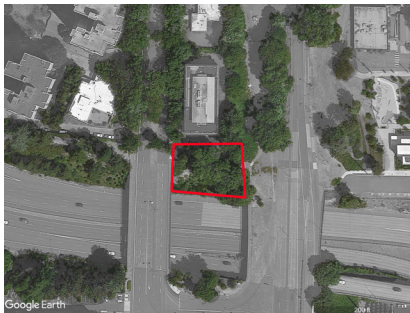
Design Experiment No. 5

Site: **Esplanade Ghost Ramp**
 Typology: **Ghost Ramp**
 Longest Length: **260'**
 Shortest Length: **254'**
 Widest Width: **25'**
 Narrowest Width: **5'**
 Perimeter: **544'**
 Square Footage: **4,312**
 Highest Elevation: **60'**



Design Experiment No. 6

Site: **Esplanade Underpass**
 Typology: **Underpass**
 Longest Length: **540'**
 Shortest Length: **518'**
 Widest Width: **45'**
 Narrowest Width: **2'**
 Perimeter: **1,140'**
 Square Footage: **13,918**
 Highest Elevation: **60'**



Design Experiment No. 7

Site: **I-405 Underpass**
 Typology: **Underpass**
 Longest Length: **145'**
 Shortest Length: **110'**
 Widest Width: **100'**
 Narrowest Width: **2'**
 Perimeter: **576'**
 Square Footage: **15,422**
 Highest Elevation: **30'**

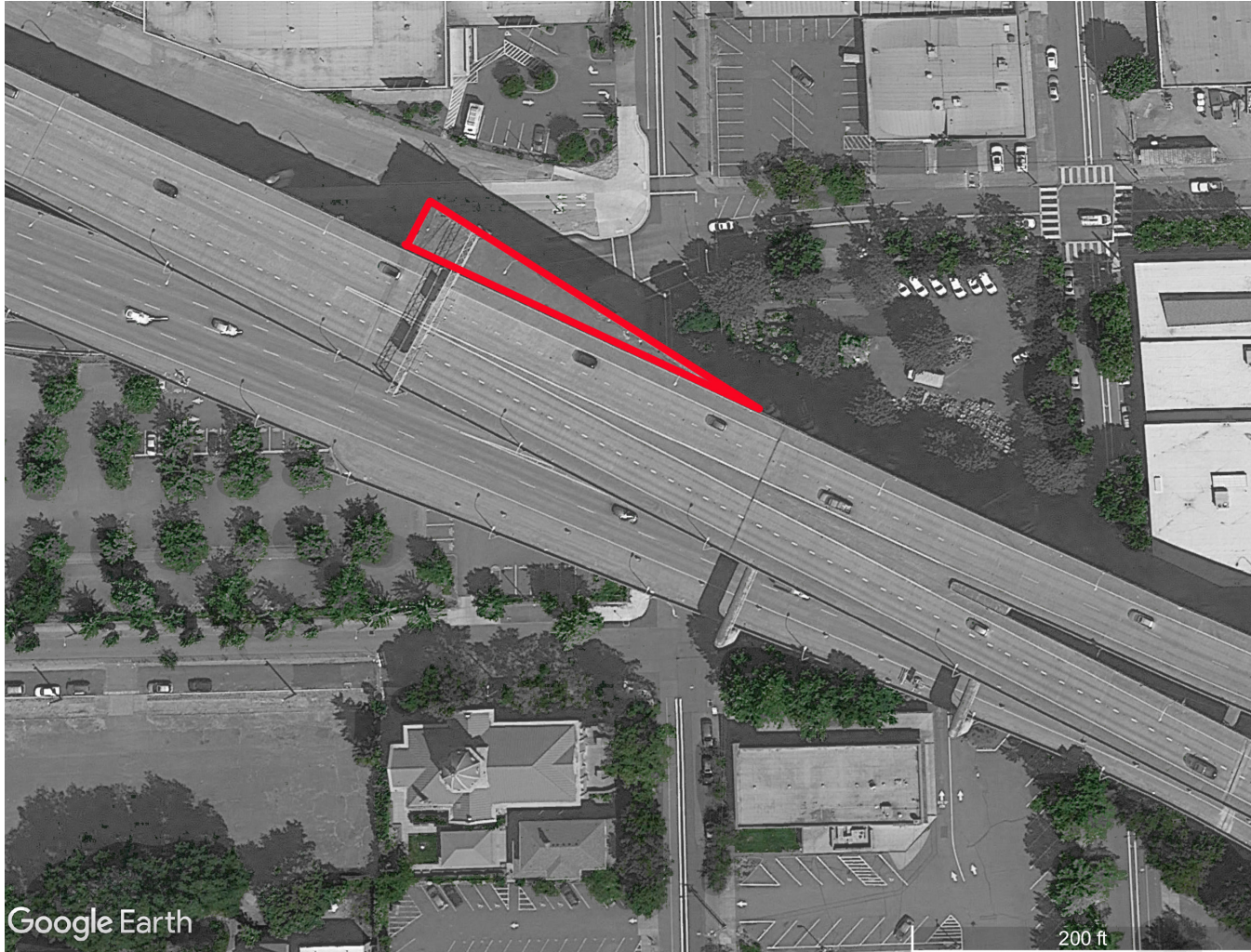


Design Experiment No. 8

Site: **I-405 Right of Way**
 Typology: **Right of Way**
 Longest Length: **1,050'**
 Shortest Length: **1,040'**
 Widest Width: **100'**
 Narrowest Width: **10'**
 Perimeter: **2,327'**
 Square Footage: **69,600**
 Highest Elevation: **25'**

DESIGN EXPERIMENT NO. 1 - NORTHWEST UNDERPASS

Existing Conditions: The top of this underpass is a ghost ramp that overlooks industrial northwest Portland, facing north towards the river. While the area is mostly surrounded by industrial, there is also commercial and residential nearby. Presently, the underpass is used as a motive space almost exclusively for local bikes and cars. There are nearby settlements but not on the underpass site, this is probably due to wetness and slope.



Northwest Underpass - Aerial



Northwest Underpass - Photo Collage

Design Experiment No. 3

Site: **Northwest Underpass**

Typology: **Underpass**

Longest Length: **225'**

Shortest Length: **224'**

Widest Width: **25'**

Narrowest Width: **2'**

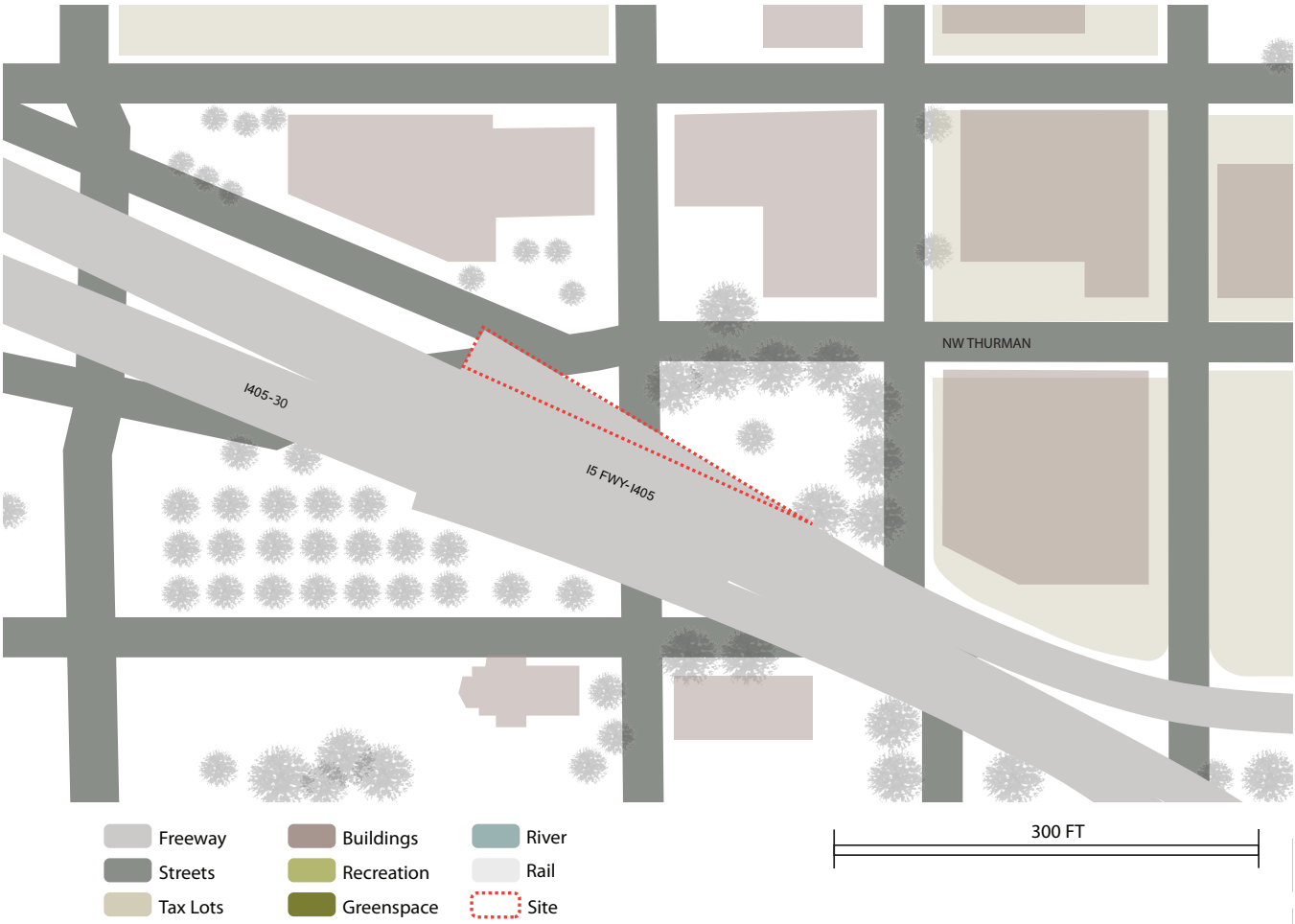
Perimeter: **471'**

Square Footage: **3,420**

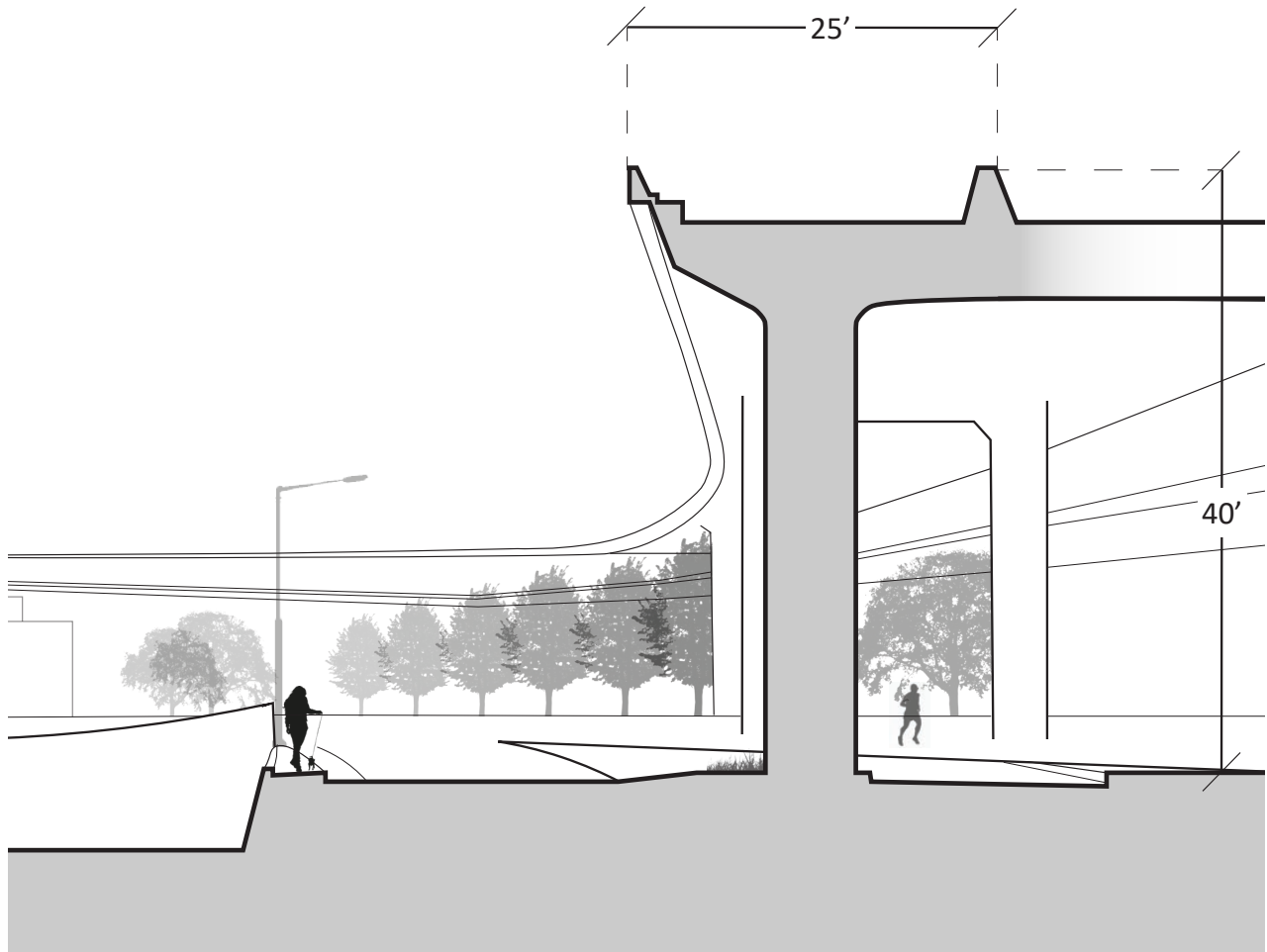
Highest Elevation: **40'**

Design Constraints/ Opportunities: This site would be great for an avian urban habitat that needs access to the waterfront or nearby Forest Park. The ramp could facilitate vertical wind turbines to generate electricity for site amenities. A settlement of about 60 people flanks the north facing side of the underpass, directly under the bridge. They could benefit from services like free internet access/ phones/ and 211 resources. However, this space should stay motive, it is not recommended for large gatherings due to swift moving car traffic with no physical barriers. Traffic calming is recommended.

NORTHWEST UNDERPASS: EXISTING CONDITIONS



Northwest Underpass - Illustrative Plan

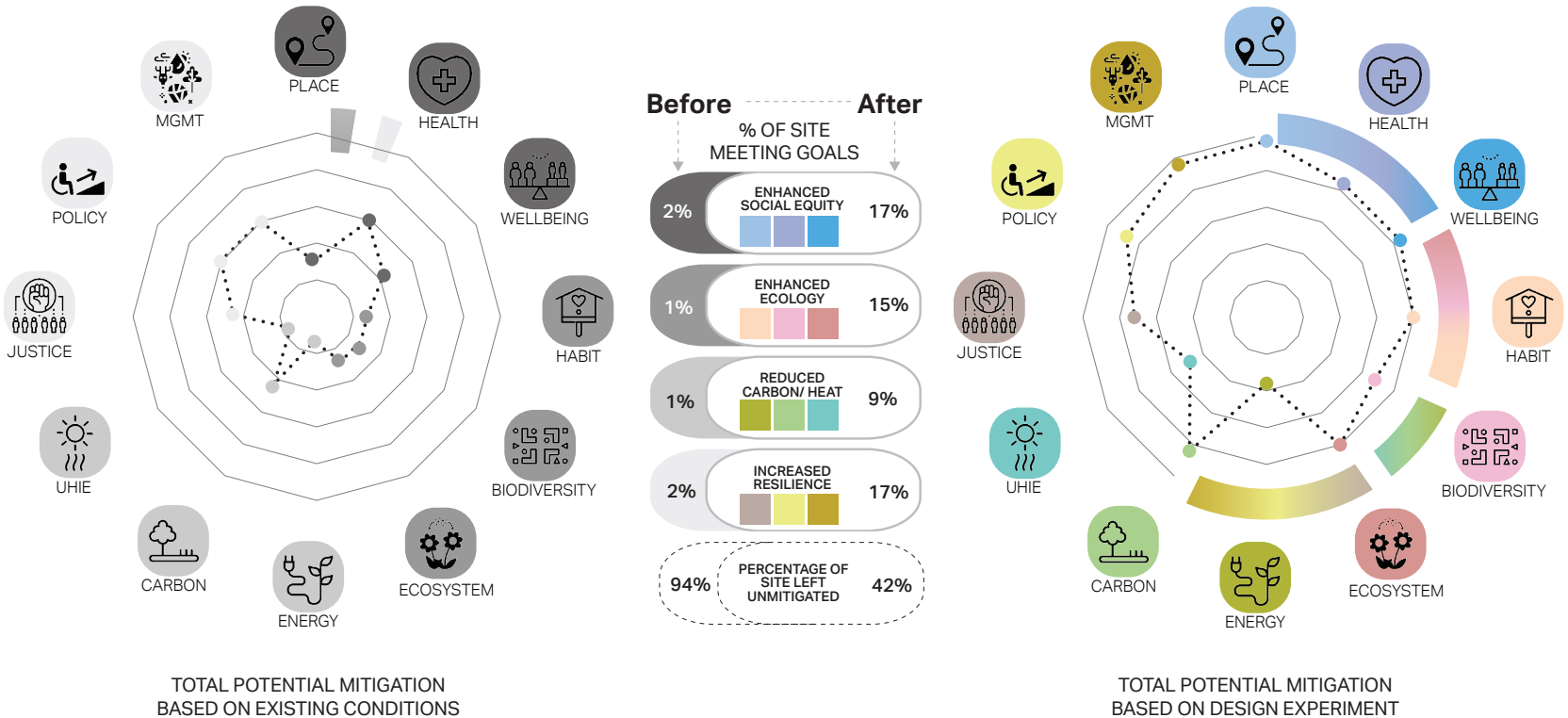


Northwest Underpass - Section Elevation

NORTHWEST UNDERPASS: FINDINGS

Design Experiment: Free internet computers and free local phones are proposed to connect anyone in the area to 211 resources (which have been critical in Portland during the pandemic). Vending machines that take food stamps can run on vertical turbine generation from above. Since this is a totally motive space, not meant for hanging out, there will be no seating, and it should stay lit all night for 24/7 access. Bike pump stations will benefit commuters, such as locals on their way to work in the NW Industrial area. Hoary bat habitat and bat houses will be placed on the ramp and will be tracked and maintained on civic ecology apps. Bat habitat will also be documented below on a habitat tracking screen and in murals. A traffic calming street mural will slow traffic locally, alerting commuters to pedestrian traffic. [Appendix B1]

Northwest Underpass Regenerative Hubs Design Experiment



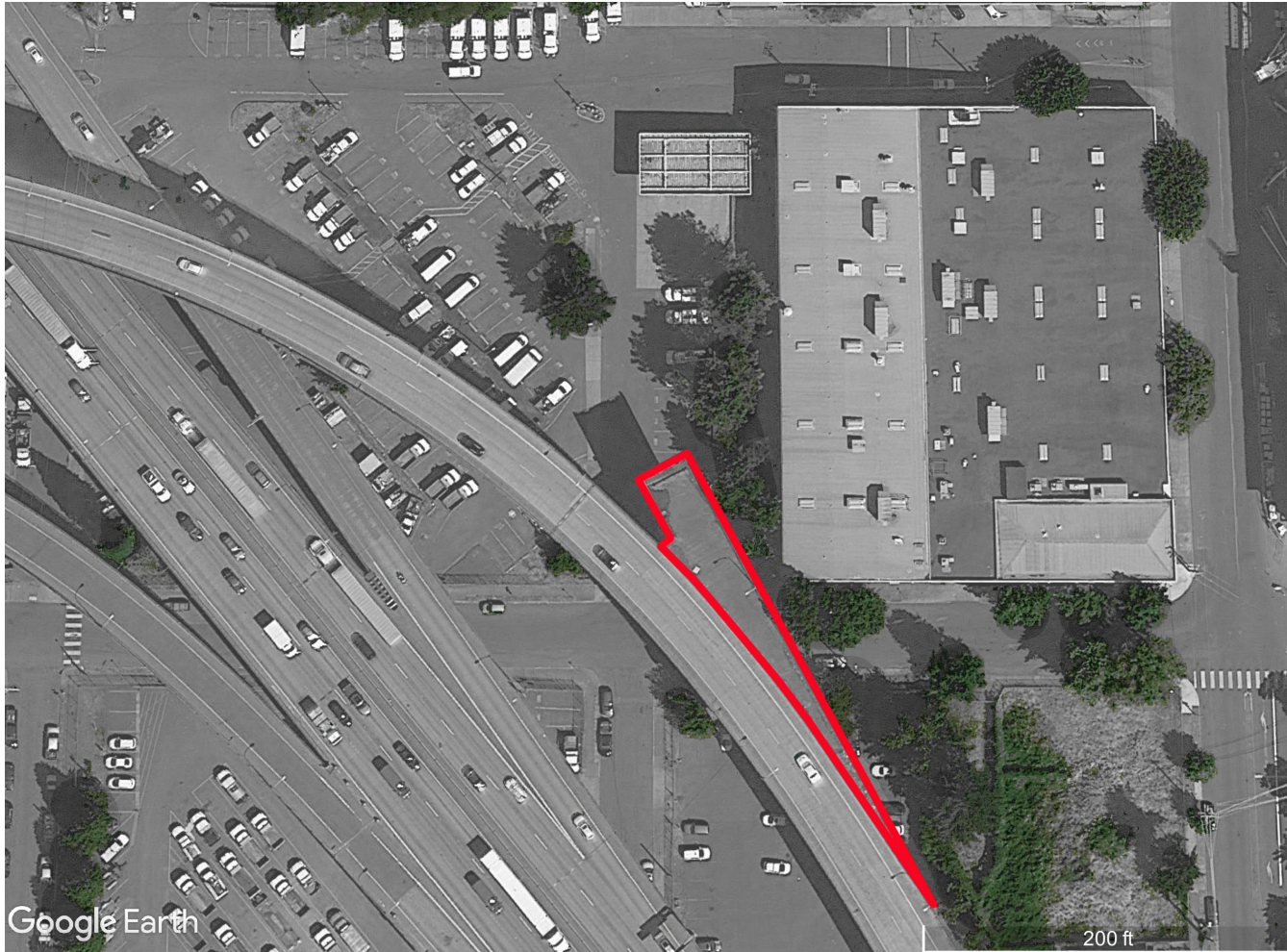
Findings: The design experiment shows that there is potential for climate change mitigation on this site, particularly with regard to social equity and resilience. A bike-oriented civic center with free internet, vending machines that takes food stamps, and bike pumps powered by solar panels would benefit local residents and activate the motive space. Bat habitat with migration connection to west hills above and civic ecology would inform the neighborhood of biodiversity and ecosystem services efforts.



Northwest Underpass - "Feels Like"

DESIGN EXPERIMENT NO. 2 - BORTHWICK UNDERPASS

Existing Conditions: Borthwick street below the ghost ramp is in an inner NE Portland industrial area. The ramp overhangs a parking lot. While bustling Mississippi, Russel, and Williams with a 10-minute walking distance, the area is very inactive – even during the day. There are no settlements nearby and the area is not on a central commute path (though has potential to become one). The site is accessed by municipal workers, industrial workers, or Emanuel hospital employees.



Northwest Underpass - Aerial



Northwest Underpass - Photo Collage

Design Experiment No. 2

Site: **Borthwick Underpass**

Typology: **Underpass**

Longest Length: **268'**

Shortest Length: **264'**

Widest Width: **19'**

Narrowest Width: **2'**

Perimeter: **576'**

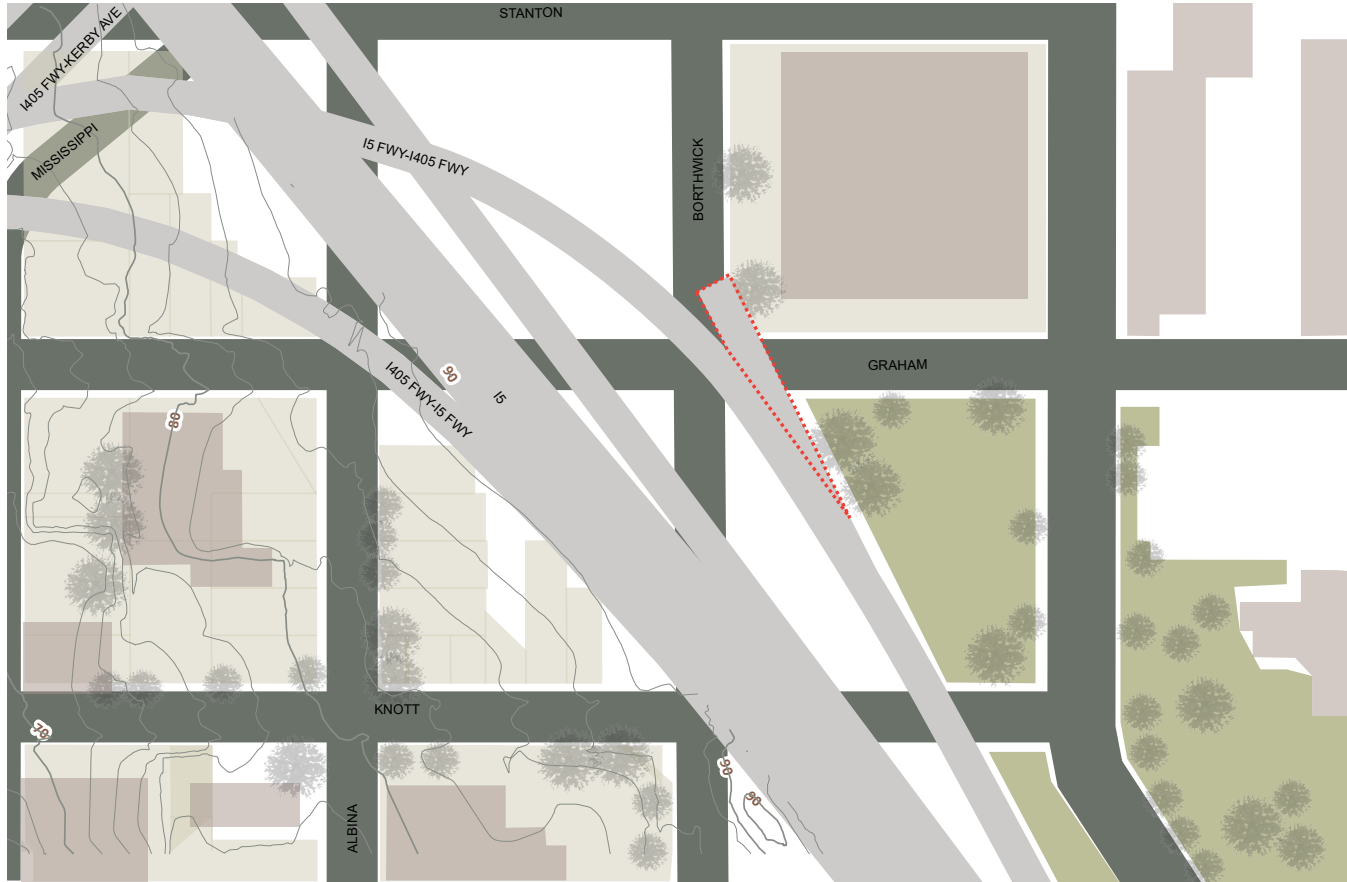
Square Footage: **5,021**

Highest Elevation: **55'**

Design Constraints/ Opportunities:

This ghost ramp is surrounded by municipal fleet cars, where people stop to pick up another car or go on lunch break, so some seating and centralizing for working class employees would be considerate. The area is at minimal risk of gentrification due to the fact that it is zone industrial, with little to no commercial and residential uses to displace. While the area is walkable to local restaurants and very central to the city, it is not a place you would want to frequent at night. Therefore, the area needs lighting and would benefit from activities that a fleet driver or a nearby hospital employee would want to use on a break.

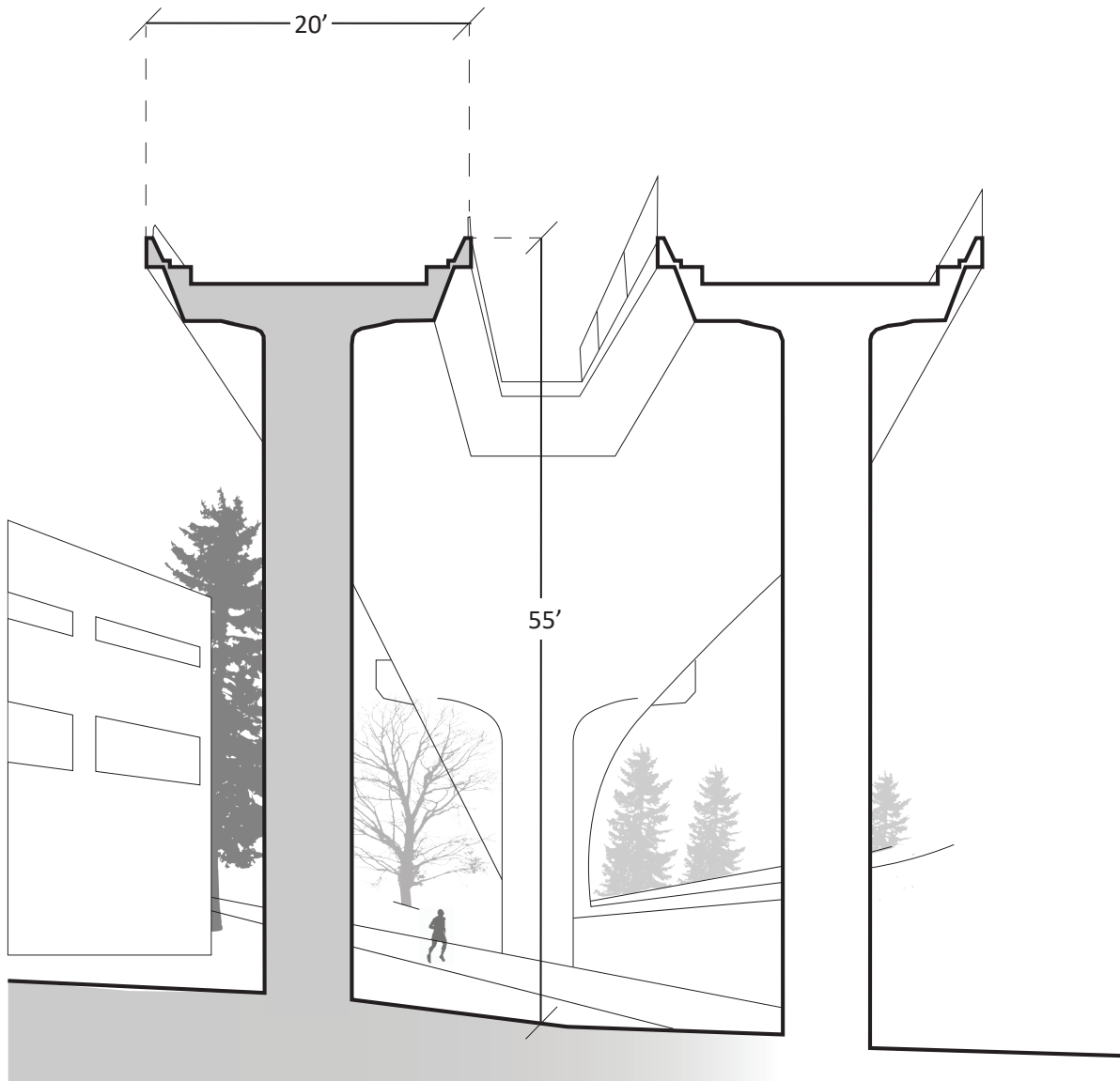
BORTHWICK UNDERPASS: EXISTING CONDITIONS



- | | | |
|---|---|---|
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300 FT

Northwest Underpass - Illustrative Plan

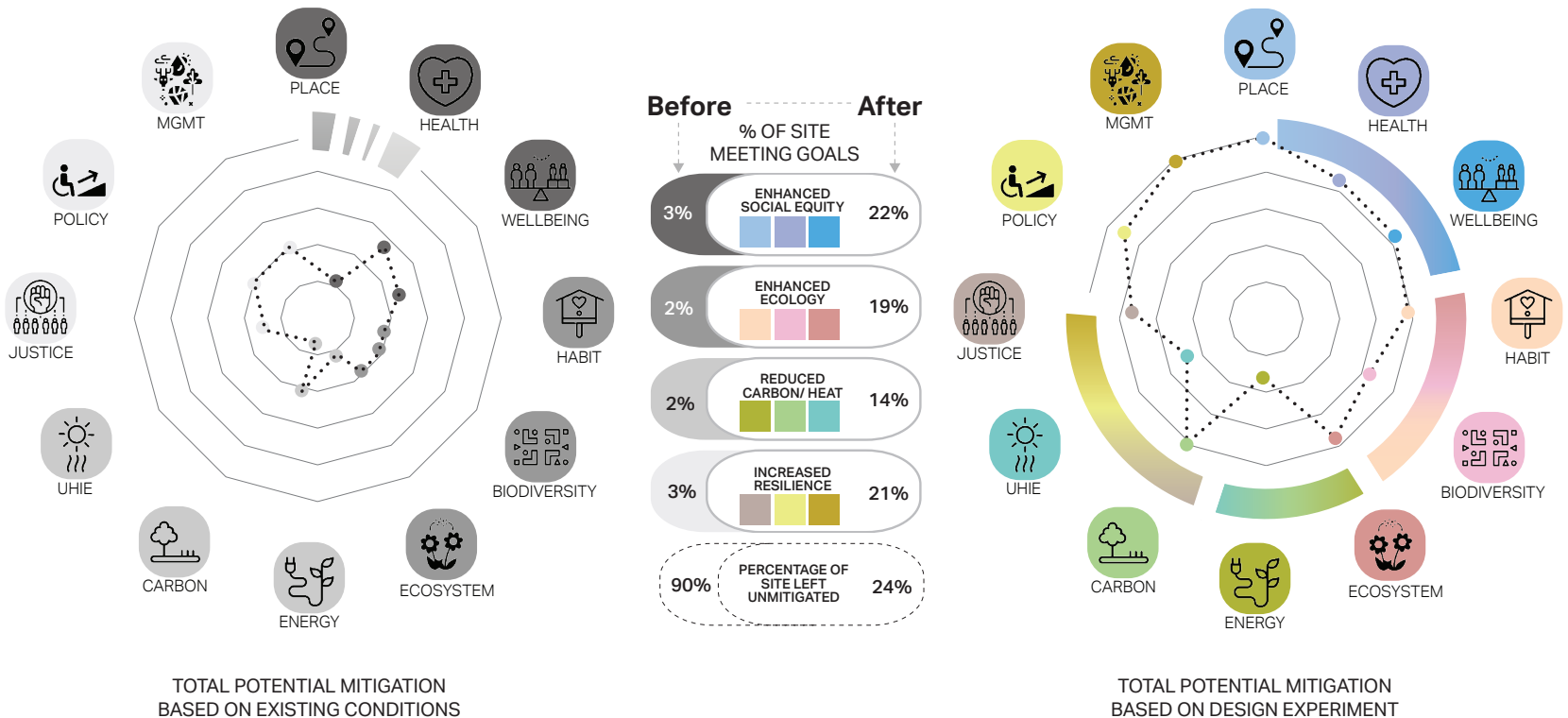


Northwest Underpass - Section Elevation

BORTHWICK UNDERPASS: FINDINGS

Design Experiment: The area calls for an adult playground with a calming sanctuary of herbaceous plants and a canopy of existing conifers. Having seen a great horned owl while there, owl houses and habitat have been integrated. This playground is for working class adults, to activate the area 24/7 and provide amenities to the existing workforce who work on an 24/7 shift cycle. Calming rainwater features make soothing sounds and evergreen trees provide shade. Bioswales capture runoff and provide on-site storm water facilities. Owl habitat on top of the underpass would be visible with live webcam coverage below. trees provide shade. Bioswales capture runoff and provide on-site storm water facilities. Owl habitat on top of the underpass would be visible with live webcam coverage below. [Appendix B2]

Borthwick Underpass Regenerative Hubs Design Experiment



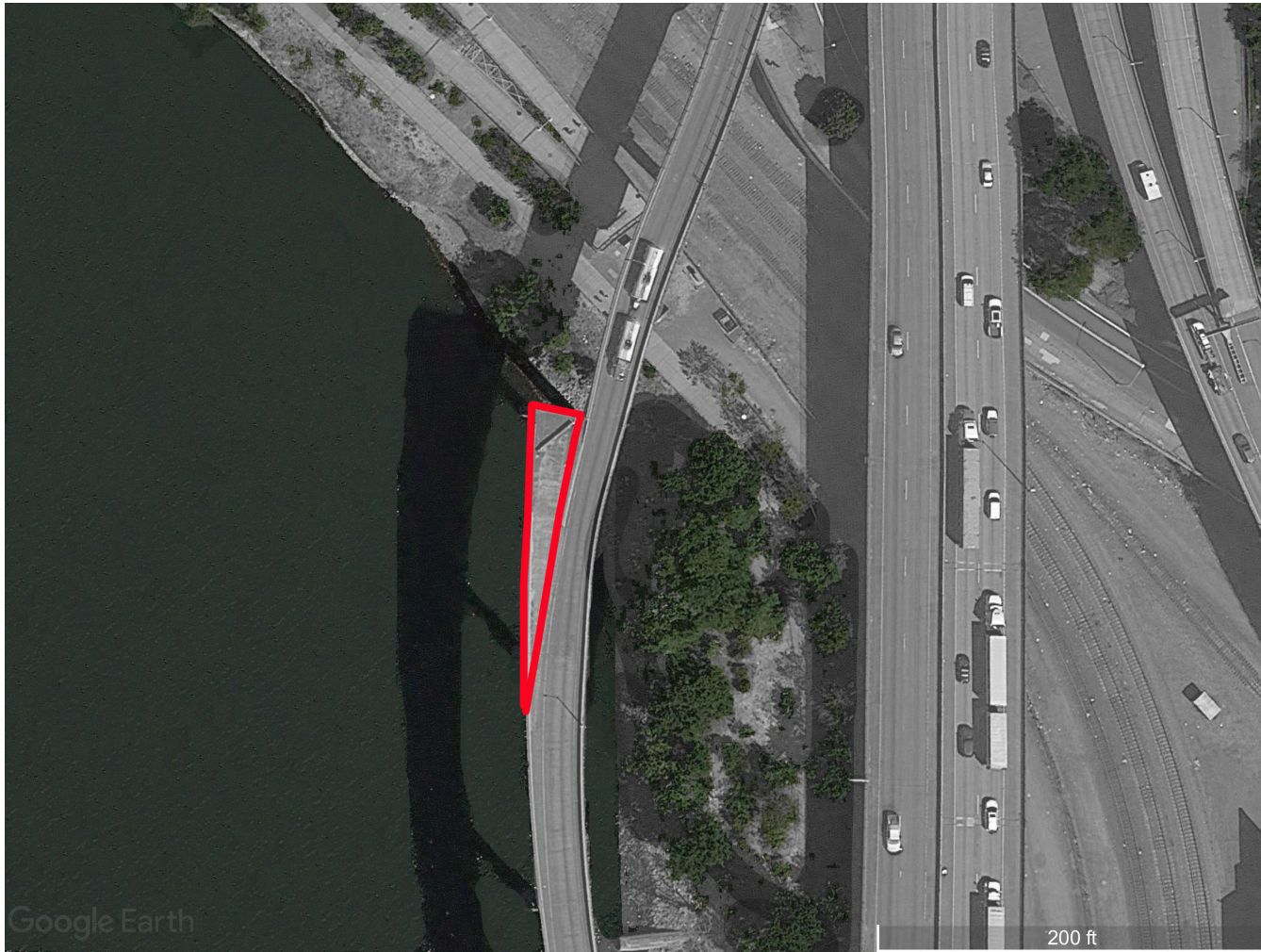
Findings: The design experiment shows that an adult playground with built in recreation activities and great horned owl habitat above would increase Social Equity and Resilience, leaving on 24% of the site's potential for mitigation unused. Conifer trees and native plantings below also rank high for ecology compared to other sites.



Borthwick Ghost Ramp - "Feels Like"

DEISGN EXPERIMENT NO. 3 - ESTBANK GHOST RAMP

Existing Conditions: This ghost ramp is visible from the east bank esplanade and the downtown waterfront, it's the most visible ghost ramp. It protrudes from an I-5 south exit towards I-84. It has very limited use for social equity and should not be accessed by people, but it does have great potential for public art and placemaking. With the riparian areas and river below, it would be great for water loving birds.



Eastbank Ghost Ramp - Aerial



i-5 Right-Of-Way - Photo Collage

Design Experiment No. 3

Site: **Eastbank Ghost Ramp**

Typology: **Ghost Ramp**

Longest Length: **173'**

Shortest Length: **145'**

Widest Width: **30'**

Narrowest Width: **2'**

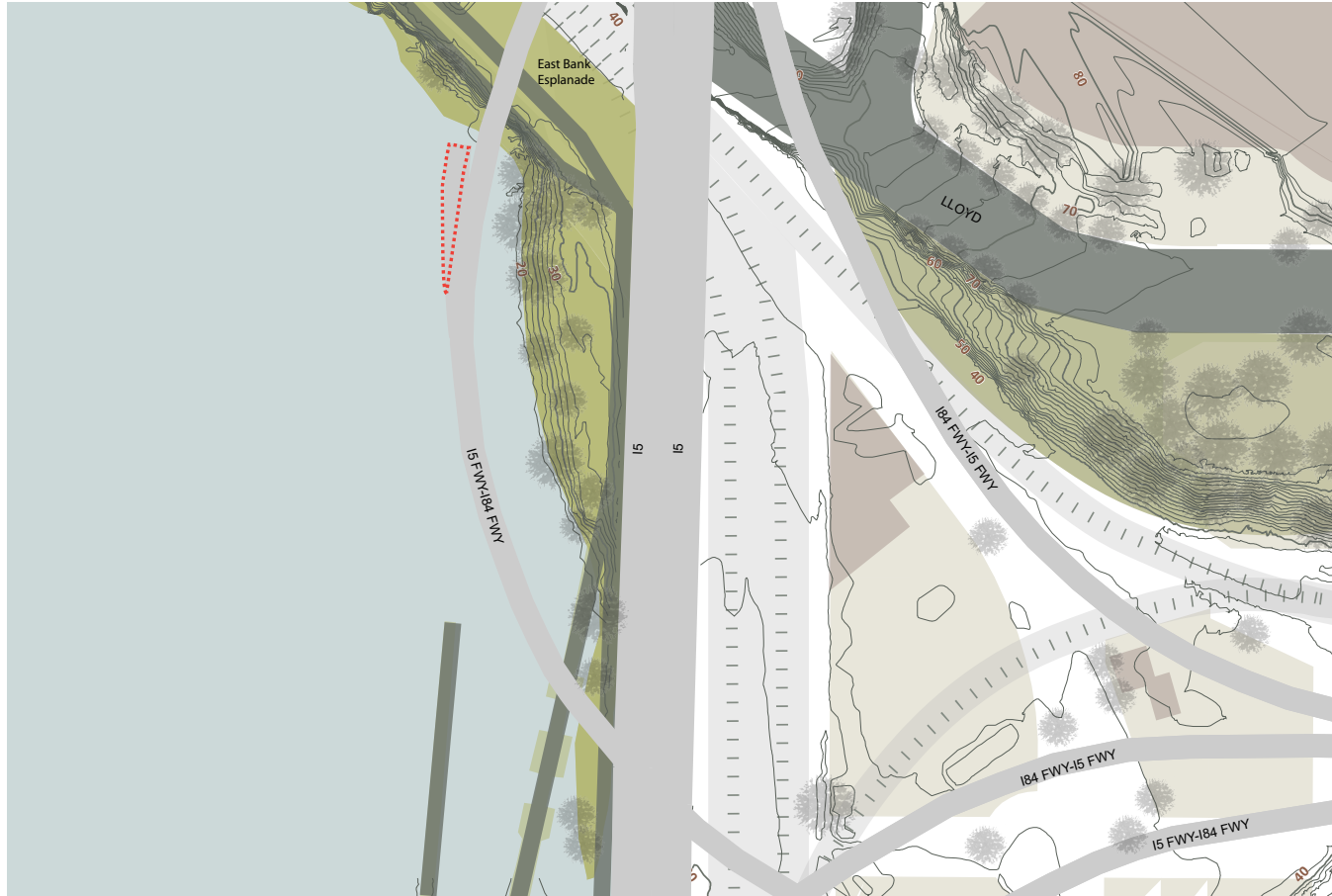
Perimeter: **376'**




Square Footage: **2,806**

Highest Elevation: **110'**

Design Constraints/ Opportunities: This site could accommodate a dramatic art installation that can be seen hundreds of feet away but should not have public access. As the most visible of the ghost ramps, it should function as a tourist attraction and climate change awareness-making installation. The peregrine falcon in Portland is already known to nest on the Fremont bridge nearby, so this site could be set up with snags, gravel, and nurse logs to attract falcons. Indicators from monitoring of the bird's presence should be monitored. Solar panels can be set up for electricity.

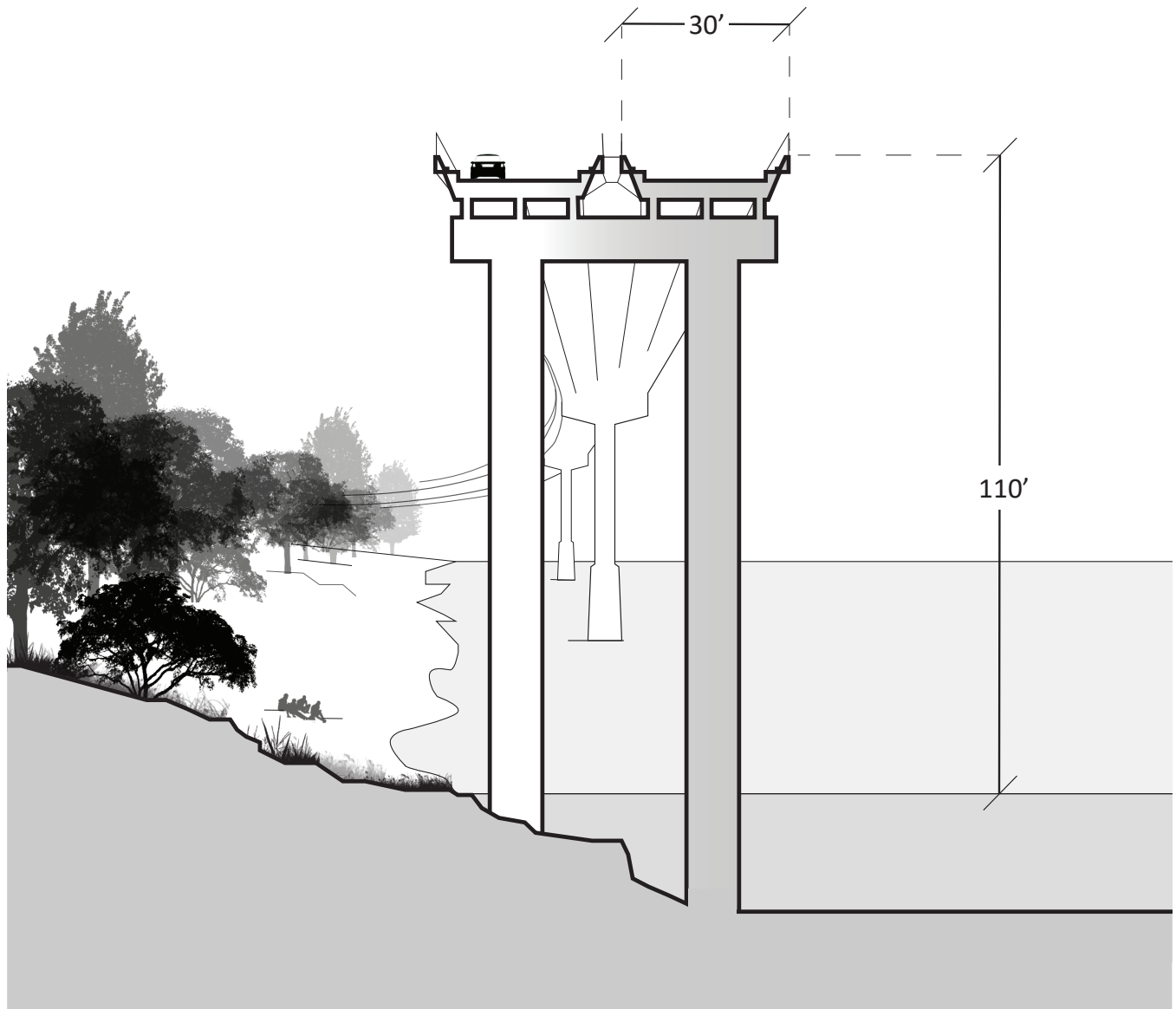
EASTBANK GHOST RAMP: EXISTING CONDITIONS



- | | | |
|--|--|---|
|  Freeway |  Buildings |  River |
|  Streets |  Recreation |  Rail |
|  Tax Lots |  Greenspace |  Site |

300 FT

Eastbank Ghost Ramp - Illustrative Plan

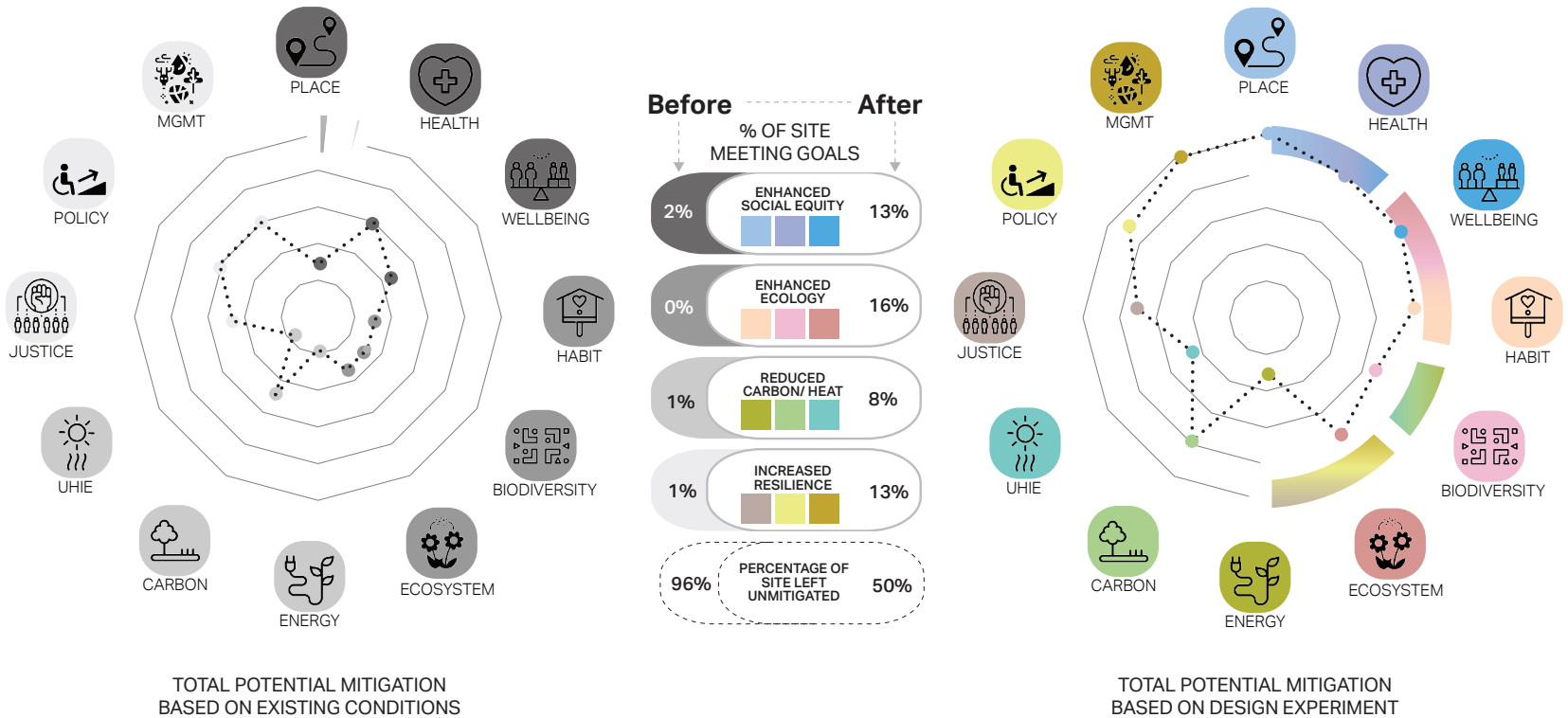


Eastbank Ghost Ramp - Section Elevation

EASTBANK GHOST RAMP: FINDINGS

Design Experiment: This site has a dramatic waterfall. The water is sucked up from a tank in the Willamette river and spouted out from the ramp itself. Snags, small wind tolerant pines, and nest boxes for falcons will accompany an subtle rain garden of albedo reducing materials. Light displays will show off bird's status (is it there, is it nesting) at night. The light show will blend in with Portland night skyline where many structures are lit up, and light will be based on data triggered by citizen science apps. Pedestrians on the esplanade below can watch for falcons in person or on a webcam, which will feed research. [Appendix B3]

Eastbank Ghost Ramp Regenerative Hubs Design Experiment



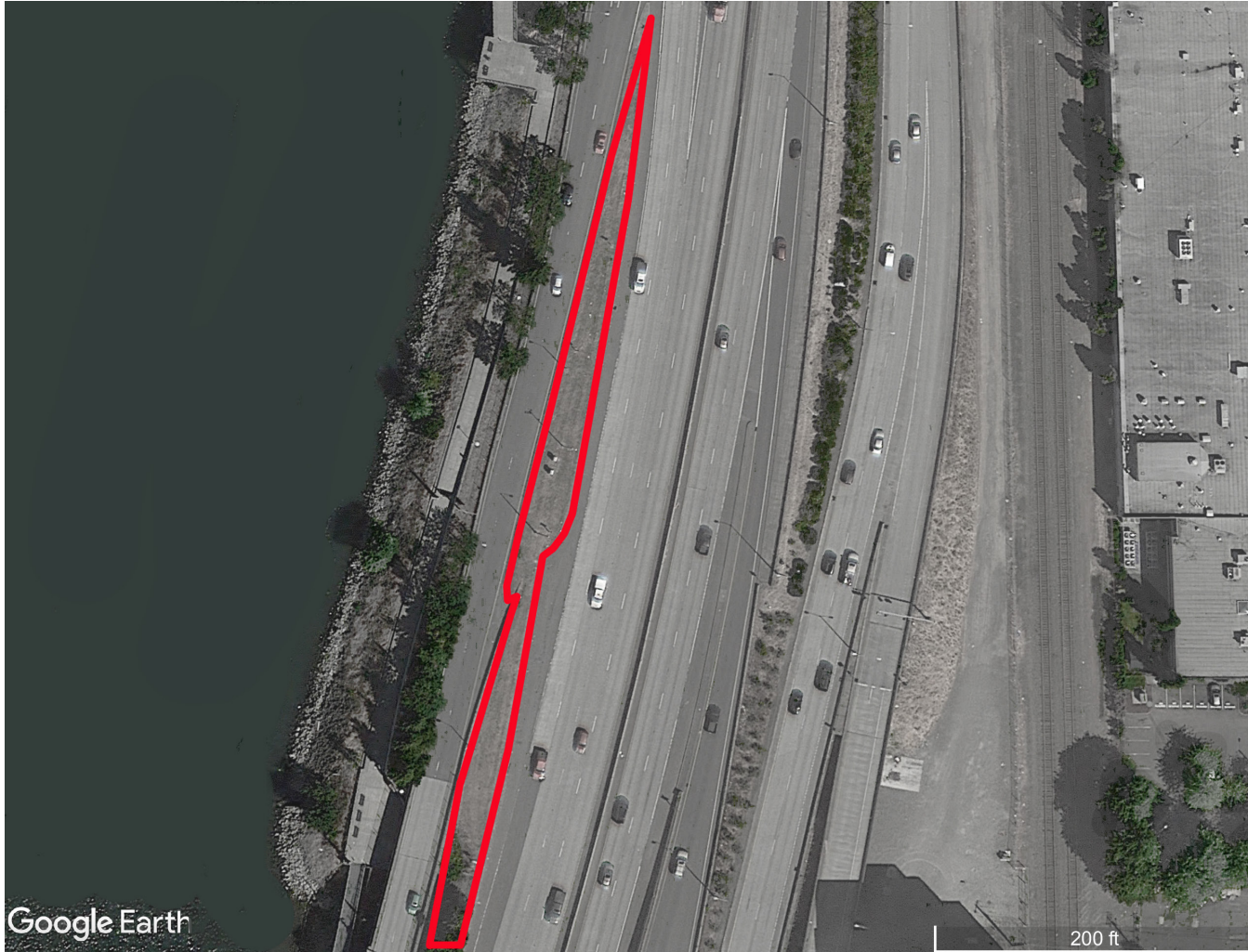
Findings: Public art, awareness, peregrine falcon habitat is a good fit for this considering existing conditions. The design experiment shows that shrub, snag, and groundcover will mitigate for carbon.



Eastbank Ghost Ramp - "Feels Like"

DESIGN EXPERIMENT NO. 4 - I-5 RIGHT OF WAY

Existing Conditions: This is a freeway median between two heavily used lanes of traffic. It presently is covered in grass and has a few naturalized shrubs. This is a huge site. It runs parallel to east bank esplanade along the waterfront and the southern end it is close to a few large evergreens.



I-5 Right Of Way - Aerial



i-5 Right-Of-Way - Photo Collage

Design Experiment No. 4

Site: **I-5 Right of Way**
Typology: **Right of Way**
Longest Length: **560'**
Shortest Length: **486'**
Widest Width: **40'**
Narrowest Width: **14'**
Perimeter: **1,186'**
Square Footage: **16,771**
Highest Elevation: **3'**

Design Constraints/ Opportunities: This site is visible from the esplanade but not accessible by public and should not be accessed by public. The slope of the freeway running south would allow this site to process a lot of runoff. The site has capacity for a lot of plants, including large trees. This site would be a great constructed wetland but due to its level with traffic should not attract too much wildlife.

I-5 RIGHT OF WAY: EXISTING CONDITIONS



- | | | |
|--|--|---|
|  Freeway |  Buildings |  River |
|  Streets |  Recreation |  Rail |
|  Tax Lots |  Greenspace |  Site |

300 FT

I-5 Right Of Way - Illustrative Plan

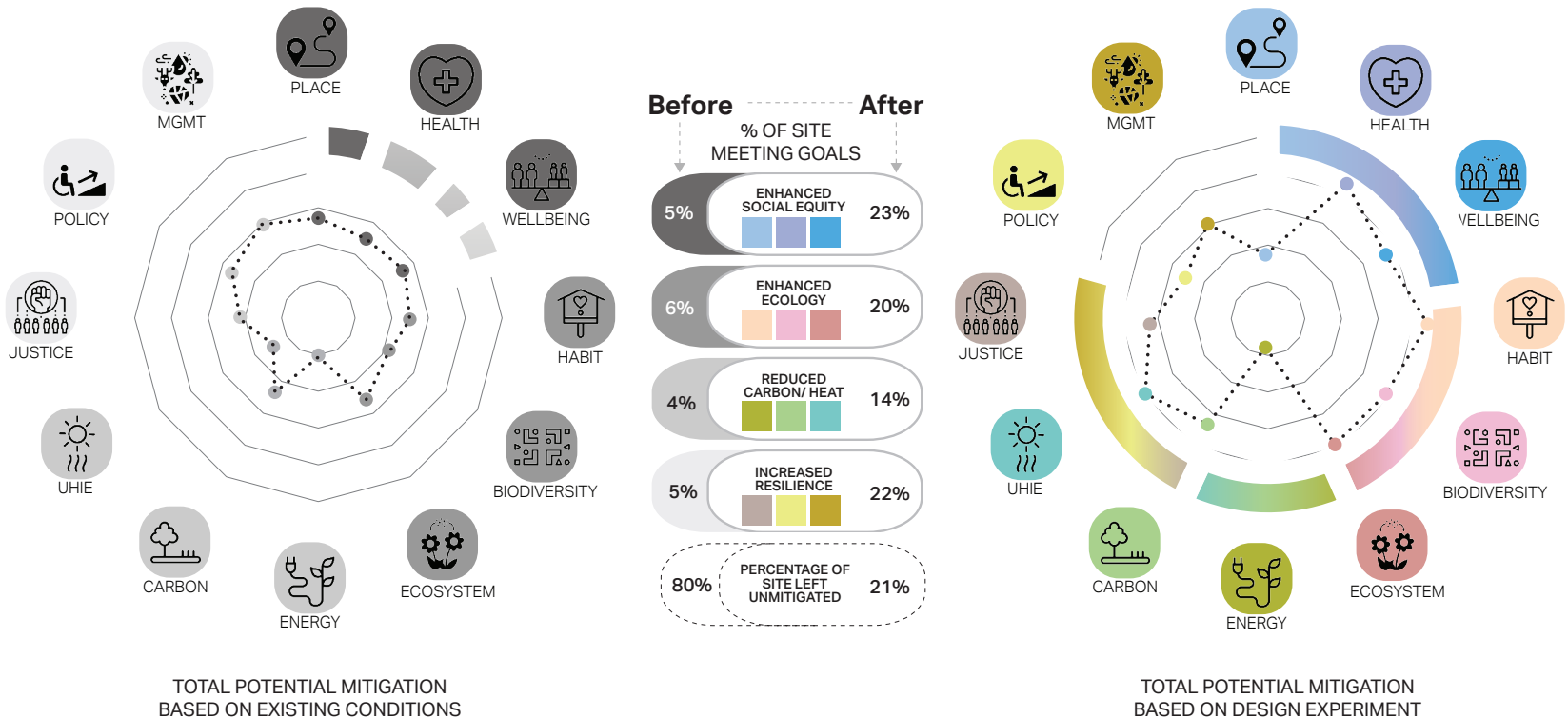


i-5 Right-Of-Way - Section Elevation

I-5 RIGHT OF WAY: FINDINGS

Design Experiment: This site will be a constructed wetland with NORM storm water processing system that feeds water to esplanade for runners or passerby. It will offer a large bioswale system that captures rainwater from the freeway east to west and use plants and the NORM system for processing. It will offer habitat to pollinators and will provide water to surrounding urban wildlife, but water will be protected by a grate so as not to attract and threaten wildlife to the freeway. [Appendix B4]

I-405 Right of Way Regenerative Hubs Design Experiment



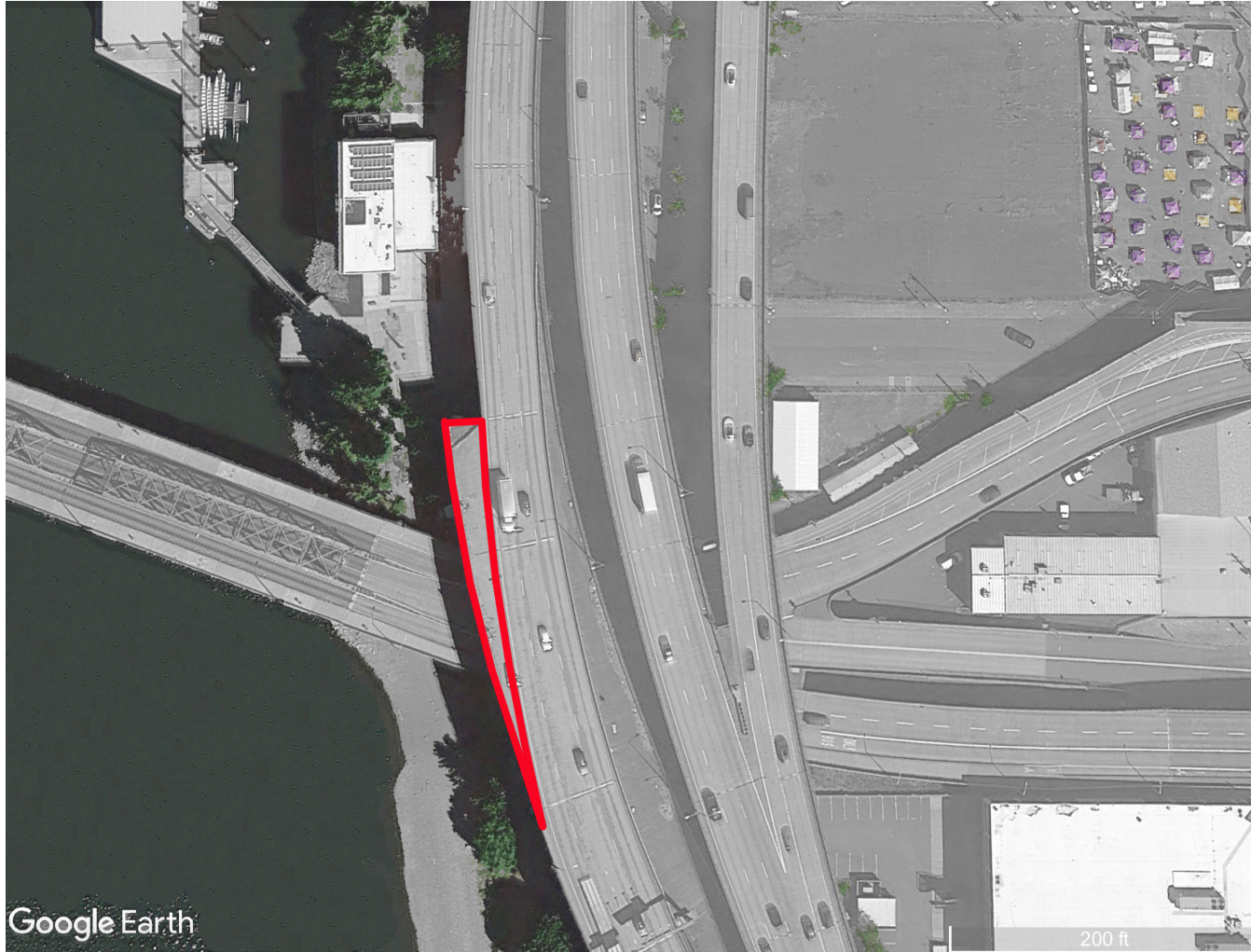
Findings: Constructed wetland with NORM storm water processing system that feeds potable water to esplanade would offer both a public amenity and climate mitigation. Taller riparian trees would provide ecosystems services to surrounding wildlife as well, making this site rank score high on ecology and resilience despite the fact the water in the wetlands will not be accessible to animals.



i-5 Right-Of-Way - "Feels Like"

DESIGN EXPERIMENT NO. 5 - ESPLANADE GHOST RAMP

Existing Conditions: This Ghost ramp is very visible from the Vera Katz esplanade and it covers a short portion of the promenade. It is also adjacent to another ghost ramp (No. 5). The ghost ramp portion of this site cannot be accessed from above, but the columns can be painted along the Vera Katz Esplanade below. Currently there are no settlements on this site but there are a few in the nearby eastside industrial district.



Esplanade Ghost Ramp - Aerial



Esplanade Ghost Ramp - Photo Collage

Design Experiment No. 5

Site: **Esplanade Ghost Ramp**

Typology: **Ghost Ramp**

Longest Length: **260'**

Shortest Length: **254'**

Widest Width: **25'**

Narrowest Width: **5'**

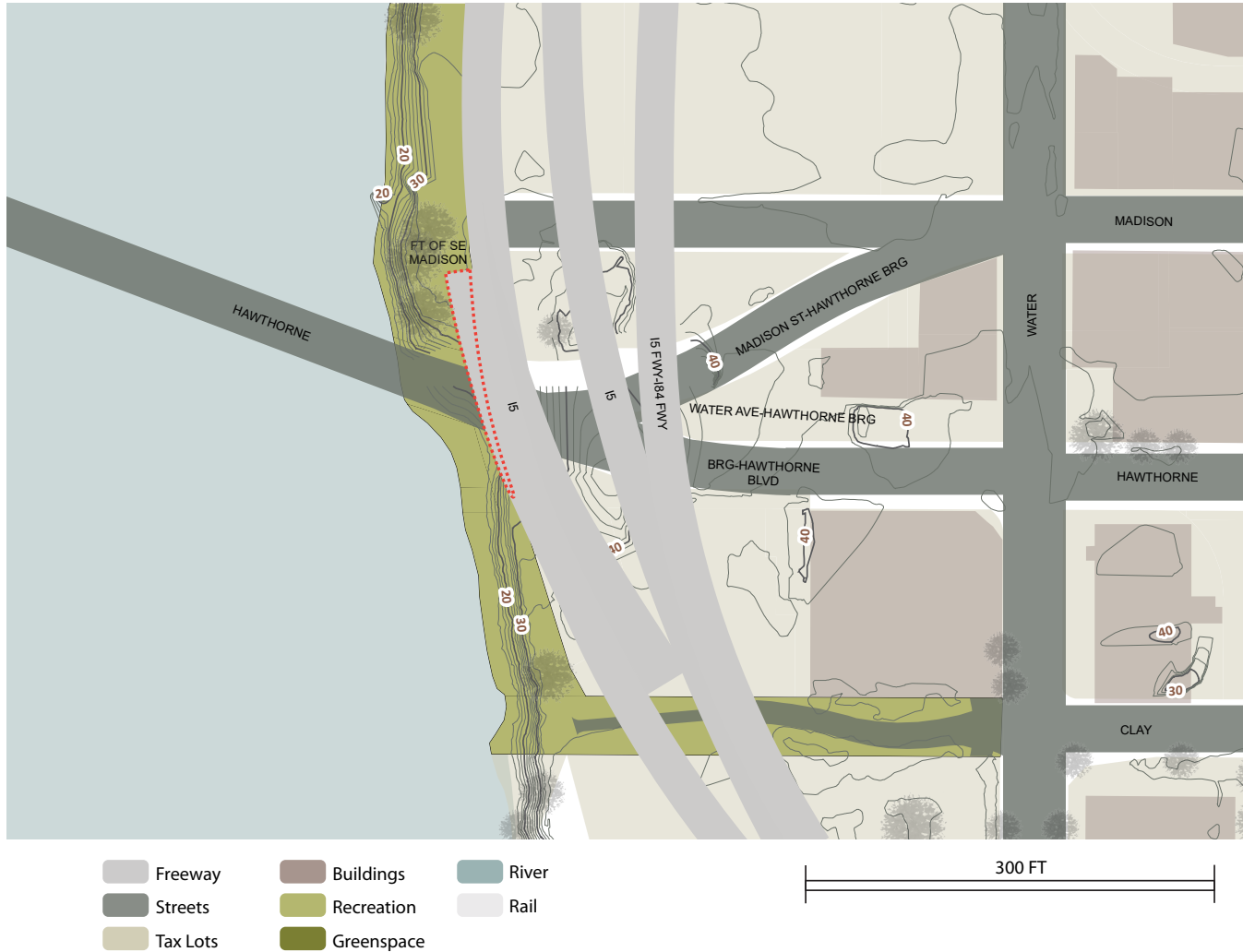
Perimeter: **544'**

Square Footage: **4,312**

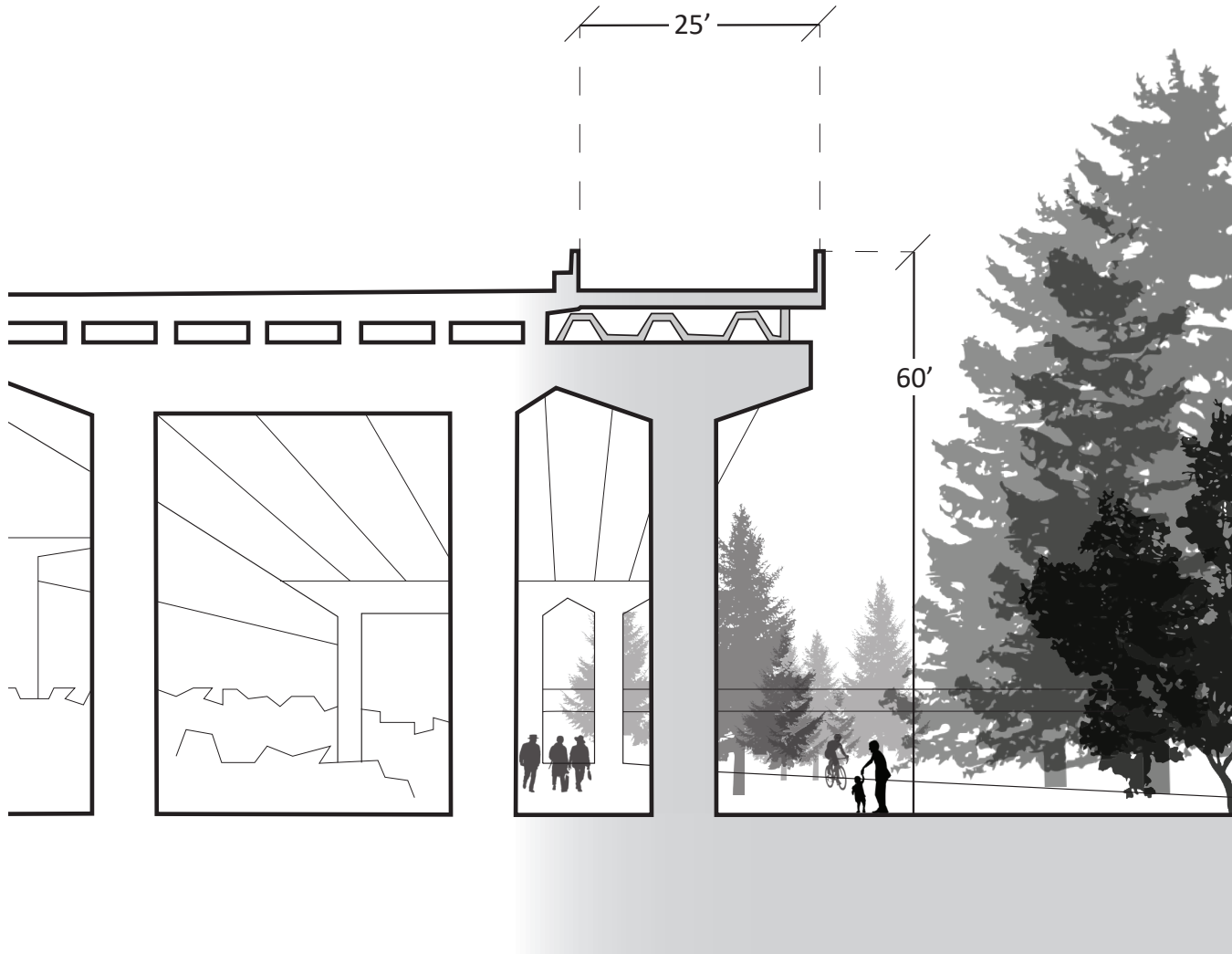
Highest Elevation: **60'**

Design Constraints/ Opportunities: This site is proximity to the riparian area of the esplanade and surrounding vegetation would make it great for pollinator habitat. The esplanade that runs under the underpass can be used for wayfinding, public information, and bike share. Additional seating would promote this site as a tourist attraction and wayfinding could provide opportunity to generation public awareness of local pollinator species.

ESPLANDADE GHOST RAMP: EXISTING CONDITIONS



Esplanade Ghost Ramp - Illustrative Plan

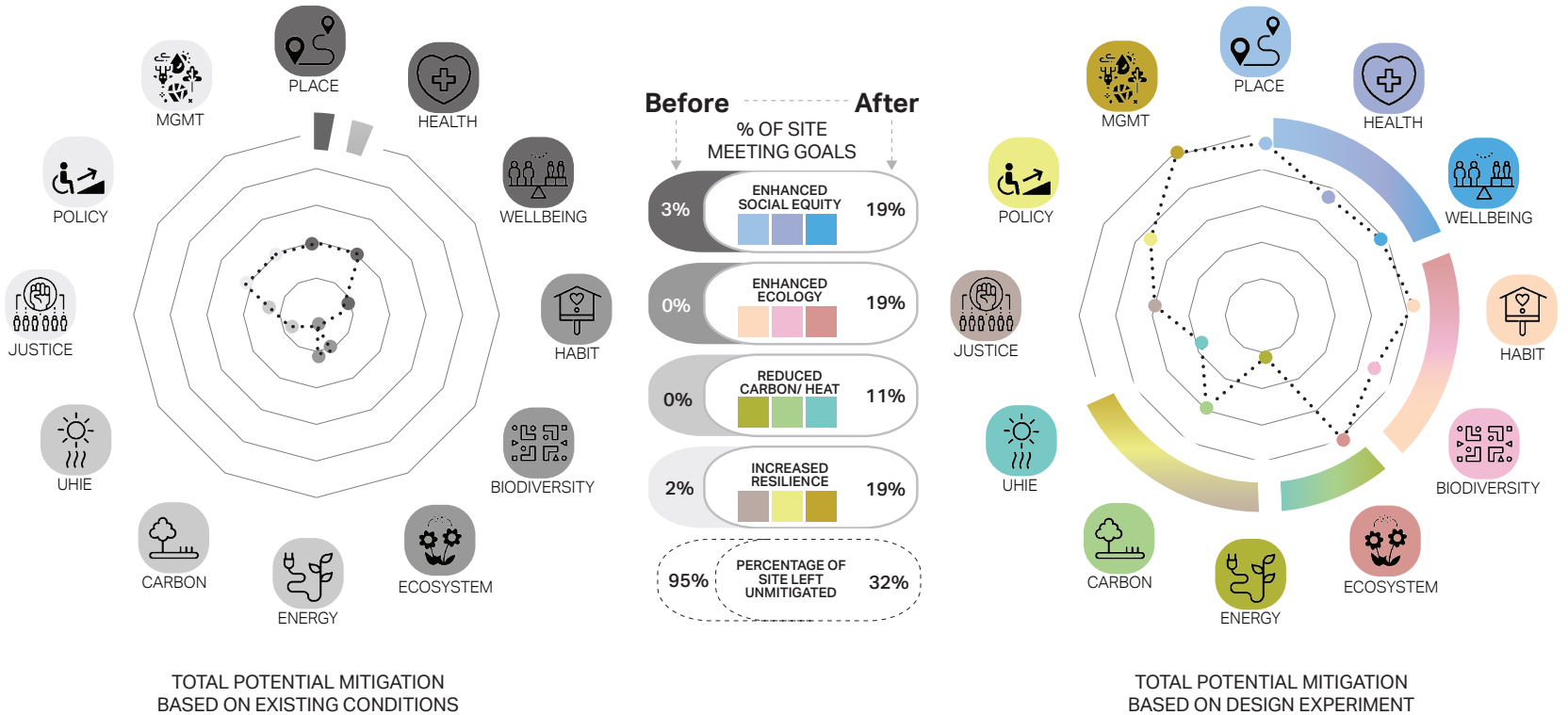


Esplanade Ghost Ramp - Section Elevation

ESPLANADE GHOST RAMP: FINDINGS

Design Experiment: This ghost ramp will feature pollinator habitat above and art education and wayfinding below. Murals should tie into the species attracted and attracting the pollination garden. Civic ecology app QR codes should be present. Meadow plants and native prairie flowers will be represented in the planting and in the mural to enhance awareness of biodiversity. [Appendix B5]

Esplanade Ghost Ramp Regenerative Hubs Design Experiment



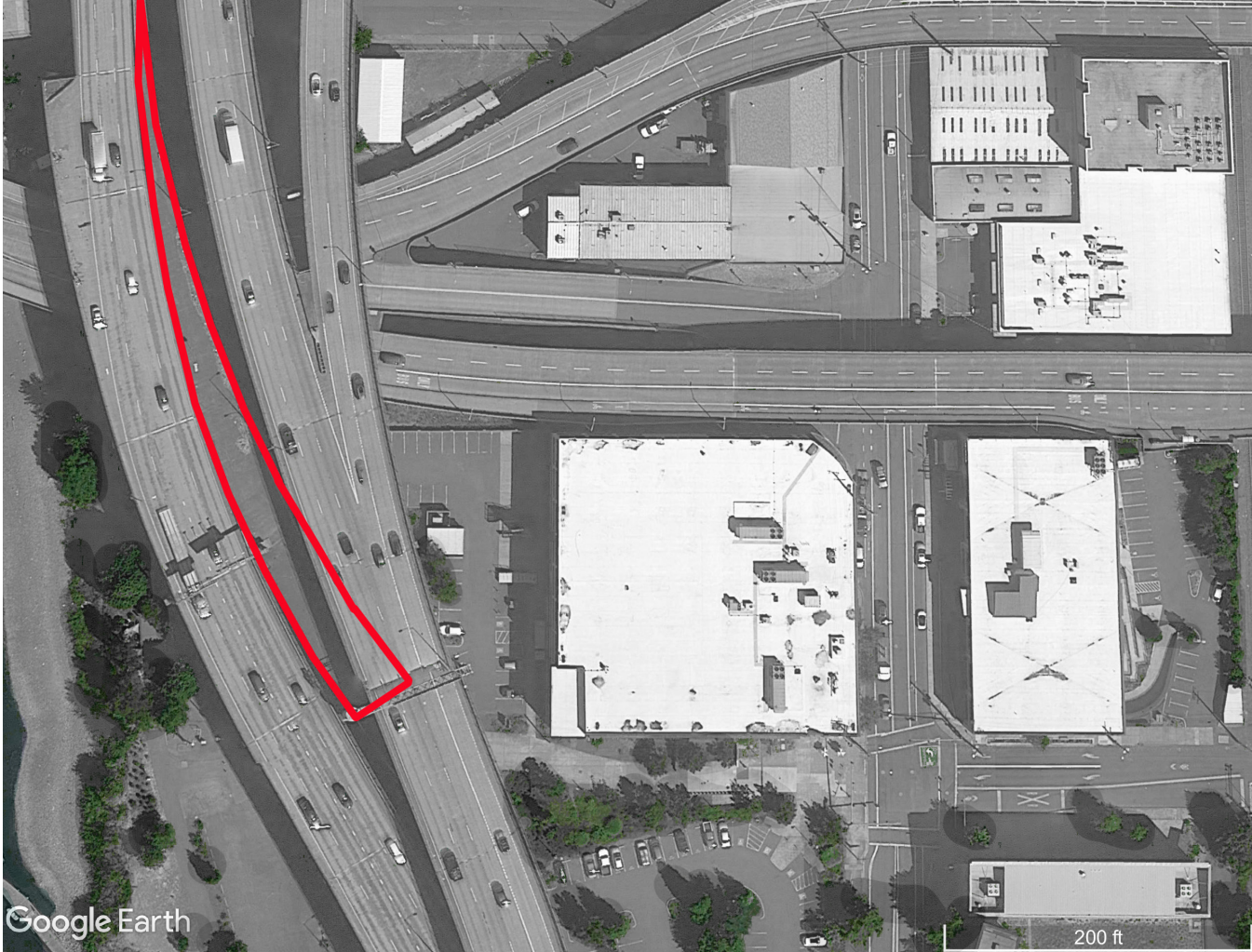
Findings: The design experiment shows that a pollinator garden with native species and murals promoting civic ecology and local pride in biodiversity would rank high among social equity and ecology. Not surprisingly, meadows also sequester carbon and could provide habitat for ground nesting species.



Esplanade Ghost Ramp - "Feels Like"

DESIGN EXPERIMENT NO. 6 - ESPLANADE UNDERPASS

Existing Conditions: This underpass is very visible from the MacKenzie and OMSI parking lot and is probably the most photographed of the ghost ramp because it is accessible from so many angles. The site is between the riparian buffered esplanade to the west and a large homeless settlement to the east. It also services a thriving commercial and industrial area, as well as tourists. And the underpass below is pleasantly situated near the waterfront. The area is loud.



Esplanade Underpass - Aerial



Esplanade Underpass - Photo Collage

Design Experiment No. 7

Site: **I-405 Underpass**

Typology: **Underpass**

Longest Length: **145'**

Shortest Length: **110'**

Widest Width: **100'**

Narrowest Width: **2'**

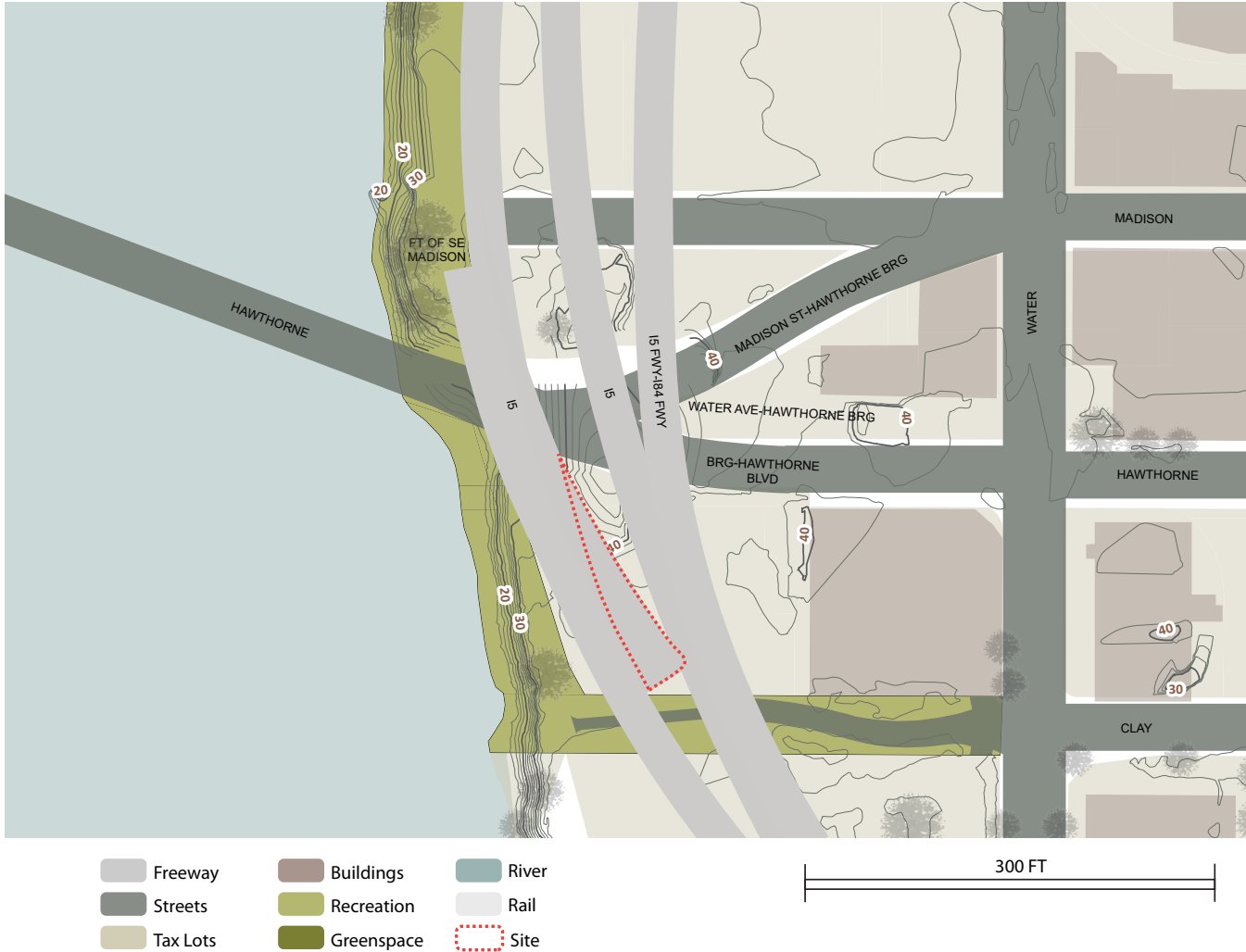
Perimeter: **576'**

Square Footage: **15,422**

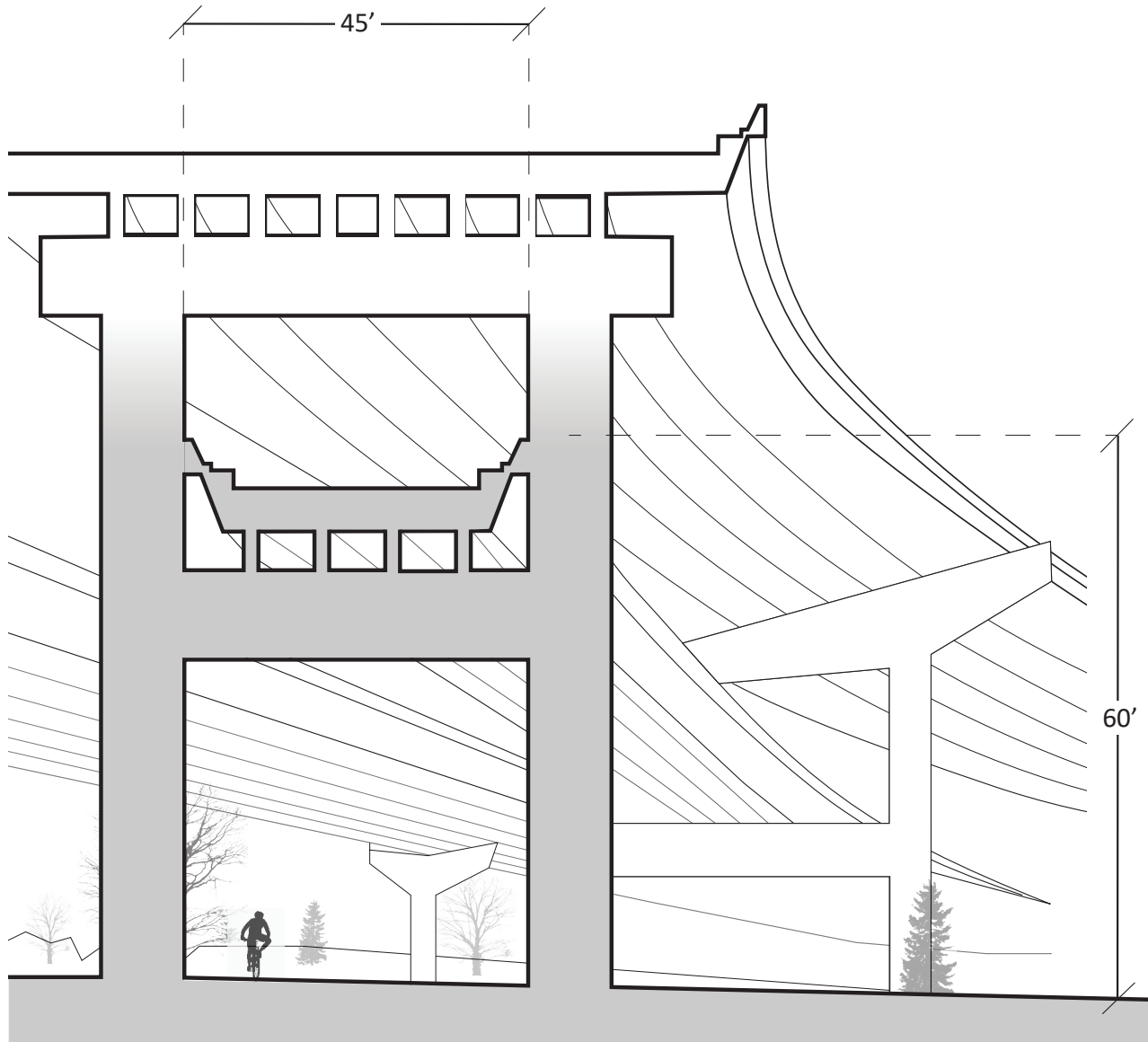
Highest Elevation: **30'**

Design Constraints/ Opportunities: The ghost ramp above is rather large and famous but not publicly accessible and should not be accessed by the public. The underpass below however is shaded and pleasant due to its proximity to the river. It receives ample light from most directions. The Mackenzie offices below make it less likely to get vandalized during daylight hours but is essentially abandoned at night.

ESPLANADE UNDERPASS: EXISTING CONDITIONS



Esplanade Underpass - Illustrative Plan

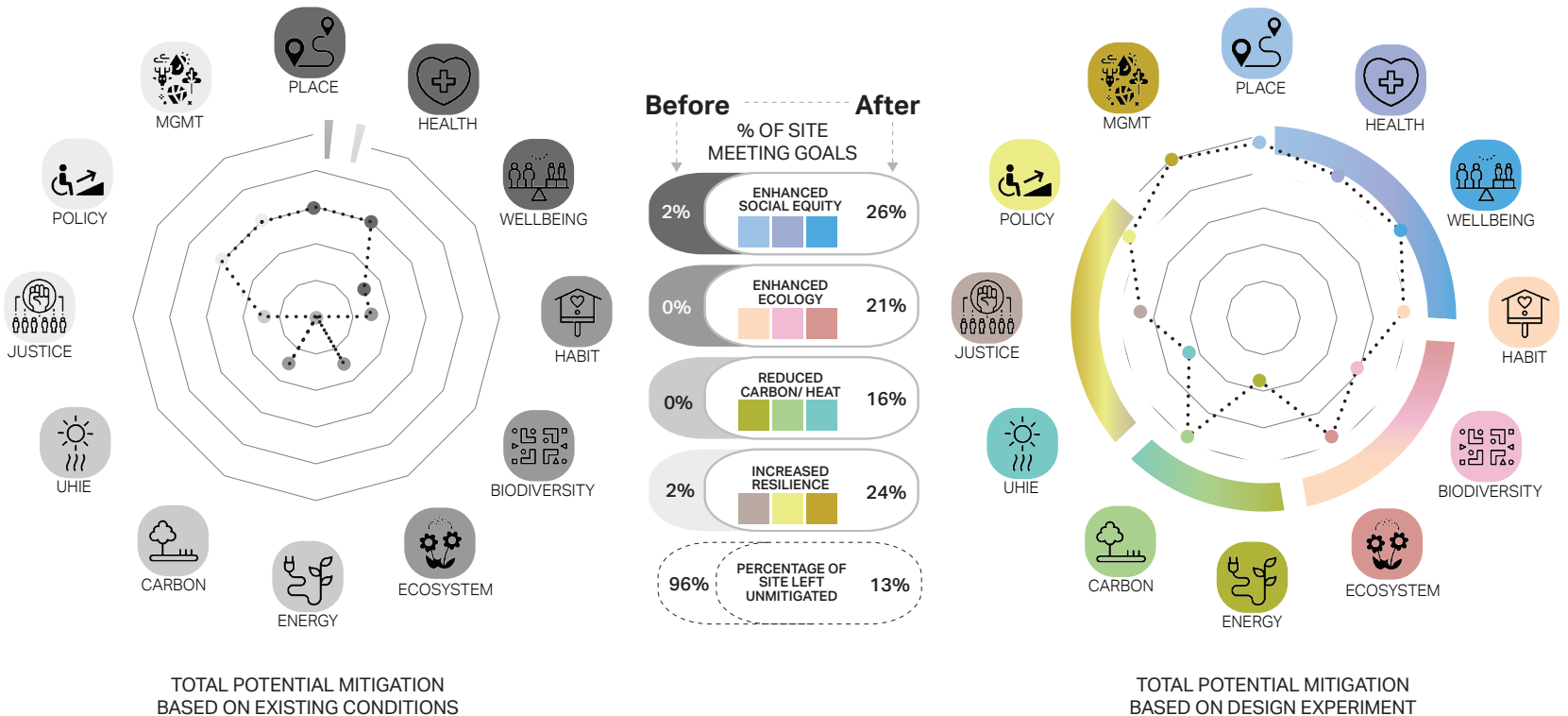


Esplanade Underpass - Section Elevation

ESPLANADE UNDERPASS: FINDINGS

Brief Design Description: This site calls for an urban orchard above that can be harvested by volunteer staff and gated urban farm below. Gated only at night and monitored during the day. The surrounding area should have fruit and berry trees with wayfinding and plaques for gleaners. The food should be harvested on a rotating schedule and the nearby houseless community can volunteer. Free CSA will be provided to anyone who signs up. [Appendix B6]

Esplanade Underpass Regenerative Hubs Design Experiment



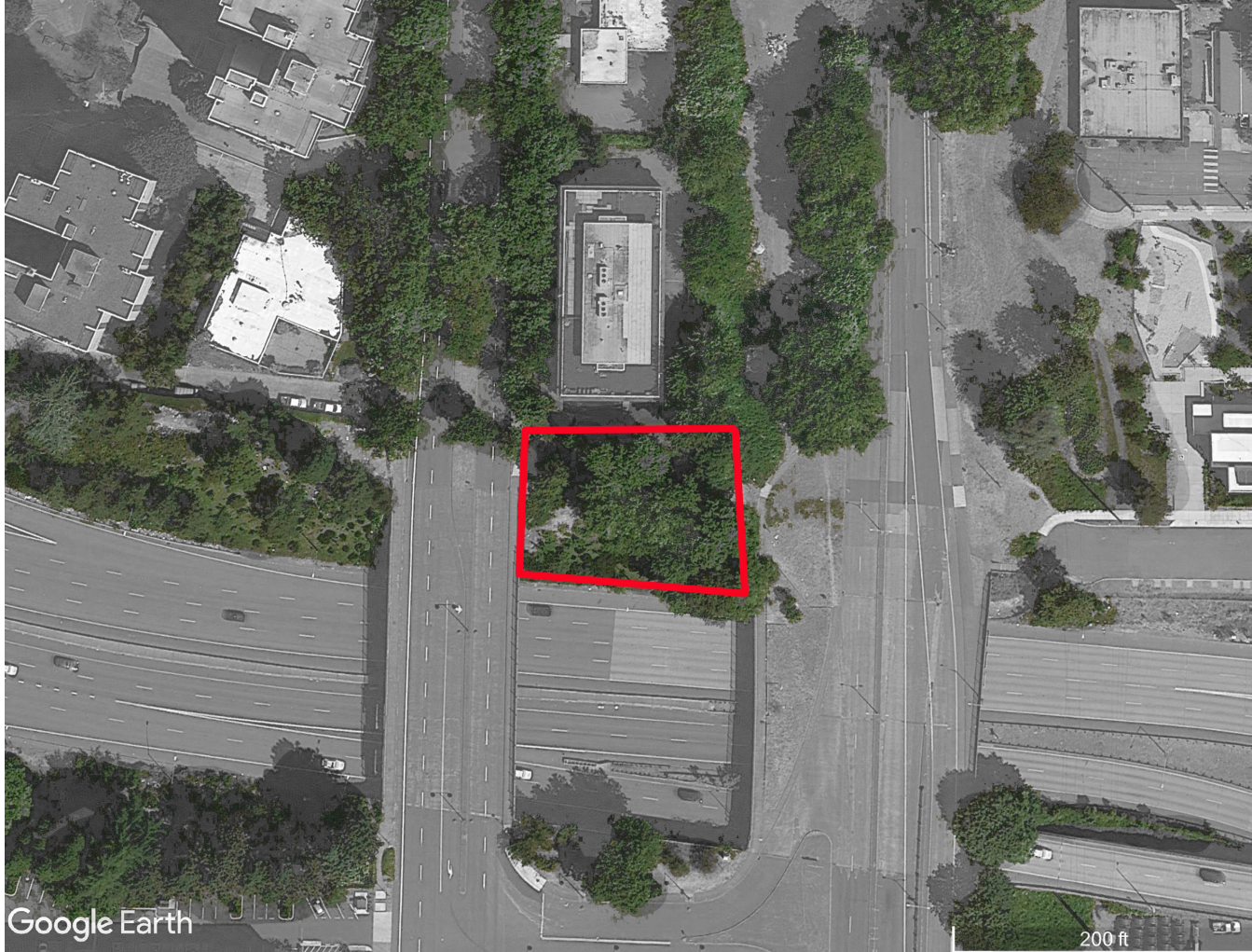
The urban orchard ranks on social equity, ecology, and resilience because urban agriculture provides all of that. However it should be noted that these benefits are seasonal and this intervention is more costly than some of the others, particularly if a large greenhouse is developed (as shown).



Esplanade Underpass - "Feels Like"

DESIGN EXPERIMENT NO. 7 - I-405 UNDERPASS

Existing Conditions: This site is between two underpasses in the Halprin Fountain district near PSU. It is not settled by houseless currently, but people do attempt to transverse it. The area has existing vegetation and large leafy trees which should be preserved. The site is part of the future Green Loop proposal and that development should be factored in.



I-405 Underpass - Aerial



I-405 Underpass - Photo Collage

Design Experiment No. 6

Site: **Esplanade Underpass**

Typology: **Underpass**

Longest Length: **540'**

Shortest Length: **518'**

Widest Width: **45'**

Narrowest Width: **2'**

Perimeter: **1,140'**

Square Footage: **13,918**

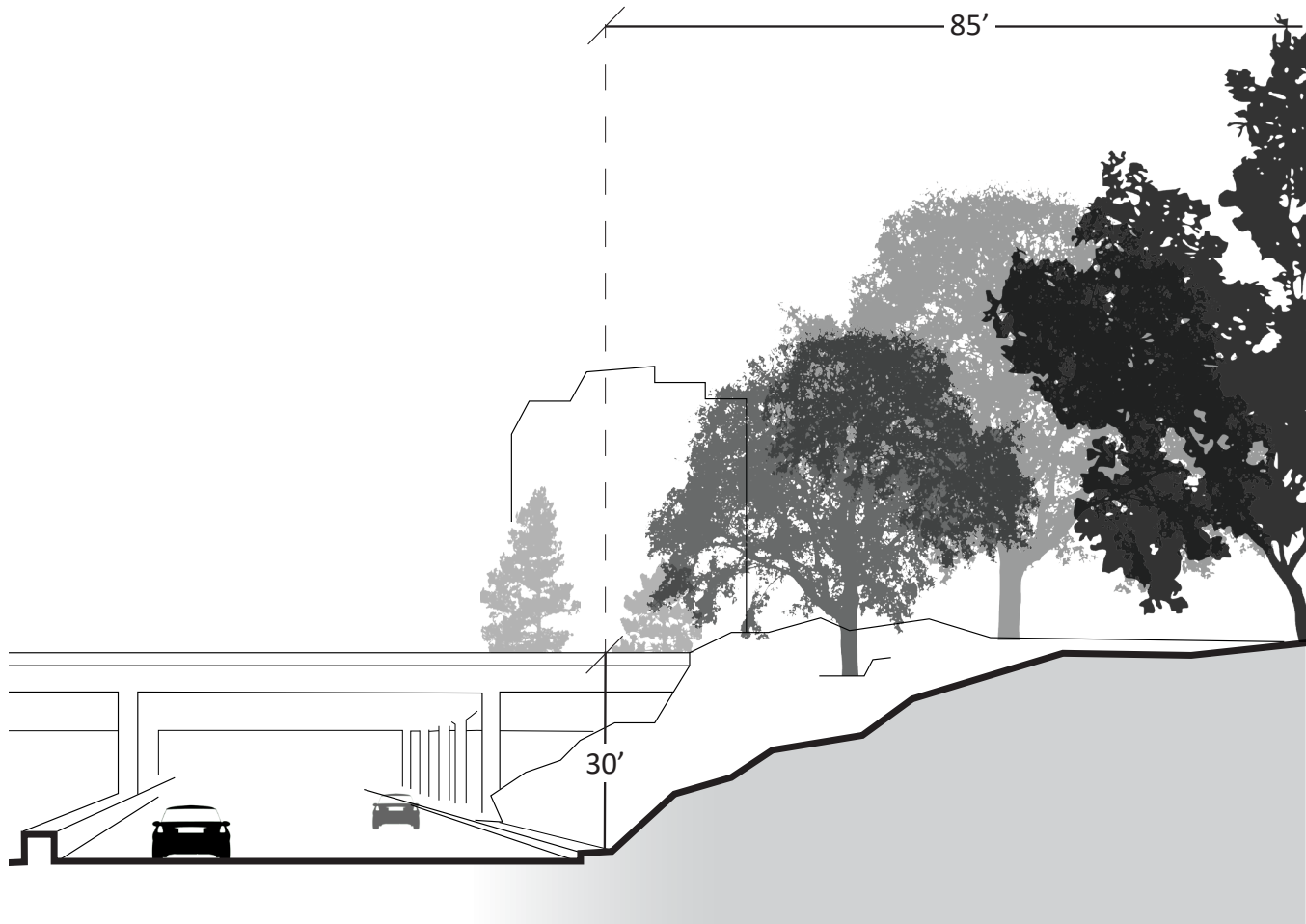
Highest Elevation: **60'**

Design Constraints/ Opportunities: This site is the first site you will see as you enter Portland from I-5 south and therefore the design should reflect Portland in some way. The Green Loop's Halprin Bike path should run along this site, as that is the plan opening the site up on the east and west sides. The site is also aligned with the Halprin Fountain Sequence.

I-405 UNDERPASS: EXISTING CONDITIONS



I-405 Underpass - Illustrative Plan

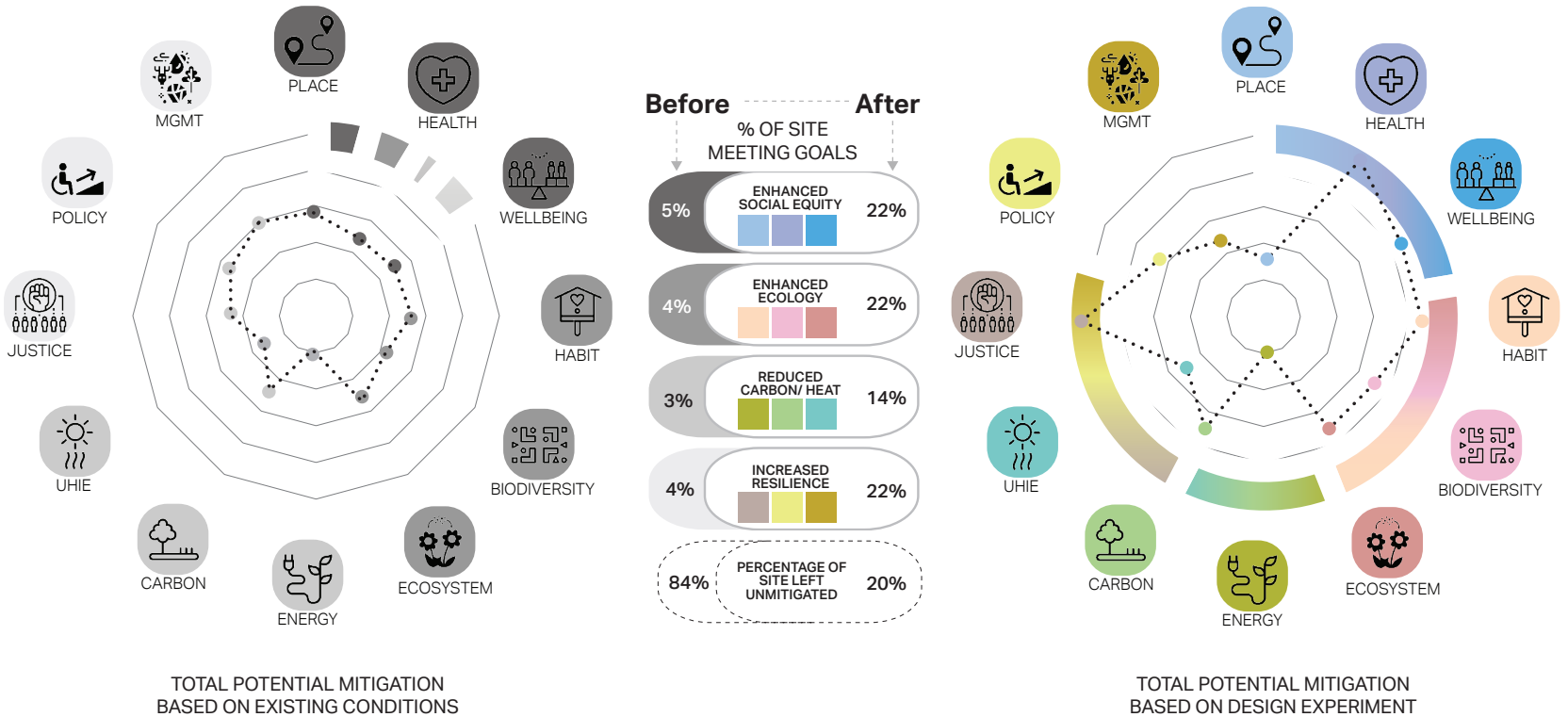


I-405 Underpass - Section Elevation

I-405 UNDERPASS: EXPERIMENT NO. 2 - FINDINGS

Design Experiment: This site is the first site you will see as you enter Portland from the freeway and therefore should celebrate Portland’s bioswale design culture as well as the Fountain District where it is located, without celebrating the modernity that displaced the original residents for the freeway. An illuminated bioswale fountain terrace with bird habitat and water features will process stormwater for the entire block. This will be a symbolic end to Halprin’s source fountain to carry on the legacy of Halprin’s “metaphorical watershed” concept for the areas. A path connects to the green loop to site No. 8, which provides social services. The bioswales will function as carbon sinks and provide ecosystem services. The display will be visible from the freeway. [Appendix B7]

I-405 Underpass Regenerative Hubs Design Experiment



Findings: This site ranks particularly high in resilience because of its processing of local storm water and providing ecosystem services. Also due to the nature of cleaning the air with large trees and carbon sinks, as well as the Green Loop's bike/ pedestrian path, the area also scores high in social equity.



I-405 Underpass - "Feels Like"

DESIGN EXPERIMENT NO. 8 - I-405 RIGHT OF WAY

Existing Conditions: This site a large right of way along the fourth avenue exist as you arrive in Portland from the south. It should be symbolic of Portland and function as a gateway. The site is occasionally settled but not consistently. It is slated for a portion of the Green Loop and connects to the source fountain and site No. 7. It has many ponderosa pines that should be kept. The area abuts a commercial parking lot and a residential tower in the Halprin's Fountain District.



I-405 ROW - Aerial



I-405 ROW - Photo Collage

Design Experiment No. 8

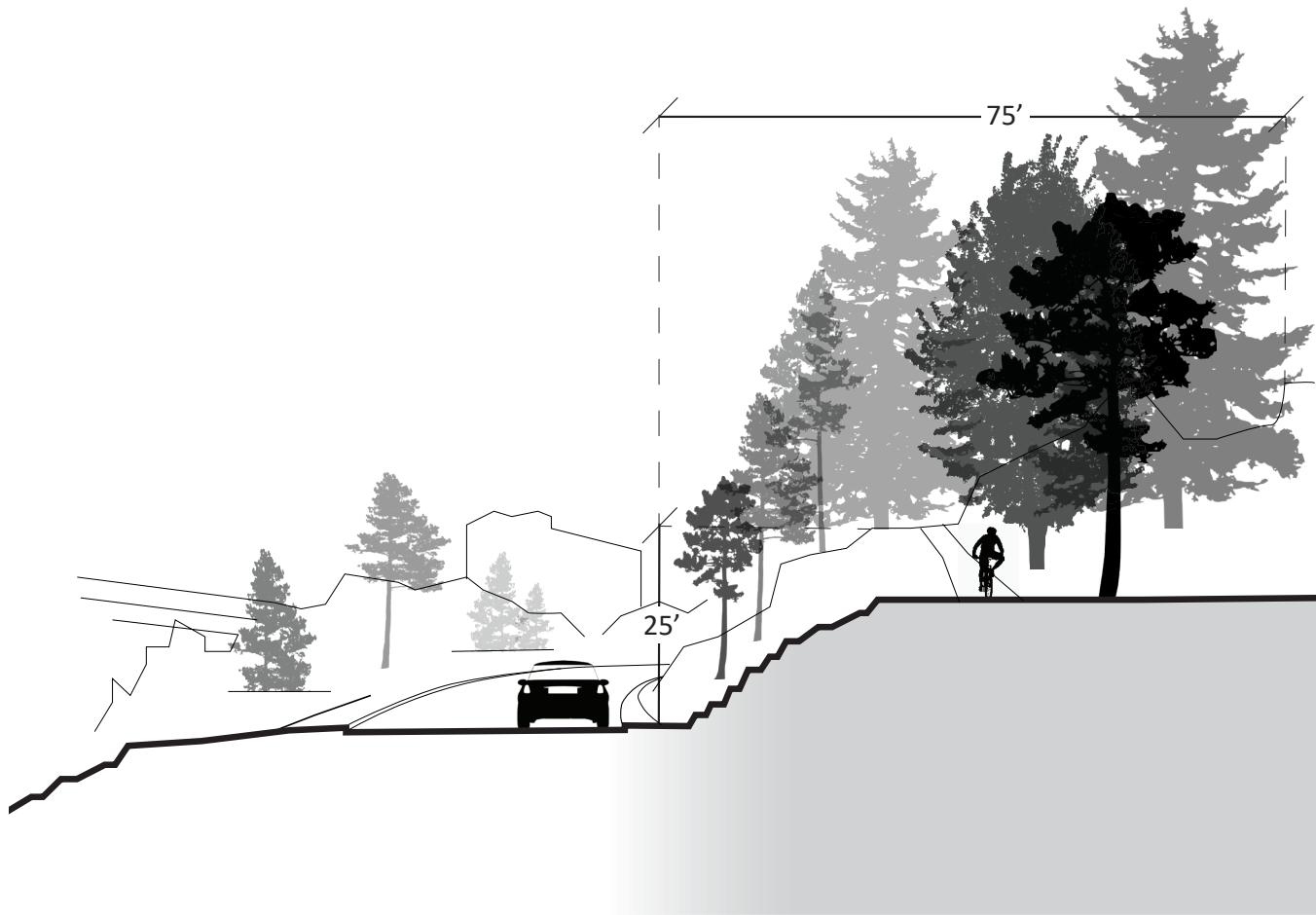
Site: **I-405 Right of Way**
Typology: **Right of Way**
Longest Length: **1,050'**
Shortest Length: **1,040'**
Widest Width: **100'**
Narrowest Width: **10'**
Perimeter: **2,327'**
Square Footage: **69,600**
Highest Elevation: **25'**

Design Constraints/ Opportunities: The site has a 30% slope, which will make a difficult to develop and so a system of retaining walls is recommended. Large trees do provide shade and the area has a number of parks and large trees, so bird habitat is likely. Creating an additional noise buffer from the freeway would be neighborly and great mitigation solution.

I-405 RIGHT OF WAY: EXISTING CONDITIONS



I-405 Right Of Way - Illustrative Plan

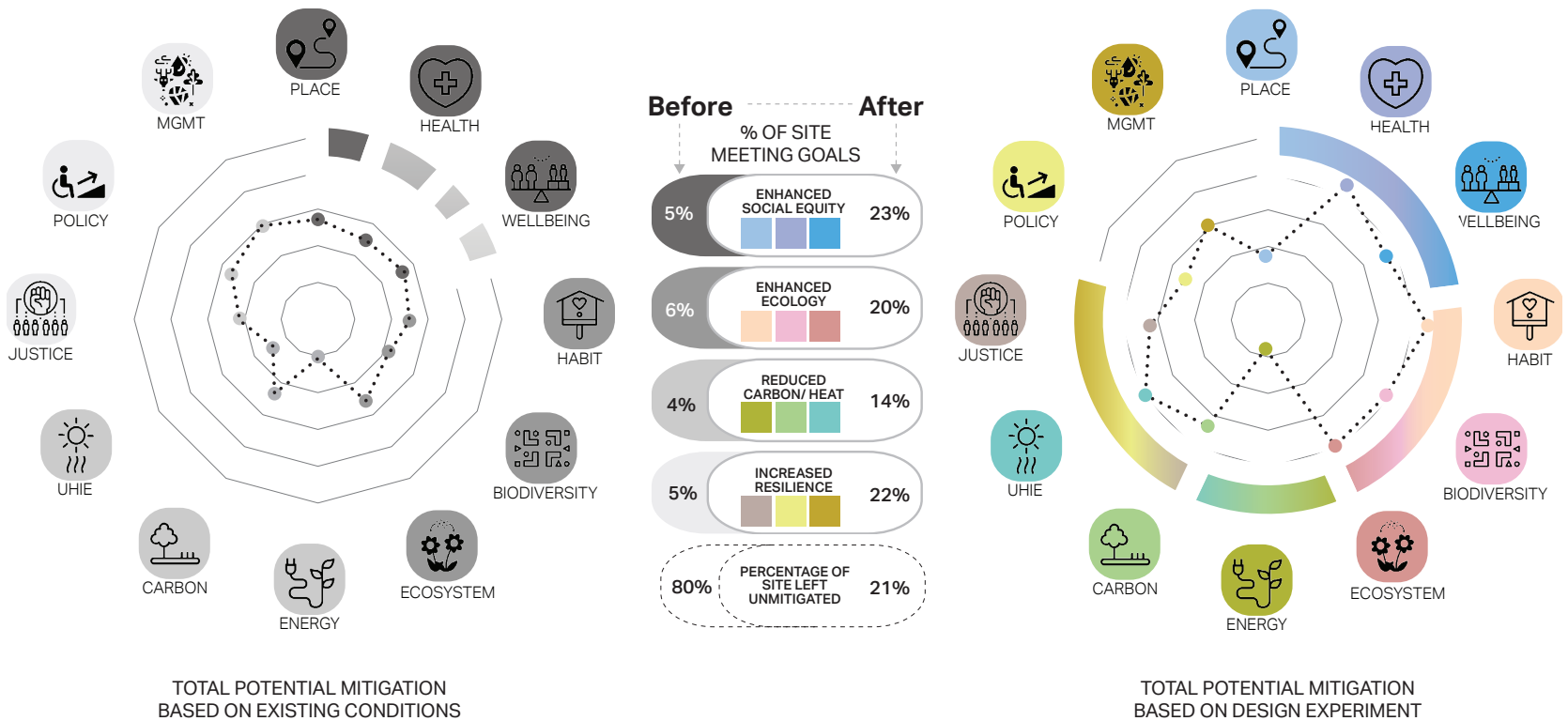


I-405 Right-Of-Way - Section Elevation

I-405 RIGHT OF WAY: FINDINGS

Design Experiment: This design is called the Mutual Mile. It's actually only a quarter mile long, but you get the point. Inspired by the Black Lives Matters protest, it offers a centralized “mile” of mutual aid powered by alternative electricity - operating 24/7. Robotic lockers line the original Halprin bike path. People in need (“receivers”) can sign up and create a list of items needed (jackets, shoes, gift cards, books, rent checks) and anonymous “givers” can sign up to fulfill the items on the need list. The process is anonymous to ensure “horizontal participation” but specific to needs so that it can’t become technocratic. From one side a receiver can request items and on the other side givers can insert those things if they want to. Wayfinding will be built into a bright universal design. This site is climate proof complete with a pollinator meadow and constructed wetland terrace, which processes local stormwater and provides ecosystem services. [Appendix B8]

I-405 Right of Way Regenerative Hubs Design Experiment



Findings: As you would image the mutual mile scores high on social equity and resilience. The site also scores high on ecology and carbon mitigation. Due to the complexity of this design, it is one of the high scores of the liminal landscapes in this project.



I-405 Right-Of-Way - "Feels Like"

CHAPTER 4 - FINDINGS AND CONCLUSION

FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

The answer to the research question: can a regenerative framework maximize environmental benefits on undevelopable sites? Is, yes. Not only can climate change mitigation work on these site typologies, but some sites work better than others based on their existing conditions.

Other major findings exposed through this project's analysis include the following:

1. It is possible to maximize environmental benefits on undevelopable sites.
2. A combination of climate change mitigation goals can be analyzed using a regenerative hub framework.
3. Regenerative design is an excellent way to perceive, understand, and communicate with a broken nature.
4. Underutilized space can be upcycled for climate change and some typologies work better than others.
5. The most impactful designs for underutilized or liminal public lands are based on local conditions.
6. Best Practices for landscaping small spaces for maximum environmental benefit are already being done in city policy.
7. The consequences of doing nothing keep us on course with a pending climate catastrophe without adequate adaptability.

Conclusion Based on Case Studies and Portland's Typologies

Ghost Ramps increase UHI, lack ecology, and contain toxic runoff. These sites scored highest for ecology because of their habitat generation capacity being away from human contact and up in the air. However, many avian species will not tolerate traffic noise and exposure, so a vegetative buffer is recommended. Of the liminal landscape typologies they are the most difficult to maintain and therefore low maintenance is recommended. These sites are conceivably able to support a freight truck, and therefore structural constraints are less limiting than a typical landscape on structure. I recommend small extreme weather resistant trees that are fastened in place to withstand heavy wind, water can be used in a rain catchment system. Drought tolerant species are recommended.

Most of liminal space Right of Ways in Portland are occupied by the growing houseless population, which was made worse during the pandemic. So some of them presently do have a non-conforming use. These sites often are vegetated and provide some ecological services, but I think they could be enhanced with stormwater process and/ or public greenways. These sites scored highest in resilience and carbon because of their ability to process stormwater, but they

offer so much more. In Portland now they have begun to glue massive boulders together to deter the homeless, and obviously that is ridiculously and not the highest and best use. They are not great for pollinators due to the wind from cars and pesticides in the runoff, unless they are on a slope.

The underpass sites in Portland are underutilized gems. These were the winner of the site typologies I looked at. The elevations of the underpasses themselves are usually tall enough to ensure ample light below and room for large trees. Like the Ghost Ramps, they have insignificant environmental benefits and contribute to climate change. The local context does make a difference in terms of design, and can be viewed as an opportunity. Underpasses scored highest in resilience, given they were able to use the ramps above to generate a few forms of decentralized energy, and they scored high in social equity because they offer great naturally sheltered public nodes, and they scored high on carbon and ecology because they are easily vegetated and can mitigate stormwater.

Recommandations for Climate Change Mitigation on Liminal Landscapes from the Project Process

1. As cities adapt to climate change, programs that value biophilic urbanism and a regenerative design approach for climate change mitigation should not be limited to wide open spaces. Small publically owned landscapes can be considered for this work and existing city and non profit programs can align best practices. As cities change and become denser, liminal landscapes could be inventoried and monitored for performance to maintain a working understanding of best practice and best use on undevelopable land.
2. Climate change mitigation pilot programs and strategies should always be intersectional and account for the full range of issues stakeholders faces, with particular attention to the marginalized and most vulnerable populations who are disproportionately impacted by climate change. Programs work best when they are constantly tweaked and revised to address moving targets of environmental racism and environmental ableism as they arise in new climate conditions. The impact of the pandemic increasing homelessness on right of ways is a good example of that. Therefore, existing conditions are the design opportunities and challenges in the future of climate change mitigation.
3. Monitoring should be set up with a responsible party for each climate change mitigation interventions. Biologist can engage and rely on the surrounding community as a resource for monitoring as civic ecology will also increase the awareness of the complex issues cities face with climate change and ensure continued public investment in targeted mitigation solutions. These sites are a great use for research and awareness.
4. Cities could inventory parcels of publicly owned and operated land that can be used solely for climate change mitigation by developing a liminal landscape criteria. The inventory could be adjusted for future uses and given a sanctuary status. The inventory could be evaluated for its possible mitigation achievements by public benefits and beyond economic indicators. This information could also be use to create a “cost of doing nothing” analysis, which could be used to urge munipal government and secure support/ funding for climate change mitigation efforts.

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APPENDIX A - CITY PROGRAM MATRIX

76%	Ecology	100%	Social Equity	100%	Resilience	100%	Carbon
25	Birds? Platinum Backyard Bird Habitat Certification Requirements	6	People? Portland equity programs	25	Bioswales? Portland Stormwater Green Streets Approved List	6	MGMT? Portland carbon sequestration
y	No Creeping Jenny (<i>Lysimachia nummularia</i>)	y	OMWESB Contractor with Green Workforce Apprentice and Journeyman	y	Carex obnupta	y	15% of site or development impact area
y	No English & Portuguese Laurel (<i>Prunus spp.</i>)	y	If history is being celebrated, it is relevant to the community surrounding it.	y	Juncus patens	y	If site needs water, is rainwater captured.
y	No Fennel (<i>Foeniculum spp.</i>)	y	If site is being used to spread awareness or be used for an art installation, the artist local.	y	Liriope muscari 'Big Blue'	y	If site needs energy or light, is solar captured.
y	No Large & Small-leaf Periwinkle (<i>Vinca spp.</i>)	y	If possible, the city creates or accommodates existing jobs.	y	Fragaria chiloensis	y	The site sequesters carbon.
y	No Reed Canarygrass & Ribbon Grass (<i>Phalaris arundinacea</i>)	y	If public, city has civic engagement like citizen science apps or wayfinding	y	Rubus calcynoides & pentalobus	y	The site reduces albedo.
y	No Noxious Trees – over 20ft	y	Site uses plants that clean air, water, or soil.	y	Carex morrowii 'Ice Dance'	y	The site uses renewable energy, or none at all.
y	No Black Locust (<i>Robinia pseudoacacia</i>)	Cont.		y	Carex morrowii 'Ice Dance' 'Ice Dance Japanese sedge A/B N N 12" 12" - Iris douglasiana		
y	No English Hawthorn (<i>Crataegus monogyna</i>)			y	Iris douglasiana		
y	No English Holly (<i>Ilex aquifolium</i>)			y	Berberis (Mahonia) repens		
y	No Norway Maple (<i>Acer platanoides</i>)			y	Cornus sericea 'Kelseyi'		
y	No Tree-of-Heaven (<i>Ailanthus altissima</i>)			y	Lavandula angustifolia 'Hidcote Blue'		
y	Naturescape at least 50% of available property with locally native plants*			y	Nandina domestica 'Moon Bay' / 'Nana'		
y	Include all 5 vegetation levels			y	Spiraea japonica 'Walburna'		
y	Use only GREEN zone chemicals if necessary, according to an IPM strategy			y	Spiraea japonica 'Goldmound'		
y	No use of RED or YELLOW zone chemicals			y	Celtis occidentalis		
y	Take the Metro No Pesticides Pledge			y	Frangula purshiana		
y	Large canopy tree over 30ft (cannot be nuisance species)	y	Pollinator and beneficial insect nesting habitat (i.e. rock piles, bundles of stems and branches, mason bee house) OR	y	Gleditsia triacanthosvar. inermis 'Impcole' / 'Skycole'		
y	Disconnected downspouts, where appropriate	y	Snag or nurse log OR	y	Nyssa sylvatica		
y	Raingardens, where appropriate	y	Reduce outdoor lighting during bird migration (March-May, Sept-Nov) OR	y	Prunus virginiana 'Canada Red'		
y	Remove impervious surfaces and/or grass 500ft or more	y	Reduce bird window collisions OR	y	Quercus bicolor		
y	Ecoroof according to City specifications	y	Native pollinator meadow which bloom through the growing season OR	y	Quercus shumardii		
y	Increase naturescaping 10% higher than your certification level requirement	y	Site creates a patch system for protected or endangered species	y	Zelkova serrata 'Green Vase' / 'Village Green'		

APPENDIX B1 - DESIGN OPPORTUNITIES MATRIX

Design No. 1	Y/N	Equity	Ecology	Carbon	Resilience	None	Equity	Ecology	Carbon	Resilience	None	Place	Health	Wellbeing	Habitat	Biodiversity	Ecosystem	Energy	Carbon	UHI	Justice	Policy	MGMT	Sum
		8	2	2	7		51	44	26	51	128	19	15	17	16	13	15	7	13	6	14	17	20	172
NW Regeneration Station	Y/N	8	2	2	7		51	44	26	51	128	19	15	17	16	13	15	7	13	6	14	17	20	172
Accessible Places	6 y	3	0	1	2	6	y	3	1	2	6	x	x	x					x		x	x		6
Adaptive Reuse	0 n						y	3	2	2	10	x	x	x	x	x	x	x	x		x		x	10
Anti-gentrification measures	0 n						y	3	1	1	6	x	x	x	x				x		x			6
Bikes/ Scooter/ Car-Share Stations	0 n						n																	0
Bioremediation / Toxic Cleanup	0 n						n																	0
Bioswales	0 n						n																	0
Carbon Sequestration	0 n						y	3	3	2	11	x	x	x	x	x	x		x	x	x	x	x	11
Centralized Public Node	0 n						y	2	1	2	6	x	x				x	x				x	x	6
Citizen Science Apps	0 n						y	1	3	2	6	x			x	x	x					x	x	6
Civic Ecology	0 n						y	1	3	3	7	x			x	x	x				x	x	x	7
Constructed Wetlands	0 n						n																	0
Decentralize Energy/ Microgrids	0 n						y	2	3	1	9	x		x	x	x	x	x			x	x	x	9
Design Public Safety	0 n						y	3	1	3	7	x	x	x				x			x	x	x	7
Employment Land Preservation	0 n						y	2	3	3	10	x		x	x	x	x		x	x	x	x	x	10
Habitat Creation/ Conservation/ Restoration	0 n						y	3	3	3	11	x	x	x	x	x	x		x	x	x	x	x	11
Historic Preservation	0 n						n																	0
Inclusive Streetscaping	0 n						y	3		2	5	x	x	x								x	x	5
Job Creation/ Retention	0 n						n																	0
Local Business Preservation	0 n						n																	0
Increasing Public Transportation	0 n						n																	0
Materials that Reduce Albedo	0 n						y	1	2	1	5		x		x	x				x	x			5
Migration Design	0 n						y	1	3	1	5	x			x	x	x						x	5
Native Plantings	0 n						y		3	2	7				x	x	x		x	x		x	x	7
Noise Mitigation	0 n						y	2	2	1	5		x	x	x		x				x			5
Placemaking/ Public Art	0 n						y	2			2	x		x										2
Pollinator Gardens	0 n						n																	0
Rain Gardens	0 n						n																	0
Rainwater Features	0 n						n																	0
Recreation Opportunities	0 n						n																	0
Renewable Energy Infrastructure	0 n						y	1	3	2	8			x	x	x	x	x	x			x	x	8
Reused/Recycled/ Local materials	0 n						y	1	1	1	3	x							x				x	3
Safe Bike/ Pedestrian Paths	8 y	3	2	1	2	8	y	3	2	2	8	x	x	x	x		x		x			x	x	8
Sense of Place	5 y	2	0	0	3	5	y	2	3	3	5	x	x								x	x	x	5
Smart Growth Urban Design	0 n						y	2	3	1	9		x	x	x	x	x		x		x	x	x	9
Stormwater Facilities	0 n						n																	0
Tourism	0 n						y	2		1	3	x		x									x	3
Tree canopy/ Shade Making	0 n						y	2	3	3	11		x	x	x	x	x	x	x	x	x	x	x	11
Urban Agriculture	0 n						n																	0
Urban Forest	0 n						n																	0
Solar-Lit Bus Stops/ Kiosks	0 n						y	3	2	2	7	x	x	x				x	x			x	x	7

APPENDIX B2 - DESIGN MATRIX

Design No. 2	Y/N	Equity	Ecology	Carbon	Resilience	None	Equity	Ecology	Carbon	Resilience	None	Place	Health	Wellbeing	Habitat	Biodiversity	Ecosystem	Energy	Carbon	UHIE	Justice	Policy	MGMT	Sum
		9	6	5	11		66	57	42	64	71	24	21	21	20	17	20	9	21	12	18	22	24	229
Borthwick Underpass - Night Owl	Y/N	9	6	5	11		66	57	42	64	71	24	21	21	20	17	20	9	21	12	18	22	24	229
Accessible Places	0	n					y	3	1	2	6	x	x	x					x		x	x		6
Adaptive Reuse	0	n					y	3	3	2	10	x	x	x	x	x	x	x	x		x		x	10
Anti-gentrification measures	0	n					y	3	1	1	6	x	x	x	x				x		x			6
Bikes/ Scooter/ Car-Share Stations	0	n					y	3	3	3	12	x	x	x	x	x	x	x	x	x	x	x	x	12
Bioremediation / Toxic Cleanup	0	n					y	2	3	1	9		x	x	x	x	x		x		x	x	x	9
Bioswales	0	n					y	1	3	2	9	x			x	x	x		x	x	x	x	x	9
Carbon Sequestration	0	n					y	3	3	2	11	x	x	x	x	x	x		x	x	x	x	x	11
Centralized Public Node	0	n					y	2	1	1	6	x	x				x	x				x	x	6
Citizen Science Apps	0	n					y	1	3	2	6	x			x	x	x					x	x	6
Civic Ecology	0	n					y	1	3	3	7	x			x	x	x				x	x	x	7
Constructed Wetlands	0	n					n																	0
Decentralize Energy/ Microgrids	0	n					y	2	3	1	9	x		x	x	x	x	x			x	x	x	9
Design Public Safety	0	n					y	3	1	3	7	x	x	x				x			x	x	x	7
Employment Land Preservation	0	n					y	2	3	2	10	x		x	x	x	x		x	x	x	x	x	10
Habitat Creation/ Conservation/ Restoration	0	n					n																	0
Historic Preservation	0	n					n																	0
Inclusive Streetscaping	0	n					y	3		2	5	x	x	x								x	x	5
Job Creation/ Retention	6	y	3	0	1	2	y	3	1	2	6	x	x	x					x			x	x	6
Local Business Preservation	0	n					y	3	2	2	8	x	x	x	x		x	x	x		x			8
Increasing Public Transportation	0	n					y	3	3	3	12	x	x	x	x	x	x	x	x	x	x	x	x	12
Materials that Reduce Albedo	0	n					y	1	2	1	5		x		x	x				x	x			5
Migration Design	0	n					n																	0
Native Plantings	0	n					y	3	2	2	7				x	x	x		x	x		x	x	7
Noise Mitigation	0	n					n																	0
Placemaking/ Public Art	0	n					y	2			2	x		x										2
Pollinator Gardens	0	n					n																	0
Rain Gardens	0	n					y	3	3	2	9	x	x	x	x	x	x		x	x			x	9
Rainwater Features	0	n					y	1	1	1	3	x					x			x				3
Recreation Opportunities	0	n					y	3	1	1	5	x	x	x					x		x			5
Renewable Energy Infrastructure	0	n					n																	0
Reused/Recycled/ Local materials	0	n					y	1	1	1	3	x							x				x	3
Safe Bike/ Pedestrian Paths	0	n					y	3	2	1	8	x	x	x	x		x		x			x	x	8
Sense of Place	5	y	2	0	0	3	y	2		3	5	x	x								x	x	x	5
Smart Growth Urban Design	9	y	2	3	1	3	y	2	3	1	9		x	x	x	x	x		x		x	x	x	9
Stormwater Facilities	0	n					y	3	2	2	7				x	x	x		x	x		x	x	7
Tourism	0	n					n																	0
Tree canopy/ Shade Making	11	y	2	3	3	3	y	2	3	3	11		x	x	x	x	x	x	x	x	x	x	x	11
Urban Agriculture	0	n					n																	0
Urban Forest	0	n					y	2	3	2	9		x	x	x	x	x		x	x		x	x	9
Solar-Lit Bus Stops/ Kiosks	0	n					y	3	2	2	7	x	x	x				x	x			x	x	7

APPENDIX B3 - DESIGN MATRIX

Design No. 3		Equity	Ecology	Carbon	Resilience	None	Y/N	Equity	Ecology	Carbon	Resilience	None	Place	Health	Wellbeing	Habitat	Biodiversity	Ecosystem	Energy	Carbon	UHIE	Justice	Policy	MGMT	Sum	
Eastbank Ghost Ramp - Birds of Prey		5	2	2	4	.	Y/N	38	47	25	40	150	16	10	12	16	15	16	4	12	9	10	12	18	150	
Accessible Places	0	n					n																			0
Adaptive Reuse	0	n					y	3	3	2	2	10	x	x	x	x	x	x	x	x	x	x	x	x	x	10
Anti-gentrification measures	0	n					n																			0
Bikes/ Scooter/ Car-Share Stations	0	n					n																			0
Bioremediation / Toxic Cleanup	0	n					n																			0
Bioswales	0	n					y	1	3	2	3	9	x			x	x	x		x	x	x	x	x	x	9
Carbon Sequestration	0	n					y	3	3	2	3	11	x	x	x	x	x	x		x	x	x	x	x	x	11
Centralized Public Node	0	n					n																			0
Citizen Science Apps	0	n					y	1	3	0	2	6	x			x	x	x					x	x	6	
Civic Ecology	0	n					y	1	3	0	3	7	x			x	x	x				x	x	x	7	
Constructed Wetlands	0	n					n																			0
Decentralize Energy/ Microgrids	0	n					y	2	3	1	3	9	x		x	x	x	x	x			x	x	x	9	
Design Public Safety	0	n					n																			0
Employment Land Preservation	0	n					n																			0
Habitat Creation/ Conservation/ Restoration	0	n					y	3	3	2	3	11	x	x	x	x	x	x		x	x	x	x	x	x	11
Historic Preservation	8	y	3	2	2	1	y	3	2	2	1	8	x	x	x	x		x	x	x				x	8	
Inclusive Streetscaping	0	n					n																			0
Job Creation/ Retention	0	n					n																			0
Local Business Preservation	0	n					n																			0
Increasing Public Transportation	0	n					n																			0
Materials that Reduce Albedo	0	n					y	1	2	1	1	5		x		x	x				x	x			5	
Migration Design	0	n					y	1	3	0	1	5	x			x	x	x						x	5	
Native Plantings	0	n					y		3	2	2	7				x	x	x		x	x		x	x	7	
Noise Mitigation	0	n					n																			0
Placemaking/ Public Art	0	n					y	2	0	0		2	x		x										2	
Pollinator Gardens	0	n					y	3	3	2	3	11	x	x	x	x	x	x		x	x	x	x	x	x	11
Rain Gardens	0	n					y	3	3	2	1	9	x	x	x	x	x	x		x	x				x	9
Rainwater Features	0	n					y	1	1	1		3	x					x			x				3	
Recreation Opportunities	0	n					n																			0
Renewable Energy Infrastructure	0	n					y	1	3	2	2	8			x	x	x	x	x	x			x	x	8	
Reused/Recycled/ Local materials	0	n					y	1		1	1	3	x							x					x	3
Safe Bike/ Pedestrian Paths	0	n					n																			0
Sense of Place	5	y	2	0	0	3	y	2	0	0	3	5	x	x								x	x	x	5	
Smart Growth Urban Design	0	n					y	2	3	1	3	9		x	x	x	x	x		x		x	x	x	9	
Stormwater Facilities	0	n					n																			0
Tourism	0	n					y	2	0	0	1	3	x		x										x	3
Tree canopy/ Shade Making	0	n					n																			0
Urban Agriculture	0	n					n																			0
Urban Forest	0	n					y	2	3	2	2	9		x	x	x	x	x		x	x		x	x	9	
Solar-Lit Bus Stops/ Kiosks	0	n					n																			0

APPENDIX B4 - DESIGN MATRIX

Design No. 4

I-5 Right of Way – Urban Wetlands	Y/N	Equity	Ecology	Carbon	Resilience	None	Y/N	Equity	Ecology	Carbon	Resilience	None	Place	Health	Wellbeing	Habitat	Biodiversity	Ecosystem	Energy	Carbon	UHIE	Justice	Policy	MGMT	Sum	
		9	10	5	6		Y/N	42	59	30	50	119	14	13	15	20	19	20	4	14	12	14	16	20	181	
Accessible Places	0	n					n																			
Adaptive Reuse	0	n					y	3	3	2	2	10	x	x	x	x	x	x	x	x			x		x	10
Anti-gentrification measures	0	n					n																			
Bikes/ Scooter/ Car-Share Stations	0	n					n																			
Bioremediation / Toxic Cleanup	0	n					y	2	3	1	3	9		x	x	x	x	x			x		x	x	x	9
Bioswales	0	n					y	1	3	2	3	9	x			x	x	x			x	x	x	x	x	9
Carbon Sequestration	0	n					y	3	3	2	3	11	x	x	x	x	x	x			x	x	x	x	x	11
Centralized Public Node	0	n					n																			
Citizen Science Apps	0	n					y	1	3	0	2	6	x			x	x	x						x	x	6
Civic Ecology	0	n					y	1	3	0	3	7	x			x	x	x					x	x	x	7
Constructed Wetlands	0	n					y	2	3	2	3	10		x	x	x	x	x			x	x	x	x	x	10
Decentralize Energy/ Microgrids	0	n					y	2	3	1	3	9	x		x	x	x	x	x				x	x	x	9
Design Public Safety	0	n					n																			
Employment Land Preservation	0	n					n																			
Habitat Creation/ Conservation/ Restoration	0	n					y	3	3	2	3	11	x	x	x	x	x	x			x	x	x	x	x	11
Historic Preservation	0	n					n																			
Inclusive Streetscaping	0	n					n																			
Job Creation/ Retention	0	n					n																			
Local Business Preservation	0	n					n																			
Increasing Public Transportation	0	n					n																			
Materials that Reduce Albedo	5	y	1	2	1	1	5	y	1	2	1	5		x		x	x					x	x			5
Migration Design	0	n					y	1	3	0	1	5	x			x	x	x							x	5
Native Plantings	0	n					y	3	2	2	2	7				x	x	x			x	x		x	x	7
Noise Mitigation	5	y	2	2	0	1	5	y	2	2	0	5		x	x	x		x					x			5
Placemaking/ Public Art	0	n					y	2	0	0	0	2	x		x											2
Pollinator Gardens	11	y	3	3	2	3	11	y	3	3	2	11	x	x	x	x	x	x			x	x	x	x	x	11
Rain Gardens	9	y	3	3	2	1	9	y	3	3	2	9	x	x	x	x	x	x			x	x			x	9
Rainwater Features	0	n					y	1	1	1	1	3	x					x				x				3
Recreation Opportunities	0	n					n																			
Renewable Energy Infrastructure	0	n					y	1	3	2	2	8			x	x	x	x	x	x	x			x	x	8
Reused/Recycled/ Local materials	0	n					n																			
Safe Bike/ Pedestrian Paths	0	n					n																			
Sense of Place	0	n					y	2	0	0	3	5	x	x									x	x	x	5
Smart Growth Urban Design	0	n					y	2	3	1	3	9		x	x	x	x	x			x		x	x	x	9
Stormwater Facilities	0	n					y	0	3	2	2	7				x	x	x			x	x		x	x	7
Tourism	0	n					y	2	0	0	1	3	x		x										x	3
Tree canopy/ Shade Making	0	n					y	2	3	3	3	11		x	x	x	x	x	x	x	x	x	x	x	x	11
Urban Agriculture	0	n					n																			
Urban Forest	0	n					y	2	3	2	2	9		x	x	x	x	x			x	x		x	x	9
Solar-Lit Bus Stops/ Kiosks	0	n					n																			

APPENDIX B5 - DESIGN MATRIX

Design No. 5	Y/N	Equity	Ecology	Carbon	Resilience	None	Equity	Ecology	Carbon	Resilience	None	Place	Health	Wellbeing	Habitat	Biodiversity	Ecosystem	Energy	Carbon	UHIE	Justice	Policy	MGMT	Sum
		7	1	1	7		57	58	33	57	95	22	17	18	20	17	21	7	16	10	15	18	24	205
Underpass Ghost Ramp - Pollinator	Y/N	7	1	1	7		57	58	33	57	95	22	17	18	20	17	21	7	16	10	15	18	24	205
Accessible Places	0	n					n																	0
Adaptive Reuse	0	n					y	3	3	2	2	10	x	x	x	x	x	x	x		x		x	10
Anti-gentrification measures	0	n					n																	0
Bikes/ Scooter/ Car-Share Stations	0	n					y	3	3	3	3	12	x	x	x	x	x	x	x	x	x	x	x	12
Bioremediation / Toxic Cleanup	0	n					y	2	3	1	3	9		x	x	x	x	x		x		x	x	9
Bioswales	0	n					y	1	3	2	3	9	x			x	x	x		x	x	x	x	9
Carbon Sequestration	0	n					y	3	3	2	3	11	x	x	x	x	x	x		x	x	x	x	11
Centralized Public Node	6	y	2	1	1	2	6	2	1	1	2	6	x	x				x	x			x	x	6
Citizen Science Apps	0	n					y	1	3		2	6	x			x	x	x					x	6
Civic Ecology	0	n					y	1	3		3	7	x			x	x	x				x	x	7
Constructed Wetlands	0	n					n																	0
Decentralize Energy/ Microgrids	0	n					y	2	3	1	3	9	x		x	x	x	x			x	x	x	9
Design Public Safety	0	n					y	3		1	3	7	x	x	x			x			x	x	x	7
Employment Land Preservation	0	n					n																	0
Habitat Creation/ Conservation/ Restoration	0	n					y	3	3	2	3	11	x	x	x	x	x	x		x	x	x	x	11
Historic Preservation	0	n					y	3	2	2	1	8	x	x	x	x		x	x	x			x	8
Inclusive Streetscaping	5	y	3	0	0	2	5	3			2	5	x	x	x							x	x	5
Job Creation/ Retention	0	n					n																	0
Local Business Preservation	0	n					n																	0
Increasing Public Transportation	0	n					n																	0
Materials that Reduce Albedo	0	n					y	1	2	1	1	5		x		x	x				x	x		5
Migration Design	0	n					y	1	3		1	5	x			x	x	x					x	5
Native Plantings	0	n					y		3	2	2	7				x	x	x		x	x	x	x	7
Noise Mitigation	0	n					y	2	2		1	5		x	x	x		x				x		5
Placemaking/ Public Art	0	n					y	2				2	x		x									2
Pollinator Gardens	0	n					y	3	3	2	3	11	x	x	x	x	x	x		x	x	x	x	11
Rain Gardens	0	n					y	3	3	2	1	9	x	x	x	x	x	x		x	x			9
Rainwater Features	0	n					y	1	1	1		3	x				x			x				3
Recreation Opportunities	0	n					y	3		1	1	5	x	x	x						x			5
Renewable Energy Infrastructure	0	n					y	1	3	2	2	8			x	x	x	x	x				x	8
Reused/Recycled/ Local materials	0	n					y	1		1	1	3	x						x				x	3
Safe Bike/ Pedestrian Paths	0	n					y	3	2	1	2	8	x	x	x	x		x		x			x	8
Sense of Place	5	y	2	0	0	3	5	2			3	5	x	x								x	x	5
Smart Growth Urban Design	0	n					y	2	3	1	3	9		x	x	x	x	x		x		x	x	9
Stormwater Facilities	0	n					y		3	2	2	7				x	x	x		x	x		x	7
Tourism	0	n					y	2			1	3	x		x									3
Tree canopy/ Shade Making	0	n					n																	0
Urban Agriculture	0	n					n																	0
Urban Forest	0	n					n																	0
Solar-Lit Bus Stops/ Kiosks	0	n					n																	0

APPENDIX B6 - DESIGN MATRIX

Design No. 6

Esplanade Underpass - Urban Ag	Y/N	Equity	Ecology	Carbon	Resilience	None	Y/N	Equity	Ecology	Carbon	Resilience	None	Place	Health	Wellbeing	Habitat	Biodiversity	Ecosystem	Energy	Carbon	UHI	Justice	Policy	MGMT	Sum
		5	2	1	5			78	64	47	71	40	27	25	26	23	18	23	11	23	13	19	24	28	260
Accessible Places	0	n					y	3	1	1	2	6	x	x	x					x		x	x		6
Adaptive Reuse	0	n					y	3	3	2	2	10	x	x	x	x	x	x	x	x			x		10
Anti-gentrification measures	0	n					y	3	1	1	1	6	x	x	x	x				x		x			6
Bikes/ Scooter/ Car-Share Stations	0	n					y	3	3	3	3	12	x	x	x	x	x	x	x	x	x	x	x	x	12
Bioremediation / Toxic Cleanup	0	n					y	2	3	1	3	9		x	x	x	x	x	x	x		x	x	x	9
Bioswales	0	n					y	1	3	2	3	9	x			x	x	x			x	x	x	x	9
Carbon Sequestration	0	n					y	3	3	2	3	11	x	x	x	x	x	x			x	x	x	x	11
Centralized Public Node	0	n					y	2	1	1	2	6	x	x				x	x				x	x	6
Citizen Science Apps	0	n					y	1	3	0	2	6	x			x	x	x					x	x	6
Civic Ecology	0	n					y	1	3	0	3	7	x			x	x	x				x	x	x	7
Constructed Wetlands	0	n					n																		0
Decentralize Energy/ Microgrids	0	n					y	2	3	1	3	9	x		x	x	x	x	x			x	x	x	9
Design Public Safety	0	n					y	3	0	1	3	7	x	x	x				x			x	x	x	7
Employment Land Preservation	0	n					n																		0
Habitat Creation/ Conservation/ Restoration	0	n					y	3	3	2	3	11	x	x	x	x	x	x			x	x	x	x	11
Historic Preservation	0	n					y	3	2	2	1	8	x	x	x	x		x	x	x				x	8
Inclusive Streetscaping	0	n					y	3	0	0	2	5	x	x	x								x	x	5
Job Creation/ Retention	0	n					y	3	0	1	2	6	x	x	x						x			x	6
Local Business Preservation	0	n					n																		0
Increasing Public Transportation	0	n					y	3	3	3	3	12	x	x	x	x	x	x	x	x	x	x	x	x	12
Materials that Reduce Albedo	0	n					y	1	2	1	1	5		x		x	x					x	x		5
Migration Design	0	n					n																		0
Native Plantings	0	n					n																		0
Noise Mitigation	0	n					y	2	2	0	1	5		x	x	x		x					x		5
Placemaking/ Public Art	0	n					y	2	0	0	0	2	x		x										2
Pollinator Gardens	0	n					y	3	3	2	3	11	x	x	x	x	x	x			x	x	x	x	11
Rain Gardens	0	n					y	3	3	2	1	9	x	x	x	x	x	x			x	x			9
Rainwater Features	0	n					y	1	1	1	1	3	x					x				x			3
Recreation Opportunities	0	n					y	3	0	1	1	5	x	x	x						x		x		5
Renewable Energy Infrastructure	0	n					y	1	3	2	2	8			x	x	x	x	x	x			x	x	8
Reused/Recycled/ Local materials	0	n					y	1	0	1	1	3	x								x				3
Safe Bike/ Pedestrian Paths	8	y	3	2	1	2	8	3	2	1	2	8	x	x	x	x		x			x		x	x	8
Sense of Place	5	y	2	0	0	3	5	2	0	0	3	5	x	x									x	x	5
Smart Growth Urban Design	0	n					y	2	3	1	3	9		x	x	x	x	x			x		x	x	9
Stormwater Facilities	0	n					y	1	3	2	2	7				x	x	x			x	x		x	7
Tourism	0	n					y	2	0	0	1	3	x		x										3
Tree canopy/ Shade Making	0	n					y	2	3	3	3	11		x	x	x	x	x	x	x	x	x	x	x	11
Urban Agriculture	0	n					y	3	2	3	2	10	x	x	x	x		x	x	x	x		x	x	10
Urban Forest	0	n					y	2	3	2	2	9		x	x	x	x	x			x	x		x	9
Solar-Lit Bus Stops/ Kiosks	0	n					y	3	0	2	2	7	x	x	x					x	x			x	7

APPENDIX B7 - DESIGN MATRIX

Design No. 7		Y/ N	Equity	Ecology	Carbon	Resilience	None	Y/ N	Equity	Ecology	Carbon	Resilience	None	Place	Health	Wellbeing	Habitat	Biodiversity	Ecosystem	Energy	Carbon	UHIe	Justice	Policy	MGMT	Sum
			13	13	8	13		Y/ N	67	65	41	66	61	24	21	22	23	19	23	8	20	13	19	22	25	23 9
I-405 Underpass - Bioswale Fountains	6	y	3	0	1	2	6	y	3	0	1	2	6	x	x	x					x		x	x		6
Accessible Places	0	n						n																		
Adaptive Reuse	0	n						y	3	1	1	1	6	x	x	x	x				x		x			6
Anti-gentrification measures	0	n						y	3	3	3	3	12	x	x	x	x	x	x	x	x	x	x	x	x	12
Bikes/ Scooter/ Car-Share Stations	9	y	2	3	1	3	9	y	2	3	1	3	9		x	x	x	x	x		x		x	x	x	9
Bioremediation / Toxic Cleanup	0	n						y	1	3	2	3	9	x			x	x	x		x	x	x	x	x	9
Bioswales	1	y	3	3	2	3	11	y	3	3	2	3	11	x	x	x	x	x	x		x	x	x	x	x	11
Carbon Sequestration	0	n						y	2	1	1	2	6	x	x				x	x				x	x	6
Centralized Public Node	0	n						y	1	3		2	6	x			x	x	x					x	x	6
Citizen Science Apps	0	n						y	1	3		3	7	x			x	x	x				x	x	x	7
Civic Ecology	0	n						n																		0
Constructed Wetlands	0	n						y	2	3	1	3	9	x		x	x	x	x	x			x	x	x	9
Decentralize Energy/ Microgrids	0	n						y	3		1	3	7	x	x	x				x			x	x	x	7
Design Public Safety	0	n						n																		0
Employment Land Preservation	0	n						y	3	3	2	3	11	x	x	x	x	x	x		x	x	x	x	x	11
Habitat Creation/ Conservation/ Restoration	0	n						n																		0
Historic Preservation	0	n						y	3			2	5	x	x	x								x	x	5
Inclusive Streetscaping	0	n						n																		0
Job Creation/ Retention	0	n						y	3	2	2	1	8	x	x	x	x		x	x	x		x			8
Local Business Preservation	0	n						y	3	3	3	3	12	x	x	x	x	x	x	x	x	x	x	x	x	12
Increasing Public Transportation	5	y	1	2	1	1	5	y	1	2	1	1	5		x		x	x					x	x		5
Materials that Reduce Albedo	0	n						y	1	3		1	5	x			x	x	x						x	5
Migration Design	0	n						y	1	3	2	2	7				x	x	x		x	x		x	x	7
Native Plantings	5	y	2	2	0	1	5	y	2	2		1	5		x	x	x		x				x			5
Noise Mitigation	0	n						y	2				2	x		x										2
Placemaking/ Public Art	0	n						y	3	3	2	3	11	x	x	x	x	x	x	x	x	x	x	x	x	11
Pollinator Gardens	0	n						y	3	3	2	1	9	x	x	x	x	x	x		x	x			x	9
Rain Gardens	0	n						y	1	1	1		3	x					x			x				3
Rainwater Features	0	n						y	3		1	1	5	x	x	x					x		x			5
Recreation Opportunities	0	n						y	1	3	2	2	8			x	x	x	x	x	x	x		x	x	8
Renewable Energy Infrastructure	0	n						y	1		1	1	3	x							x				x	3
Reused/Recycled/ Local materials	0	n						y	3	2	1	2	8	x	x	x	x		x		x			x	x	8
Safe Bike/ Pedestrian Paths	0	n						y	2			3	5	x	x								x	x	x	5
Sense of Place	0	n						y	2	3	1	3	9		x	x	x	x	x		x		x	x	x	9
Smart Growth Urban Design	0	n						y	3	2	2	2	7				x	x	x		x	x		x	x	7
Stormwater Facilities	0	n						y	2			1	3	x		x									x	3
Tourism	1	y	2	3	3	3	11	y	2	3	3	3	11		x	x	x	x	x	x	x	x	x	x	x	11
Tree canopy/ Shade Making	0	n						n																		0
Urban Agriculture	0	n						y	2	3	2	2	9		x	x	x	x	x		x	x		x	x	9
Urban Forest	0	n						n																		0
Solar-Lit Bus Stops/ Kiosks	0	n						n																		0

APPENDIX B8 - DESIGN MATRIX

Design No. 8	Y/ N	Equity	Ecology	Carbon	Resilience	None	Y/ N	Equity	Ecology	Carbon	Resilience	None	Place	Health	Wellbeing	Habitat	Biodiversity	Ecosystem	Energy	Carbon	UHIE	Justice	Policy	MGMT	Sum
		16	19	12	14			69	61	41	67	62	24	22	23	21	18	22	9	20	12	18	23	26	23 8
I-405 Right of Way - Mutual Mile																									
Accessible Places	0	n					y	3		1	2		x	x	x					x		x	x		6
Adaptive Reuse	0	n					n																		0
Anti-gentrification measures	0	n					n																		0
Bikes/ Scooter/ Car-Share Stations	0	n					y	3	3	3	3	12	x	x	x	x	x	x	x	x	x	x	x	x	12
Bioremediation / Toxic Cleanup	0	n					y	2	3	1	3	9		x	x	x	x	x		x		x	x	x	9
Bioswales	0	n					n																		0
Carbon Sequestration	1	y	3	3	2	3	11	y	3	3	2	3	11	x	x	x	x	x		x	x	x	x	x	11
Centralized Public Node	0	n					y	2	1	1	2	6	x	x				x	x				x	x	6
Citizen Science Apps	0	n					y	1	3		2	6	x			x	x	x					x	x	6
Civic Ecology	0	n					y	1	3		3	7	x			x	x	x				x	x	x	7
Constructed Wetlands	0	n					y	2	3	2	3	10		x	x	x	x	x		x	x	x	x	x	10
Decentralize Energy/ Microgrids	0	n					y	2	3	1	3	9	x		x	x	x	x	x			x	x	x	9
Design Public Safety	0	n					y	3		1	3	7	x	x	x				x			x	x	x	7
Employment Land Preservation	0	n					n																		0
Habitat Creation/ Conservation/ Restoration	1	y	3	3	2	3	11	y	3	3	2	3	11	x	x	x	x	x		x	x	x	x	x	11
Historic Preservation	0	n					n																		0
Inclusive Streetscaping	0	n					y	3			2	5	x	x	x								x	x	5
Job Creation/ Retention	0	n					y	3		1	2	6	x	x	x					x			x	x	6
Local Business Preservation	0	n					y	3	2	2	1	8	x	x	x	x		x	x	x		x			8
Increasing Public Transportation	0	n					y	3	3	3	3	12	x	x	x	x	x	x	x	x	x	x	x	x	12
Materials that Reduce Albedo	5	y	1	2	1	1	5	y	1	2	1	5		x		x	x				x	x			5
Migration Design	0	n					y	1	3		1	5	x			x	x	x						x	5
Native Plantings	0	n					y		3	2	2	7				x	x	x		x	x		x	x	7
Noise Mitigation	5	y	2	2	0	1	5	y	2	2	1	5		x	x	x		x			x				5
Placemaking/ Public Art	0	n					y	2				2	x		x										2
Pollinator Gardens	0	n					y	3	3	2	3	11	x	x	x	x	x	x		x	x	x	x	x	11
Rain Gardens	9	y	3	3	2	1	9	y	3	3	2	9	x	x	x	x	x	x		x	x				9
Rainwater Features	0	n					y	1	1	1		3	x					x			x				3
Recreation Opportunities	0	n					y	3		1	1	5	x	x	x					x		x			5
Renewable Energy Infrastructure	0	n					y	1	3	2	2	8			x	x	x	x	x	x			x	x	8
Reused/Recycled/ Local materials	0	n					y	1		1	1	3	x							x					3
Safe Bike/ Pedestrian Paths	0	n					y	3	2	1	2	8	x	x	x	x		x		x			x	x	8
Sense of Place	0	n					y	2			3	5	x	x								x	x	x	5
Smart Growth Urban Design	0	n					y	2	3	1	3	9		x	x	x	x	x		x		x	x	x	9
Stormwater Facilities	0	n					y		3	2	2	7				x	x	x		x	x		x	x	7
Tourism	0	n					y	2			1	3	x		x									x	3
Tree canopy/ Shade Making	1	y	2	3	3	3	11	y	2	3	3	11		x	x	x	x	x	x	x	x	x	x	x	11
Urban Agriculture	0	n					n																		0
Urban Forest	9	y	2	3	2	2	9	n																	0
Solar-Lit Bus Stops/ Kiosks/ Nodes	0	n					y	3			2	7	x	x	x				x	x			x	x	7

