ABSTRACT

Title of Thesis:	MANUFACTURING CHANGE
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Historically, many industrial centers were developed on our urban waterfronts, for ease of transportation and manufacturing. Due to ever-evolving economic drivers, technological advancements, and a heightened concern for industrial pollution, many of these former industrial waterfront hubs have since fallen into abandonment. Even though many of these abandoned sites have ceased functional operation for decades, they continue to disrupt the social and environmental ecosystems they sit in. Waterfront brownfields contribute to heightened runoff, contaminated soil, water contamination, while also negatively impacting the health and socioeconomic wellbeing of the marginalized communities surrounding them, restricting the public from the waterfront. Now, with climate change continuing to create additional pressures on these coastline communities, intervention will be necessary to reutilize these abandoned manufacturing sites. This thesis explores the revitalization of waterfront brownfields, utilizing adaptive reuse and ecological remediation to restitch these abandoned manufacturing sites into a wider urban fabric. The reinvigoration of abandoned waterfront sites, with thoughtful utilization of adaptive reuse and environmental restoration would help create more resilient communities

that can both relate to the regional environment and reconnect to a historic industrial identity. The successful reutilization of these brownfields could provide a new blueprint for smarter urban waterfront redevelopment that promotes a better habitat for the public and natural species.

MANUFACTURING CHANGE: REDEVELOPING WATERFRONT BROWNFIELDS

by

Matthew Mariano

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Dedication

To my family, friends, and everyone that has supported me on my education journey.

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Table of Contents

List of Figures

Chapter 1: Introduction to Brownfields

Brownfields: History and Impact

The historic industry of the United States has long since fleeted from its urban waterfronts, leaving mighty ruins of manufacturing as a consequence for today's residents. Once a strategic position to headquarter production and storage due to its direct access to water, much of the historic waterfront industry has since fallen into abandonment today. In industry's place, these waterfront sites have become brownfields; "properties where the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant."[1]. Waterfront brownfields have become a multi-faceted blight that negatively impacts the environment, water quality, health, economics, and social opportunity of surrounding communities. The abandonment of waterfront properties is not only a blight, but a missed opportunity for cities to create additional revenue, reclaim their waterfronts for their citizens, and showcase their industrial heritage. With these problems established, the question emerges, what actions will be necessary to restitch these blights into a wider urban fabric? This chapter will focus on the problems that waterfront brownfields create, and the potential solutions that can be achieved with our built environment.

[1] "Brownfield Overview and Definition." EPA, August 3, 2016. https://19january2017snapshot.epa.gov/brownfields/brownfield-overview-and-definition_.html.

Fig. 1 Abandoned grain elevators at 'Silo City' in Buffalo, NY. Image Credit: Karen Foley

The remnants of man-made intervention and industrial pollutants left behind at waterfront brownfields have interrupted the natural coastline, and its ability to house functional habitat, while creating other complications that harm the natural environment. At the typical waterfront brownfield, the dynamic estuary of a natural coastline has long been erased by backfill, concrete bulkheads, and piers. This lost environment has resulted in a loss of ecological diversity, and less healthy waterways from a lack of filter feeders, fish, and birds. Simultaneously, brownfields are notorious for seeping pollutants into the soil and water below the surface. Improperly disposed chemicals from past industries are often still buried beneath the surface, making brownfields inhospitable for most plant life or poisonous for species that grow back in. These same chemicals can seep into the water table below the site or become a part of runoff during heavy rain on the brownfield's impervious surfaces. These untreated chemicals are at risk of being further exposed via erosion due to a rising sea level, which will only complicate the environmental and health issues associated.

Due in part to known chemical and environmental dangers, urban neighborhoods surrounding waterfront brownfields have historically been marginalized through unfair redlining and zoning, leaving residents to endure the consequences of heavy industrial activity. In the early 20th century, banks denied minority housing loans based on neighborhoods, and cities simultaneously zoned hazardous industry in low-income neighborhoods [2]. These practices often restricted minorities to living in undesirable plots of land near polluting industries, essentially removing them from the city's socioeconomic plan. When industry left, there was little incentive to redevelop the land, especially amid a national migration to suburbs. These unfair zoning practices and lack of economic development have since developed generational social and economic inopportunity, driving crime to become more prevalent in these communities. Given there is little to no opportunity to leave these neighborhoods, long-term health complications also are known to be more prevalent in these places. Being exposed to industrial chemicals is known to cause birth defects, as well as higher rates of cancers, respiratory diseases, and heart diseases [3].

Architectural & Environmental Intervention

To begin to address the problems that waterfront brownfields pose, it is clear a built response will be necessary to satisfy human and natural needs. The redevelopment of waterfront brownfields will begin to provide a sense of environmental justice to the residents who live in nearby communities and will allow the reconnection of the waterfront to a wider urban scale. All of the following strategies are part of a greater commitment to sustainable practice that aims to shift a historic polluter into a place that manufactures connection between people and nature, and reconnects the city to the waterfront.

To begin the process of redeveloping abandoned industrial plots, brownfield clean up will be necessary to understand soil quality, water quality and the health of plants, animals,

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[2] Gonzalez, Joaquin Jay, Tad McGalliard, and Ignacio Dayrit. 2021. *Brownfields Redevelopment : Case Studies and Concepts in Community Revitalization.* Jefferson: McFarland & Company, Incorporated Publishers.

[3] Litt, Jill S, Nga L Tran, and Thomas A Burke. "Examining Urban Brownfields through the Public Health 'Macroscope'." *Environmental Health Perspectives* 110, no. suppl 2 (April 2002): 183–93. https://doi.org/10.1289/ehp.02110s2183.

and local citizens. Remediation will sometimes be needed to ensure the property is once again safe for long-term human occupation, and to pave the way for environmental restoration. Different site conditions warrant different levels of remediation, whether it may be as little as removing abandoned infrastructure, or as complicated as full-scale soil washing and replacement. Though not "building" it is the first step to allowing for a built response where humans and nature can coexist more healthily.

Next, green infrastructure is an important element of the built environment to consider when addressing the redevelopment of waterfront brownfields. Using a variety of strategies, green infrastructure at the waterfront can preserve land with the reintroduction of a manicured habitat, which helps manage water during tide changes, helping limit the everyday impact of sea level rise from climate change. There is a scale of strategies that can be utilized in green infrastructure, ranging from full-scale environmental restoration, to strategically placed bioswales. Green infrastructure provides an opportunity to provide a slice of nature and recreational space for the people who live in nearby communities to gather and connect at.

Finally, adaptive reuse must be a major consideration in order to preserve cultural character and develop within the principle of sustainable practice. A common challenge and critique of contemporary redevelopment is an inability to maintain a distinct regional identity that is able to both represent and benefit the community. Adaptive reuse provides the opportunity to adjust the programmatic function of a useless building to better support the current needs of the surrounding community. Simultaneously, a portion of industrial history will be preserved and celebrated when that building is restitched into the community, instead of sitting inaccessible from the public and deteriorating. Adaptive re-utility does not just provide an opportunity for a formerly industrial building to retain a cultural significance and become a pillar for wider revitalization but also serves an environmental purpose. Reusing any amount of the original building on-site will provide huge embodied energy and carbon savings. Once fulfilled, a husk of what once was, can become a provider once again, and with a manufacturing rebirth acting as a symbol for the resiliency of a place’s people.

Chapter 2: Literature Review

Introduction

This chapter consolidates the literature reviewed relevant to the concerns and solutions of the thesis question. How can waterfront brownfields be reconnected to surrounding fabric to create more resilient communities? This literature review uncovers the history of brownfields and the details regarding lingering socioeconomic, health, and environmental effects created by them in the United States today. These effects clarify what must be addressed to resolve both regional disinvestment and more general 'wicked problems.' This review also aims to address and critique the methods of redevelopment to determine the role that architecture plays in creating resilient urban communities that are better prepared for climate change and address past mistakes via environmental justice.

History of Brownfields

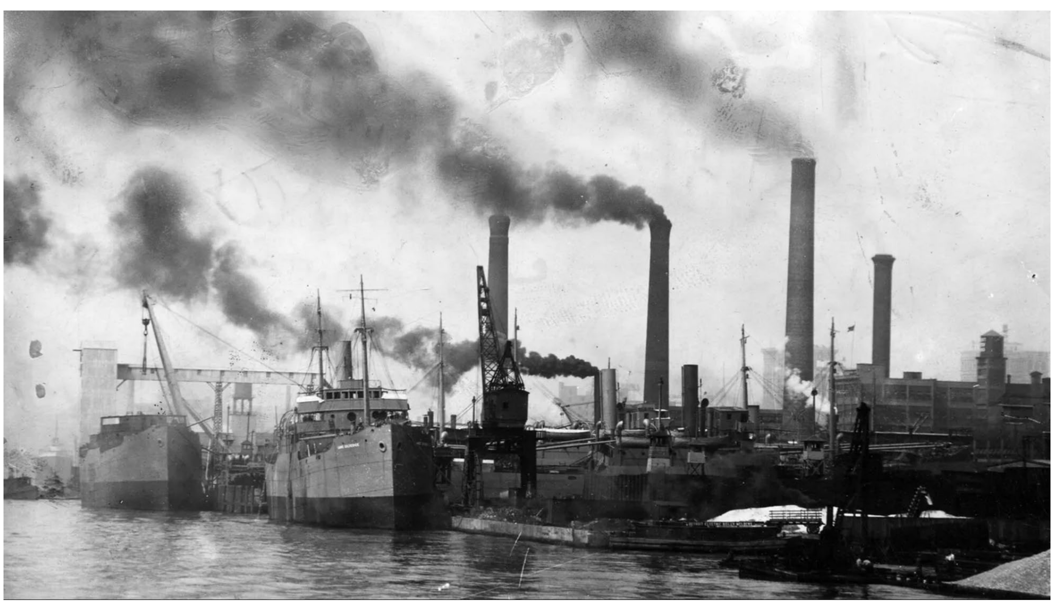

Fig.2 "Smokestacks from industries belch smoke into the air along the Detroit waterfront in 1927." Image Credit: The Detroit News Archives

Industrialization escalated the manufacturing productivity of the United States during the decades leading up to the turn of the 20th century, completely overhauling the economics of the country and transforming it from an agrarian society to primarily industrial. During this era, newly invented manufacturing technologies like steam and coal-powered machinery enabled an economy of scale, and to produce at-scale, many corporations invested into the buildings needed to support widespread production. Industrial hubs sprung up in America's urban landscapes, particularly in the Northeast and Rust Belt regions, replacing natural waterfronts to enable easy access to shipping routes and direct access to the water that fueled, or cooled early industrial machinery. This rapid industrialization marched strongly onwards into the mid-20th century, until an ever-globalizing economy began to create a national industrial shift in manufacturing. By the 1950s, as manufacturers found it cheaper to build their products overseas, industry began to move out of American cities abroad, "leaving behind older buildings and the remnants of processes which contaminated their property."[4] This industrial flight and deindustrialization occurred concurrently with deurbanization and modern city planning practices of the time. So as urban centers cleared out, the deindustrialization and abandonment of many former manufacturing powerhouses happened alongside it.

[4] Hula, Richard C, Cynthia Jackson-Elmoore, and Laura A Reese. 2016. *Reclaiming Brownfields : A Comparative Analysis of Adaptive Reuse of Contaminated Properties*. 1st ed. London ; Routledge. https://doi.org/10.4324/9781315603902.

Fig.3 Richmond Generating Plant in Philadelphia, PA sits abandoned, 2009 Image Credit: Matthew Christopher of Abandoned America

Many of these abandoned industrial waterfront sites then sat empty for decades, as new development looked outwards towards the suburbs. These waterfront sites are a part of a larger total that are known as brownfields; polluted, abandoned land with an industrial history. This problem has become prevalent in the United States, today, the Environmental Protection Agency recognizes that there are over 450,000 brownfields in the United States alone.[5] These remnants of past industry have become a widespread blight today for many of the people across the country, with brownfields plaguing their surrounding environments and communities' wellbeing. In 2020, the Environmental Protection Agency published statistics regarding the demographics living near 27,030 brownfields being redeveloped with federal funding. The results found that, "27 million people live within a half-mile of a brownfield site, and up to 144 million people live within three miles of a brownfield site."[6] The latter EPA statistic represents nearly 44% of the nation's population today, and many of these people living closest to these sites are also commonly the most marginalized or disadvantaged

[5] U.S. EPA, Office of Land and Emergency Management 2020. Data collected includes: (1) Brownfields site information from ACRES as of the end of FY2019; and (2) population data from the 2015-2018 American Community Survey.
[6] U.S EPA

in our society. The brownfield situation is one that is prevalent and directly involved in the lives of nearly half of all Americans, even if it is not directly known by the general public.

TABLE 1: **Proportions of Key Demographics in the Total Near Site Population and the Total U.S. Population**

	Population within 0.5mile of All Sites	Population within 1 mile of All Sites	Population within 3 miles of All Sites	U.S. Population
Minority	55.2%	53.6%	47.8%	39.6%
Below poverty level	22.1%	20.1%	16.3%	13.7%
Linguistically isolated	7.4%	7.2%	6.5%	5.1%
Less than a High School Education	17.8%	16.8%	14.2%	12.5%

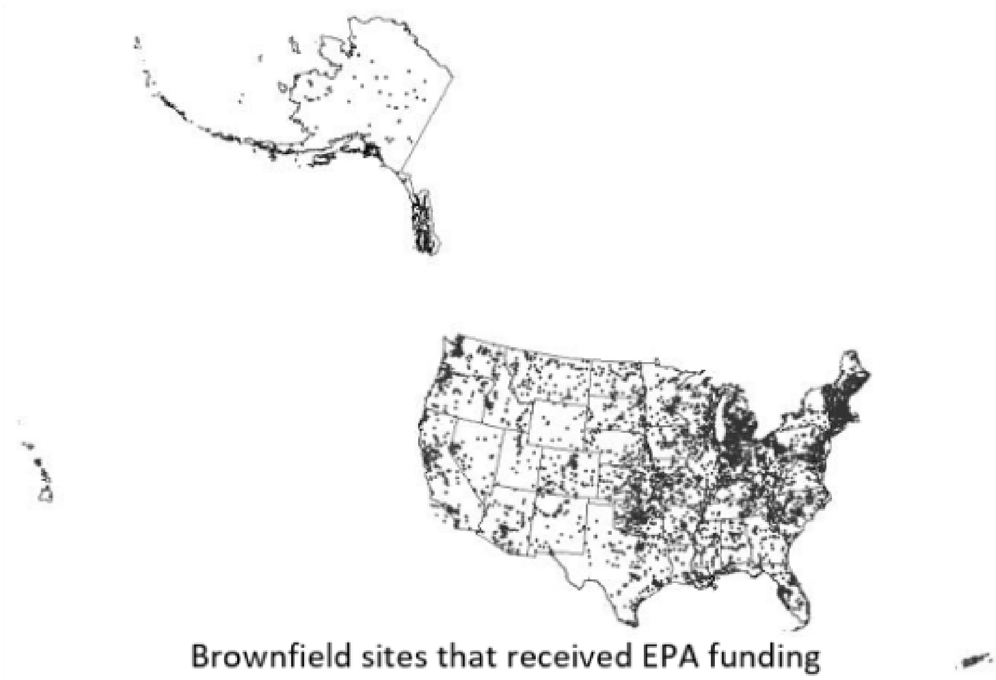

Fig. 4: EPA Demographic characteristics (top)
Fig. 5: Locations of the 27,030 sites surveyed by the EPA (bottom) Note the distribution of sites in Northeast former manufacturing hubs. Image Credit: EPA

A Blight : Introduction

As established, brownfields are a common blight that affects hundreds of millions of people in the United States, with these deserted lands negatively impacting the public health and socio-economic status of those living in impacted communities. The health, social, and economic wellbeing of those living within the radius of brownfields are statistically lower than those outside their reach; in part due to the site's abandonment and pollution spurring years of disinvestment and a neglect of environmental justice. This disinvestment perpetuates poor living conditions and makes it difficult for people to break out of this vicious cycle. Often, brownfields sit as untouchable places in a wider public realm.

A Blight : Health & Socio-Economics of Impacted Communities

The health of people living near brownfields is a primary concern due to the industries that used to preside there, and the industrial processes associated with the production and assembly of their products. Due to industrial pollutants such as heavy metals and volatile organic compounds (VOCs), health complications have been known to develop in the people living near or accessing these sites.[7] The effects of these industrial pollutants on humans can be found in a review conducted by Wang et al. The researchers found that, while studies may be limited, there is a strong association between brownfield proximity and a density of at least one negative health impact.[8] One of the studies reviewed was a 2022 study conducted in North Carolina, which found, “a positive association between cardiovascular and external birth defects given any brownfield exposure”[9], when measured by home address within 2000m of the site. Another earlier study in Baltimore had found, “communities in areas with land marked as ‘high hazard potential’ experienced a higher mortality rate due to diseases such as cancer, lung cancer, or other respiratory ailment.”[10] As they sit abandoned, brownfields are quietly exposing the people who live nearby them with industrial-grade

[7] Hollander, Justin, Niall Kirkwood, and Julia Gold. “Principles of Brownfield Regeneration : Cleanup, Design, and Reuse of Derelict Land.” Washington: Island Press, 2010. https://research.ebsco.com/linkprocessor/plink?id=12364a80-08a3-3a5b-a366-9fc6351e3324.

[8] Wang, Weiyi, Sarah Dack, Ian Mudway, Holly Walder, Bethan Davies, Robie Kamanyire, and Daniela Fecht. “Brownfield Land and Health: A Systematic Review of the Literature.” *PLOS ONE* 18, no. 8 (August 4, 2023). https://doi.org/10.1371/journal.pone.0289470.

[9] Slawsky, Erik D., Anne M. Weaver, Thomas J. Luben, and Kristen M. Rappazzo. “A Cross-sectional Study of Brownfields and Birth Defects.” *Birth Defects Research* 114, no. 5–6 (February 19, 2022): 197–207. https://doi.org/10.1002/bdr2.1992.

[10] Litt, Jill S, Nga L Tran, and Thomas A Burke. “Examining Urban Brownfields through the Public Health ‘Macroscope’.” *Environmental Health Perspectives* 110, no. suppl 2 (April 2002): 183–93. https://doi.org/10.1289/ehp.02110s2183.

contaminants in their soil, water, and local plant life. Given that, "of the top 10 chemicals found at brownfields with the greatest hazard potential, 80% were suspected or recognized as respiratory irritants."[11] It is no secret that brownfields are active public health hazards that must be addressed to improve regional public health.

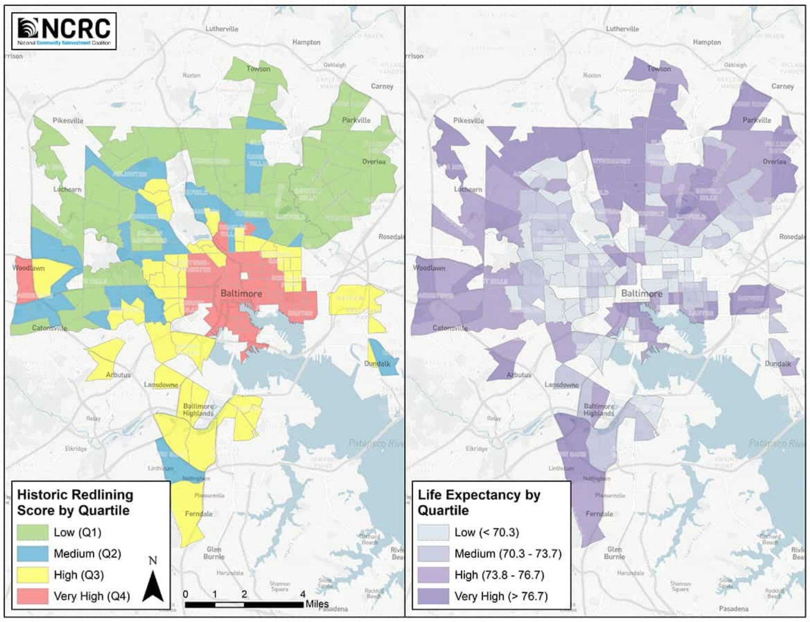

Fig. 6 Comparison between Historic Redlining Scores and Today's Life Expectancy in Baltimore, MD. Image Source: NCRC

This neglected health crisis is compounded by the fact that it is often the most underrepresented and underprivileged people in our country living in the communities closest to brownfields. In the study surveying populations near 27,030 brownfields, resident demographics were measured within 3 miles of each site surveyed. The results found that within ½ mile of a brownfield, 55.2% of residents were minorities, and 22.1% of residents were determined to be living below the poverty line.[12] People who are less likely to afford

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[11] Litt, Jill S. and Burke, Thomas A,PhD., M.P.H. , "Uncovering the Historic Environmental Hazards of Urban Brownfields," *Journal of Urban Health* 79, no. 4 (2002): 464-81, doi:https://doi.org/10.1093/jurban/79.4.464. https://www.proquest.com/scholarly-journals/uncovering-historic-environmental-hazards-urban/docview/821815866/se-2.

[12] U.S. EPA, Office of Land and Emergency Management 2020. Data collected includes: (1) Brownfields site information from ACRES as of the end of FY2019; and (2) population data from the 2015-2018 American Community Survey.

and have access to proper healthcare services to treat ailments caused by brownfields, are unfortunately those who are more commonly exposed to those ailments. A heightened minority population, and lack of necessary health infrastructure are likely resultant from in 20th century redlining practices which had discriminately zoned hazardous industry in predominantly minority neighborhoods.[13] Due to the known risks of brownfields, and general disinvestment and historic zoning practices in these neighborhoods surrounding former industrial hubs, there is "a strong correlation between the presence of brownfield sites and lower neighborhood property values, making poor residents more vulnerable to foreclosures and premature deaths."[14] The low land value, and risks associated with brownfields scare off potential investors, perpetuating a cycle of disinvestment and social injustice. It is this history of disinvestment and injustice that has also created the crime often associated with brownfields and other abandoned properties.

A Blight: Environmental Impact

In addition to the socioeconomic and health concerns reserved for people, brownfields are also environmental blights that impede habitats and animal life. Industrial development on waterfront sites often interrupts the natural coastline and ability of estuaries to properly function. In nature, a waterfront should be able to host a variety of ecological values, and play a role in protecting ecosystems by providing cover for aquatic and coastal species. Depending on the past industry which had occupied the land, every brownfield site could potentially contain a cocktail of pollutants that make it difficult for natural life to thrive. These pollutants include but are not limited to; volatile organic compounds (VOCs),

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[13] Gonzalez, Joaquin Jay, Tad McGalliard, and Ignacio Dayrit. 2021. *Brownfields Redevelopment : Case Studies and Concepts in Community Revitalization.* Jefferson: McFarland & Company, Incorporated Publishers.

[14] Chien, Shih-Chieh, and Charles Knoble. "Uneven Burdens: The Intersection of Brownfields, Pollution, and Socioeconomic Disparities in New Jersey, USA." *Sustainability* 16, no. 23 (November 30, 2024): 10535. https://doi.org/10.3390/su162310535.

total petroleum hydrocarbons (TPHs), pesticides, polychlorinated biphenyls (PCBs), and heavy metals.[15] When instilled into soil, these pollutants are known to limit microbial growth, leading to reduced plant growth and survival rates; therefore limiting the site's ability to contribute itself to become a carbon sink, and its capability to regulate local climate.[16] This pollution disables these large abandoned plots of land from contributing in a patchwork to mitigate heat island effect in urban regions, unable to promote diverse ecology, and keeps them from being a positive public resource to the resident community and for natural populations.

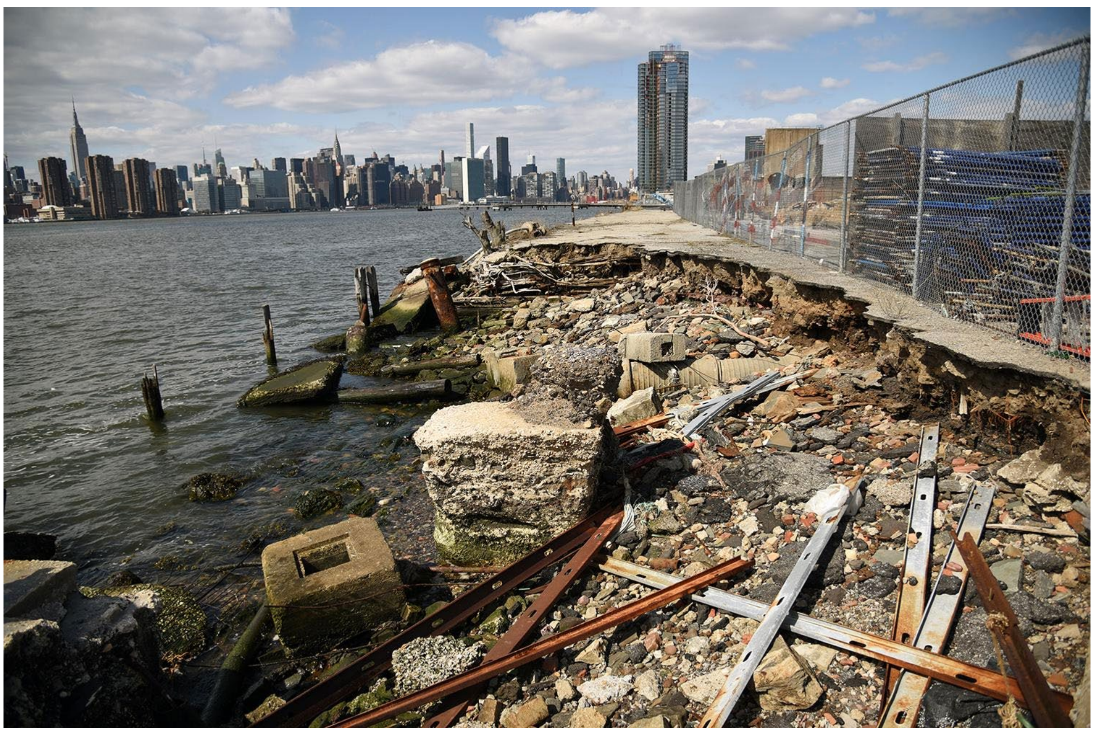

Fig.7 Industrial Site eroded into the East River in New York City, 2013 Image Credit: Nathan Kensinger

Another negative environmental impact particularly prevalent in waterfront or watershed brownfields, is that of water management and runoff. Many brownfields had been

[15] Justin Hollander, Niall Kirkwood, and Julia Gold. "Principles of Brownfield Regeneration : Cleanup, Design, and Reuse of Derelict Land" Washington: Island Press, 2010.

[16] Chien, Shih-Chieh, and Charles Knoble. "Uneven Burdens: The Intersection of Brownfields, Pollution, and Socioeconomic Disparities in New Jersey, USA." *Sustainability* 16, no. 23 (November 30, 2024): 10535. https://doi.org/10.3390/su162310535.

paved with impervious surfaces during their industrial lifespans, to create space for trucks and industrial equipment. The pavement, though once useful for commerce at these urban industrial hubs, restricts the natural ability for the earth to absorb rainwater. The inability to absorb rainwater creates runoff, which results in erosion and the pollution of local waterways. During rainstorms, leftover industrial pollutants on-site get swept up in this runoff and dumped directly into the waters of local ecosystems. One study found, “It is estimated that the runoff volume generated by impervious surfaces can be as much as 20 times greater than the volume in undisturbed watersheds.”[17] Addressing this issue of runoff must be done to promote the natural regeneration of habitats, protect our shorelines, and to re-establish an ecosystem for the species that had been displaced by the development of urban industry in the past century.

A Blight: Reflection

The effect of decades of socioeconomic and environmental disinvestment has led the surrounding communities of brownfields to fall into a debilitated built and natural landscape. The sometimes poor social and economic circumstances in neighborhoods adjacent to brownfields hints that there may be an element of psychology unaddressed. In research conducted by Toader, Maria, and Ilin, “When asked if atmosphere played an effect on people in architecture, it was found that 96.2% of the test respondents believed the atmosphere of a location is important to them.”[18] This overwhelming response shows how people’s emotions and thoughts on a place may be inspired by their surroundings. For the process of urban redevelopment and reinvestment to begin, one must begin with brownfield sites, and bring

[17] Gray, Thelma, ed. 2015. *Issues in Green Infrastructure : Operations and Maintenance Lessons and Coastal Research Needs*. Nova Science Publishers, Inc.
[18] Coțovanu Toader, Iulia-Maria, and Corina Ilin. “Architecture and Psychology – A Study of the Connection of Architectural Image With Urban Environment Perception”. *Smart Cities and Regional Development (SCRD) Preprints* 1 (1). 2024 https://scrd.eu/index.php/scrd-pp/article/view/573.

them back into the community realm. Often, a brownfields' visual aesthetics house the problematic physical conditions that humans psychologically relate to higher levels of unsafety and crime. This "broken windows" effect scares off middle-class families and investors whose largest concern when moving is crime.[19] In order to attract the outside resources necessary to turn a new leaf in our natural and social environments, redevelopment of the source of troubles is the best way to proceed.

Importance of Redevelopment and Approach to Design

As established, brownfields act as a blight on our built environment, and create a negative impact on health, economics, and social equality in the bordering community. The redevelopment and reconnection of urban waterfront brownfields can provide an opportunity to begin alleviating years of localized environmental pollution and socio-economic injustice. A local focus on redevelopment can help influence the exact program of the redevelopment project, but the impact of a job well done will inadvertently help in diluting national and even global wicked problems far beyond a single neighborhood's scope.

But why build on brownfields instead of greenfields? With sustainable design benefits aside, the efficiency, existing infrastructure, and land value are overwhelmingly crucial to a project's success. One study revealed that it took, "4.5 acres of greenfields to accommodate the same growth as one acre of brownfield redevelopment."[20]

[19] Brown, Barbara B., Douglas D. Perkins, and Graham Brown. 2004. "Crime, New Housing, and Housing Incivilities in a First-ring Suburb: Multilevel Relationships across Time." *Housing Policy Debate* 15 (2): 301–45. doi:10.1080/10511482.2004.9521504.

[20] Hersh, Barry F. "The Complexity of Urban Waterfront Redevelopment." NAIOP, 2012. https://www.naiop.org/research-and-publications/research-reports/reports/the-complexity-of-urban-waterfront-redevelopment/.

Fig.8 Comparative Greenfield and Brownfield Growth. Image Credit: Author

Redeveloping in a city is a stronger market opportunity to developers because of the transit-oriented development that is missing in our sprawling suburbs.[21] Oftentimes, transit infrastructure is stronger in historic downtowns of cities, because of the centuries we have spent developing them. These same downtowns are usually built near the water because of historic industry's need for shipping and manufacturing. This is the value of waterfront brownfield redevelopment; the available existing public infrastructure beyond a site creates greater potential for economic viability and an opportunity to address environmental sensitivity. "Views of the water, access, the unique history and feel of the waterfronts are extraordinarily valuable. Successful projects bring the community back to its waterfront."[22] People feel connected to the natural environment, want to be near the water, and the role of biophilia can bring a community together and make it more resilient.

Redevelopment and Design: Remediation

In this next section, we will delve deeper into strategies of environmental restoration and sustainable practice to create stronger communities. Each step will include analysis and

[21] Hersh, Barry F. "The Complexity of Urban Waterfront Redevelopment." NAIOP, 2012. https://www.naiop.org/research-and-publications/research-reports/reports/the-complexity-of-urban-waterfront-redevelopment/.

[22] Hersh, Barry F. "The Complexity of Urban Waterfront Redevelopment." NAIOP, 2012. https://www.naiop.org/research-and-publications/research-reports/reports/the-complexity-of-urban-waterfront-redevelopment/.

examples to create considerations when undertaking a redevelopment project at a waterfront brownfield site. By analyzing the achievements and shortcomings of every step, one can see the challenges and achievements of reimagining waterfront brownfields into a part of resilient communities.

The step-by-step process of reforming brownfield sites is tenuous. But to begin working towards redeveloping brownfields in any capacity, the first step necessary is the environmental clean-up, making the land safe for long-term human and natural habitation. A thoughtful remediation will be vital to the health and safety of those living on or near the site due to the aforementioned health risks caused by industrial pollutants. The method to remediate varies depending on circumstance, different site conditions may allow one method to be effective in some situations, while insufficient in its capability at others. With this said, there are methods that are seemingly better than others when considering a future vision of redevelopment.

During remediation, elements such as structurally unstable buildings, impervious surfaces, industrial waste, oil storage, and outdated infrastructure are needed to be addressed.[23] After thorough soil testing to determine the contaminants on-site, the method of remediation can be chosen. Historically, the remediation methods of brownfields have been limited, "examples included air sparging, bioventing, encapsulation, excavation, incineration, permeable reactive barriers, pump and treat, and soil vapor extraction."[24] Of these, most are invasive strategies that require significant excavation and oftentimes total relocation of all topsoil on-site. From these historic examples, encapsulation is one of the most popular methods, least invasive, and least expensive. Encapsulation essentially caps the toxic materials underground under an impervious surface to prevent rainwater from washing

[23] Justin Hollander, Niall Kirkwood, and Julia Gold. "Principles of Brownfield Regeneration : Cleanup, Design, and Reuse of Derelict Land" Washington: Island Press, 2010.
[24] Justin Hollander, Niall Kirkwood, and Julia Gold.

trapped underground chemicals out into watersheds.[25] The limitation of this method is that it renders the existing land useless, and requires new soil to be laid on top of the newly capped site if any landscape were to be reconstructed. Given that encapsulation creates a new impervious surface for runoff to form on, and creates challenges if new underground infrastructure is to be run to new development on-site, it may not be the best methodology for environmental reclamation.

More recently, other remediation strategies have been popularized which are more dependent on the past industry and pollutants involved at the site. Some of these methods are less invasive, leaving open the ability to re-establish a manicured environment without total excavation. Some newer remediation strategies include, “bioremediation, landfarming, natural attenuation, phytoremediation, soil washing, and thermal desorption.”[26] Of these types of remediation; bioremediation, natural attenuation, and phytoremediation are the least invasive types, and utilize plant life and elements of natural systems to clean an affected site, creating a foundation for manufactured landscape.

Phytoremediation is the utilization of living organisms and their metabolic processes to absorb and degrade pollutants and contaminants in the environment.[27] This natural process is accelerated by human intervention and careful selection of plant specimen type; selecting hardy plants that are known to withstand the stresses of being on a chemically imbalanced site. According to research done in Italy, it was found that a polyculture selection of plants is the most effective approach to phytoremediation, as a variety of plants are able to filter a

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25 Justin Hollander, Niall Kirkwood, and Julia Gold.

26 Justin Hollander, Niall Kirkwood, and Julia Gold. “Principles of Brownfield Regeneration : Cleanup, Design, and Reuse of Derelict Land” Washington: Island Press, 2010.

27 Zuzolo, Daniela, Carmine Guarino, Alessia Postiglione, Maria Tartaglia, Pierpaolo Scarano, Antonello Prigioniero, Roberto Terzano, et al. “Overcome the Limits of Multi-Contaminated Industrial Soils Bioremediation: Insights from a Multi-Disciplinary Study.” *Journal of Hazardous Materials* 421 (January 2022): 126762. https://doi.org/10.1016/j.jhazmat.2021.126762.

wider variety of contaminants.[28] This study also found that shrubs in the *festuca* genus were the best performers because of an, "overexpression of metal transporters able in both PTEs influx and sequestration from the cytoplasm."[29] Ideally, local species in the *festuca* genus or family should be considered depending on the brownfield's region to avoid introducing invasive species, and to ensure that the pollutants are absorbed. With these positives, one must still consider elements like the extended timeframe of this process, as well as the depth of remediation, since it will only spread as far as the plants root systems will.

Bioremediation is similar in principle to phytoremediation and is also minimally invasive, but instead of the absorption of pollutants, bioremediation focuses on the complete removal or neutralization of pollutants.[30] Bioremediation utilizes new and existing plants, fungi and microbes to remove contaminants through the plant's and bacteria's needs for nutrients to survive and grow. Abandoned industrial sites can contain nutrients that also double as the pollutants intoxicating the land. These pollutants act as feed for plants, fungi, and bacteria, with some nutrients being carbon, nitrogen, phosphate, and heavy metals.[31] The drawback of this methodology is also the timeframe required for its success, as these natural processes can take a long time and may not be appropriate for quick clean up.[32] It must be noted as well that this is not a sufficient solution for all chemical compounds found at brownfields, some chemicals may not be broken down by plants or bacteria.

Finally, there is natural attenuation which takes almost all human intervention out of the clean-up process of brownfields. Natural attenuation relies entirely on the natural systems

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[28] Zuzolo, Daniela, Carmine Guarino, Alessia Postiglione, Maria Tartaglia, Pierpaolo Scarano, Antonello Prigioniero, Roberto Terzano, et al.
[29] Zuzolo, Daniela, Carmine Guarino, Alessia Postiglione, Maria Tartaglia, Pierpaolo Scarano, Antonello Prigioniero, Roberto Terzano, et al.
[30] Zuzolo, Daniela, Carmine Guarino, Alessia Postiglione, Maria Tartaglia, Pierpaolo Scarano, Antonello Prigioniero, Roberto Terzano, et al.
[31] Justin Hollander, Niall Kirkwood, and Julia Gold.
[32] Justin Hollander, Niall Kirkwood, and Julia Gold.

below ground to slowly clean-up underground pollutants in the soil. This process is the closest with a natural reclamation and will indirectly take place at every site. However, the conditions must be right to clean the site properly at some specific sites. To determine the effectiveness of natural attenuation, surveyors can monitor the rate of processes such as dilution, volatilization, biodegradation, adsorption, and chemical reactions.[33]

In order to create a stronger built environment, while considering the energy required to remediate, and the ability to provide some habitat restoration, the newer, less invasive options of remediation should be considered. Given that many traditional methods require the total relocation of a site's soil, and often leaves a blacktop in its place, these methods do not promote the creation of resilient communities and a stronger urban landscape. "When residents of neighborhoods can create well-tended landscapes, they also feel greater neighborhood safety"[34] so it is important to utilize methodologies that can create these landscapes in areas that had been robbed of environmental justice in the past.

Redevelopment and Design: Adaptive Reuse

Once remediation is underway, if available, adaptive reuse may provide the best opportunity to solve some of the current problems these overlooked sites face, via the restoration and repurposing of underutilized industrial buildings. The primary argument for utilizing adaptive reuse surrounds cutting the high environmental and economic costs of the resources and the emissions associated with new construction. Given that, "annual building demolition generates nearly double the waste landfilled by all US cities and towns combined."[35] Adaptive reuse is an opportunity to keep tons of waste out of landfill by

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33 Justin Hollander, Niall Kirkwood, and Julia Gold.

34 Brown, Barbara B., Douglas D. Perkins, and Graham Brown. 2004. "Crime, New Housing, and Housing Incivilities in a First-ring Suburb: Multilevel Relationships across Time." *Housing Policy Debate* 15 (2): 301–45. doi:10.1080/10511482.2004.9521504.

35 Carl Elefante, *Going for Zero: Decarbonizing the Built Environment on the Path to Our Urban Future* (Washington, DC: Island Press, 2025).

reutilizing buildings that would have otherwise sat empty or destroyed. This responsibility of sustainability falls to the building construction sector as it is one of the highest resource consumers and carbon emitters globally. Up to 40% of all energy, 40% of raw resources, and 12-16% of usable water is utilized by the construction sector alone.[36] In addition to this, building construction also produces 30-40% of global carbon emissions and waste.[37] No matter the project's programmatic function, existing buildings can be utilized in their entirety or through selective demolition to cut back on these rates of consumption and waste. Reutilizing the remnants of what has already been built would roll back the accelerated rate of climate change and waste involved in construction.

With this said, adaptive reuse can create questions on what is salvageable, and if the rate of savings is truly worth the hassle of at least partial preservation. In regard to the reuse of industrial buildings specifically, a study conducted in California has found that industrial to residential building adaptation is among the best ways to save on energy, emissions, and materials in building development. The study found, "A repurposed [industrial] building avoids about 56% of embodied energy, 34-48% of CO2 eq emissions, and 72% of materials by mass compared to building a new apartment building."[38] These savings are likely due to the robust materials of historic industrial buildings, built to withstand heavy utilization and low maintenance during its operation. Oftentimes, the concrete, steel, or masonry structures holding up these buildings can extend their lifespans beyond industry as the primary or secondary structural members in residential buildings. The open floorplans of industrial

[36] Abdul Ghani Olabi et al., "The Role of Green Buildings in Achieving the Sustainable Development Goals," *International Journal of Thermofluids* 25 (January 2025): 101002, https://doi.org/10.1016/j.ijft.2024.101002.
[37] Abdul Ghani Olabi et al.
[38] Aysegul Petek Gursel, Arman Shehabi, and Arpad Horvath, "What Are the Energy and Greenhouse Gas Benefits of Repurposing Non-Residential Buildings into Apartments?," *Resources, Conservation and Recycling* 198 (November 2023): 107143, https://doi.org/10.1016/j.resconrec.2023.107143.

typologies like factories and warehouses enable easier spatial rearrangement during adaptive reuse projects.

Redevelopment and Design: Cultural Value

In addition to the environmental benefits, practicing adaptive reuse provides an opportunity to preserve the historic character of a place. Modernist 'global' architecture and planning introduced a prescribed design language in the twentieth century that has destroyed much of the history from place, and left brownfields as abandoned in the first place. In the era since deindustrialization, and the popularization of modernism, there has been a rise in industrial heritage as a form of historical preservation. Preserving the gritty hard-working history of a place instills pride in the people who live there and creates an interest in learning about the regions' history.[39] By bringing life back to abandoned historical buildings, one can achieve the revitalization of economic and social factors in a contemporary context, while preserving historical character and reinforcing the unique cultural heritage of a place.

Resilient Communities

In a world where there are levels of both local and global challenges, developing resilient communities will be a necessity to give residents the resources necessary to continue to thrive. There are a variety of necessary "supporting systems" in resilient communities that should be considered when developing brownfields. These supporting systems include transportation, energy, water, natural environment, food protection/agriculture, solid waste, and economics.[40] By choosing to revitalize waterfront brownfields, their redevelopment can

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[39] International Committee for the Conservation of the Industrial Heritage, issuing body, and James Douet. 2016. *Industrial Heritage Re-Tooled : The TICCIH Guide to Industrial Heritage Conservation.* Edited by James Douet. 1st ed. New York: Routledge.
[40] Coyle, Stephen. *Sustainable and Resilient Communities: A comprehensive action plan for towns, cities, and Regions*. Hoboken, NJ: John Wiley & Sons, 2011.

open up additional opportunities to improve some of these systems beyond their current capacities, therefore strengthening the wider community.

Resilient Communities: Energy & Water

Some community energy and water management can be supported via integrated systems on a building, and on the site of a former brownfield. Net-zero energy production for a redevelopment project can be achieved through the utilization of technology including solar arrays, and geothermal wells. Depending on the region, by using a combination of solar and geothermal energy, households could save money on power, while producing little to no carbon emissions.[41] When paired with rebates, and a national shift from non-renewable to renewables, it is responsible to reduce pressure on a national power grid with growing demands.[42]

Managing water on-site and the currents from the coast will be a necessity in the redevelopment project to avoid runoff, flooding, and erosion, and could help improve the wider community's relationship with water. Historic gray infrastructure such as berms, causeways, and embankments may have success in directing water, but operation and maintenance costs can be high, and their impervious nature increases water speed which raises erosion risk. To further develop a manicured environment while managing water, green infrastructure should be utilized where possible. The more forgiving permeable surfaces provide a place for water to drain, and studies show that green infrastructure is, "5-30% less to construct and 25% cheaper to maintain." when compared to gray infrastructure.[43] Some

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[41] Coyle, Stephen.
[42] Langevin, Jared, Chioke B. Harris, Aven Satre-Meloy, Handi Chandra-Putra, Andrew Speake, Elaina Present, Rajendra Adhikari, Eric J.H. Wilson, and Andrew J. Satchwell. "US Building Energy Efficiency and Flexibility as an Electric Grid Resource." *Joule* 5, no. 8 (August 2021): 2102–28. https://doi.org/10.1016/j.joule.2021.06.002.
[43] Gray, Thelma, ed. 2015. *Issues in Green Infrastructure : Operations and Maintenance Lessons and Coastal Research Needs*. Nova Science Publishers, Inc.

green strategies for the shoreline include, soft stabilization via vegetation, hybrid stabilization that combines armoring and vegetation, nature-based breakwaters, and tidal wetlands.[44] Strategies for green stormwater include bioretention, wetland treatment, and impervious surface conversion.[45] With an approach to utilize green infrastructure, it not only manages water, but creates moments of biophilia for people, and encourages micro-habitats to develop.

Resilient Communities: Natural Environment

The utilization of green infrastructure helps partially address a community's natural environment. During or after initial remediation of a waterfront brownfield, consideration should be given to undertake a larger environmental restoration though; to better prepare our waterfronts for the current challenges and future effects of climate change and sea-level rise, create a habitat for animals to reside and create a public place for residents' recreational use. Wetlands are a vital habitat for a variety of species, and their homes have been systematically destroyed over the years. Half of the original 197 million acres of wetlands in the United States have been lost, with 10% of this destruction directly resultant from urban development.[46] The revival of wetlands will not only provide a place for animals to reside, but it will also restore natural cleaning properties of wetlands. Wetlands can act as containment sinks, filtering, chemically breaking down pollutants, and plant species biological absorption.[47] The effort to regenerate wetlands will create further beneficial properties to habitats outside of the immediate community. The beneficiaries are not all nature though, research has also found that a view of blue or green is beneficial for mental

[44] Huber, Jeffrey E. *Salty urbanism: A design manual to address sea level rise and climate change for urban areas in the Coastal Zones*. Novato, CA: ORO Editions, 2024.
[45] Huber, Jeffrey E.
[46] France, R. L. *Wetland design: Principles and practices for landscape architects and land-use planners*. New York: Norton, 2003.
[47] France, R. L.

health, increasing alpha brain wave activity, and lowering anxiety levels.[48] Landscape architecture's intervention can make a community's natural environment more accessible to all, providing a place for people to come and relax.

Resilient Communities: Economics

Economically, the revitalization of abandoned property creates the opportunity for commerce in its place. Waterfront property is worth more after just remediation, even before full development. In a case study investigating wetlands reconstruction, a project to stabilize the shoreline of Lake Michigan projected to increase property value by $12 million, leading to $600,000 extra property tax per year for local governments.[49] Higher tax rates create further resources for local governments to improve other elements of their local communities, ideally improving their resiliency. Additionally, the utilization of adaptive reuse can help improve economic opportunities for those living and working in the community. Construction projects on-site create jobs for local workers in the industry, and if commercial spaces are built on the site, it opens opportunities for businesses to invest into the community. To fight the potential gentrification that would come alongside with increased taxes and property values, resources like the EPA's Brownfield Job Training Program can help create jobs for those in the neighborhood, and community land trusts could ensure non-profits build housing on brownfield sites.[50]

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[48] Elsadek, Mohamed, Zhang Deshun, and Binyi Liu. "High-Rise Window Views: Evaluating the Physiological and Psychological Impacts of Green, Blue, and Built Environments." *Building and Environment* 262 (August 2024). https://doi.org/10.1016/j.buildenv.2024.111798.

[49] Samonte, Giselle, Peter E. T Edwards, and issuing body United States. National Marine Fisheries Service. Office of Habitat Conservation. 2017. *Socioeconomic Benefits of Habitat Restoration*. Silver Spring, Md: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

[50] Gonzalez, Joaquin Jay, Tad McGalliard, and Ignacio Dayrit. 2021. *Brownfields Redevelopment : Case Studies and Concepts in Community Revitalization.* Jefferson: McFarland & Company, Incorporated Publishers.

Resilient Communities: Food Protection

Lastly, though not necessarily directly making their own neighborhood a stronger place agriculturally, the redevelopment of brownfields does improve general access to food. By redeveloping the land we had already used in the past and since abandoned, we are protecting our rural landscape and reducing sprawl into greenfield sites of untouched nature or farmland. With our current rate of suburbanization, "1 million acres of farmland is developed yearly for residential usage"[51] This sprawl strains our current infrastructure, and the elimination of more agricultural lands may jeopardize food security if not for themselves, for others. Through the development of brownfields, there is an opportunity to maintain the national "breadbasket" without tearing into more of our natural landscape.

Conclusion

Waterfront brownfields can become a key in creating more resilient urban communities through architectural development. Remediation on these abandoned sites can save lives in public health, create better economic conditions for the people living nearby, and change public perception about a place. Adaptive Reuse can give these communities an identity, create a narrative of strength in the community, all while utilizing sustainable practice. Together, these elements come together to be a part of a larger resilient community given that the redevelopment accounts for elements of ecological reconstruction, stormwater management, and energy production.

[51] Carroon, Jean, and Richard Moe. *Sustainable Preservation: Greening existing buildings*. Hoboken, N.J: Wiley, 2010.

Chapter 3: Research Methodologies

Introduction

To best determine the problems a waterfront brownfield generates, the prevalence of the issue in the United States, a promising site, as well as determining the best solutions to address a particular waterfront brownfield; a variety of methodologies were utilized to conduct research. Data was gathered from a variety of sources including academic journals, websites, theory and articles. In addition to the research utilizing existing sources, on-site explorations and observations were utilized to obtain more specifics when available data appeared to be inconclusive or unavailable. This chapter reflects some of the means and methods utilized to gather, develop, and analyze information needed for this thesis.

Redevelopment Research

To determine why it is necessary to redevelop brownfields, and develop a better understanding of brownfields, a preliminary quantitative investigation was utilized to uncover the scale and prevalence of brownfields in the United States. Government authorities like the Environmental Protection Agency were referenced to understand the brownfield definition, as well as the amount and distribution of existing sites in the United States. This research provided an understanding of the groups of people brownfields currently impact, as well as how many of them. After discovering the scale of the problem, and determining the need to provide solutions, additional quantitative data from medical research was utilized to understand the human cost of the problem. Quantitative data was also utilized to determine statistics around energy savings, sea level rise, and other environmental factors that can be measured.

To develop an understanding of the strategies involved in restoring an abandoned brownfield, more preliminary research shifted to more subjective, qualitative data. Qualitative data, though not numerical, provides an opportunity for analysis and inspiration. A variety of architectural precedents were investigated, with research focused on analyzing building programs, adaptive reuse strategies, green-gray water infrastructure, environmental restoration, and waterfront activation. Additionally, analyzing how waterfront brownfield redevelopment begins at an adaptive reuse site and how it influences future development and the revitalization of entire neighborhoods or districts. Theory regarding sustainable practice was also consulted, and though there was not always tangible statistics, the learnings and methodologies were applied to the design language for the thesis.

Site Research

Site selection was selected based on a variety of factors, because the site location plays a vital role in adjusting the specific attributes and programmatic goals for addressing a brownfield and incorporating the waterfront. Some required factors included;

- The proposed site is a brownfield (An abandoned, former commercial or industrial use), though it does not need to be listed as such by the EPA.
- The site has direct waterfront access.
- The existing urban or developing context surrounding the site provides opportunity to reconnect.
- There are existing buildings on-site and these buildings have historic or structural value to the project.
- The site is large enough for large-scale green-infrastructure and environmental restoration.
- Some documentation or past proposals exist for the site to reinforce project feasibility.

Heavy consideration was given to the context surrounding the brownfield site, investigating the history of the community via available satellite imagery, historic maps, and Sanborn maps to compare the present built environment of the community with its historic roots. The programmatic function of the site adjusts based on community needs, so it weighed heavily on the site determination.

Once the site was determined, on-site qualitative research was conducted. On-site, field notes became a baseline to develop understanding and serve as a journal of observations. Site photography and audio recordings were utilized to achieve a better understanding of the existing utilization of the site and activity surrounding it. Multiple site visits at different points of the day, on different days of the week notes the fluctuating function. Observation of locals was included, and interviewing those who live in the surrounding neighborhood and utilize the local amenities will create additional insight into what is needed. Outside of on-site recording, to gain deeper insight into the statistics of the surrounding local communities, additional objective research was utilized to acquire additional quantitative data. The quantitative methods of data collection allow for the exact numeric when regarding statistics like, local demographics, populations, and crime. This data set allows a better perspective on what are the concrete needs of the local community and fills in the administrative gaps that may not represent the day-to-day lives of residents.

Professional Input

During the whole process, interdisciplinary professional partners were also consulted for more information on elements of redevelopment. An advisor for environmental restoration was referred to, as to provide details for brownfield reclamation and describing the needs and strategies that can be done. A licensed architect was also consulted for sustainable strategies and as a resource for precedent projects. Meetings with these partners were regularly scheduled to ensure they were involved every step of the way.

Conclusion

In conclusion, the variety of research methods and sources provided were needed to obtain information necessary to conduct this thesis. Quantitative research was necessary to quantify the issues and prevalence of brownfields, finding hard statistics to support the need and functions of the thesis. Qualitative research was necessary to understand the unmeasurable upside of brownfield redevelopment, site-specifics, and information that may not be found in academia, but is a lived experience of those who deal with brownfields.

Chapter 4: Precedent Studies

Introduction

To achieve a greater understanding of the architectural strategies that can facilitate a thoughtful redevelopment of waterfront brownfields, investigating precedent case studies became an essential element of the thesis development. These precedent investigations aimed to uncover and analyze projects in our built environment that executed brownfield reclamation, adaptive reuse, mixed-use programming, public activation, and green infrastructure. Though not all precedent projects investigated were cases of waterfront redevelopment, and not every project worked to solve each of those design challenges, the lessons available are still crucial and can be applied to this thesis' strategies. This chapter investigates five of the precedents selected to serve as influence, including an analysis of the strategies and spatial techniques implemented.

Empire Stores

Empire Stores is an adaptive reuse project that transformed an abandoned former coffee warehouse into a high-end retailer destination. Completed in 2017, the retail hub was designed by the adaptive reuse specialists at S9 Architecture alongside Perkins Eastman, and Studio V, the group of firms working to bring life back to property that had sat abandoned for over 40 years. This project was one of a larger movement that had aimed to restitch the formerly industrial waterfront of Dumbo, Brooklyn to the wider city, all while maintaining some of the past industrial character that has become a crucial part of the neighborhood's identity. Empire Stores approaches this challenge through its utilization of materiality; primarily by combining new and historic character in the building's appearance, structure, and programmatic shift towards retail.

Fig. 9 Empire Stores from the East River, Brooklyn, NY. Image Credit: Empire Stores

The play on the historic and new architecture is almost immediately apparent from the street. At first glance, the building preserves much of the character of the historic industrial architecture by retaining the facade of the original warehouse. New architecture is added on the roof, to provide spaces with exclusive views of the water and nearby historic bridges. In places of the building, new architecture can also be seen beyond the 'skin' of the original facade, creating a layering that encourages exploration. Spatially, the project utilizes a subtractive design, creating a corridor and courtyard through the center of the warehouse to develop a place of gathering and a channel of direction for those entering on River Street towards the East River waterfront.

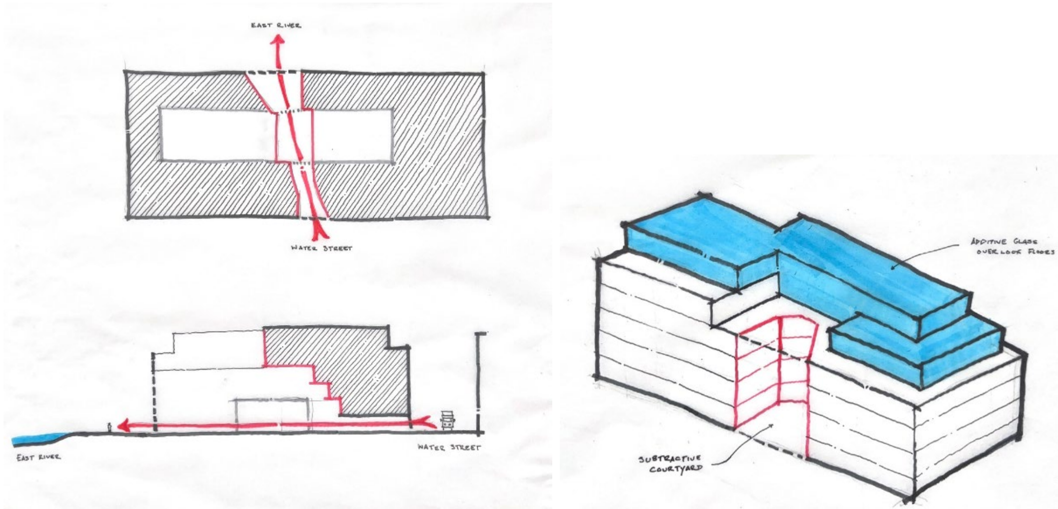

Fig. 10 Diagrammatic exploration of the subtractive and additive strategies to reconnect with the waterfront. Image Credit: Author

Structurally, the building uses two eras of structural systems to enforce a dialogue of preservation and architectural advancement via their distinct aesthetic and tectonic differences. The original wooden structure of the warehouse was restored on the interior, maintaining a tightly knit structural grid, and saving material from demolition. The original system relies on a combination of these wooden elements and masonry sheer walls, while the new architectural intervention strategically interrupts this grid. The areas with new intervention distinguish their tectonics by using concrete and steel to cantilever longer distances, and structurally support larger, open gathering spaces. This comparison between the original and intervention creates recognizable space via dynamic moves in the floorplan.

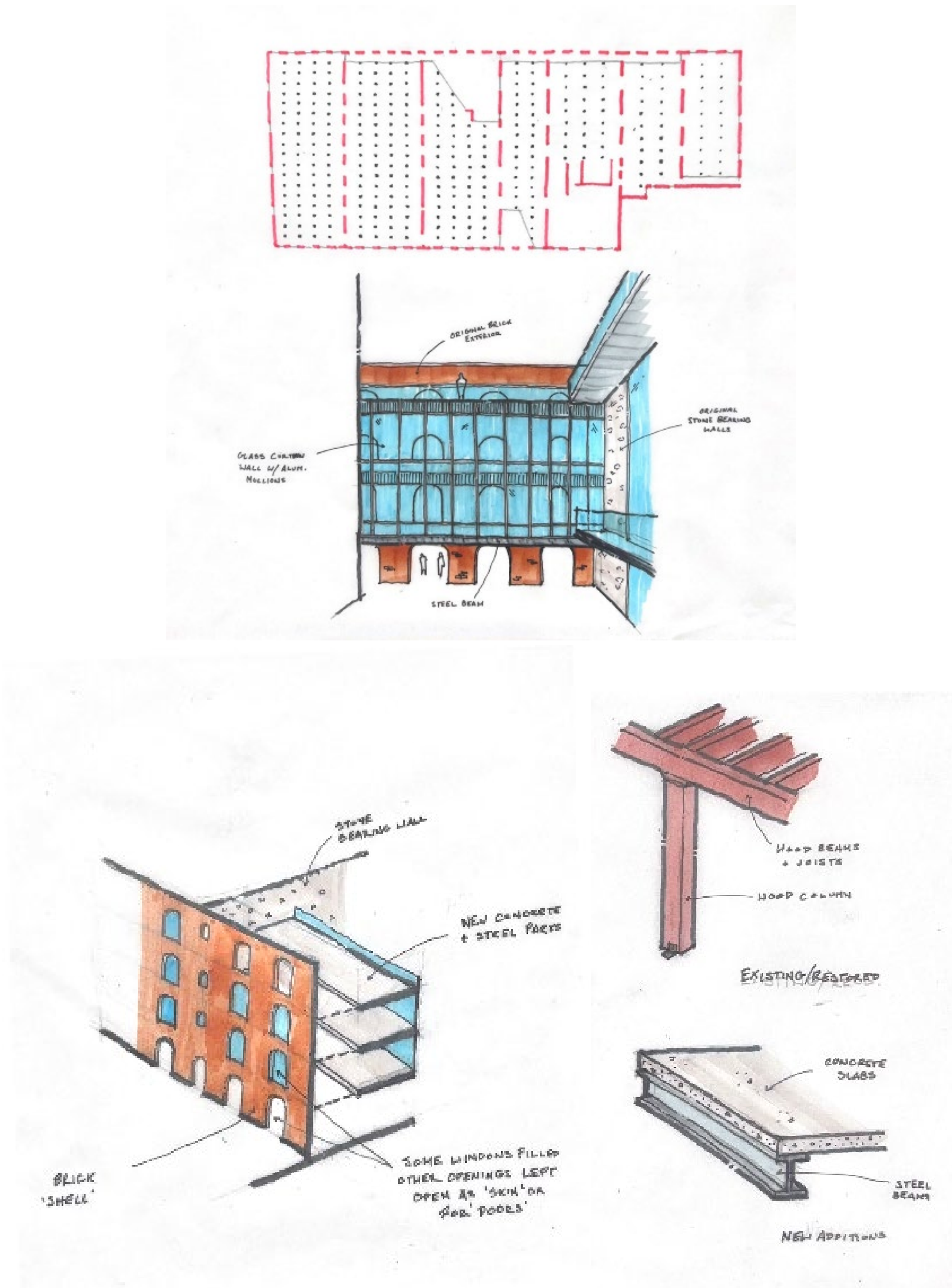

Fig. 11 Diagrammatic exploration of Empire Store's structural tectonics and materiality.
Image Credit: Author

This building precedent served as an inspiration of industrial preservation for neighborhood character, particularly with its unique utilization of materiality in tectonics.

When redeveloping for resiliency in communities, history must be preserved and celebrated to maintain the neighborhood's identity, even while the place continues to evolve. Creating a distinctive place that becomes attractive for tourists and residents alike is to give it a feeling that cannot be replicated with its history and accessibility, establishing itself as a landmark. For the waterfront brownfield in this thesis, to evolve the building to fit contemporary programmatic needs, structural tectonics could be an interesting dichotomy of old and new. The adaptive reuse of the industrial past will designate the place as a community anchor and landmark that represents the resilience and history of a neighborhood, while new intervention proves its ability to evolve to today’s trends and needs.

Mill 19

Another adaptive reuse precedent investigated was Mill 19 in Pittsburgh, PA, completed in phases between 2015-2023 and designed by MSR Design along with R3A Architecture and tenxten studio. The site is part of land that was once the site of the Jones & Laughlin Steel Company’s Pittsburgh mill, which had become synonymous with the steel city’s identity. By the early 2000s, most abandoned buildings on the company’s property had been demolished after the company’s closing and the city's steel industry collapsed. All buildings were cleared but a former slag furnace, which became the catalyst for this project. Mill 19 is the first phase of the Hazelwood Green redevelopment initiative, and its success has led to the spawn of neighboring buildings under construction now. This project is a strong precedent for its thoughtful approach to adaptive reuse, and its integration of sustainable systems, with impressive stormwater management and green energy numbers.

Fig. 12 Mill 19, Pittsburgh, PA. Image Credit: Corey Gaffer Photography

To begin, the existing slag building was stripped down to only its steel superstructure, which had continuous spans from end-to-end of the building. The steel superstructure, now exposed to the elements, was then used as a gantry and enclosure for new infill buildings that were built beneath. The steel superstructure was almost entirely covered in solar panels, and acts as a cog in a larger part of rainwater management, giving a surface for rain to slope off of. Spatially, the building then utilizes additive intervention to insert new spaces beneath the existing steel. These spaces are more capable to support modern programming and functionality as a robotics discovery campus than the original building could. Between these infill, visitors circulate underneath the overhead steel structure and solar panel shell. Though it may not seem like much of the original building was saved, the overbuilt steel structure provided an opportunity to save on carbon and embodied energy, and creates an unintentional platform to incorporate sustainable strategies. It also provides the opportunity to create a unique building that pays homage to the industry that once dominated the city's ethos.

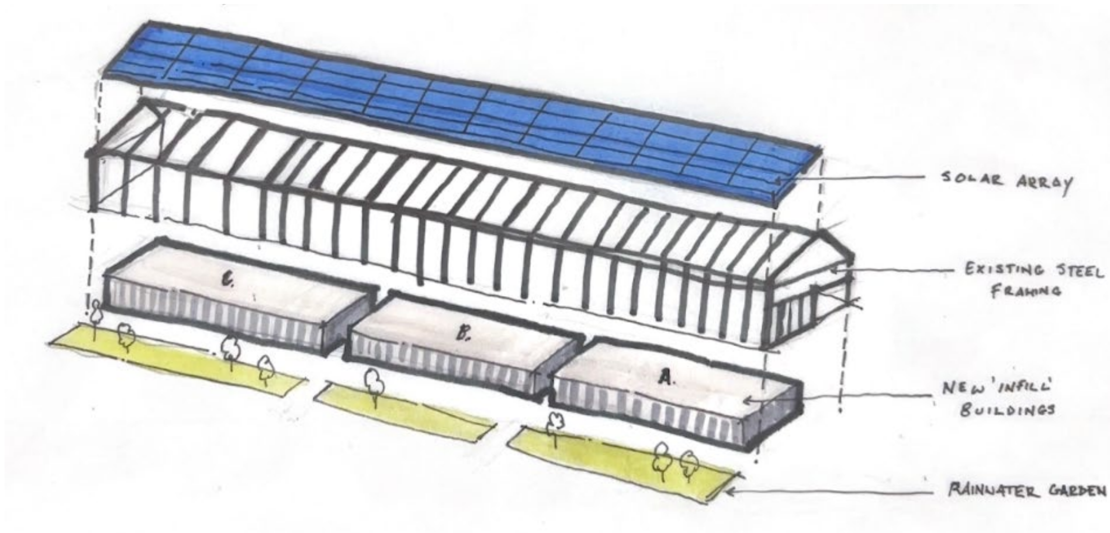

Fig. 13 Diagram representing the spatial relationship of the building, including additive infill beneath the existing steel structure. Image Credit: Author

The project's commitment to sustainable strategies resolving stormwater management and power production is admirable. The solar panel array is the largest rooftop unit in the United States, with the ability to power 380 homes.[52] The building is also able to manage 87% of its stormwater on-site through the site's surrounding infiltration gardens and retention basins.[53] Some of this water is collected off of the solar panel roofing, and used in-house for its cooling towers, cutting the building's need for potable water by 52%.[54] This commitment to sustainable practice has led to this building to be recognized and awarded by the AIA in 2023 with a Committee on the Environment (COTE) Top Ten Award.

[52] "RIDC Mill 19." RIDC. https://ridc.org/park/mill-19/.
[53] April 20, 2023, 2025 June 5, 2024 June 6, and 2024 May 24. "RIDC Mill 19: Buildings A & B." The American Institute of Architects. https://www.aia.org/design-excellence/award-winners/ridc-mill-19-buildings-b.
[54] AIA

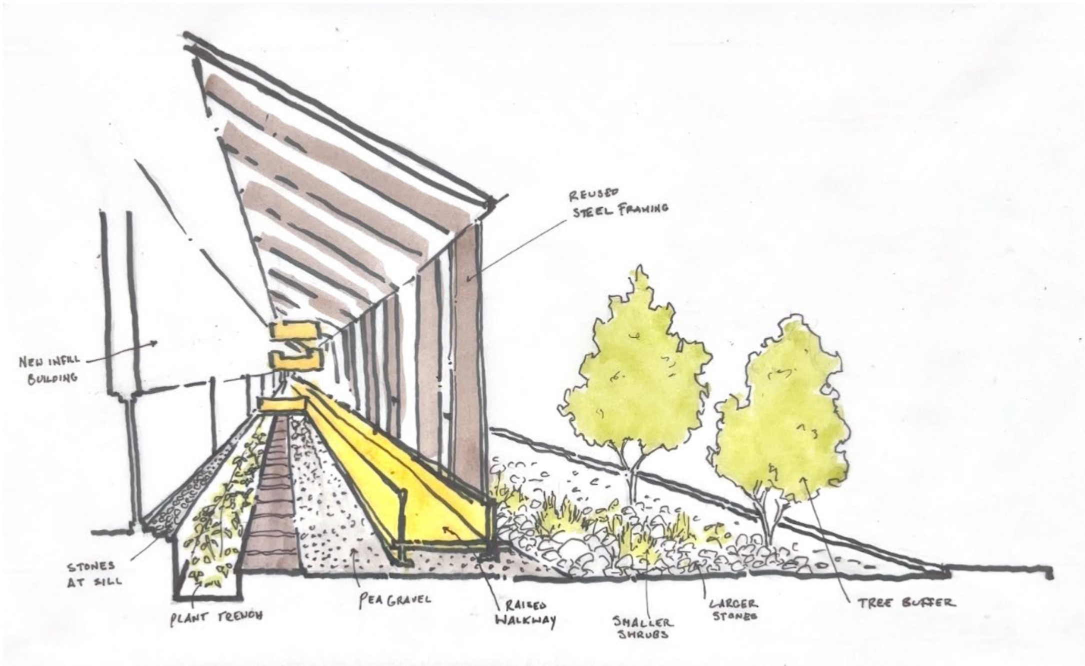

Fig. 14 Diagram to represent the exterior experience and rainwater landscaping. Image Credit: Author

This development serves as inspiration for how sustainable practice can help create resilient communities, and how a successful project can inspire further change in its community. This building was the foundation for an ongoing redevelopment project, and its success and publicity has attracted development nearby. This success may be in part to the project's commitment to sustainable practice. Utilizing green infrastructure, integrated power, and integrated water systems could enable struggling communities to reduce their costs long-term and their carbon footprint, while also attracting the attention of new developers. For the waterfront brownfield in this thesis, it will be important to apply similar strategies to manage storm and flood waters using infiltration gardens, retention, and cisterns. Simultaneously, to give further credence to sustainable practice, integrated power generation could cut away the carbon cost of the building's future lifecycle.

Houtan Park

Project three, Houtan Park, rests on a former waterfront brownfield site that has since been redeveloped into a park space and water filtration. system Completed in 2010, and designed by landscape architects Turenscape, the project completely transformed a former industrial waterfront in Shanghai, China, and transformed it back into a curated natural landscape for recreation. This project aimed to reintroduce access to the waterfront, and is a unique precedent because of the park's ability to positively benefit the surrounding ecosystem, by cleaning river water through a series of native plantings, while simultaneously being open for recreation.

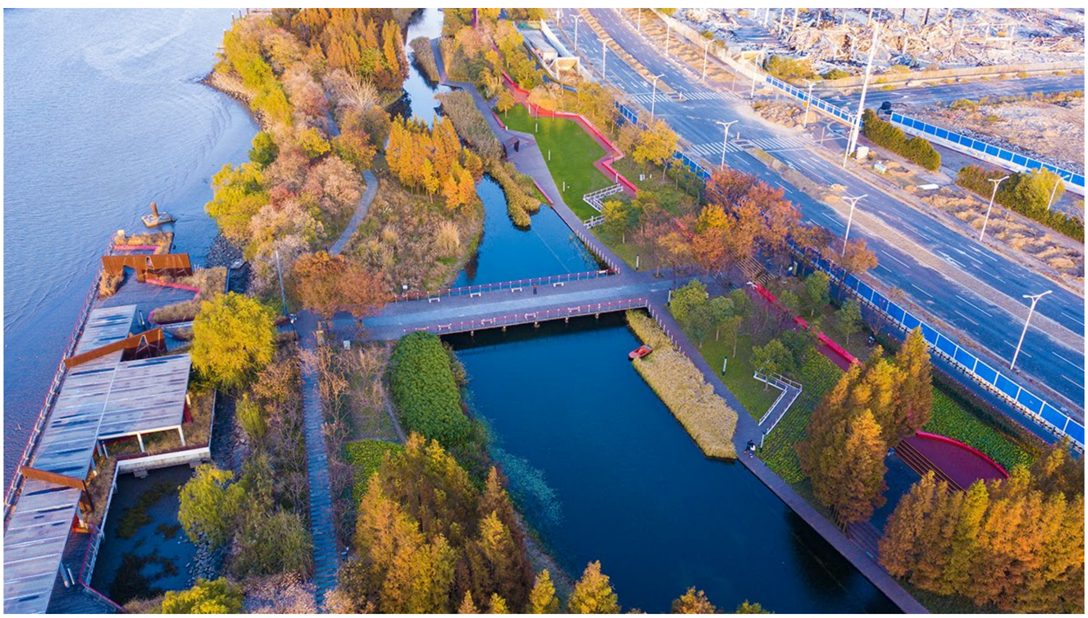

Fig. 15 Houtan Park, Shanghai, China. Image Credit: Turenscape

Given the park's riverfront location, it aims to promote a better relationship between humans and nature with its design intention. Man-made canals, slightly inland, direct in water from the Huangpu River. Footpaths sprawl alongside the man-made 'wetland', populated with native grasses that filter the water as it passes through, downstream. This canal with surrounding pathways provides a new place of habitat, particularly for the water's young fishes and riverside species, all while helping the filtration of the wider river and the education of the general public. Along this canal, there are many places for people to stop and educate themselves on the filtration process, while also enjoying views of the Huangpu River overlooking downtown Shanghai. This landscape design enables the integration of green infrastructure as a place of environmental restoration, and a recreational learning space.

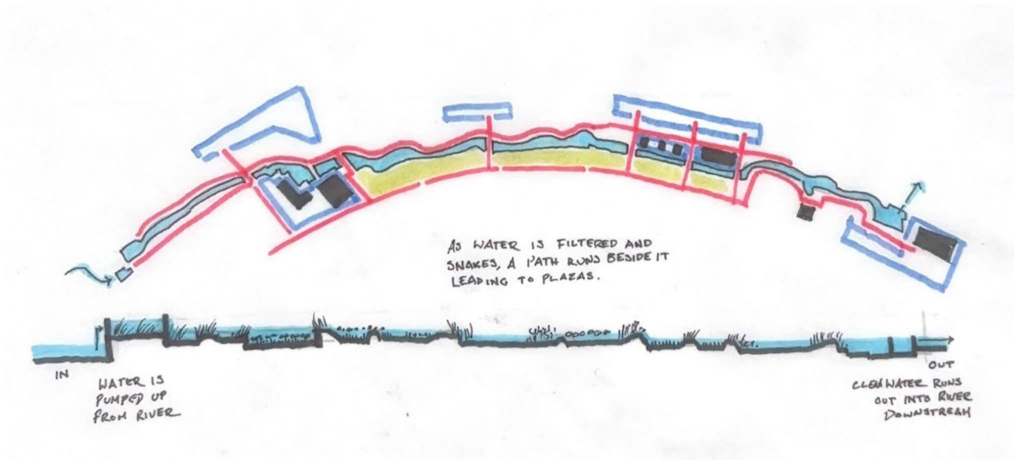

Fig. 16 Diagram that illustrates filtration section, and park circulation Image Credit: Author

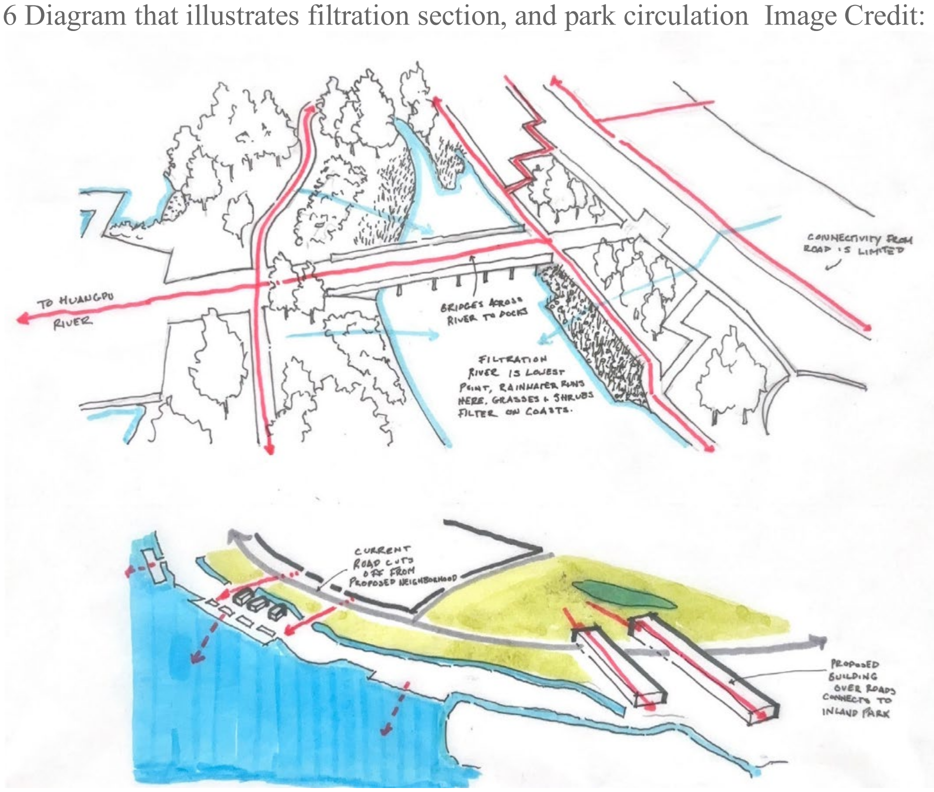

Fig. 17 Diagram representing circulation of water and people throughout the Park. Image Credit: Author

This precedent serves as a great example of environmental restoration that activates recreational function and provides a third space for the wider community at the waterfront, re-establishing the coast's importance. Having public space available at our coastlines will encourage gathering and provide the opportunity to host events that attract visitors and benefit the local community's publicity and economy. Incorporating this recreational functionality into an environmental restoration project creates a biophilic attraction for those who live in brownfield communities; places which are traditionally underserved and primarily industrial. When combined, the site is able to give back to the environment by cleaning water and providing shelter for animals, while establishing itself as a community center.

Tate Modern

The Tate Modern is a museum located in London, England, housed inside of what had formerly been Bankside Power Station. The power plant originally opened in 1963, but had been renovated to become the museum by 2000. The project, headed by Herzog & de Meuron, was a primarily interior renovation, aiming to conserve the exterior facade and structural elements, while entirely reprogramming the interior functions for. Given the building's location adjacent to the River Thames, the Tate Modern also created an opportunity to reactivate the waterfront in a space that had formerly been closed off to public access. All a part of a wider initiative to reclaim the River Thames for the public after industrial deterioration.

Fig. 18 Tate Modern, London, England. Image Credit: Herzog & de Meuron

To reactivate the waterfront, a plaza was built in front of the building to look outward onto the Thames River, and a bridge connects the museum across the river onto the boulevard to St. Paul's cathedral. With this intervention, the Tate became a destination, with the tower of the building appearing as the datum of this pathway, essentially becoming the anchor of the axis, and a place to congregate. When inside the building, the large lobby, 'Turbine Hall', is where the generators were once housed. This open space has visitors step down from the ground level, before being released into the grand space, creating a compressive to expansive spatial language that essentially acts as a portal into a civic space. Inside, lighting was installed to create a dynamic experience that can change based on installation and use.

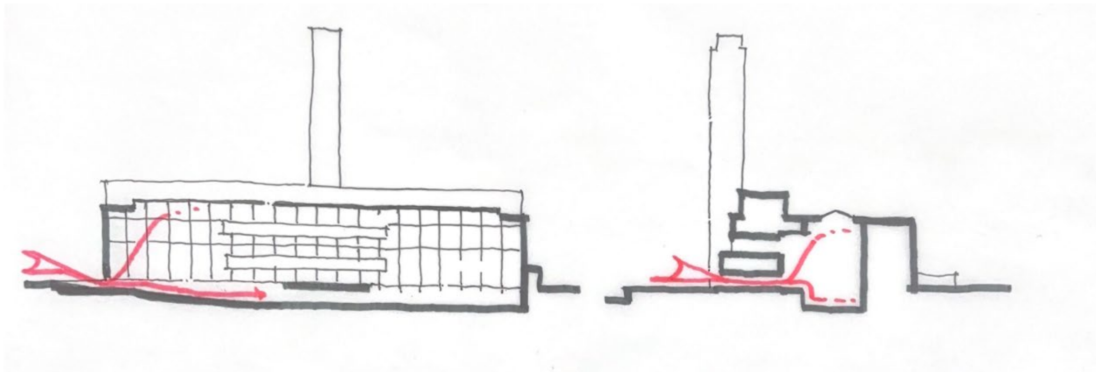

Fig. 19 Diagram showcasing compressive-expansion spatial relationship. Image Credit: Author

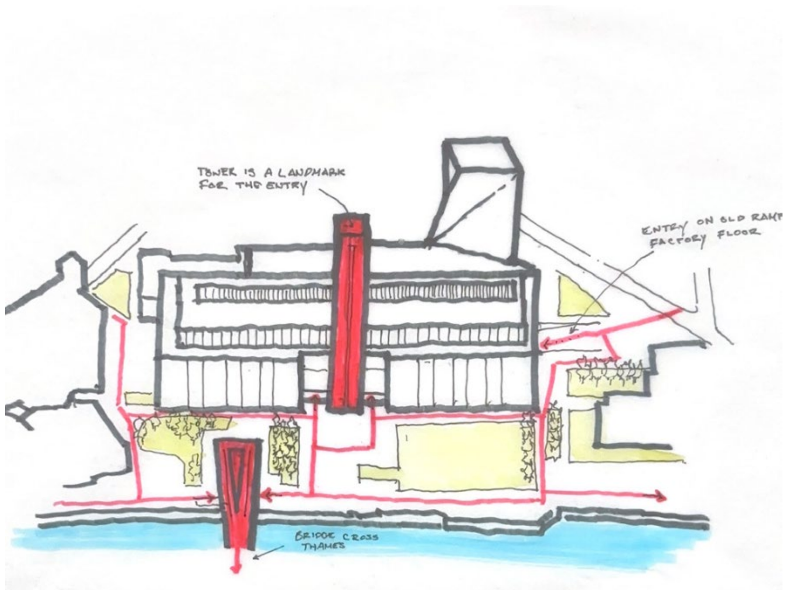

Fig. 20 Diagram circulation and wayfinding from the river. Image Credit: Author

This building's impeding silhouette serves as an important landmark in its local surroundings, and its positioning ensures an activated waterfront. Considering the surroundings of the brownfield is a vital part of the design solution to re-activate the waterfront. It is necessary to understand what connections can be made in its surroundings to make it a popular public space. This building's factory or powerplant typology makes it a great candidate for adaptive reuse projects. The existing building is overbuilt and often has much more life beyond its first program, and provides an open platform for both a unique environmental and spatial experience.

Unité d' Habitation

Lastly, the final precedent to cover is the Unité d' Habitation. The brainchild of a new housing typology created by Le Corbusier, the Unité aimed to revolutionize functionality in apartment housing. Located in Marseille, France, and completed in 1952, the building remains as a successful housing complex over 70 years later. Though this is not an adaptive reuse, nor is it on a brownfield site, this investigation primarily aimed to study the unique programming of the building and analyze the building's massing similarities to industrial architecture of the era.

Fig. 21 The Unité d' Habitation, Marseille, France. Image Credit: Denis Esakov

The building is raised up off the ground on piloti, to provide privacy for residents and encourage underneath as a communal gathering space. These piloti's forms are reminiscent of industrial architecture and the site-cast concrete utilized in typologies such as grain elevators and factories, something Le Corbusier admired in the engineering architecture which he had written about in his manifesto *Towards a New Architecture*. It sits on a plot with open gardens, and rises high above, creating a "tower in the garden" aesthetic that aims to withdraw living from dirtier urban environments.

Spatially this building utilizes unique strategies to hold its diverse programmatic functions. The apartments in this building rise two floors each to allow for air circulation with a hallway only on every other floor, which also would have enabled its modularity. The building holds multiple programs, which translate in the building facade materiality. The building acts almost like its own ecosystem, housing, retail, and communal spaces like a gym, pool, and clinics, all in one place.

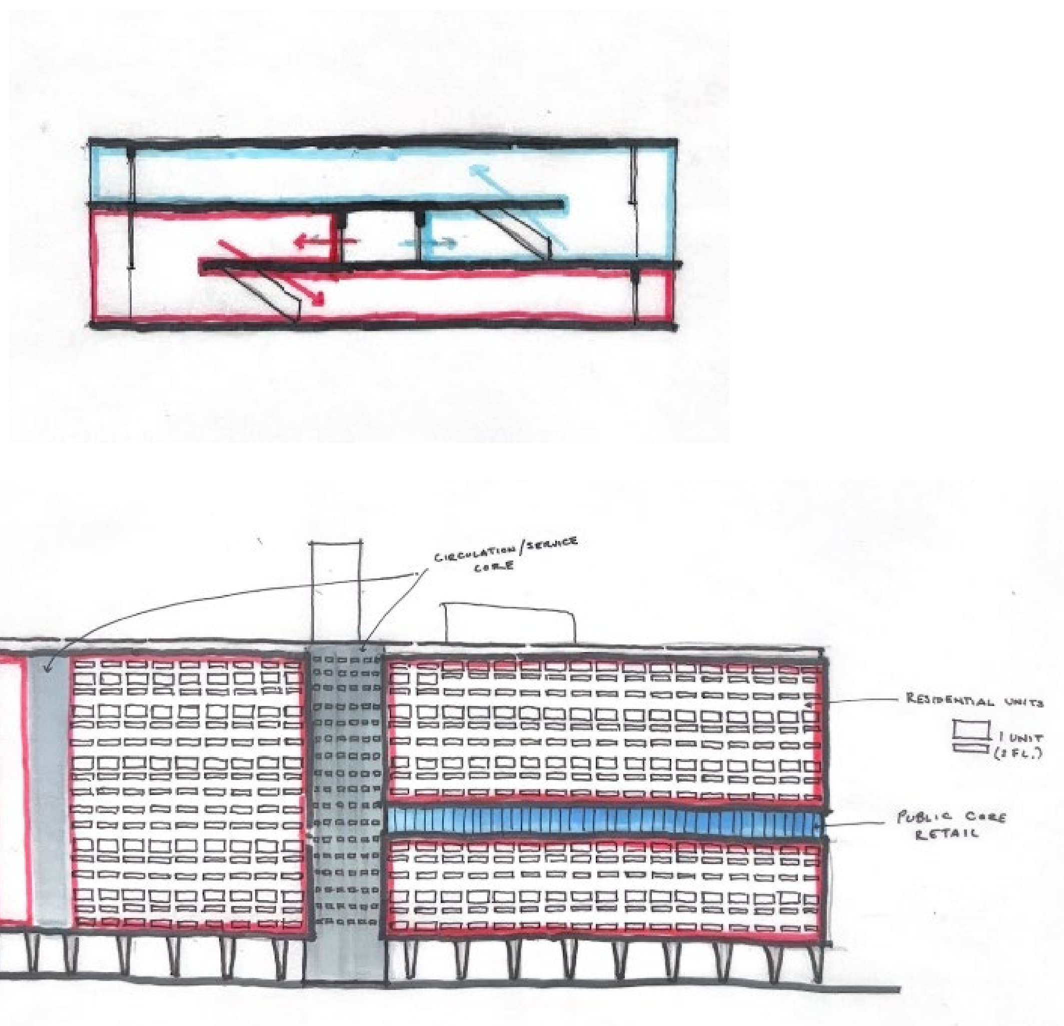

Fig. 22 An apartment section and building facade with functions labeled. Image Credit: Author

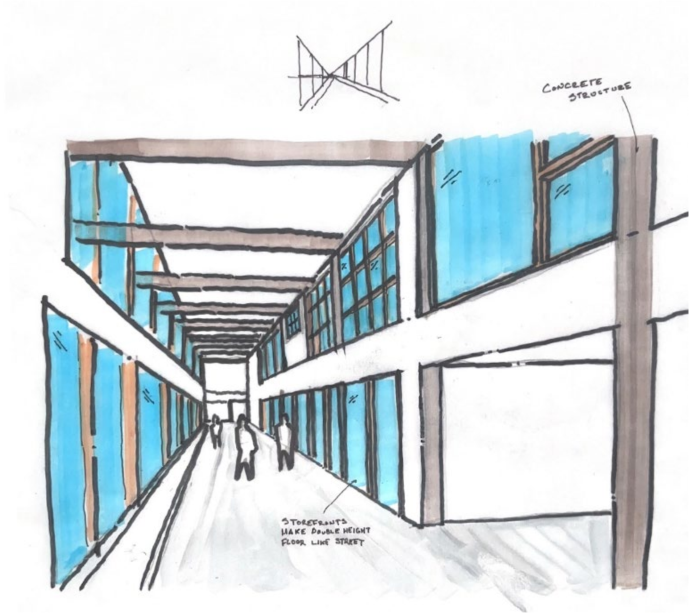

Fig. 23 A rendering of the double-height retail floor. Image Credit: Author

This building serves as an important precedent because it is mixed use, housing apartments, retail, and other community functions. Communities surrounding brownfields are typically underdeveloped, so incorporating a multi-use program into the thesis will be vital to its outreach to the community and making it a more resilient place. The unique spatial layout of the Unité d' Habitation's apartments could be adjusted to take advantage of passive environmental strategies to lower cooling costs and increase comfort. Additionally, this 'tower in a garden' typology could serve as inspiration for a repurposed industrial building in the middle of revitalized wetlands.

Conclusion

In conclusion, the exploration of these precedents served to provide a better understanding of the available strategies that can be employed in directing the waterfront brownfield redevelopment for this thesis. These projects suggested the important benefits of maintaining historical architecture, and how history can be integrated with new architectural and programmatic needs, with tectonics and materiality. Additionally, these precedents proposed different spatial moves to adjust for building programming in adaptive reuse projects; intervention can be made with additive, subtractive, parasitic methodology if the current bounds of the building cannot satisfy the needs. Finally, these investigations demonstrated how sustainable practice and environmental restoration can be used to provide not just humans, but giving back to our natural environment.

Chapter 5: Building Zones & Program

Introduction

Brownfields have been a blight for the health and development of surrounding neighborhoods and nature. On-site waste, pollutants in the earth from industrial byproducts, as well as polluted runoff all negatively affect the health and safety of surrounding residents and natural habitats. This is not an isolated issue, in the United States, there is a brownfield within 3 miles of over 144 million people today. With more general environmental challenges such as climate change, as well as social challenges like the national housing crisis, and years of local disinvestment, a program must be put forward to repurpose these sites to better serve our built and natural environments.

Manufacturing Change will help create a more resilient community that revitalizes the built and natural environment in and surrounding a waterfront brownfield site. The project's program aims to address past habitat destruction, reinforce community resiliency, and reinvigorate the community beyond the site. For the brownfield redevelopment to be a fulfilling solution, the program will need to house retail, community needs, and residential apartments in an adaptively-reused building with surrounding outdoor leisure space. All of these elements will all be necessary to help residents find comfort, identity, and convenience when living or visiting there.

Project Zones

To begin reconciling past damage to the landscape, prepare for current and future environmental challenges, and to reach the goal of being an aide to community resilience, the program must integrate multiple levels of natural and built intervention.. This integration should be woven throughout the reclaimed natural landscape and adaptively-reused buildings. If all these program elements are met, this project could become a benchmark of planning design, encouraging multi-use sustainable function to reinvigorate past industrial hubs, over the environmental destruction and sprawl often associated with typical suburban neighborhoods.

Fig. 24 Diagram representing the main programmatic goals of the project. Image Credit: Author

The programming specifics of the thesis project aims to adapt to the community needs surrounding the site, but all actions will circulate around five programmatic pillars to redevelop the waterfront brownfield. The program is divided into these directions based on activities that take place within the type of space. These pillars include Gather, which focuses on social and environmental habitat. Create, which centers on developing a waterfront and community amenities. Living, which focuses on establishing a residential environment that is responsive to regional culture. Place, which focuses on instilling public spaces that are able to showcase cultural pride. Finally, Connection establishes the infrastructure necessary for people to connect with nature and bridge the neighborhood to the site. The following section will delve into the specifics on which each pillar entails for the project.

Gather

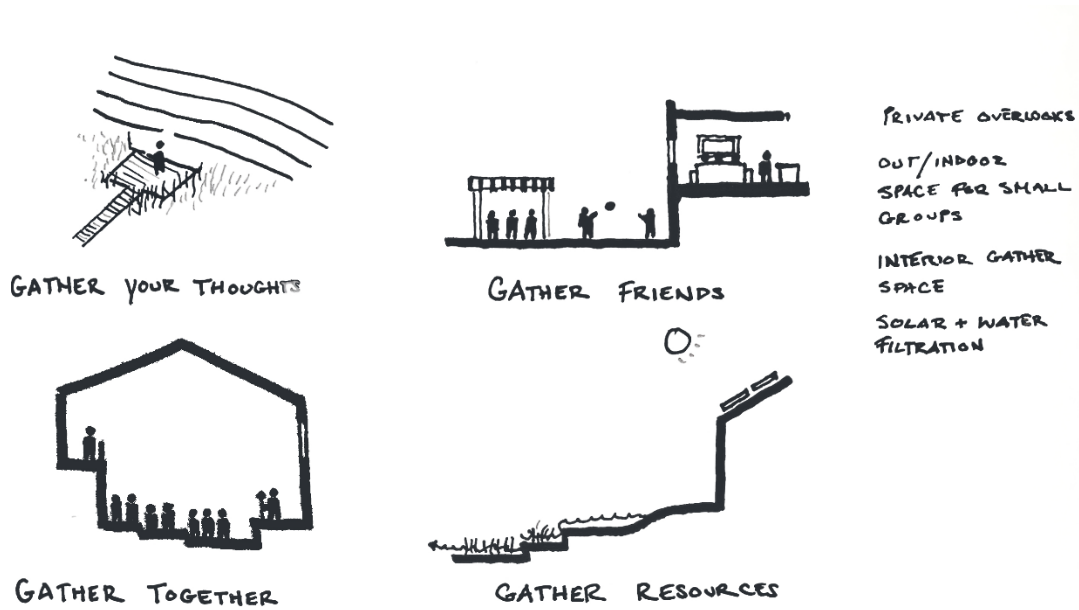

Fig. 25 Diagram representing key elements of the 'Gather' program pillar. Image Credit: Author

The Gather category seeks to bring people and resources together to make a stronger social and environmental habitat. To achieve this, the project must provide a variety of spaces for gathering people together, with attractions or spatial qualities to make them uniquely attractive. Additionally, the gathering of resources, such as power and water through the utilization of integrated systems and green infrastructure will enable the community's ability to be more resilient and sustainable in the face of environmental pressures. This section will focus on the elements necessitated to achieve a place of gathering.

A pavilion will provide a large indoor and outdoor meeting space separate from the adapted industrial building to host events and outreach in order to gather the local community and attract visitors. Ideally, it would be positioned between the converted building and the surrounding community, acting as a gateway that uses the industrial building as a backdrop. When not used by larger organizations for events, it can become a place for family gatherings and day-to-day lounging.

Water and energy treatment facilities will also need spaces on site. This space will be reserved for the technical functions of gathering solar and water harvesting. They could be integrated into the adapted building or built out separately. This space would support the solar array by housing the system's inverter and battery. Another space could house graywater collection/filtration. If the water and energy systems are visible to the public realm, it can become an educational opportunity, and environmental attraction while maintaining a commitment to sustainable practice. Additional outdoor spaces, including a rooftop deck, will become a place for residents to gather, and a space to house the intake of the project's solar and water capability. The roof will have a solar farm, if space is available, the rooftop can also serve as an amenity sitting space for residents.

Create

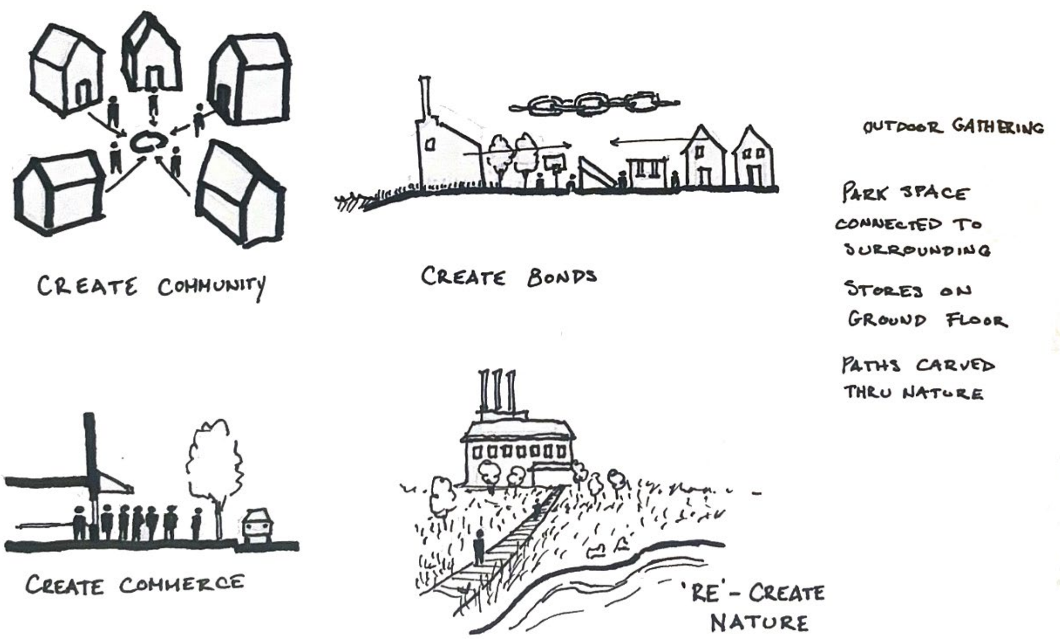

Fig. 26 Diagram representing key elements of the 'Create' program pillar. Image Credit: Author

The Create pillar aims to restore waterfront access for the community that has been lost since the region's industrialization. The redevelopment of a brownfield into a manicured landscape for recreation and habitation aims to emulate a natural environment and provide biophilia in a predominantly built-environment. Additionally, this project aims to create new resources to satisfy the modern needs of nearby residents, bolstering community resiliency. This pillar will require mixed use programming in order to provide utilities outside of residential use.

Amenity spaces will provide building residents to receive the amenities expected from a modern apartment building in the adaptive reuse building. To make the adaptive reuse an attractive residential property in the community, it will be important to provide spaces not available in the neighborhood. Spaces will include, gym, spa, and pool and be private for residents. To supplement the wider needs of the community, a public community center will provide similar amenities, with a larger focus on outreach; including a library, and food pantry. These two will work together to create solutions for things the surrounding region falls short in; fitness, education, outreach. The size and need may be dependent on the existing accessibility to a community center off-site.

Outside the building, regenerated wetlands will re-create a more natural environment that can reintroduce habitat for at-risk species, and create a more resilient shoreline in the face of climate uncertainty.. This will play a part of a wider stormwater management plan bolstered by bioswales, raingardens, and permeable surfaces. Alongside this development, pathways and playgrounds can create a connection to the surrounding community, providing a place of recreation providing a recreational green space in the urban surroundings.

<u>*Living*</u>

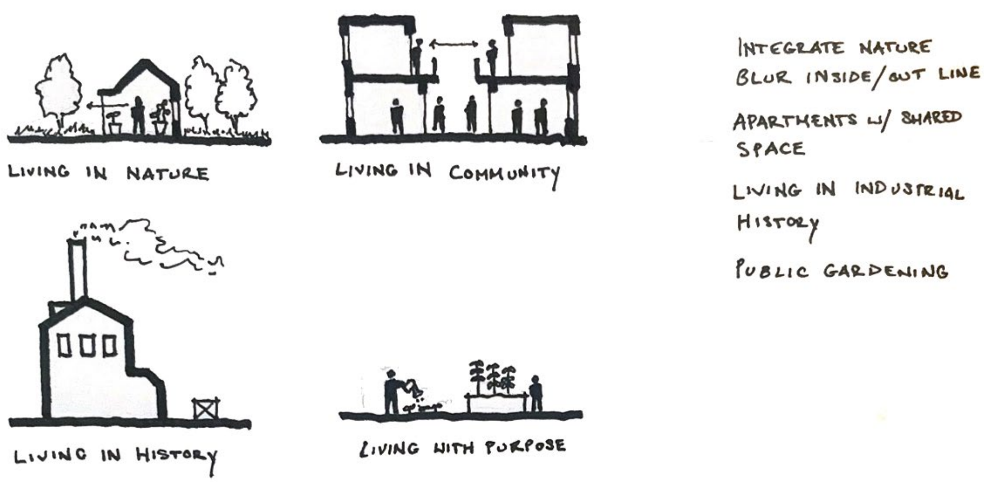

Fig. 27 Diagram representing key elements of the 'Living' program pillar. Image Credit: Author

The Living pillar provides a smarter way of residential planning and living. Instead of investing in continuous sprawl, redevelopment will create a cultural pride about living in a space vital to regional industrial history. Redevelopment should give residents and visitors an opportunity to educate themselves and get involved in giving back to their community, to create a sense of purpose in their living.

The adaptive reuse should create apartments. This space will create a new place to live, to help assist in alleviating a limited housing market. Sizing will be partially dependent on the existing building. Ideally, the apartments will be equivalent to a midsized apartment building, 20+ units to make it economically viable. There would be a range of unit types to best fit the needs of the neighborhood. (Studio ~500sf, 1 bed ~750sf, 2 bed ~1000sf, 3 bed ~1350sf, 4 bed ~1650sf). Historical preservation must be undertaken to create the dynamic of living alongside history. This element is vital to the appeal of this adaptive reuse project, particularly to maintain a cultural identity. This dedication to preservation will include information about the history of the region and house artifacts from the site.

Outside, among the landscape, providing a garden for growing organic foods for the community develops a sense of personal purpose and impact on the local community. People will be able to work in it to help themselves and others, strengthening neighborly bonds. This is especially important for underprivileged communities surrounding brownfields where perceived stigmas, limits economic investment.

Place

Fig. 28 Diagram representing key elements of the 'Place' program pillar. Image Credit: Author

The Place category instills a sense of usefulness and cultural pride into the once abandoned site. By providing public spaces that invite the community in, creating economic activity, and community services, people will be able to recognize the building as a central landmark in their neighborhood. The restoration of a historic building via adaptive reuse, creates an industrial pride in what their community has created, and a sense of feeling for the place. This step is vital to spawning future redevelopment, to create a character distinct to that region.

Commercial space to house retail opportunities will help create the former brownfield into a place with much to offer, a destination for people in and outside the community. This space will be partially dependent on the existing building spatially, and the needs of the community for the businesses that will make it up. It is a rentable space that shop owners can rent to sell their product. Spaces should be able to be fitted out for tenants, or at least a variety of spaces must be available. Ideally would house cafes, boutiques, and a small store for the people that live there.

Entry Plaza An entry to the property, to distinguish it as an important place in the community. An entry plaza would allow for assembly space for people to gather together and enjoy the public resources available. It can also act as a landmark in the community via a statue/fountain/or interactive public art piece.

Connect

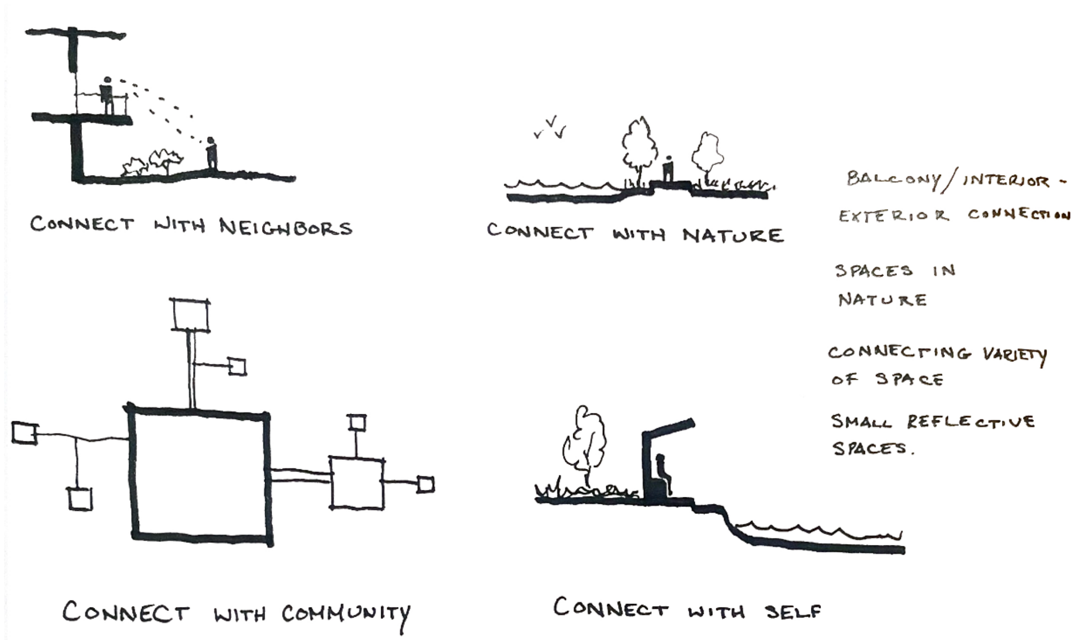

Fig. 29 Diagram representing key elements of the 'Connect' program pillar. Image Credit: Author

The connection pillar aims to establish a reconnection to the surrounding community with the former brownfield and connect people with the natural environment. On-site, spaces will be created to foster connection between one another and nature. The remediation of the site and creation of a manicured environment will also reconnect the site to the natural processes of nature and estuary. Providing the utilities for transit on-site also encourages a connection with the community and encourages healthy movement. Incorporating reflective spaces on-site will allow for self-reflection and encourages a personal connection to the surrounding nature. These small spaces will only be large enough for a couple of people together, similar in size to bird blinds, to ensure an intimate feeling and connection with nature in an urban environment. These spaces will be flexible to provide a space for working-from home, or a gathering space for small groups. This can be a part of a wider outdoor learning experience which will help educate people on the clean-up process involved on the site and help them feel more with nature. There will be details about the plants and animals living in the new habitat, seen with posted signs on the paths that carve through the landscape.

There must be a way for people to arrive on-site, connecting the site to the wider neighborhood. By providing space for bike parking and its integration into the site, the building encourages more healthy movement. Given site conditions that may not enable parking on-site, and limited street parking, it is important to provide the infrastructure necessary for other methods of available transportation.

Conclusion

This thesis' programming transforms a waterfront industrial brownfield into a resilient community-centered environment by utilizing these five distinct categories of programming; Gather, Create, Living, Place, and Connection. Together these pillars aim to restore ecological function, reintroduce a waterfront connection, and introduce community-centric amenities that support long term success and investment in the neighborhood. Public spaces, including a pavilion, garden, regenerated native environment, paired with integrated energy and water systems frame the redevelopment as a place of recreation and education, while making air and water quality better. Simultaneously, the mixed-use functionality of the adaptive reuse provides new housing opportunities with modern amenities, retail, and community needs, to neglected communities, while preserving a local industrial heritage. Collectively, these interventions produce a vibrant destination that focuses on environmental stewardship while establishing a cultural identity to support an enduring neighborhood revitalization.

Chapter 6: Site Selection & Analysis

Role of Site

Site selection plays a vital role in adjusting the specific attributes and goals for any adaptive reuse of waterfront brownfields, *Manufacturing Change* is no different, and the site-specifics came to drive much of the project development. To determine a site's ability to be redeveloped, a checklist of requirements were developed for both the site itself, as well as external factors beyond the site constraints. On-site, elements such as the prior contamination, existing building conditions, and site size were considered due to their impact on the approach of the architectural intervention and landscape restoration undertaken. Meanwhile, off-site elements also had determining impacts on the project; the neighborhood of the site, the history of that place, and the needs of the general public in that place impacted the programmatic use and the overall goals of the project. All of these elements play an effect in the transformation of a waterfront brownfield into a successful property; and the following paragraphs will go into specifics as to what was important in selecting the site for this thesis.

Since *Manufacturing Change* aimed to restitch a waterfront brownfield site while utilizing adaptive reuse as well as environmental restoration; the search for the site was immediately limited to the coastlines of formerly industrial port cities. For on-site specifics; given the requirement of adaptive reuse, the site needed to have an existing building or structure left undemolished, as it would be utilized in some capacity for the final project. In addition to this, the existing derelict building or structure would ideally contain historic architectural or industrial features that could be preserved, to help reinforce an industrial heritage for the community. The scale of the project was determined by site restrictions and existing building conditions; a project done in a former powerplant would be a lot larger than one done in a former single-story pier or warehouse. With this said, both were still viable targets for redevelopment given their industrial roots and architectural viability. Off-site considerations were also important to determine a site given the wider impact the waterfront redevelopment project could have. Accessibility was a primary element to be considered. How accessible is the site to the neighborhood? What is the existing transit infrastructure? Was the site historically accessed by the public? Were all questions heavily considered.

Selection Criteria

Setting out a specific criteria helped ensure a more qualified site to create a more successful adaptive reuse of a waterfront brownfield. To best test the research conducted with this thesis, there was a framework developed to find the sites with the best opportunities to reconnect urban waterfronts to their wider communities. The following four main pillars were distilled from the previous paragraph, and were all necessary for the sites considered:

- Brownfield site (Former commercial or industrial use)
    - Located in historic port cities from the early 20th century.
    - Direct waterfront access on at least one side.
- Viability of urban context
    - Accessibility to the site from the local neighborhood.
    - Existing transit infrastructure.
    - Deep neighborhood history and evolution.
- Existing buildings on-site
    - The existing building has historic value in industry to promote regional industrial heritage.
    - The existing building is made of carbon/energy heavy materials to reutilize in adaptive reuse.
- Site large enough for landscaping opportunities
    - Space for environmental restoration at shoreline.

- Space for outdoor intervention to provide public space.

Methodologies Utilized

Using the framework specified above, to find sites that fit the requirements of the thesis, mapping software and satellite imagery from sources like Google Earth were initially utilized to begin locating viable abandoned waterfront brownfields. To narrow the region of search, only cities in the Northeast and Rust Belt were considered due to a higher concentration of reported brownfield sites in the region. After searching, a shortlist of ten properties were selected, where further research into the location, population, site size, building typology, cultural significance, accessibility, and other visual qualities were then considered for each individual property.

After this research cycle and interviews with the thesis chair, thesis partners, and an environmental restoration specialist, it was determined that the Red Hook Grain Elevator in Red Hook Brooklyn, NY would be the most fitting candidate for transformation. This site provides an opportunity to restore waterfront access in one of New York’s most infamously disconnected neighborhoods; through a notorious ‘landmark’ that has been standing abandoned and unoccupiable for over 60 years.

Fig. 30 Location map of the Red Hook neighborhood (highlighted in red) in wider Brooklyn, NY Image Credit: Author

Fig. 31 Location of the Red Hook Grain Terminal (highlighted in red) in the Red Hook neighborhood. Image Credit: Author

The grain terminal sits right on the water, with the Gowanus Bay to the South and flanked by the Henry Street Basin to the East, which creates a protected water area. This property provides an opportunity to drive the development of a neighborhood that is in transition; evolving from heavy industrial roots to a place with more light industry and residential space. It was decided figurally, what better way than by restoring what had been part of a generator for livelihoods in the past for today's demands.

Chapter 7: Conceptual Testing

Introduction

With Red Hook Grain Terminal selected, further exploration into the building and region informed many decisions in the thesis' design development. Site analysis aimed to uncover how the site could be restitched to the existing conditions of Red Hook. Additionally, this research helped uncover a better understanding of the needs of the community and helped influence further development into the programming the building would cater to. Finally, understanding the building's specific history and materiality influenced the methodology of interventions that the project would cover, particularly in its massing and tectonic makeup. This section aims to provide wider context into the decisions made during design development

Site Analysis: History

With the site selected, further historical site analysis was conducted aimed to reveal the site's history and connectivity to the surrounding community. It was discovered that this site was historically utilized for grain storage, and has been used more recently as vehicle storage. This helped clarify the limited need for remediation, given a lack of heavy production industry on-site.

The existing building at 699 Columbia St, Brooklyn, NY is known commonly as the Red Hook Grain Terminal, constructed in 1922, as part of wider development on the

Gowanus Bay and Canal. During that era, the region was a bustling shipping hub, and the terminal was built to store grain for transit coming through the city.

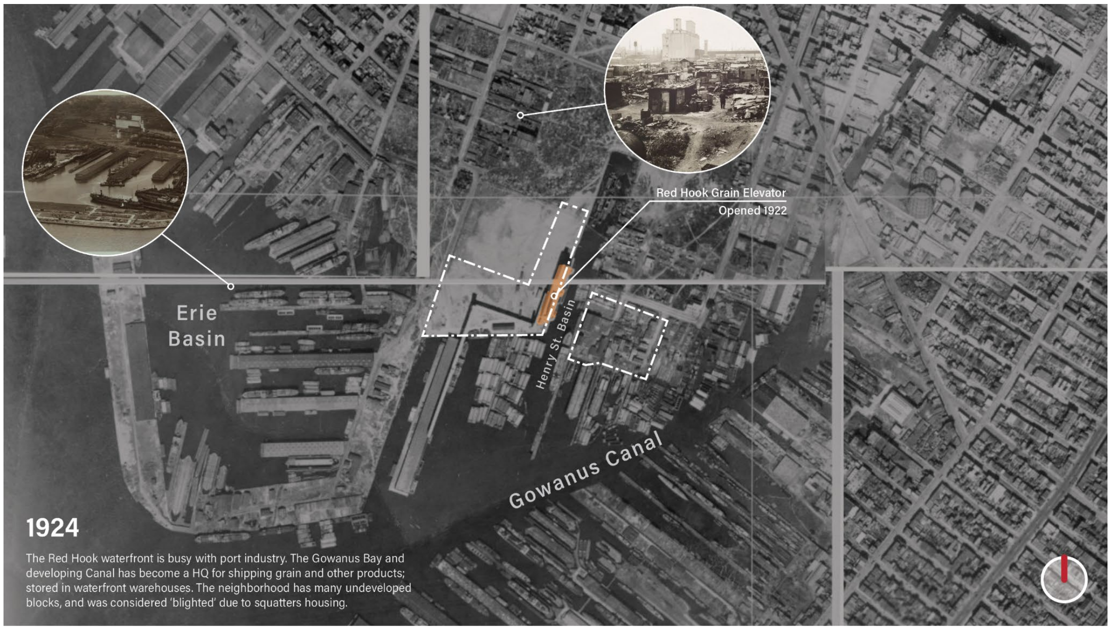

Fig. 32 Historic Aerial Imagery of the region (1924) Note the industrial development on the canal and the still developing grid in the surrounding neighborhood. Image Credit: Author

The grain terminal as well as a strong port economy initially spurred further development in the neighborhood, particularly in the 1930s and 40s. In this time, the Red Hook Recreation Center, Red Hook Homes, and Red Hook Park, Smith 9th Street, and the Gowanus Expressway were constructed under the direction of Robert Moses. Though this development provided housing, this development also ended up severing the neighborhood from the rest of the city, as the subway system was not extended into Red Hook, and the Gowanus Expressway interrupted the urban fabric between Red Hook and Carroll Gardens. The decisions made during this time still have long term implications, as Red Hook Homes remains a large part of the building stock in the neighborhood, despite its age. Additionally, the large plots of land given to Red Hook Park at this time made it impossible to continue the gridded development through it that is seen elsewhere in the neighborhood.

Despite this development in the surrounding neighborhood, the grain terminal itself was quickly showing signs of trouble. In 1944, the grain terminal's ownership was transferred to the New York Port Authority, given that it had struggled to make profit. The extensive complex was overkill in capacity, and loading grain here was much more expensive than other port cities, making it difficult to pull in barges who could go elsewhere.

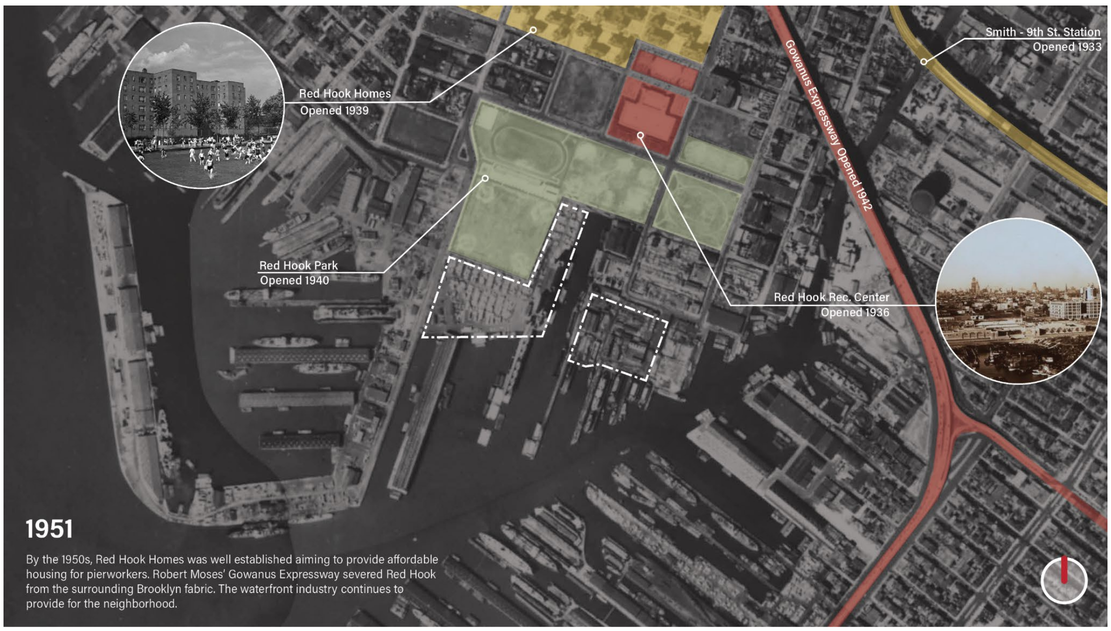

Fig. 33 Historic Aerial Imagery of the region (1951). Note the development of land to the north of the site, transformed into Red Hook Park. Image Credit: Author

As deindustrialization took place across the country, Red Hook was not spared by the departing industry. In 1965, the Red Hook Grain Terminal permanently closed, as it never was able to become a successful economic endeavor. By the end of the 20th century a majority of the port industry in the neighborhood was gone; leaving behind waterfront brownfields that prevented waterfront accessibility. From the lack of connectivity to the water and to the wider city, as well as the lack of opportunities for work within the confines of Red Hook, the neighborhood's population declined, and crime spiked.

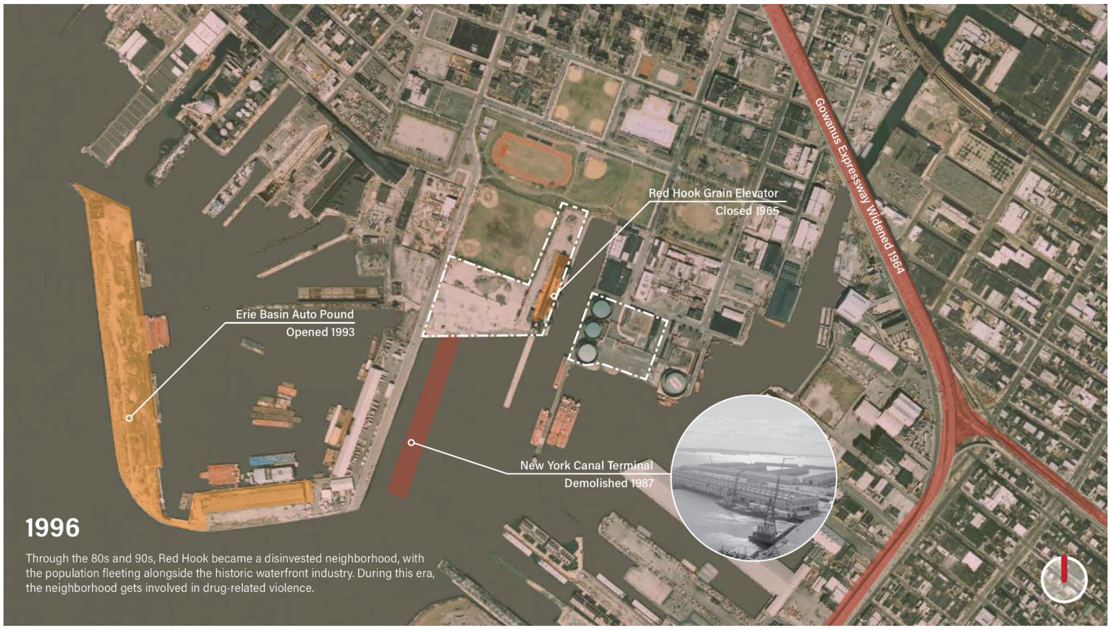

Fig. 34 Satellite Imagery of the region (1996). Note the demolition of most waterfront industries, the abandonment of the Grain Terminal in 1965. Image Credit: Author

Since the end of the 20th century, it seems the neighborhood has been in a phase of transition. New light industry and commercial development has provided opportunities for new jobs and amenities that residents can utilize; including places like the local IKEA and supermarket. This new development legitimizes *Manufacturing Change's* ambition to add additional residential building stock, and small commercial space, to encourage further development and resettling of the neighborhood's waterfront to hopefully increase the neighborhood's viability as a place to live, and general connectivity.

Fig. 35 Satellite Imagery of the region (2010). Note the development of some waterfront property, primarily the Columbia Street Esplanade; as well as commercial buildings. Image Credit: Author

Fig. 36 Satellite Imagery of the region (2024). Note the further development of light industry in the neighborhood. Image Credit: Author

<u>Site Analysis: Connectivity</u>

An in-person site visit and further analysis also revealed that the site is largely disconnected from the wide-reaching New York City subway and bus routes. The nearest transit station is the bus station at Otsego Road, 0.33 miles from the building. The closest transit infrastructure available for the site is a shared bike lane on Columbia Road, which passes directly next to the site. To improve connectivity, it became evident that the building program should provide facilities for bike storage and that site strategies would aim to transform the revamped terminal into a node for local travel. Site strategies would aim to further a connection along the water to the neighboring Esplanade, west of Columbia Road, and connect inland by foot and bike to the Red Hook Park north of the site.

Fig. 37 Existing Transit Access. Image Credit: Author

Fig. 38 The disconnection of the Red Hook neighborhood from the waterfront via industrial land, and from wider Brooklyn via the raised Gowanus Expressway. Image Credit: Author

Building Analysis

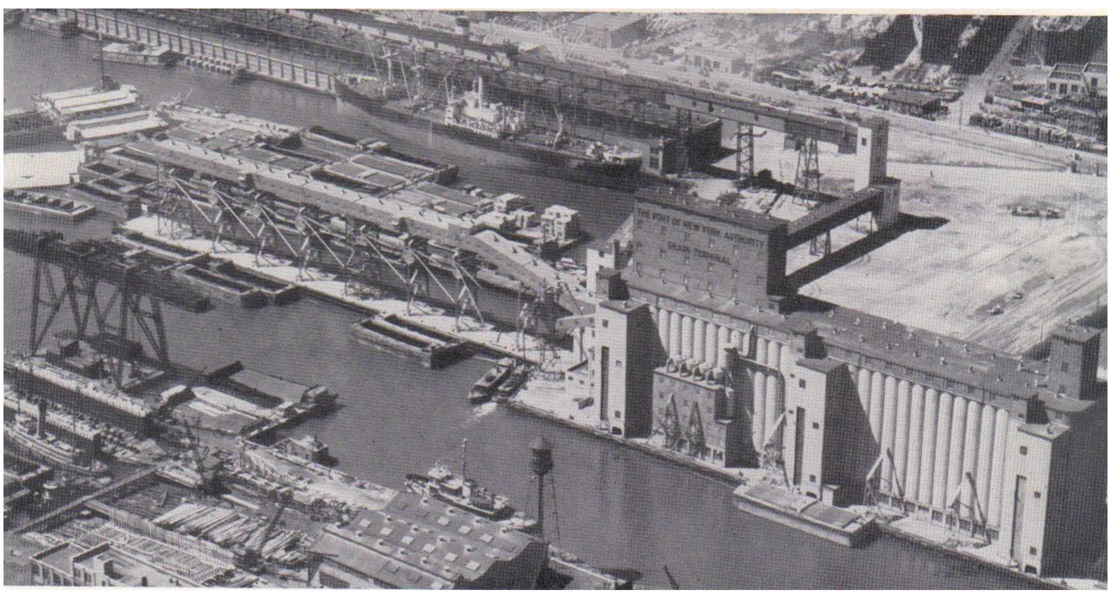

Fig. 39 Red Hook Grain Terminal as it appeared in the 1940s. Image Credit: Montclair State University.

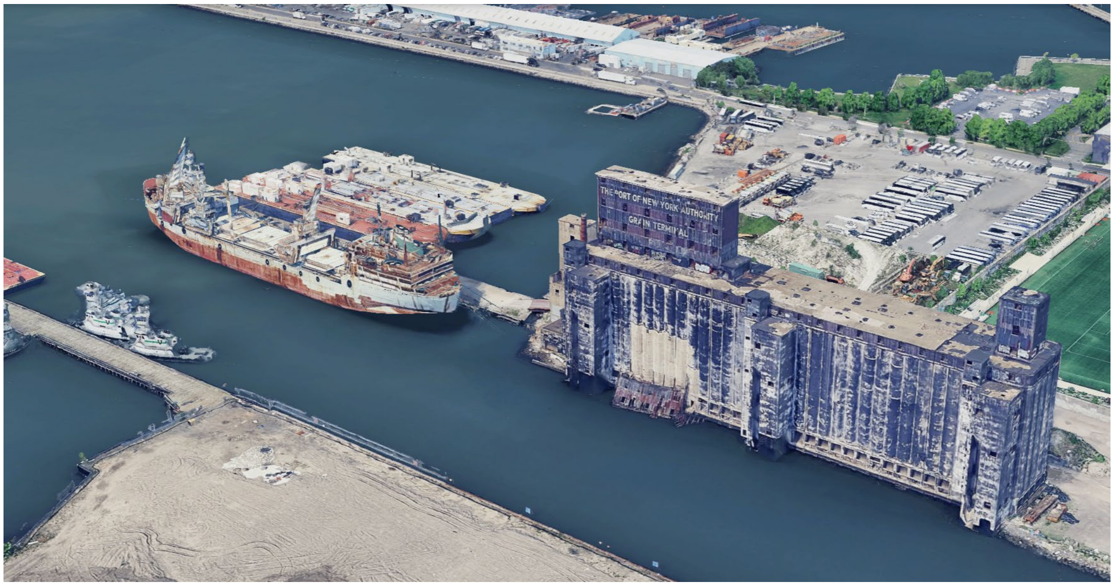

Fig. 40 Red Hook Grain Terminal as it appears in the present. Image Credit: Google Earth.

With the site location better understood, further understanding of the building composition was necessary to make interventions possible. The building was constructed utilizing slip-form concrete, a process where concrete is poured in formwork, cured, then the formwork was pressed upward with jacks to then complete another segment. This construction type allows for continuous, jointless concrete silos, which became popular to prevent fires and explosions from grain dust build-up. This terminal was constructed in less than a year, with 8” reinforced concrete walls. This structural understanding informed the design language of the project, essentially putting extractive moves at the forefront of design, as openings could be cut into the continuous forms.

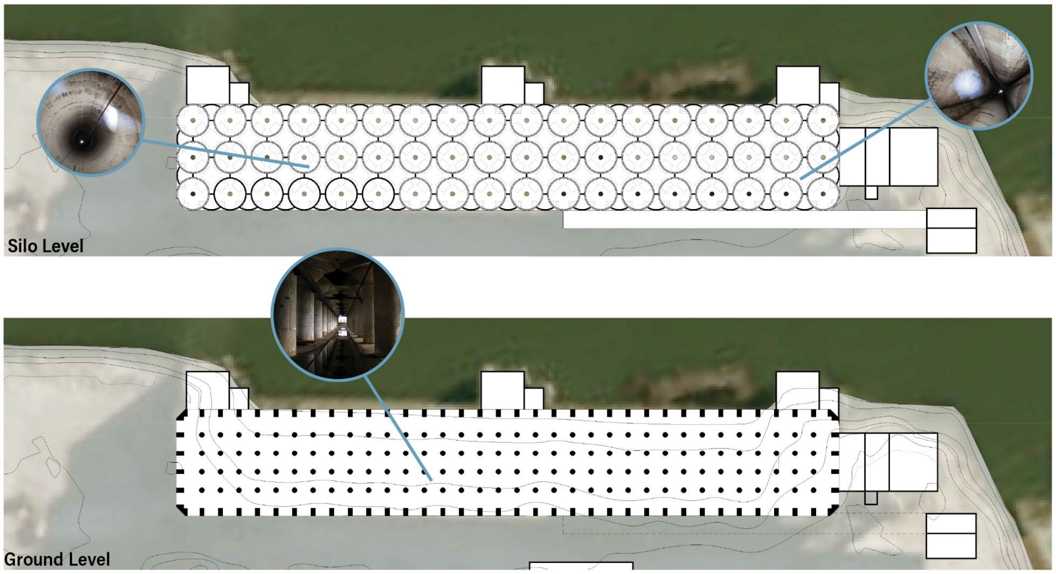

Fig. 41 Approximate existing plan conditions with on-site photos. Image Credit: Author

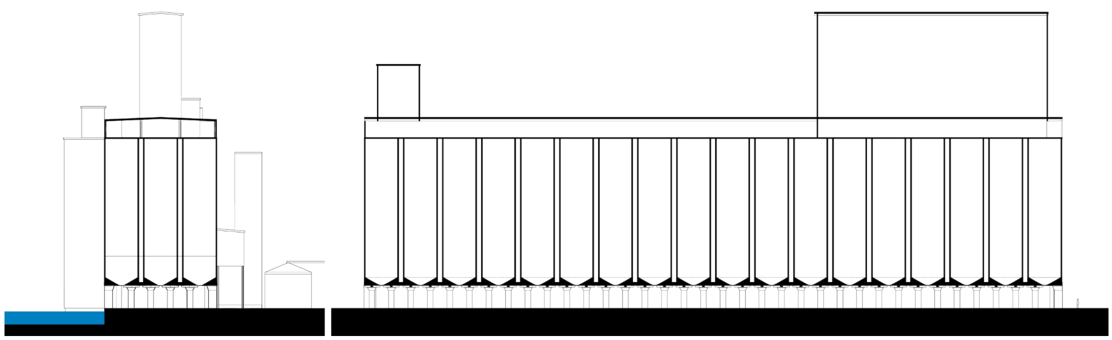

Fig. 42 Existing Condition of Red Hook Grain Elevator seen in section. Note that there are no floors in the existing silos. Image Credit: Author

Massing Evolution

The existing massing of the terminal has a repetitive rounded concrete facade, formed from the full silos, with smaller ones scalloping in-between them. Given that the grain terminal is entirely solid concrete formwork, openings must be made to provide natural light and vistas outwards towards the city and surrounding waters, and to create larger spaces than the ~20’ diameter silos. To begin to experiment with massing, a variety of massing studies were conducted utilizing 3d modeling software and physical modelmaking. The initial set of studies focused on three major design moves, a central subtractive strategy which put large “windows” through the building where new structure would be visible. A stepping strategy that stepped upwards from the north side of the building, towards the water. And a third “wave” strategy that aimed to create a central opening for a marketplace, but silos were cut at different heights to mimic a wave form.

Fig. 43 Initial massing studies (from left to right) the existing condition, central subtractive strategy, stepping subtractive strategy, “wave” form strategy. Image Credit: Author

From these studies, an aggregate of successful massing elements were utilized to influence a new round of larger massing models. At this point, it was decided that some of the half silos in-between each full silo would be demolished to accentuate the industrial nature of the building, and its unique fluted formology. Additionally, it became evident that a saddle-bag form would be added on regions of the building where programming like apartments, the community center, and the library would be added, to provide additional square footage and outward views. At this time, it was determined that the project would focus on housing a community center, residences, a marketplace, retail units, and an art gallery.

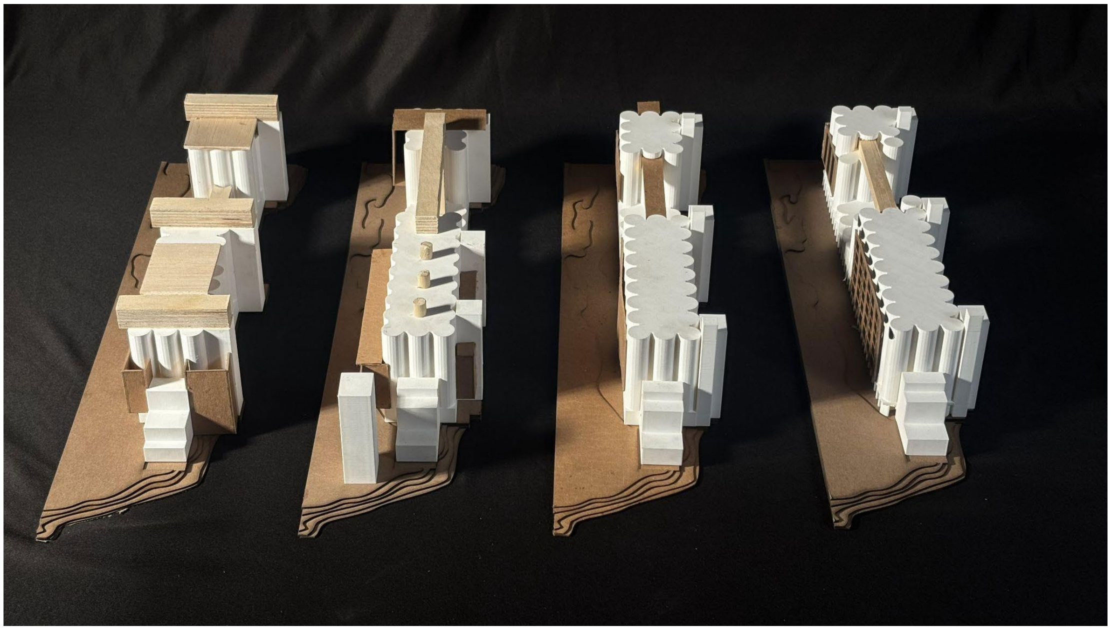

Fig. 44 Further massing studies shaped programming requirements. Image Credit: Author

The final massing strategy made way for the final programming of the building and essentially split the existing structure into thirds to accommodate for different functionality. Facing the north of the site, and towards the city sat the “community” wing of the building, making it a destination connecting visually with the existing park and Red Hook Recreation Center. This section of the building would house an art gallery, a library, and community rooms. Embedded in the center of the structure, would be the marketplace, accessible on the ground level, and leading through the building west to east. The south part of the building would be committed to housing, residences, including flats and lofts were to be located here, to look back towards the city and Gowanus Bay.

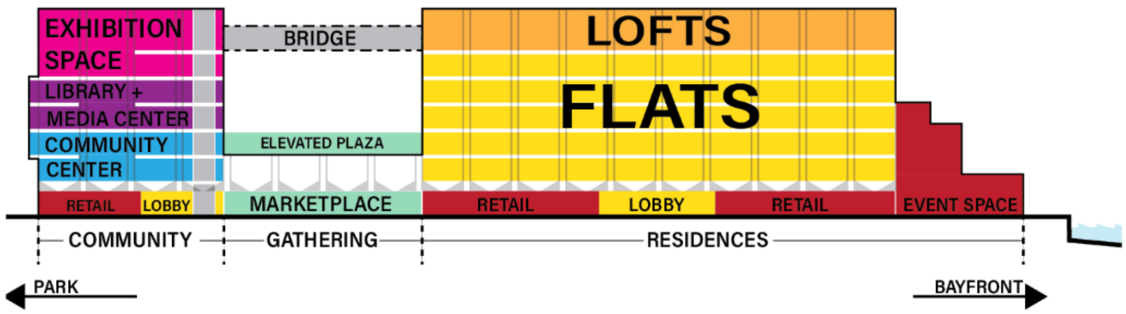

Fig. 45 Existing Condition of Red Hook Grain Elevator seen in section. Note that there are no floors in the existing silos. Image Credit: Author

The final massing strategy reflected the programmatic diagram above. As seen in the figure below, to enable the insertion of floors into the silos above, and to reveal the fluted industrial form, the first step 'Figural Reveal' aimed to achieve just that. Next, in the 'Program Division' step, to split the Community function from the Residential function, a part of the silos above the marketplace are mostly removed. This step aims to direct attention to the marketplace on the ground floor by breaking up the facade, and to provide an outdoor terrace for visitors and residents alike. Next, 'Program Additions' adds on extra square footage for the apartments and community center, also providing a stronger insulative envelope in sensitive living areas. Next, 'New Circulation' adds a bridge connecting the community tower with the residential part of the building, and adds a new elevator tower to meet modern egress requirements. Lastly, 'New Lighting' is added to create overhead skylights, increasing daylighting capabilities.

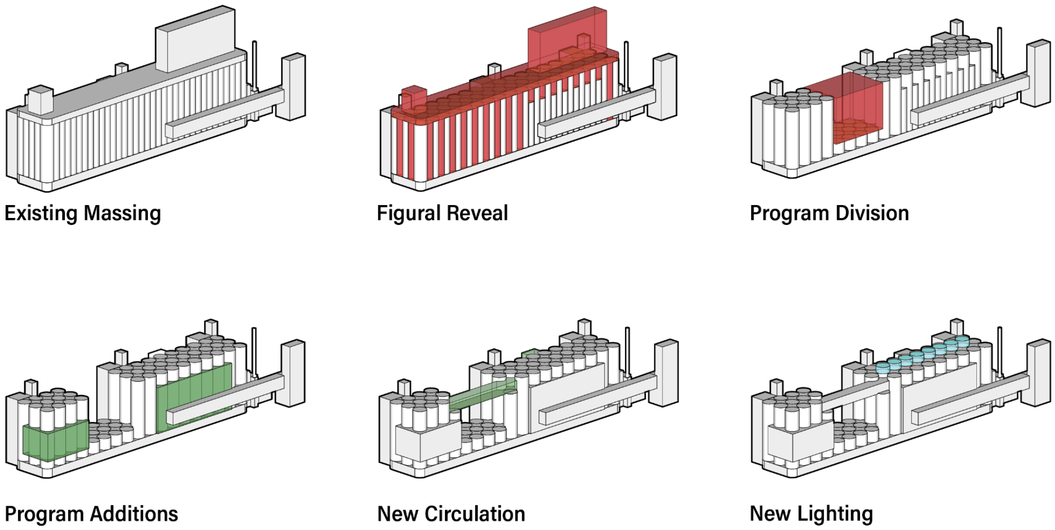

Fig. 46 Final Massing Process Image Credit: Author

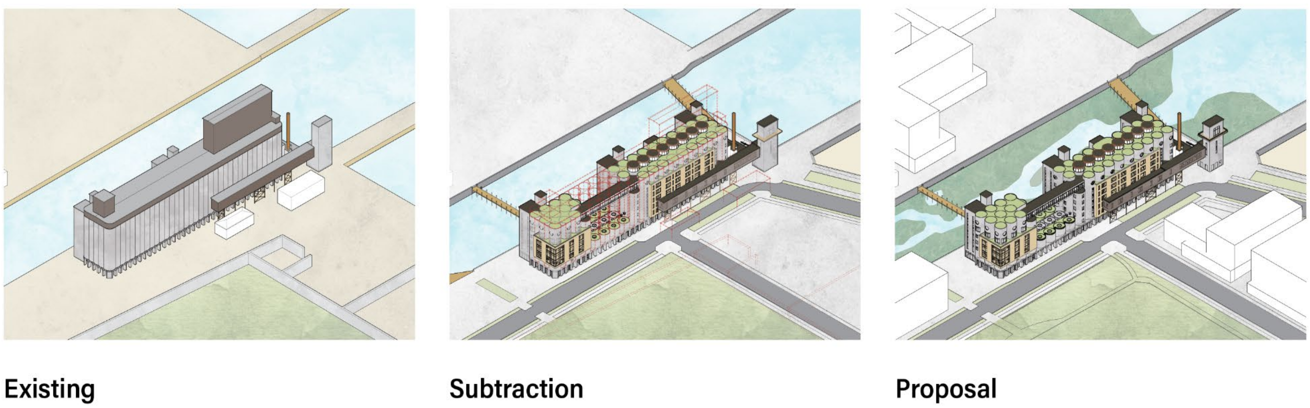

Fig. 47 Existing, Subtractive, and Proposed Axons Image Credit: Author

Structural Tectonics

This thesis aims to reutilize the concrete silos as a distinctive building feature, in-part to maintain the building's industrial appearance, and also due to the large carbon and energy savings its maintenance could provide. The existing building has a total of 54 full circular silos. Each full silo has 4 mushroom shaped columns holding them from the base, and sit in rows of 3, repeating 18 times to complete the 430' long building.

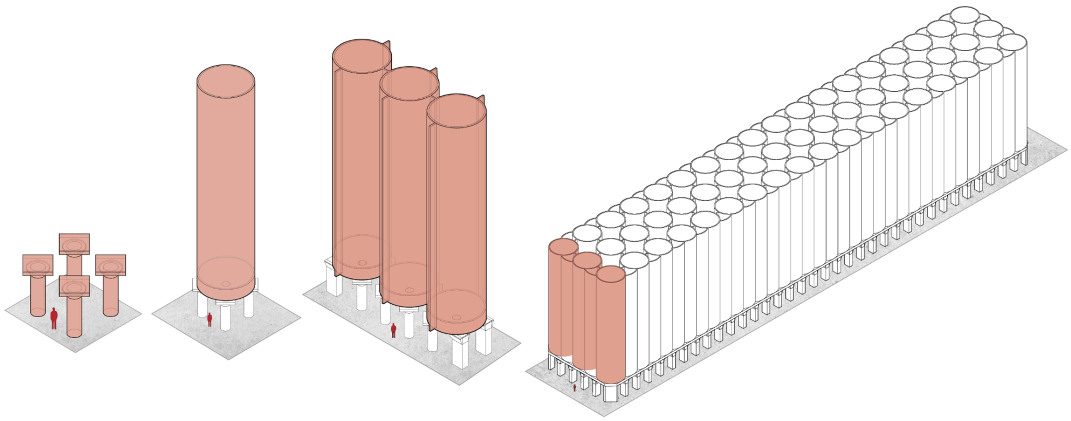

Fig. 48 Full Silo Pattern in Red Hook Grain Terminal, a total of 54 full-sized silos. Image Credit: Author

To make room for new programming, insertions to the building will be added to provide space for new floors and building systems. A strategy was developed to remove the current steel cupola of the building and to lower prefabricated floor units into each silo via crane. To distinguish old from new, a different material palette will be used in parts where the renovation work is completed. These floors would be made of cross laminated timber and positioned on pre-formed curved beams, which will be drilled into place inside of each silo.

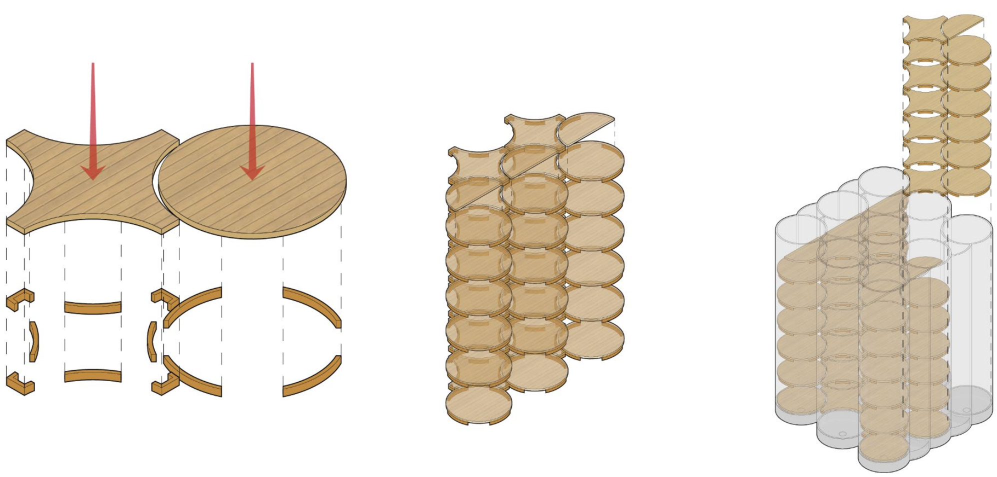

Fig. 49 Strategy for installation of mass timber flooring and beams into existing concrete columns. Image Credit: Author

This tectonic language aimed to make creating interior floors easier, and was part of a wider array of "bolting on" to the original concrete skeleton of the building. The original concrete structure would be showcased and visible, while contrasted by the materiality of new architectural moves, being both visible on the interior and exterior of the building.

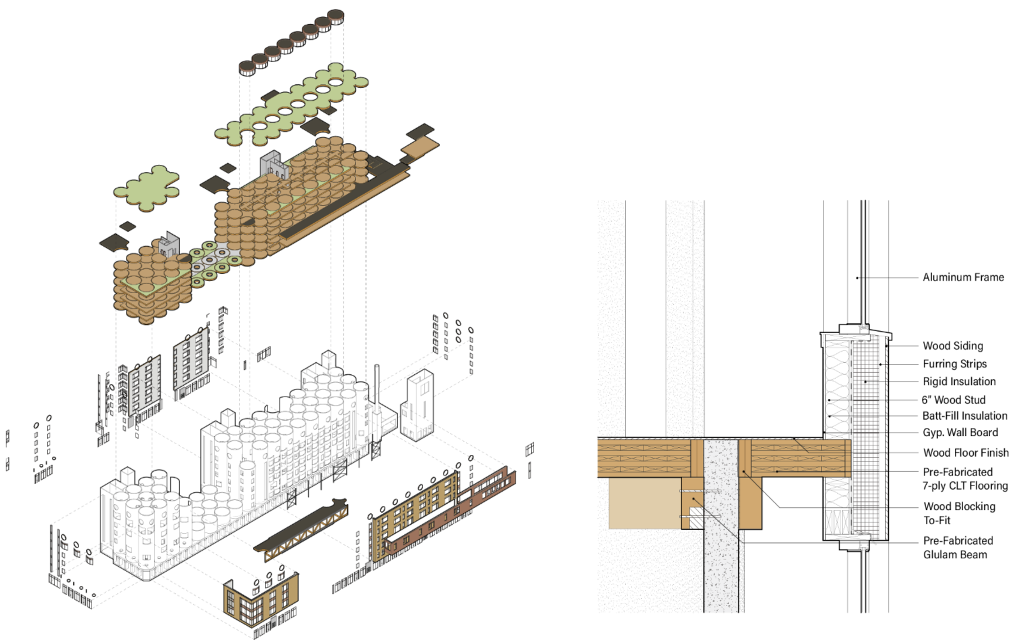

Fig. 50 Exploded axon of additions and insertions to the concrete silos (left). Detail of mass timber connection (right). Image Credit: Author

Chapter 8: Design Exploration

The complete transformation of Red Hook Grain Terminal converts the building from abandoned grain elevator to a mixed use building that houses residences, a marketplace, community center, library, and art gallery, with additional space for boutique retail and a flex space. This transformation reimagines what brownfield sites could be with adaptive reuse, transforming something from inaccessible and a blight, to a multi functional utility for the community.

On the site, reintegrating the abandoned land into the wider fabric of Red Hook began with new roads that protrude into Red Hook Park and connect to the existing grid. New bike paths connect towards the existing at the Columbia Street Esplanade, and lead both across the Henry Street Basin and towards the Red Hook Park. These strategies essentially utilize the park as a promenade to the site, restoring access to the shoreline that had once been abandoned and inaccessible.

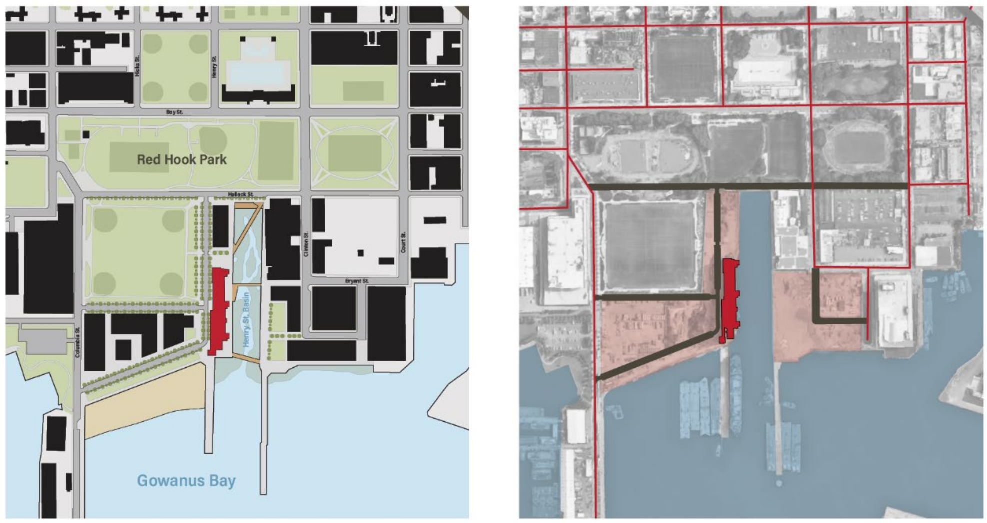

Figure Ground **Connection**

Fig. 51 Figure Ground of the site in its context (left) Gray streets connect to existing red streets (right). Image Credit: Author

Additionally, the area surrounding the Henry Street Basin is developed, creating a waterfront walk on an extended concrete bulkhead. This bulkhead overlooks the transformation Henry St. Basin has undergone. Now, floating wetlands are tethered in-place, supporting native plantings for a tidal salt marsh. To get across the basin, wooden walkways stitch the east and west side of the basin at the top of the building, at the building's marketplace, and nearest the Bay. An infill pebble beach is also added to the South of the site to help provide close access to the waters, as well as be a natural barrier against erosion.

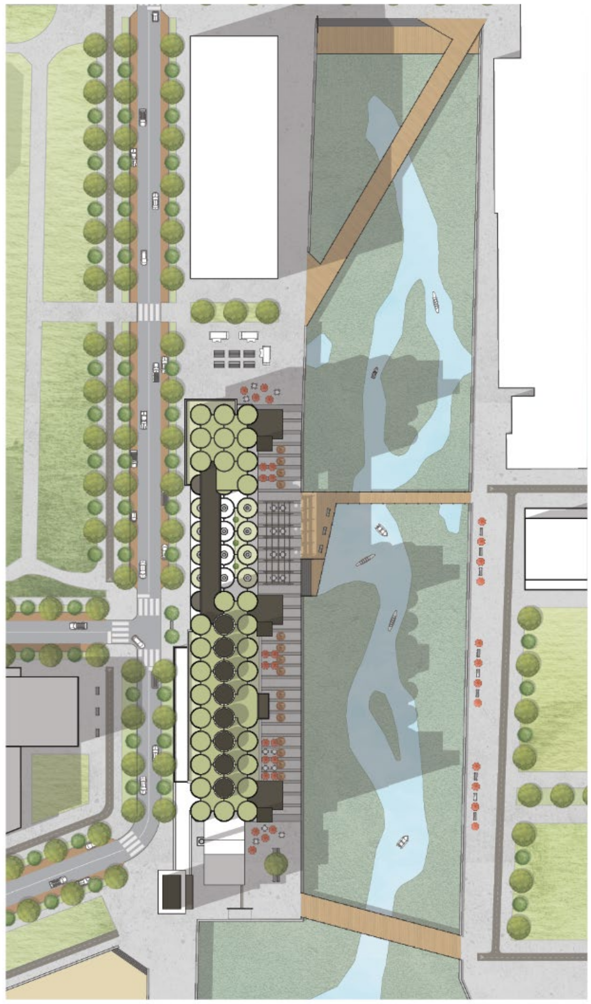

Fig. 52 Proposed site plan of redeveloped Red Hook Grain Terminal and Henry Street Basin development. Image Credit: Author

The building itself is transformed from internal tectonics. The terminal's concrete is in collage with new intervention on the facade, creating a dynamic combination of both wood and concrete. Interior floors of mass timber construction match this, with intervention bolting onto the existing frame in-place.

Fig. 53 Proposed Elevations. Image Credit: Author

The building's layout provides three distinct areas, with distinctive architectural features, interior and exterior to shape three distinctive programmatic regions. In the Community part of the building, double height spaces create a more public atmosphere, and an environment for art exhibitions. In the marketplace, the silos are cut lower, and the market is called out despite being on the ground level via the bridge overhead. The marketplace has overhead skylights that bring daylight down to the ground level, and the market connects the park to the Henry Street basin on the opposite side of the building. Finally, the residences are a more private realm, with a catwalk atrium that gives an opportunity to appreciate the scale and materiality of the existing silos, before leading into private apartments.

Fig. 54 Proposed Floor Plans. Image Credit: Author

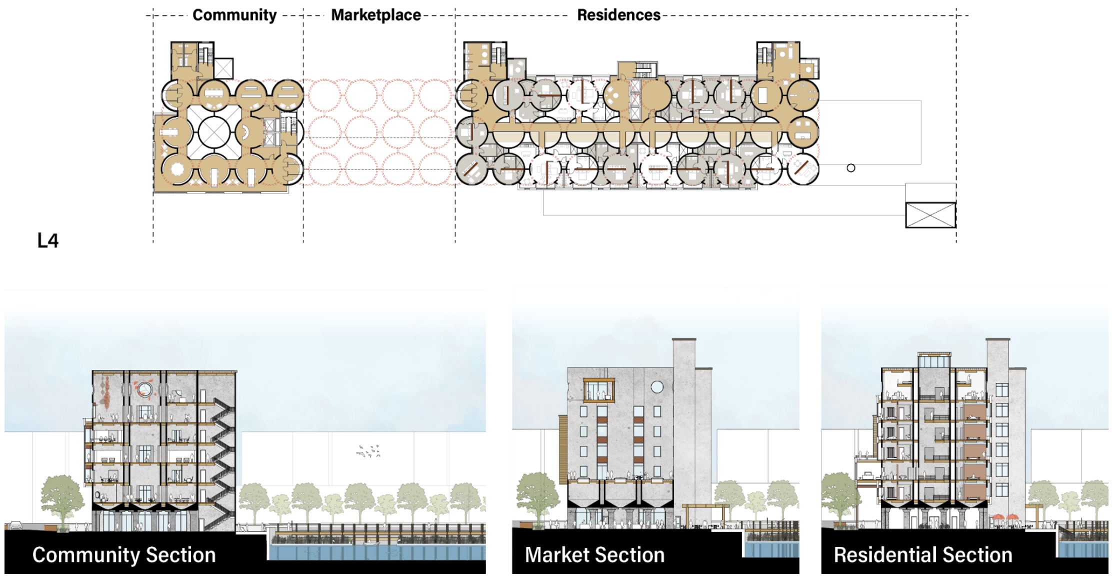

Fig. 55 Proposed Sections. Note distinctive program differences associated with sections. Image Credit: Author

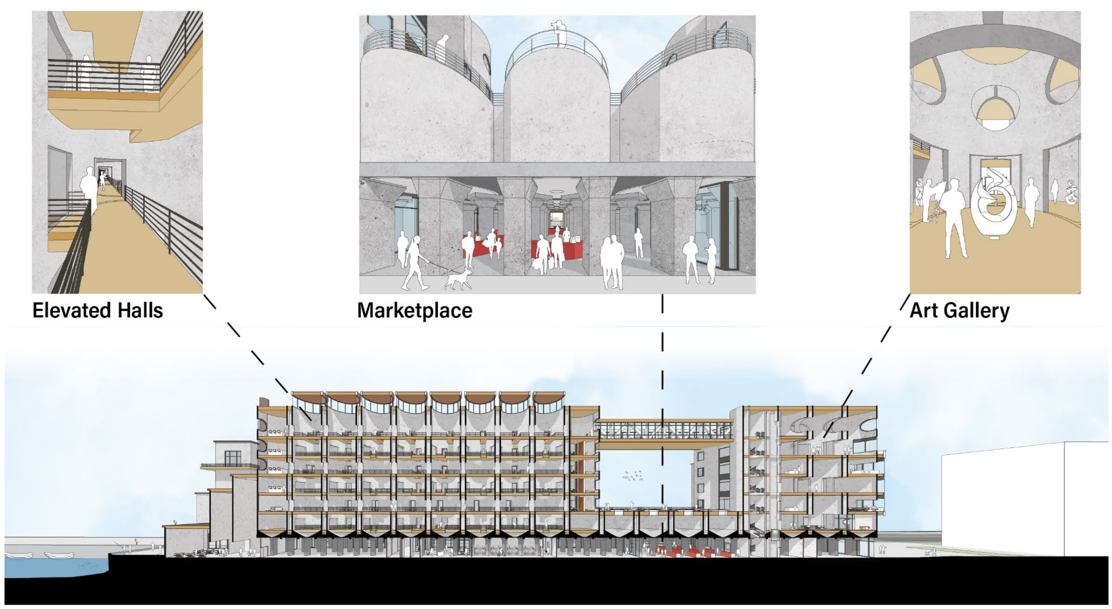

Fig. 56 Section Perspective with Perspectives to distinguish architectural features and experiences in each part of the renovation.. Image Credit: Author

In the apartments themselves, a strategy was implemented to maintain as much of the silo form as possible and to create views that look outwards, without building new partition walls that interrupt the space. The plans utilize a piece of central cabinetry as an anchor between rooms, floating in the space. A centralized cut looking outwards creates views between rooms, or large openings with space for furniture. The central row of silos are left with minimal cuts to create a unique atrium hall space between units.

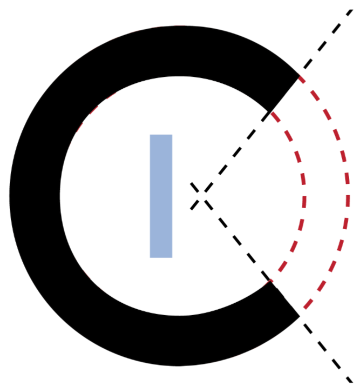

Fig. 57 Parti of apartment strategy. Centralized cabinetry and a large central opening looking outwards. Image Credit: Author

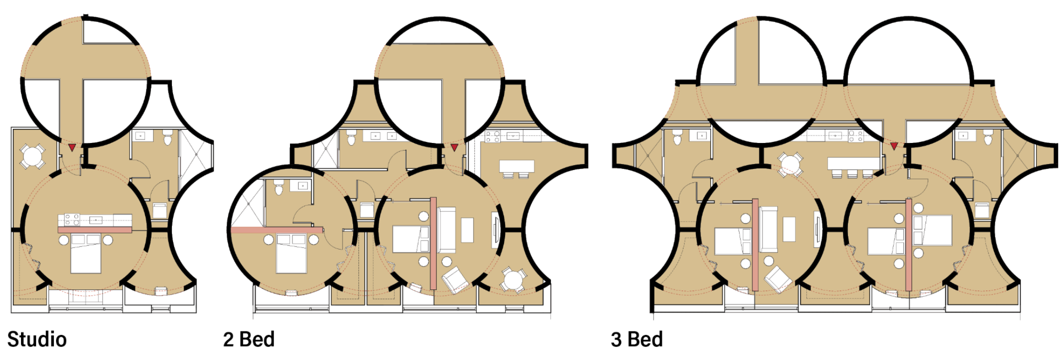

Fig. 58 Studio, 2 Bedroom, and 3 Bedroom examples of apartment floor plans utilizing the parti strategy. Image Credit: Author

Fig. 59 View of proposed building from the Gowanus Bay.. Image Credit: Author

Fig. 60 View of the proposed building and floating wetlands at Henry Street Basin. Image Credit: Author

Fig. 61 View from Red Hook Park, looking towards the community part of the building. Image Credit: Author

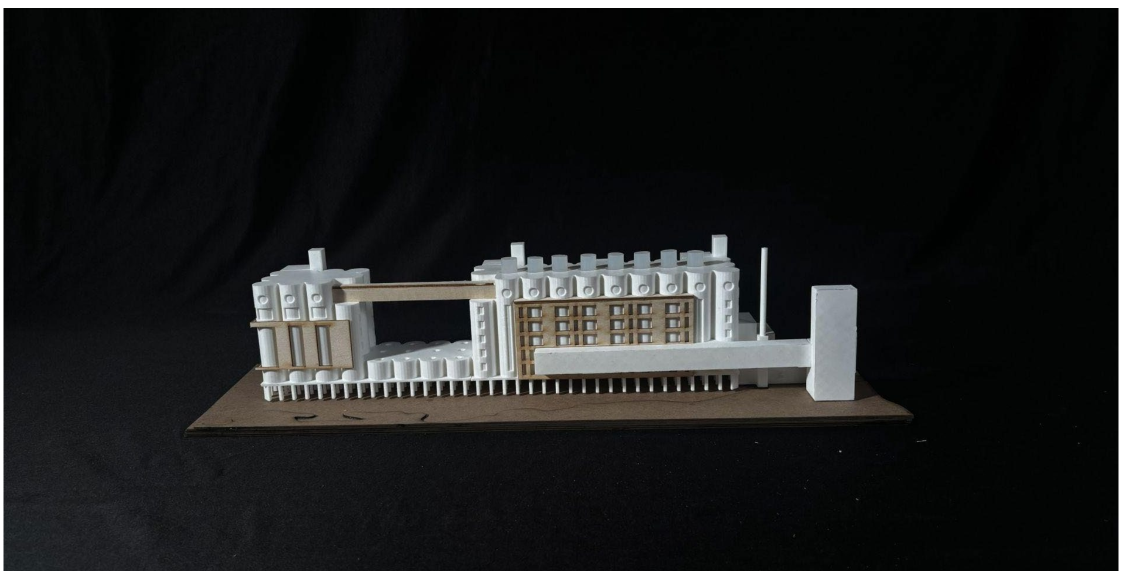

Fig. 62 View of model from West Facade. Image Credit: Author

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