DESIGNING DECLINE: THE RECLAMATION OF AN INDUSTRIAL SITE AND THE DESIGN IMPACTS ON ENVIRONMENTAL, SOCIAL AND ECONOMIC RESILIENCE

By

Brooke Shevela

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

Environmental Design-Master of Arts

2022

ABSTRACT

DESIGNING DECLINE: THE RECLAMATION OF AN INDUSTRIAL SITE AND THE DESIGN IMPACTS ON ENVIRONMENTAL, SOCIAL AND ECONOMIC RESILIENCE

By

Brooke Shevela

The abandoned industrial crisis in Michigan, USA calls for the redevelopment of abandoned industrial site areas into functioning public spaces. These neglected spaces develop negative impacts on the surrounding communities regarding aesthetic, safety, economic, and environmental issues. The purpose of this study is to examine the redevelopment of an underused site, especially featuring an industrial site element, and the effects on the nearby community by applying quantitative measures. The Michigan Central Station in Detroit, Michigan, USA was selected as a case study. Landscape performance research was applied to quantitively analyze the environmental, social and economic benefits of reclaiming abandoned industrial sites and their inner elements. In this research, findings showed the case study redesign resulted in positive environmental impacts. These impacts included: expanded areas of ecologically valuable land, increases in carbon sequestration, increases in retained stormwater, the use of recycled content and reductions in sulfur dioxide. The case study redevelopment showed impacts on the surrounding economics through savings on water treatment cost through stormwater retention, increases in property values, and job creation. Furthermore, the redesign also impacted social aspects for the surrounding areas including increases in the area of proposed gathering space, safety enhancements, additions of sidewalks and bike lanes, and increases in the area of public open space. The findings of this study will help designers and urban planners to see the value in reusing existing industrial sites instead of undergoing the harmful demolition process and eventually lead to a more sustainable community design.

ACKNOWLEDGMENTS

This research was supported by the Undergraduate Research Program Grant from the College of Agriculture and Natural Resources at Michigan State University. I want to thank my studio teammates, Mallory Koning and Ted Cook, for their contribution to the case study design. I also want to thank my studio instructor and thesis chair, Dr. Jun-Hyun Kim, for his guidance and direction throughout the design process. Finally, I'd like to thank my family for their continuous support.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

KEY TO ABBREVIATIONS

ADA Americans with Disabilities Act

LPR Landscape Performance Research

LAF Landscape Architecture Foundation

SWOT Strengths, weaknesses, opportunities, and threats

CHAPTER 1: INTRODUCTION

The UN (2012) predicts that urban populations are expected to double during the years of 2011 and 2050 and cities will grow 2.5 times in area by 2030 (Angel et al.,2005). These trends project an immense quantity of urban expansion world-wide and more demand for developable urban land in city fringes while leaving inner cities' dilapidated areas as eye sores. Urban expansion could consequently contribute to increases in urban vacancies (Newman et al., 2016b). The abandoned industrial crisis in the Michigan calls for the redevelopment and reuse of these neglected industrial site areas. According to Gabbianelli (2012), abandoned industrial structures, though previously useful, have created a predicament in the landscape due to their lack of current need and social function. Abandoned industrial areas may still hold traces of past operating systems. These elements, when abandoned, can relate to something poor and impure in nature. These spaces generate an aesthetic, safety, economic, and environmental issue for those living nearby (Gabbianelli, 2012). These undefined and uncertain spaces are characterized by the absence of use, however, also promise and hope.

Property values near these abandoned spaces may be negatively impacted due to the perception of neglected spaces as unsafe or undesirable. There has been a significant increase in spatial planning as a part of the social process and development of industrial affected regions (Burian, 2012). Spatial planning and access to diverse land uses proves to be important in new developments, showing the public's desire for better connectivity in their surrounding areas. Research by Gu et al. (2019) suggests that the inclusion of mixed-land uses can assist in weathering the battle against urban decline over time (Gu et al., 2019). In developing public spaces, Piemontese (2008) mentions that a new redevelopment project can generate design strength through the incorporation of past site materials, industrial features, and existing plants.

This process gives a connection between the present and the past, while changing the landscape as a way to mend the relationship between its different components (Piemontese, 2008). Gaps in past research include a lack of abandonment studies done in Michigan that involve the quantitative analysis of social, environmental and economic aspects of an abandoned industrial redevelopment .

Newman et al. (2016a) explains that severely depopulating cities have become a recent topic and bring into existence a new term called ‘shrinking cities’ (Newman et al., 2016a). According to Oswalt and Rieniets (2007), cities such as Cleveland in Ohio and Detroit in Michigan are seen as the posterchildren of shrinkage (Oswalt and Rieniets, 2007). Detroit is a sprawling city with many abandoned lots existing at the outer edges of usable development. According to recent research, aggressive urban expansion contributes to increases in these urban vacancies (Newman et al., 2016a).

As a decaying city, Detroit has urban vacancy issues and they are rising exponentially. According to Bluestone (2013), the population loss is mostly due to the deindustrialization of the inner city where the factories used to stand. There are widespread social issues in Detroit, as well as many urban cities around the globe. These may include population decline, crime, poverty, and bad economics. After an economic boom in 1950, many factories moved to the surrounding suburbs, leaving no work for the existing working-class demographic (Bluestone, 2013). This led to a lack of jobs and a rise in crime rates. Abandoned site elements can provide a place for criminal activity because of their lack of monitoring. According to David Uberti, this lack of safety drove even more people out of the city (Uberti, 2014). This creates a devastating loop. According to Davis (2020), in 2020, the city’s annual unemployment rate was at 9%. This is very high compared to the rest of the United Stated in 2020 at 3.5%. Detroit’s population has

decreased by half since the 1950s. This has left a large number of homes and commercial buildings abandoned or neglected (Davis, 2020).

Existing research looks at the different kinds of reuse strategies for redeveloping abandoned rail infrastructure. According to Zhang et al. (2020), about reusing railroad spaces, a proposal of three separate redeveloping perspectives may help in their reuse. These are: a new transportation route, a place for tourism or commerce, and as a green corridor (Zhang et al., 2020). According to Maria et al. (2020), the transformation of historic buildings and industrial site reclamation projects are becoming topics of renewed interest (Biddau, 2020). According to Chin and Kupfer (2019), greenways provide not only public health benefits but also environmental and ecological values through their role as a habitat and their ability to enhance connectivity (Chin and Kupfer, 2019). Deeg and Segedy's study (2004) looked at the reuse potential of abandoned industrial land and infrastructure and its benefits towards health, safety, and historical preservation. The redevelopment of brownfield sites is believed to lead to a positive effect on public perception of crime, safety, and walkability. In research by Garcia-Mayor et al. (2020), green infrastructure is referred to as eco-corridors which are framework for environmental, social, and economic health (Garcia-Mayor, 2020).

Regarding mental health, South et al. (2018) showed that emotions of depression and worthlessness were significantly decreased for those living near greened vacant land. In the study, the research team held an intervention which included removing trash, grading the land, adding plants and grasses, and installing a low perimeter fence. The research used self-reported mental health measured by the Kessler-6 Psychological Distress Scale and the components of this scale. The results from this research serve as a useful guide for using green spaces as mental health treatment alongside other medical-level treatments.

There are determined research purposes to be carried throughout this study. The first objective is to examine the issues and challenges of urban vacancy regarding abandoned industrial areas. There are many negative issues associated with urban vacancy including decreased safety, lack of education, vandalism, dissatisfaction, lack of visual quality and reduced health. Another purpose of the research is to develop a comprehensive master plan for an abandoned industrial site. This will be completed with a case study involving the redevelopment of the Michigan Central Station site and adjacent Roosevelt Park in Detroit, MI. Lastly, this research is to quantify the design impact based on the principle of landscape performance research (LPR), aiming the ultimate enhancement of the environment, social and economic benefits of an industrial site in an effective manner. By quantifying design benefits, this study will provide a useful alternative design and planning guideline that will help lower urban vacancy and industrial abandonment while creating safe and unique public spaces for people of all ages. The significance of this study is to provide a useful design framework of how to quantify design impact through analyzing a redeveloped site based on the environment, social factors and surrounding economics. It is expected that environmental benefits could include increases in uses of non-mobile ways of travel, pollinator gardens, flood-control garden systems, as well as the obvious environmental benefits of reusing existing abandoned site elements versus constructing new sites. Economic benefits of the research could include local increases in property values. Numerous studies, including research by Bolitzer & Netusil (2000), have shown a positive association between natural amenities and property values (Bolitzer and Netusil, 2000).

CHAPTER 2: LITERATURE REVIEW

2.1 The Impact of Urban Vacancy

Previous research shows that the over-expansion of cities may lead to urban core decline over time. Research by Newman et al. (2016a), used an exploratory, quasi-experimental longitudinal analysis. This research compared 40 U.S. cities of over 100,000 people from 2000 to 2010 and found that a higher rate of urban expansion causes increased urban vacancy, especially in residential land uses. The researchers noted that as cities grow into megacities, designers and urban planners must utilize existing abandoned spaces as a land bank for future urban development (Newman et al., 2016a). In research by Gu et al. (2019), it is suggested that the proximity to mixed land uses was associated with increasing or decreasing the probability of tax delinquent status for single family lots. This research suggested that planning for mixed land use inclusion can prevent urban decline and help reduce the impact of tax delinquency (Gu et al., 2019). Internal planning for reuse could play an important role in future sustainable urban growth patterns through infill development.

Previous studies have documented the trend of declining cities and how to redevelop these areas and planning is one of the most effective ways to combat the issue of vacancy (Newman et al., 2016a). Unoccupied urban areas have become a significant area of interest in the United States, most notably in the Rust Belt region, including Michigan, Illinois, Indiana, New Jersey, New York, Ohio, Pennsylvania, and West Virginia (Gu et al., 2019). Due to these desires to find solutions to urban vacancy, it is important to develop comprehensive land use plans to redevelop declining cities. According to Millington (2015), sites like the “Highline” redevelopment, in New York, note the illegal activity and trespassing on the pre-renovated site. Urban vacancy and site abandonment are hot spots for crime and thus provide a stigma of being

unsafe. This can deem an area “undesirable” for surrounding properties and cause lower property values (Millington, 2015). Given the context, economic benefits driven by redevelopment projects could include increases in local property values. Many studies, including research by Bolitzer and Netusil (2000), have shown a positive association between natural amenities and property values (Bolitzer and Netusil, 2000). Previous research, from Zhang et al. (2018), found proximity to trail entrances have positive impacts on property values. They indicate that decreasing the distance to the closest trail by one foot increases a house property value by $.92 (Zhang et al., 2018). A previous study tested whether adding greenery could reduce violent crime in Philadelphia. They cleaned the lots, planted grass and trees, and built a wooden fence around the perimeter in a randomized controlled trial of vacant lots. Through the crime data in the area, from the Philadelphia Police Department, and the perception from the neighborhood participants; their outcome discovered that adding these green elements could add to reduced violent crime and increased perceptions of safety for communities (Garvin et al., 2013). Yang et al., (2020), proposed a design and planning guideline for vacant lots in Flint, Michigan, USA. These lot designs hope to create profit for the community through stormwater management, mitigating illegal dumping, improving soil quality, and transforming vacant lots into community property. The guideline provides diverse scenarios of lot design based on an adoption level of redevelopment strategies, so residents and local municipalities can choose the ideal design that aligns best with their budget, maintenance level, and experience.

Detroit Future City (DFC) has developed a 50-year vision plan to address those problems and create a better long-term future for the city (Pool and Stratton, 2015). The plan looks at a city with multiple employment zones and a transportation structure that connects people with opportunities: it looks to a green city where the outside environment contributes to health, and it

will be a city of distinct, attractive neighborhoods (Pool and Stratton, 2015). Proper planning and preparation for a city's redevelopment will potentially lead to better overall functionality in the end. Detroit is a prime example as a city that holds urban expansion issues and its effects. The city faces steep decline and has raised awareness of the need for a plan to combat these issues.

In summary, there are multiple issues and impacts of urban vacancy and it's up to landscape architects to begin to tackle some of these present and future issues. Issues of urban vacancy include urban sprawl, urban decline, mental health, and vacant lots leading to crime. Landscape architecture is on the forefront to combatting these issues when it comes to redesigning these vacant spaces. These spaces are prime spots for new parks, transportation hubs, roads, bike networks and other valuable land uses. Removing these abandoned spaces may promote increases in property values. New developments may also provide job opportunities for nearby communities and stimulate local community involvement. When choosing spaces to develop, these decaying spaces may be a great place to start through the process of a redevelopment. According to Newman et al. (2016b), disinvestment, suburbanization and annexation are main causes of increases of urban vacancy. Ways to solve this are through growing local economies, population in-migration, and city policies (Newman et al., 2016b).

2.2 Sustainable Waste Management

Post-industrial design is practicing sustainable waste management through the redevelopment of existing brownfields or other remnants of a past industrial operating area. According to the World Bank Group (2018), global waste is to grow by 70% by 2050 (World Bank Group, 2018). As urban growth continues, there will be more solid waste produced. According to Wells, the economic future of our cities and the health of individuals depends on

the healing of these unused urban areas. America's half-million brownfields are lacking any functionality or purpose for the surrounding communities (Wells, 1998). According to Li and Tsai (2017), brownfields and abandoned industrial areas occur because of far-reaching structural changes to regions that were formerly dominated by heavy industry (Li, H.-W., & Tsai, T.-C. (2017). The reuse and reclamation of these unused sites and their elements is the start of good sustainable waste management in urban communities.

According to the Environmental Protection Agency (2022), without sustainable waste management practices, there will be increased waste that is combusted or landfilled, soil contamination, air pollution, release of toxic materials and other potential environmental issues (Environmental Protection Agency, 2022). To combat this issue, cities and states can create new standards and other relief to create incentives to clean up and redevelop these brownfield sites. This is important in the landscape architecture field, as landscape architects can seek out these types of redevelopment projects to help preserve historical context to communities and redevelop abandoned and contaminated areas. This is important to minimize the impact on the environment where people live. It is important for designers to recognize and interpret the history, ecology and significance of the redevelopment site. Through choosing to redevelop these post-industrial contaminated sites, it may lead to sustainable waste management and aid in the cleanup of urban areas to enforce their improved sustainability.

2.3 Landscape Performance Research (LPR)

LPR was applied for this study as approached by numerous past studies (Yang et al., 2020). This section will address some of the past studies that included LPR and their general design challenges and considerations. Each example primarily shows how LPR benefited a site

environmentally, socially, or economically. Through analyzing similar past research, it becomes clear that LPR is valuable and useful with the redesign of the study area, Michigan Central Station, in Detroit, MI.

LPR is a widely accepted research analytical tool to measure the impacts of landscape design and planning projects. The Landscape Architecture foundation (LAF) website provides several LPR results of past constructed projects and associated benefits that can be used as evidence for the future success of projects (LAF, 2018). In practice, designers use these past analyzed projects as a tool to strengthen the quality of their strategies. For built designs, these case studies can lead to better management practices, better landscape policy, and an increase in knowledge for the website's visitors. Currently, LAF has over 150 case studies commonly referenced by designers, students, researchers, journalists, policymakers, and advocates. For LPR, LAF has a primary focus on the environmental, social, and economic impacts of built landscape projects (LAF, 2018). Examples of current measurement tools on their website include but are not limited to carbon sequestration, air quality and public life improvements.

LPR helps to look at specific design features on a project site and how they individually impact the local zone. According to Yang et al. (2020), LPR has been widely accepted to show how aspects of a design can affect the nearby environment (Yang et al., 2020). Featured on the LAF website is Thoren's dedication to the Dutch Kills Green project, located in Long Island City, NY (LAF, 2021). The site spanned the length of eight urban blocks and dealt with the design of three subway lines, two elevated routes, and congested streets surrounding a parking lot. These conditions made the site unsafe for pedestrians. To help this, Thoren improved the traffic network, while making room for people, plants, and water among the infrastructure. The design introduced bikeways in green corridors and improved senses of safety. After analyzing

environmental, social and economic benefits, they found that there can be major cost savings for the future through proper environmental design efforts (LAF, 2021a). Through reduced energy consumption, improvements to air quality, carbon storage, there was an estimated $20,000-$37,000 in net annual benefits to the city. This design also led to increases in surrounding property value. Environmentally, the project added many plants to help store water and introduced a separate upgraded stormwater infrastructure. The 174 added trees sequestered 1,079 pounds of carbon per year. Her project is a part of the LPR series along with many others who have shown numerous cost and environmental benefits (LAF, 2021a).

Another example is a 23-acre urban neglected greyfield site called Buffalo Bayou in Houston, Texas, designed and built by SWA (LAF, 2021b). The site challenges included working around existing freeway infrastructure which created extreme shade and a flooding issue surrounding an existing stream. The design team created a pedestrian-friendly environment on the site, which previously was perceived as unsafe. The new design incorporated native plantings and increased flood storage. Environmentally, according to the landscape performance assessment, the new plants helped improve flood control by 400% and helped to sequester 29.74 tons of carbon. As far as social aspects, the design reportedly created a sense of safety and security for 66% of survey respondents and ultimately contributed to increased employment and number of surrounding establishments (LAF, 2021b).

A 9.5-acre site called Hunter's Point South, in New York, is an open space waterfront development with challenges including the need for an active and passive recreational site that incorporated and introduced native plants, protected iconic views, and provided sustainable and resilient flood protection (LAF, 2021c). The design created flooding features through a turf overflow catchment area. The project also added riprap against wave action, including rock filled

gabions along a biofiltration swale to slow the current. Economically, this design contributed to a 49% increase in assessed property values for 8 randomly selected parcels from 2012 to 2017. This site attracts roughly 1,170 visitors a day, promotes physical activity, provides iconic views, and increases ridership for the NYC ferry (LAF, 2021c).

The Salvation Army Kroc Community Center, in Philadelphia, acts as a methodology for landscape performance benefits (LAF, 2021d). Landscape performance analytics helped prove that the site's redevelopment had major effects on the environment and community. First, the study used standard hydraulic and hydrologic approaches to foster estimates of the post development performance of the stormwater facilities for the different rainfall events. They found that the new site design captures the first inch of stormwater runoff from the site and building and infiltrates it or uses it throughout the landscape. The site also sequesters 15,293 pounds of carbon dioxide, every year, through the 562 new trees and shrubs planted. This is essential research for all studies involving the redevelopment of urban industrial spaces. The Salvation Army study specifically saved $575,000 in disposal fees and prevented 12,500 cubic yards of material from entering landfills. They did this by reusing 100% of the existing pavement onsite found during their pre-design investigations. They used the recycled materials as sub-base below paved areas, as well as bulk aggregate fill. They discovered the cost benefits while comparing the estimated total disposal costs ($11.65 for hauling material offsite) (LAF, 2021c).

Another beneficial case study that used LPR is the Port of Los Angeles Wilmington Waterfront Park, in California (LAF, 2021d). The site environmental benefits include the removal of nitrogen oxides from 2.45 million gallons per day of air that passes across a test panel coated with titanium dioxide. The site design also reduces noise levels for C street residents by

approximately 10 decibels, which cuts the experienced sound level in half and improves outdoor environment conditions for the site (LAF, 2021d).

The last case study example, in this section, is Vista Hermosa in Los Angeles, California (LAF, 2021e). This is an abandoned oil field featuring a toxic history of harmful gasses and chemicals below the surface. The researchers used LPR methods to analyze various environmental benefits. The Tree Benefit Calculator was used to calculate the amount of sequestered carbon dioxide onsite. The new site sequesters an estimated 22 tons of atmospheric carbon dioxide every year from the 800 trees onsite. Social characteristics were also measured, including the education of an average of 1,487 visitors, annually, through the site's 67 programs in English and Spanish between 2008 and 2012 (LAF, 2021e). Findings from case studies reviewed in this chapter will help demonstrate comprehensive, positive effects of the development of public space and transportation in communities. The studies also underscore the significance of redeveloping industrial sites to promote public physical health and increase outdoor activity.

CHAPTER 3: METHODOLOGY

3.1 Study Area

The abandoned Michigan Central Station in Detroit, Michigan provides both opportunities and challenges for the redesign as the study area of this research. The historical elements of the site are already drawing in visitors, but the abandoned features of the site were dangerous situations for these visitors. When designing the study area, it was important to ensure that the new design benefited the general public by evaluating and responding to the social and economic needs of the surrounding area. The choice of Detroit, as the project location, was due to the site's relativity to the researcher for easy returning access for the data collection. The choice was also based on the number of existing attractions that are nearby or intersecting the project site. These included, but were not limited to, bike lanes, downtown areas and restaurants. Having these nearby attractions may help to increase overall interest in the area.

3.2 Surrounding Area of the Study Site in the Regional Context

The study area of this research is the Michigan Central Station in Detroit, Michigan. Around 420 houses surround the project area within a typical quarter mile radius (Figure 1). The site acts as a connecting opportunity to the lively waterfront stretch along the Detroit River. The site will link into existing bike lanes and trails to provide key access to its surrounding neighborhoods that otherwise would lack connections to the waterfront parks and activities. There are many surrounding landmarks, including: museums, casinos and theatres. In regard to Detroit's overall existing environment, according to the "Community Action to Promote Healthy Environments" group, there are high levels of increasing temperatures, air pollution, water

pollution and soil contamination in Detroit (Community Action to Promote Healthy Environments, 2022).

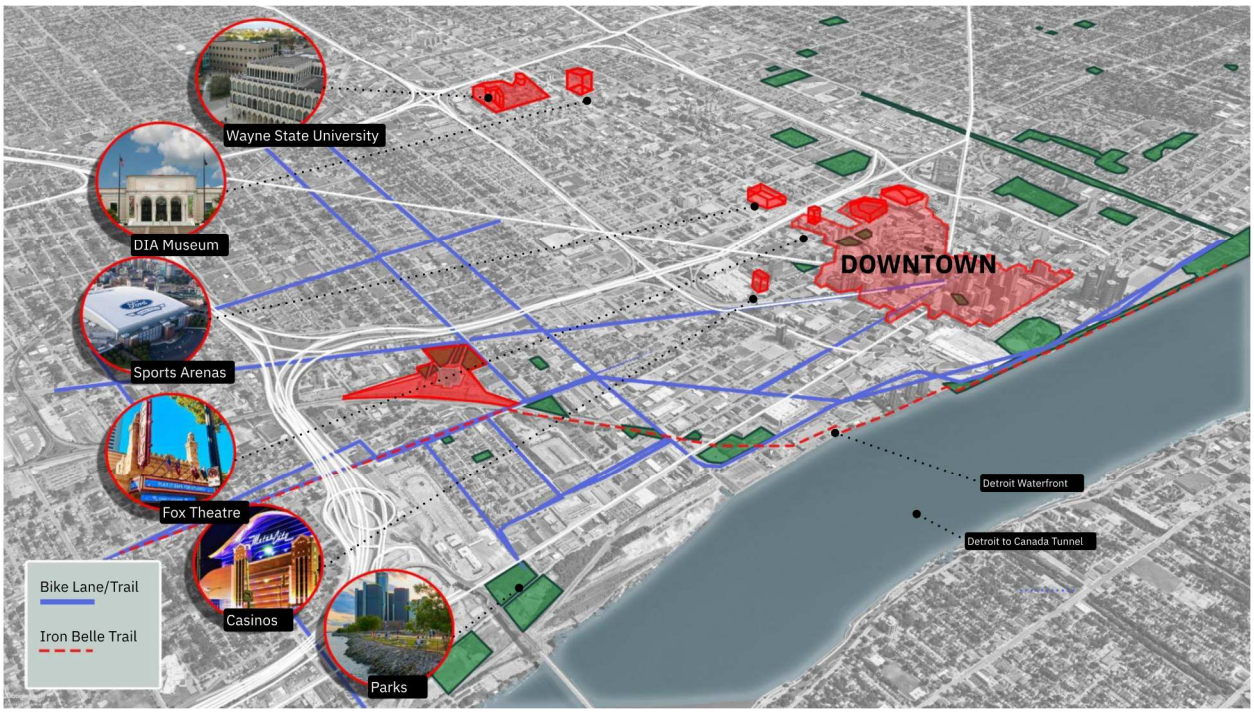


Figure 1 Surrounding Area of the Study Site © Brooke Shevela, Ted Cook, Mallory Koning

3.3 Surrounding Neighborhoods

The study area is inside the neighborhoods of Corktown and Mexicantown in Detroit, Michigan (Figure 2). Corktown's census tract is known to be one of the most diverse, mixed-income tracts in the United States. According to the City Observatory (2018), the town ranks in the top 10 percent of all tracts nationally in measured racial and ethnic diversity. It also ranks in the top 5 percent of income diversity (City Observatory, 2018). Due to a large portion of Corktown being consumed by highways and infrastructure, Corktown Demographics and Statistics (2021) shows a relatively low residential urban population of 3,555 people in 2019. The area had its peak population of 30,400 residents in the 1930s. In recent years, the population

has experienced a significant decline. 38 percent of the neighborhood is White while a comparable 33 percent is Black and 26% are Hispanic. The median age in this neighborhood is 33 years of age and 25% of the households have children. 40% of people in the area are homeowners while 60% are renters. The median income is about $34,000 a year. The poverty rate of this neighborhood is 34%, more than double the metropolitan average but still lower than the average in Detroit (Corktown demographics and statistics, 2021).

Figure 2 Adjacent Area of the Study Site © Brooke Shevela, Ted Cook, Mallory Koning

According to the U.S. Census Bureau, 7.6 percent of Detroit's urban population are Hispanic or Latino and many of them live in Mexicantown (Bureau, 2021). According to the Mexicantown demographics and statistics website, 48 percent of the people in the area are Hispanic, while 25 percent are white, and 25 percent are African American. 54 percent of people are male in the area and 46 percent are female which means this area is relatively even with the

amount of each gender. Most people in the area are either 45-54 years old or less than 10 years old. The median household income is relatively low at $24,028 (Mexicantown Demographics and Statistics, 2021). According to Mexicantown website's homepage, there are many authentic Mexican cuisine restaurants and museums in the area, along with painted art displays throughout the town (Mexicantown Detroit, 2018).

3.4 Michigan Central Station

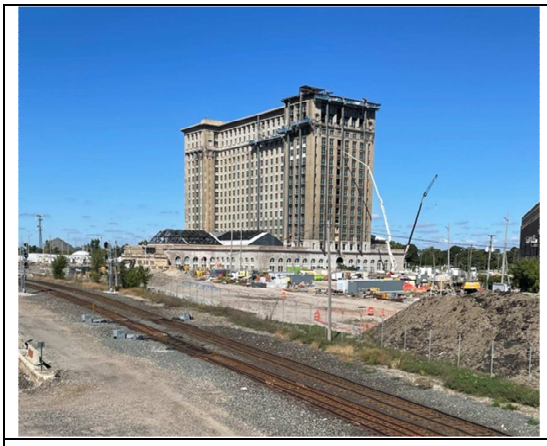
The abandoned Michigan Central Station site (Figure 3), which featured abandoned elevated railbeds and a single operating rail, was selected to be the main study area in this research. It was important to analyze inventory information at the site context, including the history of the station, the context of the site, the on-site transportation infrastructure, and the main access points.

(a) Station Building (Front of Building)

(b) Roosevelt Park Entrance (Front of Building)

Figure 3 Site Photos © Brooke Shevela, Ted Cook, Mallory Koning

Figure 3 (cont'd)

	
(c) Single Remaining Operating Railroad (Back of Building)	(d) Main Road that Passes Underneath the Elevated Rail Beds

History of the Michigan Central Station

In the 19th century, America's industrial revolution led to better transportation for both industry and social life. Built in 1912, Michigan Central Station served as people's first step into the city of Detroit. The railroad business was growing, and they decided to add an underwater rail connection to Canada. In 1913, there was a fire that started at the depot and determined the station unable to operate. The trains were redirected instantly. Soon after, the station was redeveloped, and this is the building that still exists to this day. The station functioned for seventy-five years. However, soon passenger trains fell into decline because of highway additions. Since the 1990s, the station has been a place of abandonment and has served as an area for vandalism, thrill-seekers and the homeless. Currently, although abandoned, the station is an architectural inspiration to many. The station's hardscape and attached Roosevelt Park are still used often for light shows and cycling events. In 2021, Ford revealed a plan for inclusive walkable mobility innovation redevelopment of the station and abandoned rail infrastructure

(HistoricDetroit.org, 2021). The station, infrastructure and park are all owned by the Ford Motor Company.

When the station was first built, it was the tallest station in the entire world (HistoricDetroit.org, 2021). Now, it towers over nearby greenspace as an eye-sore and shows the worsening of Detroit's once powerful buildings. The train station shows Detroit's extensive history with transportation. However, its current abandonment shows how the automobile industry is leaving Detroit and calls for the need to prepare for this shift in the urban environment (HistoricDetroit.org, 2021). Shujian and Haishan (2020) looked at these underused spaces surrounding railroad elements and how they ultimately result in a "rust belt" (Shujian and Haishan, 2020). The city planning department reported Detroit already having 80,000 abandoned lots and buildings (Kellogg, 2009).

Ecological, Physical, and Social Layers of the Michigan Central Station

The site is surrounded by highways to the North and West. Interstate I-75 stretches above the site to the North and joins I-96 on the West of the site (Figure 4). The station site's immediate surroundings included the downtown Corktown strip, including bars, restaurants, and shopping. It was surrounded by an existing UPS station, dog park, church and nearby highway infrastructure. The nearby highways that provided access to the site are I-75 and M-10. West Vernor Highway traveled underneath the elevated rail beds towards the west end of the site. Numerous active bus routes surrounded the site with many bus stops in front of the station site itself.

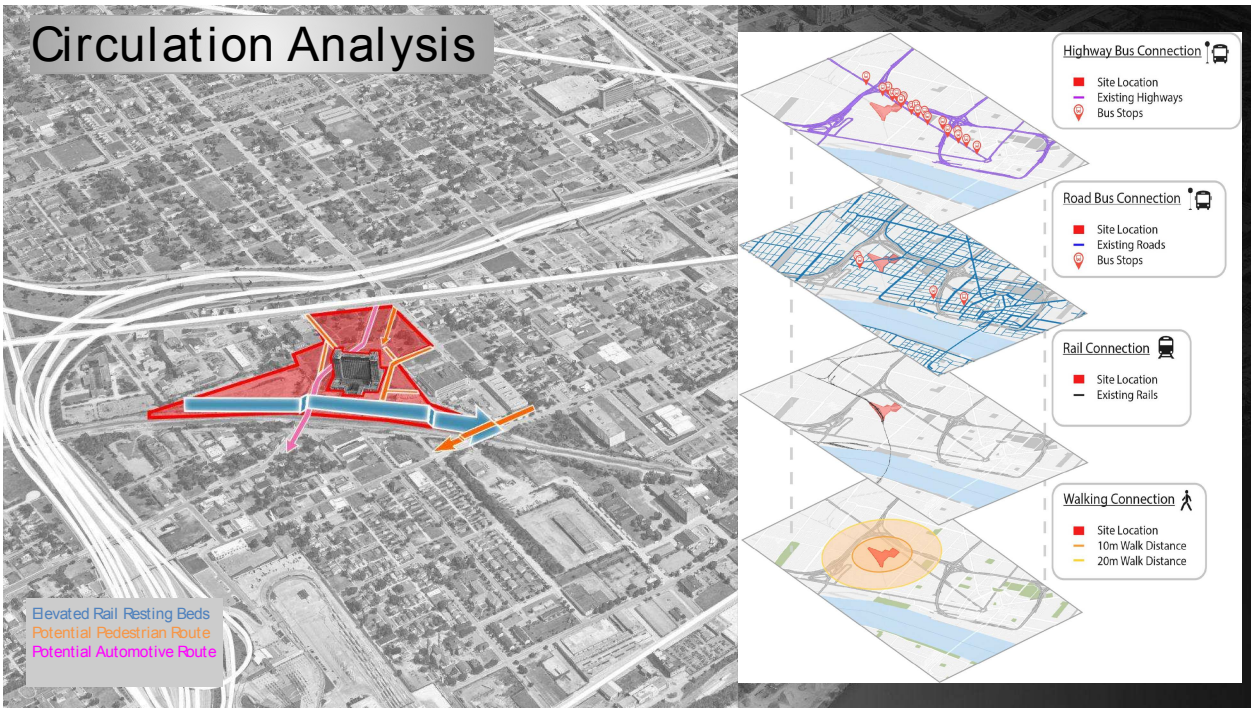


Figure 4 On-Site and Off-Site Circulation © Brooke Shevela, Ted Cook, Mallory Koning

The station building is a 500,000-square foot, 15-story abandoned element and sits in front of the elevated rail resting beds. Note the existing site featured a public park named Roosevelt Park (Figure 5). Combining the station site with the attached Roosevelt Park, the design site reaches over 17 acres in size.

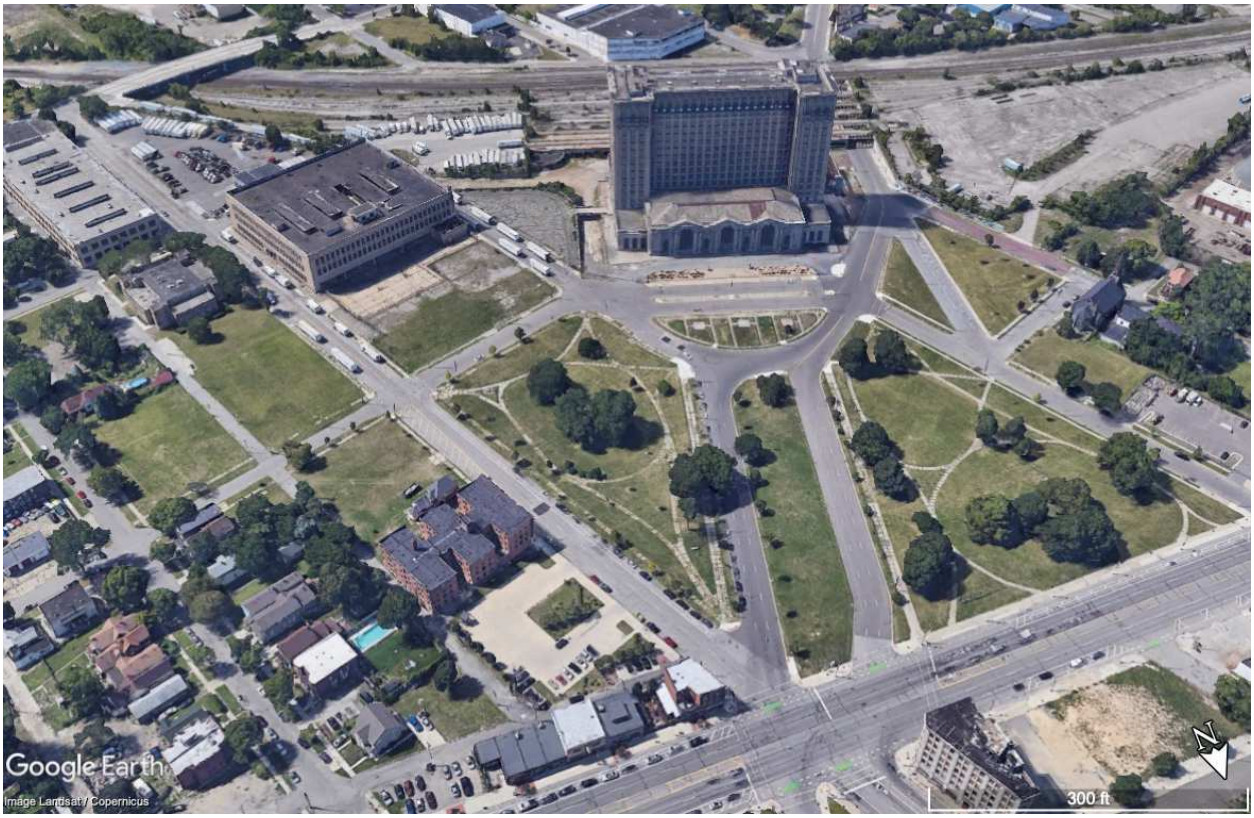


Figure 5 Aerial View of the Study Site © Google Earth Image

The slope onsite was relatively insignificant, around 0-5 percent. Since the site is relatively flat, there are no major water issues to combat. Still the site could use water management through capturing the rainfall volume to recycle for irrigation on the site. Incorporated into the design, this will lead to economic benefits due to savings of little to no additional irrigation required onsite and less overall maintenance costs. The soil conditions, wildlife and vegetation on the site were typical of the Detroit region; sandy loam soil made up the majority of the park space. Mixed urban concrete was the remainder of the site due to the large elevated railbeds towards the South end of the site. The vegetation on the site included maple trees, black walnut trees, and oak.

The station's elevated railbeds stretch above 16th avenue at the Southern end of the site. These are made up primarily of rail resting beds and one functioning rail that sits frthest away from the core of the site (Michigan Central Station, 2021). With so much on-site infrastructure and site history, the site plan needed to consider the reuse of certain industrial elements.

Based on the site SWOT (Strengths, weaknesses, opportunities, and threats) analysis (Figure 6), major strengths of the existing site include the overall flat topography. Noted strengths on the existing site were the open greenspace and historical architecture which provided major interest to the final design proposal. As mentioned above, the bike and trail connection could be a huge opportunity to create a better transportation system for the surrounding communities and improve existing green corridors and travel linkages. Another advantage to the site was the distance to downtown Corktown which is a developed urban area with many activities. Corktown, itself, is a unique community as it is ranked within the top 10% of income and racial diversity (Detroit's Corktown, 2018). This is important and is seen as an advantage due to the project site's unique standing (Figure 6).

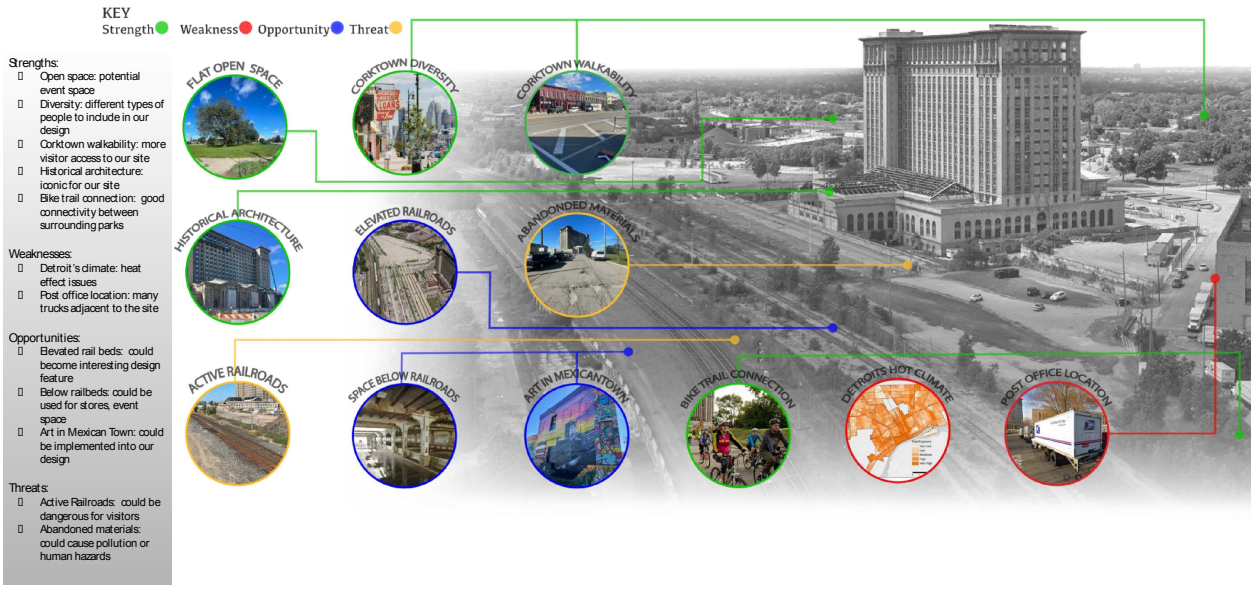


Figure 6 SWOT Analysis © Brooke Shevela, Ted Cook, Mallory Koning

The overall weaknesses of the site included the active railroad on the south end. Although rarely operating, this acted as a safety hazard before it was screened off by fences and plantings. It also causes noise pollution for the project site before the proper fence blockage. The existing post office near the site was a large building which caused view obstruction. On the team's site visit, minor standing water was noticed along the entrance roads. This can be infiltrated through future proper planting designs that implement rain gardens. Lastly, Detroit's overall pollution could be an issue for the design (Figure 6). This is because Detroit has many large industrial pollution point sources in the form of coal-fired power plants, coke, steel, and cement factories. These produce a large amount of Sulfur Dioxide and other pollutants (CAPHE, 2021).

The opportunities of the site included the space below the elevated rail on the site. These empty infrastructure shells could be converted into an interesting design feature, as market space,

access to the elevated redeveloped railbeds and storage areas. The elevated railbeds, although abandoned and dirty, were an opportunity due to their uniqueness and structural design capabilities. The existing graffiti on the site could be an opportunity because of the rise of popularity of seeing graffiti as public art (Figure 6). This art could be contained and provide a place for artists nearby to express their work.

Threats to the site design include the one remaining active railroad towards the southern end of the site. This could be dangerous for visitors and will require safety measures. Also, the abandoned materials onsite are a threat because they could cause pollution or human hazards.

The proposed design helped to develop a plan to combat these social and economic issues and enhance environmental quality of the project area. The design also helped to integrate existing elements. For instance, in the design site, the elevated railways ended up serving as an elevated pedestrian walkway to connect site elements. Also, the abandoned train resting beds serve as the garden container for native Michigan plantings and screenings.

3.5 Landscape Performance Measurements

This study proposed a series of landscape metrics focusing on three main categories: environmental, social, and economic benefits (See Table 1). LPR will help to analyze the effects of the proposed design solution in the project area and on the surrounding environment (LAF, 2021).

Table 1 Selected Landscape Performance Metrics

Metric	Variable	Unit	Methods	Expected correlation with site resilience
Environmental benefits				
Area of critical habitat or ecologically valuable land created	Additional critical habitat or preserved ecological land created through design	Square Feet	Site Map	+
Carbon sequestration	Reduced amount of carbon dioxide estimated from tree species, DBH (inches), land use and height	Tons / year	Pathfinder: Landscape Carbon Calculator	+
Retained stormwater	Percent of wet days retained	%	National Stormwater Calculator (developed by U.S. Environmental Protection Agency)	+
	Retained amount of average annual runoff volume	Inches / year	National Stormwater Calculator (developed by U.S. Environmental Protection Agency)	+
Recycled content	Abandoned elevated rail bed space reused	Pounds	Site map, Recycled content calculator on LAF	+

Table 1 (cont'd)

Sulfur dioxide absorbed	Amount of sulfur dioxide air pollution absorbed	Pounds / year	iTree Planting	+
Economic benefits				
Low Impact Development (LID) controls / Annual cost savings from irrigating site with infiltrated water	Amount of water infiltrated on site converted to a monetary value using local city water bill rate	$ / Cubic Feet	City Water Bill Rate	+
Property value	Increased property values	$/month	The Park Catalog	+
Job creation	# of jobs created per businesses proposed in the design	# of jobs created	Comparables	+
Social benefits				
Area of proposed gathering space (square feet) / space for each guest (square feet / person)	Visitor capacity	Maximum Number of Visitors	Heskey, E. (n.d.). eHow Calculator	+
Safety enhancement	Number of pedestrian crosswalks added	Each	Site Map	+
New sidewalks	Length of new sidewalks added	Linear Feet	Site Map	+
New bike lanes	Length of new bike lanes added	Linear Feet	Site Map	+

Table 1 (cont'd)

Event gathering space	Number of community event gathering spaces added	Square Feet	Site Map	+
Open recreational space	Amount of added open / Recreational space	Square Feet	Site Map	+

CHAPTER 4: RESULTS

4.1 Design Goals and Program

The main design goals of this project are 1) safety and social improvements 2) fostering economic growth and 3) environmental resilience. To achieve each goal, this study established detailed design programs. The existing site may have been seen as unsafe by the public due to its excess of abandoned elements. For the safety improvement goal, safety issues may be resolved through redesigning the abandoned industrial elements. The site would hopefully have a reduction in crime and regain a lively reputation. For the education goal, the building usage is designed for tech and robotics classrooms as a place for visitation from nearby schools. Also, there are outdoor learning activities regarding the history of the station and railroads.

The fostering economic growth goal is important for the project site because the redeveloped railroads will provide space for markets or commercial businesses beneath. For this goal, the new space provides for up to thirty new commercial storefronts as well as potential space for vendors on the surface of the railbeds. The site will save on the cost of demolition due to its reuse of the elevated rail beds instead of paying for the cost to haul raw materials offsite (estimated $4,656 total for hauling rail material). This is based on an average rate of $1.50 per cubic foot of junk material (HomeGuide, 2022). There are additional benefits by saving on the costs to send waste to landfills and combustion facilities.

There are many environmental benefits to reusing the existing site. For the environmental resilience goal, the site will be less disturbed due to the reuse of materials and less transportation required onsite. There will be extensive tree and garden additions throughout to reduce the nearby air pollution. Lastly, the aesthetics of the site will be greatly improved due to the redevelopment of the abandoned and neglected areas. The site will have many art and light

displays, play features, and improved landscape and hardscape elements. The paths onsite will represent an abstracted view of the old railroad connections of both Detroit and Windsor, Canada.

As for the building usage (Figure 7), the first floor acts as a lobby and train station museum (approximately 83,333 sf). The second through eighth floors will be classrooms featuring robotics technology for elective courses through the nearby school district (approximately 166,666 sf). The ninth floor through fourteenth floors will be collaboration studios for rent for businesses or meetings (approximately 166,666 sf). The fifteenth through eighteenth floors will be a ballroom for events (83,333 sf). There will be memberships available for purchase for the station site and some of the attached features. These features may include, collaboration studio memberships, museum memberships, or renting for outdoor play elements such as large outdoor chess pieces.

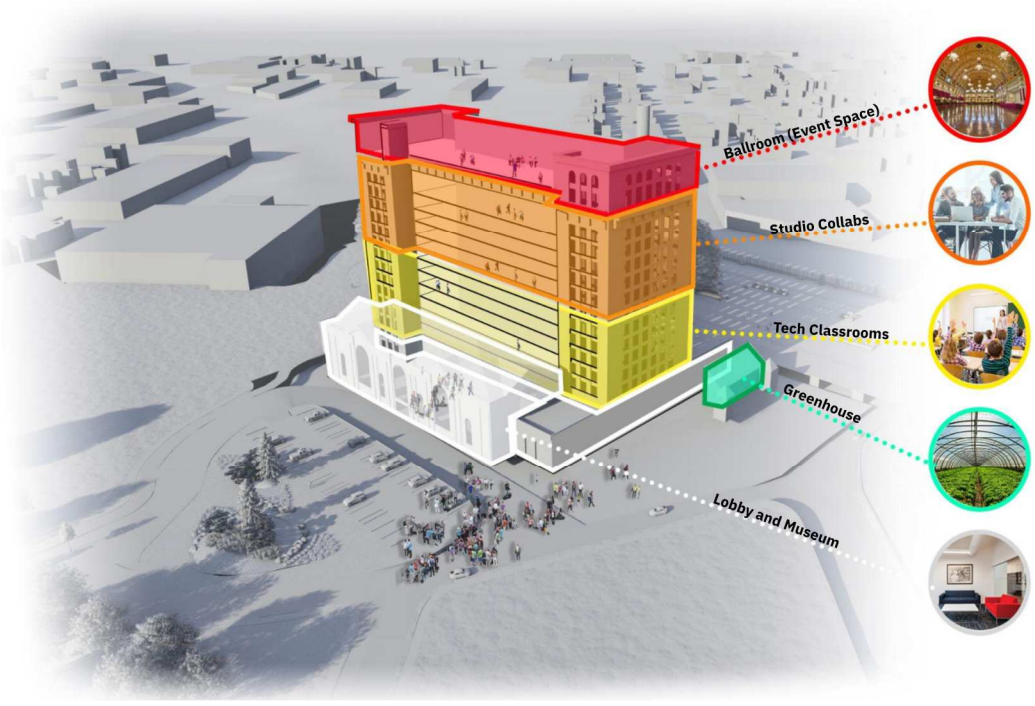


Figure 7 Proposed Building Usage © Brooke Shevela, Ted Cook, Mallory Koning

4.2 Master Plan

This study's master plan had many design components to bring a vibrant new community space to the Corktown and Mexicantown neighborhoods (Figure 8). The design features an extensive amount of open greenspace. This provides an area for field sports, picnics, or running space for children. The redesign also sections off forested areas to offer scenery, deliver environmental benefits and habitat space. This provides shade and climate mitigation for the southern end of the site. Gardens are placed all throughout the redevelopment as an aesthetic and environmental benefit. Many of these planted areas also feature local artwork and bench seats. Old Detroit and Canada railroads were applied, as a concept, to the sidewalk paths weaving through the site. A raingarden is added to the middle of the entrance drive lanes to help infiltrate water onsite. The redesign of the abandoned elevated railbeds provided the site with up to 30 new businesses. These stores are designed to exist beneath the railbed structure and are roughly 1,000 square feet each. This acts as an open marketplace for local businesses in the lower street section of the site. Using the old railbeds as a base concept, the elevated railbeds have been converted into a park space nicknamed "Central Station Park". This portion of the site will have moveable and non-moveable planted components, play features, greenspace, and event space. This event space is created through moving the moveable compartments west to provide extra space for a concert stage or other large gatherings. The elevated railbeds are ADA accessible through a ramp section underneath the center of the railbeds. These ramps stretch on both sides of a large focal-point tree that is planted to show the top half of the tree above the elevated railbeds. This helps to connect the underground section to the Central Station Park. Glass walls surround the tree and ramps so visitors can peer over into the below access routes. There is also

an added parking garage on the west end, adjacent to the Central Station Park. This is a multi-level structure to support many visitors during events and large gatherings.

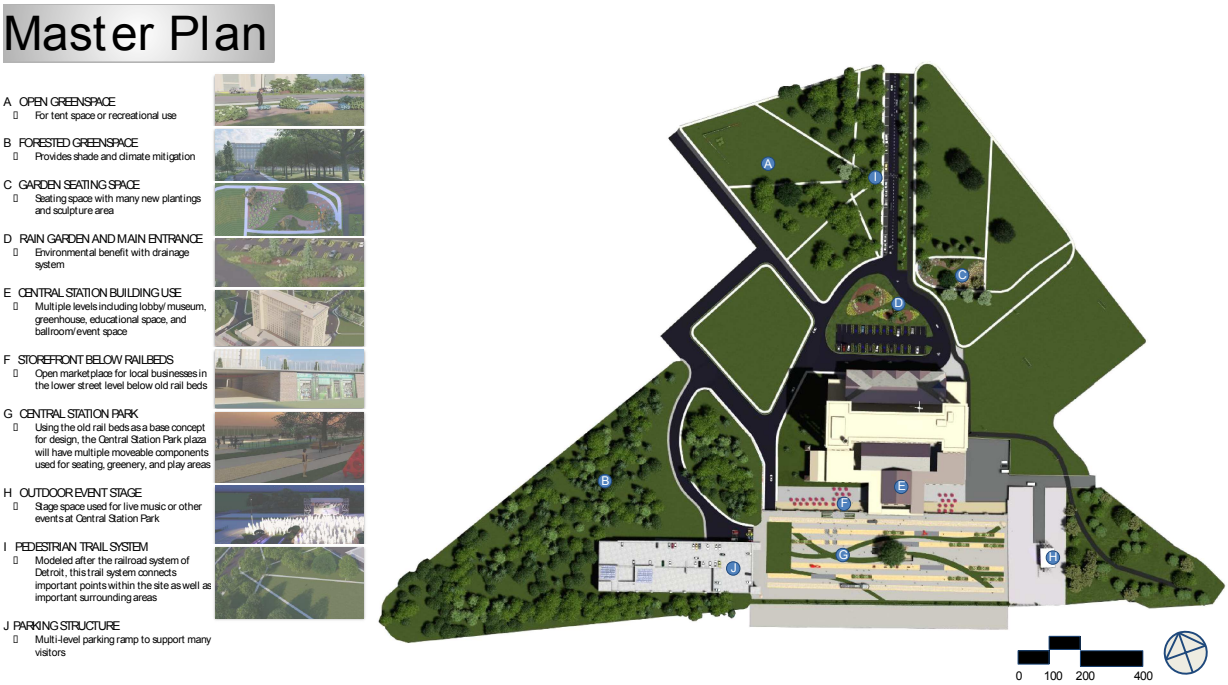


Figure 8 Master Plan © Brooke Shevela, Ted Cook, Mallory Koning

The abandoned elevated railbeds will feature repeating both moveable and non-moveable compartments (Figure 9). The individual compartments include moveable bench seating, patio table seating, adult and children play, and planted zones. The moveable elements will be important because of the concert space alongside them. When a concert or event takes place, they will be able to shift to the west and provide space for stacked seating.

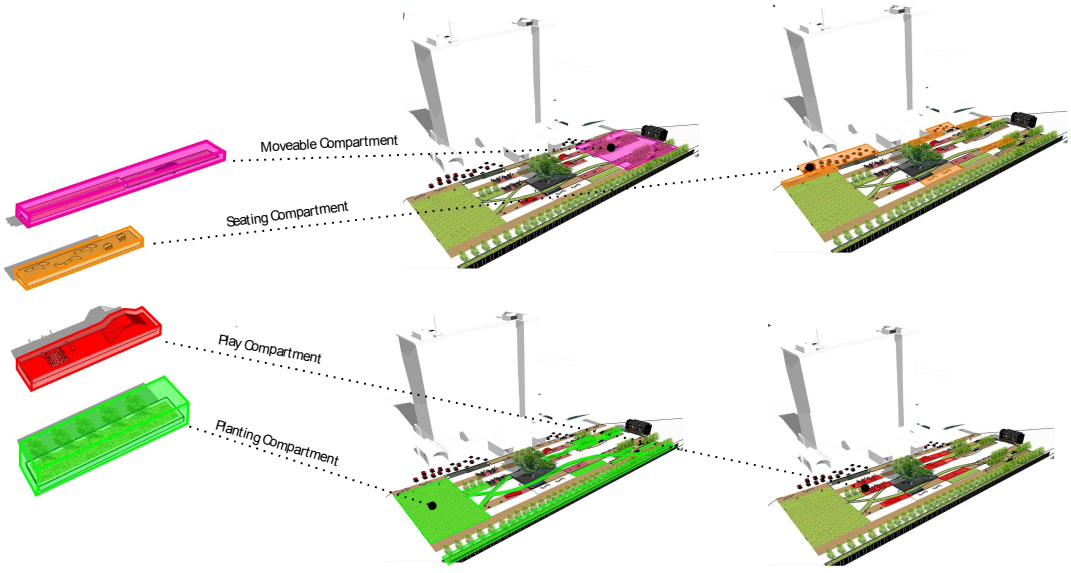


Figure 9 Railbed Redevelopment Design © Brooke Shevela, Ted Cook, Mallory Koning

4.3 Landscape Performance Results

To study the benefits of the station site redesign, LPR was used. This study proposed a series of landscape metrics that focused on three main categories: environmental, social and economic benefits. LPR is used to examine the results of the proposed design solution in the project area and on the neighboring environment (LAF, 2021).

4.3.1 Environmental Benefits

For testing the environmental benefits, different variables were selected. These included: (1) habitat creation, (2) carbon sequestration, (3) stormwater retention, (4) waste recycling and (5) sulfur dioxide reduction (See Table 2). To standardize different units of variables and find the changes for the different environmental benefits, the percent change equation was used. For

example, if the site benefit increased, this formula is used: [(Post-design value – Pre-design value)/(Pre-design value)] and then multiplying that number by 100 to give the percent change. The design proposal indicates a significant increase in areas deemed to be ecologically valuable through plantings (Figure 10). There is a 624% increase in the planted valuable land by comparing existing square footage (17,854) to proposed (129,189). The new design predicts 5.5 tons of carbon sequestered on site based on a 1-year lifetime analysis through the iTree Planting application. Comparing this to the .36 tons being sequestered on the existing site, there is a 1,427% increase in carbon sequestered per year (Figure 10). Through using the National Stormwater Calculator (EPA), estimations suggest that there is a 37% increase in percent of wet days retained, as well as a 14% decrease in the amount of average annual runoff volume (Figure 10). The proposed site design retains 8,185,386 gallons of water annually. This is largely due to the addition of the raingarden onsite in the middle of the north entrance lanes (Figure 11). This water retained will be used as the irrigation for the site's landscape.

The recycled content variable was also studied regarding the design's reuse of the elevated iron rail track. The Recycled Content Tool determined that 193,830 pounds of recycled iron rail track were used in the redesign (Figure 12). Lastly, sulfur dioxide was reduced by 1,400% through tree plantings as shown by the iTree planting calculator (Figure 13).

Table 2 Environmental Benefits © Brooke Shevela

Metric	Variable	Unit	Methods	Baseline Scenario	Results
Environmental benefits					
Area of critical habitat or ecologically valuable land created	Additional critical habitat or preserved ecological land created through design	Square feet	Site Map	362,089 square feet	953,020 square feet. Lawn space increased by 163%, and planted area increased by 624%.
Carbon sequestration	Reduced amount of carbon dioxide estimated from tree species, DBH (inches), land use and height	Tons / year	Pathfinder: Landscape Carbon Calculator	Existing plantings avoided .36 tons of carbon dioxide.	1,427% more carbon is sequestered yearly. Total carbon sequestered yearly onsite: 5.5 tons.
Retained stormwater	Percent of wet days retained	%	National Stormwater Calculator (developed by U.S. Environmental Protection Agency)	Percent of wet days retained was 27.16%.	Percent of wet days retained increased by 37%. Percent of wet days retained is 64.08%.
	Reduced amount of average annual runoff volume	Inches / year	National Stormwater Calculator (developed by U.S. Environmental Protection Agency)	Average annual runoff volume was 33.19 inches.	Amount of annual runoff volume reduced by 14%. The average annual runoff volume is 7.37 inches. The site retains 8,185,386 gallons of water.
Recycled content	Abandoned Elevated Rail Bed Space Reused	Pounds	Site Map, Recycled Content Calculator on LAF	N/A	The redesign used 193,830 pounds of recycled iron rail track.

Table 2 (cont'd)

Sulfur dioxide Reduction	Reduced amount of Sulfur dioxide air pollution	Pounds / year	iTree Planting	Amount of Sulfur dioxide reduced was .1 pounds.	Amount of Sulfur dioxide reduced is 1.5 pounds. There is a 1,400% reduction in Sulfur dioxide.

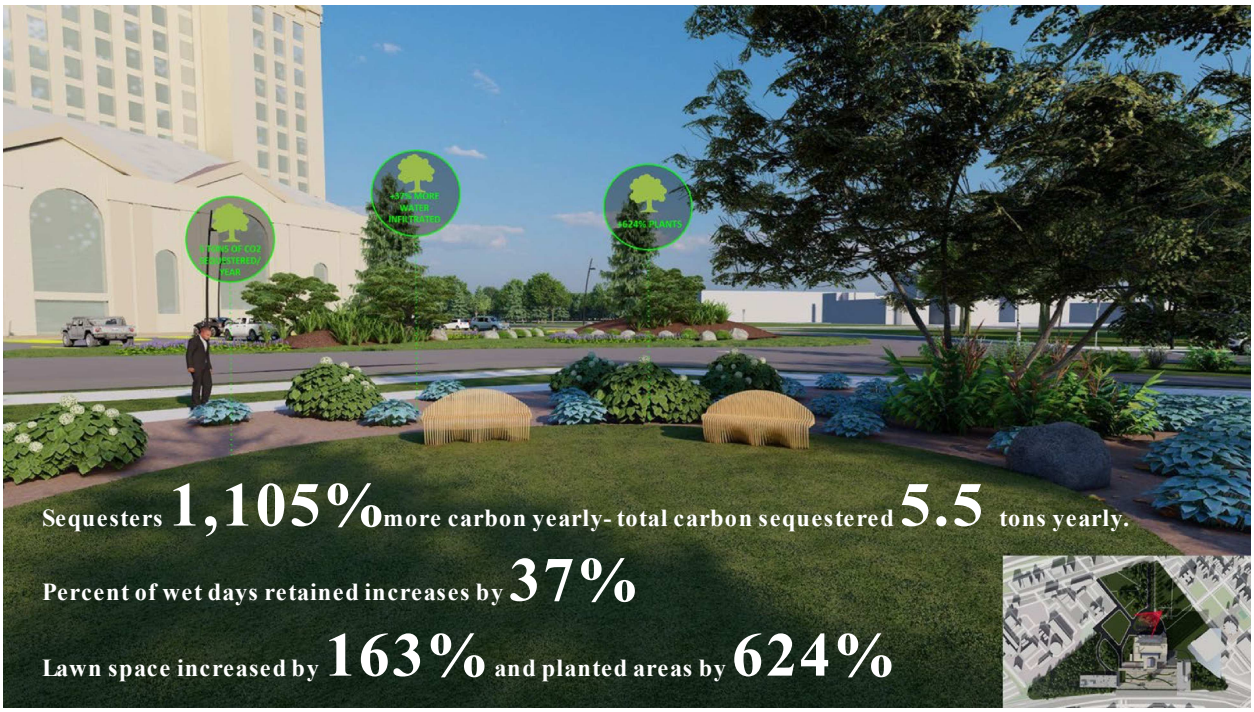


Figure 10 Front Plantings © Brooke Shevela, Ted Cook, Mallory Koning

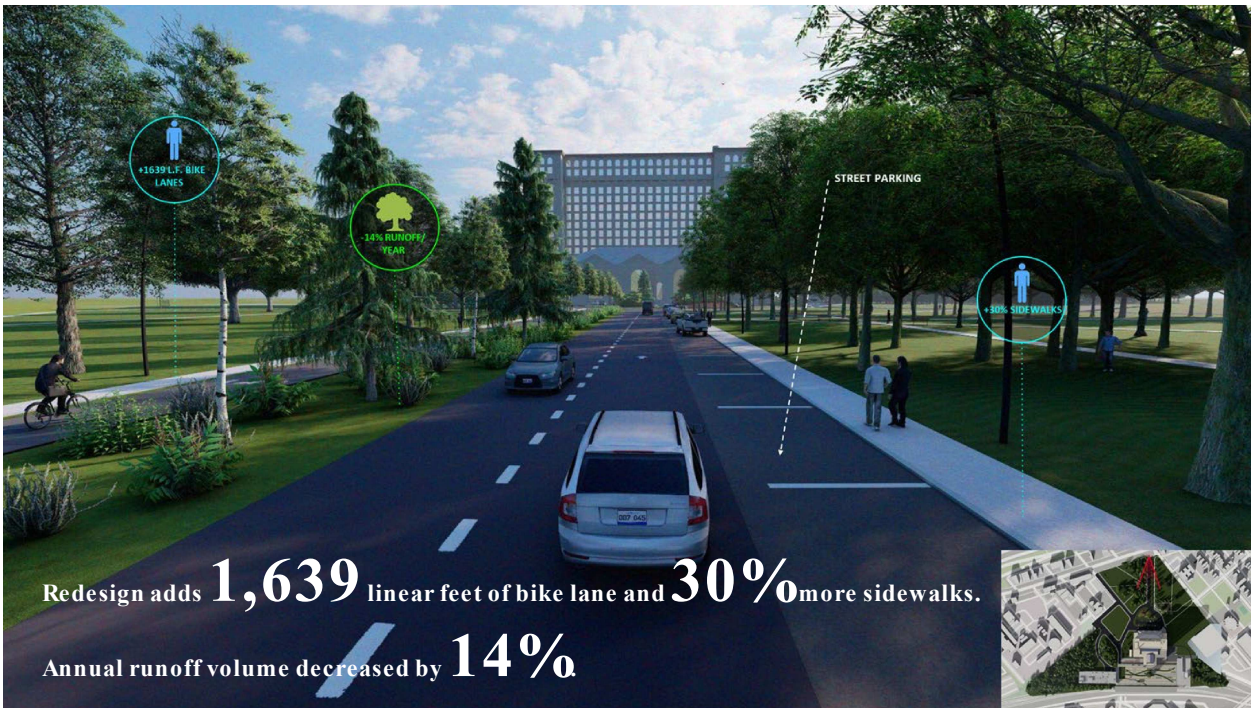


Figure 11 Entrance Routes © Brooke Shevela, Ted Cook, Mallory Koning

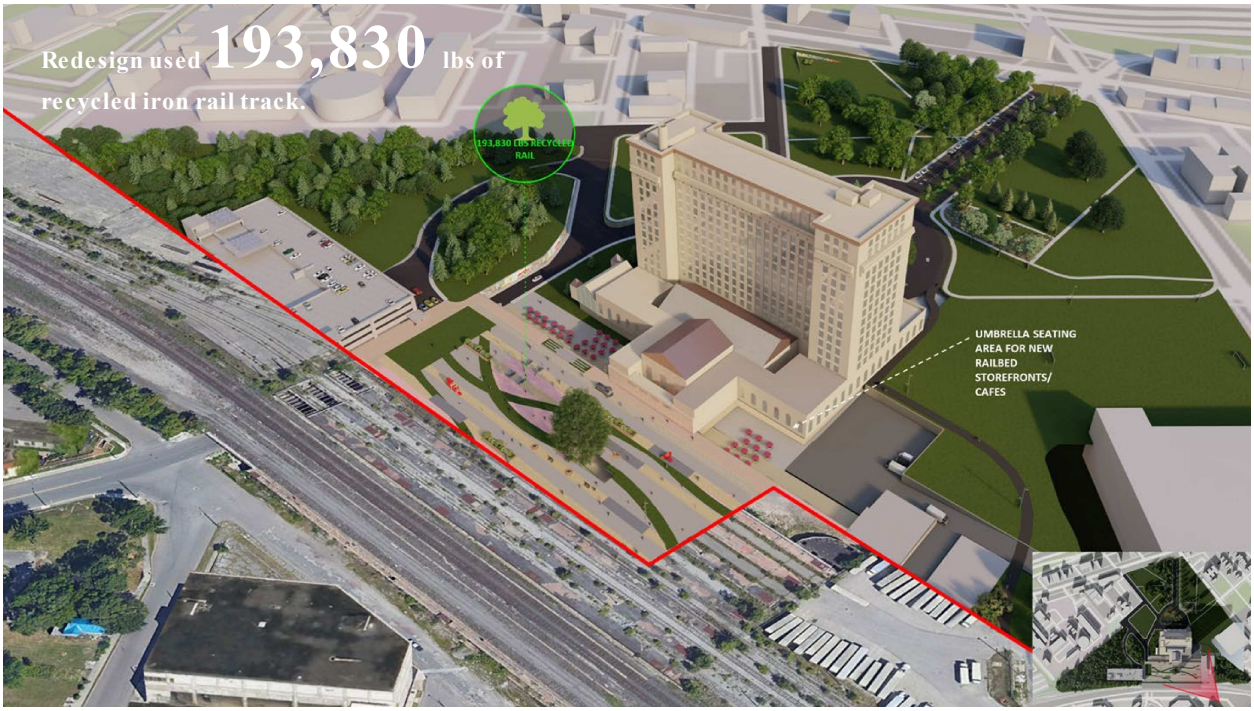


Figure 12 Proposed Rail Track Design © Brooke Shevela, Ted Cook, Mallory Koning

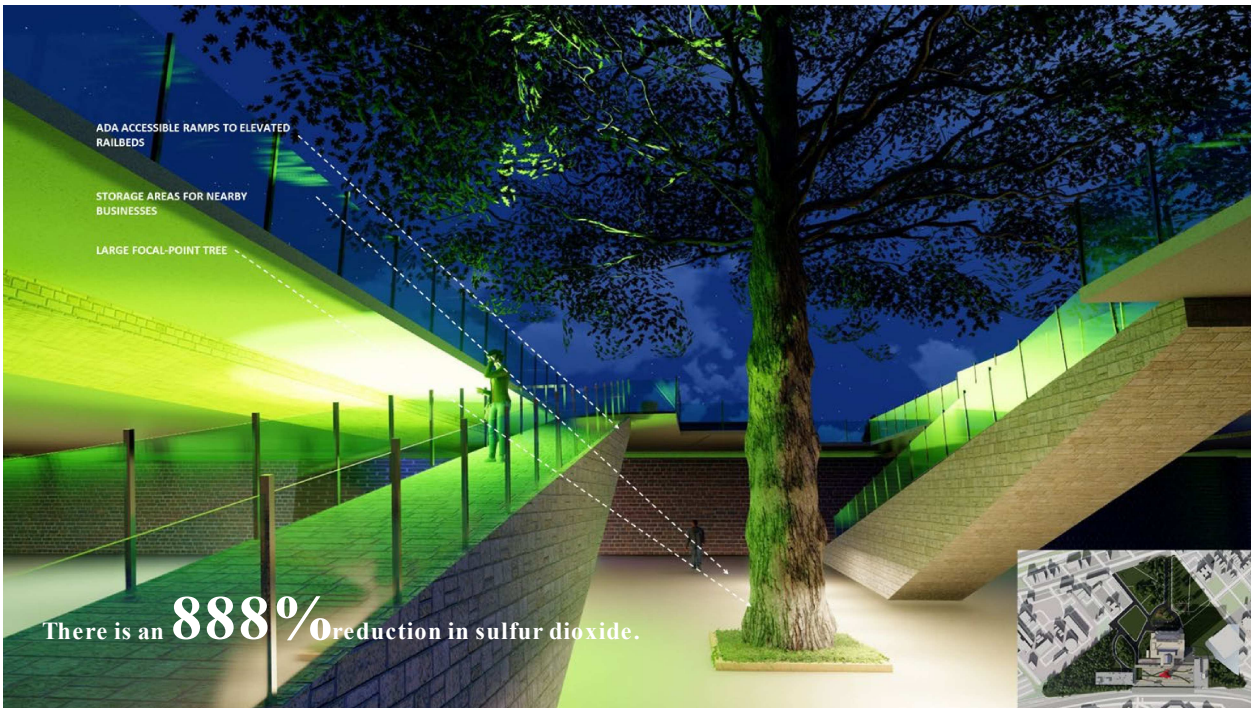


Figure 13 ADA Accessible Routes © Brooke Shevela, Ted Cook, Mallory Koning

4.3.2 Economic Benefits

This study looks into the economic benefits of the redesign of the station project site. The variables studied include (1) the annual cost savings from stormwater retained, (2) property value impacts, and (3) job creation. The water volume retained on-site, through plantings, will be used as irrigation for the site landscape. This has economic savings because the site will not require any additional water to be brought onto the site to water plantings, and therefore, less overall maintenance and labor costs to irrigate. In studying the annual cost savings from using the stormwater retained on site, it was necessary to find Detroit's Water Volume Rate. According to the City of Detroit Water and Sewage Department, Detroit's Water Volume Rate is $25.20 per 1,000 cubic feet. There is 1,094,226 cubic feet of water infiltrated on site annually through plantings, this saves $27,574.49 each year that would have otherwise needed to be treated.

When looking at how the surrounding area was affected, it was important to understand how adding a park space can affect nearby property values. According to Caston (2018), parks at a similar scale to the Michigan Central Station site are known to greatly increase the property values of nearby homes in a range from 8-20% (The Park Catalog, 2018). This will help to increase overall property values of Corktown and Mexicantown and stimulate economic growth for the area.

Also, the redevelopment of Michigan Central Station's elevated railbeds adds up to 30 new businesses (Figure 14). These businesses are sized 20 feet of storefront by 50 feet of store depth. This totals 1,000 square feet for each of the 30 small new businesses. According to Mel Kleiman (2012), the average store employed an average of 9 people, with a range of 4-36 (Kleiman, 2012). Based on the size of retail space in this case study, we plan to provide a minimum of four jobs per business. With 30 new businesses, at four employees each, this adds a minimum of 120 new jobs for the community.

Table 3 Economic Benefits © Brooke Shevela

Metric	**Variable**	**Unit**	**Methods**	**Baseline Scenario**	**Results**
Economic benefits					
Low Impact Development controls and annual cost savings from irrigating site with infiltrated water	Amount of water infiltrated on site converted to a monetary value using local city water bill rate	$ / Cubic Foot	City of Detroit Water and Sewage Department	$0.00/ year in cost savings due to no maintenance of abandoned site.	The annual cost savings from retained stormwater on site is $27,574.49 / year.
Property Value	Increased property values	$ / Month	TheParkCatalog	N/A	The nearby property values increase by 8-20%.

Table 3 (cont'd)

Job Creation	Number of jobs created per businesses proposed in the design	Number of Jobs Created	Comparables	0 jobs	The number of jobs created increases to 120.

Figure 14 Proposed Store Fronts © Brooke Shevela, Ted Cook, Mallory Koning

4.3.3 Social Benefits

This study looks into the social benefits of the redesign of the station project site. The variables studied included (1) the capacity and space for each guest, (2) safety enhancements, (3) new sidewalks, (4) bike lane additions, (5) public gathering space, and (6) open recreational space. In studying the proposed capacity space added, it was determined that there should be 10 square feet per person through referencing the guide by Heskey, E. The proposed site design allows for a total capacity of 86,017 on site (Figure 15). For safety enhancements, five crosswalks were added to provide easy walking and biking access throughout the site (Figure

16). There was a 43% increase in sidewalks added based on the existing linear feet of available sidewalk (6,502) compared to the proposed sidewalk (9,323). There were no bike lanes on the existing site, while the new site design adds 1,639 linear feet. The public gathering space increased by 138% due to the square footage of the existing (362,089) compared to the proposed (860,178) (Figure 15). Lastly, the open recreational space was studied comparing the existing square footage (362,089) to the proposed (695,955) to show that there was a 92% increase (Figure 16).

Table 4 Social Benefits © Brooke Shevela

Metric	**Variable**	**Unit**	**Methods**	**Baseline Scenario**	**Results**
Social benefits					
Area of proposed gathering space (total site square feet / square feet per person)	Visitor capacity	Maximum Number of Visitors	Heskey, E. (n.d.). eHow Calculator	Based on 10 square feet per person, there was a total site capacity of 36,208 people.	Based on 10 square feet per person, there is a total site capacity of 86,017 people.
Safety Enhancement	Number of pedestrian crosswalks added	Each	Site Map	There were 0 functioning crosswalks.	There are 5 added crosswalks.
New sidewalks	Length of new sidewalks added	Linear Feet	Site Map	There was 6,502 linear feet of sidewalks.	The amount of new sidewalks increases by 43%. There is 9,323 linear feet of total sidewalks.
New bike Lanes	Length of new bike lanes added	Linear Feet	Site Map	There were 0 bike lanes.	Bike lanes increase by 1,639 linear feet.

Table 4 (cont'd)

Event Gathering space	Number of community event gathering spaces added	Square Feet	Site Map	There was 164,223 square feet of gathering space.	The number of community event gathering spaces increased by 138%. There is 695,955 square feet of community space.
Open recreational space	Amount of added open / Recreational space	Square Feet	Site Map	There was 257,065 square feet of open / recreational space.	The amount of open / recreational space increased by 92%.There is 953,020 square feet of open / recreational space.

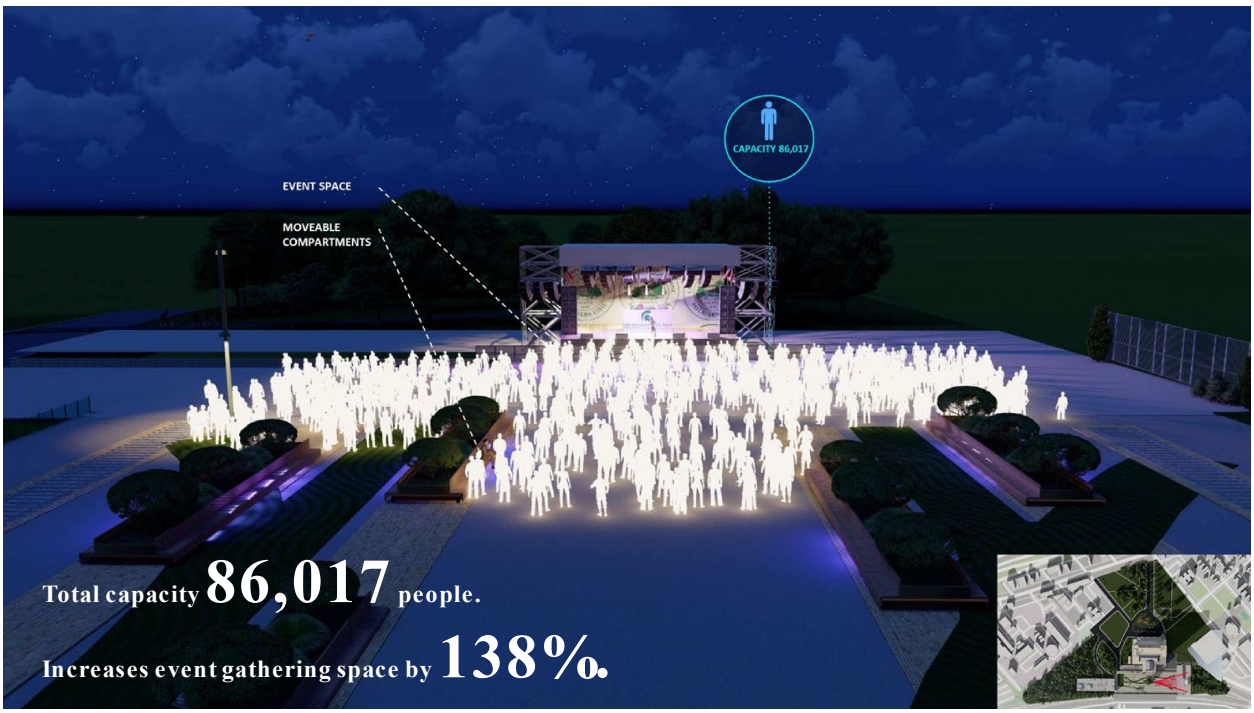


Figure 15 Event Space on Elevated Railbeds © Brooke Shevela, Ted Cook, Mallory Koning

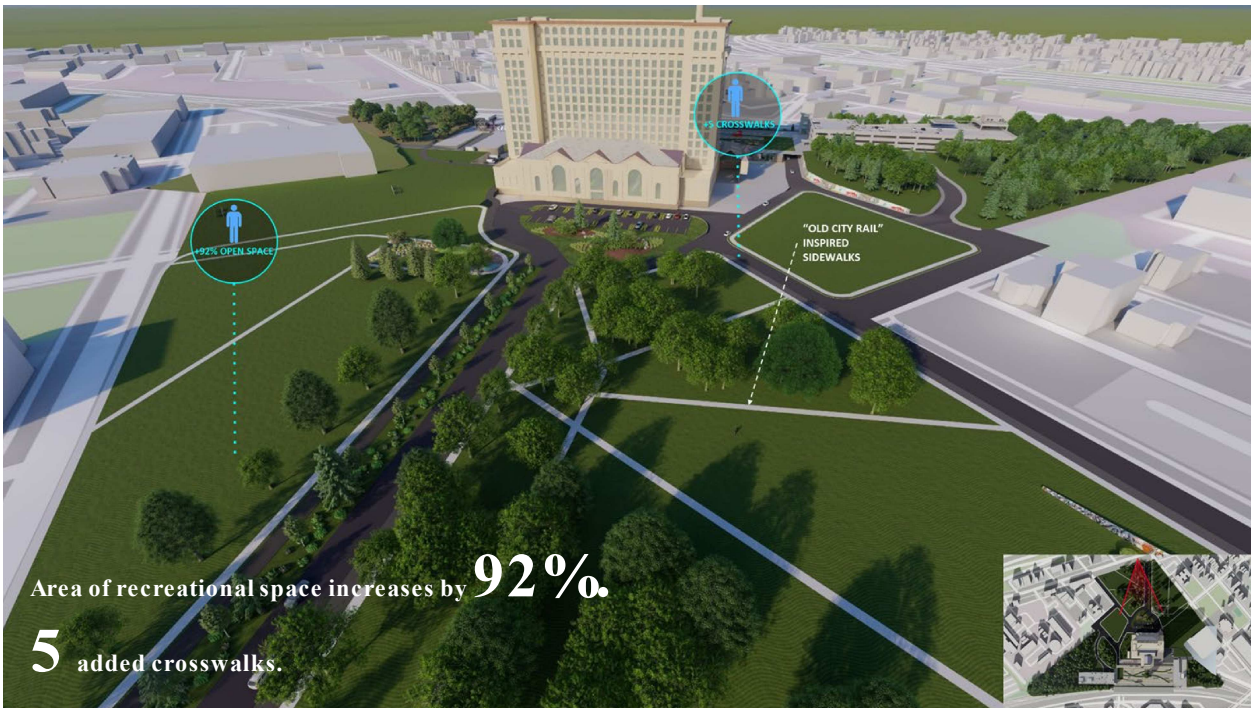


Figure 16 Crosswalks and Open Space © Brooke Shevela, Ted Cook, Mallory Koning

CHAPTER 5: DISCUSSION AND CONCLUSIONS

Urban vacancy is accelerating in urban cities such as Detroit. There are many reasons that urban vacancy happens, including the decrease of available jobs, deindustrialization and suburban sprawl (Kremer et al., 2013). Designers have a multitude of access to these decaying sites and it's crucial to focus on the importance of their redevelopment to stop urban sprawl and provide case study examples to showcase the benefits of redeveloping outdoor environments to preserve the history on site.

The purpose of this study was to examine the redevelopment of an underused site, especially focusing on industrial site elements, and the effects on the adjacent community. The proposed master plan shows a balance of environmental improvements, community features, and economic benefits. The increases in plantings, reuse of materials and increases in stormwater retention will benefit the air quality and overall environment on the site. The additions of public art, games, open space, and safety features will benefit local communities by offering diverse outdoor opportunities. The bike lanes and sidewalk additions will improve accessibility of the adjacent neighborhoods' existing bike networks and lead to the downtown waterfront district. Through adding storefronts under the elevated railbeds there will be opportunities for local economic growth and new jobs. Overall, the redevelopment of an urban site with abandoned elements that feature Detroit history is an important case study to showcase the benefits of reuse versus demolishment.

Based on a scientific assumption that the redevelopment of the abandoned industrial site generates a positive effect on the social, environmental, and economics of the nearby communities, this research ultimately aims to reveal social, environmental and economic values of redeveloping an industrial site with an abandoned element. By looking at these three different

aspects, it showed a wide range of benefits of reusing site elements versus turning to demolition. The use of LPR also unveiled the benefits of stormwater management, improved air quality and increased ecologically valuable spaces. In regard to social aspects, the research aimed to uncover if turning these abandoned elements into greenways, bike lanes and pedestrian paths could provide a more positive perception of safety on the site. As previously stated, relevant studies support that the redevelopment of abandoned site elements tends to increase public perception of safety. This helps to hypothesize similar effects on this current research project's redeveloped site. Lastly, the economics were analyzed first starting with a map of the surrounding properties near the site to show the number properties that may be positively impacted. These were compared to similar property values in relation to accessibility to the new project. Past research regarding greenways, bike lanes and trails and property values was analyzed to show there is a beneficial property value effect to adding comparable public parks. The research conducted in this study is an important step in realizing the benefits of reusing abandoned site elements.

Limitations of this research include the chosen plantings used on the redeveloped site. Plants will have to be individually analyzed due to differences in plant zones, characteristics and local needs. For the purpose of this study, the plantings are in the plant zone of southeastern Michigan. Expense support that cannot be obtained during this research may have caused a limitation. It is important to note that every urban industrial site, with abandoned elements, may have different needs and unique attributes to consider. The results of this study are subject to site-specific conditions. Therefore, the generalization of this research's findings onto other projects may be limited.

This study will potentially impact future designs in urban settings on sites that feature an abandoned industrial element. This could provide important insight in determining designers'

decisions to redevelop these site elements versus demolishing them. There may be a cost incentive for local government with these developments causing increases in property values and decreasing environmental hazards such as flooding. By using quantitative methods, this research promotes quantifying the design impact to determine design impacts in future studies. This redeveloped site may also provide inspiration for similar sites and act as a malleable guidebook. Increases in this type of redevelopment will contribute to building better urban communities and outdoor lifestyle.

REFERENCES

REFERENCES

Air Pollutant Sources, exposures, & health impacts. CAPHE. (n.d.). Retrieved December 17, 2021, from http://caphedetroit.sph.umich.edu/air-pollutant-source-exposures-health-impacts/

Angel, S., Sheppard, S., Civco, D. L., Buckley, R., Chabaeva, A., Gitlin, L., & Perlin, M. (2005). The dynamics of global urban expansion: World Bank, transport and urban development department. (Washington, DC).

AlRayyan, K., Hamarneh, C., Sukkar, H., Ghaith, A., & Abu-Jaber, N. (2017). From abandoned mines to a labyrinth of Knowledge: A conceptual design for a Geoheritage Park Museum in Jordan. *Geoheritage*, *11*(2), 257–270. https://doi.org/10.1007/s12371-017-0266-8

Bluestone, B. (2013). *Detroit and deindustrialization*. Detroit and Deindustrialization | Dollars & Sense. Retrieved January 22, 2022, from http://dollarsandsense.org/archives/2013/0913bluestone.html

Biddau, G. M., Marotta, A., & Sanna, G. (2020). Abandoned landscape project design. *City, Territory and Architecture*, *7*(1). https://doi.org/10.1186/s40410-020-00118-7

Bolitzer, B., & Netusil, N. R. (2000). The impact of open spaces on property values in Portland, Oregon. *Journal of Environmental Management*, *59*(3), 185–193. https://doi.org/10.1006/jema.2000.0351

Burian, J. (2012). Advances in spatial planning. InTechOpen. https://www.intechopen.com/books/advances-in-spatial-planning

Bureau, U. S. C. (2021, November 8). Census.gov. Retrieved November 9, 2021, from https://www.census.gov/

Air Pollutant Sources, exposures, & health impacts. Community Action to Promote Healthy Environments. (n.d.). Retrieved January 22, 2022, from http://caphedetroit.sph.umich.edu/air-pollutant-source-exposures-health-impacts/

Caston, R. (2018, October 12). *Research shows parks add significant boost in home values nearby*. The Park Blog. Retrieved January 21, 2022, from https://www.theparkcatalog.com/blog/parks-homes-values/

Chin, E. Y., & Kupfer, J. A. (2019). Prevalence of ecological, environmental, and societal objectives in urban greenway master plans. *Southeastern Geographer, 59*(2), 153-171. http://dx.doi.org/10.1353/sgo.2019.0013

Climate positive design: Pathfinder. Climate Positive Design | Pathfinder. (n.d.). Retrieved February 3, 2022, from http://app.climatepositivedesign.com/

Corktown demographics and statistics. Niche. (n.d.). Retrieved September 24, 2021, from https://www.niche.com/places-to-live/n/corktown-detroit-mi/residents/.

Davis, M. (2020, February 27). Violent crime statistics in Detroit: DAVIS Law Group. Retrieved May 04, 2021, from https://www.michigancriminallawyer.com/violent-crime-statistics-detroit/

Deeg, L. R., & Segedy, J. A. (2004). *Prepare the winding path: Examining the reuse potential of abandoned industrial infrastructure in community health, housing, transportation, recreation, and tourism*

City Observatory. (2018, November 5). *Detroit's corktown: Portrait of a diverse neighborhood*. Retrieved September 24, 2021, from https://cityobservatory.org/corktown/

Di Ruocco, G., Sicignano, E., Fiore, P., & D'Andria, E. (2017). Sustainable Reuse of Disused Railway. *Procedia Engineering*, *180*, 1643–1652. https://doi.org/10.1016/j.proeng.2017.04.327

Eizaguirre-Iribar, A., Igiñiz, L. E., & Hernández-Minguillón, R. J. (2016). A multilevel approach of non motorised accessibility in disused railway systems: The case-study of the Vasco Navarro railway. Journal of transport geography, 57, 35-43.

Environmental Protection Agency. (n.d.). Help prevent pollution by controlling stormwater runoff. EPA. Retrieved February 3, 2022, from https://swcweb.epa.gov/stormwatercalculator/

Environmental Protection Agency. (n.d.). What are the trends in wastes and their effects on human health and the environment? EPA. Retrieved March 16, 2022, from https://www.epa.gov/report-environment/wastes

Environmental Protection Agency. (n.d.). Recycled Content (ReCon) Tool . EPA. Retrieved February 3, 2022, from https://www.epa.gov/warm/recycled-content-recon-tool

Gabbianelli A (2012) Spazi residuali, IUAV Giornale dell'Università, 2012/106

García-Mayor, C., Martí, P., Castaño, M., & Bernabeu-Bautista, Á. (2020b). The Unexploited Potential of Converting Rail Tracks to Greenways: The Spanish Vías Verdes. *Sustainability*, *12*(3), 881. https://doi.org/10.3390/su12030881

Garvin, E. C., Cannuscio, C. C., & Branas, C. C. (2013). Greening vacant lots to reduce violent crime: A randomised controlled trial. Injury Prevention, 19(3), 198–203. https://doi.org/10.1136/injuryprev-2012-040439

Greiving, S., Ubaura, M., & Tešliar, J. (Eds.). (2016). *Spatial planning and resilience following disasters: International and comparative perspectives*. Policy Press.

Gu, D., Newman, G., Kim, J. –H., Park, Y., & Lee, J. (2019). Neighborhood decline and mixed land uses: Mitigating housing abandonment in shrinking cities. *Land Use Policy,* 83, 505 511. https://doi.org/10.1016/j.landusepol.2019.02.033

HistoricDetroit.org, D. A. N. A. U. S. T. I. N. of. (n.d.). *Michigan Central Station: Historic Detroit*. Michigan Central Station -. Retrieved October 15, 2021, from https://www.historicdetroit.org/buildings/michigan-central-station

HomeGuide. (n.d.). *2022 junk removal prices list: How much to haul away trash?* Retrieved March 12, 2022, from https://homeguide.com/costs/junk-removal-prices

How deep should a retail space be? City Comforts, the blog. (n.d.). Retrieved January 21, 2022, from https://citycomfortsblog.typepad.com/cities/2008/04/lucky-in-lake-c.html

I-tree planting calculator! v2.1.3. I-tree planting. (n.d.). Retrieved February 3, 2022, from https://planting.itreetools.org/

Kellogg, A. P. (2009, Nov 06). How do you put the dump into dump truck? push it off the fourth floor -- detroit's abandoned industrial landscape has become a playground for pranksters. *Wall Street Journal* Retrieved from https://www.wsj.com/articles/SB125745924791631907

Kim, E. J., & Kang, Y. (2019). Relationship among pollution concerns, attitudes toward social problems, and environmental perceptions in abandoned sites using bayesian inferential analysis. *Environmental Science and Pollution Research International, 26*(8), 8007-8018.

Kleiman, M., & Kleiman, M. (2012, April 10). *Managing today's retail workforce*. CStore Decisions. Retrieved January 21, 2022, from https://cstoredecisions.com/2012/04/10/managing-todays-retail-workforce-2-2/

Kremer, P., Hamstead, Z. A., & McPhearson, T. (2013). A social-ecological assessment of vacant lots in New York City. *Landscape and Urban Planning, 120,* 218-233. https://doi.org/10.1016/j.landurbplan.2013.05.003

Landscape Architecture Foundation. Retrieved November 9, 2021, from https://www.lafoundation.org/

Landscape performance series. (2021, March 10). Retrieved March 17, 2021, from https://www.landscapeperformance.org/

Leaf Group. (n.d.). *How to figure out the capacity for events*. eHow. Retrieved December 17, 2021, from https://www.ehow.com/how_8066810_figure-out-capacity-events.html

Li, H.-W., & Tsai, T.-C. (2017). REVITALIZATION STRATEGIES FOR ABANDONED SUGAR FACTORY SITES IN TAIWAN. *International Journal of Organizational Innovation*, *10*(1), 229–237.

Mexicantown demographics and statistics. Niche. (n.d.). Retrieved November 9, 2021, from https://www.niche.com/places-to-live/n/mexicantown-detroit-mi/residents/.

Mexicantown Detroit. (2018, July 20). Retrieved November 9, 2021, from https://www.mexicantown.com/.

Michigan central Station. Architectuul. (n.d.). Retrieved September 24, 2021, from http://architectuul.com/architecture/michigan-central-station

Michigan Central Station: Mobility Innovation District. Michigan Central. (2021, September 17). Retrieved November 10, 2021, from https://michigancentral.com/.

Millenium village neighborhood in Detroit, Michigan (MI), 48216 detailed profile. Millenium Village neighborhood in Detroit, Michigan (MI), 48216 subdivision profile - real estate, apartments, condos, homes, community, population, jobs, income, streets. (n.d.). http://www.city-data.com/neighborhood/Millenium-Village-Detroit-MI.html.

Millington, N. (2015). From urban Scar To 'park in the sky': Terrain vague, urban design, and the Remaking of New YORK CITY'S High Line Park. *Environment and Planning A: Economy and Space*, *47*(11), 2324–2338. https://doi.org/10.1177/0308518x15599294

Newman, G., 2013. A conceptual model for measuring neglect in historic districts. J. Preserv. Educ. Res. 6, 41–58.

Newman, G., Saginor, J., 2014. Four imperatives for preventing demolition by neglect. J. Urban Des. 19, 622–637.

Newman, G., Gu, D., Kim, J.-H., Li, W., 2016a. Elasticity and urban vacancy: a longitudinal comparison of US cities. Cities 58, 143–151.

Newman, G.D., Bowman, A.O.M., Jung Lee, R., Kim, B., 2016b. A current inventory of vacant urban land in America. J. Urban Des. 21, 302–319.

Nicholls, R. J., & Cazenave, A. (2010). Sea-level rise and its impact on coastal zones.*Science (Washington), 328*(5985), 1517-1520.

Noh, Y. (2019). Does converting abandoned railways to greenways impact neighboring housing prices? *Landscape and Urban Planning, 183*, 157-166.

Oswalt, P. & Rieniets, T. (2007). Global Context. Shrinking Cities. Atlas of Shrinking Cities.

Piemontese F (2008) Aree dismesse e progetto urbano. Architettura, territorio, trasformazione. Gangemi, Roma.

Pool, R., & Stratton, K. R. (2015). Detroit Future City. In *Bringing public health into urban revitalization: Workshop summary*. Washington, DC: The National Academies Press.

Rovelli, R., Senes, G., Fumagalli, N., Sacco, J., & De Montis, A. (2020). From railways to greenways: a complex index for supporting policymaking and planning. A case study in Piedmont (Italy). Land Use Policy, 99, 104835. https://doi.org/10.1016/j.landusepol.2020.104835

South, E. C., Hohl, B. C., Kondo, M. C., MacDonald, J. M., & Branas, C. C. (2018). Effect of Greening Vacant Land on Mental Health of Community-Dwelling Adults: A Cluster Randomized Trial. JAMA Network Open, 1(3). https://doi.org/10.1001/jamanetworkopen.2018.0298

STAMP, L. (1951). The reclamation of abandoned industrial areas. *Journal of the Royal Society of Arts,100*(4863), 97-122. Retrieved September 19, 2020, from http://www.jstor.org/stable/41365305

Uberti, D. (2014, April 3). *The death of a Great American city: Why does anyone still live in Detroit?* The Guardian. Retrieved January 22, 2022, from https://www.theguardian.com/cities/2014/apr/03/the-death-of-a-great-american-city-why does-anyone-still-live-in-detroit

Viña, C. (2010, November 14). BUILDING SAN ANTONIO; How far will you walk to the grocery or park? *San Antonio Express-News (TX)*.

Water Rates 2019-2020 Detroit Final for Web. (n.d.). City of Detroit Water and Sewage Department. Retrieved January 30, 2022, from https://detroitmi.gov

Wells, G. (1998). Urban Environmentalism: Redeveloping America's Brownfields. Hispanic Engineer and Information Technology, 13(2), 56-57.

World Bank Group. (2018). Global waste to grow by 70 percent by 2050 unless urgent action is taken: World Bank Report. World Bank. Retrieved March 13, 2022, from

https://www.worldbank.org/en/news/press-release/2018/09/20/global-waste-to-grow-by-70-percent-by-2050-unless-urgent-action-is-taken-world-bank-report

Yang, S., Kim, J.-H., Sohn, W., and Kotval-Karamchandani, Z. (2020). Developing a revitalization planning and design guideline for enhancing land use performance of a shrinking city. Journal of People, Plants, and Environment. 23(4), 387~398. https://doi.org/10.11628/ksppe.2020.23.4.387

Zhang, C., Shujian, D., & Haishan, X. (2020). Reuse of abandoned railways leads to urban regeneration: A tale from a rust track to a green corridor in zhangjiakou. *Urban Rail Transit, 6*(2), 104-115. https://doi.org/10.1007/s40864-020-00127-2

Zhang, W., Oh, S., & Rainer, v. H. (2018). Transforming abandoned rail corridors into multi-purpose trails: Applying a spatial hedonic approach to estimating the economic benefits of the little Miami scenic trail in Cincinnati, Ohio, USA. *Urban Rail Transit, 4*(4), 274. https://doi.org/10.1007/s40864-018-0094-4