Alternative Uses for Vacant Land in Detroit, Michigan

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Abstract

Detroit is situated in a historically productive lake plain in the Great Lakes region of the Midwestern United States. Geographic centrality, access to rail and water transportation, and industrial innovation were responsible for the growth of the central city. Deindustrialization, suburbanization and discrimination were responsible for the decline of the central city. The current state of the economy in the metro Detroit region makes redevelopment of large tracts of vacancy within the city of Detroit economically challenging. Detroit is not alone as an urban area facing the challenges of a shrinking population in a declining economy. The experiences of other shrinking cities illustrate that standard planning approaches may not be functional in situations of decline, and that the generation of alternative responses to these situations is valuable and necessary.

The tracts of vacancy in the city of Detroit are currently functioning at some ecological level, but the history of industrial contamination must be addressed in order to limit the effects of the contamination on the ecological systems. Restoration methods operating within a system that has high levels of degradation should integrate methods of remediation. Bioremediation may be among the most plausible remediation approaches in Detroit where money is limited but time is available. A native low input high diversity prairie could operate as a restoration, a form of bioremediation and a source of biomass for the production of cellulosic ethanol. The utilization of a low input high diversity prairie as a source of ethanol biomass could provide an economic pathway for executing landscape change throughout Detroit while not limiting potential pathways of future development. The southern Great Lakes region's productive soils and history of agriculture support the plausibility of harvesting prairie for biomass. Detroit's geographic centrality and access to rail and water transport could make it an effective production center to ship or receive large quantities of biomass. Sustainable industrial innovation could stimulate renewed growth within the city of Detroit.

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Introduction

Context of experience

While in the process of drafting this document I received a letter from Catherine McClary, treasurer for Washtenaw County. The letter informed me that the owners of the house that I had been renting in Ann Arbor had unpaid taxes dating to 2005 or before. This meant the property had been forfeited in March 2007 and would face final foreclosure in six weeks, on March 1st 2008. Pending the sale of the property, we should be prepared to move; a shocking notification that carried near immediate and somewhat dramatic consequences.

Unfortunately, this situation is not unique in southeastern Michigan. As of January 28th, 2008 the Detroit Free Press had 26,885 properties listed in its foreclosure database for Oakland, Macomb and Wayne counties. Detroit alone had 11,790 listings (Detroit Free Press, 2008). And these listings only represented properties that had been foreclosed *this year*.

The fate of these properties is uncertain; some will be sold, some will be taken over by governmental entities, and some will be retained by the current owners who settle their outstanding debts. Still, these numbers give a snapshot view of the scale of pressure that diminishing economies are exerting on neighborhoods, communities and broader regions all over the globe.

The city of Detroit has been dealing with the effects of a shrinking population since 1953. Today, less than 50% of the population that peaked at nearly 2 million remains within its borders. This extreme population change carries deep implications for the landscape that is forced to accommodate it, bringing along complex new challenges for designers, planners and social institutions. In response to those challenges, professionals all over the world are attempting to construct a new paradigm of thought that will provide a framework to effectively address them.

This project adds to that dialogue through the examination of city-owned vacant properties in Detroit. A GIS based analysis is utilized to develop management strategies which are described and illustrated through neighborhood scale management details. This project frames one approach to the problems posed by a shrinking population in the central city of a large metropolis; a city that has lost more than 1 million people. The proposals are specific to Detroit, but the broader level of thinking illustrated may be transferable across contexts.

Definition of problem

Without an effective, broadly encompassing management plan in place, vacant properties throughout Detroit present many hazards to the community and the ecology of the city. The communities have been burdened to deal with blighted structures and yards that become magnets for illegal dumping and harbors for criminal activities. They are disruptions of inhabited blocks that provoke a pervasive sense of despair. They are found in many states of disrepair, ownership is often ambiguous, and they are potential sources of contamination.

As the number of these sites continues to increase, so do the feelings of disconnection and disempowerment within the community. The city is under many economic pressures and is presently unable to allocate substantial funds towards this issue. The municipal approach to revitalization has largely focused on areas of the city that are the most well off and in need of the least amount of restructuring (Detroit Free Press, 2007; Sugrue, 2005). Predictably, the largest concentrations of vacancy lie outside these reinvestment targets. The neighborhoods with the highest percentages of these properties are, perhaps by definition, some of the most neglected in the city. These areas may be characterized by up to 80% vacancy with most of the properties void of structures (See Census Mapping results; Vacant Land Area).

These properties also present ecological hazards. While they are not typically of a character that we would label 'wilderness', they are in a state that is slowly evolving away from urban form and back, or more accurately, forward into nature. They are unintentionally serving ecological functions that may have both positive and negative influences on the broader ecology and the individual species that are present. They may be infiltrating stormwater more effectively than their historically impervious urban form. They are harboring species and acting as habitat. They are part of a complex and unplanned matrix of open space within the urban grid. They may act as habitat stepping stones for species utilizing the broader ecological context of the metro Detroit region, the Detroit River and the Great Lakes.

Yet all this function may be potentially detrimental to the ecological health of the area. There are contaminants throughout the city that are being exposed by these uses. Plants may be engaging the contaminants with their roots and presenting them to the herbivorous community through their vegetative parts and their fruits. Animals may be at a physical risk from dangerous rubble, debris and contamination currently present on these sites. Stormwater may be spreading contamination to places where it was formerly absent. These hazards must be addressed in order for the sites to positively influence the ecology of the region.

The city needs to act on an overarching management plan that deals effectively with the overwhelming number of these properties. The sheer numerical magnitude creates issues even for the most rudimentary forms of management. Even the current most basic element of the city's management, mowing, does not regularly occur on many of these properties. This is a further signal of neglect to the community already dealing with the effects of physical absence and an indication that a more self-sustaining methodology must be implemented.

Unfortunately, the economy of the region makes it difficult to propose the redevelopment of many of these properties. The most recent regional outlook, published by the Southeast Michigan Council of Governments (SEMCOG) in 2008, projects declines in population and housing in Detroit through 2035 (the extent of their forecast), with only a moderate 7% rate of growth in population throughout the region (SEMCOG, 2008). This indicates that not only do most of the current vacancies have little chance for successful redevelopment back to residential, but more currently inhabited properties will join them in vacancy status. An alternative approach is needed.

Statement of objectives

Detroit has an opportunity to become an international leader through the demonstration of innovative solutions to this new set of problems. This project strives to develop an effective, implementable broad scale management approach for the vacant properties in Detroit. This project proposes one pathway to change for these properties that acknowledges the limitations of the regional economy. This project considers the social, ecological and economic implications of these properties, and addresses them through a management solution.

The major products of this project are a thorough literature review of relevant topics, a comprehensive analysis, and a detailed management proposal illustrated through a neighborhood scale plan. There is a broader need within the landscape ecological and landscape architectural disciplines to create linkages between spatial analysis and management planning (Opdam, 2002); this project synthesizes methodologies from these disciplines to provide cohesive, broad-thinking proposals.

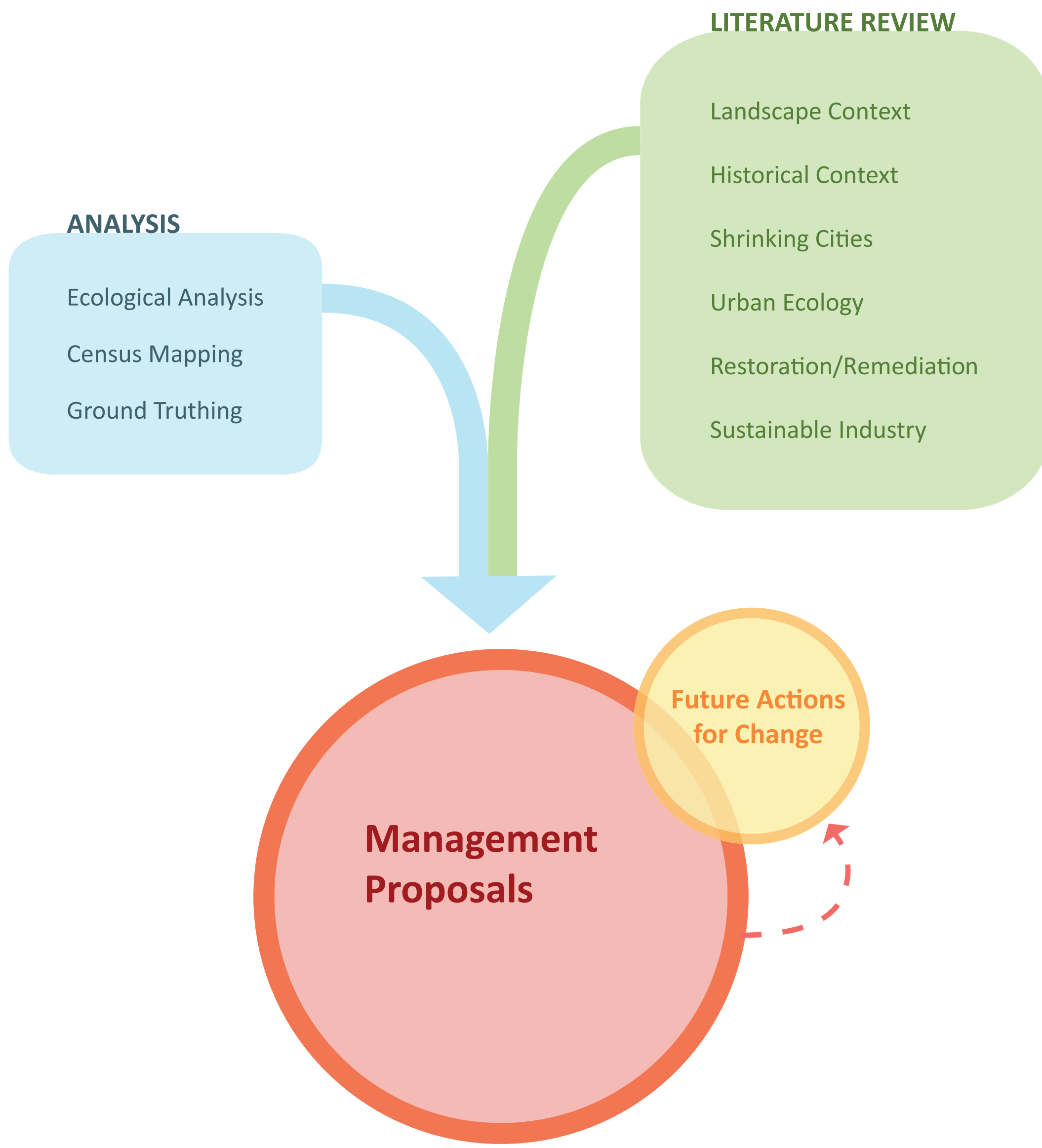

Figure 1.1: *Conceptual Flow of the Project*

The conceptual approach undertaken to develop the management proposals for this project.

Note: Due to limitations of the selection, some active city owned properties may be included.

City Owned Vacancies in Detroit, MI

Data Source: The City of Detroit, SEMCOG, and the US Census 2000

1 Theoretical framework

In order to aid the development of effective management decisions, this project carefully considers: the cultural and landscape histories of Detroit, its position within the context of shrinking cities, the potential for and the challenges of functioning ecologies in a post-industrial urban setting, the implications of restoration and remediation, and the potential relevance of cellulosic ethanol technologies. The following literature review is an examination of the current research on each of these topics, with a focus on their relevance to Detroit.

1.1 Detroit Landscape Context and Historical Background

Landscape Context

The Great Lakes region owes much of its geophysical character to the glacial movements of the Pleistocene period between 2 million and 10,000 years ago, being most recently affected by the Wisconsin period glacial movements that occurred between 10,000 and 15,000 years ago (Schaetzl, 2007). As the ice sheets advanced and retreated, they molded the land leaving a scarred, nascent, heterogeneous landscape that set in motion the trajectory of ecosystem development we see today. The foundation of soils left by the glaciers, coupled with topography and drainage, largely dictates the ecological communities present.

Detroit is located in the Huron Erie lakeplain region of the glaciations. Lakeplains are characterized by a flat, somewhat featureless landscape resulting from the deposition of materials in the deeper areas of the lake and the flattening activities of the waves along the shore. Clays were deposited in the Huron Erie lakeplain resulting in fertile lands for agriculture and extended marsh and wetland features associated with low lying topography and poor drainage. Detroit's lake plain is broken up in the middle of the city by a morainal deposition that extends to the north, approximately along the Woodward corridor. This deposition left mixed till and sands as parent material for soil development (Shaetzl, 2007).

Historical accounts of the pre-settlement character of the Detroit area give several important indications of the ecosystems at the time. The broader metro region was characterized by open oak savannahs; tall forests of elm, beech, maple and walnut; and marshland that existed in low lying topography and in the beds along creeks, streams and rivers (Bingham, 1945).

Frances Xavier Charlevoix, a French settler and priest, wrote this of the Detroit region in the early 18th century: "The lands have a mixture of sand, and in the neighboring forests there are bottoms almost constantly under water; however, these very lands have produced wheat eighteen years successively without the least manure, and you have no great way to go to find the finest soil in the world. With respect to woods, without going a great way from the fort [Ponchartrain] I have seen as I have been walking such as may vie with our noblest forests." (Bingham, 1945)

The marshy areas of the city and surrounding region discouraged exploration too far from the settlement. The wetlands of northwestern Detroit and Ferndale were thought to be indications of landscape quality for an indefinite distance and so the marshes were rarely breached. In 1818 Major Oliver Williams reported this from his first exploration through the swamps: "That flat land in the rear of our city which has been called a swamp is not a swamp, but is rich land covered with large timber and though in certain seasons it is wet, it is now perfectly dry." Through "the dim light of the forest" he came upon "oak land interspersed with prairies covered thickly with high grass" (Bingham, 1945).

Another account references pre-settlement tulip tree stands of impressive heights: "One of the worst obstacles in clearing off the timber preparatory to opening up the land for agriculture was the great whitewood (tulip) trees, often 70-80 feet to the limbs, 2-8 feet in diameter and as straight as a column of a temple. These trees, when fallen and green, positively refused to burn, and it took all the patience and skill of the pioneer to rid the land of them. Other trees were felled across them and a fire started and kept burning, sometimes for weeks, until the great logs finally yielded." (Bingham, 1945)

These accounts provide insight into the great productivity of a region with fertile soils, abundant moisture and a moderate climate. They also provide a vivid image of the perspective of the European settlers to these ecosystems. Today there are few remnants of these systems left in a metropolitan area that has been extensively disturbed for development. Deforestation practices, drainage systems, agricultural use and urban development have altered the native ecology to an unrecognizable extent. All of the soils within Detroit are classified as urban, while their profiles have been significantly altered through the development of roads, buildings, sewers and other utilities.

These historical accounts are valuable references when envisioning the potential the landscape may have in the future. While development has irreparably removed these native systems, some of the fundamental elements of their ecology still remain: the parent material of the soils, the climate, and their relative location to the Great Lakes, for example. These fundamental elements are now coupled with the consequences of our urban and industrial legacy on the landscape, leaving us at a new starting point.

Historical Context

The Detroit area was a major crossroads for many indigenous tribes, including; Huron, Ottawa, Potawatomie, Wyandot, Iroquois, Chippewa, Ojibwa, Delaware, Shawnee and Miami (Poremba, 2001). The Native Americans extensively managed the lands of pre-European southern Michigan. They burned prairies and planted fruit trees and other crops, suppressing woodlands from large swaths of land and keeping hunting grounds open (Poremba, 2001; Bingham, 1945).

Detroit was settled by the French as a strategic control point for the fur trades originating in the Great Lakes region (Poremba, 2001). A fortress was constructed along the river and was operated as a trading post. Detroit changed hands from the French to English and eventually to the Americans

(Poremba, 2001). When the Erie Canal was constructed in 1825, Detroit's population began to grow.

As the railroads were built, Detroit became a hub for the transportation of industrial raw goods (Metzger, 2004). The civil war brought intense demands for industrial goods throughout the country, and Detroit's geographic convenience and access to raw materials helped make it an industrial center (Metzger, 2004). Centralization was a major reason why Detroit was an effective industrial center; industrial development took place along the rail and water corridors of the city (Sugrue, 1996). After the Civil War primed the city's industrial growth, the industry continued to shift to meet new post war demands for goods such as pharmaceuticals, furniture, stoves, beer and railcars (Poremba 2001, Metzger 2004).

In the early 20th century, the rise of the auto industry transformed Detroit into the industrial marvel of the world. Historian Olivier Zunz labeled Detroit the 'Total Industrial Landscape' at the time, and Diego Rivera painted his famous 'Detroit Industry' murals at the Detroit Institute of the Arts (Sugrue, 2005). By 1904, tens of thousands of cars began to emerge from the manufacturing plants in the city (Poremba, 2001). This growth of industry provoked massive immigrations of the working class, who took advantage of the workforce demand the industry was providing. Neighborhoods of standardized housing were developed throughout the city, most within walking distance of the plants, which were themselves located adjacent to the rail lines (Sugrue, 2005).

The dominance of industry in Detroit is apparent in its patterns of growth. Nicer residential neighborhoods were infringed upon by the industry and manufacturing, the showrooms and the row houses. The fabric of the city was discretely woven together by the entangled lines of rails that dictated industrial positioning (Sugrue, 2005). The infrastructure that this new industry demanded also stressed the sanitary conditions of the city, negatively influencing the overall public health (Poremba, 2001). A more extensive road network was constructed, and the wealthier citizens were enabled to move further away from the city center.

World War I brought about a new stage of dramatic growth for Detroit. In order to support war efforts in Europe, the automotive plants switched production to war machinery. They produced aircraft engines, tanks, tractors, military vehicles and guns in the same buildings that once housed and would shortly resume housing the auto manufacturing (Poremba, 2001).

The population of Detroit was over 1.5 million as the Great Depression took hold of the country in early 1930 (Poremba, 2001). Thousands of industrial workers lost jobs, and the city found itself in economic troubles due to tax delinquency (Poremba, 2001). A statewide sales tax was implemented to relieve debt. FDR implemented the New Deal, and the economy began to recover. The United Auto Workers union was formed (Poremba, 2001).

By World War II, Detroit was at its industrial apex. Between 1940 and 1947 the city of Detroit saw an increase in manufacturing jobs by 40% (Sugrue, 2005). The sudden demand for war machinery and the exodus of troops brought about a labor shortage that resulted in a second wave of worker immigration. Hundreds of thousands of workers would be employed in the plants that had again been converted from auto manufacturing to war purposes (Sugrue, 2005). The housing and infrastructure demands required to accommodate the new labor force brought about hasty solutions and 'Emergency Defense Housing' was developed, eventually proving to be insufficient (Poremba, 2001). These inequities in housing quality, and the developmen of segregated but adjacent neighborhoods would contribute to building racial tensions, which reached the point of riots in 1942 and 1943 (Sugrue, 2005; Poremba, 2001).

By the end of World War 2, Detroit would produce over 90% of the vehicles used in the war, almost 90% of the bombs and helmets, and about 50% of the engines, tanks and machine guns (Poremba, 2001a). 500,000 Detroit men and women were enlisted in the services and participated in war efforts. Detroit was given the moniker 'Arsenal of Democracy' for its major industrial contributions to the war (Sugrue, 2005).

Post-Industrial decline began in Detroit shortly after World War II. While Detroit's period of growth was characterized by centralized industry, its decline was a result of decentralization and deindustrialization (Metzger, 2004). The surrounding counties of Oakland, Macomb, and Wayne all began to grow as residents left the central city. Federal housing policies that partially subsidized development of the suburbs and the construction of the expressway systems were partial drivers of the suburbanization that took place after World War II (Sugrue, 2005). The combined effects these converging pressures had on the Detroit metropolitan region were severe. Detroit lost nearly 500,000 residents between 1950 and 1970, while the inner city landscape was characterized by a deteriorating downtown, inadequate housing and racial tension (crowned by the famous race riots of 1967) (Metzger, 2004). Through the 1970's, Detroit continued to decline. Over 200,000 jobs were lost in this decade alone (Oswalt, 2004), and the population would dip below one million by the year 2000 (US Census, 2008).

Thomas Sugrue identifies three major contributing factors to the resulting urban crisis in Detroit: 1) the flight of jobs out of the central city, most notably the high-paying, unionized, industrial jobs; 2) the persistence of workplace discrimination in the face of the successes of the civil rights movement; and 3) intractable segregation of housing which led to differential access to power and resources (Sugrue, 2005).

June Manning Thomas concurs that racial disunity is a major factor in directing the population shifts (Thomas, 1997). In her analysis of research on discrimination conducted in Detroit in the 70's and 90's, she illustrates that African Americans were more tolerant of racial integration than whites (Thomas, 1997). While African Americans were willing to move into integrated neighborhoods, whites were likely to try to move out (Thomas, 1997). These attitudes did not change significantly over the two decades sampled for the study (Thomas, 1997), and do not appear to have significantly changed since. Racial disunity is directly related to disparities in quality of life, and can feed feelings of unrest, especially in a region where these disparities are so severe (Thomas, 1997).

Sugrue (2005) maps the history of the movements of African American neighborhoods in the *Origins of the Urban Crisis*. Of the pattern of movement he says this: "Between 1948 and 1960, black housing conditions in Detroit improved significantly. The number of blacks in substandard buildings (dilapidated buildings or those that lacked running water or indoor toilets) plummeted between 1950 and 1960 from 29.3 percent to only 10.3 percent, and the number of overcrowded residences fell from 25.3 percent to 17.5 percent. The reason for the decline was simple: blacks moved out of the oldest, most run-down sections of the city into newer neighborhoods, including some that contained some of Detroit's finest housing stock that had been all white through World War II." ... "An unintended consequence of the opening of Detroit's housing market was a hardening of class divisions within black Detroit. As white movement increased the housing options available to black city dwellers, blacks began the process of sifting and subdividing, replicating within Detroit's center city the divisions of class that characterized the twentieth-century metropolis as a whole." (Sugrue, 2005)

This pattern has continued to the present, where now 83% of the population of Detroit is African American, and much of the white population has moved to the suburbs (80% of the suburban population) (US Census, 2008). A visual comparison of the map of the older, historically African American neighborhoods (from 1970, Sugrue 2005) and current vacancies seems to elucidate a trend in the pattern of vacancy (see Appendix 1). The densest areas of vacancy seem to correspond to some of the older, historically African American neighborhoods. Perhaps, as the housing stock degraded and white residents relocated to the suburbs, the African American residents who could afford to upgraded to the nicer housing of the white neighborhoods, leaving behind sub-standard housing that may lay vacant and eventually be demolished (Sugrue, 2005). Those that couldn't afford the mobility or those who had no desire to leave stayed in these neighborhoods as hold-outs in an area that had little incentive for redevelopment.

Cultural conventions may greatly influence landscape pattern (Nassauer, 1995). In order to effectively investigate this spatial trend, further research must be conducted. This relationship could provide insight into the causality of the spatial distribution of vacancies in Detroit. Other factors that may be involved include: quality of the original housing, quality of the city services to the neighborhood, cohesiveness of the community, and environmental factors such as flooding, proximity to industry and contamination.

Today the population of the city of Detroit hovers around 834,000 (US Census, 2008) with no prospect of growth in the future (SEMCOG, 2008). The socio-economic disparities between Detroit and the surrounding region continue to create barriers and limit opportunities for city residents. In the year 2000, Detroit residents earned, on average, half the salary of their suburban counterparts. While 26.1% of the population in Detroit lives below the poverty level, only 6.5% of the suburban population does (Oswalt, 2005). While 27.1% of the suburban population, age 25 and older, are equipped with a college degree, only 11.0% of Detroiters have one. 85.3% of suburban residents 25 or older have obtained their high school diplomas, while only 69.6% of Detroit residents have one (Metzger, 2004). 22.2% of residents in Detroit are unemployed (US Census, 2008); while in the suburbs only 4.2% are (Oswalt, 2005). These numbers don't take into account those adults who have given up looking for work, or 'disappointed job seekers' as economists have called them (Sugrue, 2005).

According to the US Census (2008), 85,951 housing units currently stand vacant in the city of Detroit, accounting for 23% of the total housing in the city. Between 1950 and 2000, 147,000 houses were demolished in Detroit while over 1,000,000 were built in the suburbs (Oswalt, 2005) and while there is no definitive count of vacant lots within the city of Detroit, estimates place the number at around 60,000 (Sugrue, 2005). I am examining 33,000 of these vacant lots owned by the city for this project.

The resulting landscape legacy left in the wake of deindustrialization, suburbanization, and discrimination is severe. A city that was built for 2,000,000 now holds less than half of that. A city that once employed over two hundred thousand manufacturing jobs (Sugrue, 2005) now employs fewer than 50,000 (US Census, 2008). A city that was once an economic powerhouse is now among the poorest cities in the US. The physical evidence of this transition is evident throughout the streets of the city. Vacant lots sit adjacent to crumbling housing, trash piles and abandoned industrial complexes, themselves adjacent to occupied residences and elementary schools. It is evident that there is a collective need to take action against the urban chaos that has resulted. This sentiment is strongly echoed in the words of residents in our passing conversations.

1.2 Shrinking Cities

Though it may be an archetype of urban decline, Detroit is not globally unique as a city that has lost significant population and industry while its physical borders remain the same. Many cities in the industrialized countries across the globe are experiencing similar trends. Deindustrialization, suburbanization, post-socialist decline, military conflict, aging population and demographically relevant social behavior (segregation and discrimination) are all major causal factors in the decline of urban areas throughout the world (Oswalt, 2005). This process began in Europe at the turn of the century (London lost 45% of its population between 1901 and 1981), and in the US at the end of the World War II (Rienets, 2005). In the nineties, a new wave of shrinking cities was initiated by the fall of socialism in Eastern Europe, especially affecting cities in Russia, Germany, Romania, Poland and the Ukraine (Rienets, 2005). Cities in South Africa, Japan, Korea, Argentina, Indonesia, India and even China are part of this trend as well (Rienets, 2005).

In the United States, most of the shrinking cities are located in the rust belt of the Midwest (Rienets, 2005). Detroit, Flint, Pittsburg, St. Louis, Akron, Youngstown and Cleveland are some of the more extraordinary examples in a region where more than 30 cities of over 100,000 inhabitants have experienced a population loss of greater than 10% (Rienets, 2005). Shrinking cities in the United States are not generally characterized by a loss of population over the entire region. They are characterized by relocation of the population to the periphery alongside overall regional growth (Fishman, 2005). Deindustrialization, suburbanization and discrimination are the major causal factors in this region.

Funded by the Federal Cultural Foundation of Germany, Philipp Oswalt (a German architect and writer) has brought together individuals of many fields interested in researching and working for action against the cultural challenges generated by the effects of shrinking cities (Oswalt, 2005). The work produced by this group has travelled internationally, drawing attention to this phenomenon. A major symposium accompanied the display of these works was held in Detroit during the winter of 2007.

In his introduction to the first volume of international research on shrinking cities, Oswalt (2005) states: "We can learn from the ways in which other societies have dealt with the problem [of shrinking cities], and we may come to understand our own situation not as an exception but as part of a more general trend, thereby putting the issue into a new perspective and yielding new insights." The acknowledgement of this perspective is valuable during the processing of envisioning potential change in a situation that when isolated may seem overwhelming.

1.3 Urban Landscape Ecology

The pervasiveness of abandonment throughout Detroit engages even the casual observer to conjure images of a powerful nature overwhelming a city in the process of dramatic decline. Numerous blogs document Detroit's architectural ruins and urban pastoral areas, while photos, articles, books and even Harvard courses have all contributed to the public imagining of a city taken over by nature. What are the real implications of this dynamic coexistence and what parts of this grand image harbor actual functioning ecological processes, not just aesthetically convincing landscape replicas?

Landscape ecology within an urban context is simultaneously more complex and less understood than landscape ecology in other systems. It is influenced by many unique factors which may not be present in or have relevance to the undisturbed system. The landscape structure of the urban environment has high proportions of human dominated land uses which exert additional pressures on adjacent and incorporated ecological systems. Contamination, soil disturbance, ecologically disruptive historic and adjacent land use, grey network infrastructure and invasive species all have a high level of influence on the ecology of urban spaces.

Nonetheless, ecological function is occurring at some level for some species; most often those able to take advantage of spaces less attractive to their more conservative counterparts. Organisms with different scales of resource use will be able to utilize landscapes of varying qualities and sizes. McIntyre and Hobbs contend: "*A landscape considered structurally fragmented by humans may be functionally variegated for other species.*" (McIntyre, 1999)

Recent fieldwork by Julie Cotton at the University of Michigan has identified the presence of numerous native plant and invertebrate species on vacant parcels in Detroit (Cotton, pers. comm.). The Michigan Natural Features Inventory has located populations of conservative native species in both the River Rouge and Palmer Parks (Grese, pers. comm.). It is common to come across ring-necked pheasants calling from the grasses in many downtown neighborhoods, to see coyotes and foxes (as well as free roaming domestic dogs) sneaking through yards, or to stumble upon a patch of wild ginger (which I came across while doing ground truthing work for this project).

These hints of urban ecological vitality must be critically considered in context. Are they cues of fully functioning systems? Are they evidence of nature's tenacious bid for available resources? Is it irresponsible for us to allow these ecological components to be present in a harsh urban environment that may be detrimental to their health, or are they providing services to the urban system that will benefit the health of the overall community in the long term? The following section examines some of the critical components of urban ecology.

Species richness

Urban systems are often potentially rich in species due to the diversity of habitats that results from the mix of land uses in the urban context (Niemela, 1999). These manmade habitats support unique ecologies and have been shown to harbor rare species. Eversham (1999) found that 35% of the rare carabid beetles of Britain were found in manmade habitats, such as; roadsides, rubble heaps and quarries (Niemela, 1999). Urban habitats are also prone to invasion by the numerous exotic species brought to the area through human interests. This is an important factor in qualifying the high levels of species richness that may be found in the urban context.

The urban environment may be potentially inhospitable to native species due to: disturbed soils, increased average temperatures, high levels of non-native invasion, high proportions of edge habitat, dispersal difficulties, and a potentially impermeable matrix. The limiting effect these factors may exhibit on species is largely dependent on their individual life history traits.

Portions of the urban system can be said to generally follow the intermediate disturbance hypothesis: species richness is highest in systems with intermediate amounts of disturbance. Species richness alone should not be used as an indicator of ecological health. Often, greater richness conversely affects success of native species, especially when a large proportion of the species on the richness index are exotic or invasive with a high potential to out compete the natives.

Urban soils

Soils in the urban context may present many problems for native species. Urban soils are highly disturbed due to the development activities that take place on and around them. The soil profiles have often been inverted through digging and dumping, and they may contain debris and contamination. If grass lawns are planted, this prevents soil development at any substantial depth in the profile.

Subsurface infrastructure may also interfere with a healthy soil profile. Utility lines and sewers are extensively networked through cities, creating disturbance wherever they are present. Old sewer systems are imperfect, and may cause contamination and fluid disturbance to the soils in which they are embedded. This could be a major factor in Detroit, where the sewers are combined with stormwater, and the systems themselves are quite old and potentially unmaintained.

Urban soils may be a significant limiting factor in the establishment of specific native plant systems, though it may be possible to select a plant palette that will establish native cover with the ability to help develop soils for further stages of native succession.

Increased average temperatures

The increased average temperatures of urban areas in relation to their rural counterparts are a result of the urban heat island effect, and may influence the selection of certain species. Species more tolerant of warmer average temperatures are more likely to be successful. Some natives may be negatively influenced by the warmer temperatures and would be selected against (Niemela, 1998).

Increased average temperatures may also influence ecological processes in urban systems. Pouyat (1997) found that mineralization rates of nitrogen in oak litter was faster in urban stands, potentially triggered by warmer soil temperatures associated with extensive paving. Further studies on the relationship between ecological processes and urban conditions could further illuminate a management approach for these systems. It is interesting to consider the implications of this factor within the context of global warming. Could a well managed native urban habitat provide source populations for surrounding natural areas as global warming exerts its influence?

Successional patterns

Successional patterns in the urban matrix are unique as a result of the random disturbances exerted on small parts of the system. One yard may be managed differently than the next, and most are kept in the early stages of succession through constant mowing (Niemela, 1999). These early successional, or frequently disturbed, lawns often exhibit high contrast to old growth trees that may be present in the urban systems, creating a unique dynamic.

Matrix permeability

Within a highly fragmented habitat, management of the matrix is important to the potential for ecological success (Turner, 2001). The theory of island biogeography states that the numbers of species present on a habitat island is directly proportional to the size of the island and inversely proportional to the distance of that habitat island from other populated patches (MacArthur, 1967). These factors, among others, will influence the rates of migration and extinction. This fundamental understanding of population dynamics may be helpful when considering potential species richness in urban habitats. There are several important questions particular to urban ecological dynamics that extend beyond the reach of this theory: how permeable is the matrix? What constitutes a patch? What scales are appropriate for analytical consideration? How do you acceptably quantify the value of one large reserve versus several small reserves (the SLOSS debate).

Fernandez-Juricic (2000) found that birds in the urban environment are able to use wooded streets as corridors between urban parks, and that their use of landscape elements in the urban environment is directly correlated with the habitat quality of the element. He found that species richness was negatively influenced by higher rates of traffic and lower vegetation cover. He was able to conclude that wooded streets could possibly serve as suitable corridors for avifaunal species that did not require shrub habitat breeding or large swaths of habitat for foraging.

Influence of contamination

It is already evident that the natural world is resiliently able to recolonize spaces that were once fully converted into a relictual landscape (an environment with less than 10% habitat retention [McIntyre, 1999]). But is it suitable for this to occur haphazardly, or is there a higher level approach that may be dictated through design and premeditated restoration?

Concerns about the inherent quality of the sites strongly suggest that a thoroughly researched decision making process is necessary to make the best proposals for site usage. Contaminants may be mobilized through the processes of restoration or remediation and thus drawn into the biological cycles of the ecosystem, potentially accumulating into toxic levels throughout the food chain. Caution must be exercised when making design decisions for contaminated sites. Further discussion regarding this issue is presented in the "Ecologically positive activities in Detroit" section of this paper.

Landscape patterns

"Spatial patterns are the result of complex interplay between abiotic constraints, biotic interactions, and disturbances. The pattern is not simply a constraint imposed on the ecological system by topography and soils. Instead, there is an intimate tie between pattern and process that forms an important core for the understanding of landscape ecology." (Turner, 2001, pg. 18)

The vacant parcels in Detroit have a unique pattern. The result of abandonment and depopulation, the expansive spread of parcels does have central areas of densities and nodal points that may represent some underlying cause dictated by social conditions, planning frameworks or even geophysical hindrances bound to the site.

Can the spatial distribution of the vacant space within Detroit create a stable, heterogeneous ecology? An inherent benefit that is derived from the spatial organization of vacant land in Detroit is that it contains many reserves. Landscapes containing a higher number of reserves are less likely to experience extinction because populations are able to reside in multiple patches (Turner, 2001). The negative side to the spatial patterns of the vacant land in Detroit is that there is abundant edge habitat. The resulting ecology of the vacant land must be stable with a high proportion of edge habitat.

1.4 Ecologically Positive Activities in Detroit

How do these factors of urban ecology influence the management decisions for vacant land in Detroit? They provide points of critique and concern that could be considered in an analytical approach. They also provide insight into management suggestions that may have real viability for enhancing the current conditions of the urban environment. The path to a more wholly functioning urban ecology in Detroit, as with many post-industrial environments, includes processes of restoration and remediation. The following sections discuss approaches to these ecologically positive activities.

Restoration

When contemplating an appropriate approach to defining restorative activities, one may run into various semantical debates regarding our definition of nature. Nature is, perhaps, most succinctly defined in the words of Eric Katz, as "that which is independent of the actions of humanity" or, less stridently, "objects and processes that exist as far as possible from human manipulation and control" (Attfield, 2000). Under these confines it initially seems far-fetched that we would be able to find a place for nature within the context of a highly degraded urban system and seemingly even less likely that we would be able to influence its ability to exist there.

Examined more closely though, these definitions can be seen to elucidate events and processes that are already occurring in the context of modern Detroit (and any other urban environment for that matter). The core qualities of these 'objects and processes' don't have to exist spatially independent of humans to be outside of their control. Stormwater is falling across Detroit independent of human control, though its infiltration is manipulated. Nitrogen is cycling through Detroit independent of human control, though its rates are influenced. Songbirds are migrating through Detroit independent of human control, though their exposure to contamination is a result of human neglect. Where exactly then does the boundary between humans and nature, if there is one at all, exist?

Through all the efforts of humans to remove themselves from the consequences of nature, we are still responsible for maintaining a quality interface through which we interact with the natural world; a relationship in which we, to the best of our ability,responsibly manage our negative environmental impacts while taking positive action towards restoration, remediation and rehabilitation. It is with this intention that the procedures for restoration, rehabilitation and remediation throughout Detroit are proposed. With an understanding that while it may be impossible to successfully restore to a target historical system in a post-urban system or to completely eliminate our xenobiotic contributions to the environment, it is still possible to positively influence and responsibly manage the ecological interface (the extent to which our actions affect the systems and processes around us) that we present to our fellow living beings. This sensitivity is especially important in Detroit where land and resources are available for ecological use, and the semblances of these processes are occurring whether or not we take responsibility for our end of the deal.

The Society for Ecological Restoration defines restoration as "the process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed" (SER, 2004). This definition allows restoration to be interpreted as a process that can be applied to a wide range of systems; from those that have been completely altered to those that have only slightly been changed. In these varying contexts restoration takes on a different face, hopes for a different result and provides a different utility. The Society for Ecological Restoration provides a set of attributes that may be referenced to measure the success of the restoration effort. They are as follows:

1) The restored ecosystem contains a characteristic assemblage of the species that occur in the reference ecosystem and that provides appropriate community structure.
2) The restored ecosystem consists of indigenous species to the greatest practicable extent.
3) All functional groups necessary for the continued development and/or stability of the restored ecosystem are represented or, if they are not, the missing groups have the potential to colonize by natural means.
4) The physical environment of the restored ecosystem is capable of sustaining reproducing populations of the species necessary for its continued stability or development along the desired trajectory.
5) The restored ecosystem apparently functions normally for its ecological stage of development, and signs of dysfunction are absent.
6) The restored ecosystem is suitably integrated into a larger ecological matrix or landscape, with which it interacts through abiotic and biotic flows and exchanges.
7) Potential threats to the health and integrity of the restored ecosystem from the surrounding landscape have been eliminated or reduced as much as possible.
8) The restored ecosystem is sufficiently resilient to endure the normal periodic stress events in the local environment that serve to maintain the integrity of the ecosystem.
9) The restored ecosystem is self-sustaining to the same degree as its reference ecosystem, and has the potential to persist indefinitely under existing environmental conditions.
(SER, 2004)

These detailed and explicit attributes provide clear lines from which a restoration can be measured. They also provide deeper insight into the intent with which ecological restorations should be undertaken. While defining a reference system is extremely important, it is also clear that restorationists attempt to build back both *resilience* and *sustainability* into systems that have undergone atrophy.

Defining a reference system will help guide, direct, and qualify the restoration efforts. As the level of degradation of the system increases, the difficulty of defining the target system increases as well. In a highly urbanized environment the present state of the land may have retained little to no characteristics of the systems that were historically on site. In this case, what relational scale is appropriate? Could there be other systems that would generate more sustainable and resilient landscapes that are, themselves, outside of the reference ecosystems?

In the urban context, restoration also involves the added dimension of community. The relationship of people and land is at the heart of all efforts towards restoration. Whether one has compassionate hopes for the healing of the landscape or a strong desire to positively influence young lives by providing access to real nature, there is a common thread of human benevolence. (Footnote: Malevolent restoration does exist, unfortunately. This practice occurs when someone uses the potential for restoration as a justification for destroying intact systems.) Within the boundaries of the city, these relationships are critical, and should be considered an important attribute in the measure of the success of a restoration effort.

It is apparent that well maintained urban green space can positively influence social conditions within a city. Numerous studies suggest that natural settings, even in the most basic forms (including trees, grassy areas and gardens), can be cognitively rejuvenating (Kuo, 2001). Frances Kuo (2001) proposes that aggression and violence in the urban environment can be reduced by increasing access to urban green space.

Participation in restoration activities can also be rewarding and engaging to community members. Irene Miles, et al (2000) found that volunteering for restoration activities not only enhanced the environment, but provided benefits for the participants as well. Qualities of volunteering for restoration activities that Miles et al. found to be beneficial for participants included: Spending time doing something engaging; spending time doing something that's supportive; doing something outside of one's ordinary routine; connecting with the larger world; donating time and energy in support of a cause; making a difference; accomplishing a goal, a task or something meaningful; doing something tangible on behalf of the environment and community; meeting people with similar interests; increasing personal growth; and undertaking a physical challenge (Miles, 2000).

Sally Eden et al (2006) propose that these valuable contributions to the community are frequently not fully realized. They note that while urban restoration may be scientifically radical, it is not radical socially because it fails to challenge the model of 'technocratic environmental management'. In order for these practices to result in a more wholly satisfying, engaging and community based effort, the social sciences must be further integrated into the development of these projects (Eden, 2006).

One fundamental challenge restoration projects face in the urban environment is the presence of contamination. The approach to restoration must be fundamentally changed when dealing with environmental contamination that may be potentially mobilized.

Remediation

The framework for ecological restoration must be presented with clear intentions in a highly ecologically-degraded, post-industrial system. Many additional complexities must be considered including: contamination, historical and future land uses, and social perceptions. These additional complications further distance the system from its native form and may permanently alter the intended 'natural' use for the site.

In consideration of the history of land uses throughout Detroit, it is highly plausible to assume that a significant level of contaminants reside throughout the extent of the urban soils. It is absolutely necessary to treat these contaminants with caution, and assume that their integration into ecological processes could be potentially harmful. In order to wholly address this issue, the first step of the restoration process of the lands of Detroit must be remediation.

Accurate, detailed assessment of the contaminants present on site will enable the creation of a targeted mode of remediation. In lieu of that information, it is possible to offer broader remediation frameworks that provide detailed methodologies for handling the most common contaminants in this type of environment. More importantly, the presentation of a remediation philosophy will directly influence strategies generated to handle specific contaminant types once they have been identified.

During a personal conversation with Jeremy Semrau, a phytoremediation expert here at the University of Michigan, he offered this insight: You can think of remediation options all plotted along a continuous linear line on a graph with time as the x-axis and cost as the y-axis. It is possible to accomplish remediation in a very rapid time period, but the cost is very high. It is also possible to accomplish remediation at a low cost, but the time period required is very long. Excavation and replacement of the contaminated soil is an example placed at the high cost/low time end of the graph. Bioremediation is what would be placed on the low cost/high time end of the graph. The other options exist somewhere between them along this linear relationship.

This clear conceptualization of the potential time and money benefits of different remediation strategies offers strong clues as to how they may be implemented in different economic situations. It is apparent that the city of Detroit would value a low cost solution. It is also apparent that they are rich in the valuable resource of time.

Bioremediation

Bioremediation techniques utilize living organisms to remove, stabilize or degrade contaminants in situ. Naturally occurring populations of microorganisms are able to degrade virtually all anthropogenic organic contaminants along metabolic pathways derived through natural selection as long as environmental conditions are favorable. Many types of plants are able to uptake, degrade, volatilize, bind and stabilize contaminants. These specific interactions are the basis for the development of remediation strategies that utilize living organisms.

Unlike forms of mechanical remediation, bioremediation may physically alter the contaminant itself into a less or non-harmful form. There is inherent value in this ability to permanently degrade a harmful substance, even if the process is complex and imperfect. All petroleum-based contaminants can be degraded by common microorganisms found in nearly any soil sample as long as they are not limited by phosphorous or nitrogen. These microorganisms may be stimulated through associations with plant roots, especially those that fix nitrogen. This associative degradation is called rhizodegradation (Pivetz, 2001). Phosphorous and nitrogen are also generally readily available in the urban environment – they are fertilizers that contaminate water bodies through surface runoff. Inorganic contaminants may be taken up by plants into vegetative parts (phytoextraction), bound by root systems (rhizofiltration), volatilized through transpiration (phytovolatization), immobilized in the ground water (hydraulic control), and immobilized in the soil (phytostabilization) (Pivetz, 2001).

Clayton Rugh and a research team from Michigan State University have been conducting phytoremediation trials at the Ford River Rouge plant. They are testing Michigan native plants for their ability to stimulate the degradation of PAH's (Polyaromatic Hydrocarbons), a common persistent organic pollutant, on a highly contaminated site at the Ford Rouge industrial complex. They tested several prairie natives such as; big bluestem, prairie dock, New England aster and cardinal flower. Their experimental results showed the ability of all of these plants to stimulate the degradation of PAH's, some as much as 50% in one year (Rugh, 2004). While only a few of the many Michigan native prairie plants have been tested, this research supports the proposal that native prairie systems could effectively stimulate rhizodegradation processes on contaminated sites for some types of contaminants but not others. What if this remediation strategy was also able to dually serve as a sustainable source of energy?

Potential Relevance of Cellulosic Ethanol Production

Cellulosic ethanol utilizes enzymes from fungus and bacteria to degrade the cellulose fibers in plants into more basic sugars that are then converted to ethanol through processes of fermentation. Any plant material may be used for this process, as opposed to corn ethanol which utilizes the sugars and starches of the food product of plants to ferment into ethanol. The production of biomass biofuels provides an alternative energy source to fossil fuels and, if managed properly, can generate net carbon dioxide reduction through the sequestration of carbon in root systems. It also circumvents potential conflicts that are created by utilizing food crops for energy, as well as being more efficient through the use of any or all the above ground plants parts.

Utilizing vacant urban land, especially in large contiguous quantities, for the production of energy fuels eliminates a potential competitive conflict with food crops for fertile agricultural lands. Due to the potential presence of contaminants in the urban soils, this land may not be appropriate for large scale production of food crops without remediation efforts. Utilizing plant material grown on this land for energy could also function as a remediation activity.

In his research on low input high diversity (LIHD) native grassland productivity and biofuels potential on agriculturally degraded lands, David Tilman (2006) illustrated that ecosystems are more stable with higher biodiversity, and in time this leads to greater productivity. By utilizing a diverse native prairie mix that included grasses, forbs, legumes and woody plants, he saw a net productivity increase of 240% after a decade of harvesting relative to monoculture grasses. The primary mechanisms for this increased productivity are that: 1) diverse prairie mixes that include legumes are able to fix nitrogen without external inputs; and 2) the diverse community structure is able to more fully and efficiently utilize water, sun and nutrient inputs.

He illustrated that while current corn ethanol based biofuels have energetic output to input ratios of only 1.25 /1, biomass ethanol rated at 8.09/1 (Tilman, 2006). Tilman also asserts that these production levels are especially noteworthy because the experiments were conducted on low fertility, degraded agricultural lands with low agrichemical input. Nearly all of the land in Detroit was once used for agriculture; its current state could be viewed as degraded former agricultural lands. Timan's research has many pertinent implications for the vacant land of Detroit.

Aside from the productive potential of this LIHD prairie agricultural approach, the land would also benefit from two important ecological perspectives. The plants are both degrading and taking up contaminants from the sites, remediating the soils, and the roots are degrading contaminants and developing soil structure. When the plant parts are harvested, the contaminants that were extracted into the above ground vegetation would be effectively isolated from the site. The methodology for generating cellulosic ethanol accommodates the necessary stage of contaminant disposal; as the plant parts are gasified, the contaminants would be trapped in filters in the gasification chamber (similar to the process the plants would go through during contaminant disposal anyway), and the rest of the product would be utilized for energy.

There is much debate about the long term sustainability of utilizing cellulosic ethanol as a major energy source. There are limitations to the current technology that must be overcome to make this process more technologically feasible, less environmentally consumptive and profitable at a large scale. Nonetheless, major projects are underway in the Midwest developing plants and industry that will execute this technology (Coskata and Macoma), receiving major amounts of federal funding from the Department of Energy and major investment commitments from General Motors in an unspecified amount (Reuters News, 2008). George Bush recently signed a bill mandating an increased production of biofuels up to 36 billion gallons a year by 2022 (up from the current production rate of about 4 billion gallons a year), with 16 billion of those from cellulosic ethanol (Reuters News, 2008). For the purposes of this project, this technology is referenced primarily as a potentially effective mechanism that could activate change in a landscape whose characteristics seem particularly suited for it. It would provide an economic pathway that could fund a large scale landscape intervention throughout the city of Detroit.

2 Analytical methods

The goal of this practicum is to synthetically consider challenges facing the landscape of Detroit in order to assemble a plausible management regime for the vacant land in Detroit that would improve the quality of life for current and future residents. While the first chapter provides us with a theoretical framework that deeply informs the decision-making process, the second chapter provides two sets of analyses that may direct a management approach: a quantitative metric-based ecological analysis, and a census-based social analysis that spatially illustrates several demographic trends. In order to most effectively target limited resources, methods of quantitative geographic information system (GIS) analysis were utilized. After these analyses were completed, a ground truthing and photo documentation process was executed.

2.1 Ecological Analysis

This analysis was constructed to provide insight into the potential value these properties may have in the ecological context. After considering potential management scenarios, a scenario utilizing these properties for some form of ecological benefit seemed the most plausible and of the most interest. This scenario involves a compassionate and benevolent action: improving the inherent quality of the land that has been degraded.

Landscape Metric Approach

Marc Antrop (2000) defines three approaches to landscape analysis: the thematic approach, the regional (or spatial) approach and the use of landscape metrics. The thematic approach individually analyzes landscape components leading to a synthesis of these components at the end. This results in a series of individual theme maps which may be overlaid to aid in synthesis. The regional approach utilizes satellite images or aerial photos to divide the landscape into units that are then classified and arranged hierarchically. The landscape metric approach attempts to quantitatively describe the landscape, often through the use of raster based GIS analysis. The landscape metric approach can lead to more objective comparisons between different sections of the landscape (Antrop 2000).

This ecological analysis utilizes the landscape metric approach, quantitatively evaluating the ecological potential of the city-owned vacant parcels. Only city-owned vacant parcels are considered in the analysis because they were the only form of vacant property that could be isolated from the available data sets. This analysis attempts to extract the spatially variable features of the parcels in study that may exert the most influence on their potential ecological function. During the management write-up, an analysis of aerial photos in comparison with the GIS results is utilized to estimate total vacancy for the neighborhood scale site.

Weighted Linear Combination method

The weighted linear combination method was used to execute this analysis. This method is a commonly applied GIS technique that can be used for land-use suitability, site selection and resource evaluation problems (Malczewski, 2000). It involves creating an objective, selecting important attributes and defining the evaluation criteria.

The objective can be defined as the desired outcome for the real world problem being studied (Malczewski, 2000). In this project, the objective was to evaluate the ecological potential of the vacant land in Detroit. As stated above, I arrived at this objective after consideration of alternative scenarios. This objective seemed to be the most plausible real world outcome, as well as the one that would respond best to raster analysis.

Many attributes may be necessary to provide an assessment of the objective. These attributes provide a measure of performance relative to the objective (Malczewski, 2000). In this project the important question became; what spatially known properties of this landscape may be important to potential ecological function? The attributes for this analysis were defined as: density of vacant parcels, proximity to current parks and natural areas, historical ecology, distance to heavy or medium industry, and proximity to the center of the neighborhoods.

There are many other real world variables that hold influence on the defined objective, but analysis is always limited by the available data. These attributes were selected because they each provided good individual measures of the objective, and illuminated important factors even if they weren't direct measures of them (distance to industry/contamination). These attributes could be strengthened by acquiring direct numerical measurements of these values.

Deriving Attribute Maps that Relate

A challenge specific to the weighted linear combination method of GIS analysis is the development of attribute maps that relate well to each other. In order to function in weighted linear combination, attributes must be valued on commensurate scales (Malczewski, 2000). In reality, the attributes are likely to have many varying scales of evaluation, and converting them reliably is often difficult. The linear scale transformation method was utilized for this analysis. Linear scale transformation is a method of converting input data into standardized scores (Malczewski, 2000). The score range procedure was then used to reclassify all numerical attributes into the same scale. This process was challenging for this analysis due to the varied nature of the attribute inputs.

Several of the attributes were measured in linear proximity (distance to parks, distance to medium or heavy industry, neighborhood centrality). I standardized these values to a 0-100 scale. This meant that 100 was the furthest distance any grid cell was from the attribute of interest, and 0 was immediately adjacent to it. In the case of parks and neighborhood centrality, further away represented a lower value, so the values were then taken from 100 (i.e., 100 - distance to park).

The values for historical ecology were perhaps the most difficult to qualify in terms of their effect on the overall index value. The incentive to use this layer was the hypothesis that areas that held more unique historical ecosystems may have more value to restore because of rare or unique characteristics of the site. Therefore, sites in Detroit that had wet prairie were given a higher score than sites that had beech-maple. While the intent behind this attribute may have significant influence in some analyses, its impact on a heavily altered landscape may not be as great. This limited effect was compensated for by giving the numerical values of this attribute the lowest range (60-100 instead of 0-100). Range of attribute value is a major factor on its overall influence.

Density of vacant sites was given the most influential weight for two reasons: 1) it is a directly quantifiable value that accurately represents important spatial characteristics of the study system, and 2) this spatial characteristic is a measurement of potential habitat fragmentation and potential size of reserves (as density of vacant parcels increases, potential reserve size increases and habitat fragmentation decreases). The score range for this attribute was on the 0-1 scale (as opposed to the 0-100 scale), so the weight factor compensated accordingly (it was multiplied by 30, not .30).

Assigning Weights

Assigned weights were then defined to measure the effect of these attributes on the objective. This process is imperfect and somewhat subjective, as the researcher is responsible for generating fixed numerical relationships for phenomena that are fluid and interdependent in reality. These numerical relationships are abstracted to another level when you acknowledge that the attribute values are themselves abstract representations of reality.

A weighting scheme was developed to reflect the hierarchy of value that was determined to be present in the relationship of the attributes. This weighting scheme considered the score range of the individual attributes, and treated them accordingly as they were factored into the combination formula. Orders of magnitude and positive/negative relationships were considered while developing the formula.

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Distance to parks and quality of historical ecosystems were both given the second most influential weight. Distance to parks provides a quantifiable measurement for potential ecosystem connectivity. This value is acting as a general extrapolation of a landscape characteristic that is very complex in reality. This potential could change greatly depending on the species of interest and quality of the systems being linked.

Historical ecotype provides an indication of site specific characteristics (such as soils, hydrology, and topography), which, though significantly altered today, could still hold influence on restoration activities.

Proximity to industry and neighborhood centrality were given the smallest influence. Contamination is an extremely important that most be strongly considered when proposing alternative uses for the vacant land in Detroit, but the true value for this factor was not available for this analysis (and does not exist for many or all of the sites studied). Site specific soil tests need to be conducted in order to accurately assess site contamination. Proximity to mid and heavy industry was used as a surrogate; sites closer to heavy industrial areas may have more contamination. Since this important value was only extrapolated, it was not given a heavy influence.

Neighborhood centrality values were derived from delineations of neighborhoods provided by the city of Detroit. This value may influence the social acceptance of natural areas in neighborhoods, and may have an effect on the success of the restored systems. The true neighborhood center may be a result of other characteristics of the neighborhood such as a community center or an elementary school; factors which were not known during the execution of this analysis. Therefore, the resulting weight of this factor was relatively low.

The factors were weighted according to this scheme:

30(cluster_value) + .2(100-(dist_park)) + .2(hist_eco) + .15(100-(dist_center)) +.15(dist_ind) = Ecological Potential Index

Resolution

Parcel level data was used for the selection of city owned vacancies. This parcel level data enabled me to execute the analysis at a very fine scale. In order maintain such acute fidelity of the data, all raster analyses were performed utilizing 20ft by 20ft grid cells. This allowed the final composite map of the weighted linear combination to have multiple cell values for each parcel (which was still in vector format). The resulting values of the raster analyses were then analyzed through zonal statistics for each polygon in the vacant parcel layer. The mean of the raster values was derived for each polygon (this was the product of the zonal statistics), and that value was considered its final index score; the product of the weighted scheme illustrated above. All 33,299 selected vacant parcels have individual weighted linear combination (final index) scores representing their ecological potential.

Attribute Details

Data source: Data was obtained from three sources; the city of Detroit, SEMCOG , and the US Census 2000. The city of Detroit data was provided through Dr. Margret Dewar in the Urban Planning department at the University of Michigan. Data from SEMCOG was acquired through the data services provided at their website, www.semcog.gov. Data from the US Census was acquired from the US Census fact finder services. This data was downloaded as spreadsheets and then joined to census block group shape files to make it spatially explicit.

Vacant Parcels: This layer was extracted from the parcel level land-use data. The method for extraction was based on tax status, which gives an indication of city ownership. Selected parcels were then filtered by owner name. Through this selection many actively run city-owned parcels are filtered out of the vacant selection.

This is an imperfect method of identifying vacancy and it doesn't include all vacant land, but does identify 33,299 parcels. This attribute is acting as a surrogate value for true vacancy. This method of identifying vacancy is limited in the following ways: it only includes properties which the city has officially taken over, it only includes properties that the city had entered into their database prior to winter 2005, and it may include some active properties owned by the city that are currently being utilized. This method of identifying vacancy is useful for the following purposes: it provides a method for identifying general trends in vacancy patterns within the city, it provides parcel level resolution of vacancy, and it is fairly accurate within the residential portions of the city.

It is plausible to assume that the true number of vacant properties owned or to be owned shortly by the city of Detroit greatly exceeds the 33,299 included in the analysis (estimates often double that number [Murphy, 1998; Sugrue, 2005].

Density of Vacant Land: Contiguous or semi-contiguous parcels provide greater potential habitat value than highly dispersed parcels. This value was generated through neighborhood analysis of the vacant parcel layer and is therefore only based on city-owned parcels for which I have data.

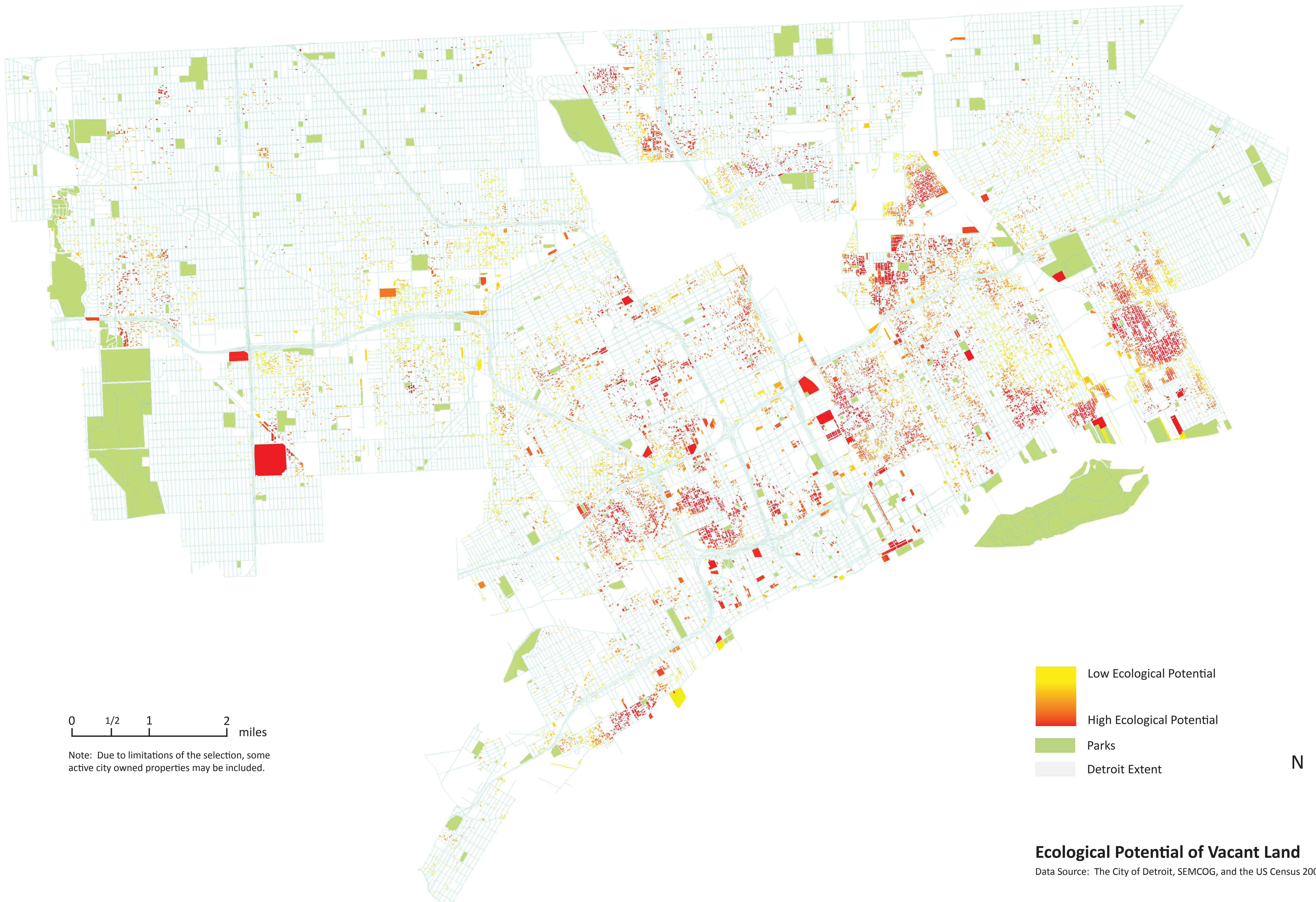
Proximity to Current Parks: This value provides insight into the potential linkage between parks and the establishment of a larger more cohesive natural areas network. This can be an indicator of migration potential. Parks were selected from the land use layer, and Euclidean distance measurements were taken from them. Distance values were converted to the 0-100 score range.

Historical Ecology: This is derived from a layer provided by SEMCOG containing vegetation information from survey notes circa 1800. This was used as an indicator for unique microhabitat conditions. Attributes in this layer include; beech-sugar maple forest, black ash swamp, lake/river, mixed conifer swamp, mixed hardwood swamp, mixed oak savannah, muskeg/bog, oak-hickory forest, shrub swamp/emergent marsh, and wet prairie.

Distance to the Neighborhood Center: This was derived from a layer provided by the city that contained polygons of the border of the major neighborhoods within the city. In order to find the approximate center of the neighborhood, the polygon data was converted to point data. This only provides a spatial sense of where the geographic center of the neighborhood is, not a social indication. This is a social variable which may influence the success of natural areas which are primarily dependent on community acceptance and management as well. Attributes in this layer include point data for; *Airport, Bagley, Boynton, Brightmoor, Brooks, Burbank, Butzel, Central Business District, Cerveny/Grandmont, Chadsey, Chandler Park, Cody, Condon, Conner, Corktown, Davison, Denby,* *Durfee, East Riverside, Evergreen, Finney, Grant, Greenfield, Harmony Village, Hubbard Richard, Indian Village, Jefferson/Mack, Jefferies, Kettering, Lower East Central, Lower Woodward, Mackenzie, McNichols, Middle East Central, Middle Woodward, Mt Olivet, Near East Riverfront, Nolan, Palmer Park, Pembroke, Pershing, Rosa Parks, Rosedale, Rouge, Springwells, State Fair, Tireman, Upper East Central, Vernor/Junction, West Riverfront, Winterhalter, St Jean, Foch, Redford*.

Distance to Medium and Heavy Industrial Development: This was used as a surrogate for more specific data indicating brownfield conditions or presence of pollutants. Current land use zoned for medium or heavy industry were reclassified together and Euclidean distance measurements were taken from that composite. Distance values were converted to the 0-100 score range.

Considering Detroit's rich and varied industrial history, more complete information is needed regarding contamination. This analysis assumed an increase in contaminant level the closer the site was to medium or heavy industrial land uses. This was based on current land use; it is possible that current residential is located on former heavy industrial sites, though a careful evaluation of Sanborn maps is necessary to identify to areas where this occurs. It was assumed that low levels of contamination were spread throughout the city, and the planning proposals address this potential of wide-spread contamination.



Ecological Potential of Vacant Land

Data Source: The City of Detroit, SEMCOG, and the US Census 2000

2.2 Social Analysis

These social analyses were constructed in an effort to provide insight into the social challenges the neighborhoods are facing in relationship to the density of abandonment. They were derived from the 2000 US Census data.

Census Mapping

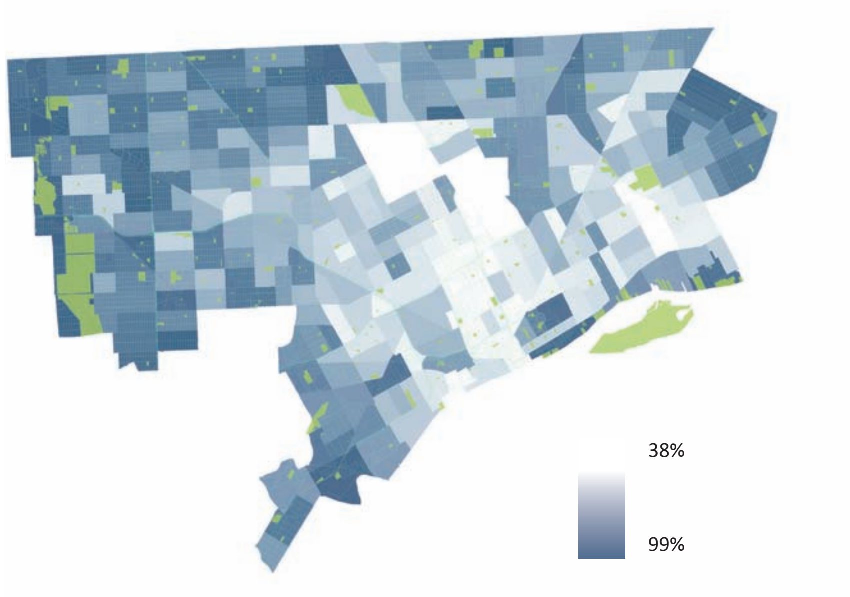
While not as spatially articulate as dasymetric mapping or chloropleth mapping (which utilize landscape and land use features to place demographic data), census mapping is a simple method for visualizing demographic information (Feidler, 2006). Census mapping provides a visualization of a generalized set of data only as resolved as the block group level of census classification. It is acknowledged that more sophisticated techniques would lead to stronger conclusions about the spatial relationships between vacancy and demographics (Martin, 2003), but these analyses are included here with the intention of triggering interest in such a pathway of research. These census maps were not used to influence the land management proposals, instead they present an emotive point of interest that could engage debate, critical thinking and future research (see also appendix one).

Details

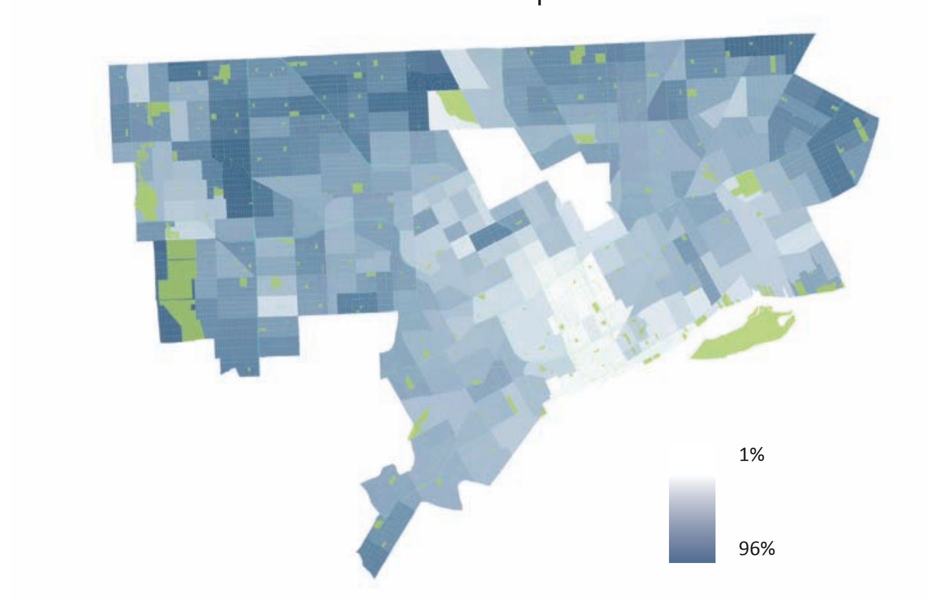
This analysis was generated by creating data tables of relevant demographic categories from the 2000 US Census data. Raw data was downloaded through the US Census fact finder website (US Census, 2008), and processed in excel. Many demographic categories were included in the excel summary, though only two of the mapped results are included here. These tables were joined to census block groups in the city of Detroit to provide spatial references for the demographic information. The complete attribute chart is available in the appendices of this paper.

A summary was then made of the percent vacancy within each census block group, and this information was linked to the block group shape file as well. This summary was created by converting the vacancy shape layer into a binary raster file (1=vacant parcel, 0=everything else) and calculating the total area of vacancy within each block group. The resulting maps seem to illustrate some level of spatial unity between density of vacancy and percent of the population living below the poverty level.

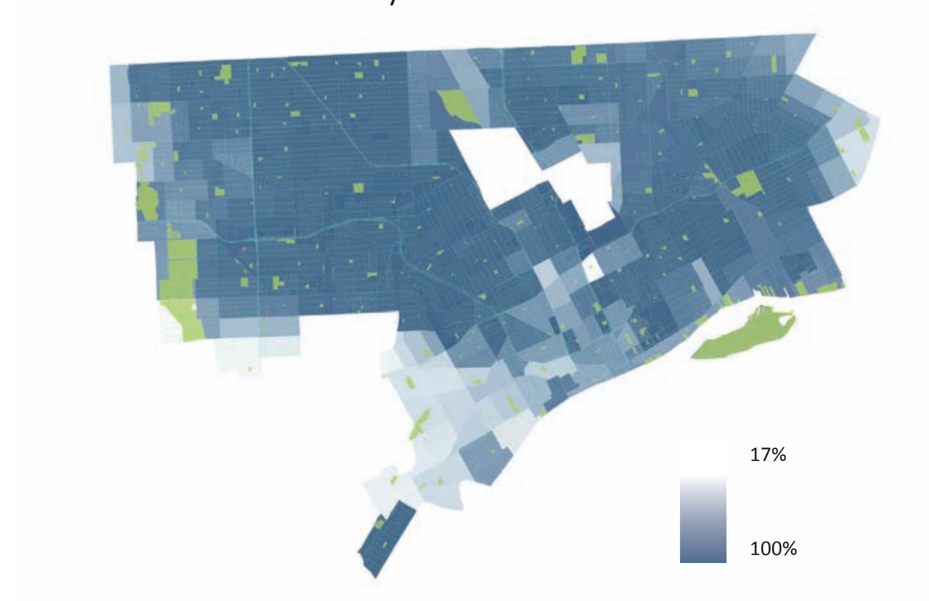
Percent Workers Who Own a Car



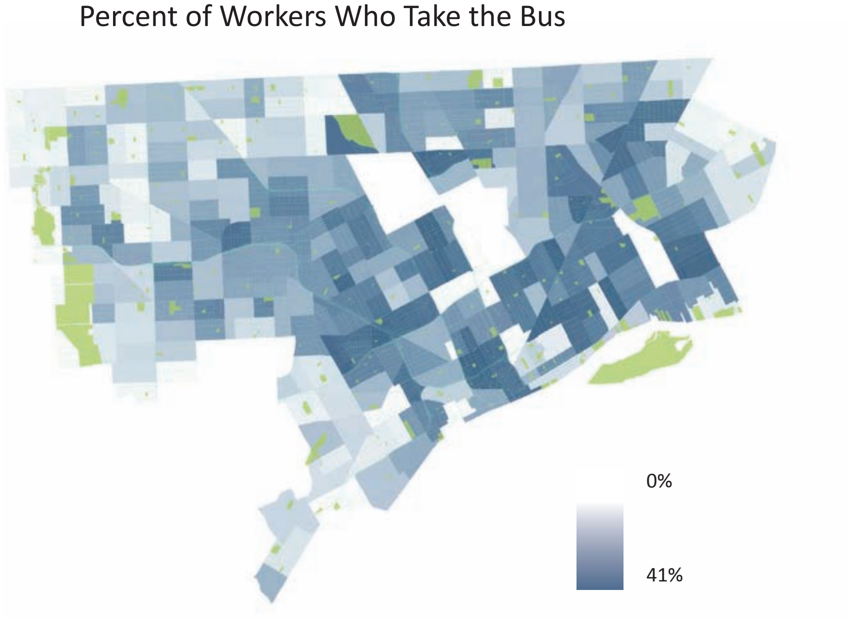
Percent Homes Owner Occupied



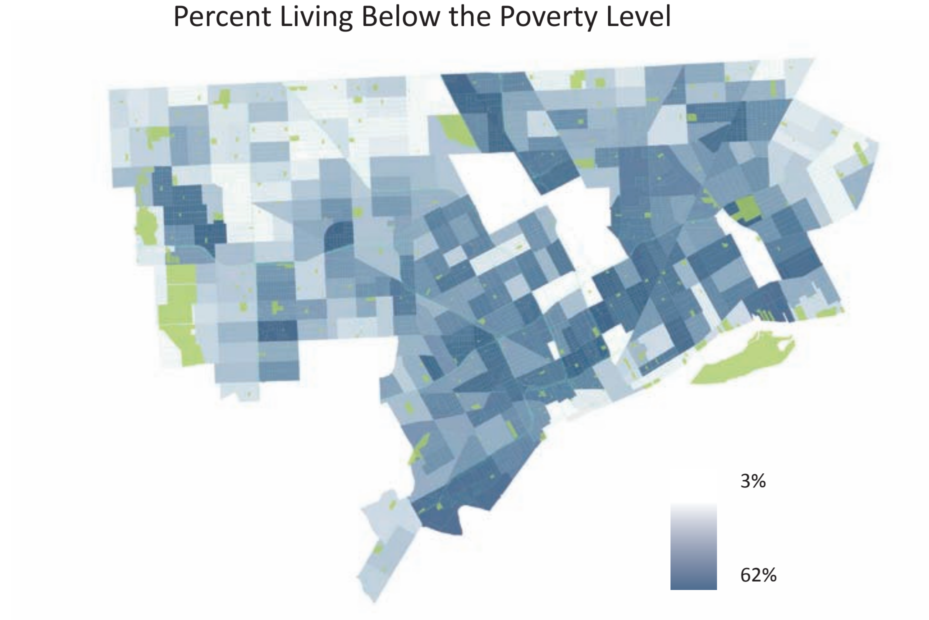
Percent Minority Inhabitants



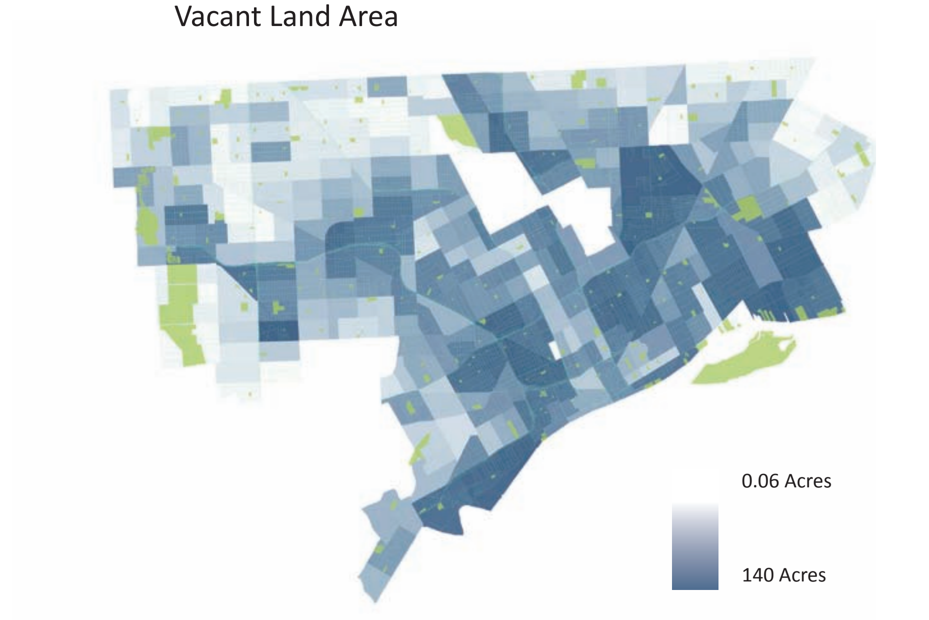
Percent of Workers Who Take the Bus



Percent Living Below the Poverty Level



Vacant Land Area



Demographic Census Mapping in Detroit

Data Source: The City of Detroit, SEMCOG, and the US Census 2000

2.3 Ground Truthing and Photo Documentation

I engaged in a process of ground truthing and photo documentation to better understand the relationship between the abstract analyses and the reality of what is taking place in these neighborhoods. I was very aware that the GIS selected properties did not fully represent the conditions of the neighborhoods, but in order to feel confident in its portrayal of the general patterns of vacancy I needed to execute an on the ground comparison. Photographer Peter Baker joined me on a trip to several target neighborhoods throughout the city, taking photos of important landscape features. After our initial visit I have been back several times to gather more information and execute a more detailed site analysis of the neighborhoods chosen for design demonstration of management details.

Approach

Sites for the initial investigation were selected based on the results of the weighted linear combination approach. Sites were selected in order to represent a broad cross-section of resulting values in an effort to make an on the ground assessment of sites with varying levels of quality. The sites selected are shown in the ground truthing map that follows. The majority of time in the field was spent in southeast and east central Detroit, in neighborhoods between Woodward and Grosse Pointe, after which we traveled along the river into the southwest industrial area near Zug Island. We were unable to visit some of the target sites, but those were still included in the map in order to potentially aid in future work for this project.

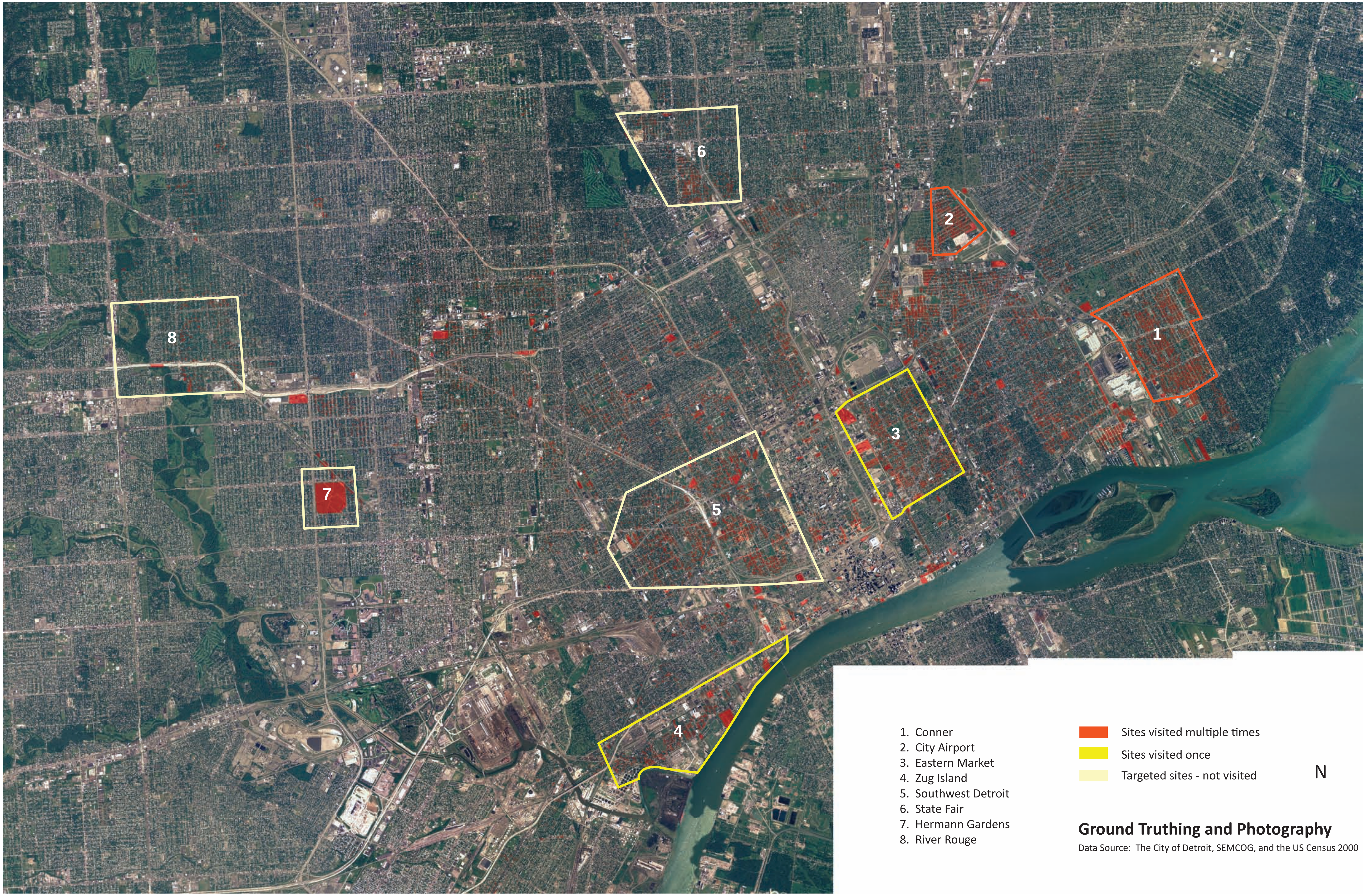
Eight target sites were selected: *Conner, City airport area, Eastern market area, Zug Island area, Southwest Detroit, State Fair, Hermann Gardens and River Rouge*. Conner, City airport, Eastern market and State Fair were selected due to their exceptional density of vacancies and relative high score on the ecological potential analysis. Southwest Detroit was selected because it contained a diverse range of density of vacancy, and was positioned within a community with a history of action and organizing. Hermann Gardens, the site of a former housing project, was selected because it is an exceptionally large tract of vacant land within the city. River rouge was selected because of it's relative low density of vacancy adjacent to a large natural area/city park.

Findings

What we found throughout the neighborhoods we visited exceeded the levels of vacancy that were expected based on the results of the GIS analysis. The relationship of the land and housing has a rural undertone that conflicts aesthetically with the harshness of the infrastructural degradation. The vast quantities of vacancy require a level of upkeep that overwhelms even the most diligent resident, leading to a condition of blight that undoubtedly depresses community enthusiasm. The city's commitment to these properties seems to be limited and sporadic; where some neighborhoods benefited from frequent mowing, others were entirely overgrown and littered with accumulated debris.

Ownership of the property is ambiguous on the ground. There were many instances where city owned properties were separated by vacant lots that result in contiguous vacancy in the landscape that when viewed analytically seem fragmented. This comparison is illustrated in the analysis of the mid-scale neighborhood detail. There are also many instances where vacant lots are taken over by neighbors for use as an expansion of their property. These lots have been termed ‘blots’, as they occasionally result in an entire block being taken over by one property owner. The most common use of these lots is parking.

The following section selects photographs taken during our documentation trip. Each photo was selected as a representation of important qualities of the vacant spaces in Detroit. These qualities are summarized in the captions provided under the photos.



1
2
3
4
5
6
7
8
1. Conner
2. City Airport
3. Eastern Market
4. Zug Island
5. Southwest Detroit
6. State Fair
7. Hermann Gardens
8. River Rouge
Sites visited multiple times
Sites visited once
Targeted sites - not visited
N
Ground Truthing and Photography
Data Source: The City of Detroit, SEMCOG, and the US Census 2000

Photo by Peter Baker, 2007

Photo 1: *A heterogenous urban landscape*

This photo illustrates important and unique elements of the vacant urban landscapes in the city of Detroit. A patchy distribution of overstory trees represents both native and exotic species including: sugar maple, ash (mostly deadfall now as a result of the emerald ash borer), and a spruce that was planted for landscaping purposes. An overgrown field of turf mowed periodically through the growing season maintains a frequent enough disturbance regime to limit invasion by shrubs, though exotic and invasive shrubs hide out on edges and as remnants of foundation plantings ready for an opportunity to spread. This habitat zone is restrained on all sides by an aging street and sidewalk system that is gradually being degraded into soil substrate. Isolated housing is still inhabitated, often by community members who still remember when every lot was occupied.

Photo by Peter Baker, 2007

Photo 2: *City infrastructure overwhelmed by natural processes*

It is apparent that in some of Detroit's neighborhoods, vacancy has been a problem for many years. There is little remaining evidence of the housing that once occupied the lots, and the utility infrastucture is giving way to the vegetation (as in the fire hydrant shown above). Take a closer look to notice the cap is missing, yet no water is flowing. This problem is exacerbated by the fact that the vacant buildings in this neighborhood and ones like it are frequent targets of arson in Detroit.

Photo by Peter Baker, 2007

Photo 3: *Degraded housing stock is a danger to the community*

Somebody painted a teal dot on the side of this house to draw attention to the pressing need for municipal attention to the blight on the interior of this and many similar neighborhoods. Vacant housing in all states of degradation can attract squatters and become refuges for crime. Trees can be seen growing through the windows and compromised roofs of structures like this throughout the city. The removal of these structures provides an obvious starting point for neighborhood improvements.

Photo by Peter Baker, 2007

Photo 4: *Underutilized interstitial space*

This neighborhood in southeast Detroit showcases an alley typical of many throughout the city. No longer used as everyday access to housing, the alley can quickly become a forgotten place that collects trash and debris. Plants are growing vigorously through the cracks in the concrete, and the trees seem to be leaning into the openess. Would these spaces be able to contribute to a more functioning urban ecology?

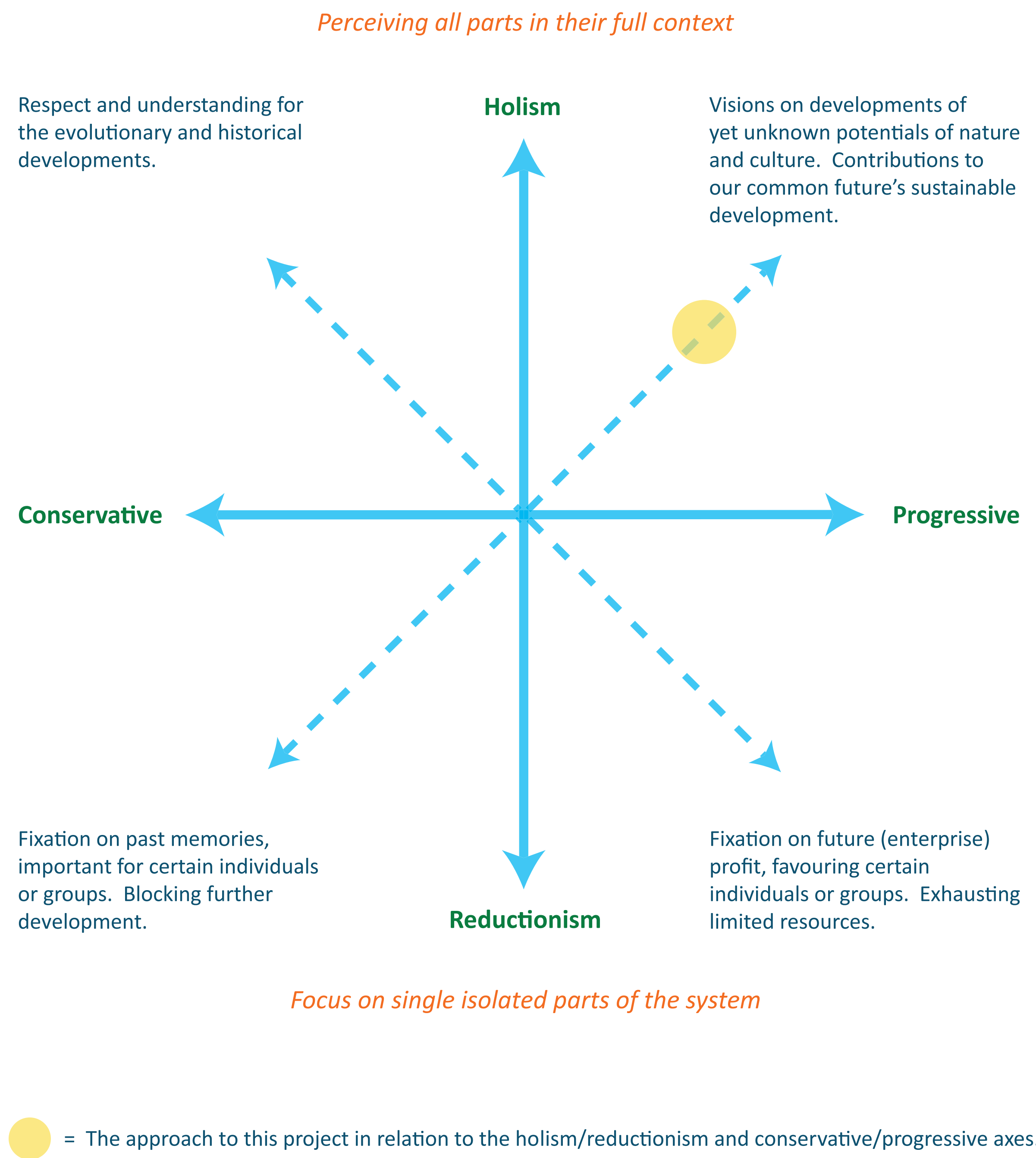


Figure 3.1: *This project uses a progressive holistic approach*

This Cartesian distribution of potential human interactions with the landscape was redrawn from Naveh (2000). Naveh uses it to show how culture can become polarized by either fixating on future enterprise and profit at the expense exhaustible resources, or the conservation of all resources with respect to the whole (Naveh, 2000). This project balances between those extremes, seeking solutions for a sustainable future.

3 Applications of the Results

The numerous complex challenges presented by the vacant land and consequential deterioration of neighborhoods within the city of Detroit call for innovative multi-modal solutions that can address economic, environmental and social concerns. The management intent for this project considers the economic, environmental and social challenges presented by these vacant properties and addresses them through a plausible management approach. This management scenario proposes a typology of management that would be compliant with other development intentions that investors may have. It is spatially and temporally flexible, allowing the approach to be implemented where it would be most optimally beneficial. The proposal presented here is a management strategy that aims to reinvest ecological and social quality into land in Detroit that has long been neglected and underutilized.

3.1 Management Proposal

I am proposing to restore vacant lands in Detroit to native tall grass prairie which could be utilized as a source of biomass for the production of cellulosic ethanol. The picture of the ecological quality that could re-emerge from the city's fabric after many years of restorative management is inspiring. Using these prairies to generate biomass for cellulosic ethanol could provide economic incentive for the establishment of these native prairie systems while structuring a management regime that would be able to sustain its costs while potentially bringing some profit back into the community.

The community would benefit from having its physical surroundings enhanced. Prairie restoration would do this in many ways, including: the establishment of diverse native plants and flowers; potential contaminant removal through bioremediation; the eventual establishment of habitat for birds; insects and small mammals; the engagement of the community through restoring; burning and seed collecting; the signs of care shown through these actions; and the renewed sense of beauty as the landscape responds to human care. This management regime would be a plausible positive landscape intervention that would benefit the communities of Detroit in many ways.

A Culture of Repair

"Culture suggests the enormous array of *possible* human actions and constructions in the landscape, including landscapes that do not exist now but might be designed to promote ecological function." Nassauer, 1995

"Specific to shrinking cities is dramatic transformation brought about without local intervention through construction. The utilization and programming of urban space undergo fundamental change, yet without initial physical changes taking place. Our conventional ideas and concepts of how to respond fail here…" Oswalt, 2005

What have these physical spaces done to the cultural space of the residents? Could benevolent acts of restoration begin to heal the community even if the initial physical changes seem modest? Central to the value of this proposal is balanced consideration of both ecology and culture, and a belief that there is an underlying symbiosis of the two. Compassion, benevolence and healing are qualities that will positively influence both. In this sense, humble actions toward repair are the necessary first step.

In his writing on shrinking cities, Oswalt (2005) compares the cultural implications of urban agriculture in three different circumstances across the globe. "Whereas urban farming has arisen in Russia as a result of the basic need to survive, in the United States it represents a living social utopia of small, dedicated groups and in eastern Germany a state measure to beautify fallow lots." The reason he makes these comparisons is to facilitate a synthetic learning process between places far apart in distance but close together in circumstance. In Detroit, let the function of urban agriculture extend beyond the ideals of a small, dedicated group. Let it address ecological and cultural needs while beautifying the landscape as well.

Restorative Potential

There are three major reasons why there is a great potential for system restoration even if the above ground biomass is being harvested annually. First, the majority of the biomass of a prairie exists below the surface: approximately 65%, even in the late fall when the above ground biomass is peaking (Miller, 2005). This below ground system is highly active and responsible for developing symbiotic relationships with bacteria and fungi, which in turn participate in consortiums that will degrade organic contaminants (Miller, 2005). At the same time, the rhizosphere is helping to develop structure in a disturbed soil. When aggregates and crumbs are formed in soil, the resulting structure will provide shelter and access to water and nutrients for soil microorganisms. These microorganisms will help create an underground ecology that will eventually facilitate a more functional above ground one.

Secondly, prairie systems are adapted to frequent disturbance, so annual harvesting is a selection pressure that favors them over other systems that would be ready to take over. Mowing is a recommended form of management for newly established prairie restorations (Packard, 2005), and a more sophisticated management regime that incorporates burning (discussed in more depth further in this section), will be able to more completely mimic the patterns of a natural disturbance regime.

And lastly, due to the potential for contamination throughout the city, a restoration approach that facilitates remediation is preferential over other approaches. Annual harvesting could provide a method of contamination extraction that temporally limits the mobility of contaminants into the system. Supplying this biomass to cellulosic ethanol producers not only provides a means of isolating and disposing of the contamination, it creates value out of something that would normally be expensive to dispose of. While more specific information is needed on contamination before final conclusions can be made about this, research has provided many reasons for optimism about this potential (Barman, 2000; Turnau, 2006; Rugh, 2004).

Developing a Typology: Indentifying Appropriately Sized Parcels

There are many spatial implications that accompany the proposal to convert currently mowed vacant land into tall grass prairie. Tall grass prairie plants may reach 7 ft in height by the end of the growing season, and grow in dense stands. The relationship between these prairies and currently inhabited residential units is important and has been considered.

I am proposing that four or more contiguously vacant parcels will provide enough open area to comfortably accommodate an urban prairie while allowing a sufficient separation from occupied residential housing. The prairie will consist of tall dense grasses and forbs, and should be separated from current occupied residential by 30 ft mowed buffers.

How will these plots feel? Will they feel safer or more dangerous than the current landscape? Most likely there will be elements of both. Regular community attention and actual caretaking of the space will make them feel safer. Tall dense grass may make them feel shadowy and dangerous at night. What kinds of strategies are available to mitigate the negative/dangerous perceptions, and increase the caring/safe perceptions and reality?

What is an Operational Unit for this Plan?

It is important to identify a scale of implementation that would make this management proposal feasible. I believe this management plan could acceptably function at some level on any scale. On the largest scale - the utilization of all vacant land in Detroit for this purpose - the operation could function both ecologically and economically. On the smallest scale, a single lot prairie could still contribute aesthetically and ecologically. Implementation at the scale of one neighborhood at a time would be the most optimal method of establishment, simultaneously generating economic, cultural and environmental benefits.

It would be advantageous to restore these properties in neighborhood increments. After an initial prairie plot is successfully established, seed from that site could be used to propagate future restorations. In this fashion, money and labor could be most efficiently distributed and the process of restoration could be self sustained.

3.2 Site Preparation

Treatment of Degraded Housing

Though this management plan can function without it, I strongly recommend directing resources towards the demolition of degraded housing. Though not a complete solution for many problems the city is facing (Oswalt, 2005), this is a clear pathway to immediately improving the quality of the environment for residents of the city. This is not only a starting point for further action, but a necessary stage of any type of substantial improvement to the neighborhoods.

In this management scenario, the removal of vacant structures would greatly increase the coherence of the open space within the neighborhoods. This would also increase the number of sites suitable for conversion to prairie according to the typology defined above, while making them more contiguously accessible for management needs. Nonetheless, if no resources were available to remove these structures, this management plan could still be implemented. If structures are removed in the future, that land could then be incorporated into this management scheme.

Trash Removal

An initial challenge that must be dealt with throughout the extent of the project sites is the removal of trash and unwanted debris. This action alone will transform the neighborhoods for the better, while drawing attention to the positive change taking place. Scattered debris is found in various densities throughout the vacant lots. Both large accumulations and small dispersions should be addressed and removed.

Shrub Removal

There are occasional trees of various native and non-native species present throughout these properties. Non-native trees and shrubs should be removed from the site and treated as biomass for cellulosic ethanol. Native trees and shrubs should be left around the perimeter of the plots, and evaluated individually inside the plots. Over-story trees should be left within the plots, as well as young oaks. After years of management as prairie, it could be decided that oak savannah is more preferable.

3.3 Establishing the Prairie

There are two plausible options for establishing prairie in currently open turf dominated fields. The first method is plowing and seeding, which requires access to heavy equipment to till the ground and compact the seed into the soil. The second method is interseeding, which can be executed without any heavy equipment. These methods are discussed in more detail in the following section.

Plowing and Seeding

Plowing and seeding is a method of prairie restoration that can establish dense, healthy prairies in a short time period. It is considered to be the most accepted successful and predictable method for prairie restoration (Morgan, 2005). This method is most appropriate if there are few desired plants on site, and the current vegetation is herbaceous, non-woody plants (Packard, 2005). This is not appropriate for landscapes with extremes slopes because it greatly increases the erosive potential; but in Detroit on the Huron Erie glacial lake plain, this should not be a problem.

Site inventory should be conducted to evaluate current populations of aggressive weeds. It may be necessary to treat these populations with herbicide if they are well established perennial species. For more information on herbicide treatments and all the other restoration methodologies discussed here please consult *The Tallgrass Restoration Handbook* (Packard, 2005), an excellent and comprehensive write up on the art of prairie restoration. Conducting a late fall or early spring burn prior to tilling could also help reduce the perennial weed populations.

Begin in early spring by utilizing a light-duty cultivator to till the ground to 2 inches. Shallow tillage is important in order to prevent the activation of the full seed bank of annual weeds. This procedure should be repeated every three weeks through early June to exhaust the exposed annual weed seed bank (Morgan, 2005). Broadcast seed across the site with the appropriate prairie mix immediately after the last tillage in early June.

After the site has been seeded, it must be compacted. Utilizing a water-filled roller is the best method for the compaction of the seed bed (Morgan, 2005). Compaction will create a moisture retaining crust on the surface of the soil, eliminate air passageways that could dry out the seeds prior to germination, and ensure good seed to soil contact (Morgan, 2005). Inclusion of a cover crop in the seed mix will help prevent the establishment of weeds on site. Annual varieties of oats are good for this use, and should not reseed the next season.

Interseeding

Interseeding is a method for restoring prairie systems into turf grass dominated fields without tilling. This method can be preferable for prairie restoration because of its relatively low demand for site preparation. This method takes longer to fully establish the prairie, but it also has many benefits, including: allowing native seeds to germinate within established vegetation; utilizing current vegetative cover to protect against the establishment of new invasive plants; better establishment of more conservative species; less erosive potential; and no heavy equipment is required (Packard, 2005).

The land, in this case, would most effectively be prepared through the execution of a fall burn and then the broadcasting of the prairie interseed mix immediately afterwards. This should be done well enough into the fall that the temperature is cycling in and out of freezing, and preferably immediately preceding a precipitation event. While the temperature oscillates in and out of freezing it is agitating the soil surface, eliminating the need to rake in the seed, and the precipitation will weigh down wind dispersed seeds before they have a chance to blow away (Packard, 2005).

Seed should be broadcast at a density of 1 cup per 100 sq ft, where one cup equals ½ perlite and ½ seeds of the prairie mix. The seed should be broadcast by hand evenly throughout the site. Sowing seed in late fall after a burn will alleviate the necessity to rake the seed in (Packard, 2005).

At a city wide scale, raking seed into the soil could be prohibitively labor intensive, but if these restoration efforts took place on a smaller neighborhood scale raking seed into the soil could be considered in place of broadcasting after a fall burn. Seed could be incorporated into the soil through the use of hand rakes, harrowing, disking or drilling (Packard, 2005). Any type of strong metal rake would be appropriate to use so long as it would break up the surface soil to ½ to ¼ inches. When raking into existing turf, the surfaces will be irregular and will make it impossible to incorporate the seed evenly throughout. This will be suitable for the prairie seed mix, as some seeds do better with deeper incorporation, while others do better with little to virtually none (Packard, 2005).

The following spring, the site should be mowed over when the plant material is between 12” and 18” tall. This will prevent the turf grasses (which will still be dominating) from completely shading out the prairie seedlings.

Species List

A comprehensive list of the appropriate species and necessary volumes of seed/area is available in the appendices.

Seed Source

It is important to utilize seed stock that comes from the nearest local populations available. This practice will decrease the likelihood of unintentionally establishing a more aggressive genotype that could overtake the native populations of the region and shift the ecological balance of the plant community. It will also protect communities against potentially detrimental effects caused by outbreeding depression (Hufford, 2003). While there may not be many quality seed sources available in the city of Detroit for the prairie plants, Washtenaw and Oakland counties have established prairie systems that could provide good seed if collected with the appropriate permits.

Local purveyors of native plants, such as the Native Plants Nursery (Ann Arbor, MI) and the Wildtype Nursery (Mason, MI), may have seed that they are willing to sell, though special orders will probably be necessary for the large quantities required for this project. A complete list of these nurseries is provided in the appendices.

Seed Collecting

Collecting seeds from the established prairie plants would be an effective way to engage community residents while simultaneously providing a low cost method of propagating the established prairie plants. If the establishment of prairie plots were undertaken one neighborhood at a time, seeds from the sites first planted could be used to establish new sites. In this way, the propagation of the prairie could be self sustaining.

The practice of collecting seeds is a relaxing, enjoyable and reflective activity that could help give citizens a feeling of stewardship for the land. Organizing this activity as an event for the community could help develop a sense of ownership of the space while cultivating relationships between residents that may not otherwise interact. Seed collection could be an opportune time to educate residents about the goals of the restoration project and the benefits it can provide. Seed collection will also draw attention to the space and provide a physical human presence in the landscape that signals care to the neighborhood.

The diverse plants of the prairie will provide mature seeds at various times throughout the spring, summer and fall. Having an understanding of the timing of these seeds is essential in effectively targeting the seed collection activities. A list of plants and seeding times is provided in the appendices.

Harvesting

After successful establishment, the prairies should be harvested once a year in the fall. The plant materials will be baled and stored or shipped to the cellulosic ethanol plant. It will be necessary to have access to a tractor, a tractor-pulled mower, a tractor-pulled rake and a small tractor-pulled square baler for this process.

Standing biomass must be mowed towards the end of the growing season and laid in windrows to release moisture before baling and transport; grasses have a water content of 80-90% before mowing at the end of the growing season (Agrability, 2003). Most commercial mowers have built in conditioners that rupture stems to increase the drying rate (Agrability, 2003). A tractor-pulled mower would be optimal for this project because it would save costs by increasing the interoperability of the equipment (utilizing the tractor for plowing, mowing, raking, baling and transport).

Six inches of above ground plant material will be left standing to be burned after the rest of the materials are removed from the site. An area of prairie within each cultivated neighborhood unit will also be left standing each year. This section of prairie will act as a refuge for insects, mammals and birds that inhabit the prairie at the time of harvest.

After the grasses have been mowed and laid in windrows, they should be moved into narrower windrows with a tractor-pulled rake. This should occur when the grasses have reached about 40% water content (Agrability, 2003). Basically, this process agitates the grasses in order to expose moisture that had been trapped within the windrows. Other methods to achieve this include inverting and merging.

A small tractor-pulled baler will then be utilized to package and bind the windrows in to small square bales. This type of baling will also facilitate flexibility in storage and maneuverability, as the bales will be small enough to be transported by hand, tractor, truck or rail, and stored in both larger and smaller store spaces depending on what is available.

Development of storage locations at each major node of production would be most cost effective for the economics of the lingo-cellulosic biomass to ethanol process (Thorsell, 2004). In Detroit, adaptive reuse of industrial or warehouse buildings for the storage of prairie biomass would be an interesting avenue of investigation.

Burn Management

Fires are part of the native ecology of grasslands. They select against woody shrub invasion and promote the maintenance of prairies and oak savannahs. Fire increases the growth, seed and vigor of prairie plants while stimulating microbial activity in the soil. It is a fast-acting, effective management tool (Pauly, 2005). By harvesting the biomass of the prairie annually, some challenges are created for standard burn management.

Every year, the remaining 6" of stubble in the harvested areas of the prairie will be burned. This will provide some of the stimulating effects of burning while also reserving the majority of the produced biomass for energy use. The reserve that was not harvested will also not be burned, providing a refuge for birds, insects and other prairie community members.

3.4 Organizational Structure

In order to successfully execute any of the proposed actions, a functional organizational structure must be established to orchestrate them. I propose the establishment of a small non-profit dedicated to building a coalition of groups interested in supporting this cause. While upstart funding costs may be intimidating for a single non-profit entity, they would be quite modest if larger organizations and corporate entities became involved.

General Motors has recently invested in two cellulosic ethanol plants, Mascoma and Coskata, and seems clearly interested in becoming a pioneer in the growth of this field of industry (General Motors, 2008). They are also a major anchor institution within the city of Detroit, whose public relationship could greatly benefit from reinvestment in the local community. Organizing support from General Motors, one of the largest corporate entities in the world, could go a long way towards funding the modest project budget this would require.

There are also current non-profit entities that may have an interest in participating in this project. The Greening of Detroit and the Urban Agriculture Network are both active groups working towards a more sustainable Detroit. As members of a coalition they could potentially contribute local expertise, local contacts and networking capabilities.

Another essential level of organization is community involvement. While anchor institutions and established non-profits could help with macro-level organizational challenges, neighborhood community groups would most effectively help organize on the ground participation. If there were an economic return from the sale of the biomass, this should be reinvested directly into the community from which it originated. This would help the community build capacity for other stages of improvements it may desire to undertake. In order for this type of reinvestment to be effective, the community must be organized and engaged. With a proposed method for instigating change in place, perhaps there would be more incentive to get organized.

Potential for New Industry

While outside of the scope of this project, it should be noted that there would be many potential advantages to the development of new industry to produce cellulosic ethanol within Detroit. One of the major limiting factors in the growth of the industry is the cost of transportation of biomass (Mapemba, 2008). The original physical characteristics of Detroit that accommodated rapid industrial growth are still relevant: it is centrally positioned in the Midwest with easy access to water, rail and truck transportation. Perhaps this centrality could again be a decisive factor for stimulating a renewed industrial vigor.

Detroit also has many underutilized industrial sites. Development of new industry on rural greenfield sites is accompanied by the high cost of developing infrastructure to provide access to power, water and transport. These needs would already be in place in Detroit. There would also be the inherent environmental benefit that is associated with the redevelopment of a brownfield instead of a greenfield.

This type of development would also provide new industrial jobs to a city that has lost so many. This sector of job development is especially important to Detroit where most of the new jobs are in the service sector. While the production of energy crops could bring in some income for the community, industrial reinvestment would elevate the city, as the economist Jeffery Sachs might say, up another rung on the ladder of prosperity (Sachs, 2005).

Concentrating development will be a key to the sustainability of cities in the future. Travel is energetically expensive and energy is environmentally expensive. A major component of the plausibility of renewable energies will be a cultural restructuring of our energy uses. Here is an apparent opportunity to take positive action towards both.

Photo Collage by Michael Yun, 2008

Photo Collage 1: *Nature beautifies the city*

After years of restorative management and remediative efforts, the urban prairies would be able to take on a healthy ecological function. They would diversify plant, insect and avian biota. This collage also illustrates the growing stage of the prairie, a seasonal occurence during the spring and summer.

Photo Collage by Michael Yun, 2008

Photo Collage 2: *Community members engage with natural processes*

Community members would be able to become an active participant in their landscape. Volunteer activities can be satisfying and beneficial to both the ecosystem and the community. This collage shows a child participating in seed collecting. This seasonal event would occur in the fall, though smaller seed collecting expeditions could take place for certain species throughout the entire growing season.

Photo Collage by Michael Yun, 2008

Photo Collage 3: *Agriculture transforms the urban landscape*

Active management of the landscape would transform forgotten, leftover spaces into community assets. Physical care of the landscape could generate positive feelings throughout the community. This would take place in the fall after seed collecting activities.

Photo Collage by Michael Yun, 2008

Photo Collage 4: *Fire management promotes ecological health*

Fire is an important component of the prairie system. Community participation in burns provides another opportunity for active engagement with the landscape. This is a fun and enjoyable event that could help bring people together, while simultaneously caring for the local ecology. This would occur after the bales have been removed and transported to the cellulosic ethanol plant.

3.6 Design Demonstration

The following sections detail how these management proposals would exist spatially within a neighborhood. They are intended to provide a template of the methodology of change which one may imagine the rest of the city undergoing.

Utilizing the ecological potential index map, along with the results of ground truthing trips, an intermediate scale site was selected for management demonstration. This neighborhood, known as Fox Creek, showcased many characteristics that would make it not only a plausible representation of other neighborhoods throughout the city, but also an optimal site to begin to implement this management strategy. It is adjacent to an auto manufacturing plant and has several abandoned industrial sites within the neighborhood. Some blocks are almost entirely vacant, while others are almost entirely inhabited. There is an operational elementary school at the center of the site. Grosse Pointe borders the neighborhood to the east, providing a stringent contrast some of the vacant conditions in Detroit.

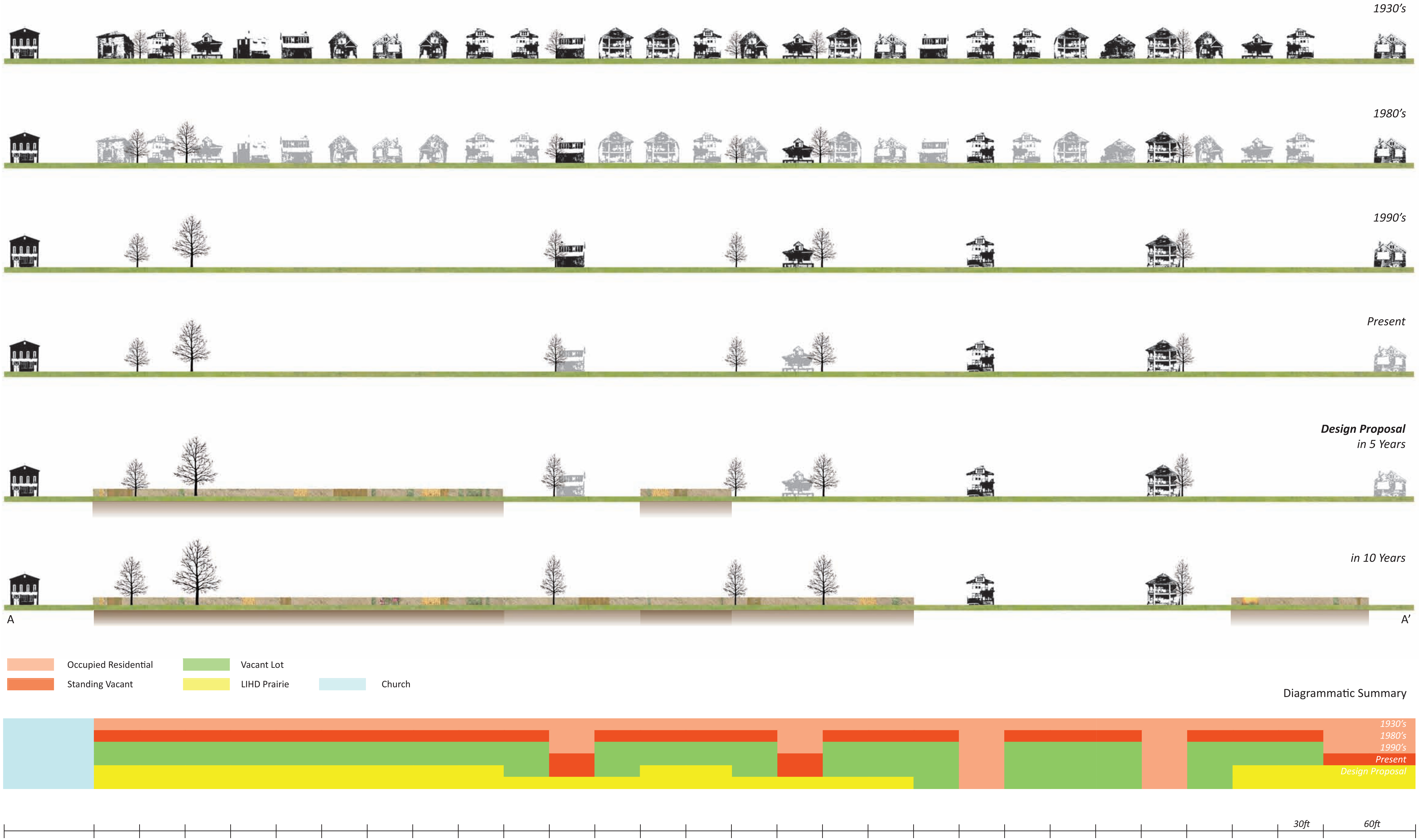
Within this mid-scale neighborhood, a six block tract was selected to illustrate the management details. This six block section is located at the center of the neighborhood. The elementary school is at the center of this site and is surrounded by blocks of varying degrees of vacancy with residential, retail and social services represented. This variability facilitated the illustration of the relationship of the urban prairie to many different types of land-use.


Mack Ave
Charlevoix Street
Carsten Elementary
Alter
Detroit
Grosse Pointe
Daimler Chrysler Jefferson Assembly
Conner Ave
Vernor Highway
Kercheval
Jefferson Ave
Area Enlarged
Site Detail
Operational Unit
Detroit Border
N
NTS
Mid-Scale Site Selection
Management Demonstration

Carsten Elementary Neighborhood
Management Demonstration

Coplin Street, Detroit: *Landscape Change*

1 in = 60ft   Looking Southwest



3.7 Conclusions

There is an opportunity for positive change to occur on a large scale throughout the city of Detroit. By incorporating a progressive and holistic perspective in the analysis of current ecological, social, and economic challenges, positive actions towards change can be envisioned. The current that intersects these seemingly disparate variables is strong, and a synthetic approach that composes a unified solution is necessary. The proposals presented here are the seeds of future actions for change. Their ability to stimulate dialogue, debate, imagination and action may be a true measure of their value.

Literature Cited

Antrop, M., *Background Concepts for Integrated Landscape Analysis*, Agriculture, Ecosystems and Environment, 77, 17-28, 2000

Apfelbaum, S.I., Bader, B.J., Faessler, F., Mahler, D., *Obtaining and Processing Seeds*, in Packard, S., Mutel, C.F. (Ed.), *The Tallgrass Restoration Handbook: For Prairies, Savannas, and Woodlands*, Island Press, Washington D.C., 2005

Aronson, J., Le Floc'h, E., *Vital Landscape Attributes: Missing Tools for Restoration Ecology*, Restoration Ecology, 4, 377-387, 1996

Barman, S.C., Sahu, R.K., Bargava, S.K., Chaterjee, C., *Distribution of Heavy Metals in Wheat, Mustard, and Weeds Grown in Fields Irrigated with Industrial Effluents,* Bulletin of Environmental Contamination and Toxicology, 64, 489-496, 2000

Bell, S.S., Fonseca, M.S., Motten, L.B., *Linking Restoration and Landscape Ecology*, Restoration Ecology, 5:4, 318-323, 1997

Bingham, M.T., *Flora of Oakland County, Michigan: A study in Physiographic Plant Ecology*, Cranbrook Institute of Science, Bloomfield Hills, 1945

Ceotto, E., *Grasslands for Bioenergy Production: A Review*, Agronomy for Sustainable Development, 27, 2007

Clergeau, P., Jokimaki, J., Savard, J.P., *Are Urban Bird Communities Influenced by the Bird Diversity of Adjacent Landscapes?*, Journal of Applied Ecology, 38, 1122-1134, 2001

Cook, E.A., *Landscape Structure Indices for Assessing Urban Ecological Networks*, Landscape and Urban Planning, 58, 269-280, 2002

Cook, W.M., Lane, K.T., Foster, B.L., Holt, R.D., *Island Theory, Matrix Effects and Species Richness Patterns in Habitat Fragments*, Ecology Letters, 5, 619-623, 2002

Daghino S., Martino E., Fenoglio I., Tomatis M., Perotto S., Fubini B., *Inorganic materials and living organisms: surface modifications and fungal responses to various asbestos forms,* Chem. Eur. J. 11: 5611-5618, 2005

Donald, P.F., Evans, A.D., *Habitat Connectivity and Matrix Restoration: the Wider Implications of Agri-Environment Schemes*, Journal of Applied Ecology, 43, 209-218, 2006

Duaber, J., Hirsch, M., Simmering, D., Waldhardt, R., Otte, A., Wolters, V., *Landscape Structure as an Indicator of Biodiversity: Matrix effects on Species Richness*, Agriculture, Ecosystems and Environment, 98, 321-329, 2003

Drexler, J., *Post-Industrial Nature in the Coal Mine of Gottelborn, Germany: The Integration of Ruderal Vegetation in the Conversion of a Brownfield*, Wild Urban Woodlands, Springer-Verlag Berlin, Heidelberg, 277-286, 2005

Eden, S., Tunstall, S., *Ecological versus Social Restoration? How Urban River Restoration Challenges but also Fails to Challenge the Science-Policy Nexus in the United Kindom*, Environment and Planning C: Government and Policy, 24, 661-680, 2006

Eppllin, F.M., Clark, C.D., Roberts, R.K., Hwang, S., *Challenges to the Development of a Dedicated Energy Crop*, Journal of Agricultural Economics, 89:5, 1296-1302, 2007

Evans F., Rosado A., Sebastian G., Casella R., Machado P., Holmstrom C., Kjelleberg S., van Elsas J., Seldin L., *Impact of Oil Contamination and Biostimulation on the Diversity of Indigenous Bacterial Communities in Soil Microcosms*, Microbiology Ecology 49: 295-305, 2004

Ewing, K., *Mounding as a Technique for Restoration of Prairie on a Capped Landfill in the Puget Sound Lowlands*, Restoration Ecology, 10:2, 289-296, 2002

Felson, A.J., Pickett, S.T., *Designed Experiments: New Approaches to Studying Urban Ecosystems*, Frontiers in Ecology and the Environment, 3:10, 549-556, 2005

Fernandez-Juricic, E., *Avifaunal Use of Wooded Streets in an Urban Landscape*, Conservation Biology, 14:2, 513-521, 2000

Fernandez-Juricic, E., Jokimaki, J., *A Habitat Island Approach to Conserving Birds in Urban Landscapes: Case Studies from Southern and Northern Europe*, Biodiversity and Conservation, 10, 2023-2043, 2001

Fiedler, R., Schuurman, N., Hyndman, J., *Improving Census-based Socioeconomic GIS for Public Poliy: Recent Immigrants, Spatially Concentrated Poverty and Housing Need in Vancouver*, International E-Journal for Critical Geographies, 4:1, 145-171, 2006

Fishman, R., *Suburbanization: USA*, In Oswalt, P. (Ed), *Shrinking Cities Volume 1: International Research*, Hatje Cantz Verag, Ostfildern-Ruit, Germany, 2005

Flores, A., Pickett, S.T., Zipperer, W.C., Pouyat, R.V., Pirani, R., *Adopting a Modern Ecological View of the Metropolitan Landscape: the Case of a Greenspace System for the New York City Region*, Landscape and Urban Planning, 39, 295-308, 1998

Gobster, P.H., *Visions of Nature: Conflict and Compatibility in Urban Park Restoration*, Landscape and Urban Planning, 56, 35-51, 2001

Grese, R.E., *Caring for Urban Wilds: Restoring and Managing Natural Areas in the City*, Research in the Interest of the Public and the Environment, Presentation, November 11th, 1999

Hartig, J.H., *Honoring our Detroit River: Caring for our Home*, Cranbrook Institute of Science, Bloomfield Hills, MI, 2003

Hay Making and Handling Made Easier, National Agrability Assistive Technology and Product Database, 2003, http://www.agrabilityproject.org/assistivetech/tips/hayhandling.cfm

Hester, R.T., *Design for Ecological Democracy*, MIT Press, MA, 2006

Hill, J., Nelson, E., Tilman, D., Polasky, S., Tiffany, D., *Environmental, Economic, and Energetic Costs and Benefits of Biodiesel and Ethanol Biofuels*, Proceedings of the National Academy of Sciences, 103:30, 11206-11210, 2006

Hope, D., Gries, C., Zhu, W., Fagan, W.F., Redman, C.L., Grimm, N.B., Nelson, A.L., Martin, C., Kinzig, A., *Socioeconomics Drive Urban Plant Diversity*, Proceedings of the National Academy of Sciences, 100:15, 8788-8792, 2003

Huang, S., Lai, H., Lee, C., *Energy Hierarchy and Urban Landscape System*, Landscape and Urban Planning, 53, 145-161, 2001

Hufford, K.M., Mazer, S.J., *Plant Ecotypes: Genetic Differentiation in the Age of Ecological Restoration*, Trends in Ecology and Evolution, 18, 147-155, 2003

Huttl, R.F., *Aspect of Reclamation Ecology*, Landscape and Urban Planning, 51, 73-74, 2000

Johnson, D.H., Haseltine, S.D., Cowardin, L.M., *Wildlife Habitat Management on the Northern Prairie Landscape*, Landscape and Urban Planning, 28, 5-21, 1994

Jokimaki, J., *Occurrence of Breeding Bird Species in Urban Parks: Effects of Park Structure and Broad-Scale Variables*, Urban Ecosystems, 3, 21-34, 1999

Kuo, F.E., Sullivan, W.C., *Aggression and Violence in the Inner City: Effects of Environment via Mental Fatigue*, Environment and Behavior, 33, 543-571, 2001

Leitao, A.B., Ahern, J., *Applying Landscape Ecological Concepts and Metrics in Sustainable Landscape Planning*, Landscape and Urban Planning, 59, 65-93, 2002

Liu S., Suflita J.M., *Ecology and evolution of microbial populations for bioremediation*, Trends in Biotechnology 11: 344-352, 1993

Malzcewski, J., *On the Use of Weighted Linear Combination method in GIS: Common and Best Practice Approaches, Transactions in GIS*, 4 (1), 5-22, 2000

Malzcewski, J., *GIS-based Land Use Suitability Analysis: a Critical Overview*, Progress in Planning, 62, 3-65, 2004

Mapemba, L.D., Epplin, F.M., Huhnke, R.L., Taliaferro, C.M., *Herbaceous Plant Biomass Harvest and Delivery Cost with Harvest Segmented by Month and Number of Harvest Machines Endogenously Determined*, Biomass and Bioenergy, 2008, DOI:10.1016/j.biombioe.2008.02.003

Martin, D., *Optimizing Census Geography: the Separation of Collection and Output Geographies*, International Journal of Geographical Information Science, 12:7, 673-685, 1998

McGuckin, C.P., Brown, R.D., *A Landscape Ecological Model for Wildlife Enhancement of Stormwater Management Practices in Urban Greenways,* Landscape and Urban Planning, 33, 227-246, 1995

McIntyre, S., Hobbs, R., *A Framework for Conceptualizing Human Effects on Landscapes and Its Relevance to Management and Research Models*, Conservation Biology, 13:6, 1282-1292, 1999

Metzger, K., Booza, J., *On some Socio-Economic Aspects of Detroit*, Shrinking Cities Studies, III, Wayne State University Center for Urban Studies, 2004

Miles, I., Sullivan, W.C., Kuo, F.E., *Psychological Benefits of Volunteering for Restoration Projects*, Ecological Restoration, 18:4, 218-228, 2000

Miles, I., Sullivan, W.C., Kuo, F.E., *Ecological Restoration Volunteers: the Benefits of Participation*, Urban Ecosystems, 2, 27-41, 1998

Miller, J.R., *Restoration, Reconciliation, and Reconnecting with Nature Nearby*, Biological Conservation, 127, 356-361, 2006

Miller, R.M., *Prairie Underground*, In Packard, S., Mutel, C.F. (Ed.), *The Tallgrass Restoration Handbook: For Prairies, Savannas, and Woodlands*, Island Press, Washington D.C., 2005

Morgan, J.P., *Plowing and Seeding*, in Packard, S., Mutel, C.F. (Ed.), *The Tallgrass Restoration Handbook: For Prairies, Savannas, and Woodlands*, Island Press, Washington D.C., 2005

Murphy, H.T., Lovett-Doust, J., *Context and Connectivity in Plant Metapopulations and Landscape Mosaics: Does the Matrix Matter?*, Oikos, 105, 3-14, 2004

Nassauer, J.I., *Culture and Changing Landscape Structure*, Landscape Ecology, 10:4, 229-237, 1995

Nassauer, J.I., Corry, R.C., *Limitations of using Landscape Pattern Indices to Evaluate the Ecological Consequences of Alternative Plans and Designs*, Landscape and Urban Planning, 72, 265-280, 2005

Naveh, Z., *Ecological and Cultural Landscape Restoration and the Cultural Evolution towards a Post-Industrial Symbiosis between Human Society and Nature*, Restoration Ecology, 6:2, 135-143, 1998

Naveh, Z., *What is Holistic Landscape Ecology? A Conceptual Introduction*, Landscape and Urban Planning, 50, 7-26, 2000

Niemela, J., *Ecology and Urban Planning*, Biodiversity and Conservation, 8, 119-131, 1999

Nilon, C.H., Pais, R.C., *Terrestrial Vertebrates in Urban Ecosystems: Developing Hypotheses for the Gwynns Falls Watershed in Baltimore, Maryland*, Urban Ecosystems, 1, 247-257, 1997

Ogden, J.C., Browder, J.A., Gentile, J.H., Gunderson, L.H., Fennema, R., Wang, J., *Environmental Management Scenarios: Ecological Implications*, Urban Ecosystems, 3, 279-303, 1999

Opdam, P., Foppen, R., Vos, C., *Bridging the Gap between Ecology and Spatial Planning in Landscape Ecology*, Landscape Ecology, 16, 767-779, 2002

Oswalt, P., *Introduction*, In Oswalt, P. (Ed), *Shrinking Cities Volume 1: International Research*, Hatje Cantz Verag, Ostfildern-Ruit, Germany, 2005

Oswalt, P. (Ed), *Shrinking Cities Volume 1: International Research*, Hatje Cantz Verag, Ostfildern-Ruit, Germany, 2005

Packard, S., *Interseeding*, in Packard, S., Mutel, C.F. (Ed.), *The Tallgrass Restoration Handbook: For Prairies, Savannas, and Woodlands*, Island Press, Washington D.C., 2005

Packard, S., Mutel, C.F. (Ed.), *The Tallgrass Restoration Handbook: For Prairies, Savannas, and Woodlands*, Island Press, Washington D.C., 2005

Palang, H., Mander, U., Naveh, Z., *Holistic Landscape Ecology in Action*, Landscape and Urban Planning, 50, 1-6, 2000

Pickett, S.T., Cadenasso, M.L., *Linking Ecological and Built Components of Urban Mosaics: An Open Cycle of Ecological Design*, Journal of Ecology, 96, 8-12, 2008

Pivetz P., *Phytoremediation of contaminated soil and ground water at hazardous waste sites*, Ground Water Issue, United States Environmental Protection Agency, 540: S-01/500, 1-36, 2001

Poremba, D.L., *Detroit in Its World Setting: A Three Hundred Year Chronology, 1701-2001*, Wayne State University Press, Detroit, MI, 2001

Poremba, D.L., *Detroit: A Motor City History*, Arcadia Publishing, Charleston, SC, 2001

Rieniets, T., *Global Shrinkage*, In Oswalt, P. (Ed), *Shrinking Cities Volume 1: International Research*, Hatje Cantz Verag, Ostfildern-Ruit, Germany, 2005

Rodewald, A.D., *The Importance of Land Uses within the Landscape Matrix*, Wildlife Society Bulletin, 31:2, 586-592, 2003

Romantshuk M., Sarand I., Retanen T., Peltola R., Jonsson-Vihanne M., Koivula R., Yrjala K., Haahtela K., *Means to improve the effect of in situ bioremediation of contaminated soil: an overview of novel approaches*, Environmental Pollution 107: 179-185, 2000

Rugh, C., Thomas, J., Russell, D., Leinauer, B., Carreira, L., (2004) *Ecological Influences on PAH-Phytoremediation*, International Journal of Phytoremediation, 6(2), 186-187, 2004

Russelle, M.P., Morey, R.V., Baker, J.M., Porter, P.M., Jung, H.G., *Comment on 'Carbon-Negative Biofuels from Low-Input High Diversity Grassland Biomass'*, Science, 316, 1567b, 2007

Ryznar, R., Wagner, T., *Using Remotely Sensed Imagery to Detect Urban Change; viewing Detroit from space*, Journal of the American Planning Association, 67:3, 327-336

Singer A.C., Thompson I. P., Bailey M.J., *The Tritrophic Trinity: a source of pollutant-degrading enzymes and its implications for phytoremediation*, Current Opinion in Microbiology, 7: 239-244, 2004

Sugrue, T.J., *On the Origins of the Urban Crisis; Race and inequality in Postwar Detroit*, Princeton University Press, Princeton, NJ, 2005

Sugrue, T.J., *Racism and Urban Decline*, In Oswalt, P. (Ed), *Shrinking Cities Volume 1: International Research*, Hatje Cantz Verag, Ostfildern-Ruit, Germany, 2005

Tembo, G., Epplin, F.M., Huhnke, R.L., *Integrative Investment Appraisal of a Lignocellulosic Biomass-to-Ethanol Industry*, Journal of Agricultural and Resource Economics, 28:3, 611-633, 2003

Thomas, J.M., *Redevelopment and Race: Planning a Finer City in Postwar Detroit*, Johns Hopkins University Press, Baltimore, MD, 1997

Thorsell, S., Epplin, F.M., Huhnke, R.L., Taliaferro, C.M., *Economics of a Coordinated Biorefinery Feedstock Harvest System: Lignocellulosic Biomass Harvest Cost*, Biomass and Bioenergy, 27, 327-337, 2004

Tilman, D., Hill, J., Lehman, C., *Carbon-Negative Biofuels from Low-Input High-Diversity Grassland Biomass*, Science, 314, 1598, 2006

Tilman, D., Hill, J., Lehman, C., *Response to Comment on 'Carbon-Negative Biofuels from Low-Input High-Diversity Grassland Biomass'*, Science, 316, 1567c, 2007

Tilman, D., Wedin, D., Knops, J., *Productivity and Sustainability Influenced by Biodiversity in Grassland Ecosystems*, Nature, 379, 718-720, 1996

Tilman, D., Knops, J., Wedin, D., Reich, P., Ritchie, M., Siemann, E., *The Influence of Functional Diversity and Composition on Ecosystem Processes*, Science, 277, 1300, 1997

Turnau, K, Orlowska, E., Ryszka, P., Zubek, S., Anielska, T., Gawronski, S., Jurkiewicz, A., *Role of Mycorrhizal Fungi in Phytoremediation and Toxicity Monitoring of Heavy Metal Rich Industrial Wastes in Southern Poland*, Soil and Water Pollution Monitoring, Protection and Remediation, 3:23, 533-551, 2006

Turner, M.G., Gardner, R.H., O'Neill, R.V., *Landscape Ecology in Theory and Practice: Pattern and Process*, Springer Science, New York, NY, 2001

U.S. Census Bureau; Census 2000, Summary File; generated by Michael Yun; using American FactFinder; <http://factfinder.census.gov>; April 2008

Wood, B.C., Pullin, A.S., *Persistence of Species in a Fragmented Urban Landscape: the Importance of Dispersal Ability and Habitat Availability for Grassland Butterflies,* Biodiversity and Conservation, 11, 1451-1458, 2002

Wyly, E.K., *Continuity and Change in the Restless Urban Landscape*, Economic Geography, 75:4, 309-338, 1999

Yokohari, M., Amati, M., *Nature in the City, City in the Nature: Case Studies of Restoration of Urban Nature in Tokyo, Japan and Toronto, Canada*, Landscape and Ecological Engineering, 1, 53-59, 2005

Zedler, J.B., Leach, M.K., *Managing Urban Wetlands for Multiple Uses: Research, Restoration and Recreation*, Urban Ecosystems, 2, 189-204, 1998

Zipperer, W.C., Wu, J., Pouyat, R.V., Pickett, S.T., *The Application of Ecological Principles to Urban and Urbanizing Landscapes*, Ecological Applications, 10:3, 685-688, 2000

Zmyslony, J., Gagnon, D., *Residential Management of Urban Front-Yard Landscape: A Random Process?*, Landscape and Urban Planning, 40, 295-307, 1998

Appendices

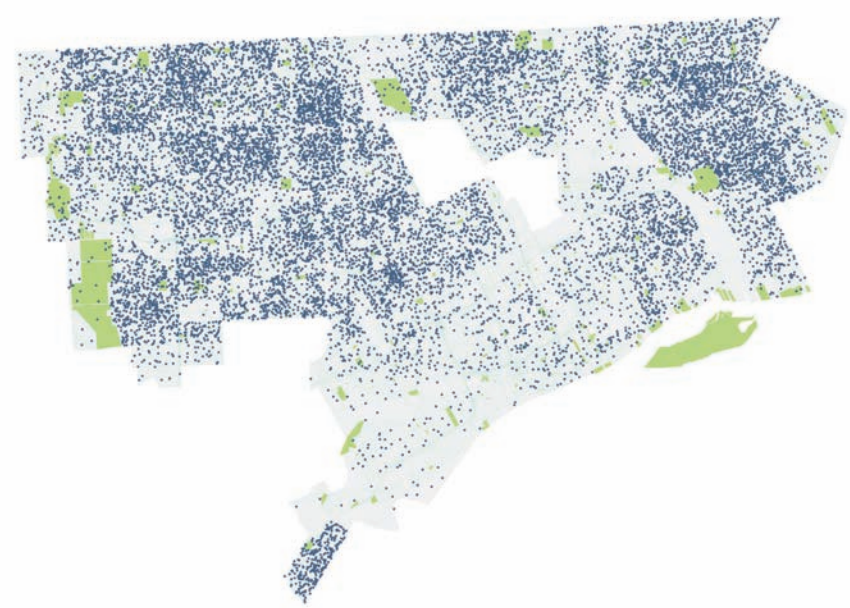
1940 (Sugrue, 2005)

1950 (Sugrue, 2005)

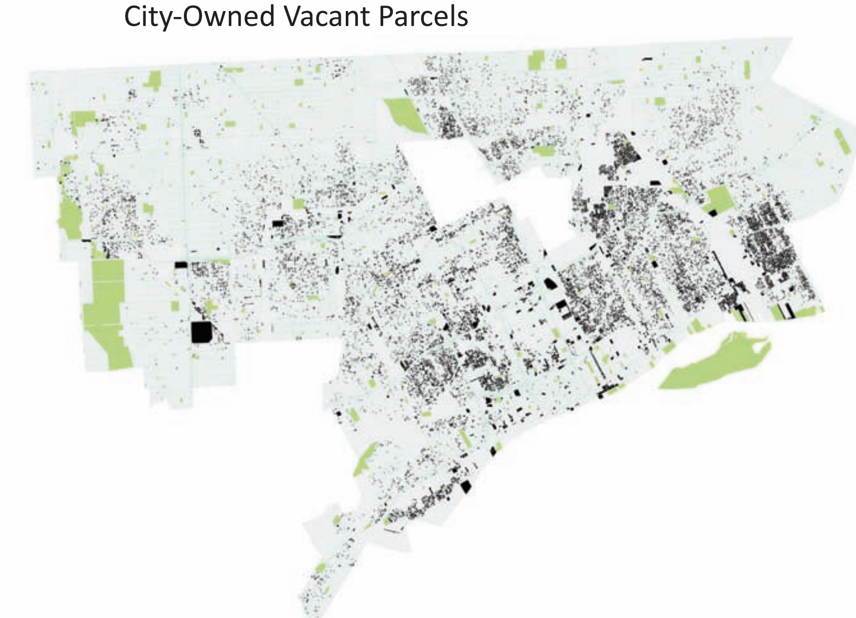
1960 (Sugrue, 2005)

1970 (Sugrue, 2005)

2000



City-Owned Vacant Parcels



Historical movement of the African-American population in Detroit (Sugrue, 2005)
In comparison with present day population and vacancy

1 Dot = 200

Extension of Sugrue's Population Analysis

Data Source: The City of Detroit, SEMCOG, and the US Census 2000 and Thomas Sugrue (2005)

Seed Mix for a Mesic Tallgrass Prairie Planting (quantities listed per 10,000 ft^2)

Forbs	Common Name	% of Mix	# Seeds	Seeds/Gram	# Grams	Seeds/Ft^2
Allium cernuum	nodding wild onion	2	10,000	270	37.04	1
Amorpha canescens	lead plant	1	5,000	600	8.34	0.5
Aster laevis	smooth blue aster	3	15,000	1,700	8.82	1.5
Aster novae-angliae	New England aster	3	15,000	2,400	6.25	1.5
Aster oolentangiensis	azure aster	3	15,000	2,900	5.17	1.5
Astragalus canadensis	Canadian milk vetch	3	15,000	560	26.79	1.5
Baptisia alba macrophylla	white wild indigo	0.5	2,500	60	41.67	0.25
Baptisia bracteata leucophaea	cream wild indigo	0.5	2,500	60	41.67	0.25
Dalea purpurea	purple prairie clover	3	15,000	700	21.43	1.5
Desmodium canadense	showy tick trefoil	0.5	2,500	160	15.63	0.25
Echinacea pallida	pale purple coneflower	3	15,000	180	83.33	1.5
Echinacea purpurea	purple coneflower	2	10,000	230	43.48	1
Eryngium yuccifolium	rattlesnake master	2	10,000	280	35.71	1
Helianthus pauciflorus	showy sunflower	0.5	2,500	160	15.63	0.25
Heliopsis helianthoides	false sunflower	2	10,000	230	43.48	1
Lespedeza capitata	round-headed bush clover	2	10,000	350	28.57	1
Liatris aspera	rough blazing star	4	20,000	420	47.62	2
Monarda fistulosa	wild bergamot	3	15,000	2,750	5.45	1.5
Parthenium integrifolium	wild quinine	1	5,000	240	20.85	0.5
Penstemon digitalis	foxglove beard tongue	4	20,000	3,530	5.67	2
Ratibida pinnata	grey-headed coneflower	4	20,000	950	21.05	2
Rudbeckia hirta	black-eyed Susan	4	20,000	3,530	5.67	2
Rudbeckia subtomentosa	sweet black-eyed Susan	1	5,000	1,620	3.09	0.5
Silphium integrifolium	rosinweed	0.5	2,500	140	17.86	0.25
Silphium laciniatum	compass plant	0.5	2,500	25	100	0.25
Solidago rigida	stiff goldenrod	2	10,000	1,620	6.17	1
Solidago speciosa	showy goldenrod	3	15,000	3,700	4.05	1.5
Zizia aurea	golden alexanders	2	10,000	320	31.25	1
28 Total Forbs		60	300,000		731.74	30

Grasses	Common Name	% of Mix	# Seeds	Seeds/Gram	# Grams	Seeds/Sq Ft
Andropogon gerardii	big bluestem	4	20,000	290	68.97	2
Elymus canadensis	Canada wild rye	7	35,000	150	233.33	3.5
Schizachyrium scoparium	little bluestem	12	60,000	310	193.55	6
Sorghastrum nutans	Indian grass	10	50,000	300	166.67	5
Sporobolus heterolepis	prairie dropseed	7	35,000	490	71.43	3.5
5 Total Grasses		40	200,000		733.94	20
33 Total Forbs and Grasses		**100**	**500,000**		**1465.69**	**50**

(Source: The Tallgrass Prairie Restoration Handbook (Packard, 2005) - *some plants changed in favor of MI natives)*

Why Use Michigan Natives

Whether you are planting a small plot in your yard, landscaping a workplace, naturalizing a golf course, or restoring a natural area, it just makes good sense to utilize plant species native to Michigan.

Native species are adapted to Michigan's climate and soils. Over time utilizing native species can save both the environment and money as fertilizers, watering, and continuous mowing are not necessary. These plants provide habitat for Michigan's wildlife, which is quickly disappearing with development.

Not only are these plants beautiful and interesting to the eye, but the incredible root system of these plants rebuild the soil and work as filtering systems. Michigan's native flora is unique to Michigan and provides us with a sense of place. We encourage you to learn about, celebrate, and utilize these plants in your landscape.

Esther Durnwald
Michigan Wildflower Farm

About Michigan Genotype Native Plants

"Michigan native plants" are here defined as species that occurred prior to European settlement. The Floristic Quality Assessment, developed in 2001 by the Michigan Department of Natural Resources Natural Heritage Program, was used to determine whether a species is native to Michigan.

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Photo by Ruth Vrbensky – Oakland Wildflower Farm

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