Multimodal Transportation as a Framework for Sustainable Growth in Metro Detroit

An Honors Thesis (LA 404)

by

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ABSTRACT

This project presents a new paradigm in public transportation as the backbone of future sustainable development in Metro Detroit. A holistic analysis of historical patterns in transportation, development, demographics, and the environment reveals issues often overlooked in modern planning and development. To address these issues, the proposal harnesses principles of sustainable urban design and transit-oriented development (TOD) to create a unique plan for Detroit's metropolitan development. This plan is then exemplified in downtown Rochester – a historic city center within Detroit's northern suburbs – as a multi-modal transportation hub and civic center.

While the experts behind American city planning and development commonly understand that automobile-based sprawl is less environmentally and socially sustainable than other modes of transit-related development, today's community development is still largely determined by automobile dependency. Combined with an ever-growing population, these sprawling metropolitan development patterns have become the single greatest sustainability issue our world faces today. The predominant goal of this project is to illuminate the social, environmental, and developmental issues that have resulted from contemporary urban growth in northern Metro Detroit, and then propose a way to begin correcting them. Just as automobile-dependence facilitated sprawl, a new paradigm in transit could become the primary influence for a newfound future of sustainable metropolitan development.

Among the diverse urban fabric of Metro Detroit, the City of Rochester stands as a microcosm of the issues that sprawl presents within populous, historically significant suburban communities. This project proposes a way for Rochester to reinvent its transportation networks, recover its ecological heritage, and – most of all – direct its amenities toward pedestrians rather than automobiles. By welcoming public transportation back within its city limits, Rochester has the opportunity to once again become a junction and destination for economic and recreational activity that is sustainable, diverse, and contributable to Metro Detroit as a whole.
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Transit-Oriented Development and Ecological Restoration in Rochester, Michigan

Mark Sandberg

Landscape Architecture Comprehensive Project
Ball State University
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INTRODUCTION

Detroit, Michigan. The Motor City. Motown. The birthplace of the automobile and the home to the industrial forces that took the reigns on the car-making game over a century ago. This claim to fame is a great source of pride for the City of Detroit and the State of Michigan, and rightly so. Cars have defined significant parts of the entire country’s culture: lifestyles, occupations, innovation, design, manufacturing, development, and even more. However, there is far more to the history of motorized wheels than cars alone. Americans today seldom realize that modern public transportation was an American innovation before commercially available cars appeared on the scene. The first electric railway was implemented in Richmond, Virginia, in 1887, before Henry Ford even started toying with gasoline engines (Dalzell 60).

By now, this landmark accomplishment for commuting the masses is far more apparent in other countries around the world. As the popularity and convenience of the personal automobile enabled people to travel freely and cheaply, poorly organized public transportation systems began to fade away or disappear completely from metropolitan areas. Today, there is a clear divide between dense, rail-dependent urban communities and the sprawling, auto-dependant suburban areas that grew around them. No matter how much Americans cherish their historic downtowns and make efforts to revive them, sprawling development continues to draw people away from them. Today, as terms like “sustainability” and “going green” have been manipulated to describe business ethics more than actually improving the way we live within our environment, the need for real, ecologically sensitive lifestyles is more important than ever. In Metro Detroit, sustainable urban development seems absent from the overall municipal planning discussion. As once vibrant inner-city developments are continually abandoned for new communities on undeveloped land, more than just the health of the natural environment is at stake.

While the experts behind American city planning and development commonly understand that automobile-based sprawl is less environmentally and socially sustainable than other modes of transit-related development, today’s community development is still largely determined by automobile dependency. Perhaps the best place to start addressing this anomaly would be the birthplace of automobile-based urban development itself: Detroit. In the early 1900s, when Henry Ford developed a manufacturing process that made cars affordable to the masses, Detroit became the first major city to implement a road infrastructure that would promote the rapid construction of suburban development. All of this growth has subsequently demanded the support of extensive commercial, industrial, municipal, and energy utility developments, an expansion which usually occurred with no regard for ecological health. Fueled by the idealism of upper-middle class status and historic race and class discrimination, this rapid expansion tore away from the dense development patterns that once allowed small cities and villages to be vibrant, walkable, and independently prosperous. Among the diverse urban fabric of
Metro Detroit, the City of Rochester stands as a microcosm of the issues that sprawl presents within populous, historically significant suburban communities.

The greatest challenge for Metro Detroit’s future urban development efforts will be how to promote social and environmental equity within an expanded, diversified transportation network. Auto dependency must be lowered to balance transport systems and reduce the environmental impacts of both vehicle emissions and infrastructure. Land use policy must be improved so that sprawl is limited and accessibility to transit is increased. Furthermore, public transportation must become more appealing and convenient for all people as part of their everyday lives. This project proposes a solution to the global epidemic of unsustainable automotive-related sprawl at its root: Metro Detroit. Efforts to accomplish these goals will not be easy, and they will not happen overnight. With the heart of the metropolitan area currently in a state of economic peril, coordinated regional progress is especially challenging.

The time has come for the city that taught the world to drive to learn how to embrace and protect public transportation as a way to promote regional economic development, embrace social equity, and heal the environmental scars of ineffective development over the last century. Increased links between cities, suburbs, and economic corridors across the metropolitan area will help push development forward. After all, Detroit was not built only by itself; it took the entire region’s resources and efforts to bring it to prosperity. Efficient, coordinated, multimodal transportation will allow Detroit to achieve regional connectivity and increased opportunities for its entire population. Perhaps Detroit could set the precedent for curing sprawl-related issues around the world.
LITERATURE REVIEW  PART I: THE PROBLEM

Automobile Dependency & Sprawl: How We Got Here and Why It Won’t Work

The way people move from place to place offers a strong definition of how their society truly functions. Automobile-dependant transportation – including the interstate highway system, a web of intercity roadway infrastructure, and tens of thousands of gas stations – is heavily engrained in American culture. Automobiles are so celebrated in the United States that a car, or a certain brand or model of one, often becomes symbolic of a person’s taste and socioeconomic status. Owning a car allows people to live greater distances from work and school, creates the means for families and friends to separate by great distances, and enables urban development to sprawl across the landscape. For over a century, reliance on automobiles has permitted certain metropolises, usually younger ones, to develop in a completely different fashion than the rest of the world. Such heavy dependence and enormous infrastructure requirements has put tremendous strain on the environment, so much that the damage appears irreversible. Today, our society faces a great choice: continue to travel as we have in the past, or adopt a sustainable alternative that will have a smaller impact on the environment.

Before discrediting and abandoning our sprawling, automobile-dependent culture, it is important to look back on the reasons our society developed the way it did. At one time, the automobile was the best possible means of transportation for the general public. It had benefits over all other existing forms of transit, especially ease of transport and affordability. To better understand the popular mindset during this time, it is essential to examine the foundation of all our modern amenities: the Industrial Revolution.

In their book Cradle to Cradle: Remaking the Way We Make Things, architect Bill McDonough and chemist Michael Braungart propose a way to make future industrial manufacturing more ecologically effective. They discuss the Industrial Revolution as an era that came about sporadically, with almost no collective design. If the era had actually been designed to perform as it did, it would have programmed to:

- put billions of pounds of toxic material into the air, water, and soil every year.
- produce some materials so dangerous they will require constant vigilance by future generations.
- result in gigantic amounts of waste.
- put valuable materials in holes all over the planet, where they can never be retrieved.
- require thousands of complex regulations – not to keep people and natural systems safe, but rather to keep them from being poisoned too quickly.
- measure productivity by how few people are working.
- create prosperity by digging up or cutting down natural resources and then burying or burning them.
- erode the diversity of species and cultural practices.

(McDonough & Braungart 18)

Though we consider the Industrial Revolution to be long over, these traits still characterize our industrious culture, especially the manufacturing, lifetime use, and disposal of today's automobiles and their necessary infrastructure. Designers of a new paradigm in transportation would never purposefully include the traits listed above, yet a century of American life has been built around the gas-powered automobile, no matter how wasteful and inefficient the technology has been.

While this proposal will ultimately suggest alternatives to the car altogether, it must first identify issues surrounding alternative fuels and assess whether it is possible to create a sustainable future that relies solely on a different type of automobile. Today, the average American lifestyle relies on the car, even though most Americans would admit that automobile emissions pollute the air, water, and soil, and consequently have negative effects on human health. Efforts to create cleaner, more efficient cars have resulted in cleaner individual vehicles, but they have also encouraged more people to drive. Therefore, as long as the population keeps growing and demanding cars, achievements in automotive efficiency alone cannot deter automobiles from distressing the environment.

Will It Help to Make Cars Less Oil-Dependent?

In 2006, MIT's Professor John Heywood described the extent of global transportation in an article in Scientific American: "Transportation accounts for 25 percent of worldwide greenhouse gas emissions. ... The U.S. light-duty vehicle fleet (automobiles, pickup trucks, SUVs, vans and small trucks) currently consumes 150 billion gallons of gasoline a year, or 1.3 gallons of gasoline per person a day. If other nations burned gasoline at the same rate, world consumption would rise by a factor of almost 10." Heywood identifies three factors about the existing global transportation system:

1) Transportation is well suited to the developed world, its primary context;
2) The "vast optimized" system depends on petroleum as its convenient energy source and has adapted to use oil through evolved technologies;
3) Vehicles last a long time, so "rapid change is doubly difficult."

To reach a state of modern urbanization, many developing nations are rapidly building the same transportation infrastructure found throughout the developed world. "As countries in the developing world rapidly motorize, the increasing global demand for fuel will pose one of the biggest challenges to controlling the concentration of greenhouse gases in the atmosphere" (60).

Though they have existed for a century and become much more advanced
in the last 25 years, modern motorized vehicles are still quite inefficient. *New York Times* reporter Matthew Wald explains: “for the conventional gasoline internal-combustion engine, 85 percent of the energy in the gasoline tank is lost” (34). This number accurately reinstates Heywood’s claim that cars use only about 10 percent of the chemical energy in their fuel tank when actually driving. As of 2006, American light-duty vehicles averaged just under 25 miles per gallon in the city, and half of those vehicles drove 25 miles per day or less. On average, then, half of American vehicles consume over a gallon of gasoline each day. “Today’s gasoline spark-ignition engine is about 20 percent efficient in urban driving and 35 percent efficient at its best operating point.” In the best operating conditions, any vehicle could be wasting more than 65% of its produced energy. In colder climates, short trips, aggressive driving, and a cold engine and transmission leads to worse fuel consumption. The common practice of idling the engine in traffic does not help either. The 90 percent of chemical energy in the fuel tank that is not used to spin the wheels is directed towards vehicular functions or simply expelled as heat in the air (Heywood 61). As of 2006, the world consumed an overall 53 million barrels of petroleum per day for transportation. Over half of that was used to provide land transport for people, over a third supplied freight by land, and about 10 percent went towards commercial and freight flights. In the United States, more than 200 million motor vehicles consume about two-thirds of the 20 million barrels of oil the U.S. uses every day. Improvements in technology have helped reduce fuel consumption over the last 25 years, but Americans have for some reason chosen to buy larger, heavier, and faster vehicles (61). Furthermore, recent worldwide petroleum consumption continues to steadily increase by about 2 percent each year.

The process of actively using cars is not the only energy-use problem at hand. The manufacture and disposal of cars consumes about a quarter of the global automobile fleet’s lifetime energy use, and depends almost wholly on burning fossil fuels for energy. According to renewable energy researchers Mark Jacobson and Mark Delucchi, “The world manufactures 73 million cars and light trucks every year” (61). While many people might assume that global car production would eventually slow down, it actually keeps climbing. Moreover, manufacturing this massive fleet requires unfathomable amounts of natural resources and energy. Heywood describes the fleet’s total embodied energy in three phases:

1) Well-to-Tank: the energy required to produce & distribute fuel (15% of lifetime energy use)
2) Tank-to-Wheels: The energy required to drive a vehicle through an average lifetime of 150,000 miles (75% of lifetime energy use)
3) Cradle-to-Grave: the energy required to manufacture, maintain, and dispose of a vehicle (10% of lifetime energy use) (61)

This information reveals that while drastic inefficiencies within the entire automotive fleet have continually and increasingly wasted our fuel resources, nothing has effectively slowed our conventional method of global transportation since it was first developed in the early 20th century.
Of the many attempts to curb America’s oil-dependency, technological developments toward alternative fuel sources rank among the most successful. Alternative technologies attempt to replace inefficiencies of the internal combustion engine, help reduce global carbon emissions, and offer the promise of cutting dependency on foreign oil altogether. Considering that the United States currently imports about 60% of its oil from foreign countries, this is quite an important promise. Thus, the discussion shifts to how alternative transportation technologies work, if they are feasible, and what is necessary to make them feasible on a grand scale.

Among the most prominent alternatives are biofuel engines, hydrogen cells, electric motors, and gas-electric hybrids. Biofuel production, which usually mixes plant-based alcohols and petroleum products, requires extensive agricultural land and practices that could otherwise be directed towards food production. Hydrogen cars require expensive fuel cells that are environmentally hazardous to produce. Any sustainable electric cars would require cleanly produced electricity, yet most of America is powered by burning coal, and solar-powered vehicles are not suitable for most of the nation’s climates. Like traditional gas-burning engines, all of these alternatives come with issues that will require tremendous research, time, money, and energy before they can ever be accepted for widespread sustainable implementation. As a result, efforts to change fuel sources often turn to shorter-term alterations of the existing vehicle base, such as designing cars to be smaller and lighter. Regrettably, increases in the size and weight of vehicles around the world have altogether negated the effect of improved engine efficiency.

Over the next twenty years, by “increasing the efficiency of the engine and transmission, decreasing weight, improving tires, and reducing drag,” Heywood suggests that it is possible to bring fuel consumption of light-duty vehicles down by a third (1-2% improvement annually). During manufacture, such a reduction would cost between $500 and $1,000 per vehicle (61). Heywood further suggests that “if vehicle weight and size can be reduced and if both buyers and manufacturers can step off the ever increasing horsepower-performance path ... then we may be able to slow the rate of petroleum demand, level it off in 15 to 20 years at about 20 percent above current demand, and start on a slow downward path” (62). While these alterations could greatly improve the current fuel emission and oil-dependency trajectory, they would also meet the current patterns of automobile demand. However, increases in fuel efficiency translate to reductions in travel cost, which in turn would promote an increase of automobile transportation and resulting emissions. Furthermore, it would be challenging to require each of the world’s car owners – let alone Detroit’s – to achieve a new light-duty vehicle mindset and then quickly phase old cars out. This would require some sort of overarching regulating process that could limit progress in automotive innovation. It also demands adequate income of car owners and assumes they would be willing to purchase new, smaller vehicles in a short amount of time.

Cars will undoubtedly continue to remain influential to the world for generations to come, and it should be clear that this proposal does not aim to eliminate them. The automobile is an amazingly useful technology for transportation,
and it has revolutionized lifestyles around the world. Although alternative automotive technologies and manufacturing techniques are needed to reduce global fuel consumption, they alone cannot change the fact that even in a "green"-minded market, the most efficient, environmentally-friendly vehicles will encourage more people to believe that driving cars is an acceptable way to meet transportation needs. With a growing population and continually sprawling development will come the need for more cars and more fuel. Unfortunately, while we wait for something “big” to happen – whether a technological miracle, a global oil shortage, or an environmental collapse – improvements in automotive efficiency will stand as the priority over improvements in alternative transportation modes.

**Global Warming and Peak Oil: Are they Emergencies?**

Global warming has yet to be definitively proven or disproven. While many scientists and government officials back it, just as many lobby against it. Unfortunately, researchers have still not found irrefutable evidence that greenhouse gas emissions are the root cause of recent climate and temperature changes. The reality that we face is that global temperature fluctuation is a normal occurrence. Throughout its history, Earth has fluctuated between multiple warm and cool eras. Over the last 5,000 years, cooler weather patterns have occurred simultaneously with various volcanic eruptions that decrease the planet’s exposure to solar radiation. However, the era of warmer weather that we are currently experiencing seems to line up with our Industrial Revolution, leading to the theory that our industrial practices are largely responsible for global warming. At any rate, without solid irrefutable evidence for the cause of recent climate trends, immediate calls to action against global warming will continue to meet resistance.

Though some may not acknowledge global warming to be completely true, we must recognize that if its causes are not constrained, its proven and theoretical effects will continue to threaten our modern lifestyle. Air and water pollution, loss of ecosystems, rising sea levels, disappearance of glaciers, and extreme weather conditions are all real conditions of present-day climate change. Within this set, pollution and loss of ecosystems can be caused by emissions alone. If we do not restrict the types and amounts of gases we release into the atmosphere, we will inevitably see more dramatic and harmful changes in the future. Because greenhouse gas emissions pose a serious threat, we must act now to diminish their release. The longer we wait, the more damage we will have to correct.

Most manmade greenhouse gases are emitted by industrial processes. Our oil-dependent industrial culture further contributes to global emissions through our transportation sector. The manufacture and combustion of petroleum products contributes to all three major greenhouse gases: carbon dioxide (CO$_2$), methane (CH$_4$), and nitrous oxide (N$_2$O). Compared to emissions released by burning coal and natural gas, petroleum combustion emissions are more complex (US EPA). Methane and nitrous oxide, which are less present in coal and natural gas byproducts, are
more effective than CO2 at trapping heat. Thus, it is especially important to lower our petroleum-based emissions, both to prevent possible climate change and to decrease air and water pollution. The simplest way to do this is to lower our dependency on petroleum products.

Pollution is not the only environmental concern surrounding our oil dependency. Since there is only so much oil beneath the earth’s surface, researchers speculate that we might run out of it more quickly than we imagine. Peak oil theory is based on the idea that oil production will someday peak and then begin to decline sharply as oil reserves run dry. This could happen as soon as 2030. Predictions that known oil reserves will last for decades of future consumption are believed to be vastly overstated in attempts to sell more of it. In the words of RMIT University transport planning professor Paul Mees, “Peak oil does not mean that there will be no oil left; rather, if true, it means the end of cheap oil” (40). In the past five years alone, Americans have experienced record high gas prices that have often led to decreased automobile use. If oil resources dwindle greatly in the near future, the price of gasoline could become so expensive that driving would be uneconomical.

Peak oil theory becomes increasingly pertinent every day because while oil is not quickly renewable, we use more of it each day. Since oil takes thousands of years to form, some scientists suggest that a peak oil reality could be delayed by developing better technologies to locate new oil resources. We could also create more fuel-efficient vehicles and industries to help conserve the oil that we do have. However, creating more efficient technologies will unavoidably translate into making our oil-dependent culture even more accessible. Additionally, there is still no realistic way to stop the burning of oil from creating the same harmful pollutants. If we increase oil use by allowing it to become more accessible, we will essentially place higher demands on known oil reserves and further encourage excessive emissions.

Without reworking our existing vehicle infrastructure, there are some alternatives to oil. However, none of these options are currently viable. According to Mees:

If conventional oil runs out or becomes prohibitively expensive there are substitutes available, but these are neither cheap nor environmentally friendly. Canada and Venezuela have vast fields of shale and sand oil, while coal can be converted to oil-like fuels through industrial processes. In each case, more energy is used to produce the oil than it actually provides, so extensive use of these substitutes would dramatically increase greenhouse emissions. Biofuels are a partial substitute for oil-based fuels, but are also fraught with problems. Biofuels are either made from food, in which case they drive up prices and increase hunger among the world’s poor, or from specially grown crops planted on land created by clearing rainforests in places like Brazil and Indonesia. (40)

The International Energy Agency (IEA) releases annual global energy reports. In the World Energy Outlook 2008, the IEA projected that total oil is not expected to peak until after 2030. However, as we near 2030, the production of conventional oil is expected to level off “as almost all the additional capacity from new oilfields is offset by declines in output at existing fields” (Mees 41). We do not yet know if our
theoretical solution to peak oil will be a discovery of other cheap fuels or the human ingenuity that will offer alternative solutions. Perhaps a severe shortage in the near future will force alternatives to happen more quickly.

To avoid future catastrophe, we should not wait for a real oil shortage to trigger us to act. We should become more independent of oil as soon as possible. According to the IEA,

It is not an exaggeration to claim that the future of human prosperity depends on how successfully we tackle the two central energy challenges facing us today: securing the supply of efficient and affordable energy; and effecting a rapid transformation to a low-carbon, efficient and environmentally benign system of energy supply. (Mees 40)

The United States has been very slow to act on this issue. Conversely, European efforts have already been made. Responding to climate change and the risk of peak oil, Swedish officials appointed a Commission on Oil Independence in 2005 to phase out its dependency on oil and eventually replace fossil fuel energy sources with renewable ones. One of the commission’s recommended measures was to increase the attractiveness of public transport for urban and interurban travel. In many European cities, the car is no longer seen as feasible mode of transportation for the masses. Rather than idling behind, American cities should follow their lead.

**Effects of Automobile Dependence**

At the turn of the 20th century, cars were a fantastic solution to urban problems. America’s major cities were once polluted by the manure of thousands of horses, creating a persistent irritant and health hazard. Electric streetcars were the first innovation to reduce horse-powered urban transport, but after World War I, cars, trucks, and buses had eliminated it. With horses and walking as the primary modes of transport, congestion was already a major urban problem, but it worsened considerably with affordable motor vehicles for every family and an undeveloped road infrastructure. The easiest way to solve congestion was to get out of it. Henry Ford said it quite plainly in 1922: “We shall solve the city problem by leaving the city.” Changes in industrial employment practices accelerated this pattern. The suburbanization of the United States was a direct result of higher wages and shorter working hours. Depopulating cities improved conditions for everyone as urban centers became healthier and less congested. For individuals, car ownership offered an independent, quick solution that did not require anyone to wait for others to act. Furthermore, “the mechanization of agriculture actually accelerated rural depopulation” (Mees 11). People in rural communities could do more work in less time, and thus hardworking farming families found new opportunities to seek higher-paying industrial work in the cities and towns. The suburbs were truly combining the urban and the rural – by popular decision, design, and essence. After World War II, the suburban lifestyle was synonymous with the American Dream.
Suburban shopping centers furthered the decline of central cities across the U.S., though they were originally planned as a way to improve social and civic life. In the 1940s, shopping centers were viewed as antidotes to the “formless outward spread of the city” as sprawl became imminent. They were not just centers for shopping, but also for new community development. Malls surrounded by parking lots became a new medium “for social and civic reform” (Gillette 78). Early shopping centers were designed to foster comfortable spaces to drift and relax in; to cultivate contemplation, human interaction, and entertainment. At the time, cities were considered to be “grim and ugly, formal and unwelcome” (91). Suburban malls were – and still are – “perceived as attractive, safe, comfortable, and dependable,” partly because “a mall has one management that controls the environment” (92). However, due to their encouragement of sprawl as a safe-haven, shopping centers have stolen most of the social relationships that once created attractive, diverse, cohesive environments in city centers. Several malls around Metro Detroit became milestones for the development of suburban shopping centers in growing metropolitan areas. By now, suburbanization has become a global phenomenon, largely due to the practices that began in Detroit.

“The car offered urban planners freedom from having to solve the problem of providing effective public transport, a problem that was particularly fraught in American cities. ... With car use rising and public transport declining, the easiest option for city planners was to go with the flow” (Mees 13). It is evident that policymakers and consumers today actually prefer the car, and that, without a reasonable, attractive alternative, Americans will prefer to remain auto-dependent. After all, the technological, economic, and social movements that have altered the structure and character of America thus far in history could be considered natural forces worth building upon.

Unfortunately, the problems attached to our car culture suggest the automobile is not a healthy way to travel, nor should it be a prized member of the family. It should not be acceptable that air pollution, traffic, noise, injurious and fatal accidents, landscape degradation, wasted space, and environmental harm be attached to the basis of our transportation culture. It should not be acceptable that the land used for our transportation infrastructure “devours valuable natural habitat or land that could be used for housing and agriculture” (McDonough & Braungart 179). Automotive culture has revolutionized and even typified the trend of modern global industry. “At its deepest foundation, the industrial infrastructure we have today is linear: it is focused on making a product and getting it to a customer quickly and cheaply without considering much else” (26).

Not surprisingly, environmental concerns have historically been addressed as afterthoughts, issues that will be solved by some future innovations rather than by expedited measures. “The dominant approach to the environmental problems of automobile dominance has been to seek salvation in technology, rather than mode shift. The clean car becomes the preferred solution, thus absolving policy makers of the need to make substantive changes to transport policy” (Mees 41). While we wait for a better alternative, our auto-based infrastructure is under growing pressure from
metropolitan development patterns. In their collection of literature on metropolitan transportation reform, Bruce Katz, Robert Puentes, and Scott Bernstein describe the pandemic quite simply.

Congestion is worsening in metropolitan areas of every size as regional economies continue to spread out in low-density ways."

The infrastructure network is aging, with about a quarter of the roads in urban and metropolitan areas rated in poor or mediocre condition, and nearly a third of urban bridges rated structurally deficient or functionally obsolete. Yet, in many places, transportation decision making still favors new construction, typically on the suburban and exurban fringe.

Americans are now spending more on transportation than ever before, primarily because our sprawling metropolitan communities require families to drive longer and more often to satisfy their daily needs.

Regardless of policy and market interventions, metropolitan congestion will continue to increase as the number of vehicles, drivers, miles traveled, and intercity trucks grow and as regional economies continue to decentralize along low-density settlement patterns.

Idling car engines release more emissions than engines in drive. The increase in congestion is directly proportional to the increase in air pollution.

[A] recent analysis ... estimates that the nation's aging infrastructure costs American drivers $5.8 billion in repairs each year. Such costs subvert regional competitiveness and productivity by impeding the flow of people, goods, and services between America's cities and suburbs.

[After housing costs] "transportation is now the second largest expense for most American households, consuming on average 19 cents out of every dollar." This is more than the average household spends on food (13 cents).

Beyond these economic concerns, our dependence on automobiles has also created peculiar social issues. The double-wide garage door is now the focal point of the suburban home, and driving is selfish and anti-social by nature. Most folks drive themselves to work in a two-ton, gas-guzzling car designed to carry four or more people. When they glance outside their vehicle, they are afraid to make eye contact with the person in the next lane. A slow driver will likely cause an entire group of individuals to break into a nervous sweat and yell furiously. The inability to find a parking space is cause to hate the parking lot but not the space-wasting mode of transportation that requires it.

More seriously, the nature of sprawling middle-class development has created a gaping disparity in class separation, which has further illustrated the somehow seldom-acknowledged reality of designed racial segregation. The idea that the automobile can ever provide equity for all people is completely flawed. Katz, Puentes, and Bernstein observe,

In suburbs entry-level jobs abound in manufacturing, wholesale trade, and retailing – and hold out in opportunities for people with basic education and skills. However, the absence of viable transportation options – combined with persistent residential racial segregation and a lack of affordable suburban housing – effectively
cuts many inner-city workers off from regional labor markets.

The transportation burden disproportionately affects the poor and working poor, moreover. Those in the lowest income brackets spent nearly 10 percent of their personal income on commuting in 1999 - more than double the national average. The working poor who used their own vehicle to commute spent a larger share of their income (as do all workers) than those who are able to use transit.

Although transit fares are often relatively inexpensive and fund very little of transit company budgets in America, transportation costs affect people with low incomes far more than those with high incomes. Below, Figure 2 shows that low-income households tend to depend more heavily on public transportation and, therefore, spend more on it. Likewise, low-income households with access to a personal or family vehicle tend to have cheaper, older vehicles that require more maintenance than newer, more efficient ones. The cost of transportation varies extremely among different income levels.

![Portion of US Household Income Spent on Transport (BLS, 2000)](image)

In cities like Detroit, where an expansive amount of urban land separates people from their destinations, residents in the lowest income bracket are likely to spend even more of their income to meet their transportation needs. "In many cities, lower-cost housing is located in automobile dependent areas at the urban fringe. As a result, lower-income households face a choice between unaffordable housing or excessive transport expenses and reduced accessibility for non-drivers" (Litman 9). Trips to employment opportunities in more prosperous suburbs become increasingly difficult when they are at such great distances from Detroit neighborhoods. Even in wealthy communities, substantial numbers of people cannot drive a vehicle due to age, disabilities, income, immigrant status, or simply their personal preference.

As long as the car determines urban and suburban growth patterns, social
balance in a large metropolis is an unachievable goal. "Inner-city populations are declining as a percentage of metropolitan totals and are falling absolutely in many cities; work trips have fallen as a share of overall travel; the share of metropolitan employment in city centers is trending downwards" (Mees 38). We cannot save our cities until we learn to facilitate equitable movement of the populations that live within them.
LITERATURE REVIEW

New Transportation is Most Important in America

The energy the world chooses to focus into its transportation needs will determine the outcome of sustainable development in the near future. Unless radical improvements take place within or in place of the existing infrastructure, the era of the combustion engine is over. To address an environment visibly calling for change, the world’s increasingly auto-dependent nations must embrace alternatives other than high-emission automobiles. If the world truly wishes to halt climate change and promote sustainable development, global transportation modes must be reformed as soon as possible. The choice the world faces today has never been more important because a successful, widespread alternative for the car could spur innovative inspiration for alternatives across all fields – industrial, manufacturing, and energy alike.

Scientific American editor David Biello explains that over the past fifty years, human population has doubled. During the same time, the rate at which humans consume resources has quadrupled. Americans, at only 5% of the world’s overall population, are responsible for over 25% of the world’s energy consumption. On average, Americans use 194 pounds of resources derived from the Earth each day. To this end, the United States obviously to needs to change its wasteful habits more than any other country. Such change requires cooperation from all facets of government and the population, especially when addressing inefficient modes of transportation that are engrained into the nation’s culture. Regrettably, Katz, Puentes, and Bernstein note that Americans have an incredibly difficult time initiating visibly smart change.

In 2003, for the first time in history, the statutes governing surface transportation policy, aviation, and passenger rail were slated to be considered during the same Congress. [This could have been a] superb opportunity for policymakers to transcend the nation’s past and current separation of those modes and end the separate treatment of inter- and intrametropolitan policies. [The U.S. is] the only industrialized country in the world that has not pursued an integrated approach to transportation policy. This ignores both travel and political reality. (32)

What could possibly spur a new paradigm in U.S. transit policy? Such initiative might require a real crisis, or perhaps congestion itself will inspire alternative to cars. Congestion has historically been the major reason to improve and widen roads. Yet allowing it to happen for single-occupant vehicles is a practical method of promoting transit and carpools. HOV (high occupancy vehicle) lanes for buses, shuttles, and carpooling could promote multiple-passenger vehicles as a way to save time by escaping traffic backups. However, even this solution requires a significant change in roadway function (and policy) that would likely be unaccepted by the majority of car owners everywhere. The best solution would be to develop a new system of HOV transport altogether – one that is completely independent of existing automobile traffic.
Multimodal Public Transportation as the Alternative to Cars

Motorized public transportation, even in the same form as modern light rail, is not a new concept in America. The world’s first electric rail system was implemented in Richmond, Virginia, in 1887 by innovator Frank J. Sprague (Dalzell 60). In the following decades, electric streetcars and electric interurban trains quickly took root across the nation, setting a new rapid transportation standard that spurred the growth of hundreds of cities and villages. Interestingly, Sprague envisioned electric rail as an alternative to the dingy, smoky atmosphere produced by London’s Metropolitan District underground steam engines. His intentions were to create a sustainable, and thus marketable, alternative to faulty and unhealthy modes of transportation.

Sprague’s innovation influenced the growth of many U.S. cities, but other forces began to threaten the longevity of urban electric rail. By the 1930s, many Midwestern electric interurban rail companies were folding due to poor organization, combined with the popular acceptance of buses and the increasing interest in a national network of paved roads. By the 1960s, urban electric streetcars were under the same pressures that have effectively eliminated them from most American cities. Contrary to popular belief, the streetcar was not killed by a General Motors conspiracy. A multitude of factors contributed to its demise, including increasing auto ownership, increasing labor costs, competition on congested downtown streets, worn-out infrastructures, and, of course, sprawl and a decrease in urban density.

If Sprague were alive today to see the absence of his innovation in the U.S. – plus the nation’s reliance on one polluting, wasteful mode of transportation – he would surely start innovating further. Just as before, new innovations in electric rail can provide cleaner, more attractive, and more sustainable alternatives to the woes of contemporary transportation. Unfortunately, a complex slew of regulations, legalities, and funding issues thwart new rail innovations from ever reaching implementation. Efforts to generate clean, renewable electricity have been foiled for similar reasons, leaving electric-powered alternatives with a less environmentally-sensitive platform. Yet today’s global environmental problems call for innovations faster than ever. Climate change and insecure oil supplies are urgent reasons to act with fervor and speed. Because global transportation is currently the second-largest source of energy-related greenhouse emissions after electricity generation, transportation changes are vital to an environmentally stable future. Affluent industrialized countries account for two-thirds of global transport emissions, but developing nations are catching up quickly. “Transport is also the fastest-growing source of emissions, the rate of increase having overtaken that for electricity generation in the last decade. Three-quarters of transport-related emissions come from road vehicles” (Mees 38).

Group transport and public transportation are much cleaner than conventional personal transportation emissions. However, the way public transportation is powered and its average passenger capacity are important factors that contribute to emission release.
Public transport generally produces lower emissions per passenger than cars, but the difference depends on two factors. The first is the energy source used to power it: coal-fired power stations are actually less efficient than petrol- or diesel-powered engines, while hydro-electricity hardly produces any emissions. The second factor is vehicle occupancy rates: a bus with half a dozen passengers will be no more efficient, in greenhouse terms, than if the passengers travelled in cars at average occupancies.

To become a major alternative, public transportation in the form of electric rail must be competitive to traveling by car, and it must also be combined with other sustainable forms of transport like walking and cycling. Otherwise, public transit will never succeed as a convenient, competitive mode of travel. Society must view “alternative transportation” not as one simple cure but as multiple, integrated modes that provide an effective substitute to car-dependence. Furthermore, the only way buses and trains can effectively reduce energy use and greenhouse gas emissions is to achieve high ridership rates. The idea is simple: use less and waste less while providing people with the means to travel where they need to go during their daily lives.

Successful adoption of public transportation also depends on a change in public perception. The pessimism against a mode shift to public transport, walking, and cycling comes from the perception that large increases in car-related costs are required to significantly influence the demand of those modes. Because cars are so easy to use, and relatively inexpensive for most drivers to maintain, people tend to use them even when they are not necessary. “As many as half the trips even in the most auto-dependent cities are short enough to be made on foot or by bicycle, cutting emissions to zero” (Mees 42). In addition, people are not likely to use transit services simply because they exist. Frankly, environmental concerns are not enough of a motive for most people to drop the personal freedom that cars provide. This poses a question: If public transit is not as enticing as the competition, how will it ever succeed?

Public transportation’s greatest strength is its ability to carry people with different trip origins and destinations with less social and environmental costs than if they had traveled separately. However, because different people have different places to go without needing to stop in between, this attribute can also be considered a weakness. According to Mees, the best way to combat this weakness is networks.

Instead of ‘tailor-made’ public transport, a ‘ready-made’ service is provided that relies on transfers. This is the only way to enable anywhere-to-anywhere travel while keeping occupancy rates high. Visitors to Paris soon learn that this is how the famous Metro works: nearly every trip requires a transfer, but transfers are free and high frequencies ensure minimal waiting. Even in the dense urban settings of the City of Paris, it is not feasible to economically provide high-quality, transfer-free services; in dispersed environments the difficulties are much greater. Public transport is even more likely to be a natural monopoly in a dispersed area, because without network planning little or no service can be economically supported. (Mees 83)

Therefore, the best way to make public transportation attractive to all people is to
design it as a web of diverse modes that link together at shared stops, allowing passengers to conveniently transfer between different modes at their own will. In a sense, multi-modal transportation can be modeled after an ecosystem. “The vitality of ecosystems depends on relationships: what goes on between species, their uses and exchanges of materials and energy in a given place” (McDonough & Braungart 121). Humans have historically pushed these ecological relationships aside, even when understanding them can benefit the planning of human systems. A more complex system, whether it is economic, energy-related, or transportation-based, can survive times of unexpected disruption better than a simple homogeneous system. Diversity is nature’s design framework, and our design solutions should reflect that.

Multimodal transit anchored by high-speed electric commuter rail could be the best option for spurring a sustainable future. Therefore, the concepts of transportation planning and urban development should be integrated to promote denser, more walkable communities that include central access to trains and buses. The term transit-oriented development (TOD) has been applied to this urban design concept, though such development was naturally present when fixed-route public transportation first appeared. The modern TOD concept shares much in common with "the idea of the ‘Garden City,’ from the dawn of the twentieth century, in which more or less self-sufficient suburbs are centered on commuter train stations.” In many ways, “TOD is really a repackaging of what was for many years the typical form of center city and suburban development in the United States” (Jacobson 53). This also typified Metro Detroit from 1900–1930. Though high-density, multi-use planning is very much part of TOD, it should not be the only element that dictates where transit is applied.

**Good Public Transit Can Be Independent of Density**

European cities are commonly acclaimed for having more successful and prolific public transportation systems than cities in other developed nations. What allows these metropolitan areas to boast greater public transportation services? In *Transport for Suburbia*, Dr. Paul Mees identifies good planning and politics as the key ingredients of thriving European transit. Ironically, planning and politics are also the greatest factors that prohibit public transit in much of the English-speaking world. These factors are usually exacerbated by the notion that certain types of development can never support transit.

Urban planners across Australia, the UK, the US, Canada, and New Zealand insist that transport patterns are outcomes of urban form. The way to improve public transport is through compact cities, new urbanism, smart growth and transit-oriented design. ... There is much less interest in directly tackling transport policy...

... Density is not destiny. Transport policy itself has a bigger impact on transport patterns than urban planners have realized, and suburbs don’t have to be totally reliant on the car. Planners who insist that car dominance can only be addressed by
impossibly large increases in density may actually be entrenching the problem they are trying to solve. (Mees 5)

Implementing public transportation in low-density urban areas should be easier than people think. Promoting more compact cities and smart urban growth is crucial to healthier cities but actually not vital to the development of successful transit. Suburbs do not have to be demolished for metropolitan areas to support public transportation. Rather, strong transportation politics must be created to meet suburban needs. The ideal that transportation will never work outside of the dense, compact city is often pushed by transit advocates and environmentalists and therefore unintentionally supports the continuation of poor transportation policies. In fact, in 2005 the UK’s Commission for Architecture and the Built Environment “endorsed 275 people per hectare as a ‘sustainable urban density,’” which is completely unrealistic (52). The City of Paris – which has an acclaimed transit network – averages 250 people per hectare.

In Transport for Suburbia, Mees explores how characteristics of sprawl and transportation are unique to different nations based on growth patterns and policies. Of all the developed nations, English-speaking countries have fallen behind in implementing successful public transit even though many of their cities are more densely populated. For example, cities in Great Britain have a higher overall density than the rest of Europe’s major cities because “green belts and strong national policies have worked against extremely low-density scattered growth” (62). However, these cities’ transit systems and riderships are not necessarily better by any means. Canadian cities have much lower densities than British cities, yet Canadian cities have moderately more modes of public transportation (64). The belief that public transit use is more dependent on density than any other factors is false. Mees explains,

In 2004, a team of Israeli researchers re-examined the Australian and US cities in the original Cities and Automobile Dependence dataset. Their analysis, replete with a reproduction of the famous hyperbola, found no correlation between density and energy consumption: the US cities had similar densities to the Australian cities, but much higher car and energy uses. (56)

The metropolis that Australian, Canadian and American planners like to think of as the paradigm of urban sprawl, [Los Angeles,] actually has the highest density of all, while Portland, Oregon, the national poster-city for ‘smart growth’, has less than half that density. Boston’s density is lower than that of Detroit or Dallas’ [yet it has a remarkable public transportation system.] (58)

Portland – not Los Angeles – is credited with an outstanding public transportation network, even though its density is nowhere near LA’s. This exemplifies how transportation networks and sustainable metropolitan growth are interdependent, no matter their density. With good planning and policy promoting transit-oriented economic development, low-density urban areas can most certainly host successful transportation systems.
The mode shares for public transport and walking in US and Canadian cities correspond more closely to the share of economic activity in the Central Business District than they do to density. Urban structure appears more important than urban form... (65)

Canadian cities tend to have stronger urban centers (and therefore stronger modes of public transportation) for reasons that include “a greater propensity for the wealthy to reside in the inner city and the absence of a federally funded urban freeway program” (65). Of America’s cities, New York has the strongest urban center, which is a major reason for the high rate of public transit there. The city’s high population density is only a supporting factor; density in the city is dependent on good public transit and a strong economic center in the first place. According to Mees, if an urban center is strong enough to hold a significant share of regional jobs and economic activity, then it could adequately support public transportation with as low as 12 people per hectare (3,108 per sq. mile). The population density of Detroit’s center is right on the cusp – 11.9 people per hectare – and Southeast Michigan’s biggest businesses have a tremendous presence in the downtown core. Due to daily commutes towards the city center and back out, density in the central business district is more important for supporting high commuter rail ridership than it is for supporting light rail and buses.

American public transit efforts are harmed much more by deregulation and scarce funding than they are by a lack of density. Smart transit-oriented development depends first on establishing applicable facets of planning and legislation. This should involve correcting transit policy directly. Unfortunately, transport policy applications are rarely covered in the media because their planners and leaders lack the time to write books or give presentations about such achievements. Efforts to improve transit by fixing land use patterns are not enough by themselves, but they are essential to sustainable transit planning in the long run. After all, increasing population density by developing higher-density housing will make it easier to provide and maintain public transport. Enabling policies and regulations for an attractive transit system – and augmenting it with sustainable methods of development – promotes denser, more walkable, and healthier cities. With proper legislation and popular support, public transportation can be designed to work in Metro Detroit’s suburbs.

Making Public Transit Popular Again

Once upon a time, Americans romanticized about public transportation because it idealized a time of societal progression. In The Metropolitan Corridor, Harvard University’s Professor John Stilgoe cites several century-old celebrations of commuting by rail. In “The Gates of the City,” a 1907 article for Century Magazine, Jesse Lynch Williams describes late-night theater-goers taking the last trains home to the suburbs.

Implicit in [his] analysis is a vision of the future American city, a place where all ethnic groups, all social classes, all ages live graciously because of engineering. (Ctd. In Stilgoe 44)
In “The Poetry of the Machine Age,” an article for *Atlantic Monthly* in 1900, Gerald Stanley Lee proclaims,

“Trains shall say deeper things than sermons say ... In the rhythm of the anthem of them, singing along the rails, we shall find again the worship we have lost in church. In the terminal, from its doors to its concourse, from platform to throat to yards, precise flowing movement spoke of new forces capable of entrancing the human spirit, of the future, of ages of organized human and mechanical energy rising to the height of poetry.”

(Ctd. Stilgoe 45)

Though we have romanticized with the automobile for the same reasons of progress, we also now realize that it has caused many problems that are unsolvable with the same mode of transport. A century later, it is time to discover the beauty of rail transport once again.

Some of the greatest problems facing the popular acceptance of any form of urban transportation are cost, quality of service, pollution, safety, and accessibility to jobs and recreational activities. According to microeconomic experts Clifford Winston and Chad Shirley, the biggest solutions to current transportation problems rarely focus on alternatives. Instead, they explain,

... most solutions, whether from concerned citizens or the research community, mainly focus on highway congestion and take one of three approaches: increasing transportation capacity, managing existing capacity, or using prices to allocate scarce capacity. (17)

The authors estimate that while the annual benefits of urban highways exceed annual costs by more than $200 billion, the annual benefits of public transit are $6 billion below its annual cost. Thus, as public transit systems begin to show signs of neglect, people choose to leave bus or rail transit in favor of comfortably driving themselves. Yet as populations grow and continue to sprawl into new commercial and residential suburban developments, highway congestion will continue to worsen. To address this problem without promoting the development of more automobile infrastructure, public transportation alternatives must become the new priority, and their efforts must be funded at the highest level. Unfortunately, many Americans, including most suburbanites, hold a stigma against public transportation, stereotyping it as transport for the lower class, a magnet for crime, and therefore an uncomfortable last resort. This stigma strengthens historical patterns of race and class segregation. For new public transport to succeed, it must first become popular to all segments of society.

In suburban and rural communities, the automobile is predominantly habitual. Efforts to push for sustainable transit alternatives are generally argued or disregarded in the suburbs because they are often paired with blatant criticisms of suburban municipalities. Mees argues that the crusade against suburbia has actually harmed public acceptance of sustainable transport alternatives:

The cause of sustainable transport needs to be detached from the crusade against suburbia. Suburbanites, who are the great majority of the population in developed cities, perceive [this] crusade as being directed against themselves and their communities – and they are probably right. (200)
Implementing sustainable public transport in metropolitan suburbs is so important because Katz, Puentes, and Bernstein assert that

Metropolitan areas are literally where America lives. Not only do eight out of ten people in the US now reside in metropolitan areas, but these crucial places drive the economy. Together, these regions not only produce more than 85 percent of the nation's economic output but also generate 84 percent of America's jobs. Increasingly, the metro areas are where the business of American life is carried on. (15)

Continuing to keep public transportation out of most of the nation's metropolitan areas is keeping the vast majority of the nation's economic output devoid of healthier connections. At the same time, quickly applying public transport to today's suburbs would introduce something quite unnatural to most people. Though it will always be difficult to teach old dogs new tricks, people's daily habits will have to change to support transit. Dependence on walking and cycling would seem forced and intentional at first, but once shown to be effective with public transport, it would become just as habitual as driving is today. Zoning for parking provisions would have to be limited, and parking garages – though they are at least ten times more expensive than at-grade parking – would need to be encouraged to create more room for denser mixed-use urban developments. Cars would still exist, and they would still be helpful, but they would no longer determine how cities develop.

Compared to automobiles, the design of public transportation vehicles has lacked vision and innovation. In 1940, cars and even buses were designed to appeal to current trends by incorporating curved, streamlined forms. Over the decades, while car design advanced through different phases of shapes, forms, and colors, most city buses reverted to unimaginative white boxes on wheels. In My Kind of Transit, urban designer Darrin Nordahl argues that

Banal public vehicles are not the answer to our public transportation needs, and it might behoove us to take a page from the design manual for private automobiles. To guarantee the popularity of transit in this nation once again, these public vehicles will have to possess the style, comfort, heart-fluttering appeal, and visceral thrill of private automobiles and more. A ride aboard transit should be seen as an opportunity to connect with all kinds of people and all kinds of places within a city, a compelling offer that the automobile cannot match. Quite simply, people should want to ride public vehicles, not feel as if they have to. (24)

Metropolitan regions should see access to attractive public transit as a means to spur economic development. According to transportation planner Samuel Seskin, cities like Philadelphia, Boston, Portland, and Arlington (VA) have capitalized properties in close proximity to rail stations into higher residential property values (26). As a result, the value of nonresidential properties has also increased in these areas. Thus, attractive public transportation planning can influence smart development by encouraging new, creative ideas for commercial zoning.

Making public transportation popular enough to implement it will require more than a handful of activists; it will take the whole village. Public transit should
be seen as the purveyor of community, the venue for people to meet friends and
family and a place where chance encounters happen. Attached to a public plaza,
transit stations can become civic centers where people come together for their daily
commutes, regional travels, and entertainment. If we consider public transportation
vehicles to be an extension of public space, then they must be conducive to public
life. Transit car design must appeal to our human conditions by providing comfort,
both physically and psychologically. Public transit should foster an appreciation for
our community environments and engage ourselves with our community neighbors.
Successful transportation design will influence people to understand how beneficial
public transit can truly be.

Making Suburban Public Transit Work

To help public transportation, the U.S. must change laws at the federal and
state levels – especially those that apply to roadway infrastructure. Allocation of
roadway infrastructure funds is typically not proportional to the jurisdictions in which
people reside. Additionally, current federal rules make new rail projects excessively
difficult. The necessary “justification requirements and demonstration of long-term
financial commitment” extend far beyond the rules applied to any roadway projects
(Katz 23). The bottom line is that metropolitan transportation issues will only begin to
be addressed if metropolitan areas are given “more powers, greater tools, and higher
capacity to get transportation policy right for their places” (38). In exchange for this
greater flexibility, regions like Metro Detroit would be more directly responsible for
achieving their own successful, endemic transportation system.

One of the greatest obstacles for public transportation is that, historically,
economic research and approaches to the major transit problems have received
little attention from policymakers. However, economic research has helped influence
policymakers to replace government regulation with unregulated competition in other
U.S. industries. In successful cases, this change in competition has substantially
improved resource allocation. Similar regulation changes should be applied to help
public transportation. Winston and Shirley believe that the private sector could
improve the US urban transportation significantly.

Facing fewer operating restrictions, greater economic incentives, and stronger
competitive pressures, private suppliers of urban transportation could significantly
improve the efficiency of urban operations and offer services that are more
responsive to the preferences of all travelers. Moreover, these improvements are not
likely to come at the expense of a massive redistribution of income from economically
disadvantaged travelers to wealthier citizens and operators. (19-20)

The current major efforts to promote public transit advancements in Metro
Detroit are short-term adjustments that are nowhere near new regional systems.
None of them tend to alter dependence on the automobile; instead they only aim to
increase existing transit ridership and stimulate economic development in adjacent
areas. The M-1 Rail project proposes a 3.4-mile light rail system along Woodward
Avenue in downtown Detroit. Unfortunately, it has never been made clear how this transit mode will coordinate with or strengthen the existing bus system or park and ride options. The system is essentially a bus on rails, and it has been slow to garner support. In the northern suburbs of Troy and Birmingham, the 15-Mile Transit project proposes a strengthened transportation hub with an adjacent dense mixed-use development. This hub is based on the existing Amtrak Wolverine train service and encourages future connections between an expanded SMART bus service. It proposes an entirely new development, rather than a direct relationship with an existing historic downtown. Both of these projects have been put on hold due to issues with legislation and funding, and while alternatives like Bus Rapid Transit (BRT) have been added to the mix, there is no real certainty on what will take root or when.

Metro Detroit is unique, and there is no other metropolis like it. Its mix of radiating urban roads combined with an expansive square-mile street grid is complemented by a diverse mix of people who share common facets of Detroit culture. Implementing public transit in Metro Detroit should require more than merely inserting the same system used in other cities. What works in other cities might not appeal to Detroit or even function correctly. Therefore, the Motor City will need to carefully plan its system around its specific transportation needs and its distinct character. Such individualism is a good thing, because it will begin to create a unique style of development for Detroit's future growth. McDonough and Braungart express that people prefer unique places:

According to visual preference surveys, most people see culturally distinctive communities as desirable environments in which to live. When they are shown fast-food restaurants or generic-looking buildings, they score the image very low. They prefer quaint New England streets to modern suburbs, even though they may live in developments that destroyed the Main Streets in their very own hometowns. When given the opportunity, people choose something other than that which they are offered in most one-size-fits-all designs: the strip, the subdivision, the mall. People want diversity because it brings them more pleasure and delight. (144)

Successfully applying multimodal public transportation to Metro Detroit could change the game for regional transportation and growth throughout Southeast Michigan and the Midwest. Just as Detroit has spurred vehicle and technology innovation over the past century, there is an untapped opportunity for it to revolutionize global public transportation into the future. Such an endeavor would create regional jobs and a new sense of global importance for a city that has become synonymous with institutional abandonment and urban decay.
Encouraging Multimodal Transit Management

To promote and manage sustainable, multimodal public transit in Metro Detroit:

1) Old-fashioned public authorities need to think on a larger scale and further ahead. Our communities have changed dramatically over the last fifty years. We should not allow our unattended problems persist for the next fifty.

2) Efforts must be made to avoid resistance from the usual suspects: academically trained economists and the governments and agencies that follow their advice.

3) Transit must be managed by more privatized companies who put the customers' interest first. No urban transit should be fully public or fully private. Because some tasks are better suited for a certain entity, these companies must be appropriately administrated (Mees 72).

4) Diverse multi-modal networks should be managed on the regional, tactical level by central agencies that work beyond the municipal department. “Close political control can work against efficient operations, while the bureaucratic culture of a government department may not be the best environment to foster innovative tactical planning” (Mees 73).

5) Transit modes must be integrated by one single agency to allow passengers to move freely, conveniently, and comfortably. Critics commonly use passengers’ tendency to avoid transferring “as proof that no effort should be made to change things” when this is actually a result of poor system design (Mees 84). The best networks minimize the inconveniences associated with the necessary walking, waiting, and transferring.

6) Public transport incentives must be complemented by automobile disincentives.

7) Land-use planners must help public transport through locating and designing trip attractors like employment, retail, and services.

8) Public transport must match the “anywhere to anywhere” service that personal automobiles provide drivers.

9) Regional development must channel development and growth near urban transit nodes, not on the urban fringe.

10) Urban transit-oriented development must become denser to cater to pedestrians and motivate new walking habits.

11) Policies and programs must be made to promote private sector investments in station areas and transit-oriented development.
**Prerequisites for Transit-Oriented Development**

Principles of transit-oriented development and route planning, plus lessons from the following case studies, will guide the planning of a transit network for Metro Detroit. Routes will be designed to converge at well-designed stations and stops throughout the region’s vital, historic economic centers. TOD principles will be guided by the framework of an extensive ecological systems analysis. The final product of this design proposal will be an innovative, inventive, and exciting urban design that will push the future of sustainable transit-based growth.

Transit-oriented development relies on new land use patterns to support higher levels of transit use. One or more of the following characteristics must be present to allow TOD to be possible:

- Compact urban form
- Reduced number of significant employment centers in the region
- Employment and residences in corridors served by high-capacity transit
- Richer mixes of land uses in the transit corridors
- Environmental enhancement for pedestrians and bicyclists (Seskin 6)

As previously noted, high population density is not necessary for good transit, but density in both housing and employment is essential to determining transit demand. A mix of land uses in neighborhoods supports transit use, but it is actually less influential than density (19). On the local municipal and county administration level, TOD requires

- A political culture supportive of transit
- Strong, respected institutions and agencies
- Delivery of a high-quality transit service
- Transit investments that precede or coincide with growth
- Stations that have development potential
- A variety of public policy tools to focus growth (Seskin 34-5)

The most successful transit-oriented developments also include excellent facilities for easy, efficient transfers between transit modes. These transfer nodes influence routing and serve as points where multiple routes overlap. Cities with the highest transit riding habit are generally those with the highest transfer ratios, like Boston, Paris, Toronto, and Zurich. Cities that lack ease in transferring, like Melbourne, Australia, are inefficient because bus networks rely mostly on walk-on customs. Most of Melbourne’s bus routes meander directly to their destinations. Instead of creating a network, the bus system creates multiple stretched chains linked only at the station. Buses are infrequent and do not collaborate with train schedules, causing the rail system to require a large operating subsidy. Thus, no surplus funding is generated to aid the whole transportation network (Mees 94).

Buses are the most common mode of transit for dispersed routes that feed commuter rail anchors. The principle disadvantage of buses is “low speeds and capacity relative to rail-based modes, but these problems stem mainly from having to share the streets with other vehicles” (Mees 112). The advantage of buses is
that they can provide effective service at lower costs than rail with little or no extra infrastructure required. Because Americans tend to live fast-paced, heavily scheduled lifestyles, the most appealing modes of transportation will be must be separate from automobile traffic to reach higher speeds. Raised commuter rail, off-street light rail, and rapid buses with separate road lanes will be the best modes to promote speedy public transportation. In-traffic bus routes should be designed as if they were “trams or trains, with simple, direct structures and as little duplication and overlap as possible” (Mees 169). Parallel routes have a tendency to split the potential demand, allowing multiple routes to compete for the same passengers.

Traditionally, the availability of adequate parking has had a larger impact on commuter rail ridership than feeder buses have. However, creating bus lines that are more than just feeders could counter that relationship. In the suburbs, offering parking space with limited feeder bus routes will respect the desire for multi-modal options that offer different ways to reach the same destination. Of course, routes and service levels will always need to be adjusted according to ridership trends and specific trip demands (Seskin 35). No matter how routes change over time, good TOD hubs will include appropriate accommodating features for all modes of transit: rail, bus, taxis and shuttles, cars, bikes, and pedestrians.

**Qualities of Transit-Oriented Development**

Well-designed TOD promotes a greater mix of housing types and a community lifestyle that is more convenient, affordable, and active for people of all ages, including those who cannot or choose not to drive. Beyond offering better affordable household alternatives for middle and lower-class families, “housing in transit-oriented developments produces as much as 50% less traffic than conventional developments” (US EPA 7). Furthermore, property values in TODs tend to be higher than standard, low-density suburban developments.

Transit is proven to generate value that can be captured and reinvested in communities because it concentrates development and business activity and the tax base in a way that allows for focused value capture strategies. (US EPA 2)

**Strategies to capture value in land use:**

- Property & sales taxes
- Real estate lease and sales revenues
- Farebox revenues
- Fees on everything from parking to business licenses
- Joint development
- Special assessment districts
- Public-private partnerships

According to the EPA, solutions to some of the greatest national environmental and resource problems can be solved simply by implementing more TODs. Because these smart developments bring so many added benefits, they may very well be the most
effective solution for our current issues.

... It is increasingly clear that one of the most sustainable, low-cost, long-term solutions to a host of pending problems – including climate change and dependence on foreign oil – is public-private investment in neighborhoods where people don’t have to drive. (US EPA 2)

Besides increasing transit ridership, TODs can also promote neighborhood revitalization, guarantee affordability, influence public and private investment, provide greater choices for residents, reduce traffic and pollution, and provide neighborhoods with more sustainable economic and environmental systems. Successful TODs require effective public-private-nonprofit partnerships, strong leadership, greater public involvement, creative financing, quality design, and perseverance (US EPA 6). Therefore, communities must adopt and maintain a more collaborative method of policymaking than is necessary for automobile-dependent development. Furthermore, bolstered regional and municipal cooperations will improve metropolitan development even after TODs have been implemented.

Zoning plays a vital role in how successful TODs take shape. Traditionally, special transit districts are created so that mixed-used zoning can be overlaid on the conventional zoning grid. However, this strategy has no real guaranteed success, partly because it does not change the existing requirements of auto-dependent planning. As a result, “many cities are instead turning to form-based codes to achieve more vibrant and human-scaled neighborhoods.” In contrast to conventional codes, form-based codes “focus on the architectural and urban form of the built environment and regulate key aspects such as building heights and setbacks, windows and doors, the street and sidewalks” (US EPA 11). This type of coding is inherently mixed-use, yet it is more open to creativity and allows development to match the needs of new transit modes. The focus is on the relationships between building facades and the public realm and how the shapes of building relate to one another and the human scale. For this reason, good TODs can create more dynamic, vibrant neighborhoods.

Parking is an important part of transit zoning that can single-handedly persuade the outcome of a development’s success. “Parking mandates crafted for single land uses overestimate the parking needs of development near transit and undermine opportunities for higher-value uses” (US EPA 7). While parking must exist within a thriving TOD, it must not be so prevalent that it consumes developable space or encourages car-dependency.

Parking policy is every bit as important to creating vibrant, pedestrian-friendly mixed-use districts as streetscapes, parks and high-quality public space because it largely determines whether a neighborhood is compact and walkable.

Shared parking is a parking management policy that allows for parking spaces to be shared by more than one user, since most parking spaces are only used some of the time and many parking facilities include many unused spaces with patterns of usage that follow predictable daily, weekly and annual cycles. (US EPA 9)

With the implementation of proactive zoning policies backed by strong leadership and active public-private partnerships, transit-oriented development can excel far
beyond status as a mere transit node. Good TODs are known as being prosperous neighborhoods and vibrant destinations.

Site-Specific Street Considerations for TOD:

- Well-planned transit routes are the skeleton of a successful transit system.
- Transit stops in more densely developed areas require sufficient sidewalk width to provide accessibility and transit stop amenities.
- Provide safe pedestrian crossings within light-rail transit station areas.
- Provide streetscape improvements to support pedestrian accessibility to transit stops and light rail transit station areas.
- Transit-oriented features should serve as amenities for surrounding land uses and activities.
- Leverage desired transit facilities from development when impacts warrant them.
- Pedestrian and local street crossings of light-rail transit corridors are important design elements of station community development
- Enhance bicycle access through the provision of bike racks and lockers at transit stations.

Site-Specific Street Guidelines for TOD:

- Bus shelters should be oriented to provide easy access to and from the public pedestrian network and the transit boarding/de-boarding area
- Provide bus stops on regional streets based on demand, or provide bus stops at regular intervals of 1/8 to 1/4-mile in areas of high intensity land uses. Typical bus stop spacing ranges from 600 to 900 feet in central business districts to 1,000 to 5,000 feet in areas of lower-intensity land use.
- Minimum curbside bus stop width is 10 feet, or 11 feet if bus is turning right.
- Provide pedestrian crossings at all transit stops using striped crosswalks, pedestrian refuges and curb extensions, as appropriate.
- Ensure that bus stops are properly designed for vehicle length and turning radius
- Implement bus pre-emption (priority) systems on high-capacity, frequent and express bus routes
- Ensure passenger waiting areas do not interfere with passage on sidewalk. Increase size of waiting area based on patron demand.
- Provide secure bicycle parking at transit stations.
- Preferred clearance between curb and street furniture at a bus stop is 6 feet (3 feet min.). Preferred distance between the curb and a bus shelter is 6 feet or more (2.5 feet min.) unless shelter faces away from street.
- The minimum ADA required bus drop-off clear zone is 5 feet by 8 feet. The width of a passenger waiting area with a bench is 5 feet min. or 7.5 feet with a bus shelter. (Creating Livable Streets: Metro 40-41)
PROBLEM STATEMENT

Present-day Metro Detroit shows a clear divide between dense, rail-dependent urban communities and the sprawling, automobile-dependant suburban areas that grew around them. Contemporary patterns of urban and suburban development demand an extensive transportation and energy infrastructure that is huge, costly, and environmentally unsound. Increasing populations pressure this already discordant infrastructure and accelerate poor planning decisions. Furthermore, the regional development of affordable, low-density, cookie-cutter suburban homes has normalized the existence of neighborhoods that are unreasonably far away from historic downtowns. As a result, many of these historic commercial areas have suffered recent periods of economic hardship, leading to population loss and architectural decay.

At the same time, the region’s ecosystems have been trampled over to make way for new development. Many unique habitats have become inhospitable to their native organisms because poor management practices have resulted in heavily polluted water sources. While many Metro Detroit municipalities needlessly develop virgin land, numerous inner-city developments remain neglected and polluted. Very few polluted landscapes have been restored. For the most part, sustainable urban development seems absent from the overall metropolitan planning discussion.

According to UPenn Professor Jonathan Barnett of the American Planning Association, “current metropolitan growth and development patterns are our biggest single sustainability issue” (78). Since our dependency on transportation has played a major role in developing these major problems, perhaps a new paradigm of sustainable transportation could offer new solutions.
HYPOTHESES

Regional urban growth based on multimodal transit will influence a more economically, socially, and environmentally sustainable framework for Metro Detroit's future development. A new system of commuter railways, combined with limits on urban expansion and proactive urban design, can transform Metro Detroit's historic downtowns into regional hubs for economic and recreational activity, just as they were less than a century ago. These planning measures can create new connections and relationships between diverse municipalities that, no matter their individual condition or prosperity, define the shape of the Metro Detroit community as a whole.

Applied to Rochester, these sustainable urban design principles will create a downtown that is physically and culturally connected to the surrounding historic downtowns. It will become less dependent on automobile-related demands and provide opportunity to relieve automobile-related pressures on the three subwatersheds that meet near Main Street. Furthermore, this proposal will spur denser development in downtown Rochester, which could include mixed-use multi-family living units, commercial and office space, and light industrial units. Such strategies will save virgin land on the edge of the Metro Detroit urban area from residential and commercial development, and Rochester will become a richer metropolitan destination while maintaining its suburban and family-oriented character.
PROJECT REQUIREMENTS

Assumptions

- Automotive transportation cannot support a sustainable future.
- Communities within Metro Detroit and neighboring counties would be politically and economically interested in the implementation of a unique, innovative method of transportation.
- A web of sustainable transit modes – including trains, buses, taxis, carpooling, biking, and walking – will have immediate trouble supporting a sprawling suburban community. However, if all future design plans aim to condense populated areas and support this network, it will be the appropriate first step towards a sustainable suburban city.
- Metro Detroit does not need any more sprawling suburban neighborhoods, nor does it have the capacity for any. Such types of residential development would be avoided by planning for dense, transit-supportive developments.
- Variances in zoning regulations will be made available for the development of dense, mixed-use buildings and appropriate landscape changes.
- Road and rail right-of-ways, parking lots, vacant lots, and, in some cases, existing buildings, can be repurposed as new developments that will maximize Rochester’s potential for sustainable, dense urban development.
- Historic preservation will play an important role in developing a new model for Rochester.
- Partnerships between public and private organizations throughout the metropolitan area would be used to help promote responsible development practices.

Delimitations

- The research and statistics for this project will focus on the Clinton River Watershed, Oakland County, and Rochester and its adjacent municipalities. While this project will propose a regional transportation system to address social, economic, and environmental issues, it may not mention some important areas of Metro Detroit.
- This project does not propose a fully sustainable Downtown Rochester, but it will include fundamental steps toward making the city more sustainable.
- The site of the proposed development will include a transportation hub and the surrounding lots that will support a transit district within Downtown Rochester.
- Funding issues will be considered in the design proposal, but the specifics of the funding will not be fully analyzed.
Goals & Objectives

I. Limit suburban sprawl and spur the development of historically significant downtown in Metro Detroit.
   A. Establish a future transportation paradigm as the necessary backbone for sustainable development:
   B. Promote social, environmental, and economic equity within an expanded, diversified public transportation network.
   C. Design a new electric rail system for inter-city transportation. In order to reach historic downtowns and commercial areas, route this system primarily along historic rail right-of-ways. This system will serve as the anchor for multi-modal transit stations and regional transit-oriented development.

II. Propose a transit-hub in Rochester as the basis for a more vibrant, livable, walkable, and attractive downtown.
   A. Embrace Rochester’s transportation history as guidance for planning a new system. Gear all new developments toward preservation of Rochester’s unique history and character.
   B. Use Rochester’s existing economic and recreational attractions to influence a new identity: Rochester as regional destination.
   C. Plan the transit station and supportive infrastructure to accommodate multiple modes of transit, including buses, taxis, shuttles, cars, bicycles, and pedestrians. Integrate these modes of transit and encourage transfers.

III. Implement good Transit-Oriented Development practices in Rochester.
   A. Propose a method of land use that promotes greater accessibility for people, businesses, and policies, thus encouraging denser development.
   B. Propose mixed-use multi-family living units, commercial and office space, and light industrial units to diversify the downtown area and promote greater employment options. Rather than dictating which zoning types mixed-use lots can develop for, design for form-based coding that focuses on architectural and urban form.
   C. Enhance Rochester’s streets for pedestrians and bicyclists. Design the streetscape for a safe and successful transit district. Support the station with a civic plaza and unique spaces that are suited for a variety of uses and users.
   D. Design a public transportation entity that is more appealing to all people.

IV. Respect, preserve, and restore Rochester’s natural ecology.
   A. Ensure that proposed developments are suitable for corresponding soil types.
   B. Revive the presence of Paint Creek on the site by improving views and pedestrian accessibility and by restoring its historic path.
   C. Propose a stormwater management system that mitigates the pressure of polluted runoff on Paint Creek and the Clinton River.
   D. Design plantings with suitable native plants.
Clients

The site design intends to accommodate two major user groups:

1) Residents of the greater Rochester community
2) Transit passengers that stop at the Rochester station

Both groups will include different types of transportation users, including (but not limited to):

- walkers & joggers
- bicyclists
- car drivers/passengers
- taxi/shuttle passengers
- bus passengers
- train passengers

Program

Multimodal Transit Hub
- Raised Railway
- Combination Train & Bus Station
- Drop-off Loop & Service Drive
- Transit Plaza with Adjacent Commercial Space
- Parking Structures

Transit District
- Mixed-Use Infill, including:
  - Grocery Store
  - Office Space
  - Retail Space
- Multi-Family Infill
- Multipurpose Event/Market Plaza

Pedestrian Amenities
- Revitalized & Expanded Trail Network
- Improved Streetscapes
- Passive and Active Recreation Space
- Creek Lookouts and Access Points

Ecological Revitalization
- Paint Creek Restoration
- Constructed Wetlands for Stormwater & Wastewater Management
- Native Plantings
The site for the implementation of this proposal will be in Rochester, Michigan, which is located about twenty miles north of Detroit in eastern Oakland County. The city’s rich agricultural and industrial history in connection to the Motor City will serve as a complex and pertinent study of sprawling suburban development in America and how sprawl has affected the role of historic villages in metropolitan areas throughout history. The following investigation creates a profile for Rochester’s history that involves demographic, transportation, economic and ecological information.

First Settlers & Transportation

French fur traders were the first Europeans to explore Michigan in the early 1600s. As time moved forward, the City of Detroit would develop from the site of the Fort Pontchartrain du Détroit. The name was derived from the French name for the River, d’Étroit, meaning “of the strait” between Lake St. Clair and Lake Erie. For about two centuries, the Potawatomi, other Algonquin Indians, and European explorers lived near each other in the region. However, as more Europeans and Americans from the original colonies began to settle near Detroit in the early 1800s, these tribes were pushed further north and west from Detroit.

Today, Metro Detroit is mostly contained within Wayne, Macomb, and Oakland Counties. In the early to mid-1800s, Oakland County was home to three different Native American Reservations, two of which were Potawatomi, that were mandated by the federal government. These lands were located in the present-day municipalities of Orchard Lake, Southfield, Franklin, and Beverly Hills. These reservations were within a 15-mile radius of the village of Rochester, which happened to be developing around the same time.

By 1931, five burial mounds of the agriculture-dependent Hopewell Indians (BCE) had been discovered in Oakland County. In the early 1950s, a large cemetery of Younge Tradition Indians was uncovered in Avon Township (now Rochester Hills). Early records from Oakland County settlers point to ancient agricultural endeavors, such as fields of corn, bean, and squash. It is assumed that 12,000 years ago, the land that is now Southeast Michigan was defined by spruce and larch groves, meadows, marshes, and lakes. The region was home to herds of mammoth, mastodon, elk, caribou, deer, as well as black bear, and beaver. When Paleo-Americans migrated to the area, theses large mammals became sources of food, tools, and clothing. By the end of the ice age, the largest animals were hunted nearly or completely to extinction. As a result, native peoples that remained in Southeast Michigan probably adapted to hunting smaller mammals and aquatic animals and raising food for sustenance. As many of the first peoples in the Great Lakes region lived nomadic lifestyles, it is likely that present-day Metro Detroit was never occupied by any single tribe for very long (Hagman 13).
Many of present-day Detroit's roads and railways were once significant Native American footpaths. These once narrow walking trails were likely created and used by the Sauk, Chippewa, Ottawa, Potawatomi, Miami, Sauk, Fox, Huron, and other tribes for trade and migration purposes. In the 1600s, French trappers and colonists utilized them for trading, trapping, and exploring. One hundred years later, they became routes for the British. By the early 1800s, settlers from New York and New England came to the region seeking land and new livelihoods. Remarkably, the locations for many of Metro Detroit's significant historic settlements were determined not by land sales and policy but by the intersections of Native American footpaths with rivers, creeks, and lakes. In Oakland County, these settlements include Pontiac, Birmingham, Royal Oak, Franklin, Farmington, Walled Lake, Waterford, Clarkston, Oxford, Lake Orion, and Rochester. By the late 1800s, some of these footpaths had become widened roads for horse-drawn wagons, carriages, and sleighs. Others turned into steam and electric railways. Today, while parts of these routes are now freeways, six-lane roads, and freight railroads, some have reverted back into narrow footpaths – this time for recreation (Oakland County Native Americans).

**Oakland County Routes that were Originally Native American Footpaths**

<table>
<thead>
<tr>
<th>Now:</th>
<th>Then:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woodward Ave</td>
<td>The 100-Mile Saginaw Trail</td>
</tr>
<tr>
<td>Dixie Hwy</td>
<td>[Detroit – Pontiac – Flint – Saginaw]</td>
</tr>
<tr>
<td></td>
<td>The 200-Mile Grand River Trail;</td>
</tr>
<tr>
<td></td>
<td>[Detroit - Lansing – Grand Rapids – Muskegon]</td>
</tr>
<tr>
<td></td>
<td>Parts of the 150-Mile Shiawassee Trail</td>
</tr>
<tr>
<td></td>
<td>[Detroit – Saginaw &amp; northward]</td>
</tr>
<tr>
<td>Pontiac Trail</td>
<td>The 40-Mile Pontiac Trail</td>
</tr>
<tr>
<td>Orchard Lake</td>
<td>[Pontiac – Ann Arbor]</td>
</tr>
<tr>
<td>Road</td>
<td>Paint Creek Trail (formerly Penn Central Railroad), Orion Road, Lapeer Road</td>
</tr>
<tr>
<td></td>
<td>Unnamed trail</td>
</tr>
<tr>
<td></td>
<td>[Rochester – Lake Orion – Oxford – Lapeer &amp; northward]</td>
</tr>
<tr>
<td>Joslyn Road</td>
<td>Unnamed trail</td>
</tr>
<tr>
<td></td>
<td>[Pontiac – Oxford]</td>
</tr>
</tbody>
</table>

(Oakland County Native Americans)
The Development of Modern Rochester

Agricultural Development

1817 The first permanent settlement in Oakland County is located in present-day Rochester.

1819 Oakland County becomes the first organized county in Michigan's interior. Most of its settlers come from New York, New Jersey, New England, Pennsylvania, and Canada in search of affordable farmland.

1820 County Population: 330

1825 The Erie Canal serves as a vital migration & trade resource through 1832. What was once a two week trip from New York now takes only five days.

1835 Avon Township (now the Cities of Rochester & Rochester Hills) is incorporated. The convergence of Paint Creek and Stony Creek with the Clinton River allows for water-powered mills. The eighteen mills in Avon Township would produce lumber, flour, grist, cider, wool, as well as flax, shoddy, and carding for textiles.

1838 The Clinton-Kalamazoo Canal begins construction. The canal is proposed to cross the entire state, connecting Lake St. Clair to Lake Michigan. Construction ceased in 1842 due to a lack of funding, unorganized labor, and the simultaneous development of railroads. The canal began at the Clinton River, just west of downtown Mount Clemens in Macomb County. Rochester was its western terminus until most of the canal was filled in.

1840 County Population: 23,646

1850 Avon Township is home to several notable, privately owned farms. Most farms in the township are self-sufficient. The most well-known farms include:

- The Van Hoosen Farm, which is built on 1849 Gold Rush money. Practices include raising poultry and dairy cows. The Van Hoosen daughters become renowned dairy farmers and medical researchers.
- Meadow Brook Farm, which was owned by the Dodge family. Produce includes wheat, oats, corn, and fruit orchards, and the family breeds horses. The land would become Oakland University in the mid-1900s.
- McGregor Farm, known for raising Guernsey & Aberdeen Angus cows.

1860 County Population: 38,261

One of every seven men in Avon Township will fight in the Civil War. The war creates a greater demand for farm medicine from the township and also spurs Rochester's industrialization.

1869 Rochester becomes a village within Avon Township.

1880 County Population: 41,537
1890  Most farms produce either wheat or corn. Other produce, in order of popularity, includes oats, rye, potatoes, hay, and fruit. Stock raising is also common. Developed railroads enable subsistence crops to become cash crops. The township exports swine, sheep, milk, butter, cheese, apples, cider, and fruit throughout the region and Detroit. Imports for luxury include fruit, dairy, and oysters. New settlers begin to arrive for manufacturing and mill work rather than farming. By this time, many Germans, Poles, and Italians have immigrated to Detroit.  

1896  Henry Ford develops his first car, the Ford Quadricycle, in Detroit.

Agricultural to Industrial

1900  County Population:  44,792  
       Avon Township:  2,584  
       Village of Rochester:  1,535  

During this time, Henry Ford becomes the first to implement the method of assembly line manufacturing to commercial automobile production. Residents begin working at Detroit factories, traveling by the newly built Detroit United Railway (DUR). This electric interurban streetcar system would eventually span from Detroit and Wayne County into eight surrounding counties, plus Toledo, Ohio and Windsor, Ontario.

1903  A soil survey for the areas surrounding Pontiac reports that the average farm contains about 80 acres of land. The townships are characterized by well-painted barns with gambrel roofs. Windmills and artesian wells are used for pumping water. In Oakland County, farmland that abuts electric railways is two to six times more expensive than other farmland, regardless of the soil quality. Oakland County farmers were notably progressive with modern machinery, especially in harvesting machines. The most popular fruits harvested are peaches and apples, with smaller-scale production of cherries, plums, pears, and grapes. In natural areas, common trees include oak, hickory, walnut, and poplar in the uplands, as well as tamarack, aspen, elm, willow, cedar, basswood, maple, cottonwood, ash, and eastern white-cedar in the lowlands.

1907  Twenty-five freight and eight passenger trains stop in Rochester each day.

1910  County Population:  49,576

1920  County Population:  90,050

Avon Township’s agrarian identity starts to fade. New factories build farm equipment and manufacture raw farm products into processed goods. As farmers leave, their land is sold for subdivisions, scientific farms, and wealthy estates. Many workers from the township commute to Flint, Pontiac, and Detroit to earn wages at the auto
factories. About 62 interurban streetcars come in and out of Rochester each day. Tens of thousands of African-Americans have immigrated to Detroit from the South. Other major immigrant groups include Russians, Greeks, and many other Eastern Europeans.

1930
County Population: 211,251
During the Great Depression, tool and auto plants close across Metro Detroit. Most mills in Avon Township have burnt down or gone out of business. The DUR has given up many of its lines to other rail companies, and Rochester's lines will soon be either stripped or paved over.

Shaping the Present

1940
County Population: 254,068
At the end of World War II, cars, trucks, buses and airplanes would overtake rail transportation.

1950
County Population: 396,001
Avon Township: 13,182
Village of Rochester: 4,279
Very few Avon Township families earn a living by farming. By this time, the cities in southeastern Oakland County had developed most of their land into dense residential subdivisions, especially those off of Woodward Avenue. The demand for more upper-middle class family housing would soon push its way into Southfield, Farmington, West Bloomfield, Troy, and Avon Townships.

1960
County Population: 690,259
The land at major county road intersections begin to be developed into shopping malls and shopping plazas surrounded by ample parking lots. Avon Township residents will no longer need to travel to the village of Rochester to shop and do business.

1964
The last passenger train passes through Rochester.

1967
After 98 years as a village, Rochester becomes a city. Efforts to consolidate the new city and the rest of the township over the next five years would ultimately fail.

1970
County Population: 907,871
New subdivisions in Avon Township would be characterized by larger homes and yards that consumed more land per family. Many people that reside in the township work in neighboring cities.

1980
County Population: 1,011,793
Population influx in Oakland County will include immigrants from India, China, Southeastern Asia, and the Middle East. Avon Township will become home to substantial Indian and Chinese populations.

1984
Avon Township approves a city charter and becomes the City of Rochester Hills.
1988 The author is born in Rochester Hills.
1990 County Population: 1,083,592
2000 County Population: 1,194,156
   Rochester Hills: 68,825
   Rochester: 10,467
2010 County Population: 1,202,362
   Rochester Hills: 70,995
   Rochester: 12,711

Sources:
Downtown Rochester History
(Hagman) Oakland County History
Rochester Hills History
US Census Bureau
Wilder (Pontiac Area Soil Survey)
As of 2013, the State of Michigan contains thirty-one municipalities with populations over 50,000 (Figure 3). Populations this large qualify a city for urban area status as defined by the US Census Bureau.

Twenty-four of those cities are inside Detroit’s Metropolitan Statistical Area. The metropolitan Urban Area (1,337 mi$^2$) has a population size of over 3,700,000, ranking 11th largest in America. Of the nation’s largest cities by area, Detroit ranks 16th in population size. The city area comprises nearly 143 square miles, 10% of the entire metropolitan urban area. Due to earlier and denser urbanization, approximately 20% of the urban area population (more than 700,000) lives within Detroit city limits.

Historic pre-automobile development maps were spliced together to create a comprehensive historical map of all of Oakland County and most of Metro Detroit. Nine quadrants from the US Geological Survey, ranging from 1902 – 1926, made up most of the map (Figure 4). The quadrant boundaries are based on latitudinal and longitudinal location, and the map features elevation, hydrography, political boundaries, and road and rail networks. Because a section of Oakland County was not surveyed during that USGS mapping era, a substitute was derived from a similar 1949 Army Corps of Engineers map (Michigan Historical Topographic Maps).
Though not accurate to any single point in time, the map displays a remarkable time in the Motor City's history. In fact, the oldest portions of this map show a time when cars had not yet spurred the paving of major roadways. At this time, new steam and electric rail systems were in demand as the primary modes of transportation for goods and people. By overlaying different sets of geographic data on this base, the following series of maps explores the shape of Detroit by focusing on ecology,
patterns in development, population, and methods of transportation.

In 1909, the first mile of concrete highway in the world was built in the City of Detroit. By 1916, dubbed Woodward Avenue, the highway had extended twenty-seven miles northwest to Pontiac in Oakland County. The creation of Woodward Avenue, M-1, would help determine the course of American urban development throughout the twentieth century. The nation’s first three-color traffic light appeared on the thoroughfare in 1919 (Woodward Avenue). Already the automotive capital of the world, Detroit continued to lead the way as the Big Three (Ford, General Motors, and Chrysler) progressed through the decades. Subsequently, the population of Detroit and its nearby suburbs flourished as people from around the country and the world flocked to find work in the city that would change the course of transportation history. Hundreds of automotive-related businesses have since located in or found themselves working directly with Detroit: the birthplace of the automobile, the city that taught the world to drive, Motown. While this heritage remains a true definition of the Motor City, much has changed.

Once a bustling metropolis on par with the world’s leading cities, Detroit has become the poster child for urban decay. The city is occupied by less than half the projected population that it was planned for during the mid-twentieth century. Due to socioeconomic, political, and racial issues that plagued the city during the twentieth century and even today, the future once destined for the city exists in shards, scattered amongst abandoned neighborhoods, divided politics, joblessness, and among other aspects, its flourishing suburbs. Since 1950, while the Metro Detroit area has welcomed over a million new residents, the City of Detroit’s population has fallen from 1.8 million to just over 700,000. Affluent families tend to live in Metro Detroit not because they are attracted to Detroit itself but because its suburbs offer comfort and a greater quantity of schools, jobs, and recreational opportunities. As a result, Detroit’s population is now largely lower-class and more than 80% African American. The disappearance of work, widespread institutional abandonment, crumbling infrastructures, historic segregation, erosion of a working tax base, disinvestment in municipal services, and the rise of crime have helped the “most cosmopolitan city of the Midwest” to become one of the nation’s most pitied (Detroit Lives).

While the current state of Detroit is disheartening, many great things never left the city. People who call Detroit home – even those from the suburbs – are often proud to say so, and there is much happening within the city to make it better. Grassroots community organizations, social entrepreneurs, increasing public involvement, and diehard sports and arts communities have further built up that pride in recent years. The issue Detroit faces today is not as much how to overcome its troubled history as it is how to prepare for a bright future. In the city where the automobile was born, and at a time when sustainable development is the key to future success, the preparation starts with transportation. Because transportation links American families to their livelihoods, good transportation policy is also sound economic policy (Katz 199).

Even at half its intended capacity, Detroit is still the eleventh largest
metropolitan area in the United States. The way people move within and between the metropolitan cities in the next ten years will create a framework in which Motown can redevelop. Nothing can be done, however, without first examining the role Detroit’s transportation plays in current social and environmental issues today.

This project focuses almost entirely within Oakland County’s limits, and so Oakland is the only fully represented county on the map. Because Rochester lies on the county’s eastern border, the project does involve neighboring Macomb County for the purpose of influencing transit destinations. Figure 6 shows that development before 1930 was quite equal across the different counties. Each county seat (Flint, Ann Arbor, Pontiac, Detroit, and Mt. Clemens) were at this time the most significant, prosperous cities in their respective counties. Commercial Areas are defined as centers for trade and commerce that involved any combination of businesses, industries, municipal buildings, or residences. There are 64 areas represented on this map. The mass within Detroit alone accounts for 15 distinct neighborhood commercial areas. Beginning around the 1950s, many of these commercial areas began fall into states of neglect. This has been the case in smaller commercial strips as much as it has in the large downtown county seats. Pontiac (Oakland County), Mt. Clemens (Macomb County), Flint (Genesee County) and Detroit (Wayne County) have all undergone significant periods of recession.

The next three maps can help explain why the region’s historic commercial strips and downtowns are so easily abandoned during periods of change. To the right, Figure 7 clearly displays that the growth of the Metro Detroit urban area grew significantly from 1990 to 2010, centering its growth along major roads but not necessarily around historic commercial areas. These widespread areas of growth represent where land was developed for commercial, industrial, residential, and other economic purposes. Because cars allow people to move great distances relatively quickly, much of these developments are able to be built more than 3 miles away from any historic commercial area. Thus, as new developments welcomed people with new attractions and easily accessible parking space for their cars, the districts that were designed for pedestrians, horse and buggy, and interurban train passengers began to lose their purpose as a hub. Furthermore, these hubs have lacked true connections for over 75 years. During the first few decades of the 20th century, each commercial area was also a transit stop, meaning that it was an active hub for pedestrian activity each day.

At their peak development near 1930, several rail networks made up the most express routes of transit the region had ever seen. Nearly every commercial area was directly connected. Of the 64 commercial areas represented on the map, only Clarkston and Grosse Pointe Woods were located more than a half-mile from a rail station. Rochester was a major 7-way junction of freight and passenger rail service (Figure 8). In addition to moving thousands of people each day, both interurban and freight lines moved goods and permitted direct trade between neighboring hubs. Today, as seen in Figure 9, such movement is hardly possible. Freight lines hardly run through most of the region’s commercial areas, and the only passenger service, Amtrak, is limited to one corridor that stops only three times per
SOUTHEAST MICHIGAN RAILWAYS
AT PEAK DEVELOPMENT

- Detroit United Railway & Streetcar Routes (Pre-1930)
- Freight & Heavy Commuter Rail Routes (All-time)
- Commercial Areas (Pre-1930)
- County Boundaries

SCALE 1" = 8 miles
CURRENT FREIGHT RAILWAYS
WITH SOME FREQUENCY OF TRAFFIC

- Amtrak & Freight Routes
- Freight Rail Routes
- Amtrak Stations
- Commercial Areas
- County Boundaries
day at each stop. Because development has been geared towards automobile access for the past century, the idea of a central hub for a town's commercial resources has been nearly forgotten. Today, with regional attractions spread out in a seemingly haphazard fashion, express transportation looks quite different than it did with trains and interurban streetcars. In order to permit speeds of over 50 miles per hour, freeways were developed far outside city centers. State highways were incorporated into some “Main Streets” but also encouraged sprawling commercial development on the outskirts of town. As an unfortunate result, most historic commercial areas have been long deprived of the resource that naturally made them competitive economic hubs. Without transit and a regular influx of people, historic villages are left to compete against malls and shopping plazas for adequate business. As urban areas are projected to grow even further away from Detroit over the next twenty years, Southeast Michigan’s historic districts will continue to be threatened (Figure 10).

Because these historic commercial areas relied on a combination of density, walkability, and frequent transit, it would be very likely that their success ultimately depends on how well we can readopt the development standards that predated the automobile. This is important to investigate because public transportation has been most successful in cities that peaked in development before the advent of the automobile. If urban growth in Metro Detroit had focused on walkability and train stations instead of road construction and automobiles, community development would have radiated from historic commercial areas. By now, much of Detroit’s developed land is so unnecessarily far away from these areas that tens of thousands of acres are now more than 50% impervious. These impervious lands depend on a sprawling system of engineered pipes and ditches to collect and drain water so that flooding is prevented. The only reason such a huge stormwater management system ever needed to be developed is because suburban growth was never restricted.

To turn this development trend around and lessen regional dependence on expensive stormwater management systems, the planning of more dense communities and the promotion of population growth in existing urban centers should become central to community planning. It would be better to see suburban shopping malls, strip malls, and car dealerships disappear than it would to see historic places like Detroit and Pontiac fall further into disrepair. It is time to invest in the places we truly care about.
URBAN GROWTH ALTERNATIVE COMPARED TO CURRENT DEVELOPMENT

- **Rail-Based Dense Growth Alternative**

**CURRENT LAND DEVELOPMENT TREND**
- Developed by 1990
- Developed by 2000
- Developed by 2030
- Remaining developable land (2030)
- Not developable

SCALE: 1" = 8 miles
PROPOSED COMMUTER RAIL LINES FOLLOWING ROAD & RAIL RIGHT-OF-WAYS

- Commercial Areas (Pre-1930)
- Proposed Railways - raised or at grade
- Freeways & State Roads
- Urban Areas (1990)
- Urban Areas (2010)
The adoption of a regional railway system in Metro Detroit would be a large and complex initiative. Fortunately, many of the tracks that were abandoned over the last half century are survived by their right-of-ways. In some cases, like in Rochester, old railways have been converted into recreational trail networks.

Figure 11 displays the suggestion that future railways could follow historic rail routes, as well as some commercial road corridors. The ultimate goal of the rail system would be to repurpose historic commercial areas into the transit hubs that they used to be. In this way, the regional railway system would stand as the connecting thread between historic commercial districts throughout the region. For such a train to appeal to the masses, it would need to be capable of traveling at high speeds, separate from slow street traffic in urban areas.

The trains should aspire to be innovative and push the boundaries of train design. This could be the setting for a new type of high-speed regional commuter rail that enables the fastest traveling time of any type of urban transportation. Speeds could range from 50 to 80 miles per hour on open stretches of track. Train service would undoubtedly shift with demand, but it can be assumed that different lines would stop in each city upwards of four times per day. Each train might have three or more cars, depending on the level of service required for that line.

Figure 12
DESIGN PROCESS

SITE INVENTORY

Oakland County's population is greater than 1,210,000. Together, Rochester Hills and Rochester are home to nearly 84,000 residents. With amenities that include excellent schools, diverse housing choices, strong community groups, and over a dozen technology parks, the Rochester Area continues to be an attractive community for families and businesses (US Census).

Rochester Hills Motto: "Historic, Distinctive, Progressive."

2010 Community Statistics

<table>
<thead>
<tr>
<th></th>
<th>Rochester</th>
<th>Rochester Hills</th>
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</thead>
<tbody>
<tr>
<td>Area:</td>
<td>3.83 mi²</td>
<td>32.82 mi²</td>
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<tr>
<td>Population (2010):</td>
<td>12,771</td>
<td>70,995</td>
</tr>
<tr>
<td>Persons per square mile:</td>
<td>3,323.1</td>
<td>2,163.2</td>
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<tr>
<td>Expected Growth 2010 – 2030:</td>
<td>1,500 (11.7%)</td>
<td>5,400 (7.6%)</td>
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<tr>
<td>Median Age:</td>
<td>38</td>
<td>39</td>
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<tr>
<td>Number of Households:</td>
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<td>Median Household Income:</td>
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<td>Robotics</td>
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<td></td>
<td></td>
<td>Automotive</td>
</tr>
</tbody>
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Transportation Profile

Most Rochester Area residents do not live close enough to their employers, schools, stores, and recreational attractions to rely solely on walking or biking for commute. Most residents are dependant on a car to meet their daily needs, and it is not uncommon for a household to have a car for each member of the family. Rochester and Rochester Hills currently have no tangible public transportation system within their city boundaries. The only semblance of transit is an irregular shuttle service that runs a 4-mile route between Oakland University and downtown Rochester. The SMART bus system (Suburban Mobility Authority for Regional Transportation) is implemented throughout Metro Detroit. The nearest the system routes come to Rochester Hills is in neighboring Auburn Hills, about a half-mile west of city limits.

Rochester was a prosperous, growing village for more than a century before cars became its primary mode of regional transportation in about 1930. At this time, the village had a population of about 3,000 people. After 50 years of car-dependence, the village population had more than doubled while the surrounding township had completely shifted from agricultural land to residential suburb. By
no coincidence, Rochester found many businesses in its downtown outdated and struggling to attract clientele during 1980s. Today, each historic downtown in Oakland County has a Downtown Development Authority (DDA) to promote the revitalization and smart growth of their historic city centers.

Because this scenario is quite stereotypical of American suburbs, it can be attributed to a choice of location and lifestyle. In fact, Rochester and Rochester Hills residents have voted against taxation policies towards the regional bus system and have therefore opted out of its service. At the same time, many Rochester Area residents choose to live where they do because they are drawn to the historic downtown, the parks and schools, and the nearby amenities and attractions. They surely do not choose to live in the area so that their method of transportation is restrained to only the car. By understanding that this dependency on cars is a result of 80 years of unregulated sprawling growth, this scenario can also be attributed to an antiquated style of urban development. The situation in Rochester is a microcosm of suburban sprawl issues across the United States and the world.
The specific project site is located just several hundred feet from all the shops and restaurants on Rochester's Main Street. In the northeastern quadrant of the city's major intersection (Main Street & University Drive) lies an interesting build context which includes the Rochester Post Office, the Rochester Hills Public Library, and a diverse mix of small shops and restaurants. This entire quadrant - encompassed by Main Street, University Drive, and Paint Creek - will be the site of the proposed transit center. Within it is the only section of rail right-of-way that has been developed over: Near Main Street there has been recent on-street retail infill, and several parking lots have been developed over the right-of-way to accommodate the surrounding businesses.

The site is mostly access roads and parking lots, which offers a nearly blank canvas adjacent to Rochester's most significant civic buildings, as well as two of its
most prominent historic buildings: an early 20th century train station a late 19th century grain elevator at the intersection of the old tracks and University Drive. Rochester Train Depot, now a small gift shop, served as the city’s train station for 60 years. The Rochester Elevator, just recently repainted, is a testament to the area’s agricultural roots. The railroad tracks were removed during the 1980s, but the diagonal alignment of the buildings serves as a reminder of their original purposes.
Over the last century, the alignments of Paint Creek and the Clinton River have been periodically changed in order to power mills, control flooding, and increase developable land. After torrential rains caused the Western Knitting Mills dam to flood in the 1940s, the mill pond was filled in. Paint Creek would not follow its original path, so it was channeled in its present right-angle form (Remembering Rochester). The site now contains the public library, the post office, The Royal Park Hotel, and a senior living center.
Looking west on Paint Creek. The Main Street Bridge was replaced in 2012.

Looking south at the grain elevator and the depot.
DESIGN PROCESS ANALYSIS

Transit for Today's Needs

Downtown Rochester was once a hub of commerce and transportation that succeeded because it was a center of trade, a meeting place, and a junction between towns across the region. Accessible multi-modal transportation in Rochester today would create a similar, yet new paradigm in urban growth across Metro Detroit. Using principles of transit-oriented design (TOD), Rochester's new station would spur denser, more walkable developments around historic Main Street. As a result, residents would be able to enjoy a wider variety of employment, shopping, and entertainment. As an initial framework, the transit system would reformulate traditional patterns of suburban development by using denser commercial, industrial, and municipal growth to promote a more vibrant, sustainable Rochester.

In the surrounding areas of Rochester Hills, new zoning ordinances could be created to limit new residential development. Any undeveloped land should remain undeveloped or else transformed into recreation or conservation areas. Developable land near downtown Rochester would become more dense to promote a larger population around the central commercial district. As a result, pressure on waterways, ecological habitats, and existing road and utility infrastructures would be lessened.

Rochester's transit hub and bus system routes will be designed very carefully to address the unique characteristics of northern Metro Detroit. This new form of public transportation must be sensitive to the needs of people, communities, businesses, and popular destinations while maintaining the overall goal of pioneering sustainable suburban development. Native ecosystems and ecologically-sensitive ideals will help define the opportunities and constraints for Rochester's future growth. Water systems are of particular concern. Polluted sedimentary runoff from vehicular roadways is detrimental to riparian ecosystems and must be cut back by decreasing traffic and better managing stormwater runoff.

Regarding a local transit network, primary bus routes should be designed to create major, frequent connections between Downtown Rochester, Oakland University, and Downtown Auburn Hills. Rochester and Auburn Hills are currently linked by the Clinton River Trail, an old rail bed that will lend part of its right-of-way to the elevated regional rail system. Oakland University is three miles west of Rochester and three miles north of Downtown Auburn Hills, making it an interesting halfway point to capitalize on more dense campus development in the future. These three destinations would likely make up the most prominent cultural destinations for transit in Rochester Hills.
It is all too evident that spaces have been designed for cars more than they have been for pedestrians. A less car-dependent society could change this and transform "parking lot" into "town square".

Paint Creek has seen different alignments several times during its history of human interaction. Reconfiguring the course of the stream could provide opportunity to restore the streambed and transform the "backyard" creek into an exciting focal point.
Opportunities & Constraints
Successful Alternative Transportation Planning

In the City of Zurich, Switzerland, one of the world’s wealthiest communities, the car has become the minority mode of transit. “More city residents own public transport passes than cars” (Mees 49). Almost two-thirds of the work trips in 2000 were by public transport, and only one-quarter were by car or some other personal vehicle. Mees observes,

Zurich has avoided two extremes. Many cities that built metros have concentrated high service levels on the metro lines, leaving passengers wishing to reach locations that are not on the metro with an infrequent and unattractive service. By contrast, Zurich offers high frequencies and reliable services on all corridors, cross-city as well as radial, with multi-modal fares and excellent facilities easing transfers between routes. Zurich has also avoided the other extreme of a bewildering and inefficient array of low-quality routes... Bus routes serving city and suburban areas beyond the tram system terminate at tram interchanges or railway stations, and generally do not enter the city center. Passengers must transfer to complete their journeys... the economical densities of patronage this practice creates allow trams to cross-subsidize buses, ensuring high service levels all round – as well as keeping the city center free of congestion from buses. (132)

Commuter rail is typically more successful in Europe and Asia where cities grew and aged densely before the automobile promoted an unsustainable, sprawling urban infrastructure. European and Asian cities have different urban characteristics and economic trends than younger auto-dependent cities like Detroit, and generally have not had the challenge of convincing such large percentages of their population to limit automobile usage. Therefore, it will be most relevant to this proposal to study successful TOD in New World cities that sprawled with the automobile.

In the United States, New York City, Boston, Philadelphia, and Chicago all have comprehensive rail transit systems, but by today’s standards, they are old. Cities like San Francisco and Atlanta have newer systems, but they do not serve the whole region the way the Washington Metro does. According to Jonathan Barnett, “The Washington D.C. metropolitan area transit system is the most comprehensive new rail transit system in the United States” (55).

In Canada, Ottawa is a public transport success because of its adoption of bus rapid transit (BRT). The system includes bus lanes that are exclusive for buses, most of which are at different elevations than auto traffic. However, some of the BRT-serviced areas are being transformed for light rail to great region-wide network planning (Mees 116). Toronto is another great example for successful transit. Though it has a comparatively small rail system, Toronto’s train network excels by using buses to extend its reach.

Because of the economical densities of patronage generated by the feeder bus network, the Toronto subway returned an operating surplus, which helped defray the loss incurred by the buses. (93)
This precedent shows how

Combining radial and cross-city travel on a single bus network produced high occupancy rates, resulting in relatively low subsidies, and greenhouse emissions, per passenger. (94)

The Toronto Transit Commission (TTC) succeeded by enabling a high rate of bus-to-bus transferring, meaning that the bus lines do not only feed the rail system, they feed each other, which promotes cross-suburban travel by bus.

Transfers are free because the fare system is fully multi-modal, and at most subway stations passengers proceed directly between buses and trains without the inconvenience and delay of ticket checking. These 'free-body transfers' are possible because buses, and even trams, enter the station precinct on specially designed roadways, placing the whole bus-rail interchange inside the station fare gates. (94)

“Bus-to-bus transfers are encouraged by physical design” because stops are located at intersections where routes cross. Though stopping buses block a lane of traffic, the TTC can justify themselves by noting that buses carry many more passengers than cars.

In South America, Brazil has been under the global transit spotlight for the success of Curitiba in the state of Paraná. BRT is routed in the center lanes of highways, with barrier walls along their sides to ensure that no other traffic can interfere with moving bus traffic. Stops are located at about every quarter-mile. The system features express routes and extra-large bi-articulated buses. Innovatively designed “boarding tube” stations pull riders up to the level of the bus, which allows the Curitiba bus system to mimic the seamlessness of a metro train service. Riders pay at the station, not on the bus, so waiting time during boarding is much lower. However, congestion is an increasing problem. Curitiba’s buses are currently the predominant mode of transport, with few other medium- to-heavy capacity modes for support. Rail will be necessary to replace the busiest BRT routes over the coming years (Mees 118).

Transit-Oriented Development Case Studies

Before applying transit-oriented development to Metro Detroit, designers and planners must understand how different types of TODs are successful and unsuccessful on the urban design level. The success of a TOD is ultimately found in how well it caters to transit riders and the people who choose to shop, work, and live there – not just by how well planning and legislation strategies have worked. In their article, Seven American TODs” Justin Jacobson and Ann Forsyth observe,

TOD projects depend on good urban design to coordinate transportation types, mix land uses, and create an appealing public space, all in a limited area. Scholarly attention, however, has been largely focused on the public policy aspects of TOD development such as planning strategies and financing options. (51)
For the purposes of this proposal, urban design can be defined as "the design of the built environment beyond the scale of the building, typically focusing on blocks, neighborhoods, or districts." Good urban design allows communities to achieve true balance. "Good intentions with poor design execution can wind up being no improvement, or possibly even a detriment, to the central city or suburban surroundings" (54). Exploring different urban design qualities of TOD reveals the best practices of site-level details used to implement appropriate solutions to future developments.

Case Study #1: Rosslyn Ballston Corridor [Washington, D.C.]

The Washington Metro is one of the United States' most successful commuter rail networks. Planners located Metro stations in market areas that were already independently attractive for development. This has helped develop nearby cities in Maryland (New Carrollton) and Virginia (Arlington County). Arlington is particularly interesting because it has created hubs around its transit stations, including the recent development of a major retail center.

Unfortunately, the Metro system was not designed well for commuting between the metropolitan suburbs, unless such a commute would take someone through the congested District of Columbia. As a result, the metro system has not eliminated most sprawl and traffic problems within the community.

Washington Metro's Orange Line runs west-southwest out of the District of Columbia through Arlington County, home to the Rosslyn Ballston Corridor. Located less than two miles west of DC, Rosslyn station acts as the Arlington's gateway at
the Potomac River. Clarendon, one mile southwest of Rosslyn, was envisioned as an urban village in 1984, yet it maintained its characteristic residential neighborhood. Ballston, another mile southwest of Clarendon, is home to significant mixed-use office and retail areas, plus a wide array of housing options.

The corridor "illustrates how TOD can accommodate tremendous development in a livable community that provides benefits to both new and existing residents" (US EPA 2). Thirty years ago, most of the corridor was a declining, low-density commercial area. Instead of letting it slip further into disrepair, planners decided to focus development around five closely spaced rail stations. Since then, enormous amounts of development have been accomplished, while single-family neighborhoods have remarkably been preserved just a short walk away. Overall benefits along the corridor have been extraordinary. The value of land around stations increased by about 81% in ten years, and 8% of county land now generates 33% of county revenues, which allows Arlington to have the lowest property taxes in Northern Virginia. Approximately 50% of residents currently take transit to work, and 73% of those residents walk to the stations (US EPA 2).

Ballston and Clarendon are interesting case studies because they are more suburban areas of the corridor. The two districts might be comparable to Pontiac and Rochester, Michigan, in that Ballston was once the "downtown" of Arlington County and Clarendon is a neighboring "urban village". Ballston today has major office developments that tend to crowd out less-profitable land uses. Small businesses and apartments are at risk of being priced out of the area, which creates tension. Clarendon, on the other hand, has struggled between replicating its neighbors and emphasizing a smaller, human scale. The village has incorporated intricate facades and decorative paving to enhance its small business and single-family character. With space left to develop, Clarendon is at risk of losing its smaller character due to future economic prospects (Jacobson 64-5).

Further examination of the Rosslyn Ballston Corridor will be very useful as urban design precedents for this proposal. Understanding how sensitive development relates to transit stops will shed light on how transit-based growth can be achieved while preserving historic character.
Case Study #2: Delmar Loop  [St. Louis]

The Saint Louis MetroLink is a newer light rail transit (LRT) system that served as a catalyst for transit-oriented development in several stagnant neighborhood districts around St. Louis. Delmar Loop, about five miles northwest of downtown St. Louis, was “surviving but not thriving” when the MetroLink began operating there in the mid 1990s. TOD was used to preserve and extend existing commercial activity across municipal borders from St. Louis proper, which in turn boosted economic development in Delmar. The exemplary quality of the Delmar Loop area is that transit there “was used to enhance and augment pre-existing development.” MetroLink was built on an old railroad corridor, which locked the station location right next to the main commercial strip. There is some “mismatch” between the station and the development area, but distance is not a problem (Jacobson 65-6).

The greatest challenge with this district is how to integrate it within the entire neighborhood. Wide cross-streets have not been addressed well and present a safety issue. To encourage better pedestrian access, streetscape renovations and efforts to use common signage throughout the area have been implemented. Aesthetic and functional improvements include wider sidewalks, newly installed landscaping, the use of decorative pavement, and also public art displays, which have helped to create a new theme for the neighborhood (66).

TOD in the Delmar Loop presents a lucid precedent for urban design in this proposal. The way that function and aesthetics play roles in successfully enhancing Delmar’s pre-existing development offers a lesson that will be extremely useful in Metro Detroit’s historic downtowns.
Fruitvale, less than two miles southeast of Oakland, California, is historically one of Oakland’s poorest neighborhoods. The central district is in progress of being significantly revitalized as a direct result of its agreement with Bay Area Rapid Transit (BART), the regional rail system. In the early 1990s, BART planners proposed to add extra parking to increase the number of park-and-ride commuters, but residents “feared that giving over more land for parking would detract from the commercial and residential potential of the area” (Jacobson 68). The Latino community, specifically, worried that extra parking areas would push the already distressed neighborhoods into further decline (US EPA 6). BART withdrew its plans and worked on an alternative with community councils.

Today, the Fruitvale “transit village” links the commercial center and BART station to a mixed-use center of small-scale retail and apartments. The primary pedestrian corridor includes shop-lined plazas, offices, apartments and municipal services. Remarkably, the village includes a health clinic, a child development center, a senior center, and the community library. Design features that help attract people to the district include, ample seating, outdoor tables for dining, and landscape planter boxes. Housing surrounds the edge of the development and is also included above shops in the village center (Jacobson 69).

Fruitvale’s greatest challenge lies in a design flaw that has limited accessibility between BART users and the Fruitvale Transit Village. Unfortunately, the parking lots and bus bays were located on opposite sides of the station from the village, physically separating park-and-ride commuters from the retail portion of the project. Additionally, housing construction has been much slower than planned, which haltered possibilities of quicker economic growth (69).

Further studies of the Fruitvale Transit Village will be very useful as urban
design precedents during this project. It is important to understand how to direct pedestrian traffic to influence the economic sustainability of the transit district. Furthermore, this case shows that it is very meaningful to incorporate community participation and human services in the vision for implementing TOD.

**Principles for Planning Successful TOD & Urban Design**

**Processes**
1: Strong planning and development take a long time to appear on the street level.
2: Engage the public and experts as collaborators and work with activist energy.
3: Program spaces for uses during different times.
4: Invest in the long-term maintenance of spaces, paths, and trails.

**Places**
5: Design at a human scale so that pedestrians are engaged in their surroundings.
6: Provide public spaces that accommodate a variety of uses and users.
7: Use design and programming strategies to increase safety.
8: Allow for variety and complexity for an eclectic sense of place.
9: Create connections between spaces.

**Facilities**
10: Design sidewalks and crosswalks for appropriate, active pedestrian use.
11: Integrate complicated transit and transit facilities into the urban pattern.
12: Respect and Plan for car movement and car parking, but do not encourage it.

(Jacobson 72-82)
**Cheap & Simple.** All infill is arranged to fit best into the surrounding context. Very little is torn down or removed, leaving disjointed pedestrian spaces.

**Clean Slate.** Non-contributing buildings are torn down to create room for more dense and vibrant infill options, including a large park-like area.

**Ecological Focus.** Paint Creek is restored to a more natural course and integrated with the infill opportunities throughout the site.
Preliminary Plan. Paint Creek is brought to the library's front doors and adorned with constructed wetlands and native plantings. As visitors walk between the station and the library, they experience an immersive relationship to Rochester's ecology coupled with vibrant pedestrian activities.
**Organic Geometries.** Edges found in nature inspire a new take on traditional hard shapes in built forms.

**Gateway & Enclosure.** Entryways and pathways enhance site characteristics with simple and elegant placemaking capabilities.
The elevated railway sets a canopy over businesses, markets, the bustle of daily life, and recreational opportunities. An arcade lined with shops welcomes pedestrians off of the intersection of Main & University. Between the arcade and station is a plaza with space for vendors, seating, and plantings. University Drive is enhanced with a median and bicycle lanes to become a tree-lined boulevard.

The station is modified to provide parking for six city buses. The bus drive doubles as the post office service drive, remaining separate from major pedestrian spaces yet vital to the function of the buildings on site. The addition of a grocery store compliments the adjacent plaza that is programmed for the weekend farmers’ market. Flexible retail and office space provides potential for a vibrant array of employment opportunities and services within the transit district, boulevard.
DESIGN DESIGN PROCESS

SITE CHARACTERISTICS

Station Ticket Entry
Dubai, UAE

Elevated Boarding Platform
Dubai, UAE

Raised Railbed as Gateway
Paris, France

Bus Loop and Service Drive
Berlin, Germany

Vibrant Lighting
Tallinn, Estonia
Patterned Brick Pavers
Pompeii, Italy

Boulevard & Bike Lanes
Paris, France

Native Plantings
Paris, France

Trees as Garden Accent
Shanghai, China

Constructed Wetlands
Seattle, WA
CONCLUSION

Metro Detroit could address major issues in environmental, social, and economic health simply by meeting the region’s need for public transportation. In this sense, it is possible to address multiple issues of sustainability with one agenda.

Much of the world’s air and water pollution comes from fuel stations and cars themselves. However, a greater amount of pollutants, including sediments, results from destroyed native ecosystems and the engineered, unnatural stormwater management systems that roadways and parking lots require. Ultimately, these pollutants affect the health of all life on Earth, and may be more responsible for more human diseases than we know. In order to relieve our ecosystems from these pressures, we must adopt an alternative to automobile-based development as soon as possible.

This proposal acknowledges that there are many different alternatives to contemporary automobiles. However, public transportation is acclaimed as the most beneficial. In order to protect and preserve regional ecological resources, Metro Detroit must limit sprawl and plan for more dense communities. By lessening regional dependence on an ever-expanding infrastructure for automobiles, land can be protected for smarter uses, including conservation and preservation. Lower car use across the region will promote lower amounts of pollution in the air, soil, and water. In the long run, transferring sprawling growth on the suburban fringe to dense growth in urban cores will help spur the revitalization of struggling cities like Detroit, Pontiac, Mt. Clemens, and Flint, among others.

The greatest challenge for Metro Detroit’s transportation efforts in the future will be to promote equity and social inclusion within a diversified, expanded suburban transit network. Auto dependency must be lowered to balance transport systems, land use needs to be improved for greater accessibility, and travel needs to become more affordable for the disadvantaged. Because these issues are complex, and because historic race and class issues are still largely unresolved throughout the metropolitan environment, solutions will take much time and care to be successful. Under the weight of imminent bankruptcy, Detroit must lift itself from the fear of failure and focus instead on the prospects of opportunity. The time has come for the city that taught the world to drive to learn how to embrace and protect public transportation as a way to not only promote regional economic development, but as a guiding factor for social equity and environmental change. Through sustainably effective, coordinated, multimodal transportation, Detroit could have the chance to achieve regional connectivity and increased opportunities for all people.

This proposal offers multi-modal public transportation, coupled with specialized development to cater to it, as the best way to promote a smart metro political future. Contrary to popular belief, it is possible to implement public transportation in low-density suburbs, provided that regulations and policies are adopted to ensure its successful planning and management. This new paradigm in transport would offer Metro Detroit residents with access to more jobs and the opportunity to live and work in more vibrant downtown districts. A high-speed,
metropolitan commuter rail system would promote connections between historic downtowns. In this sense, sustainable TOD would pay homage to the rail system that built Metro Detroit before the car did. Furthermore, an extensive metropolitan bus network would serve to connect neighborhoods to downtowns, where walking, cycling, and ride-sharing would become more habitual forms of metropolitan transport.

This project aims to show how a new paradigm in metropolitan transportation might successfully function in a historic suburban downtown. If a regional goal of public transportation is adopted, transit-oriented development (TOD) principles could revitalize many historic downtowns throughout Metro Detroit, and perhaps even Detroit itself.
APPENDIX A: Ecological & Watershed Characteristics

Since its early days as a French fort in the 1700s, Detroit has experienced a rich, dynamic history that distinguishes it from the other Great Lakes industrial cities. Detroit’s natural ecology and climate, however, have endured characteristic consistencies throughout centuries of human pressures. Apart from cultural factors, ecological features have been the primary factors that have defined the course of human settlement and growth. For this reason, the study of Metro Detroit’s ecology is essential to addressing its development. By no coincidence, all of Detroit’s most populous cities lie within or on the border of the same two EPA (Level III) ecoregions: the Southern Michigan/Northern Indiana Drift Plains (56) and the Huron/Erie Lake Plains (57). These ecoregions are defined by similar biotic and abiotic phenomena that include “geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology” (Ecoregions of Michigan).

Oakland County has 575,360 acres of land and is home to more natural lakes than any other county in the State of Michigan. Altogether, the county holds 1468 lakes and the headwaters of 5 major rivers: the Clinton, Huron, Rouge, Shiawassee, and Flint. The county also contains a diverse array of streams, creeks, gravel pits, wetlands, and ponds. A mixed deciduous and coniferous forest used to cover most of the county, with tree species differing according to upland and lowland conditions. The northwestern portion of Oakland County is defined by more uplands than the rest of the county. As of 1982, woodland covered 27% of the county. The county is home to many whitetail deer, rabbits, squirrels, raccoon, opossum, other small mammals, tree birds, ducks, geese, swans, herons, fish, frogs, toads, turtles, and nonpoisonous snakes. Muskrat, mink, foxes, and coyotes are also present.

Average wind in the region comes from the southwest at an average 8-12 mpg. Summer winds tend to originate more southerly, while faster winter winds tend to originate more westerly (Soil Survey).

TODAY’S URBAN DEVELOPMENT HARMS OUR WATERSHEDS

Our waterways:
- Naturally control flooding (storage and slow release)
- Maintain water supplies
- Trap excess sediment
- Cleanse & transform nutrients
- Recycle organic matter
- Maintain biological diversity

Converting natural landscapes to urban surfaces makes the earth's surface less permeable, making stormwater infiltration less possible. Due to the large proportions
of urban surfaces in Wayne, Macomb, and Oakland Counties, rainwater reaches waterbodies more frequently with a greater volume of runoff. As a result, stormwater flows faster in developed areas than in non-developed areas. In addition, drainage canals, culverts, storm sewers, and engineered shorelines have altered natural waterway functions in an attempt to control water removal and prevent flooding. Many of the naturally occurring bends in creeks and streams have been straightened, resulting in faster, more powerful water flow, which intensifies erosion and increases sedimentation. This increased flow also increases the amount of surface sediments and pollutants that are carried straight into our waterways. Other negative impacts of channeled waterways include increased water temperature and the depletion of dissolved oxygen, qualities that are necessary for the health of native organisms (Clinton Main).

POLLUTANTS HARM OUR WATERSHEDS

In 2000, the Clinton River Public Advisory Council claimed stormwater runoff as its most important pollution issue today “as it carries pollutants from impervious surfaces and exacerbates erosion and sedimentation problems” (Clinton Main).

- Non-Point Source Pollution
Nutrients, sediments, organic chemicals, and heavy metals have negative effects on our waterways when they accumulate in excess. However, these pollutants do not always have a single point of origin and are therefore difficult to regulate. Non-point source pollutants can disrupt aquatic organism physiology and accumulate in the fatty tissues of fish and other organisms.

    The primary nutrient of concern is phosphorus (from detergents, fertilizers, animal waste, yard clippings, and soil erosion) because it causes aquatic plants to grow out of control and promotes aggressive algae blooms, throwing aquatic systems out of balance. Sediments, including roadway runoff and road salt, are dangerous because they can physically harm marine organisms and block sunlight from marine ecosystems. Auto-related sediments that are of particular concern are polychlorinated biphenyls (PCBs) and petroleum hydrocarbons, which come from lubricants, oils, and gasoline.

    A common source of organic chemical pollutants is automobile fluids like gasoline and lubricating oils. Heavy metals like lead, copper, mercury, zinc, chromium, and cadmium (Pb, Cu, Hg, Zn, Cr, and Cd, respectively) often come as by-products of manufacturing, agricultural, and road surface runoff, as well as from airborne exhaust particulates that deposit in waterways.

- Point Source Pollution
Point source pollutants, which are discernibly confined, are less of an issue today since the Environmental Protection Agency (EPA) has enforced strict regulations on all industrial origins, an effort that began with the 1972 Clean Water Act. However, there
are still point sources that have been more difficult to regulate, including an endless fleet of motorized vehicles, runoff from roadway construction and maintenance, and fuel station runoff.

A CALL FOR CHANGE

Pollution caused by poor development patterns does not only affect our waterways and natural ecosystems. It also affects us by contaminating the very water we use for drinking, bathing, and recreation. It is time to see the health of our ecosystems as a direct reflection of our health as a society. After all, humans do not live outside of the environment. They are an integral part of it. We must not consider ourselves a dominant force over natural systems. It is our ecosystems — not our civil constructions — that provide us with the basic essentials for life. Nothing we build can replace that.

In addition to a multitude of ecological issues, automobile pollution has caused direct problems in human health, like respiratory diseases and cancers. In fact, many of the compounds in car exhaust are also found in cigarette smoke (Macnair). Nevertheless, while cigarette smoking is strictly regulated in many American cities, depending on cars is socially acceptable, promoted, and encouraged. Starting today — actually, yesterday — we can no longer tolerate such environmentally irresponsible development. We must create new systems of living, commerce, agriculture, industry, and transportation that exist harmoniously within the natural environment. Our future depends on it.

A NEW MODE OF TRANSPORTATION WILL HELP

In suburban Metro Detroit, roadways (not including parking lots) commonly use around 10% of the city’s entire land area. Therefore, automobile-related development alone is responsible for the eradication of more than a tenth of what was once congruent native vegetation and wildlife habitat. Still, the increasing Southeast Michigan population will continue to demand wider roads and new neighborhood development. The combination of more impervious surfaces with ongoing poor stormwater management practices will pose serious implications on the future health of our communities as our population continues to grow in an irresponsible fashion.

CLINTON RIVER WATERSHED PROFILE

The following information has been provided by existing studies and field data collection supplied by the Clinton River Watershed Council. This information includes community land use and planning statistics as well as landscape characteristics, such as wetlands, ecoregions, soil types, and water qualities.
The Clinton River Watershed is one of 5 watersheds in Oakland County. The City of Rochester Hills is mostly within the Clinton Watershed, but the community also contains a small portion of the Rouge Watershed in its southwestern corner. Likewise, the City of Rochester is completely within the Clinton River Watershed. Therefore, the hydrological portion of this project will focus mainly on the Clinton Watershed. The watershed is made up of seven subwatersheds, and Rochester and Rochester Hills contain parts of three of them: the Clinton Main, the Paint Creek, the Stony Creek, and the Red Run. The watershed council recognizes the Paint Creek and Stony Creek as one statistical subwatershed.

**LAND USE:**

<table>
<thead>
<tr>
<th></th>
<th>Clinton Main</th>
<th>Paint &amp; Stony</th>
<th>Red Run</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Family</td>
<td>27%</td>
<td>~36%</td>
<td>~47%</td>
</tr>
<tr>
<td>Industry/Commercial/Office</td>
<td>15%</td>
<td>15%</td>
<td>19%</td>
</tr>
<tr>
<td>Vacant Land</td>
<td>12%</td>
<td>20%</td>
<td>~5%</td>
</tr>
<tr>
<td>Road Right-of-Way</td>
<td>13%</td>
<td>~10%</td>
<td>~11%</td>
</tr>
<tr>
<td>Recreation/Conservation</td>
<td>8%</td>
<td>13%</td>
<td>6%</td>
</tr>
<tr>
<td>Public/Institutional</td>
<td>8%</td>
<td>N/A</td>
<td>6%</td>
</tr>
<tr>
<td>Multiple Family</td>
<td>4%</td>
<td>N/A</td>
<td>4%</td>
</tr>
<tr>
<td>Agricultural or Other</td>
<td>3%</td>
<td>6%</td>
<td>1%</td>
</tr>
<tr>
<td>Rail Right-of-Way-</td>
<td>&lt;1%</td>
<td>&lt;1%</td>
<td>1%</td>
</tr>
</tbody>
</table>

(Percentage of Clinton River Watershed)

<table>
<thead>
<tr>
<th></th>
<th>Clinton Main</th>
<th>Paint &amp; Stony</th>
<th>Red Run</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Pollutant Load:</td>
<td>15.2%</td>
<td>9.6%</td>
<td>22.1%</td>
</tr>
<tr>
<td>Sediment</td>
<td>24.3%</td>
<td>4.9%</td>
<td>19.8%</td>
</tr>
</tbody>
</table>

(over 46,000 tons in a year)

Rochester Hills touches more subwatersheds than any other community in the subwatershed: the Clinton Main, the Paint Creek, the Stony Creek, The Red Run, and also a portion of the River Rouge Watershed in its southwest corner. The Red Run, Clinton East, and North Branch Subwatersheds are the most polluted subwatersheds due to agricultural and industrial non-point source runoff, plus the accumulation of pollutants from upstream.

The Paint and Stony Creek Subwatershed

This subwatershed is the least developed in the Clinton River Watershed and is therefore the cleanest. It has only recently begun to show signs of impairment. According to the Stony/Paint Creeks Subwatershed Plan, "Preserving a creek is much easier than trying to restore it once it has been degraded". It is imperative that this subwatershed be protected from further suburban sprawl. "As development continues to advance northward, hydrologic alteration of Stony and Paint Creeks will continue unless steps are taken to protect the natural ability of the land to absorb precipitation" (90). Paint Creek is surrounded by more densely developed land than
Stony Creek, causing most of its quality test locations to be in worse conditions (more poor & fair ratings) than Stony Creek (more good & excellent ratings). These ratings include marine life observations as well as pollutant measurements.

From 2000-2030, Oakland and Macomb Counties' less-developed township populations were expected to increase from 17-100% (Brandon, Oxford, Bruce, Addison, Independence, Orion, Oakland, and Washington Townships). During the same period, populations in Villages and mostly-developed cities (Oxford, Lake Orion, Auburn Hills, Rochester Hills, and Rochester) were projected to grow 0–7%, even though 5–12% of their land was vacant. Surprisingly, these plateauing populations may still see a significantly larger increase in housing units as the number of people living in the average household continues to decrease (Stony/Paint).

The Clinton Main Subwatershed

From 2000-2030, the only populations within this subwatershed that were expected to increase by more than 15%, were Oakland Township (100% growth) and Orion Township (33% growth). The growth in this entire subwatershed could stand to be greater without being detrimental to the environment since its communities, namely Pontiac and Downtown Auburn Hills, possess a more appropriate infrastructure for a larger, denser population (Clinton Main).

The Red Run

This subwatershed is the most historically developed in the Clinton River Watershed. It is home to the most dense residential areas within Rochester Hills. The entire subwatershed has been an area of concern for decades, due in part to unregulated practices during much of the last century. In fact, by the 1940s, the Red Run’s once diverse community of aquatic mussels had been eradicated. Although the 1972 Clean Water Act has strictly regulated all point source industrial waste within the Clinton River Watershed, levels of heavy metals and organic chemicals increased in the Red Run between the 1980s and 1990s. This statistic is more than likely attributable to non-point source pollution (Red Run).

From 2000-2030, the only community populations within the Red Run Subwatershed that are expected to increase by more than 5% are Rochester Hills, Shelby Township, and Clinton Township. The cities of Warren, Troy, Ferndale, Clawson, Royal Oak, and Birmingham are expected to lose from 4–19% in the same time period. This loss of population could help to ease pressures on the Red Run Subwatershed, but it could cause just as much harm if the majority of that population chooses to settle on currently undeveloped land.
NON-POINT SOURCE POLLUTANTS in the Clinton River Watershed

“Overall, the delineated basins within the Main Branch of the Clinton River are somewhere between a rural and an urban watershed. However, most of the values of the pollutant loadings more closely resemble the loadings produced from a highly urban basin” (Clinton Main 65). Highways are the third greatest source of Total Suspended Solids (sediments and other pollutants) after industrial and agricultural sources. Highways are also the third highest source of phosphorous runoff after low and medium density residential areas (likely fertilizer applications). Highways are also comparatively large sources of copper runoff.

Of these four subwatersheds, Stony Creek has the least non-point pollution, followed by Paint Creek. These two creeks actually resemble rural conditions, and the most critical areas within them are the lands that include or are immediately adjacent to streams. The Clinton Main Subwatershed is affected by more non-point source pollutants, but not quite as much as The Red Run Subwatershed. The Red Run resembles urban conditions, and shows 3 to 6 times as many pollutants as Stony Creek in each category.

THREATENED NATIVE VEGETATION
in the Clinton Main [C), Paint & Stony [PS], and Red Run [RR] Subwatersheds

Dozens of plants that are native to the three subwatersheds are at risk of losing suitable habitat. As more native plants disappear, more native primary consumers, including insects, marine life, and mammals, will begin to disappear. Such disappearances will result in low food sources for fish, birds, and larger mammals, which can cause native wildlife populations to further diminish. These plants are also specially adapted to the water conditions of our region, meaning that they have the ability to take up more water than many non-native plants used for landscaping. We must start planning to prevent the loss of these plants before the resulting problems become more pronounced than they already are.

[E] Endangered Plants
C/PS/RR Agalinis gattingeri Gattinger’s Gerardia
PS Castanea dentata American Chestnut
C Epioblasma triquetra Snuffbox
C/PS/RR Gentiana puberulenta Downy Gentian
### State Special Concern Plants

<table>
<thead>
<tr>
<th>Group</th>
<th>Species Name</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>C/PS</td>
<td>Amorpha canascens</td>
<td>Leadplant</td>
</tr>
<tr>
<td>C/PS/RR</td>
<td>Angelica venenosa</td>
<td>Hairy Angelica</td>
</tr>
<tr>
<td>C/PS/RR</td>
<td>Arabis missouriensis var. deamii</td>
<td>Missouri Rock-cress</td>
</tr>
<tr>
<td>PS</td>
<td>Calephelis mutica</td>
<td>Swamp Metalmark</td>
</tr>
<tr>
<td>C/PS/RR</td>
<td>Carex richardsonii</td>
<td>Richardson's Sedge</td>
</tr>
<tr>
<td>C/PS/RR</td>
<td>Cirsium hillii</td>
<td>Hill's Thistle</td>
</tr>
<tr>
<td>RR</td>
<td>Euonymus atropurpurea</td>
<td>Wahoo</td>
</tr>
<tr>
<td>C</td>
<td>Gymnocladus dioicus</td>
<td>Kentucky Coffeetree</td>
</tr>
<tr>
<td>SC</td>
<td>Hibiscus moscheutos</td>
<td>Swamp Rose-mallow</td>
</tr>
<tr>
<td>C/PS</td>
<td>Hieracium paniculatum</td>
<td>Panicled Hawkweed</td>
</tr>
<tr>
<td>PS</td>
<td>Linum sulcatum</td>
<td>Furrowed Flax</td>
</tr>
<tr>
<td>RR</td>
<td>Penstemon pallidus</td>
<td>Pale Beard Tongue</td>
</tr>
<tr>
<td>C/PS/RR</td>
<td>Scirpus clintonii</td>
<td>Clinton's Bulrush</td>
</tr>
<tr>
<td>RR</td>
<td>Scleria triglomerata</td>
<td>Tall Nut-rush</td>
</tr>
<tr>
<td>RR</td>
<td>Smilax herbacea</td>
<td>Smooth Carrion-flower</td>
</tr>
</tbody>
</table>

### Threatened Plants

<table>
<thead>
<tr>
<th>Group</th>
<th>Species Name</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>RR</td>
<td>Aristolochia serpentaria</td>
<td>Virginia Snakeroot</td>
</tr>
<tr>
<td>RR</td>
<td>Asclepias sullivantii</td>
<td>Sullivant's Milkweed</td>
</tr>
<tr>
<td>C</td>
<td>Astragalus Canadensis</td>
<td>Canadian Milk-vetch</td>
</tr>
<tr>
<td>C/PS</td>
<td>Bouteloua curtipendula</td>
<td>Side-oats Grama</td>
</tr>
<tr>
<td>C/RR</td>
<td>Carex lупuliformis</td>
<td>False Hop Sedge</td>
</tr>
<tr>
<td>PS</td>
<td>Cyripedium candidum</td>
<td>White Lady-Slipper</td>
</tr>
<tr>
<td>PS</td>
<td>Fuirena squarrosa</td>
<td>Umbrella-Grass</td>
</tr>
<tr>
<td>C/PS/RR</td>
<td>Galearis spectabilis</td>
<td>Showy Orchid</td>
</tr>
<tr>
<td>C/PS/RR</td>
<td>Gentianella quinquefolia</td>
<td>Stiff Gentian</td>
</tr>
<tr>
<td>C/PS/RR</td>
<td>Hydrastis canadensis</td>
<td>Goldenseal</td>
</tr>
<tr>
<td>C/PS</td>
<td>Linum virginianum</td>
<td>Virginia Flax</td>
</tr>
<tr>
<td>PS</td>
<td>Panax quinquefolia</td>
<td>Ginseng</td>
</tr>
<tr>
<td>RR</td>
<td>Trillium recurvatum</td>
<td>Prairie Trillium</td>
</tr>
<tr>
<td>PS</td>
<td>Platanthera ciliaris</td>
<td>Orange/Yellow Fringed Orchid</td>
</tr>
<tr>
<td>PS</td>
<td>Psilocrarya scirpoides</td>
<td>Bald-Rush</td>
</tr>
<tr>
<td>C</td>
<td>Trichostema cichotomum</td>
<td>Bastard Pennyroyal</td>
</tr>
<tr>
<td>PS</td>
<td>Trillium sessile</td>
<td>Toadshade</td>
</tr>
<tr>
<td>C/PS</td>
<td>Valeriana edulis var. ciliata</td>
<td>Edible Valerian</td>
</tr>
<tr>
<td>PS</td>
<td>Viola pendatifida</td>
<td>Prairie Birdfoot Violet</td>
</tr>
</tbody>
</table>

### Extirpated from Watershed

<table>
<thead>
<tr>
<th>Group</th>
<th>Species Name</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Cyperus acuminatus</td>
<td>Nut-grass</td>
</tr>
<tr>
<td>RR</td>
<td>Liatris squarrosa</td>
<td>Blazing-star</td>
</tr>
</tbody>
</table>
TAKING ACTION

In most communities’ current master plans, including Rochester’s and Rochester Hills’, the only proposed treatment of pollution in the watersheds is the future minimization of impervious surfaces. This does very little to prevent impervious construction when new roads, sidewalks, parking lots, and buildings are currently in demand across the growing metropolitan area. Although these developments can all be designed to be “green”, very few include pervious materials or on-site water retention to aid in the cause. The “preservation” and “protection” of natural features is only one small step in treating over a century of environmentally hazardous practices. Many community master plans have never even established an ordinance or guideline to promote the implementation of native vegetation. Stormwater regulations are not implemented nearly as much as they need to be.

In order to protect and preserve regional water resources, the goals for Metro Detroit’s future development must include:

- The elimination of further sprawl and the limiting of of limits on new or widened road infrastructure.
- The planning and implementation of more dense communities.
- The preservation of undeveloped land and the revitalization of natural ecosystems to allow for more pervious land.
- A lower amount of automobile use to decrease car-related sediments, organic chemicals, and heavy metals in stormwater runoff.
- The implementation of better stormwater management systems across the region.
- Regulations that enforce and reward the on-site collection and cleansing of stormwater within new and existing developments.

The majority of these goals can be achieved by implementing an alternative system of transportation. In this sense, by addressing the health of our ecosystems and meeting the region’s need for public transportation, we can address multiple issues with one agenda.
IMPERVIOUS LAND PERCENTAGE
WITHIN THE CLINTON RIVER WATERSHED

Rail-Based Dense Growth Alternative

PERCENT IMPERVIOUS (National Land Cover Database) 2008

- 0%
- 1%–10%
- 10%–20%
- 20%–30%
- 30%–40%
- 40%–50%
- 50%–60%
- 60%–70%
- 70%–80%
- 80%–90%
- 90%–100%

SCALE: 1" = 8 miles
NATIVE LANDSCAPES
WITHIN THE CLINTON RIVER WATERSHED

- Subwatershed Boundaries
- Aspen-Birch forest
- Beech-Sugar maple
- Black ash swamp
- Black oak barren
- Cedar swamp
- Grassland
- Hemlock-White pine
- Lake/River
- Conifer swamp
- Hardwood swamp
- Oak forest
- Oak savanna
- Muskeg/Bog
- Oak-Hickory forest
- Oak/Pine barrens
- Sand dune
- Emergent marsh
- Spruce-Fir-Cedar
- Wet prairie
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   www.bing.com/maps
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REFERENCES


