The Report Committee for Qianying Zhang

Certifies that this is the approved version of the following report:

A Tool for Collective Visioning of Community Sustainability

- Application in the Austin, TX region focusing on transportation

APPROVED BY

SUPERVISING COMMITTEE:

Supervisor: ______________________________

Ming Zhang

____

Robert Paterson

A Tool for Collective Visioning of Community Sustainability

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by

Qianying Zhang, B.E.

Report

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Qianying Zhang, M.S.C.R.P

The University of Texas at Austin, 2013

SUPERVISOR: Ming Zhang

Abstract:

Sustainability has become a universal goal stated by communities and public agencies in visioning their future. However, when it comes to implementing sustainability, stakeholders often confront all sorts of barriers, ranging from different metrics of performance measures to competing local or agency-specific interests. This professional report (PR) introduces a tool developed through the Sustainable Places Project (SPP) for the Austin, TX region for collective visioning and practicing of sustainable development. SPP received a grant support from the federal program “the Partnership for Sustainable Communities”, which was initiated jointly by the US Department of Housing and Urban Development, Department of Transportation, and Environmental Protection Agency in 2009. Under SPP, the Capital Area Texas Sustainability (CATS) Consortium was formed. “Envision Tomorrow plus for Austin” (ET+Austin) is developed as both an analytical tool and a platform for public dialogue among CATS partners.

The PR focuses on the development of transportation modules within ET+Austin.It

first introduces the local setting in which SPP originated. Following the introduction, the PR describes a general policy context concerning sustainability and sustainable transportation. Next, it provides a review of the empirical and analytical context in which the transportation modules of ET+Austinare structured and built. The basis that transportation indicators are selected and grouped is presented in the subsequent section. The implementation of ET+Austin Transportation is illustrated through scenario analyses for four SPP demo sites from four communities in the region; they are Hutto, Elgin, Dripping Spring and Lorkhart. The PR ends with a brief summary and discussion of directions for tool improvements.

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1. INTRODUCTION

In 2009, US Department of Housing and Urban Development, Department of Transportation, and Environment Protection Agency, jointly initiated a program, “the Partnership for Sustainable Communities” for selected communities nationwide to develop partnership among local stakeholders for achieving sustainability.The Partnership has developed six livability principles: (1) provide more transportation choices; (2) promote equitable, affordable housing; (3) enhance economic competitiveness; (4) support existing communities; (5) coordinate and leverage federal policies and investment; and (6) value communities and neighborhood (“Partnership for Sustainable Communities”). Based on the principles, the three federal agencies work to coordinate federal investments on housing, transportation, water, and other infrastructures. Cities of Partner agencies around the country include Denver, CO, Normal, OL, Greensburg, KS, Boston, MA, Minneapolis-St. Paul, MN, Kansas City, MO, Hudson/Bergen, NJ, Redmond, WA, Ranson/Charles Town, MV, Cinncinatti, OH, Wellprint, WA, Montgomery, AL, Bridgeport, CT, Los Angeles, CA, New Orleans, LA, Mason County, WA, Pine Ridge Reservation, SD, Greensboro, NC, Little Rock, AR, Milwaukee, WI, Cleveland, OH, Randolph County, WV, Moline, IL, Greenvile, SC, Seattle, WA, Indianapolis, IN, etc.

Capital Area Texas Sustainability (CATS) Consortium, Austin, TX, is one of those partners. Through the Sustainable Places Project (SPP), CATS is developing an innovative analytics tool to identify the long-term effects of various scenarios. Based on the analysis, the city will develop plans that align housing, jobs, transportation options in a way that complements existing community values (“Sustainable Places Project”). The project involves a regional partnership of local governments and other stakeholder groups. It focuses on the Austin-Round Rock-San Marcos five-county MSA, a region that has experienced rapid population and economic growth recent years. Along with the ongoing economic prosperity, however, the traffic congestion in the region is aggravated, and the housing affordability is decreasing. Thus at the critic moment, the region has to face the trends that could challenge its success as it becomes less attractive to those employers who are interested in places with high quality.

Under this circumstance, in 2001, the Envision Central Texas (ECT) was founded to assist in the public development and implementation of a regional vision of Austin MSA. It is composed of a diverse group of citizens, including neighborhoods, environmentalists, business leaders, and policy makers. A Preferred Vision was developed in 2004, with an emphasis on land use, transportation, and environment, to promote focused growth in the existing communities, as well as the new ones along major transportation corridors. Based on this scenario, the Capital Area Metropolitan Planning Organization (CAMPO) of Austin MSA adopted*2035 Regional Transportation Plan* to propose a centers map to guide the transportation investments and planning resources, and to encourage the development of a connected regional network of denser and mixed-use activity centers. The Activity Center concept ultimately drives the SPP project.

Throughout the planning progress, CAMPO implemented consistent outreach programs to present the voice of people and public agencies. Concerns about existing transportation system are listed below (CAMPO 2010). These concerns are ranked by importance.

Non-motorized transportation users

Bicycle access is primarily provided by interconnected, low volume streets, and shoulders or occasional bike lanes on higher volume streets. Concerns about sidewalks include discontinuousness, width, pavement, and overall pedestrian environment. The lack of designated roadway and a connected network increases the risk of crash for cyclists and pedestrians. Also, poor accessibility to such facilities increases the dependence on automobiles and thus raises concerns about equity issues for those who do not or are unable to drive.

Congestion

The congestion condition in the Austin area is getting worse. Study of Capital Metro's Austin In Motion (AIM) indicates that congestion/traffic is the most serious problem that has resulted from fast growth in the Austin area according to their respondents ("Austin's Transport Challenge"). Interstate 35 (I-35) that passes throughthe city of Austin and connects Round Rock is one of the most congested corridors. It lengthens travel time, especially commuting time during peak hours, and results in excessive time as well as monetary costs.

Transit

Austin's metro service does not cover the whole region since some communities have not opted to contribute sales tax to Capita Metro. Also, there is a lack of intercity transit service to connect Austin with its surrounding cities. Current routes also need improvements on service frequency, safety, and reliability.

Transportation Safety

Stakeholders are concerned about the high speed and large volume of vehicles along major highways, especially at some confusing and unprotected intersections. Also, the surface conditions of roads need to be improved.

Resource Protection

Some stakeholders raised up the issue of natural resource preservation. Economic development should not establish on the depletion of resources. Thus, the City of Austin needs to launch projects targeting on protecting natural resources and implement environmental protection measures along major roadways.

Roadway Connectivity

Suburban and residential roadway network typically contains more cul-de-cacs and are unconnected. It tends to increase travel distance, travel time, and congestion, and especially adversely influences non-motorized activities.

In consideration of these concerns, ECT envisions the future transportation system as an effective system with multiple transportation choices and enhanced effectiveness that supported by the denser land development (ECT, 2004). Also, CAMPO identifies that the Austin MSA will "develop a comprehensive multimodal regional transportation system that safely and efficiently addresses mobility needs over time, is economically and environmentally sustainable, and supports regional quality of life" (CAMPO, 2010). Based on the visionsand the requirements of federal law, twelve goals are developed:

Table 1-1. CAMPO 2035 Regional Transportation Goals

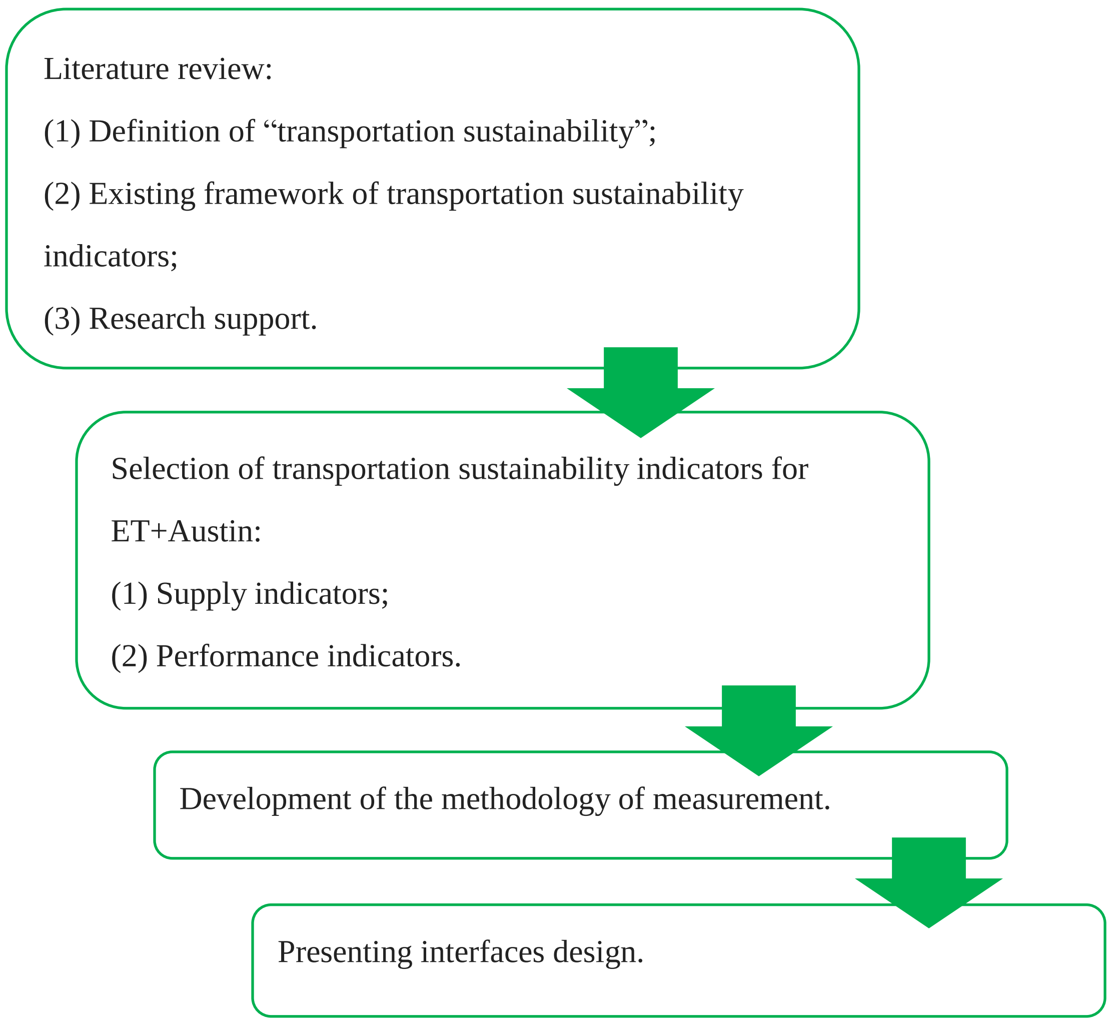
System Effectiveness	Environment	Economy	Society
Safety	Air quality, climate protection, and energy	Economic competitiveness	Social equity
System preservation	Environment, noise, and neighborhood character	Land use and economic development	Cost effectiveness
Efficiency			
Security			

Planning often involves tradeoffs between goals and objectives. Conventional planningusually assigns a problem to one specific agency. One agency is responsible for making zoning codes and regulations, another is appointed to resolve the heavy traffic congestion, another reduces the traffic crashes, another focuses on the preservation of environment, while another improves the quality and efficiency of economic growth. However, one agency's efforts sometimes exacerbate others' problems (Litman, 2006). For example, expanding highway network improves the mobility of vehicles, whereas results in environmental issues such as noise, air pollution, runoff pollution, and disruption of habitat. Therefore, the new approaches require the collaboration between agencies and public involvements.

SPP provides such a platform for stakeholders in the MSA region. Based on the Envision Tomorrow software package, it is developing the "Envision Tomorrow for Austin" (ET+Austin) to measure the sustainability of communities, and to facilitate public dialogue among related cities and counties, Metropolitan Planning Organizations (MPOs) and Council of Governments (COGs), neighborhood representatives, and other stakeholders. Several transportation models that provided by the University of Utah are incorporated with the tool to address local concerns. Also, each indicator is accompanied with pop-up box (detailed texts in Appendix A) that warns when a scenario exceeds the acceptable threshold and directly links to studies referenced by the indicator. The goal of the project is to examine several growth scenarios for activity center in Hutto, Elgin, Dripping Springs, and Lockhart, and to demonstrate that sustainable activity center growth can benefit these communities. Indicators emphasize on land use, transportation, and equity. This report mainly discusses how sustainable transportation indicators are selected and measured in ET+Austin.

Figure 1-1 shows the designing process as the remainder of this report is organized. Section 2 provides a literature review of conceptual and policy context. Section 3 provides research support, an introduction to ET platform, and the selection of transportation indicators in ET+Austin. The indicators will be grouped into two categories: (1) supply indicators; and (2) performance indicators. Section 4 provides the methodology of indicator measurement as well as presenting interface, and the results of the indicators that were run for the four demonstration sites of CATS project. Section 5 discusses the issues and limitations of ET+Austin.

Figure 1-1. Flow chart of the designing process



2. THE CONCEPTUAL AND POLICY CONTEXT

Transportation Sustainability

In 1987, the World Commission on Environment and Development (WCED) provided the most widely quoted definition of sustainability: “sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987). Specifically, it is a reconciliatory approach for achieving the goals of environmental preservation, social equity, and economic prosperity for all members of society (Krizek and Power, 1996).Its major goal is to optimize the system efficiency and reduce the negative impacts on the three elements by the maximization of existing resources and limitation of the necessity of infrastructure expansion (Samberg, et al, 2011).Sustainability is a concept of time as well as space. It strives to ensure that local planning works are consistent with regional and global efforts, and short-term decisions are accord with long-term goals. Thus,there is a need to coordinate decisions among different sectors, groups, and jurisdictions (Litman, 2007).

Since sustainable development becomes an international priority of various communities and public agencies, as part of urban infrastructure, transportation sustainability has become growing area of concern. Several Departments of Transportation (DOTs) in the United States as well as in other countries worldwide have adopted sustainability within their mission statements. The operational definition of the transportation system sustainability, while varies, captures attributes of system effectiveness and efficiency, and system impacts on the economy, environment, and social quality of life (Jeonand Amekudzi, 2005). Environment contains issues such as natural resource preservation and pollution prevention. Economy is concerned with the maximization of economic efficiency by increasing user welfare benefits and decreasing total time/cost spent in traffic, affordability, and support to the vibrant and sustainable economic activities. And social sustainability captures social equity, human health, safety and security for people and property, accessibility to basic services, and the overall quality of life.

Jeon reviewed the regional goals of numbers of metropolitans' planning documentations and prior literatures, and concluded that transportation system effectiveness and system impacts should be considered in the transportation planning context as well(Jeon, et al, 2010). Particularly, it captures the concept of mobility, which is defined as the ability to move freely, and system performance for roadway network (including driveways, sidewalks and bike lanes, and transit system). Moreover, the World Business Council for Sustainability Development (WBCSD) names the specific needs and refers to mobility explicitly in transportation. It defined sustainable mobility as "the ability to meet society's desires and needs to move freely, gain access, communicate, trade and establish relationships without sacrificing other essential human or ecological values, today or in the future" (WBCSD, 2001). Some agencies and authors focus on the non-motorized users of the transportation system. It was accepted that a sustainable transportation network is partially created from a system that addresses multiple modalities, and policies that are supportive of those modalities (Samberg, et al, 2011).Also, numbers of planners put emphasis on the relationship between transportation and land use planning, and suggest that a true sustainable transportation network is partially created from a system that addresses multiple modalities, land use, and land use policy that is supportive of those modalities, for example, transit-oriented development (Samberg, et al, 2011).The Canadian Center for Sustainable Transportation reviews and summarizes many existing definitions of "sustainable transportation", anddefines a sustainable transportation system as one that: (1) allows the basic access needs of individuals and societies to be met safely and in a manner consistent with human and ecosystem health, and with equity within and between generations; (2) is affordable, operates efficiently, offers the choices of transportation mode, and supports a vibrant economy; and (3) limits emissions and wasting within the planet ability to absorb them, minimizes consumption of non-renewable resources, reuses and recycles its components, and minimizes the use of land and production of noise (CST, 2002).

For decades, automobile is the dominant transport mode in most cities of the United States. The national highway system has improved the quality of life through increased access to health care, education, employment, recreation, and a wide range of consumer goods (TRB, 2005). However, these benefits come along with multiple negative impacts including road crashes, air pollution, physical inactivity (WHO, 2005), and increasing commuting time.A discussion of some unsustainable impacts of transportation facilities and activities is provided below.

Air Pollution

Air pollution is one of the most urgent environmental problems that transportation contributes to. The major air pollutants include carbon monoxide, sulfur dioxide, lead, nitrogen oxides and nitrogen dioxide, ozone, and particulate matter (Black, 2012). Increasingly mounting scientific evidence indicates that the greenhouse gas emissions is one of the reasons that cause climate changing (Blottnitz and Curran, 2006), while the use of petroleum-based fossil fuels for transportation is responsible for more than one-fourth of U.S. emissions of carbon dioxide (Black, 2005). Also, the diesel engines of trucks, trains, buses, and ships are the major sources of fine particulates (TRB, 2009).

Traffic Crashes

WHO data shows that nearly 1.2 million people worldwide died as a result of road traffic injuries in 2002, and between 20 million and 50 million people injured or disabled each year (Scurfield, 2004). In United States, fatalities and injuries at unacceptable levels occur on the nation’s highway system. Particularly, despite some technological improvements on vehicles and roads, there is a lack of such protection on pedestrians, cyclists, and motorcyclists.

Congestion

Congestion has grown everywhere in areas of all sizes and occurs during longer portions of the day and delays more travelers and goods than ever before (Schrank, 2008). The rise in congestion negatively affects personal mobility, freight movement, and the economic and social health.

Inequitable Mobility

The cost of transportation is growing, which places a burden particularly on those with the lowest incomes (Policy, 2005). As U.S. transportation system dominated by the automobile, challenges are generated for those with limited incomes or physical disabilities or for those who do not or cannot drive.

Based on the definition of sustainability, a sustainable transportation system is one that meets the transportation needs of the present without compromising the ability of future generations to meet their needs. The National Cooperative Highway Research Program (NCHRP) envisions sustainability as meeting human needs for the present and future while preserving and restoring environmental and ecological system, fostering community health and vitality, promoting economic development and prosperity, and ensuring equity between and among populations groups and over generations (Ramani, 2012). The challenge lies in minimizing the unsustainable impacts while providing the benefits of transportation to all. Therefore during the planning process, there is a need to ensure that environmental, economic, and social considerations are factored into decisions affecting transportation activities (Transport Canada, 1999), and to maintain the ease of access to the transportation system and the expected travel time. Based on related studies, a general vision for sustainable transportation is summarized below (Banister, 1997; Banister, 2005; CST, 2002; Curtis, 2008; Goldman, 2006; Kemp, 2004; Omer, 2008;Stigson, 2004).

Increased Accessibility

People have adequate access to goods, services, jobs, and social opportunities, particularly people who are economically disadvantaged or who face unusual physical challenges. Improved accessibility is achieved by the integration of land use and transportation planning. The framework includes a strong system of regional planning, a state agency structure organized around land use transport integration, and a planning strategy produced and supported by the regional community.

Less Need of Movement

Journeys are shorter for the movement of both people and goods in part because urban areas are more compact with a good mix of land uses and people have improved accessibility. The centralized urban distribution and logistics centers can provide cooperative local delivery of goods to reduce total vehicle miles traveled (VMT). Also, the private cooperatives among shippers or major retailers to coordinate deliveries are encouraged by public policies.

Transportation Alternatives

More trips are completed by non-motorized means of transport, and public transportation since living and working arrangements become much more compact and there are improved infrastructure and services. Walking, bicycling, and public transport become much more acceptable and agreeable. Therefore, people can choose modes of transport appropriate to the purposes and distance.

Decreased Impacts on the Environment and on Human Health

Alternative fuels with improved fuel efficiency are used. The percentage of trips by non-motorized transport modes increases and the total VMT decreases. Thus, the net results are decreased emissions, and energy and water consumption.

Existing Sustainable Transportation Indicator Framework

Sustainability is usually evaluated using a set of measurable indicators to track trends, predict problems, compare areas and activities, evaluate particular policies and planning options, and set performance targets (Litman, 2003; CST, 2001). Ideal indicators are easy to understand and able to provide a clear indication of moving toward an established goal, and can be tracked using accessible and available data (Zietsman, 2011). To distinguish between conventional transport indicators and those can be termed sustainable indicators, transportation sustainability indicators should be selected and organized by a set of specific goals and objectives. Litman and Burwell conclude that instead using automobile-centric performance measures, emphasis should be put on non-motorized and public transport (Litman, 2006). Similarly, Zietsman summarizes that paradigm has shifted from measuring mobility to accessibility, and from outputs to outcomes (Zietsman, 2000). In general, sustainable transportation indicators should reflect various levels of analysis, including the external trends, such as changes in demographic structure; decision-making process; options and incentives; responses (physical impacts), like changes in mobility, mode choice, pollution emissions, crashes, land development patterns, etc.; human and environmental effects; economic impacts; and their performance evaluation which indicates the ability to achieve specific targets (Litman, 2013).

Different types of indicators reflect various goals and objectives. The indicators selected significantly influence analysis results. A particular policy or program may rank high when evaluated using one set of indicators, but low when evaluated by another (Litman, 2006). Selecting indicators often involves tradeoffs. In most situations, sustainability policies involve conflicts between different interests and jurisdictions. Thus there is no universally accepted sustainable transportation evaluation system. Jurisdictions and programs should select indicators based on how problems are defined and goals are prioritized.

Also, indicators that can be measured vary with the availability of data. There is a tension between convenience and comprehensiveness when selecting indicators (Litman, 2007). A smaller set of indicators requires less data which are easily available and thus is more convenient to collect and analyze. A larger set can be inclusive of the important impacts of transportation projects and activities on economy, society, and environment, but gnerates excessive data collection and analysis costs.

There is substantial literature on indicator system of sustainable transportation. Usually indicators are selected to measure how the goals and objectives are achieved. Some rating systems select indicators based on multiple sustainability dimensions: transportation system effectiveness, environmental sustainability, economic sustainability, and social sustainability. STAR Community Index offers local governments guidance for improving community sustainability. It covers community priorities across the three pillars of sustainability, and integrates evaluation measures across six goal areas: built environment; climate and energy; education, arts, and community; economy and jobs; equity and empowerment; health and safety; and natural systems (DDOE, 2012). There is a similar way to organize indicators by Halifax Regional Municipality, Canada (GPI, 2008), Composite Sustainability Index (CSI) (Jeon et al., 2008), the city of Lyons, France, the World Business Council for Sustainable Development (WBCSD), and the Organization for Economic Cooperation and Development (OECD). Lyons indicator system uses local travel survey data and other available information to evaluate transportation impacts disaggregated by modes, locations, and household demographics (Nicolas et al., 2003). As an association composed by hundreds of companies, the WBCSD’s Sustainable Mobility Project focuses more on the concerns of the users of the transportation system, the society as a whole, and business as well. It measures accessibility, travel time, reliability, safety, security, greenhouse gas emissions, impactson the environment and on public well-being, resource use, equity implications, financial outlay required of users, impacts on public revenues and expenditures, and the prospective rate of return to private business (Stigson, 2004). The OECD specifically focuses on the environmental sustainability. It suggests measuring CO_2, NO_X and VOC emissions, particulates, noise, and transport facility land consumption and concludes that environmentally sustainable transport will require more accessible development patterns, reduction in car ownership and use, reduced long-distance travel and increased non-motorized short-distance travel, and more energy-efficient production (OECD, 2011). Some studies focus on the non-motorized transport activities. Hale argues that transport project assessment should account for broader, strategic planning objectives and long-term impacts, and proposes a set of regional transportation performance indicators to evaluate walking, cycling, and public transit project benefits (Hale, 2011). Roughton specifically identifies non-motorized transport performance indicators based on infrastructure, use and safety of the transportation system, program impacts and public opinion (Roughton et al., 2012).

Some indicator systems organize indicators based on their characters. The SMART Growth Index 2.0 is a sketch tool for community planning that emphasizes on land use, housing, employment, environment, parks, infrastructure, transportation, and air quality and climate change (Criterion Planners/Engineers Inc, 2002). Definition and formula are provided with each indicator. The European Union's Transportation and Environment Reporting Mechanism (TERM) divides the sustainable transportation indicators into two groups. One measures transport and environment performance including the environmental consequences of transport, and the transport volume and intensity. The other is the determinants of the transport/environment system including indicators of urban form, transport supply, price, technology and management (EEA, 2002). The Sustainable Transportation Performance Indicators (STPI) project by the Centre for

Sustainable Transportation (CST) produces the indicators in seven categories: land use and urban form, supply of transport infrastructure and services, transport expenditures and pricing, transport activity, environmental and health consequences of transport, technology adoption, and implementation and monitoring (Gilbert, 2002). In STPI indicator set, there are respectively initial indictors, short-term additions, and long-term additions, thus it is more feasible to monitor the planning progress and update the plan.

3. EMPIRICAL AND ANALYTICAL CONTEXT

Research Support

Since the impacts of growth are analyzed based on land use scenarios in ET, it is necessary to establish a relationship between land uses and transportation facilities and activities.A number of studies have identified such relationship. For example, VMT is adversely affected by residential density (Brownstone, 2009), street connectivity (Marshall, 2010), and measure of land use mix (Badoe, 2000). The mode share of walk trips is associated with density (Saelens, 2003), job-housing balance, and distance to stores (Frank, 1994). The mode share of transit trips is associated with street network type (Messenger, 1996), and measure of land use mix (Kitamura, 1997).By reviewing more than 200 studies that relate quantitatively characteristics of the built environment to measures of travel, Ewing and Cervero (Ewing, Cervero, 2010) have generalized the effects of such relationship. They conclude that the elasticity of VMT with respect to the distance to downtown is -0.22, to the job accessibility by auto is -0.2, elasticities to the intersection density and to the percentage of four-way intersections are both -0.12. The elasticity of walking with respect to the intersection density is 0.39, to the distance to a store is 0.25, to the job-housing balance is 0.19, elasticities to the land use mix, the job within one mile, and the distance to the nearest transit stop are 0.15. The elasticities of transit use with respect to the percentage of four-way intersections and to the distance to the nearest transit stop are 0.29, elasticity to intersection density is 0.23.

The Institute of Transportation (ITE) has compiled trip generation studies for various sites and single land uses, and developed a library of simple linear regression or exponential regression models for estimating daily vehicle trip generation rates based on land use amounts or on the number of residents or dwelling units by types including residential, retail, office, and industrial (ITE, 2008). It provides a standard for trip generation rate estimates used by transportation engineers as well as planners across the country. Moreover, ITE has produced a handbook on application of the data and equations to accompany the *Trip Generation* manual. It includes guidance for estimating project site trip generation, internal capture, collection of local data, and development of local trip generation rates (ITE, 2004).

Ewing et al. have conducted a study to address the traffic impacts of mixed-use developments (MXDs) (Ewing et al., 2009). The independent variables are a set of built environment factors. It is widely accepted that built environment is consisted of 6 Ds: density, land use diversity, pedestrian-oriented design, destination accessibility, distance to transit, and development scale. And a 7th D, demographics, characterizes the residents and employment of developments. Thus, they pool land use data from 239 MXD sites in six diverse regions including Atlanta, Boston, Houston, Portland, Sacramento, and Seattle, and 35,000 trips to, from, and within those MXDs. Hierarchical modeling is used in this study. Trip generation rates estimated from basic ITE methodology are factored based on the research of traffic generated by MXD. Its models estimate the natural log of the odds of internal trips, the natural log of the odds of walk and vehicle trips for both internal and external travel, and external transit trips to the site, and both internal and external vehicle trip length. Those traffic impacts are disaggregated by trip purposes. Also the estimates of the VMT for the vehicle trips can be produced from the model.

Using the same data set, Ewing has also developed models to predict household travel outcomes including household vehicle trips, walk trips, bike trips, and transit trips, and household VMT (Reid, 2012). The independent variables to predict household bike trips are household size of site, activity density and intersection density within 1 mile buffer, and land use mix within 1/4 mile buffer of the study area.

Based on the county crash data for years 2008 to 2011 from 48 states, and VMT and other urbanized area data for 441 urbanized areas, Ewing develops a crash prediction model for urbanized areas (Ewing, 2012). The independent variables to estimate total crash rate are VMT per capita, employment density, and intersection density.

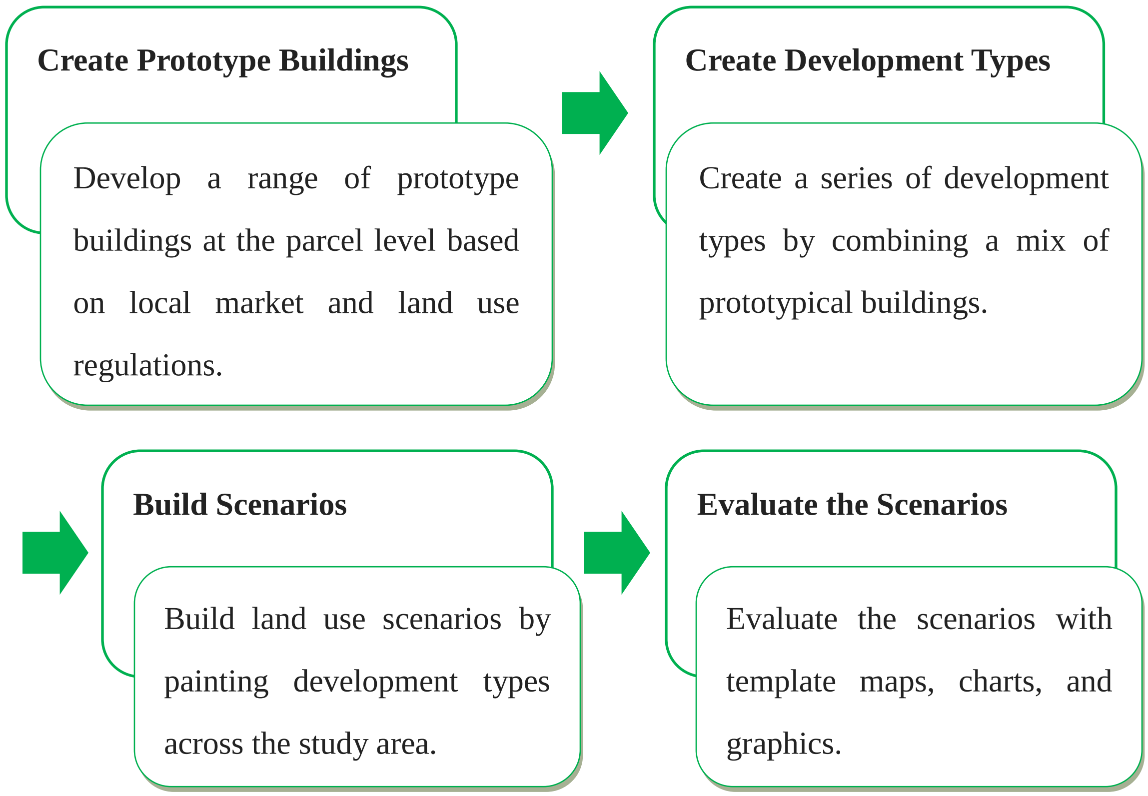
Envision Tomorrow

The CATS platform is developed based on a suite of urban and planning tools, Envision Tomorrow (ET). It consists of two primary parts: the Prototype Builder, and the Scenario Builder (“Fregonese Associates”).

The Prototype Builder is a return on investment (ROI) spreadsheet tool that can be used to model buildings and test the physical and financial feasibility of development. It allows users to set the assumptions based on local land use regulations including height limits, floor are ratio (FAR) limits, landscaping and set-back requirements, and parking requirements, and on current development market factors including construction costs, property acquisition costs, rents, subsidies, and sales prices. Users can also indentify building prototypes with FAR, density of land, residents, dwelling units, and employees, building uses, occupied types (owner or renter), and parking spaces. Then the spreadsheet will estimate internal rate of return (IRR), project profits, costs, and number of residents and employees based on user’s inputs.

The Scenario Builder adds scenario-building functionality to ArcGIS. It defines development types with a library of buildings and with urban form characteristics including block size and street characteristics. Then users can “paint the landscape” in ArcGIS by allocating different development types across the study area to create up to five unique land use scenarios. Based on a set of metrics, the scenarios’ basic urban form elements such as land uses, land area, street length, and intersections, and demographic characteristics including number of residents, employees, and dwelling units, can be estimated. It enables users to conduct real-time evaluation of each scenario through a set of user-defined indicators to compare between scenarios. Figure 3-1 shows the running process of ET.

Figure 3-1. The Envision Tomorrow process



The whole set of ET is built on ArcGIS and spreadsheet, with transparent sources and rate information found throughout the spreadsheet model. ET is a versatile and expandable tool that can be adapted to accommodate various uses by incorporating new models based on existing data, due to its transparency,

Data

The original GIS data sources are the census 2010 demographic data, land fragmentation analysis 2010 shapefile of five counties, Austin Traffic Analysis Zone (TAZ) 2005 shapefile, regional street shapefile, and Capital Metro transit stops shapefile.The inputs including existing residents, employees, housing units, and median household income of study areas are derived from TAZ shapefile weighted by area. The intersection shapefile is derived from regional street centerlines.

The emission rates of greenhouse gas (GHG), NO_X, and volatile organic compound (VOC) are provided by CAMPO. The crash data of Texas is provided by the Texas Department of Transportation. The recommendation for the valuation of social and environmental factors is provided by HDR, Inc. (HDR, 2013).

ET+Austin Transportation Indicators

For the transportation planning tools, traffic impact analyses are usually conducted at Traffic Analysis Zone (TAZ) level for the region. There is a lack of such a tool for localities and communities. Also, several studies have concluded that the mixed-use type development would affect travelers' behavior (Reid Ewing, et al, 2011), whereas the impacts are barely considered. By reviewing existing indicator frameworks of transportation sustainability, it is found that most of the scenario analysis tools focus only on the supply of transportation infrastructure, while very few include vehicles and system operation evaluation. A small number of studies, as previously stated, consider transportation activities including the daily number of trips by modes and by purposes, vehicle miles traveled per capita, and crash rate (Nicolas, 2003; EEA, 2002; Gilbert et al, 2003). These indicators are evaluated for existing transportation system by available travel survey data. It is also found that indicator frameworks for sketch-planning are focused on transportation facilities, such as land use mix, the total length of sidewalks and bike lanes, transit stop density, the proximity to transit stops. Although substantial studies indicates that such improvements of infrastructure would encourage non-motorized trips and reduce the crash rate (Dill, 2009; Reynolds, 2009), it is challenging to convince decision makers and stakeholders without explaining how these improvements affect transportation activities and the community. Thus, there is a lack of such estimation of performance for transportation system in sketch-planning.

Based on related studies and handbooks on sustainability indicator and transportation indicator measurement, a list of indicators of transportation sustainability is developed. Indicators address the issues including mobility for non-motorized transportation users, congestion, connectivity, transit service, safety, resource protection and air environment, and reflect the achievements on the efficiency and safety of the transportation system, accessibility, mobility for transportation alternatives, air quality, land use, social equity, and cost effectiveness. Yet some indicators are removed from the list due to the lack of data. For example, although bicycle compatibility index (BCI) provides a comprehensive evaluation on bicycle system, it requires detailed geometric, geographic, traffic, and operation data, which are challenging to assume in sketch-planning. Thus, transportation sustainability indicators for ET+Austin are produced in terms of rationality, fitness to community's issues and goals, and the feasibility to measure. Indicators are grouped into two categories: (1) supply indicators; and (2) performance indicators. Supply indicators evaluate the existence and quality of transport infrastructure, while performance indicators measure the aggregated traffic impacts of the area as well as individual travel behavior.

Table 3-1. Sustainable transportation indicators of ET+Austin

Indicator	Definition/Formula
Supply Indicators: Built Environment	
Activity Density	Activity Density = (Number of population + Number of employees) / The gross area
Job-Population Balance	Job-Population Balance $=1 - \left\lvert\frac{\text{Number of employment} - 0.2 * \text{number of population}}{\text{Number of employment} + 0.2 * \text{number of population}}\right\rvert$
Land Use Mix (Entropy)	$\text{Land Use Mix} = (\frac{\text{Residential land area}}{Total\ land\ area} \times \ln\frac{\text{Residential land area}}{Total\ land\ area} + \frac{\text{Retail land area}}{Total\ land\ area} \times \ln\frac{\text{Retail land area}}{Total\ land\ area} + \frac{\text{Office land area}}{Total\ land\ area} \times \ln\frac{\text{Officel land area}}{Total\ land\ area} + \frac{\text{Indusstrial area}}{Total\ land\ area} \times \ln\frac{\text{Industrial land area}}{Total\ land\ area})/\ln(4)$
Street Connectivity (Internal)	Street Connectivity = Number of intersections / The gross area
Proportion of Area within 1/4 mile of Transit Stops	This indicator measures the proportion of the area within appropriate walking distance to transit stops.
Supply Indicators: Transportation System	
Street Network Density	Street Connectivity = Street centerline length / The gross area
Transit Stop Coverage	Transit Stop Coverage = Number of transit stops / The gross area

Table 3-1. (continued)

Indicator	Definition/Formula
Bicycle Network Coverage	Bicycle Network Coverage = The total mileage of bicycle lanes / Street centerline length
Sidewalk Completeness	Sidewalk Completeness = The total mileage of sidewalks / Street centerline length
Sidewalk Density	Sidewalk Density = The total mileage of sidewalks / The gross area
Vehicle per Capita	This indicator predicts the vehicle ownership per capita.
Parking Supply	This indicator predicts the parking spaces that
Performance Indicators: Individual Travel Behavior	
Daily Walk Trip Rate per capita	This indicator estimates the daily walk trip per capita.
Average Auto Trips Length	This indicator estimates the average auto trip length.
Average Internal Auto Trip Length by Purposes	This indicator estimates average internal auto trip length disaggregated by purposes.
Average External Auto Trip Length by Purposes	This indicator estimates average external auto trip length disaggregated by purposes.
Average Auto Trip Time	This indicator estimates the average auto trip time per trip.
Average Auto Commute Time	It estimates the average auto trip time for commuters in the study area to their workplaces over the region.

Table 3-1. (continued)

Indicator	Definition/Formula
VMT per capita	This indicator estimates the VMT per capita.
Performance Indicators: Aggregated Traffic Impact	
Internal Trip Rate	This indicator estimates the number of internal trips disaggregated by purposes.
Internal Walk Trip Rate	This indicator estimates the number of internal walk trips disaggregated by purposes.
External Walk Trip Rate	This indicator estimates the number of external walk trips disaggregated by purposes.
Transit Trip Rate	This indicator estimates the number of external transit trips disaggregated by purposes.
Total VMT Generated by Residential Land	This indicator estimates the VMT generated by residential land use disaggregated by purposes.
Total VMT Generated by Retail Land	This indicator estimates the VMT generated by retail land use disaggregated by purposes.
Total VMT Generated by Office and Industrial Land	This indicator estimates the VMT generated by office and industrial land uses disaggregated by purposes.
Share of Internal Trips	This indicator estimates the percentage of internal trips within the study area.
Share of Transit Trips	This indicator estimates the percentage of transit trips generated by the site.

Table 3-1. (continued)

Indicator	Definition/Formula
Share of Walk Trips	This indicator estimates the percentage of walk trips generated by the site.
Total Trips	This indicator estimates the total trips generated by the site.
Total Transit Trips	It estimates the total transit trips generated by the site.
Job Accessibility	This indicator measures the ease of people reaching their jobs.
Total Crash Rate	This indicator estimates the total crash rate generated by the site.
Parking Demand	This indicator estimates the increased demand of parking associated with new development in the study area.
GHG Emissions	This indicator estimates the amount of vehicle greenhouse gases emissions.
Social Cost of GHG	This indicator measures the social cost of vehicle greenhouse gases emissions.
Social Cost of CAC	This indicator measures the social cost of criteria air contaminants including SO_2, NO_X, $PM_{2.5}$, and volatile organic compound (VOC).
Social Cost of Motor Vehicle Accidents	This indicator measures the social cost of motor vehicle accidents generated by new development.
Vehicle Operating Costs	This indicator measures the vehicle operating costs.
Value of Time	This indicator measures the monetizing value of travel time.
Commuter Biking Mobility Benefits	This indicator measures the monetizing value of improved mobility for cyclists.

The built environment indicators measure those elements of urban form that have the strongest influence on travel. The *activity density*, *job-population balance*, *land use mix* score, and *street connectivity* are positively associated with internal capture of trips and non-motorized trip rates, and adversely affect VMT. As 1/4 mile is usually considered as a standard walking distance for most people could accommodate, higher *proportion of the area within 1/4 mile of transit stops* increases the probability that people would choose to take public transit, and positively affect walk trips.

The supply indicators show the community and residents improvements on transportation infrastructure provided by new developments. The *street network density*, *sidewalk density*, and *transit stop coverage* are positively associated with accessibility, especially for travelers who do not drive or are unable to drive. Recommended by the Smart Growth America Organization that complete streets should be designed for all users instead of only for cars (Smith, 2010), the *bicycle network* and *sidewalk completeness* measure the completeness that street system is accommodated to pedestrians and cyclists. And the *vehicle per capita* and *parking supply* measure the state of ownership and usage of private vehicles.

For decision makers and public agencies, the supply indicators provide an evaluation on the provision of transportation infrastructure. Indicators address the needs of all users of the transportation system including walking, cycling, transit, and driving. A more balanced transportation system with lower automobile dependency promotes social equity for people who tend to be the transportation disadvantaged. Also, the shift from driving to non-motorized modes and to public transit has an effect on congestion mitigation, environment, and human health. The supplies of transportation facilities are strongly associated with travel patterns. The *street network density* is significantly related with traveler’s mode choice on walking and bicycling, especially for non-work trips. Enhanced *transit stop coverage*, *bicycle network*, *sidewalk density*, *sidewalk* *completeness* improve accessibility for non-drivers and thus reduce private vehicle trip rate. *Vehicle per capita* indicates the degree of dependency on automobile of residents in the study area. These traffic impacts are addressed by performance indicators explained below.

The performance indicators provide decision makers the basis for developing policies to achieve their preferred scenario with increased non-motorized trips and transit trips, reduced private vehicle trips, decreased VMT, trip length and travel time. Indicators measure the impacts on human travel behaviors as well as aggregated impacts on the transportation system, environment, social equity, and economy. Indicators of individual travel behavior measure the travel patterns including *daily walk trip rate per capita*, *average auto trip length*, *average auto trip time*, *average auto commute time*, and *VMT per capita*. Aggregated traffic impacts include the frequency of trips (*total trips*, and *total transit trips*), trip internalization (*share of internal trips*), mode splits (*share of transit trips*, and *share of walk trips*), total VMT, accessibility (*job accessibility*), safety (*total crash rate*), *parking demand*, *GHG emissions*, *vehicle operating cost*, *value of time*, social costs of transportation activities (*social cost of GHG*, *social cost of CAC*, and *social cost of motor vehicle accidents*), and monetizing benefits from the improvements on transportation facilities (*commuter biking mobility benefits*). Indicators address mobility for all transportation users, and the impacts of transportation activities on environment, social equity, and economy. Internal trips are made between on-site land uses without travel on the off-site street system, with an effect on congestion mitigation. Also, the mixed uses in the community allow what might otherwise be external car trips to become internal trips, within walking or biking distance, thus improve the mobility of non-drivers and increase the non-motorized trip rates. Other than modes, land use types, and internalization, some traffic impacts are disaggregated by three trip purposes: home-based work, home-based others, and non-home based (*internal trips rate*, *internal* *walk trips rate*, *external walk trip rate*, *transit trip rate*, *total VMT generated by residential land*, *total VMT generated by retail land*, and *total VMT generated by the office and industrial land*). These indicators provide a substantial basis for decision makers and public agencies to make and update land use and transportation plans. For example, a desirable transportation system is that home-based work trips area accommodated by public transit as an alternative of automobile because commuting trips are usually routine in terms of travel locations and time, and home-based other trips are accomplished by walking and bicycling if the community can provide for residents service including education, medical care, and retail, and access to fresh food.

4. IMPLEMENTATION

Indicator Measurement

Three models are incorporated in ET+Austin: MXD Trip Generation Model, Household Travel Model, and Traffic Safety Model.

Input Data and Assumptions

The three applications require inputs including the geographic, demographic, built environment, and regional data of existing development in the study area. Users can the input and view data in “Existing Dev” tab grouped in six columns: total area, developed land, built environment, demographic characteristics, employment and income, and region (Figure 4-1).

The pink color indicates input cells. Some errors of input value due to the lack of available data is acceptable, since anticipated findings of ET are the differences between different scenarios and the existing conditions only provide a general status of the study area.

Figure 4-1. Interface of “Existing Dev” Tab

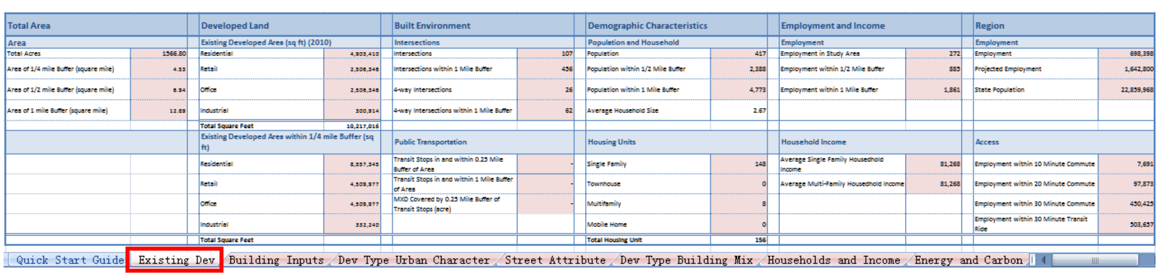


Figure 4-2. Interface of user inputs in “Existing Dev” tab

Total Area		Developed Land	
Area		**Existing Developed Area (sq ft) (2010)**	
Total Acres	1566.80	Residential	4,903,410
Area of 1/4 mile Buffer (square mile)	4.53	Retail	2,506,346
Area of 1/2 mile Buffer (square mile)	6.94	Office	2,506,346
Area of 1 mile Buffer (square mile)	12.89	Industrial	300,914
		Total Square Feet	**10,217,016**
		Existing Developed Area within 1/4 mile Buffer (sq ft)	
		Residential	8,557,345
		Retail	4,509,977
		Office	4,509,977
		Industrial	332,240
		Total Square Feet	**17,909,539**

Built Environment		Demographic Characteristics	
Intersections		**Population and Household**	
Intersections	107	Population	417
Intersections within 1 Mile Buffer	456	Population within 1/2 Mile Buffer	2,388
4-way Intersections	26	Population within 1 Mile Buffer	4,773
4-way Intersections within 1 Mile Buffer	62	Average Household Size	2.67
Public Transportation		**Housing Units**	
Transit Stops in and within 0.25 Mile Buffer of Area	-	Single Family	148
Transit Stops in and within 1 Mile Buffer of Area		Townhouse	0
MXD Covered by 0.25 Mile Buffer of Transit Stops (acre)	-	Multi-Family	8
		Mobile Home	0
		Total Housing Unit	**156**

Figure 4-2. (continued)

Employment and Income		Region	
Employment		**Employment**	
Employment in Study Area	272	Employment	698,398
Employment within 1/2 Mile Buffer	885	Projected Employment	1,642,800
Employment within 1 Mile Buffer	1,861	State Population	22,859,968
Household Income		**Access**	
Average Single Family Housedhold Income	81,268	Employment within 10 Minute Commute	7,691
Average Multi-Family Housedhold Income	81,268	Employment within 20 Minute Commute	97,873
		Employment within 30 Minute Commute	450,425
		Employment within 30 Minute Transit Ride	503,657

Total area includes total acres of the study site, and area of 1/4 mile, 1/2 mile and 1 mile buffer of the study area.

Developed Land includes the square feet of developed area by residential, retail, office, and industrial respectively of the study area and of 1/2 mile buffer of the study area.

Built Environment includes data about street intersections and public transit. Intersection data contains the number of intersections and four-way intersections of the study area and of 1 mile buffer of the study area. Public transit data includes the number of transit stops within 1/4 mile buffer and 1 mile buffer of the study area, and the proportion of the study area within 1/4 mile of transit stops.

Demographic characteristics includes population of the study area and of 1/2 mile and 1 mile buffer of the study area, and the number of housing units in terms of single family, townhouse, multi-family, and mobile home.

Employment and income includes employment in the study area and within 1/2 mile and 1 mile buffer of the study area, and average household income of single family households and of multi-family households.

Regional data includes the number of regional employments in planning year and in project year, state population, and employment within 10-minute, 20-minute and 30-minute commute by automobile and within 30-minute commute by public transit.

Figure 4-3. The interface of “Trip Attributes” tab

Percentage of Trips by Purpose

Land Use	HBW	HBO	NHB
Residential	0.25	0.75	0
Commercial (Retail)	0.05	0.45	0.5
Office / Industrial	0.65	0.05	0.3

Travel Time

Mode	Distance (MI)	Time (Min)	Speed (MPH)
Walk	0.25	5	3
Bike	0.25	1.5	10
Walk	0.5	10	3
Bike	0.5	3	10
Walk	1	20	3
Bike	1	6	10
Auto	4.5	10	27
Auto	9	20	27
Auto	13.5	30	27
Transit	10	30	20

Note

Information from NCHRP 365 and the Nationwide Personal Transportation Survey (NPTS).

is2 / Transit / Trip Attributes / Transportation Summary / MXD Summary / MXD

“Trip Attributes” tab (Figure 4-3) shows the assumptions of percentage of trips by trip purpose and the average travel speed of different modes. The data used in the model is derived from National Cooperative Highway Research Program (NCHRP) (Ward, 2007) and Nationwide Personal Transportation Survey (NPTS) (Hu, 1999). User can also use data from local survey and studies if they are available.

The evaluation of social costs of crashes is based on the severity of injury. Thus usersneed to input the local traffic accident rates of recent years in “Crash Data” tab (Figure 4-4). For example, the Texas Department of Transportation provides annual statewide motor vehicle crash statistics from 2003 to 2012 by severity in four grades: fatal, serious injury, other injury, and non-injury.

Figure 4-4. The interface of “Crash Data” tab

Texas Statewide Traffic Accident Rate						
	Fatal Crashes	Serious Injury Crashes	Other Injury Crashes	Non-Injury Crashes	Unknown Severisty Crashes	Total Crashes
2010	2,781	60,228	81,629	233,979	13,283	391,900
	0.7%	15.4%	20.8%	59.7%	3.4%	100%
2011	2,803	58,339	81,292	228,391	13,471	384,296
	0.7%	15.2%	21.2%	59.4%	3.5%	100%
2012	3,018	63,610	88,439	247,177	14,626	416,870
	0.7%	15.3%	21.2%	59.3%	3.5%	100%
Average	**0.7%**	**15.3%**	**21.1%**	**59.5%**	**3.5%**	**100%**

Crash Data | Traffic Safety | Parking Demand Inputs & Calcs | Parking Time o

Figure 4-5. The interface of “Emissions” tab

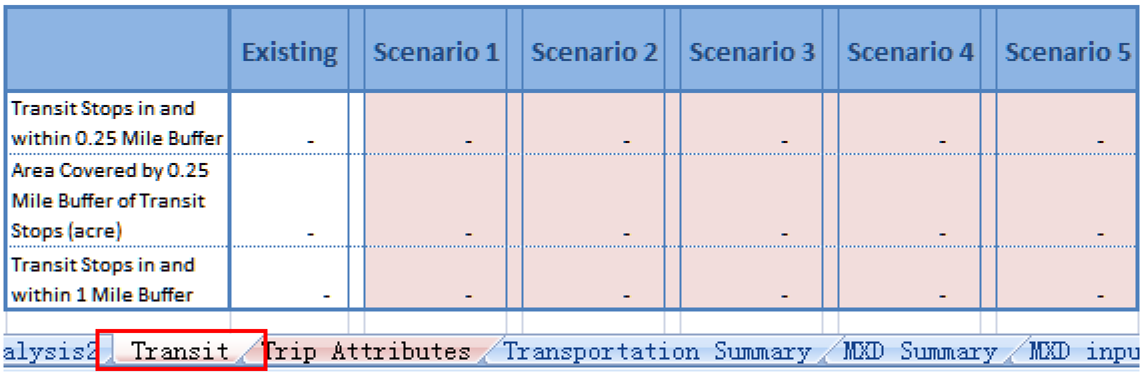
CAMPO Projescted Emissions in 2035												
County	Type	VMT	VHT	Speed	Units	VOC	CO	NOX	CO2	THC	NMHC
Bastrop	24h	4770082.8	123768	39	lbs.	3212	54589	2654	3645612	3439	3259
Caldwell	24h	2878289.4	69066	42	lbs.	1966	34139	1687	2223362	2104	1995
Hays	24h	8507868.3	217859	39	lbs.	5099	89504	4526	6979590	5467	5174
Travis	24h	43384162	1387154	31	lbs.	18420	303708	12511	33966640	19502	18666
Williamson	24h	23105439	682153	34	lbs.	9038	159412	6742	18234919	9584	9161

Emissions | Parking Demand Inputs & Calcs | Parking Time of Day Calcs

Also users are required to input the local emission rate by VMT in “Emission Rate” tab to estimate the impacts on environment (Figure 4-5).

At last, users need to address the transit planning by identifying the number of transit stops within 1/4 mile and 1mile buffer of the study area, and the area covered by 1/4 mile buffer of transit stops in "Transit" tab (Figure 4-6).

Figure 4-6. Interface of "Transit" tab



	Existing	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Transit Stops in and within 0.25 Mile Buffer	-	-	-	-	-	-
Area Covered by 0.25 Mile Buffer of Transit Stops (acre)	-	-	-	-	-	-
Transit Stops in and within 1 Mile Buffer	-	-	-	-	-	-

MXD Trip Generation Model

Based on Ewing et al.'s study (Ewing et al., 2010), MXD Trip Generation App is incorporated in the Scenario Builder to analyze the impact of different land use scenarios on vehicle ownership, VMT, and mode share. It is consisted of four tabs (Figure 4-7) in the spreadsheet: MXD inputs, MXD Travel Probabilities, MXD Travel Calcs, and MXD Summary (Figure 4-8). A results table is produced with the following statistics for an MXD: number of internal and external vehicle trips, number of internal and external walk trips, number of external transit trips, and VMT. Intermediate results within the app provide numerous additional metrics, such as totals per dwelling unit and totals per capita.

Figure 4-7. Tabs of MXD Trip Generation Model

Figure 4-8. The interface of “MXD Summary” tab

Trip Generation Summary	Existing	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Walk Trips						
Internal	79	2,009	2,813	2,698	79	79
- HBW	0	1	1	2	0	0
- HBO	18	1,487	2,024	1,803	18	18
- NHB	61	522	787	893	61	61
External	288	1,289	2,408	2,518	284	284
- HBW	219	678	1,250	1,375	215	215
- HBO	40	386	636	619	39	39
- NHB	30	224	522	524	30	30
Total	**368**	**3,298**	**5,220**	**5,217**	**363**	**363**
Transit Trips						
Internal	-	-	-	-	-	-
External	2,022	2,894	3,809	3,708	1,820	1,820
- HBW	112	372	580	621	92	92
- HBO	150	845	1,106	1,073	148	148
- NHB	1,761	1,677	2,124	2,014	1,580	1,580
Total	**2,022**	**2,894**	**3,809**	**3,708**	**1,820**	**1,820**
Vehicle Trips						
Internal	6,695	17,699	20,101	19,604	6,684	6,684
- HBW	196	1,426	1,721	1,767	196	196
- HBO	2,449	11,559	12,657	11,306	2,437	2,437
- NHB	4,050	4,714	5,723	6,531	4,050	4,050

MXD Summary / MXD inputs / MXD Travel Probabilities / MXD Travel Calcs / HH Travel Elastisities / HH Travel Model / Traffic Safety Elastic

The model is based on ITE Trip Generation handbooks and the trip estimation procedures described in the Ewing et al.’s study, for its ability to estimate walk trips and transit trips. The process and all equations used for this model are provided below:

1. Calculate the estimated total vehicle trips by the land use area based on ITE trip generation equations (Tab: MXD Travel Calcs);
2. Separate the vehicle trips by trip purposes (Tab: MXD Travel Calcs);
3. Predict the number of vehicles per household based on 7D Household Vehicle Ownership Model(Tab: MXD inputs);
4. Estimate vehicle internal and external trips (Tab: MXD Travel Probabilities);
5. Factor the estimated internal and external vehicle trips into walking trips, transit trips, and vehicle trips (Tab: MXD Probabilities); and
6. Estimate VMT. (Tab: MXD Calcs)

All results including trip rates disaggregated by modes, purposes, and internalization, and VMT disaggregated by land uses and by trips purposes are summarized in “MXD Summary” tab.

ITE Equations

Single Family Residential (ITE Code 210)

$\mathrm{Ln}(T) = 0.92 * \mathrm{Ln}(D) + 2.71$

Multi-family Residential (ITE Code 220)

$T = 6.06 * D + 123.56$

Townhomes (ITE Code 230)

$\mathrm{Ln}(T) = 0.87 * \mathrm{Ln}(D) + 2.46$

Mobile Home (ITE Code 240)

$T = 3.52 * D + 277.51$

Retail (ITE Code 820)

$\mathrm{Ln}(T) = 0.65 * \mathrm{Ln}(X) + 5.83$

Office (ITE Code 710)

$\mathrm{Ln}(T) = 0.77 * \mathrm{Ln}(X) + 3.56$

Industrial (ITE Code 130)

$T = 6.96 * X$

7D Household Vehicle Ownership Model

Single Family Households

$$\mathrm{Ln}(V) = -1.42478 + [0.33331 * \mathrm{Ln}(HHSIZE)] + [0.220001 * \mathrm{Ln}(SFINCOME)] + [-0.09165 * \mathrm{Ln}(INTDEN)] + [-0.01382 * \mathrm{Ln}(EMP30T)]$$

Other Households

$$\mathrm{Ln}(V) = -2.27444 + [0.390903 * \mathrm{Ln}(OHHSIZE)] + [0.315116 * \mathrm{Ln}(OINCOME)] + [-0.1513 * \mathrm{Ln}(INTDEN1)] + [-0.02201 * \mathrm{Ln}(TMILE)]$$

MXD Trip Generation Model

Internal Share of Total Trips – HBW

$$\ln(P) / [1 + \ln(P)] = -1.75 + [0.389 * \ln(JOBPOP)] - [1.33 * \ln(HHSIZE)] - [0.99 * \ln(VEHCAP)]$$

Internal Share of Total Trips – HBO

$$\ln(P) / [1 + \ln(P)] = -2.43 + [0.486 * \ln(AREA)] + [0.399 * \ln(JOBPOP)] + [0.385 * \ln(INTDEN)] - [0.867 * \ln(HHSIZE)] - [0.59 * \ln(VEHCAP)]$$

Internal Share of Total Trips – NHB

$$\ln(P) / [1 + \ln(P)] = -5.32 + [0.208 * \ln(EMP)] + [0.468 * \ln(AREA)] + [0.638 * \ln(INTDEN)] - [0.237 * \ln(HHSIZE)] - [0.163 * \ln(VEHCAP)]$$

External Automobile Trip Length – HBW

$$L = 6.54 + [1.07 * \ln(AREA)] - [0.298 * \ln(JOBPOP)] - [1.19 * \ln(EMP30A)] + [2.76 * \ln(HHSIZE)] + [2.76 * \ln(VEHCAP]$$

External Automobile Trip Length – HBO

$$L = 4.33 - [0.356 * \ln(JOBPOP)] - [0.697 * \ln(EMP20A)] + [0.772 * \ln(HHSIZE)] + [1.48 * \ln(VEHCAP)]$$

External Automobile Trip Length – NHB

$$L = 8.99 - [0.282 * \ln(JOBPOP)] - [0.832 * \ln(INTDEN)] - [0.823 * \ln(EMP20A)] + [0.52 * \ln(HHSIZE)] + [1.06 * \ln(VEHCAP)]$$

Internal share of walk trips – HBW

$$\ln(P) / [1 + \ln(P)] = -18.56 + 1.91 * \ln(ACTDEN) + 5.72 * \ln(LUMIX) + 2.63 * \ln(HHSIZE)$$

Internal share of walk trips – HBO

$$\ln(P) / [1 + \ln(P)] = -12.18 + 0.751 * \ln(ACTDEN) + 0.803 * \ln(INTDEN)$$

Internal share of walk trips – NHB

$$\ln(P) / [1 + \ln(P)] = -10.81 + 0.43 * \ln(ACTDEN) + 1.11 * \ln(INTDEN)$$

External share of walk trips – HBW

$$\ln(P) / [1 + \ln(P)] = -5.55 + 0.226 * \ln(JOBPOP) + 0.385 * \ln(EMP1MILE) - 1.57$$

$* \ln(HHSIZE) - 1.84 * \ln(VEHCAP)$

External share of walk trips – HBO

$$\ln(P) / [1 + \ln(P)] = -10.96 - 0.415 * \ln(AREA) + 0.37 * \ln(ACTDEN) + 0.219 * \ln(JOBPOP) + 0.45 * \ln(EMP1MILE) - 0.486 * \ln(HHSIZE) - 0.768 * \ln(VEHCAP)$$

External share of walk trips – NHB

$$\ln(P) / [1 + \ln(P)] = -15.09 + 0.377 * \ln(ACTDEN) + 0.803 * \ln(INTDEN) + 0.44 * \ln(EMP1MILE) - 0.281 * \ln(HHSIZE) - 0.242 * \ln(VEHCAP)$$

External share of transit trips – HBW

$$\ln(P) / [1 + \ln(P)] = -8.05 + 1.12 * \ln(INTDEN) + 0.209 * \ln(EMP30T) - 1.14 * \ln(HHSIZE) - 1.68 * \ln(VEHCAP) + 0.357 * \ln(MXD25T)$$

External share of transit trips – HBO

$$\ln(P)/[1 + \ln(P)] = -6.08 + 0.324 * \ln(ACTDEN) - 0.958 * \ln(HHSIZE) - 1.09 * \ln(VEHCAP) + 0.467 * \ln(MXD25T)$$

External share of transit trips – NHB

$$\ln(P) / [1 + \ln(P)] = -2.69 + 0.134 * \ln(EMP30T) - 0.34 * \ln(MXD25T)$$

Explanatory Variables

ACTDEN = activity (population plus employment) density in MXD

AREA = total area of MXD

D = number of dwelling units in MXD

EMP =number of employment in MXD

EMP1MILE = number of employment in MXD's 1-mile buffer area

EMP20A = employment within 20-minute commute

EMP30A = employment within 30-minute commute

EMP30T = employment within 30-minute transit ride

HHSIZE = average household size

INTDEN = intersection density of MXD

INTDEN1 = intersection density of MXD and its 1-mile buffer area

JOPPOP = ratio of population to employment of MXD

LUMIX = land use mix entropy of MXD

MXD25T = proportion of area of MXD within 0.25 mile buffer of transit stops

OHHSIZE = average household size of non-single family households

OINCOME = median household income of non-single family households

P = percentage of trips

SFINCOME= median household income of single family households

T =number of daily vehicle trips

TMILE = number of transit stops within 1/4 mile buffer of MXD

V= number of vehicles per household

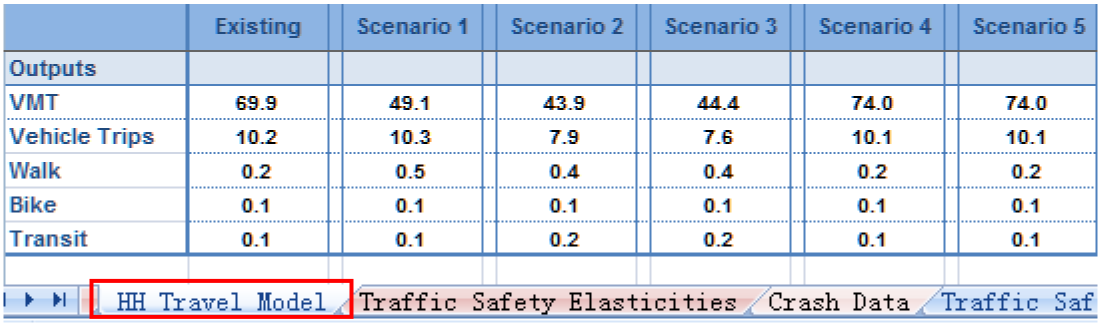
VEHCAP = number of vehicle per capita

X = 1,000 square feet of gross leasable area in MXD

Household Travel Model

Based on Ewing's study on household travel model (Ewing, 2012), the "HH Travel Model" is incorporated in the scenario builder spreadsheet of ET+Austin (Figure 4-9). It produces results including household VMT and household trip rate estimates by automobile, walking, biking, and transit generated by the households in the study area. Formulas are provided below.

Figure 4-9. The interface of the results of HH Travel Model



	Existing	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Outputs						
VMT	69.9	49.1	43.9	44.4	74.0	74.0
Vehicle Trips	10.2	10.3	7.9	7.6	10.1	10.1
Walk	0.2	0.5	0.4	0.4	0.2	0.2
Bike	0.1	0.1	0.1	0.1	0.1	0.1
Transit	0.1	0.1	0.2	0.2	0.1	0.1

Household VMT

Ln (HH VMT) = 2.51 + 0.76 * Ln (HHSIZE) + 0.158 * HHWORKERS + 0.172 * Ln(HHINCOME) – 0.102 * Ln (ACTDEN1) – 0.00767 * INTDEN1 – 0.0951 * Ln ((INT4W1) – 0.000941 * STOPDEN1 – 0.0523 * Ln (EMP10A)

Household Private Vehicle Trips

Ln (T) = -0.023 + 0.977 * Ln(HHSIZE) + 0.141 * Ln (HHINCOME) – 0.00055 * STOPDEN1/4 – 0.00001 * ACTDEN1 + 0.00619 * EMP10A

Household Walk Trips

Ln (T) = -3.64 + 0.424 * HHSIZE – 0.0892 * Ln (HHINCOME) + 0.379 * LUMIX1/4 + 0.279 * Ln(ACTDEN1) + 0.0114 * INT4W1 + 0.00507 * STOPDEN1

Household Bike Trips

Ln (T) = -5.91 + 0.472 * HHSIZE + 0.406 * LUMIX1/4 + 0.000006 * ACTDEN1 + 0.726 * Ln (INT4W1)

Household Transit Trips

Ln (T) = -0.837 - 0.575 * Ln (HHSIZE) + 0.255 * HHWORKERS – 0.462 * Ln(HHINCOME) + 0.321 * LUMIX1/4 + 0.00229 * STOPDEN1/4 + 0.161 * Ln (ACTDEN1/2)

Explanatory Variables

ACTDEN 1/2 = activity (population plus employment) density of 1/2 mile buffer of the study area

ACTDEN 1 = activity (population plus employment) density of 1 mile buffer of study area

EMP1MILE = number of employment in MXD's 1-mile buffer area

EMP10A = percentage of regional employment accessible within 10-minute commute by automobile

EMP30T = percentage of regional employment accessible within 30-minute transit ride trip

HHSIZE = average household size

HHWORKERS = average number of employed workers in the household

INTDEN1 = intersection density of the study area and its 1-mile buffer area

LUMIX1/4 = land use mix entropy of 1/4 mile buffer of the study area

STOPDEN1/4 = transit stop density of 1/4 mile buffer of the study area

STOPDEN1 = transit stop density of 1 mile buffer of the study area

T =number of daily household trips

Traffic Safety Model

Ewing and Kim's traffic safety model (Ewing et al., 2012) is incorporated within the scenario builder in "Traffic Safety" tab to estimate the total crash rate in the study area (Figure 4-10). Then based on statewide crash data, the crash rates by injury severity are estimated. Equation of traffic safety model is provided below.

Figure 4-10. The interface of “Traffic Safety” tab

	Existing	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Total Crash Rate	**8**	**175**	**363**	**423**	**290**	**290**
VMT per Capita	1,262	54	73	79	1,414	1,414
Employment Density	111	819	2,994	3,487	111	111
Intersection Density	44	75	87	86	44	44
Crashe Rate						
Fatal Crashes	**0**	**1**	**3**	**3**	**2**	**2**
Serious Injury Crashes	**1**	**27**	**55**	**65**	**44**	**44**
Other Injury Crashes	**2**	**37**	**76**	**89**	**61**	**61**
Non-Injury Crashes	**5**	**104**	**216**	**252**	**173**	**173**

Traffic Safety / Parking Demand Inputs & Calcs / Parking Time of Day Ca

Total Crash Rate

Total Crashes = POP * (EXCRASH / EXPOP) * (1 + 0.54 * (VMT – EXVMT) / EXVMT) * (1+ 0.18 * (EMPDEN – EXEMPDEN) / EXEMPDEN) * (1 – 0.53 * (INTDEN – EXINTDEN) / EXINTDEN)

Explanatory Variables

EXCRASH = existing total crash rate in the study area

EXEMPDEN = existing employment density in the study area

EXINTDEN = existing intersection density in the study area

EXPOP = existing population in the study area

EXVMT = existing VMT generated by the study area

EMPDEN = employment density of new development

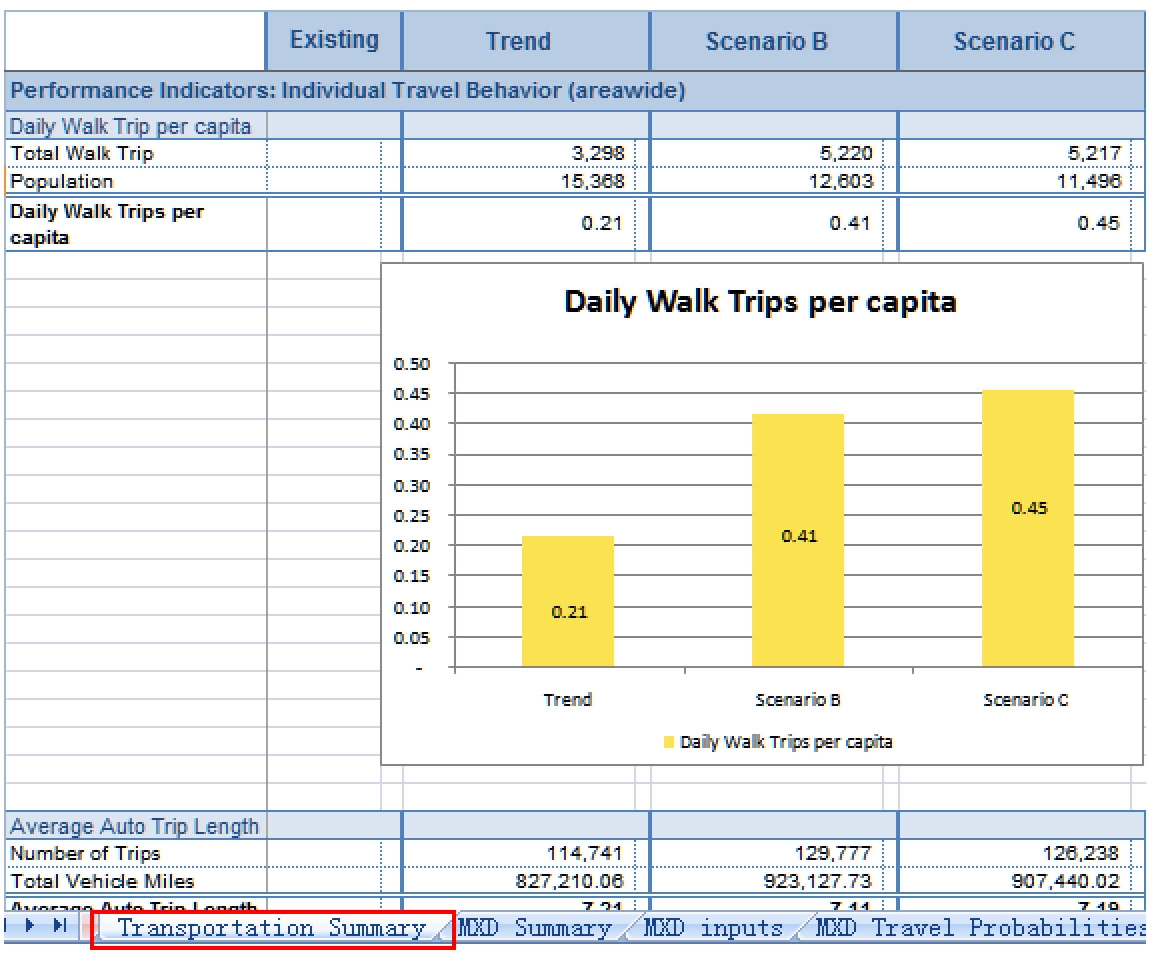
INTDEN = intersection density of new development

VMT = VMT generated by new development

Indicator Dashboard

Transportation indicators are summarized in "Transportation Summary" tab with tables and charts (Figure 4-11) based on formulas showed in table 2-1 and estimates from transportation models. As mentioned in the indicator development chapter, indicators are grouped in (1) supply indicators, and (2) performance indicators. Since ET provides basis for planners to make decisions, and future scenarios for residents, community, and developers, users are able to focus on the indicators that they are particularly interested in.

Figure 4-11. The interface of "Transportation Summary"



Land Use Scenarios

Hutto, Elgin, Dripping Spring, and Lockhart are selected by CATS project as four demonstration sites in 2011. The project has been engaged in public outreach during the two years. Substantial stakeholders and institutions are involved including the City of Austin, CAMPO, CAPCOG, the University of Texas at Austin, local governments, residents live in and near the demo sites, and developers. As partners with the SPP, the local governments provide staff support for the planning process and the City Council will decide whether to approve the final plans and strategies developed by the SPP team. And there is a Stakeholder Committee for each demo site to provide feedback on the SPP's planning efforts and products and assist in community outreach.

Besides, several public hearing meetings are conducted. The first public workshop introduced the project, and asked attendees to identify the major issues in their community in terms of transportation, housing, and economy. For example, Hutto concerns about the bicycle and pedestrian facilities, while Elgin would like to improve public transit system first. However, all four demo sites express the need to enhance the access to other cities in the region. At the second workshop, residents painted their preferred land use scenarios for demo sites in ET and received real–time evaluation of some critical indicators that they are most concerned about. Based on those land use scenarios that residents came up with, the SPP team produced two preferred scenarios. Compared with the trend scenario based on the studies that CAMPO has been done for years on the five-county MSA, residents were invited to the third workshop, and exchanged their opinions with their neighbors, developers, and planners.

ET+Austin defines nine development types: town center, compact neighborhood, single family neighborhood, main street commercial, corridor commercial, office, industrial, civic, and open space. Users can identify the development type for vacant parcels within the demo site by painting in ArcGIS map. Based on the existing conditions of demo sites, feedbacks from public outreach, and opinions from developers, and professional planners, three scenarios are created. Scenario A is the trend scenario, Scenario B aims to create balanced jobs and housing within the demo site, and Scenario C is towards a balance of jobs and housing citywide. Detailed information about land use scenarios for four demo sites, including maps and tables, are provided below.

Hutto

Hutto is one of the fastest growing communities in the region. The Hutto demo site has an area of 1567 acres, including several schools and commercial centers, and historic Old Town Hutto. The city is interested to preserve the old town characteristics and improve pedestrian and bicycle facilities. Also it expects to strengthen the downtown Hutto as the commercial, cultural and civic heart of the community, and develop the vacant lands near Downtown as a neighborhood with a diverse mix of housing types.

Figure 4-12. Land use scenarios of Hutto

Table 4-1. Summary table of Hutto scenarios

	Scenario A		Scenario B		Scenario C	
	Acres	%	Acres	%	Acres	%
Town Center	0.9	0.1%	12.1	1.3%	26.7	2.9%
Compact Neighborhood	3.8	0.4%	223.2	23.7%	263.6	28.8%
Single Family Neighborhood	843.7	87.6%	281	29.8%	159.7	17.4%
Main Street Commercial	3	0.3%	57.4	6.1%	14.6	1.6%
Corridor Commercial	17	1.8%	98.6	10.5%	92.4	10.1%
Office	6.1	0.6%	64.7	6.9%	124.2	13.6%
Industrial	57	5.9%	45.1	4.8%	59.1	6.5%
Civic	31.6	3.3%	69.2	7.4%	88.9	9.7%
Open Space	/	/	90.5	9.6%	86.4	9.4%
Total	963	100%	942	100%	916	100%

The land uses in trend scenario are mostly single-family housing. Scenario B contains balanced compact neighborhood and single-family neighborhood, and more main street commercial. Scenario C puts emphasis on the development of compact neighborhood, town center, and office.

Elgin

The Elgin demo site is primarily located in the historic downtown and includes a variety of land uses and a diverse mix of housing. It provides multi-modal transportation for the residents and contains mix-use development near transit service. The existing infrastructure is able to support future growth, thus development will include adaptive reuse and infill development. Also the city is interested in a plan to help create transit-oriented development within the area and improve pedestrian activity.

Figure 4-13. Land use scenarios of Elgin

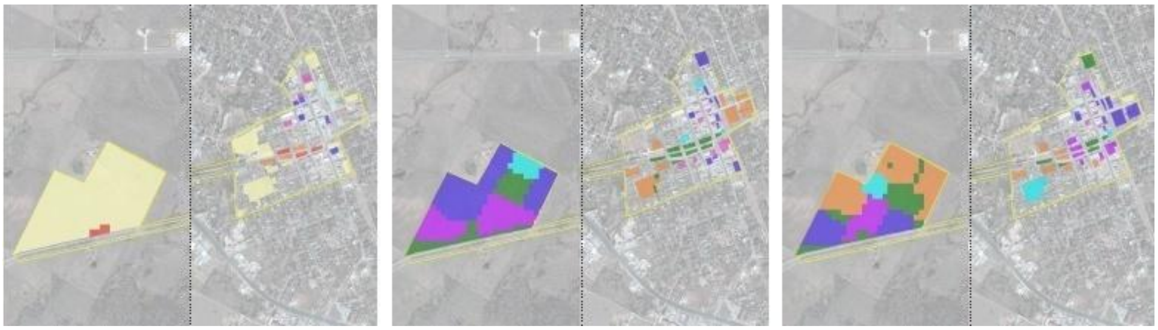


Table 4-2. Summary table of Elgin scenarios

	Scenario A		Scenario B		Scenario C	
	Acres	%	Acres	%	Acres	%
Town Center	/	/	25.7	25.2%	13.7	13.4%
Compact Neighborhood	1.4	1.3%	10.1	9.9%	37	36.3%
Single Family Neighborhood	96.8	91.2%	0.4	0.4%	1.1	1.1%
Main Street Commercial	1.4	1.3%	2.5	2.5%	0.7	0.7%
Corridor Commercial	2.8	2.7%	/	/	/	/
Office	1.6	1.5%	37.5	36.8%	21.7	21.3%
Industrial	2.1	2%	/	/	/	/
Civic	/	/	6.4	6.3%	8.6	8.5%
Open Space	/	/	19.4	19%	19	18.7%
Total	106	100%	102	100%	102	100%

More than 90 percent of developed lands in Scenario A are single family neighborhood. Land uses in Scenario B include 25 percent town center and 37 percent office. Developments in Scenario C lay emphasis on compact neighborhood and office.

Dripping Spring

Dripping Spring demo site includes the historic district with many remnant historic buildings and several city-owned properties. Recent development promotes a vibrant local economy, yet future growth is challenging existing small town infrastructure. Several existing land use codes need to be revised to meet the sustainable vision and the greenfield sites are likely to become a green activity center with unique natural environment.

Figure 4-14. Land use scenarios of Dripping Spring

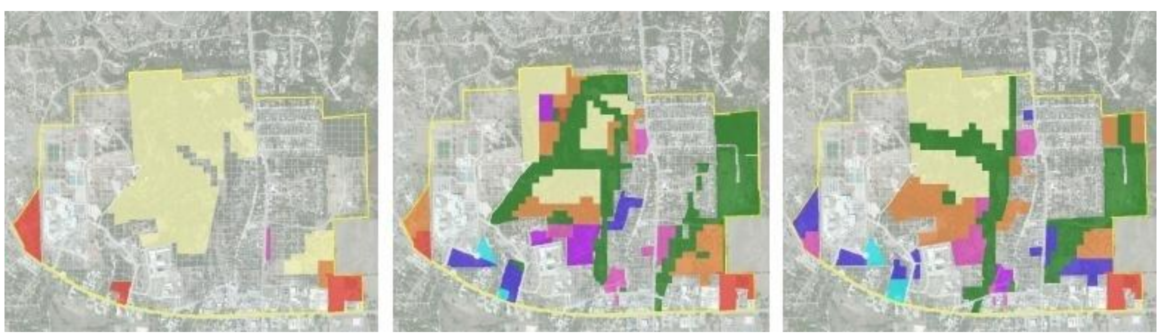


Table 4-3. Summary table of Dripping Spring scenarios

	Scenario A		Scenario B		Scenario C	
	Acres	%	Acres	%	Acres	%
Town Center	/	/	18.3	5.9%	4	1.3%
Compact Neighborhood	3.8	1.7%	61.9	20%	63.9	20.3%
Single Family Neighborhood	193.5	85.6%	64.8	20.9%	94.7	30%
Main Street Commercial	1.6	0.7%	18.4	6%	24.7	7.8%
Corridor Commercial	27.1	12%	15.5	5%	10.9	3.5%
Office	/	/	17.7	5.7%	31.6	10%
Industrial	/	/	/	/	/	/
Civic	/	/	4	1.3%	8.3	2.6%
Open Space	/	/	108.6	35.1%	77.1	24.5%
Total	226	100%	309	100%	315	100%

Nearly 90 percent development in trend scenario is single family neighborhood, and 12 percent is corridor commercial. Land uses in Scenario B and Scenario C contain more open space.

Lorkhart

The city of Lockhart is experiencing the development pressures and investment opportunities brought by the new construction of SH-130. Yet it is challenging to continue the viability of the historic central business district. Lockhart demo site includes a mix of land uses and several underutilized or vacant properties. The city has envisioned more diverse land uses and more walkable environment and is interested in a plan for the growth corridors that support and connect with downtown.

Figure 4-15. Land use scenarios of Lockhart

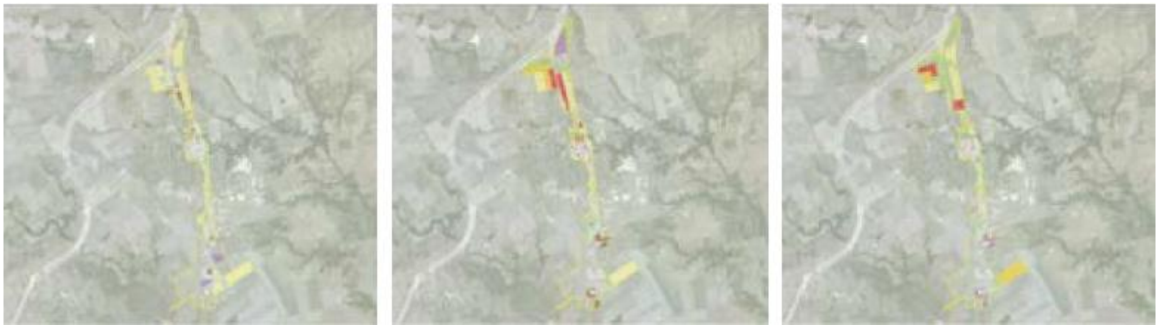


Table 4-4. Summary table of Lorkhart scenarios

	Scenario A		Scenario B		Scenario C	
	Acres	%	Acres	%	Acres	%
Town Center	/	/	7.8	1.6%	/	/
Compact Neighborhood	8.5	2.1%	58.6	11.8%	109.4	20.9%
Single Family Neighborhood	321	81.2%	168.9	33.9%	113.1	21.7%
Main Street Commercial	1	0.3%	66.9	13.4%	59.1	11.3%
Corridor Commercial	/	/	/	/	/	/
Office	23.1	5.8%	48.2	9.7%	0.5	0.1%
Industrial	41.8	10.6%	51.7	10.4%	50	9.6%
Civic	/	/	5.8	1.2%	11.4	2.2%
Open Space	/	/	90.2	18.1%	178.7	34.2%
Total	395	100%	498	100%	522	100%

More than 80 percent of new development in Scenario A is single family neighborhood. Scenario B puts emphasis on office development. And land uses in

Scenario C include balanced development of compact neighborhood and single family neighborhood, and more than 30 percent open space.

Indicator Analysis

Hutto

Scenario C has the highest activity density and land use mix score, and isaccommodated with the most adequate street network and sidewalks. It has the largest share of home-based work transit trips, highest personal walk trip rate, highest job accessibility and shortest average auto commute time. Despite of improved pedestrian and transit accessibility, it also generates the highest personal VMT among three scenarios. Scenario B, though, has the shortest average auto trip length as well as trip time.

Elgin

Scenario B has the highest activity density and land use mix score. Scenario B has the highest internal accessibility and Scenario C has the highest external accessibility. Overall, the average auto trip length and trip time is the lowest in Scenario C. But Scenario B has the highest job accessibility due to the large number of jobs in the study area. Supply of sidewalks and street network are most adequate in Scenario C, however, the pedestrian activities are most active in Scenario B.

Dripping Spring

Scenario C has the highest activity density and land use mix score among three scenarios. Overall, Scenario A provides the most connected and densest street network, Scenario B has the shortest average auto trip length and trip time, and Scenario C generates the highest walk trips and transit ridership and lowest VMT per capita, with highest job accessibility.

Lorkhart

Scenario B has the largest activity density and land use mix score. Scenario C provides the most adequate bicycle and pedestrian facilities. The walk trip rate and transit trip rate are highest in Scenario B, yet the internal trip rate is the lowest. It has the highest job accessibility due to substantial jobs in the study area. Also Scenario B generates the highest personal VMT among three scenarios. Scenario C has the shortest average auto trip length and trip time.

5. SUMMARY AND CONCLUSIONS

Envision Tomorrow generates substantial data about land uses and building types for each scenario. It provides a platform that allows various models based on those available land use, urban form and demographic data to be incorporated within it. And real-time evaluation of impacts on land use, environment, economy, social equity, and transportation of new development is produced.

Usually there are tradeoffs between the interest groups when making plans. Developers are interested in economic benefits, while residents concern about improvements on the livability including safety, mobility, accessibility to grocery stores and medical care, etc. The community strives to preserve its unique characteristic while connect with the region, and environmentalists aim to minimize the negative impacts on the natural environment. Under this circumstance, ET provides a forum for all stakeholders, including public agencies, non-profit organizations, developers, communities, and residents to be involved in the process of planning. Users are able to envision what will happen to the community, and especially, what the community will become due tonew developments.

Three models are incorporated within original ET spreadsheet to evaluate transportation sustainability indicators for SPP. Models are developed by the University of Utah, based on travel surveys data from six regions and crash data from the nation. Based on the definition of MXD, the validity and reliability of MXD trip generation model is limited by small geography coverage. Thus it cannot account for regional travel estimates.

Some variables in MXD trip generation model and household travel model require data from the buffer area of the study site, or regional data. ET+Austin assumes that areas outside the study site would remain the same in the planning year due to the lack of such data, which is not the case in reality. Thus the model is useful in comparing the impacts of transportation facilities and activities between different scenarios, but is limited to get accurate estimates.

Also the household travel model and traffic safety model only consider limited independent variables. For example, the household travel model has omitted those variables related to demand management, including parking prices and parking supplies, and self-selection that people tend to choose residential locations that match their travel preferences, which has been identified by several studies (Cao, 2009; Handy, 2006). And the unexplained, yet critical variables of traffic safety model include speed, highway classification, driver action, and time of day.

The data of MXD trip generation model and household travel model is derived from six various regions, with all types of development pattern. And the traffic safety model uses nationwide crash rate at the county level, assuming each county as a unit of homogeneous density, land use mix, and accessibility, yet there are likely to be large differences within its borders. However, cities and communities are able to build their own models to build in ET based on sufficient local travel survey data and land use data.

At last, the tool focuses on a small area and projects transportation outcome from site-scale projects through static extrapolations of existing empirical parameters, whereas transportation activities are dynamic and affected by the improvements on overall region. Especially, the 37 Activity Centers are proposed be connected as a regional network. There is a lack of such estimates of interconnection between activity centers and influences of transportation development of other areas. The tool is expected to measure the impacts of alternative development strategies expanding from the four demo sites to all 37 Activity Centers in the Austin region, therefore a tool with dynamic, regional modeling capability would be necessary in order to fully capture the regional effects.

Appendix 1

Pop-up Text

Activity Density

Why is it important?

Activity refers to the residential population plus employment within the study area. It is positively associated with trip rates generated as well as attracted. It is showed that the higher the activity density is, the better the pedestrian environment and the more accessible attractions will be to those who are interested in traveling into the community. Thus activity density also supports transportation choice on walking for both internal and external trips, due to the better overall walking conditions and increased number of trip chaining opportunities (Ewing et al., 2011).

What are some strategies for improvement?

- Encourage the development of mixed-use office.
- Provide diverse housing choices including multi-family housing and town homes.

Job-Population Balance

Why is it important?

The Job-Population Balance Index measures the balance between the number of jobs and residents. The value of index ranges from 0, where only jobs or residents are present in a study area, to 1, where the ratio of jobs to residents is optimal in terms of trip generation. The value 0.2 represents a balance of employment and population that generates the highest trip rate (Ewing et al., 2011).

The internalization of trips is most significantly related to the job-population balance within the area. A high job-population balance value indicates more opportunities to live and work on-site. It also affects the mode choices for external trips, although the association is not very obvious. For external home-based trips, the odds of walking increase with job-population balance within the study area. One possibility is that on-site balance creates opportunities for trip chaining, another one is that on-site balance is associated with off-site, nearby balance as well, which further induces walking in the community. Job-population balance is also negatively related to external automobile trip length. Areas with good job-population balance reduce the need for very long external trips, and facilitate trip chaining. Thus for external home-based trips by private vehicle, trip distance declines with a study area's job-population balance (Ewing et al., 2011).

What are some strategies for improvement?

- Balance the development of residential and office/industrial.

Land Use Mix

Why is it important?

Land use mix captures the variety of land uses within the study area. Land uses include residential, retail, office, and industrial. The entropy index varies in value from 0, where all developed land is in one land use category, to 1, where developed land is evenly divided among these land use categories. Mixed-use developments increase the walkability and bikeability of the area. Therefore land use mix is positively associated with internal capture of trips and non-motorized trips (Ewing et al., 2011). Plus, combined with improved walkability, increasing land use mix tends to be particularly effective at reducing automobile shopping and recreational trips (Littman, 2012).

What are some strategies for improvement?

- Determine the mix of uses of the area.
- Determine appropriate areas for mixed-use zoning, such as downtown, commercial centers, employment centers, main streets, corridors or nodes in neighborhoods, and transportation-efficient development.
- Identify stakeholders likely to be affected by mixed-use development and representing various points of view in the community.
- Promote the benefits of mixed-use development.
- Adopt new mixed-use zoning requirements.

Street Connectivity

Why is it important?

Connectivity refers to the density of connections in path or road network and the directness of links. As connectivity increases, travel distances decrease and route options increase. Hence there are more direct travel between destinations and route options, non-motorized travel becomes more feasible, and a more accessible and resilient system is created. A connected road network tends to emphasize accessibility by accommodating more travel with traffic dispersed over more roads, improving walking and cycling conditions, and supporting transit use. Sometimes different levels of connectivity are intentionally applied to different modes (VTPI, 2012).

A *Connectivity Index* can be used to quantify how well a roadway network connects the destinations. One of the methods is to measure the number of surface street intersections within a given area (Handy, Peterson, and Butler, 2004), such as a square mile. The more intersections there are, the greater the degree of connectivity is. It is found that increased street intersection density reduces VMT, and increases the trip rates of walking and public transit (Handy, Tal and Boarnet, 2010). Intersection density is also positively associated with the odds of internal capture of trips (Ewing et al., 2011). The Congress for the New Urbanism proposes using a metric of 150 intersections per square mile (CNU).

What are some strategies for improvement?

- Develop a well-connected road or path network that has many short links, numerous intersections, and minimal dead-ends (cul-de-sacs).
- Build the internal circulation route as an interconnected, grid-like transportation system. Green space with size longer than 150 feet must include a pedestrian and bicycle shared-use path.

- Set the maximum block size. The site shall be divided into internal blocks no longer than 660 feet by 330 feet from curb to curb. The maximum block length applies both to blocks containing buildings and blocks containing surface parking. Blocks must not exceed 660 by 330 in most cases.

Proportion of Area within 1/4 mile of Transit Stops

Why is it important?

Typically 1/4 mile is considered a standard walking distance for most people could accommodate. Residence within the standard quarter-mile walking distance of a bus stop indicates acceptable accessibility to transit. Thus the existence of transit stops within 1/4 mile increases the probability that people would choose to take public transit. For external home-based trips, the odds of transit use are significantly higher for households living within 1/4 mile of a bus stop than those further away (Ewing et al., 2011). Also public transit is the transportation mode that is most likely to replace private vehicles for long-distance trips. Integrated with improvements on bicycle and pedestrian facilities, community with transit stops nearby could encourage non-motorized transportation modes.

What are some strategies for improvement?

- Incorporate public transportation plan into community planning.
- Incorporate the community into regional transportation plans that include public transit.
- Encourage high-density and mixed-use residential and commercial development within a radius of 1/4 to 1/2 mile from a transit stop to maximize access to public transport.

Street Network Density

Why is it important?

Street network density refers to the ratio of the length (in miles) of scenario's total road network to the land area (in square miles). Higher street network density is usually associated with better street connectivity. Street density is highly significant associated with travelers' mode choice, especially on non-work trips (Ewing et al., 2011). Also, denser street networks are related with fewer crashes across all severity of injury levels (Marshall and Garrick, 2011).

What are some strategies for improvement?

- Develop a well-connected road or path network that has many short links, numerous intersections, and minimal dead-ends (cul-de-sacs).
- Build the internal circulation route as an interconnected, grid-like transportation system. Green space with size longer than 150 feet must include a pedestrian and bicycle shared-use path.
- Set the maximum block size. The site shall be divided into internal blocks no longer than 660 feet by 330 feet from curb to curb. The maximum block length applies both to blocks containing buildings and blocks containing surface parking. Blocks must not exceed 660 by 330 in most cases.

Transit Stop Coverage

Why is it important?

Transit stop coverage measures the density of transit stops of the study area (Criterion Planners/Engineers Inc, 2002). High transit stop coverage rate provides for more opportunities to access transit. Better transit accessibility results in a higher percentage of trips by public transit and a lower percentage by driving. Lessvehicle trips can lower VMT, mitigate congestion impacts, and reduce vehicle ownership. It also has environmental impacts in the form of reduced carbon emission.

It is found that improved transit stop coverage affects travelers' transit mode choice with the elasticity value at 0.08. (Cervero, Ewing, 2010).

What are some strategies for improvement?

- Public transit improvements include providing high quality service and riding experiences, increased service frequency, expanding routes, high punctuality, lower fares, convenient pricing systems, improved vehicles, HOV priority, improved transit stations and waiting areas, accessible riding information, and easy access to transit stops.
- Provide for interagency coordination of transit services in several of its transit funding programs.
- Improve the coordination between the urban transit provider and adjacent suburban or rural provider(s).
- Develop regional plan for public transportation coordination.

Bicycle Network Coverage

Why is it important?

Bicycle network coverage measures the proportion of streets with bike lanes in the study area (Criterion Planners/Engineers Inc, 2002). Recommended by the Smart Growth America Organization that complete streets should be designed for all users instead of only for cars (Smith, 2010), this indicator measures the completeness that street system is accommodated to cyclists. Cycling is one of the most affordable transportation options. High bicycle network coverage provides cycling as an alternative transportation option and improved mobility, especially for non-drivers. Enhanced bicycle facilities create a more balanced transportation system with lower automobile dependency, and promote social equity for people who are transportation disadvantaged. The shift to non-motorized modes also has an effect on congestion mitigation, improved efficiency of street and parking infrastructures, and support on other transportation alternatives. The value of bicycle network coverage varies from 0, where no bike lane is installed to the street in the study area, to 2, where there are complete bike lanes for both directions of the road. Generally the value of 1 indicates that adequate bike lanes equipped in the area.

What are some strategies for improvement?

- Provide improved bicycle facility management and maintenance, including adequate bike lanes and paths, bicycle parking, and bike racks on the buses.
- Provide separate bike lanes for cyclists and implement traffic calming strategies to reduce the conflicts between bicycles and cars on the major roads.
- Promote bicycle sharing program over the region.
- Improve the cooperation between leaders engaged in planning advocacy and implementation all over the region.

Sidewalk Completeness

Why is it important?

Sidewalk completeness measures the proportion of streets with bike lanes in the study area (Criterion Planners/Engineers Inc, 2002). Recommended by the Smart Growth America Organization that complete streets should be designed for all users instead of only for cars (Smith, 2010), this indicatormeasures the completeness that street system is accommodated to pedestrians. The availability of sidewalks significantly improves the accessibility for pedestrians and increases the likelihood that residents and employees in the area will walk to final and intermediate destinations.A complete sidewalk network is one of the important ingredients in a pedestrian-friendly environment. It enhances the sense of pedestrian environment, provides people with more travel alternatives, and reduces the frequency of vehicle-pedestrian collisions. The replacement of vehicle trips by walk trips reduces the vehicle miles traveled (VMT), mitigates traffic congestion, benefits the environment, and improves the health condition of the whole community. Also, it provides equal transportation alternatives, especially for those who do not have a car, and who are unable, or do not want drive a car. The value of sidewalk completeness varies from 0, where no sidewalk is installed to the street in the study area, to 1, where there are complete sidewalks for both direction of the road.

It is found that sidewalk completeness improves the rate of walk mode choice, with the elasticity value ranging from 0.27 to 1.23 (Ewing et al., 2010, Rodriguez & Joo, 2004). It is also indicated that sidewalk completeness can increase transit mode choice for commuter trips at the elasticity value 0.28 (Rodriguez & Joo, 2004).

What are some strategies for improvement?

- Provide continuous and ample sidewalks along both sides of all roads, with exceptions where low pedestrian demand is expected.

- Provide pedestrian paths at street's cul-de-sacs.
- Provide sidewalks with at least 5 feet width. Set back the sidewalks with a planting strip to separate pedestrians from vehicles where the right-of-way is appropriate.
- Use appropriate sidewalk paving treatments that can be easily and properly maintained. Use permeable pavement to increase rainwater infiltration and groundwater recharge. It enhances pedestrian comfort and emphasize pedestrian environment.
- Provide sidewalks with appropriate pavement and curb ramps between the sidewalks and roadways at all intersections and mid-block crosswalks for people using wheelchairs as well as for people who have trouble stepping up and down high curbs. Sidewalks should be wide enough for at least one wheelchair. All obstacles, including public facilities should be removed from sidewalks. Make the community accessible to people of all abilities, including pedestrians with mobility impairments.
- Install appropriate neighborhood light on both sides of the streets to improve pedestrians' safety at night.
- Increase the funding for sidewalk projects.
- Work with developers to obtain the rights-of-way.

Sidewalk Density

Why is it important?

Sidewalk density refers to ratio of the length (in miles) of sidewalks to the study area's land area (in square miles). Higher sidewalk density is usually associated with better connectivity for pedestrians. And it is positively associated with increased walk trips due to the improved connectivity, and fewer auto trips because vehicles have to make more frequent stops at intersections. Also enhanced sidewalk connectivity improves transit accessibility where transit stops area available, therefore increases the odds of transit trips.

What are some strategies for improvement?

- Provide sidewalks along both sides of all roads, with exceptions where low pedestrian demand is expected.
- Create an interconnected sidewalk network to increase directness of pedestrian route.
- Increase funding for sidewalk projects.
- Work with developers to obtain the rights-of-way.
- Set the maximum block size for new developments.

Vehicle per Capita

Why is it important?

This indicator estimates the vehicles per capita within the study area. Lower vehicle ownership indicates less dependence on automobile.

What are some strategies for improvement?

- Provide fewer parking spaces, or increase parking fee in town center and in high density area.

Parking Supply

Why is it important?

This indicator estimates the number of parking spaces associated with the new developments. Parking convenience affects the ease of reaching destinations and therefore affects overall accessibility (Litman, 2012). However, parking facilities are a major cost to society, and affect travelers' mode choice. By reducing parking spaces, along with improvement on public transport service, and bicycle and pedestrian facilities, the odds of personal vehicle trips decrease.

What are some strategies for improvement?

- Reduce minimum parking requirements.
- Incorporate parking maximums or area-wide parking caps to ensure that there is not an excess supply of parking.
- Permit shared parking for different buildings and facilities to take advantage of different peak parking characteristics.

Internal Trips

Why is it important?

This indicator estimates the number of trips that remain within the study area by trip purposes.

What are some strategies for improvement?

- Encourage compact and mixed uses in the community to provide essential services and support commercial activities in the walking distance for households.
- Improve street connectivity.
- Improve bicycle and pedestrian facilities.

Internal Walk Trips

Why is it important?

This indicator estimates the number of walk trips within the area by trip purposes.

What are some strategies for improvement?

- Encourage compact and mixed uses in community to provide essential service and commercial activities in walking distance for households within the study area.
- Improve street connectivity.
- Improve bicycle and pedestrian facilities.
- Enhance the overall walking environment.

External Walk Trips

Why is it important?

This indicator estimates the number of walk trips to or from outside of the study area by trip purposes.

What are some strategies for improvement?

- Improve street connectivity.
- Improve bicycle and pedestrian facilities.
- Enhance the overall walking environment.

External Transit Trips

Why is it important?

This indicator estimates the number of transit trips generated or attracted by the study area disaggregated by trip purposes. It is recommended that a desirable transportation system is one that home-based work trips are accommodated by public transit as an alternative of driving because commuting trips are usually routine in terms of travel locations and time, and home-based other trips are accomplished by walking and bicycling if the community can provide for residents services including education, medical care, and retail, and access to fresh food within appropriate distance.

What are some strategies for improvement?

- Provide public transportation service to accommodate the needs of home-based work trips.
- Improve street connectivity.
- Improve bicycle and pedestrian facilities.
- Enhance the overall walking environment.

Total VMT Generated by Residential Development

Why is it important?

This indicator estimates the vehicle miles traveled (VMT) for different trip purposes generated by residential land use.

What are some strategies for improvement?

- Encourage compact and mixed uses in community to provide essential services and support commercial activities in walking distance for households within the study area.
- Improve street connectivity.
- Provide public transportation service to accommodate the needs of home-based work trips.
- Improve bicycle and pedestrian facilities.
- Enhance the overall walking environment.

Total VMT Generated by Retail Development

Why is it important?

This indicator estimates the vehicle miles traveled (VMT) for different trip purposes generated by retail land use.

What are some strategies for improvement?

- Encourage compact and mixed uses in community to provide essential services and support commercial activities in walking distance for households within the study area.
- Improve street connectivity.
- Improve bicycle and pedestrian facilities.
- Enhance the overall walking environment.

Total VMT Generated by Office/Industrial Development

Why is it important?

This indicator estimates the vehicle miles traveled (VMT) for different trip purposes generated by office and industrial land uses.

What are some strategies for improvement?

- Encourage compact and mixed uses in community to provide essential services and support commercial activities in walking distance for households within the study area.
- Improve street connectivity.
- Provide public transportation service to accommodate the needs of home-based work trips.
- Improve bicycle and pedestrian facilities.
- Enhance the overall walking environment.

Percentage of Internal Trips

Why is it important?

This indicator estimates the percentage of internal trips. The number of internal trips is significantly associated with the variety of land uses within the study area. Trips between on-site land uses are able to be made without travel on the off-site street system due to the mixed uses. Also, the replacement of external car trips by internal trips, within walking or biking distance, increases the non-motorized trip share.

What are some strategies for improvement?

- Encourage compact and mixed uses in community to provide essential service and commercial activities in walking distance for households.
- Provide facilities for pedestrians and cyclists, including sidewalks, designated bike lanes, bike racks, safe crossings, and lights, etc.
- Enhance the overall walking environment.

Percentage of Walk Trips

Why is it important?

This indicator estimates the walk trip share. A transportation system that is conducive to walking can reap many benefits in terms of health of individuals, reduced traffic congestion, and improved quality of life. Economic rewards are also realized through reduction in health care costs, decreased vehicle operation costs, and increased economic vitality of communities. Finally, walkable communities are more equitable in that they provide transportation choice for all citizens, regardless of their ability to afford an automobile.

What are some strategies for improvement?

- Mix the uses to bring the origins and destinations closer.
- Provide appropriate landscaping with trees, shades, flowers, and bushes to create a pleasant pedestrian environment.
- Encourage shops and businesses that open directly to the sidewalks to make friendly and unique building faces.

Percentage of Transit Trips

Why is it important?

This indicator estimates the transit trip share. Public transportation provides an affordable alternative to driving. It offers mobility for those who do not drive or cannot drive. Public transportation facilities and corridors encourage economic and social activities and help create strong neighborhood centers, thus foster more livable communities.

What are some strategies for improvement?

- Focus on the market to primarily accommodate home-based work trips.
- Allocate more money to build new transit routes, expand existing transit system, and provide public transportation facilities.
- Integrate transit system with land use regulations.
- Provide access to transit stops.

Total Trips

Why is it important?

This indicator estimates the total trips generated and attracted by the study area. With more transportation alternatives provided, and better connectivity and accessibility, more trips would be generated.

What are some strategies for improvement?

- Mix the land uses within the study area.
- Provide facilities to accommodate transit trips, walking, and biking.

Total Transit Trips

Why is it important?

This indicator estimates the total transit trips of the study area. Public transportation provides an affordable alternative to driving. It offers mobility for those who do not drive or cannot drive. The number of total transit trips represents the demand on the transit system from mass transit operators.

What are some strategies for improvement?

- Focus on the market to primarily accommodate home-based work trips.
- Allocate more money on public transportation system including building new transit routes, expanding existing transit system, and providing public transportation facilities.
- Provide safe and reliable transit service.
- Integrate transit system with land use regulations.
- Provide access to transit stops.

Job Accessibility

Why is it important?

This indicator measures the ease of people reaching their jobs. People who live in places with higher accessibility can reach many destinations more quickly, while people in less accessible places reach fewer places in the same amount of time. Accessibility is a measure of potential for interaction. It accounts for both transportation and activity distribution patterns, and has been considered an important indicator of the quality of life. Places with higher job accessibility are usually more likely to attract people live and work there, therefore bringing more economic opportunities for the community. Also, high accessibility attributes to the social equality because it provides more opportunities of reaching destinations for those without a car or unable to drive.

What are some strategies for improvement?

- Increase the level of service of the roadway network and public transit system.
- Create a community friendly to pedestrians and cyclists.
- Cluster jobs and residents at a location with more transportation options and in area with greater connectivity to job centers.

Parking Demand

Why is it important?

This indicator estimates the increased parking demand by new development. Parking facilities are a major cost to society, and affect travelers' mode choice. By reducing parking spaces, along with improvement on public transport service, and bicycle and pedestrian facilities, the odds of personal vehicle trips decrease.

What are some strategies for improvement?

- Create town center or neighborhood center with supporting public transit service.
- Encourage compact, mixed-use developments.
- Provide facilities to accommodate walking and biking.
- Permit shared parking for different buildings and facilities to take advantage of different peak parking characteristics.

Daily Walk Trip per Capita

Why is it important?

This indicator estimates the daily walk trip per capita. Regular daily physical activities benefit individual health by reducing the risk of many disease and obesity as well as environment. It also reflects the livability of community because there tend to be more activities taking place on the streets and more interactions between neighbors.

What are some strategies for improvement?

- Encourage mixed-use and compact developments.
- Provide adequate sidewalks and pedestrian facilities.
- Provide appropriate landscaping to create a pleasant pedestrian environment.
- Implement traffic calming strategies to create a safe environment for pedestrians.
- Encourage shops and businesses that open directly to the sidewalks to make friendly and unique building faces.

Average Auto Trip Length

Why is it important?

This indicator estimates the average auto trip length. Shorter length indicates better accessibility to the destinations.

What are some strategies for improvement?

- Improve the existing transportation system.
- Improve street connectivity.
- Implement strategies for traffic congestion mitigation.
- Encourage the mixed-use and compact developments.

Average Internal Auto Trip Length

Why is it important?

This indicator estimates the average internal auto trip length by purposes. Shorter length indicates better accessibility to the destinations.

What are some strategies for improvement?

- Encourage the mixed-use and compact developments to provide essential services and support commercial activities within walking distance for households in the community.
- Improve street connectivity.

Average External Auto Trip Length

Why is it important?

This indicator estimates the average external auto trip length by purposes. Shorter length indicates better accessibility to the destinations.

What are some strategies for improvement?

- Improve the existing transportation system.
- Improve street connectivity.
- Implement strategies for traffic congestion mitigation.

Average Auto Trip Time

Why is it important?

This indicator estimates the average auto trip time. Less time indicates better accessibility to the destinations.

What are some strategies for improvement?

- Improve the existing transportation system.
- Improve street connectivity.
- Implement strategies for traffic congestion mitigation.
- Encourage mixed-use and compact developments.

Average Auto Commute Time

Why is it important?

It estimates the average auto trip time. Less commute time indicates better accessibility to jobs for residents in the study area.

What are some strategies for improvement?

- Cluster job opportunities and individuals at a location closer to the existing transportation system.
- Encourage the mixed uses of residential and office.
- Improve the existing transportation system.
- Improve street connectivity.
- Implement strategies for traffic congestion mitigation.

VMT per Capita

Why is it important?

This indicator estimates the number of vehicle miles traveled (VMT) per capita on the roadway system by motor vehicles. High personal VMT results in traffic congestion on highway or urban core area in most places, followed by the environmental issues including gas consumption and air pollution. It is usually the result of high dependency on private vehicles, and may also indicate less accessibility for those who do not own a car or are unable to drive.

What are some strategies for improvement?

- Encourage the use public transportation and carpooling
- Provide high-quality, reliable and safe public transportation system that is easily access to.
- Create friendly environment for pedestrians and cyclists to support non-mobile transportation alternatives.
- Integrate land use planning with transportation system and promote mixed-used and compact development, and transit-oriented development (TOD).

Social Cost of GHG Emissions

Why is it important?

Major greenhouse gases (GHG) include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and industrial gases. The vast majority of emissions are CO_2. Increased emissions of GHG due to human activities have been linked to global warming and changes in climate patterns. The social cost of GHG emissions estimates the monetary valuation that per capita in study area is likely to pay for the damages that may be caused by these increased emissions in the present, as well as in the future.

What are some strategies for improvement?

- Increase the usage of alternative fuels.
- Improve fuel efficiency.
- Implement carpool incentive programs to redue single occupant auto travel.
- Improve public transit service.
- Improve pedestrian and bicycle facilities.

Social Cost of CAC Emissions

Why is it important?

Criteria air contaminants (CAC) are a set of air pollutants primarily emitted from the combustion of fossil fuels or industrial processes. CAC in particular refer to a group of contaminants that include sulphur dioxide (SO2), nitrogen oxides (NOx), volatile organic compounds (VOC), and particulate matter (primarily PM2.5). The social cost of CAC estimates the monetary valuation that per capita in study area is likely to pay for the damages to human health, the environment, and structures caused by these pollutants.

What are some strategies for improvement?

- Increase the usage of alternative fuels.
- Improve fuel efficiency.
- Implement carpool incentive programs to redue single occupant auto travel.
- Improve public transit service.
- Improve pedestrian and bicycle facilities.

Social Cost of Motor Vehicle Accidents

Why is it important?

Accident costs are the costs in social resources associated with an accident and the loss in welfare incurred as a result of an accident. The specific costs that are typically covered are comprehensive in nature and include both private costs to the affected individuals and costs to society at large; costs incurred by an individual include out-of-pocket costs, health care costs, and pain and suffering. This indicator estimates the cost that per capita in study area is likely to pay for motor vehicle accidents.

What are some strategies for improvement?

- Incorporate "complete streets" design strategies into planning to accommodate all transportation users.
- Implement traffic calming measures.
- Improve roadway facilities such as roundabouts, speed bumps, traffic islands, etc.
- Implement site-specific projects to improve traffic safety.

Vehicle Operating Costs

Why is it important?

Vehicle operating costs (VOC) represent the personal costs borne by travelers using their own vehicle to make a trip. Total VOC are indirectly based on changes in vehicle miles traveled (VMT). Generally, VOC include fuel costs, tire costs, repair and maintenance costs, vehicle depreciation, and oil costs. This indicator estimates the cost that per capita in study area is likely to pay for vehicle operating.

What are some strategies for improvement?

- Implement congestion mitigation programs.
- Improve access to transit.
- Improve major road networks.
- Improve pedestrian and bicycle facilities.

Values of Travel Time Savings

Why is it important?

Travel time has value because travelers can dedicate this time to work and earning income, or use it to engage in leisure activities, rather than spending time traveling, possibly in uncomfortable and stressful conditions. The value of travel time therefore represents the opportunity cost of alternative activities and the cost of discomfort that may be involved in traveling. This indicator estimates the monetary valuation of travel time savings per trip generated by activities in study area compared to existing condition.

What are some strategies for improvement?

- Implement congestion mitigation programs.
- Improve access to transit.
- Improve major road networks.
- Improve pedestrian and bicycle facilities.
- Integrate land use regulations with transport projects.

Commuter Bike Mobility Benefits

Why is it important?

Commuter bike mobility benefits refer to the monetary value of people's greater satisfaction from cycling in their communities. This indicator estimates the monetary valuation of benefits that per capita in study area is likely to receive due to the improvements on bike mobility.

What are some strategies for improvement?

- Incorporate "complete streets" design strategies into planning to accommodate all transportation users.
- Provide adequate bike lanes.
- Provide bike parking facilities and showers at workplaces.
- Provide multi-modal corridors.

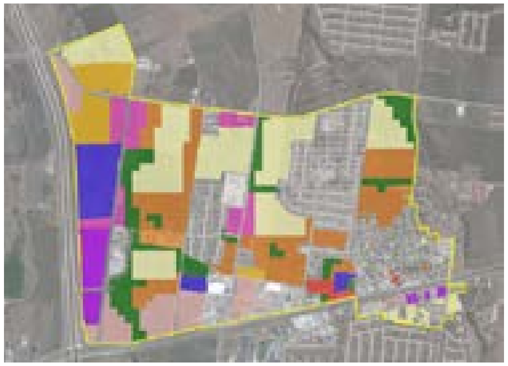
Appendix 2

Indicator Results

Land Use Scenarios - Hutto

Scenario A: Trend

Scenario B: Balance jobs and housing within the Demonstration Site



Scenario C: Towards a balance of jobs and housing citywide

Legend

Summary Table

	Scenario A		Scenario B		Scenario C	
	Acres	%	Acres	%	Acres	%
Town Center	0.9	0.1%	12.1	1.3%	26.7	2.9%
Compact Neighborhood	3.8	0.4%	223.2	23.7%	263.6	28.8%
Single Family Neighborhood Subdivision	843.7	87.6%	281	29.8%	159.7	17.4%
Main Street Commercial	3	0.3%	57.4	6.1%	14.6	1.6%
Highway-Oriented Retail and Office	17	1.8%	98.6	10.5%	92.4	10.1%
Office	6.1	0.6%	64.7	6.9%	124.2	13.6%
Industrial	57	5.9%	45.1	4.8%	59.1	6.5%
Civic	31.6	3.3%	69.2	7.4%	88.9	9.7%
Open Space	/	/	90.5	9.6%	86.4	9.4%
Total	**963**	**100%**	**942**	**100%**	**916**	**100%**

Activity Density - Hutto

Definition

Activity density refers to the residential population plus employment within the study area. Higher activity density indicates higher trip rates generated and attracted. Higher activity density within the study area supports internal walk trips, and is also positively related to walking on external trips.

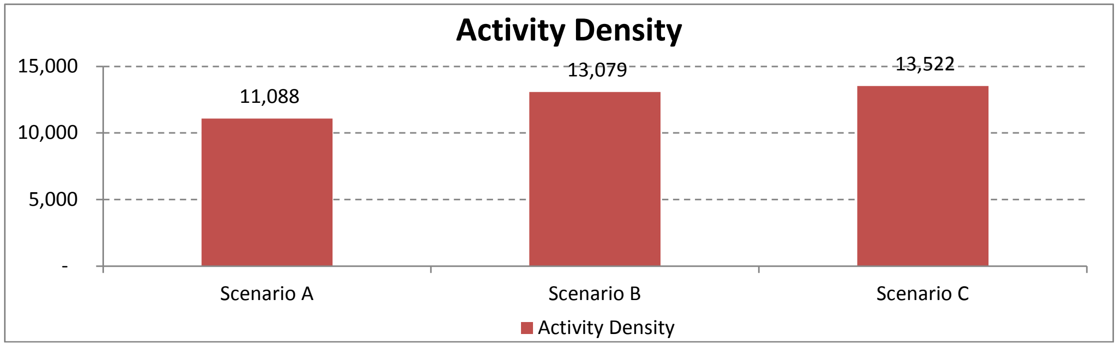
A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

Scenario A has the highest residential population. However, due to the mixed use development in Scenario B and Scenario C, the number of jobs in the two scenarios is higher than the Trend Scenario. Overall, Scenario C has the highest activity density.



What would improve the results

- Encourage the development of mixed use and office uses.
- Provide diverse housing choices including multi-family housing and town homes.

	Scenario A	Scenario B	Scenario C
Population	14,951	12,186	11,079
Employment	1,734	7,059	8,266
Area (square mile)	1.5	1.47	1.43
Activity Density (per sq mile)	**11,088**	**13,079**	**13,522**

Job-Population Balance - Hutto

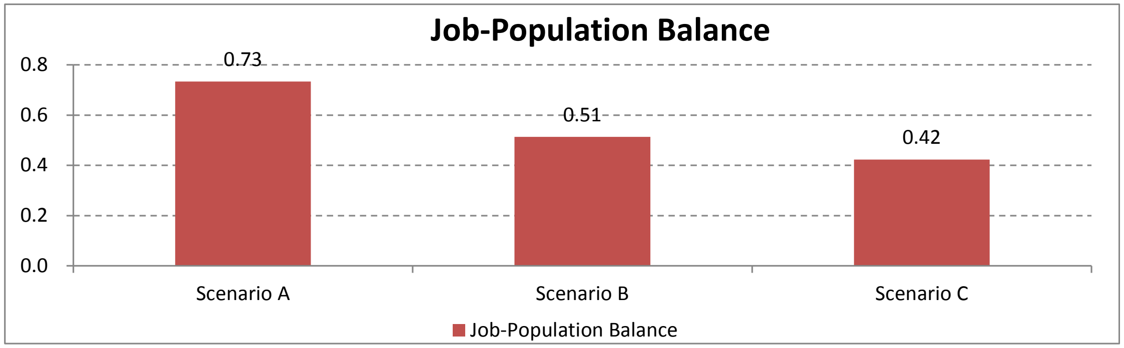
Definition
The Job-Population Balance Index measures the balance between the number of jobs and residents. The index ranges from 0, where only jobs or residents are present in a study area, to 1 where the ratio of jobs to residents is optimal in terms of trip genertation. The value 0.2 represents a balance of employment and population that generates the highest trip rate.

A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results
It is proposed that 0.2 is the job-population ratio that would generate the highest trip rate. In this case, the job-population balance in Scenario A is better than in Scenario B and Scenario C. Scenario C has relatively more jobs than the other two scenarios, thus its job-population balance index is the lowest.



What would improve the results
• Balance the development of residential and office/industrial.

	Scenario A	Scenario B	Scenario C
Population	14,951	12,186	14,951
Employment	1,734	7,059	8,266
Job-Population Balance	**0.73**	**0.51**	**0.42**

Land Use Mix - Hutto

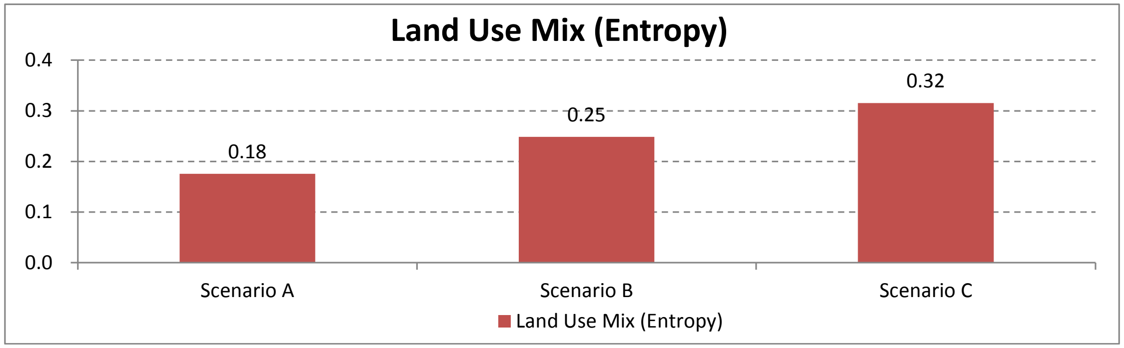
Definition
Land use mix captures the variety of land uses within the study area. The index varies in value from 0, where all developed land is in one land use category, to 1, where developed land is evenly divided among land use categories. Mixed-use development increases the walkability and bikability of the area. Land use mix is positively associated with internal capture of tips and non-motorized trips.

A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results
Scenario A is residential-dominant, thus it has the lowest land use mix score. Land uses in Scenario B and Scenario C are more devoted to retail and office. Compared to other scenarios, Scenario B has the most retail development, while Scenario C has more office and industrial. Overall, new development in Scenario C is the most diverse, followed by Scenario B.



What would improve the results
- Identify stakeholders likely to be affected by mixed use development.
- Promote the benefits of mixed-use development.
- Determine the mix of uses and appropriate areas for mixed use zoning.

	Scenario A	Scenario B	Scenario C
Residential (sq ft)	10,025,260	7,678,873	6,825,607
Retail (sq ft)	198,308	1,380,731	1,012,620
Office (sq ft)	446,911	1,577,914	2,114,594
Industrial (sq ft)	400,176	466,367	709,424
Land Use Mix	**0.18**	**0.25**	**0.32**

Street Connectivity - Hutto

Definition

Connectivity refers to the density of connections and the directness of links. As connectivity increases, travel distances decrease and route options increase, offering more route options, and making non-motorized travel more feasible. A connected road network tends to emphasize accessibility by accommodating more travel with traffic dispersed over more roads, to improve walking and cycling conditions, and to support transit use.

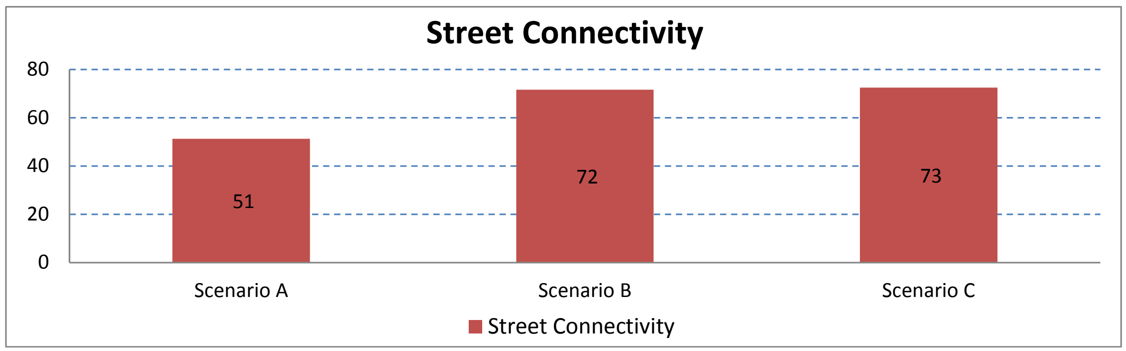
A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

Single family neighborhood usually contains fewer intersections and more cul-de-sacs to preserve its neighborhood character. Thus, Scenario A has the lowest street connectivity due to the high percentage of single family residential development. Scenario B and Scenario C have similar connectivity.



	Scenario A	Scenario B	Scenario C
Number of Intersections	77	105	104
Area	1.5	1.47	1.43
Intersection Density	**51**	**72**	**73**

What would improve the results

• Develop a well-connected road or path network that has many short links, numerous intersections, and minimal dead-ends.
• Build the internal circulation route as an interconnected, grid-like transportation system.
• Set a maximum block size.

Proportion of Area within 1/4 mile of Transit Stops - Hutto

Definition

Typically, 1/4 mile is considered a standard walking distance for most people could accomodate. A transit stop within walking distance increases the probability people would choose to take public transit. Nearby transit stops may also stimulate walking.

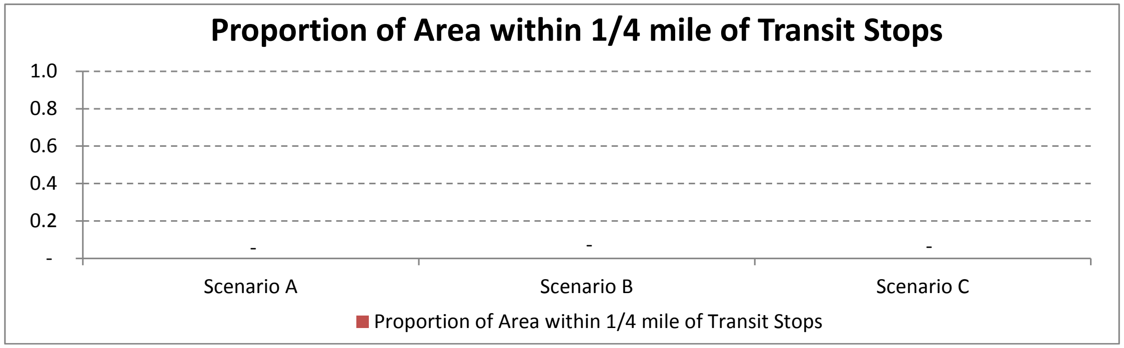
A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

There is no transit stop. Thus, the proportion of area within 1/4 mile of transit stops is zero in all three scenarios.



What would improve the results

- Incorporate the community into regional transportation plans that include transit..
- Encourage high-density and mixed-use residential and commercial development within a radius of 1/4 to 1/2 mile from a transit stop to maximize access to transit.

	Scenario A	Scenario B	Scenario C
Proportion of Area within 1/4 mile of Transit Stops	-	-	-

Street Network Density - Hutto

Definition

Street network density refers to ratio of the length (in miles) of scenario's road network to the land area (in square miles) in the study area. Higher street network density is usually associated with better street connectivity. Street density is significantly associated with travelers' mode choice. Street network density has an even greater influence on non-work trips.

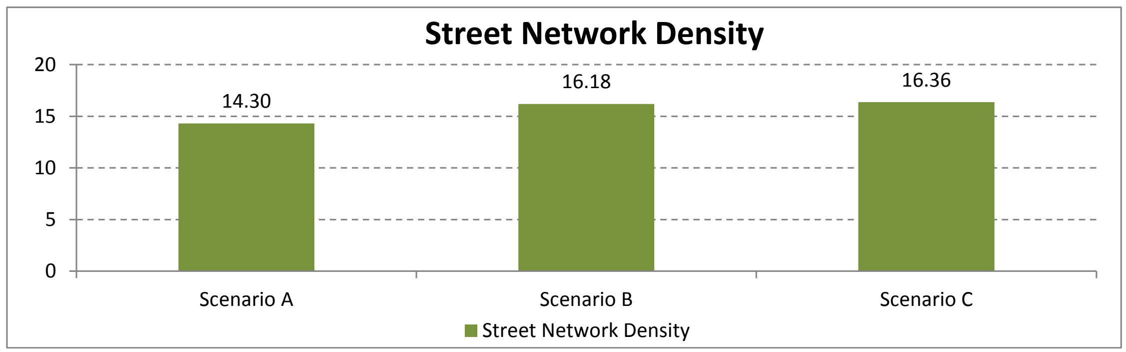
A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

Main street commercial and corridor commercial developement accommodate highest street network density, while single family neighborhood, office, and industrial accommodate the lowest. Due to its single family-dominant character, Scenario A has the lowest street network density among the three scenarios.



What would improve the results

- Build the internal circulation route as an interconnected, grid-like transportation system.
- Set a maximum block size.

	Scenario A	Scenario B	Scenario C
Street Centerline Length (mile)	22	24	23
Total Area (sq mile)	1.5	1.47	1.43
Street Network Density	**14.3**	**16.18**	**16.36**

Transit Stop Coverage - Hutto

Definition

High transit stop coverage rate provides more opportunities to access transit. Better transit accessibility results in a higher percentage of trips be public transit and lowers the amount of driving. Less vehicle trips can lower VMT, mitigate congestion impacts, and reduce vehicle ownership. Improved transit stop coverage also has environmental impacts in the form of reduced carbon emissions.

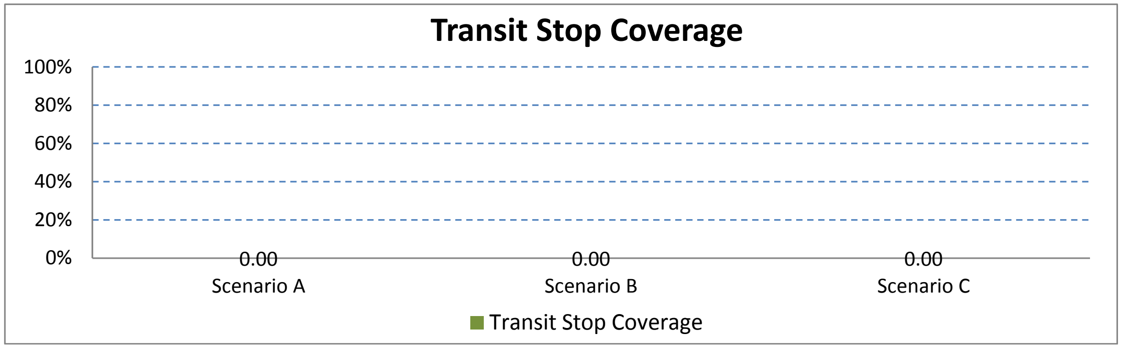
A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

There is no transit stop in the study area. Thus the transit stop coverage is zero in all three scenarios.



What would improve the results

- Provide for interagency coordination of transit services in several of its transit funding programs.
- Develop a regional plan for public transportation coordination.

	Scenario A	Scenario B	Scenario C
Number of Transit Stops	0	0	0
Total Area (sq mile)	1.5	1.47	1.43
Transit Stop Coverage	-	-	-

Bicycle Network - Hutto

Definition

Cycling is one of the most affordable transportation options. High bicycle network coverage provides more transportation options and better mobility, especially for non-drivers. Improved bicycle facilities create more balanced transportation systems with lower automobile dependency, and promote social equity for people who are transportation disadvantaged. The shift to non-motorized modes also has a mitigating effect on congestionn.

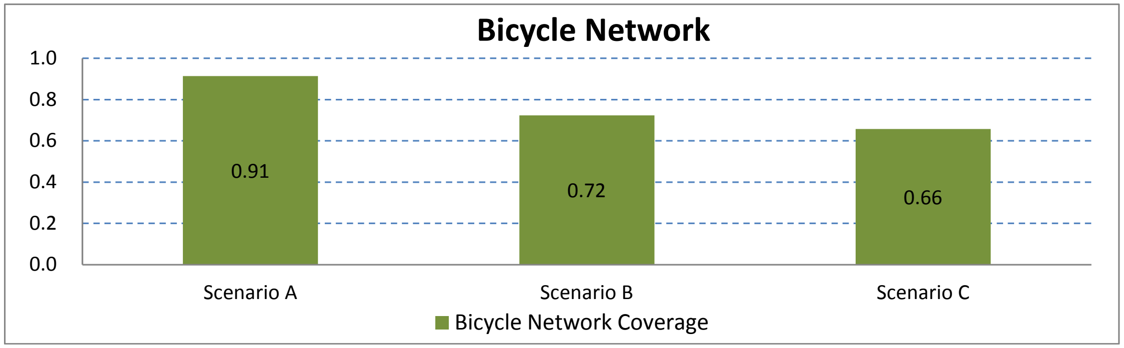
A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

Residential, civic, town center, and main street commercial accommodate bike lanes better than office and industrial. Due to the high proportion industrial and office developemtn in Scenario B and especially Scenario C, bicycle network coverage these scenarios is lower than in Scenario A.



What would improve the results

- Provide improved bicycle facility management and maintenance.
- Implement traffic calming strategies.
- Promote a bicycle sharing program.
- Improve the cooperation throughout the region.

	Scenario A	Scenario B	Scenario C
Bike Lane Length	20	17	15
Street Centerline Length (mile)	22	24	23
Bicycle Network Coverage	**0.91**	**0.72**	**0.66**

Sidewalk Completeness - Hutto

Definition

The availability of sidewalks improves the accessibility and increases the likelihood of walk trips. A complete sidewalk network provides people with more travel alternatives and reduces the frequency of vehicle-pedestrian collisions. It also reduces the number of vehicle miles traveled, mitigates traffic congestion, benefits the environment, and improves the health condition of the community.

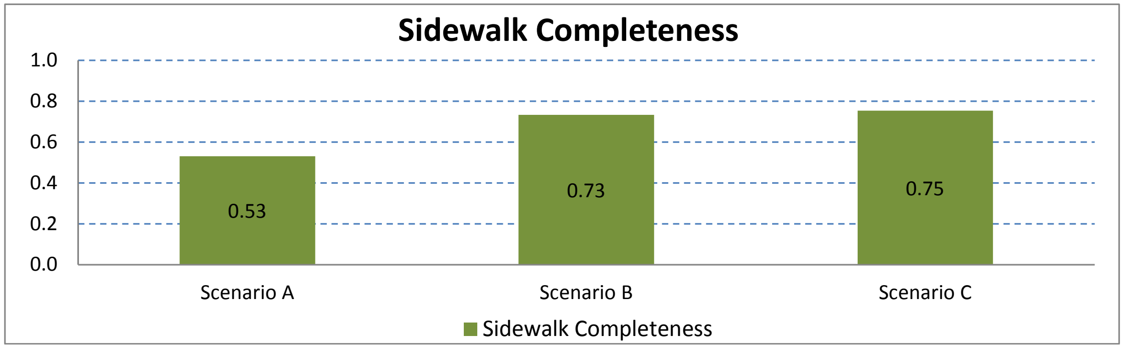
A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

Town center, compact neighborhood, main street commercial, and civic development accommodate the sidewalks in both directions. Scenario C has the most complete sidewalks. Scenario B has the second most complete sidewalks.



What would improve the results

- Provide sidewalks along both sides of all roads.
- Provide pedestrian paths at cul-de-sacs.
- Increase funding for sidewalk projects.
- Work with developers to obtain rights-of-way.

	Scenario A	Scenario B	Scenario C
Sidewalk Length	23	35	35
Street Centerline Length (mile)	22	24	23
Sidewalk Completeness	**0.53**	**0.73**	**0.75**

Sidewalk Density - Hutto

Definition

Sidewalk density refers to ratio of the length (in miles) of sidewalks to the study area's land area (in square miles). Higher sidewalk density is usually associated with better connectivity for pedestrians. It is positively associated with increased walk trips and fewer auto trips. Also better sidewalk connectivity improves accessibility to transit, where transit stops are available.

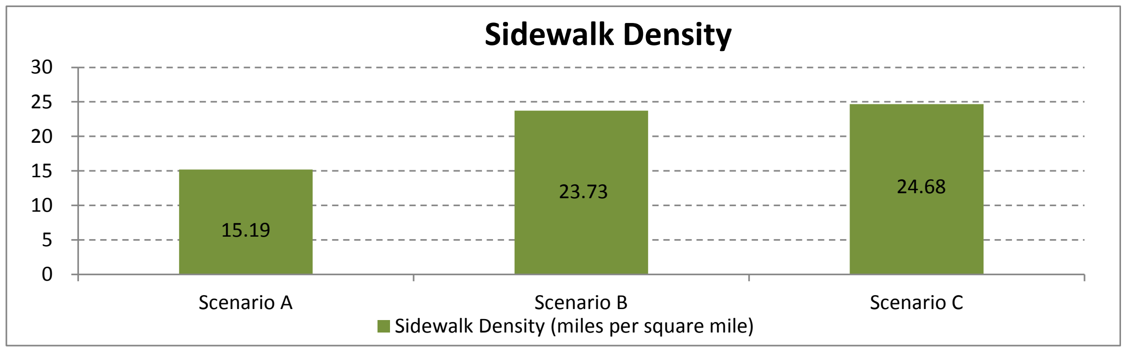
A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

Town center, compact neighborhood, main street commercial, and civic development are equipped with denser sidewalks to acoommodate pedestrians' needs. Scenario B has the densest sidewalks. And Scenario C has the second densest sidewalks.



What would improve the results

- Provide sidewalks along both sides of all roads.
- Increase funding for sidewalk projects.
- Work with developers to obtain rights-of-way.
- Set a maximum block size for new development.

	Scenario A	Scenario B	Scenario C
Sidewalk Length	23	35	35
Total Area (sq mile)	1.5	1.47	1.43
Sidewalk Density	**15.19**	**23.73**	**24.68**

Vehicles per Capita - Hutto

Definition

This indicator estimates vehicles per capita within the study area. Lower vehicle ownership indicates less dependence on automobiles.

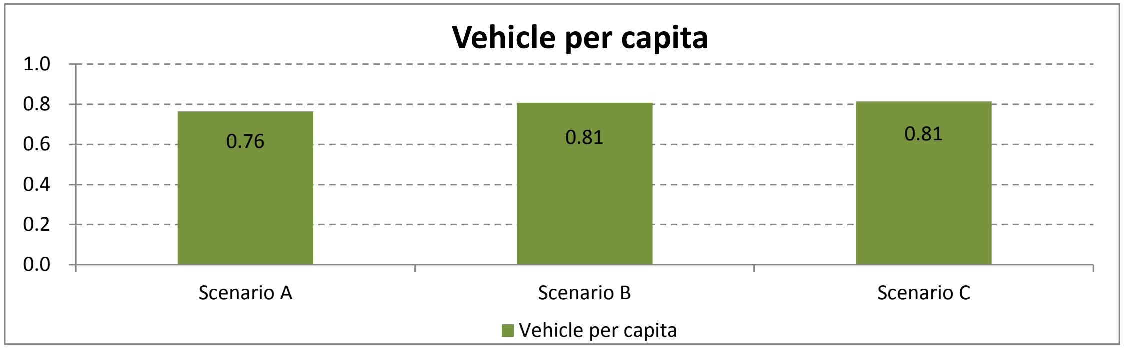
A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

Single family households have fewer vehicles per family member than other households since family members tend to share one car. Thus, estimated vehicle per capita is lowest in Scenario A.



What would improve the results

- Provide less parking space, or increase parking fees in the town center and in high density areas.

	Scenario A	Scenario B	Scenario C
Vehicle per Capita	**0.76**	**0.81**	**0.81**

Parking Supply - Hutto

Definition

This indicator estimates the number of parking spaces associated with new developments.

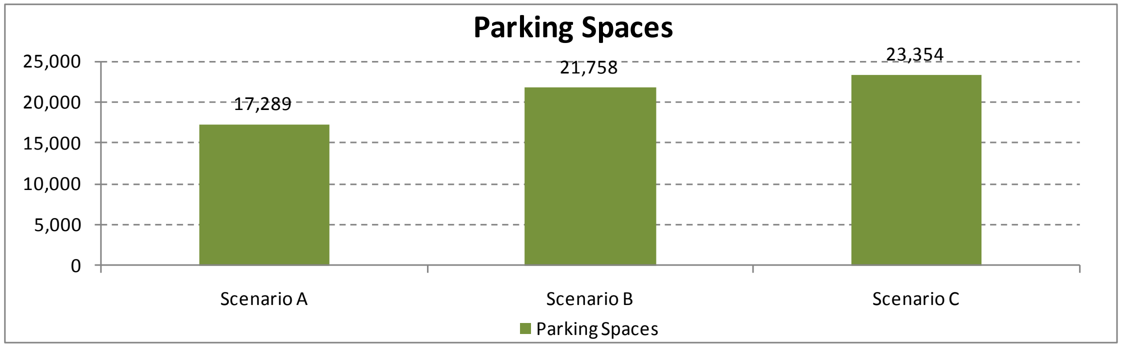
A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

Due to denser development in Scenario B and Scenario C, the numbers of parking spaces associated with new developments in these scenarios are greater than Scenario A.



What would improve the results

- Reduce minimum parking requirements.
- Incorporate parking maximums or area-wide parking caps.
- Permit shared parking for different buildings and facilities to take advantage of different peak parking characteristics.

	Scenario A	Scenario B	Scenario C
Parking Spaces Supply	**17,289**	**21,758**	**23,354**

Internal Trips - Hutto

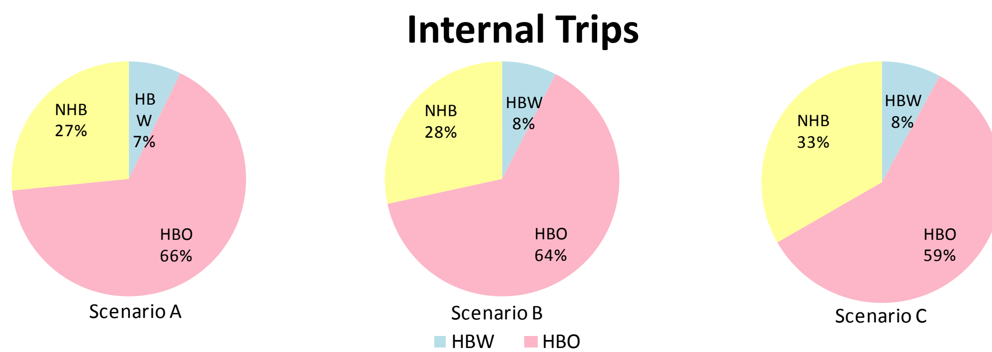
Definition
This indicator estimates the number of trips that remain within the study area.

A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results
Most internal trips are in the home-based other category. In Scenario B and Scenario C, there are more non-home based trips generated. This might be a change of trip chain due to mixed-use development. The proportions of home-based work trips are very close in three scenarios.



What would improve the results
- Encourage compact and mixed uses in community.
- Improve street connectivity.
- Improve bicycle and pedestrian facilities.
- Enhance the overall walking environment.

	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	1,427	1,723	1,769
HBO (Home-based others)	13,048	14,681	13,109
NHB (Non-home based)	5,236	6,510	7,423
Total	**19,708**	**22,913**	**22,302**

Internal Walk Trips - Hutto

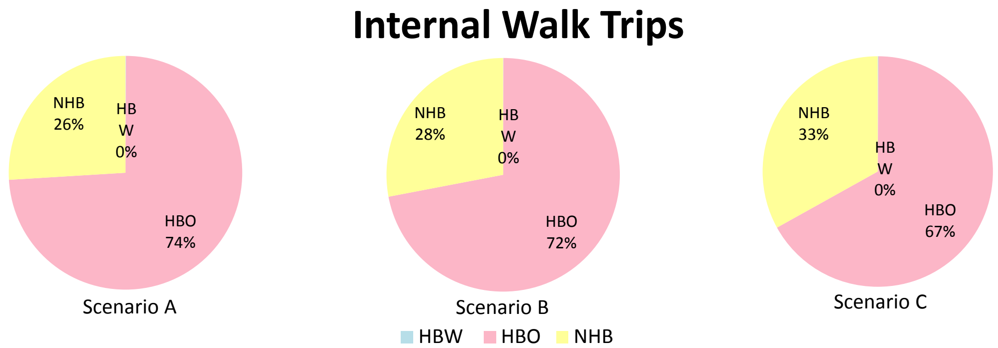
Definition
This indicator estimates the number of walk trips within the study area.

A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results
There are few internal walk trips in the home-based work category in all three scenarios. Home-based other is the main purpose for internal walk trips. In mixed-use development scenarios, the share of non-home based trips is slightly greater.



What would improve the results
- Encourage compact and mixed uses in community.
- Improve street connectivity.
- Improve bicycle and pedestrian facilities.
- Enhance the overall walking environment.

	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	1	1	2
HBO (Home-based others)	1,487	2,024	1,803
NHB (Non-home based)	522	787	893
Total	**2,009**	**2,813**	**2,698**

External Walk Trips - Hutto

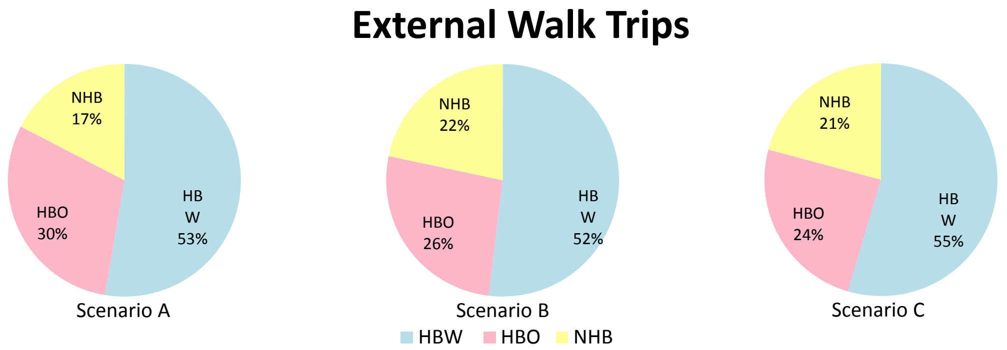
Definition
This indicator estimates the number of walk trips outside of study area.

A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results
Home-based work is the main external walk trip purpose. Its share increases in mixed-use development scenarios. As the land use mix increases, the proportion of non-home based trips grows and proportion of home-based others trips decreases.



What would improve the results
• Improve street connectivity.
• Improve bicycle and pedestrian facilities.
• Enhance the overall walking environment.

	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	678	1,250	1,375
HBO (Home-based others)	386	636	619
NHB (Non-home based)	224	522	524
Total	**1,289**	**2,408**	**2,518**

External Transit Trips - Hutto

Definition

This indicator estimates the number of transit trips. It is recommended that public transit accomodate home-based work trips as an alternative to automobile use because commuting trips are usually routine in terms of travel time and places.

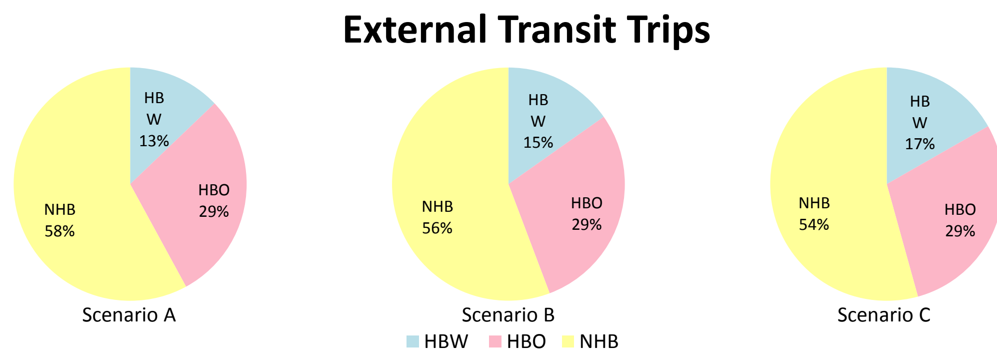
A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

Non-home based is the main purpose of external transit trips. Generally, as land use mix index increases, the share of non-home based trips decreases and the share of home-based work trips increases.



What would improve the results

- Provide public transportation service to accommodate the needs of home-based work trips.
- Improve street connectivity.
- Improve non-mobile facilities.
- Enhance the overall walking environment.

	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	372	580	621
HBO (Home-based others)	845	1,106	1,073
NHB (Non-home based)	1,677	2,124	2,014
Total	**2,894**	**3,809**	**3,708**

Total VMT Generated by Residential - Hutto

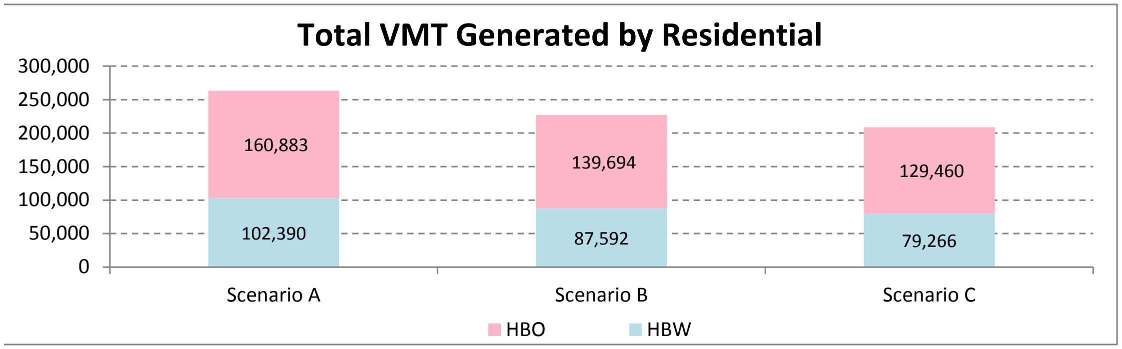
Definition
This indicator estimates the vehicle miles traveled (VMT) generated by residential land use.

A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results
New developments in Scenario A are single family dominant. Therefore the VMT generated by residential in Scenario A is the highest. It is the second highest in Scenario B, and the lowest in Scenario C.



What would improve the results
- Encourage compact and mixed uses in community.
- Improve street connectivity.
- Provide public transportation service.
- Improve non-mobile facilities.
- Enhance the overall walking environment.

	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	102,390	87,592	79,266
HBO (Home-based others)	160,883	139,694	129,460
Total	**263,273**	**227,286**	**208,725**

Total VMT Generated by Retail - Hutto

Definition

This indicator estimates the vehicle miles traveled (VMT) generated by retail land use.

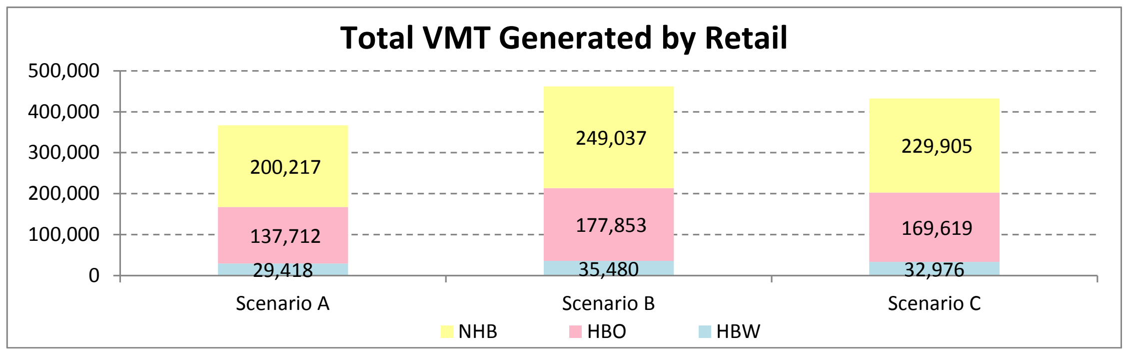
A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

Scenario B has the highest VMT generated by retail land use due to its focus on retail development. Scenario C has the second highest VMT generated by retail land use.



What would improve the results

- Encourage compact and mixed uses in the community to provide retail service in walking distance for residents.
- Improve street connectivity.
- Improve non-mobile facilities.
- Enhance the overall walking environment.

	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	29,418	35,480	32,976
HBO (Home-based others)	137,712	177,853	169,619
NHB (Non-home based)	200,217	249,037	229,905
Total	**367,347**	**462,340**	**432,500**

Total VMT Generated by Office and Industrial - Hutto

Definition

This indicaor estimates the vehicle miles traveled (VMT) generated by office and industrial land uses.

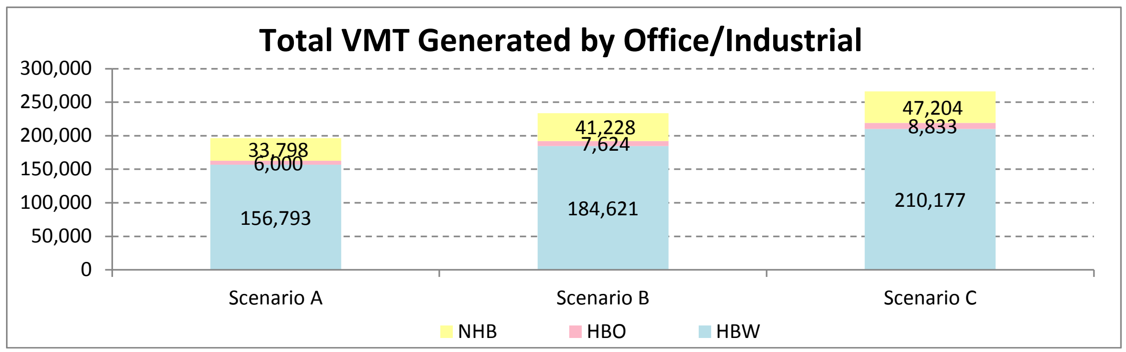
A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

Scenario C has the hightest office and industrial VMT due to its focus on office and industrial developments. Also, its VMT of home-based work trips is significantly higher than the other two scenarios since office and industrial are the primary workplaces. Scenario B has the second highest VMT generated by office and industrial land uses.



What would improve the results

- Encourage compact and mixed uses.
- Improve street connectivity.
- Provide public transportation service to accommodate the needs of home-based work trips.
- Improve non-mobile facilities.
- Enhance the walking environment.

	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	156,793	184,621	210,177
HBO (Home-based others)	6,000	7,624	8,833
NHB (Non-home based)	33,798	41,228	47,204
Total	**196,591**	**233,472**	**266,214**

Percentage of Internal Trips - Hutto

Definition

This indicator estimates the percentage of trips within the study area. Usually mixed-use development (MXD) increases the share of internal trips the variety of developments in the study area because trips between on-site land uses could be made without travel on the off-site street system. MXD allows what might otherwise be external car trips to become internal trips, within walking or biking distance, thus increasing the share of non-motorized trips.

Scenario Results

Percentage of internal trips increases in Scenario B and Scenario C due to mixed-use development, although the difference is not very significant.

What would improve the results

• Encourage compact and mixed-use developments in the area.

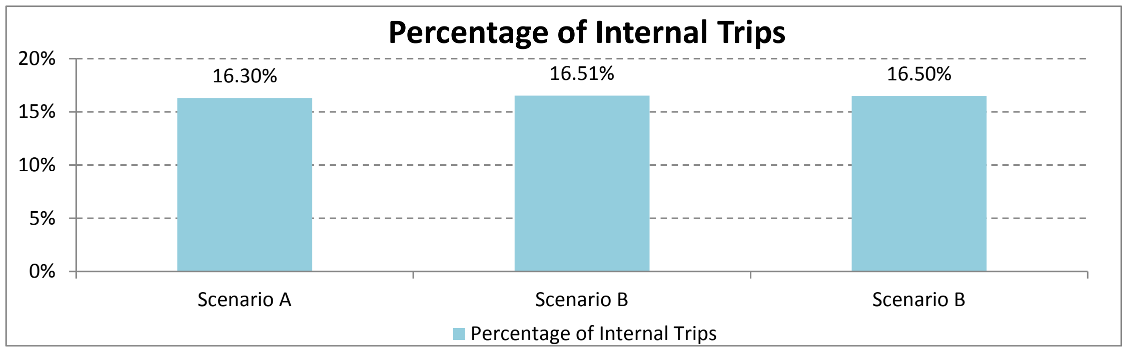
• Provide facilities for pedestrians and cyclists, including sidewalks, designated bike lanes, bike racks, safe crossings, and lights, etc.

• Enhance the walking environment.

A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide



	Scenario A	Scenario B	Scenario C
Number of Internal Trips	19,708	22,913	22,302
Total Trips	120,933	138,807	135,163
Percentage of Internal Trips	**5.6%**	**14.2%**	**16.95%**

Percentage of Walk Trips - Hutto

Definition

This indicator estimates walk trip share. A transportation system that is conducive to walking can reap many benefits including health of individuals, reduced congestion, and improved quality of life. Economic rewards are also realized through reduction in health care costs, reduced dependency on autos, and increased economic vitality of commnities. Finally, walkable communities are more equitable in that they provides trnaportation choice for all citizens.

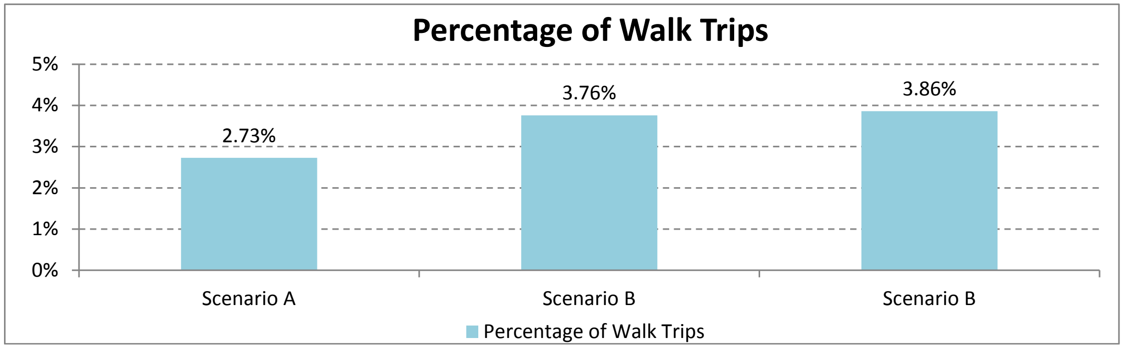
Scenario Results

The share of walk trip increases in Scenario B and in Scenario C due to the mixed-use and compact development.

A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide



What would improve the results

- Mix uses to bring origins and destinations closer.
- Provide appropriate landscaping to create a pleasant pedestrian environment.
- Make friendly and unique building facades.

	Scenario A	Scenario B	Scenario C
Number of Walk Trips	3,298	5,220	5,217
Total Trips	120,933	138,807	135,163
Percentage of Internal Trips	**2.73%**	**3.76%**	**3.86%**

Percentage of Transit Trips - Hutto

Definition

This indicator estimates the transit trip share. Public transportation provides an affordable alternative to driving. It offers mobility for those who do not drive or cannot drive. Public transportation facilities and corridors encourage economic and social activities and help create strong neighborhood centers, thus fostering more livable communities.

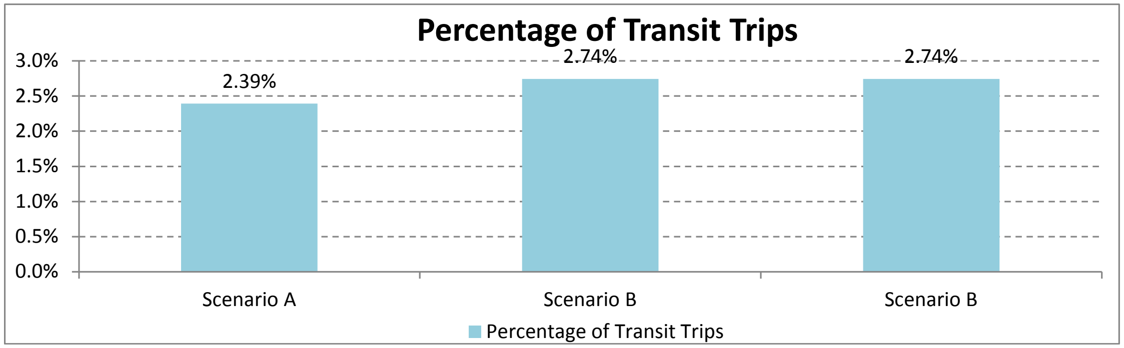
A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

The share of transit trips increases slightly in Scenario B and Scenario C.



What would improve the results

- Accommodate home-based work trips.
- Build new transit routes, expand the existing transit system, and provide public transportation facilities.
- Integrate the transit system with land use regulations.
- Provide access to transit stops.

	Scenario A	Scenario B	Scenario C
Number of Transit Trips	2,894	3,809	3,708
Total Trips	120,933	138,807	135,163
Percentage of Internal Trips	**2.39%**	**2.74%**	**2.74%**

Total Trips - Hutto

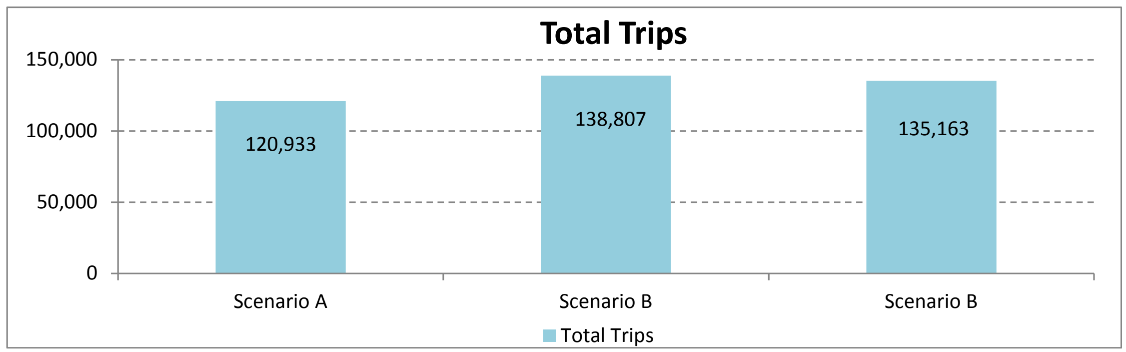
Definition
This indicator estimates the total trips in the study area. With more transportation alternatives provided, and better connectivity and accessibility, more trips would be generated.

A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results
Scenario B generates the highest total trip rate, followed by Scenario C.



What would improve the results
- Mix land uses.
- Provide facilities to accomodate transit trips, walking, and biking.

	Scenario A	Scenario B	Scenario C
Total Trips	**120,933**	**138,807**	**135,163**

Total Transit Trips - Hutto

Definition

This indicator estimates the total transit trips of the study area. Public transportation provides an affordable alternative to driving. It offers mobility for those who do not drive or cannot drive. Also the number of total transit trips provides the demand of transit system for mass transit operators.

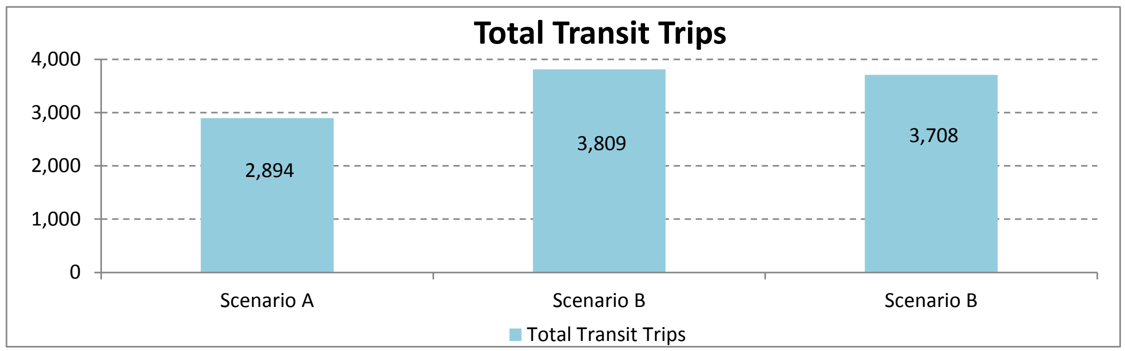
A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

The total transit trip rate gets higher in mixed-use development scenarios. Scenario B has the highest transit trips rate. And then Scenario C.



What would improve the results

- Accommodate home-based work trips
- Allocate more money for the public transportation system.
- Provide safe and reliable transit service.
- Integrate the transit system with land use planning.
- Provide access to transit stops.

	Scenario A	Scenario B	Scenario C
Number of Transit Trips	**2,894**	**3,809**	**3,708**

Job Accessibility - Hutto

Definition

This indicator measures the ease of people reaching their jobs. People who live in places with higher accessibility can reach many destinations more quickly. Accessibility is a measure of potential for interaction. Places with higher job accessibility are usually more likely to attract people to live or work there, therefore bringing more economic opportunities for the community.

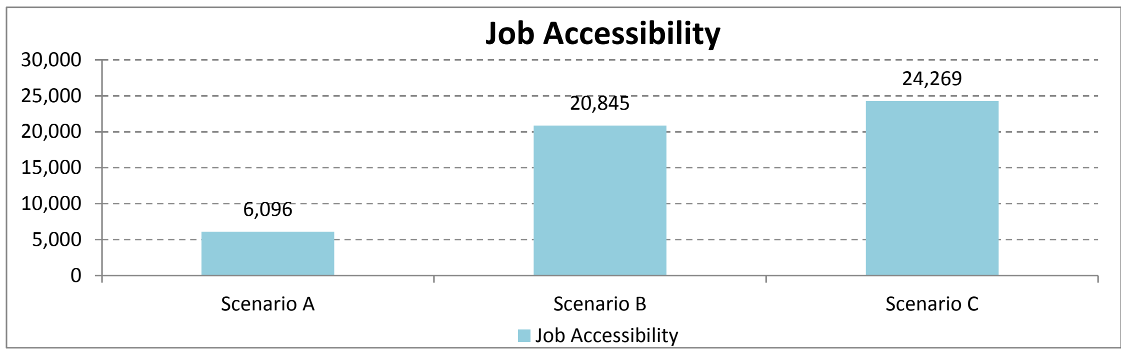
A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

The number of jobs is much higher in Scenario B and Scenario C. Also, the average auto commute time is slightly shorter. Thus, job accessibility significantly increases in these two scenarios, especially in Scenario C.



	Scenario A	Scenario B	Scenario C
Number of Jobs	2,006	7,331	8,538
Average Auto Commute Time	11.12	10.45	10.45
Job Accessibility	**6,096**	**20,845**	**24,269**

What would improve the results

- Improve the service for the roadway network and public transportation system.
- Create a community friendly to pedestrians and cyclists.
- Cluster job and residents at a location closer to the given transportation system and in area with greater connectivity.

Parking Demand - Hutto

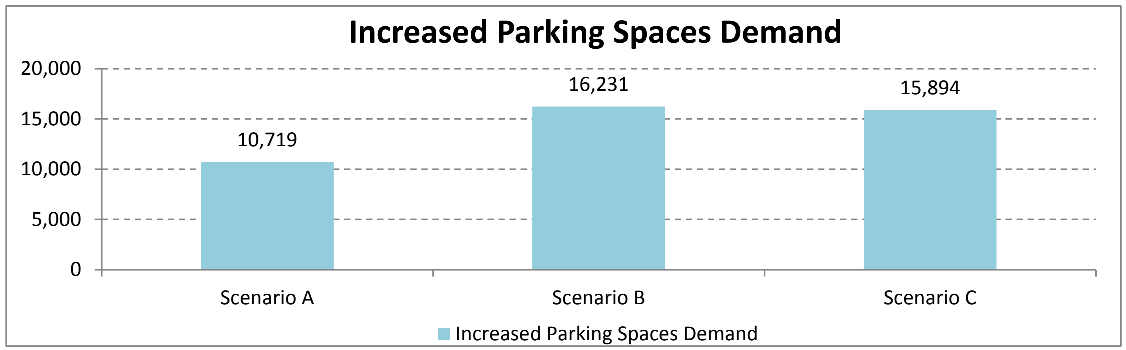
Definition
This indicator estimates the increased demand for parking associated with new development in study area.

A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results
Retail requires the most parking spaces compared to other developments. Thus the increased parking demand of Scenario B is the highest. In Scenario C, the high parking demand is due to the office development. Scenario A is residential dominant, thus it has the lowest parking demand.



What would improve the results
- Create town a center/neighborhood center supported by public transit service.
- Encourage compact, mixed-use developments.
- Provide facilities to accommodate walking and biking.
- Encourage shared parking arrangements.

	Scenario A	Scenario B	Scenario C
Parking Spaces Demand	**10,719**	**16,231**	**15,894**

Daily Walk Trip per Capita - Hutto

Definition

This indicator estimates daily walk trips per capita. Regular daily physical activities benefit indivual health by reducing the risk of many disease and obesity as well as environment. It also reflects the livability of the community because there tend to be more activities taking place on the streets and more interactions between neighbors.

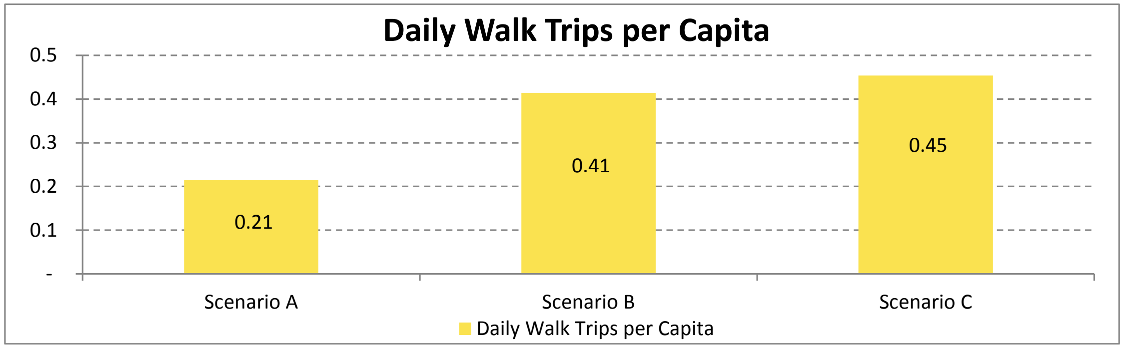
A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

Mixed-use development significantly increases the personal walk trip rate. For example, Scenario C generates more than doubled daily walk trips per capita than Scenario A does.



What would improve the results

- Encourage mixed and compact developments.
- Provide appropriate landscaping to create a pleasant pedestrian environment.
- Encourage shops and businesses that open directly to the sidewalk to make friendly and unique building facades.

	Scenario A	Scenario B	Scenario C
Number of Walk Trips	3,298	5,220	5,217
Population	15,368	12,603	11,496
Daily Walk Trips per Capita	**0.21**	**0.41**	**0.45**

Average Auto Trip Length - Hutto

Definition

This indicator estimates the average auto trip length. Shorter trip length indicates better accessibitliy to the destinations.

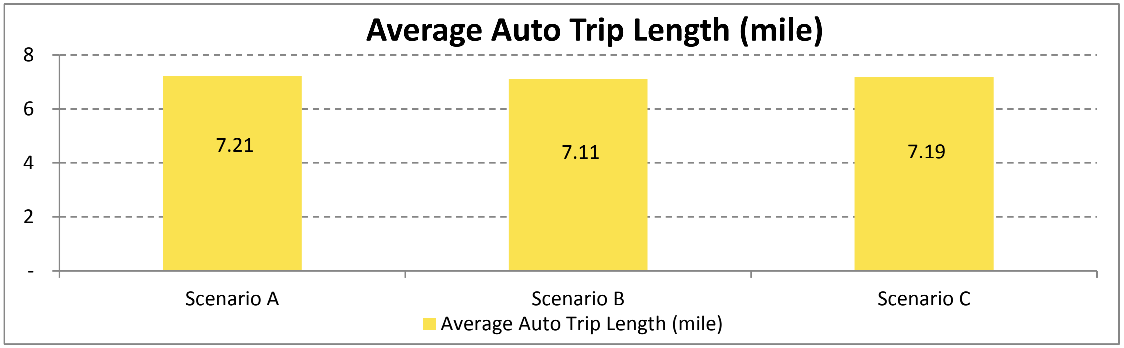
A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

Average auto trip length of Scenario B and Scenario C are slightly less than Scenario A. But the difference is not very significant.



What would improve the results

- Improve the existing transportation system.
- Improve street connectivity.
- Implement strategies for traffic congestion mitigation.
- Encourage the mixed use and compact developments.

	Scenario A	Scenario B	Scenario C
Total Trips	114,741	129,777	126,238
Total Vehicle Miles Traveled	827,210	923,128	907,440
Average Auto Trip Length (miles)	**7.21**	**7.11**	**7.19**

Average Internal Auto Trip Length - Hutto

Definition

This indicator estimates average internal auto trip length.

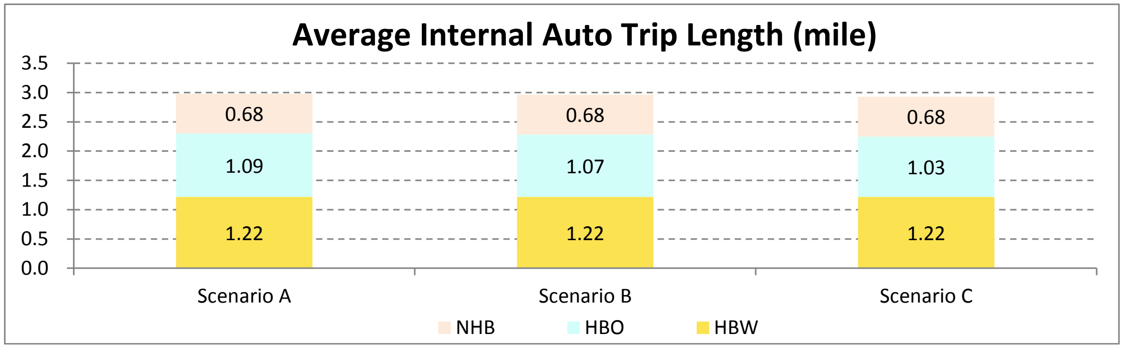
A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

The length of home-based work trips and non-home based trips do not have any difference in three scenarios. However, the average home-based other trip length reduces due to the mixed-use developments in Scenario B and Scenario C.



What would improve the results

- Encourage the mixed use and compact developments to provide essential and commercial services within walking distance for residents in the community.
- Improve street connectivity.

	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	1.22	1.22	1.22
HBO (Home-based others)	1.09	1.07	1.03
NHB (Non-home based)	0.68	0.68	0.68

Average External Auto Trip Length - Hutto

Definition

This indicator estimates average external auto trip length by purpose.

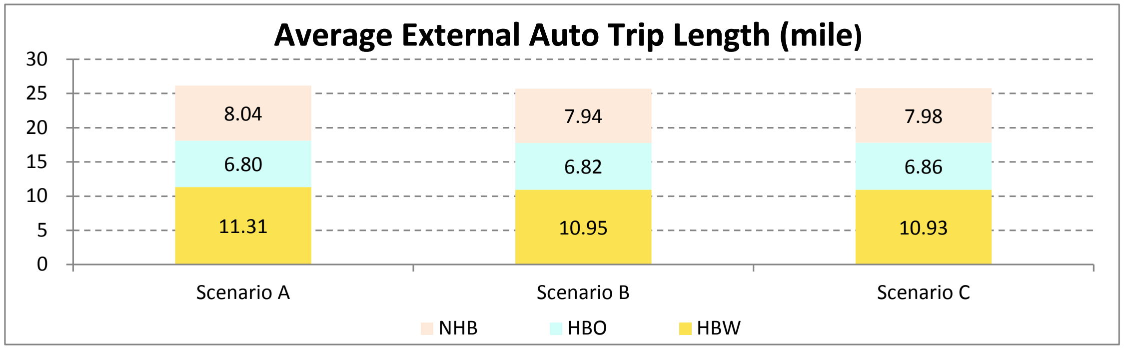
A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

For the external trips, home-based work trips and non-home based trips get shorter in the mixed-use development scenarios. However, the average length of home-based others trips increases slightly. It is probably because that a better transportation system increase trip rate.



What would improve the results

- Improve the existing transportation system.
- Improve street connectivity.
- Implement strategies for traffic congestion mitigation.

	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	11.31	10.96	10.93
HBO (Home-based others)	6.8	6.82	6.86
NHB (Non-home based)	8.04	7.94	7.98

Average Auto Trip Time - Hutto

Definition

This indicator estimates the average auto trip time. A shorter average auto trip time indicates greater accessibitliy to destinations.

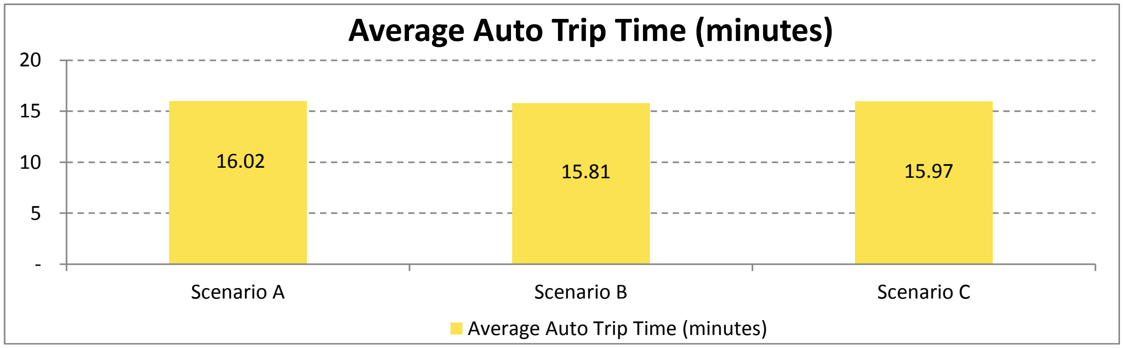
A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

Average auto trip time of Scenario B and Scenario C are slightly shorter than Scenario A due to more mixed and compact development, but the difference is not very significant.



	Scenario A	Scenario B	Scenario C
Average Trip Length	7.21	7.11	7.19
Speed	27	27	27
Average Auto Trip Time (minutes)	**16.02**	**15.81**	**15.97**

What would improve the results

- Improve the existing transportation system.
- Improve street connectivity.
- Implement strategies for traffic congestion mitigation.
- Encourage mixed use and compact developments.

Average Auto Commute Time - Hutto

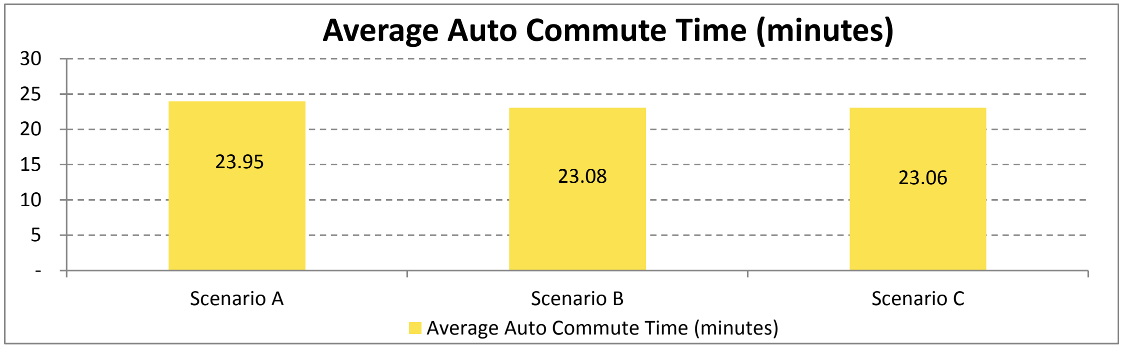
Definition
This indicator estimates the average auto trip time for commuters in the study area to their workplaces over the region. A shorter commute time indicates better accessibitliy to jobs.

A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results
The average auto commute times of Scenario B and Scenario C are slightly shorter than Scenario A due to greater job accessibility, but the difference is not very significant.



What would improve the results
• Cluster job opportunities and individuals at a location closer to alternative transportation options.
• Encourage development of a mix of residential and office uses.

	Scenario A	Scenario B	Scenario C
Average Auto Commute Length	10.78	10.38	10.38
Total Vehicle Miles Traveled	27	27	27
Average Auto Commte Time (minutes)	**23.95**	**23.08**	**23.06**

VMT per Capita - Hutto

Definition

This indicator estimates the number of vehicle miles traveled (VMT) per capita. High VMT leads to higher level of traffic congestion, gas consumption, and air pollution. It is usually the result of dependency on private vehicles. It may also indicates less accessibility for those who do not own a car or are unable to drive.

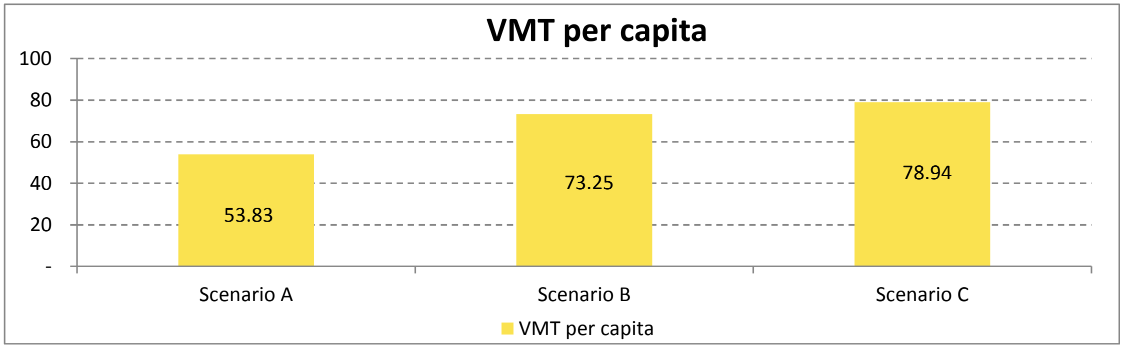
A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

The daily trip rate per person is higher in Scenario B and in Scenario C. Thus Scenario C's average VMT is the highest and Scenario B's is the second.



What would improve the results

• Encourage public transit and carpooling.

• Provide high-quality, reliable and safe public transportation system that easily access.

• Create a friendly environment for pedestrians and cyclists to support non-motorized transportation modes.

	Scenario A	Scenario B	Scenario C
Total VMT	827,210	923,128	907,440
Population	15,368	12,603	11,496
Vehicle Miles Traveled per Capita	**53.83**	**73.25**	**78.94**

Social Cost of GHG Emissions - Hutto

Definition

Major greenhouse gases (GHG) include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and industrial gases. The vast majority of emissions are CO_2. Increased emissions of GHG due to human activities have been linked to global warming and changes in the climate pattern. The monetary value of the damages that may be caused by these changes currently and in the future is the social cost of greenhouse gases.

Scenario Results

The amount GHG emissions is highly associated with vehicle miles traveled (VMT). Scenario B generates the highest VMT due to the high density of population and employment, thus it produces the largest amount of GHG. Scenario A has the lowest social cost of GHG emissions. However, improvements on clean and fuel efficient cars can also reduce GHG emissions.

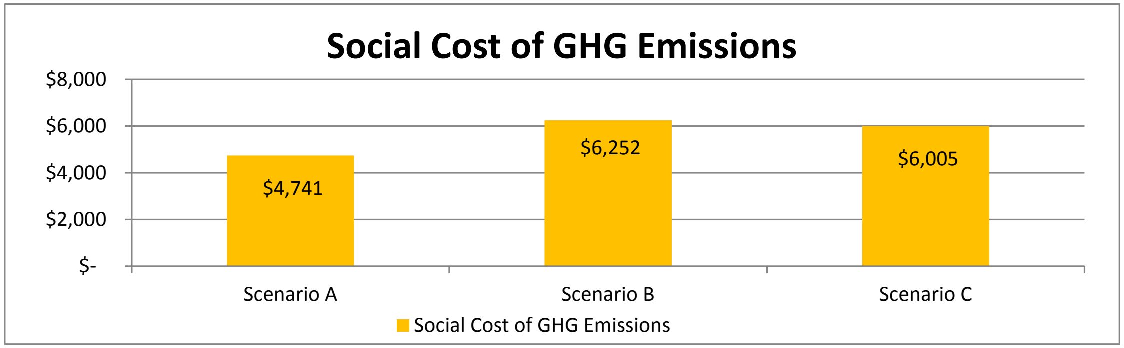
What would improve the results

- Increase the usage of alternative fuels.
- Improve the fuel efficiency.
- Implement carpool incentive programs to reduce single occupant auto travel.
- Improve public transit service.
- Improve pedestrian and bicycle facilities.

A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide



	Scenario A	Scenario B	Scenario C
Total CO_2 Emissions Contributed (tons)	119	157	150
Social Cost of GHG Emissions	**$4,741**	**$6,252**	**$6,005**

Social Cost of CAC - Hutto

Definition

Criteria air contaminants (CAC) are a set of air pollutants emitted from many sources in industry. CAC in particular refer to a group of contaminants that include sulphur dioxide (SO_2), nitrogen oxides (NO_x), volatile organic compounds (VOC), and particulate matter (primarily $PM_{2.5}$). The social cost of CAC is the monetary valuation of the damages to human health, environment and structures caused by these pollutants.

Scenario Results

The amount CAC emissions is highly associated with vehicle miles traveled (VMT). Scenario B generates the highest VMT due to the high density of population and employment, thus it produces the largest amount of CAC. Scenario A has the lowest social cost of CAC. However, improvements on clean and fuel efficient cars can also reduce CAC.

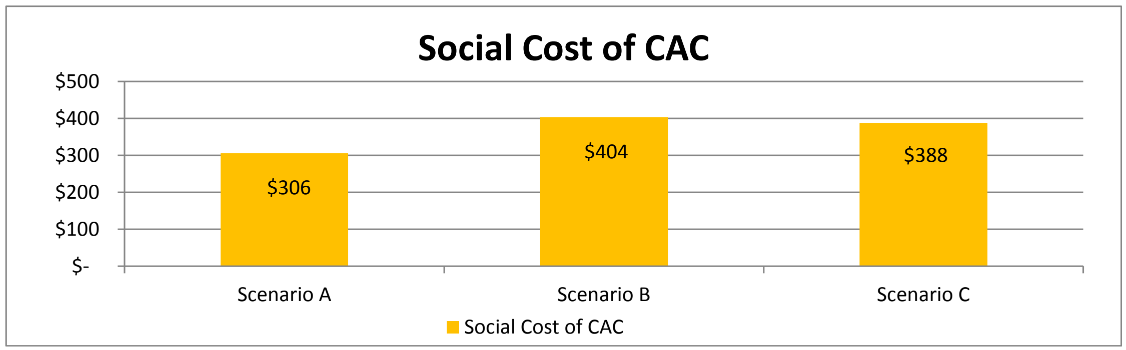
What would improve the results

- Increase the usage of alternative fuels.
- Improve the fuel efficiency.
- Implement carpool incentive programs to reduce single occupant auto travel.
- Improve public transit service.
- Improve pedestrian and bicycle facilities.

A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide



	Scenario A	Scenario B	Scenario C
Total NO_x Emissions Contributed (tons)	0.04	0.06	0.06
Total VOC Emissions Contributed (tons)	0.06	0.08	0.07
Social Cost of CAC	**$306**	**$404**	**$388**

Social Cost of Motor Vehicle Accident - Hutto

Definition

Accident costs are the costs of social resources lost in an accident and the loss in welfare incurred as a result of an accident. The specific costs that are typically covered are comprehensive in nature and include both private costs to the affected individuals and costs to the society at large; costs incurred by an individual out-of-pocket, costs of health care, and costs of pain and suffering.

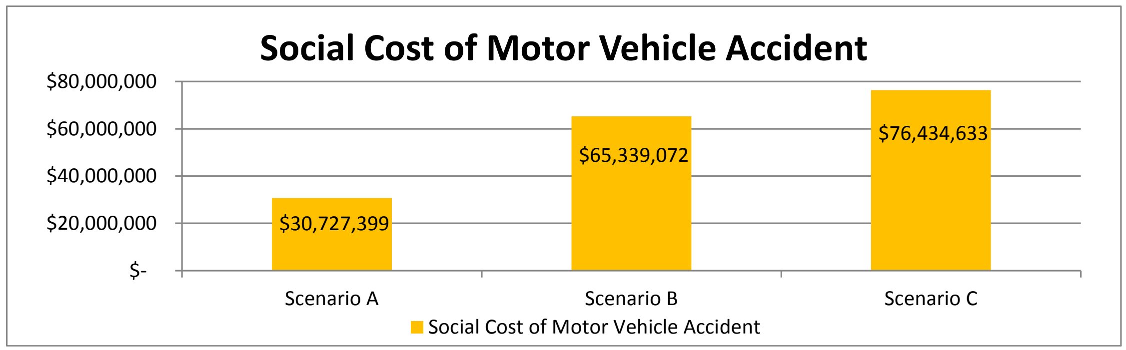
A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

Crash rate is associated with personal VMT, employment density, and intersection density. Scenario C generates the highest crash rate due to the denser developments. Scenario A produces the leastf motor vehicle accident. However, improvements on roadway safety facilities and implementation of traffic calming measures can also reduce the crash rate.



What would improve the results

- Incorporate "complete streets" design into planning
- Implement traffic calming measures.
- Improve roadway facilities.
- Implement site-specific projects to improve traffic safety.

(per year)	Scenario A	Scenario B	Scenario C
Fatal Crash Rate	1	3	3
Serious Injury Crash Rate	26	54	63
Other Injury Crash Rate	35	75	88
Non-injury Crash Rate	99	211	247
Social Cost of Accident	**$30,727,399**	**$65,339,072**	**$76,434,633**

Vehicle Operating Costs - Hutto

Definition

Vehicle operating costs (VOC) represents the personal costs borne by travelers using their own vehicle to make a trip. Total VOC are indirectly based on changes in vehicle miles traveled (VMT). Generally, VOC include fuel costs, tire costs, repair and maintenance costs, vehicle depreciation, and oil costs.

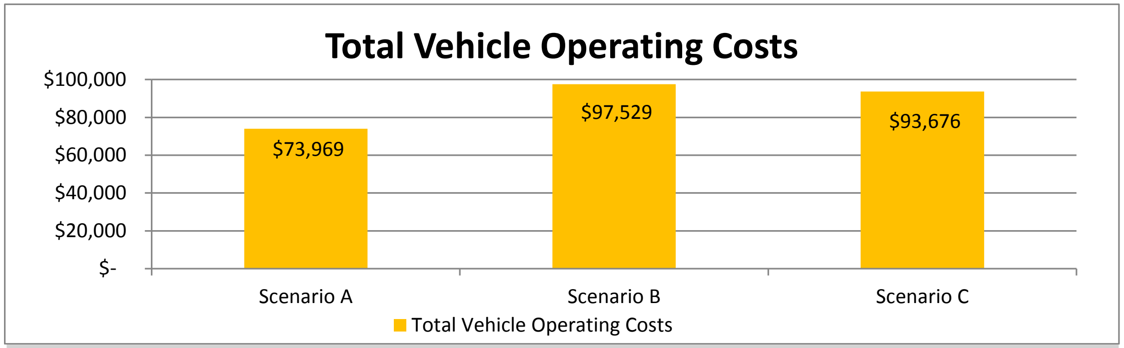
A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

The total vehicle operating costs are highly associated with vehicle miles traveled (VMT). Scenario B generates the highest VMT due to the high density of population and employment, thus it produces the largest vehicle operating costs. Scenario A has the lowest total vehicle operating costs.



	Scenario A	Scenario B	Scenario C
Fuel Costs	$43,967	$57,971	$55,680
Tire Costs	$1,438	$1,896	$1,821
Repair and Maintenance Costs	$40,323	$53,166	$51,066
Vehicle Depreciable Value	$27,396	$36,122	$34,695
Oil Costs	$4,812	$6,344	$6,094
Total Vehicle Operating Costs	**$73,969**	**$97,529**	**$93,676**

What would improve the results

- Implement congestion mitigation programs.
- Improve access to transit.
- Improve major road networks.
- Improve pedestrian and bicycle facilities.

Values of Travel Time Savings - Hutto

Definition
Travel time has value because travelers can dedicate this time to work and earning income, or use it to engage in leisure activities, rather than spending travelling. The value of travel time represents thus the opportunity cost of alternative activities and the cost of discomfort that may be involved in travelling. It can be compared against other project benefits and costs to help evaluate and justify transport improvement project.

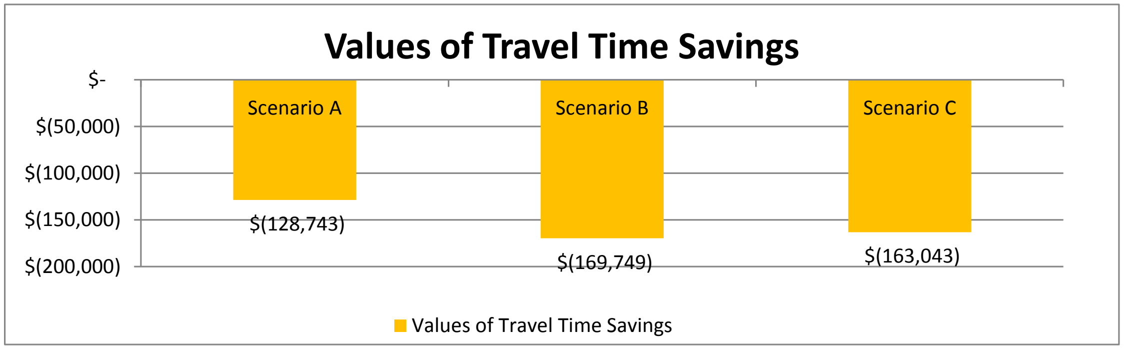
Scenario Results
The values of travel time savings are highly associated with vehicle miles traveled (VMT). Scenario B generates the highest VMT due to the high density of population and employment, thus it produces the largest travel time costs. Scenario A has the lowest travel time costs.

What would improve the results
- Implement congestion mitigation programs.
- Improve access to transit.
- Improve major road networks.
- Improve non-mobile facilities.
- Integrate land use regulations with transport projects.

A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide



	Scenario A	Scenario B	Scenario C
Total Travel Time Savings (hours)	-8,891	-11,723	-11,260
Total Travel Time Savings/Costs	**-$128,743**	**-$169,749**	**-$163,043**

Commuter Bike Mobility Benefits - Hutto

Definition

The commuter bike mobility benefits refer to the monetary value of people's greater satisfaction of cycling in their communities.

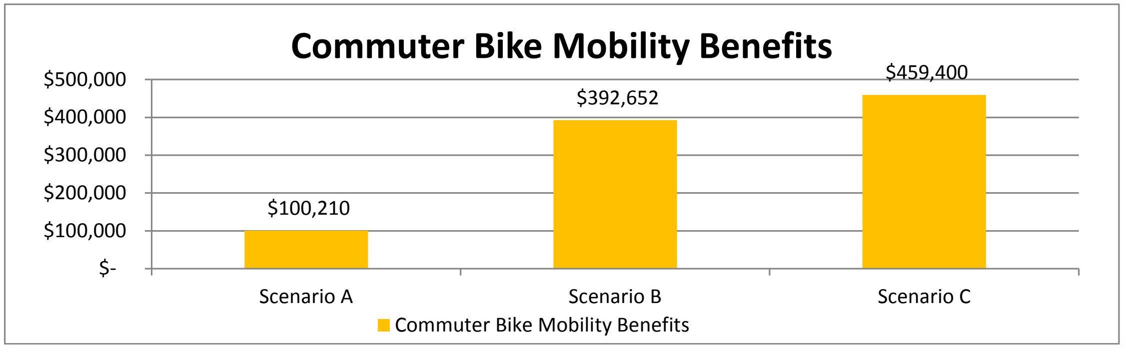
A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

Urban form and demographic characteristics affect transportation choices. Bike trip rate is highly associated with intersection density, land use mix, and household size. Scenario C generates the highest bike trip rate, thus produces the highest commuter bike mobility benefits. Scenario A has the lowest commuter bike mobility benefits.



What would improve the results

- Incorporate "complete streets" design into planning to accommodate all transportation users.
- Provide adequate bike lanes.
- Provide bike parking facilities and shower at workplace.
- Provide multi-modal corridors.

	Scenario A	Scenario B	Scenario C
Number of Commuters by Bike (per day)	23	90	106
Commuter Bike Mobility Benefits	**$100,210**	**$392,652**	**$459,400**

Land Use Scenarios - Elgin

Scenario A: Trend

Scenario B: Balance jobs and housing within the Demonstration Site

Scenario C: Towards a balance of jobs and housing citywide

Legend

Summary Table

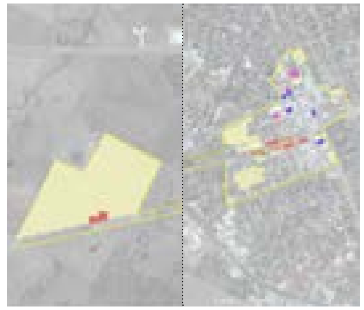
	Scenario A		Scenario B		Scenario C	
	Acres	%	Acres	%	Acres	%
Town Center	/	/	25.7	25.2%	13.7	13.4%
Compact Neighborhood	1.4	1.3%	10.1	9.9%	37	36.3%
Single Family Neighborhood Subdivision	96.8	91.2%	0.4	0.4%	1.1	1.1%
Main Street Commercial	1.4	1.3%	2.5	2.5%	0.7	0.7%
Highway-Oriented Retail and Office	2.8	2.7%	/	/	/	/
Office	1.6	1.5%	37.5	36.8%	21.7	21.3%
Industrial	2.1	2%	/	/	/	/
Civic	/	/	6.4	6.3%	8.6	8.5%
Open Space	/	/	19.4	19%	19	18.7%
Total	**106**	**100%**	**102**	**100%**	**102**	**100%**

Activity Density - Elgin

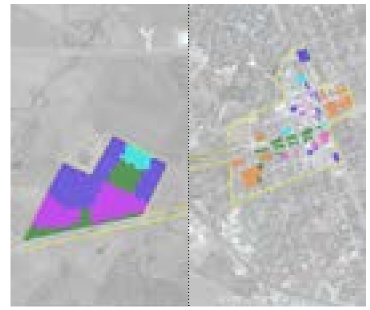
Definition

Activity density refers to the residential population plus employment within the study area. Higher activity density indicates higher trip rates generated and attracted. Higher activity density within the study area supports internal walk trips, and is also positively related to walking on external trips.

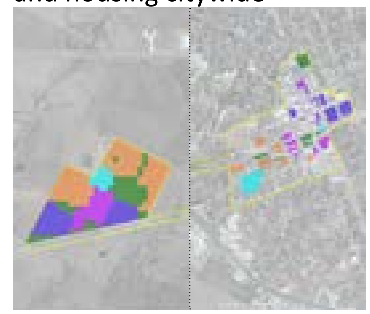
Scenario A: Trend



B: Balance jobs and housing within the Site

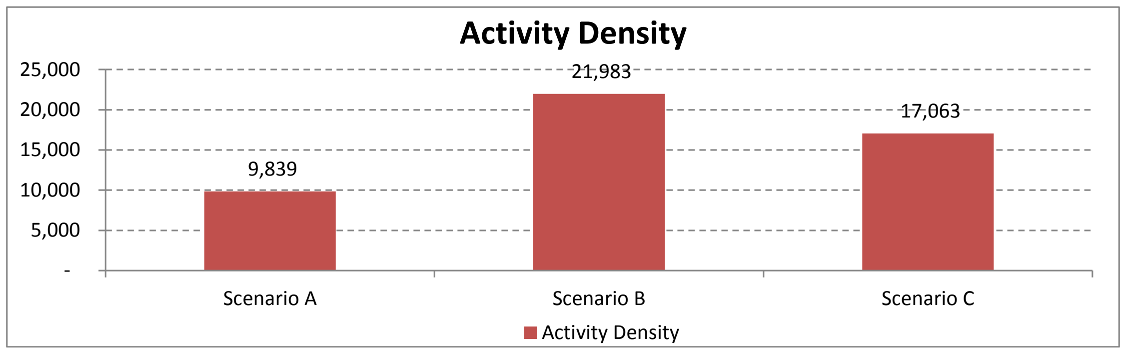


C: Towards a balance of jobs and housing citywide



Scenario Results

Scenario A has the highest residential population. However, due to the mixed use development in Scenario B and Scenario C, the number of jobs in Scenario B and C is higher than the trend Scenario. Overall, Scenario B has the highest activity density.



What would improve the results

- Encourage the development of mixed use office.
- Provide diverse housing choices including multi-family housing and town homes.

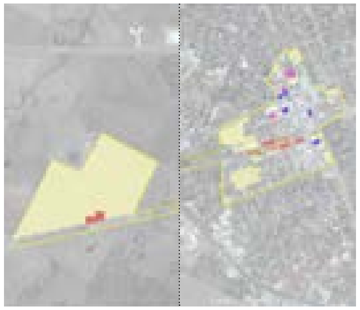
	Scenario A	Scenario B	Scenario C
Population	1,458	1,169	1,325
Employment	174	2,335	1,390
Area (square mile)	0.17	0.16	0.16
Activity Density (per sq mile)	**9,839**	**21,983**	**17,063**

Job-Population Balance - Elgin

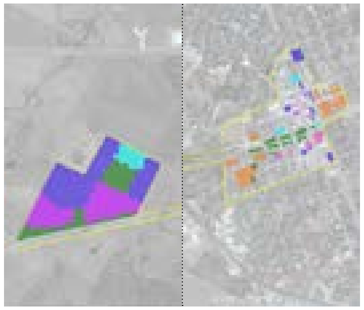
Definition

The job-population Balance Index measures the balance between the number of jobs and residents. The index ranges from 0, where only jobs or residents are present in an study area, to 1 where the ratio of jobs to residents is optimal in terms of trip genertation. The value 0.2 represents a balance of employment and population that generates the highest trip rate.

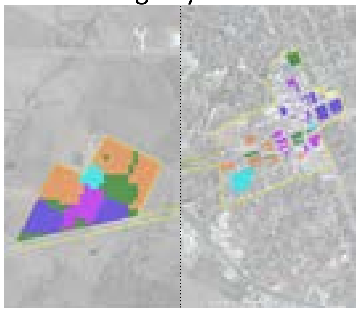
Scenario A: Trend



B: Balance jobs and housing within the Site

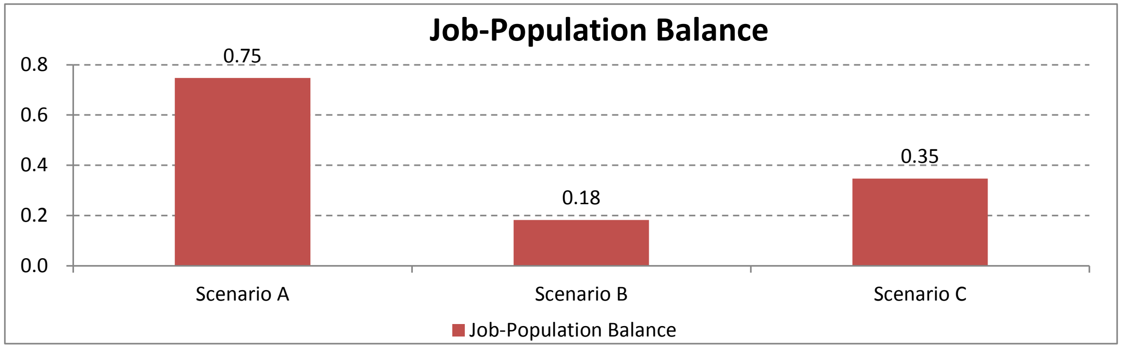


C: Towards a balance of jobs and housing citywide



Scenario Results

It is proposed that 0.2 is the optimal job-population ratio that would generate the highest trip rate. In this case, the job-population balance in Scenario A is better than in Scenario B and Scenario C. Scenario B has relatively higher empolyment, thus its job-population balance index is the lowest.



What would improve the results

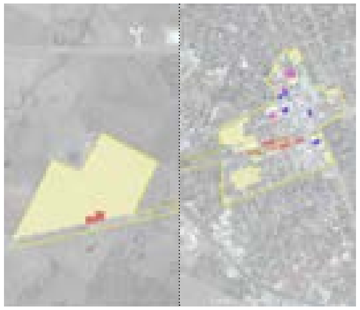
• Balance the development of residential and office/industrial.

	Scenario A	Scenario B	Scenario C
Population	1,458	1,169	1,458
Employment	174	2,335	1,390
Job-Population Balance	**0.75**	**0.18**	**0.35**

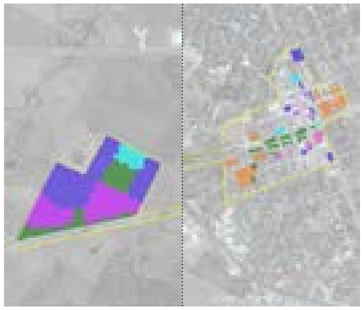
Land Use Mix - Elgin

Definition
Land use mix captures the variety of land uses within the study area. The index varies in value from 0, where all developed land is in one land use category, to 1, where developed land is evenly divided among land use categories. Mixed-use developments increase the walkability and bikability of the area. Land use mix is positively associated with internal capture of trips and non-motorized trips.

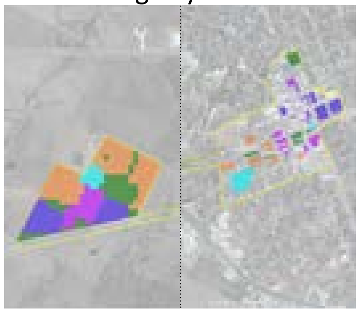
Scenario A: Trend

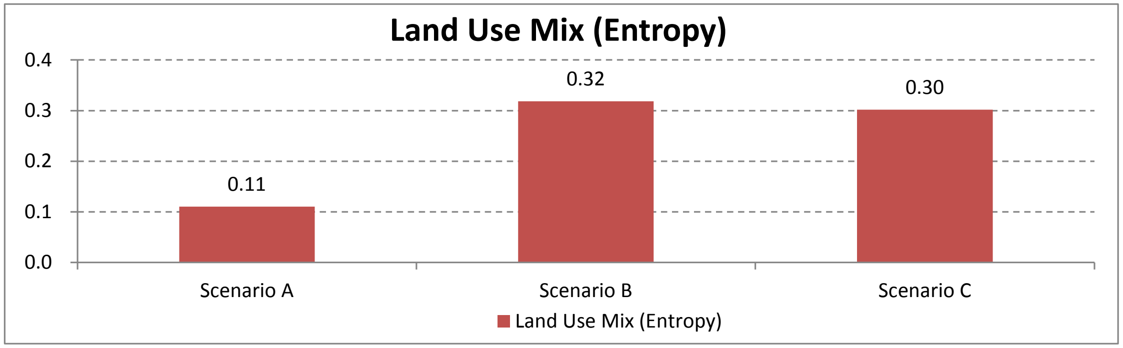


B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide





	Scenario A	Scenario B	Scenario C
Residential (sq ft)	1,267,731	882,113	982,983
Retail (sq ft)	36,262	610,970	372,594
Office (sq ft)	21,004	107,064	61,942
Industrial (sq ft)	1,366,338	1,826,532	1,531,640
Land Use Mix	**0.11**	**0.32**	**0.3**

Scenario Results
New Developments in Scenario A are primarily single family residential, thus it has the lowest land use mix score. New development in Scenario B includes more retail, office, and industrial uses. Scenario C includes the greatest diversity of land uses, followed by Scenario B. Overall, new developments in Scenario C is the most diverse, where new development in Scenario B is the second most diverse.

What would improve the results
- Promote the benefits of mixed-use development.
- Determine the mix of uses and appropriate areas for mixed use zoning.
- Adopt new mixed use zoning requirements.

Street Connectivity - Elgin

Definition

Connectivity refers to the density of connections and the directness of links. As connectivity increases, travel distances decrease and route options increase, offering more route options, and making non-motorized travel more feasible. A connected road network tends to emphasize accessibility by accommodating more travel with traffic dispersed over more roads, to improve walking and cycling conditions, and to support transit use.

Scenario Results

Industrial development contains least intersetions, and single family neighborhood usually contains fewer intersections, whereas town center, corridor commercial and civic encourages higher street connectivity. Scenario B has the highest street connectivity due to the town center development. Scenario C is the second most connected and Scenario A is the least connected.

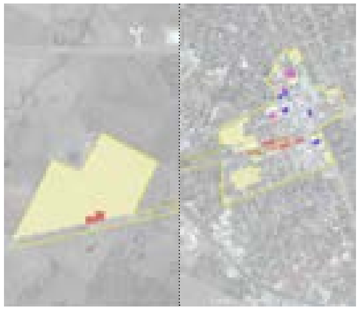
What would improve the results

• Develop a well-connected road or path network that has many short links, numerous intersections, and minimal dead-ends.

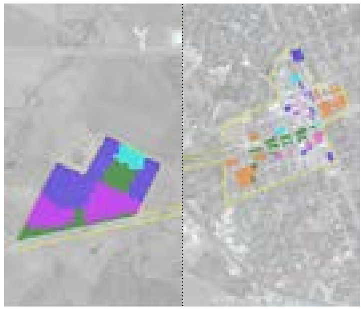
• Build the internal circulation route as an interconnected, grid-like transportation system.

• Set a maximum block size.

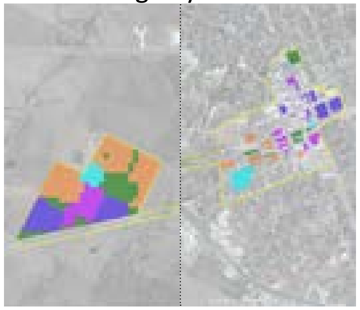
Scenario A: Trend

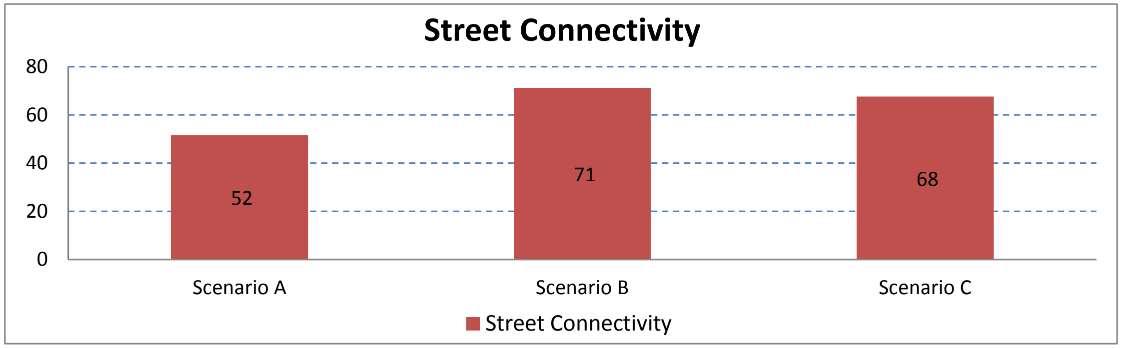


B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



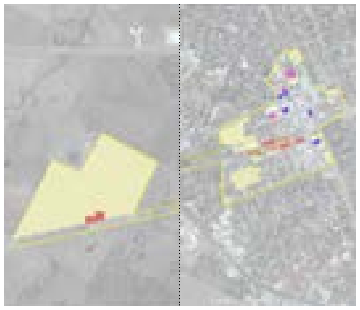


	Scenario A	Scenario B	Scenario C
Number of Intersections	9	11	11
Area	0.17	0.16	0.16
Intersection Density	**52**	**71**	**68**

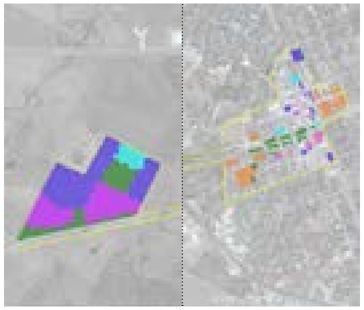
Proportion of Area within 1/4 mile of Transit Stops - Elgin

Definition
Typically 1/4 mile is considered a standard walking distance for most people could accomodate. A transit stop within walking distance increases the probability people would choose to take public transit. Near-by transit stops may also stimulate walk-ing.

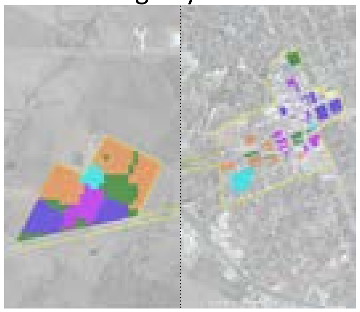
Scenario A: Trend



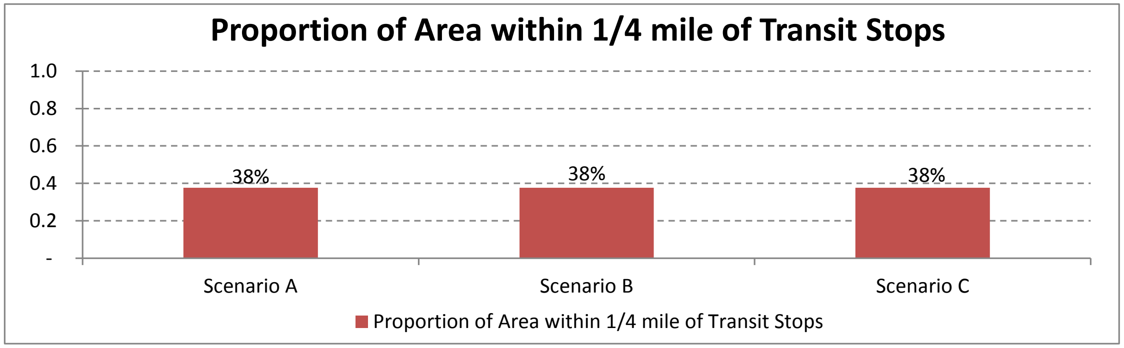
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
Two transit stops are proposed. 38% of the area is covered within the walking dis-tance (1/4 mile) of transit stops.



What would improve the results
• Incorporate the community into regional transportation plans that include transit..
• Encourage high-density and mixed-use residential and commercial development within a radius of 1/4 to 1/2 mile from a transit stop to maximize access to transit.

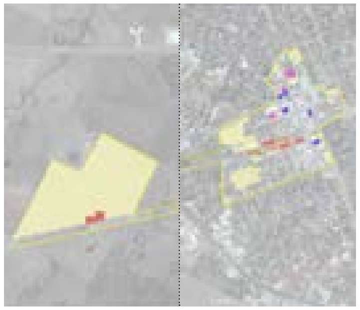
	Scenario A	Scenario B	Scenario C
Proportion of Area within 1/4 mile of Transit Stops	**38%**	**38%**	**38%**

Street Network Density - Elgin

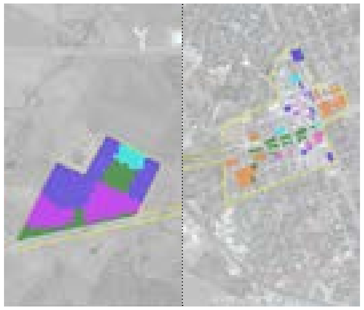
Definition

Street network density refers to the ratio of the length (in miles) of scenario's road network to the land area (in square miles) in the study area. Higher street network density is usually associated with better street connectivity. Street density is significantly associated with travelers' mode choice. Greater street network density has an even greater influence on non-work trips.

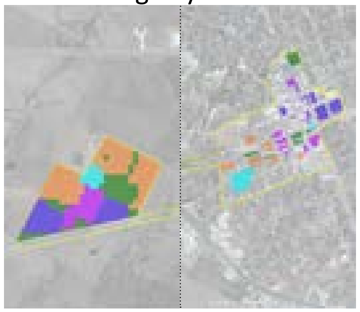
Scenario A: Trend



B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide

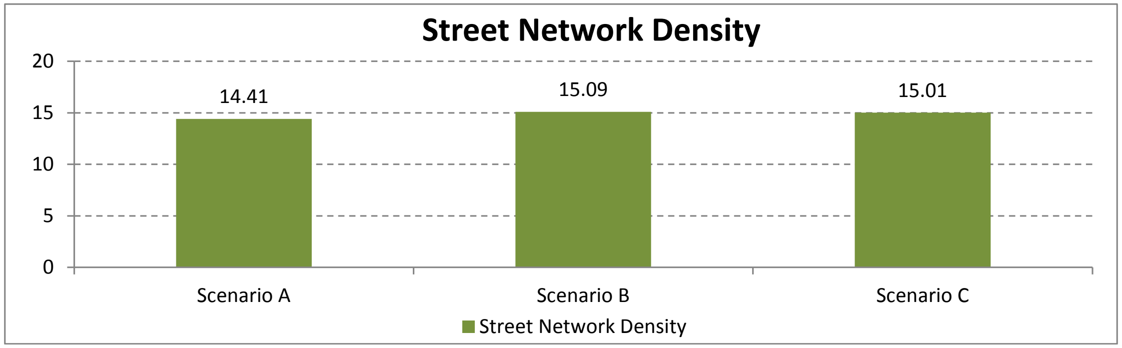


Scenario Results

Main street commercial and corridor commercial developement accommodate the highest street network density, while single family neighborhood, office, and industrial accommodate the lowest. Scenario B has the highest street network density due to the compact developments, while Scenario A has the lowest street network density due to the single family development.

What would improve the results

- Build the internal circulation route as an interconnected, grid-like transportation system.
- Set a maximum block size.



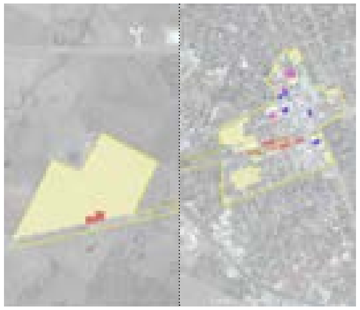
	Scenario A	Scenario B	Scenario C
Street Centerline Length (mile)	2	2	2
Total Area (sq mile)	0.17	0.16	0.16
Street Network Density	**14.41**	**15.09**	**15.01**

Transit Stop Coverage - Elgin

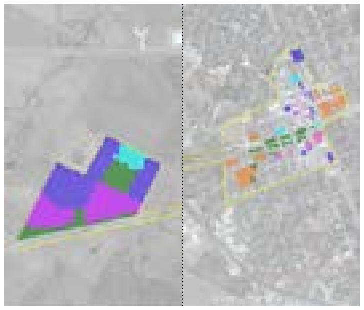
Definition

High transit stop coverage rate provides more opportunities to access transit. Better transit accessibility results in a higher percentage of trips by public transit and lowers the amount of driving. Less vehicle trips can lower VMT, mitigate congestion impacts, and reduce vehicle ownership. It also has environmental impacts in the form of reduced carbon emissions.

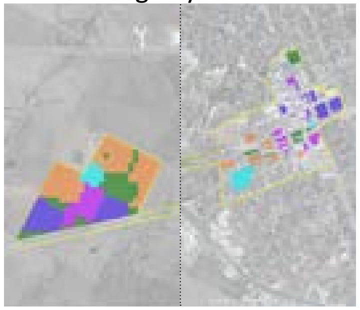
Scenario A: Trend



B: Balance jobs and housing within the Site

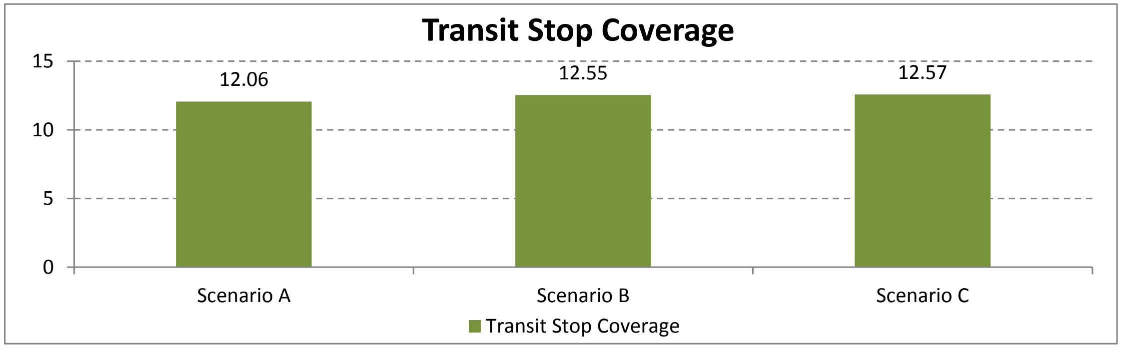


C: Towards a balance of jobs and housing citywide



Scenario Results

There are two rail stations proposed. For new developments in Scenario A, the transit stop coverage is 12.06 per square mile; for Scenario B, it is 12.55 per square mile; and for Scenario C, it is 12.57 per square mile.



What would improve the results

• Provide for interagency coordination of transit services in several of its transit funding programs.

• Develop a regional plan for public transportation coordination.

	Scenario A	Scenario B	Scenario C
Number of Transit Stops	2	2	2
Total Area (sq mile)	0.17	0.16	0.16
Transit Stop Coverage	**12.06**	**12.55**	**12.57**

Bicycle Network - Elgin

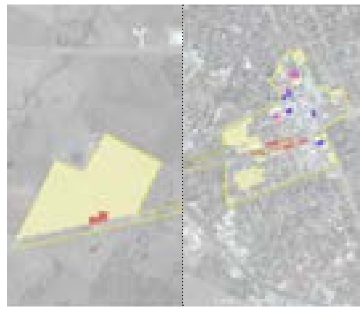
Definition

Cycling is one of the most affordable transportation options. High bicycle network coverage provides more transportation options and better mobility, especially for non-drivers. Improved bicycle facilities create more balanced transportation systems with lower automobile dependency, and promote social equity for people who are transportation disadvantaged. The shift to non-motorized modes also has a mitigating effect on congestionn.

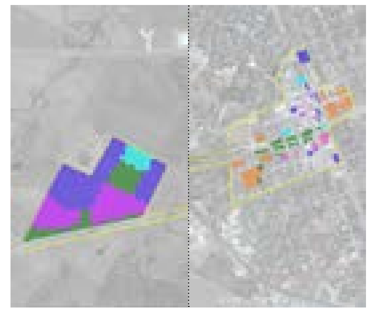
Scenario Results

Residential, civic, town center, and main street commercial accommodate the bike lanes better than office and industrial. Land uses in Scenario B and Scenario C include large proportion of office, thus their bicycle network coverage are lower than Scenario A.

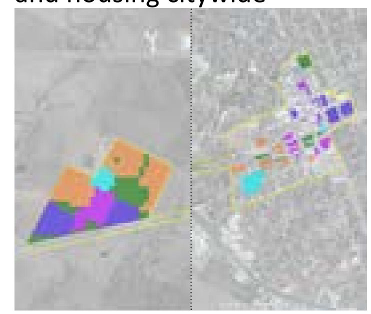
Scenario A: Trend

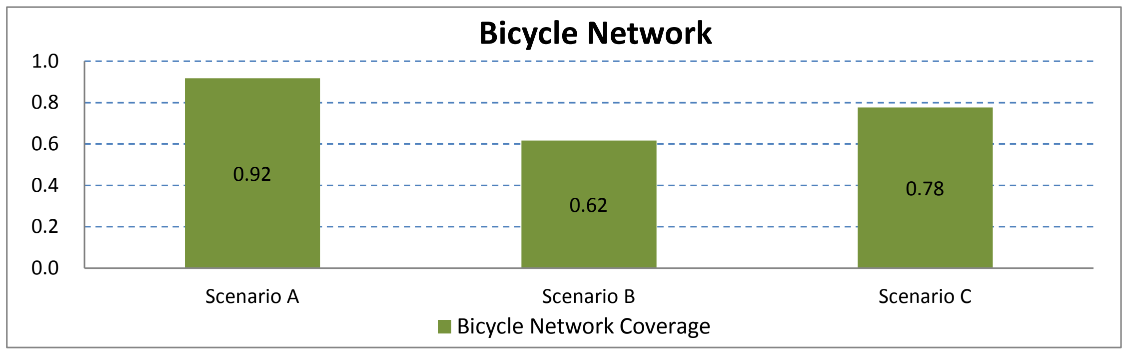


B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide





	Scenario A	Scenario B	Scenario C
Bike Lane Length	2.19	1.48	1.85
Street Centerline Length (mile)	2.39	2.4	2.39
Bicycle Network Coverage	**0.92**	**0.62**	**0.78**

What would improve the results

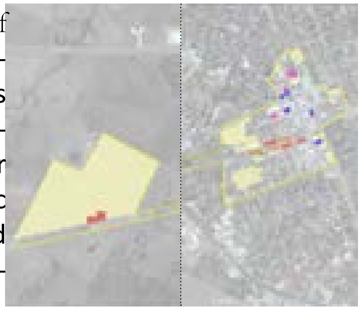
- Provide improved bicycle facility management and maintenance.
- Provide separate bike lanes for cyclists and implement traffic calming strategies.
- Promote bicycle sharing program.
- Improve cooperation throughout the region.

Sidewalk Completeness - Elgin

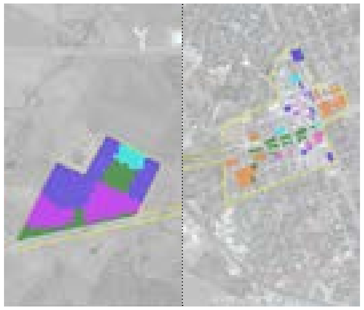
Definition

The availability of sidewalks improves the accessibility and increases the likelihood of walk trips. A complete sidewalk network provides people with more travel alternatives and reduces the frequency of vehicle-pedestrian collisions. It also reduces the number of vehicle miles traveled, mitigates traffic congestion, benefits the environment, and improves the health condition of the community.

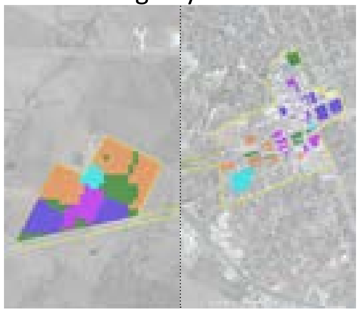
Scenario A: Trend



B: Balance jobs and housing within the Site

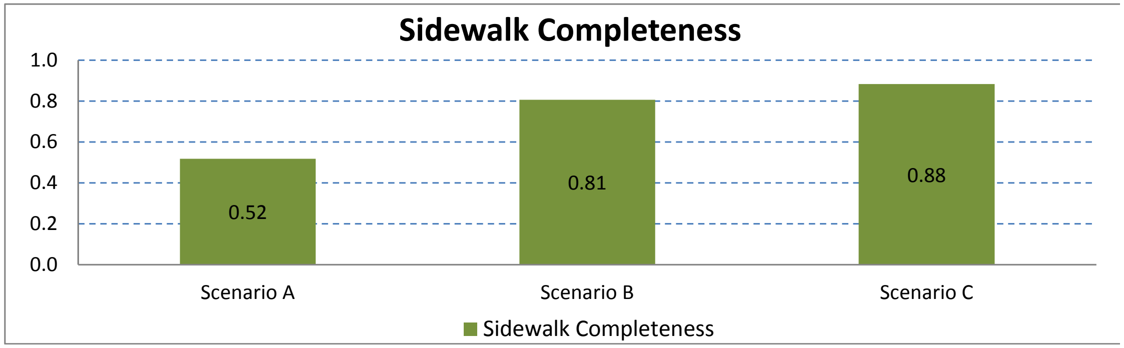


C: Towards a balance of jobs and housing citywide



Scenario Results

Town center, compact neighborhood, main street commercial, and civic development accommodate the sidewalks in both directions. Scenario C has the most complete sidewalks. Scenario B has the second most complete sidewalks. Scenario A has the least complete sidewalks.



What would improve the results

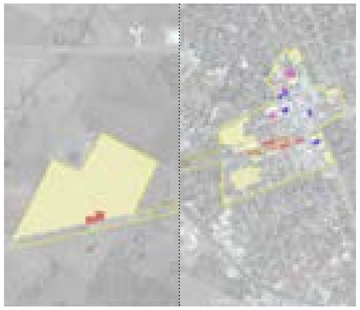
- Provide sidewalks along both sides of all roads, with exceptions where low pedestrian demand is expected.
- Provide pedestrian paths at street's cul-de-sacs.
- Increase funding for sidewalk projects.
- Work with developers to obtain rights-of-way.

	Scenario A	Scenario B	Scenario C
Sidewalk Length	2.48	3.88	4.22
Street Centerline Length (mile)	2.39	2.4	2.39
Sidewalk Completeness	**0.52**	**0.81**	**0.88**

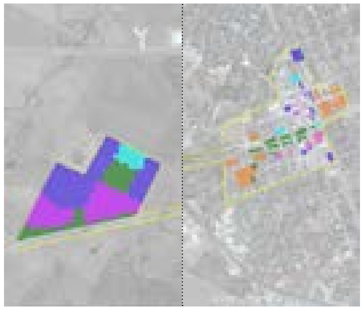
Sidewalk Density - Elgin

Definition
Sidewalk density refers to the ratio of the length (in miles) of sidewalks to the study area's land area (in square miles). Higher sidewalk density is usually associated with better connectivity for pedestrians. Higher sidewalk density is positively associated with increased walk trips and fewer auto trips. Better sidewalk connectivity improves accessibility to transit, where transit stops are available.

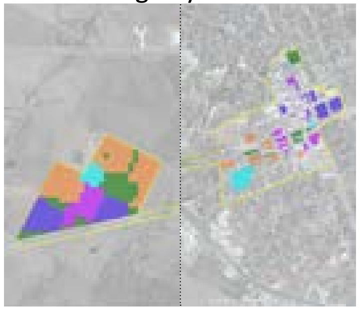
Scenario A: Trend



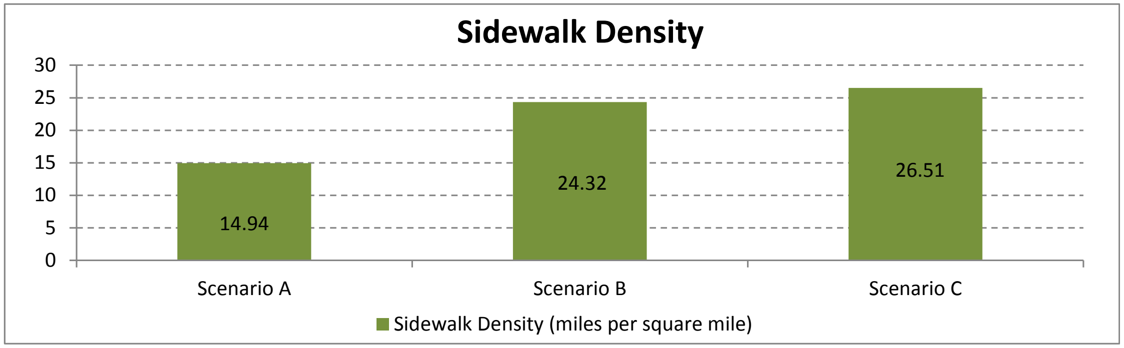
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
Town center, compact neighborhood, main street commercial, and civic development are equipped with dense sidewalks to acoommodate pedestrians. Scenario C has the densest sidewalks. Scenario B has the second densest sidewalks.



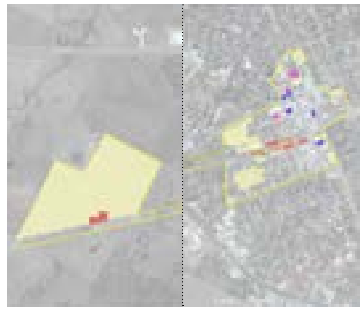
What would improve the results
- Provide sidewalks along both sides of all roads.
- Increase funding for sidewalk projects.
- Work with developers to obtain rights-of-way.
- Set a maximum block size for new development.

	Scenario A	Scenario B	Scenario C
Sidewalk Length	2.48	3.88	4.22
Total Area (sq mile)	0.17	0.16	0.16
Sidewalk Density	**14.94**	**24.32**	**26.51**

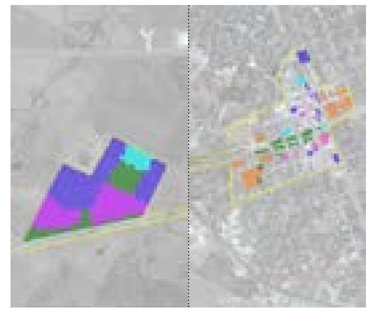
Vehicle per Capita - Elgin

Definition
This indicator estimates vehicles per capita within the study area. Lower vehicle ownership indicates less dependence on automobile.

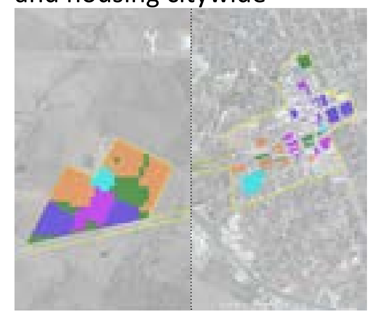
Scenario A: Trend



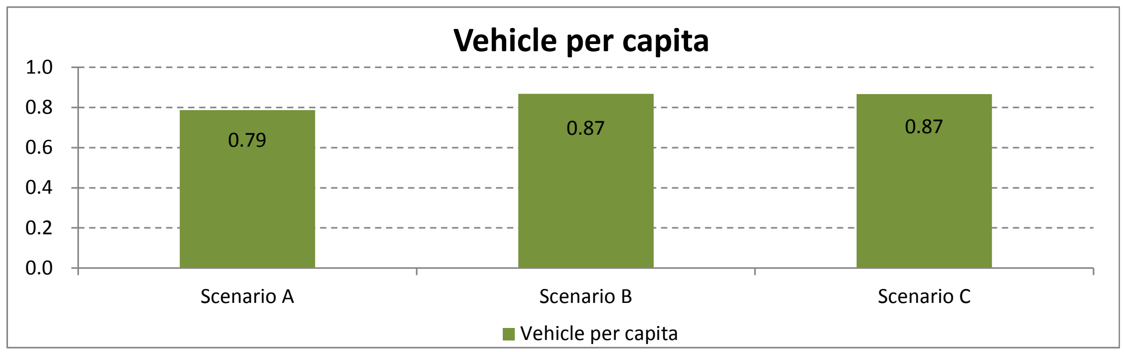
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
Single family households have fewer vehicle per family member than other households since family members tend to share one car. Thus, estimated vehicle per capita is the lowest in Scenario A.



What would improve the results
• Provide less parking space, or increase parking fees in the town center and in high density areas.

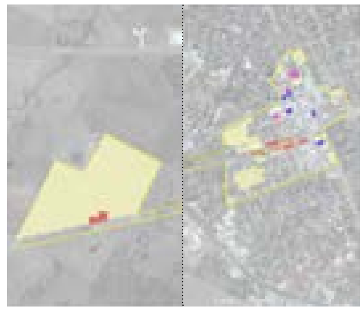
	Scenario A	Scenario B	Scenario C
Vehicle per Capita	**0.79**	**0.87**	**0.87**

Parking Supply - Elgin

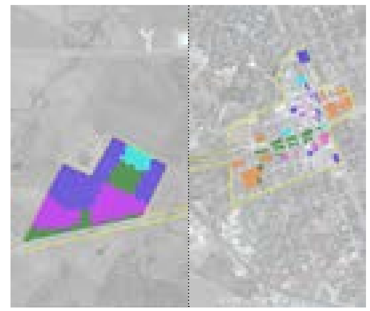
Definition

This indicator estimates the number of parking spaces associated with new developments.

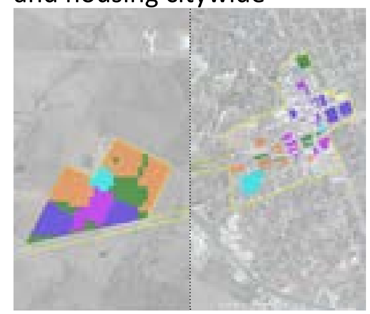
Scenario A: Trend



B: Balance jobs and housing within the Site

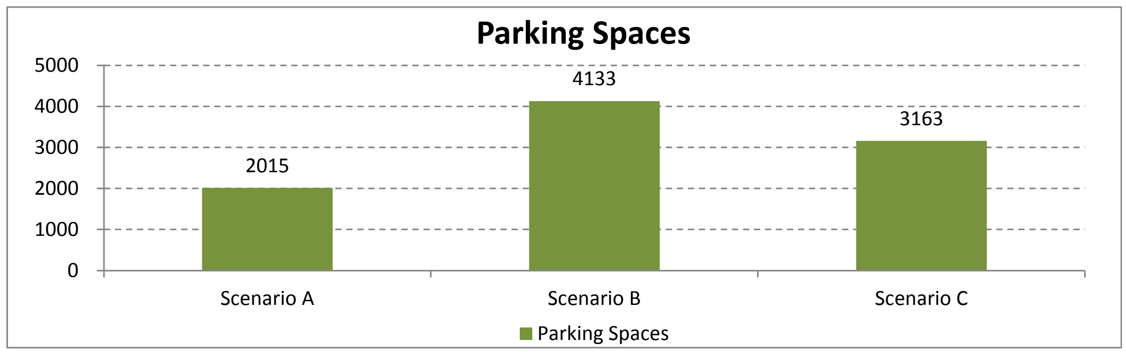


C: Towards a balance of jobs and housing citywide



Scenario Results

Town center and office provide more parking spaces compared to other development types. Due to the dense development of office and town center in Scenario B and Scenario C, the number of parking spaces in these scenarios are greater than those in Scenario A.



	Scenario A	Scenario B	Scenario C
Parking Spaces Supply	**2,015**	**4,133**	**3,163**

What would improve the results

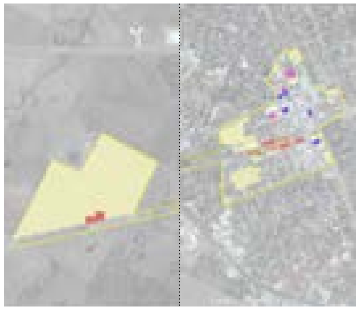
- Reduce minimum parking requirements.
- Incorporate parking maximums or area-wide parking caps to ensure that there is not an excess supply of parking.
- Permit shared parking for different buildings and facilities to take advantage of different peak parking characteristics.

Internal Trips - Elgin

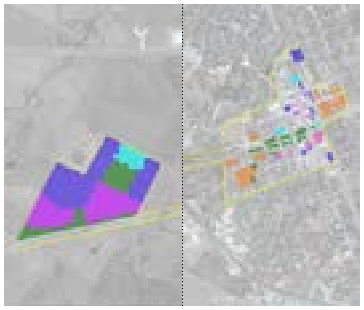
Definition

This indicator estimates the number of trips that remain within the study area.

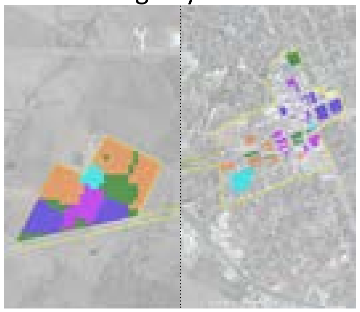
Scenario A: Trend



B: Balance jobs and housing within the Site

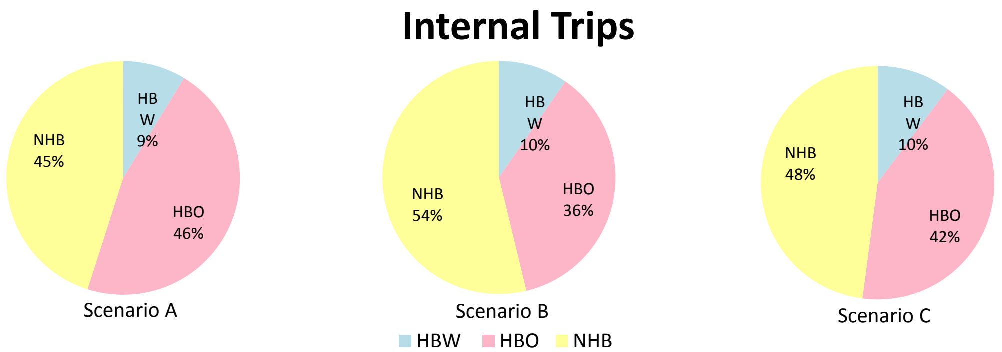


C: Towards a balance of jobs and housing citywide



Scenario Results

Most internal trips are for non-home based and home-based others. For Scenario B and Scenario C, where the land uses are more mixed, there are more non-home based trips. This might be the change of trip chain due to mixed-use development. Proportion of home-based work trips are very close in three scenarios.



What would improve the results

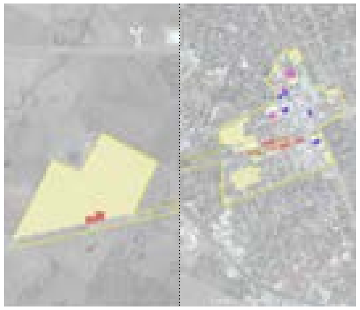
- Encourage compact and mixed uses in community.
- Improve street connectivity.
- Improve non-monbile facilities.
- Enhance the overall walking environment.

	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	391	526	544
HBO (Home-based others)	2,069	2,002	2,230
NHB (Non-home based)	2,017	2,940	2,554
Total	**4,477**	**5,468**	**5,329**

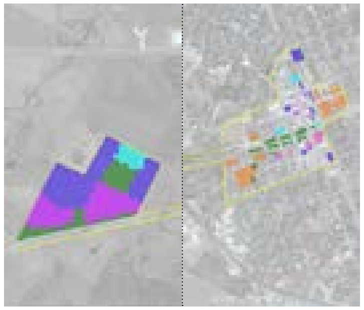
Internal Walk Trips - Elgin

Definition
This indicator estimates the number of walk trips within the study area.

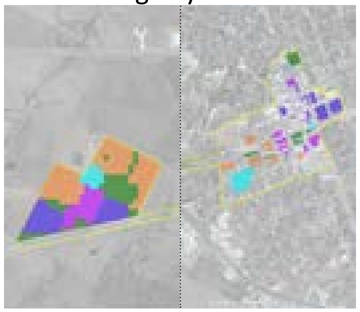
Scenario A: Trend



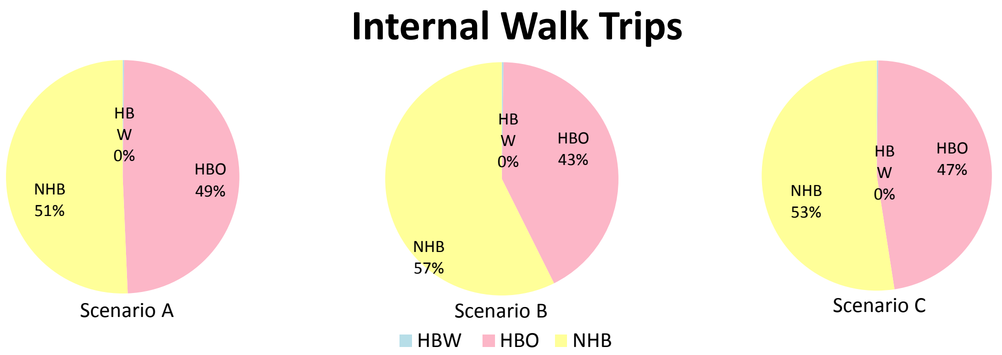
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
There are few internal walk trips in the home-based work category in all three scenarios. Home-based other is the main category for internal walk trips. In mixed-use development scenarios, the share of non-home based trip is slightly higher.



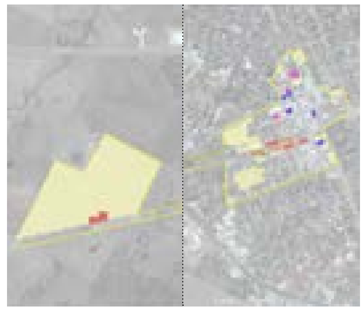
What would improve the results
• Encourage compact and mixed uses in the community.
• Improve street connectivity.
• Improve non-mobile facilities.
• Enhance the overall walking environment.

	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	1	3	2
HBO (Home-based others)	330	473	463
NHB (Non-home based)	340	640	512
Total	**671**	**1,115**	**977**

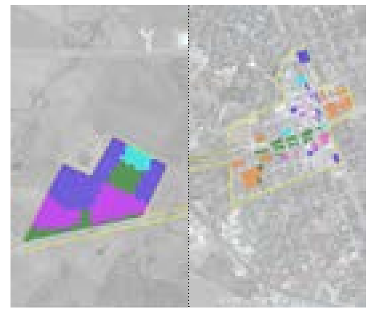
External Walk Trips - Elgin

Definition
This indicator estimates the number of walk trips to outside of study area.

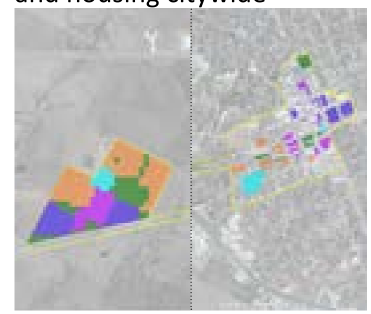
Scenario A: Trend



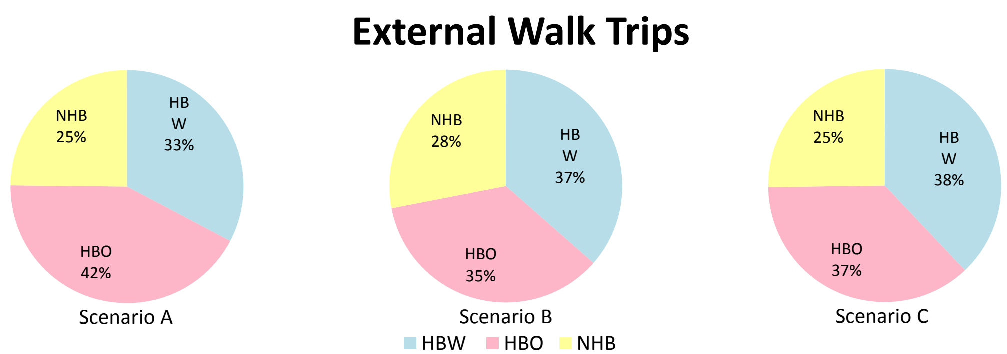
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
Home-based others is the main external walk trip purpose. However, its share decreases in mixed-use development scenarios. Also, as land use mix increases, the proportion of home-based work trips increases.



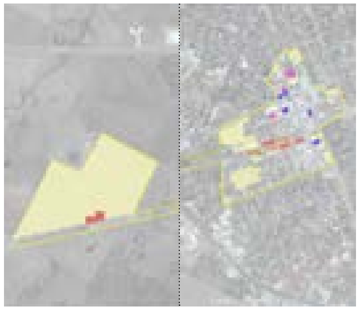
What would improve the results
- Improve street connectivity.
- Improve bicycle and pedestrian facilities.
- Enhance the overall walking environment.

	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	146	342	294
HBO (Home-based others)	190	333	285
NHB (Non-home based)	111	263	195
Total	**447**	**938**	**775**

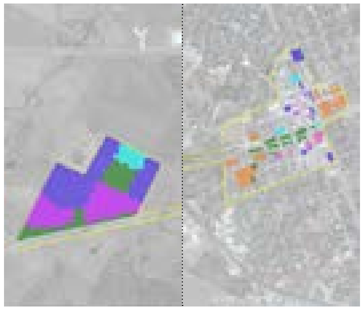
External Transit Trips - Elgin

Definition
This indicator estimates the number of transit trips. It is recommended that public transit accomodate home-based work trips as an alternative to automobile use because commuting trips are usually routine in terms of travel time and places.

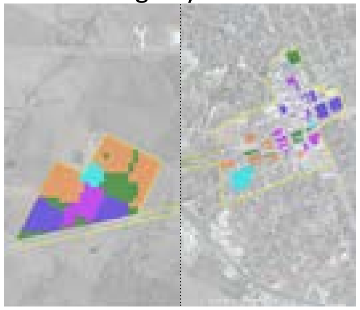
Scenario A: Trend



B: Balance jobs and housing within the Site

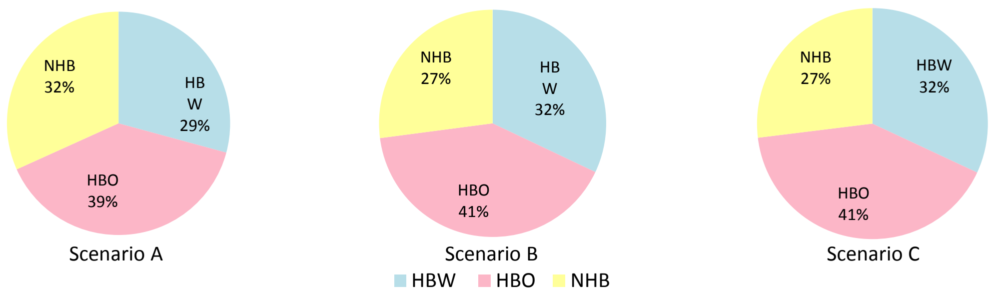


C: Towards a balance of jobs and housing citywide



Scenario Results
Home-based other is the main category of external transit trips. As land use mix index increases, the share of non-home based trips decreases and of home-based trips increases.

External Transit Trips



What would improve the results
• Provide public transportation service to accommodate the needs of home-based work trips.
• Improve street connectivity.
• Improve mobile facilities.
• Enhance the overall walking environment.

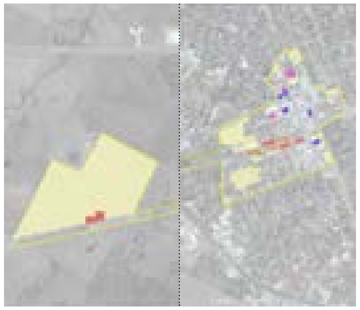
	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	213	448	385
HBO (Home-based others)	284	572	496
NHB (Non-home based)	231	379	325
Total	**728**	**1,398**	**1,206**

Total VMT Generated by Residental - Elgin

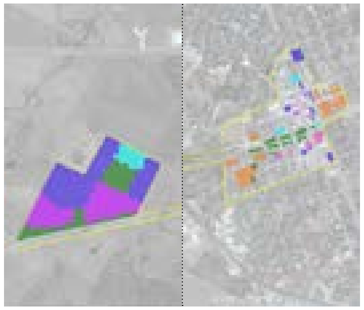
Definition

This indicator estimates the vehicle miles traveled (VMT) generated by residential land use.

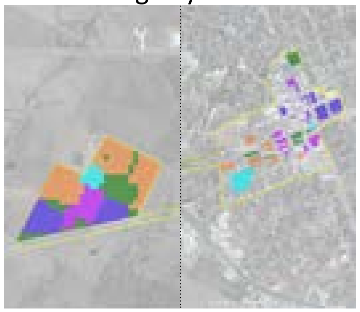
Scenario A: Trend



B: Balance jobs and housing within the Site

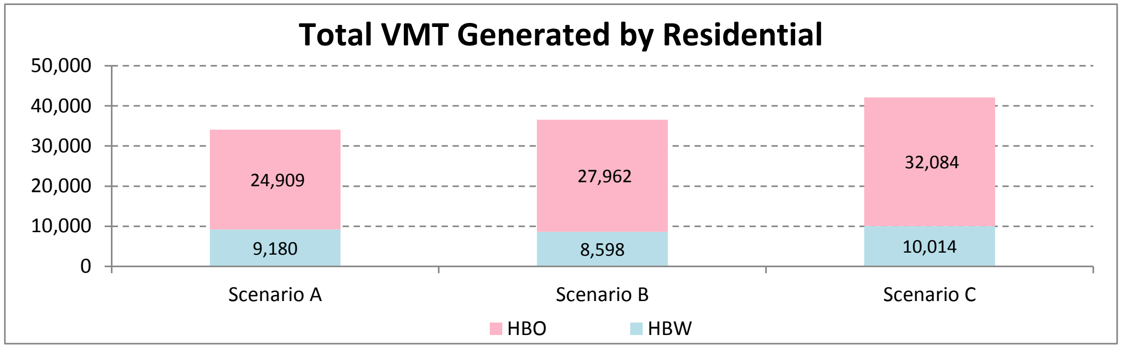


C: Towards a balance of jobs and housing citywide



Scenario Results

The VMT generated by residential use in Scenario C is the highest. It is the second highest in Scenario B, and the lowest in Scenario A.



	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	9,180	8,598	10,014
HBO (Home-based others)	24,909	27,962	32,084
Total	**34,089**	**36,560**	**42,098**

What would improve the results

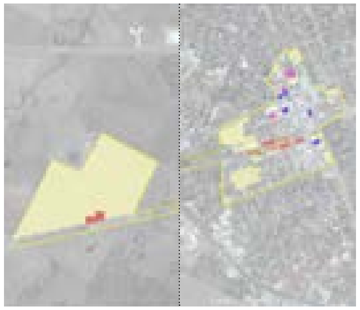
- Encourage compact and mixed uses in community.
- Improve street connectivity.
- Provide public transportation service.
- Improve mobile facilities.
- Enhance the overall walking environment.

Total VMT Generated by Retail - Elgin

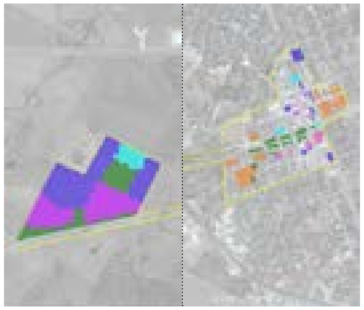
Definition

This indicator estimates the vehicle miles traveled (VMT) generated by retail land use.

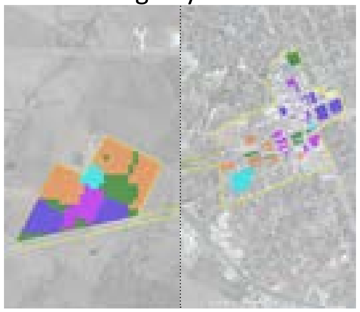
Scenario A: Trend



B: Balance jobs and housing within the Site

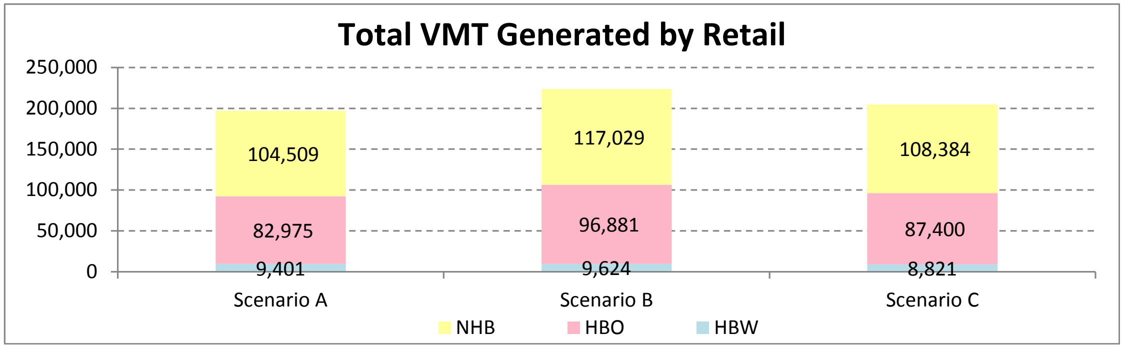


C: Towards a balance of jobs and housing citywide



Scenario Results

Scenario B has the highest VMT generated by retail use due to its focus on retail development. Scenario C is the second.



What would improve the results

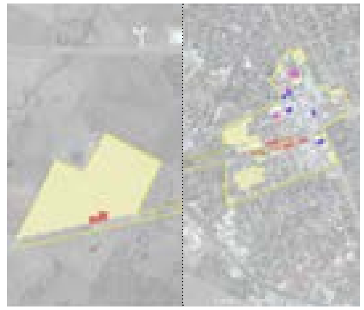
- Encourage compact and mixed uses in community to provide retail service in walking distance for residents.
- Improve street connectivity.
- Improve non-mobile facilities.
- Enhance the overall walking environment.

	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	9,401	9,624	8,821
HBO (Home-based others)	82,975	96,881	87,400
NHB (Non-home based)	104,509	117,029	108,384
Total	**187,485**	**213,910**	**195,784**

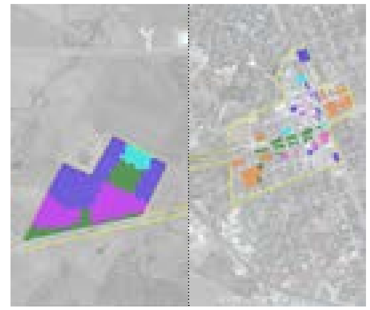
Total VMT Generated by Office/Industrial - Elgin

Definition
This indicator estimates the vehicle miles traveled (VMT) generated by office and industrial land uses.

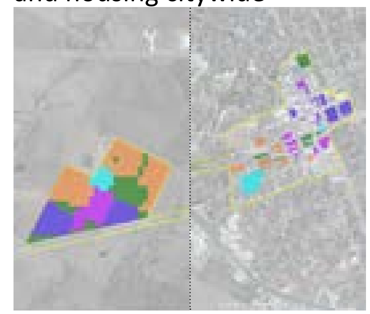
Scenario A: Trend



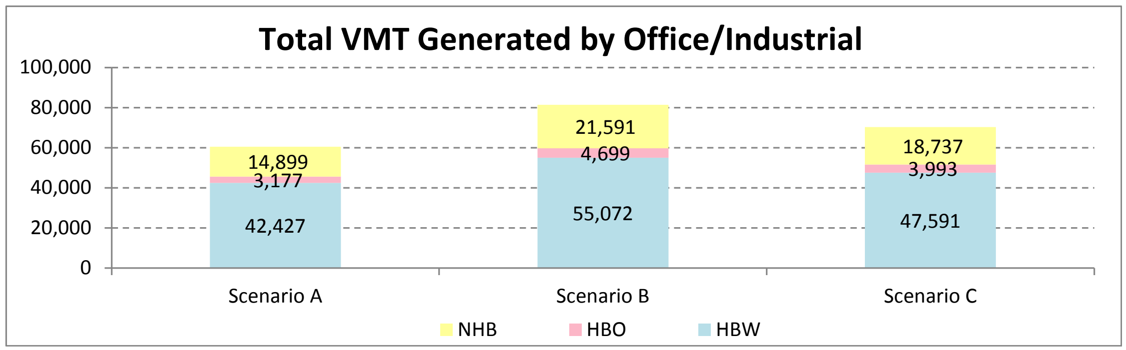
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
Scenario B generates the hightest VMT by office and industrial uses. Scenario B's VMT of home-based work trips is significantly higher than the other two scenarios since office is the primary workplaces. Scenario C has the second highest VMT generated by office and industrial.



What would improve the results
N/A

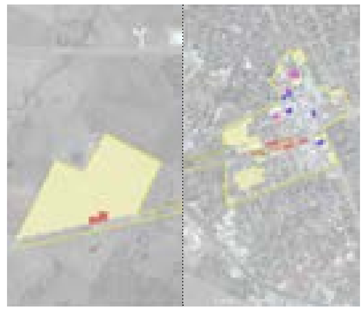
	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	42,427	55,072	47,591
HBO (Home-based others)	3,177	4,699	3,993
NHB (Non-home based)	14,899	21,591	18,737
Total	**18,076**	**26,290**	**22,730**

Percentage of Internal Trips - Elgin

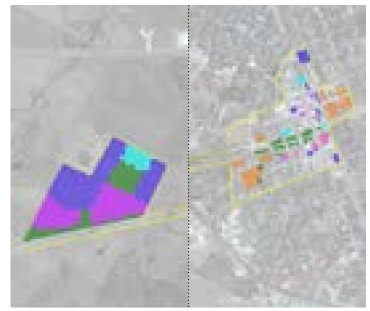
Definition

This indicator estimates the percentage of internal trips. The definition of mixed-use development requires some trips between on-site land uses to be made without travel on the off-site street system. MXD allows what might otherwise be external car trips to become internal trips, within walking or biking distance, and thus increases the non-motorized trip share.

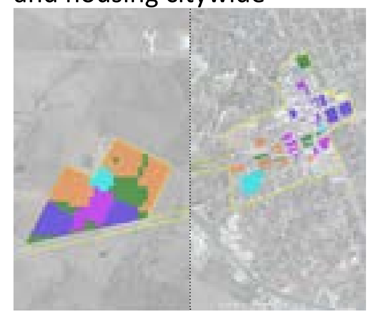
Scenario A: Trend



B: Balance jobs and housing within the Site

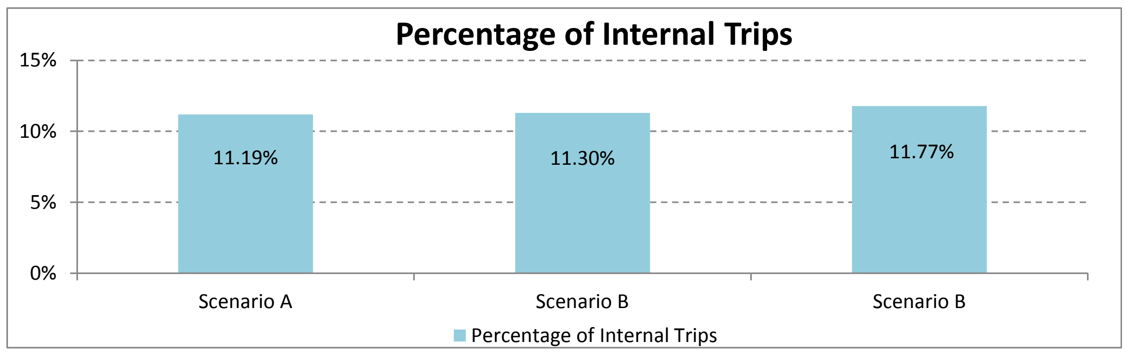


C: Towards a balance of jobs and housing citywide



Scenario Results

Percentage of internal trips slightly increases in Scenario B and Scenario C due to mixed-use development.



What would improve the results

- Encourage compact and mixed-use developments in the area.
- Provide facilities for pedestrians and cyclists, including sidewalks, designated bike lanes, bike racks, safe crossings, and lights, etc.
- Enhance the walking environment.

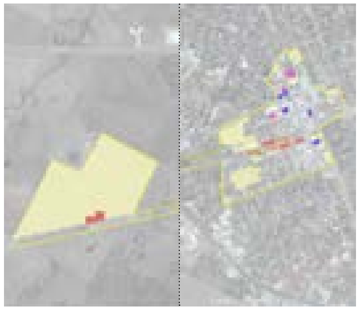
	Scenario A	Scenario B	Scenario C
Number of Internal Trips	4,477	5,468	5,329
Total Trips	39,992	48,376	45,264
Percentage of Internal Trips	**11.19%**	**11.3%**	**11.77%**

Percentage of Walk Trips - Elgin

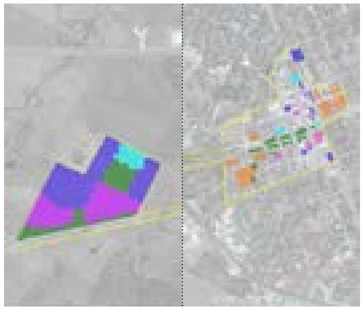
Definition

This indicator estimates the walk trip share. A transportation system that is conducive to walking can reap many benefits including health of individuals, reduced congestion, and improved quality of life. Economic rewards are also realized through reduction in health care costs, reduced dependency on autos, and increased economic vitality of commnities. Finally, walkable communities are more equitable.

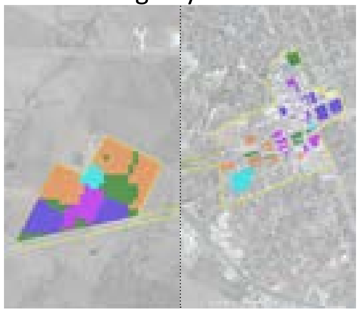
Scenario A: Trend



B: Balance jobs and housing within the Site

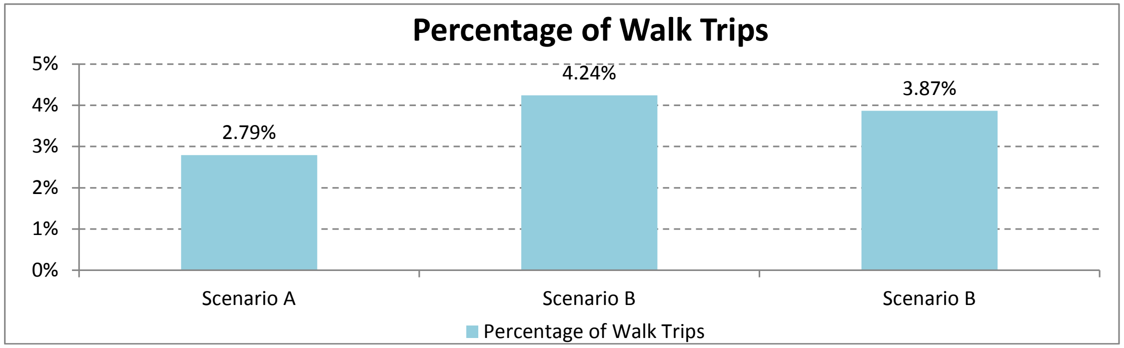


C: Towards a balance of jobs and housing citywide



Scenario Results

The walk trip share increases in Scenario B and in Scenario C due to the mixed-use and compact development.



What would improve the results

- Mix the uses to bring the origins and destinations closer.
- Provide appropriate landscaping to create a pleasant pedestrian environment.
- Encourage shops and businesses that open directly to the sidewalk to make friendly and unique building faces.

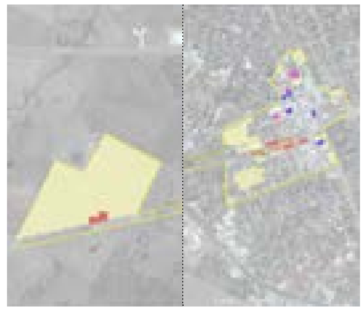
	Scenario A	Scenario B	Scenario C
Number of Walk Trips	1,118	2,052	1,751
Total Trips	39,992	48,376	45,264
Percentage of Internal Trips	**2.79%**	**4.24%**	**3.87%**

Percentage of Transit Trips - Elgin

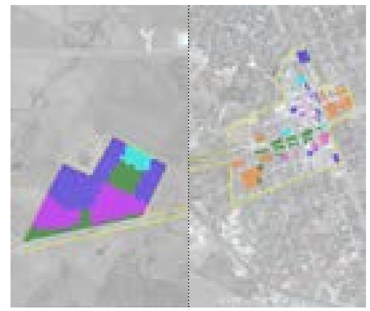
Definition

This indicator estimates the transit trip share. Public transportation provides an affordable alternative to driving. It offers mobility for those who do not drive or cannot drive. Public transportation facilities and corridors encourage economic and social activities and help create strong neighborhood centers, thus foster more livable communities.

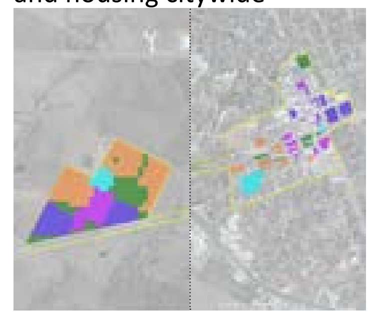
Scenario A: Trend



B: Balance jobs and housing within the Site

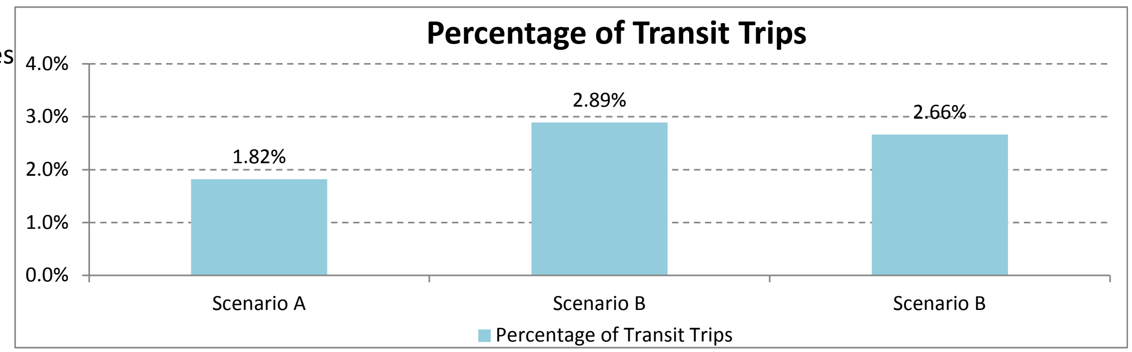


C: Towards a balance of jobs and housing citywide



Scenario Results

The proportion of transit trips increases slightly in Scenario B and Scenario C.



What would improve the results

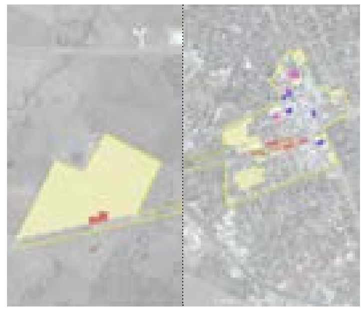
- Accommodate home-based work trips.
- Build new transit routes, expand the existing transit system, and provide public transportation facilities.
- Integrate transit system with land use regulations.
- Provide access to transit stops.

	Scenario A	Scenario B	Scenario C
Number of Transit Trips	728	1,398	1,206
Total Trips	39,992	48,376	45,264
Percentage of Internal Trips	**1.82%**	**2.89%**	**2.66%**

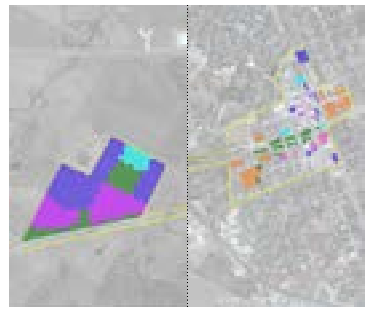
Total Trips - Elgin

Definition
This indicator estimates the total trips in the study area. With more transportation alternatives provided, and better connectivity and accessibility, more trips would be generated.

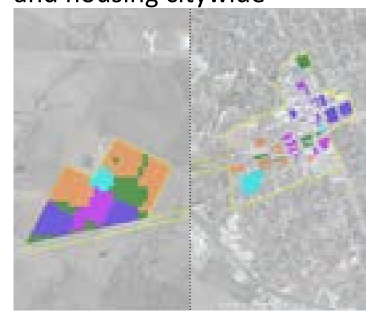
Scenario A: Trend



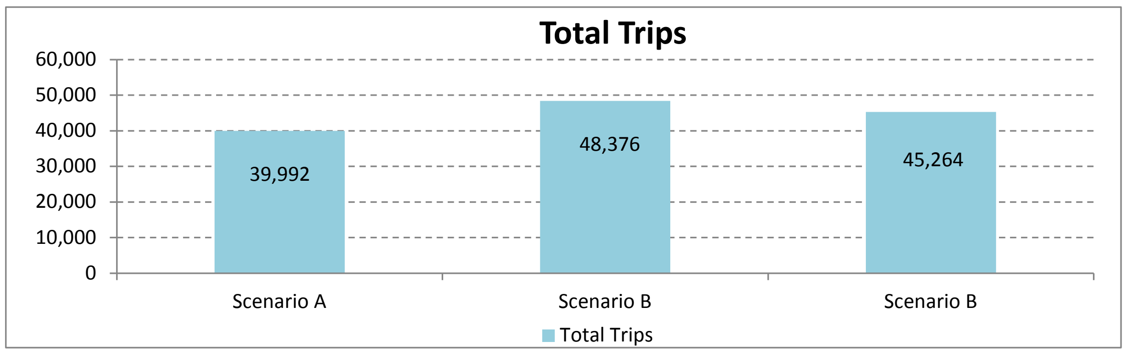
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
Scenario B generates the highest total trip rate. And Scenario C generates the second highest trip rate.



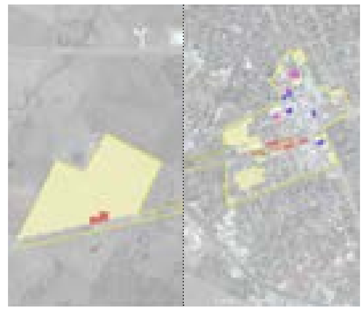
What would improve the results
- Mix land uses.
- Provide facilities to accomodate transit trips, walking, and biking.

	Scenario A	Scenario B	Scenario C
Total Trips	39,992	48,376	45,264

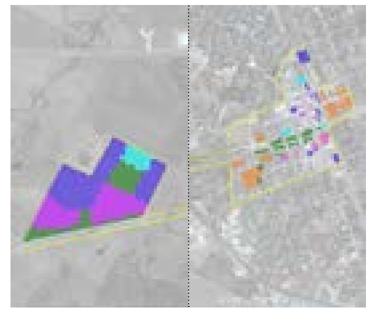
Total Transit Trips - Elgin

Definition
This indicator estimates the total transit trips of the study area. Public transportation provides an affordable alternative to driving. It offers mobility for those who do not drive or cannot drive. The number of total transit trips represents the demand on the transit system from mass transit operators.

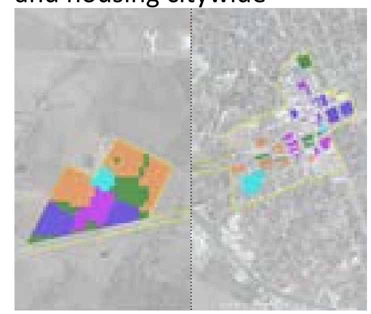
Scenario A: Trend



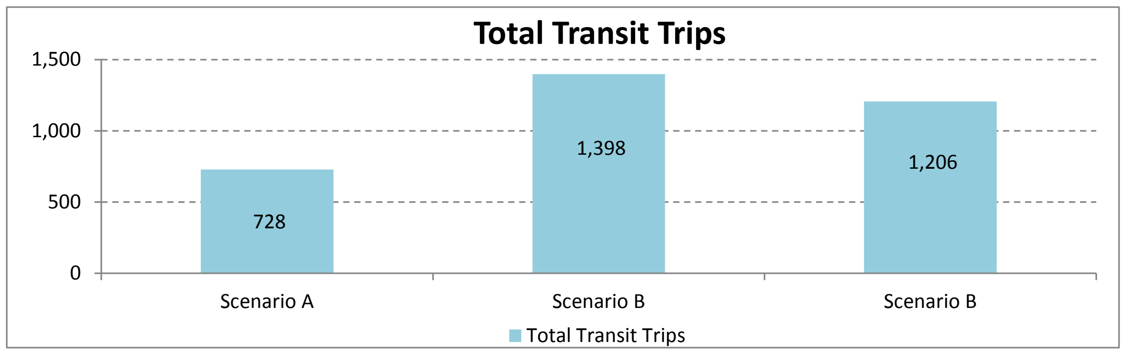
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
Mixed-use development scenarios generates higher total transit trips. Scenario B has the highest transit trips rate, followed by Scenario C.



	Scenario A	Scenario B	Scenario C
Number of Transit Trips	**728**	**1,398**	**1,206**

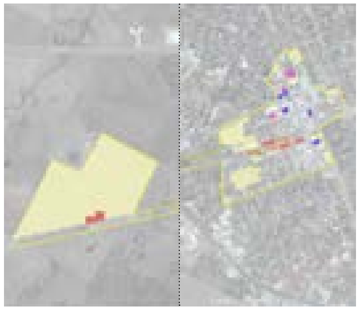
What would improve the results
- Accommodate home-based work trips
- Allocate more money on public transportation system.
- Provide safe and reliable transit service.
- Integrate transit system with land use planning.
- Provide access to transit stops.

Job Accessibility - Elgin

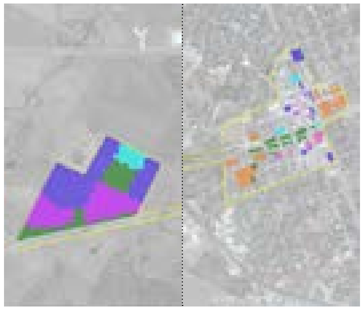
Definition

This indicator measures the ease of people reaching their jobs. People who live in places with higher accessibility can reach many destinations more quickly. Accessibility is a measure of potential for interaction. Places with higher job accessibility are usually more likely to attract people to live or work there, therefore bringing more economic opportunities for the community.

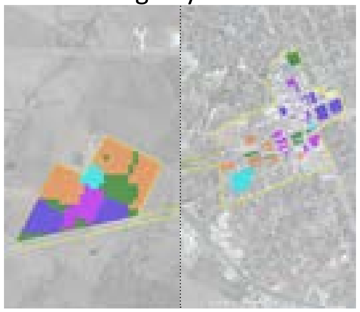
Scenario A: Trend



B: Balance jobs and housing within the Site

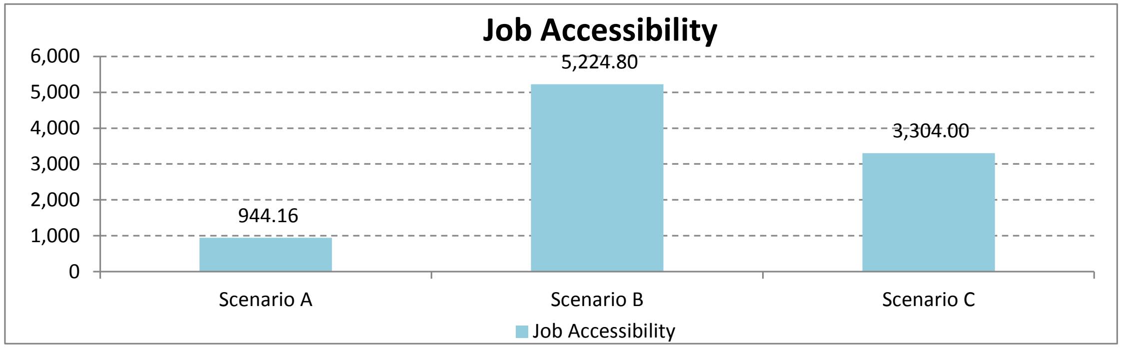


C: Towards a balance of jobs and housing citywide



Scenario Results

The number of jobs is much higher in Scenario B and Scenario C. Also, the average auto commute time is slightly shorter. Thus the job accessibility significantly increases in the two scenarios, especially in Scenario B.



What would improve the results

- Improve service for the roadway network and public transportation system.
- Create a community friendly to pedestrians and cyclists.
- Cluster jobs and residents at a location with more transportation options and in area with greater connectivity.

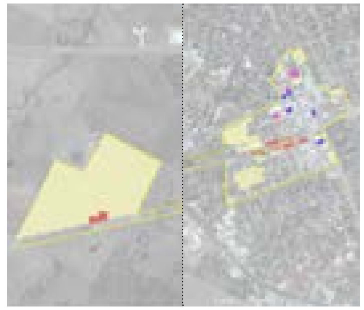
	Scenario A	Scenario B	Scenario C
Number of Jobs	444	2,605	1,660
Average Auto Commute Time	7.55	6.96	6.88
Job Accessibility	**944**	**5,225**	**3,304**

Parking Demand - Elgin

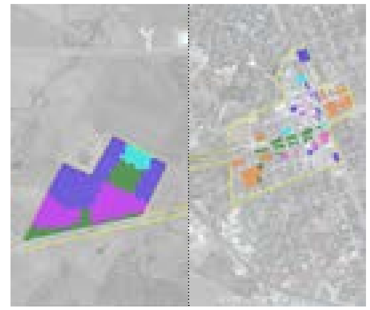
Definition

This indicator estimates the increased demand for parking associated with new development in study area.

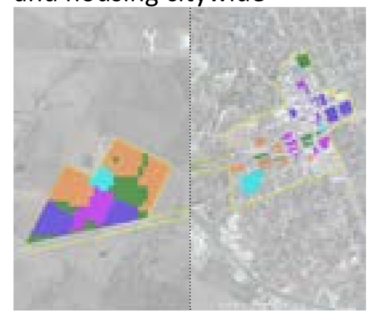
Scenario A: Trend



B: Balance jobs and housing within the Site

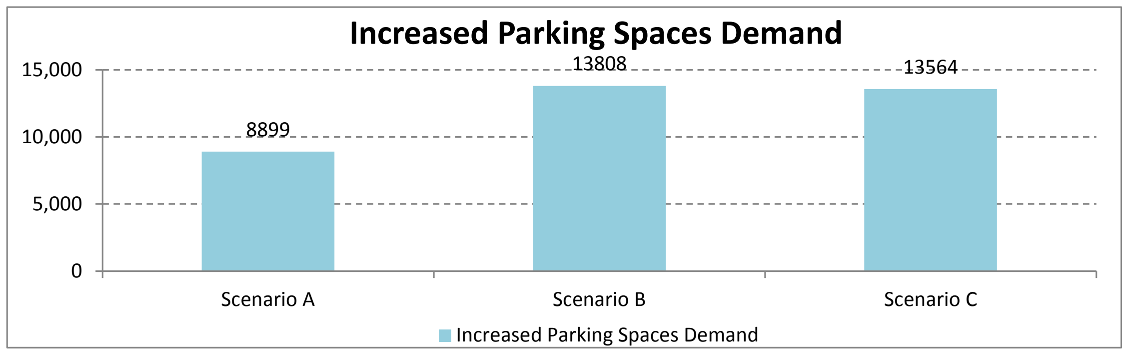


C: Towards a balance of jobs and housing citywide



Scenario Results

Office accomodates the most parking spaces compared to other developments. Thus, the increased parking demand of Scenario B is the highest due to its focus on office development. Land uses in Scenario A include the most residential, thus it has the lowest parking demand.



What would improve the results

• Encourage compact, mixed-use developments.

• Provide facilities to accommodate walking and biking.

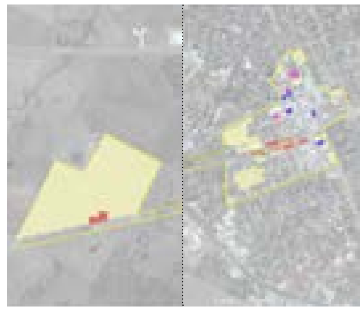
• Encourage shared parking arrangements.

	Scenario A	Scenario B	Scenario C
Parking Spaces Demand	**8,899**	**13,808**	**13,564**

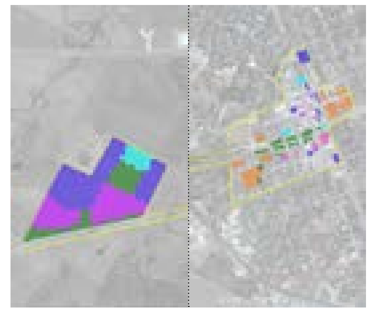
Daily Walk Trip per Capita - Elgin

Definition
This indicator estimates the daily walk trip per capita. Regular daily physical activities benefit indivual health by reducing the risk of many disease and obesity as well as environment. It also reflects the livability of community because there tend to be more activities taking place on the streets and more interactions between neighbors.

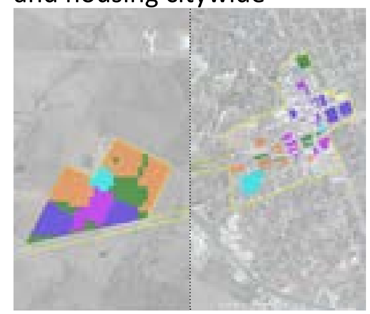
Scenario A: Trend



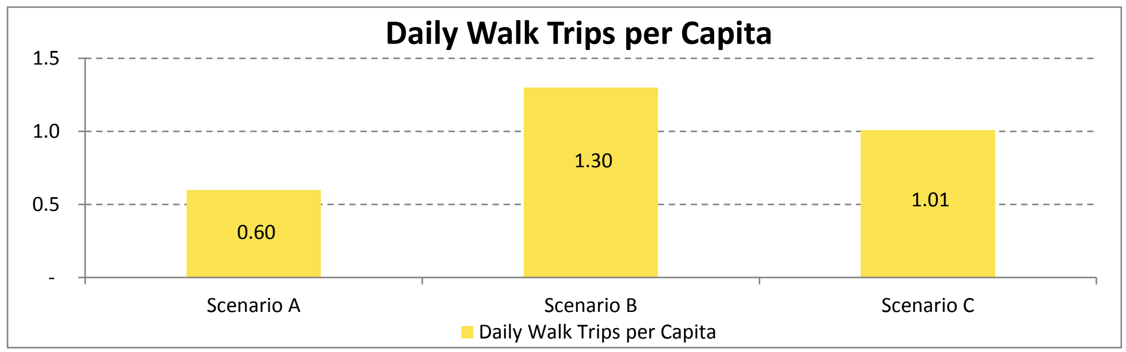
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
Mixed-use development significantly increases personal walk trip rate. For example, Scenario B generates more than doubled daily walk trips per capita than Scenario A does.



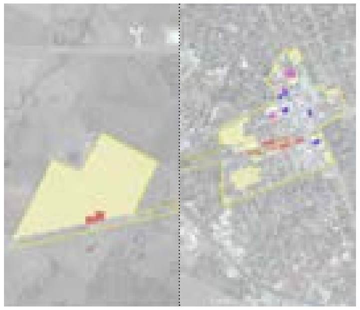
	Scenario A	Scenario B	Scenario C
Number of Walk Trips	1,118	2,052	1,751
Population	1,868	1,579	1,735
Daily Walk Trips per Capita	**0.6**	**1.3**	**1.01**

What would improve the results
• Encourage mixed and compact developments.
• Provide appropriate landscaping to create a pleasant pedestrian environment.
• Encourage shops and businesses that open directly to the sidewalk to make friendly and unique building facades.

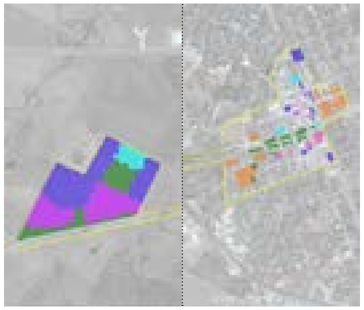
Average Auto Trip Length - Elgin

Definition
This indicator estimates the average auto trip length. Shorter length indicates better accessibitliy to the destinations.

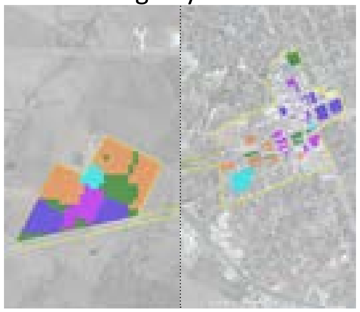
Scenario A: Trend



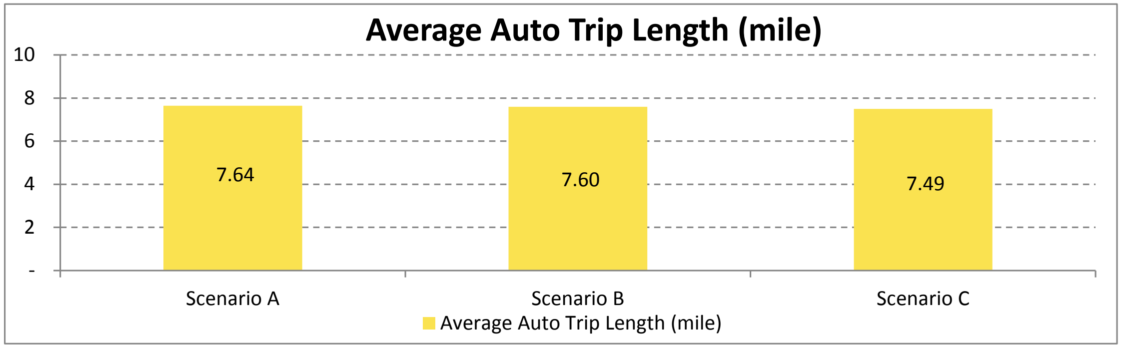
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
Average auto trip length of Scenario B and Scenario C are slightly less than Scenario A, but the difference is not very significant.



What would improve the results
• Improve the existing transportation system.
• Improve street connectivity.
• Implement strategies for traffic congestion mitigation.
• Encourage mixed use and compact developments.

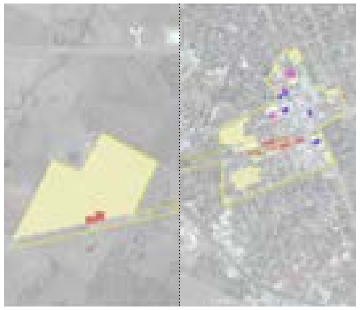
	Scenario A	Scenario B	Scenario C
Total Trips	38,146	44,925	42,307
Total Vehicle Miles Traveled	291,477	341,456	**317/025**
Average Auto Trip Length (miles)	**7.64**	**7.6**	**7.49**

Average Internal Auto Trip Length - Elgin

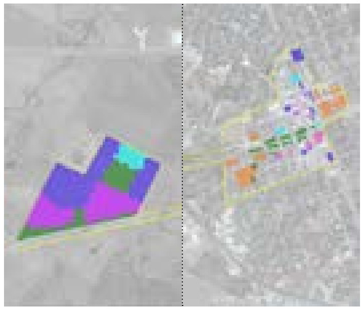
Definition

This indicator estimates average internal auto trip length.

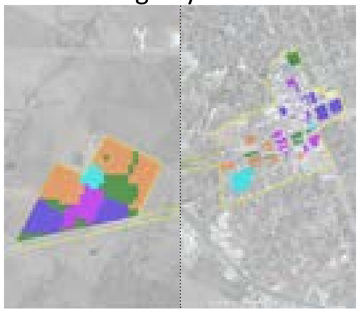
Scenario A: Trend



B: Balance jobs and housing within the Site

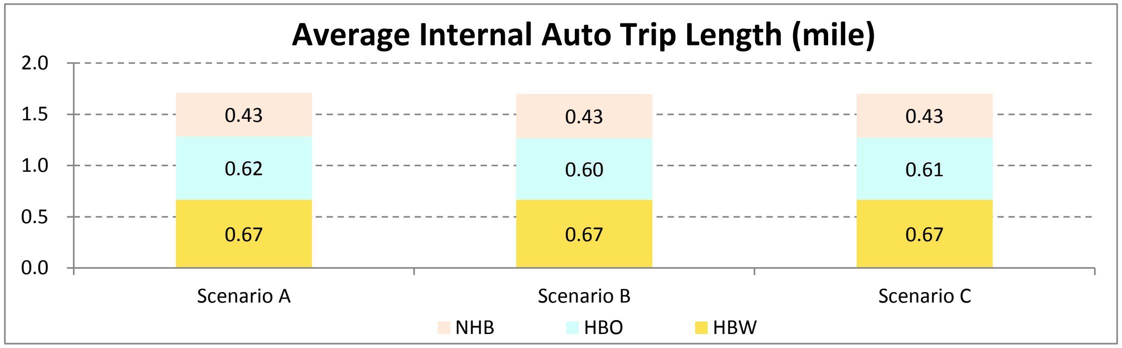


C: Towards a balance of jobs and housing citywide



Scenario Results

The length of home-based work trips and non-home based trips do not have any difference in three scenarios. However, the average home-based other trip length reduces due to the mixed-use developments in Scenario B and Scenario C.



What would improve the results

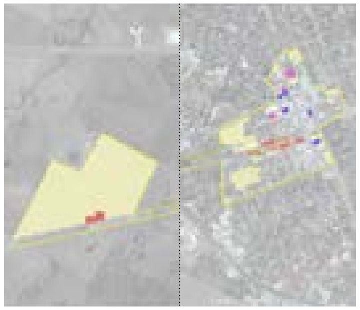
- Encourage the mixed use and compact developments to provide essential and commercial services within walking distance for residents in the community.
- Improve street connectivity.

	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	0.67	0.67	0.67
HBO (Home-based others)	0.62	0.6	0.61
NHB (Non-home based)	0.43	0.43	0.43

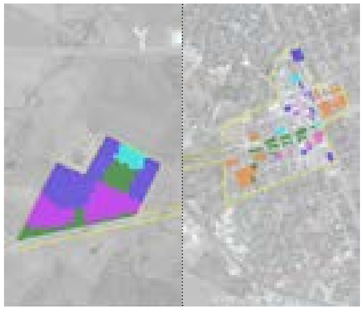
Average External Auto Trip Length - Elgin

Definition
This indicator estimates average external auto trip length by purpose.

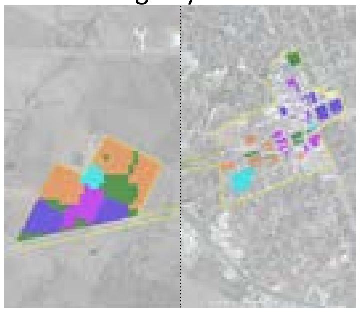
Scenario A: Trend



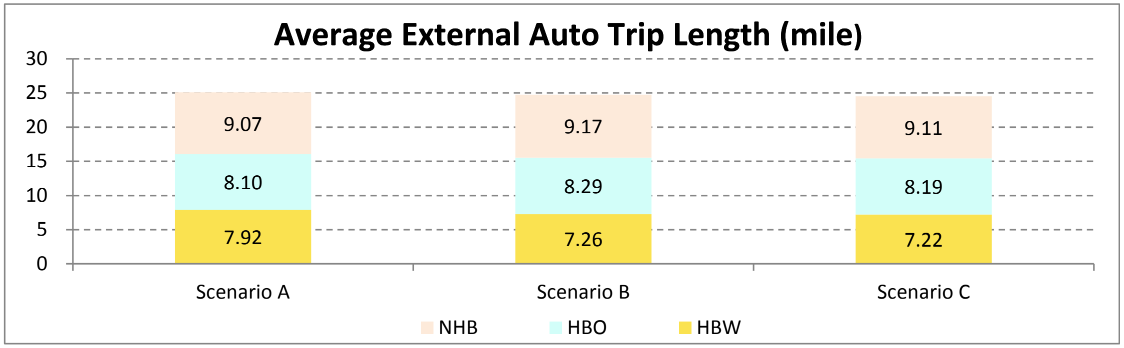
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
For the external trips, the length of home-based work trips decreases in mixed-use development scenarios. However, the average length of home-based others trips and non-home based trips increase slightly.



What would improve the results
• Improve the existing transportation system.
• Improve street connectivity.
• Implement strategies for traffic congestion mitigation.

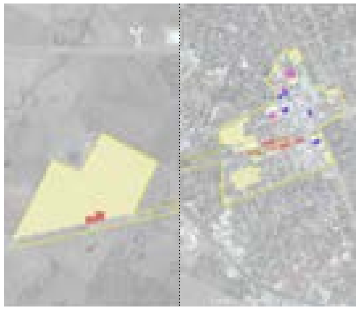
	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	7.92	7.26	7.22
HBO (Home-based others)	8.10	8.29	8.19
NHB (Non-home based)	9.07	9.17	9.11

Average Auto Trip Time - Elgin

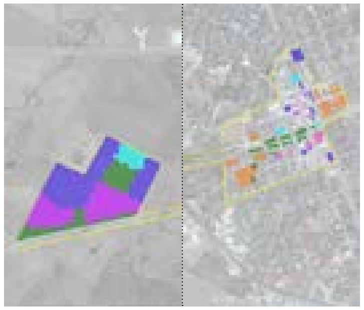
Definition

This indicator estimates the average auto trip time per trip. A shorter average auto trip time indicates greater accessibitliy to the destinations.

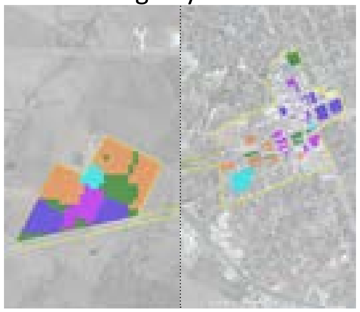
Scenario A: Trend



B: Balance jobs and housing within the Site

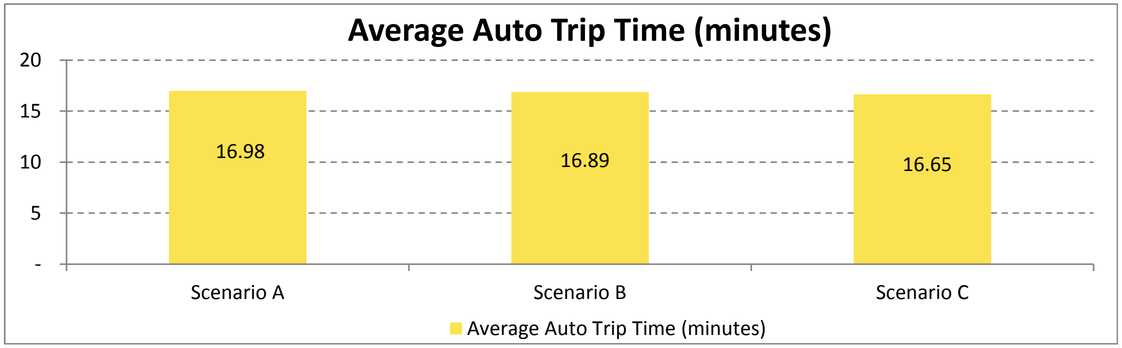


C: Towards a balance of jobs and housing citywide



Scenario Results

Commute time of Scenario B and Scenario C are slightly shorter than Scenario A, but the difference is not very significant.



What would improve the results

- Improve the existing transportation system.
- Improve street connectivity.
- Implement strategies for traffic congestion mitigation.
- Encourage mixed use and compact developments.

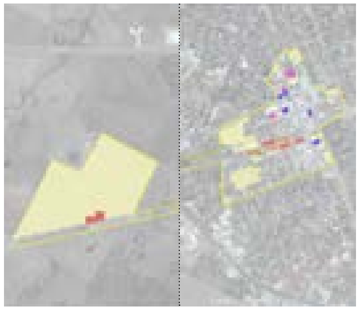
	Scenario A	Scenario B	Scenario C
Average Trip Length	7.64	7.6	7.49
Speed	27	27	27
Average Auto Trip Time (minutes)	**16.98**	**16.89**	**16.65**

Average Auto Commute Time - Elgin

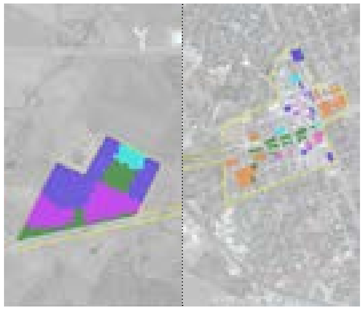
Definition

This indicator estimates the average auto trip time for commuters in the study area to their workplaces over the region. A shorter commute time indicates better accessibitliy to jobs.

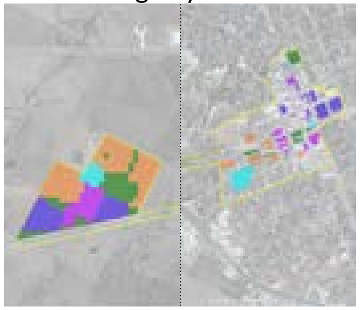
Scenario A: Trend



B: Balance jobs and housing within the Site

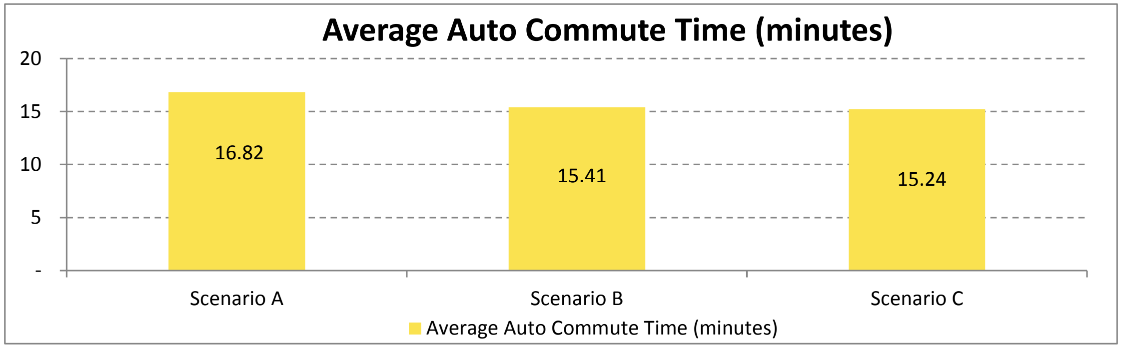


C: Towards a balance of jobs and housing citywide



Scenario Results

Average auto commute time of Scenario B and Scenario C are slightly shorter than Scenario A due to greater job accessibility.



What would improve the results

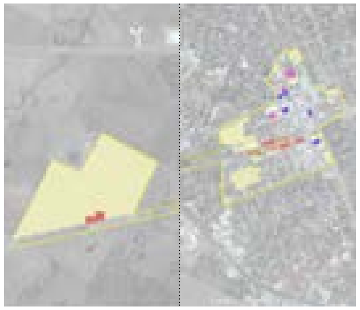
- Cluster job opportunities and individuals at a location closer to alternative transportation choices.
- Encourage the mixed use of residential and office.

	Scenario A	Scenario B	Scenario C
Average Auto Commute Length	7.57	6.93	6.86
Total Vehicle Miles Traveled	27	27	27
Average Auto Commte Time (minutes)	**16.82**	**15.41**	**15.24**

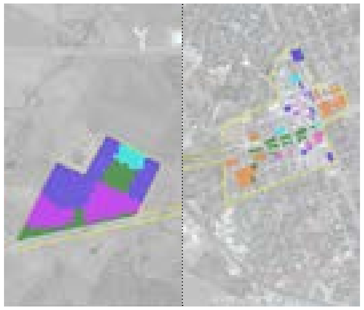
VMT per Capita - Elgin

Definition
This indicator estimates the number of vehicle miles traveled (VMT) per capita. High VMT leads to hifher level of traffic congestion, gas consumption, and air pollution. It is usually the result of dependency on private vehicles. It may also indicate less accessibility for those who do not own a car or are unable to drive.

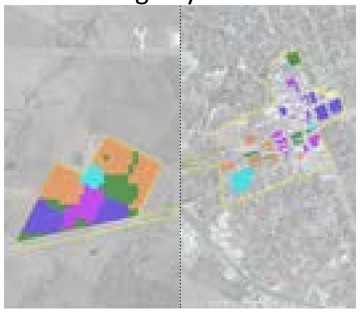
Scenario A: Trend



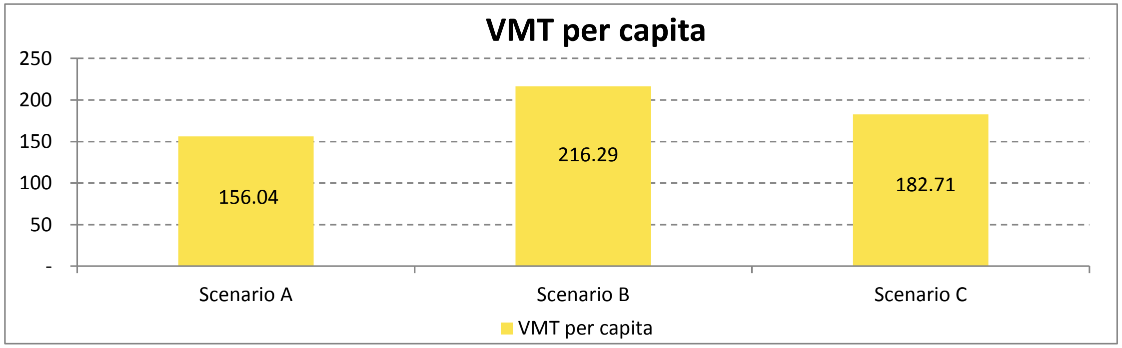
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
The daily trip rate per person is higher in Scenario B and in Scenario C. Thus the VMT generated in the two scenarios is higher.



What would improve the results
• Encourage the use of public transit and carpooling.
• Provide high-quality, reliable and safe public transportation system that easily access.
• Create friendly environment for pedestrians and cyclists.

	Scenario A	Scenario B	Scenario C
Total VMT	291,477	341,456	317,026
Population	1,868	1,579	1,735
Vehicle Miles Traveled per Capita	**156.04**	**216.29**	**182.71**

Social Cost of GHG Emissions - Elgin

Definition

Major greenhouse gases (GHG) include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and industrial gases. The vast majority of emissions are CO_2. Increased emissions of GHG due to human activities have been linked to global warming and changes in the climate pattern. The monetary value of the damages that may be caused by these changes currently and in the future is the social cost of greenhouse gases.

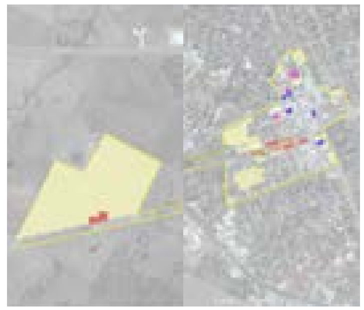
Scenario Results

The amount GHG emissions is highly associated with vehicle miles traveled (VMT). Scenario B generates the highest VMT due to the high density of population and employment, thus it produces the largest amount of GHG. Scenario A has the lowest social cost of GHG emissions. However, improvements on clean and fuel efficient cars can also reduce GHG emissions.

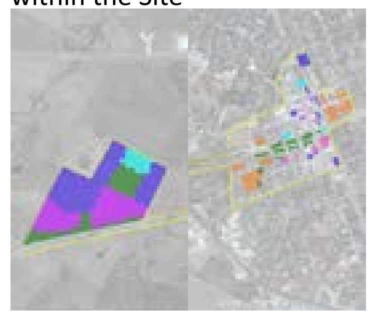
What would improve the results

- Increase the usage of alternative fuels.
- Improve the fuel efficiency.
- Implement carpool incentive programs to reduce single occupant auto travel.
- Improve public transit service.
- Improve pedestrian and bicycle facilities.

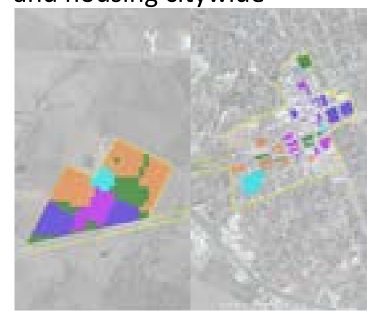
Scenario A: Trend

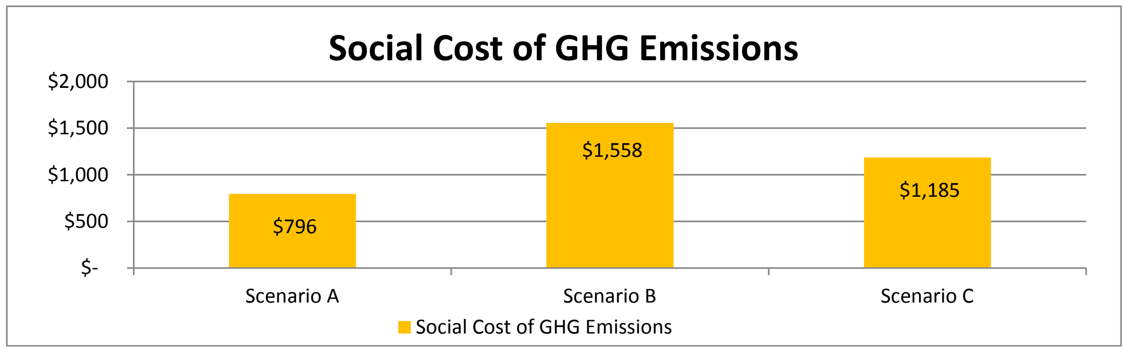


B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide





	Scenario A	Scenario B	Scenario C
Total CO_2 Emissions Contributed (tons)	20	39	30
Social Cost of GHG Emissions	**$796**	**$1,558**	**$1,185**

Social Cost of CAC - Elgin

Definition

Criteria air contaminants (CAC) are a set of air pollutants emitted from many sources in industry. CAC in particular refer to a group of contaminants that include sulphur dioxide (SO_2), nitrogen oxides (NO_x), volatile organic compounds (VOC), and particulate matter (primarily $PM_{2.5}$). The social cost of CAC is the monetary valuation of the damages to human health, environment and structures caused by these pollutants.

Scenario Results

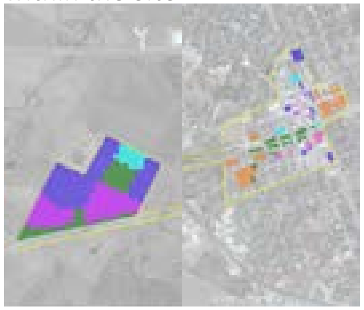
The amount CAC emissions is highly associated with vehicle miles traveled (VMT). Scenario B generates the highest VMT due to the high density of population and employment, thus it produces the largest amount of CAC. Scenario A has the lowest social cost of CAC. However, improvements on clean and fuel efficient cars can also reduce CAC.

What would improve the results

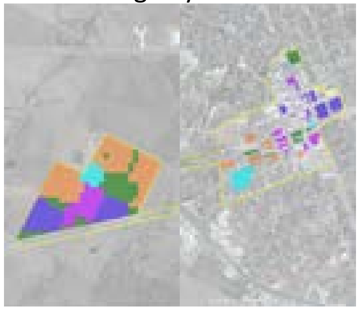
• Increase the usage of alternative fuels.
• Improve the fuel efficiency.
• Implement carpool incentive programs to reduce single occupant auto travel.
• Improve public transit service.
• Improve pedestrian and bicycle facilities.

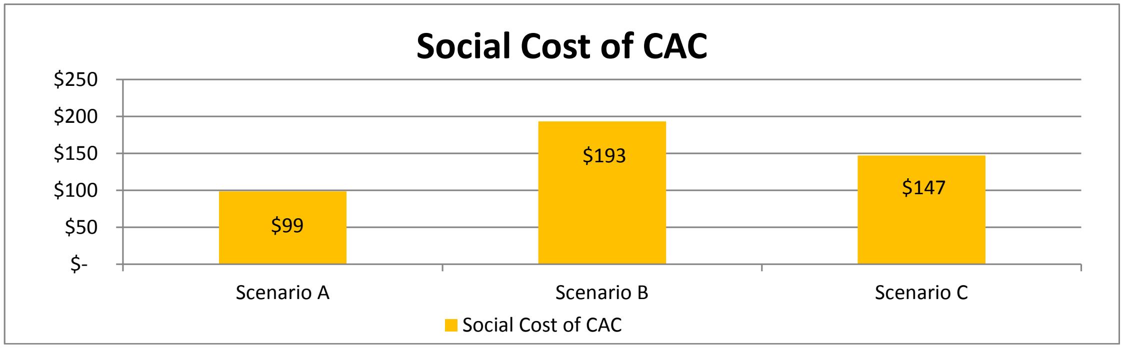
Scenario A: Trend

B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide





	Scenario A	Scenario B	Scenario C
Total NO_x Emissions Contributed (tons)	0.01	0.03	0.02
Total VOC Emissions Contributed (tons)	0.02	0.03	0.03
Social Cost of CAC	**$99**	**$193**	**$147**

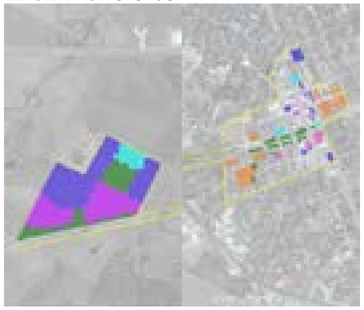
Social Cost of Motor Vehicle Accident - Elgin

Definition

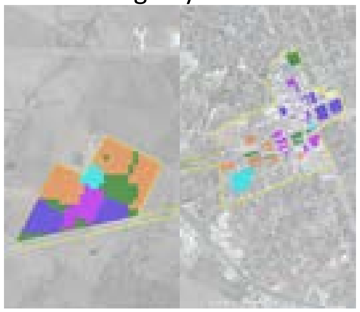
Accident costs are the costs of social resources lost in an accident and the loss in welfare incurred as a result of an accident. The specific costs that are typically covered are comprehensive in nature and include both private costs to the affected individuals and costs to the society at large; costs incurred by an individual out-of-pocket, costs of health care, and costs of pain and suffering.

Scenario A: Trend

B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide

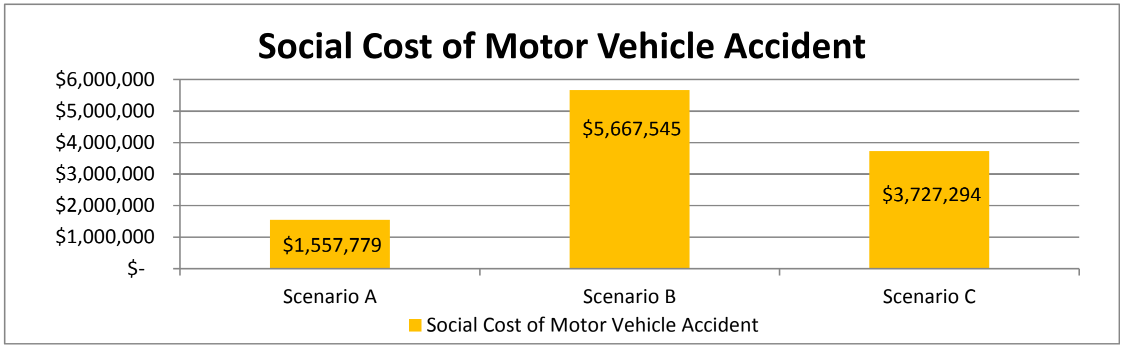


Scenario Results

Crash rate is associated with personal VMT, employment density, and intersection density. Scenario B generates the highest crash rate due to the denser developments. Scenario A produces the lowest social cost of motor vehicle accident. However, improvements on roadway safety facilities and implementation of traffic calming measures can also reduce the crash rate.

What would improve the results

- Incorporate "complete strees" design into planning to accommodate all transportation users.
- Implement traffic calming measures.
- Improve roadway facilities.
- Implement site-specific projects to improve traffic safety.



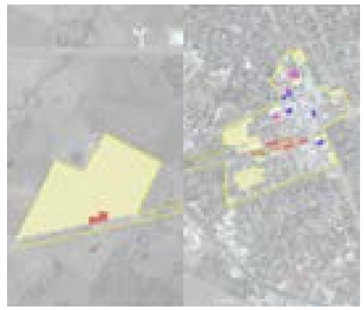
(per year)	Scenario A	Scenario B	Scenario C
Fatal Crash Rate	0	0	0
Serious Injury Crash Rate	1	5	3
Other Injury Crash Rate	2	6	4
Non-injury Crash Rate	5	18	12
Social Cost of Accident	**$1,557,779**	**$5,667,545**	**$3,727,294**

Vehicle Operating Costs - Elgin

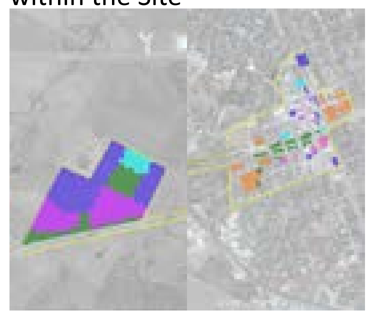
Definition

Vehicle operating costs (VOC) represents the personal costs borne by travelers using their own vehicle to make a trip. Total VOC are indirectly based on changes in vehicle miles traveled (VMT). Generally, VOC include fuel costs, tire costs, repair and maintenance costs, vehicle depreciation, and oil costs.

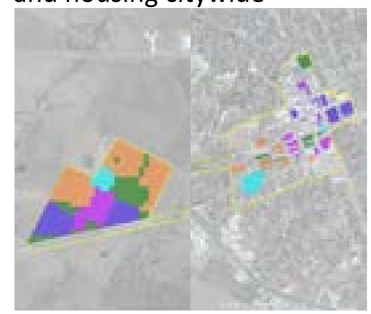
Scenario A: Trend



B: Balance jobs and housing within the Site

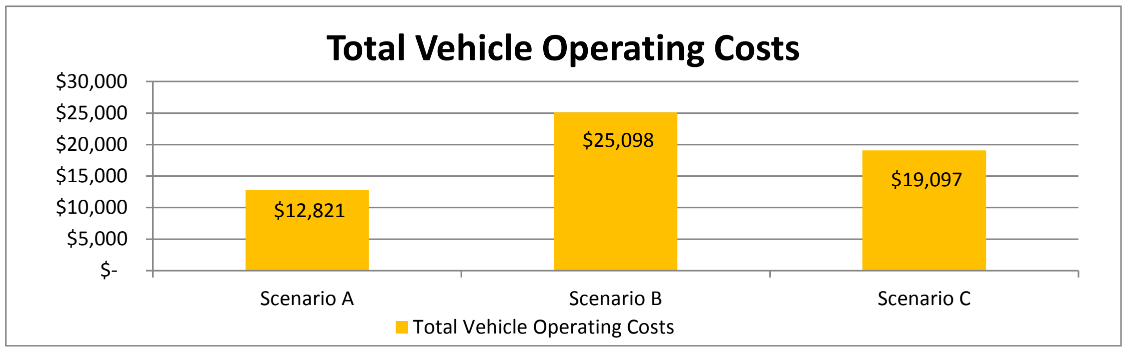


C: Towards a balance of jobs and housing citywide



Scenario Results

The total vehicle operating costs are highly associated with vehicle miles traveled (VMT). Scenario B generates the highest VMT due to the high density of population and employment, thus it produces the largest vehicle operating costs. Scenario A has the lowest total vehicle operating costs.



	Scenario A	Scenario B	Scenario C
Fuel Costs	$7,621	$14,918	$11,351
Tire Costs	$249	$488	$371
Repair and Maintenance Costs	$6,989	$13,681	$10,410
Vehicle Depreciable Value	$4,749	$9,296	$7,073
Oil Costs	$834	$1,633	$1,242
Total Vehicle Operating Costs	**$12,821**	**$25,098**	**$19,097**

What would improve the results

- Implement congestion mitigation programs.
- Improve access to transit.
- Improve major road networks.
- Improve pedestrian and bicycle facilities.

Values of Travel Time Savings - Elgin

Definition

Travel time has value because travelers can dedicate this time to work and earning income, or use it to engage in leisure activities. The value of travel time represents thus the opportunity cost of alternative activities and the cost of discomfort that may be involved in travelling. The monetized travel time savings can be compared against other project benefits and costs to help evaluate and justify transport improvement project.

Scenario Results

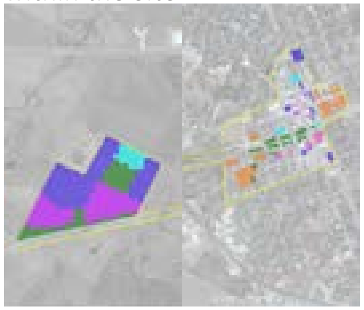
The values of travel time savings are highly associated with vehicle miles traveled (VMT). Scenario B generates the highest VMT due to the high density of population and employment, thus it produces the largest travel time costs. Scenario A has the lowest travel time costs.

What would improve the results

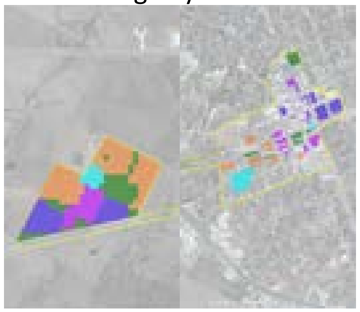
• Implement congestion mitigation programs.
• Improve access to transit.
• Improve major road networks.
• Improve non-mobile facilities.
• Integrate land use regulations with transport projects.

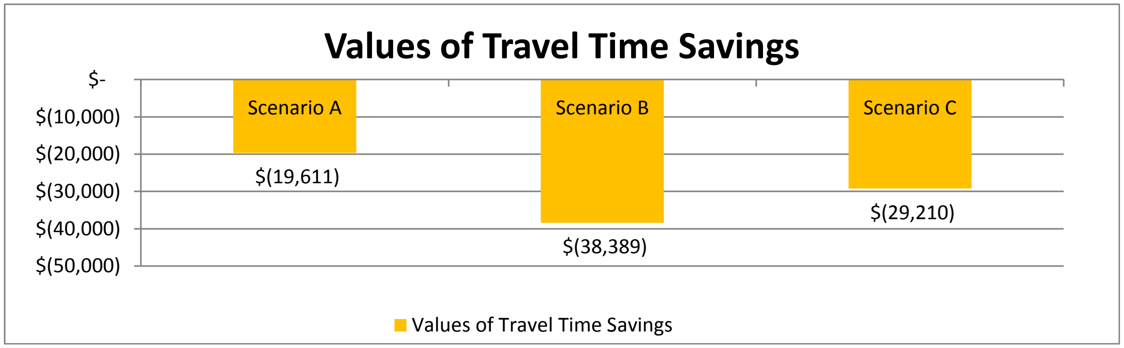
Scenario A: Trend

B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide





	Scenario A	Scenario B	Scenario C
Total Travel Time Savings (hours)	-1,354	-2,651	-2,017
Total Travel Time Savings/Costs	**-$19,611**	**-$38,389**	**-$29,210**

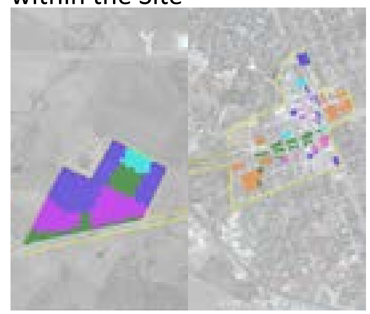
Commuter Bike Mobility Benefits - Elgin

Definition

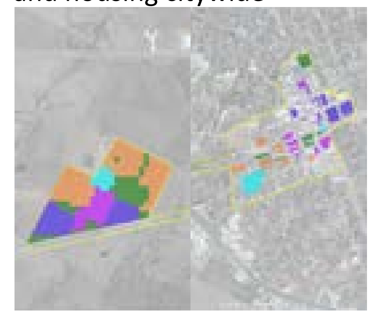
The commuter bike mobility benefits refer to the monetary value of people's greater satisfaction of cycling in their communities.

Scenario A: Trend

B: Balance jobs and housing within the Site

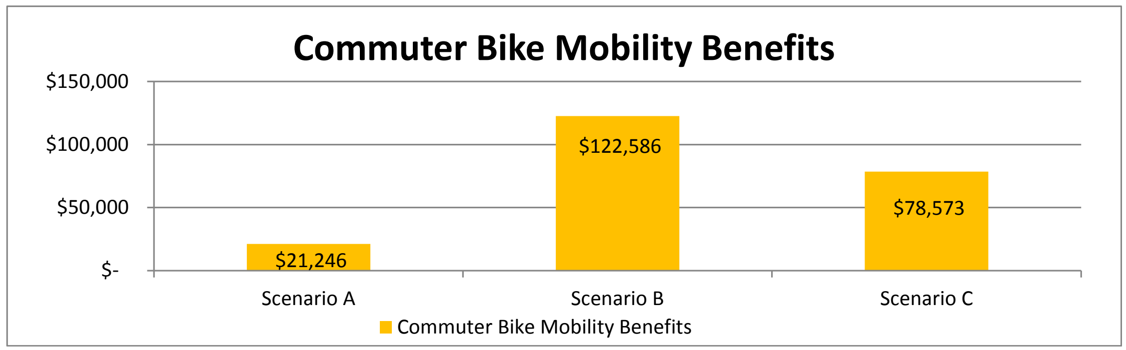


C: Towards a balance of jobs and housing citywide



Scenario Results

Urban form and demographic characteristics affect transportation choices. Bike trip rate is highly associated with intersection density, land use mix, and household size. Scenario B generates the highest bike trip rate, thus produces the highest commuter bike mobility benefits. Scenario A has the lowest commuter bike mobility benefits.



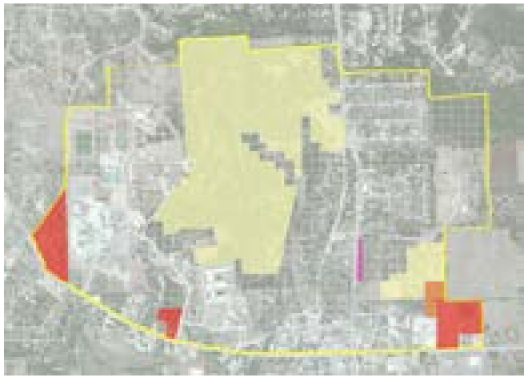
	Scenario A	Scenario B	Scenario C
Number of Commuters by Bike (per day)	5	28	18
Commuter Bike Mobility Benefits	**$21,246**	**$122,586**	**$78,573**

What would improve the results

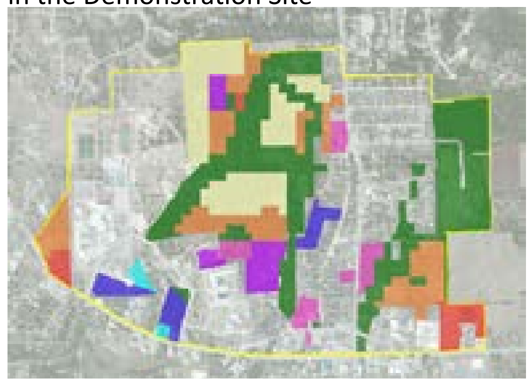
- Incorporate "complete streets" design into planning to accommodate all transportation users.
- Provide adequate bike lanes.
- Provide bike parking facilities and shower at workplace.
- Provide multi-modal corridors.

Land Use Scenarios - Dripping Spring

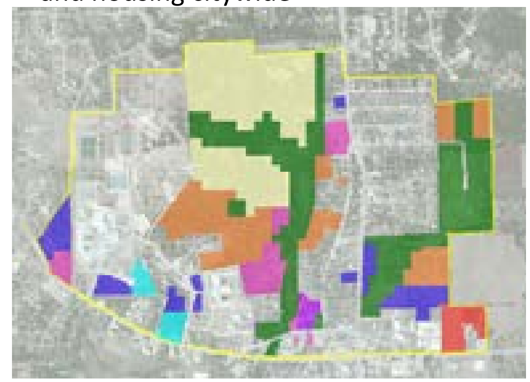
Scenario A: Trend



Scenario B: Balance jobs and housing within the Demonstration Site



Scenario C: Towards a balance of jobs and housing citywide



Legend

Summary Table

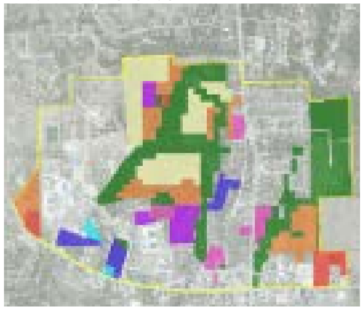
Legend	Scenario A		Scenario B		Scenario C	
	Acres	%	Acres	%	Acres	%
Town Center	/	/	18.3	5.9%	4	1.3%
Compact Neighborhood	3.8	1.7%	61.9	20%	63.9	20.3%
Single Family Neighborhood Subdivision	193.5	85.6%	64.8	20.9%	94.7	30%
Main Street Commercial	1.6	0.7%	18.4	6%	24.7	7.8%
Highway-Oriented Retail and Office	27.1	12%	15.5	5%	10.9	3.5%
Office	/	/	17.7	5.7%	31.6	10%
Industrial	/	/	/	/	/	/
Civic	/	/	4	1.3%	8.3	2.6%
Open Space	/	/	108.6	35.1%	77.1	24.5%
Total	**226**	**100%**	**309**	**100%**	**315**	**100%**

Activity Density - Dripping Springs

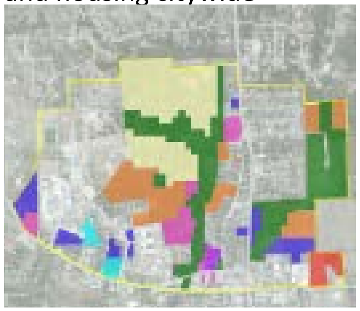
Definition
Activity density refers to the residential population plus employment within the study area. Higher activity density indicates higher trip rates generated and attracted. Higher activity density within the study area supports internal walk trips, and is also
positively related to walking on external trips.

Scenario A: Trend

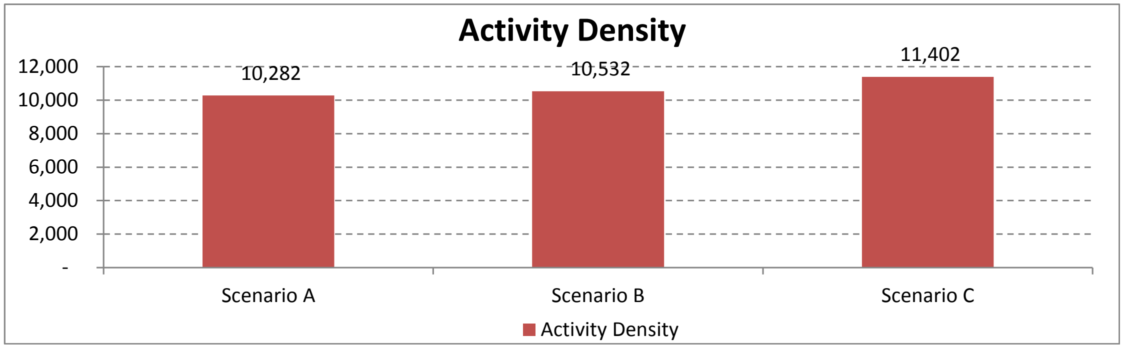
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
Scenario A has the highest residential population. However, due to the mixed use development in Scenario B and Scenario C, the level of employment in the two
scenarios are higher than the trend Scenario. Overall, Scenario C has the highest activity density.



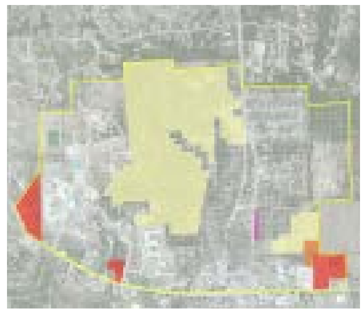
What would improve the results
• Encourage the development of mixed use and office uses.
• Provide diverse housing choices including multi-family housing and town homes.

	Scenario A	Scenario B	Scenario C
Population	3,276	3,224	3,460
Employment	356	1,864	2,153
Area (square mile)	0.35	0.48	0.49
Activity Density (per sq mile)	**10,282**	**10,532**	**11,028**

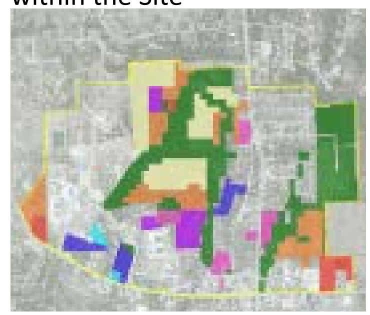
Job-Population Balance - Dripping Springs

Definition
The Job-Population Balance Index measures the balance between the number of jobs and residents. The index ranges from 0, where only jobs or residents are present in a study area, to 1 where the ratio of jobs to residents is optimal in terms of trip
genertation. The value 0.2 represents a balance of employment and population that generates the highest trip rate.

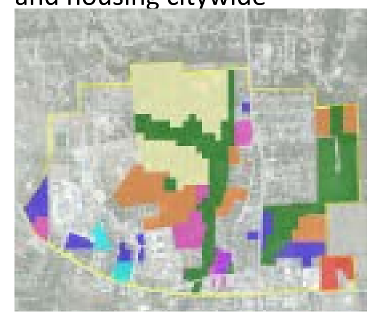
Scenario A: Trend



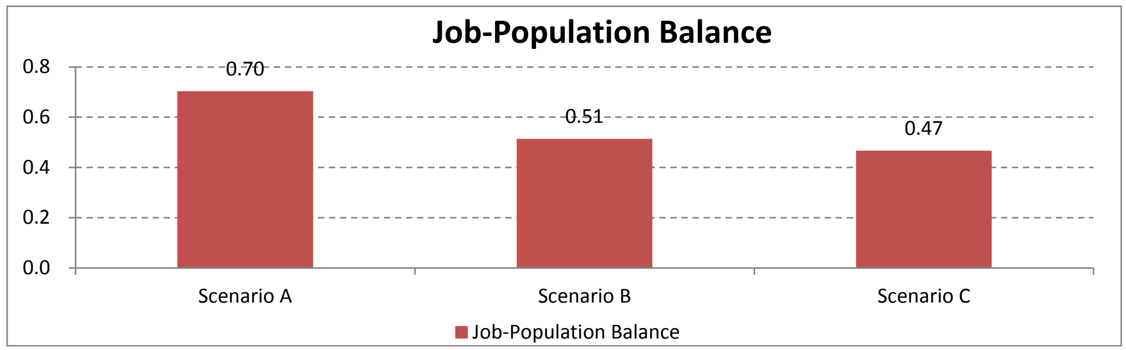
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
It is proposed that 0.2 is the optimal job-population ratio that would generate the highest trip rate. In this case, the job-population balance in Scenario A is better. Scenario C has relatively higher employment, thus its job-population balance index is the lowest.



What would improve the results
• Balance the development of residential and office/industrial.

	Scenario A	Scenario B	Scenario C
Population	3,276	3,224	3,276
Employment	356	1,864	2,153
Job-Population Balance	**0.7**	**0.51**	**0.47**

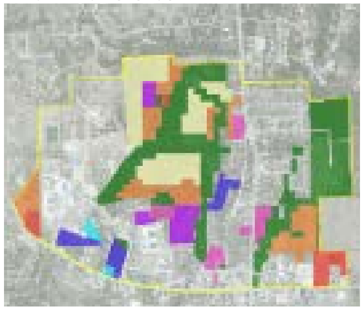
Land Use Mix - Dripping Springs

Definition

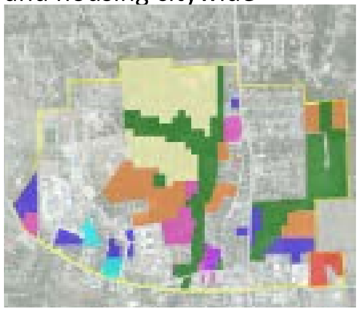
Land use mix captures the variety of land uses within the study area. The index varies in value from 0, where all developed land is in one land use category, to 1, where developed land is evenly divided among land use categories. Mixed-use development increases the walkability and bikability of the area. Land use mix is positively associated with internal capture of trips and non-motorized trips.

Scenario A: Trend

B: Balance jobs and housing within the Site

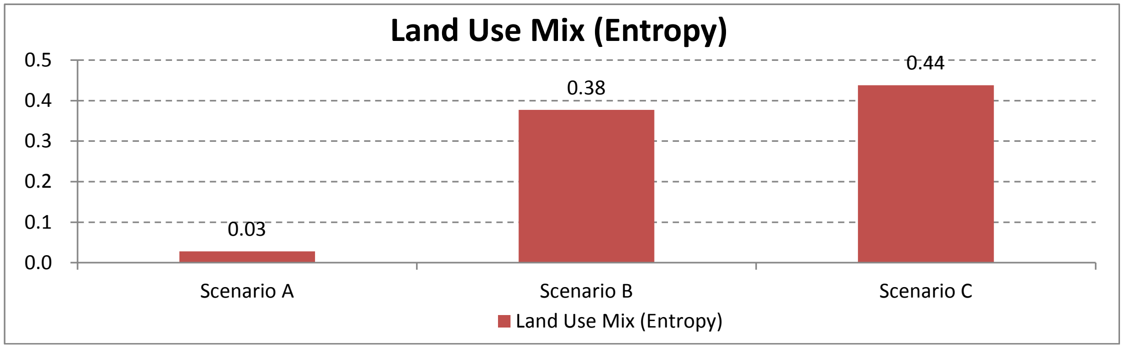


C: Towards a balance of jobs and housing citywide



Scenario Results

Development in Scenario A is residential-dominant, thus it has the lowest land use mix score. Land uses in Scenario B and Scenario C contain more retail and office. Compared to other scenarios, Scenario B has the most retail developments, while Scenario C has more office and industrial. Overall, new developments in Scenario C are the most diverse.



What would improve the results

- Identify stakeholders likely to be affected by mixed use development.
- Determine the mix of uses and appropriate areas for mixed use zoning.
- Adopt new mixed use zoning requirements.

	Scenario A	Scenario B	Scenario C
Residential (sq ft)	2,230,534	2,030,970	2,216,768
Retail (sq ft)	196,782	396,390	363,688
Office (sq ft)	31,866	396,802	501,180
Industrial (sq ft)	-	44,228	78,906
Land Use Mix	**0.03**	**0.2**	**0.23**

Street Connectivity - Dripping Springs

Definition

Connectivity refers to the density of connections and the directness of links. As connectivity increases, travel distances decrease and route options increase, offering more route options, and making non-motorized travel more feasible. A connected road network tends to emphasize accessibility by accommodating more travel with traffic dispersed over more roads, to improve walking and cycling conditions, and to support transit use.

Scenario Results

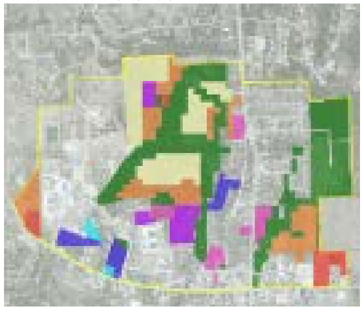
Single family neighborhoods usually contain fewer intersections and more cul-de-sacs, whereas mixed use development encourages higher street connectivity. A large portion of Scenario B is allocated toward green space; therefore, this scenario shows the lowest intersection density.

What would improve the results

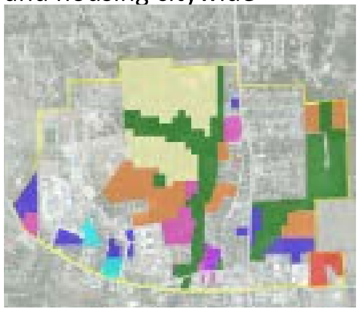
- Develop a well-connected road or path network that has many short links, numerous intersections, and minimal dead-ends.
- Build the internal circulation route as an interconnected system.
- Set a maximum block size.

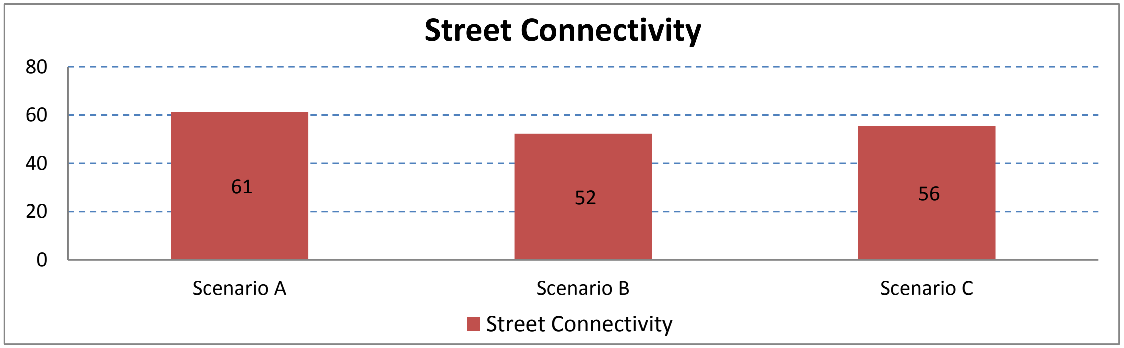
Scenario A: Trend

B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide





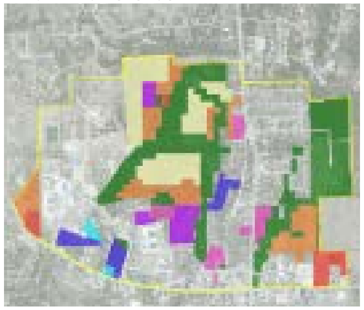
	Scenario A	Scenario B	Scenario C
Number of Intersections	22	25	27
Area	0.35	0.48	0.49
Intersection Density	**61**	**52**	**56**

Proportion of Area within 1/4 mile of Transit Stops - Dripping Springs

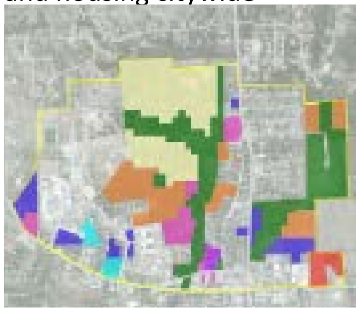
Definition
Typically, 1/4 mile is considered a standard walking distance most people can accomodate. A transit stop within walking distance increases the probability people would choose to take public transit. Nearby transit stops may also stimulate walking.

Scenario A: Trend

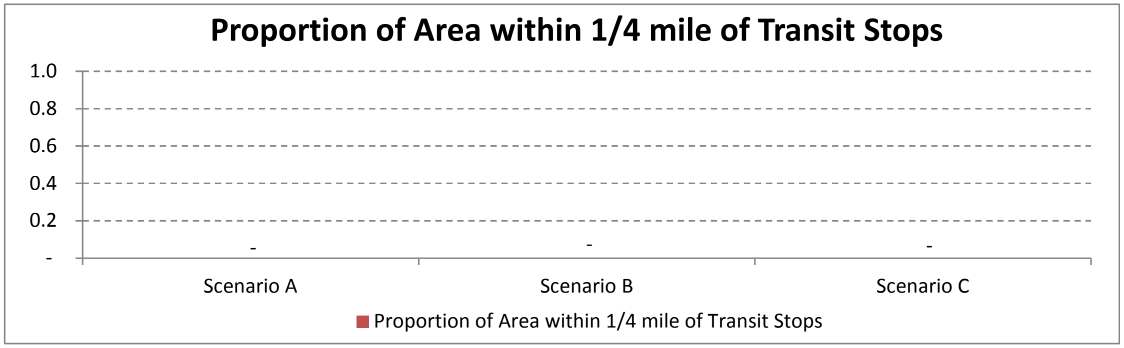
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
There is no transit stop. Thus the proportion of space within 1/4 mile of transit stops is zero to all the three scenarios.



What would improve the results
• Incorporate the community into regional transportation plans that include transit.
• Encourage high-density and mixed-use residential and commercial development within a radius of 1/4 to 1/2 mile from a transit stop to maximize access to transit.

	Scenario A	Scenario B	Scenario C
Proportion of Area within 1/4 mile of Transit Stops	-	-	-

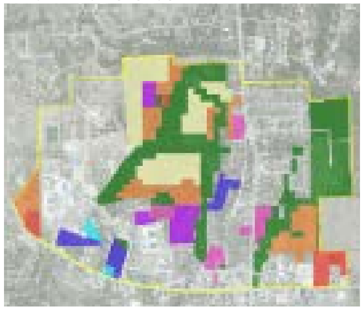
Street Network Density - Dripping Springs

Definition

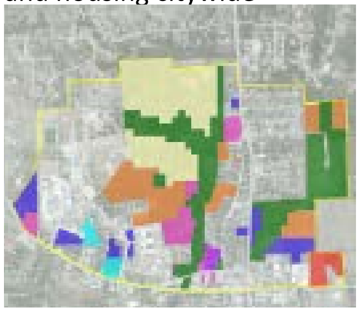
Street network density refers to the ratio of the length (in miles) of scenario's road network to the land area (in square miles) in study area. Higher street network density is usually associated with better street connectivity. It is also significantly associated with the traveler's mode choice. Greater street network density has an even greater influence on non-work trips.

Scenario A: Trend

B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide

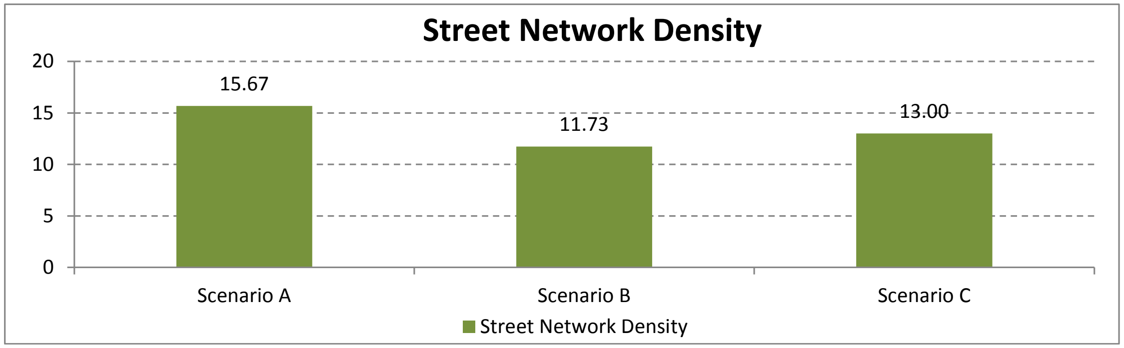


Scenario Results

Main street commercial and corridor commercial developement accommodate the highest street network density, while single family neighborhood, office, and industrial accommodate the lowest. There is no street designated in open space. Therefore, Scenario B and Scenario C have a very low street network density associated with large areas of open space.

What would improve the results

- Build an internal circulation route as an interconnected, grid-like transportation system.
- Set a maximum block size.



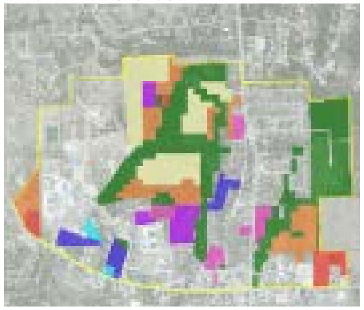
	Scenario A	Scenario B	Scenario C
Street Centerline Length (mile)	5.53	5.67	6.4
Total Area (sq mile)	0.35	0.48	0.49
Street Network Density	**15.67**	**11.73**	**13**

Transit Stop Coverage - Dripping Springs

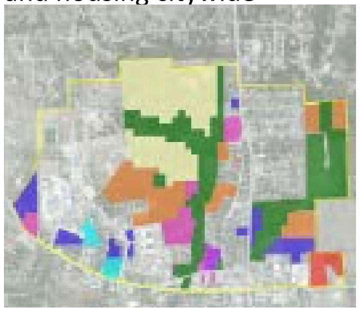
Definition
A high transit stop coverage rate provides more opportunities to access transit. Better transit accessibility results in a higher percentage of trips on public transit and lowers the amount of driving. Less vehicle trips can lower VMT, mitigate congestion impacts, and reduce vehicle ownership. Increased transit stop coverage also has environmental impacts by reducing carbon emissions.

Scenario A: Trend

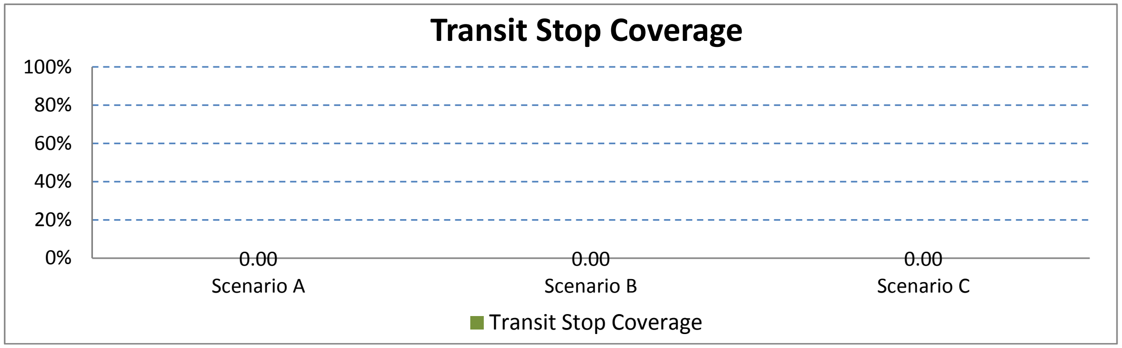
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
There are no transit stops in or near the study area; therefore, transit stop coverage is zero in all three scenarios.



What would improve the results
• Provide for interagency coordination of transit services in several of its transit funding programs.
• Develop regional plan for public transportation coordination.

	Scenario A	Scenario B	Scenario C
Number of Transit Stops	0	0	0
Total Area (sq mile)	1.17	1.17	1.17
Transit Stop Coverage	-	-	-

Bicycle Network - Dripping Springs

Definition

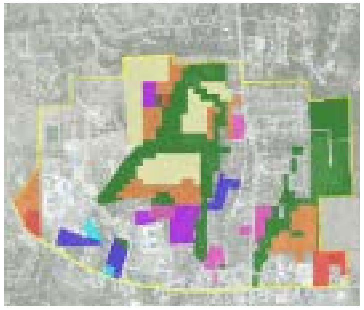
Cycling is one of the most affordable transportation options. High bicycle network coverage provides more transportation options and better mobility. Improved bicycle facilities create more balanced transportation systems with lower automobile dependency, and promote social equity for transportation disadvantaged. The shift to non-motorized modes also has a mitigating effect on congestion and improves the function of streets.

Scenario Results

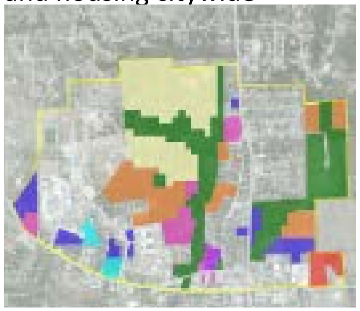
Town center, compact neighborhood, main street commercial, and civic accommodate bike lanes better than other development types. Bicycle network coverage is slightly higher in Scenario B and C than Scenario A.

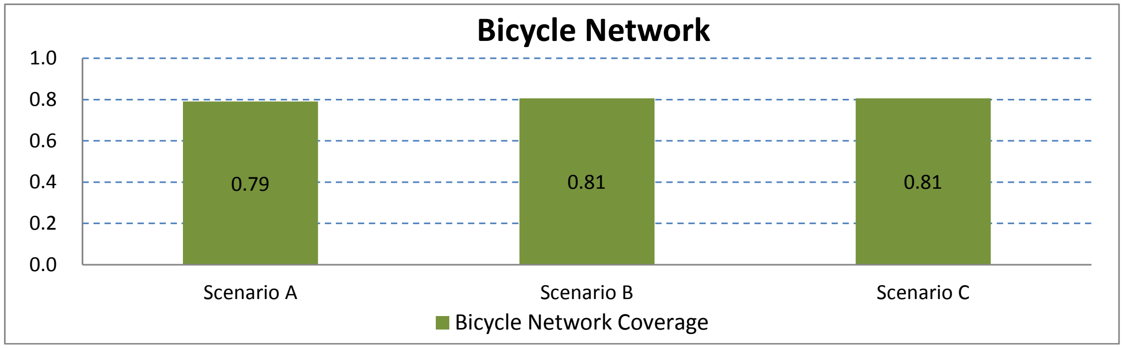
Scenario A: Trend

B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide





What would improve the results

- Provide improved bicycle facility management and maintenance.
- Provide separate bike lanes for cyclists and implement traffic calming strategies.
- Promote bicycle sharing program.
- Improve the cooperation throughout the region.

	Scenario A	Scenario B	Scenario C
Bike Lane Length	4	5	5
Street Centerline Length (mile)	6	6	6
Bicycle Network Coverage	**0.79**	**0.81**	**0.81**

Sidewalk Completeness - Dripping Springs

Definition

The availability of sidewalks improves accessibility and increases the likelihood that residents and employees will walk. A complete sidewalk network provides people with more travel alternatives and reduces the frequency of vehicle-pedestrian collisions. More walk trips reduce the number of vehicle miles traveled (VMT), mitigate traffic congestion, benefit the environment, and improve the health of the community.

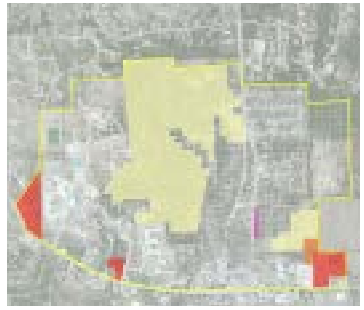
Scenario Results

Town center, compact neighborhood, main street commercial, and civic development typically accommodate sidewalks in both directions. Scenario B has the most complete sidewalks followed by Scenario C.

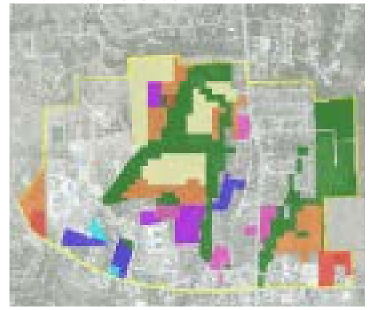
What would improve the results

- Provide sidewalks along both sides of all roads.
- Provide pedestrian paths at street's cul-de-sacs.
- Increase funding for sidewalk projects.
- Work with developers to obtain rights-of-way.

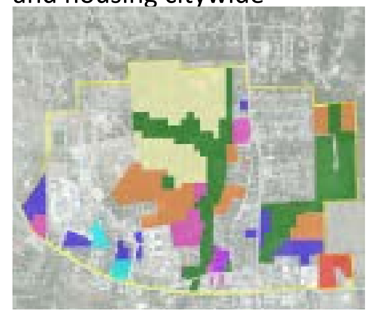
Scenario A: Trend

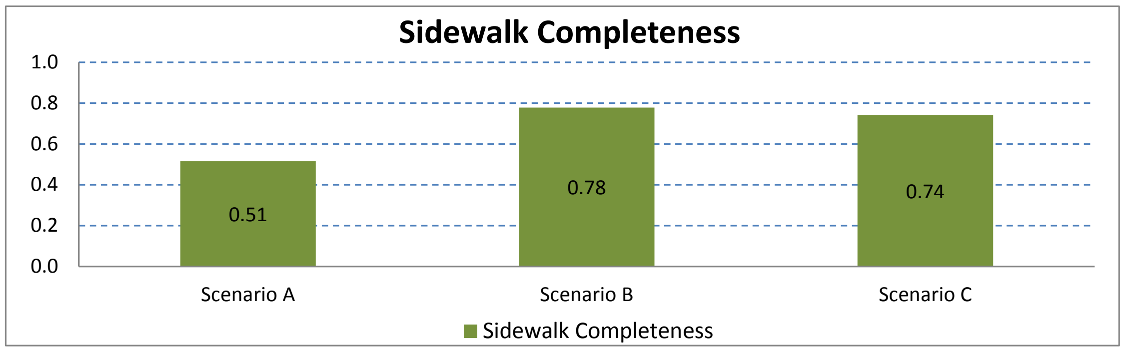


B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide





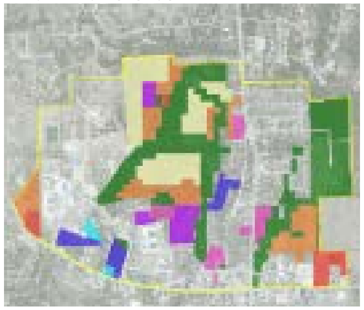
	Scenario A	Scenario B	Scenario C
Sidewalk Length	5.5	5.7	6.4
Street Centerline Length (mile)	5.7	8.8	9.5
Sidewalk Completeness	**0.51**	**0.78**	**0.74**

Sidewalk Density - Dripping Springs

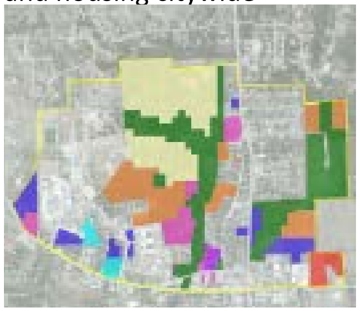
Definition
Sidewalk density refers to ratio of the length (in miles) of sidewalks to the study area's land area (in square miles). Higher sidewalk density is usually associated with better connectivity for pedestrians. It is positively associated with increased walk trips and fewer auto trips. Better sidewalk connectivity also improves accessibility to transit, where transit stops are available.

Scenario A: Trend

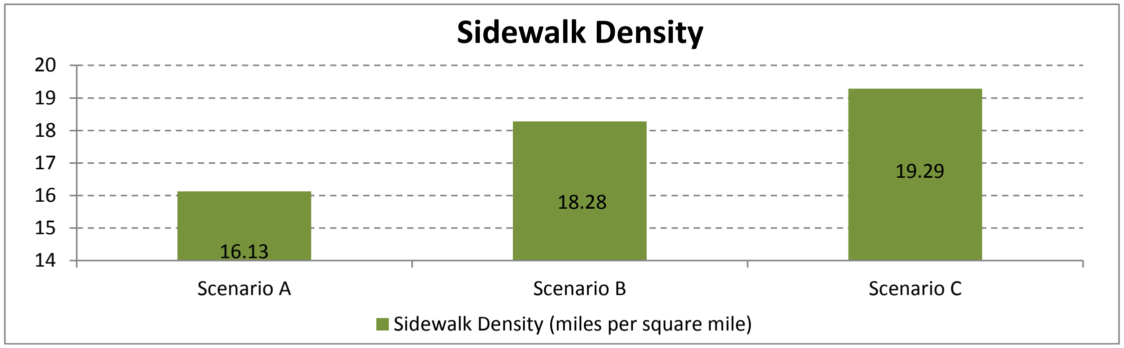
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
Town center, compact neighborhood, main street commercial, and civic development are equipped with denser sidewalks to accommodate pedestrians. Scenario C has the highest sidewalk density score, followed by Scenario B. Scenario A has the lowest sidewalk density.



What would improve the results
- Provide sidewalks along both sides of all roads.
- Increase funding for sidewalk projects.
- Work with developers to obtain rights-of-way.
- Set a maximum block size for new development.

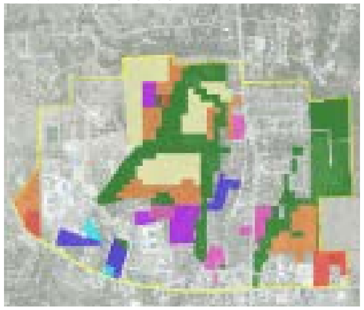
	Scenario A	Scenario B	Scenario C
Sidewalk Length	5.5	5.7	6.4
Total Area (sq mile)	0.35	0.48	0.49
Sidewalk Density	**16.13**	**18.28**	**19.29**

Vehicle per Capita - Dripping Springs

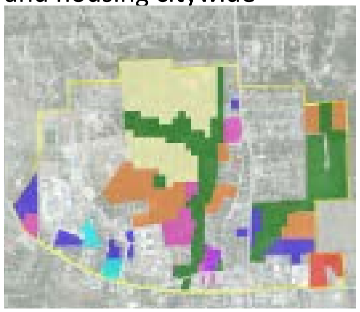
Definition
This indicator estimates the number of vehicles per capita within the study area. Lower vehicle ownership indicates less dependence on automobile.

Scenario A: Trend

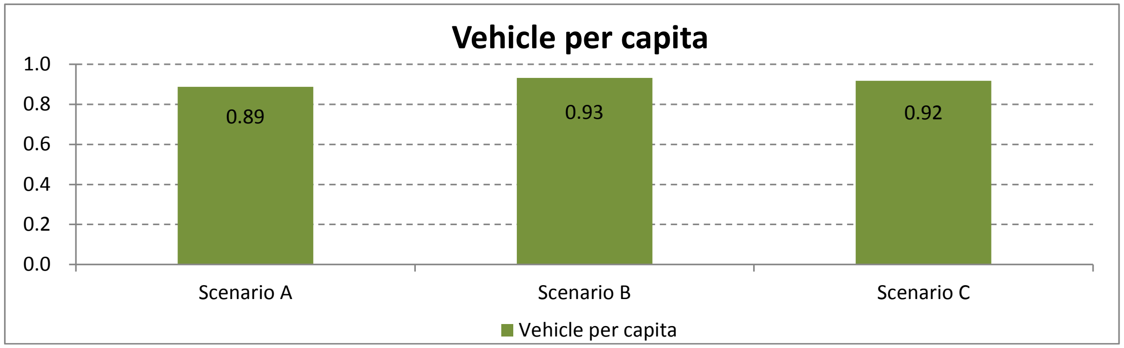
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
Single family households have fewer vehicle per family member than other households because family members tend to share cars. Thus estimated vehicle per capita is the lowest in Scenario A.



What would improve the results
• Provide less parking space, or increase parking fee in town center and in high density area.

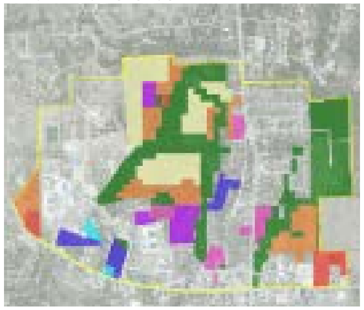
	Scenario A	Scenario B	Scenario C
Vehicle per Capita	**0.89**	**0.93**	**0.92**

Parking Supply - Dripping Springs

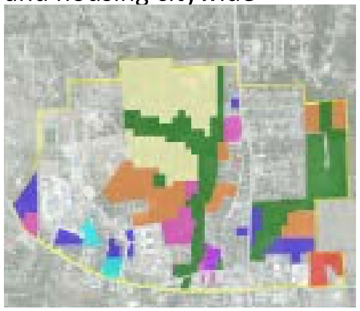
Definition
This indicator estimates the number of parking spaces associated with new developments.

Scenario A: Trend

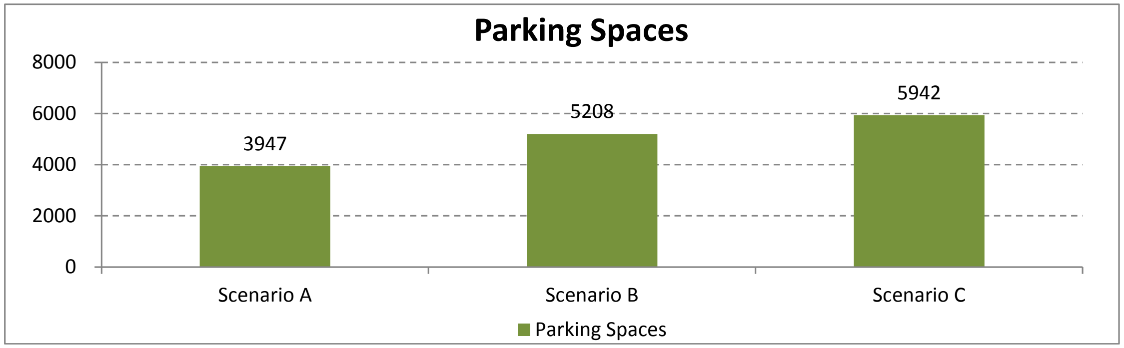
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
Due to the diversity of new development, including more mixed use, town center, and commercial, there are more parking spaces, Scenarios B and C contain more parking spaces than Scenario A.



	Scenario A	Scenario B	Scenario C
Parking Spaces Supply	**3,947**	**5,208**	**5,942**

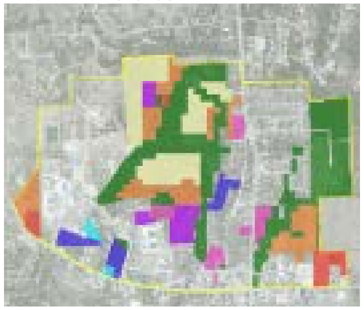
What would improve the results
- Reduce minimum parking requirements.
- Incorporate parking maximums or area-wide parking caps to ensure that there is not an excess supply of parking.
- Permit shared parking for different buildings and facilities to take advantage of different peak parking characteristics.

Internal Trips - Dripping Springs

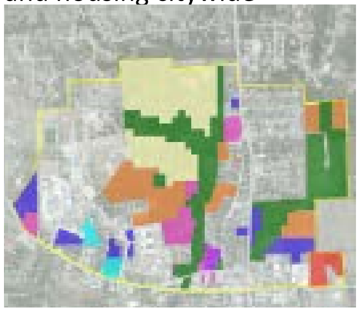
Definition
This indicator estimates the number of trips that remain within the study area.

Scenario A: Trend

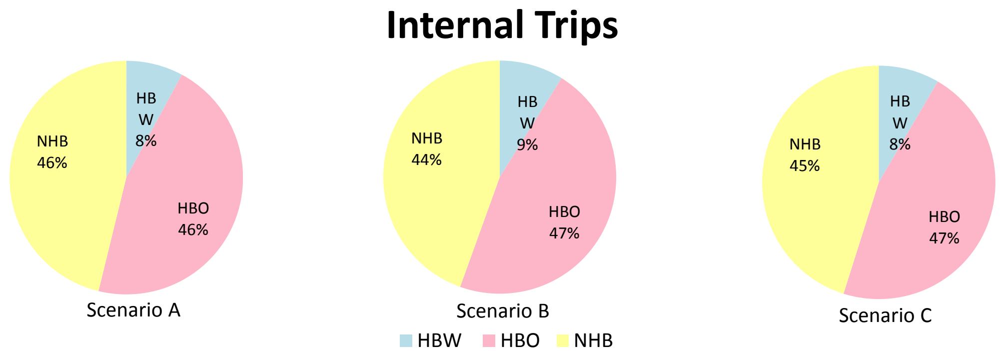
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
Most internal trips are for non-home based and home-based other puposes. In Scenario B and Scenario C, there are more home-based trips generated. This indicates improved accessibility to work, services, and entertainment for residents in study area in these two scenarios.



What would improve the results
- Encourage compact and mixed uses in the community.
- Improve street connectivity.
- Improve non-mobile facilities.
- Enhance the overall walking environment.

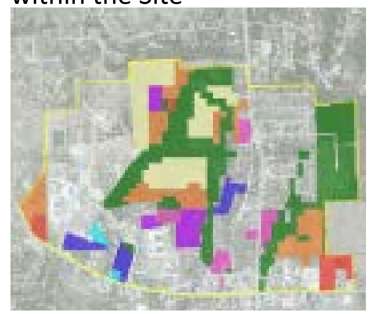
	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	962	1,211	1,162
HBO (Home-based others)	5,608	6,353	6,404
NHB (Non-home based)	5,633	6,061	6,217
Total	**12,203**	**13,626**	**13,784**

Internal Walk Trips - Dripping Springs

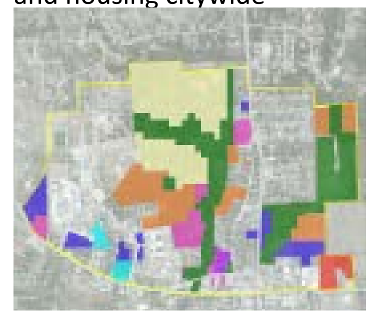
Definition
This indicator estimates the number of walk trips within the study area.

Scenario A: Trend

B: Balance jobs and housing within the Site

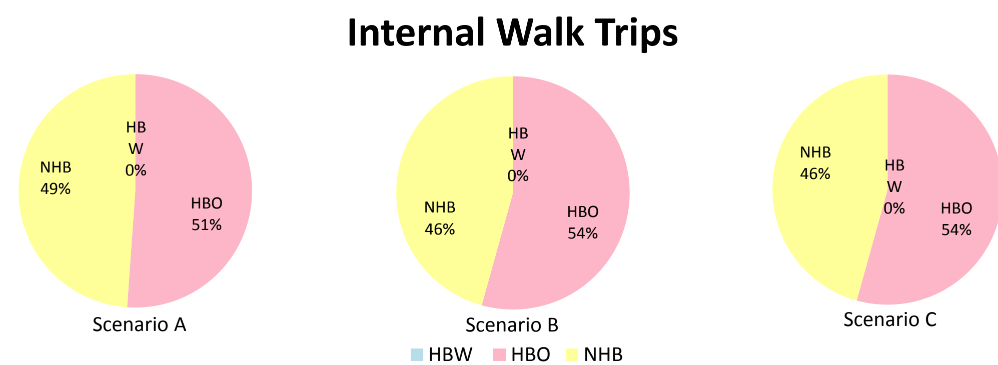


C: Towards a balance of jobs and housing citywide



Scenario Results
There are quite few internal walk trips for home-based work purpose in all three scenarios. Home-based others is the main purpose for internal walk trips. In mixed-use development scenario, the share of non-home based trip is slightly higher. This might be due to a change of trip chain in which residents could engage in more activities in one trip.

What would improve the results
• Encourage compact and mixed uses in community.
• Improve street connectivity.
• Improve non-mobile facilities.
• Enhance the overall walking environment.



	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	0	0	0
HBO (Home-based others)	272	403	445
NHB (Non-home based)	260	339	374
Total	**531**	**742**	**819**

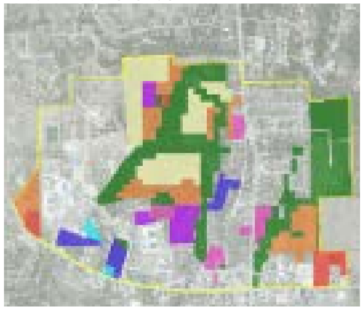
External Walk Trips - Dripping Springs

Definition

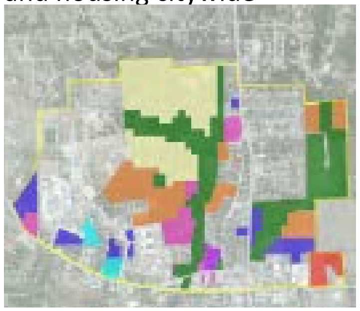
This indicator estimates the number of walk trips to outside of the study area.

Scenario A: Trend

B: Balance jobs and housing within the Site

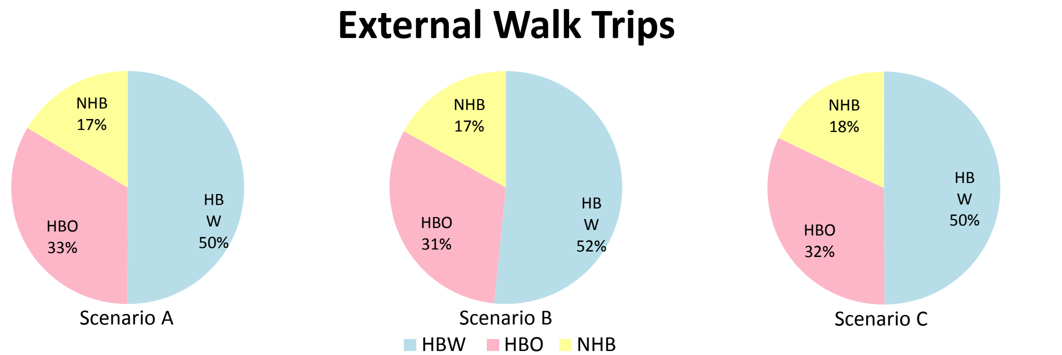


C: Towards a balance of jobs and housing citywide



Scenario Results

Home-based work is the main external walk trip purpose. And its share increases in mixed-use scenario. This indicates improved job accessibility by walking for residents in the study area.



What would improve the results

- Improve street connectivity.
- Improve bicycle and pedestrian facilities.
- Enhance the overall walking environment.

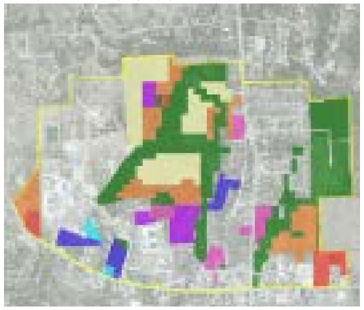
	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	624	520	524
HBO (Home-based others)	177	316	337
NHB (Non-home based)	87	171	188
Total	**528**	**1,006**	**1,049**

External Transit Trips - Dripping Springs

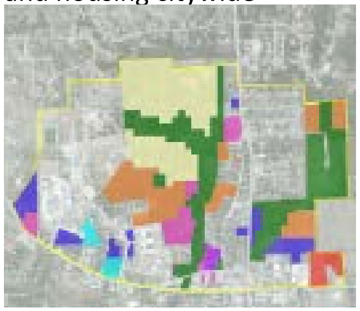
Definition
This indicator estimates the number of transit trips. It is recommended that public transit be used as an alternative to automobile use for home-based work trips because commuting trips are usually routine in terms of travel time and places.

Scenario A: Trend

B: Balance jobs and housing within the Site

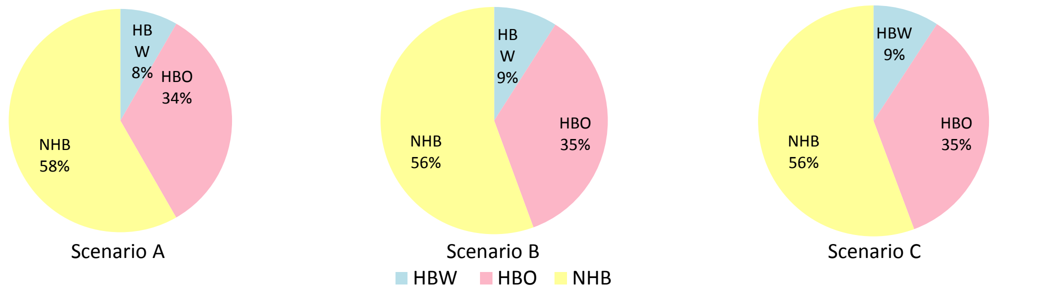


C: Towards a balance of jobs and housing citywide



Scenario Results
Non-home based is the main category of external transit trips in all three scenarios. As land use mix index increases, the share of non-home based trips decreases and that of home-based work trips increases. This indicates improved accessibility via transit for residents in study area.

External Transit Trips



What would improve the results
• Provide public transportation service to accommodate the needs of home-based work trips.
• Improve street connectivity.
• Improve non-mobile facilities.
• Enhance the overall walking environment.

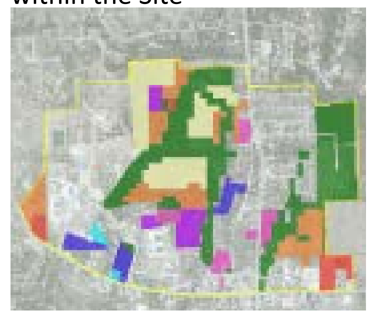
	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	127	185	191
HBO (Home-based others)	508	723	727
NHB (Non-home based)	888	1,138	1,156
Total	**1,523**	**2,046**	**2,075**

Total VMT Generated by Residental - Dripping Springs

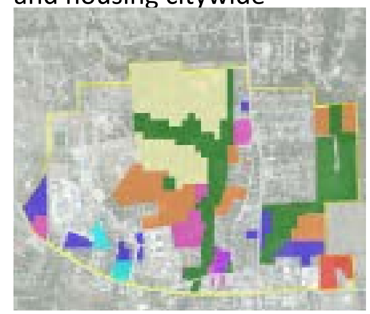
Definition
This indicator estimates the vehicle miles traveled (VMT) generated by residential land use.

Scenario A: Trend

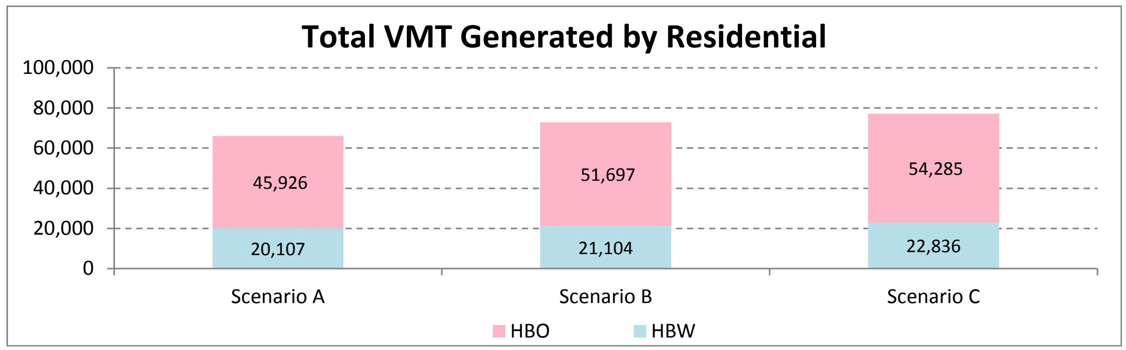
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
Scenario C has the highest VMT generated by residential land use, followed by scenario B.



What would improve the results
• Encourage compact and mixed uses in community.
• Improve street connectivity.
• Provide public transportation service.
• Improve non-mobile facilities.
• Enhance the overall walking environment.

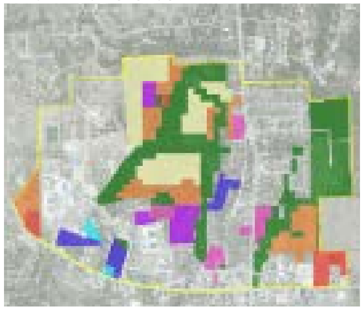
	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	20,107	21,104	22,836
HBO (Home-based others)	45,926	51,697	54,285
Total	**66,033**	**72,801**	**77,121**

Total VMT Generated by Retail - Dripping Springs

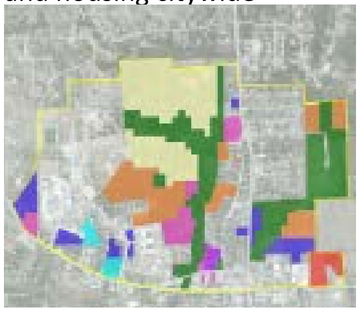
Definition
This indicator estimates the vehicle miles traveled (VMT) generated by retail land use.

Scenario A: Trend

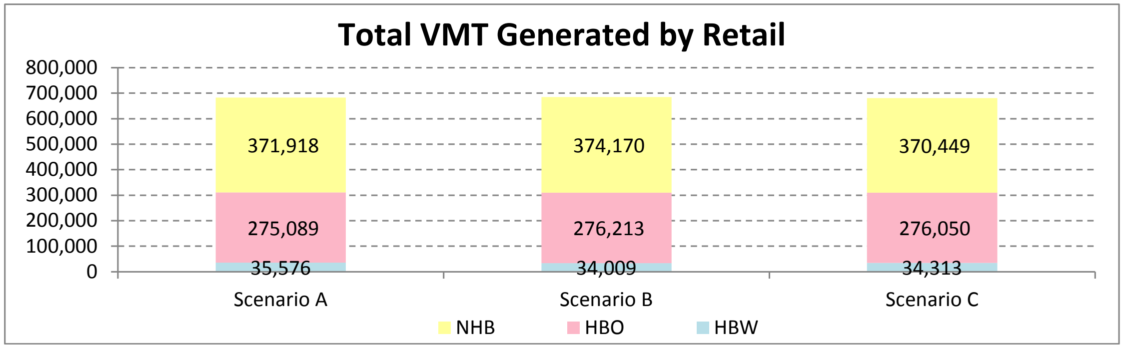
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
The total VMT generated by retail is comparable across the three scenarios. Mixed land uses support non-motorized transportation choice. Thus, even though there is more retail dvelopment in Scenario B and Scenario C, VMT does not increase significantly.



What would improve the results
• Encourage compact and mixed uses in community to provide retail service in walking distance for residents.
• Improve street connectivity.
• Improve bicycle and pedestrian facilities.
• Enhance the overall walking environment.

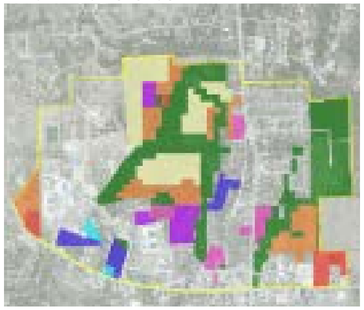
	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	35,576	34,009	34,313
HBO (Home-based others)	275,089	276,213	276,050
NHB (Non-home based)	371,918	374,170	370,449
Total	**682,584**	**684,392**	**680,812**

Total VMT Generated by Office/Industrial - Dripping Springs

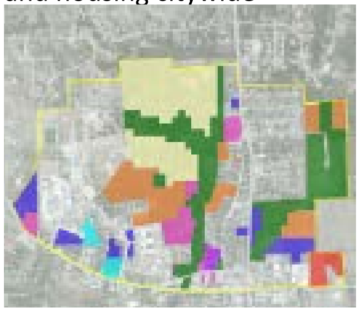
Definition
This indicator estimates the vehicle miles traveled (VMT) generated by office and industrial land uses.

Scenario A: Trend

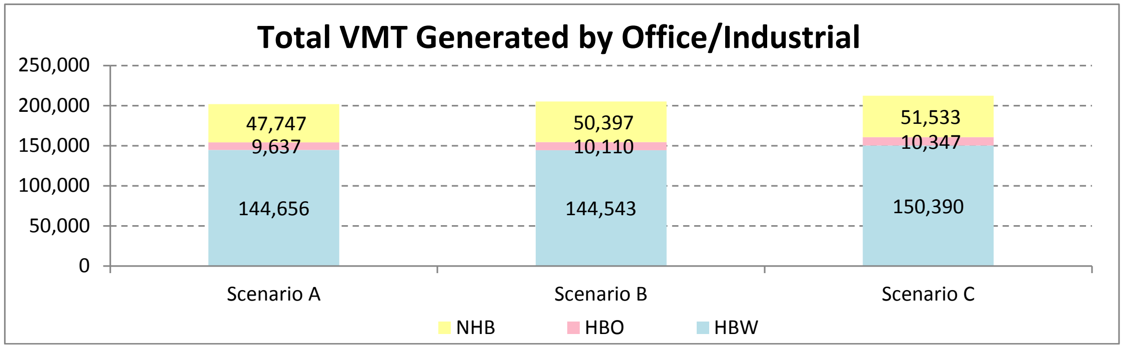
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
Office and industrial land uses are the primary workplaces, therefore home-based work is the main purpose for trips generated by office/industrial. Scenario C has the highest office/industrial VMT due to the office developments. Scenario B has the second highest VMT generated by office/industrial.



What would improve the results
- Encourage compact and mixed uses in community.
- Improve street connectivity.
- Provide public transportation service.
- Improve non-mobile facilities.
- Enhance the overall walking environment.

	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	144,656	144,543	150,390
HBO (Home-based others)	9,637	10,110	10,347
NHB (Non-home based)	47,747	50,397	51,533
Total	**202,040**	**205,049**	**212,270**

Percentage of Internal Trips - Dripping Springs

Definition

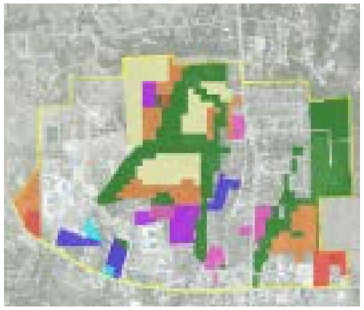
This indicator estimates the percentage of trips within the study area. Usually mixed-use development (MXD) increases the share of internal trips the variety of developments in the study area because trips between on-site land uses could be made without travel on the off-site street system. MXD allows what might otherwise be external car trips to become internal trips, within walking or biking distance, thus increasing the share of non-motorized trips.

Scenario Results

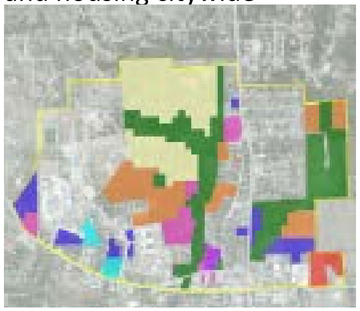
Percentage of internal trips increases in Scenario B and Scenario C due to the mixed-use development.

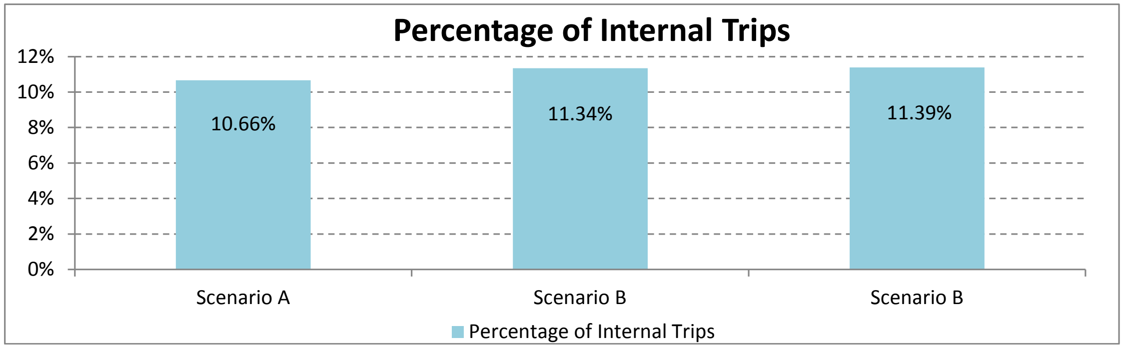
Scenario A: Trend

B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide





What would improve the results

- Encourage compact and mixed-use developments in the area.
- Provide facilities for pedestrians and cyclists, including sidewalks, designated bike lanes, bike racks, safe crossings, and lights, etc.
- Enhance the walking environment.

	Scenario A	Scenario B	Scenario C
Number of Internal Trips	12,203	13,626	13,784
Total Trips	114,440	120,175	121,064
Percentage of Internal Trips	**10.66%**	**11.34%**	**11.39%**

Percentage of Walk Trips - Dripping Springs

Definition

This indicator estimates the walk trip share. A transportation system that is conducive to walking can reap many benefits including health of individuals, reduced congestion, and improved quality of life. Economic rewards are also realized through reduction in health care costs, reduced dependency on autos, and increased economic vitality of commnities. Finally, walkable communities are more equitable.

Scenario Results

The walk trip share increases in Scenario B and in Scenario C. This indicates improved accessibility by walking for residents in study area.

What would improve the results

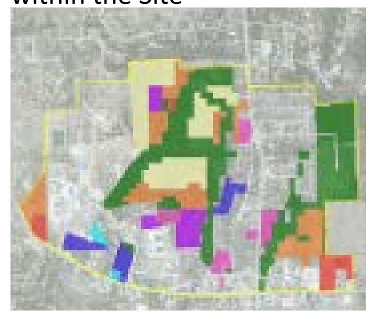
• Mix the uses to bring origins and destinations closer.

• Provide appropriate landscaping to create a pleasant pedestrian environment.

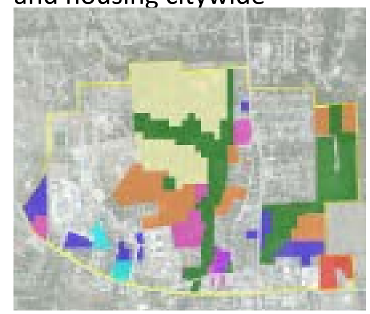
• Encourage shops and businesses that open directly to the sidewalk to make friendly and unique building faces.

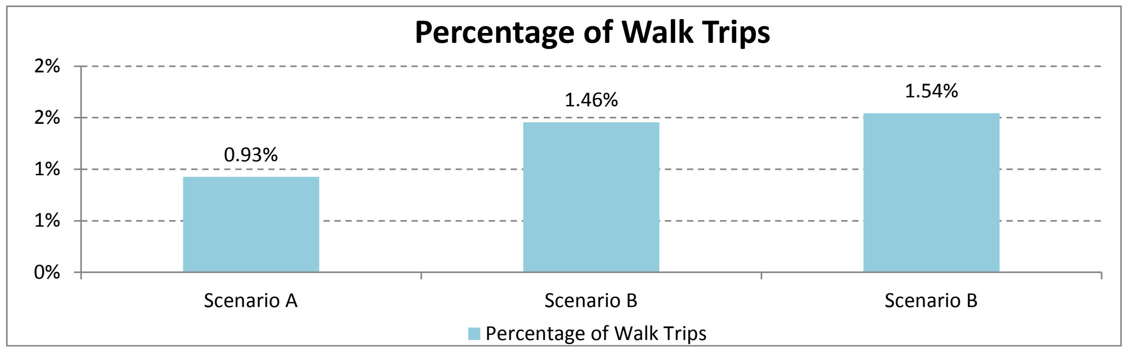
Scenario A: Trend

B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide





	Scenario A	Scenario B	Scenario C
Number of Walk Trips	1,059	1,749	1,869
Total Trips	114,440	120,175	121,064
Percentage of Internal Trips	**0.93%**	**1.46%**	**1.54%**

Percentage of Transit Trips - Dripping Springs

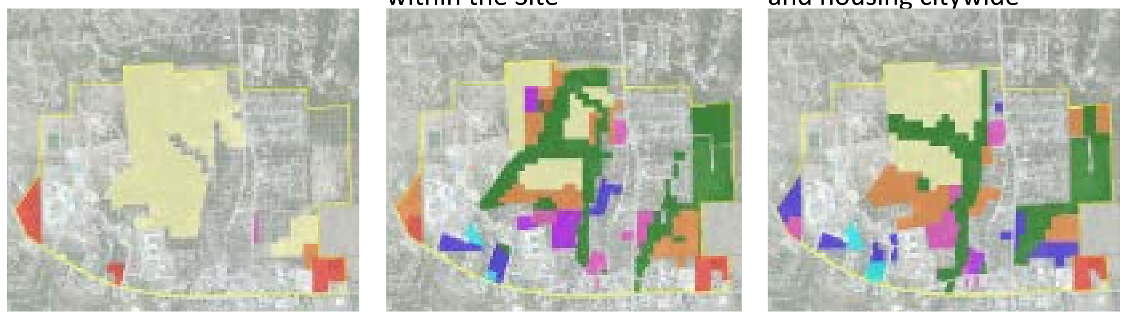
Definition

This indicator estimates the transit trip share. Public transportation provides an affordable alternative to driving. It offers mobility for those who do not drive or cannot drive. Public transportation facilities and corridors encourage economic and social activities and help create strong neighborhood centers, and thus foster more livable communities.

Scenario A: Trend

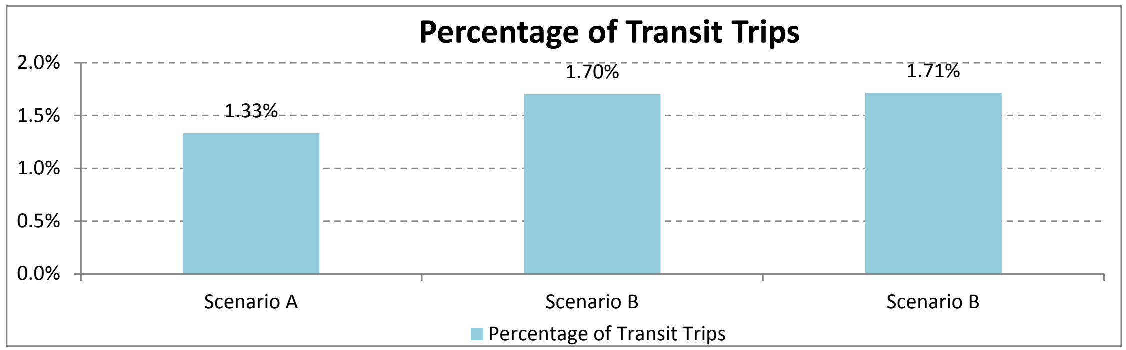
B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide



Scenario Results

The proportion of transit trips increases slightly in Scenario B and Scenario C. This indicates improved accessibility by transit for residents in the study area.



What would improve the results

- Accommodate home-based work trips.
- Build new transit routes, expand the existing transit system, and provide public transportation facilities.
- Integrate transit system with land use regulations.
- Provide access to transit stops.

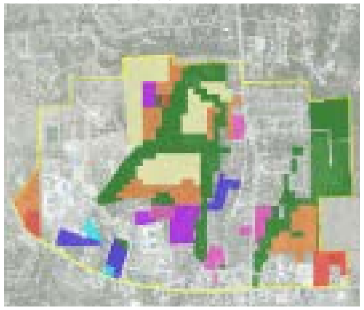
	Scenario A	Scenario B	Scenario C
Number of Transit Trips	1,523	2,046	2,075
Total Trips	114,440	120,175	121,064
Percentage of Internal Trips	**1.33%**	**1.7%**	**1.71%**

Total Trips - Dripping Springs

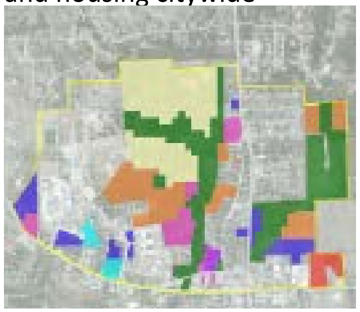
Definition
This indicator estimates the total trips in the study area. With more transportation alternatives provided, and better connectivity and accessibility, more trips would be generated.

Scenario A: Trend

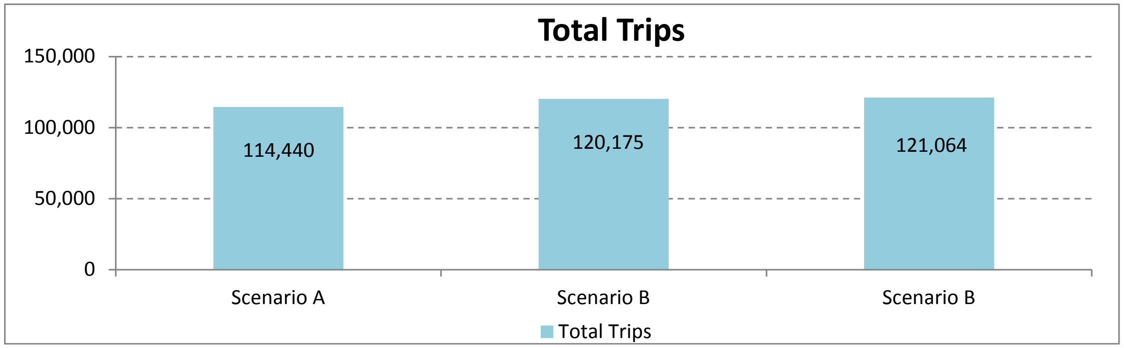
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
Trip rate in Scenario B is the highest, in Scenario C is the second highest, and is the lowest in Scenario A.



What would improve the results
- Mix land uses.
- Provide facilities to accomodate transit trips, walking, and biking.

	Scenario A	Scenario B	Scenario C
Total Trips	114,440	120,175	121,064

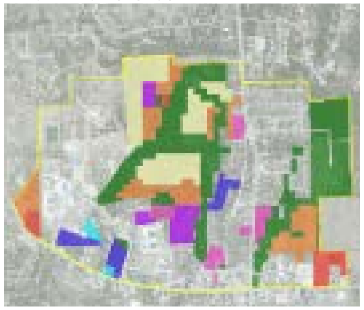
Total Transit Trips - Dripping Springs

Definition

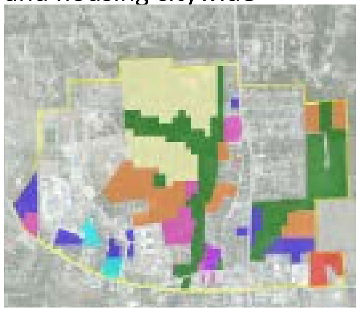
This indicator estimates the total transit trips in the study area. Public transportation provides an affordable alternative to driving. It offers mobility for those who do not drive or cannot drive. Also the number of total transit trips provides the demand of transit system for mass transit operators.

Scenario A: Trend

B: Balance jobs and housing within the Site

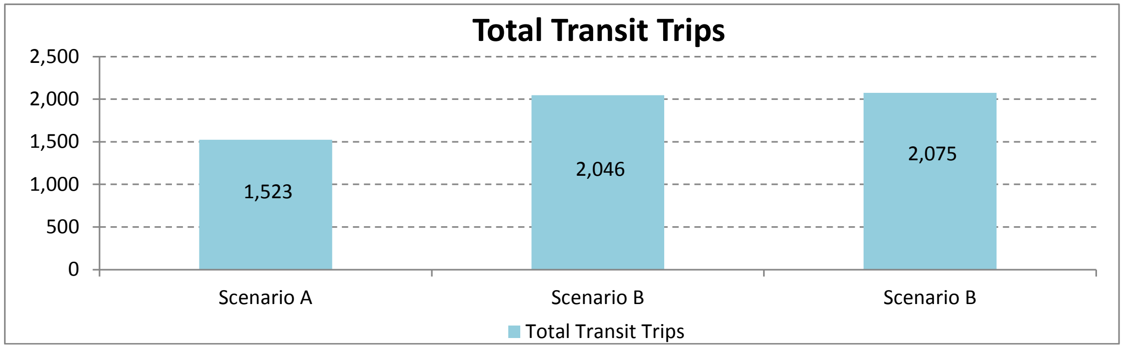


C: Towards a balance of jobs and housing citywide



Scenario Results

Scenario C's transit trip rate is the highest, follwed by Scenario B. This indicates improved accessibility by transit for residents in study area.



	Scenario A	Scenario B	Scenario C
Number of Transit Trips	1,523	2,046	2,075

What would improve the results

- Accommodate home-based work trips.
- Allocate more money on public transportation system.
- Provide safe and reliable transit service.
- Integrate transit system with land use planning.
- Provide access to transit stops.

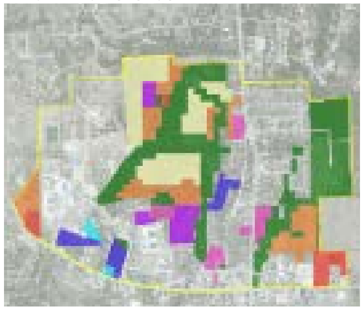
Job Accessibility - Dripping Springs

Definition

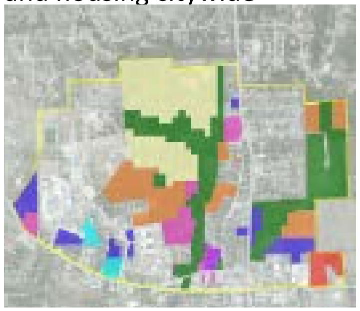
This indicator measures the ease of people reaching their jobs. People who live in places with higher accessibility can reach many destinations more quickly. Accessibility is a measure of potential for interaction. Places with higher job accessibility are usually more likely to attract people to live or work there, therefore bringing more economic opportunities to the community.

Scenario A: Trend

B: Balance jobs and housing within the Site

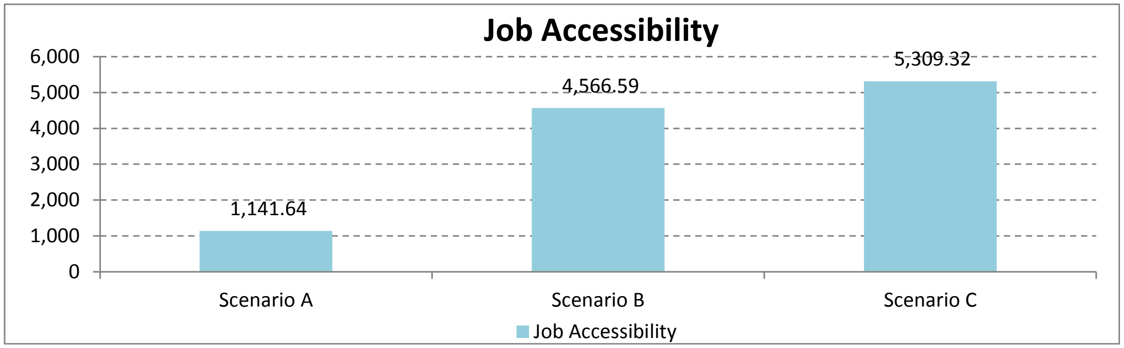


C: Towards a balance of jobs and housing citywide



Scenario Results

The number of jobs is much higher in Scenario B and Scenario C. The average auto commute time is significantly reduced for those residents who live and work in the same area. Thus the job accessibility significantly increases in the two scenarios, especially in Scenario C.



What would improve the results

- Improve service for the roadway network and of public transportation system.
- Create a community friendly to pedestrians and cyclists.
- Cluster job and residents at a location closer to the given transportation system and in area with greater connectivity.

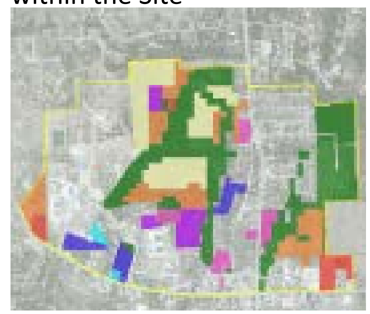
	Scenario A	Scenario B	Scenario C
Number of Jobs	452	1,960	2,249
Average Auto Commute Time	9.28	8.46	8.59
Job Accessibility	**1,142**	**4,567**	**5,309**

Parking Demand - Dripping Springs

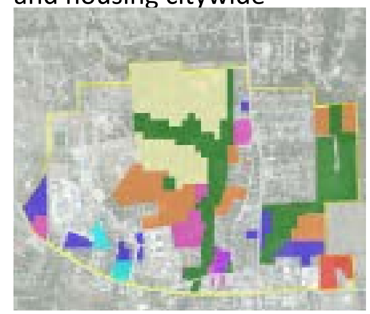
Definition
This indicator estimates the increased demand for parking associated with new development in study area.

Scenario A: Trend

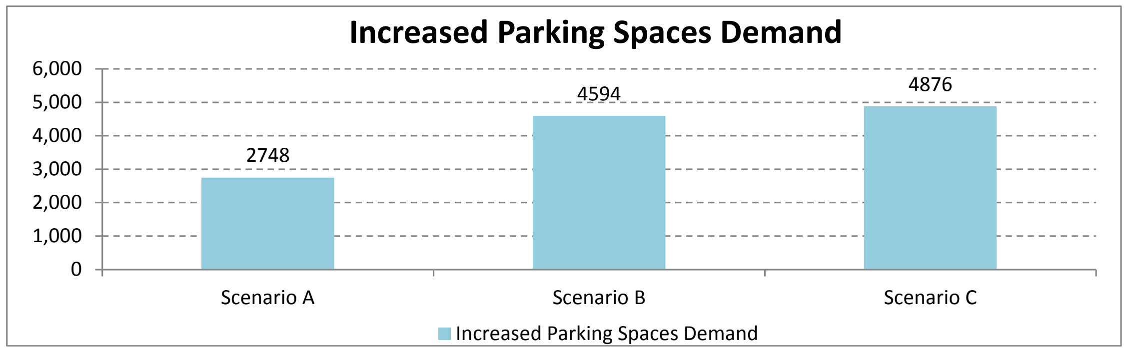
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
Retail and office require the most parking spaces compared to other developments. Therefore, there is higher demand for parking associated with scenarios B and C.



	Scenario A	Scenario B	Scenario C
Parking Spaces Demand	**2,748**	**4,594**	**4,876**

What would improve the results
- Create town center/neighborhood center with supporting public transit service.
- Encourage compact, mixed-use developments.
- Improve non-mobile facilities.
- Encourage shared parking arrangements.

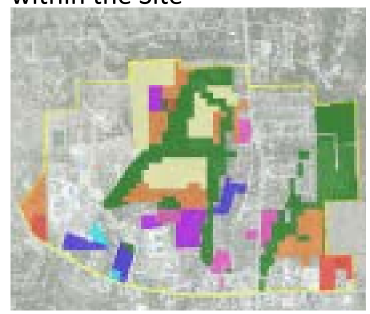
Daily Walk Trip per Capita - Dripping Springs

Definition

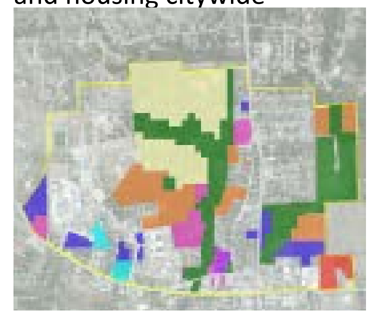
This indicator estimates the daily walk trip per capita. Regular daily physical activities benefit indivual health by reducing the risk of many disease and obesity as well as environment. It also reflects the livability of the community because there tend to be more activities taking place on the streets and more interactions between neighbors.

Scenario A: Trend

B: Balance jobs and housing within the Site

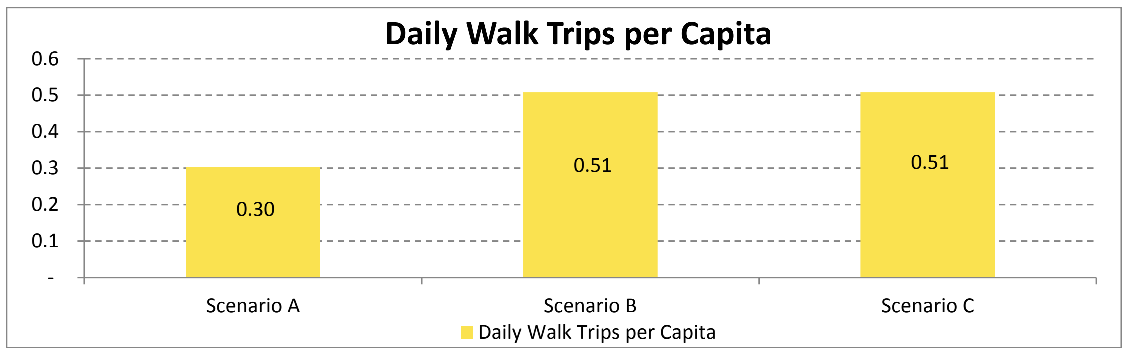


C: Towards a balance of jobs and housing citywide



Scenario Results

Mixed use development significantly increases the personal walk trip rate in Scenario B and Scenario C.



What would improve the results

• Encourage mixed and compact developments.

• Provide appropriate landscaping to create a pleasant pedestrian environment.

• Encourage shops and businesses that open directly to the sidewalk to make friendly and unique building facades.

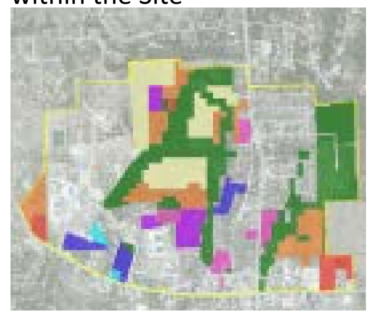
	Scenario A	Scenario B	Scenario C
Number of Walk Trips	1,059	1,749	1,869
Population	3,496	3,444	3,680
Daily Walk Trips per Capita	**0.3**	**0.51**	**0.51**

Average Auto Trip Length - Dripping Springs

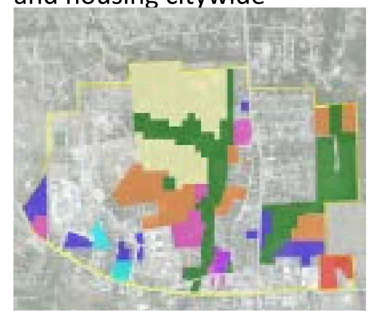
Definition
This indicator estimates the average auto trip length. Shorter length indicates better accessibitliy to destinations.

Scenario A: Trend

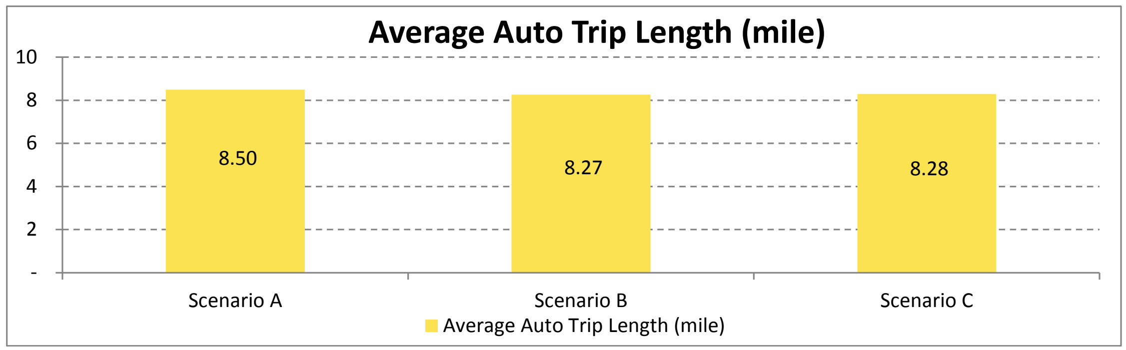
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
Average auto trip length in Scenarios B and C are slightly lower than Scenario A. But the difference is not very significant.



What would improve the results
• Improve the existing transportation system.
• Improve street connectivity.
• Implement strategies for traffic congestion mitigation.
• Encourage the mixed use and compact developments.

	Scenario A	Scenario B	Scenario C
Total Trips	111,857	116,380	117,121
Total Vehicle Miles Traveled	950.656	**962,243**	**970,204**
Average Auto Trip Length (miles)	**8.5**	**8.27**	**8.28**

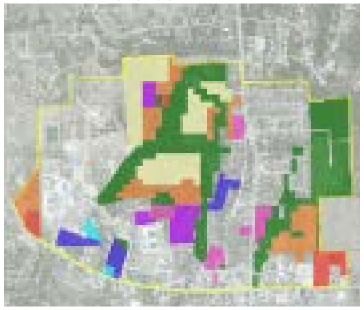
Average Internal Auto Trip Length - Dripping Springs

Definition

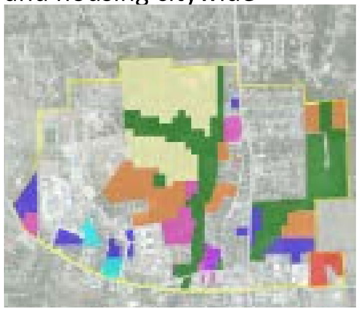
This indicator estimates average internal auto trip length.

Scenario A: Trend

B: Balance jobs and housing within the Site

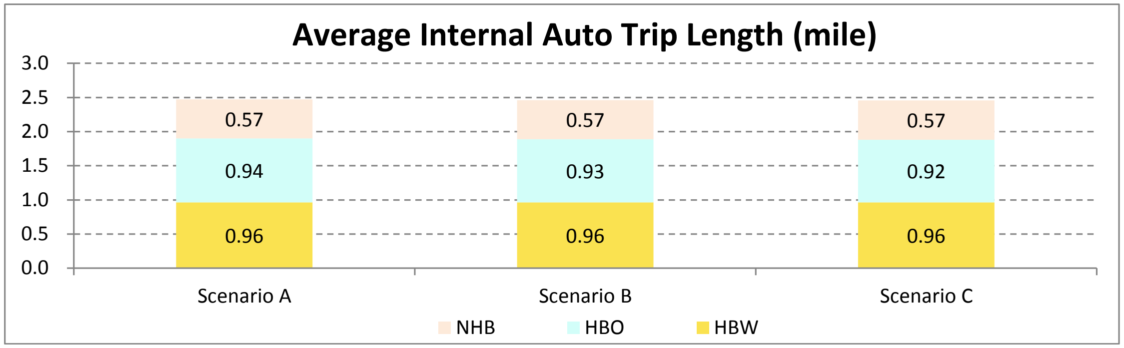


C: Towards a balance of jobs and housing citywide



Scenario Results

The length of home-based work and non-home based trips do not have any difference in three scenarios. However, the average 'home-based other' trip length is slightly less in Scenarios B and C, due to new mixed use development.



What would improve the results

• Encourage mixed use and compact developments to provide essential and commercial services within walking distance for residents in the community.
• Improve street connectivity.

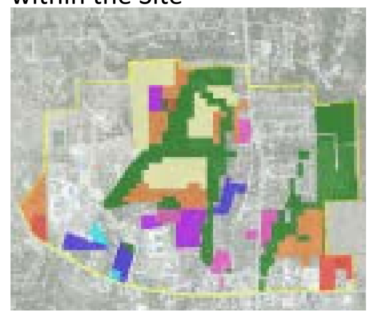
	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	0.96	0.96	0.96
HBO (Home-based others)	0.94	0.93	0.92
NHB (Non-home based)	0.57	0.57	0.57

Average External Auto Trip Length - Dripping Springs

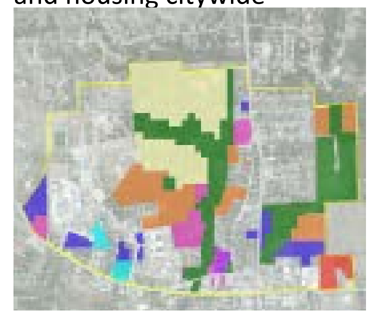
Definition
This indicator estimates average external auto trip length by purpose.

Scenario A: Trend

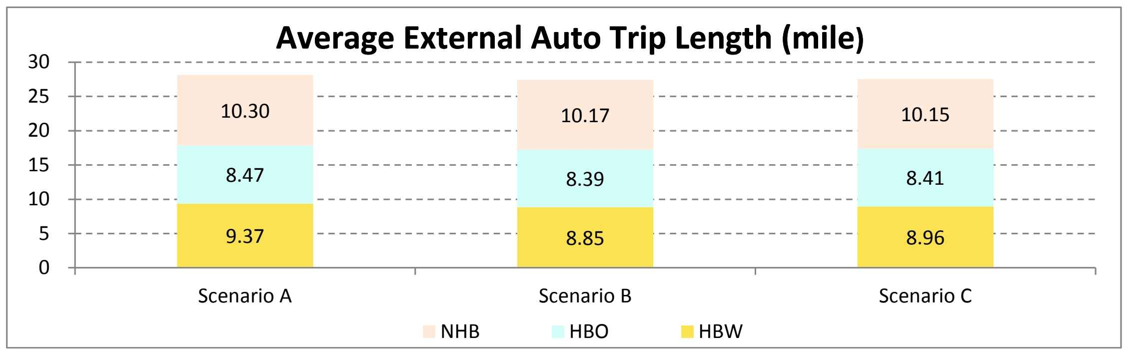
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
For external trips, average trip length decreases slightly in the mixed-use development scenarios.



What would improve the results
• Improve the existing transportation system.
• Improve street connectivity.
• Implement strategies for traffic congestion mitigation.

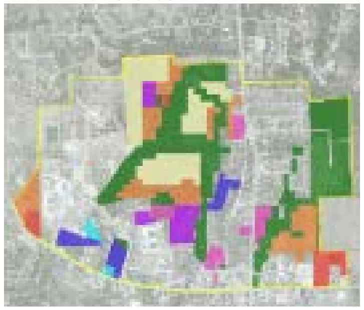
	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	9.37	8.85	8.96
HBO (Home-based others)	8.47	8.39	8.41
NHB (Non-home based)	10.3	10.17	10.15

Average Auto Trip Time - Dripping Springs

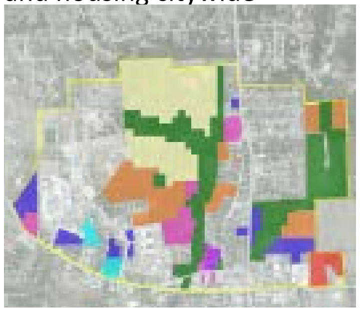
Definition
This indicator estimates the average time per auto trip. A shorter average auto trip time indicates greater accessibitliy to destinations.

Scenario A: Trend

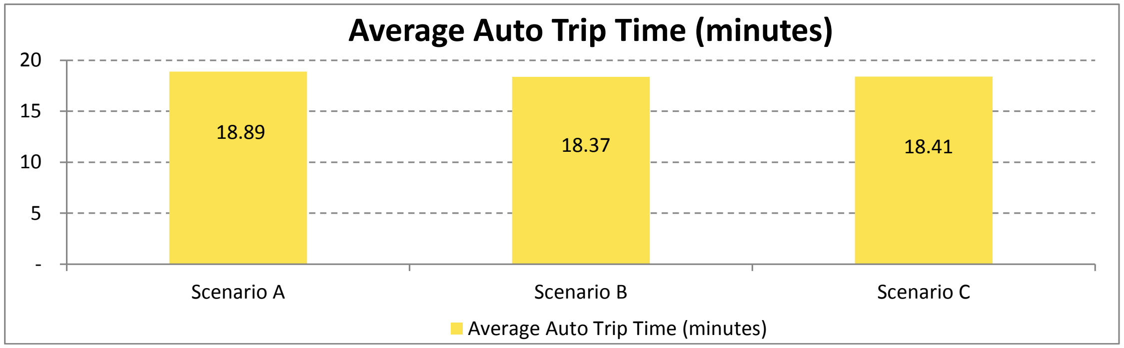
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
Average commute times in Scenarios B and C are slightly less than Scenario A. But the difference is not very significant.



What would improve the results
• Improve the existing transportation system.
• Improve street connectivity.
• Implement strategies for traffic congestion mitigation.
• Encourage mixed use and compact developments.

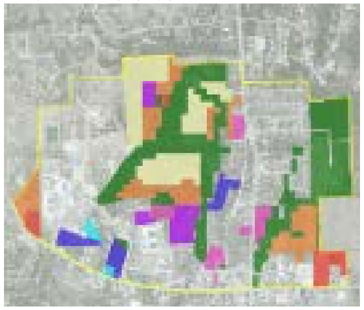
	Scenario A	Scenario B	Scenario C
Average Trip Length	8.5	8.27	8.28
Speed	27	27	27
Average Auto Trip Time (minutes)	**18.89**	**18.37**	**18.41**

Average Auto Commute Time - Dripping Springs

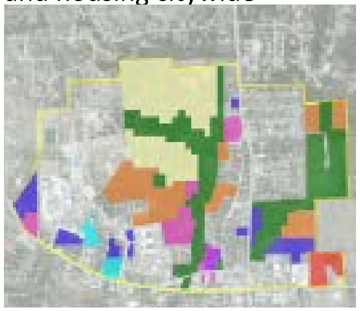
Definition
This indicator estimates the average auto trip time for commuters in the study area to their workplaces throughout the region. A shorter commute time indicates better accessibitliy to jobs.

Scenario A: Trend

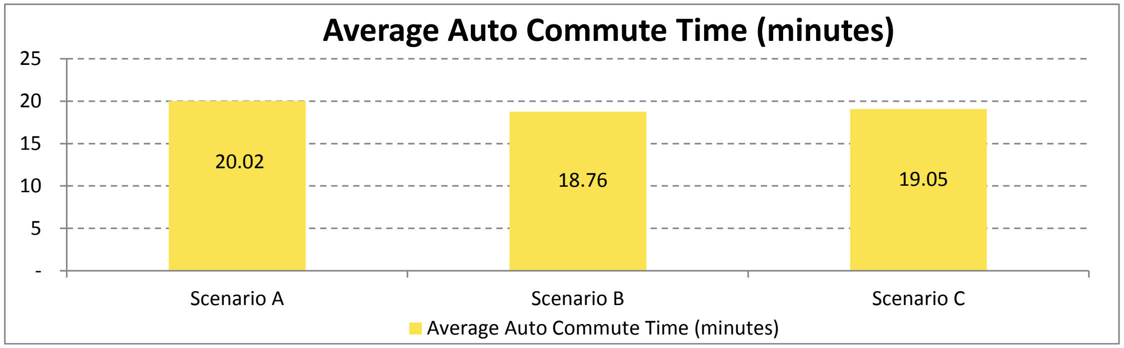
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
Commute time of Scenario B and Scenario C are slightly less than Scenario A. But the difference is not very significant.



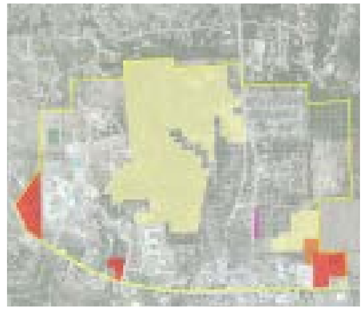
What would improve the results
• Cluster job opportunities and individuals at a location closer to the given transportation system.
• Encourage a mix of residential and office uses.

	Scenario A	Scenario B	Scenario C
Average Auto Commute Length	9.01	8.44	8.57
Speed	27	27	27
Average Auto Commte Time (minutes)	**20.02**	**18.76**	**19.05**

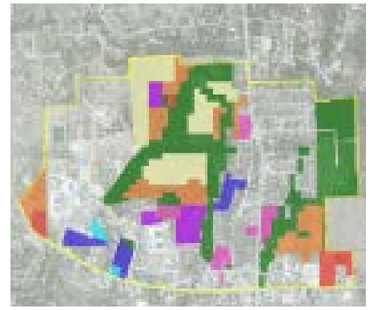
VMT per Capita - Dripping Springs

Definition
This indicator estimates the number of vehicle miles traveled (VMT) per capita. High VMT leads to a higher level of traffic congestion, gas consumption, and air pollution. It is usually the result of dependency on private vehicles. It may also indicate less accessibility for those who do not own a car or are unable to drive.

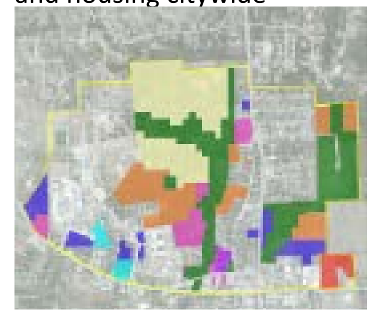
Scenario A: Trend



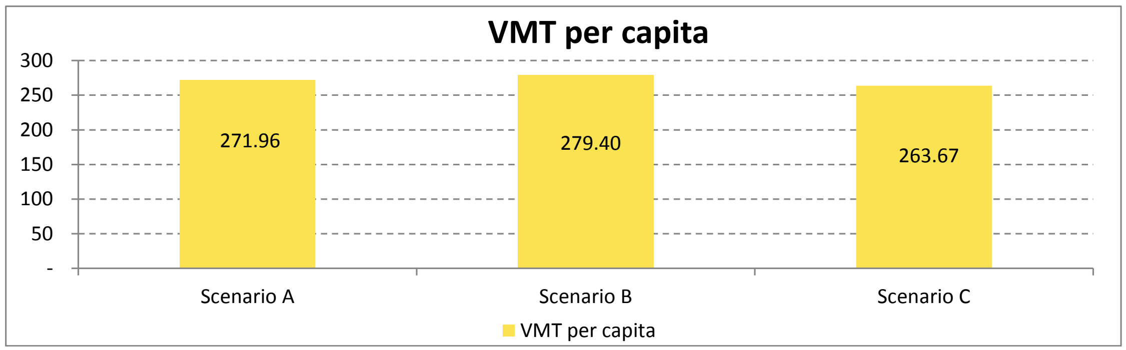
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
The daily trip rate per person is higher in Scenario B. Thus it generates the highest personal VMT. Scenario C generates the lowest personal VMT due to its citywide balanced job-housing development.



What would improve the results
• Encourage the use of public transit and carpooling.
• Provide high-quality, reliable, and safe public transportation system.
• Create friendly environment for pedestrians and cyclists to support non-motorized transportation modes.

	Scenario A	Scenario B	Scenario C
Total VMT	950,656	962,243	970,203
Population	3,496	3,444	3,680
Vehicle Miles Traveled per Capita	**272**	**279**	**264**

Social Cost of GHG Emissions - Dripping Spring

Definition

Major greenhouse gases (GHG) include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and industrial gases. The vast majority of emissions are CO_2. Increased emissions of GHG due to human activities have been linked to global warming and changes in the climate pattern. The monetary value of the damages that may be caused by these changes currently and in the future is the social cost of greenhouse gases.

Scenario Results

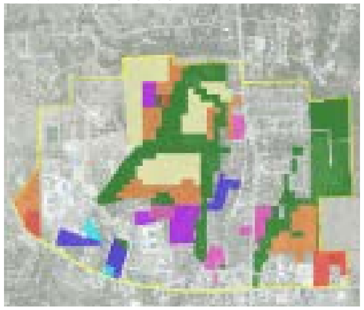
The amount GHG emissions is highly associated with vehicle miles traveled (VMT). Scenario C generates the highest VMT due to the high density of population and employment, thus it produces the largest amount of GHG. Scenario A has the lowest social cost of GHG emissions. However, improvements on clean and fuel efficient cars can also reduce GHG emissions.

What would improve the results

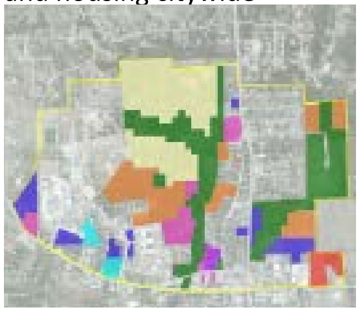
- Increase the usage of alternative fuels.
- Improve the fuel efficiency.
- Implement carpool incentive programs to reduce single occupant auto travel.
- Improve public transit service.
- Improve pedestrian and bicycle facilities.

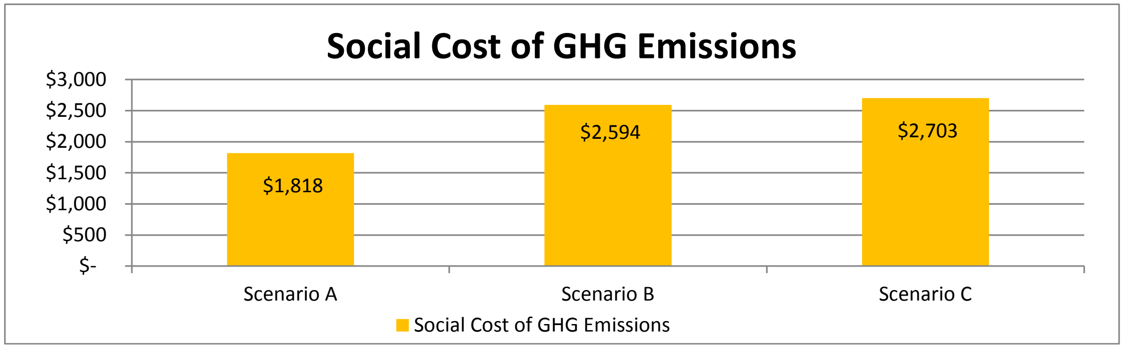
Scenario A: Trend

B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide





	Scenario A	Scenario B	Scenario C
Total CO_2 Emissions Contributed (tons)	46	65	68
Social Cost of GHG Emissions	**$1,818**	**$2,594**	**$2,703**

Social Cost of CAC - Dripping Spring

Definition

Criteria air contaminants (CAC) are a set of air pollutants emitted from many sources in industry. CAC in particular refer to a group of contaminants that include sulphur dioxide (SO_2), nitrogen oxides (NO_x), volatile organic compounds (VOC), and particulate matter (primarily $PM_{2.5}$). The social cost of CAC is the monetary valuation of the damages to human health, environment and structures caused by these pollutants.

Scenario Results

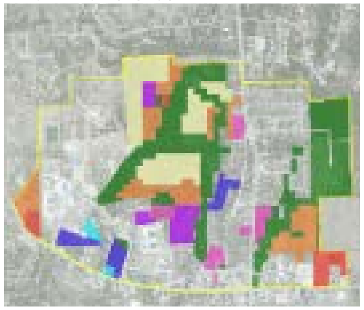
The amount CAC emissions is highly associated with vehicle miles traveled (VMT). Scenario C generates the highest VMT due to the high density of population and employment, thus it produces the largest amount of CAC. Scenario A has the lowest social cost of CAC. However, improvements on clean and fuel efficient cars can also reduce CAC.

What would improve the results

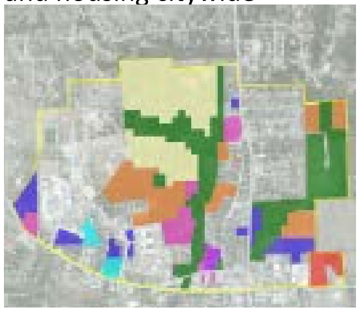
- Increase the usage of alternative fuels.
- Improve the fuel efficiency.
- Implement carpool incentive programs to reduce single occupant auto travel.
- Improve public transit service.
- Improve pedestrian and bicycle facilities.

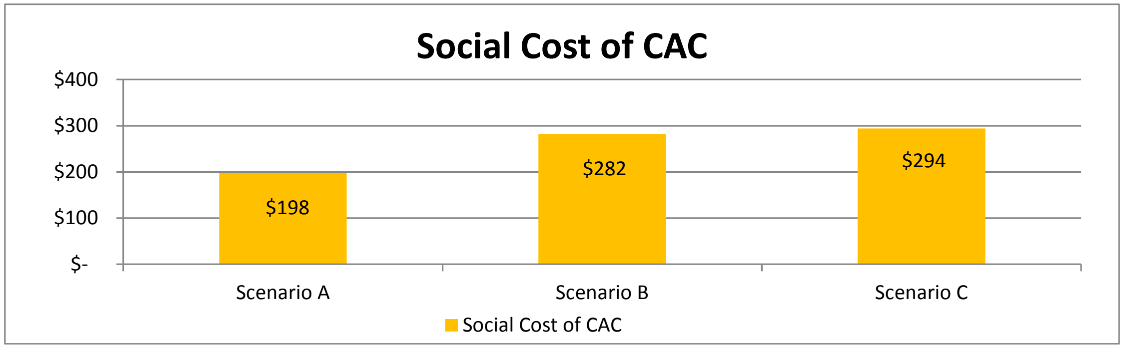
Scenario A: Trend

B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide





	Scenario A	Scenario B	Scenario C
Total NO_x Emissions Contributed (tons)	0.03	0.04	0.04
Total VOC Emissions Contributed (tons)	0.03	0.05	0.05
Social Cost of CAC	**$198**	**$282**	**$294**

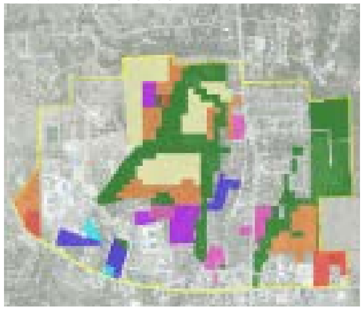
Social Cost of Motor Vehicle Accident - Dripping Spring

Definition

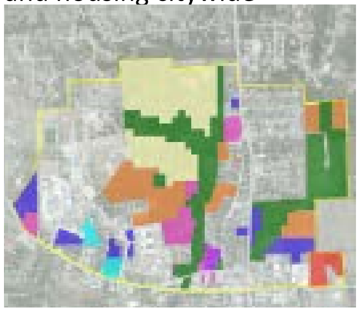
Accident costs are the costs of social resources lost in an accident and the loss in welfare incurred as a result of an accident. The specific costs that are typically covered are comprehensive in nature and include both private costs to the affected individuals and costs to the society at large; costs incurred by an individual out-of-pocket, costs of health care, and costs of pain and suffering.

Scenario A: Trend

B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide

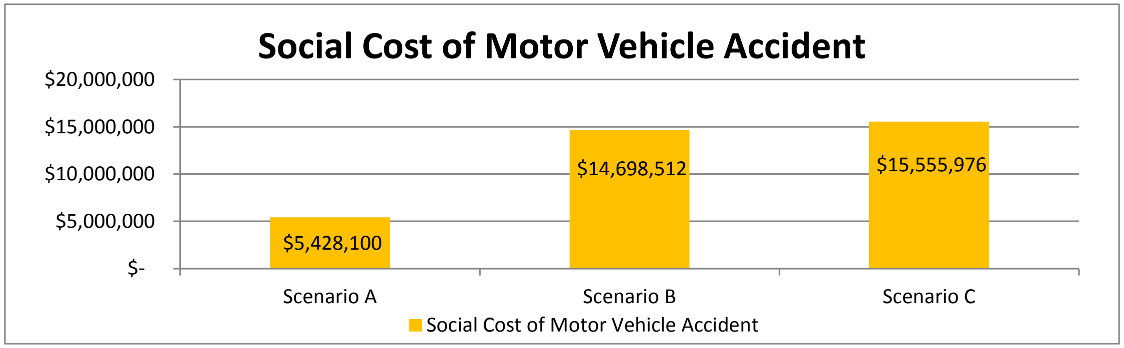


Scenario Results

Crash rate is associated with personal VMT, employment density, and intersection density. Scenario C generates the highest crash rate due to the denser developments. Scenario A produces the lowest social cost of motor vehicle accident. However, improvements on roadway safety facilities and implementation of traffic calming measures can also reduce the crash rate.

What would improve the results

- Incorporate "complete streets" design into planning.
- Implement traffic calming measures.
- Improve roadway facilities.
- Implement site-specific projects to improve traffic safety.



(per year)	Scenario A	Scenario B	Scenario C
Fatal Crash Rate	0	1	1
Serious Injury Crash Rate	5	12	13
Other Injury Crash Rate	6	17	18
Non-injury Crash Rate	18	48	50
Social Cost of Accident	**$5,428,100**	**$14,698,512**	**$15,555,976**

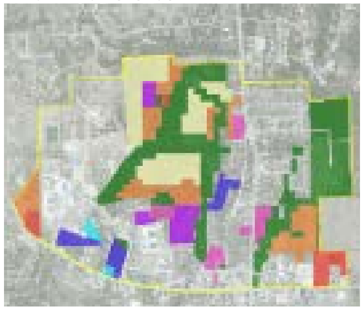
Vehicle Operating Costs - Dripping Spring

Definition

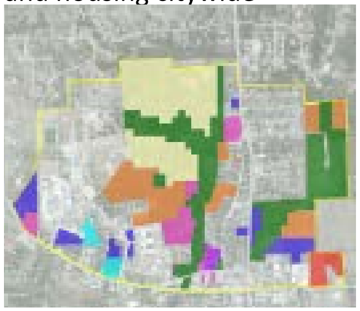
Vehicle operating costs (VOC) represents the personal costs borne by travelers using their own vehicle to make a trip. Total VOC are indirectly based on changes in vehicle miles traveled (VMT). Generally, VOC include fuel costs, tire costs, repair and maintenance costs, vehicle depreciation, and oil costs.

Scenario A: Trend

B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide

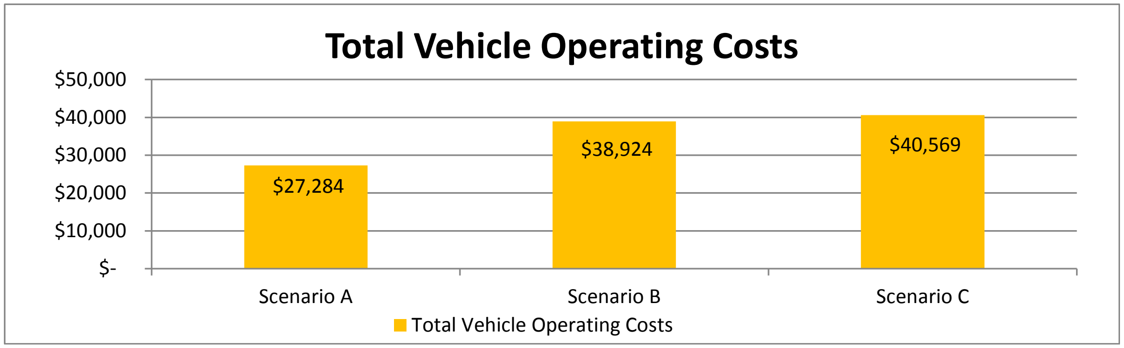


Scenario Results

The total vehicle operating costs are highly associated with vehicle miles traveled (VMT). Scenario C generates the highest VMT due to the high density of population and employment, thus it produces the largest vehicle operating costs. Scenario A has the lowest total vehicle operating costs.

What would improve the results

• Implement congestion mitigation programs.
• Improve access to transit.
• Improve major road networks.
• Improve pedestrian and bicycle facilities.



	Scenario A	Scenario B	Scenario C
Fuel Costs	$16,217	$23,136	$24,114
Tire Costs	$531	$757	$789
Repair and Maintenance Costs	$14,873	$21,219	$22,115
Vehicle Depreciable Value	$10,105	$14,416	$15,026
Oil Costs	$1,775	$2,532	$2,639
Total Vehicle Operating Costs	**$27,284**	**$38,924**	**$40,569**

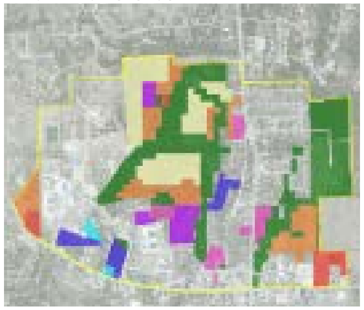
Values of Travel Time Savings - Dripping Spring

Definition

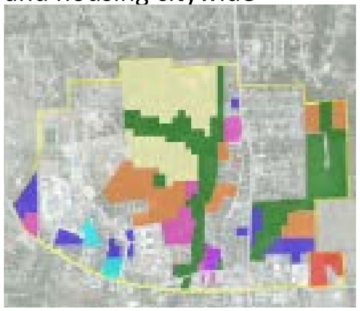
Travel time has value because travelers can dedicate this time to work and earning income, or use it to engage in leisure activities. The value of travel time represents thus the opportunity cost of alternative activities and the cost of discomfort that may be involved in travelling. The monetized travel time savings can be compared against other project benefits and costs to help evaluate and justify transport improvement project.

Scenario A: Trend

B: Balance jobs and housing within the Site

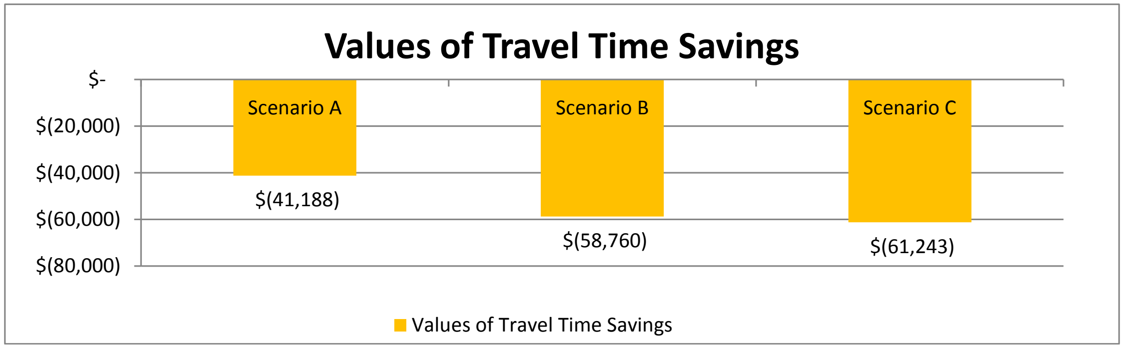


C: Towards a balance of jobs and housing citywide



Scenario Results

The values of travel time savings are highly associated with vehicle miles traveled (VMT). Scenario C generates the highest VMT due to the high density of population and employment, thus it produces the largest travel time costs. Scenario A has the lowest travel time costs.



What would improve the results

- Implement congestion mitigation programs.
- Improve access to transit.
- Improve major road networks.
- Improve non-mobile facilities.
- Integrate land use regulations with transport projects.

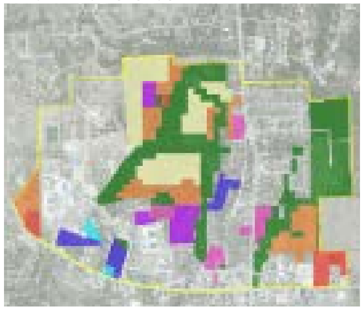
	Scenario A	Scenario B	Scenario C
Total Travel Time Savings (hours)	-2,844	-4,058	-4,230
Total Travel Time Savings/Costs	**-$41,188**	**-$58,760**	**-$61,243**

Commuter Bike Mobility Benefits - Dripping Spring

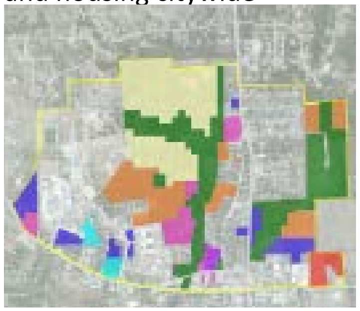
Definition
The commuter bike mobility benefits refer to the monetary value of people's greater satisfaction of cycling in their communities.

Scenario A: Trend

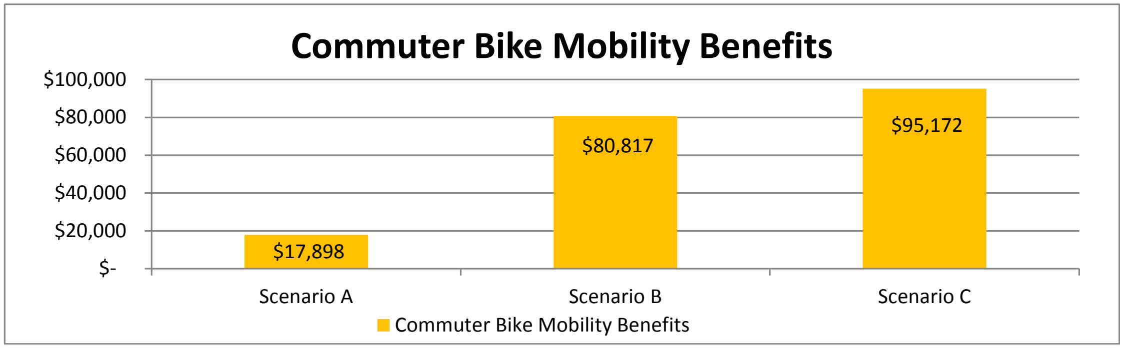
B: Balance jobs and housing within the Site



C: Towards a balance of jobs and housing citywide



Scenario Results
Urban form and demographic characteristics affect transportation choices. Bike trip rate is highly associated with intersection density, land use mix, and household size. Scenario C generates the highest bike trip rate, thus produces the highest commuter bike mobility benefits. Scenario A has the lowest commuter bike mobility benefits.



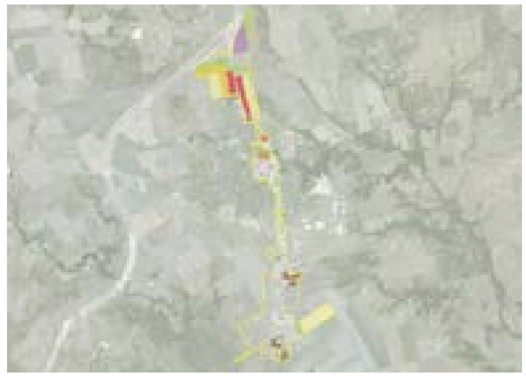
	Scenario A	Scenario B	Scenario C
Number of Commuters by Bike (per day)	4	19	22
Commuter Bike Mobility Benefits	**$17,898**	**$80,817**	**$95,172**

What would improve the results
• Incorporate "complete streets" design into planning to accommodate all transportation users.
• Provide adequate bike lanes.
• Provide bike parking facilities and shower at workplace.
• Provide multi-modal corridors.

Land Use Scenarios - Lockhart

Scenario A: Trend

Scenario B: Balance jobs and housing within the Demonstration Site



Scenario C: Towards a balance of jobs and housing citywide

Legend

Summary Table

	Scenario A		Scenario B		Scenario C	
	Acres	%	Acres	%	Acres	%
Town Center	/	/	7.8	1.6%	/	/
Compact Neighborhood	8.5	2.1%	58.6	11.8%	109.4	20.9%
Single Family Neighborhood Subdivision	321	81.2%	168.9	33.9%	113.1	21.7%
Main Street Commercial	1	0.3%	66.9	13.4%	59.1	11.3%
Highway-Oriented Retail and Office	/	/	/	/	/	/
Office	23.1	5.8%	48.2	9.7%	0.5	0.1%
Industrial	41.8	10.6%	51.7	10.4%	50	9.6%
Civic	/	/	5.8	1.2%	11.4	2.2%
Open Space	/	/	90.2	18.1%	178.7	34.2%
Total	**395**	**100%**	**498**	**100%**	**522**	**100%**

Activity Density - Lockhart

Definition

Activity density refers to the residential population plus employment within the study area. Higher activity density indicates higher trip rates generated and attracted. Higher activity density within the study area supports internal walk trips, and is also positively related to walking on external trips.

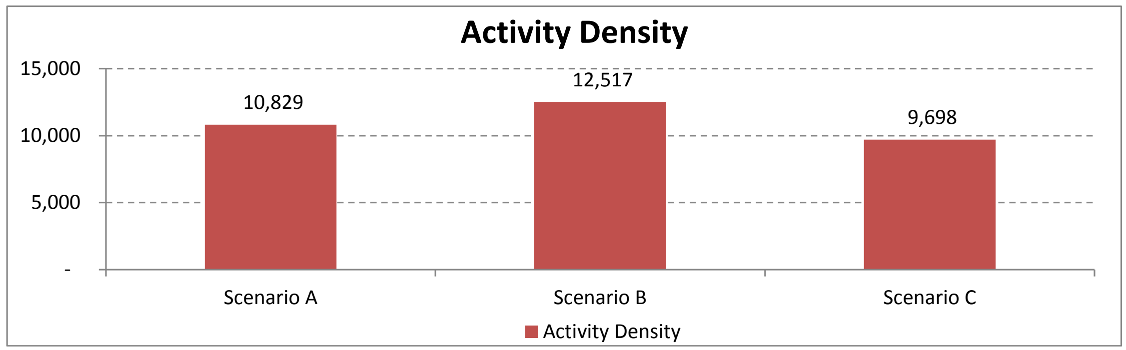
Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

Land uses in Scenario A include the most single family development. Housing in Scenarios B and C are more mixed. Land uses in Scenario B include the most office development, while in Scenario C includes the most open space. Population in the three scenarios are comparable. However, with more jobs, Scenario B has the highest activity density, followed by Scenario C.



What would improve the results

- Encourage the development of mixed use and office uses.
- Provide diverse housing choices including multi-family housing and town homes.

	Scenario A	Scenario B	Scenario C
Population	5,465	5,140	5,140
Employment	1,224	4,600	2,770
Area (square mile)	0.62	0.78	0.82
Activity Density (per sq mile)	**10,829**	**12,517**	**9,698**

Job-Population Balance - Lockhart

Definition

The Job-Population Balance Index measures the balance between the number of jobs and residents. The index ranges from 0, where only jobs or residents are present in a study area, to 1 where the ratio of jobs to residents is optimal in terms of trip generation. The value 0.2 represents a balance of employment and population that generates the highest trip rate.

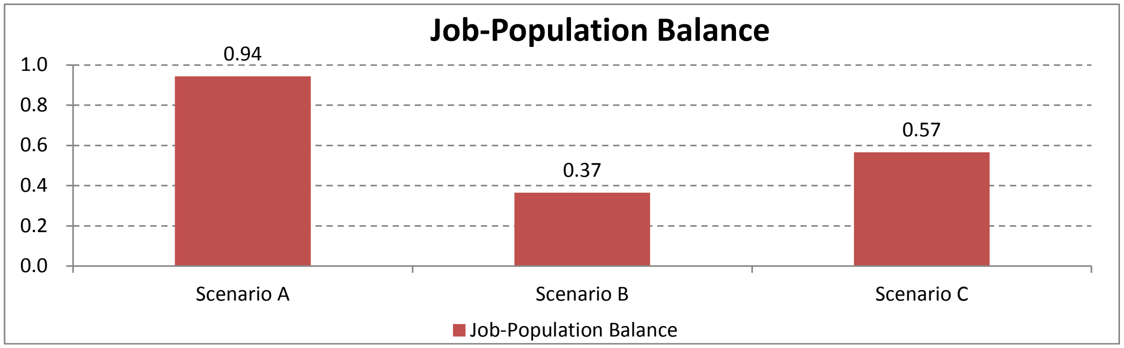
Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

It is proposed that 0.2 is the job-population ratio that would generate the highest trip rate. In this case, the job-population balance in Scenario A is better than Scenario B and Scenario C. Scenario B has the lowest job-population balance due to far more jobs than residents in this scenario.



What would improve the results

- Balance the development of residential and office/industrial.

	Scenario A	Scenario B	Scenario C
Population	5,465	5,140	5,465
Employment	1,224	4,600	2,770
Job-Population Balance	**0.94**	**0.37**	**0.57**

Land Use Mix - Lockhart

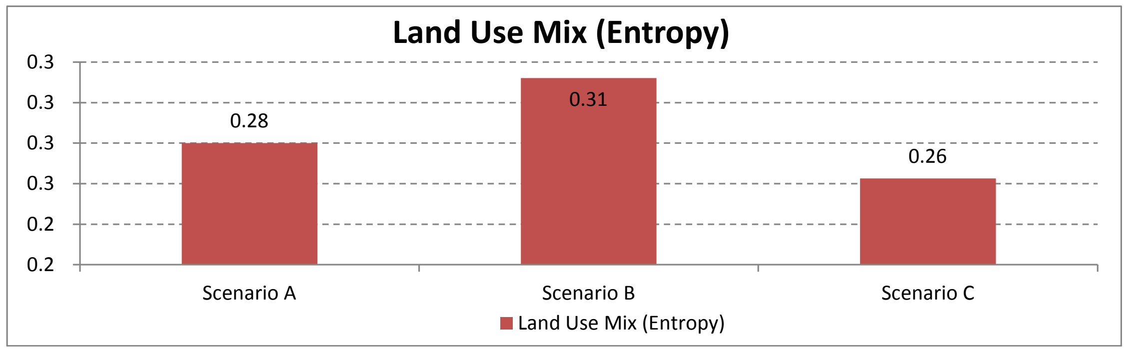
Definition
Land use mix captures the variety of land uses within the study area. The index varies in value from 0, where all developed land is in one land use category, to 1, where developed land is evenly divided among land use categories. Mixed-use development increases the walkability and bikability of the area. Land use mix is positively associated with internal capture of trips and non-motorized trips.

Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results
Land uses in Scenario A include more residential development, those in Scenario B include more office development, and those in Scenario C include more open space. Scenario B's land use mix index is the highest, followed by Scenario A.



What would improve the results
- Identify stakeholders likely to be affected by mixed use development.
- Determine the mix of uses and appropriate areas for mixed use zoning.
- Adopt new mixed use zoning requirements.

	Scenario A	Scenario B	Scenario C
Residential (sq ft)	3,717,574	3,360,150	3,271,270
Retail (sq ft)	55,639	797,947	652,215
Office (sq ft)	352,942	1,051,095	552,178
Industrial (sq ft)	339,861	469,854	338,815
Land Use Mix	**0.28**	**0.31**	**0.26**

Street Connectivity - Lockhart

Definition
Connectivity refers to the density of connections and the directness of links. As connectivity increases, travel distances decrease and route options increase, offering more route options, and making non-motorized travel more feasible. A connected road network tends to emphasize accessibility by accommodating more travel with traffic dispersed over more roads, to improve walking and cycling conditions, and to support transit use.

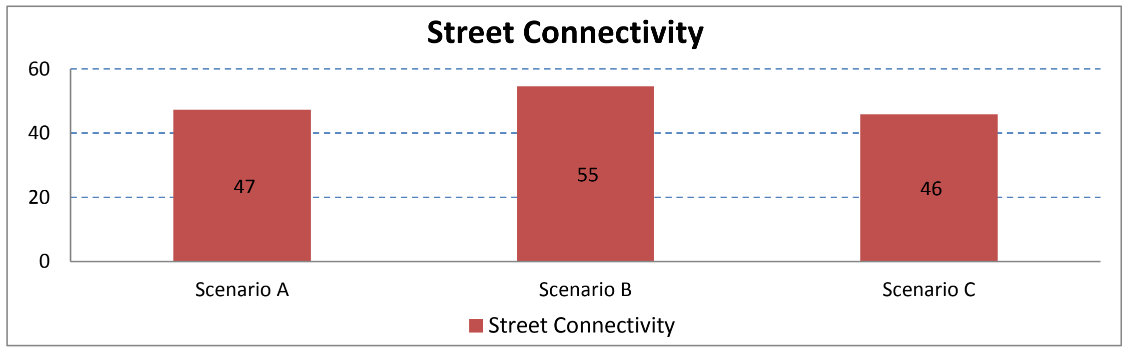
Scenario Results
Town center, main street commercial, corridor commercial and civic development usually contain more intersections. Intersection density in Scenario B is the highest. A large proportion of land uses in Scenario C is open space development, which contains no intersections, thus its street connectivity is the lowest.

What would improve the results
• Develop a well-connected road or path network that has many short links, numerous intersections, and minimal dead-ends.
• Build the internal circulation route as an interconnected, grid-like transportation system.
• Set the maximum block size.

Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide



	Scenario A	Scenario B	Scenario C
Number of Intersections	29	42	37
Area (sq mile)	0.62	0.78	0.49
Intersection Density	**47**	**55**	**46**

Proportion of Area within 1/4 mile of Transit Stops - Lockhart

Definition

Typically, 1/4 mile is considered a standard walking distance most people could accomodate. A transit stop within walking distance increases the probability people would choose to take public transit. Nearby transit stops may also stimulate walking.

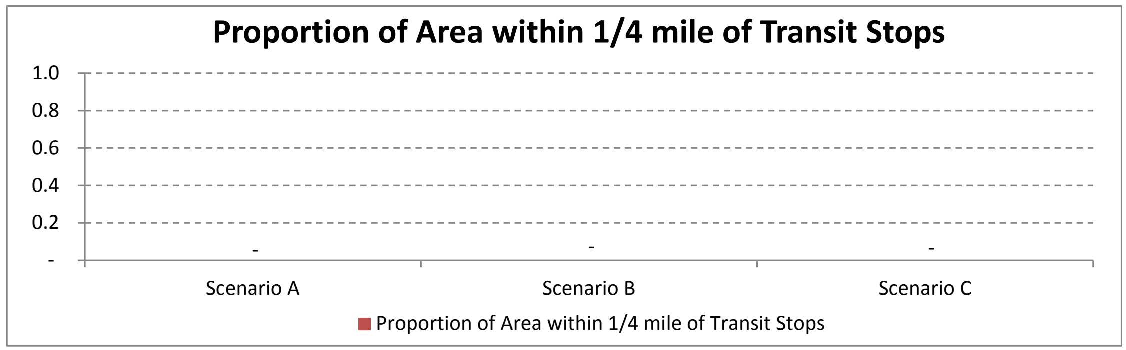
Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

There is no transit stop in study area. Thus the proportion of area within 1/4 mile of transit stops is zero in all the three scenarios.



What would improve the results

• Incorporate the community into regional transportation plans that include tranit.

• Encourage high-density and mixed-use residential and commercial development within a radius of 1/4 to 1/2 mile from a transit stop to maximize access to transit.

	Scenario A	Scenario B	Scenario C
Proportion of Area within 1/4 mile of Transit Stops	-	-	-

Street Network Density - Lockhart

Definition

Street network density refers to ratio of the length (in miles) of scenario's road network to the land area (in square miles) in the study area. Higher street network density is usually associated with better street connectivity. It is significantly associated with the traveler's mode choice. And greater street network density has an even greater influence on non-work trips.

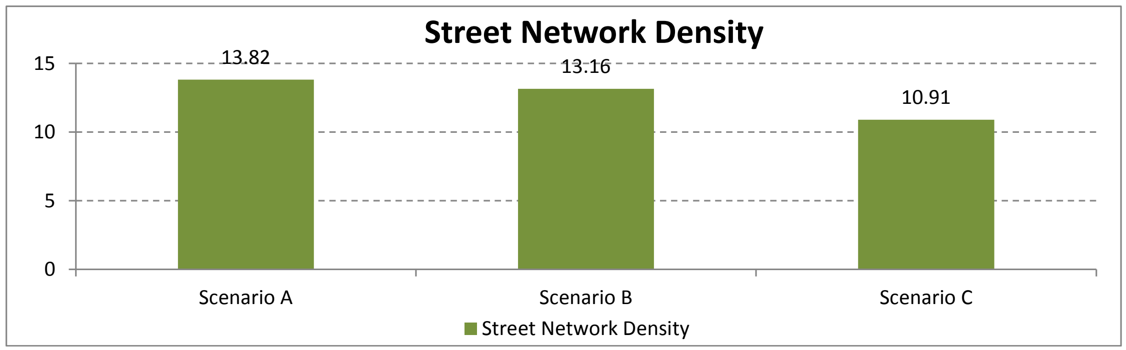
Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

Main street commercial and corridor commercial developement accommodate highest street network density, while single family neighborhood, office, and industrial accommodate the lowest. There is no street designated in open space. Thus Scenario B and Scenario C have very low street network density due to the large proportion of open space.



What would improve the results

- Build the internal circulation route as an interconnected, grid-like transportation system.
- Set a maximum block size.

	Scenario A	Scenario B	Scenario C
Street Centerline Length (mile)	9	10	9
Total Area (sq mile)	0.62	0.78	0.82
Street Network Density	**13.82**	**13.16**	**10.91**

Transit Stop Coverage - Lockhart

Definition

High transit stop coverage rate provides more opportunities to access transit. Better transit accessibility results in a higher percentage of trips be public transit and lowers the amount of driving. Less vehicle trips can lower VMT, mitigate congestion impacts, and reduce vehicle ownership. It also has environmental impacts by reducing the carbon emission.

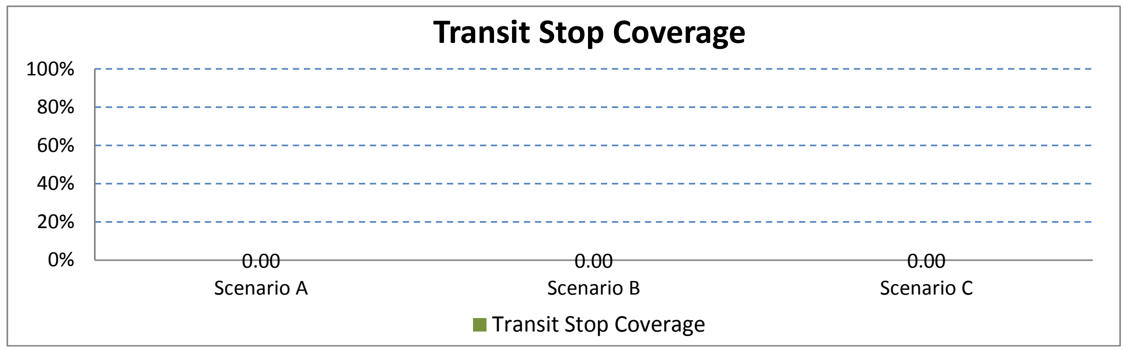
Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

There is no transit stop in or near the study area. Thus the transit stop coverage is zero to all the three scenarios.



What would improve the results

- Provide for interagency coordination of transit services in several transit funding programs.
- Develop a regional plan for public transportation coordination.

	Scenario A	Scenario B	Scenario C
Number of Transit Stops	-	-	-
Total Area (sq mile)	0.62	0.78	0.82
Transit Stop Coverage	**0**	**0**	**0**

Bicycle Network - Lockhart

Definition
Cycling is one of the most affordable transportation options. High bicycle network coverage provides more transportation options and better mobility. Improved bicycle facilities create more balanced transportation systems with lower automobile dependency, and promote social equity for transportation disadvantaged. The shift to non-motorized modes also has a mitigating effect on congestion and improves the function of streets.

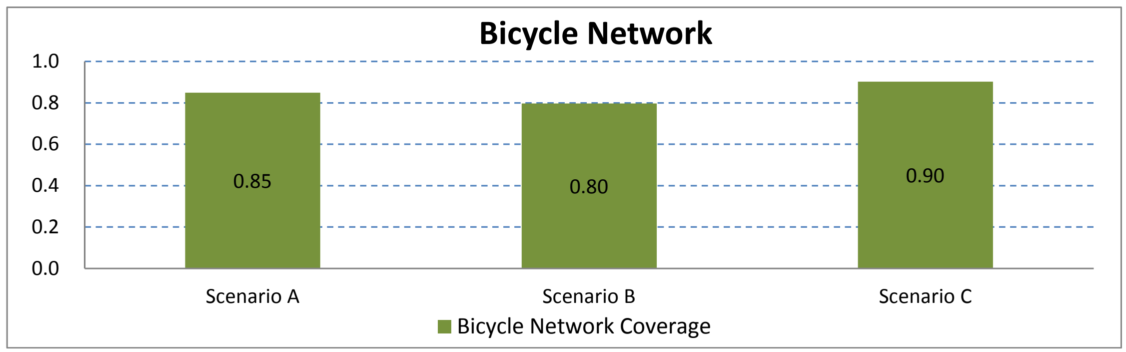
Scenario Results
Residential, civic, town center, and main street commercial development typically contain more bike lanes than office and industrial development. Due to the high proportion of office development in Scenario B, its bicycle network coverage is the lowest. Scenario C has higher bicycle network because its land uses include more main street commercial development.

What would improve the results
• Provide improved bicycle facility management and maintenance.
• Provide separate bike lanes for cyclists and implement traffic calming strategies.
• Promote bicycle sharing program.
• Improve cooperation throughout the region.

Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide



	Scenario A	Scenario B	Scenario C
Bike Lane Length	7.3	8.2	8
Street Centerline Length (mile)	8.5	10.2	8.9
Bicycle Network Coverage	**0.85**	**0.80**	**0.90**

Sidewalk Completeness - Lockhart

Definition

The availability of sidewalks improves the accessibility and increases the likelihood that residents and employees will walk. A complete sidewalk network provides people with more travel alternatives and reduces the frequency of vehicle-pedestrian collisions. More walk trips reduce the number of vehicle miles traveled (VMT), mitigate traffic congestion, benefit the environment, and improve the health of the community.

Scenario Results

Town center, compact neighborhood, main
street commercial, and civic development typically accommodate sidewalks in both directions. Scenario B has the most complete
sidewalks, followed by Scenario C.

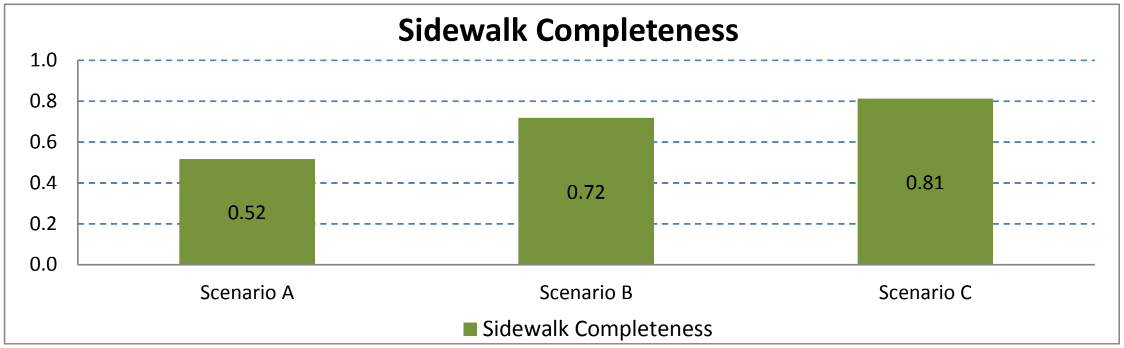
What would improve the results

- Provide sidewalks along both sides of all roads.
- Provide pedestrian paths at street's cul-de-sacs.
- Increase funding for sidewalk projects.
- Work with developers to obtain rights-of-way.

Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide



	Scenario A	Scenario B	Scenario C
Sidewalk Length	9	15	14
Street Centerline Length (mile)	9	10	9
Sidewalk Completeness	**0.52**	**0.72**	**0.81**

Sidewalk Density - Lockhart

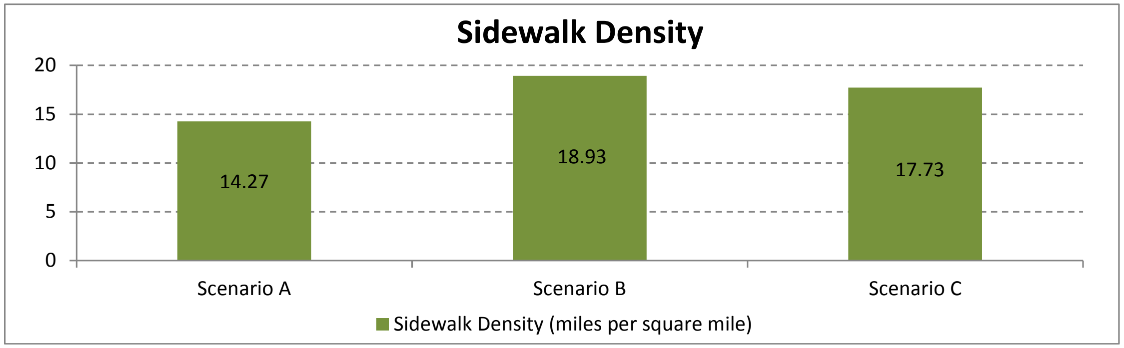
Definition
Sidewalk density refers to ratio of the length (in miles) of sidewalks to the study area's land area (in square miles). Higher sidewalk density is usually associated with better connectivity for pedestrians. Higher sidewalk connectivity is positively associated with increased walk trips and fewer auto trips. Better sidewalk connectivity also improves accessibility to transit, where transit stops are available.

Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results
Town center, compact neighborhood, main street commercial, and civic development are equipped with denser sidewalks to accommodate pedestrians. Scenario B has the densest sidewalks, followed by Scenario C.



What would improve the results
• Provide sidewalks along both sides of all roads.
• Increase funding for sidewalk projects.
• Work with developers to obtain the right-of-way.
• Set a maximum block size for new development.

	Scenario A	Scenario B	Scenario C
Sidewalk Length	9	15	14
Total Area (sq mile)	0.62	0.78	0.82
Sidewalk Density	**14.27**	**18.93**	**17.73**

Vehicle per Capita - Lockhart

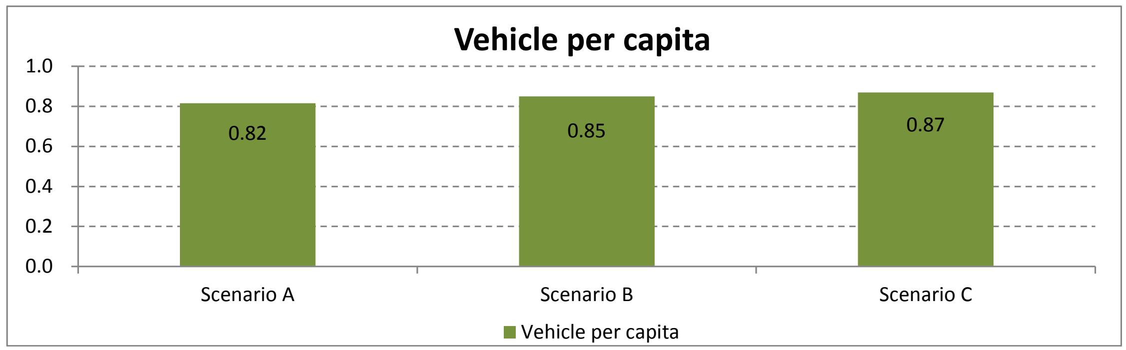
Definition
This indicator estimates the vehicles per capita within the study area. Lower vehicle ownership indicates less dependence on automobiles.

Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results
Single family households have fewer vehicles per family member than other households since family members tend to share one car. Thus, estimated vehicle per capita is the lowest in Scenario A.



What would improve the results
• Provide fewer parking spaces, or increase parking fees in the town center and in high density areas.

	Scenario A	Scenario B	Scenario C
Vehicle per Capita	**0.82**	**0.85**	**0.87**

Parking Supply - Lockhart

Definition

This indicator estimates the number of parking spaces associated with new developments.

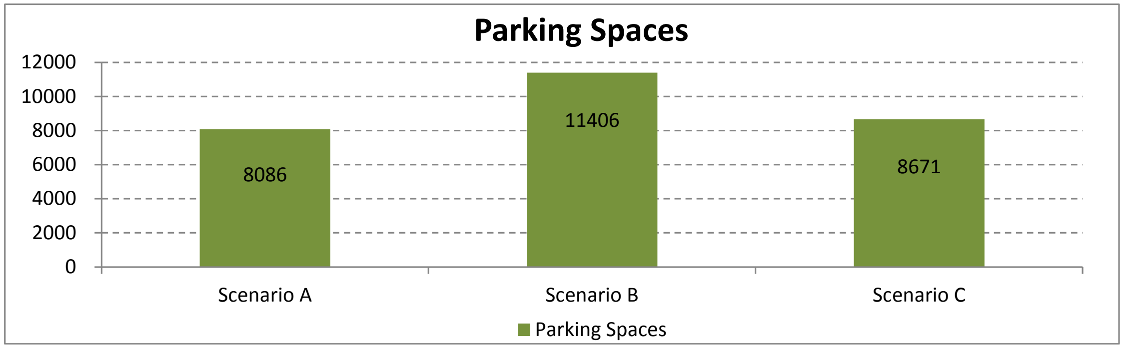
Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

Due to denser development in Scenario B and Scenario C, the numbers of parking spaces associated with new developments in these scenarios are higher than Scenario A. Particularly, Scenario B has the largest parking space supply because of a higher proportion of office development.



	Scenario A	Scenario B	Scenario C
Parking Spaces Supply	**8,086**	**11,406**	**8,671**

What would improve the results

- Reduce minimum parking requirements.
- Incorporate parking maximums or area-wide parking caps to ensure that there is not an excess supply of parking.
- Permit shared parking for different buildings and facilities to take advantage of different peak parking characteristics.

Internal Trips - Lockhart

Definition

This indicator estimates the number of trips that remain within the study area.

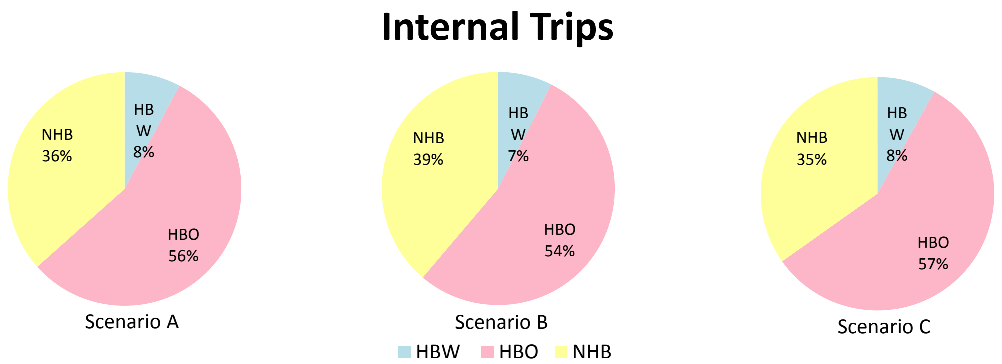
Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

Scenario C generates the most internal trips, followed by Scenaro B. Most internal trips are home-based other trips. In Scenario B and Scenario C, there are more non-home based trips and less home-based other trips. This might be a change of trip chain due to mixed-use development.



What would improve the results

- Encourage compact and mixed uses in community.
- Improve street connectivity.
- Improve bicycle and pedestrian facilities.
- Enhance the overall walking environment.

	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	1,378	1,423	1,556
HBO (Home-based others)	9,868	10,188	10,943
NHB (Non-home based)	6,488	7,362	6,679
Total	**17,734**	**18,973**	**19,177**

Internal Walk Trips - Lockhart

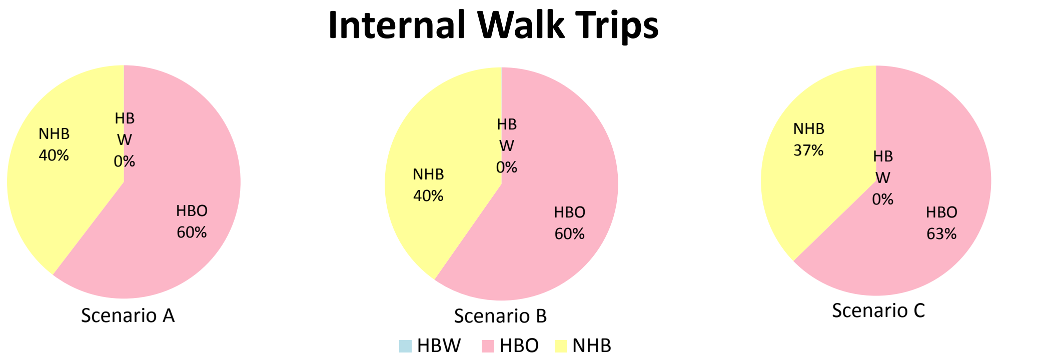
Definition
This indicator estimates the number of walk trips within the study area.

Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results
There are few internal walk trips for home-based work purpose in all three scenarios. Scenaro B generates the most internal walk trips, followed by Scenario C. Home-based others is the main purpose for internal walk trips.



What would improve the results
- Encourage compact and mixed uses in the community.
- Improve street connectivity.
- Improve bicycle and pedestrian facilities.
- Enhance the overall walking environment.

	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	0	1	0
HBO (Home-based others)	695	955	886
NHB (Non-home based)	456	644	527
Total	**1,152**	**1,600**	**1,413**

External Walk Trips - Lockhart

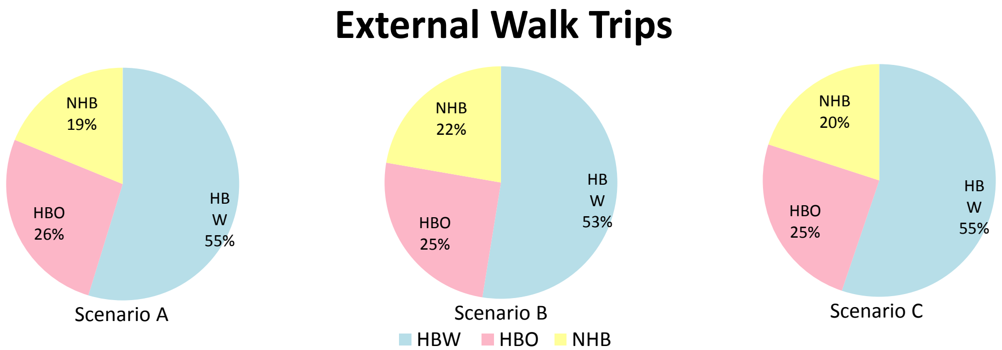
Definition
This indicator estimates the number of walk trips that leave the study area.

Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results
Scenario B generates the most external walk trips, followed by Scenario C. Home-based work is the most common external work trip purpose. As land use mix increases, the proportion of non-home based trips increases. This might be a change of trip chain due to mixed-use development.



What would improve the results
- Improve street connectivity.
- Improve bicycle and pedestrian facilities.
- Enhance the overall walking environment.

	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	632	966	866
HBO (Home-based others)	305	462	398
NHB (Non-home based)	217	409	321
Total	**1,155**	**1,838**	**1,605**

External Transit Trips - Lockhart

Definition

This indicator estimates the number of transit trips. It is recommended that public transit accomodate home-based work trips as an alternative to automobiles because commuting trips are usually routine in terms of travel time and places.

Scenario A: Trend

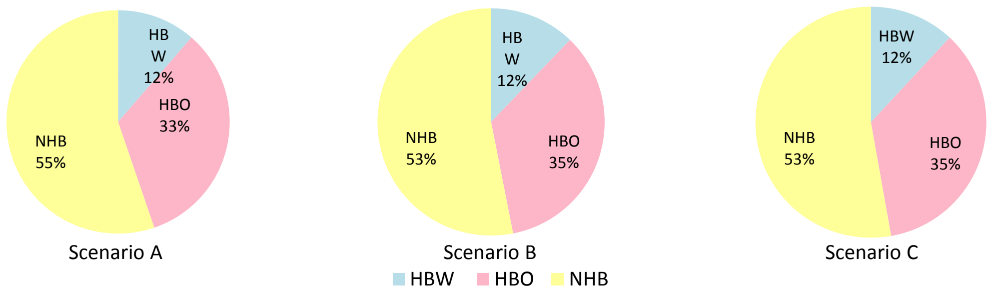
B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

Scenario B generates the most transit trips, followed by Scenario C. Non-home based is the main purpose of external transit trips. The proportion of home-based other transit trips increases in Scenario C. This indicates improved accessibility by transit for residents in study area.

External Transit Trips



What would improve the results

• Provide public transportation service to accommodate the needs of home-based work trips.
• Improve street connectivity.
• Improve non-mobile facilities.
• Enhance the overall walking environment.

	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	212	312	282
HBO (Home-based others)	622	889	831
NHB (Non-home based)	1,030	1,361	1,245
Total	**1,864**	**2,562**	**2,358**

Total VMT Generated by Residental - Lockhart

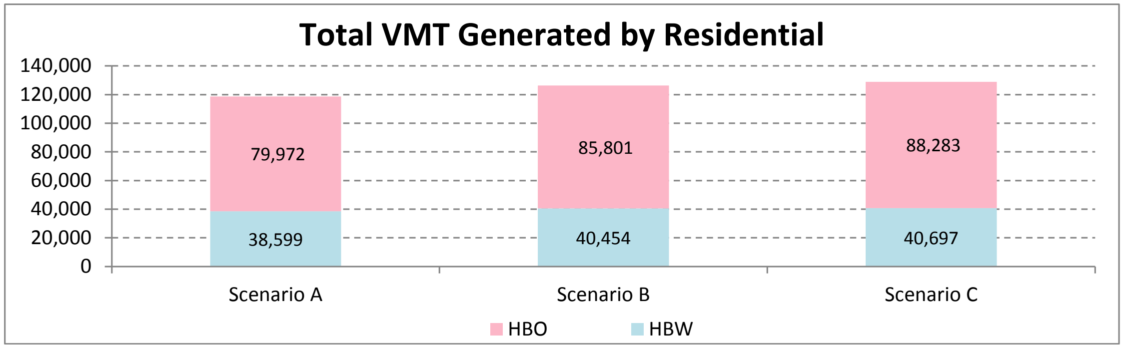
Definition
This indicator estimates the vehicle miles traveled (VMT) generated by residential land use.

Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results
The VMT generated by residential in Scenario C is the highest, followed by Scenario C.



What would improve the results
- Encourage compact and mixed uses in community.
- Improve street connectivity.
- Provide public transportation service.
- Improve non-mobile facilities.
- Enhance the overall walking environment.

	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	38,599	40,454	40,697
HBO (Home-based others)	79,972	85,801	88,283
Total	**118,571**	**126,255**	**128,980**

Total VMT Generated by Retail - Lockhart

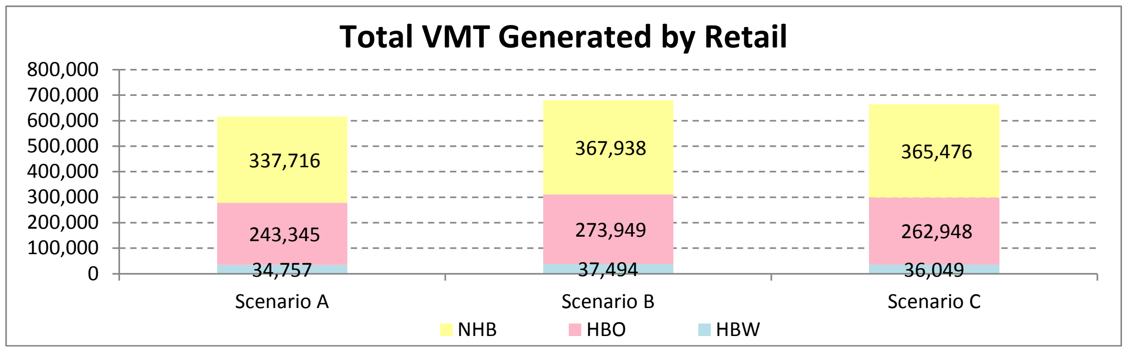
Definition
This indicator estimates the vehicle miles traveled (VMT) generated by retail land use.

Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results
Scenario B has the highest VMT generated by retail land use due to the high proportion of retail development in its land uses, followed by Scenario C.



What would improve the results
- Encourage compact and mixed uses in community to provide retail service in walking distance for residents.
- Improve street connectivity.
- Improve non-mobile facilities.
- Enhance the overall walking environment.

	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	34,757	37,494	36,049
HBO (Home-based others)	243,345	273,949	262,948
NHB (Non-home based)	337,716	367,938	365,476
Total	**615,817**	**679,381**	**664,472**

Total VMT Generated by Office/Industrial - Lockhart

Definition

This indicaor estimates the vehicle miles traveled (VMT) generated by office and industrial land uses.

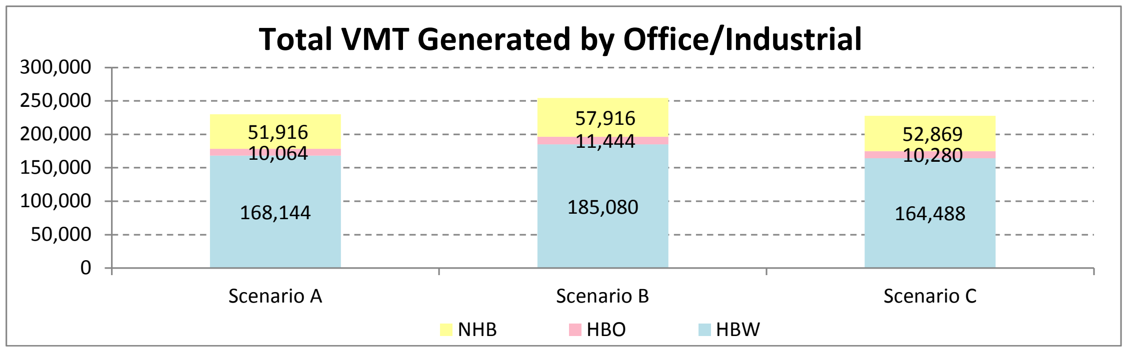
Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

Scenario B generates the hightest office/industrial VMT due to its office developments. Scenario B's home-based work trip VMT is significantly higher than the other two scenarios since office is the primary workplace. Office/Industrial land uses in Scenario A generate the second highest VMT.



What would improve the results

- Encourage compact and mixed uses.
- Improve street connectivity.
- Provide public transportation service.
- Improve bicycle and pedestrian facilities.
- Enhance the overall walking environment.

	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	168,144	185,080	164,488
HBO (Home-based others)	10,064	11,444	10,280
NHB (Non-home based)	51,916	57,916	52,869
Total	**230,124**	**254,440**	**227,637**

Percentage of Internal Trips - Lockhart

Definition

This indicator estimates the percentage of trips within the study area. Usually mixed-use development (MXD) increases the share of internal trips because trips between on-site land uses could be made without travel on the off-site street system. MXD allows what might otherwise be external car trips to become internal trips, within the walking or biking distance, thus increasing the share of non-motorized trips.

Scenario Results

Percentage of internal trips is lowest in Scenario B and highest in Scenario C. However, the difference between each scenario is not very significant.

What would improve the results

• Encourage compact and mixed-use developments in the area.

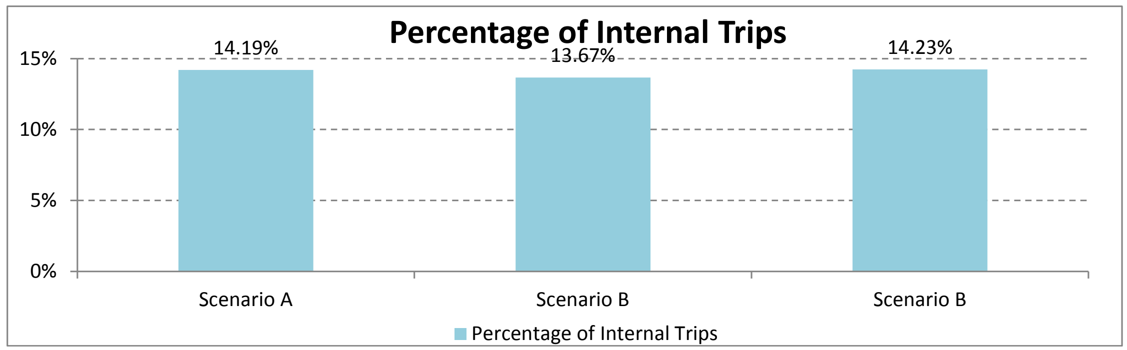
• Provide facilities for pedestrians and cyclists, including sidewalks, designated bike lanes, bike racks, safe crossings, and lights, etc.

• Enhance the walking environment.

Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide



	Scenario A	Scenario B	Scenario C
Number of Internal Trips	17,734	18,973	19,177
Total Trips	124,934	138,788	134,773
Percentage of Internal Trips	**14.19%**	**13.67%**	**14.23%**

Percentage of Walk Trips - Lockhart

Definition

This indicator estimates the walk trip share. A transportation system that is conducive to walking can reap many benefits including individuals, reduced traffic congestion, and improved quality of life. Economic rewards are also realized through reduction in health care costs, reduced dependency on autos, and increased economic vitality of commnities. Finally, walkable communities are more equitable.

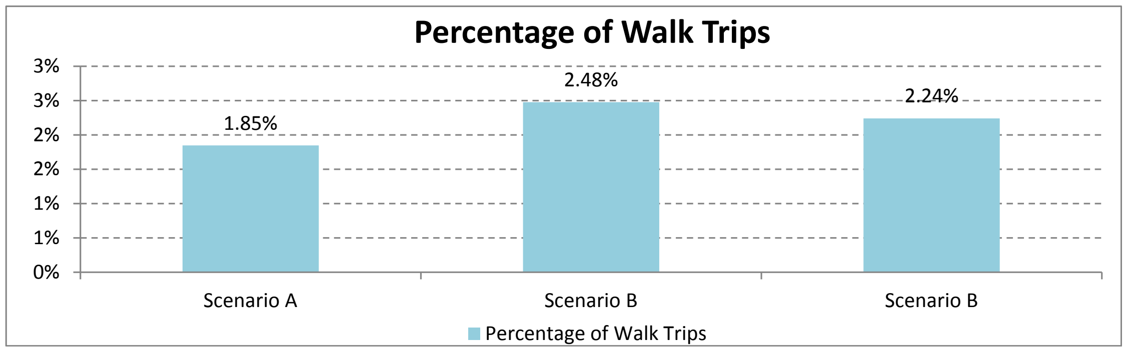
Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

The share of walk trip increases in Scenario B and in Scenario C due to the mixed-use and compact development.



What would improve the results

• Mix the uses to bring the origins and destinations closer.

• Provide appropriate landscaping to create a pleasant pedestrian environment.

• Encourage shops and businesses that open directly to the sidewalk to make friendly and unique building facades.

	Scenario A	Scenario B	Scenario C
Number of Walk Trips	2,307	3,438	3,018
Total Trips	124,934	138,788	134,773
Percentage of Internal Trips	**1.85%**	**2.48%**	**2.24%**

Percentage of Transit Trips - Lockhart

Definition

This indicator estimates the transit trip share. Public transportation provides an affordable alternative to driving. It offers mobility for those who do not drive or cannot drive. Public transportation facilities and corridors encourage economic and social activities and help create strong neighborhood centers, thus fostering more livable communities.

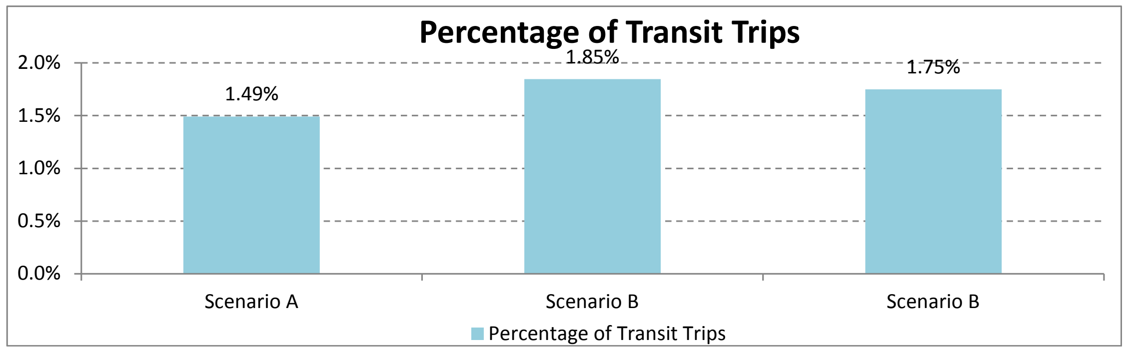
Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

The share of transit trips is the highest in Scenario B, followed by Scenario C. Although the differences between the three scenarios are not very significant.



What would improve the results

• Accommodate home-based work trips.
• Build new transit routes, expand existing transit system, and provide public transportation facilities.
• Integrate transit system with land use regulations.
• Provide access to transit stops.

	Scenario A	Scenario B	Scenario C
Number of Transit Trips	1,864	2,562	2,358
Total Trips	124,934	138,788	134,773
Percentage of Internal Trips	**1.49%**	**1.85%**	**1.75%**

Total Trips - Lockhart

Definition

This indicator estimates the total trips in the study area. With more transportation alternatives provided, and better connectivity and accessibility, more trips would be generated.

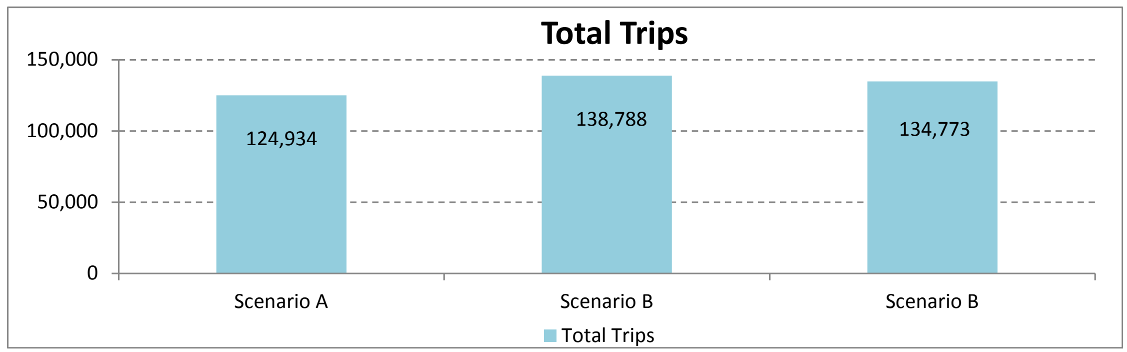
Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

Scenario B generates the highest total trip rate, followed by Scenario C.



What would improve the results

- Mix land uses.
- Provide facilities to accomodate transit trips, walking, and biking.

	Scenario A	Scenario B	Scenario C
Total Trips	124,934	138,788	134,773

Total Transit Trips - Lockhart

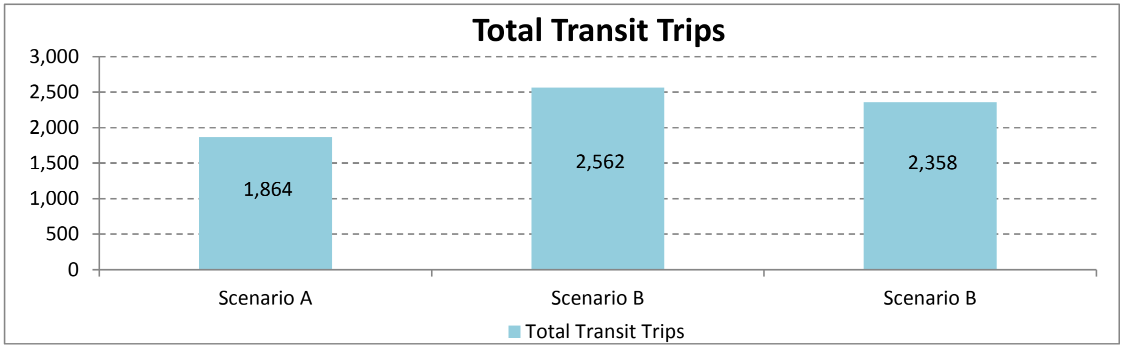
Definition
This indicator estimates the total transit trips of the study area. Public transportation provides an affordable alternative to driving. It offers mobility for those who do not drive or cannot drive. Also the number of total transit trips provides the demand of transit system for mass transit operators.

Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results
Scenario B generates the highest tranist trips, followed by Scenario C. This indicates improved accessibility by transit for residents in study area.



	Scenario A	Scenario B	Scenario C
Number of Transit Trips	**1,864**	**2,562**	**2,358**

What would improve the results
- Accommodate home-based work trips
- Allocate more money on public transportation system.
- Provide safe and reliable transit service.
- Integrate transit system with land use planning.
- Provide access to transit stops.

Job Accessibility - Lockhart

Definition

This indicator measures the ease of people reaching their jobs. People who live in places with higher accessibility can reach many destinations more quickly. Accessibility is a measure of potential for interaction. Places with higher job accessibility are usually more likely to attract people to live or work there, therefore bringing more economic opportunities for the community.

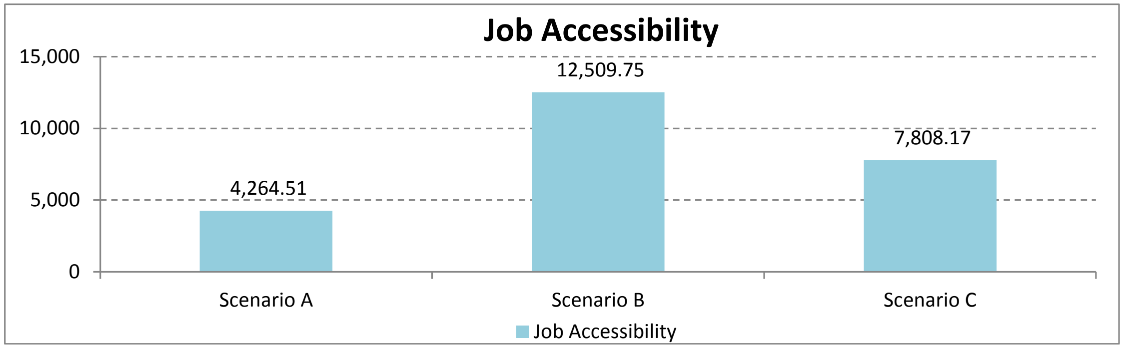
Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

The number of jobs is much higher in Scenario B and Scenario C. Moreover, the average auto commute time in the two scenarios is shorter. Thus, job accessibility significantly higher in these two scenarios, especially in Scenario B.



What would improve the results

• Improve service for the roadway network and public transportation system.
• Create a pedestrian- and cyclist-friendly community.
• Cluster job and residents at a location closer to the given transportation system and in an area with greater connectivity.

	Scenario A	Scenario B	Scenario C
Number of Jobs	1,672	5,048	3,218
Average Auto Commute Time	9.37	9.08	8.86
Job Accessibility	**4,265**	**12,510**	**7,808**

Parking Demand - Lockhart

Definition

This indicator estimates the increased demand for parking associated with new development in the study area.

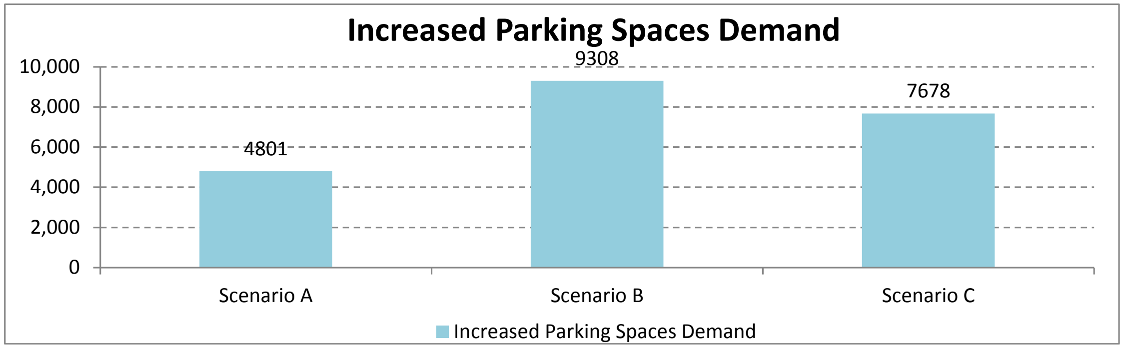
Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

Retail requires the most parking spaces compared to other developments. Thus the increase in parking demand in Scenario B is the highest. In Scenario C, the high parking demand is due to the office development.



What would improve the results

- Create a town center/neighborhood center with public transit service.
- Encourage compact, mixed-use developments.
- Provide facilities to accommodate walking and biking.
- Encourage shared parking arrangements.

	Scenario A	Scenario B	Scenario C
Parking Spaces Demand	**4,801**	**9,308**	**7,678**

Daily Walk Trip per Capita - Lockhart

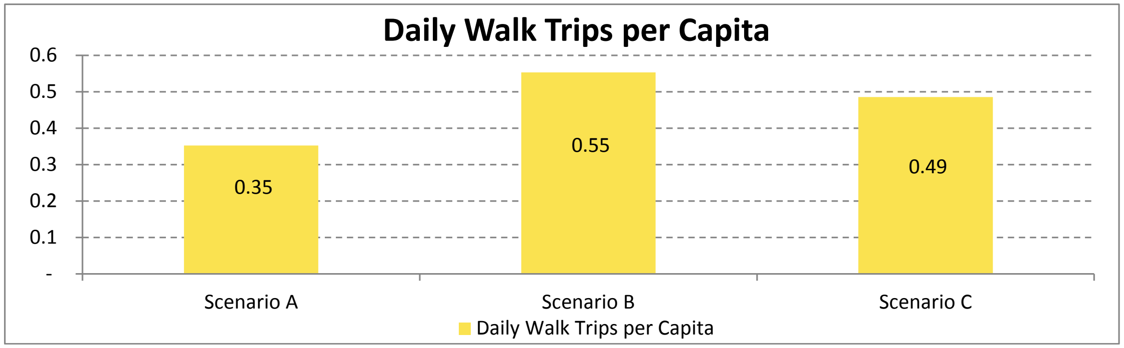
Definition
This indicator estimates the daily walk trip per capita. Regular daily physical activities benefit indivual health by reducing the risk of disease and obesity, and imporve the environment. The indicator also reflects the livability of community because there tend to be more activities taking place on the streets and more interaction between neighbors.

Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results
Mixed-use development significantly increases the personal walk trip rate. Scenario B generates the highest personal daily walk trips, followed by Scenario C. This indicates improved accessibility for residents in study area in the two scenarios.



What would improve the results
• Encourage mixed and compact developments.
• Provide appropriate landscaping to create a pleasant pedestrian environment.
• Encourage shops and businesses that open directly to the sidewalk to make friendly and unique building facades.

	Scenario A	Scenario B	Scenario C
Number of Walk Trips	2,307	3,438	3,018
Population	6,537	6,212	6,212
Daily Walk Trips per Capita	**0.35**	**0.55**	**0.49**

Average Auto Trip Length - Lockhart

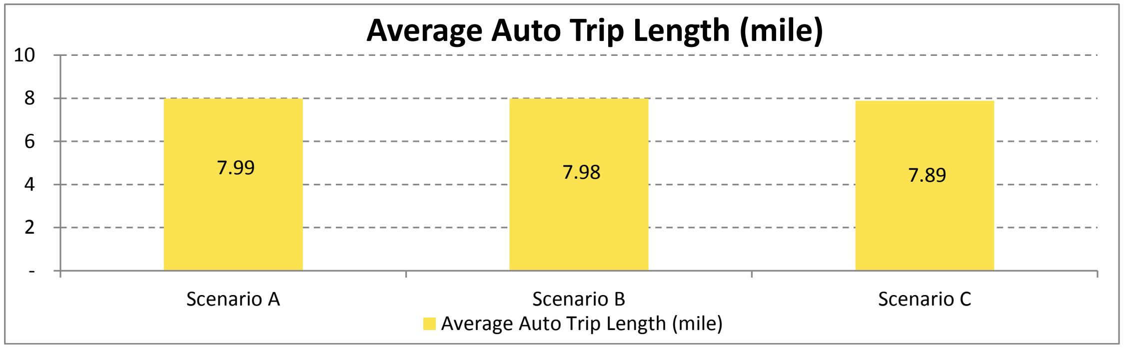
Definition
This indicator estimates the average auto trip length. Shorter length indicates better accessibitliy to destinations.

Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results
Average auto trip length in Scenario C is the shortest, followed by Scenario B. But the differences between three scenarios are not very significant.



What would improve the results
- Improve the existing transportation system.
- Improve street connectivity.
- Implement strategies for traffic congestion mitigation.
- Encourage the mixed use and compact developments.

	Scenario A	Scenario B	Scenario C
Total Trips	120,763	132,788	129,397
Total Vehicle Miles Travelled	964,512	1,060,076	1,021,089
Average Auto Trip Length (miles)	**7.99**	**7.98**	**7.89**

Average Internal Auto Trip Length - Lockhart

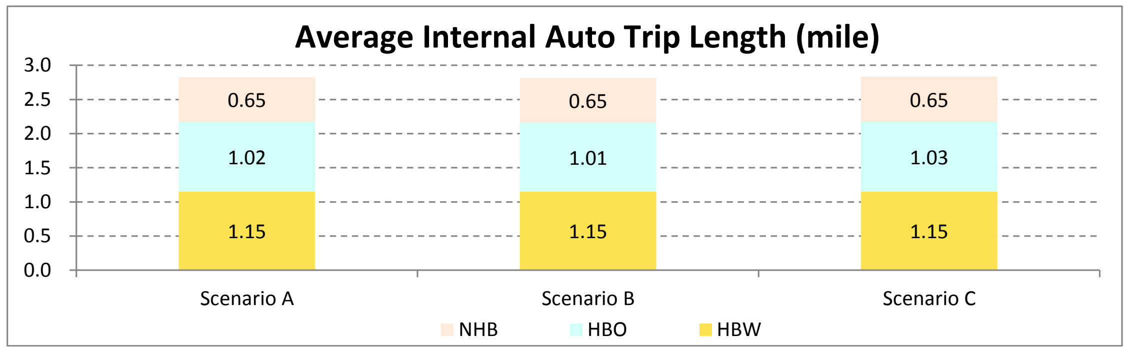
Definition
This indicator estimates average internal auto trip length.

Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results
The length of home-based work and non-home based trips do not have any difference in three scenarios. However, the average home-based others trip length reduces due to the mixed-use developments in Scenario B and increases slightly in Scenario C.



What would improve the results
• Encourage the mixed use and compact developments to provide essential and commercial services within walking distance for residents in the community.
• Improve street connectivity.

	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	1.15	1.15	1.15
HBO (Home-based others)	1.02	1.01	1.03
NHB (Non-home based)	0.65	0.65	0.65

Average External Auto Trip Length - Lockhart

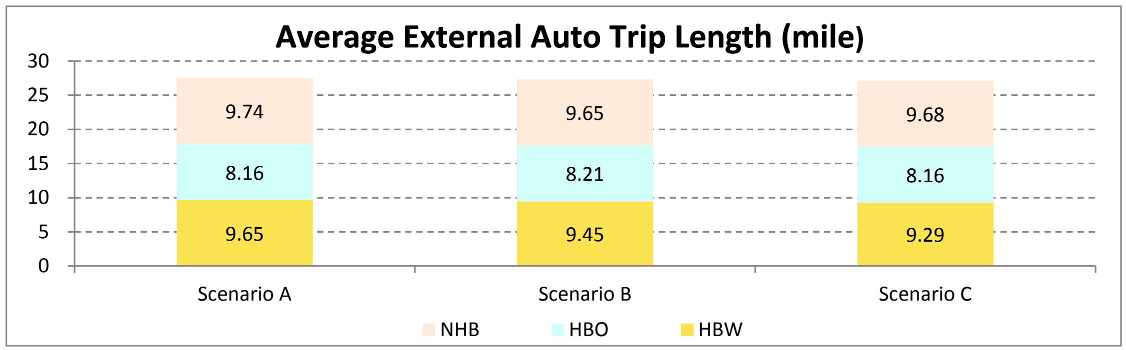
Definition
This indicator estimates average external auto trip length by purpose.

Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results
For the external trips, home-based work trips and non-home based trips are shorter in the Scenario B and Scenario C. The average length of home-based others trips is slightly longer in Scenario B.



What would improve the results
- Improve the existing transportation system.
- Improve street connectivity.
- Implement strategies for traffic congestion mitigation.

	Scenario A	Scenario B	Scenario C
HBW (Home-based work)	9.65	9.45	9.29
HBO (Home-based others)	8.16	8.21	8.16
NHB (Non-home based)	9.74	9.65	9.68

Average Auto Trip Time - Lockhart

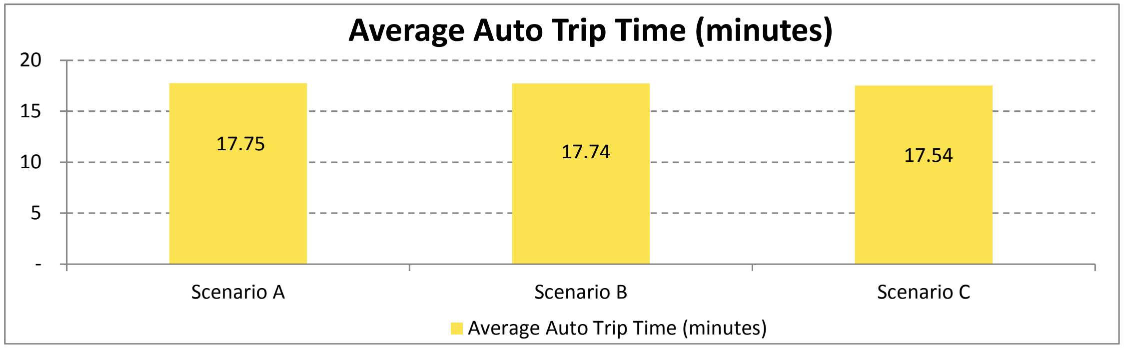
Definition
This indicator estimates the average time per auto trip. A shorter average auto trip time indicates greater accessibitliy to destinations.

Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results
Average auto trip time in Scenario C is the shortest, followed by Scenario B. This indicates improved accessibility for residents in study the area. However, the differences between three scenarios are not very significant.



What would improve the results
• Improve the existing transportation system.
• Improve street connectivity.
• Implement strategies for traffic congestion mitigation.
• Encourage mixed use and compact developments.

	Scenario A	Scenario B	Scenario C
Average Trip Length	7.99	7.98	7.89
Speed (mph)	27	27	27
Average Auto Trip Time (minutes)	**17.75**	**17.74**	**17.54**

Average Auto Commute Time - Lockhart

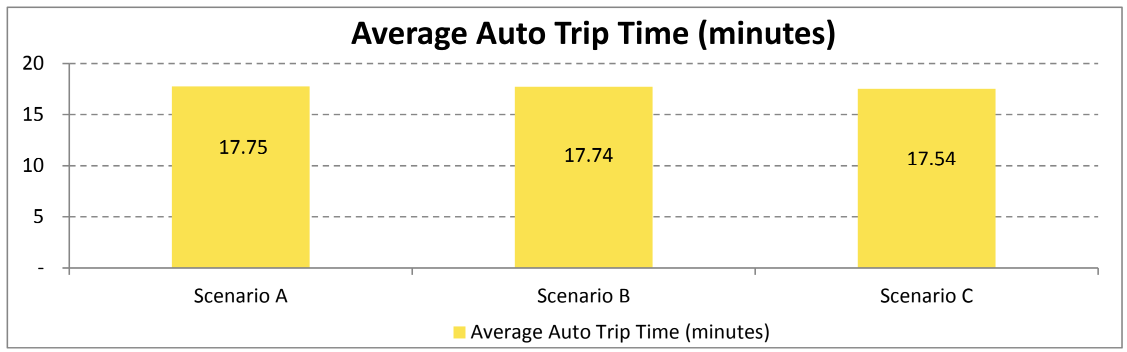
Definition
This indicator estimates the average auto trip time for commuters in the study area to their workplaces throughout the region. A shorter commute time indicates better accessibitliy to jobs.

Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results
Commute time in Scenario C is the shortest, followed by Scenario B. This indicates improved accessibility to jobs for the residents in study area. Although the differences between three scenarios are not very significant.



What would improve the results
• Cluster job opportunities and individuals at a location closer to the given transportation system.
• Encourage mixed use residential and office development.

	Scenario A	Scenario B	Scenario C
Average Auto Commute Time	9.20	9.04	8.83
Speed (mph)	27	27	27
Average Auto Commte Time (minutes)	**20.45**	**20.09**	**19.61**

VMT per Capita - Lockhart

Definition

This indicator estimates the number of vehicle miles traveled (VMT) per capita. High VMT leads to higher levels of traffic congestion, gas consumption, and air pollution. A high VMT per capita is usually the result of dependence on private vehicles. It may also indicates less accessibility for those who do not own a car or are unable to drive.

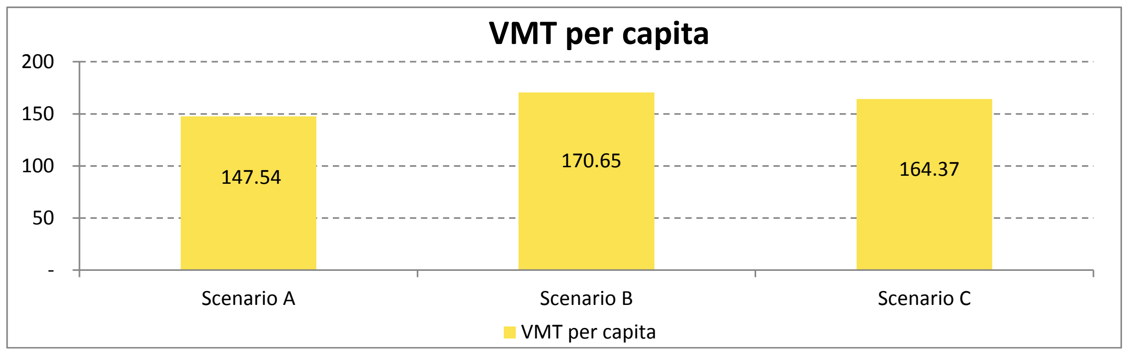
Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

The daily trip rate per person is higher in Scenario B and in Scenario C. Thus Scenario B generates the higher personal VMT, followed by Scenario C.



What would improve the results

- Encourage the use of public transit and carpooling.
- Provide high-quality, reliable and safe public transportation system that easily access.
- Create a friendly environment for pedestrians and cyclists.

	Scenario A	Scenario B	Scenario C
Total VMT	964,512	1,060,076	1,021,089
Population	6,537	6,212	6,212
Vehicle Miles Traveled per Capita	**148**	**171**	**164**

Social Cost of GHG Emissions - Lockhart

Definition

Major greenhouse gases (GHG) include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and industrial gases. The vast majority of emissions are CO_2. Increased emissions of GHG due to human activities have been linked to global warming and changes in the climate pattern. The monetary value of the damages that may be caused by these changes currently and in the future is the social cost of greenhouse gases.

Scenario Results

The amount GHG emissions is highly associated with vehicle miles traveled (VMT). Scenario B generates the highest VMT due to the high density of population and employment, thus it produces the largest amount of GHG. Scenario A has the lowest social cost of GHG emissions. However, improvements on clean and fuel efficient cars can also reduce GHG emissions.

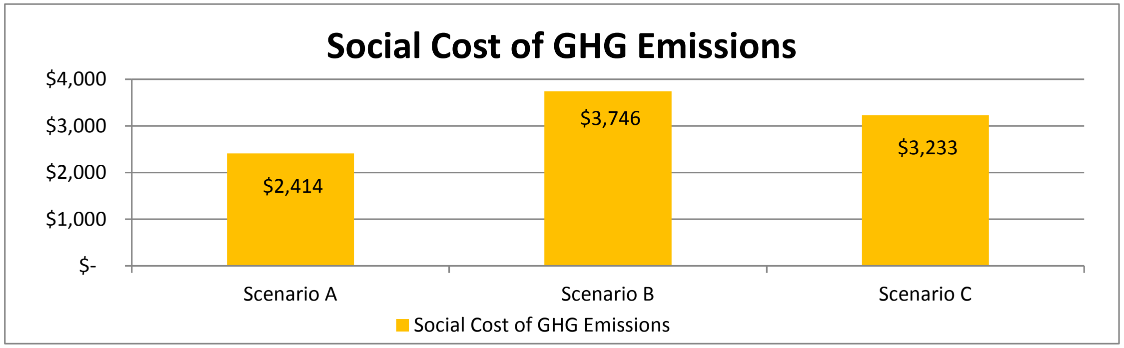
What would improve the results

- Increase the usage of alternative fuels.
- Improve the fuel efficiency.
- Implement carpool incentive programs to reduce single occupant auto travel.
- Improve public transit service.
- Improve pedestrian and bicycle facilities.

Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide



	Scenario A	Scenario B	Scenario C
Total CO_2 Emissions Contributed (tons)	60	94	81
Social Cost of GHG Emissions	**$2,414**	**$3,746**	**$3,233**

Social Cost of CAC - Lockhart

Definition
Criteria air contaminants (CAC) are a set of air pollutants emitted from many sources in industry. CAC in particular refer to a group of contaminants that include sulphur dioxide (SO_2), nitrogen oxides (NO_x), volatile organic compounds (VOC), and particulate matter (primarily $PM_{2.5}$). The social cost of CAC is the monetary valuation of the damages to human health, environment and structures caused by these pollutants.

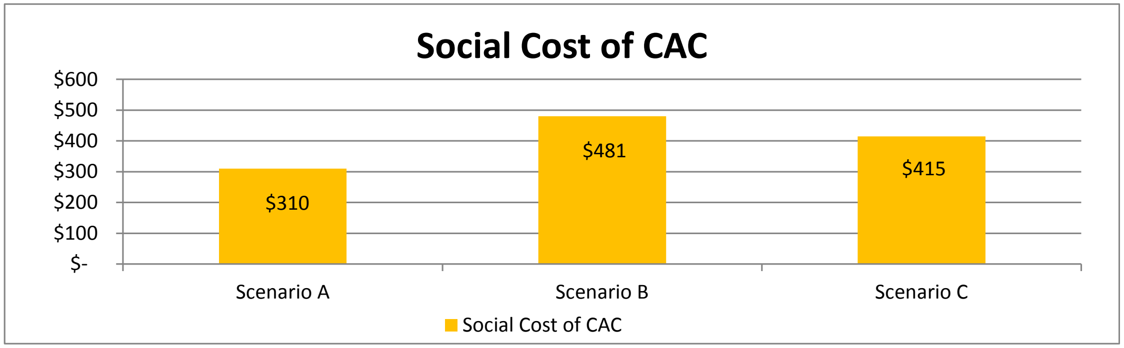
Scenario Results
The amount CAC emissions is highly associated with vehicle miles traveled (VMT). Scenario B generates the highest VMT due to the high density of population and employment, thus it produces the largest amount of CAC. Scenario A has the lowest social cost of CAC. However, improvements on clean and fuel efficient cars can also reduce CAC.

What would improve the results
- Increase the usage of alternative fuels.
- Improve the fuel efficiency.
- Implement carpool incentive programs to reduce single occupant auto travel.
- Improve public transit service.
- Improve pedestrian and bicycle facilities.

Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide



	Scenario A	Scenario B	Scenario C
Total NO_x Emissions Contributed (tons)	0.05	0.07	0.06
Total VOC Emissions Contributed (tons)	0.05	0.08	0.07
Social Cost of CAC	**$310**	**$481**	**$415**

Social Cost of Motor Vehicle Accident - Lockhart

Definition

Accident costs are the costs of social resources lost in an accident and the loss in welfare incurred as a result of an accident. The specific costs that are typically covered are comprehensive in nature and include both private costs to the affected individuals and costs to the society at large; costs incurred by an individual out-of-pocket, costs of health care, and costs of pain and suffering.

Scenario A: Trend

B: Balance jobs and housing within the Site

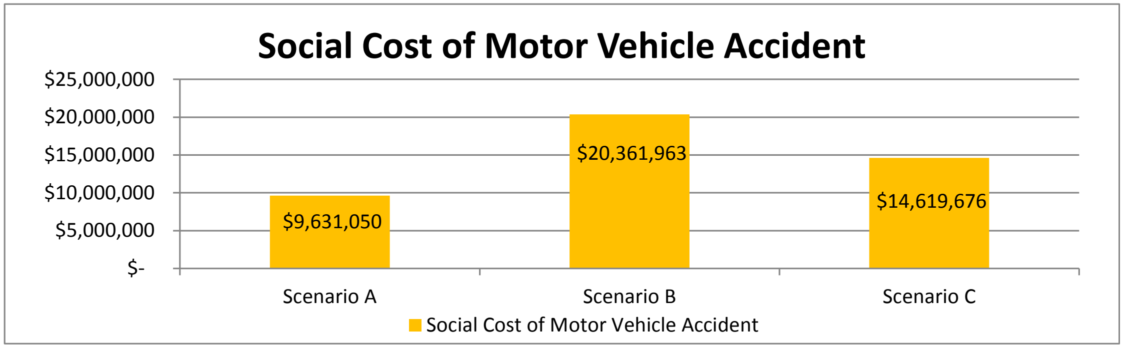
C: Towards a balance of jobs and housing citywide

Scenario Results

Crash rate is associated with personal VMT, employment density, and intersection density. Scenario B generates the highest crash rate due to the denser developments. Scenario A produces the lowest social cost of motor vehicle accident. However, improvements on roadway safety facilities and implementation of traffic calming measures can also reduce the crash rate.

What would improve the results

• Incorporate "complete streets" design into planning to accommodate all transportation users.
• Implement traffic calming measures.
• Improve roadway facilities.
• Implement site-specific projects to improve traffic safety.



(per year)	Scenario A	Scenario B	Scenario C
Fatal Crash Rate	0	1	1
Serious Injury Crash Rate	8	17	12
Other Injury Crash Rate	11	23	17
Non-injury Crash Rate	31	66	47
Social Cost of Accident	**$9,631,050**	**$20,361,963**	**$14,619,676**

Vehicle Operating Costs - Lockhart

Definition

Vehicle operating costs (VOC) represents the personal costs borne by travelers using their own vehicle to make a trip. Total VOC are indirectly based on changes in vehicle miles traveled (VMT). Generally, VOC include fuel costs, tire costs, repair and maintenance costs, vehicle depreciation, and oil costs.

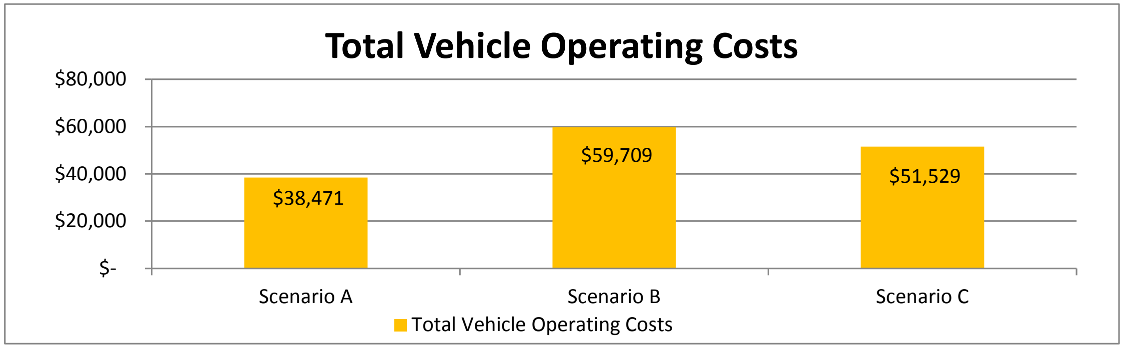
Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results

The total vehicle operating costs are highly associated with vehicle miles traveled (VMT). Scenario B generates the highest VMT due to the high density of population and employment, thus it produces the largest vehicle operating costs. Scenario A has the lowest total vehicle operating costs.



What would improve the results

- Implement congestion mitigation programs.
- Improve access to transit.
- Improve major road networks.
- Improve pedestrian and bicycle facilities.

	Scenario A	Scenario B	Scenario C
Fuel Costs	$22,867	$35,490	$30,629
Tire Costs	$748	$1,161	$1,002
Repair and Maintenance Costs	$20,972	$32,549	$28,090
Vehicle Depreciable Value	$14,249	$22,115	$19,085
Oil Costs	$2,503	$3,884	$3,352
Total Vehicle Operating Costs	**$38,471**	**$59,709**	**$51,529**

Values of Travel Time Savings - Lockhart

Definition

Travel time has value because travelers can dedicate this time to work and earning income, or use it to engage in leisure activities. The value of travel time represents thus the opportunity cost of alternative activities and the cost of discomfort that may be involved in travelling. The monetized travel time savings can be compared against other project benefits and costs to help evaluate and justify transport improvement project.

Scenario Results

The values of travel time savings are highly associated with vehicle miles traveled (VMT). Scenario B generates the highest VMT due to the high density of population and employment, thus it produces the largest travel time costs. Scenario A has the lowest travel time costs.

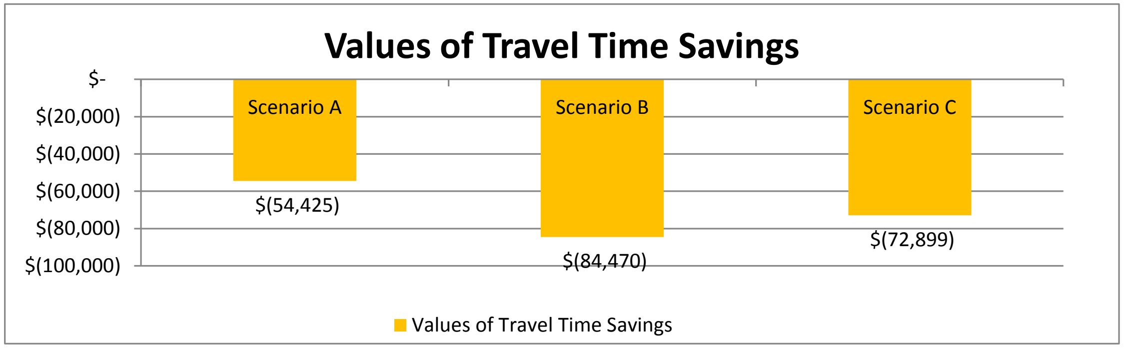
What would improve the results

- Implement congestion mitigation programs.
- Improve access to transit.
- Improve major road networks.
- Improve non-mobile facilities.
- Integrate land use regulations with transport projects.

Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide



	Scenario A	Scenario B	Scenario C
Total Travel Time Savings (hours)	-3,759	-5,834	-5,034
Total Travel Time Savings/Costs	**-$54,425**	**-$84,470**	**-$72,899**

Commuter Bike Mobility Benefits - Lockhart

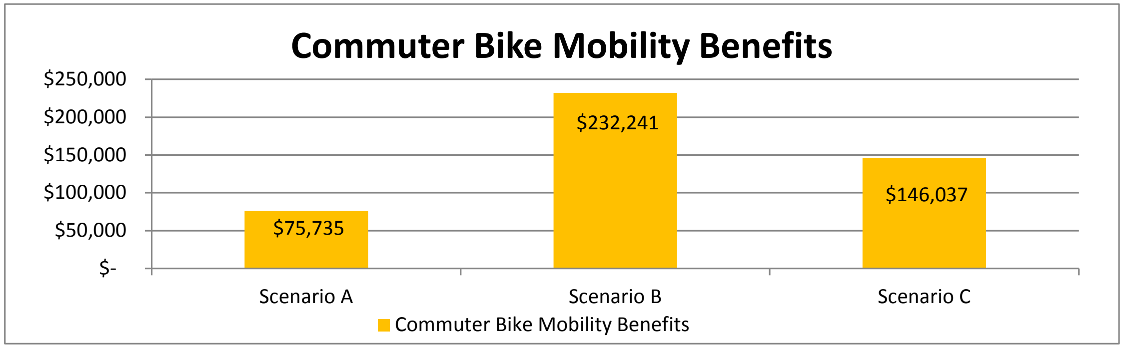
Definition
The commuter bike mobility benefits refer to the monetary value of people's greater satisfaction of cycling in their communities.

Scenario A: Trend

B: Balance jobs and housing within the Site

C: Towards a balance of jobs and housing citywide

Scenario Results
Urban form and demographic characteristics affect transportation choices. Bike trip rate is highly associated with intersection density, land use mix, and household size. Scenario B generates the highest bike trip rate, thus produces the highest commuter bike mobility benefits. Scenario A has the lowest commuter bike mobility benefits.



What would improve the results
• Incorporate "complete streets" design into planning to accommodate all transportation users.
• Provide adequate bike lanes.
• Provide bike parking facilities and shower at workplace.
• Provide multi-modal corridors.

	Scenario A	Scenario B	Scenario C
Number of Commuters by Bike (per day)	17	53	34
Commuter Bike Mobility Benefits	**$75,735**	**$232,241**	**$146,037**

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