Metropolitan Council

Land Use and Planning Resources Report

Progress Report to the Minnesota Legislature

October 15, 2010

Metropolitan Council

390 North Robert Street, St. Paul, Minnesota 55101

Metropolitan Council Members

Peter Bell	Chair
Roger Scherer	District 1
Tony Pistilli	District 2
Robert McFarlin	District 3
Craig Peterson	District 4
Polly Bowles	District 5
Peggy Leppik	District 6
Annette Meeks	District 7
Lynette Wittsack	District 8
Natalie Haas Steffen	District 9
Kris Sanda	District 10
Georgeanne Hilker	District 11
Sherry Broecker	District 12
Rick Aguilar	District 13
Kirstin Sersland Beach	District 14
Daniel Wolter	District 15
Wendy Wulff	District 16

General phone	651 602-1000
Data Center	651-602-1140
TTY	651 291-0904
E-mail	*data.center@metc.state.mn.us*
Web site	*www.metrocouncil.org*

Publication no. 78-10-052

Printed on recycled paper with at least 20% post-consumer waste.

On request, this publication will be made available in alternative formats to people with disabilities. Call the Metropolitan Council Data Center at 651 602-1140 or TTY 651 291-0904.

Contents

Preface

In 2009, the Minnesota Legislature passed a law requiring a *Land Use and Planning Resources Report*.[1] The bill specifies:

(a) By January 15, 2011, the Metropolitan Council shall submit a report to the chairs and ranking minority members of the house of representatives and senate committees with jurisdiction over transportation policy and finance. The report must identify and assess the effectiveness of local level and regional level land use and transportation planning strategies and processes for:

(1) reducing air pollution;

(2) mitigating congestion; and

(3) reducing costs for operation, maintenance, or improvement of infrastructure.

(b) The report must emphasize approaches that reduce or manage travel demand through land use and access to transportation options.

(c) The Metropolitan Council shall (1) identify and adapt existing information and resources that are found to be applicable to Minnesota, taking into account travel and demographic trends specific to the Twin Cities metropolitan area; and (2) collaborate with local units of government and other stakeholders interested in development and refinement of the resources.

(d) The Metropolitan Council shall submit progress reports on development and application of the land use and planning resources report to the chairs and ranking minority members of the house of representatives and senate committees with jurisdiction over transportation policy and finance by October 15, 2009; April 15, 2010; and October 15, 2010.

(e) The Metropolitan Council may enter into a contract for up to $375,000 with the Board of Regents of the University of Minnesota for the Center for Transportation Studies to assist in creation of the report required under this section.

[1] Minn. Laws 2009, Ch. 36, Art. 3, Sec. 22.

Executive Summary

This third progress report describes the Metropolitan Council's continued work on a *Land Use and Planning Resources Report* to the Minnesota Legislature. It focuses on:

- Planning and implementation tools that can help enable land use and transportation, working together, achieve legislative goals.
- Development of a tool to estimate changes in travel-related emissions.
- Outreach and collaboration efforts.

Transportation and Land Use Policies and Strategies

The Metropolitan Council's policies and strategies for land use and transportation provide context for this entire study. They support legislative goals of reducing air pollution, mitigating congestion, and reducing infrastructure costs. Regional and local policies and strategies were identified in the April 2010 report, previously submitted to the Legislature. They also address reducing or managing travel demand through land use and transportation access options, another legislative requirement.

Regional strategies are organized into the four main topics:

1. Protect the natural environment and minimize negative impacts:
   - Promote strategies to reduce transportation emissions of pollutants.
   - Protect natural resources through planning, technical assistance and transportation investments.
   - Expand the regional parks system.
2. Manage congestion and improve performance of the transportation system:
   - Improve efficient use of the transportation system.
   - Manage travel demand and provide multimodal alternatives to travel on congested roadways.
   - Plan highway investments within financial constraints to mitigate but not eliminate congestion.
3. Expand and enhance transportation choices:
   - Plan a multimodal transportation system, expand transit and develop a network of transitways.
   - Support expanded transportation choices with transportation services.
   - Coordinate transportation investments.
4. Improve connections and access:
   - Maximize accessibility and intensify development along transitways and bus routes.
   - Support travel by alternative modes through land use and interconnected transportation.
   - Coordinate transportation and land use.
   - Invest resources to use land efficiently and achieve multiple goals.

Resources and Tools

Resources found in a literature search identified strategies and practices that affect travel behavior, reduce air pollution and mitigate congestion, including tools that can be used by local governments in the Twin Cities seven-county metropolitan area.

The research did not reveal much that is new; many similar strategies have been adopted in this region and many tools implemented as well:

- Numerous strategies are already included in the Metropolitan Council's *Regional Development Framework* and *2030 Transportation Policy Plan*. Examples include increasing transportation choices, supporting land-use patterns to efficiently connect places and improve access, and intensifying development along transportation corridors.
- Implementation tools include a range of different types that are available to local governments.
- Communities in the region are already using various tools and programs. They include specific area plans in complex or large development projects, urban parks and landscaping, travel demand management, parking management and Complete Streets initiatives that connect local streets, paths and trails.

Combined strategies that integrate transportation and land use are more effective than those implemented individually:

- Integrating land use with a multimodal transportation is key to addressing congestion and improving regional mobility.
- Changes in the built environment generally contribute modest changes in travel behavior but, combined with transportation strategies, have more significant effects.
- The Council's *Framework* and *2030 Transportation Policy Plan* recognize how land use and transportation work together. Regional policies emphasize coordinating and connecting transportation investments and land-use development.

Six strategies stand out from a literature search of influences on travel behavior:

- They are: (1) access to activity centers along transportation corridors; (2) street design and connectivity of transportation networks; (3) mixed land uses; (4) high-quality transit; (5) density combined with other strategies; and (6) transportation management and parking.
- Access to activity centers along transportation corridors is a leading influence on choice of travel mode. Street design and connectivity of local transportation networks is second in importance.
- Impacts of higher density on travel behavior are complex. Research concludes that density alone is not as effective as density combined with other strategies, such as connections to major centers, a high-quality local transportation network, a mix of land uses, and transit.

Implementation takes time and may require adapting strategies to fit local circumstances:

- Changing land uses is a long-term strategy, given existing development patterns. Impacts of land-use changes, however, build and accumulate over time.
- Promoting changes that make a difference at the regional level will require acceptance and action by local communities.
- One size does not fit all. Some strategies or tools apply to many areas, while others are more relevant to specific types of locations, such as transportation corridors or high-density developments.

- Within this region, the diversity of communities' existing tools shows that they can be tailored to meet local needs.

Air Quality Assessment Tool

The Council is continuing to develop a voluntary tool for estimating air pollutants generated by travel in the region. The air quality assessment tool provides a way to assess how different land-use or development scenarios affect travel behavior and potentially decrease travel-related emissions. Scenarios built into the tool emphasize approaches that reduce or manage travel demand through land use and access to transportation options. While the tool is not required in this study, its development responds to a legislative goal of reducing air pollution.

What the tool will do**:**

- Provide a way to assess how changes to land use or development in proposed projects or subareas could affect air pollutant emissions.
- Estimate changes in air pollutants for land use or alternative development scenarios with potential for generating fewer vehicle miles traveled. Results compare travel-related emissions for "before" and "after" scenarios.

Purpose and use of tool:

- Use is voluntary.
- Provides information; does not advocate strategies or mandate policies.
- Assists informed decision-making, and aids communication about the impact of growth and development.
- Supports implementation of regional policies in 2030 comprehensive plans of local governments, especially strategies to improve accessibility, connectivity and other interactions between land use and transportation.

Preliminary results from testing hypothetical examples:

- Testing the tool has produced preliminary results, and it remains a work in progress. The air quality assessment tool will be further developed for the final report.
- When reviewing examples of how the tool could be applied, results show that individual strategies produce modest changes.
- Results give approximate rather than precise answers and do not identify a single solution to significantly reduce air pollution.

Other considerations for understanding the tool and evaluating its use:

- Tool options will give users flexibility to choose among strategies to meet local circumstances.
- Local travel conditions and other available, local information are built into the tool.
- Part of the tool uses some controversial measures of how land use or alternative development scenarios potentially change vehicle miles traveled. Furthermore, measures are based on national and international literature and may not reflect local conditions.

Collaboration and Outreach

A variety of stakeholders gave guidance and advice on the direction of this report, development of the air quality assessment tool, and useful resources. Stakeholder involvement meets a legislative requirement of collaborating with local units of government and other stakeholders interested in development and refinement of resources in the study. From the early stages of this study to the present, representatives of environmental or other advocacy groups shared feedback and participated at meetings. Council staff met with land-use and transportation advisory committees for the Council and encouraged participation by all stakeholders. Their questions, comments and other input helped influence study elements and respond to local concerns.

- Members of the Land Use Advisory Committee (LUAC) contributed a full spectrum of comments. Presentations on the air quality assessment tool, in particular, prompted considerable discussion. A number of committee members repeatedly expressed qualms about how the tool could be used and concern over how the tool is communicated. LUAC reacted positively to information shared on tools that communities are using to implement 2030 comprehensive plans.
- Members of transportation advisory committees also shared many comments on the air quality assessment tool. They questioned how to deal with areas lacking transit, impacts on costs, and investment strategies given funding constraints. Committee members additionally offered advice on resources and tools and noted questions to answer when communicating findings.

Next Steps

Continued work on this study will concentrate on four topics. First, more results from 2030 comprehensive plans will show what local communities in the region are doing to implement and integrate land-use and transportation strategies. Second, the air quality assessment tool will be further developed and reviewed for its policy implications. Third, an assessment summary will pull together outcomes and rely on an updated *2030 Transportation Policy Plan* to address transportation infrastructure costs. In addition, outreach and collaboration efforts will encourage communication and inform the final report due by January 15, 2011.

Introduction

In this report, the Metropolitan Council continues its work on a land use and planning resources study. The study addresses legislative goals of reducing air pollution, mitigating congestion and reducing infrastructure costs. It emphasizes approaches that reduce or manage travel demand through land use and access to transportation options.

Three topics are the focus of this progress report. The first topic covers resources for land use and transportation planning and implementation tools. The second is development of a tool to estimate changes in travel-related emissions. The third deals with outreach and collaboration efforts. The report adds new material and summarizes selected parts of earlier reports to provide context. Appendices and a bibliography supply supplemental or reference material. Sections include:

- Regional transportation and land-use policies and strategies – brief summary
- Resources and tools – resources from literature search and implementation tools
- Air quality assessment tool – further development of tool
- Collaboration and outreach – update on stakeholder input
- Appendices – supplemental or reference information
- Bibliography – primary studies used as resources

The final report will build on previous reports, add information and summarize findings. The air quality assessment tool will be furthered developed and reviewed for its policy implications. Results from 2030 comprehensive plans will highlight more information on how communities are implementing and integrating land use and transportation strategies. An assessment summary will pull together outcomes and rely on an updated *2030 Transportation Policy Plan* to address transportation infrastructure costs. For all topics, the content of upcoming reports may change with the addition of resources and emerging information on dynamic topics relevant to land use and transportation.

Timeframe of Reports

The Council will complete a final land use and planning resources study by January 15, 2011, following three previous progress reports. The first report on October 15, 2009, introduced plans for the study. A second progress report on April 15, 2010, outlined the Council's approach to specific parts of the study and shared early results. This report and the final report will be submitted to the chairs and ranking minority members of the Minnesota House of Representatives and Minnesota Senate committees with jurisdiction over transportation policy and finance.

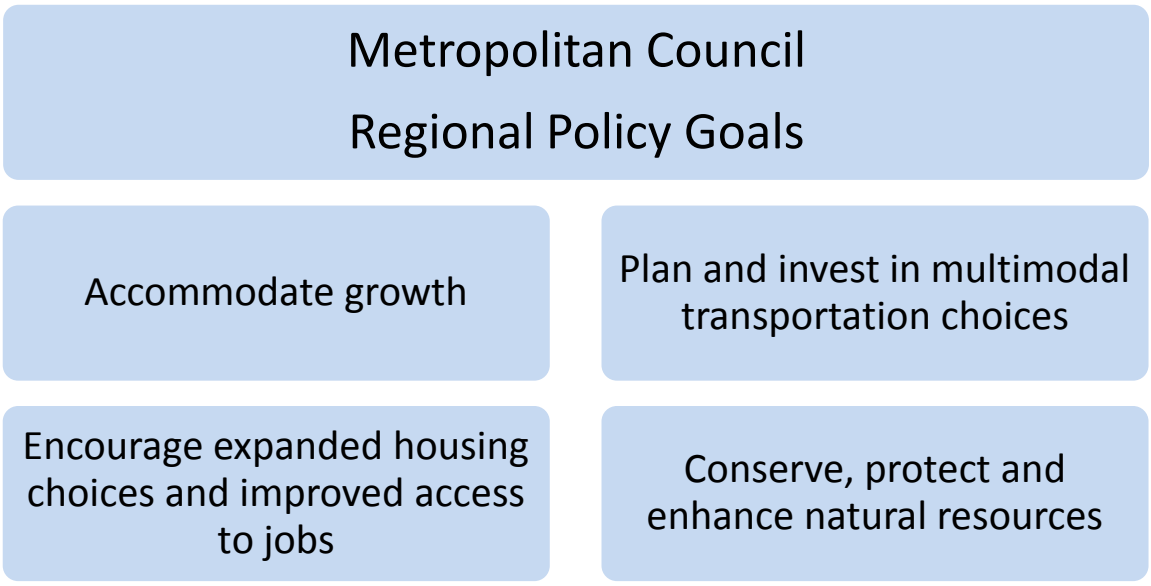
Transportation and Land Use Policies and Strategies

The Metropolitan Council's land-use and transportation policies and strategies provide context for this entire study. Strategies and policies support legislative goals of reducing air pollution, mitigating congestion, and reducing infrastructure costs. They additionally emphasize approaches that reduce or manage travel demand through land use and access to transportation options, another legislative requirement.

This progress report briefly summarizes regional land-use and transportation policies and strategies. Regional and local policies and strategies were identified in the April 2010 progress report, previously submitted to the Legislature, and are not repeated in detail. Land-use and transportation policies and strategies are found in the Metropolitan Council's *Regional Development Framework* and 2010 draft update to the *2030 Transportation Policy Plan*.[2]

Adopted by the Council in 2004, the *Framework* is the Council's comprehensive guide for development in the seven-county metropolitan area. Its policies, strategies and goals integrate plans for four regional systems, including transportation, airports, wastewater service, and regional parks, trails and open space. Policies and strategies support one or more of the Council's four core policies in the *Framework*, seen in Figure 1. (Appendix A supplies an overview of policy directions and strategies from the *Framework*.)

Figure 1



[2] 2010 draft update to the current *2030 Transportation Policy Plan* adopted in January 2009. The Metropolitan Council plans to consider adoption of the draft plan in November 2010.

The *2030 Transportation Policy Plan* (TPP) guides the development of the region's transportation system to 2030. Strategies in the TPP emphasize approaches that reduce or manage travel demand through land use and access to transportation options. Proposed policies and strategies in the 2010 draft update to the TPP are included in this report, but will be replaced with adopted policies in the final *Land Use and Planning Resources Report.*

Main Messages

Regional strategies are organized into four main topics and summarized below. The four topics are: (1) protect the natural environment and minimize negative impacts; (2) manage congestion and improve performance of the transportation system; (3) expand and enhance transportation choices; and (4) improve connections and access.

Protect the natural environment and minimize negative impacts:

- Promote strategies to reduce transportation emissions of pollutants.
- Protect natural resources through planning, technical assistance and transportation investments.
- Expand the regional parks system.

Manage congestion and improve performance of the transportation system:

- Improve efficient use of the transportation system.
- Manage travel demand and provide multimodal alternatives to travel on congested roadways.
- Plan highway investments within financial constraints to mitigate but not eliminate congestion.

Expand and enhance transportation choices:

- Plan a multimodal transportation system, expand transit and develop a network of transitways.
- Support expanded transportation choices with transportation services.
- Coordinate transportation investments.

Improve connections and access:

- Maximize accessibility and intensify development along transitways and bus routes.
- Support travel by alternative modes through land use and interconnected transportation.
- Coordinate transportation and land use.
- Invest resources to use land efficiently and achieve multiple goals.

Summary of Regional Land Use and Transportation Strategies

Regional land-use and transportation policies and strategies are summarized in this progress report because they apply to all communities in the region. Local strategies are not shown, but were included in the April 2010 progress report. A range of local strategies are specifically tailored to groups of communities in different stages of development and characterized by different densities, expectations for growth, and transportation and wastewater services. Groups of communities, called geographic planning areas, are described and mapped in Appendix B.

As mentioned earlier, strategies in this report are organized into four main topics. A fifth group of strategies that support broad policies beyond land use and transportation were included in the April 2010 progress report. Supportive benefits are described for each of the four topics covered.

Protect the Natural Environment and Minimize Negative Impacts

A primary goal of the Council is to work with local and regional partners to reclaim, conserve, protect and enhance the region's vital natural resources, including air quality. Means of achieving this goal include reducing transportation emissions of pollutants, expanding the regional parks system, and taking additional measures to protect national resources. Parks and open space protect natural resources, and forested areas sequester carbon drawn from carbon dioxide in the air.[3]

Regional Strategies

Promote strategies to reduce transportation emissions of pollutants:

- Promote strategies to reduce transportation emissions of pollutants identified in the federal Clean Air Act. Implement initiatives to reduce greenhouse gas emissions.
- Give priority to projects that help the region comply with federal air quality standards when making transportation investment decisions.

Protect natural resources through planning, technical assistance and transportation investments:

- Conserve natural resources identified in natural resource inventories.
- Provide technical assistance to communities, and conserve natural resources and protect vital natural areas when planning and constructing regional infrastructure.
- Give special consideration to preserving and enhancing the region's cultural and natural resources in regional transportation projects.

Expand the regional parks system:

- Expand the regional parks system, and invest in acquisition and development of land for the regional parks system. By 2030, the Twin Cities region plans to expand its regional parks system from over 54,000 acres to nearly 70,000 acres and to quadruple the trail system from 231 miles to 980 miles.[4] Three new regional parks are planned, as well as new greenway corridors to link regional parks in three counties.

[3] Philip Groth et al., *Quantifying the Greenhouse Gas Benefits of Urban Parks* (San Francisco, CA: The Trust for Public Land, 2008), p. 24.

[4] 2010 draft update to the *2030 Regional Parks Policy Plan*. The Metropolitan Council plans to consider adoption of the draft plan in December 2010.

Supportive Benefits

Other strategies for land use and transportation can help minimize environmental impacts. Expanding trails enhances transportation choices (such as commuting to work by bicycling), potentially mitigates congestion by providing more alternatives to highway driving, and strengthens connections and access. Trails offer walking and biking alternatives that can reduce the number of vehicle trips and their impact on air quality.

Natural resources support improved water quality by filtering water and reducing runoff.[5] Complying with federal air quality standards will avoid costly federal pollution control requirements and enhance the region's ability to grow economically. Moreover, reducing air pollution and encouraging increased physical activity through walking and biking in parks and on trails have significant health benefits. In addition, expanding parks, trails and open space will help meet the recreation needs of the region's growing population.

Manage Congestion and Improve Performance of the Transportation System

A primary goal of the Council is to plan and invest in multimodal transportation choices, based on the full range of costs and benefits, to slow the growth of congestion and serve the region's economic needs. The Council recognizes that congestion will not be eliminated or significantly reduced in the metropolitan area. Congestion, however, can be mitigated with greater efficiencies in highway system performance, changes in travel patterns and alternatives to travel on congested roadways. Strategies focus on making the transportation system more efficient, modifying travel behavior while providing multimodal alternatives, and planning highway investments within financial constraints.

Enhancing transportation choices by expanding the transit system supports the goal of mitigating highway congestion. (See the next topic for further discussion of transportation choices.) Improving performance of the transportation system also reduces air pollution caused by vehicles stuck in traffic and reinforces improved connections and access to land uses.

Regional Strategies

Improve efficient use of the transportation system:

- Implement a multimodal roadway system. Increase efficiency of the multimodal transportation system, reduce vehicle use and provide lower-cost safety and mobility projects where feasible through the congestion management process in the *2030 Transportation Policy Plan*.
- Maximize use of the existing highway system and increase its capacity to move people, as measured by person throughput.[6] Reduce impacts of highway congestion on freight movement.
- Support cost-effective technologies to manage and optimize use of both highway and transit systems. Examples include high occupancy toll lanes and ramp metering.

---

[5] Philip Groth, p. 14.

[6] Person throughput measures the number of people traveling on a highway or highway lane rather than tracking only the number of vehicles. This measure takes into account use of transit and high-occupancy vehicle (HOV) lanes.

Manage travel demand and provide multimodal alternatives to travel on congested roadways:

- Promote a wide range of transportation demand management (TDM) initiatives that help to avoid and lessen congestion. Initiatives help reduce automobile use, especially during the most congested times of the day.
- Provide alternatives to traveling in congested highway conditions and save travel time by developing and implementing bus-only shoulders and managed lanes. Managed lanes are high-occupancy vehicle (HOV) and high-occupancy toll (HOT) lanes, and priced or non-priced dynamic shoulder lanes.
- In highway planning and corridor studies, give priority to the alternatives mentioned above.
- Consider implementing pricing on any expansion project.
- Define the relationship of parking pricing and availability to use of modes (single-occupant vehicle versus transit and other modes).

Plan highway investments within financial constraints to mitigate but not eliminate congestion:

- Prioritize highway system investments. First priority is preserving, operating and maintaining existing systems and facilities. Second is managing the system. Third is expansion that optimizes performance. In the draft update to the TPP, preservation and bridge projects are expected to take up about 75 percent of state road construction funds anticipated during 2015 to 2030.
- Plan for the metropolitan highway system with the understanding that congestion will not be eliminated or significantly reduced. In the draft update to the TPP, many expansion projects proposed in the past have been reassessed to bring them more in line with projected transportation revenues.[7]
- Implement active traffic management (ATM) improvements, lower-cost/high benefit projects, new managed lanes and affordable, strategic capacity expansion to mitigate congestion. In the draft update to the TPP, about $900 million is projected to be available for mobility enhancements and congestion mitigation from 2015 to 2030.
- Allocate limited available resources for the most system-wide benefit, as proposed in the draft update to the TPP. Address a large number of problem areas region-wide rather than focusing the majority of limited available resources on a few major expansion projects.

Supportive Benefits

Benefits of these strategies extend beyond transportation and land use. Managing congestion can shorten daily commutes and leave more time for personal or family activities. Fewer traffic jams that slow travel speeds also means drivers save money on fuel. Reducing congestion affects freight movement and ultimately impacts economic competitiveness.

[7] A principal arterial study conducted by Mn/DOT and the Metropolitan Council in 2007 concluded that $40 billion (2005 dollars) in highway investments would be needed by 2030 to “fix” congestion in the region. This is more than five times the total highway revenues expected for the region between now and 2030.

Expand and Enhance Transportation Choices

The Council is responsible for the regional transportation planning of highway and transit systems. It operates and develops the region's largest bus system, light-rail transit and commuter rail. Strategies to expand and enhance transportation choices are fundamental to achieving a Council goal of doubling transit ridership by 2030.

In the Council's regional policy directions and strategies, a primary goal is to plan and invest in multi-modal transportation choices. By improving transportation choices, the goal is to mitigate congestion, reduce air pollution, improve mobility and lessen energy costs. Strategies to achieve these ends include planning a multimodal transportation system, supporting other transportation modes, and coordinating transportation investments.

Regional Strategies

Plan a multimodal transportation system, expand transit and develop a network of transitways:

- Plan a multimodal, interconnected transportation system.
- Implement a regional network of transitways to provide travel-time advantages for transit vehicles, improve reliability and increase the convenience and attractiveness of transit service. Transitway modes will include commuter rail, light rail, bus rapid transit, and express buses with transit advantages.
- Local and state agencies should implement a multimodal system and consider providing facilities for pedestrian and bicyclists in the design and planning of road projects (Complete Streets).
- Plan a multimodal, interconnected system of roads to serve short and medium-length trips.
- Expand the local and express bus system and develop a network of rail and bus transitways to meet the 2030 goal of doubling ridership by 2030. Preserving, operating and maintaining the existing transit system has first priority.
- Expand the regional trails system.
- Support a variety of freight transport modes to link the region with larger markets. Pursue improved freight connections between the Twin Cities and other regions, and analyze needs for freight terminal access.

Support expanded transportation choices with transportation services:

- Support enhanced transit service along transitways.
- Promote and market transportation choices, including riding transit, carpooling, vanpooling, using priced lanes, bicycling or walking.
- Expand regional park-and-ride facilities to support service expansion within express corridor areas and along dedicated transitways.

Coordinate transportation investments:

- Coordinate transitways with projects, facilities and investments of other modes. Coordinate with adjacent counties to support connections between regional highways and surrounding counties.

- Encourage roadway and transit investments to include bicycle and pedestrian travel. Use criteria for federal funding to prioritize projects that encourage multimodal investments.

Supportive Benefits

Expanding transportation choices additionally aids efforts to reduce air pollution and mitigate congestion. Expanding the regional trails system not only provides another transportation mode, but also has the benefit of conserving natural resources. When integrated with land-use planning, an intermodal transportation system improves connections and access to jobs and other destinations.

Benefits of strategies go beyond land use and transportation. Households with greater access to transportation alternatives may drive less and save money on fuel. Expanding transportation alternatives also increases the region's ability to attract and retain residents who prefer a wider range of transportation choices. Supporting freight transportation has economic benefits because moving resources and goods within the region and to national and global markets is critical for increased economic competitiveness.

Improve Connections and Access

Improving connections and access through land use and transportation serve two primary goals of the Council. One goal is to work with local communities to accommodate growth in a flexible, connected and efficient manner. Another is to encourage expanded choices in housing location and types, and improved access to jobs and opportunities.

Council strategies aim to maximize accessibility, support travel by alternative modes, coordinate transportation and land use, and invest resources to use land efficiently. Fewer trips, shorter trips, and shifts to alternative transportation modes, such as biking and walking – these are the goals of increased development along transit corridors, integrated land uses and other more transportation-efficient land-use patterns.

Regional Strategies

Maximize accessibility and intensify development along transitways and bus routes:

- Maximize access to jobs, housing and services through land use planning and development.
- Use transitways and the arterial bus system as catalysts for development and growth of major employment centers and housing. Form an interconnected network of higher-density nodes along transit corridors.
- Coordinate transportation investments and land development along major transportation corridors to intensify job centers, increase transportation links and improve connections between jobs and housing.
- Encouraging local governments to implement local comprehensive plans, zoning and community development strategies, including parking policies that ensure more intensified development along transitways and arterial bus routes.
- Ensure that transitways promote efficient development and redevelopment.

Support travel by alternative modes through land use and interconnected transportation:

- Coordinate transportation investments and land development to support travel by modes other than the automobile, including travel by transit, walking and bicycling.
- Implement a system of interconnected streets, pathways and bikeways to meet local travel needs without using the regional highway system.
- Develop a safe and attractive pedestrian environment near major transit corridors and stations that connects pedestrians and bicyclists to buses and trains.

Coordinate transportation and land use:

- Adopt and implement local comprehensive plans that conform to the *2030 Transportation Policy Plan*. Comprehensive plans are updated every 10 years, as required by the Metropolitan Land Planning Act.
- Plan for development that accommodates growth and achieves other goals. Negotiate lifecycle and affordable housing goals.
- Manage access to highways to preserve capacity and enhance safety, using Minnesota Department of Transportation's (Mn/DOT) access management guidelines.[8]

Invest resources to use land efficiently and achieve multiple goals:

- Invest Council resources to increase the variety of housing types and costs, mix land uses and increase transportation choices.
- Invest Council resources – infrastructure improvements, grant programs and technical assistance – to accommodate regional growth while using regional systems and land efficiently.

Supportive Benefits

Connecting land-use decisions to transportation investments can reduce vehicle miles traveled and help slow the growth in congestion. Over the long run, results are expected to reduce air pollution, mitigate congestion, and reduce costs by making more cost-effective use of infrastructure. Strategies also bolster the effectiveness of investments to expand transportation choices.

Benefits of strategies extend beyond land use and transportation. A mix of housing provides choices for a range of ages and incomes, and connections to transit offer economic advantages for communities competing with other regions for jobs and residents. Shorter daily commutes resulting from connected land uses and integrated transportation modes save residents and businesses time and money.

[8] Access management is the practice of carefully planning the location and spacing of driveways, street connections and median openings to maximize safety and traffic carrying capacity of highways. Federal Highway Administration.

Resources and Tools

Land use and transportation are closely linked, with transportation shaping development patterns and land uses generating the need for transportation facilities and networks. This section identifies strategies and practices by regional and local governments to reduce trips made by driving alone, increase trips by other travel modes, reduce distances between destinations to shorten trips, and strengthen connections between land use and transportation. Strategies and implementation tools culled from a range of sources give examples of what regional and local governments can do to affect travel behavior, reduce air pollution and mitigate congestion.

Information first summarizes land-use and transportation strategies from the national and international literature. Examples of implementation tools used by local governments follow, including tools applied in the region. More results from the 2030 comprehensive plans of local governments will appear in the final report to further show what local communities in the region are doing to implement and integrate land use and transportation strategies. Current land uses in the region and other relevant facts and trends will give additional context to this forthcoming analysis.

Purpose

Research on resources and tools responds to legislative goals of identifying and assessing the effectiveness of local and regional land use and transportation strategies and processes to reduce air pollution, mitigate congestion and reduce infrastructure costs. Strategies and tools emphasize reducing or managing travel demand through land use and access to transportation options. Some resources also note the efficiency, effectiveness or cost of strategies. Another purpose of this research is to identify strategies from the literature to potentially reduce vehicle miles traveled (VMT) and apply those measures in an air quality assessment tool. (See Air Quality Assessment Tool section.)

Main Messages

Research on resources and tools did not reveal much that is new; many similar strategies have been adopted in this region and many tools implemented as well:

- Numerous strategies are already included in the policies and strategies of the Metropolitan Council's *Regional Development Framework* and *2030 Transportation Policy Plan*. Examples include increasing transportation choices, supporting land-use patterns to efficiently connect places and improve access, and intensifying development along transportation corridors.
- Implementation tools for local governments reflect a range of different types of tools available for implementing land-use and transportation strategies.
- Communities in the region are implementing a broad array of tools and programs. A sample of tools includes specific area plans in complex or large development projects, urban parks and landscaping, travel demand management, parking management and Complete Streets initiatives that connect local streets, paths and trails.

Combined strategies integrating transportation and land use are more effective than those implemented individually:

- Integrating land use with a multimodal transportation system is key to addressing congestion and improving regional mobility.
- Changes in the built environment generally contribute modest changes in travel behavior, but combined strategies have more significant effects.
- The Council's *Framework* and *2030 Transportation Policy Plan* recognize how land use and transportation work together. Regional policies emphasize coordinating and connecting transportation investments and land-use development.

Six land-use and transportation strategies stand out from a literature search of influences on travel behavior:

- The strategies are: (1) access to activity centers along transportation corridors; (2) street design and connectivity of transportation networks; (3) mixed land uses; (4) high-quality transit; (5) density combined with other strategies; and (6) transportation management and parking.
- Access to activity centers along transportation corridors is a leading influence on choice of travel mode. Street design and connectivity of local transportation networks is second in importance.
- Impacts of higher density on travel behavior are complex. Research concludes that density alone is not as effective as density combined with other strategies, such as connections to major centers, a high-quality local transportation network, a mix of land uses and transit.

Implementing strategies takes time and may require adapting strategies to fit local circumstances:

- Changing land uses is a long-term strategy, given existing development patterns. Impacts of land-use changes, however, build and accumulate over time.
- Promoting land-use changes that make a difference at the regional level will require acceptance and action by local communities.
- One size does not fit all. Some strategies or tools apply to many areas, while others are more relevant to specific types of locations, such as transportation corridors or high-density developments.
- Within this region, communities use a broad array of tools. The diversity of tools and their multiple objectives show how communities are tailoring strategies and tools to meet local needs.

Resources and Tools from Literature Search

In this section, conclusions are gathered from a literature search of primary sources published in recent years. Findings concentrate on practices to reduce vehicle miles traveled by providing options to travel by modes other than driving alone, and reduce the length of trips by shortening distances between the beginning and end of trips. (In the region, driving alone is the most common way of traveling. Transit,

bicycling and walking make up less than 10 percent of trips.[9]) Many practices strengthen linkages between land use and transportation. Numerous studies were reviewed because the land use-transportation relationship has attracted considerable study over the past 20 years. Most often, studies focus on individual aspects of development patterns and travel measured by VMT.

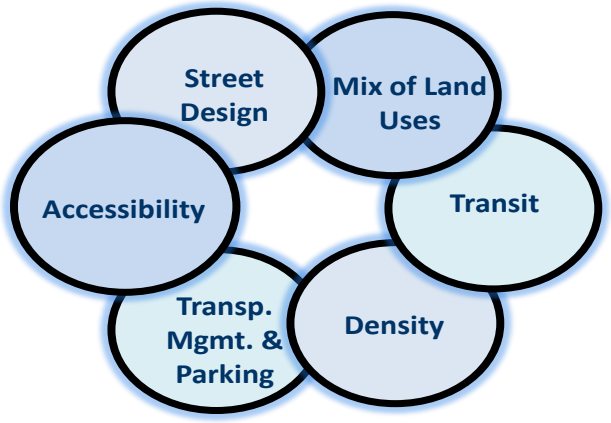
Conclusions

Overall, studies conclude that linking land use and transportation strategies and practices is essential to achieve results. Changes in the built environment generally contribute modest changes in travel, but combined strategies are more significant. Land uses do not change quickly, but benefits build over the long term. Additional benefits come out of integrating land use and transportation that go beyond reducing growth in VMT, relieving congestion or reducing air pollution. (A Resources and Tools Bibliography provides links and more information on over a dozen studies used in this report.)

A literature search identifies six land use and transportation strategies as major influences on travel behavior, summarized in Figure 2. They focus on: (1) access to activity centers along transportation corridors; (2) street design and connectivity of transportation networks; (3) mixed land uses; (4) high-quality transit; (5) density linked to other strategies; and (6) transportation management and parking (grouped as a sixth strategy).

Figure 2

Land Use and Transportation Strategies



[9] According to the last survey of travel characteristics in the region from the 2000 Travel Behavior Inventory (TBI), driving alone was the most common way of traveling. Driving alone accounted for over 47 percent of person trips. (A person trip is a one-way journey by one person between two points.) Driving with a passenger made up almost 19 percent of person trips, and riding as a passenger represented just over 23 percent. Public transit contributed 2.3 percent, walking made up 5.6 percent, and bicycling, 1.5 percent. Final results from the 2010 TBI will most likely become available after this study is completed.

General Findings

Linking land use and transportation policies and practices matters:

- Integrating land use with a multimodal transportation system is key to addressing congestion and improving overall regional mobility.
- Coordinating transportation and land-use decisions and investments enhances their effectiveness.
- Travel behavior responds to changes in land use and site development. Individual strategies generally contribute modest changes in travel, but combined strategies have more significant effects.
- Increasing transportation options does not equate to fewer trips or reduced mobility. Instead, transportation options reduce the need to drive to work, shopping, recreation and other places.
- Concentrated, contiguous development and a multimodal transportation system give people opportunities to meet their needs with shorter automobile trips or by walking, bicycling or taking transit. This helps reduce VMT and contributes to efforts that mitigate congestion and improve air quality.

Land use changes take time but benefits build over the long term:

- Land use changes can significantly reduce regional VMT. Changing land uses, however, is a long-term strategy given existing development patterns.
- Impacts of land-use changes are modest in the short term, but build over time and accumulate.
- Promoting land-use changes that make a difference at the regional level will take time and require acceptance and action by local communities.

Integrated land use and transportation yields additional benefits:

- Compact and mixed-use development decreases distances between work, housing and services. Proximity among land uses generates fewer vehicle miles traveled, offers more options by travel mode and saves travel time. (Compact development generally combines a partial or complete mix of concentrated population and/or employment, medium to higher densities, mixed land uses, interconnected streets, and access to transit and other modes of travel.)
- Economic and environmental benefits come from reducing impervious surfaces, reducing costs of providing public services and preserving habitat and open space.

Specific Strategies

1) Access to activity centers along transportation corridors is most important when deciding travel mode:

- Travel time or distance to major activity centers is critical when choosing a travel mode. Access to downtowns in the two central cities or large urban and suburban employment centers is the most important factor determining whether a person takes transit, carpools, or does something other than drive alone.
- If transit service is available, the further one lives from work, the more likely one is to take transit. The closer one lives to work or services, the more likely one is to walk or bike.

- The difference between travel times by transit versus automobile is more important than any land-use influence on ridership.
- Transit ridership is influenced more by the density of employment opportunities at a trip destination than the density of population at the origin of the trip.

2) Street design and connectivity of local transportation networks are second-most important to choice of travel mode:

- Street design is second in importance when people decide whether to drive, use transit, bicycle or walk to a destination.
- An interconnected network of local streets, sidewalks and bicycle pathways creates a pedestrian and transit-friendly environment often characterized as transit-oriented development (TOD). TOD features are as important as street design in activity centers and at transit stations or stops serving residential areas.
- Compact areas with diverse land uses, coupled with pedestrian-friendly site design, can facilitate non-auto travel by residents and workers.
- Per capita automobile travel tends to decrease in areas with connected street networks, particularly if supported by pedestrian and bicycle networks.

3) Mixed land uses are another leading influence on travel behavior:

- The mix of land uses is next in importance for affecting travel behavior. The ratio of jobs to housing in an area is also used to indicate the diversity of land uses (either mixed or predominately residential or employment-based).
- A mix of service, retail, civic or employment destinations with short and convenient access by walking reduces the need to drive, both in residential neighborhoods and activity centers.
- Compact development enhances accessibility, and complementary land uses near one another further enhance accessibility.
- Per capita automobile travel tends to decline with increased land-use mix. An example is retail and public services located within or adjacent to residential areas.
- The main benefit of jobs-housing balance is to reduce VMT during commutes. But a mix of local area land uses may be most significant in encouraging walking, carpooling and transit use.
- Where people choose to live is influenced by individual needs and preferences, and job locations are one consideration out of many. Where jobs locate depends on the needs and preferences of employers, and access to employees is but one consideration.

4) High-quality transit builds ridership:

- High-quality transit, characterized by frequent, speedy service and easy access, helps build ridership.
- Where housing, population, commercial land uses or job densities are lower, transit tends to be less available, less frequent and less used, and VMT per capita and VMT per household are higher.

- Per capita automobile travel tends to decline with access to a high-quality transit system. It particularly declines when the transit system is integrated with supportive land use (higher-density development with pedestrian access within ½ mile of transit stops and stations) characteristic of TOD development.
- Transit ridership increases with expansion of a regional transit network that links job centers, housing, educational institutions, services and cultural opportunities.

5) Density linked to other strategies influences travel behavior more than density alone:

- Density by itself is less important than the strategies mentioned above.
- Population and household concentrations matter, but density alone is not as effective in influencing travel behavior as density combined with other strategies, such as connections to major centers, a high-quality local transportation network, a mix of land uses and transit.
- A combination of strategies suited to a location has the best chance of influencing travel behavior and reducing overall VMT.
- Unlike VMT, the number of person trips does not significantly decline with an increase in the density of development. However, increased density, when combined with other strategies, promotes use of travel modes other than driving alone and reduces the distance of trips.
- Developing more compactly, with integrated transportation and connected land-use patterns, can reduce VMT, energy consumption and CO_2 emissions.

6) Transportation management strategies and parking affect land use and travel modes:

- Transportation management policies and practices can influence land-use decisions and transportation mode choices, such as driving alone. These strategies include parking policies and travel demand management programs.
- The availability of free or low-cost parking is a major deterrent to transit ridership.

Sustainable Communities Grant Program

A recent federal grant program exemplifies opportunities to build on land-use and transportation strategies and implement tools in the region. The Sustainable Communities Partnership Grant program is not mentioned in the research on resources and specific tools, but it is noteworthy for its potential to affect land use and access to transportation options.

The Twin Cities region applied for a $5 million Sustainable Communities Partnership Grant from the U.S. Department of Housing and Urban Development (HUD) in August 2010. About $100 million will be awarded nationwide through the grant program. The region's proposal focuses on emerging transit corridors. Goals include supporting planning and development strategies for emerging transit corridors and assisting local communities with tools to implement corridor-wide strategies. Program implementation is planned during 2011-2013. The program would be governed by policy makers at the Counties Transit Improvement Board (CTIB), Hennepin County, McKnight Foundation, Metropolitan Council, Minneapolis, Minnesota Housing Finance Agency, Ramsey County and Saint Paul.

The grant program comes out of a new federal partnership that underscores interconnections between housing, transportation and the environment. In 2009, HUD, U.S. Department of Transportation (DOT) and U.S. Environmental Protection Agency (EPA) announced a partnership to coordinate investments for improved access to affordable housing, more transportation choices and reduced transportation costs.[10]

Local Government Implementation Tools

In this study, local government implementation tools focus on ways to reduce air pollution, reduce growth in vehicle miles traveled (VMT) and relieve congestion. Tools strive to change travel behavior, land use patterns, sustainability practices and access to transit and transportation corridors. Local government tools selected here reflect a range of different types of tools available for implementing land use and transportation strategies.

Conclusions

Local governments have a broad array of tools to influence land-use and transportation strategies that help slow growth in VMT, reduce air pollution and mitigate congestion.

Land-use strategies focus on changing development patterns to reduce distances and increase connectivity between places. Examples of land-use strategies that local governments can implement include:

- Increasing connectivity between housing, work and services to minimize the number and distance of trips traveled.
- Encouraging travel modes other than driving alone.
- Implementing transit-oriented development (TOD), which maximizes walkability, by capturing the development benefit of available transit within ¼ to ½ mile of transit stations.
- Allowing flexibility in development standards to meet community goals that promote sustainable land use practices.
- Limiting the land area dedicated to parking to make more land available for higher-density development and encourage people to use alternative travel modes.
- Promoting higher-density development, especially along major transit and transportation corridors.

Transportation strategies help decrease the number of vehicles on the road and relieve congestion. Examples of specific local government tools include:

- Increasing ride sharing and alternative travel modes, such as transit, bicycling and walking.
- Staggering work schedules at major employers and encouraging working from home.
- Managing parking pricing and availability.

Many strategies and implementation tools do not fit neatly into separate land-use or transportation categories. For example, both transportation and land-use strategies increase connectivity among

[10] U.S. Environmental Protection Agency, *HUD, DOT and EPA Partnership: Sustainable Communities*, http://www.epa.gov/dced/pdf/dot-hud-epa-partnership-agreement.pdf (June 16, 2009).

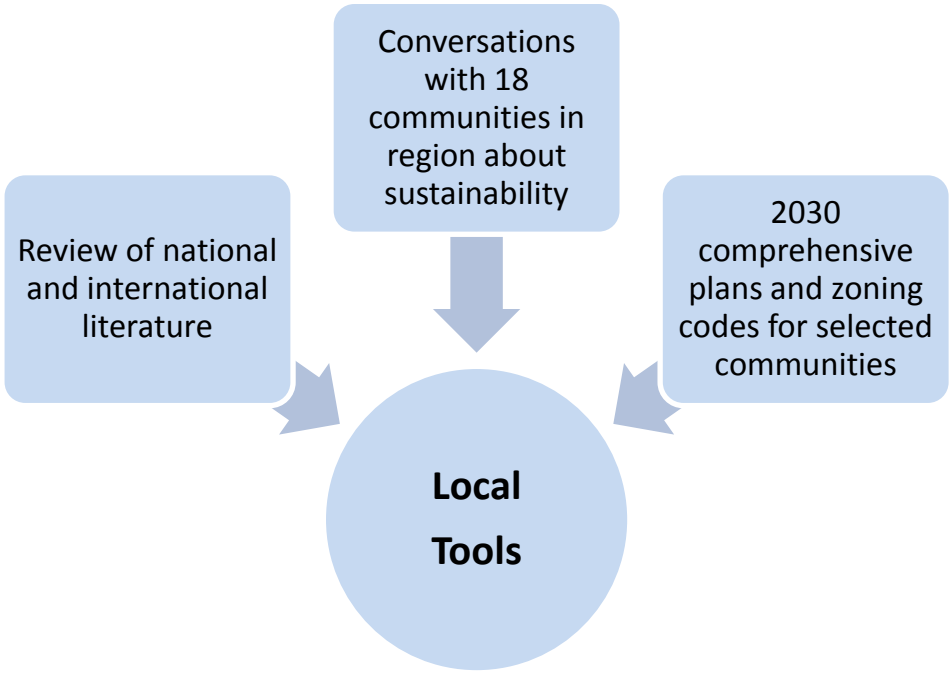
streets, trails and sidewalks within and between neighborhoods. One tool can support other tools, and this reflects how land-use and transportation tools are often entwined rather than separate.

Definitions and Sources of Tools

Tools include specific policies, practices or regulations implemented to influence land-use development patterns, increase transportation options, or both. They support the goals of reducing VMT, congestion and air pollution. Local government tools are practices that local governments can implement through their local land-use controls or transportation policies. Other local tools may encourage action by the private sector to accomplish community goals. Tools that rely on implementation of strategies by state or regional authorities are not included. For example, adding a bus route or building a Metro Transit park-and-ride facility to expand the regional transit system are not local government implement tools.

As seen in Figure 3, implementation tools included in this report come from studies, local government officials and selected 2030 comprehensive plans. Studies from a literature search were described earlier. Conversations with public officials at 18 communities in the region about sustainability are outlined in Appendix C. Review of 2030 comprehensive plans and related zoning codes covers mixed-use districts of 20 developed cities, excluding small communities. (See Appendix B for a definition of developed communities and a map.)

Figure 3



Examples of Local Government Tools

Sources mention an extensive number of tools. Examples included in this report cite only a few samples of local government tools rather than a complete set of policies, practices or regulations. Some descriptions indicate the type of geographic area where a tool is most likely to be implemented.

Examples of tools include: GreenStep Cities, sustainability plans, urban forests and parks, special area plans, form-based zoning, parking, Complete Streets, Safe Routes to Schools, Nice Ride Minnesota, bicycle highways, transportation demand management, and community benefit agreements. Descriptions mention at least one resource for additional information about the tools. Figure 4 lists examples of tools that have been applied or adapted to fit local needs in the region. Examples of tools recently enacted or under study in Minnesota appear in Figure 5.

Figure 4

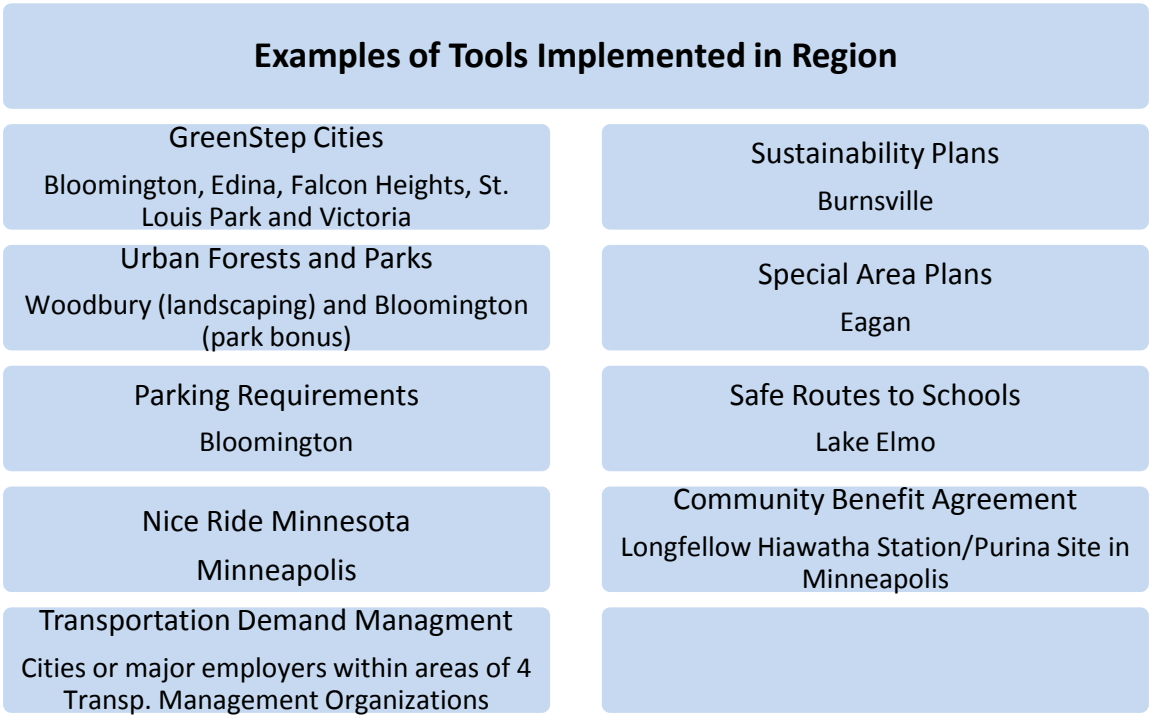
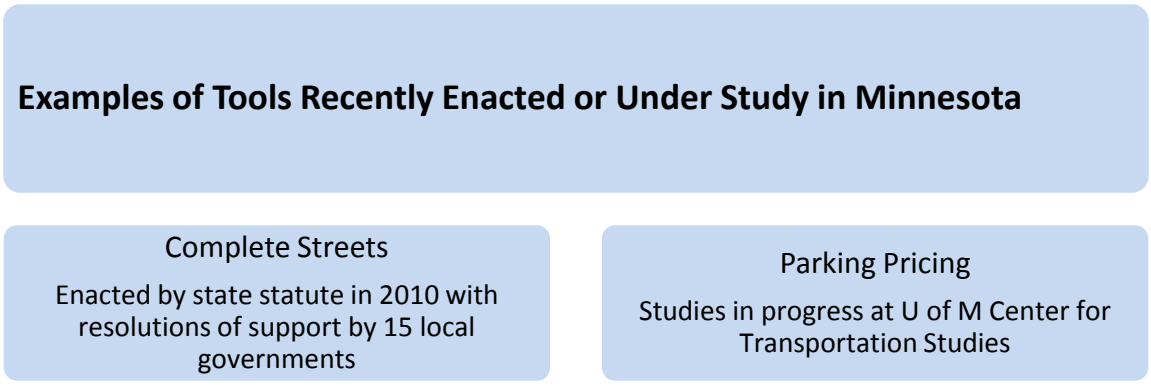


Figure 5



GreenStep Cities

GreenStep Cities provides a comprehensive toolkit for any Minnesota community to reduce greenhouse gas emissions and promote other environmental measures to increase sustainability. Many tools, such as efficient highway-oriented design, are useful for cities that are developing without transit service or high-density land use.

In 2010, the statewide GreenStep Cities program launched in response to legislative actions. The Minnesota Pollution Control Agency (MPCA), Minnesota Office of Energy Security, the Clean Energy Resource Teams, the Great Plains Institute, the League of Minnesota Cities, the Izaak Walton League - MN, and the Urban Land Institute developed the program. GreenStep Cities encourages cities to become certified for three years by adopting a specified number and set of practices that promote sustainability. Cities can choose from 28 sustainability best practices in five categories. Best-practice categories include building and lighting, land use, transportation, environmental management, and economic and community development.

Five pilot cities are in the region, including Bloomington, Edina, Falcon Heights, St. Louis Park and Victoria. At least eight cities have signed a resolution to join GreenStep Cities, and 10 more are considering resolutions.

Resource: Minnesota GreenStep Cities Program at be www.MnGreenStep.org

Sustainability Plans

Sustainability means different things to different communities. Many initiatives implement sustainable actions for public facilities and fleets. Others require private developers to incorporate sustainable features into projects. Some sustainability plans go beyond these to include other actions.

Sustainable or sustainability goals appear in several communities' communications, such as 2030 comprehensive plans. Some cities establish sustainability commissions or committees to provide leadership to and credibility for their local environmental efforts. Examples of sustainable measures for public facilities and fleets include constructing public buildings to green standards, heating with geo-thermal, requiring permeable pavements in public parking areas and purchasing hybrids for public fleets. Many communities require private developments to provide bicycle, pedestrian and street connectivity, to minimize surface water runoff, to protect ground water quality and to incorporate urban forestry principles into developments. Cities also adopt local green building and design requirements that promote local environmental objectives.

Burnsville takes a comprehensive approach in its *Sustainability Guide Plan*, which includes information on sustainable lifestyle choices, such as local food and healthy living opportunities.

Resource: *Sustainability Guide Plan*, City of Burnsville, at www.ci.burnsville.mn.us\sustainability

Urban Forests and Parks

Urban forests and parks use tree planting programs and landscaping on streetscapes for aesthetic and environmental benefits. Both urban forests and parks are land uses associated with reducing green house gases and providing an improved quality of life. Urban forests and parks are being incorporated into high-density, transit-oriented development (TOD) and station area plans. Complete Streets and roadway corridor designs include landscaping policies. Community planning and development incorporate parks into TOD and station area plans.

Historically, cities have required parkland dedication as part of local development proposals. Cities of all sizes and geographic locations have promoted and maintained landscaping along boulevards and in public places for decades. These efforts are annually recognized by the Tree City USA organization on Arbor Day. Landscaping and parks are now valued for their additional impact on reducing greenhouse gases.

Woodbury's adopted roadway corridor design principles include landscaping. Parks are also part of community planning and development to reduce greenhouse gases. Recommendations call for incorporating parks into TOD and station area plans. Bloomington's zoning ordinance has a park bonus in its high-intensity, mixed-use residential district. The *Station Area Planning Manual* by Reconnecting America identifies open space elements to complement characteristics of TOD districts.

Resources: *Roadway Corridor Design Principles Task Force Report*, City of Woodbury, January, 2009; *Station Area Planning Manual,* Reconnecting America, 2008; *Urban Forests, Environmental Quality and Human Health,* U.S. Department of Agriculture, Research Work Unit NRS-08, at http://nrs.fs.fed.us/units/urban/

Special Area Plans

Special area plans provide more specific planning than a comprehensive plan and more flexibility than a zoning code. They are used in major development, redevelopment and TOD plans. Special area plans are frequently applied in high-density and mixed-use projects along transit corridors or major transportation routes.

Special area plans are also called master plans, specific plans, required plans, subarea plans, district plans or station plans. A special area plan addresses potential development opportunities and principles for future proposals. Cities vary on how these special area plans are used in the planning and development process. The special plan will likely change when a specific development proposal goes through the planning approval process. Ultimately, all development related to the special plan must be consistent with the comprehensive plan. The Planned Unit Development (PUD) is the most frequent zoning category used. PUDs typically apply to a specific development.

Special area plans may or may not be associated with tax increment districts. In 2010, the State of Minnesota authorized tax-increment compact development districts. The local public funding tool helps

implement higher-density developments. Districts can receive tax increments over 25 years to finance eligible land acquisition, demolition and public infrastructure costs.

Eagan has used special area plans over the past decade as a mechanism to define seven redevelopment or development zones. In 2001, California adopted the specific plan as a statutory land-use planning tool.

Resource: *City of Eagan 2030 Comprehensive Land Use Plan*, City of Eagan, Minnesota, at ww.ci.eagan.mn.us

Form-Based Zoning

Form-based zoning is used to regulate mixed-use development and create a connected, integrated physical environment. This type of zoning regulates the relationship between the built environment and public infrastructure. It creates a place with certain form and scale attributes rather than regulating the location of land uses.

The goal of form-based zoning is to create a visual appearance through a prescribed form and mass of buildings related to each other and to the scale and types of public infrastructure (streets and landscaping), regardless of the type of land use. Requirements are tied to a regulatory plan that designates the appropriate form and scale of the development. Codes are regulatory, not advisory.

A review of zoning codes for selected communities in the region found several examples of specific design criteria that apply to special areas and/or zoning districts. No city exclusively used form-based zoning.

Resource: Form Based Codes at www.formbasedcodes.org

Parking

Parking focuses on either the pricing and availability of parking spaces or the land area devoted to parking. Extensive resources exist on parking tools.

Parking pricing is being studied by the University of Minnesota Center for Transportation Studies. One study explores innovative parking strategies for downtown Minneapolis. A second study investigates the relationship between innovative parking pricing and its impact on mode choices of those who use downtown contract parking.

On-street parking management is used to price street parking spaces to achieve maximum financial returns. Peak-hour parking is priced to get a “fair rent” for use of the public road as a parking space. Prices encourage parking turnover and affect vehicle use in congested areas. Higher parking costs and increased turnover may raise more revenue for transit and bicycle paths. On-street parking management is implemented with parking meter technology. For example, an offsite location can electronically set peak-hour price per minute at a parking space.

Parking benefit districts link the revenue received from on-street parking to the needs of the neighborhood most affected by parked vehicles on nearby streets. Revenue from parking meters and parking offenses goes to meet neighborhood needs, such as bikeways and trails, instead of going into the city's general fund. San Francisco, California, is piloting this tool.

Shared parking among nearby land uses is a common tool for minimizing underutilized parking areas and reducing the amount of parking. Sharing parking spaces is typically based upon the time of day that different users require parking (residential use in the evening and business use during the workday) or applies when there is an over abundance of existing parking.

Unbundled parking requirements for a specific development can minimize parking spaces. Parking spaces may be allocated to an area based upon parking demand, which is often determined by a parking survey. Business and residential developers are not required to guarantee that a certain number of spaces are designated for a specific number of residential units or square feet of office space.

Parking bonuses reduce the amount of required parking for TOD and other high-density or mixed-use developments. Reducing parking, in turn, reduces development costs. Lower investment in parking infrastructure and land can improve project feasibility and promote alternative travel modes.

Underground parking incentives is a tool that helps reduce surface area for parking and make additional land available for more compact development, such as mixed use.

Maximum parking requirements is a shift from traditional zoning, which typically requires a minimum number of parking spaces. Parking minimums for each type of specific land use are based upon numbers of housing units or the square footage of a building. Shifting from a required minimum to a maximum number of parking spaces can reduce an oversupply of parking spaces and inefficient use of land for parking associated with a development.

Bloomington's zoning ordinance for a district (high-intensity, mixed-use district with residential land use) limits parking to 70 percent of the citywide requirement. The parking minimum is based on transit availability, walkability and transportation demand management (TDM). The ordinance includes shared parking, bonuses for underground parking and a maximum rather than a minimum parking requirement.

Resources: High-intensity mixed use with residential district HX-R zoning district, City of Bloomington, Minnesota, at www.ci.bloomington.mn.us/cityhall/dept/commdev/planning/regs/zoneproject/hxr/hxr.pdf; and *Reforming Parking Policies to Support Smart Growth: Toolbox/Handbook: Parking Best Practices and Strategies for Transit Oriented Development in the San Francisco Bay Area,* Metropolitan Transportation Commission, June, 2007, at www.mtc.ca.gov

Complete Streets

Complete Streets is a comprehensive land-use and transportation program designed to increase connectivity between places and increase opportunities for travel by transit, bicycling and walking. Complete Streets enables access for all types of travel.

Complete Streets is a tool designed and operated to accommodate safe, attractive and comfortable access and travel on streets by all users. Initiatives also incorporate place-making strategies through streetscape amenities and promote healthier communities by providing opportunities to walk and bicycle. The program is part of efforts to change how urban streets are planned, designed and funded. Connectivity ordinances, either stand-alone or as part of a subdivision ordinance, are used to define and implement requirements for connectivity among streets, trails and sidewalks. These ordinances are used in existing development through retro-fitting or in new development and redevelopment.

The Minnesota Legislature enacted a Complete Streets statute in 2010 for implementation by Mn/DOT. Fifteen local governments passed resolutions of support for the legislation.

Resource: *Complete Streets: Supporting Safe and Accessible Roads for Everyone Local Toolkit*, Minnesota Complete Streets Coalition at www.mncompletestreets.org

Safe Routes to Schools

Safe Routes to Schools encourages communities to plan and construct walking and biking routes for students, including disabled students. The program is funded by the federal government and administered by Mn/DOT.

The program is designed to facilitate the planning, development and implementation of projects and activities that improve safety and reduce traffic, fuel consumption and air pollution in the vicinity (two miles) of primary and middle schools. It supports goals of the Complete Streets program.

Lake Elmo, the Stillwater School District, Washington County and Mn/DOT collaborated to design a safe walking route to school plan for the Lake Elmo Elementary School in 2007. The school is located at a busy intersection of a state highway and county road.

Resource: Minnesota Safe Routes to School, Mn/DOT, at www.dot.state.mn.us/saferoutes

Nice Ride Minnesota

Nice Ride Minnesota promotes bicycling by providing public access to bicycles for a fee. The program provides bicycles at a variety of locations (the first 30 minutes of any trip is free). It was introduced by a nonprofit organization and currently operates in Minneapolis.

Resource: Nice Ride Minnesota at www.niceridemn.org

Bicycle Highways

Bicycle highways are proposed as a way to move bicycle traffic efficiently through designated networks that are like roads, with similar traffic management features. Infrastructure to accommodate bicycles goes beyond developing trails and bicycle lanes along roads.

The Association of U.S. State-Highway Officials approved the concept of a National Bicycle Routes Corridor Plan. That could be a first step toward creating a system of bicycle interstates in the U.S. In Denmark, Copenhagen is extending its bicycle network to the suburbs. The city's highway will use "green wave lights," standardized signs and bicycle service stations along the way.

Resource: U.S .Bicycle Routes Corridor Plan at www.fastlane.dot.gov/2010/07/us-bicycle-route-system-begins-connecting-america.html

Transportation Demand Management

TDM gives incentives to regional employers and employees to use transit or van pooling instead of driving alone to work. TDM also encourages staggered work schedules and working from home. TDM is often used by major employers or a group of major employers within a geographic area.

Four Transportation Management Organizations (TMOs) market and manage TDM for the region to help reduce VMT and mitigate congestion. In some cases, cities require a TDM plan or participation in a TDM plan by major employers. Federal congestion mitigation and air quality (CMAQ) funds, allocated through the Metropolitan Council, support TDM.

Resource: *Metropolitan Council TDM Evaluation and Implementation Study*, 2010, at http://www.metrocouncil.org/planning/transportation/TDMStudy.pdf

Community Benefit Agreements

Community benefit agreements (CBAs) define specific benefits a community will receive from a planned development in a legal agreement between a developer and a community coalition. It applies to complex projects that involve public funding and may have negative impacts on neighboring residents or businesses.

CBAs have been used for complex redevelopment projects, such as Yankee Stadium in New York City, where significant housing and economic changes are anticipated from proposed development plans. Negotiating agreements requires the participation of all stakeholders, including representatives of local business owners and residents, government entities and the developer(s). Agreements are legally binding and monitored for compliance.

A local example is the Longfellow Hiawatha Station/Purina Site CBA in Minneapolis. This CBA was created in early 2008. The status of the development project is currently being reviewed.

Resources: Longfellow Station/Purina Community Benefits Agreement at www.communitybenefits.blogspot.com/2008/03/longfellow-cba.html; and The Partnership for Working Families at www.communitybenefits.org

Air Quality Assessment Tool

The Council is developing a voluntary tool for estimating travel-related air pollutants from the interaction of land use and transportation. The air quality assessment tool provides a way to assess how different land-use or development scenarios for a proposed project or subarea affect travel behavior and potentially decrease emissions. Developing the tool responds to a legislative goal of reducing air pollution, although an air quality assessment tool is not required in this study.

The tool is a work in progress, and the final form of the tool is not yet determined. Preliminary results from testing the tool give approximate rather than precise answers, and they do not point to a single solution to significantly reduce air pollution. Yet, despite caveats, the tool is a starting point to provide additional information on travel behavior and emissions. It cannot be overstated that the purpose of the tool is to provide information, not to advocate strategies or mandate policies.

Voluntary Use of Tool

The tool works by estimating changes in emissions from land-use changes or alternative development scenarios. Results compare emissions for "before" and "after" scenarios. The air quality assessment tool is geared toward smaller-scale development options for a project, neighborhood or subdivision.

It is a tool, a voluntary tool, to assist informed decision-making by groups involved in local planning, economic development and environmental issues. The tool is intended to aid communication about the impact of growth and development. It will be available to help communicate about the affects of alternative, project-based development on reducing travel-related air pollutants. For example, a city planner could use the measure to see how a proposal that clusters jobs or housing near transit may reduce air pollutants. The tool offers a way to test scenarios for proposed projects that support or further strategies to implement recently updated comprehensive plans.

The tool is designed to supplement existing analysis and planning resources. Work on the Natural Resources Inventory and Assessment serves as a model, although the air quality assessment tool is oriented toward subareas rather than entire communities. For the natural resources tool, the Council and the Minnesota Department of Natural Resources completed an inventory and assessment of regionally important natural resources. The Council distributed the information, and local governments could then opt to use the database as a base for identifying important resources and making conservation decisions.

Main Messages

What the tool will do:

- Provide a way to assess how changes to land use or development in proposed projects or subareas could affect air pollutant emissions.
- Estimate changes in air pollutants for land use or alternative development scenarios with potential for generating fewer vehicle miles traveled. Results compare travel-related emissions for "before" and "after" scenarios.

Purpose and use of tool:

- Use is voluntary.
- Provides information; does not advocate strategies or mandate policies.
- Assists informed decision-making, and aids communication about the impact of growth and development.
- Supports implementation of regional policies in 2030 comprehensive plans of local governments, especially strategies to improve accessibility, connectivity and other interactions between land use and transportation.

Preliminary results from testing hypothetical examples:

- Testing the tool has produced preliminary results, and it remains a work in progress. The air quality assessment tool will be further developed for the final report.
- When reviewing examples of how the tool could be applied, results show that individual strategies produce modest changes.
- Results give approximate rather than precise answers and do not identify a single solution to significantly reduce air pollution.

Other considerations for understanding the tool and evaluating its use:

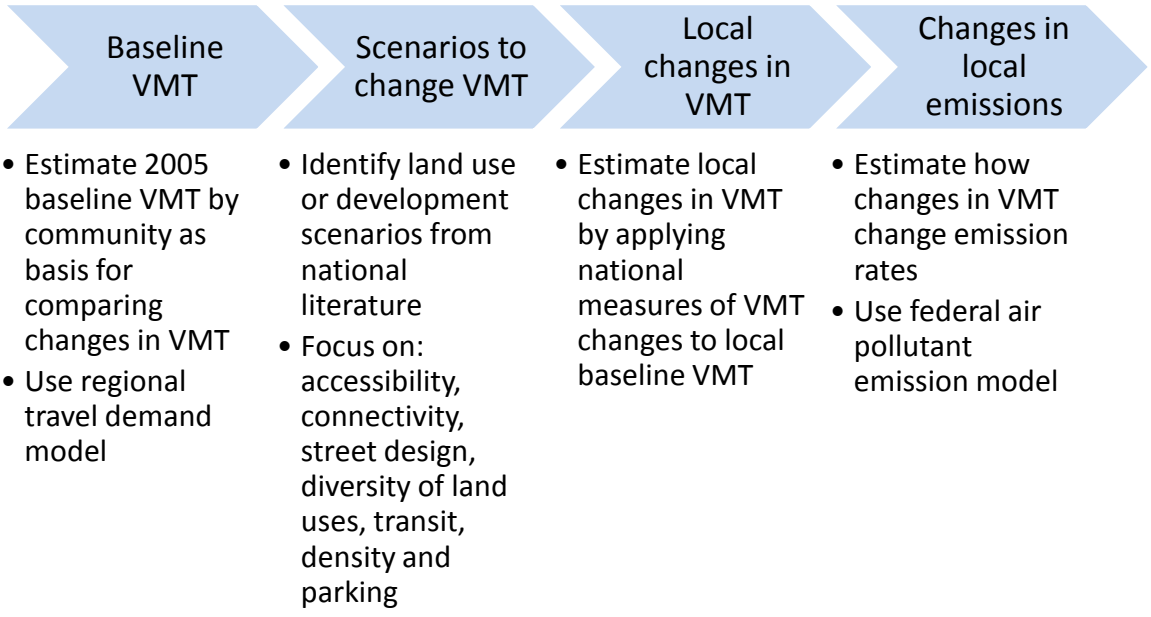
- Tool options will give users flexibility to choose among strategies to meet local circumstances.
- Local travel conditions and other available, local information are built into the tool.
- Part of the tool uses some controversial measures of how land use or alternative development scenarios potentially change vehicle miles traveled. Furthermore, measures are based on national and international literature and may not reflect local conditions.

Tool Building Blocks

As stated earlier, the tool works by estimating changes in emissions from land-use changes or alternative development scenarios (called comparative scenarios). It estimates 2005 baseline vehicle miles traveled (VMT) and then applies measures of how comparative scenarios change VMT. As a last step, the tool estimates how a change in VMT changes air pollutant emissions. Figure 6 depicts key building blocks of the tool.

Several sources of information go into the air quality assessment tool. The tool relies on: (1) regional travel demand modeling to estimate VMT by community; (2) national and international literature to measure how comparative scenarios change VMT; (3) measures from this literature search to estimate local changes in VMT from changes in land uses or development patterns; and (4) federal air pollution modeling to estimate resulting changes in emissions.

Figure 6



Understanding what went into building the tool and what the tool does and does not do is pivotal for those weighing whether to use the air quality assessment tool. More information in Appendix D helps make models, sources and methods used to develop the tool more transparent.

Definitions

The air quality assessment tool estimates air pollutants from mobile transportation sources, so not all emissions are covered. Transportation explains only a portion of total emissions, of which greenhouse gas emissions (GHG) emissions are a part. To put estimated emissions in context, Minnesota's transportation sector contributed 24 percent of total GHG emissions in 2005.[11] The tool estimates emission rates for nearly a dozen air pollutants listed in Table 1, including greenhouse gases. The tool does not measure total air pollutants or total greenhouse gases for a community. Nor will it forecast emissions in 2030.

The air quality assessment tool estimates emissions from roadway use − vehicles used for personal transportation, transit and commercial trucking. Buses are included, but not Hiawatha light-rail transit or Northstar commuter rail.[12] Air pollutants from aviation and private rail traffic are not included. The Council's regional transportation model does not include commercial rail, and the Council has no data to

[11] Center for Climate Strategies, *Final Minnesota Greenhouse Gas Inventory and Reference Case Projections 1990-2025* (Washington, D.C.: Center for Climate Strategies, 2008), pp. 5-6.

[12] The regional travel demand model does include Hiawatha LRT in the transit model network. LRT is taken into consideration in projecting modes used by travelers in that corridor. Emissions of the Hiawatha LRT line are not included in the air quality assessment tool because MOVES2010a, the EPA air pollutant emission rate model, does not produce emission rates for rail vehicles. Northstar commuter rail was not operating in 2005, which is the baseline year for the air quality assessment tool.

forecast travel behavior for a transportation mode run by private rail operators. Air traffic is not part of the tool because there is little relationship between land use and aircraft flights. Ground-transportation trips for airport passenger access and freight distribution are reflected in the tool.

Table 1
Air Pollutants Estimated

Ammonia	Nitrogen dioxide (NO_2)
Atmospheric CO_2	Nitrogen oxide (NO)
Carbon monoxide (CO)	Organic gases
CO_2 equivalent	Sulfur dioxide (SO_2)
Hydrocarbons	Volatile organic compounds (VOCs)
Methane (CH_4)	
Notes: CO_2 equivalent is calculated by MOVES2010a, taking into account the carbon content and greenhouse gas potential of carbon dioxide, methane and nitrous oxide. Energy consumption is also estimated for total energy consumption, petroleum energy consumption and fossil fuel energy consumption.	

Baseline VMT Estimates for Comparison

Estimates by community serve as a baseline for comparing changes in VMT resulting from land use or alternative development scenarios. The Twin Cities regional travel demand model produced 2005 estimates of VMT by trip purpose. Results focus on 2005 VMT rates for home-based trips and nonhome-based trips by community.[13]

Appendix D provides background information on the regional model and explains steps used to estimate VMT. Steps walk through how the model estimates the number of trips, trip mode, trip length and time of day traveled. The appendix also shares results for the region, communities, geographic planning areas and subareas. Results show that the central cities have the lowest VMT rates, while communities farther from job centers, shopping and other destinations have higher rates.

Land Use and Alternative Development Scenarios

The air quality assessment tool estimates changes in air pollutants for land use or alternative development scenarios with potential for generating fewer vehicle miles traveled. Only comparative scenarios that most affect VMT are built into the tool. Scenarios emphasize approaches that reduce or manage travel demand through land use and access to transportation options, a legislative requirement for this study.

[13] Home-based VMT rates are VMT for home-based trips divided by the number of households in the community. Rates of VMT for nonhome-based trips are VMT for nonhome-based trips divided by the number of jobs in the community.

Scenarios are mainly selected from a 2010 analysis of over 50 transportation-land use studies. Individual impacts appear relatively modest, and no single scenario delivers a big bang effect. Combined impacts of multiple scenarios are expected to produce more significant changes in travel behavior. If feasible, cumulative impacts will be shown later as the air quality assessment tool is further developed. Impacts of sustained changes could be larger than measured in studies, especially since land uses changes take effect over a long time period.

Scenarios to Reduce VMT

Tables 2 and 3 summarize strategies to reduce VMT and relate comparative scenarios to reductions in VMT. Major strategies that influence travel behavior are already described in the Resources and Tools section of this report.[14] Because some of these specific measures of change in VMT are controversial, they are included in Tables 2 and 3, so those who are evaluating the tool can see what went into this step of developing it. Changes in VMT measure how a given scenario reduces VMT. Different magnitudes of change are used in the tool, but impacts depend on the same relationship between a change in land use or development alternative and the associated change in VMT.

Table 2 identifies and briefly defines five important strategies: accessibility, street design, diversity of land uses, transit and density. These are commonly known as the "5Ds,"a short-hand reference to major influences on travel behavior from national and international studies.[15] Accessibility to destinations, characteristic of major activity centers or traditional downtowns, has the largest impact on reducing travel. Street design and connectivity is also strongly related to reducing VMT. Density has a relatively small impact, at least before combining it with an increased mix of land uses and street design with greater connectivity. Local governments have more control over the diversity of land uses, density and street design, whereas accessibility to destinations and distance to transit are more the province of regional government, transit providers or Mn/DOT.

For strategies in Table 2, analysis of national and international studies winnowed down results from more than 200 studies. Analysis also separated out other influences on travel behavior, especially socioeconomic influences. Changes in VMT reflect combined outcomes from studies with similar scenarios and enough data to make results applicable to other areas.

[14] Names of strategies differ somewhat from those in the Resources and Tools section. Strategies are based on two studies here, but strategies in the Resources and Tools section come from a variety of studies that do not use the same terms.

[15] Scenarios correspond to the 5Ds in this way: (1) destination accessibility is accessibility; (2) design is street design; (3) diversity is diversity of land uses; (4) distance to transit is transit; (5) density is the same; (6) and demand management is parking.

Table 2 Strategies and Changes in VMT from Land-Use Scenarios		
Strategy	**Alternative Land Use Scenario Relating Strategy to VMT**	**Change in VMT**
Accessibility: Ease of access to trip destinations – jobs, shopping, recreation and other destinations	Access to jobs by automobile	Increase access to jobs by car 10% ⇨ 2% decline in VMT
	Access to jobs by transit	Increase access to jobs by transit 10% ⇨ 0.5% decline in VMT
	Distance to downtown	Decrease distance to downtown 10% ⇨ 2.2% decline in VMT
Street Design: Characteristics of street network - density of intersections, connectivity (ranging from urban grids to cul-de-sacs) or streetscape	Intersection/street density	Increase street intersection/ street density 10% ⇨ 1.2% decline in VMT
	Percent of 4-way intersections	Increase percent of 4-way intersections 10% ⇨ 1.2% decline in VMT
Diversity of land uses: Number of different land uses in given area	Mix of land uses	Increase land use mix 10% ⇨ 0.9% decline in VMT
	Jobs-housing balance	Increase jobs-housing balance 10% ⇨ 0.2% decline in VMT
Transit: Shortest route along street network to nearest transit station or bus stop	Distance to nearest rail station or bus stop	Decrease distance to transit stop 10% ⇨ 0.5% decline in VMT
Density: Concentration of population or households	Household/population density	Increase density 10% ⇨ 0.4% decline in VMT

Table 2 Strategies and Changes in VMT from Land-Use Scenarios		
Strategy	**Alternative Land Use Scenario Relating Strategy to VMT**	**Change in VMT**
Source: Reid Ewing and Robert Cevero, "Travel and the Built Environment – a Meta-Analysis," *Journal of American Planning Association*, Summer 2010, Vol. 76, No. 3. Note: Change in VMT (elasticity) represents a weighted average across studies to measure how a given land use scenario reduces VMT.		

A sixth strategy covers scenarios to manage travel demand through parking. Table 3 shows the relationship between raising parking prices by a given amount per day and reducing VMT. As seen below, increasing the cost of parking can decrease travel.

Table 3 Strategies and Changes in VMT from Parking Pricing Scenarios		
Strategy	**Alternative Parking Scenario Relating Strategy to VMT**	**Change in VMT**
Parking: Parking pricing	Employee parking fees	Raise daily parking fee $1.00 ⇨ .09% decline in VMT Raise daily parking fee $3.00 ⇨ 2.4% decline in VMT
Source: Todd Litman, "Transportation Elasticities: How Prices and Other Factors Affect Travel Behavior," *Victoria Transport Policy Institute*, May 2010.		

Measures of changes in VMT have advantages and limitations. The advantages of using results from the national literature include: drawing from a depth of recent research; applying measures selected to be generalized to other areas; and relying on existing results to save time in developing this tool. Conversely, there are limitations: national studies may not mirror local circumstances; changes in VMT do not capture how one strategy may affect another strategy; and selected scenarios do not address a complete range of land use-transportation interactions. This study acknowledges that relationships between land use and travel behavior are controversial and subject to debate, no matter what studies may conclude or how impacts are measured.

Changes in Emissions

As a final step, the air quality assessment tool translates the difference in VMT into a change in air pollutants. Emission rates from mobile sources are estimated by a new air pollutant emission model.

The model is MOVES2010a, released by the U.S. Environmental Protection Agency (EPA) in January, 2010, and updated in August. Emissions cover air pollutants previously identified in Table 1. Emission rates, expressed as amounts of air pollution per VMT, are produced for each of the region's seven counties.

Air pollution estimates use 2005 as a baseline. The regional travel demand model provides model data for 2005, and Mn/DOT has traffic count data for 2005. This baseline is also consistent with Minnesota's Next Generation Energy Act, passed in 2007 to set statewide guidelines for GHG emissions and other goals.

Modeling of emission changes applied available local transportation information and national data supplied with MOVES2010a. Local information for the region's seven counties was added to tailor the model to the region's conditions. Doing so takes into account travel behavior and trends specific to the Twin Cities metropolitan area, a legislative requirement for this study. Appendix D gives details on local and national data sources used in MOVES2010a.

Examples and Future Development of Tool

The air quality assessment tool is very much a work in progress. In early testing of examples, individual strategies produce modest changes, and preliminary results do not identify a single solution to significantly reduce air pollution.

In a later phase of the tool's development, the tool will estimate changes in emissions for several hypothetical examples representing different geographic planning areas of the region. Results may describe scenarios, walk through key steps of the tool and depict scenarios to help visualize how strategies may change travel behavior. Results will give approximate rather than precise answers. Because the tool is designed to show impacts of smaller-scale development options, examples will highlight land use or development alternatives for projects or subareas rather than entire communities. Results for more than one scenario may be included. Examples will probably be based on actual developments in the region, although results will be presented as hypothetical examples.

Future Development of Tool

The form of the tool is not yet determined, but the goal is to design a user-friendly computer application. That means creating a robust, yet easy-to-use tool. Different forms of the tool will be evaluated, such as web-based, stand-alone, spreadsheet or Geographic Information Systems (GIS) options. A menu of choices will provide flexibility to fit local circumstances. As mentioned earlier, future modeling will test the feasibility of combining scenarios to show cumulative impacts rather than individual, relatively small changes.

In the final report due on January 15, 2011, the air quality assessment tool will be further developed and reviewed for its policy implications. Progress on the tool will support efforts to reduce air pollution and provide more information on approaches to manage travel demand through land use and access to transportation options.

Collaboration and Outreach

Throughout the course of the land use and planning resource study, the Council sought input from a variety of stakeholders. Stakeholder involvement meets a legislative requirement of collaborating with local units of government and other stakeholders interested in development and refinement of resources in the study. Discussions with advisory committees and other stakeholders facilitated key objectives – listening, sharing ideas and gaining feedback. Stakeholders have a say in the direction and content of progress reports and will continue to influence the final report.

Meetings with Advisory Committees and Stakeholders

Council staff met with land use and transportation advisory committees for the Council – the Land Use Advisory Committee (LUAC) and committees of the Transportation Advisory Board (TAB). They also involved stakeholders who expressed interest in participating. (Committee members and stakeholders are identified in Appendix E.) Meetings held since the April 15, 2010, progress report was completed are listed in Table 4, including dates and topics.

Committees and stakeholders offered guidance and advice about the overall approach to this study, development of the air quality assessment tool and useful planning resources. Input by committee members and stakeholders helped Council staff refine study elements and respond to local concerns. Locally elected officials on the LUAC, as well as stakeholders, shared their knowledge, made suggestions, and articulated a range of local perspectives. Discussions with committees supporting the TAB focused more on transportation impacts.

Land Use Advisory Committee

The Land Use Advisory Committee is authorized by state statute to give advice and assistance to the Council on land use, comprehensive planning, and matters of metropolitan significance. LUAC has a Council member as chair and 17 members, with one representative from each district and each county within the Council's jurisdiction. By law, at least half of committee members on the LUAC must be elected officials.

Advisory Committees of Transportation Advisory Board

Council staff also met with two advisory committees of the TAB throughout this study, which plays a central role in the region's transportation planning process. TAB is authorized by state statute and has 33 members representing elected officials, citizens, state agencies and various modes (such as freight, bicycles, pedestrians and transit). The TAB's Technical Advisory Committee (TAC) is made up of planners and engineers from cities and counties, as well as staff from the Council and other regional, state and federal agencies. Members of the TAC Planning Committee represent communities, counties, and transportation, transit, rail, and pollution control agencies. This group advises the TAC and TAB on planning issues.

Committee Feedback

Feedback came from committee meetings held from May through September 2010. Much of the input from committees concerns two main topics in this progress report – the air quality assessment tool and

resources and tools. Comments made during earlier meetings are in the April 2010 progress report. The final report will include feedback received over the course of this study.

Table 4
Key Meetings with Committees from May-September 2010

Group	Topic	Meeting Date
Planning Committee of Technical Advisory Committee for Transportation Advisory Board	Air pollution impact results; land use planning and resources report	May 13, 2010
Land Use Advisory Committee	Overview of updated *Transportation Policy Plan*; land use and planning resources progress report	June 17, 2010
Planning Committee of Technical Advisory Committee for Transportation Advisory Board	Tools and resources	July 8, 2010
Land Use Advisory Committee	Updates to air pollution index modeling; review of draft outline; tools and resources overview	August 19, 2010
Planning Committee of Technical Advisory Committee for Transportation Advisory Board	Land use and planning resources report – tools and resources	September 9, 2010
Land Use Advisory Committee	Review of land use planning resources report draft – air quality assessment tool and collaboration and outreach	September 16, 2010

Note: The air quality assessment tool has been referred to by other names, such as carbon footprint tool, air pollution impact tool and air pollution index modeling.

Members of the Land Use Advisory Committee contributed a full spectrum of comments on this study. Presentations on the air quality assessment tool, in particular, prompted considerable discussion. A number of committee members repeatedly expressed qualms about how the tool could be used and concern over how the tool is communicated. LUAC reacted positively to information shared on tools that

communities are using to implement 2030 comprehensive plans. Specific points appear below, mostly representing comments by individuals rather than the entire committee:

- Compare land uses in other metropolitan areas and look for possible solutions to reduce vehicle miles traveled (VMT) and air pollution.
- Question how employment corridors will redevelop. Some large commercial centers lack street connectivity and are not accessible. Using trails for more walking and biking may not happen.
- Repeatedly question the impact of raising density to reduce travel and air pollution. Local governments will have a hard time with the idea of raising density to lower VMT. Not all committee members agreed.
- If density is increased as a scenario in the air quality assessment tool, what happens to other factors? More density could increase congestion, raise the need to invest in public transportation and impact water quality. Density and VMT are only part of the equation for overall greenhouse gases. If the tool does not look at the whole picture, it is deceptive.
- Assumptions are not reasonable [in a hypothetical example used to test the tool]. When density is doubled for 25 percent of land in an area, it is misleading to assume that the rest of the area remains unchanged. If VMT is reduced in one area, VMT goes somewhere else.
- Fear that the tool will become a mandate.
- Find other ways to present and explain the tool. Consider flowcharts, icons, qualitative results and interactive web-based applications. How strategies to reduce VMT are presented makes a difference.
- Apprehensive about reliance on national literature to measure the relationship between land use and travel behavior. The report needs to state that the tool uses national literature from researching other areas, not local facts.
- Why develop an air quality assessment tool? Results are marginal at best. The report should have a disclaimer about the tool.
- A cost-benefit analysis would show that some changes are very expensive and yield little benefit.
- Application of the air quality assessment tool causes more concern than plans to include an assessment summary [in the final report]. Information going into an assessment of congestion, however, is a source of concern.
- Land-use changes are long term. The air quality assessment tool could help with long-term planning, but not with meeting short-term benchmarks in an assessment summary.
- Results from an analysis of tools communities are using to implement 2030 comprehensive plans show that communities are “getting it.”
- Explain why the air quality assessment tool does not estimate emissions from Hiawatha LRT and Northstar commuter rail. Will emission information for those modes be added?
- Want to weigh in on yet-to-be-completed hypothetical examples produced by the air quality assessment tool and an assessment summary. Do not want to send information to legislators in the October 2010 progress report that LUAC has not seen. Will add an extra meeting in December 2010 to discuss the final report before it is finished.
- Will more effort go into getting feedback from additional stakeholders?

Members of transportation advisory committees also shared many comments on the air quality assessment tool. They questioned how to deal with areas lacking transit, impacts on costs, and investment strategies given funding constraints. Committee members additionally offered advice on resources and tools and noted questions to answer when communicating findings. Specific points appear below, mostly representing comments by individuals rather than the entire group:

- What recommendations can be made for predominately residential communities?
- Why is 2005 used as a base year in the air quality assessment tool?
- Use caution when discussing areas with little transit service, given the increasing role of transitways to address congestion.
- Want to see a draft before the October 2010 report is completed.
- Air quality assessment tool is an asset and may potentially help gain federal funding for transportation. It could give the region a competitive advantage and should be considered for evaluating corridor changes.
- Make a few changes to local government tools included in the study, such as adding planned unit developments (PUDs) and clarifying what is meant by “local.” Add a local example of a community benefit agreement [contributed by a stakeholder].
- Acknowledge different opportunities among different types of communities. Note that the focus of this study is on transportation corridors. Legislators should not expect the higher densities along corridors to occur all over the region.
- Report does not tell a story.
- Be cautious about using the proposed, updated *2030 Transportation Policy Plan* because the plan is not complete. [The Council plans to consider adoption of the draft plan in November 2010.]
- Can air pollutant emissions be broken down beyond the county level?
- Will scenarios in the air quality assessment tool address: Access to jobs by walking and bicycling? Street connectivity of all streets or only certain functional classifications? Reverse commuting and/or busing?
- Acknowledge limitations of a congestion management strategy to strategically expand capacity with lower-cost/high-benefit investments. With underinvestment of regional freeways and principal arterials, these strategic investments are not likely for "A" minor arterials, which are forced to carry significant volumes of traffic beyond their capacity.
- Address the sustainability of major investments to expand transitways and regional trails. Also consider the effectiveness of expanding transportation choices to support more walking and bicycling.
- How to reduce costs is not addressed. Adding transit infrastructure, such as bus shelters, adds to maintenance costs. But who will shoulder this cost?
- Doubling transit use assumes a substantial increase in infrastructure, but that is optimistic given the funding picture.

Other Outreach Efforts

In addition to the meetings mentioned above, several other activities facilitated communication with stakeholders since the last progress report. A group of stakeholders, Council staff and others met in July 2010 to learn about a new application, the Energy Choice Simulator.[16] The tool shows the interaction of federal and state energy policies and can simulate economic decisions out to 2050. Fresh Energy organized a demonstration of the tool developed by the Great Plains Institute, the University of Minnesota and Forio Business Simulations.

To encourage participation from a wider group of stakeholders, the LUAC meeting agenda notices and accompanying presentations and report drafts were sent to additional groups. Those groups include the Builders Association of the Twin Cities (BATC), Commercial Real Estate Development Association (NAIOP Minnesota) and Metro Cities. Most recently, Council staff gave a presentation about the progress of this study at an annual meeting of the Minnesota Chapter of the American Planning Association in September 2010.

Council staff will continue outreach and collaboration efforts to encourage communication and inform the final report.

[16] See more information on the Energy Choice Simulator at http://www.gpisd.net/index.asp?Type=B_BASIC&SEC={211B5D67-4490-4982-9953-03419FCF38DB}

[Appendices include supplemental or reference information.]

Appendix A: Overview of Policy Directions and Strategies

The Metropolitan Council's policy directions and strategies are organized around four policies adopted in the *Regional Development Framework*, along with additional strategies for all communities to achieve regional goals. Policy directions and strategies from Chapter 2 in the *Framework* are listed below. They cover policies that go beyond land use and transportation to include wastewater services, water supply and aviation.

Work with local communities to accommodate growth in a flexible, connected and efficient manner.

- Support land-use patterns that efficiently connect housing, jobs, retail centers and civic uses within and among neighborhoods.
- Encourage growth and reinvestment in adequately sewered urban and rural centers with convenient access to transportation corridors.
- Promote development strategies that help protect and sustain the regional water supply.

- **Plan and invest in multimodal transportation choices, based on the full range of costs and benefits, to slow the growth of congestion and serve the region's economic needs.**
  - Focus highway investments on maintaining and managing the existing system, removing bottlenecks and adding capacity.
  - Make more efficient use of the regional transportation system by encouraging flexible work hours, telecommuting, ridesharing and other traffic management efforts, and by employing a variety of pricing techniques such as FAST lanes and HOT lanes.
  - Expand the transit system, add bus-only lanes on highway shoulders, provide more park-and-ride lots and develop a network of transitways.
  - Encourage local governments to implement a system of fully interconnected arterial and local streets, pathways and bikeways.
  - Promote the development and preservation of various freight modes and modal connections to adequately serve the movement of freight within the region and provide effective linkages that serve statewide, national and international markets.
  - Support airport facilities investments to keep pace with market needs and maintain the region's economic vitality.
- **Encourage expanded choices in housing location and types, and improved access to jobs and opportunities.**
  - Work to ensure an adequate supply of serviced, developable land to meet regional needs and respond to demographic trends.
  - Work with regional partners to increase housing options that meet changing market preferences.
  - Support the production and preservation of lifecycle and affordable housing with links to jobs, services and amenities accessible by auto, transit, biking and walking.

- **Work with local and regional partners to reclaim, conserve, protect and enhance the region's vital natural resources.**

  - Encourage the integration of natural-resource conservation strategies in regional and local land-use planning decisions.
  - Work with other regional partners to protect regionally important natural resources identified as unprotected in the Natural Resources Inventory and Assessment.
  - Work to preserve the quality of the region's water resources.
  - Work with our regional partners to remain in compliance with federal air quality standards for carbon monoxide, ground level ozone and fine particulate pollution.
  - Designate additional areas for the regional park system that enhance outdoor recreation opportunities and serve important natural-resource functions.

Appendix B: Geographic Planning Areas

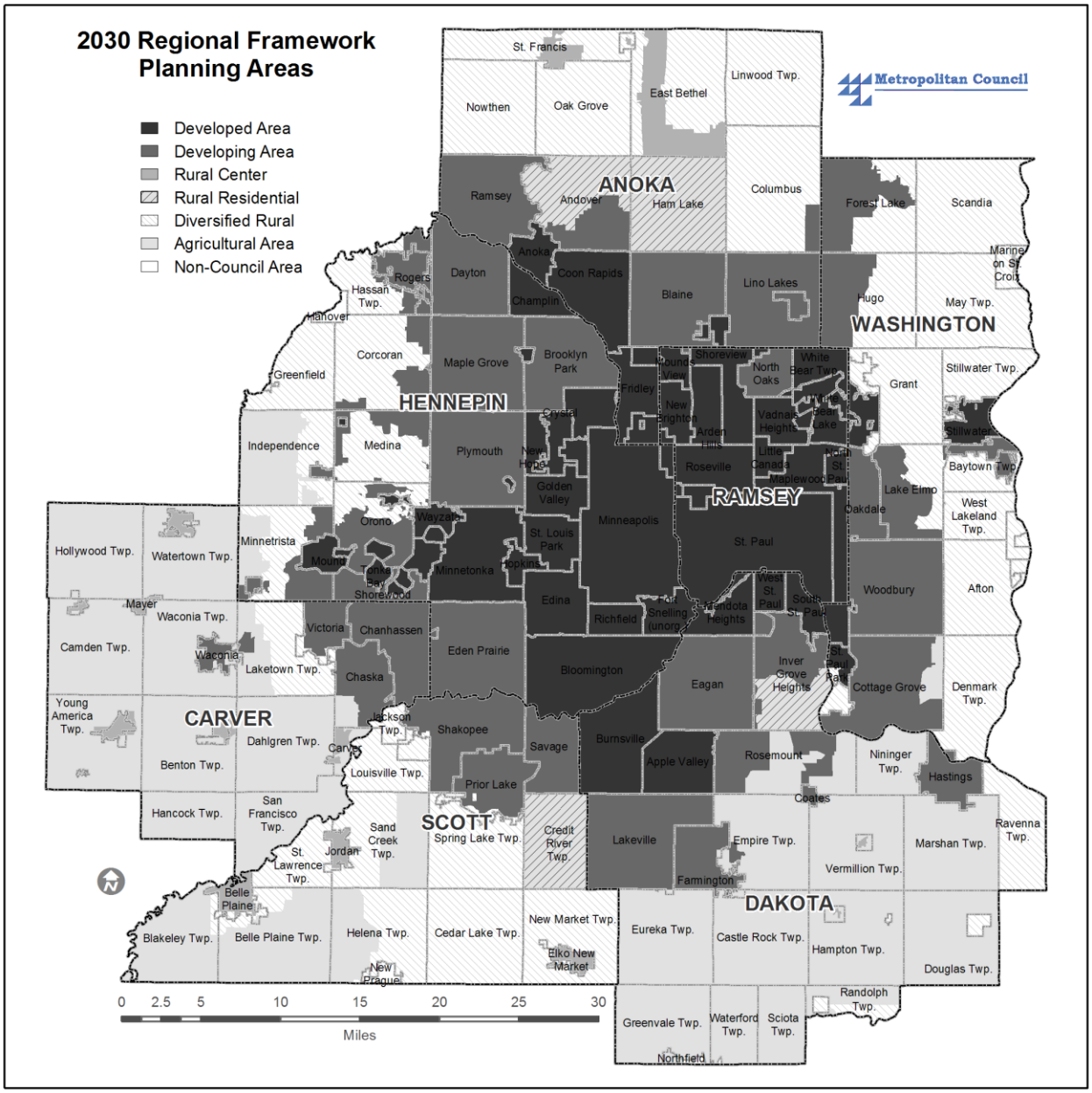
Several parts of this report refer to local areas within the region, so Appendix B supplies background information on the region's geographic planning areas defined in the Council's *Regional Development Framework*. Policies, strategies and implementation tools are tailored for different types of communities, and each community determines how to implement local strategies in the *Framework*.

The Council categorizes communities into geographic planning areas. These are developed communities, developing communities and four types of rural areas. Rural planning areas include rural centers (including rural growth centers), rural residential areas, diversified rural areas and agricultural areas. Figure 7 shows the location of the region's geographic planning areas.

Developed communities are cities where more than 85 percent of the land is developed and infrastructure is well established. Approximately 30 percent of the region's new households and about half of new jobs through 2030 are forecast to occur in these communities. Developing communities are cities where the most substantial amount of new growth will locate, about 60 percent of new households and 40 percent of new jobs. How and when development happens will influence how much additional land developing communities will need with urban services requiring substantial investments.

Rural areas make up about half of the 3,000 square miles in the region. Rural land uses range from farms to scattered or clustered homes to small towns, and rural areas include many of the region's remaining natural resources. Rural centers are small towns and may include rural growth centers with potential for and interest in growth. Most of new growth in rural areas is forecast to occur in rural growth centers, where existing infrastructure provides an alternative to individual wells and septic systems. Rural residential areas are developed at one housing unit per 2 to 2½ acres or less and have many individual sewage treatment systems. Diversified rural communities are sparsely developed areas with a variety of agricultural, large-lot residential and clustered housing, and other uses requiring a rural location. Agricultural areas are large contiguous land areas planned and zoned to maintain agriculture as the primary land use.

Figure 7


2030 Regional Framework
Planning Areas
Developed Area
Developing Area
Rural Center
Rural Residential
Diversified Rural
Agricultural Area
Non-Council Area
Metropolitan Council
ANOKA
HENNEPIN
RAMSEY
WASHINGTON
CARVER
SCOTT
DAKOTA
St. Francis
Nowthen
Oak Grove
East Bethel
Linwood Twp.
Ramsey
Andover
Ham Lake
Columbus
Forest Lake
Scandia
Marine on St Croix
Anoka
Dayton
Coon Rapids
Rogers
Hassan Twp.
Champlin
Blaine
Lino Lakes
Hugo
May Twp.
Hanover
Corcoran
Maple Grove
Brooklyn Park
Greenfield
Shoreview
North Oaks
White Bear Twp.
Grant
Stillwater Twp.
Fridley
New Brighton
Vadnais Heights
Arden Hills
Independence
Medina
Plymouth
Crystal
New Hope
Roseville
Little Canada
Maplewood
Lake Elmo
Baytown Twp.
Golden Valley
Oakdale
West Lakeland Twp.
Hollywood Twp.
Watertown Twp.
Minnetrista
Orono
Wayzata
St. Louis Park
Minneapolis
St. Paul
Mound
Tonka Bay
Shorewood
Minnetonka
Edina
Richfield
Bloomington
Eden Prairie
Chanhassen
Victoria
Mayer
Waconia Twp.
Camden Twp.
Waconia
Laketown Twp.
Chaska
Eagan
Inver Grove Heights
Cottage Grove
Denmark Twp.
Young America Twp.
Jackson Twp.
Shakopee
Savage
Burnsville
Apple Valley
Rosemount
Nininger Twp.
Hastings
Dahlgren Twp.
Benton Twp.
Louisville Twp.
Prior Lake
Coates
Hancock Twp.
San Francisco Twp.
Sand Creek Twp.
Spring Lake Twp.
Credit River Twp.
Lakeville
Empire Twp.
Marshan Twp.
Ravenna Twp.
St. Lawrence Twp.
Jordan
Farmington
Vermillion Twp.
Belle Plaine
Blakeley Twp.
Belle Plaine Twp.
Helena Twp.
Cedar Lake Twp.
New Market Twp.
Elko New Market
Eureka Twp.
Castle Rock Twp.
Hampton Twp.
Douglas Twp.
New Prague
Randolph Twp.
Greenvale Twp.
Waterford Twp.
Sciota Twp.
Northfield
0 2.5 5 10 15 20 25 30
Miles

Appendix C: Community Conversations

Introduction

During January and February, 2010, Council staff conducted informal interviews, or community conversations, with 18 communities about local activities related to the *Land Use and Planning Resources Report*. Conversations took place with city managers, community development directors and planning directors. These participants shared information on how their cities are addressing links between land use and transportation planning – emphasizing air pollution, traffic congestion, efficient use of transportation infrastructure and travel demand management. In addition, participants were also asked about community interest in a new transportation carbon footprint tool (later renamed "air quality assessment tool").

Participating Communities

Selected communities represent a variety of communities from all Metropolitan Council member districts. Communities include the two central cities, developed suburbs and developing suburbs. Where applicable, communities are further defined by major transportation corridors, both existing and planned by 2020. Types of corridors include freeway, light rail transit (LRT), commuter rail, and bus rapid transit (BRT).

- Central cities: Minneapolis (LRT and commuter rail) and St. Paul (LRT planned)
- Developed suburbs: Apple Valley (BRT), Bloomington (LRT), Burnsville, Coon Rapids (commuter rail), Minnetonka (LRT planned), Roseville, St. Louis Park (LRT planned)
- Developing suburbs: Blaine, Brooklyn Park, Eden Prairie (LRT planned), Hugo, Lakeville (BRT), Maple Grove (LRT/BRT corridor planned), Shakopee, Victoria, Woodbury

The summary below represents the substance of conversations, although comments are not attributed to specific communities.

Overall Comments

- A wide range of local activities address objectives of the *Land Use and Planning Resources Report*. Activities are known by various terms and are seen as part of other, ongoing activities. Terms used to describe activities include: sustainable development, environmental stewardship, quality of life, efficient and cost-effective operations, community development and jobs, comprehensive planning, plan implementation and conservation.
- Communities recognize strong links between transportation and land use or land-use patterns. Many local government officials see an increasing role for transit. Transitways, in particular, are seen as influencing future development decisions and land-use patterns (primarily infill and redevelopment). Most considered policies and strategies for new development as more likely to gain community support than ones addressing or retrofitting existing development.

  Many communities focus on city operations – energy use, city fleets, public buildings and facilities, and purchasing – to set an example for others in the community to follow. This included working

with ICLEI-Local Governments for Sustainability and getting green certificates for new or renovated facilities.

- A common theme among communities is "going our own way" to meet locally defined needs and directing activities toward meeting multiple objectives when addressing greenhouse gases, carbon footprint and energy efficiency/alternatives. The latter are seen as secondary benefits of local planning and development activities.
- There is interest − cautious in some communities − in a local carbon footprint tool. Such a tool is seen as potentially helping local decision-making. The "voluntary" use of the tool, by local initiative and with local direction, was received positively.
- Communities focus on development within their jurisdiction, where they have land-use control. However, communities recognize the influence and importance of transportation corridors (under the control of county, regional and state agencies). Communities are increasingly aware of how development patterns outside their communities influence them. More cooperation and coordination of land use and transportation at the subregional and corridor level is of interest.

Topic Areas

Sustainability or Sustainable Development

- Several communities reported work on sustainability − establishing sustainability commissions and taskforces and also assigning staff.
- Several communities participate in ICLEI-Local Governments for Sustainability USA activities. ICLEI is an international association of local governments, as well as national and regional local government organizations, that have made a commitment to sustainable development. ICLEI provides technical consulting, training, and information services to build capacity, share knowledge, and support local government in the implementation of sustainable development at the local level.
- Several communities are a part of GreenStep Cities, a voluntary program offering support for local implementation of sustainable best practices that focus on greenhouse gas reduction.
- Sustainability is seen as a useful, broad framework for improving not only city operations but guiding new development and redevelopment projects. Some communities have spent several years studying sustainable topics and including recommendations in their updated comprehensive plans. Several have sustainability coordinators and commissions.
- Examples of linking sustainable land use and transportation include using rain gardens to handle storm water runoff from parking lots and streets, and incorporating tree canopy in streetscape plans.

Density

- Most communities plan their highest-density residential uses near trails and commercial areas. Those uses are planned ¼ to ½ mile from trails and in nodes/station stops along existing and planned transitways for easy and short access to commercial areas.

- As noted by several communities, the case for increased density and intensity of development within the Interstate 494-694 beltway and along transit corridors needs to be made regionally. Local governments need financial assistance and new tools to implement higher-density, mixed-use developments.

Leverage LRT/Transitway Development

- Communities along existing and planned transitways (LRT, commuter rail and BRT) want to leverage that investment to support economic development. In doing so, communities see a range of development opportunities (size and scale). They are developing zoning ordinances accordingly, but see the need for other tools.
- Communities want to use market analyses to determine mix, scale and timing of station area plans and development.

Park-and-Ride and Express Transit

- Developing communities see new park-and-rides as ways to build support for transit and support smaller-scale, mixed-use development. They look to the market and developers, however, to take the lead in determining what will work.

Complete Streets

- Resolutions of support for Complete Streets have been passed by many communities. Complete Streets are designed and operated to enable safe access for all users. Pedestrians, bicyclists, motorists and bus riders of all ages and abilities are able to safely move along and across a complete street. Resolutions by communities include those in Hennepin County that also support the county's Active Living Program.
- Several communities included Complete Streets concepts and provisions in their comprehensive plans.
- Several communities have moved toward eliminating cul-de-sacs from neighborhood design. Furthermore, some assign new development plans negative points in the development review process if cul-de-sacs are part of the plan.
- Some communities have focused on "complete corridor" connectivity (for travel by auto, bus/transit, bike or foot) rather than connectivity for a single roadway.

Street Planning

- One city worked through a transportation/street building process that expands criteria for street design. The time-consuming facilitation process among engineers, planners and others went beyond safety and mobility to include livability and sustainability. The process resulted in a new plan for roadways and how they will be built.

Trails and Sidewalks

- The 2030 Comprehensive Plan Updates include plans for community-wide networks of trails and sidewalks to connect people and places through pedestrian and bicycle travel. Some have city-wide

grid plans for bicycle and pedestrian pathways/sidewalks. Other communities noted that sidewalks and trails are not acceptable in some neighborhoods.

- For community support of trails and sidewalks, health concerns, recreation and active living programs are seen as more important than commuting to work and shopping.

Transit-Oriented Development

- Communities along transitway corridors are planning for mixed-use and walkable developments. Most anticipate that such development will happen over time with the market. Some communities are reluctant to lead in this regard, preferring to leave the initiative to the development community.
- LRT, much more than BRT, is seen as an opportunity to think about redevelopment differently, in terms of market area, project-area access, and mix of uses.
- Several communities have projects that incorporate New Urbanism and predate the *2030 Transportation Policy Plan.*

Centers/Urban Village

- Several communities are encouraging development of "urban villages" or "town centers" to provide a focus for community identity or neighborhood identity in the central cities. These concepts include mixed-use, walkable, and transit-friendly retail/commercial development. The level of transit service (LRT versus express bus/regular route) is important in determining the scale of these centers and their development potential.
- Parks and trails are seen as key amenities for higher-density nodes.

Tree Planting/Canopy

- Most cities have urban forestry polices and codes that require tree plantings along roadways and preserving trees in developments. Most face challenges maximizing these planting schemes because county and state roadway safety standards control the level of and location of trees along major roadways.

Travel Demand Management

- Most communities with large, regional employment centers have travel demand management (TDM) organizations and plans to address commuting and commercial development design and access.
- Several communities support an e-workplace initiative. (Telework is an off-site work arrangement that permits employees to work away from the office for part or all of the work week.) Companies that implement effective telework strategies report an increase in competitive edge, efficiency and performance. Telework can be an effective strategy to reduce costs associated with real estate, increase employee retention, and improve employee productivity and morale overall.
- Several communities are considering new TDM ordinances for employers with more than 100 employees.

GIS and Redevelopment Implementation

- Most communities use Geographic Information Systems (GIS) as a planning tool. One community conducted a city-wide analysis of land parcels and public facility capacity to identify infill and redevelopment opportunities. The city used the information to identify a limited number of areas for city investment and leverage.

Other Related Community Activities

A. Greenhouse Gas Emission Reduction Protocol ICLEI - Local Governments for Sustainability

Background. Local governments join the Cities for Climate Protection (CCP) campaign by passing a resolution pledging to reduce greenhouse gas (GHG) emissions from their local government operations and throughout their communities. To help cities achieve their goals, ICLEI then assists cities undertaking the CCP's five milestones.

The five milestones of the CCP and the methodology behind them provide a simple, standardized means of calculating GHG emissions; establishing targets to lower emissions; reducing GHG emissions; and monitoring, measuring and reporting performance. ICLEI has developed several software tools that help cities comply with the methodology.

Members. Local members of ICLEI-Local Governments for Sustainability

- Dakota County
- Edina
- Mahtomedi
- Minneapolis
- Oakdale
- Roseville
- St. Paul
- White Bear Lake

Five Milestones. The five milestones provide a flexible framework that can accommodate varying levels of analysis, effort, and availability of data. This increases its transferability among local governments, making the CCP both unique and innovative.

Milestone 1. Conduct a baseline emissions inventory and forecast. Based on energy consumption and waste generation, the city calculates GHG emissions for a base year (e.g., 2000) and for a forecast year (e.g., 2015). The inventory and forecast provide a benchmark for measuring progress.

Milestone 2. Adopt an emissions reduction target for the forecast year. The city establishes an

emission reduction target for itself. The target both fosters political will and creates a framework to guide planning and implementation measures.

Milestone 3. Develop a Local Action Plan. Through a multi-stakeholder process, the city develops a Local Action Plan that describes policies and measures the local government will take to reduce GHG emissions and achieve its emissions reduction target. Most plans include a timeline, a description of financing mechanisms, and an assignment of responsibility to departments and staff. In addition to direct GHG reduction measures, most plans also incorporate public awareness and education efforts.

Milestone 4. Implement policies and measures. The city implements policies and measures contained in their Local Action Plan. Typical policies and measures implemented by CCP participants include: energy efficiency improvements to municipal buildings and water treatment facilities; streetlight retrofits; public transit improvements; installation of renewable power applications; and methane recovery from waste management.

Milestone 5. Monitor and verify results. Monitoring and verifying progress implementing measures to reduce or avoid GHG emissions is an ongoing process. Monitoring begins once the city implements its measures. Monitoring continues for the life of these measures, which provides important feedback that can be used to improve measures over time.

B. U.S. Conference of Mayors Climate Protection Agreement

Website: http://usmayors.org/climateprotection/agreement.htm

Background. Scientific evidence and consensus continues to strengthen the idea that climate disruption is an urgent threat to the environmental and economic health of our communities. Many cities, in this country and abroad, already have strong local policies and programs in place to reduce global warming pollution, but feel more action is needed at the local, state, and federal levels to meet the challenge. The Kyoto Protocol took legal effect on February 16, 2005. Since then, 141 countries have ratified it to date. The Kyoto Protocol is an international agreement to address climate disruption. At that time, Seattle Mayor, Greg Nickels, launched this initiative to advance the goals of the Kyoto Protocol through leadership and action by at least 141 American cities.

By the U.S. Conference of Mayors Annual Meeting in June, 2005, 141 mayors had signed the Agreement – the same number of nations that ratified the Kyoto Protocol. In May, 2007, Tulsa Mayor, Kathy Taylor, became the 500th mayor to sign on.

Metro Area Mayors – Members

Mary Hamann-Roland	Apple Valley	MN
Tim Willson	Brooklyn Center	MN

Elizabeth Kautz	Burnsville	MN
Mike Maguire	Eagan	MN
Nancy Tyra-Lukens (former Mayor)	Eden Prairie	MN
James Hovland	Edina	MN
Peter Lindstrom	Falcon Heights	MN
Linda Loomis	Golden Valley	MN
George Tourville	Inver Grove Heights	MN
Judson Marshall	Mahtomedi	MN
Diana Longrie (former Mayor)	Maplewood	MN
R.T. Rybak	Minneapolis	MN
Janis Callison (former Mayor)	Minnetonka	MN
David Beaudet	Oak Park Heights	MN
William Droste	Rosemount	MN
Craig Klausing	Roseville	MN
Chris Coleman	St. Paul	MN
Molly Park	Sunfish Lake	MN
Paul Auger (former Mayor)	White Bear Lake	MN
William Hargis	Woodbury	MN

Actions taken under the agreement. Participating cities commit to take following three actions:

- Strive to meet or beat the Kyoto Protocol targets in their own communities, through actions ranging from anti-sprawl land-use policies to urban forest restoration projects to public information campaigns;
- Urge their state governments, and the federal government, to enact policies and programs to meet or beat the GHG emission reduction target suggested for the United States in the Kyoto Protocol (7 percent reduction from 1990 levels by 2012); and
- Urge the U.S. Congress to pass the bipartisan GHG reduction legislation, which would establish a national emission trading system.

Agreement:
The U.S. Mayors Climate Protection Agreement (as endorsed at the 73rd Annual U.S. Conference of Mayors meeting, Chicago, 2005):

1. We urge the federal government and state governments to enact policies and programs to meet or beat the target of reducing global warming pollution levels to 7 percent below 1990 levels by 2012, including efforts to: reduce the United States' dependence on fossil fuels and accelerate the development of clean, economical energy resources and fuel-efficient

technologies such as conservation, methane recovery for energy generation, waste to energy, wind and solar energy, fuel cells, efficient motor vehicles, and biofuels;

2. We urge the U.S. Congress to pass bipartisan greenhouse gas reduction legislation that 1) includes clear timetables and emissions limits and 2) a flexible, market-based system of tradable allowances among emitting industries; and

3. We will strive to meet or exceed Kyoto Protocol targets for reducing global warming pollution by taking actions in our own operations and communities such as:

    a. Inventory global warming emissions in City operations and in the community, set reduction targets and create an action plan;

    b. Adopt and enforce land-use policies that reduce sprawl, preserve open space, and create compact, walkable urban communities;

    c. Promote transportation options such as bicycle trails, commute trip reduction programs, incentives for car pooling and public transit;

    d. Increase the use of clean, alternative energy by, for example, investing in “green tags”, advocating for the development of renewable energy resources, recovering landfill methane for energy production, and supporting the use of waste to energy technology;

    e. Make energy efficiency a priority through building code improvements, retrofitting city facilities with energy efficient lighting and urging employees to conserve energy and save money;

    f. Purchase only Energy Star equipment and appliances for City use;

    g. Practice and promote sustainable building practices using the U.S. Green Building Council's LEED program or a similar system;

    h. Increase the average fuel efficiency of municipal fleet vehicles; reduce the number of vehicles; launch an employee education program including anti-idling messages; convert diesel vehicles to bio-diesel;

    i. Evaluate opportunities to increase pump efficiency in water and wastewater systems; recover wastewater treatment methane for energy production;

    j. Increase recycling rates in City operations and in the community;

    k. Maintain healthy urban forests; promote tree planting to increase shading and to absorb CO_2; and

    l. Help educate the public, schools, other jurisdictions, professional associations, business and industry about reducing global warming pollution.

Appendix D: Additional Information on Air Quality Assessment Tool

Sources, models and methodologies are summarized in Appendix D to make more information available about the process of developing the air quality assessment tool. It first provides background information on the regional travel demand model and explains steps used to estimate vehicle miles traveled (VMT). This replaces a general summary of the regional travel demand model included in the April 2010 progress report. Baseline VMT estimates are shared for areas in the region, including communities. The latest federal air pollution model, MOVES2010a, is covered last. Results for the region estimate pollutants emitted by mobile sources.

Regional Travel Demand Model

The regional travel demand model produced 2005 estimates of VMT that serve as a baseline for comparing changes in VMT resulting from land use or alternative development scenarios. Baseline estimates of VMT were prepared for each community within the region, as well as for the Council's geographic planning areas, subareas, and the entire region. Several steps in the modeling combined processes not typically found in a standard travel demand model. The following material describes the modeling process.

Background Information on Modeling

Before focusing on how 2005 VMT was estimated, this section provides background information on the regional travel demand model. The modeling process covers trip generation, trip distribution, choice of travel mode and assignment of trips. Transportation analysis zones (TAZs) are also defined.

The regional travel demand model was used to estimate highway and transit use. Modeling follows procedures used in air quality conformity analysis for the Metropolitan Council's *2030 Transportation Policy Plan*. It generally follows a classic "four step" travel demand model process, as described below.

Step 1 - Trip Generation

The model first estimates person trips (trip generation) for eight purposes based on population, household and employment socio-economic data aggregated to TAZs. (A person trip is a one-way journey by one person between two points.) Totals of socio-economic data by community are allocated by the communities themselves into TAZs within their boundaries. The rates at which a household and its members produce trips and the rates at which employment locations attract trips are based on observed data from the 2000 Travel Behavior Inventory (TBI).

Step 2 - Trip Distribution

The model next projects the movement of person trips between pairs of TAZs. Generally, the likelihood of trips moving between any pair of TAZs is affected by the number of trips produced by the origin zone and attracted to the destination zone, and also by the distance between the two zones.

Step 3 – Mode Choice

The regional travel demand model estimates transit, single-occupancy vehicle (SOV) and high-occupancy vehicle (HOV) trips. In addition, the model estimates walk and bicycle trips. Mode choice (the probability of the choice among modes) is based on observed data from the TBI. Mode choice models use travel

times and costs of the highway and transit systems to estimate the proportion of trips that are allocated to the transit system, SOV trips and HOV trips.

Step 4 - Assignment

The 2005 highway network is based on the highway system that existed in 2005. Highway trips are related to geographical areas, such as rural, developing, developed, residential core, business core and outlying business. Categories of roads or highway facilities that make up the highway network include: metered freeway, unmetered freeway, metered system and local access ramps, unmetered system and local access ramps, collector/distributor roads, expressways, divided arterial, undivided arterial, collector, high-occupancy vehicle (HOV), centroid connector, and HOV ramp.

The transit network consists of bus routes related to an underlying street and highway network. Primary route attributes include type of service (express, local, LRT, etc.), run time by link or stop to stop, and frequency of service. The network also includes walk and ride access links between TAZ centroids and the transit network.

The highway assignment model distributes vehicle trips onto the highway system. Trips reflect changes in the volume of travel and associated speeds in an iterative procedure. The transit assignment model distributes person trips onto the transit system. Both assignment techniques assign the trips based on shortest travel time paths.

Detailed technical information on transportation models is found in technical memorandums developed as part of the 2000 TBI. More information is available through the Council's website or the Council's Metropolitan Transportation Services Division.

Transportation Analysis Zones (TAZs)

TAZs are used in the traffic modeling process as the common geographic unit for data summary. They serve as the geographic unit used by the models to predict attractions and productions of person trips. The system of TAZs covers the entire seven-county region (Anoka, Dakota, Carver, Hennepin, Ramsey, Scott, and Washington Counties), plus adjoining collar counties. All data drawn from home interviews and selected other trip and socioeconomic data were compiled by TAZ. In addition, the TAZ system forms the geographic framework for coding highway and transit networks. Each TAZ is linked to all others by the highway network. Inside the core seven counties, most are linked to one another by the transit network as well.

The current zone system consists of 1,201 zones within the seven-county region. Zones outside the region include: 35 "inner" external station zones around the seven counties; 364 zones in the 13-collar or ring counties (Chisago, Isanti, Mille Lacs, Sherburne, Wright, McLeod, Sibley, LeSueur, Rice, Goodhue, Pierce, WI; St. Croix, WI; and Polk, WI); and 32 zones representing "outer" external stations around the ring counties.

Internal zone boundaries most often lie along major highways or arterial streets or on any other significant physical boundary that shapes and directs trip movements, such as a large lake or major river.

County boundaries also form edges of zones. An external station is a point at the edge of the 20-county area where vehicle trips leave or enter the system without being associated with the local land use. In other words, one end of the trip is outside the 20-county area.

Estimates of Vehicle Miles Traveled (VMT)

In the air quality assessment tool, the regional travel demand model estimates 2005 baseline VMT for communities and other areas. The VMT estimates provide a means of comparing how VMT changes in response to changes in land uses or development patterns. Steps to estimate VMT are described below.

The highway assignment step produces highway model networks with traffic volumes on each of the roadway links in the model network. An attribute of each link is also the length of the roadway link, which combined with the volume on the link, produces an estimate of the vehicle miles traveled across the roadway link. (A link is a segment of road in the model network, typically between two intersections.)

When estimating VMT for each community, a first step was to group the 24 time periods for which volume assignments are produced across the day to five time periods: (1) early morning – midnight to 6:45 a.m.; (2) AM peak – 6:45 a.m. to 9:30 a.m.; (3) mid-day – 9:30 a.m. to 2:30 p.m.; (4) PM peak – 2:30 p.m. to 6:00 p.m.; and (5) evening – 6:00 p.m. to midnight.

As a next step, trip length was calculated after factoring in congestion. When measuring trip length, the model assumes that auto and truck trips occur along the shortest path between origins and destinations. The average congested travel time during each of the five time periods for each roadway link in the travel demand forecast model was calculated. Mileage along the shortest path, reflecting travel time slowed by congestion, was traced and measured between each origin TAZ to each destination TAZ. Mileage between origins and destinations was multiplied by the number of vehicle trips to estimate total VMT.

VMT between TAZs was aggregated by trip purpose for each community. For this study, VMT results focus on home-based trip and nonhome-based trips. Home-based trips include work, work-related, school (K-12), shopping, university and other trips. Nonhome-based trips are work trips or other nonhome-based trips. For home-based trips, VMT was aggregated at the community of home residence. For nonhome-based trips and for truck trips, VMT was aggregated at the community of trip origin and of trip destination. VMT from through trips (trips that neither start nor end in the community) was also estimated for each community.

Finally, VMT by type of trip was converted to VMT rates by community. VMT by home-based trips is produced by TAZ of the community of residence. Home-based VMT rates are VMT for home-based trips divided by the number of households in the community. VMT by nonhome-based trips and commercial trucking trips is available by TAZ of both the community of trip origin and the community of trip destination. Rates of VMT for nonhome-based trips are VMT for nonhome-based trips divided by the number of jobs in the community.

Baseline VMT Estimates for Areas

Figure 8 shows home-based and nonhome-based average daily VMT in 2005 by community. Travel is concentrated within the Interstate 694/Interstate 494 ring. The central cities generate the greatest VMT because they have a large number of households and jobs.

Figure 8

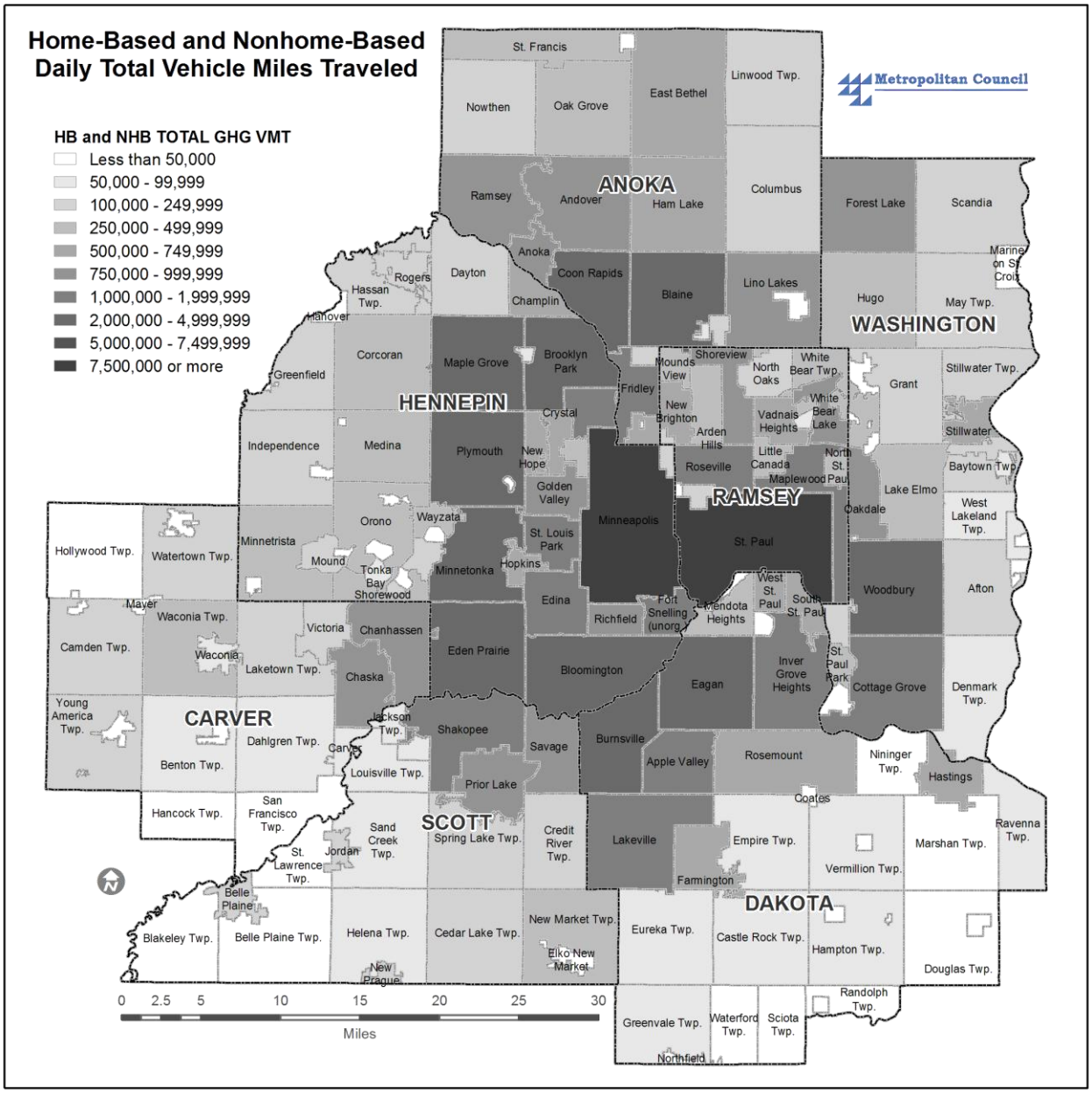


Table 5 shows average daily 2005 VMT rates for home-based trips per household and nonhome-based trip per employee. The table gives results for communities, the Council's geographic planning areas,

other subareas and the region. The central cities have the lowest rates, while communities farther from job centers, shopping and other destinations have higher VMT rates.

Table 5
Estimates of Average Daily Vehicle Miles Traveled
by Community, Planning Area, Subarea and the Region

Community	County	VMT Home-Based per Household	VMT Nonhome-Based per Employee
Afton	Washington	78.80	40.90
Andover	Anoka	79.20	50.60
Anoka	Anoka	48.20	28.30
Apple Valley	Dakota	60.70	40.00
Arden Hills	Ramsey	59.50	20.00
Bayport	Washington	34.70	10.50
Baytown Twp	Washington	166.20	737.90
Belle Plaine	Scott	60.70	40.00
Belle Plaine Twp	Scott	100.20	94.60
Benton Twp	Carver	231.30	79.30
Bethel	Anoka	62.80	10.30
Birchwood Village	Washington	4.20	38.20
Blaine	Anoka	63.90	37.00
Blakely Twp	Scott	78.00	36.10
Bloomington	Hennepin	42.90	20.00
Brooklyn Center	Hennepin	43.90	30.60
Brooklyn Park	Hennepin	49.20	31.10
Burnsville	Dakota	61.40	30.90
Camden Twp	Carver	248.90	820.00
Carver	Carver	53.00	98.70
Castle Rock Twp	Dakota	81.30	42.60
Cedar Lake Twp	Scott	128.20	168.30
Centerville	Anoka	29.00	21.70
Champlin	Hennepin	58.70	45.60
Chanhassen	Carver	74.40	31.40
Chaska	Carver	67.50	24.90
Chaska Twp	Carver	80.80	62.50
Circle Pines	Anoka	53.40	26.40
Coates	Dakota	35.30	17.20

Table 5 Estimates of Average Daily Vehicle Miles Traveled by Community, Planning Area, Subarea and the Region			
Community	**County**	**VMT Home-Based per Household**	**VMT Nonhome-Based per Employee**
Cologne	Carver	5.20	4.40
Columbia Heights	Anoka	38.40	35.50
Columbus	Anoka	101.70	36.60
Coon Rapids	Anoka	54.40	33.30
Corcoran	Hennepin	75.30	34.00
Cottage Grove	Washington	76.00	38.00
Credit River Twp	Scott	96.00	91.90
Crystal	Hennepin	39.40	39.70
Dahlgren Twp	Carver	91.30	35.70
Dayton	Hennepin	79.10	27.50
Deephaven	Hennepin	58.30	38.30
Dellwood	Washington	67.70	21.30
Denmark Twp	Washington	82.90	72.90
Douglas	Dakota	101.00	146.50
Eagan	Dakota	62.40	21.70
East Bethel	Anoka	103.00	53.50
Eden Prairie	Hennepin	55.00	21.60
Edina	Hennepin	38.40	20.80
Elko	Scott	10.40	7.10
Empire Twp	Dakota	69.80	50.30
Eureka Twp	Dakota	92.20	59.00
Excelsior	Hennepin	39.70	30.50
Falcon Heights	Ramsey	44.30	27.70
Farmington	Dakota	73.50	41.20
Forest Lake	Washington	71.40	40.60
Fort Snelling/MSP	Hennepin	0.00	25.80
Fridley	Anoka	46.10	23.10
Gem Lake	Ramsey	221.50	58.70
Golden Valley	Hennepin	43.70	19.40
Grant	Washington	87.80	57.50
Greenfield	Hennepin	72.00	60.50
Greenvale Twp	Dakota	210.40	85.00

Table 5 Estimates of Average Daily Vehicle Miles Traveled by Community, Planning Area, Subarea and the Region			
Community	**County**	**VMT Home-Based per Household**	**VMT Nonhome-Based per Employee**
Greenwood	Hennepin	74.00	44.00
Grey Cloud Island	Washington	101.70	44.10
Ham Lake	Anoka	104.00	47.60
Hamburg	Carver	3.40	3.80
Hampton	Dakota	12.30	5.50
Hampton Twp	Dakota	160.80	185.30
Hancock Twp	Carver	121.40	55.00
Hanover	Hennepin	32.00	8.70
Hassan Twp	Hennepin	93.00	37.20
Hastings	Dakota	46.20	29.40
Helena Twp	Scott	90.00	26.90
Hilltop	Anoka	35.00	21.70
Hollywood Twp	Carver	100.00	82.30
Hopkins	Hennepin	33.20	22.30
Hugo	Washington	66.10	38.60
Independence	Hennepin	132.80	2907.60
Inver Grove Heights	Dakota	66.70	47.90
Jackson Twp	Scott	89.70	64.00
Jordan	Scott	74.30	50.50
Lake Elmo	Washington	74.60	50.10
Lake St. Croix Beach	Washington	68.80	73.70
Lakeland	Washington	72.10	35.90
Lakeland Shores	Washington	101.30	97.10
Laketown Twp	Carver	168.20	54.20
Lakeville	Dakota	75.40	35.80
Landfall	Washington	17.00	46.80
Lauderdale	Ramsey	14.40	26.10
Lexington	Anoka	55.20	35.50
Lillydale	Dakota	27.90	22.20
Lino Lakes	Anoka	98.70	55.90
Linwood Twp	Anoka	126.80	177.20
Little Canada	Ramsey	45.10	28.10

Table 5 Estimates of Average Daily Vehicle Miles Traveled by Community, Planning Area, Subarea and the Region			
Community	**County**	**VMT Home-Based per Household**	**VMT Nonhome-Based per Employee**
Long Lake	Hennepin	13.40	2.90
Loretto	Hennepin	4.50	1.30
Louisville Twp	Scott	113.10	65.20
Mahtomedi	Washington	72.50	50.70
Maple Grove	Hennepin	54.20	33.50
Maple Plain	Hennepin	6.00	1.20
Maplewood	Ramsey	49.20	24.70
Marine on St. Croix	Washington	98.00	38.10
Marshan Twp	Dakota	79.50	46.50
May Twp	Washington	114.70	386.90
Mayer	Carver	5.20	10.00
Medicine Lake	Hennepin	41.40	777.70
Medina	Hennepin	79.60	30.50
Mendota	Dakota	166.70	24.50
Mendota Heights	Dakota	62.70	21.00
Miesville	Dakota	23.30	5.80
Minneapolis	Hennepin	30.10	17.80
Minnetoka Beach	Hennepin	40.90	16.10
Minnetonka	Hennepin	48.40	24.40
Minnetrista	Hennepin	153.70	166.30
Mound	Hennepin	28.10	21.30
Mounds View	Ramsey	49.40	29.00
New Brighton	Ramsey	40.60	24.00
New Germany	Carver	5.40	4.00
New Hope	Hennepin	39.20	18.00
New Market	Scott	0.00	0.00
New Market Twp	Scott	203.60	150.10
New Prague	Scott	49.90	21.30
New Trier	Dakota	7.00	2.30
Newport	Washington	60.10	27.40
Nininger Twp	Dakota	75.10	26.70
North Oaks	Ramsey	74.30	51.30

Table 5 Estimates of Average Daily Vehicle Miles Traveled by Community, Planning Area, Subarea and the Region			
Community	**County**	**VMT Home-Based per Household**	**VMT Nonhome-Based per Employee**
North St. Paul	Ramsey	38.40	30.90
Northfield	Dakota	9.90	13.70
Norwood-Young America	Carver	6.10	2.80
Nowthen	Anoka	101.20	61.30
Oak Grove	Anoka	105.30	86.60
Oak Park Heights	Washington	31.20	19.20
Oakdale	Washington	54.60	29.70
Orono	Hennepin	101.30	133.70
Osseo	Hennepin	36.40	19.90
Pine Springs	Washington	238.40	1650.40
Plymouth	Hennepin	53.40	21.90
Prior Lake	Scott	77.50	26.70
Ramsey	Anoka	82.50	40.90
Randolph	Dakota	15.70	8.50
Randolph Twp	Dakota	97.20	94.30
Ravenna Twp	Dakota	87.40	88.30
Richfield	Hennepin	33.90	31.00
Robbinsdale	Hennepin	39.40	24.00
Rockford	Hennepin	11.10	1.20
Rogers	Hennepin	30.90	18.50
Rosemount	Dakota	61.40	29.20
Roseville	Ramsey	41.80	27.50
San Francisco Twp	Carver	94.80	84.10
Sand Creek Twp	Scott	100.60	51.40
Savage	Scott	68.30	38.80
Scandia	Washington	110.20	82.70
Sciota Twp	Dakota	117.70	241.10
Shakopee	Scott	68.40	29.60
Shoreview	Ramsey	54.20	25.90
Shorewood	Hennepin	91.00	74.80
South St. Paul	Dakota	48.70	28.80
Spring Lake Park	Anoka	47.00	22.30

Table 5 Estimates of Average Daily Vehicle Miles Traveled by Community, Planning Area, Subarea and the Region			
Community	**County**	**VMT Home-Based per Household**	**VMT Nonhome-Based per Employee**
Spring Lake Twp	Scott	117.90	136.20
Spring Park	Hennepin	25.10	12.30
St. Anthony	Hennepin	34.50	27.40
St. Bonifacius	Hennepin	9.30	7.20
St. Francis	Anoka	94.10	43.20
St. Lawrence Twp	Scott	86.80	35.60
St. Louis Park	Hennepin	34.20	20.80
St. Mary's Point	Washington	91.10	233.60
St. Paul	Ramsey	34.50	19.80
St. Paul Park	Washington	104.50	96.00
Stillwater	Washington	43.80	24.60
Stillwater Twp	Washington	110.30	139.00
Sunfish Lake	Dakota	62.20	142.90
Tonka Bay	Hennepin	62.10	47.20
Vadnais Heights	Ramsey	58.30	28.60
Vermillion	Dakota	9.00	1.90
Vermillion Twp	Dakota	135.00	117.30
Victoria	Carver	60.60	29.80
Waconia	Carver	8.20	4.00
Waconia Twp	Carver	456.40	856.50
Waterford Twp	Dakota	64.30	24.80
Watertown	Carver	7.80	4.20
Watertown Twp	Carver	282.50	236.60
Wayzata	Hennepin	49.40	28.80
West Lakeland Twp	Washington	70.30	63.60
West St. Paul	Dakota	42.70	35.20
White Bear Lake	Ramsey	42.60	23.80
White Bear Twp	Ramsey	68.20	45.20
Willernie	Washington	22.10	9.70
Woodbury	Washington	61.60	37.80
Woodland	Hennepin	34.40	76.60
Young America Twp	Carver	469.10	770.20

Table 5 Estimates of Average Daily Vehicle Miles Traveled by Community, Planning Area, Subarea and the Region			
Community	**County**	**VMT Home-Based per Household**	**VMT Nonhome-Based per Employee**
Planning Area			
Central Cities		31.9	18.5
Developed Communities		44.0	25.3
Developing Communities		66.5	28.6
Rural Growth Center		44.0	24.9
Rural Residential Area		102.1	51.1
Diversified Rural Areas		106.2	120.4
Agricultural Areas		163.5	144.5
Outside Council's Jurisdiction		43.2	20.9
Suburbs		54.6	26.7
Rural Communities		115.4	111.3
Townships		115.0	83.7
Regionwide		51.0	25.0

Source: Metropolitan Council regional travel demand model.

Notes: Geographic planning areas are defined in Appendix B.

Suburbs include communities completely or partially within the metropolitan urban service area (MUSA), excluding Minneapolis and St. Paul.

A rural community is a small community in a rural area often consisting of a few homes, a church and minimal shopping and work opportunities (such as Miesville).

Changes in VMT

National studies are used to identify how land use or development scenarios change VMT.

A bibliography prepared for the Resources and Tools section includes two primary studies for measuring changes in VMT. The final report may summarize more information about these two studies, such as the areas analyzed for each of the six scenarios that are part of the tool.

Air Pollution Emission Model and Emission Rates

As a last step in the air quality assessment tool, a federal air pollutant emission model is used to estimate how changes in VMT affect local emissions. Information describes the federal model and shows intermediate results for the region. When the tool is further developed, it will become available to produce emission results for projects or other subareas within the region.

Air Pollution Emission Model

Emission rates are estimated by a new air pollutant emission model. The motor vehicle emission simulator is commonly referred to as MOVES2010a. It was released by the U.S. Environmental Protection Agency (EPA) in January, 2010, and updated in late August. The purpose of the model is to provide accurate estimates of emissions from mobile sources under a wide range of conditions defined by the person who is running the model. It replaces the previous EPA model, MOBILE6. MOVES2010a is designed to help answer "what if" questions, such as: "How would particulate matter emissions decrease in my state on a typical weekday if truck travel was reduced during rush hour?" or "How does the total hydrocarbon emission rate change if my fleet switches to gasoline from diesel fuel?"

MOVES2010a supplies national data, but default information was modified to reflect local conditions. Due to the timing of this study, local data for 2005 were developed for the region's seven counties from available sources. Table 6 identifies local information added and national data used from the EPA. Local sources of 2005 data include: the Twin Cities regional travel demand model; VMT counts by road type and county from Mn/DOT; vehicle classification count data from Mn/DOT; vehicle registration data from the Minnesota Department of Public Safety; and data on the age of the regional's vehicle fleet from a model used prior to MOVES2010a.

Table 6
Data Used in MOVES2010a

Data Source	Name of Model Input	Description
Local	Vehicle source type population	Number of vehicles by class
	VMT data	Annual VMT by vehicle class
	Month VMT fraction	Fraction of VMT by vehicle class and month
	Hour VMT fraction	Fraction of VMT by hour of the day, vehicle class, road type and type of day (weekday)
	Road type distribution	Fraction of VMT by vehicle class and road type
	Vehicle age distribution	Fraction of vehicles by age and class
	Average speed distribution	Fraction of VMT by speed, vehicle class, road type, hour of day, and type of day (weekday)
National Default	Day VMT fraction	Fraction of VMT by weekday versus weekends and by vehicle class
	Meteorology	Hourly temperature and relative humidity by month
	Fuel supply	Market share of each fuel type by month

Source: Metropolitan Council and U.S. EPA.
Note: Further information on the EPA MOVES2010a model is available at www.epa.gov/otaq/models/moves/index.htm.

Emission Rates for Region

MOVES2010a used the data in the Table 6 to generate air pollutant emission rates and energy consumption rates for each of the region's seven counties. Table 7 provides average emission rates for the region for selected air pollutants. Table 8 shows estimates of energy consumption.

Table 7 Emission Rates for Region	
Air Pollutant	**Seven-County Region Average Emission Rate (grams/VMT)**
Carbon monoxide (CO)	8.99
Atmospheric carbon dioxide (CO_2)	495.34
CO_2 equivalents	504.70
Oxides of nitrogen	2.46
Nitrogen oxide	2.28
Total organic gases	1.06
Volatile organic compounds	1.02
PM10 (particulate matter)	0.08
PM2.5	0.07
Source: Metropolitan Council estimates produced by MOVES2010a.	

Table 8 Energy Consumption for Region	
Energy Consumption	**Seven-County Region Consumption Rates (joules/VMT)**
Total energy	6,860,520.96
Petroleum energy	6,545,023.29
Fossil fuel	6,555,294.58
Source: Metropolitan Council estimates produced by MOVES2010a. Notes: Energy consumed by transportation sources attributed to petroleum comes from the combustion of gasoline and/or diesel. Fossil fuel also includes natural gases.	

Appendix E: Collaboration and Outreach

Members of Land Use Advisory Committee

Tony Pistilli, Chair and Metropolitan Council member
Duane Arens, former Metropolitan Council member
David Beaudet, Mayor of Oak Park Heights
Tami Diehm, Columbia Heights City Council member
Karl Drotning, Lakeville Planning Commission
Steve Elkins, Bloomington City Council member
David Elvig, Ramsey City Council member
Deborah Haugh, St. Paul
Andrew Hestness, City of Minneapolis
Marvin Johnson, Mayor of Independence
Bob Kermes, White Bear Township Board supervisor
Jerry McDonald, Chanhassan City Council member
J. Michael Noonan, Hennepin County
Terry Schneider, Mayor of Minnetonka
Nancy Schouweiler, Dakota County Commissioner
Bob Shaffer, Golden Valley City Council member
Barbara Thomas, former Mounds View City Council member
Jon Ulrich, Scott County Commissioner.

Members of Technical Advisory Committee of Transportation Advisory Board

Tim Mayasich, Chair, Ramsey County
Chuck Ahl, Metro Cities – Maplewood
Ann Braden (secretary - nonvoting member), Metropolitan Council
Carolyn Braun, Metro Cities - Anoka
Pat Bursaw, Minnesota Department of Transportation
Innocent Eyoh, Minnesota Pollution Control Agency
Lisa Freese, Scott County
Kate Garwood (alternate), Anoka County
Gene Goddard, Minnesota Department of Employment and Economic Development
Jim Grube (alternate), Hennepin County
Ken Haider (alternate), Ramsey County
Steven Hay, Minneapolis - planning
Brian Isaacson (alternate), Minnesota Department of Transportation
Tom Johnson, Hennepin County

John Kari, Metropolitan Council
Karl Keel, Metro Cities – Bloomington
Mike Klassen, St. Paul - engineering
Mark Krebsbach (alternate), Dakota County
Jennifer Levitt, Metro Cities – Cottage Grove
Kim Lindquist, Metro Cities – Rosemount
Jenifer Loritz, Minneapolis - engineering
Allen Lovejoy, St. Paul - planning
Richard McCoy, Metro Cities - Robbinsdale
Beverly Miller, Minnesota Valley Transit
Bob Moberg, Metro Cities - Plymouth
Susan Moe (nonvoting member), Federal Highway Administration
Jon Olson, Anoka County
Carl Ohrn, Metropolitan Council
Ed Petrie, Metro Transit
John Powell, Metro Cities - Savage
Lyndon Robjent, Carver County
Kevin Roggenbuck, Transportation Advisory Board Coordinator
Wayne Sandberg, Washington County
Ted Schoenecker (alternate), Washington County
Brian Sorenson, Dakota County
Robert Vorpahl, Metropolitan Airports Commission
Lezlie Vermillion (alternate), Scott County
Bill Weckman (alternate), Carver County

Members of Planning Committee of Technical Advisory Committee of Transportation Advisory Board

Steven Hay, Chair, City of Minneapolis
Holly Anderson, Dakota County
Carolyn Braun, Metro Cities - City of Anoka
Robert Byers, Hennepin County
Jack Corkle, Anoka County
Paul Czech, Minnesota Department of Transportation
Innocent Eyoh, Minnesota Pollution Control Agency
Lisa Freese (alternate), Scott County
Adam Harrington, Metro Transit
Craig Jenson, Scott County

John Kari, Metropolitan Council
Kim Lindquist, Metro Cities - Rosemount
Allen Lovejoy, City of Saint Paul
Steve Mahowald (alternate), Metro Transit
Bob Moberg, Metro Cities – Plymouth
Susan Moe (nonvoting member), Federal Highway Administration
Robert Paddock (secretary - nonvoting member), Metro Council
John Powell, Metro Cities – Savage
Ann Pung Terwedo, Washington County
Lyndon Robjent (alternate), Carver County
Mike Rogers, Ramsey County/Ramsey County Regional Rail Authority
Kevin Roggenbuck, Transportation Advisory Board Coordinator
Ted Schoenecker (alternate), Washington County
Mike Sobolewski (alternate), Minnesota Department of Transportation
Brian Sorenson (alternate), Dakota County
David Vessel, Metropolitan Council
Bill Weckman, Carver County

Stakeholder Participants

John Bailey, 1000 Friends of Minnesota
Lynne Bly and Ethan Fawley, Fresh Energy
Jim Erkel, Minnesota Center for Environmental Advocacy
Jenna Fletcher, Embrace Open Space and Trust for Public Land
Dave Van Hattam, Transit for Livable Communities

Additional stakeholders also participated.

Resources and Tools Bibliography

The *Land Use and Planning Resources Report* required extensive research to clarify how and to what extent land-use changes may affect travel behavior. The Metropolitan Council identified 14 sources, listed below, that provide context for understanding relationships between land use and transportation. This bibliography describes topics considered by each study and summarizes key findings.

1. "Travel and the Built Environment – a Meta-Analysis"
2. "Driving and the Built Environment: The Effects of Compact Development on Motorized Travel, Energy Use and CO_2 Emissions"
3. "Land Use and Site Design"
4. "Transit Oriented Development and the Potential for VMT-related Green House Gas Emissions Reduction"
5. "Transportation's Role in Reducing U.S. Greenhouse Gas Emissions"
6. "Land Use Impacts on Transport – How Land Use Factors Affect Travel Behavior"
7. "Urban Planning Tools for Climate Change Mitigation"
8. "Shrinking the Carbon Footprint of Metropolitan America"
9. "Effects of TOD on Housing, Parking, and Travel"
10. "Transit Oriented Development"
11. "Bus Transit and Land Use: Illuminating the Interaction"
12. "Transportation Elasticities: How Price and Other factors Affect Travel Behavior"
13. "Transportation Modeling Methods"
14. "Land Use and Driving – The Role Compact Development Can Play in Reducing Greenhouse Gas Emissions – Evidence from Three Recent Studies: 1. Moving Cooler: Land Use is an Important Climate Change Strategy; 2. Growing Cooler: The Five "Ds" of Compact Development Reduce Vehicle Miles Traveled; and 3. Driving and the Built Environment: Compact Development Lowers Driving, Emissions, and Energy Use"

1. **Reid Ewing and Robert Cervero**
   "Travel and the Built Environment – a Meta-Analysis"
   Journal of the American Planning Association. June 2010
   Volume 76, Issue 3, pp. 265-294
   Website: www.planning.org/japa/ (free for members or fee for access)

   The authors update and expand their 2001 meta-analysis of land use and travel studies to test the impacts of land-use strategies to help reduce automobile use and related social and environmental costs. They conducted a meta-analysis of the literature dealing with the built-environment/travel connection as of the end of 2009. The authors draw conclusions that could be applied broadly in land use and transportation planning practices. The study quantifies the magnitude of the effects of various land-use variables on vehicle miles traveled (VMT) and travel patterns.

   Summary Findings

   - Changes in the built environment generally result in modest changes in travel.
   - While individually producing modest results, the combined effect of several variables (access to regional destinations, street networks, the mix of land uses, distance to transit stops/stations, and density) on travel and VMT could be quite significant.
   - Consistent with prior work, the authors find that VMT is most strongly related to measures of accessibility to destinations and secondarily to street-network design variables. Walking is most strongly related to measures of land-use diversity, intersection density, and the number of destinations within walking distance.
   - Bus and train use are equally related to proximity to transit and street-network design variables, with land-use diversity a secondary factor. Interestingly, population and job densities are found to be only weakly associated with travel behavior once these other variables are controlled.
   - The results (elasticities) derived in this meta-analysis may be used to adjust outputs of travel or activity models that are otherwise insensitive to variation in the built environment. They may also be used in sketch planning applications to compute estimates of VMT, walking and transit use relative to a base case, or in post-process travel and activity forecasts.

2. **Committee for the Study on the Relationship Among Development Patterns, Vehicle Miles Traveled, and Energy Consumption, National Research Council**
   "Driving and the Built Environment: The Effects of Compact Development on Motorized Travel, Energy Use and CO_2 Emissions"
   National Research Council (ISBN: 0-309-14422-1). 2009
   Website: www.nap.edu/catalog/12747.html

   The authors of this study examine the relationship between land development patterns and motor vehicle travel in the United States to assess energy conservation benefits of more compact development patterns. The study is focused on metropolitan areas, where more compact development would have the greatest effect. International studies and experience with compact development are considered to the extent that the comparisons are relevant.

   Summary Findings

   - Developing more compactly at higher residential and employment densities is likely to reduce vehicle miles traveled (VMT).

- The national and international literature suggests that for every 10 percent increase in residential density across a metropolitan area might lower household VMT by about 0.05 to 1.2 percent, and perhaps by as much as 2.5 percent, if coupled with higher employment concentrations, significant public transit improvements, mixed uses, and other supportive demand management measures.
- More compact, mixed-use development can produce reductions in energy consumption and CO_2 emissions both directly and indirectly.
- Illustrative scenarios suggest only modest results of even significant increases in compact, mixed-use development, but the reductions in CO_2 emissions and energy consumption will grow over time.
- Increasing density alone may not be sufficient to lower VMT by a significant amount. A diversity of land uses that results in locating desired destinations, such as jobs and shopping, near housing (preferably in centers) and improved accessibility to these destinations from either home or work are also necessary. Development designs and street networks that provide good connectivity between locations and accommodate nonvehicular travel are important. Demand management policies that complement efforts to lower VMT, such as establishing maximum rather than minimum parking requirements and introducing market-based parking fees, are also needed.
- The effects of compact development on VMT can be enhanced when it is combined with other measures, such as: mixing land uses to bring housing closer to jobs and shopping; developing at densities that can support transit; designing street networks that provide good connectivity between destinations; well-located transit stops and that accommodate nonvehicular travel; and demand management measures, such as reducing the supply and increasing the cost of parking.
- The primary opportunity for changing development patterns lies in the number of new housing units that will be constructed. The durability of the housing stock makes it difficult to change development patterns, at least in the short and medium terms. Substantial change can be made by focusing on new housing units, built either in new neighborhoods or as strategic infill in existing neighborhoods (e.g., in inner suburbs or near major transit stops and along major highway corridors or interchanges).
- Most U.S. metropolitan areas have mature land-use patterns and transportation systems that make change difficult, except at the margin.

3. J. Richard Kuzmyak, Richard H. Pratt, and G. Bruce Douglas, lead chapter authors
"Land Use and Site Design"
TCRP Report 95 Chapter 15. Transportation Research Board. 2003
Website: www.trb.org/publications/tcrp/tcrp_rpt_95c15.pdf

The authors of this report provide information on the relationships between land use/site design and travel behavior. Information in the report is drawn primarily from research studies that have attempted to measure and explain the effects of these relationships.

Summary Findings

- Concentrated, contiguous development and balanced land use provide the opportunity for households to meet their daily needs with shorter automobile trips or by walking, bicycling, or

taking transit. This reduces overall vehicle miles traveled (VMT), assists efforts to manage congestion, reduces energy consumption, and improves air quality.

- Research findings suggest that land use and urban form exert an important cumulative influence over most aspects of travel demand.
- Where development is compact, land uses are compatible and intermingled, and there is good transit access and pedestrian interconnection. Average trip lengths are shorter, greater use is made of transit and non-motorized travel modes, and household vehicle trip generation and particularly household VMT are less.
- Existing urban development means that impact of land-use changes will be localized near term and extremely gradual.
- Lower household VMT is also associated with location nearer the central business district (CBD). Trip lengths are typically shorter in areas with a balance of jobs and housing, so household VMT averages are lower.
- Accessibility is not only enhanced by more compact land use, but also by placing complementary land uses near to each other.

4. Peter Haas, Gajus Miknaitis, Harley Cooper, Linda Young and Albert Benedict
"Transit Oriented Development and the Potential for VMT-related Green House Gas Emissions Reduction"
Center for Transit-Oriented Development. March 2010
Website: http://www.scribd.com/doc/19053971/Final-TOD-and-Climate-Change

The authors of this report examine the potential of reducing greenhouse gas (GHG) emissions in the transportation sector from transit-oriented development (TOD). This research calculates the potential reduction in carbon emissions associated with household vehicle travel, and how that is affected by urban form and access to transit.

The study focuses on households located within and outside of "transit zones," defined as the geographic areas within a half mile radius of a fixed rail station or stop. The study examines the potential to use transit and TOD as an emissions reduction strategy in three different future development scenarios for the Chicago metropolitan area.

Summary Findings

- Analysis of households, transit zones, and regional development scenarios indicate that location matters. For any given household, the number of autos it owns and how many miles its members drive them is largely determined by where the household lives.
- A household's vehicle miles traveled (VMT) and carbon footprint can be dramatically reduced by living in a location-efficient neighborhood, with compact development within ½ mile of a transit stop. By simply living in a central city near transit, the average household can reduce its GHG emissions by 43 percent. In the most location-efficient transit zones, a household can reduce its GHG emissions by as much as 78 percent.
- Total GHG emissions from household transportation depend on how that region chooses to grow. VMT-related GHG emissions can be reduced by 36 percent if development in that region proceeded in a more compact and efficient manner.

5. **U.S. Department of Transportation**
"Transportation's Role in Reducing U.S. Greenhouse Gas Emissions"
U.S. Department of Transportation. April 2010
Website: http://ntl.bts.gov/lib/32000/32700/32779/DOT_Climate_Change_Report_-_April_2010_-_Volume_1_and_2.pdf

The authors of this study evaluated several groups of strategies to reduce greenhouse gas (GHG) emissions from transportation: (1) low-carbon fuel alternatives, (2) increased fuel economy, (3) improved transportation system efficiency, (4) reduced travel activity, (5) aligning transportation planning and investments to achieve GHG reductions, and (6) economic pricing options.

Summary Findings

- Improved traffic engineering and bottleneck relief could relieve congestion and provide cost and time savings to travelers. However, GHG reductions are uncertain because congestion relief alone, without other measures, could induce new demand.
- Significant expansion of urban transit, in conjunction with land-use change and Complete Streets, could generate mid-term GHG reductions of 2 to 5 percent by 2030; and greater benefits long-term as urban patterns reorganize. These strategies have a number of co-benefits for mobility, household economics, and physical health.
- Coordinating transportation and land-use decisions and investments enhances the effectiveness of both systems. Key outcomes of mixed-use development and multiple transportation options can reduce trip lengths and thereby reduce GHG emissions. For this strategy, predicting reductions are the most difficult.

6. **Todd Littman with Rowan Steele**
"Land Use Impacts on Transport – How Land Use Factors Affect Travel Behavior"
Victoria Transport Policy Institute. July 9, 2010
Website: www.vtpi.org/landtravel.pdf

The authors of this paper examine how various land-use factors affect travel behavior, including per capita motor vehicle use, mode split, use of nonmotorized modes (walking and cycling), and the ability of land use management strategies for achieving transportation planning objectives.

Summary Findings

- Local land-use factors (neighborhood density, mix, design, etc.) can reduce per capita vehicle travel 10 to 20 percent. Regional land-use factors (location of development relative to urban areas) can reduce automobile travel 20 to 40 percent compared with national averages.
- Per capita automobile ownership and travel tend to decline with increasing population and employment density, and with increased land-use mix, such as where commercial and public services are located within or adjacent to residential areas. They also tend to decline with connected street networks, particularly if the nonmotorized network is relatively connected, with attractive and safe streets that accommodate pedestrian and bicycle travel, and where buildings are connected to sidewalks rather than set back behind parking lots.

- Larger and higher-density commercial centers tend to have lower rates of automobile commuting because they tend to support travel choices (more transit, ridesharing, better pedestrian facilities, etc.) and amenities such as cafés and shops.
- Per capita automobile travel tends to decline with the presence of a strong, competitive transit system, particularly when integrated with supportive land use (high-density development with good pedestrian access within ½ kilometer of transit stations).
- Most land-use strategies are mutually supportive, and are more effective if implemented with other transportation demand management (TDM) strategies. Some land-use management strategies that improve access could increase rather than reduce total vehicle travel unless implemented with appropriate TDM strategies.
- More accessible, compact land-use development tends to provide economic, social and environmental benefits, in addition to helping achieve transportation objectives. Benefits include reduced impervious surface (and therefore stormwater management costs and heat island effects), reduced costs of providing public services, increased community cohesion, and preservation of habitat and open space. Research indicates that density is only one of many factors affecting travel behavior. Where there is local resistance to significant increases in density, Smart Growth and New Urbanism can emphasize other strategies, such as land-use mix and improved walkability, and apply these to diverse land-use conditions, including urban, suburban and even rural areas.

7. Patrick M. Condon, Duncan Cavens, and Nicole Miller
"Urban Planning Tools for Climate Change Mitigation"
Lincoln Institute of Land Policy (ISBN 978-1-55844-194-1). 2009
Website: http://www.lincolninst.edu/pubs/1573_Urban-Planning-Tools

The authors of this report focus on the present state of tools to model and evaluate the relative benefits to climate change of alternative development approaches in cities, ranging in scale from projects to neighborhoods to metropolitan areas. Four case studies illustrate how selected tools are already being used in urban planning and development in the United States and Canada.

Summary Findings

- Planning and urban-design measures can substantially reduce the number and distance of vehicle trips by organizing human activity in compact communities with a range of housing types, providing reliable transit to and from employment, and placing services within easy walking distance of home.
- Strategies that reduce travel by limiting suburban expansion and encouraging more compact, walkable, full-spectrum living and working environments can potentially make a significant contribution to overall climate-change mitigation.
- A reduction of up to 10 percent in greenhouse gas (GHG) emissions may result from a change in land-use approach alone. Additional reductions will result from employing other strategies such as transit investment, fuel pricing, and parking charges (Ewing et al. 2008).
- By one estimate, approximately two-thirds of all development in 2050 will be new or will have been redeveloped since 2007, suggesting that combined land-use and transportation strategies could be quite powerful in mitigating increases in GHGs (Nelson 2006).

- The most critical gap identified by the authors is the inability of tools to move up and down the various scales (local to state) to support effective planning and regulatory decisions, and to set and adjust policy. This report on tools currently available to help reduce GHG emissions through urban planning illuminates their general approaches, scales, and utility in decision-making.

8. **Marilyn A. Brown, Frank Southworth, Andrea Sarzynski**
"Shrinking the Carbon Footprint of Metropolitan America"
Brookings Institution. May 2008
Website:
http://www.brookings.edu/reports/2008/05_carbon_footprint_sarzynski.aspx?rssid=blueprint

The authors provide an analysis of data on carbon emissions from the transportation and residential sectors for the U.S. as a whole and for the 100 largest metropolitan areas in 2000 and 2005 (total and per capita).

Summary Findings

Minneapolis/St. Paul/Bloomington (MN, WI) Rank Per Capita in 2005

Total Highway and Residential Energy	Per Capita Highway Rank	Per Capita Residential Energy
45 out of 100	37 out of 100	62 out of 100

9. **G. B. Arrington and Robert Cervero**
"Effects of TOD on Housing, Parking, and Travel"
TCRP Report 128, Transportation Research Board. 2008
Website: http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_128.pdf

The authors of this study look at the most recent literature on transit-oriented development (TOD) and the transportation performance of 17 TOD projects. The literature review focused on nine questions related to TOD travel characteristics, transit system and land-use influences, TOD ridership strategies and TOD resident/tenant characteristics.

To help understand the physical implications of the research, eight residential TOD site plan case studies were developed to test some of the physical implications of reducing residential parking ratios at a range of potential densities on a theoretical eight-acre TOD.

Summary Findings

- TOD commuters typically use transit two to five times more often than other commuters in the region.
- Transit use is heavily influenced by relative travel times by automobile and extensiveness of transit service. As the transit network links to more job centers, educational opportunities, and cultural facilities, transit use increases.
- A primary reason for higher TOD transit use is self-selection. Current transit users and those predisposed to use transit seek out TOD. The travel pattern of TOD residents prior to moving to the TOD depended on their previous access to transit.

- Transit versus auto travel time is more important than any land-use factor (density, diversity of uses, design) in ridership.
- The most effective strategy to increase TOD ridership is to increase development densities in close proximity to transit. Employment densities at trip ends have more influence on ridership than population densities at trip origins. It is critical to locate jobs near transit in order to attract households to TODs.
- Mixed uses in TODs allow the transit service to be used for a variety of trip purposes throughout the day and week. But this is not a primary consideration for prospective TOD residents. Employment access is a primary consideration.
- Mixed uses (e.g., local restaurants) and urban design treatments (e.g., pedestrian pathways) are important for their amenity and design value in attracting residents and visitors or customers. TOD residents highly value good neighborhood design in addition to transit access to work. Urban design and the local land use mix may influence which TOD prospective residents choose to live in. Good design also may make a TOD a more desirable location to travel to.
- Fast, frequent, and comfortable transit service will increase ridership, as will high parking charges and/or constrained parking supply. The availability of free or low-cost parking is a major deterrent to transit ridership.

10. John E. (Jay) Evans, IV, and Richard H. Pratt, lead chapter authors
"Transit Oriented Development"
TCRP Report 95, Chapter 17, Transportation Research Board (ISBN: 978-0-309-09892-2). 2007
Library of Congress Control Number 2007931161
Website: http://www.fta.dot.gov/documents/Transit_Oriented_Development_-_Traveler_Response_to_Transportation_System_Changes_TCRP_Report_95.pdf

The author of this chapter focused on the TOD land-use strategy and its transportation impacts, organized along three dimensions that significantly characterize TODs: regional context, land-use mix, and primary transit mode. Transit oriented development (TOD) in this report refers to higher-density development, with pedestrian priority, located within easy walking distance of a major public transit station or stop(s).

Summary Findings

- Transit usage in TODs is influenced by (1) land use and site design, (2) automobile ownership, (3) relative transit and highway accessibility, (4) parking supply, (5) parking pricing, (6) transit support, and (7) self-selection of residents as well.
- Higher densities, greater diversity of land uses, and better design are associated with more transit use and walking and fewer automobile trips per resident and per worker.
- TOD may exist in a long-established city center or in a suburban context. Although locating TOD in either type of area may boost transit ridership and increase walking, the regional context (location) plays a role in determining the overall response by travelers. City-center TODs generally have higher levels of transit service to more travel markets than suburban TODs and consequently have higher transit-ridership generation potential. However, the difference that TOD represents from the status quo in suburban contexts is likely more pronounced than in city-center contexts. This is one of the reasons why suburban applications receive more attention in the literature.

- TODs come in a variety of flavors with different mixes of office, retail, and residential space. The travel behavior response to TOD may be influenced by the type and quantity of uses present. For example, TOD that enables its occupants to address daily needs within the project may result in fewer automobile trips and lower automobile ownership rates than less diverse TOD.
- The frequent, highly connective transit service associated with most TOD offers a better alternative to automobile usage than the lesser transit service associated with more typical low-density development.
- A "TOD Index" to describe a development project's "TODness" include:
  - Centrally located transit with walking distances no more than ¼ to ½ mile.
  - Superior walkability with small blocks and pedestrian traffic management priority.
  - Extended hours of highly reliable transit service at 5- to 15-minute intervals.
  - Land-use mix to meet daily needs paired with good transit connectivity to other activities.
  - Density sufficient to support cost-effective transit, retail services, and infrastructure.
  - Managed parking with reduced supply relative to standard development.

11. Andy Johnson
"Bus Transit and Land Use: Illuminating the Interaction"
Journal of Public Transportation, Vol. 6, No. 4. 2003
Website: www.nctr.usf.edu/jpt/pdf/JPT%206-4%20Johnson.pdf

The author of this article examines the effect of land use, socioeconomics, and bus transit service on bus service transit demand in the Twin Cities. Analysis uses the Sector 5 restructuring data obtained from the Metropolitan Council. Sector 5 is the transit planning subregion that consists of downtown Minneapolis and a radial slice running due south and southwest.

Sector 5 contains four of the primary trip generators in the entire metro region: the Minneapolis central business district (CBD), Mall of America, International Airport, and part of the University of Minnesota Twin Cities campus. These data count only the downtown boardings onto buses that serve Sector 5.

Summary Findings

- Generally, mode choice is affected primarily by density and land use (the greater the intensity of land use, the greater demand for transit). In addition to density, transit ridership appears to be a function of the size of the CBD and distance from downtown (Puskarev and Zupan 1977), as well as parking supply and price, transit service quality, pedestrian accessibility, and land-use mix.
- Research suggests a positive relationship between parking price and transit use (Hess 2001).
- Planners would increase ridership to a greater degree through catalyzing retail, mixed-use and multifamily development than increasing transit service.
- Vertical mixed-use is important close to transit access, and retail plays an important role up to ¼ mile from transit service. (This analysis would not promote office use in neighborhoods, but would rather cluster office uses in the CBD.)
- Population density is more important at a block-group level than block level, suggesting that density adjacent to the transit line may not play as critical a role as density in the larger surrounding area. Changing the land use or density around a given bus stop does not necessarily make people in the vicinity more likely to use transit

12. **Todd Litman**
"Transportation Elasticities: How Price and Other Factors Affect Travel Behavior"
Victoria Transport Policy Institute. 2010
Website: http://www.vtpi.org/elasticities.pdf

The author of this report investigates the influence that prices and service quality have on travel behavior. The report summarizes research on various types of transportation elasticities and describes how to use this information to predict the travel impacts of specific price reforms and management strategies.

The report describes methods for quantifying time/money trade-offs involving transportation decisions, such as how changes in fuel prices and parking fees affect automobile travel, and how changes in transit fares and service quality affect transit travel. Economists measure price sensitivity using elasticities, defined as the percentage change in consumption of a good caused by a one-percent change in its price or other characteristics (such as traffic speed or road capacity).

Summary Findings

- Harvey and Deakin (1998) model the effect of parking fee on commuters in four California regions ("Technical Methods for Analyzing Pricing Measures to Reduce Transportation Emissions" EPA 231-R-98-006 Appendix B, August 1998). Parking fees affect trip destinations as well as vehicle use. An increase in parking prices can reduce use of parking facilities at a particular location, but this may simply shift vehicle travel to other locations. The primary impact of parking pricing would be on mode choice. Parking prices raise the cost of vehicle trips and thus increase the attractiveness of alternative modes, including transit, ridesharing and non-motorized options. Parking pricing collected as a daily fee may have a greater effect than other pricing measures, since it is directly associated with the cost of the particular trip. Parking pricing is expected to have a greater effect on shorter trips, for which it represents a higher proportion of overall trip costs. This has important implications for affecting cold starts and micro-level traffic problems. Parking pricing policies also raise practical concerns about distributional impacts (geographical).
- Increased parking prices may result in spillover parking problems, as motorists find nearby places to park for free illegally ("Parking Management," VTPI, 2005). Increases in parking prices, however, can reduce total vehicle travel if parking prices increase throughout an area, if there is effective enforcement of parking regulations, and if there are good travel alternatives,.
- The use of parking price elasticities can be confusing since most parking is currently free, so it is meaningless to measure percentage increases from zero price. Other case studies find similar impacts. Shifting from free to priced parking typically reduces drive-alone commuting by 10 to 30 percent, particularly if implemented with improvements in transit service and rideshare programs and other transportation demand management (TDM) strategies.

13. **Jerry Walters, Julie Moore, Don Hubbard (Fehrs & Peers, consultants)**
"Transportation Modeling Methods"
Technical Appendix B, Regional Development Options Report to the Metropolitan Council. October 2002

The authors of this report analyzed the transportation impacts of three illustrative development scenarios for the Twin Cities. The report incorporated regional data on the relationship between

land use and travel behavior from the 2000 Travel Behavior Inventory (TBI), along with information from the national literature, since the TBI provided limited data.

The land use/transportation relationships considered population and employment per square mile (density), the ratio between jobs and housing (diversity), measures of the completeness and connectivity of the local pedestrian network and/or objective ratings of the pedestrian environment (design), and a comprehensive measure of changes in regional accessibility (destinations).

Summary findings

- Comparing Twin Cities TBI findings with the national data show similar relationships of land use changes and household behavior.
- Destinations or regional accessibility is the most important factor in regards to analyzing different regional land use/transportation scenarios. Design (street and sidewalk networks and connectedness) is second. Both density and diversity follow in importance.

14. **Uwe Brandes, Rachel MacCleery, Sarah Jo Peterson, Matthew Johnston**
"Land Use and Driving – The Role Compact Development Can Play in Reducing Greenhouse Gas Emissions – Evidence from Three Recent Studies: 1. Moving Cooler: Land Use is an Important Climate Change Strategy; 2. Growing Cooler: The Five "Ds" of Compact Development Reduce Vehicle Miles Traveled; and 3. Driving and the Built Environment: Compact Development Lowers Driving, Emissions, and Energy Use"
Urban Land Institute (ISBN: 978-0-87420-147-5). 2010
Website: www.uli.org

The authors of this report summarize and synthesize the land-use findings of three major studies (*Moving Cooler, Growing Cooler, and Driving and Built Environment)* that analyze the effect of compact development on driving (VMT) and greenhouse gas (GHG) emissions. The authors additionally look at issues from different perspectives.

Summary Findings

- The transportation sector accounts for about a third of overall GHG emissions and is reported to be the fastest growing sector due to increased driving and the underlying land-use patterns.
- The three studies share several fundamental conclusions: compact land-use patterns result in lower VMT; decreased VMT resulting from changes in land-use patterns would appear incrementally over time; and once the land-use pattern is changed, GHG and VMT reductions are permanent.
- The studies use scenarios to test impacts, and they all show relatively modest impacts of compact development on VMT, even when very aggressive land-use changes are undertaken.