Transit-Oriented Design

Illustrations of TOD Characteristics

A WORKING PAPER - NOVEMBER 2007

Written by

William DeCoursey
and
Lorene Athey

Prepared by the

Institute for Public Administration
College of Human Services, Education & Public Policy
University of Delaware

www.ipa.udel.edu

In Cooperation with the

Delaware Department of Transportation

www.deldot.gov

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November 2007

Institute for Public Administration

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Preface and Acknowledgements

As director of the Institute of Public Administration (IPA) at the University of Delaware, I am pleased to provide this working paper, Transit-Oriented Design – Illustration of TOD Characteristics. This report has been a multi-stage process, including a literature review of best practices and field visits to a number of sites. Based on those findings, this working paper identified the concepts of "complete community design" and presents recommendations for transit-oriented design (TOD) standards and implementation practices.

I would like to take this opportunity to acknowledge the many people who helped with the preparation and production of this working paper. Project manager Ed O'Donnell coordinated the process and was involved with the planning, research, and writing. William J. Decoursey and Lorene Athey spearheaded the literature review, identified the TOD sites to visit, and wrote the report. Professor Dr. Lueder Bach, visiting from the University of Bayreuth, Germany, assisted in the design of the survey instrument regarding characteristics of TODs. Research assistants Marlon Brown, Sven Conventz, and Jason Eckley assisted in the literature review and site visits. Mark Deshon and Lisa Moreland provided excellent editorial support.

In addition to the project team efforts, IPA staff member Nelcenia Downer provided invaluable logistical support; without her, the TOD site visits would not have been such a success.

Dr. Jerome R. Lewis, Director
Institute for Public Administration

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Introduction

The recent interest in Transit-Oriented Design (TOD) in Delaware goes back to the mid-1990s when a study was commissioned by the Delaware Department of Transportation (DelDOT), in coordination with New Castle County, to review the literature and make recommendations for TOD in Delaware. That report, *Transit Overlay Districts and Transit Friendly Design Standards for New Castle County*, was completed in 1997.

Since that time, the national research has continued, especially relating to effectiveness measures and successful implementation of TODs. Additionally, much progress has been made in Delaware, and conditions have changed since the 1997 study was completed. Some recommendations have been implemented. Although the transit system remains predominantly fixed-route bus, commuter rail has been instituted in New Castle County, with long-range plans to extend the rail service west into Maryland, and south to Middletown, Dover and eventually Sussex County. Over the past several years, the Institute for Public Administration at the University of Delaware has conducted a number of studies for DelDOT and New Castle County related to transportation and land use issues, including *Mobility Friendly Standards: A Framework for Delaware* (2004), *Interconnectivity* (2006), and *Sidewalks and Shared-Used Trails: Safety, Security, and Maintenance* (2007).

This project follows previous efforts and updates the 1997 study. Part 1 defines what TOD is and why it is useful. Part 2 reviews the plethora of current research and recommendations related to the design of transit-oriented developments. Part 3 focuses on lessons learned from existing TODs and best practices for successful implementation. Part 4 describes visits to four nearby TODs with local community leaders and agency staff, including their recommendations. All the recommendations from the literature and visits are summarized in Part 5.

Authors' note: the acronym TOD is used in the literature to denote two closely related concepts, transit-oriented development and transit-oriented design. While essentially the same thing, there are subtle, connotative differences between the two terms. Generally speaking, they are entirely interchangeable. However, in some cases, different authors use different terms, mostly as they relate to scale. When discussing a single project (perhaps infill construction or a pilot project) the literature will sometimes refer to it singularly, as a transit-oriented development. When discussing a regional approach to encouraging the concept, it is more often referred to as transit-oriented design. Still, other authors use the word development to describe the ongoing process of growth and regional change, as opposed to any single development. For the purposes of this report, the terms are used interchangeably, or simply abbreviated TOD. If a distinction is important, or if in a direct quote, it will be spelled out.

Part 1: What is Transit-Oriented Development

A number of people and organizations have attempted to define transit-oriented development (TOD).

The Maryland Department of Transportation (MDOT) Office of Real Estate, in their 2006 report *About Transit Oriented Development*, offers a description of TOD: "Transit-oriented development (TOD) creates compact, walkable neighborhoods around transit stations. TOD increases transit ridership by creating destinations within a short walk of stations. Transit-oriented development targets the area within a 15-minute walk of a transit station, or up to a half-mile away."

Parker and Arrington**,** in *Statewide Transit Oriented Development Study: Factors for Success in California* (2002), define a TOD as "moderate to higher-density development, located within an easy walk of a major transit stop, generally with a mix of residential, employment and shopping opportunities designed for pedestrians without excluding the auto. TOD can be new construction or redevelopment of one or more buildings whose design and orientation facilitate transit use…. TOD is seen as an alternative to sprawl, as a mixed used, transit-friendly community, and as a specific development type."

The Greater Cleveland Regional Transit Authority, in their 2004 *Transit 2025 Long Range Plan*, defines TOD "as any medium or high-density, mixed-use development 1,200 to 2,000 feet (an approximate 5-minute walk distance) from a transit node. TOD draws heavily on the more traditional design principles found in older central cities and suburbs. These include a mix of land use (residential, retail, offices), a centrally located commercial corridor, well-connected grid street networks, and proximity to transit" (p. 61).

At the most basic level, TOD consists of walkable, compact, mixed-use, higher-density development within walking distance of a transit facility.

A. Why Promote TOD?

Research and anecdotal evidence suggest that TOD can improve quality of life in a variety of ways, including personal health and fitness, personal and household economics, community economics, environmental quality, and the creation of better places to live.

<u>Personal health and fitness</u>
A number of recent studies reveal the relationship between community design and health. Numerous researchers have proven that design and growth patterns that enhance travel choices can reduce air pollution and increase residents' physical activity and overall health. Karen Petersmark and Risa Wilkerson, in their 2003 article *Land Use Affects Public Health* (p. 3), state, "Research has demonstrated that suburban residents drive twice as far, walk and cycle one-third as often, consume twice as much energy and produce twice as much air pollution as their urban counterparts who live where land use tends to be mixed." Conversely, W.L. Roper et al. in the 2003 paper *Health and Smart Growth: Building Health, Promoting Active Communities* notes

the impacts of auto-dependent community design and growth patterns on public health, including air quality:

- Mobile-source (motor vehicle)–related air pollutants cause respiratory and cardiopulmonary problems, headaches, and premature mortality.
- Exposure to particulate air pollution shortens human life and triggers asthma attacks and respiratory irritations.
- Sprawl reduces physical activity and social interaction, both of which help maintain emotional and mental health.

Perhaps the most comprehensive study of physical community design and its relationship to health is Barbara McCann and Reid Ewing's landmark 2005 study *Measuring the Health Effects of Sprawl*. They conclude that residents of the most sprawling communities are likely to average six pounds more in weight, are more likely to be obese, and have higher incidences of hypertension or high blood pressure than their counterparts in the least sprawling locales. In addition, they find that people in more sprawling areas walk less for exercise and during the course of routine daily activities.

Lawrence Frank and Company, in the 2005 report *A Study of Land Use, Transportation, Air Quality, and Health (LUTAQH) in King County, WA*, compare activity levels, transportation choice, and air quality among residents of three neighborhoods in King County, Washington. The three neighborhoods were chosen for their physical community characteristics. One neighborhood represents a typical, low-density, suburban community. Another represents a higher-density, well-connected, mixed-use community. The third has characteristics of both. They find that, on a per capita basis, higher-density residential neighborhoods with mixed land uses and a connected street network are measurably associated with more transit ridership, walking, overall physical activity, and lower levels of obesity (p.3). Among their conclusions:

- Compact development, a wide variety of land uses close to home and work, and a connected street network with pedestrian facilities can help achieve better resident health.
- Residents walk more in neighborhoods that provide a wide variety of retail services and where connections to such services are facilitated through a connected street network.
- Walking and transit are highly synergistic—the choice to walk is highest where the convenience and efficiency of transit is the greatest. Transit use was observed to be the highest in locations where walking was the most prevalent.
- Residents of the most walkable areas of King County were less likely to be overweight or obese and more likely to report being physically active. Preliminary results suggest that residents of the most walkable communities within the county are more likely to meet the 30 minutes per day of moderate activity recommended by the U.S. Surgeon General.

<u>Personal and household economics</u>

In the article *Transit Oriented Development: Using Public Transit to Create More Accessible and Livable Neighborhoods* (2003), the Victoria Transport Policy Institute reviews the benefits and costs of transit-oriented design. Benefits of TOD include higher property values, significant declines in average vehicle ownership, reduced vehicular travel, and lower vehicle expenditures per household. The Institute concludes that consumer expenditures on motor vehicles provide little economic return. For example, an investment of $10,000 on a motor vehicle provides only $910 in equity, compared with $4,730 in equity for the same investment in housing, suggesting

significant potential consumer savings from TOD. Todd Litman, in *Land Use Impacts on Transport How Land Use Factors Affect Travel Behavior* (2006), finds that improved transit service increases transit ridership and reduces automobile trips. Residents of transit-oriented neighborhoods tend to own 10 to 30 percent fewer vehicles, drive 10 to 30 percent fewer miles, and use alternative modes two to ten times more frequently than residents of automobile-oriented communities. Parker and Arrington also list some potential consumer benefits of using TOD:

- TOD can provide mobility choices, allowing residents to choose a less expensive travel option.
- TOD can increase household disposable income by reducing driving costs, estimated at $3,000 to $4,000 per year, per household.
- TOD can contribute to more affordable housing, because housing costs for land and structures can be significantly reduced through more compact growth patterns.

Community economics

Consumers may also realize tax savings as a result of governmental efficiencies due to TOD. The Victoria Transport Policy Institute, in the previously mentioned study, finds that community benefits of TOD included increased transit service efficiency, increased commercial activity, and increased tax revenues. Specifically identified benefits of TOD include capital savings due to the reduced need for road and parking-lot building. Some costs associated with TOD include incremental transportation expenditures, such as facility improvements.

The City of Calgary Department of Land Use, Planning, and Policy, in its 2004 *Transit Oriented Development, Best Practice Handbook*, notes that TODs can revitalize older communities and commercial sectors thereby increasing tax revenues. Parker and Arrington further note:

- TOD can improve the efficiency and effectiveness of transit-service investments and increase the use of transit stations by increasing transit ridership.
- TOD can decrease infrastructure costs (such as roads, water, and sewer) through more compact and infill development.

Environmental quality

Typical suburban forms of development have been acknowledged to be land-consumptive and bad for wildlife habitat, water, and air quality. Parker and Arrington note that TOD can help conserve resource lands and open space, because it consumes less land than low-density, auto-oriented growth, reducing the need to convert farmland and open spaces to development. Brian Stone and Jessica Bullen, in their 2006 study *Urban Form and Watershed Management: How Zoning Influences Residential Stormwater Volumes*, find that denser neighborhoods with smaller lots and shorter front-yard setbacks have also been proven to reduce stormwater runoff.

Parker and Arrington, The City of Calgary, and Frank and Company each discuss the benefits of walkable TODs where people drive less, consume correspondingly less energy, and generate less air pollution as a result. According to Parker and Arrington, TOD can reduce rates of vehicle miles traveled (VMT) by 20 to 40 percent for those living or shopping near transit stations. In addition, TOD reduces air pollution and energy consumption rates and reduces greenhouse gas emissions by 2.5 to 3.7 tons per year for each household. Frank and Company further concluded

- Residents in the most interconnected areas travel 26 percent fewer vehicle miles per day than those who live in the most sprawling areas.

- Compact development, a wide variety of land uses close to home and work, and a connected street network with pedestrian facilities can help to reduce ozone and improve regional air quality.
- Increased residential density, street connectivity, and land use mix near home and work are associated with significantly lower per capita vehicle emissions; in particular, fewer oxides of nitrogen (NOx) and volatile organic compounds (VOCs), which react in sunlight to form harmful ozone. Greenhouse gasses are also reduced.

Better places to live and work

In addition to the benefits outlined above, living and/or working in a TOD can provide other quality of life benefits. As a result, the community is more desirable to both individuals and businesses. A number of sources outline the benefits that TODs provide, such as:

- Better connections between jobs and housing (City of Calgary).
- More walkable neighborhoods (City of Calgary).
- More affordable housing, reductions in VMT, and assisting in the creation of a diverse, vibrant community (City of Calgary).
- Increased commercial activity, generation of local revenues (Victoria Transport Policy Institute).
- Increased public safety. Active places that are busy throughout the day and evening provide eyes on the street (Parker and Arrington, Appleyard and Cox).
- More efficient transit service, leading to increased transit service (Victoria Transport Policy Institute).
- Improved road safety for travelers of all modes (Appleyard and Cox, Victoria Transport Policy Institute).
- Reduced parking as walking, cycling, and transit usage increase (Leach).

However, Victoria Transport Policy Institute also points out some disamenities associated with TODs and higher-density development, such as increased local traffic congestion and noise exposure.

Perhaps the greatest benefits of TOD are increased transportation choice (City of Calgary, Parker and Arrington, Victoria Transport Policy Institute) and congestion reduction (Victoria Transport Policy Institute, Frank and Company, Litman). Dennis Leach, in his 2003 presentation *30 Years of TOD Community Outcomes & Performance Measurement*, provides statistics regarding the success of TODs in the Rosslyn-Ballston metro Corridor of Arlington, Virginia. Between the early 1980s and 2003, weekday trips at the five Metrorail Stations increased from 57,100 in 1980 to 79,500 in 2002. Currently, 73.3 percent of transit patrons now travel to the station on foot, 11.1 percent arrive via bus, and cycling activity has also increased. During the same time period, the author notes stable to modest increases in vehicular traffic on most arterial and residential streets in the corridor, in comparison to neighboring areas affected by major vehicular increases.

Frank and Company conclude that on a per capita basis, higher-density residential neighborhoods with mixed land uses and a connected street network are measurably associated with less auto use. In fact, residents in the most interconnected areas of the county traveled 26 percent fewer vehicle miles per day than those who lived in the most sprawling areas of the county.

Litman sums up much of the literature and draws some broad conclusions regarding the effectiveness of specific land use factors in determining travel behavior. First, he notes that many land use factors overlap. In addition, many land use factors that may not appear to make a significant difference when reviewed individually may be quite significant when reviewed as part of a group of characteristics. Having noted that, he draws the following conclusions based on the research:

- Per capita automobile travel tends to decline as population and employment density increase.
- Per capita automobile travel tends to decline as land uses become more mixed, such as when commercial and public services are located within or adjacent to residential areas.
- Per capita automobile travel tends to decline in areas with connected street networks, particularly if the non-motorized network is relatively connected.
- Per capita automobile travel tends to decline in areas 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 better travel choices (more transit, ridesharing, better pedestrian facilities, etc.) and amenities such as cafes and shops.
- Per capita automobile travel tends to decline as the transit system becomes stronger and more competitive. This is particularly true when integrated with supportive land use (high-density development having good pedestrian access within one-half 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 miles unless implemented with appropriate TDM strategies.
- Land use management can provide various benefits to society in addition to helping to achieve transportation objectives.

B. What Are the Characteristics of TODs?

Transit-oriented development concepts advocate that land around transit stations should be used in such a way as to encourage transit-system ridership by making transit and other non-automotive modes of travel more attractive and easier to use. In addition to transit facilities and services, important characteristics include being pedestrian-friendly, incorporating a mix of uses, and being compact, with carefully designed, located, and managed parking. This type of development has also been promoted to enhance the use of existing urban resources and infrastructure and reduce the need for the development of greenfields. Existing TODs tend to be one of the following types:

- Redevelopment around urban transit stations, generally to create a mixed-use neighborhood.
- Development around suburban transit stations to create a mixed-use neighborhood, and/or services and parking to support the transit station.
- Redevelopment of an existing suburban town center.
- New greenfield development.

The Victoria Transport Policy Institute describes the general characteristics of TODs as places where residential and commercial areas are designed to maximize access to transit and non-motorized transportation and encourage transit ridership with other features. TOD is

characterized by a center with a rail or bus station, high central density, and pedestrian-scale distances. TOD incorporates several specific design elements, including a focus on cycling and walking, traffic calming, mixed-use development, and parking management. The following are some of their recommended TOD best practices:

- Integrate transit and land use planning.
- Provide high-quality pedestrian and cycling facilities around train stations and bus stops, based on universal design.
- Manage parking to minimize the amount of land devoted to car parks around transit stops and stations.
- Create complete communities, with shops, schools, and other services within convenient walking distance of transit.

Peter Calthorpe, in his 1993 book *The Next American Metropolis*, summarizes the principles of transit-oriented design, including:

- Growth is organized to be compact and transit-supportive.
- Commercial development, housing, jobs, parks, and civic uses are within walking distance of transit stops.
- Street networks are pedestrian-friendly and directly connect local destinations.
- Housing is of intermixed types, densities, and costs.
- Sensitive habitat and high-quality open space are preserved.
- Public spaces are the focus of building orientation and neighborhood activity.
- Infill and redevelopment are encouraged along transit corridors within existing neighborhoods.

The Maryland Department of Transportation lists common features frequently found at TOD sites:

- "TOD is pedestrian-friendly. The development often sits within a connected grid of streets that are easy to navigate. Pedestrians are made to feel safe with wide sidewalks, well-marked crosswalks, good lighting, and narrow streets to slow car traffic. The street scene is made inviting with landscaping, attractive public spaces, and interesting architecture.
- The tallest buildings are clustered immediately around the transit station, with the density of development tapering off as you get farther out.
- Parking should be carefully managed. The goal is to limit the number of parking spaces and encourage shared parking between different land uses that need it at different times of day or at different times of the week. Offices, for example, typically need parking during weekdays, while retail and entertainment venues more likely need it evenings or on weekends.
- Transit-oriented development should have high-quality transit service that includes, wherever possible, access to buses and rail. Many Maryland neighborhoods in the Washington metro area, for example, link residents to Metro stations with Ride-On buses."

The City of Calgary lists the following as the key components to successful TODs:

- *Get the Land Uses Right:* Ensure transit-supportive uses and discourage non-transit-supportive uses, encourage a mix of uses and locate the uses as close to the station as possible.
- *Create Convenient Pedestrian Connections:* Pedestrian routes should be short, with key destinations located within a 400- to 600-meter (1300- to 1950-foot) radius of the station. Pedestrian facilities should be continuous, easy to find and follow, and accessible to people

with mobility aids. Sidewalks should directly connect to the station and building entrances with bus stops also located close to building entrances. Make pedestrian routes convenient by minimizing stairs, grade changes, driveways, and parking-lot crossings.

- *Ensure Good Urban Design:* Create high-quality streets that are aesthetically pleasing. Make the most of architectural and design opportunities. Make sure pedestrian uses are located on the street or ground level of buildings. Provide shelter from sun, wind, and rain. Provide lighting, landscaping, and appropriate signage.
- *Create Compact Development Patterns:* Use a compact street network, cluster buildings and leave room to grow.
- *Manage Parking:* Strive to have enough, but not too much. Parking lots should be located to the rear and sides of buildings and broken into several smaller lots rather than one big lot. Provide visible, centrally located, and secure bicycle parking.
- *Make Each Station a "Place."* Create a destination when planning and developing a TOD. Use buildings as landmarks and orient all buildings to the street. Include high-quality public open spaces.
- *Promote Density.*

The Greater Cleveland Regional Transit Authority lists the following important TOD principles:

- *Mixed and Concentrated Land Use:* Locate a diversity of complementary uses within easy walking distance of transit stations and stops.
- *Supportive Access Patterns:* Create circulation patterns that form a convenient, safe, and accessible network of transportation types that interconnect surrounding residential, commercial, and employment areas, and that provide direct connections to transit stations and stops. Provide adequate (in some cases structured) parking facilities that do not visibly dominate the station areas or consume large amounts of land.
- *Enhanced Environment:* Create an environment for transit users and others that is safe, attractive, and functional. Organize public and private spaces to invite pedestrian activity and incorporate design elements to increase public access, comfort, and security.

They also list the following important TOD guidelines:

- Create pedestrian linkages that connect transit facilities to surrounding communities.
- Intensify activity within walking distance of transit stations and stops.
- Diversify land uses.
- Apply good urban design.

Robert Cervero, in his 1993 book *Transit-Supportive Development in the United States: Experiences and Prospects*, explains that the key elements of transit-supportive design are organized into three categories: land use, site design, and pedestrian/transit facilities.

- Land use includes encouraging a mix of land uses, providing transit-supportive densities, locating the highest-density development closest to the transit stop, locating new development along transit routes in existing activity centers, and focusing new development within a quarter- to half-mile of the transit stop.
- Site-design elements include locating retail and office buildings close to the roadway, minimizing the distance between the transit stop and the building entrance, discouraging abundant free parking, connecting neighborhoods and transit stops with direct pedestrian

walkways, configuring streets to allow for through and efficient movement of transit buses, and linking adjacent development parcels with new roadways.
- Pedestrian and transit facilities include using road geometrics to allow transit, appropriately locating transit stops, providing landscaped, paved walkways with safe street crossings (including through parking lots), providing bicycle-friendly facilities, ensuring that all buildings, walkways, and transit facilities are ADA-compliant, and designing for pedestrian safety and security.

The Transportation Research Board of the National Academies, in its 1997 report *The Role of Transit in Creating Livable Metropolitan Communities, TCRP Report 22*, delineates types of principal strategies: design-oriented strategies, service-oriented strategies, and traffic-calming strategies.
- Design-oriented strategies – "Bus, light rail, heavy rail, and subway stops have the potential to be centers of community life. Design-oriented strategies enhance the comfort and convenience of transit users, while having a positive impact on the surrounding area. With proper design and incentives, transit stops can attract a variety of activities and uses (like retail, community services, and special events) which increase the sense of security and help create an incubator for small retailers and entrepreneurs from the local community" (p. 11).
- Service-oriented strategies – "Service-oriented strategies are essentially transit services that increase mobility within a neighborhood area . . . Service-oriented strategies include transit shuttles and connectors, which link residential neighborhoods with commuter rail and rapid transit stations; circulators and trolleys, which enable shoppers, visitors and office workers to move more freely about the central business district; and neighborhood-based transportation services" (pp. 11-12).
- Traffic-calming strategies – "The impact of both design- and service-oriented kinds of transit improvements will be reduced, however, unless streets or roads also support community character and needs . . . Traffic calming is a term that emerged in Europe to describe the practice of slowing down cars, but not necessarily banning them, as they move through commercial areas and residential neighborhoods. The benefit for pedestrians, transit riders, and bicyclist is that cars now drive at speeds that are safer and more compatible with walking and bicycling. Buses no longer have to vie for limited space and access. There is, in fact, a kind of equilibrium achieved among all of the uses of a street so no one mode can dominate at the expense of another" (p. 12).

Frank and Company find that transit use and walking are highly synergistic. Therefore it stands to reason that a community that supports and encourages walking also supports and encourages people to ride transit. They find that a number of specific factors affect a traveler's choice of mode, including parking, transit amenities, pedestrian facilities, transit service, street trees, short block lengths, traffic calming, and density.

In short, the key components of transit-oriented development can be condensed into the concept of complete communities. Complete communities have
- Quality transit facilities and service.
- A high-quality pedestrian environment.
- A community center and the right mix of uses.
- The highest densities closest to transit.
- Parking that is carefully located, designed, and managed.

It is important to note that the majority of existing TODs are focused around rail transportation. However, it is also important to note that these principles and techniques also provide many benefits when centered on fixed-route bus systems.

Clearly, TOD is a complex type of land use that will not be successfully accomplished without many policies, tools, and partners. The next two sections of this paper will discuss the design characteristics of successful TODs as well as strategies and examples of successful implementation of TODs around the country.

Part 2: Design Characteristics of Successful TODs

In short, the key components of transit-oriented development can be condensed into the concept of complete communities. Complete communities have the following key characteristics:

- Quality transit facilities and service.
- Walkable—a high-quality pedestrian environment.
- Destinations—complete communities with a community center and the right mix of uses.
- Compact—with the highest densities closest to transit.
- Parking that is carefully located, designed, and managed.

This section will provide additional information about each of these important concepts. It is important to note that these concepts are all interrelated. Neglecting to adequately address a concept will negatively impact the others as well as the ultimate success of the TOD.

A. Quality Transit Facilities and Service

For a TOD to exist, transit service must be available. However, the level of service, the location and design of bus stops, and the presence of other transit amenities will all influence transit ridership, and therefore, the success of the TOD. As stated before, most existing TODs are centered on rail transit; however, the information included in this section is applicable for successful fixed-route bus transit as well as rail.

<u>Design and location of bus stops</u>
The Greater Cleveland Regional Transit Authority notes that regions with successful transit development programs have transit-waiting environment (TWE) guidelines for improving bus transit. Key points of these guidelines include

- Waiting for the bus should be a comfortable, safe, and predictable experience.
- Waiting for the bus should be a convenient part of everyday life.
- Bus stops must be easily identified.
- Bus stops are a community responsibility.
- Basic amenities should be provided at all stops, with added amenities at stops serving the greatest number of potential riders.

It also includes the following transit-related items on its TOD Checklist:

- Provide transit shelters, safe street crossings, paved walkways, bicycle-friendly facilities, and ample landscaping.
- Make buildings, walkways, and transit facilities easily accessible to the young, the elderly, and the disabled.
- Give high priority to transit passenger safety and security.
- Make use of passive security systems (such as closed circuit television and emergency phones).
- Participate in Community- and Transit-Watch programs.

Zelinka and Brennan, in their 2001 book *SafeScape: Creating Safer, More Livable Communities through Planning and Design,* make a number of recommendations for enhancing transit-system safety related to the design and location of bus stops:

- Locate bus stops where they are visible from neighboring buildings/land uses and the street.
- Locate bus stops adjacent to businesses and other community activities to benefit from additional lighting and visibility.
- Avoid placing bus stops near liquor stores, bars, gun stores, adult-oriented uses, and other undesirable uses. Chaperone uses, such as police stations and firehouses, can neutralize potentially negative uses.
- Design bus stops and shelters for customer comfort and safety. Desirable characteristics include good visibility both from within and without, route and schedule information, shelter from weather, seating, and lighting. Lighting is very important at all transit stops.
- Provide landscaping to improve comfort, create interest and individuality, and establish boundaries around transit stops. However, landscaping must be designed and maintained not to obstruct walkways, visibility, or sightlines.
- Maintain sidewalks, shelters, landscaping, and seating to maximize perceptions of safety. Graffiti, trash, and general disrepair are signs that nobody is watching or cares.
- Maintain lighting fixtures near bus stops in good working condition.
- Provide schedules and other route information at all bus stops.
- Clearly articulate rules and directions for transit usage.

The Charlotte Department of Transportation, on its webpage *Designing Streets for Multiple Users*, adds that it is important to select safe locations for bus stops and provide signal priority for transit vehicles in order to minimize conflicts with other travel modes. Cervero (1993) notes it is important to configure streets to allow for through and efficient movement of transit buses.

Not only are transit facilities important for safety, but Kikuchi et al., in *Micro-Level Transit Accessibility Study* (2001), identify a number of specific facilities that improved transit ridership, including the presence of bus shelters, seating, and lighting. Ridership increases when more of these amenities are present. Additionally, The Pedestrian and Bicycle Information Center, in its website article *Shared Use Paths (Trails),* finds that connections between the trail access points and local transit service can encourage trail use and boost transit ridership. The Smart Growth Network, in its 2002 handbook *Getting to Smart Growth: 100 Policies for Implementation*, also recommends connecting transportation modes to one another.

<u>Transit level of service</u>

In the article *A micro-analysis of land use and travel in five neighborhoods in the San Francisco Bay Area* (1997), Kitamura and Laidet find that measures of public-transit accessibility are significantly associated with trip generation by mode and modal split. Kikuchi et al. find that the level of transit service is important to the level of ridership. More specifically, their study indicates the specific characteristics that improve transit ridership include the frequency of service, number of routes served at a stop, and availability of network and schedule information at the individual stop.

The Maryland Department of Transportation agrees that transit-oriented development should have high-quality transit service that includes, wherever possible, access to buses and rail. It

further notes that many Maryland neighborhoods in the Washington metro area link residents to Metro stations with Ride-On buses. The Greater Cleveland Regional Transit Authority identifies characteristics common to regions that have successfully promoted transit-supportive development, such as TOD. Successful TODs have the followinig in common:

- A commitment to a regional vision of high-capacity transit connections between regional centers or in development corridors.
- A political culture that values transit.
- High-quality transit services that attract riders.
- Regional growth that provides a market for development, some of which is channelled to station areas.
- Transit stations in areas where the market supports development.
- Regional policies that focus growth in transit corridors and limit it elsewhere.
- Station area policies and programs to support private-sector investments and transit-friendly development.
- A long-term commitment to TOD.

The Urban Land Institute, in its 2003 report *Barriers and Incentives to Transit-Oriented Development, Prince George's County, Prince William County, and the District of Columbia*, notes that for a successful TOD, buses must be part of a larger, intermodal plan. In addition, Ewing, in his 1999 report, *Pedestrian- and Transit-Friendly Design: A Primer for Smart Growth*, recommends that parallel bus routes be located one-half mile apart, with transit stops closely spaced along routes, and local streets that lead directly to the stops. However, if stops are infrequent, or local streets are curvilinear, he recommends that parallel routes be even closer together. Upscale transit facilities are also highly desirable.

The Smart Growth Network, in its 2003 follow-up publication *Getting to Smart Growth II: 100 More Policies for Implementation*, also recommends using distinctive public transit to increase the attractiveness of neighborhoods such as community-based transit systems having distinctive identities, and providing riders with customized transit information.

The Transportation Research Board (1997) states that an effective strategy for transit systems is simply to offer convenient services at competitive prices. Its report advocates service-oriented strategies including transit shuttles and connectors, which link residential neighborhoods with commuter rail and rapid-transit stations; circulators and trolleys, which enable shoppers, visitors, and office workers to move more freely about the central business district; and neighborhood-based transportation services. The Big Blue Bus in Santa Monica was noted as a good example of a system that provides convenience and accessibility in an auto-dominated city. Another relatively new strategy is the use of transit shuttles and connectors to bridge the gaps in the fixed-route transit infrastructure and more effectively link residential neighborhoods and employment centers. Watts in Los Angeles and Aspen, Colo., are given as examples of areas where transit services have become more flexible by utilizing a variety of sizes of buses, which can travel to a larger number of destinations than would be possible with standard-sized buses.

The same report notes that Aspen has used a carrot-and-stick approach in solving its congestion problems. In conjunction with a pay-for-parking program, the city introduced a van service and free shuttle from outlying park-and-ride facilities, with corresponding increases in commuter

services and express runs. As a result, commuter ridership increased 35 percent in one year, and transit ridership in the city increased 23 percent over the same period. Average daily traffic into Aspen dropped by three to four percent.

Additional effectiveness data

- The article *Report: Rail use in California Mixed*, in *Growth/No Growth*, May 2004, indicates that people living in TODs are five times more likely to use transit than residents of suburban neighborhoods. Their proximity and access to transit were highly important. Commuters are the most common riders of transit. Heavy traffic congestion, the related delays, and the stress of the rush-hour driving experience were counted as strong transit motivators. The same study also finds that multiple stops lowered the likelihood of TOD residents using transit.
- Stone et al., in their 1992 paper *Neo-traditional neighborhoods: A solution to traffic congestion*, note the effects of a greatly improved transit system on the cities of Seattle, Portland, San Diego, and Los Angeles. Trips into downtown Seattle shifted heavily toward transit use and bicycling, with improved facilities and strong support from political groups. Additionally, transit gained high-volume ridership overnight when it introduced its 16-mile Red Line and Tijuana Trolley in San Diego, which started its efforts with $60 million.
- Litman finds that improved transit service increases transit ridership and reduces automobile trips. He also reviews a study that concludes rail supply has the largest effect on driving of all variables, finding that a ten percent increase in rail supply reduces driving by 4.2 percent, and a ten percent increase in a city's rail transit service reduces 40 annual VMT per capita, compared to only a one mile reduction from a ten percent increase in bus service.

B. Walkable—High-Quality Pedestrian Environment

What does walkable mean? Canada Mortgage and Housing Corporation, in its 2002 report *Research Highlights Residential Street Pattern Design*, states, "Walkability implies comfortable access to amenities such as schools, recreation areas, retail stores and workplaces" (p. 3). The walking environment is extremely important in a TOD because every transit trip begins and ends with a walk to or from the station or bus stop. Frank and Company discover a synergistic relationship between transit use and neighborhood walkability. Neighborhoods with a greater mix of land uses, better street connectivity, and higher density supported both transit use for regional mobility and walking for nearby destinations. Not surprisingly, communities that support and encourage walking also support and encourage people to ride transit. A number of specific factors have been found to affect a traveler's choice of travel mode, including parking, pedestrian facilities, street trees, short block lengths, traffic calming, and density.

Robert Cervero (1993) explains that some of the key elements of transit-supportive design include the following:

- Connect neighborhoods and transit stops with direct pedestrian walkways and minimize the distance between the transit stop and the building entrance.
- Ensure that all buildings, walkways, and transit facilities are ADA-compliant and designed for pedestrian safety and security.

In 1994 *Prevention* magazine published *Blueprint for a Walkable Community: Florida's 12-Step Program*. It makes the following comprehensive recommendations to improve walkability:

- Provide continuously linked walkways. All walkways should connect in one seamless path leading wherever one would like to go. Ideally, walkways should have shade trees, plantings, benches, transit-stop shelters, and directions to places of interest.
- "Pedestrianize" intersections. Use design features that cause cars to slow down when turning. Use design elements that reduce the amount of time a walker spends crossing traffic. Channel intersections so that a pedestrian only has to cross two lanes of traffic at a time.
- Design for Americans with disabilities (ADA). Install corner ramps and raised crosswalks to facilitate mobility. Design and standardize signals to be more accessible and help the visually impaired.
- Place signals properly. Place signals for optimum visibility for both pedestrians and drivers. Be careful not to place signals too high.
- All intersections should be well lighted, including the crosswalks and waiting areas.
- Simplify median crossings. Build landscaped medians into existing roads to allow pedestrians to cross wide roadways more securely. Focus on high-volume pedestrian areas around schools, entertainment areas, malls, and residential neighborhoods.
- Make walking to schools safer. Identify specific places for buses and cars to drop off children away from pedestrian areas. Designate areas for children to cross streets safely with as little vehicular contact as possible. Design all roadways around schools to automatically slow traffic.
- Eliminate backing up. Design parking areas with walkways for pedestrians, eliminating the need for walkers to be behind any car that may be backing up.
- Make stores more accessible. Parking areas should be adjacent to or behind stores instead of serving as large barriers that walkers must cross. Create streets in front of stores that have attractive pedestrian areas with benches and convenient crosswalks. Design mall parking lots with networks of shady pathways that lead to storefronts. Commercial areas should have sidewalks and pathways leading to and from nearby neighborhoods.
- Create auto-restricted zones. Restrict vehicles to specific spaces and/or times in busy commercial activity centers.
- Combine walking with transit. Planning and zoning should encourage development that enhances transit use and access.
- Plan walking into new developments. Development and redevelopment should favor walking over driving.

The County of Arlington, Virginia, lists criteria for a walkable community on its website, *Transit in Arlington*. The criteria include

- Intact town centers.
- Residential densities, mixed income, mixed use.
- Public space.
- Universal design.
- Key streets that are speed controlled.
- Streets and trails that are well linked.
- Design that is properly scaled.

- Town is designed for people.
- Town is thinking small.
- In walkable communities there are many people walking.
- The town and neighborhoods have a vision.
- Decision-makers are visionary, communicative, and forward thinking.

Clearly, there are a number of elements that contribute to the walkability of a location. Mixed uses, compactness and density, and the design and management of parking facilities are significant components that will be addressed in other sections of this report. Also important, and addressed in this section, are pedestrian facilities, information and orientation, building design, and street design. It is important to understand that these characteristics are interrelated, even though we have broken them out for simplicity.

Pedestrian-facility design

Pedestrian facilities are needed to separate walkers from other travelers. Routes should be continuous, direct, accessible for people of all ages and abilities, safe to use, secure from crime, pleasant, and attractive.

Zelinka and Brennan recommend separating pedestrian and vehicular movement, especially in parking lots and where entrances and driveways cross sidewalks. In addition, it is important to provide or require sidewalks as part of all new development (Smart Growth Network, 2002). In addition, Hess et al., in their 1999 paper *Neighborhood Site Design and Pedestrian Travel*, recommend providing sidewalks along all arterials and streets in and around commercial centers and surrounding housing.

Many sources also recommended providing a buffer between the sidewalk and traffic with medians, street trees, landscaping, on-street parking etc. (Zelinka and Brennan).

- Provide buffers between the street and sidewalk wherever the speed of traffic constitutes a perceived danger to pedestrians (Hess et al.).
- Provide appropriate buffering from traffic with greenstrips between the walk and the curb and street trees. Trees between the street and sidewalk form a physical and psychological buffer (Ewing).

Pucher and Dijkstra, in their 2000 article *Making walking and cycling safer: lessons from Europe*, state that in the Netherlands and Germany all new suburban commercial developments have sidewalks and bicycle paths to serve non-motorists. The authors recommend the use of auto-free pedestrian zones, bicycle streets, and bike lanes and paths for enhancing cyclist and pedestrian safety. Pedestrian Zones are auto-free zones where pedestrians have their own right of way. Bicyclists may be allowed in pedestrian zones, but only with reduced speeds and while yielding to pedestrians.

Although sidewalks are important in a TOD, to be truly successful the TOD needs to have a pedestrian network. The network must be continuous, convenient, and directly connect the destinations to which people want to walk. The City of Calgary lists a key component of successful TODs as "[Createing] Convenient Pedestrian Connections." Accordingly, pedestrian routes should be short with key destinations located within a 400- to 600-meter (1300- to 1950-

foot) radius of the station. Pedestrian facilities should be continuous, easy to find and follow, and accessible to people with mobility aids. Sidewalks should directly connect to the station and building entrances with bus stops also located close to building entrances. Make pedestrian routes convenient by minimizing stairs, grade changes, driveways, and parking lot crossings. Many other sources agree with this assessment:

- Connect walkways, parking lots, greenways, and developments. Connect transportation modes to one another (Smart Growth Network, 2002).
- Connect neighborhoods and transit stops with direct pedestrian walkways and minimize the distance between the transit stop and the building entrance (Cervero 1993).
- Provide continuous sidewalks wide enough for couples. A five-foot sidewalk is wide enough for two people to walk comfortably abreast where pedestrian traffic is light, street furniture is limited, and buildings are set back from the sidewalk. Wider sidewalks are warranted when these conditions are not met. At peak times, sidewalks must provide at least 25 sq. ft. per pedestrian, 40 sq. ft. is better, but 100 to 150 sq. ft. is ideal (Ewing).
- Locate walkways either as part of the street system, within sight of the street, or along a popular trail, park, or other active corridor. Walkways should offer a direct route, connect streets, commercial areas, and parks, and have frequent, safe road crossings (Burden and Wallwork).

Hess et all. find that many apartment complexes and suburban school campuses in their study are surrounded by fencing with only a single connection to the public-street system, creating a barrier for pedestrians seeking the shortest route. At the same time, many retail areas are also ringed with large off-street parking lots and located along difficult-to-cross, heavily trafficked streets—a hostile walking environment. Some of their recommendations for an effective pedestrian system include the following:

- Provide sidewalks along all arterials and streets in and around commercial centers and surrounding housing.
- Provide gates with marked pedestrian pathways at regular intervals (200 feet), where fences surround multi-family housing and schools.
- Design the pedestrian network to be a simple grid with 200 to 300 feet of spacing between walkway intersections.
- Provide pedestrian crossing opportunities at short (500 feet), regular intervals along streets and arterials serving concentrations of multi-family housing, commercial development, and schools. Crosswalks must be accompanied by appropriate signage and signals to make drivers aware of pedestrians.

Some additional recommendations related to pedestrian networks include the following:

- Situate the TOD within a connected grid of streets that is easy to navigate on foot (Maryland Department of Transportation).
- Locate pedestrian facilities where they will be visible from neighboring buildings or the street as much as possible and design facilities to maximize sight-lines (Zelinka and Brennan).
- Reduce/remove barriers between adjacent land uses. Barriers can be created by walls, fences, berms, landscaping, buildings, and other means. Alternatively, provide a designated pedestrian connection through the barrier (Zelinka and Brennan).

- Situate parking to enhance the pedestrian environment and facilitate access between destinations (Smart Growth Network, 2003).
- Encourage trail use and boost transit ridership by providing connections between the trail access points and local transit service (Pedestrian and Bicycle Information Center).
- Provide safe and attractive pedestrian and bicyclist crossings when an obstacle such as a highway, railroad, or river must be traversed (Pucher and Dijkstra).

According to Cervero (1993), a key element of transit-supportive design is ensuring that all buildings, walkways, and transit facilities are ADA-compliant and designed for pedestrian safety and security. Universal design refers to design that accommodates people of all abilities, enhancing their safety, independence, and dignity. With the passage of the Americans with Disabilities Act in 1996, all new buildings and public works projects are required to be handicapped-accessible. The law, however, did not require immediate retrofit of the existing transportation system, only compliance as improvements were made. As a result, many places still are not handicapped-accessible. With respect to transportation and mobility-friendly design, the law primarily affects pedestrian and transit service and facilities, such as sidewalks, street crossings, buses, and bus stops. Although Universal Design principles have been developed to address people with disabilities, following them makes mobility easier for many people without disabilities, including children, the elderly, parents of small children, and people carrying bulky or heavy items. While ADA requires facilities to be designed to certain standards and dimensions, additional attention to the needs of the disabled beyond the requirements enhances mobility for all users.

Julie B. Kirschbaum et al. provide standards for designing accessible sidewalks in their 2001 book *Designing Sidewalks and Trails for Access Part II of II: Best Practices Design Guide.* They divide the sidewalk corridor into a number of functional zones and provide suggested minimum standards. These functional zones are described as:

- *Curb zone* is immediately adjacent to roadway.
- *Planter/furniture zone* is the area between the curb and the pedestrian zone.
- *Pedestrian zone* is the area of the sidewalk corridor specifically reserved for pedestrian travel.
- *Frontage zone* is the area between the pedestrian zone and the property line.

Table 1: Sidewalk Corridor Minimum Dimensions

Zone	Minimum Width
Curb Zone	6 inches
Planter/Furniture Zone	24 inches (48 inches for trees)
Pedestrian Zone	60 inches
Frontage Zone*	30 inches
Total Sidewalk Corridor	10 feet

**If 2.5 feet of open space is available between the sidewalk corridor and the property line, no frontage zone is needed and the minimum resulting sidewalk corridor width is 7.5 feet.*

Sidewalk maintenance is another important component of accessibility. Frequent problems include

1) Step separation—vertical displacement 0.5 inches or greater on any point in a walkway.

2) Badly cracked concrete—holes and rough spots wider than 0.5 inches.
3) Spalled areas—fragments from building materials from larger structures.
4) Settled areas that trap water —segments with depressions, reverse cross slopes, indentations.
5) Tree root damage—cause the walkway surface to buckle and crack.
6) Vegetation overgrowth—ground cover, trees, or shrubs that have not been pruned.
7) Obstacles—objects that obstruct passage including trash receptacles, utility poles, newspaper vending machines, and mailboxes.

Responsibility for maintenance may belong to the local government, homeowners, or businesses. Regardless of maintenance responsibility, local government inspectors should review and approve all repairs. In addition, signs, signals, and other information should be reviewed periodically for usefulness, degradation, etc. Lastly, citizens should have access to a convenient means of reporting problems with timely responses.

Gary O. Robinette's 1985 book, *Barrier-free Exterior Design: anyone can go anywhere*, includes a number of recommendations that focus on providing a barrier-free environment for people with physical disabilities of all kinds, including:

- Paving surfaces should be hard and relatively smooth; curbs should have ramped cuts and walks should be sufficiently wide to accommodate two-way traffic (five-feet-six-inches minimum, six feet preferred). Utility poles, newspaper boxes, signage, hydrants, etc. must not be allowed to infringe on the clear width of the walkway.
- Drop-off zones should be located as close to building entrances as possible, with no grade change (such as a curb) between the roadway and sidewalk. A waiting area with lighting and protection from weather should be provided.
- Sidewalks throughout a site should provide a clear, direct route through the site. Rest areas should be provided adjacent to the sidewalk (but not infringing on the clear width of the walkway) where pedestrians must walk long distances or up slopes.
- Sidewalk maintenance is imperative to eliminate any conditions that may cause injury.
- Drainage structures should be avoided within sidewalks, but when they occur, they should be placed flush with the surface in which they occur. Do not use grates with narrow parallel bard or grates with openings larger than ¾-inch. Never locate a grate between a curb ramp and the corner of the street or immediately downgrade from a curb ramp. Always locate drains perpendicular to the direction of vehicular and pedestrian traffic.
- Mid-block crossings should be used in pedestrian areas where block lengths are long.
- Intersections and crossings should be designed with clearly marked crosswalks, pedestrian signals with buzzers, and traffic islands with pass-throughs at all legs of the intersection.

The Public Rights-of-Way Access Advisory Committee provides some additional technical recommendations above and beyond ADA. These additional guidelines for well-designed new sidewalks, documented in the 2001 report *Building a True Community: Final Report*, include

- Sidewalks shall contain a pedestrian-access route and reduced-vibration zone. The minimum clear width for the reduced-vibration zone shall be 48 inches.
- Pedestrian-access routes should have a minimum clear width of 60 inches. The clear width of the pedestrian access route may be reduced to 48 inches at driveways and alley crossings, constrained building entrances, and at street fixtures.
- Pedestrian access routes should have a maximum cross slope of 1:48.

- Grades shall be consistent with the adjacent roadway.
- Stairs shall not be a part of the pedestrian access route.
- Visual contrast, where present, is required at the leading edges of stairways.
- Vertical and horizontal separation of the sidewalk from the street is encouraged.
- Driver alerts at exits to parking structures is encouraged.
- Wall-mounted and post-mounted objects in the pedestrian-access route are discouraged.
- Street identification signs shall meet readability criteria.

ADA requirements and guidelines are about making facilities safe for people with all abilities, and following them will ensure a high degree of user safety; however, there are a few additional points that should be addressed:

- Provide wide sidewalks, well-marked crosswalks, good lighting, and narrow streets to slow car traffic (Maryland Department of Transportation).
- Keep sidewalks in good repair and free of obstructions (Zelinka and Brennan).
- Provide frequent, safe road crossings (Burden and Wallwork).
- Design communities so that kids can walk to school and encourage safe pedestrian routes to transit (Smart Growth Network, 2003).
- Use modern technology to increase pedestrian safety such as countdown signals on crosswalk signs, infrared or microwave pedestrian sensors, and audible pedestrian signals (Smart Growth Network, 2003).
- Provide clearly marked crosswalks, pedestrian and bicycle signals, and modify intersections if necessary, to maximize traveler safety (Pucher and Dijkstra).
- Provide auto-free zones where pedestrians have their own right of way. Bicyclists may be allowed in pedestrian zones, but only with reduced speeds and yielding to pedestrians (Pucher and Dijkstra).

Zelinka and Brennan provide recommendations for designing and locating sidewalks and trails to minimize opportunities for, and perceptions of, crime. Their recommendations:

- Avoid pedestrian tunnels and bridges where possible. When necessary, they should be as short as possible, straight, wide, and well lighted. Bridges should allow for full visibility from within and without.
- Eliminate hiding places created by vegetation, walls, buildings, and fences.
- Adequately light all pedestrian facilities for safe nighttime use.

Additionally, Burden and Wallwork, in the 1998 *Handbook for Walkable Communities*, recommend that walkways should either be part of the street system, within sight of the street or along a popular trail, park, or other active corridor to allow for user visibility.

Pleasant, comfortable walking environments attract people, which enhances safety and community identity, and supports commercial activity and transit usage. According to the Maryland Department of Transportation, the street scene should be inviting, with landscaping, attractive public spaces, and interesting architecture. Some specific recommendations:

- Provide shade in summer with shade trees and provide seating to encourage additional eyes on the street (Zelinka and Brennan).

- Use different and special paving materials to define boundaries and rights-of-way, as well as to channel pedestrian flows (Zelinka and Brennan).
- Provide comfortable and safe places to wait (Ewing).
- Provide closely spaced shade trees along access routes. Trees at the right spacing in the right locations contribute to many pedestrian-friendly design objectives including comfort, safety, human scale, linkage, visual enclosure, complexity, coherence, and a sense of place. Shade trees should be placed close enough together (30 feet or less on center) to form a continuous canopy over the sidewalk (Ewing).
- Beautify and maintain existing and future walkways (Smart Growth Network, 2002).
- Use trees and other green infrastructure to provide shelter, beauty, urban heat reduction, and separation from automobile traffic (Smart Growth Network, 2003).

Additional effectiveness data

- Boarnet et al., in their 2005 article *Evaluation of the California Safe Routes to School Legislation: Urban Form Changes and Children's Active Transportation to School*, find that sidewalk improvements and traffic control appeared to have some impact on the frequency with which children walk or ride a bicycle to school. Sidewalk improvements included new sidewalks, filling gaps in existing sidewalks, building walking paths, and installing curbs and curb cuts. Traffic control consisted of installing a traffic signal. Of children who pass through these projects, 15 percent increased their walking or biking to school after the improvements, compared to only four percent of the children in the control group.
- Burden and Wallwork note that walking distance increases as the quality of the pedestrian environment improves. Good surface conditions (free of trash, water, ice, snow, pavement in good condition), crossable streets, security, lighting, and high pedestrian activity have all been linked to increases in walking distance. Shade in hot weather, sun in cool weather, protection from rain, and an interesting view have been linked to increases in walking distance. Pedestrians are likely to walk up to one mile (20 minutes) for a commute trip under favorable conditions.
- Jennifer Dill, in her 2004 paper *Measuring Network Connectivity for Bicycling and Walking*, finds that multiple routes and shortest distances are among factors that influence the attractiveness of walking or bicycling. Other factors that influence walking or bicycling include slope, the presence of sidewalks, bike lanes, bike paths, the amount of motorized vehicle traffic, aesthetics, and pavement or sidewalk quality.
- Kikuchi et al. find that the presence of pedestrian paths to the bus stop and nearby signalized crosswalks contributed to greater transit ridership.
- Litman finds that improved walkway connectivity tends to increase walking and cycling activity. Improving the quality, quantity, and security of sidewalks, crosswalks, paths, and bike lanes tends to increase non-motorized travel and reduce automobile travel. Residents of more walkable communities typically walk two to four times as much and drive five to 15 percent less than those who live in automobile dependant communities.
- McMahon et al., in *Better Models for Development in Delaware: Ideas for Creating More Livable and Prosperous Communities* (2004), note that many studies demonstrate that walking trails and bicycle paths increase nearby property values. In turn, increased property values can increase local tax revenues. Greenways often provide new business opportunities and locations for commercial activities such as bed and breakfasts, recreation equipment rentals and sales, and other related businesses.

- Kitamura and Laidet find that when controlled for socioeconomic differences, the presence of sidewalks is significantly associated with trip generation by mode and modal split.
- The United States Environmental Protection Agency, in its 2003 report *Travel and Environmental Implications of School Siting*, concludes that the proportion of arterials and collectors (the model does not include local streets) with sidewalks is the second most significant influence on walking trips to school. A 25 percent across-the-board reduction in sidewalk coverage resulted in 0.8 percent decrease in walking mode share, from 4.5 to 3.7 percent of trips to school. The article also cites a study indicating that walking or bicycling to school is more likely when certain pedestrian-friendly design features, such as street trees, are present.

Information and orientation

According to Zelinka and Brennan, an important principle for designing and locating sidewalks and trails to enhance user safety is information and orientation. To feel safe, people want to know where they are and how to get to their destinations safely and efficiently, irrespective of their modes of travel. Their specific recommendations include the following:

- Clearly articulate all rules and directions and provide appropriate street signage. Directional and locational signage helps people find their destinations.
- Provide schedules and other route information at all bus stops.
- Provide kiosks and community message boards with community information in areas of high pedestrian activity.
- Design and locate business and building signage to be orderly and help people find their destinations and bearings. Visual clutter impairs way-finding ability.
- Create and preserve landmarks that help to identify a place, provide orientation, and create unique community character.
- Provide clear boundaries and borders to enhance pedestrian corridors, define ownership, and encourage appropriate behavior. Boundaries must be carefully designed and maintained so as not to obstruct pedestrian visibility and sightlines.
- Provide transitions between public and private space. Provide neighborhood identification where appropriate. Neighborhood gateways should create identity and assist visitors in finding their way. Examples of boundaries, borders, and transitions include knee walls, plazas, porches, awnings, colonnades, and doors.
- Use different and special paving materials to define boundaries and right-of-way, as well as to channel pedestrian flows.

Signs provide us with directions and needed information. McMahon et al. advocate for controlled signage. They state that too often signs are oversized, poorly planned, badly located, and altogether too numerous. Sign clutter is ugly, costly, and ineffective. As a planned, architectural feature, a business sign can be colorful, decorative, and distinguished. A good sign code is pro-business, since an attractive business district will attract more customers than an ugly one. Moreover, when signs are controlled, businesses save money. When clutter is reduced, it is easier for consumers to find what they are looking for. The careful design and placement of traffic signs and other public signs can improve community appearance and aid drivers as well as pedestrians. A profusion of signs is as confusing as a lack of them. A good sign communicates its message clearly and quickly, is compatible with its surroundings, and enhances the visual image of the community.

Ewing recommends the use of coherent, small-scale signage. If designed and applied thoughtfully, signs can add several pedestrian-friendly qualities to streetscapes such as human scale, complexity, coherence, and sense of place. Signs within an area should have a consistent vocabulary of heights, sizes, shapes, materials, colors, and lettering. Signs should be sized based on the design speed of the street they front. In addition, special pavement can contribute human scale, linkage, complexity, and coherence to the streetscape. It can clearly delineate pedestrian, bicycle, and vehicular rights-of-way.

The Smart Growth Network (2002) recommends defining communities and neighborhoods with visual cues. In its 2003 follow-up publication, the Network also recommends using visual cues and design elements to indicate pedestrian rights-of-way, minimize conflicts, develop a comprehensive way-finding system, and utilize modern technology to increase pedestrian safety. Examples include countdown signals on crosswalk signs, infrared or microwave pedestrian sensors, and audible pedestrian signals.

Building design

Building design and architectural details can make or break the pedestrian environment. Litman finds that the layout and design of buildings and parking facilities can reduce automobile trips, particularly if implemented with improved transit services. Research shows that people walk more and drive less in areas with traditional pedestrian-oriented commercial districts where building entrances connect directly to the sidewalk. Variations in site design and building orientation can account for changes of ten percent or more in vehicle miles traveled (VMT) per employee or household. According to Zelinka and Brennan, buildings should be designed to provide "eyes on the street," to enhance pedestrian safety, and should not have a fortress mentality. To that end they provide the following recommendations:

- Locate doors, windows, and other activity areas so that they always face the street. Avoid security grills (or make them attractive), and include storefront lighting.
- Provide informal gathering places such as community gardens and parks, porches, plazas, and seating at building entrances.
- Do not allow blank walls to be located adjacent to pedestrian areas such as sitting areas, sidewalks, and parking lots. Blank walls prevent visibility and encourage graffiti and vandalism. Walls should be articulated with windows, murals, and other architectural detailing to create visibility, or at least the illusion of such.
- Design ground-level building corners to optimize lines of sight and observation using windows and angled or rounded corners.
- Design building entrances (both residential and non-residential) to be open, inviting, and highly visible, while also establishing clear boundaries and providing direction.
- Design and locate buildings such that exterior corridors are adequately wide and accessible to casual observation rather than becoming entrapment areas.
- Avoid architectural projections that create hiding places adjacent to pedestrian facilities.
- Design upper facades and above-ground uses as active building elements that watch over the activity occurring below on the streets and sidewalks. Examples include windows and second-floor balconies.
- Design walls and fences to be short or transparent to allow for observation of enclosed public spaces. Wherever possible, include elements such as breaks, alternative materials,

landscaping, and transparent spacing to make walls more pedestrian-friendly. Gates should control access but also be visually appealing and welcoming.

- Set back garages away from the street. Doors, windows, and other activity areas (porches, patios, etc.) should face the street.
- Provide transitions between public and private space and between different land uses. Transitions and boundaries should encourage interaction rather than isolation. Examples of transitions include knee walls, plazas, porches, awnings, colonnades, and doors.
- Design and locate loading areas for maximum visibility from both inside and out. Locate and design buildings for visibility into alleys, if present.
- Design and locate utility areas to limit access and allow transparency and observation.
- Introduce positive uses and design features in the rear of buildings. Some communities have successfully incorporated cafe seating and rear store entrances in order to create secondary storefronts.
- Design parking garages using these same building design rules, and include ground-floor retail, and architectural design that emphasizes openness and quality.

Other sources also provide recommendations related to building design:

- Cluster buildings and leave room to grow (City of Calgary).
- Make the most of architecture and design opportunities (City of Calgary).
- Encourage seasonal-friendly design by providing shelter from sun, wind, and rain (City of Calgary).
- Place pedestrian-oriented retail uses along roadways (Greater Cleveland Regional Transit Authority).
- Use buildings as landmarks and orient all buildings to the street (City of Calgary).
- Orient buildings towards transit stops (Greater Cleveland Regional Transit Authority). Minimize the distance between the transit stop and the building entrance (Cervero 1993).
- Create an inviting street scene with landscaping, attractive public spaces, and interesting architecture (Maryland Department of Transportation).
- Provide street-oriented buildings: Buildings should be set back no farther than 25 feet from the street and ideally flush with the sidewalk or set back just far enough to allow for landscaping. Main building entrances must face the street, and significant numbers of windows need to be at street level (Ewing). Locate buildings near roadways (Greater Cleveland Regional Transit Authority). Create street walls through the use of build-to lines instead of the typical minimum setbacks (Ewing).
- Provide comfortable and safe places to wait, especially near building entrances (Ewing).
- Avoid blank walls, which create dead space (Ewing).
- Encourage small-scale buildings, or articulate larger ones (Ewing).
- Manage the transition between higher- and lower-density neighborhoods by stepping down building heights, matching building types across streets, stepping back buildings on upper stories, and matching local architectural styles (Smart Growth Network, 2003).
- Provide incentives for ground-floor retail and upper-level residential uses in existing and future development (Smart Growth Network, 2003).
- Make sure pedestrian uses are located on the street and/or ground level of buildings (City of Calgary).

- Employ a design review board to ensure that compact buildings reflect desirable design standards (Smart Growth Network, 2002).

Street design

The design of streets and street networks can make or break a TOD. In order for a TOD to be successful, it is important that vehicular facilities be pedestrian- and transit-supportive in addition to serving the car. In the broadest sense, this means slowing down and dispersing vehicular traffic in order to make the pedestrian feel safer and more comfortable. Some of the specific tools to achieve this include traffic calming, street dimensions and standards, and an interconnected street grid.

The Transportation Research Board (1997) states that the vehicular network in a TOD should serve "as a catalyst for community livability" (p. 10). The design of streets should address the comfort and safety of pedestrians and bicyclists and accommodate alternative-mobility options in addition to vehicle movement. Streets should be designed to be an attractive, inviting, human-scale environment. They should reflect, preserve, and enhance each community's unique personality, provide opportunities for people to come together, and support local businesses. In other words, successful streets in commercial and residential areas are not excessively wide, are well connected to adjacent uses, and create a driving environment where traffic moves more slowly. The Board further states, "The impact of both design- and service-oriented kinds of transit improvements will be reduced, however, unless streets or roads also support community character and needs." They recommend the use of traffic calming to slow down cars, but not necessarily ban them, as they move through commercial areas and residential neighborhoods. Using this method, cars drive at speeds that are safer and more compatible with walking and bicycling. At the same time, buses no longer have to vie for limited space and access on the roads. "There is, in fact, a kind of equilibrium achieved among all of the uses of a street so no one mode can dominate at the expense of another" (p. 12).

An important component of TOD-supportive streets is to slow traffic using traffic-calming measures and narrower street widths. According to Michael Wallwork's 1998 article, *Traffic Calming: How to make Streets more Livable*, communities have unwittingly created the need for traffic calming by mandating wide roads, long straight streets, and cul-de-sacs, while at the same time banishing schools, neighborhood stores, and parks from neighborhoods. Traffic calming involves retrofitting physical devices onto street networks to reduce vehicular speeds, eliminate cut-through traffic patterns, and create a more pleasant street environment for residents and pedestrians. Other benefits include reductions in air pollution, noise, and odors. Zelinka and Brennan stress that "vital and safe downtowns must include a mix of pedestrians and vehicles. Slow-moving vehicles provide a sense of security and eyes on the street." Many researchers have noted the relationship between street design, vehicle speeds, collisions, and the pedestrian environment.

- "Tree-lined, pedestrian-friendly streets are safer than streets with wider lanes and fewer trees" (Hines, p. 96). Trees and streetscaping signal drivers to slow down, resulting in fewer collisions with passersby (Hines, *Shared Wisdom: Road Warrior*, 2007).
- Relative collision rates decline as the numbers of pedestrians and cyclists increase (Appleyard and Cox).

- A typical 48-foot-wide street has a crash rate 18 times higher than a typical 24-foot-wide street (Appleyard and Cox).
- Wider streets have been found to encourage higher vehicular speeds (Wallwork 1993).
- Traffic calming reduces the likelihood of a pedestrian or bicyclist being hit and also increases their chances of surviving a crash (Pucher and Dijkstra). Lowering vehicular speeds on local streets results in reduced accident severity (Community Planning Workshop).
- Traffic calming tends to reduce vehicle travel and increase walking and cycling (Litman). Where the street pattern encourages speed, it invites more traffic, and as traffic volumes increase, so the pedestrian environment declines (Canada Mortgage and Housing Corporation).
- Traffic calming tends to reduce total vehicle mileage by reducing travel speeds and improving conditions for walking, cycling, and transit use. Traffic studies find that for every meter increase in street width, the 85th percentile vehicle traffic speed increases 1.6 kph, and the number of vehicles traveling 8 to 16 kph (5 or 10 mph) or more over the speed limit increases geometrically (Litman).
- Overly wide neighborhood streets encourage speeding, generate stormwater run-off and non-point-source pollution, and increase the cost of new houses along the street (McMahon et al.).
- When traffic-calming measures were introduced, 50 percent more children are allowed to walk to school on their own (Hillman, The Impact of Transport Policy on Children's Development, 1999).

Specific recommendations for slowing vehicular traffic include:

- Use narrow street design alternatives (Community Planning Workshop). Narrow street pavements to 10-, 16- and 24-foot widths (Wallwork 1998).
- Use two- or four-lane streets as much as possible. Larger streets should be rare exceptions (Ewing).
- Reduce the length of streets to reduce traffic speeds (Center for Watershed Protection, *Better Site Design*, 1998).
- Design and locate traffic control devices to keep through traffic on arterial roads, and to control the behavior of the remaining motorists (Wallwork 1998).
- Use traffic calming to reduce the impact of vehicles including street trees, on-street parking and narrow street widths (Zelinka and Brennan).
- Control motor vehicle speeds with physical barriers such as raised intersections and crosswalks, traffic circles, road narrowing, zigzag routes, curves, speed bumps, and artificial dead-ends created by mid-block street closures (Pucher and Dijkstra).
- Enact traffic calming area-wide rather than on isolated streets. This ensures that faster through-traffic travels on arterial routes designed to handle it, rather than being shifted from one local street to another (Pucher and Dijkstra).
- Use traffic-calming devices such as curb extensions, crosswalks, and landscaping to slow traffic speeds (Community Planning Workshop).
- Use traffic-calming devices at selected mid-block locations (Wallwork 1998).

For a street to be TOD-supportive, designers must address the needs of other modes, so that walkers, cyclists, transit, and emergency vehicles, can all interface with the street safely and

efficiently. Cervero (1993) also stresses the importance of configuring streets to allow for efficient through movement and local service for transit buses. Litman concludes that multi-modal street design and management increases the use of alternative modes. The Smart Growth Network (2002) recommends connecting transportation modes to one another.

Pedestrians are most likely to interface with the street when they attempt to cross. Minimized crossing distances and the design and location of crosswalks can maximize the safety and convenience of walkers. It is also important to separate pedestrian and vehicular movement, especially in parking lots and where entrances and driveways cross sidewalks (Zelinka and Brennan). Pedestrians are made to feel safe with well-marked crosswalks and good lighting (Maryland Department of Transportation). In fact, accident rates are significantly lower where marked crosswalks are provided and crossings are lighted (Ewing). The Charlotte Department of Transportation, to minimize conflict and maximize pedestrian safety, recommends the following:

- Manage driveway access to minimize and control the locations of turning cars.
- Provide median or corner pedestrian refuge islands.
- Reduce the number of travel lanes.
- Provide curb extensions.
- Design smaller curb radii.

A few other recommendations from Pucher and Dijkstra specifically related to crosswalks include the use of:

- Zebra crosswalks (sometimes raised and extra wide) with highly visible striping, usually with special overhead illumination and sometimes with flashing yellow lights to alert motorists.
- Pedestrian-activated crossing signals, both at intersections and at mid-block crosswalks.
- Pedestrian refuge islands for crossing wide streets.

Hess et al. find that pedestrians in areas with suburban characteristics (large blocks and fragmented or lacking pedestrian facilities) were more likely to jaywalk (crossing outside of crosswalks or away from an intersection). "The very high incidence of jaywalking in suburban sites suggests that pedestrians take risks because they lack options in their walking routes" (p. 4). As a result, they recommend that pedestrian crossing opportunities occur at short (500 feet), regular intervals along streets and arterials serving concentrations of multi-family housing, commercial development, and schools. Richard Untermann (Ewing) recommends marked crosswalks every 100 feet on streets with heavy pedestrian activity. In order to achieve these recommended distances, mid-block crosswalks may be needed. Mid-block crosswalks slow down traffic in the immediate vicinity and discourage pedestrians from crossing between parked cars. Burden and Wallwork provide guidelines for safe mid-block crossing design:

- Provide an at-grade cut-through at the crossing point, and ensure that the cut-through is appropriately sloped for drainage.
- Angle the cut-through 45º towards advancing vehicles to force pedestrians to look for vehicles.
- Keep all landscaping at least two feet behind the median curb.
- Create a pedestrian refuge in the median if possible (also at 45º angle).
- Provide pedestrian signals at crossings where traffic is heavy or people have special needs.

Signage, signals, striping, and traffic laws should also be used to improve the safety of the pedestrian environment.

- Accompany crosswalks with appropriate signage and signals to make drivers aware of pedestrians (Hess et al.). Provide pedestrian-activated crossing signals at intersections and at mid-block crosswalks. Use flashing yellow lights to alert motorists, if necessary (Pucher and Dijkstra). Provide sufficient signal timing so that pedestrians do not feel trapped in an intersection (Charlotte Department of Transportation).
- Use special paving materials to define boundaries and rights-of-way, as well as to channel pedestrian flows (Zelinka and Brennan).
- Use modern technology to increase pedestrian safety such as countdown signals on crosswalk signs, infrared or microwave pedestrian sensors, and audible pedestrian signals (Smart Growth Network, 2003).

Many European countries impose additional vehicular restrictions to improve pedestrian safety (Pucher and Dijkstra):

- Right turns on red are prohibited for motor vehicles. Several studies have concluded that right turns on red pose considerable danger for pedestrians and cyclists.
- Residential neighborhoods that are not traffic-calmed usually have a speed limit of 30 km per hour (19 mph), while the overall speed limit in cities is 50 km per hour (31 mph).
- Truck traffic and through-traffic of any kind is prohibited on many roads.

Cervero (1993) explains that a key element of transit-supportive design includes configuring streets to allow for efficient through movement and local service for transit buses. According to Michael Wallwork (1998), emergency-services requirements such as fire-truck access often dictate the design width and curvature of streets. In reality, the majority of residential emergency calls require an ambulance that is able to easily negotiate streets designed for the average automobile. Appleyard and Cox, in their 2006 article *At home in the zone: Creating livable streets in the U.S.,* make recommendations to address emergency response. Although these are geared towards neighborhood streets, they can be adapted for streets within a TOD as well. They note that a 9.5-foot-wide fire truck (including mirrors and equipment) requires a 35-foot turning radius and, therefore, provide the following recommendations:

- Involve emergency responders early and develop collaborative solutions. Discuss the possibility of using smaller, more maneuverable vehicles.
- Prohibit parking 20 to 35 feet from an intersection to allow fire trucks to make the turn.
- Design tight corners and curb extensions so that fire trucks can maneuver over them if necessary.
- Create 20-foot emergency-vehicle staging areas every 100 feet on narrow streets.
- Establish extra-large no-parking zones or curb extensions adjacent to fire hydrants.

Another important component of a TOD-supportive network is interconnectedness. Interconnectedness benefits all travelers by allowing more direct and convenient routes. This is especially important for pedestrians who are limited in the distance they can or will walk. Interconnectedness reduces the length of trips, thereby allowing more trips to be by walking or cycling. Suburban cul-de-sacs and long blocks make walking and bicycling more difficult by making trips circuitous and excessively long. Residential roads often feed directly into high-speed traffic arteries, increasing the danger of making trips outside the neighborhood.

Pucher and Dijkstra note that when new residential areas are located adjacent to town centers and connected by a fine mesh of local streets, the proximity to town makes trips shorter, while the finer grain of the road network allows pedestrians and bicyclists to choose quieter, less-heavily traveled streets over busier, more dangerous roads.

Hess et al. find that the size of blocks in areas with suburban characteristics is inversely related to the intensity of activities located within them. "In other words, higher-density commercial and residential development is associated with very sparse street systems even though such development generates high levels of vehicle and pedestrian traffic. Instead of taking into account the number of people who will use the streets, suburban blocks correspond to the size of the properties they serve…. Even with wide, high-capacity streets, suburban block sizes address neither pedestrian nor automobile travel demand as related to land use patterns" (pp. 4-5).

The Community Planning Workshop, in its 2003 brochure *Connecting Transportation & Land Use Planning*, states, "Connectivity implies a system of streets with multiple routes and connections serving the same origins and destinations; it relates not only to the number of intersections along a segment of a street, but also to how an entire area is connected by the street system." The brochure describes the characteristics of a highly connected area as:

- A dense system of a parallel routes and cross-connections within an area, typically forming a grid-like pattern of arterial, collector, and local streets.
- Few closed-end streets such as cul-de-sacs, dead-end, and looped streets.
- Many points of access.
- Narrow streets with sidewalks or off-street paths.
- Frequent intersections to create a pedestrian-scale block pattern.

The benefits of interconnectivity as described by the brochure include

- Providing drivers, walkers, and bikers with multiple direct routes for traveling short distances while preventing them from being forced onto arterial roads. This provides better opportunities for walking and bicycling to local destinations such as shops, schools, and friends' houses.
- Shortening vehicular travel distances, making travel more direct, reducing travel time, increasing accessibility, and lowering the number of vehicle miles traveled.
- Better accommodating the development of town centers with short blocks (typically 200 to 400 feet in length) in interconnected street patterns compared with typical strip developments found along arterial roads with long blocks.
- Reducing traffic speeds as a result of shorter street lengths, according to the Institute for Transportation Engineers.

Butler, Handy, and Patterson, in their 2003 book *Planning for Street Connectivity*, offer research results and studies based on the experience of 14 communities' efforts to incorporate greater connectivity. They find that in general, improving connectivity for cars should improve connectivity for bicycles and pedestrians, unless streets are poorly designed. If separate facilities are provided, bicycle and pedestrian connectivity can be even greater than car connectivity. Transit connectivity can also benefit from improved connectivity in all modes, although the amount of improvement depends on the design of transit routes. By influencing the travel distances for each mode, connectivity requirements can have an important impact on mode

choice. Davis, Calif., well known as a bicycling community, encourages high levels of pedestrian and bicycle connectivity through a system of greenbelts, but allows wide use of cul-de-sacs that tend to lower automobile connectivity.

Canada Mortgage and Housing Corporation reviewed the pros and cons of various residential street layouts. They define connectivity as "the accessibility on foot to various parts of the community, and the links between the neighborhood and adjacent neighborhoods, and can be measured by the frequency of connecting elements" (p. 6). They found that:

- The curvilinear streets that are typical of conventional suburban subdivisions are not inefficient. Though irregular lot shapes do not pack efficiently, this is of relatively little consequence at low densities. For comparable residential densities, loop and cul-de-sac street patterns are more efficient than traditional gridiron geometry. According to this report, the technical literature on street planning points out that conventional suburban street layouts consume 16 to 25 percent less land than the traditional grids advocated by new urbanism. However, the loop and cul-de-sac street pattern is designed for the car and is poorly adapted to pedestrian traffic. "Their discontinuity inhibits pedestrian access to facilities and amenities, while their curvilinear aspects lengthen and confuse walking trips" (p. 2). In addition, the complementary collector and arterial streets are inhospitable and unsafe as a result of the high traffic volumes, therefore discouraging pedestrians.
- T-intersections, with only three intersection paths, are safer for both drivers and pedestrians than the traditional four-way intersection with 16 possible intersecting paths.

Canada Mortgage and Housing Corporation concluded that discontinuous streets with loops and cul-de-sacs provide safety, sociability, and efficiency. However, continuous grid patterns provide connectivity and easy orientation. A combination of these two patterns to maximize the benefits and minimize the limitations of each would have the following characteristics (p. 4):

1) It would return to orthogonal geometry for clarity of organization and directness of pedestrian access.
2) It would provide loops and cul-de-sacs for local streets for safety, tranquility and land use efficiency.
3) It would use open space as a structuring element of the layout for connectivity, relief, comfort, water retention, interaction, and delight.
4) It would adopt a road hierarchy of local, collector and arterial for distributing and moving car traffic effectively.
5) It would transform arterial roads from mere traffic conveyors to activity generators. The aim of this new combined street layout is to prevent non-resident through traffic, to maximize the number of houses on cul-de-sacs and loops, to situate open space for maximum accessibility and to accommodate a range of housing types.

Other specific recommendations for achieving connectivity as described by the literature include the following:

- Site TODs within a connected grid of streets that is easy to navigate on foot (Maryland Department of Transportation). Provide grid-like street networks (Ewing).
- Plan and permit road networks of neighborhood-scaled streets with high levels of connectivity and short blocks (Smart Growth Network, 2002). Design using a combination

of mixed-use development, fine-grained street networks, and short streets, combined with T- and four-way intersections (Wallwork, 1998).

- Make public right-of-way routes short and direct (Community Planning Workshop).
- Require short to medium block lengths. More intersections mean more places where cars must stop and pedestrians can safely cross. As a result, streets are easier for pedestrians to cross and can be scaled back in size. Three-hundred-foot blocks are ideal, but 400 to 500 feet is still acceptable (Ewing). Space street connections no more than 530 feet apart, except where prevented by barriers (Community Planning Workshop).
- Require any block longer than 500 feet to have mid-block crosswalks and pass-throughs for pedestrians (Ewing). Make provisions for bike and pedestrian accessways no more than 330 feet apart when full street connections are not possible (Community Planning Workshop).
- Provide pedestrian and bicycle connections where street connections are not possible due to barriers such as topography, freeways, railroads, pre-existing development, lease provisions, easements, covenants, or water features (Community Planning Workshop).
- Limit the use of closed-end streets to situations where barriers exist (Community Planning Workshop).
- Design closed-end streets so that none may be longer than 200 feet or have more than 25 dwelling units (Community Planning Workshop).
- Consider opportunities to incrementally extend streets from nearby areas (Community Planning Workshop).

<u>Additional effectiveness measures</u>

- Frank and Company find that residents walk more in neighborhoods where access to services is facilitated through a connected street network. When controlling for demographics, for each quartile increase in the number of intersections per square kilometer, there is a corresponding 14 percent increase in the odds of walking for non-work travel. In addition, the greatest differences in vehicle miles traveled (VMT) were observed across levels of intersection density where mean VMT was 34 per person in the least, and 25 in the most connected environments of King County. This represents 26 percent fewer VMT for residents of communities that have the most interconnected street networks in the county.
- Hess et al. compare twelve sites in the central Puget Sound region for pedestrian activity and community characteristics, controlling for population density (sites ranged from 3.5 to 6 dwelling units per acre), land use mix (somewhat mixed uses) and income. They find that communities with small blocks (average of 2.7 acres or a 300x400-ft. foot block) and extensive sidewalk systems were found to have, on average, three times the pedestrian volumes of sites with large blocks (average of 32 acres or a 1,000x1300-foot block) and short or incomplete sidewalk systems.
- The U.S. Environmental Protection Agency cites a study indicating that walking or bicycling to school is more likely when certain pedestrian-friendly design features, such as short block lengths, are present.
- According to Wallwork (1993) in *Traffic Calming, The Traffic Safety Toolbox*, there has been no correlation shown between neighborhood street layout and the incidence of crime. However, having many access points encourages more on-street activity, which is a deterrent to crime.

C. Destinations—Complete Communities with a Community Center and the Right Mix of Uses

Jurisdictions that have successfully implemented TODs recommend that the TOD be planned and designed to be a destination and/or center of the surrounding community. Many sources discuss the need for an effective mix of land uses in order to promote walking and transit usage and, in fact, the separation of residential from commercial land uses increases trip distances and makes the car a necessity. Many more sources make recommendations for the design of the streetscape to encourage pedestrian activity and enhance the sense of place. Coordinating these elements can make the difference between a TOD that functions adequately or not at all, and a destination.

Litman finds that increased centeredness (the portion of commercial, employment, and other activities in major activity centers) increases the use of alternative commute modes. Typically 30-60 percent of commuters to major commercial centers use alternative modes, compared with 5-15 percent of commuters to dispersed locations. Dan Burden, in Hines's article, *Shared Wisdom: Road Warrior* (2007), notes that in Key West, Fla., the old part of town with its narrow streets and human scale makes up only 20 percent of the land mass, yet it generates 80 percent of the city's revenue. When people arrive at a pleasant place, they want to stay and they want to spend. Many sources stress the importance of this characteristic:

- The City of Calgary—Make Each Station a "Place": Create a destination when planning and developing a TOD. Use buildings as landmarks and orient all buildings to the street. Include high-quality public open spaces.
- The Smart Growth Network (2003) —Create opportunities for community interaction.
- The Victoria Transport Policy Institute—A TOD should be characterized by a center with a rail or bus station, high central density, and pedestrian-scale distances. It should incorporate several specific design elements including mixed-use development, and create complete communities, with shops, schools, and other services within convenient walking distances of transit.
- The Transportation Research Board (1997) — "Bus, light rail, heavy rail, and subway stops have the potential to be centers of community life" (p. 11). Design of TODs should seek to enhance the comfort and convenience of transit users, and have a positive impact on the surrounding area. With proper design and incentives, transit stops can attract a variety of activities and uses (like retail, community services, and special events) which increase the sense of security and help create an incubator for small retailers and entrepreneurs from the local community.

Many studies prove the relationship between land use and travel mode:

- Hess et al. find that schools, multi-family housing, and grocery stores were specifically found to generate pedestrian traffic.
- Kikuchi et al. report that the amount of nearby-trip generators encouraged greater transit ridership.
- Kitamura and Laidet find that measures of mixed land use are significantly associated with trip generation by mode and modal split. The authors conclude, however, that attitudes are more strongly associated with travel than land use characteristics, suggesting that land use policies promoting land use mixtures alone may not alter travel demand.

- Litman's literature review draws some broad conclusions regarding the effectiveness of specific land use factors in determining travel behavior. He notes a study that found the presence of worksite amenities such as banking services (ATM, direct deposit), on-site child care, a cafeteria, gym, and postal services could reduce average weekday car travel by 14 percent, due to a combination of reduced errand trips and increased ridesharing. In addition, he concludes that increased land use mix tends to reduce per capita vehicle travel, and increase the use of alternative modes, particularly walking for errands. Residents of neighborhoods with good mix of land uses typically travel 5 to 15 percent fewer vehicle-miles per capita.
- Petersmark and Wilkerson state, "Research has demonstrated that suburban residents drive twice as far, walk and cycle one-third as often, consume twice as much energy, and produce twice as much air pollution as their urban counterparts who live where land use tends to be mixed" (p. 3).
- The U.S. Environmental Protection Agency cites a study that found children were more likely to walk or bicycle to school when homes are within a mile of the school, and less likely when households have more licensed drivers to provide rides. Of secondary influence is the presence of certain pedestrian-friendly design features such as mixed land uses. Accessibility (the number of trip attractors/generators), another built-environment variable, influenced school bus ridership. The less accessible the school or home location (and the fewer other land uses in close proximity), the more likely that students would take the school bus. This study concludes that locating schools close to residents increases the viability of walking and biking to school by as much as 13 percent, reducing the total number of vehicular trips. In addition, the total number of vehicular miles traveled is reduced, further reducing auto emissions by at least 15 percent.
- A number of other studies (Wallwork 1993, Victoria Transport Policy Institute, and Zelinka and Brennan) also suggest that locating schools in and adjacent to residential neighborhoods provides benefits to the community. School design and siting can also significantly affect students' safety, development, learning, and health.

Frank and Company find that when controlling for demographics, for each quartile increase in the number of retail establishments, there is a corresponding 19 percent increase in the odds of walking for non-work travel. However, while the number of non-residential destinations did the most to influence walking, the greatest relationship with transit use came from the total square footage of commercial destinations in the neighborhood. Their key findings include

- Compact development, a wide variety of land uses close to home and work, and a connected street network with pedestrian facilities can help achieve increased transportation efficiency, reduced automobile dependence, reduced ozone, and improved regional air quality and health.
- Residents walk more in neighborhoods that provide a wide variety of retail services and where connections to such services are facilitated through a connected street network.

The same study finds that mixed use—the interspersing of homes with offices, shops, schools, parks, and other destinations—matters most when it comes to transportation efficiency. Providing retail destinations and activities near where people live and work is critical. The actual number of recreational, educational, retail, entertainment, and other commercial attractions near one's home may be more important than the size of the attraction itself in making the decision to

walk. This is an important finding, suggesting that more small uses interwoven in residential areas is the best way to encourage walking for errands and other non-work purposes. For example, a big-box store does not affect walking as much as several smaller shops with the same total square footage.

The specific land uses most strongly linked to the percentage of household trips made on foot proved to be educational facilities, commercial office buildings, restaurants and taverns, parks, and neighborhood-scale retail establishments. Civic uses and grocery stores followed closely. Having establishments such as these within a kilometer (approximately 3280 feet) of one's home allows people to meet recommended physical activity needs by walking. Data showed the odds of walking increased by 20 percent for each additional park and 21 percent for each additional educational facility within a kilometer of residents' homes. It is anticipated that this relationship is non-linear and that smaller increases in walking will likely result as demand for parks and schools is approached and met.

The greatest relationship with transit use came from the total square footage of commercial destinations in the neighborhood. The land uses associated with the greatest percentage of work trips on transit are also those associated with typical downtown areas: more commercial office floor space and retail floor space, and a greater number of large retail attractions and office buildings. Areas that included predominantly fast-food outlets, high-tech companies, office parks, and vacant land were found to be associated with lower transit ridership.

Many sources provide specific recommendations regarding TODs and mixed uses:

- Get the land uses ight—Encourage transit-supportive uses and discourage non-transit-supportive uses, encourage a mix of uses and locate the uses as close to the station as possible (City of Calgary).
- Provide supportive commercial uses such as coffee shops, news stands, dry cleaners, child care, and food stores (Ewing).
- Provide parks and other public spaces, which serve as attractions for pedestrians and add character to the street environment. Well-connected plazas generate a substantial amount of impulse use; sunken or elevated (less visible) plazas do not (Ewing).
- Encourage a mix of land uses (Greater Cleveland Regional Transit Authority).
- Place pedestrian-oriented retail uses along roadways (Greater Cleveland Regional Transit Authority).
- Concentrate critical services near homes, jobs, and transit (Smart Growth Network, 2002).
- Create active and secure open spaces (Smart Growth Network, 2002).
- Allow vendors to offer sidewalk service (Smart Growth Network, 2002).
- Locate civic buildings in existing communities rather than greenfield areas (Smart Growth Network, 2002).
- Encourage the redevelopment of single-use into mixed-use developments (Smart Growth Network, 2003).
- Provide incentives for ground-floor retail and upper-level residential uses in existing and future development (Smart Growth Network, 2003).
- Create community greens (Smart Growth Network, 2003).
- Transform park and ride lots into multiuse facilities (Smart Growth Network, 2003).
- Create neighborhoods diverse in use and population (Urban Design Associates).

- Design communities shaped by physically defined and universally accessible public spaces and community institutions (Urban Design Associates).

Zelinka and Brennan state, "Safer, more livable communities include neighborhoods closely knitted to human-scale centers (i.e., downtowns) that offer opportunities for work, school, shopping, and recreation" (p. 105). Mixing land uses provides "eyes on the street," which enhances safety because criminals do not want to be seen. Included are these recommendations:

- Design neighborhoods that blend single- and multi-family housing to allow for a more diverse, multi-generational population (such as retirees, stay-at-home moms, residents who work alternate shifts, home-based businesses, and students). Diverse populations have less-identifiable behavioral routines; therefore it is more likely that someone will be at home and watching at any given time of the day.
- Encourage a mix of land uses and housing types to encourage informal monitoring of street activity. Allow and encourage accessory dwelling units.
- Locate schools and churches within or adjacent to residential neighborhoods to strengthen neighborhood ties and increase perceptions of safety due to the activity around the school, especially during the day. The institutions enhance the community through shared facilities such as meeting rooms. Similarly, other beneficial public facilities include senior centers and police stations.
- Attract and retain public and quasi-public land uses, which are essential to fostering vital and safe downtowns.
- Locate parks, playgrounds, open space, and trails where they are visible from schools, homes, and neighboring businesses or the street for continuous monitoring.
- Design plazas and parks to allow people to feel connected to others through observation, interaction, and activity.

The Institute for Public Administration, in its 2004 report *Mobility Friendly Design Standards: A Framework for Delaware*, summarizes the national literature related to mixed land uses. Recommendations related to the specific mix of land uses for TODs include the following:

- Have a blend of single- and multi-family housing.
- Locate schools close to homes, and maximize the number of homes within one mile of a school.
- Interweave small uses into residential areas/neighborhoods that include a wide variety of retail services. Specific uses recommended close to residential and employment:
    - educational facilities
    - commercial office buildings
    - restaurants and taverns, coffee shops
    - parks
    - neighborhood-scale retail establishments, news stands, dry cleaners
    - civic uses
    - grocery stores
    - child care
- Encourage a wide variety of land uses close to employment such as banking services (ATM, direct deposit), on-site childcare, a cafeteria, gym, and postal services.
- Encourage transit use by providing more commercial office floor space and retail floor space and a greater number of large retail attractions and office buildings.

Much of the literature makes recommendations for the design of the streetscape to encourage pedestrian activity and enhance a sense of place. The streetscape encompasses many design elements that give the street its unique character and aesthetics, such as landscaping, street furniture, pavement, and art. McMahon et al. defines the streetscape as consisting of street paving, sidewalks, streetlights, traffic lights, public signs, street furniture such as benches and trash cans, landscaping, and public art. In downtowns and neighborhood commercial areas, a pleasing streetscape can repay its cost in increased tourism and shopping revenue, increased citizen use of public spaces, enhanced civic pride, and new investment in the public sector.

Dill finds that aesthetics influences the attractiveness of walking or bicycling on a network. Burden and Wallwork also note that walking distance increases as the quality of the pedestrian environment improves. Good surface conditions (free of trash, water, ice, snow, pavement in good condition), crossable streets, security, lighting, and high pedestrian activity have all been linked to increases in walking distance. Shade in hot weather, sun in cool weather, protection from rain, and an interesting view have been linked to increases in walking distance. Pedestrians are likely to walk up to one mile (20 minutes) for a commute trip under favorable conditions. McMahon et al. also find people are more likely to walk in a well-landscaped, shaded commercial area. This reduces traffic congestion and is good for business. The temperature on a tree-shaded street can be five to nine degrees cooler than on a street without shade trees.

Some specific recommendations:

- Ensure good urban design—create high-quality streets that are aesthetically pleasing. Encourage seasonal-friendly design by providing shelter from sun, wind, and rain. Provide lighting, landscaping, and appropriate signage (City of Calgary).
- Provide functional street furniture, including benches, lighting, and trash receptacles at regular intervals (Ewing).
- Contribute human scale, linkage, complexity, and coherence to the streetscape using special pavements. Special paving can reinforce and enhance other transportation objectives such as traffic calming. It can visually break up large paved areas, provide linkage between buildings, streets and public spaces, and clearly delineate pedestrian, bicycle, and vehicular rights-of-way (Ewing).
- Provide loveable objects, especially public art, which can increase pedestrian activity. Focal points can help define spaces and bring character to the streetscape (Ewing).
- Locate buildings near roadways (Greater Cleveland Regional Transit Authority).
- Plant trees throughout communities and preserve existing trees during new construction (Smart Growth Network, 2002).
- Define communities and neighborhoods with visual cues (Smart Growth Network, 2002).
- Create opportunities for community interaction (Smart Growth Network, 2002).
- Enact clear design guidelines so that streets, buildings, and public spaces work together to create a sense of place (Smart Growth Network, 2002).
- Throw out “cookie cutter” solutions. Every community design solution must be unique in order to respond to unique project, community, and site conditions (Urban Design Associates).
- Create places framed by architecture and landscape design that celebrate local history, climate, ecology, and building practice (Urban Design Associates).

Zelinka and Brennan note that a carefully designed and coordinated streetscape and street furniture can send a powerful message of community ownership and stewardship. Disregard for the streetscape also sends an equally powerful negative message. Some examples of streetscape and furniture include benches, lighting, flags and banners, planters, trash cans, newspaper racks, bollards, signage, water fountains, kiosks, clocks, and paving. They recommend that streetscapes:

- Include public art, which encourages interaction.
- Design bollards to be decorative elements of the streetscape wherever they are visible from the public realm.
- Provide seating to encourage interaction and eyes on the street.
- Preserve and create landmarks that help identify a community, contribute to community character, and assist with orientation.
- Provide clear boundaries/borders. These enhance public spaces, define ownership, and encourage appropriate behavior. The boundaries/borders, however, must be carefully designed and maintained for visibility and optimum sightlines.
- Provide transitions between public and private space. Provide neighborhood identification where appropriate. Neighborhood gateways should create identity and assist visitors in finding their way. Examples of boundaries, borders, and transitions include knee walls, plazas, porches, awnings, colonnades, and doors.
- Use landscaping to create interest, individuality, and to establish boundaries. Landscaping must be carefully designed and maintained so as not to obstruct walkways, visibility, and sightlines.

Zelinka and Brennan also note the importance of maintenance. They state that when an area has a neighborhood identity and is well maintained, people feel safe. Travelers perceive that the residents care about the neighborhood and are monitoring the area. Conversely, graffiti, trash, and general disrepair are signs that nobody cares or is watching. Further streetscape recommendations:

- Maintain all facilities, including sidewalks, shelters, benches, playgrounds, buildings, streetscapes, neighborhoods, and districts to maximize perceptions of safety.
- Maintain landscaping so as not to obstruct walkways, visibility, and sightlines.
- Maintain all lighting fixtures in good working condition.
- Restore or demolish abandoned and neglected buildings and properties. Vacant, idle, and underused properties create dead areas and have the potential to encourage undesirable activity.
- Encourage development of vacant and infill parcels. Often such parcels contribute to neighborhood decline and provide a place for undesirable activity. Interim uses can include pocket parks, community gardens, and micro-retail.

D. Compact—With the Highest Densities Closest to Transit

If people will walk up to one-half mile to access transit, it stands to reason that more people and destinations within that one-half mile radius will translate into more people riding transit. In addition to making transit viable, residential density is also needed to sustain commercial uses. The purpose of compact development, and therefore density, is to provide transit opportunities to as many people as possible. What is important is providing a high level of employment density, residential density, and minimizing the walking distance to destinations on both ends of the trip. However, it is also very important to include high-quality open space and other amenities within the TOD.

Frank and Company find that distance to bus stops or stations was an important predictor of transit use. Over a two-day period, the odds of someone making a transit trip to work decreased by 16 percent with each quarter-mile increase in the distance to transit from home and 32 percent with each quarter-mile increase in the distance to transit from work. In order to be most effective, buildings need to be clustered close together and close to the transit stop. In addition to clustering, it is important to actively discourage dead spaces within a TOD. Dead spaces include vacant lots, abandoned buildings, surface parking lots, and excessive side yards and setbacks, which are uncomfortable for pedestrians, and can unnecessarily increase walking distances. For example, Ewing notes that pedestrians are uncomfortable in areas with high-rise buildings with low lot coverage, surrounded by acres of parking and lawn. Parking will be addressed in greater detail in the next section, but here are some additional specific recommendations:

- Locate new development along transit routes in existing activity centers, and focus new development within a quarter- to half-mile of the transit stop (Cervero, 1993).
- Eliminate or minimize dead space and visible parking. Parking spaces have become the principal source of dead space in cities (Ewing).
- Encourage developers to reduce off-street surface parking (Smart Growth Network, 2002).
- Encourage street walls through the use of build-to lines instead of typical minimum setbacks (Ewing).
- Achieve higher densities using small buildings with high lot coverage (50 to 70 percent) (Ewing).
- Strategically reduce or remove minimum lot size requirements (Smart Growth Network 2003).

Numerous studies, some dating back 30 years, have proven a relationship between land use density and transit usage. We will not restate them all here, but some of the more recent include: *Rail-Oriented Office Development in California: How Successful?* (Cervero, 1994), *Impacts of Mixed-Use and Density on the Utilization of Three Modes of Travel: Single-Occupant Vehicle, Transit and Walking* (L.D. Frank and G. Pivo, 1994), *A micro-analysis of land use and travel in five neighborhoods in the San Francisco Bay Area* (Kitamura and Laidet, 1997), and *A Study of Land Use, Transportation, Air Quality, and Health (LUTAQH) in King County, WA* (Frank and Company, 2005). Kikuchi et al. note, also, that on the land use side, the presence and density of commercial activity close to a bus stop and/or the density of homes within one quarter-mile of the stop affected ridership, with greater densities correlating to greater ridership. Frank and Company find that one of the best indicators of transit use is the level of employment density at

the work-trip destination. When controlling for demographics, they also find that for each quartile increase in the level of residential density there is a corresponding 23 percent increase in the odds of walking for non-work travel.

However, some other researchers are less enthusiastic. Kitamura and Laidet find that measures of residential density are significantly associated with trip generation by mode and modal split, but felt that attitudes may be more strongly associated with travel than land use characteristics. J. Miller and Hoel (2002), in their 2002 article *The "smart growth" debate: best practices for urban transportation planning*, cite studies that confirm that compact density can reduce automobile trip rates when all other factors are controlled, but that the reduction is marginal. The authors cite another study that concludes that demand for transit services is affected more by the quality of neighborhoods than the proximity of compact development to transit stations. The U.S. Environmental Protection Agency concludes that, after controlling for travel time, density and land use mix do not appear to have had any effect on choice of travel mode to school. Litman finds that a ten percent reduction in average distance between homes and rail transit stations reduces VMT about one percent, and concludes that density by itself has a relatively modest effect on travel. According to Litman, this is good news since there is often local resistance for increased density. It means that land use management strategies can emphasize other factors such as improving land use mix and walkability. As a result, strategies such as Smart Growth and New Urbanism can therefore be applied in a variety of land use conditions, including urban, suburban, and even rural areas.

A number of sources have provided specific recommendations related to compact design:

- Cluster the tallest buildings immediately around the transit station, with the density of development tapering off as you get farther out (Maryland Department of Transportation).
- Locate the highest-density development closest to the transit stop; locate new development along transit routes in existing activity centers, and focus new development within one quarter- to one half-mile of the transit stop (Cervero, 1993).
- Maximize the value of transit-agency property through joint development of transit-oriented development projects (Smart Growth Network, 2002). Transform park-and-ride lots into multiuse facilities (Smart Growth Network, 2003).
- Manage the transition between higher- and lower-density neighborhoods using bulls-eye zoning at transit stations, and stepping down building heights combined with the strategic location of parks (Smart Growth Network, 2003).
- Locate key destinations within a 400- to 600-meter (1,300- to 1,950-foot) radius of the station (City of Calgary).
- Create Compact Development Patterns: Use a compact street network, cluster buildings and leave room to grow (City of Calgary).
- Promote density (City of Calgary).
- Provide transit-supportive densities (Cervero, 1993).

Ewing notes that an essential feature for pedestrian- and transit-friendly design is medium to high land use densities. High densities can be comfortably achieved using small buildings with high lot coverage (50 to 70 percent). Strive for at least seven dwelling units per acre (du/acre) of residential, and/or a minimum of 50 employees per acre.

McMahon et al. note that the public may perceive compact development as a bad thing, but the problem is that, in many projects, density comes without any compensating amenity. Density with amenity can and does sell well. Two of the most important amenities are high-quality design and green space. For most people, the character of the development is far more important than the size of the lot. The Canada Mortgage and Housing Corporation states that, "Quality open space has been shown to make increased residential density more acceptable to residents" (p. 3). Ewing also notes that parks and other public spaces are attractions for pedestrians and add character to the street environment. Additionally, well-connected plazas generate a substantial amount of impulse use; conversely, sunken or elevated plazas, which are less visible, do not (Ewing). Some additional recommendations include:

- Manage the transition between higher- and lower-density neighborhoods with the strategic location of parks (Smart Growth Network, 2003). Ensure ready access to open space in compactly developed places (Smart Growth Network, 2002).
- Include high-quality public open spaces (City of Calgary). Create community greens (Smart Growth Network, 2003).
- Ensure a sense of privacy through the design of homes and yards (Smart Growth Network, 2002).
- Locate parks, playgrounds, open space, and trails where they are visible from schools, homes, neighboring businesses, or the street for continuous monitoring (Zelinka and Brennan).
- Design plazas and parks to allow people to feel connected to others through observation, interaction, and activity (Zelinka and Brennan).

E. Parking That Is Carefully Located, Designed, and Managed

Accommodating those who drive with parking is an important component of any successful place. However, large surface-parking lots are ugly, hostile pedestrian environments that unnecessarily increase walking distances. Surface lots detract from the streetscape, prevent compact development, and are detrimental to the environment. In addition, the viability of transit service is undermined when abundant free parking is available. How can we address the need for parking without compromising aesthetics, pedestrians, transit riders, and the environment? The Greater Cleveland Regional Transit Authority recommends providing adequate, and in some cases structured, parking facilities that do not visibly dominate the station areas or consume large amounts of land. Parking must be carefully located and designed to support the pedestrian environment, and the amount of parking should be managed and priced to complement rather than compete with transit. Some sources suggest that there should be no free parking wherever transit is available.

<u>Design and location of parking</u>

Litman finds that the layout and design of parking facilities can reduce automobile trips, particularly if implemented in conjunction with improved transit services. Ewing also notes that how we handle parking has a big impact on walkability and transit usage. Studies have shown that downtown pedestrian counts in small cities fall as the amount of open parking increases. As discussed previously, parking spaces have become the principal source of dead space in cities. Nine percent is said to be the upper limit on the amount of land area devoted to parking beyond

which people sense that the environment is no longer theirs but belongs to cars.
Recommendations for the location of parking lots include the following:

- Situate parking to enhance the pedestrian environment and facilitate access between destinations (Smart Growth Network, 2003).
- Locate parking areas adjacent to or behind buildings instead of serving as large barriers that walkers must cross (*Blueprint for a Walkable Community*, City of Calgary, Ewing). Parking lots should not surround buildings; instead, they should be located next to or behind buildings, permitting easy access for pedestrians and bicyclists (Pucher and Dijkstra). Never allow parking more than a row or two deep in front (Ewing).
- Locate (public) parking decks on the edges of the TOD or downtown district to discourage auto travel into the core area (Pucher and Dijkstra).

Design is also important for pedestrian safety as well as for the pedestrian environment in general:

- Separate pedestrian and vehicular movement, especially in parking lots and where entrances and driveways cross sidewalks (Zelinka and Brennan).
- Design parking areas with walkways for pedestrians, eliminating the need for walkers to be behind any car that may be backing up (*Blueprint for a Walkable Community*). Design mall parking lots with networks of shady pathways that lead to storefronts (*Blueprint for a Walkable Community*).
- Design several smaller lots rather than one big lot (City of Calgary).
- Screen parking with attractive walls, hedges, or berms (Ewing). Parking lots should be screened in such a way that people entering and exiting their cars can still be seen for security purposes. Design walls and fences to be short or transparent to allow for observation of enclosed public spaces. Wherever possible, include elements such as breaks, alternative materials, landscaping, and transparent spacing to make berms and walls more pedestrian friendly. Gates should control access but also be visually appealing and welcoming (Zelinka and Brennan).
- Use special pavement to contribute human scale, linkage, complexity, and coherence to the streetscape. Special paving can help to visually break up large paved areas (Ewing).
- Provide visible, centrally located, and secure bicycle parking (City of Calgary).
- Parking garages, in addition to the other building design elements discussed in this paper, should also include ground floor retail, and architectural design that emphasizes openness and quality (Zelinka and Brennan).

<u>Managing the cost and amount of parking</u>

Although the amount and cost of parking can be touchy issues, recent research shows that managing these elements is surprisingly effective in reducing auto trips. Frank and Company find that one of the best indicators of transit use is the cost of parking, a variable measure directly related to typical downtown areas (parking charges) and suburban development (no parking charges). One of the best indicators of transit use is the cost of parking at the work trip destination. Litman finds that reduced parking supply, increased parking pricing, and implementation of other parking-management strategies can significantly reduce vehicle ownership and mileage. Cost-recovery pricing (charging users directly for parking facilities) typically reduces automobile trips by 10 to 30 percent.

A number of sources share real-world experiences related to parking management. For example, the Transportation Research Board (1997) notes that Aspen, Colo., has had great success by instituting a pay-for-parking program in combination with a new van service, free shuttle from outlying park-and-ride facilities, and corresponding increases in commuter services and express runs. Commuter ridership increased 35 percent in one year, and transit ridership in the city increased 23 percent over the same period. Parking occupancy dropped ten percent (from 95 to 85 percent) reducing parking "trolling." Pucher and Dijkstra note that most Dutch and German cities have reduced the supply of parking for cars in city centers, while at the same time increasing parking rates. Special limited-time parking meters in most residential neighborhoods discourage long-term parking by commuters in those areas, and as a further disincentive, residential parking permits are increasingly required for non-metered on-street parking. Dennis Leach notes that the TODs in the Rosslyn-Ballston metro Corridor of Arlington, Va., have been so successful at reducing vehicle trips, that dedicated station parking was eliminated, even while there have been stable to modest increases in vehicular traffic on most arterial and residential streets in the area as the corridor has become more populated.

Parking management is considered an extremely important element of successful TODs. One goal is to discourage abundant free parking (Cervero, 1993). Another goal is to limit the number of parking spaces and encourage shared parking between different land uses that need it at various times of the day or week. Offices, for example, typically need parking during weekdays, while retail and entertainment venues more likely need it evenings or on weekends (Maryland Department of Transportation). The Victoria Transport Policy Institute also recommends using parking management to minimize the amount of land devoted to car parks around stops and stations, freeing up room for more supportive land uses. The Transportation Research Board, in their 2004 report *Transit Oriented Development in the United States: Experiences, Challenges, and Prospects, TCRP Report 102*, goes even further, suggesting that TODs invite bold new parking policies that push conventional boundaries such as unbundled parking costs and flexed parking standards—simply put, requiring less parking spaces and accordingly reduced impact fees for homeowners and developers near, and likely to use, transit. Clearly, rational parking policies are essential to how a TOD station will be accessed and avoid conflicts over whether land goes to parking or development. Some specific recommendations include the following:

- Strive to have enough, but not too much parking (City of Calgary).
- Discourage abundant free parking (Greater Cleveland Regional Transit Authority).
- Set parking maximums, give credit for on-street parking, and make use of shared parking to reduce parking requirements (Ewing).
- Substitute parking garages for surface lots, and build satellite parking facilities to free pedestrian streets from heavy parking demands (Ewing).
- Encourage developers to reduce off-street surface parking (Smart Growth Network, 2002).
- Remove parking from the development equation through public-private partnerships to build community parking facilities (Smart Growth Network, 2002).
- Transform park-and-ride lots into multiuse facilities (Smart Growth Network, 2003).
- Revise parking requirements to set both the maximum and minimum allowable, in order to curb excess parking-space construction (Center for Watershed Protection). Alternatively, require extra spaces to be accommodated in structured garages.
- Review existing parking ratios taking into account local and national experiences to see if lower ratios are warranted and feasible. Actual parking-demand studies should be used to

justify exceeding the required parking ratios. Many jurisdictions require more parking than is actually needed (Center for Watershed Protection).

- Revise parking codes to lower parking requirements where mass transit is available or enforceable shared-parking arrangements are made. Actively encourage parking reductions where public transportation is present and actively encourage shared-parking arrangements (Center for Watershed Protection).
- Provide meaningful incentives to encourage structured and shared parking to make it more economically viable. Possible incentives include tax credits, stormwater waivers, and density/floor area/height bonuses (Center for Watershed Protection).

Part 2 of this paper discussed the design characteristics of successful TODs. Part 3 will discuss strategies for successful implementation of TODs.

Part 3: Lessons Learned: Tips, Tools, and Examples for Implementation

Transit-Oriented Development is not a new concept. Historically, it has been the norm. Even modern TODs have been part of the American experience for some time. The challenges, lessons, and experiences from their development lend us many clues regarding how to implement them successfully.

A. Issues and Barriers

"Americans are not irrationally car-crazed. We seem wedded to the automobile because policy after government policy encourages us to be" (Jessica Mathews in the *Washington Post* as quoted in Transportation Research Board, 1997, p. 84).

"Since the 1950's, autocentric transportation policies at every level—federal, state, and local—have effectively destroyed transportation options for Americans. These new policies have wiped out walkable, older communities while preventing the creation of new ones" (Richard Moe of the National Trust for Historic Preservation as quoted in Transportation Research Board, 1997, p. 84).

Creating walkable, transit-friendly places has not always been difficult. Until around 1940, walkable places were the norm. However, according to Michael Wallwork (1998), provisions for pedestrians and mass transit were excluded from transportation planning and design as the automobile became the dominant transportation mode in the 1940s. Cars became more affordable, contributing to a mass exodus to the suburbs. Suburbs were segregated by function into single-use zones. Cheap gas, low interest rates, the interstate highway system, and inexpensive land fueled suburban sprawl. As mass transit was removed, road standards increased to facilitate high-speed vehicular travel. Sidewalks and visual points of interest were eliminated, and open space was replaced with parking lots. Dead-end collector roads and single-entrance developments concentrated traffic onto a few arterials with a high number of turning movements, leading to an overload of the arterial system and higher numbers of conflicts and crashes. The ensuing wide, high-speed, multiple-turn-lane roads divided communities and created further barriers for pedestrians.

Efforts to change recent policies and attitudes will not be easy. Genevieve Giuliano, in her 1997 article *Land Use Policy and Transportation: Why We Won't Get There from Here*, identifies policy trends that have contributed to this issue, including tax and pricing policies favorable to car ownership and use, the Federal Interstate Highway construction program and the Highway Trust Fund, federal tax and mortgage policies that support home ownership and favor suburban residential development, and political fragmentation and powerful local governments that allow suburbanites to escape urban social and fiscal problems. In theory, past policies supported social and cultural values, including the tradition of strong private-property rights, preferences for single-family home ownership, the suburban ideal, and ethnic and racial conflicts.

Other trends, such as the shift to a service- and information-based economy and improvements in information and telecommunications technology have made businesses and individuals more "footloose." Service industries require less fixed infrastructure than manufacturing, and so they are more easily relocated. Large-scale population suburbanization has been followed by large-scale employment decentralization. Commuting between suburban locations is now responsible for the major traffic flow in the United States.

Changing individual decision-making will also be difficult. Giuliano further points out that:

- The United States continues to have the highest car ownership rate in the world.
- Decreases in non-motorized trips suggest substitution of longer trips for short trips, as well as population shifts out of core city areas to less dense (and therefore less walkable) areas.
- Rising affluence, changing demographics, and household structure (decrease in household size and the increase in non-family households), changing labor-force demographics, changing land patterns, and the increasing value of time have all contributed to mode shifts and increased driving.
- Households are willing to travel farther in exchange for preferred housing characteristics, neighborhoods, and other amenities, as the demand for housing increases.
- Shopping has become a leisure activity, and people are less willing to patronize the closest shops and more willing to travel farther to obtain greater variety and better quality.

The Community Planning Workshop lists some key barriers to integrating land use and transportation planning:

- Political mistrust/disagreement.
- Lack of transportation financing for all modes of transportation.
- Public perception and lack of wanting to change.
- Regulations that do not allow the principles to be implemented on the ground.
- Built infrastructure that promotes more development.
- General bias towards automobiles.
- Lack of funding for long range planning.
- Ordinances that do not allow smart growth strategies.
- Difficulty educating citizens about the benefits of smart growth.
- Resistance by developers to trying new ways of development.

Parker and Arrington list major barriers to implementing TOD in California including:

- Transit stations often have poor pedestrian access and broad expanses of surface-level parking lots, which separate stations from the surrounding community. Transit stations also tend to be located in areas with little development potential.
- Community concerns about density and traffic.
- Zoning codes around stations tend to favor low-density, auto-oriented uses.
- TOD can be more risky for developers and financiers, more costly, and subject to added regulations and approval processes.
- Lender concerns about financing mixed-use projects create problems for obtaining private funding.

In addition to perceived problems related to TODs, there can be real downsides. The Victoria Transport Policy Institute reviews the benefits and costs of transit-oriented design. The costs of TOD include incremental transportation expenditures, such as facility improvements, and disamenities associated with higher-density development, such as increased local traffic congestion and noise exposure.

Boarnet and Crane, in their 2001 publication *Travel by Design: The Influence of Urban Form on Travel (Spatial Information Systems),* note that TOD projects yield more transit ridership, reduce development expenses, lower commuting costs, housing costs, and air pollution. The authors also explore why TOD housing projects are relatively rare, and note that the main reasons for this are fiscal/historical, and also related to cooperation issues between suburban and urban areas. The authors point out that advocates of transit-based housing often ignore the economic and political forces that led to the demise of notable earlier rail-transit systems; yet those same economic and political forces are alive and well today and may cause localities to shy away from transit-based housing. For example, there are often conflicts between local and regional transit goals, mainly because of a mismatch in the distribution of costs and benefits. Increased transit usage is a regional benefit, while the fiscal benefits are inadequately distributed between city and suburb. TOD projects intertwine local and regional components; therefore, the fiscal concerns relate to whether the city or suburb will incur costs and receive benefits. Due to municipal funding structures, many municipalities and local jurisdictions feel they must compete with each other for economic resources, rather than working together to increase the overall health of the region.

Finally, even in locations that are considered to have successfully implemented TODs, there are still issues that remain. For example, Leach notes that although the Arlington, Va., metro corridor is nationally recognized as having successfully implemented TOD, there are many outstanding issues to be addressed including:

- Affordable housing and economic diversity.
- Historic preservation of remaining early 20th century commercial structures.
- Coherence of the built environment (attractive streets and public spaces).
- Uneven conditions of public infrastructure.
- Coordination of policy initiatives and documents.
- Outdated zoning ordinance.
- Parking policies.
- The role of surface transit in future development.

B. Case Studies and Lessons Learned

TODs have been around long enough that a number of people have explored TOD successes and failures. Parker and Arrington review a number of existing TODs in California and state the lessons learned from each one:

Rio Vista West is a transit station in suburban San Diego. It is operated by the Metropolitan Transit Development Board and was developed by a development company as a privately funded project. Development occurred in several phases. The first was a shopping center, followed by residential development, and 30,000 – 50,000 square feet of small-office and neighborhood retail

space. Parking in this area is somewhat minimal because of the availability of transit. Also, much of the parking is underground. The City of San Diego doesn't provide any sort of density bonuses but does zone for higher density around transit stations in addition to allowing mixed-uses in commercial areas. Some of the lessons learned there:

- Provide a TOD-friendly master plan to facilitate quality development.
- Have a motivated developer who is committed to the project for the long term.
- Be persistent in pursuing quality TOD design.

Fruitvale Transit Village is a transit station in an urban area of Oakland. It is operated by the Bay Area Rapid Transit District and was developed by the Fruitvale Development Corporation (FDC). It is funded through about 20 public sources, including the Federal Transit Administration Livable Communities grant and other small grants, all intended to upgrade the commercial properties along the corridor. An additional $20 million in private investments is expected. The project was conceived as part of a neighborhood alternative to the construction of a parking garage at the transit station. The area has 337 housing units, 25,000 square feet of office space, 25,000 square feet of retail commercial space, a library, and a 40,000-square-foot health clinic. The village was implemented in several phases beginning in 1998. Parking is still a concern, but the FDC obtained $7.6 million in grants for building a parking structure. Lessons learned include the following:

- Base the project on a community process.
- Keep projects simple and use phasing. Complex and large projects can hamper implementation and hold back major progress on a project.
- Prepare for the possibility that the TOD may become a victim of its own success if improvements drive up property values and displace current residents. Consider initiating a Homeownership Program that involves buying, rehabilitating, and selling homes at affordable prices to help stabilize the community.

Hollywood-Highland is a transit station in Los Angeles. It is operated by the Los Angeles Metropolitan Transit Authority (MTA) and was developed by a private developer. It is a privately funded project, with the exception that the City of Los Angeles provided a bond of $81 million for a parking structure. The transit station was completed in 2000, and the TOD was finished in 2001. The complex includes 1.3 million square feet of specialty retail, multiplex theaters, a 640-room Renaissance Hotel, restaurants, the restored Graumann's Chinese Theatre, a 3,000-space underground parking structure, plus the Kodak Theatre—the new home for the Academy Awards. The developer holds a land lease for up to 99 years from the MTA. Lessons learned include the following:

- Start TOD planning early so the design of the transit facilities and other development fit together as well as possible.
- Have seasoned construction managers involved early in negotiations and schedule operation.

Rosslyn-Ballston Corridor in the Arlington, Va., area is a part of the Washington, D.C., Metro system. Originally planned over 30 years ago and still under implementation, it includes retail, office, and residential uses. Additional information regarding this TOD can be found in Part 4. Dennis Leach lists the following lessons learned:

- Use transit investment as a catalyst to reshape communities.
- Establish a clear/consistent planning and policy framework for all parties.

- Create sector plans to provide more detailed guidance for area-specific redevelopment.
- Insist on good urban design and an attractive and functional pedestrian environment.
- Fight for mixed-use development. It is hard to achieve but worth fighting for over the long haul.
- Concentrate density and mixed-use development at transit stations.
- Provide transportation options coupled with TDM programs as part of the framework.
- Solicit and maintain broad public education and participation in the redevelopment process.

C. Strategies for Implementation

How a TOD project is implemented is just as important as how it is designed. This literature search turned up a number of recommendations for implementation, which have been grouped here into a number of categories: assembling the TOD team, TOD planning, developing and adopting regional TOD-supportive policies, making the site market-ready, funding issues, opportunities and advice.

Assembling the TOD team and working together

Developing a successful TOD requires the input and assistance of many people, including community leaders, decision-makers, the public, developers, other stakeholders, many governments, government agencies, and their staff. It is often not easy to get each of these partners working on the same page, but it is critical to the success of the TOD.

Community leaders and decision-makers are an important component of successful TOD implementation. The Transportation Research Board (2004) states that political leadership is vital to TOD implementation. The County of Arlington, Va., on its website *Transit in Arlington,* goes further, saying that decision-makers need to be visionary, communicative, and forward thinking. Other characteristics common to regions that have successfully promoted transit-supportive development, according to The Greater Cleveland Regional Transit Authority, include a political culture that values transit, and a long-term commitment to transit and TOD.

The Urban Land Institute outlines some key concepts of successful TOD strategies related to the project team:

- Political leaders need to support TOD. Good planning and good development need a champion for the vision. Champions are needed in both the public and private sectors. Otherwise, the TOD vision will languish and die or become merely another mixed-use development. While many politicians recognize the value of TOD in theory, their support may ebb in the face of constituent opposition or competing priorities. This creates the tendency to allow TOD standards to be disregarded in the pursuit of economic development.
- Community and team leaders need to make a commitment to the TOD vision, set priorities, and carry them through to completion. After a TOD proposal makes its way through the planning process, don't let it be compromised as it goes through zoning and permitting.
- Individual jurisdictions need to be consistent in what they expect from TOD, rather than look at TOD on a project-by-project basis. Don't allow political support for TOD to ebb in the presence of community opposition.

Successful implementation of TODs requires meaningful and ongoing public involvement. Leach lists "ongoing, rigorous public engagement" as an essential component of successful TOD

planning and implementation. The Transportation Research Board (2004) also notes that inclusiveness and ongoing public input during planning, design, and implementation is essential to successful TODs. Urban Design Associates, in its 2003 book *The Urban Design Handbook: Techniques and Working Methods*, recommends that the project team include representatives of the individuals and interest groups who have a stake in the project. Further, it recommends that for every project, a broad spectrum of participants be included as part of the planning and design process. It specifically recommends including:

- People who know the area best.
- People who will be the most impacted by the project.
- People who can implement and finance the effort.
- People who control the political and bureaucratic processes.
- Members of the general public.
- People who are often disenfranchised, such as the poor and minorities.

The Smart Growth Network (2002) also suggests encouraging community and stakeholder collaboration in development decisions by bringing developers and the development community into the visioning process. In addition they recommend consulting early with emergency responders when developing plans in their follow-up publication (2003).

The Smart Growth Network (2002) lists a number of strategies for implementation that are directly related to TODs, including the use public meetings to educate the community about density and compact building options. In its follow-up publication (2003), it also suggests developing walking awareness and promotion programs, and organizing a compact development-endorsement program. The Urban Land Institute also outlines some key concepts of successful TOD strategies, including excellent communication and collaboration. Making TOD possible requires developing a community consensus around TOD growth and development goals and objectives and then moving forward in an efficient and effective process to realize them. It is important to create a grass-roots constituency for TOD and to include the community in the planning process.

Developing a successful TOD involves many agencies and jurisdictions that may not understand or fully appreciate the end goal or their specific role in the project. Planning agencies and jurisdictions, permitting agencies, service providers, funding providers, economic-development organizations, affordable-housing providers, and their staffs all have an important role in the eventual success or failure of a TOD. They may indeed have conflicting objectives and processes that can prevent the best TOD plans from being implemented. Many sources point out the importance of agency and jurisdictional coordination including Leach, Parker and Arrington, and The Transportation Research Board (2004).

The Urban Land Institute identifies some of the coordination pitfalls TODs can face. They include

- A lack of communication and collaboration. Agencies tasked with economic development and planning often do not share the same goals with respect to TOD, resulting in projects that do not achieve their full potential.
- A good TOD proposal makes it through the planning process, only to be compromised as it goes through the zoning, site-plan review, and permitting processes.

- A lack of regional coordination and consistency regarding TOD makes the process difficult for developers and reduces the potential for TOD in a region. Transit crosses political boundaries. Local jurisdictions need to appreciate the development implications of this and work cooperatively to maximize TOD opportunities.
- Inconsistent expectations regarding TOD on the part of individual jurisdictions, and a tendency to look at TODs on a project-by-project basis.
- A lack of clear policies and incentives for TOD among jurisdictions and agencies. It is important to encourage a reasonable mix of uses that are appropriate to the station area, streamline the development process, and reduce barriers to more traditional neighborhood design.

State and regional agencies can play a role in improving coordination and cooperation among jurisdictions and agencies and helping local governments understand the benefits and requirements of successful TODs. Additionally, joint planning of facilities and services can improve coordination as well as help reduce costs for infrastructure and operations. Parker and Arrington also suggest that states can help implement TODs by:

- Contributing to improved data on the travel and economic impacts of TOD and incorporating the data into improved analysis and decision-making tools.
- Providing information and technical assistance on TOD implementation.

<u>Developing TOD plans</u>

Every source reviewed for this paper related to successful TOD implementation stressed the importance of planning first and foremost. The Victoria Transport Policy Institute further recommends that TOD planning integrate both land use and transit planning. The Transportation Research Board (2004) reviews case studies from around the country and concludes that:

- Successful TODs start with shared visions that guide planning and implementation for years to come.
- Successful TODs start planning early in the process.
- Successful TODs emphasize place-making: creating attractive, memorable, human-scale environs with an accent on quality-of-life and civic spaces.
- Station-area plans and planning matter (i.e., how, when, and where a TOD will evolve). They also find that transit's benefits, as reflected by indicators such as land-value premiums, generally increase with proactive planning, network development, and system maturation.

Leach lists the following as important tools and processes used to successfully guide redevelopment around transit stations:

- General Land Use Plan
- Zoning
- Sector Plans
- Sub-area plans and guidelines
- Special purpose plans
- Site-Plan Review
- TDM programs
- Ongoing, rigorous public engagement

The Urban Land Institute recommends that jurisdictions should focus less on developing parcels and more on creating "good spaces." The key to creating successful TOD projects is station-area planning, rather than planning by parcel or project. Planning for an entire district surrounding a transit site will optimize the development benefits offered by transit, provide developers with predictability, and help stable areas cope with development pressure. It also allows an opportunity to involve the public in development of the plans.

The general land use or comprehensive plan has a role to play in creating successful TODs. A general plan that integrates land use and transit planning should

- Express a commitment to a regional vision of high-capacity transit connections between regional centers or in development corridors (Greater Cleveland Regional Transit Authority).
- Direct development along transit corridors to create stronger TODs (Smart Growth Network, 2003).
- Increase transit-oriented development by adding infill stations on existing transit lines and retrofitting existing stations (Smart Growth Network, 2003).
- Encourage appropriate new office development to locate in transit-supportive areas through the amendment of land use classifications and the provision of infrastructure, etc. (City of Calgary).
- Promote land use efficiency and convenience by encouraging new housing close to transit facilities and within mixed-use centers (City of Calgary).
- Support high-quality transit services that attract riders (Greater Cleveland Regional Transit Authority).
- Preserve and reinvest in established residential neighborhoods adjacent to the transit corridor (Leach).
- Use TOD to help achieve regional growth goals. TOD can be used to help address the regional jobs/housing balance and to encourage economic and community development. It can function as a key component of regional transportation and traffic-management programs and can be a basic element of a regional mobility program by helping to move people to jobs, schools, and recreation (Urban Land Institute).
- Incorporate by-right smart-growth redevelopment into existing communities' master plans (Smart Growth Network, 2002).

The general land use plan should also identify criteria for choosing sites and/or general locations that meet those criteria. According to the Greater Cleveland Regional Transit Authority, transit stations should be located in areas where the market supports development. In addition, consider joint TOD development of transit agency property to maximize its value and effectiveness (Smart Growth Network, 2002). Urban Design Associates suggest that plans and designs should

- Identify the best things about a place, protect them, and build on them.
- Identify the worst problems and find ways of making them better.
- Make sure to use the new things to connect the best things in ways that fulfill the dreams of the people who live there.

Once a specific TOD site has been chosen, more specific area planning is needed. Key design components of TODs have been discussed in Part B of this report and should be included as appropriate in the station/area plan including goals and implementation strategies for the transit service, pedestrian environment, the creation of a destination with a center and the right mix of

uses, compact design and appropriate density, and parking location design and management. Plans need to be simple, easily understood, and include a well-thought-out phasing component. Plans that are too complex may be difficult to implement.

Some specific suggestions and issues that might be addressed in these plans include the pedestrian environment, land use, and design issues.

Walking access, quality of circulation, and the overall pedestrian environment are critical to successful TODs. However, the conflict between the role of transit stations as nodes and their role as places often makes this difficult (Transportation Research Board, 2004).

- Develop a pedestrian master plan (Smart Growth Network, 2003).
- Develop a comprehensive way-finding system in town centers and TODs (Smart Growth Network, 2003).
- Adjust existing transit services to take full advantage of transit-supportive neighborhoods and developments (Smart Growth Network, 2002).

Equally important to TOD is the land use component. Even though mixed land uses are a trademark of TOD, arriving at a workable program poses design challenges that need to be overcome for a successful TOD (Transportation Research Board, 2004).

- Concentrate density and promote mixed use at transit stations and taper development down to adjacent neighborhoods (Leach).
- Manage the transition between higher- and lower-density neighborhoods (Smart Growth Network, 2003).
- Preserve and reinvest in established residential neighborhoods adjacent to the transit corridor (Leach).

Lastly, subtle design issues play an important role. Successful TODs emphasize place-making: creating attractive, memorable, human-scale environs with an accent on quality-of-life and civic spaces (Transportation Research Board, 2004).

- Establish model state-level design standards and codes to encourage compact building design that can be adopted by local communities (Smart Growth Network, 2002).
- Employ a design review board to ensure that compact buildings reflect desirable design standards (Smart Growth Network, 2002).

<u>Developing regional/multi-jurisdictional TOD-supportive policies</u>

A number of important policies must be discussed, agreed upon, and enacted by the team members in order for a TOD to be successful. Important issues that need to be addressed include regional growth policies, policies related to accommodating the car, and tax rate/fee structures. In addition, there may be other issues important to the community that should be addressed by the team, such as historic preservation, environmental regulations, and affordable housing.

Growth policies need to be addressed as part of each jurisdiction's general land use plan; however, transit services operate across jurisdictional boundaries. Therefore, growth policies need to be addressed and agreed upon at a regional scale, to assure that individual jurisdictions' policies work together to support the TOD, rather than competing against each other. Similar to local growth policies, regional growth policies should

- Focus growth in transit corridors; limit it elsewhere and channel it to station areas (Greater Cleveland Regional Transit Authority, Smart Growth Network, 2002).
- Support the utility and vibrancy of stations by actively encouraging both public- and private-sector development and the integration of a full range of compatible land uses (residential, employment and commercial activities) at designated sites (City of Calgary) and with appropriate policies and programs around the station (Greater Cleveland Regional Transit Authority).
- Use the transit investment as a catalyst for intensive redevelopment where applicable (Leach).
- Use TOD to help achieve regional growth goals. TOD can be used to help address the regional jobs/housing balance and to encourage economic and community development. It can function as a key component of regional transportation and traffic-management programs and can be a basic element of a regional mobility program by helping to move people to jobs, schools, and recreation (Urban Land Institute).
- Facilitate the use and sale of state-owned land near major transit stations for TOD (Parker and Arrington).
- Incorporate by-right smart-growth redevelopment into existing communities' master plans (Smart Growth Network, 2002).

According to Sarker et al., in their 2002 article *Impact of Transportation Infrastructure Development on Modal Choice*, to create a successful TOD, it is necessary to limit the supply of auto-related transportation with respect to demand while improving efficient and sustainable alternative-transportation systems. The Transportation Research Board (2004) looked at case studies from around the country and notes that rational parking policies are essential to how a TOD station will be accessed to avoid conflicts over whether land goes to parking or development. In addition, they suggest that TODs should invite bold new policies and push conventional boundaries while acknowledging the unique market niches that are being served. Unbundled parking costs and flexed parking standards are good examples of outside-of-the-box thinking.

One issue that needs to be addressed is traffic-impact-analysis methods. According to Millard-Ball and Siegman, in their 2006 article *Playing the Numbers Game*, conventional traffic-analysis methods are not always sensitive to TOD and similar types of development. Typical Institute of Transportation Engineers trip-generation rates may drastically overestimate the amount of traffic generated, leading to oversized streets. Oversizing can lead to more lanes, wider lanes, and longer signal phases than are warranted. This adds to development costs and reduces the amount of space available for trees and other amenities, increases environmental impacts, and creates physical barriers and safety issues for pedestrians.

Other specific vehicular policies that need to be addressed include level-of-service standards, modeling and surveys that support the TOD, street and sidewalk design standards, TDM, and parking strategies. Additionally, workplace policies have a strong effect on transit ridership. According to the article *Report: Rail use in California Mixed,* the vast majority of employers (65 percent) offer free parking, in contrast to only 20 percent who provide some type of funding for transit. Some policy recommendations:

- Modify roadway level-of-service standards in areas served by transit and make sure transportation models and surveys accurately reflect all modes of travel (Smart Growth Network, 2002).
- Adopt design standards for streets and sidewalks that ensure safety and mobility for pedestrians and non-motorized modes of transport (Smart Growth Network, 2002).
- Require traffic-calming techniques where traffic speed through residential and urban neighborhoods is excessive (Smart Growth Network, 2002). Key streets are speed-controlled (County of Arlington, Virginia).
- Ensure that streets, sidewalks, and trails are well linked (County of Arlington, Virginia).
- Encourage car-sharing to reduce the need to own automobiles (Victoria Transport Policy Institute). Create programs and policies that support car-sharing (Smart Growth Network, 2003).
- Adjust existing transit services to take full advantage of transit-supportive neighborhoods and developments (Smart Growth Network, 2002).
- Create comprehensive bicycling programs (Smart Growth Network, 2003).
- Introduce value-pricing such as congestion pricing, variable-rate tolls, and high-occupancy toll (HOT) lanes (Smart Growth Network, 2003).
- Remove parking from the development equation through public-private partnerships by building community parking facilities (Smart Growth Network, 2002).

As noted in previous sections of this report, federal, state, and local policies have traditionally favored suburban-type development. Although the team may have little recourse regarding federal policies, state and local policies regarding taxes, utility rates, and other fees (such as development fees) should be reviewed and revised in support of TOD development. Some specific suggestions:

- Structure property taxes, development fees, and utility rates to reflect the lower public service costs of clustered, infill development (Victoria Transport Policy Institute).
- Institute sliding-scale impact fees (Transportation Research Board, 2004).
- Use a split-rate property tax to encourage development on vacant or blighted properties in existing communities (Smart Growth Network, 2002).
- Create economic incentives for businesses and homeowners to locate in areas with existing infrastructure (Smart Growth Network, 2003).
- Modify average-cost pricing practices related to utilities to better account for the costs of expanding infrastructure in greenfield areas (Smart Growth Network, 2003).
- Use transportation funds as an incentive to provide housing near transit (Smart Growth Network 2003).
- Adopt property tax–exemption programs for mixed-income developments and low-income homeowners (Smart Growth Network, 2003).
- Provide incentives to encourage residents to live near where they work (Smart Growth Network, 2002), such as with location-efficient-mortgage (LEM) programs in targeted areas (Transportation Research Board, 2004).

As noted in the case studies, communities with successful TODs are still struggling with other community issues, sometimes as a result of their own success. Issues such as historic preservation within the targeted area and affordable housing can become problems if not planned

for and addressed in the planning stages of the TOD. In particular, improvements can drive up property values and displace existing residents. Unless policies and programs are in place to assure affordable housing units from the outset, initiatives to provide affordable housing within a TOD can fail. Address important community goals and values from the outset, and consider developing community indicators to make sure that development is meeting community goals (Smart Growth Network, 2003).

Making it market-ready

Market-readiness is about streamlining the process and removing barriers so that appropriate development can occur in an expeditious fashion. For example, will your existing zoning and subdivision codes allow the kind of development you want in the chosen location? Are utilities available? Are special permits or approvals needed? What other issues or barriers will the TOD face as it goes through the process from design through construction? A market-ready site is correctly zoned, has utilities in place or on the way, and other barriers and issues have been identified and strategies developed by the team to deal with them efficiently.

The Transportation Research Board (2004) notes that more permissive regulatory environments and enabling legislation are often needed if transit agencies, local governments, and regional planning organizations are to proactively implement TOD. In addition, the report says that TOD success can hinge on rewarding developers with measures that grant more latitude in design, allow mixing of uses, increase density envelopes, and offer certainty, clarity, and built-in assurances that the public sector will follow through on planning commitments. The Urban Land Institute comments that jurisdictions may need to streamline the development process and reduce barriers to TOD-style design. They caution that after a TOD proposal makes its way through the planning process, don't let it be compromised as it goes through zoning and permitting.

Other sources provide more specific suggestions to make a site market-ready for TOD.

Zoning

- Zone in proximity to transit stations to allow higher-density development (Urban Land Institute).
- Use innovative zoning tools to encourage mixed-use communities and buildings (Smart Growth Network, 2002).
- Zone areas by building type, not use (Smart Growth Network, 2002).
- Use flexible zoning to allow developers to easily supply space in response to market demands (Smart Growth Network, 2002).
- Match building scale to street type in zoning processes (Smart Growth Network, 2002).
- Revise zoning and building codes to permit a wider variety of housing types (Smart Growth Network, 2002).
- Zone for concentrated activity centers around transit service (Smart Growth Network, 2002).
- Make zoning and other land-development regulations simple and easy to read (Smart Growth Network, 2003).
- Use floating zones to plan for certain types of undetermined uses (Smart Growth Network, 2003).

Codes

- Adopt smart-growth codes to parallel existing conventional codes (Smart Growth Network, 2002).
- Use density bonuses to encourage developers to increase floor-to-area ratio (FAR) (Smart Growth Network, 2002).
- Require building design that makes commercial areas more accessible (Smart Growth Network, 2002).
- Strategically reduce or remove minimum lot-size requirements (Smart Growth Network, 2003).
- Provide incentives for ground-floor retail and upper-level residential uses in existing and future development (Smart Growth Network, 2003).
- Require sidewalks in all new developments (Smart Growth Network, 2002).
- Enact clear design guidelines so that streets, buildings, and public spaces work together to create a sense of place (Smart Growth Network, 2002).
- Display zoning regulations and design goals in pictorial fashion to better illustrate development goals (Smart Growth Network, 2002).
- Create pattern books to streamline construction and enhance project marketability (Smart Growth Network, 2003).

Approval process

- Match building scale to street type in permit-approval processes (Smart Growth Network, 2002).
- Expedite plan and permit approval for smart-growth projects (Smart Growth Network, 2002).
- Examine state environmental review requirements in relation to TOD to determine whether changes may be needed to reduce barriers (Parker and Arrington).
- Use compact development and on-site best management practices to improve environmental outcomes (Smart Growth Network, 2003).
- Use quick-response teams to gain approvals for smart-growth developments (Smart Growth Network, 2003).
- Create an incentives expert for developers and businesses when an area has been designated for development or redevelopment (Smart Growth Network, 2003).

Incentives and opportunities

- Provide financial incentives to aid the development of smart-growth projects and facilitate financing of mixed-use properties (Smart Growth Network, 2002).
- Create opportunities to retrofit single-use commercial and retail developments into walkable mixed-use communities (Smart Growth Network, 2002).
- Remove parking from the development equation through public-private partnerships to build community parking facilities (Smart Growth Network, 2002).
- Maximize the value of transit-agency property through joint development of transit-oriented development (Smart Growth Network, 2002).

<u>TOD funding issues, opportunities, and advice</u>

Planning, permitting, constructing, and providing utilities and transit services to a TOD require substantial amounts of private and public money. The Greater Cleveland Regional Transit

Authority notes that joint planning of facilities can help to reduce costs for infrastructure and operations. Similarly, the Maryland Department of Transportation suggests enhancing the potential to receive federal funding for transit expansion by showing that development patterns can support transit.

The Transportation Research Board (2004), in looking at case studies from around the country, makes some important points related to funding TODs:

- TODs benefit from efforts to recapture some of the value conferred by transit investments to generate revenues needed for ancillary improvements.
- Creative financing is essential to equitably share the risks, expand the base of knowledge and experience, and tap into the fiscal advantages of certain partners, such as local governments' superior bond ratings and guarantees, so that projects "pencil out."
- Market fundamentals, not a TOD label, govern whether private capital gets invested around transit stations.

Parker and Arrington target some of their recommendations towards developers seeking TOD funding, including:

- Develop a solid track record for implementing projects and conduct accurate market studies.
- Plan phasing carefully. Some component of the overall development needs to generate cash flow early while the remaining phases of the TOD are being completed.
- Have multiple capital sources with varying investment timelines. This allows a development to satisfy the higher rate of return on some short-term capital sources.

Some more specific funding ideas from a number of sources:

- Provide state funding to local jurisdictions to prepare plans and adopt ordinances that facilitate transit-oriented development (Maryland Department of Transportation).
- Provide financial incentives for local agencies and private organizations to implement TOD (Maryland Department of Transportation).
- Offer state funding for specific types of TOD demonstration projects (Maryland Department of Transportation).
- Allow local agencies to provide tax-increment financing around major transit stations, even if they are located outside of redevelopment areas (Maryland Department of Transportation).
- Allow greater flexibility in the use of state transportation funds for TOD (Maryland Department of Transportation).
- Give priority to TOD projects in allocating federal housing and community-development funds (Smart Growth Network, 2002).
- Create special improvement districts for focused investment (Smart Growth Network, 2002).
- Use a split-rate property tax to encourage development on vacant or blighted properties in existing communities (Smart Growth Network, 2002).
- Provide financial incentives to aid the development of TOD projects (Smart Growth Network, 2002).
- Use transportation enhancement funds to create places of distinction (Smart Growth Network, 2003).

Many sources suggest creating economic incentives for businesses and homeowners to locate in targeted areas using location-efficient-mortgage (LEM) programs (Smart Growth Network 2002, Maryland Department of Transportation, Transportation Research Board 2004, and Greater Cleveland Regional Transit Authority). An LEM is a fairly new type of mortgage loan that supports public-transit use and may help create more transit-friendly communities. The LEM allows lenders to acknowledge that some places are less car-dependent than others, and that being less car-dependent can translate into lower monthly transportation expenses (fewer miles driven, fewer vehicles owned, etc.). A portion of this savings (i.e., avoided additional expense) can be applied to a larger mortgage payment without increasing the borrower's risk of default. A person who qualifies for a $100,000 loan under a standard mortgage formula might qualify for $130,000 in a location-efficient area. The awareness of these mortgages can inspire local officials and developers to create developments that qualify for these loans (Greater Cleveland Regional Transit Authority). The TOD team can work to make private TOD mortgage instruments such as the LEM program more widely available.

Additional points to remember

The Urban Land Institute reminds TOD advocates that the market creates opportunities for TOD, that TOD and transit do not by themselves create a successful market. The Transportation Research Board (2004) also makes a few closing points about successfully implementing TODs:

- TOD's ridership bonuses are substantially a product of residential self-selection, suggesting that policy reforms should focus on allowing residents to sort themselves into transit-served neighborhoods unimpeded.
- TOD benefits are not automatic and generally accrue during upswings in local economies (i.e., when traffic congestion increases).
- Transit's benefits, as reflected by land-value premiums, also generally increase with proactive planning, network development, and system maturation.
- Transit-service improvements and system upgrades can trigger TOD activities, especially in settings with expensive housing markets and a pent-up demand for transit-oriented living.

Part 3 covered strategies for successfully implementing TODs. In Part 4, local community leaders make recommendations for designing and implementing TODs in Delaware.

Part 4: Field Trip and Recommendations for Local Implementation

In the spring of 2007, the Institute for Public Administration at the University of Delaware took a busload of Delaware's community leaders, agency officials, and staff to visit four established or emerging TODs in the Washington, D.C.-Baltimore metro area. The TODs included an established corridor on the Washington Metro system, an established community designed around a fixed-route bus system, an emerging suburban employment center on the Baltimore Metro system, and a small town at the terminus of the MARC line, which is intended to become the southern terminus of the SEPTA commuter rail line as well. Participants were asked to fill out questionnaires for each TOD visited to articulate what worked and what didn't, as well as important lessons for implementing TOD in Delaware. In developing the questionnaire, IPA staff administered surveys (using the Delphi method) to a number of staff, students, and experts in the field. The intent was to ensure that the field trip attendees were asked the most pertinent questions. The internal survey sought to determine the most important aspects of TOD at a variety of scales: local/neighborhood, urban/city, and regional. The results were quite uniform. Directness of routes and way-finding were most important at the local scale and diminished as distances/scale increased. Safety, and the perception thereof, rated high on all scales, but particularly so on the local/urban scale. Design ranked high for larger-scale projects. Predictably, access via bicycles and pedestrians scored high on the local/urban scale. Access via car ranked higher on the regional side.

A. The Sites

Columbia, Maryland

Columbia is a planned community in Howard County that was designed in the 1960s using then state-of-the-art planning principles. It was designed and built as a collection of walkable villages surrounding a community center. Each village was intended to be somewhat self-contained with an elementary school, grocery store and other community facilities. The village center includes an indoor shopping mall, office buildings, community college, and other retail and employment uses. The entire community is marbled with greenways, open space, and paths geared towards recreation. The street system includes a connecting spine with a ring road around the village center. The original intent was for a local bus system to run throughout the community and connect to regional transportation centers. There is a significant employment component on the edge of the community.

Participants met Barbara Kellner, manager of the Columbia archives and community historian. She gave a brief history of the community and was able to answer questions as both a historian and long-time resident. The community is not incorporated and is still somewhat controlled by a development company. Following Ms. Kellner's presentation, participants got a brief tour of several of the villages. Some of the elementary schools and grocery stores have since closed, but, in general, the community looks like a typical suburban community. Some parts of this community worked better than others, but Ms. Kellner agreed that transportation was the one element that had never really worked as planned.

She explained that the bus system never fully developed into what had been envisioned. Another unforeseen development was a significant underutilization of the area's deliberately planned walking trails. The conceptual plan segregated pedestrians and bicyclists from vehicular flows, presumably to keep the pedestrian or cyclists safe. Planners envisioned students walking to school and employees walking to work on the scenic, winding trails provided. Unfortunately, a critical mass of users never developed. Ms. Kellner speculated that perhaps the perceived danger of walking alone in a wooded area was more of a deterrent than the actual perils of walking or bicycling in proximity to automobiles. In time some of the trails were essentially abandoned. The lack of an effective pedestrian-circulation system may help to explain why the robust, inter-village bus system never took hold.

External, and largely unforeseeable, factors have also impacted Columbia. School realignments have caused some of the village elementary schools to be abandoned. Similarly, not all of the village grocery stores have endured. Increased competition and economies of scale have dictated that at least one be closed. Others may follow.

Dorsey Station, Maryland

Participants heard some background information about Dorsey station from Gary Sightler, transportation planner for Howard County. Dorsey station is a relatively new commuter-rail station in close proximity to significant employment. This was a typical suburban campus surrounded by acres of parking. Located at a dedicated exit of a major limited-access highway, the group found out by accident that the entrance road from the highway was not connected to the road accessing all of the office and industrial employment uses. In general, this station was not very successful and could have been much more effective.

Dorsey did well in that it combined large-scale office space and a junior-college campus within a stone's throw of transit. However, other, glaring problems served to nullify the advantage. To the casual observer, the development didn't look walkable. Well over 80 percent of the available space was dedicated to surface parking. Trip participants were forced to walk between rows of cars, through grassy medians, and around stormwater-drainage features to get to the station hub. Even the bus driver had a difficult time navigating the internal-street network.

The Arlington, Virginia, Ballston/Rosslyn Corridor

This is a carefully planned urban corridor on the Washington, D.C. Metro system. Participants met Darren Smith, transportation planner for the Metropolitan Washington Council of Governments, who provided some background information about the corridor and the region. Participants also met Robert Brosnan, director of planning for Arlington County. Planning for TOD redevelopment in this corridor began in the late 1960s, with implementation ongoing. This corridor is much denser than the other TODs visited, and participants were able to see an overview of the area from the 12th floor of the county offices. This planning effort has been so successful that station-area parking has been eliminated in favor of additional retail and employment uses.

Arlington is regarded as somewhat of a model of successful TOD planning and development. The area is typically choked with automotive traffic during peak hours. However, its transit

system and mix of uses give residents and commuters a viable/attractive alternative to sitting in traffic. Most conveniences are within an easy walk of residential neighborhoods and centers of employment. If anything, Arlington has become a victim of its own success. Such demand exists for its transit services that crowded trains are beginning to become an issue. The region is also struggling to add additional trains to an already busy transit line.

Perryville, Maryland

This small Maryland town on the Susquehanna River is poised for major growth as a result of the military-base relocation and closure activities of the federal government, which will bring about 40,000 jobs to the area surrounding the Aberdeen Proving Ground, just across the river. This small town is currently the location of the northern terminus of the MARC commuter rail (centered on Baltimore with connections to Washington, D.C.), and is being considered as a possible southern terminus for the SEPTA commuter rail (centered in Philadelphia). The current station is little more than an over-crowded parking lot on the edge of town with a historic station structure still present, though it is not currently affiliated with the present station.

A key issue with the Perryville station is its size. Put bluntly, it is simply too small and cramped for any sort of meaningful bus access. Even during a period of renovation, its diminutive parking lot was filled to capacity. It is therefore doubtful that the station, as configured, could serve as a true TOD. Fortunately, the physical location of the station in relation to the town, as well as the town's location (well within the projected growth area for the Aberdeen Base project) offers a great deal of promise. The station is within a quarter-mile of "downtown" Perryville. The only large parcel that separates it from the core of the town is a mobile-home park, and the possibility of reconnecting the new and old station locations is well within the realm of reason.

B. Participants' Reactions

Participants were asked to complete a one-page questionnaire for each TOD visited (see Appendix B). The questionnaire consisted of four open-ended questions and a series of statements rated on a scale of one through five, with five being the most positive rating. Statements were grouped into pedestrian characteristics, vehicular characteristics, pedestrian/vehicular interface and land use characteristics. In addition, a few statements were included to get the gut reactions of our participants to each TOD as a place. The table below shows the average scores for each group of statements as well as the single question "Overall, how well does it work as a TOD?"

Table 2: TOD Field Trip Responses to Sites Visited

	Pedestrian Characteristics	Ped/Veh Interface	Land Use Characteristics	Vehicular Characteristics	Gut Reaction	How Well Did it Work
Columbia	3.7	3.6	3.9	3.6	3.8	3.1
Dorsey Station	1.4	1.2	1.1	1.9	1.2	1.1
Arlington	4.4	4.1	4.5	4.1	4.7	4.9
Perryville	2.5	2.1	2.4	2.4	2.2	2.2

Source: IPA Survey (see appendix) collected April 2007.

Overall, Dorsey Station rated the most poorly (1.2 overall), Perryville rated better but still not very well (2.2 overall), Columbia rated more positively (3.8 overall), and Arlington rated very well (4.7 overall). Ratings tended to be consistent across all categories.

What worked?

In Columbia participants commented on the extensive recreational walking/biking trails, planned open space, and overall shade and greenness. They noted the safe, clean sidewalks, the functionality of the road system for cars, and the ready availability of parking. One participant noted the pre-planning and overall control by a single, forward-looking developer. Another liked the very low speed limits. One person stated that "it's very nice as a well-planned, well-designed suburb, but it is still very car-centered." In general, participants were impressed with the area's pedestrian amenities and land uses, but struggled to see a clear, defined role for transit.

Dorsey Station didn't generate a lot of praise. The positive comments here included the proximity of the station to the highway, access by bus, and the availability of parking. Additionally, one participant appreciated the open, safe appearance and relative cleanliness of the site. Others noted the presence of the office building and college campus as positives.

In Arlington participants felt that almost everything worked very well. The sidewalk network close to buildings, short blocks, density, a mix of uses, and the ability to choose from a number of transportation modes were all specifically noted. Several participants noted that the sheer modal choice "limits the car problem;" therefore, the area was "not overwhelmed by cars, roads or parking." Another participant noted that it was well planned.

In Perryville participants noted that the town is very walkable in scale, that the train and station are close to a mix of densities and land uses, including residential, and that there is a reasonably good sidewalk system in place leading to the station.

What didn't work?

In Columbia, it appears that the transit system is not working very well. Additional routes and frequencies were suggested. Others noted that the community is relatively spread out, land uses were too far apart – making distances too great for convenient walking – and that there was not enough density for transit. With respect to the pedestrian system, blocks were very long with few mid-block crossings, many streets were too wide to be pedestrian friendly, and there was too much surface parking through which one must walk. One person noted that it is "too auto-dependent… [I] wouldn't characterize Columbia as transit-oriented."

Dorsey Station appeared to represent a missed opportunity. There were no pedestrian facilities through the parking lots or connecting the buildings. There was a great deal of vehicular capacity, but it didn't work either. The road through the employment district and the access to the highway were not physically connected, although they were side-by-side, creating confusion and frustration. Signage was also confusing. One participant noted the remoteness of the station.

In Arlington a number of participants noted that there was too much car congestion, parking was limited and expensive, and that buses were stuck in traffic along with the cars. At least one

person also noted that (except for the buses) this situation was operating as intended, which is a good thing.
In Perryville the problems highlighted included a lack of sidewalks within the site, not enough parking, parking that was awkwardly configured, and entirely inadequate bus access to the station.

What would you change?
Participants seemed to like Columbia as a community but recognized that the transportation system was auto-dominated and not transit-friendly. To that end, a number of suggestions were made. These included eliminating the mall in favor of a walkable, mixed-use center; reducing and redesigning parking lots with structured parking and relocating it behind buildings; including more landscaping; and creating more curvilinear circulation to make it easier for buses. Adding more turnarounds and extra lanes at bus stops, creating a true transit hub, and increasing connectivity with additional through streets, was also suggested.

At Dorsey Station, participants suggested a number of changes that would be relatively easy to make, given the vast amount of space currently dedicated to parking. First and foremost, the station needs to be connected to the employment buildings with pedestrian facilities, bike facilities, and the street network. Participants also suggested filling vacant areas between buildings with mixed uses and high-density residential.

In Arlington participants only mentioned a couple of possible changes. These included adding more rail and transit capacity, adding more green (landscaping) in the higher-density areas, and redesigning the parking garages so as not to have blank walls at street level.

Participants felt that Perryville had a lot of potential to become a TOD with good planning. Specifically, changes included using infill and redevelopment to increase density and add a mix of uses near the station. Other recommended changes included adding more parking, especially structured parking, and improving train frequency. Participants also favored improved bus and pedestrian access to the town, the employment center across the tracks, and the military base. Participants were strongly divided as to whether the location in a town was good or bad.

What are the lessons for TODs in Delaware?
Participants came away from the trip with a number of valuable recommendations for successfully designing and implementing TOD in Delaware:

Lessons for Design of TODs in Delaware
- Use bowtie or figure-eight collectors for easier transit operations (Columbia).
- Develop neighborhoods, not developments (Columbia).
- Mix and integrate assorted types of housing (Columbia).
- Avoid strip-commercial development (Columbia).
- "This is a blank, one-function facility geared only to commuters driving to their destination." This is an example of "what not to do." Do not do "anything like it in Delaware" (Dorsey Station).
- Mix land uses (Dorsey Station).

- Don't isolate the station; connect it to surrounding uses with pedestrian and vehicular facilities (Dorsey Station).
- Focus on the attractiveness of development, not the density (Arlington).
- Landscaping, buffers, trees, and open space are important to creating livable, dense, mixed-use communities. However, 50 percent open space is not necessary when the community is well planned (Columbia).
- "High density and mass transit saves green space. If you build for cars, all you get is cars and parking spaces" (Arlington).
- Compactness is important (Columbia).
- Limit parking requirements. Parking requirements in Delaware are "skewed the wrong way" (Arlington).

Lessons for Implementing TODs in Delaware

- Leadership is essential (Arlington).
- Provide public education regarding mixed uses and density (Arlington).
- "Make a decision and stick with it" (Arlington).
- Plan before developing (Dorsey Station). Regional advance planning is the key. Plan for transit first, and then develop according to the plan (Columbia).
- Plan for parking (Perryville).
- Be prepared for growth to happen; plan for development and redevelopment (Perryville).
- Corridors need to be well planned. Plan for the long term; "30 years is nothing." The corridor-shaped growth pattern works in Arlington. "Pick a direction and encourage growth within a quarter mile" (Arlington).
- Be creative and utilize what you have to the fullest (Perryville).
- Create incentives to focus development (density) in corridors. Delaware needs to allow density to be increased around the transportation system and the municipalities (Arlington).
- Explore the use of form-based zoning and flexible zoning options (Arlington).
- Need to identify appropriate uses for mixing and provide flexible zoning for those uses to allow for demographic and economic changes (Columbia).
- Limit parking requirements. Parking requirements in Delaware are "skewed the wrong way" (Arlington).

C. Conclusions

The recommendations from the participants of the trip are very similar to the recommendations gleaned from the literature sources and encompass both design and implementation issues. Part 5 summarizes all of the recommendations for the successful design and implementation of transit-oriented development.

Part 5: Summary of Recommendations for Delaware TODs.

Since the last paper on TODs for Delaware was written in 1997, there has been a great deal of activity throughout the country relating to developing successful TODs. Previous sections of this paper reviewed the recent literature related to the design and implementation of TODs. Comments were also solicited from local community and agency leaders in response to visiting nearby examples of transit-oriented development. Throughout this paper, there are a number of recommendations. In this section, the most important and relevant concepts for designing and implementing successful TODs in Delaware are summarized.

A. Design Characteristics

For ease of use, design recommendations are according to the key characteristics, but all of these characteristics are interrelated and a part of the complete communities concept. A TOD should be designed and planned to be a community. Neglecting one of the key components will affect the success of the entire TOD.

Transit facilities and service

- Design and locate transit stops and stations for maximum passenger comfort, convenience, and security.
- Provide high-quality transit service. Rail is preferable to bus.
- Make a long-term commitment to high-quality transit service.

Walkable, high-quality pedestrian environment

- Create a pedestrian network that is direct, connected, convenient, safe, pleasant, accessible, and separate from wheeled modes of travel. Remove barriers that prevent this.
- Design intersections and pedestrian crossings carefully to maximize pedestrian safety and convenience.
- Provide clear and convenient information and cues regarding orientation.
- Design buildings that support the pedestrian environment: close to the sidewalk and close together, doors and windows at street level, no blank walls, and architecturally interesting.
- Design streets that slow traffic, provide safe and convenient pedestrian crossings, address transit needs, and are well connected.
- Use bowtie or figure-eight collectors in Delaware for easier transit operations.
- Maintain all transportation facilities and adjacent properties in good repair.

Create Destinations

- Create neighborhoods rather than developments. Create places, destinations, and/or centers, not projects or developments.
- Mix land uses. Mix and integrate various types of housing.
- Get the right mix of land uses. Many commercial uses encourage walking; a high square footage of commercial encourages transit use.
- Avoid creating blank, one-function facilities geared only to commuters driving to their destination such as strip-commercial development.

- Connect the station to surrounding uses with pedestrian and vehicular facilities. Do not isolate the stop or station, especially with parking.
- Create streetscapes that are distinctive and enhance community character.
- Focus on creating good places and good design rather than on developments or individual projects.

Compact

- Put as many land uses and trip generators as close to the station or stop as possible. Focus development into these locations.
- Eliminate dead space and reduce walking distances between uses. Vacant properties, abandoned buildings, surface parking lots, excessive side yards and setbacks are all significant contributors.
- Use bulls-eye zoning to place the highest density closest to the station or stop, then reduce density as the distance from the station increases.
- Use high-quality open space and design to compensate for density.
- Use higher density and mass transit to save green space. "If you build for cars, all you get is cars and parking spaces."
- Focus on the attractiveness of development, not the density.
- Incorporate landscaping, buffers, trees, and open space to creating livable, dense, mixed-use communities. When the community is well planned, 50 percent open space is not necessary.

Carefully managed, designed, and located parking

- Locate parking so that it does not increase walking distances—to the side or rear of the building, or above or below street level.
- Use several small lots instead of one big lot. Provide screening and pleasant, landscaped pedestrian walkways through surface lots.
- Reduce the amount of parking and consider charging for parking within a TOD. Limit parking requirements.
- Provide incentives to encourage structured parking.

B. Implementation

Assembling the team

- Find strong leaders. TOD projects require champions, visionary thinking, and a long-term commitment. Leadership is essential.
- Include all affected parties, jurisdictions, decision-makers, and bureaucrats. Include broad public representation.
- Engage in meaningful and on-going public involvement and public education. Provide public education regarding mixed uses and density.
- Work hard to achieve inter- and intra-agency and jurisdictional agreement and coordination.
- "Make a decision and stick with it."

Planning

- Conduct planning at all levels of the project from broad-reaching comprehensive planning to site-specific area and station plans. Prepare for growth to happen, plan for development and redevelopment. Begin the planning process early.
- Integrate transportation and land use. Regional advance planning is the key. Plan for transit first, and then develop according to the plan. Corridors need to be well planned. The corridor-shaped growth pattern works in Arlington. "Pick a direction and encourage growth within a quarter mile."
- Plan for the long term; "30 years is nothing."
- Be creative and utilize what you have to the fullest.
- Plan for parking.

Regional TOD-supportive policies

- Work to get everybody in agreement and on the same page.
- Identify community values and goals and enact policies to address them from the outset.
- Develop TOD-supportive policies, including regional growth plans, transit level-of-service commitments, vehicular policies such as parking, TDM and street design, and fiscal policies (including the use of taxes and development/impact fees to encourage the desired outcome.

Market-ready

- Revise zoning codes and other regulations to allow appropriate development before a proposal is submitted.
- Explore the use of form-based zoning and flexible zoning options.
- Identify the appropriate uses for mixing and provide flexible zoning for those uses to allow for demographic and economic changes.
- Limit parking requirements. Parking requirements in Delaware are "skewed the wrong way."
- Identify potential regulatory barriers, such as approvals and permits, and develop strategies to resolve the problems.
- Create incentives to focus development (density) in corridors. Allow density to be increased around the transportation system and the municipalities.

Funding

- Work to achieve agreement among all affected parties. Excellent coordination and market-readiness can help to reduce overall implementation costs.
- Be creative with financing. Recognize that many sources of funding will be needed, public and private, to create a successful TOD.
- Identify existing sources of funds, focus them towards achieving the desired result, and look for ways to provide flexibility in using them.

C. Wilmington's Potential

Though Delaware shares some commonalities with the more-successful sites visited, it is, in general, a much-less-dense area. Additionally, access to commuter rail is negligible, aside from the SEPTA connection from Newark to Wilmington and on to Philadelphia. Even so, Riverfront redevelopment and efforts to improve transit and pedestrian rights-of-way have resulted in the

Riverfront area of the city closely resembling a TOD, particularly as the bulk of the redevelopment efforts are in proximity (several blocks) to the Wilmington Amtrak station and the adjacent bus station.

In less than a decade, substantial numbers of new condominiums and townhomes have been built near the waterfront. This is significant. First, it is the first surge in residential construction within the city's municipal boundary in decades. Second, the types of structures being predominantly built provide a level of density suitable to support sustainable transit operations and to warrant the thoughtful installation of pedestrian amenities and infrastructure.

Moreover, commercial and civic redevelopment is also underway, helping to provide the mix of uses that is so important for a functional TOD. Though not by definition a transit-oriented development, the Wilmington area has attempted to incorporate any number of the lessons and practices relating to transit-oriented design.

In June of 2007, IPA staff met with representatives from Wilmington, Planning Director Peter Besecker and Director of Transportation David Blankenship, to discuss the redevelopment trends discussed above and to discover any opportunities or barriers to the Riverfront area's potential transformation into a model transit-oriented community. Generally speaking, the two men were pleased with the area's progress. They cited the realignment of Madison Street and mixed-use developments at Justison Landing and Christiana Landing as keystones to the area's new identity. According to them, the relatively new trolley service has also been well received. Mr. Blankenship also said there had been initial discussions to explore the installation of car-share pods and the use of location-efficient mortgages. He also noted that the city is interested in reviving its Transit Center Phase III project, which would hopefully lead to the installation of an inter- and intra-city bus terminal, substantially adding to the area's transit alternatives.

Though many of the "big-ticket" components of transit-oriented design have begun to fall into place, the two saw the more mundane, detail-oriented aspects as the most in need of improvement. Of particular concern were pedestrian flows and routes. Though Mr. Besecker and Mr. Blankenship characterized the downtown area as, "pretty safe," they acknowledged that the area's identity and the casual citizen's perception of the area served as a deterrent to the full utilization of pedestrian and transit features. From their data, they concluded that a sizable percentage of the recently constructed residential units had been sold to relatively higher income families from the New York and Baltimore areas. New to the area and surrounded by less-affluent neighborhoods, the challenge, according to the Wilmington representatives, will be to help these new residents form TOD-appropriate habits—walking short distances rather than driving and using transit for work commutes over single-occupancy auto trips.

As observed in the TOD site visits and earlier surveys, safety, and the perception thereof, is paramount. Concerning physical safety, both men cited the need to light the rail-line underpasses between Martin Luther King Boulevard and the train station, currently somewhat of a choke point. They also felt more had to be done to reach an understanding with Amtrak, as a variety of maintenance and improvement issues have historically been hampered by a lack of dialogue and differing priorities. Similarly, the two felt that sidewalk improvements and street re-striping would improve the physical safety of pedestrians and cyclists.

They felt, however, that residents' *perception* of safety was possibly even more important. To this end, again, they felt adequate lighting was key, obviously for trip-and-fall issues, but more to the point, to benefit the pedestrian's psychological well being—the sense of security present only when one can be fully aware of their environment and confident that there is no criminal element loitering in the tunnel on their trip home. Similarly, simple maintenance issues, such as trash and graffiti, tend to intimidate and discourage those who would otherwise feel comfortable walking.

They also felt the area would continue to benefit from an increasing diversity of uses. Wilmington's population nearly doubles during the workday but empties shortly after 5:00 p.m. They felt this had the effect of "rolling up the sidewalks." The two were optimistic that increasing residential and commercial uses open during the evening would continue to make headway against this trend.

Lastly, Mr. Besecker and Mr. Blankenship shared their thoughts on overarching infrastructure, transit, and parking issues that may serve to hinder the area's transition. First, they felt many residents harbored a bias against buses. Fortunately, both agreed that the city's new trolley service (which, in reality, is a bus adapted to look like a rail-going trolley) has been well received. However, the fact remains that most of the area's streets are not bus-friendly, meaning they are difficult to navigate and drivers struggle to find space to pull over for the boarding and discharge of passengers.

A great deal of this difficulty is associated with traffic and on-street parking and enforcement. More to the point though, both felt that the overabundance of free or cheap parking was, perhaps, one of the biggest sticking points. With no disincentive to drive, it is more difficult to change peoples' transportation habits. Unfortunately, this was an area fraught with difficulties. Though Wilmington's Riverfront area has begun to show signs of revitalization, the city's overall economic status is still somewhat tenuous. Most development models still rely on a set number of square feet of parking (or a set number of parking spaces) for specific uses. These same models have been used by financial institutions for decades to determine a project's financial feasibility. Both men worried that a sudden regulatory stance curbing allowable parking could serve to slow, if not stop, growth and progress in the area. They also worried that irritated residents, annoyed by a sudden scarcity of free/cheap parking, could "vote with their feet" and move out of the city.

Challenges aside, the Riverfront area has, unarguably, made significant strides. Development of a density rarely seen in the state has flourished in close proximity to transit. A revamped trolley service has provided a more acceptable option to the standard bus, and an array of commercial and civic uses have been sprinkled in. Most notably, hundreds of professionally employed residents now live within blocks of their work, close enough to walk, bicycle, or take a short trolley ride. Even if they don't today, the underlying framework is in place to encourage them tomorrow.

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Appendix B: Field Trip Questionnaire

TOD _____

What works for 1) pedestrians, 2) transit/buses, 3) cars? Why?

What does not work for 1) pedestrians, 2) transit/buses, 3) cars? Why?

What would you change if you could?

What are important lessons for development in Delaware?

Rate the following on a scale of 1 to 5, with five being the best:

Pedestrian Characteristics
____Pedestrian network is direct, continuous
____Pedestrian network connects streets, commercial areas, parks, residences and other destinations
____Buildings are designed for pedestrians (windows, doors and entrances face sidewalk, door is close to sidewalk)
____ There are informal gathering places, places to sit, shade
____ There are clear boundaries and borders

Pedestrian/Vehicular interface:
____Pedestrian network is interconnected with 200 to 300 foot spacing between pedestrian intersections
____Safe, short and simple crosswalks. Do people jaywalk? Is there enough time for an elderly person to cross?
____Buffer between pedestrians and cars
____Parking lot design: back-in? Pedestrian walkway, landscaping, screening?
____ Signage is uniform, clear and easy to understand. Could a child understand it?
____ Bus stops are convenient and attractive

Land Use Characteristics:
____There is quality open space. How much dead space is there (such as between buildings)?
____Good mix of uses and destinations
____Good mix of residential types and costs
____The density is about right here
____ Density is in the right location
____ The location of land uses make sense for pedestrians

Vehicular Characteristics:
____Street network is well connected: short blocks, few dead-ends/cul-de-sacs
____Comfortable vehicular travel speeds, and street width
____ The amount of parking is adequate and appropriately located

Your gut reaction:
____ It is attractive
____ This is a nice place to live
____ This is a nice place to work
____ This is a nice place to shop
____ How much do you like it?
____Overall, how well does it work as a TOD?

Institute for Public Administration
College of Human Services, Education & Public Policy
University of Delaware
180 Graham Hall
Newark, DE 19716-7380

phone: ***302-831-8971*** *e-mail:* ***ipa@udel.edu*** *fax:* ***302-831-3488***

www.ipa.udel.edu

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