

Traffic Calming

Traffic-calming incorporates a variety of design and management strategies in local streetscapes to control volume and speed of traffic for the safety of both motorists and non-motorists.

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Preliminary Sections

Summary

Traffic-calming incorporates a variety of design and management strategies into local streetscapes to control motor vehicle speeds and traffic volume for the safety of both motorists and non-motorists. For example, speed tables or speed bumps compel drivers to slow down to speeds at which they are better able to react to unexpected situations such as a child darting across the street. Even if a crash does occur, lower speed crashes are less likely to kill or seriously injure.

Typical End Users

- Local government

Track Record

Over decades of use, traffic-calming solutions have proven to reduce both the number and severity of pedestrian and vehicular crashes.

In Pennsylvania, scores of communities have implemented traffic-calming strategies to improve the safety of specific intersections or neighborhoods and improve safety conditions for pedestrians, motorists and bikers.

Introduction

History

Traffic-calming is founded on the idea that streets are a means of connecting people to their communities, offering critical functionalities that help to create and preserve a sense of place. They provide a service to the community as a whole and should adequately and safely serve multiple users such as walkers, shoppers, tourists, cyclists, runners, children and families, as well as motorized vehicle passengers and mass transit riders.

Traffic-calming uses techniques designed to lessen the impact of motor vehicle traffic by slowing it down, or literally “calming” it. This helps build human-scale, walkable, bikable and livable communities where motor vehicles are intended to be one form of transportation but not the sole form of transportation.

Traffic-calming began in the Netherlands in the 1960s with the design of “woonerven”, or “living yards”. The Woonerven in The Netherlands is a street or road where pedestrians and cyclists have legal priority over motorists. Using a variety of traffic-calming techniques, woonervens were intended to improve pedestrian, bicycle and motor vehicle safety.

In the late 1970s, Germany began working in this area using the term “Verkehrsberuhigung” which would eventually be translated as “traffic calming”. A number of communities in the United States began applying the principles of traffic-calming in the late 1970s, at the same time that it was spreading to other European countries, Canada, and Australia. However, it has taken many years for traffic-calming to gain popularity in America. As a result, many of the initial studies on the effects of traffic-calming have taken place abroad, where its application has reportedly lowered crash and injury rates anywhere from 20 to 80 percent.

Purpose

The basic principle behind traffic-calming is that reducing the speed of motorized vehicles will decrease the likelihood that pedestrians or cyclists will be hit; and even if a collision does occur, the impact is reduced and the injuries are not as severe. Statistically, collisions that occur at lower speeds are less likely to kill or seriously injure.

Communities may wish to control vehicular speeds and traffic volumes to achieve a variety of objectives. Those objectives might include: reducing accidents, collisions, noise, vibration, pollution, and crime. Some communities are also exploring how providing safe conduits for pedestrians and bikers can provide for healthier lifestyles.

According to the U.S. Department of Transportation, general objectives of traffic-calming include:

- To encourage citizen involvement in the traffic-calming process by incorporating the preferences and requirements of the citizens
- To reduce vehicular speeds
- To promote safe and pleasant conditions for motorists, bicyclists, pedestrians, and residents
- To improve the environment and livability of neighborhood streets
- To improve real and perceived safety for non-motorized users of the streets
- To discourage use of residential streets for cut-through vehicular traffic

Effectiveness

Enhanced safety is one of the most fundamental benefits of traffic-calming and one of the primary reasons that programs are created. By reducing speed and decreasing traffic volume, the number and severity of vehicle crashes are significantly reduced.

According to a report by the Insurance Corporation of British Columbia, which examined 43 international studies, collision frequencies in areas with traffic-calming measures declined between 8-100%. The report also revealed that there were no increases in collision frequencies where traffic-calming measures had been employed.ⁱ

A more recent study conducted found that children living near traffic-calming devices were 50% less likely to be hit and injured by an automobile in their neighborhood.ⁱⁱ

Reducing vehicle speed creates a more walkable environment and significantly reduces the likelihood of serious injury or fatality of pedestrians. In fact, speed of the vehicle is by far the most significant factor contributing to pedestrian fatalities. According to data from the National Accident Sampling System, the rate of severe injury for people involved in crashes at impact speeds of 21-30 mph is 11.1; this rate increases to 27.9 at impact speeds of 31-40 mph and to 54.3 at speeds of 50 mph or more. Any collision with a pedestrian taking place at more than 50 mph is almost certain to result in a fatality.

Traffic-calming strategies typically include a combination of education, enforcement and engineering, each of which are covered more comprehensively below. Each of these, dependent on the municipality's overall goal or objectives, varies in effectiveness when used independently of one another; often effectiveness is improved when one or more of these strategies is utilized:

- Educational/outreach programs can be fairly cost-effective, but are most effective when used in combination with enforcement and engineered alterations.
- Highly visible, long-term law enforcement can be very effective though such techniques can be disruptive on high volume streets and provide only short-term results. Enforcement strategies may be more effective in conjunction with an educational campaign that makes residents more aware of the potential consequences of their driving practices.
- Engineered traffic-calming measures are most often implemented to reduce traffic volume and speed and include a variety of options. Engineered traffic-calming measures have proven far more effective in preventing child pedestrian injuries than basic road safety education, which has been unsuccessful in changing the behavior of children. The table below provides a quick overview on the effectiveness of each engineered traffic-calming strategy based on its overall goal.

	Volume Reduction	Speed Reduction	Conflict Reduction	Emergency Response
Horizontal Deflection				
Bulb-out / curb extension	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Chicane	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Gateway	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
On-street parking	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Raised median island / pedestrian refuge	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Traffic circle	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Vertical Deflection				
Textured crosswalk	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Speed hump	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Raised crosswalk	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Raised intersection	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Physical Obstruction				
Semi-diverter	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Diagonal diverter	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Right-in / right-out island	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Raised median through intersection	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Street closure	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Signing and Pavement Markings				
Speed limit signing	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Multi-way stop control	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Turn prohibitions	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
One-way streets	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Commercial vehicle prohibitions	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Roadway narrowing with edge lines	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Transverse markings	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- ☐ Minimal or no effect
☒ Moderate effect
☒ Significant effect

Source: Pennsylvania's Traffic-calming Handbook (PennDOT, 2001)

Traffic-Calming Planning & Approval Process

Preliminary Issues

Funding

Expenses related to implementing and maintaining traffic-calming related programs are often much less in comparison to other transportation related costs. Local governments nationwide most frequently fund their traffic-calming programs from municipal capital improvement funds, general funds, or state gas tax subsidies. Neighborhood residents may choose to help cover costs of the installation and/or maintenance of specific traffic calming measures; this is particularly beneficial if the project is low on the municipality's priority list.

Act 209 of 1990 amended the Pennsylvania Municipalities Planning Code (LINK) to enable municipalities to impose an impact fee on new development to generate revenue for funding eligible transportation improvement projects needed as a result of the development. Impact fees can be used for capacity improvements to accommodate traffic

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generated by new development, but not to address existing or anticipated deficiencies unrelated to the development. Before establishing an impact fee ordinance, municipalities must first complete a series of transportation studies as defined by Act 209. The process is daunting, deterring most municipalities from using the impact fee tool. Learn more by reading *Transportation Impact Fees: A Handbook for Pennsylvania's Municipalities* (LINK TO LIBRARY ITEM).

No money has been designated at the state or federal level specifically for implementation of traffic-calming projects. Municipalities may apply for competitive grants, including:

Transportation Enhancement Program - Provides federal funds to local municipalities to help expand transportation choices and enhance the transportation experience through 12 eligible TE activities related to surface transportation, including pedestrian and bicycle infrastructure and safety programs, scenic and historic highway programs, landscaping and scenic beautification, historic preservation, and environmental mitigation. For more information, visit the [Pennsylvania Transportation Enhancements Program Website](#) (LINK)

Safe Routes to School Program – Federal grant program established enable and encourage primary and secondary school children to walk and bicycle to school. For more information: [Pennsylvania Federal Safe Routes to School Program](#) (LINK) and [National Center for Safe Routes to School](#) (LINK).

Pennsylvania Community Transportation Initiative (PCTI)* - PCTI is a competitive funding process to help municipalities fund local transportation projects that best exemplify the goals of PennDOT's Smart Transportation initiative. The Smart Transportation goals include the linking of transportation planning and land use as well as the design of sustainable roadways that meet the needs of all users and modes of transportation including pedestrians, bicyclists, transit, and motor vehicles. For more information, visit [Smart-Transportation.com](http://www.smart-transportation.com) (LINK). Municipalities may also contact their local PennDOT Engineering District to obtain information on the Pennsylvania Community Transportation Initiative (LINK: <http://www.smart-transportation.com/pcti.html>). [*Editor's Note: PennDOT has allocated all available PCTI funds for projects to be completed through 2012. As of July 2011, the future of the funding is uncertain.]

Liquid Fuels Funds

In Pennsylvania, Liquid Fuels funds may be used for traffic-calming measures provided that a well defined "Traffic-calming Study and Approval Process" has been followed.

For any project that involves state or federal money, or Liquid Fuels funds, the processes outlined in Pennsylvania Department of Transportation's (PennDOT) Design Manual Part 1 and 1A (LINK TO LIBRARY ITEM) must be followed. Whenever Liquid Fuels funds are considered for a traffic-calming project, the local municipality should contact PennDOT's Municipal Services representative in the local Engineering District Office.

Calming of State Highways

Before traffic-calming measures are installed on State highways, a written agreement between the local municipality and PennDOT's local Engineering District must be established to outline funding responsibilities for installation, maintenance, pavement markings, and any other associated traffic control devices such as warning signs. This agreement will indicate that the funding for each of these areas will be the responsibility of the local municipality, unless otherwise agreed upon by PennDOT.

Legal Issues

Safety/Liability

Since governments may be held liable for any foreseeable condition, a traffic-calming measure should be designed so that a driver acting reasonably and exercising ordinary care would perceive the intent of the measure and safely negotiate it. To do this, geometric design, signing, pavement markings, and lighting should conform to standard engineering principles as much as possible and comply with state transportation department standards and approved procedures. Installation of traffic-calming measures should be done only after careful study by a qualified engineer. (PennDOT Traffic-calming Guide)

Eminent Domain

Eminent domain may be required in the implementation of traffic-calming measures. The two types of eminent domain include 1) *consequential damages*, where injuries to property occurring are a natural result of an act lawfully done, but not amounting to a taking of the property; and *de facto taking* occurs when exceptional circumstances amount to the substantial deprivation of the use and enjoyment of the property. Both types have a causation requirement. If the damage to the property is not the direct, immediate, necessary, and unavoidable consequence of the government's actions or activities, there can be no recovery in eminent domain. (PennDOT Traffic-calming Guide)

American Disabilities Act

The American Disabilities Act must also be considered when implementing traffic-calming measures. Traffic-calming measures must be designed, installed, and maintained so as not to impede the mobility of individuals with disabilities. In addition, any alteration to the facility that affects its usability, such as installation of a physical device in the street, or a change to the curbing or sidewalk, triggers the obligation to construct curb ramps or other appropriate accommodations to the entire facility. (PennDOT Traffic-calming Guide)

Large Trucks

Communities may see traffic-calming measures that narrow road width as a solution to heavy volumes of large trucks. However, local ordinances that establish measures designed solely to unreasonably restrict access to 102-inch-wide truck combinations are subject to legal challenge under the Pennsylvania Surface Transportation Assistance Act (STAA) of 1982.

Preliminary Study

A preliminary study can result from a request by citizens or simply because the municipality recognizes a problem in a particular location of the municipality. Municipal officials must have a good understanding of the issues before fully implementing any traffic-calming measures.

The Pennsylvania Department of Transportation (PennDOT) “Pennsylvania’s Traffic-calming Handbook” provides specific guidance on the “Traffic-calming Study and Approval Process”, which PennDOT strongly recommends in the establishment of a well-organized traffic-calming program. This process has been designed as a supplement to existing policies and procedures and is not intended to replace or supersede any current requirements. Not all traffic-calming projects will require the use of the “Traffic-calming Study and Approval Process” since many traffic-calming measures are used routinely without any resistance from the community. For any project that involves state or federal money, or Liquid Fuels funds, the process outlined in PennDOT’s Design Manual Part 1 and 1A [LIBRARY ITEM] must be followed.

Prior to installing traffic-calming measures on local streets, traffic conditions on adjacent arterial streets should be investigated to determine if operational deficiencies are contributing to the identified traffic concerns. If the adjacent arterial streets are the responsibility of the local government, these deficiencies should be addressed before traffic-calming is considered. In addition, when the use of traffic-calming measures may divert large volumes of traffic from local streets, the effects on adjacent roadways should be addressed.

Project Prioritization

Because a municipality may not have the funding to complete every traffic-calming project that is proposed, it may be helpful to establish a ranking system to prioritize specific projects in an effort to best address the needs of the community. During the prioritization process, community leaders may review a variety of criteria including speed, traffic volume, number of crashes, pedestrian safety, pedestrian or cyclist volume, designated school zone, etc., assigning a certain number of points to each element and a statement explaining the point assignment.

Local Traffic Advisory Committee (LTAC)

The Pennsylvania Department of Transportation recommends the establishment of a Local Traffic Advisory Committee (LTAC) when a community is considering implementing traffic-calming measures. The LTAC is a standing committee, appointed by the elected officials, typically comprised of a municipal/county engineer, a municipal/county planner, a representative from the governing body, a representative from emergency services, one or more local citizens, and a representative from public works. The LTAC coordinates all requests for traffic-calming measures made within a local jurisdiction.

Supporting Data Collection

The study process involves gathering of preliminary information, including:

- **Identification of Project Areas** – identify specific locations where the municipality would like to traffic-calming strategies may make local intersections or roadways safer
- **Classification of Street Functions and Land Use** – identify general functions of the neighborhoods where traffic-calming measures are proposed (e.g., residential, industrial, school zone, business district)
- **Identify Speeding & Cut-Through Problems** – specifically identify areas where speeding and volume are issues
- **Neighborhood Traffic-calming Survey** - the local government, the LTAC, or the interested neighborhood group should compile a list of all residents and businesses in the project area and conduct either a mail or door-to-door inquiry to document interest in the traffic-calming project.

Plan Development

A good traffic-calming plan is developed with robust input from the community, guidance from a qualified engineer or consultant, and approved by the necessary elected and appointed officials. The plan will make specific recommendations on how to adjust traffic patterns and increase safety on targeted roadways.

The components of a traffic-calming plan will most likely incorporate various approaches, including engineering strategies, educational and outreach efforts as well as increased enforcement. (see Three E's of Traffic Calming)

The development of the plan should include public meetings, providing residents and stakeholders with the opportunity to ask questions of the municipal officials and the consultant hired to facilitate the project.

A Neighborhood Traffic-calming Committee (NTCC) should be established from interested residents attending the public meeting. The municipal engineer, with assistance from the LTAC and the NTCC, should gather more extensive data that can be used to further define the traffic problem affecting the neighborhood. In addition, the data may help identify appropriate solutions or define which traffic-calming measures are appropriate for the particular application.

Although LTAC and NTCC representatives can assist in this endeavor, traffic data collection and analysis must be performed by appropriate traffic engineering or technical professional.

The planning process should include:

- Examining arterial streets for operational deficiencies which might contribute to traffic safety and flow issues;
- Examining neighborhood streets to ensure that traffic-calming strategies implemented on arterial streets would not shift traffic problems to other areas in the community;
- Review and select all potential traffic-calming strategies that could resolve the issues that have been identified;

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- Develop alternative traffic-calming plans to be considered, reviewing the pros and cons of each strategy;
- Provide ample opportunities for the public and impacted stakeholders to understand the alternative traffic-calming strategies and provide input and comments; (See Approval Process)
- An implementation strategy, once the final draft of the plan has been approved, which should include cost estimates, project priorities and a realistic time line.

Approval Process

Public Meeting

Once consensus has been reached by the LTAC and local government officials, the preliminary and final traffic-calming plans should be presented at an open house or public meeting.

Finalize Plan

Following public review, any necessary modifications are made to the traffic-calming plan. Additional public meetings can be held if the changes are very substantial. Otherwise, the plan is ready for community approval. The final plan should include implementation strategies.

Neighborhood Survey

Once the traffic-calming plan is completed, a second neighborhood survey should be conducted. PennDOT recommends that a 70% approval threshold be used to indicate overall community support for the traffic-calming project. If less than 70% is obtained, additional modifications to the plan may be needed.

Local Government Approval

After 70% community approval is obtained, the traffic-calming plan must be officially approved by the local government. At this point, the funding source should be clearly identified and money set aside for implementation and maintenance.

PennDOT Approval (if required)

If the project involves a State road, or if State, Federal, or Liquid Fuels funds are requested, PennDOT approval is also required. This approval will include the issuance of a highway occupancy permit. When a State road is involved, a legal agreement between PennDOT and the local municipality identifying the installation and maintenance responsibilities must be established.

Plan Implementation

After the traffic-calming plan has been reviewed and approved by residents, impacted stakeholders and by elected local government officials, the plan can be implemented.

Implementation of the plan should include:

- Determining design strategies based on the best available current practices;
- Determining prioritization for implementation of strategies;
- Determining timeline for implementing various strategies;

- Monitoring impacts of implemented strategies to determine how effective the chosen traffic-calming solutions are and how they meet pre-determined goals and objectives;

Traffic-calming Strategies

Traffic-calming can be addressed in a number of ways and usually includes a combination of three strategies: education, enforcement and engineering. Using this three-tiered approach can provide municipalities with greater flexibility and help identify specific traffic-calming measures to be implemented while prioritizing projects accordingly.

Different traffic-calming methods have varied levels of effectiveness based on the overall goal or objective. For example, some methods are more effective in reducing the speed of motorized vehicles while others are intended to decrease congestion or overall amount of traffic. Although education and enforcement may offer more cost-effective solutions to traffic calming, municipalities do often find that engineering strategies are required especially when a municipality or community is trying to reduce “cut through” traffic, traffic that utilizes local streets rather than the arterial roadway network that circumvents the community.

Education & Outreach

Municipalities can help calm traffic and reduce high speeds on local streets through an outreach campaign that addresses the consequences of speeding and reckless driving.

Public education can be an effective tool in changing the attitude and behavior of drivers. Educational efforts focus on the consequences of unsafe driving practices as well as educating inattentive, aggressive drivers that modifications of their own driving behavior may help solve the problem of unsafe roadways.

Outreach campaigns may use brochures or neighborhood newsletters to spread this message. Newsletters may also contain information on speeding fines (particularly in school zones), pedestrian and bicycle safety tips, and information on average speeds in the neighborhood.

Methods

- **Neighborhood Meeting** – Organize a meeting with the affected neighborhood to discuss the specific traffic issues for that neighborhood and recommend ways for residents to personally reduce speeds and increase safety in their neighborhood.
- **Traffic Safety Newsletter** - Preparation of a newsletter designed for a specific neighborhood describing the traffic concerns and recommendations. The newsletter may provide information on volumes and speeds in the area, as well as reminders of traffic laws and traffic safety tips.
- **Speed Trailer** – Use of a portable trailer equipped with a radar unit, which detects the speed of passing vehicles and displays it on a reader board. The trailer shows drivers their actual speed versus the posted speed limit and encourages

compliance. The device also helps by-standers to gauge how fast the posted speed limit looks as drivers pass by.

- **Neighborhood Pledge or “Pace” Cars** – A pledge form may be distributed through the neighborhood to encourage neighbors to commit to driving the speed limit. The municipality may also provide a bumper sticker or decal for residents committed to driving the speed limit. The drivers of these “pace” cars will lead by example through their neighborhood and others.
- **Signing** – The posting of appropriate regulatory or warning signs to remind drivers of the traffic laws. Examples of signing that could be used to educate drivers of traffic laws include: speed limit, no outlet, pedestrian crossing or school warning signs.
- **Turn restrictions** – Full or part-time turn restrictions may be used where a specific movement is creating a safety problem or where cut-through in a neighborhood is an issue. This could also apply to “No Right on Red” designations. However, installing this type of sign requires continued police enforcement.

Enforcement Strategies

Enforcement strategies can be very useful in addressing traffic-calming issues in a community. Increasing enforcement in targeted areas where speeding is an issue may encourage motorists to drive at the posted speeds or risk some form of punishment by local law enforcement. However, enforcement strategies may require a consistent and continual presence of law enforcement to be most effective. Many communities may find that this is cost prohibitive since rarely do the fines collected cover the full cost of the enforcement. Enforcement strategies are often coupled with education measures that can help address specific safety issues in a community and educate the public on why increased enforcement is needed.

Methods

- **Neighborhood Speed Watch Program** - A speed-monitoring program in which residents of a neighborhood measure vehicle speeds with a radar unit and record license plate numbers of those exceeding the speed limit. The registered owners are sent letters explaining the safety concerns in the neighborhood and asking them to reduce their speeds.
- **Targeted Police Enforcement** - Increased police enforcement of traffic regulations within a designated area.

Engineered Traffic-Calming Measures

Engineered measures include structural modifications as well as signs and pavement markings. Different traffic-calming methods have varied levels of effectiveness based on the overall goal or objective. Traffic-calming measures can be separated into two groups based on the intended impact of the measure:

- 1) **Speed control measures** are primarily used to address speeding problems by changing vertical alignment, changing horizontal alignment, or narrowing the roadway.
- 2) **Volume control measures** are primarily used to address cut-through traffic problems by blocking certain movements, thereby diverting traffic to streets better able to handle it.

[INSERT PHOTOS OF VARIOUS MEASURES]

Speed Control Measures

Horizontal Deflection

There are two types of horizontal deflection devices used in traffic calming. Although horizontal deflection measures are mainly used to address speed concerns, applications that narrow the travel lane can improve pedestrian safety by reducing the width of the crossing. Horizontal deflection measures may also have the secondary effect of reducing volumes; however, the effects will typically be minor.

The first type hinders the driver's ability to drive in a straight line by creating a horizontal shift in the roadway. This shift forces drivers to slow their vehicles in order to safely navigate the measure.

The second type of horizontal deflection measure is designed to narrow the width of the travel lane. Doing so reduces the usable surface of the roadway causing drivers to slow their vehicles to maintain an acceptable level of comfort.

Examples of horizontal deflection measures, include:

- **Curb extension / bulb-out / Neckdown**- areas of expanded curbing that extend across a parking lane and may narrow a travel lane.
- **Chicane** - series of 3 bulb-outs, staggered at mid-block locations on alternating sides of the street.
- **Gateway** - entrance treatment, typically using physical and textural changes, that provides identity to an area.
- **On-street parking** – provision of on-street parking that reduces roadway width.
- **Raised median island / pedestrian refuge** - narrow islands, at mid-block or intersections, between travel lanes with breaks in landscaping and curbing for pedestrians.
- **Traffic circle** - raised island in the center of an intersection that requires vehicles to travel counterclockwise around the circle.

Vertical Deflection

These are traffic-calming measures that create a change in the height of the roadway. When designed properly, vehicles must slow down over these measures in order to avoid unpleasant bumping sensations. As with horizontal deflection measures, vertical deflection measures are mainly used to reduce vehicle speeds, with only minor effects on

traffic volumes. Vertical deflection measures can also be used to improve the safety of pedestrian crossings.

- **Textured crosswalk** - use of pavers or other materials to demarcate crosswalks and alert motorists that they are entering a pedestrian-friendly area.
- **Speed hump** - raised humps in the roadway, typically 3 inches high with a 12 or 22-foot travel length.
- **Raised or textured crosswalk** - marked pedestrian crossings elevated 3 to 6 inches above street grade at intersections or mid-block.
- **Raised intersection** - intersections, including crosswalks, raised 3 to 6 inches above street grade.

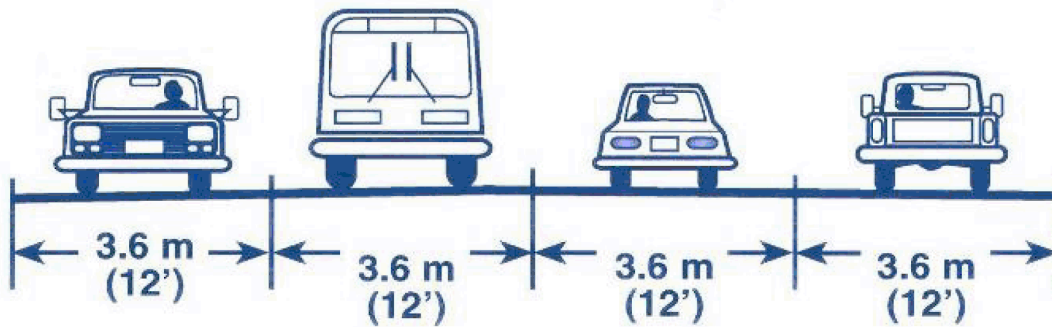
Horizontal Narrowing or Road Diet

A Road Diet is the removal of travel lanes from a roadway and converting that space for other uses such as bike lanes, parking, and landscaping. Narrowing traffic lanes differs from other road treatments by making slower speeds seem more natural to drivers and less of an artificial imposition, as opposed to most other treatments used that physically force lower speeds or restrict route choice. Some examples include:

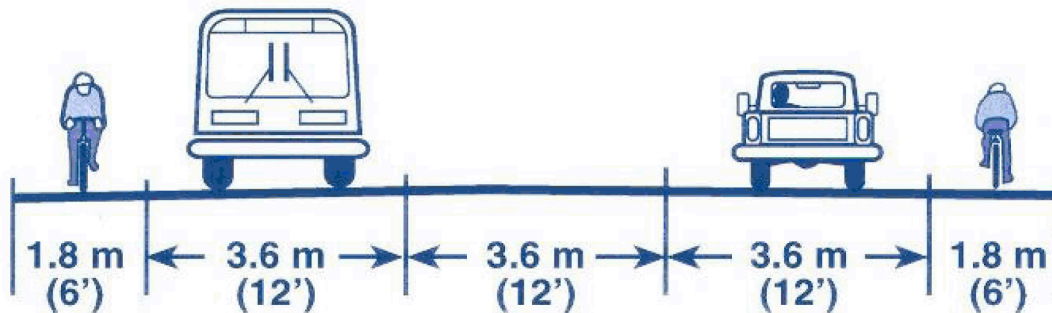
- **Neckdown** - curb extensions at intersections that reduce the roadway width from curb to curb.
- **Center Island Narrowings** - a raised island located along the centerline of a street that narrow the travel lanes at that location.
- **Chokers** - curb extensions at midblock locations that narrow a street by widening the sidewalk or planting strip

A common Road Diet measure is the conversion of a four lane arterial to three lanes. The new three lane configuration would feature one through lane per direction with left turn lanes at all signalized intersections.

BEFORE:



AFTER:



The Road Diet concept is supported by PennDOT's Smart Transportation Guidebook ([Link to Library Item](#)), which states that "the desire to go 'through' a place must be balanced with the desire to go 'to' a place." The Road Diet concept is based on the premise that roadways are meant for all users and modes of transportation including vehicles, pedestrians, bicyclists, and mass transit. As such, if a roadway can effectively slow or calm vehicular traffic, it is more likely to be used safely and comfortably by pedestrians and bicyclists.

The U.S. Department of Transportation (USDOT) completed a study of selected Road Diet measures implemented across the country. After reviewing the data, the report concluded, a 6 percent decrease in the proportion of crashes at road diet sites in the after period than at the comparison sites in the after period. See U.S. Department of Transportation/Federal Highway Administration's report entitled "Evaluation of Lane Reduction 'Road Diet' Measures and Their Effects on Crashes and Injuries". ([LINK TO LIBRARY ITEM](#))

Signs and Pavement Markings

Signs and markings can be used as traffic-calming measures that regulate traffic movements in lieu of physical changes to the roadway. In certain applications, these measures may produce the same effect as the physical traffic-calming measures. However, police enforcement is often required to ensure motorist compliance.

Volume Control Measures

Physical Obstruction

Physical Obstruction refers to measures that prevent particular vehicle movements, thereby discouraging or eliminating cut-through traffic. The overall traffic volume reduction depends upon the nature of the traffic-calming measure and the number of movements obstructed. Including:

- **Semi-diverter** - directional closure created by physically blocking half the street.
- **Diagonal diverter** - physical barrier placed diagonally across a four-way intersection to create two unconnected intersections.
- **Right-in / right-out island** - the use of raised islands to prevent left turns and through movements, to and from side streets, at intersections with major streets.
- **Raised median through intersection** - median barrier through an intersection that discourages through traffic in a residential area by restricting movements.
- **Street closure** - the use of a cul-de-sac to close a roadway by extending a physical barrier across the entire width, obstructing all traffic movements.

Learn more about the benefits and application of each of these measures at Pennsylvania's Neighborhood Traffic-calming Resource (<http://www.students.bucknell.edu/projects/trafficcalming/Measures.html>). Also see Traffic-calming Measures at <http://www.trafficcalming.org/measures2.html>.

Case Studies

Lemoyne Borough (Cumberland County, PA)

Lemoyne Borough made the decision to apply streetscape design and traffic-calming strategies to a stretch of road that runs through the center of the community's commercial district. Through an open public process, the borough actively worked to improve safety conditions for motor and non-motorized users, improve the aesthetics of the downtown business district and expand the borough's ecological stewardship practices.

The borough recognized that heavy traffic volumes needed to be better managed along the Market Street Corridor and wanted to approach the issue proactively before the situation worsened. Borough Counsel was interested in creating a safer environment for both pedestrians, including school children crossing, and motorists with the added objective of creating safer, improved access to downtown businesses.

Borough officials reached out to their Downtown Revitalization Committee and the Kairos Design Group, LLC to evaluate potential solutions and to help build public consensus. The business operators, residents, property owners and the Lemoyne Business Association were engaged in a series of public meetings to discuss analysis results, conceptual alternatives, selected preliminary designs and final designs.

The project included the analysis of hardscapes and landscapes, historical context, transportation, utilities, the existing business environment, real estate considerations, lighting, etc. The design consultants worked closely with the Downtown Revitalization Committee in a highly interactive process to ensure that the needs of the community were properly reflected in the final Master Plan.

[BEFORE/AFTER PHOTOS]

The traffic-calming strategies chosen included:

- paved and textured crosswalks to alert motorists that they are entering a pedestrian-friendly area; (PHOTO)



- bump outs, or curb-extensions that extend into the parking lanes but do not impact the travel lanes thus providing vertical protection for parked cars, improving pedestrian visibility and minimizing exposed crossing distances for pedestrians; and (PHOTO)



- crosswalk lighting for proper nighttime illumination of the crosswalks. (PHOTO)

Streetscape safety in the Market Street corridor is planned to be achieved in Phase 1 and subsequent phases by separating modes of different speeds and vulnerabilities to the

extent possible by both space and time (bicyclists from pedestrians and pedestrians from vehicles), informing ALL users of the presence and mix of travel modes (walk, bike, drive) and establishing provisions for adequate sight distance.

The borough has made a commitment to “green” their streets and improve the quality of life for its residents through a holistic, cost-savings strategy that combines traffic-calming streetscape and stormwater management elements. These improvements include infiltration pavers in the sidewalks, rain gardens, bump-outs, pedestrian scale lighting, native plantings and branded “L” bike racks.

Through the public input process, residents also developed a variety of community-based projects that included organized borough clean-ups, planters at the 3rd Street intersection, and the creation of gateway signage. Residents were also very supportive of the engineered measures (e.g., bump-outs, paved crosswalks) installed, recognizing the added safety benefits they provide for pedestrians, bicyclists and motorists.

The Borough funded the project through borough capital funds and through assistance from the Cumberland County Redevelopment Authority, Senator Pat Vance’s office, Representative Glenn Grell’s office, the Lemoyne Business Association, Pennsylvania Department of Community & Economic & Development grant funding, as well as private and business donations and volunteer support.

Though the borough has not completed before and after traffic studies, it is easily observed that traffic has been calmed through this section of Market Street, creating a safer environment for residents and visitors as well as a more pedestrian-friendly environment for consumers to explore the downtown’s shops and eateries. The rain gardens have been successful in filtering petroleum products and salt from reaching the river.

Craig Bachik, Kairos Design Group, LLC recommends a holistic approach that “involves all potential stakeholders (especially maintenance personnel who will inherit the project once it is complete)” and adds that in Lemoyne Borough the maintenance staff “has been outstanding in their commitment to the effort”.

“Start with understanding your community’s history, strengths and weaknesses and never give up on creating a vision for future generations,” Bachik explains. “It takes a lot of entities to make these projects happen in a successful way. That is why broad-based support is critical.”

Carlisle Borough (Cumberland County, PA)

Carlisle’s downtown is currently troubled by excessive vehicle speeds and long crosswalks. The two four-lane highways that intersect at the Square in the center of town create an auto-dominance that makes it difficult for bicyclists and pedestrians to navigate through town. Carlisle’s proximity to Interstate 81 and the Pennsylvania Turnpike along with the large number of warehouses in and around the borough generates truck traffic

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that degrades the downtown experience with unwanted noise, air pollution, and traffic congestion.

The proposed traffic-calming project will be an excellent opportunity for Carlisle to recreate the thriving, walkable downtown that it once had. Currently, transportation engineers are planning and designing sustainable roadways that meet the needs of all users and modes of transportation including pedestrians, bicyclists, and motor vehicles.

In 2007, a group of concerned stakeholders formed which included members of the Clean Air Board, the Downtown Carlisle Association, Dickinson College, the Letort Regional Authority, and the Redevelopment Authority of Cumberland County, among others. The stakeholders approached the Carlisle Borough Council and requested that something be done to calm traffic and improve the quality of life in Downtown Carlisle. In response, the Borough Council, with a commitment of \$20,000, and Dickinson College, with a pledge of \$50,000, teamed together to fund the Comprehensive Traffic Study of Downtown Carlisle. This study produced the recommendations, which became the Downtown Carlisle Improvements Project, which is currently under construction.

A series of four stakeholder meetings were held to develop traffic-calming strategies that met the following objectives:

- Devise a traffic flow that calms traffic and enhances an intimate, small-town feeling.
- Promote walking by making it easier for pedestrians to cross roadways.
- Promote bicycling by providing bicycle facilities through the downtown, linking employment and recreation areas.
- Reduce vehicle accidents.
- Reduce pollution and noise from vehicles.
- Maximize downtown business success.
- Improve access and safety of on-street and off-street parking.

In addition to the stakeholder meetings, two public meetings and several Borough Council meetings were utilized to present the traffic-calming recommendations and obtain feedback from the public. Input received was used to shape the final traffic-calming recommendations which were submitted to PennDOT District 8-0 for approval.

The primary traffic pattern change is a traffic-calming “Road Diet” for High and Hanover Streets. Road Diets have been proven to reduce vehicle speeds by up to five mph and to significantly reduce the number of accidents at intersections. The Road Diet will convert the existing four lanes to three lanes with the addition of a five feet wide bike lane in each direction.

“The idea of a Road Diet may seem counter-intuitive and counter-productive to improve traffic flow”, explains Chad Decker, Senior Traffic Engineer for Dewberry and manager of this project, “but [this approach] has been proven to be successful in many locations, including Pottstown, Indiana, Butler, Lewistown, and Philadelphia.”

A dedicated left turn lane will be provided for High and Hanover Streets at each intersection in the Downtown to improve traffic flow. A traversable brick pattern median will be created in select locations to calm traffic and improve the appearance of the downtown. Significant upgrades to the existing traffic signals include a state of the art traffic adaptive signal system, emergency vehicle preemption, and audible countdown signals to better serve pedestrians.

A Truck Mitigation Signing Plan is also included to direct trucks away from Carlisle's downtown. Curb extensions at intersections are planned to shorten the crossing distance for pedestrians to reduce their exposure to vehicles. The existing parallel parking spaces will remain as they currently are. The proposed bike lanes will also serve as a buffer to make parallel parking easier and make entering and exiting your vehicle safer.

The first phase of improvements were completed in the summer of 2011. Post-construction travel time and delay studies will be conducted a few months after completion after people have settled in to the new traffic patterns. The following rendering depicts what the post construction downtown will look like.



Carlisle Borough received a \$2,826,000 grant in 2009 through The Pennsylvania Community Transportation Initiative (PCTI).

In January 2011, Carlisle Borough received a \$539,643 PCTI grant, which will be used to continue its traffic calming initiatives. The funds will enable the borough to develop a comprehensive network of on-street bike lanes and off-road trails, linking all components of the Borough's existing trail system. The concept for the network came from the LeTort Regional Authority's 2008 Master Trail/Urban Greenway Plan. In addition to linking

parks, schools, and other points of interest within the borough, the trail network will also provide links to Carlisle's surrounding townships.

Decker advises that achieving community acceptance of the concept is vital to the project's success. "Allowing residents and business owners to participate in the planning process can help them obtain a sense of ownership in the project and will lead to greater acceptance."

Besides building strong public support, Decker recommends municipalities focus their energy on obtaining the necessary funding for construction and implementation of the traffic calming strategies.

Doylestown Borough (Bucks County, Pennsylvania)

Doylestown Borough first began to review the need for traffic-calming strategies during the commercial redevelopment of the borough's train station area, where traffic speeds were determined unsafe for a high-pedestrian area. Concerned members of the community initiated the process and developed a neighborhood committee to share their concerns and findings with the elected officials regarding the renovation project.

This case study describes two projects that relate to Doylestown Borough's traffic-calming program.

Green Street Traffic Study/ Traffic-calming Improvements

This project was brought about by the need to alleviate a documented speeding problem in an area with a high volume of pedestrian traffic. Additionally, a number of cars parked along this street had been damaged due to the high volume of fast moving vehicles. The project incorporated a number of standard traffic-calming elements including lane shifts, traffic tables and curb bump-outs. The curb bump-outs also serve to protect on-street parking spaces, as well as add a street beautification element by incorporating landscape treatments. Highly visible pedestrian crossings, utilizing a combination of textured and painted crosswalks to improve pedestrian safety in the area.

AFTER PHOTOS PROVIDED

West Court Street Traffic-calming and Beautification

The West Court Street traffic-calming project incorporated a number of standard traffic-calming elements to slow traffic in front of Central Bucks West High School:

- Landscaped curb bump-outs provide protected parking spaces and add a beautification element to the area.
- A twenty-six foot wide raised brick walkway was added to aid pedestrian traffic at the school entrance and also serves to slow traffic.
- Brick accents were added at various locations in the existing sidewalk.
- A lane shift was incorporated with curb bump-outs as a traffic-calming method.

- At the intersection of West Court and Memorial Streets a ‘gateway into the Borough’ was constructed which includes a low stone wall, brick and cobblestone pavers, historic street lighting, welcome signage and landscaping.

AFTER PHOTOS PROVIDED

Neighborhood residents in areas where traffic-calming has been implemented seem to be satisfied with the results. Speed data was collected where center islands were installed, revealing the 85th percentile speed was reduced by 4 mph.

Funding for traffic-calming in Doylestown has been provided through various means including the Borough’s general fund, grants and revenues as a result of construction by developers.

According to Karyn Hyland, Project Engineer for Gilmore & Associates, the borough’s engineering consultant, “Community involvement was the key element throughout this project.” In addition, she adds, “traffic-calming efforts work best as a combination of multiple strategies. For example, coupling streetscape elements, curb bump-outs, lane narrowing and gateway treatments is more effective and provide greater benefits than just the installation of one traffic-calming element.

Related Guides

Library

Related Library Categories at ConservationTools.org

Featured Library Items at ConservationTools.org

Title: Pennsylvania’s Traffic-calming Handbook

Author:

Organization/Source: Pennsylvania Department of Transportation/Bureau of Highway Safety & Engineering

Year: 2001

Description: This Handbook contains information on various traffic-calming issues such as legal authority, liability, funding, impacts on emergency services, as well as many others. Chapter 4 includes a “Traffic-calming Study and Approval Process” which is critical for the development of a well organized traffic-calming program.

url:

<http://www.dot.state.pa.us/Internet/pdHwyIntHS.nsf/frmTrafficCalming?OpenFrameset>

Fee: no

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Type: Guide/Handbook

Title: Taming Traffic: Context-Sensitive Solutions in the DVRPC Region

Author:

Organization/Source: Delaware Valley Regional Planning Commission

Year: 2000

Description: This document details the findings and recommendations of a study focused on a problem location that will benefit from the implementation of CSS techniques.

url: <http://www.dvrpc.org/reports/09067.pdf>

Fee: no

Type: Guide/Handbook

Title: Integrating Transportation and Land Use in Comprehensive Plans

Author:

Organization/Source: Pennsylvania Department of Transportation

Year: 2009

Description: This handbook is intended as a resource for Pennsylvania's county and municipal leaders who seek practical guidance in better integrating land use and transportation in their comprehensive plan efforts.

url:

Fee: no

Type: Guide/Handbook

Title: Pennsylvania Neighborhood Traffic-calming Resource

Author:

Organization/Source: Bucknell University

Year: n/a

Description: This site is designed to introduce communities and individuals to traffic calming. Here, you will find the necessary tools and information to make informed decisions about implementing traffic-calming in your area.

url: <http://www.students.bucknell.edu/projects/trafficcalming/index.html>

Fee: no

Type: website

Title: TrafficCalming.org

Author:

Organization/Source: Fehr & Peers Transportation Consultants

Year: n/a

Description: This site serves as a practical guide to traffic-calming and neighborhood traffic management.

url: <http://trafficcalming.org>

Fee: no

Type: website

Title: U.S. Traffic-calming Manual

Author: Reid Ewing, Steven Brown

Organization/Source: APA Planners Press and American Society of Civil Engineers
Year: 2009

Description: A comprehensive how-to manual for traffic-calming in the United States. Planners and engineers can look to this manual for guidance on the appropriate use, design, and signing and marking of traffic-calming measures. For local officials, developers, and community associations, it is an introduction to the goals and tactics of traffic calming.

url: <http://www.planning.org/apastore/Search/Default.aspx?p=3945>

Fee: yes

Type: Book (hardcover)

Title: Traffic Calming: State of the Practice

Author:

Organization/Source: Institute of Transportation Engineers/U.S. Department of Transportation

Year: 1999

Description: The information in this document has been obtained from the research and experiences of transportation engineering and planning professionals.

url: <http://www.ite.org/traffic/tcstate.asp#tcsop>

Fee: no

Type: Guide/Handbook

Title: Lancaster County Smart Growth Toolbox

Author:

Organization/Source: Lancaster County

Year: n/a

Description: The Toolbox includes a wide variety of strategies, ordinances, programs, and best management practices that can be applied by communities to implement the goals and objectives of the County Comprehensive Plan as well as regional and local comprehensive plans.

url: <http://www.co.lancaster.pa.us/toolbox/site/default.asp?toolboxNav=>

Fee: no

Type: website

Title: Evaluation of Lane Reduction “Road Diet” Measures and Their Effects on Crashes and Injuries

Author:

Organization/Source: U.S. DOT

Year: n/a

Description: This study evaluated road diets at several locations in California and Washington.

url: <http://www.fhwa.dot.gov/publications/research/safety/humanfac/04082/index.cfm>

Type: guide

Title: Smart Transportation Guidebook: Planning and Designing Highways and Streets that Support Sustainable and Livable Communities

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Organization: PennDOT/NJDOT

Year: 2008

Description: The goal of the Guidebook is to integrate the planning and design of streets and highways in a manner that fosters development of sustainable and livable communities. The Guidebook has equal applicability to rural, suburban and urban areas.

Fee: No

Type: Guide

Title: Road Diet Handbook: Setting Trends for Livable Streets

Author: Jennifer Rosales

Organization/Source: n/a

Year: 2009

Description: This book takes a practitioner through planning, analysis, design, and implementation of road diet projects. It includes guidelines for identifying and evaluating potential road diet sites, design concepts such as typical cross-sections, and lessons learned from experiences.

Fee: no

url: <http://www.ite.org/emodules/scriptcontent/Orders/ProductDetail.cfm?pc=LP-670>

Type: textbook

Title: Local Government Commission

Author: n/a

Organization/Source: Local Government Commission

Year: n/a

Description: The Local Government Commission (LGC) is a nonprofit, nonpartisan, membership organization that provides inspiration, technical assistance, and networking to local elected officials and other dedicated community leaders who are working to create healthy, walkable, and resource-efficient communities.

Fee: no

url: <http://www.lgc.org/>

Type: website

Title: AmericaWalks.org

Author: Mark Fenton

Organization/Source: America Walks

Year: n/a

Description: The mission of America Walks is to foster the development of community-based pedestrian advocacy groups, to educate the public about the benefits of walking, and, when appropriate, to act as a collective voice for walking advocates.

url: <http://www.americawalks.org>

Fee: no

Type: website

Title: Promoting Safe Walking and Cycling to Improve Public Health: Lessons From The Netherlands and Germany

Author: John Pucher, PhD, and Lewis Dijkstra, PhD

Organization/Source: America Walks

Year: 2003

Organization/Source: American Journal of Public Health

Description: This study examines a wide range of measures available to improve the safety of walking and cycling in American cities, both to reduce fatalities and injuries and to encourage walking and cycling.

url: <http://policy.rutgers.edu/faculty/pucher/AJPHfromJacobsen.pdf>

Fee: no

Type: Journal article

Title: Safety Benefits of Traffic Calming

Author: SR Zein, E. Geddes, S. Hemsing, M. Johnson

Organization/Source: Pedestrian and Bicycle Research

Year: 1997

Organization/Source: American Journal of Public Health

Description: This study was conducted to determine whether there are quantifiable collision-reduction benefits that result from traffic calming.

Type: Journal article

Experts

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Guide Blurb:

Craig Bachik, Kairos Design Group, LLC, has served as Lead Project Designer and Senior Landscape Architect for the master planning of urban revitalization and streetscape enhancement projects.

Bio:

Mr. Bachik is one the two founding principals of KAIROS DESIGN GROUP, LLC and has served as Lead Project Designer and Senior Landscape Architect for the master planning of urban revitalization strategies, streetscape enhancement projects, health care campuses and educational facilities.

Mr. Bachik's work experience includes urban site redevelopment programs, community parks and recreation facilities, single and multi family residential developments and corporate business/industrial parks. Having worked with public and private sector clients on multiple Feasibility Studies, Land Use Plans, Streetscape and Economic Development

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Master Plans Mr. Bachik is the Principal that leads the KAIROS team through the analysis and visioning stages of every project, as well as guiding the research and documentation, schematic design, final design, implementation, and financial feasibility phases. He oversees client coordination and is intimately involved with project development and design, preparation of perspectives, project presentations and direct communication with the client and any outside agencies that would be needed in support of this project.

Mr. Bachik has lectured at a variety of conferences related to urban revitalization and redevelopment strategies including the National Historic Preservation Conference related to lighting design and historic streetscapes.

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Guide Blurb:

Chad Decker is a Senior Traffic Engineer and Project Manager with 14 years of experience and is responsible for the day to day management of the Traffic Engineering Group. He has managed numerous traffic calming projects.

Bio:

Chad Decker is a Senior Traffic Engineer and Project Manager with 14 years of experience with Dewberry. He is responsible for the day to day management of the Traffic Engineering Group in Dewberry's Carlisle, PA office. His duties also include project management, traffic signal design, traffic control plans, signing and pavement marking plans, and traffic studies.

Chad received his Bachelor's and Master's degrees from Penn State University. He is a registered Professional Engineer in Pennsylvania and New Jersey and is also a certified Professional Traffic Operations Engineer (PTOE).

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<https://www.dot7.state.pa.us/LTAP/>

PennDOT LTAP provides technical information and proven technologies dealing with roadway maintenance and safety methods to meet the growing demands on municipal governments.

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Submit Comments and Suggestions

The Pennsylvania Land Trust Association would like to know your thoughts about this guide: Did we miss issues? Do any subjects need clarification or expansion? Other concerns? Please contact Andy Loza at 717-230-8560 or aloza@conserveland.org with your thoughts. Thank you.

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ⁱ Sany R. Zein, Geddes, E., Hemsing, S. & Johnson, M. (1997). Safety Benefits of Traffic Calming. *Transportation Research Record* 1578, 3-10.

ⁱⁱ Pucher, PhD, John & Dijkstra, L, (2003). Promoting Safe Walking and Cycling to Improve Public Health: Lessons Learned from The Netherlands and Germany, *American Journal of Public Health* 93, 1509-16.