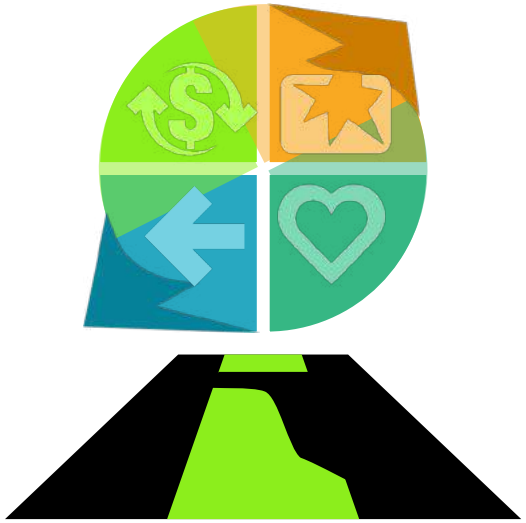

ACCESS MANAGEMENT COMMUNICATION TOOLKIT

NCHRP 1032

How to Measure and Communicate the Value of Access Management

Prepared for:
National Cooperative Highway Research Program
Transportation Research Board

Prepared by:
Center for Urban Transportation Research
Texas A&M Transportation Institute
AECOM
Teach America

Transportation Research Board
NAS-NRC

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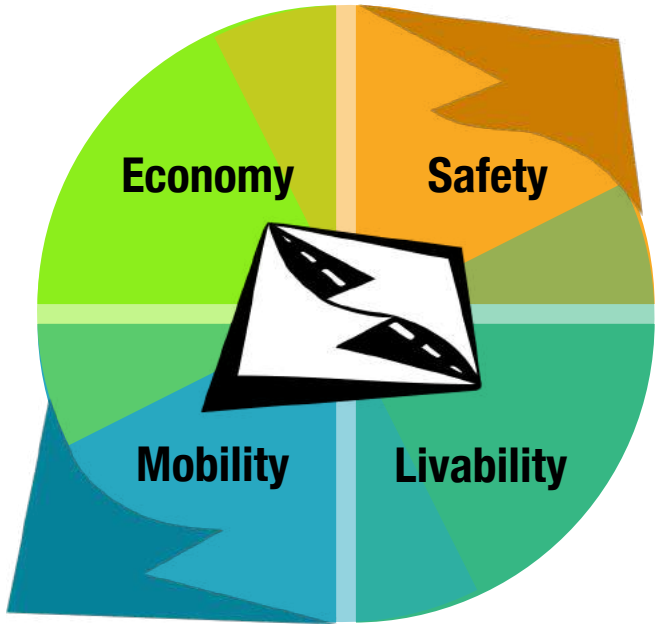
Introduction



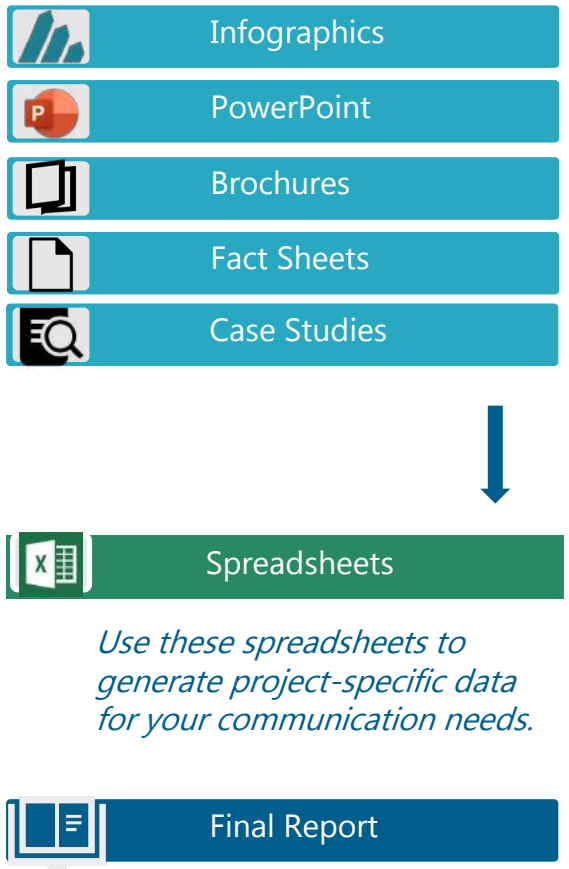
MESSAGING

Today's busy world demands better ways to keep up with the latest research. Research reports often take too long to read between e-mails and meetings. So, we ignore them until our schedules allow a long block of time to consume dense information—if that time ever comes.

This Toolkit helps you quickly get the answers you need to communicate the value of access management to safety, mobility, the economy and livability.

Access management saves lives, improves the economy, moves people and goods more efficiently and increases the livability of our communities. Simply put, it is good planning and engineering.

About the Toolkit



The goal of the toolkit is to synthesize research findings and provide analysis methods that are simple and repeatable by the user. Consideration is given to providing analysis outputs and messages that are compelling, easy to understand, and useful to agency personnel in communicating the rationale for access-related decisions.

The tools are grounded in research, so engineers and planners can rely on their technical strength to address public concerns. The following pages explain how the toolkit is organized.

The benefits of effective access management include, but are not limited to, improved safety, reduced delay, better multimodal quality of service, and livability. These benefits translate into economic benefits to the agency and the public.

About the Toolkit

MESSAGING

The Toolkit offers ideas on communicating the value of access management techniques. Every section focuses on a technique and its value. The Toolkit includes messages and links to communication tools that you can download and customize for your program or project.

The next page explains how to use the toolkit. You will select techniques you want to apply. Then click through the information on their value. Use the images and ideas to create customized communication tools with PowerPoint, video, handouts, and infographics to meet the needs of your project.

The spreadsheets provide simple planning level calculations to estimate the impact of specific techniques.

Communicate the value of these techniques

- Access Management Program
- Median Treatments
- Turn Lanes
- Signalized Access Spacing
- Driveways & Unsignalized Access Spacing
- Network Connectivity

This Toolkit is a visual document that organizes ideas, images, and resources on the value of access management.

HOW TO USE THE TOOLKIT
Safety | Economy | Mobility | Livability

This area above indicates the value being communicated.

Photo by J. Malone

The photo or graphic shown in this area can be used or modified to communicate about your project. Please credit photographer or source where indicated.

The technique is highlighted here with an icon so you know where you are in the Toolkit.

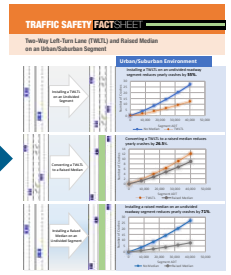
MESSAGING

This area shows messages you can share with stakeholders.

Access management preserves the safety, economy, mobility and livability of our community.

Communication tools can be created or adapted using these resources.

A Fact Sheet is available for every spreadsheet



Simple spreadsheet tools provide help in calculating the safety, mobility, and economic value of selected techniques.

TECHNICAL SUPPORT

This area provides technical support in the form of information, tools, and other resources.

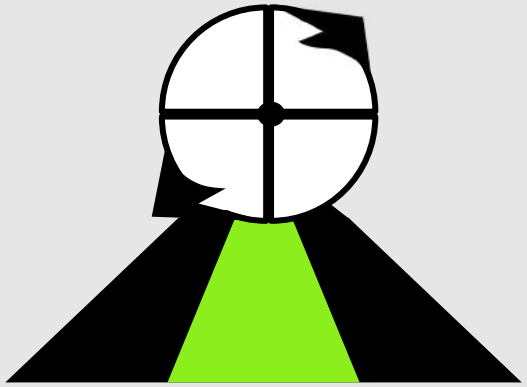
- Infographics
- PowerPoint
- Brochures
- Fact Sheets
- Case Studies

Use the spreadsheets to generate project-specific data for your communication tools

- Spreadsheets

See the final report for more information on how to use the tools.

Access Management Programs



This section of the toolkit address the value of access management programs. It summarizes content that is detailed further in subsequent sections on specific techniques. It also links to tools that are useful for programs and plans.

MESSAGING

Safety

Source: Citrus County Chronicle; B. Thompson

The primary benefit of access management is a reduction in crashes, including fatal and serious injury crashes. Access management has been shown to improve safety for all roadway users.

Economy

Source: J. Malone

Access management helps the transportation system function safely and efficiently as development occurs, which is vital to the economy. It is a low-cost way to maintain the transportation system in an era of limited resources.

Mobility

Source: Utah DOT

Improving mobility improves market area and shortens freight delivery times. It also reduces the need for costly road widening projects that displaces homes and businesses.

Livability

Making a corridor safer for non-motorized users supports priorities like Vision Zero, Safe Routes to School, curb management, and Complete Streets. Fewer driveways and landscaped medians enhance the aesthetics of major corridors.

Access Management is…

…the coordinated planning, regulation, and design of access between roadways and land development."

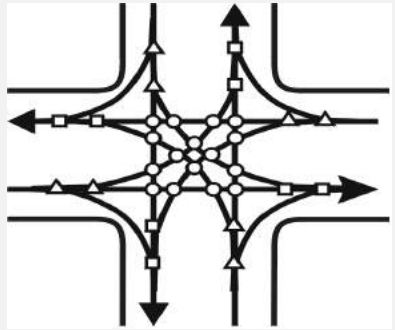
Source: FDOT

Techniques include:

- Locating traffic signals to support signal coordination and efficient traffic progression;
- Median treatments to limit the exposure of through traffic and pedestrians or bicyclists to left-turning vehicles and provide a refuge for midblock crossings;
- Providing right- and left-turn lanes so drivers can wait safely to complete a turn and do not delay through traffic;
- Limiting and separating driveways and median openings to reduce the number of potential conflicts;
- Restricting driveways near signalized intersections to reduce conflicts and crashes;
- Providing a local and collector street network and internal connections between land uses to support local circulation and reduce use of major roads for short local trips.

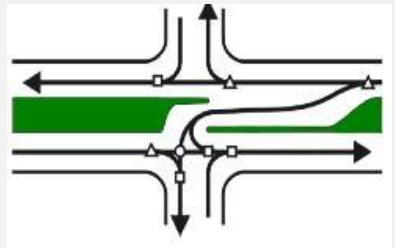
Full movement intersection

- 32 total conflict points
- 48 with bike/ped



Directional median opening

- 8 total conflict points
- 14 with bike/ped



Failure to manage access…

…results in ugly, unsafe and less functional corridors."

This is NOT

Sustainable

Capable of being continued with minimal long-term effect on the environment

MESSAGING

Costs of failure to manage access include, but are not limited to:

- Increase in vehicular crashes and collisions involving pedestrians and cyclists
- Accelerated reduction in roadway efficiency
- Need for continuous road widening or bypasses
- Longer commute times
- Smaller market area for businesses and economic development
- Declining property values
- Increased fuel consumption and emissions

Only one road can be used to access these businesses.

TECHNICAL SUPPORT

Not managing access is costly to the public.

Public dollars are often needed to fix problems caused by poorly managed development access. This may include the need to:

- replace or widen a major roadway and install turn lanes;
- replace or reconstruct a highway interchange;
- reconstruct site access to improve vehicular, pedestrian and bicycle safety.

Poorly managed access can also result in potential liabilities to the permitting agency and the landowner, including the need to mitigate adverse safety and operational effects of poor access location and design.

Comprehensive Programs

Policies → Procedures → Standards

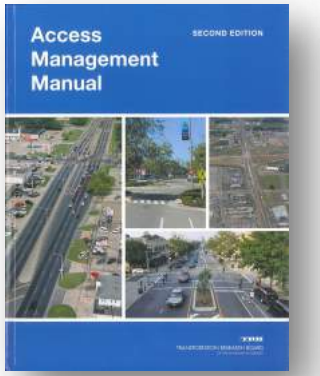
The value of access management is best achieved when it is **systematically applied** to the transportation system through a comprehensive program of policies, procedures, and standards.

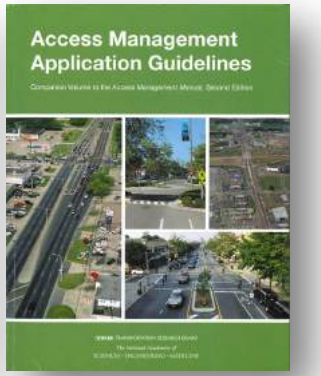
A majority of states and many local agencies practice some form of access management, but often these standards and criteria have not been updated in many years. The resources provided or referenced in this section of the toolkit can help you update your program, using the latest guidance and best practices.

MESSAGING

Contemporary access management programs include:

- An access classification system that builds upon functional classification and land use context
- Permitted levels of access for each access class
- Signalized and unsignalized access spacing
- Means of enforcing policies and standards
- Provisions for variances and waivers





Go to trb.org for the latest guidance on developing or updating your access management program.

TECHNICAL SUPPORT

Example State Highway System Access Classification Framework

Freeway (National)	
Principal Arterial (Statewide)	
R1 (rural principal)	U1 (urban principal)
Secondary Arterial (Regional)	
R2 (rural secondary)	U2 (urban mixed)
	U3 (urban secondary)
Collector (District)	

Download and adapt this brochure

Access Management Brochure 2020.pdf

Corridors and Bypasses

Corridor access management plans and projects address the unique needs of a roadway corridor or interchange area. Resources in this section of the toolkit can help communicate the value of access management on major corridors, Including bypasses and connecting roadways.

Don't forget to "right-size" the bypassed road and transform it into a "complete street."

Source: City of Lakeland and Polk TPO

MESSAGING

Bypasses are a costly solution to congested highways. Access management and land use controls (zoning, subdivision regulations) are needed to preserve this investment.

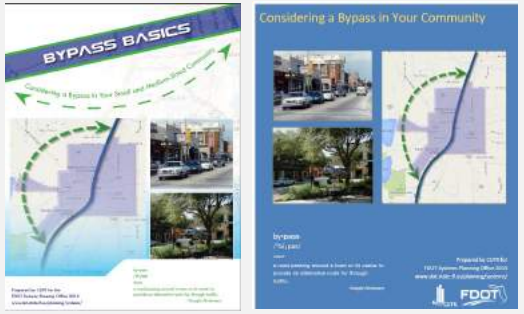
A bypass may resolve congestion and improve travel speed, but there will be indirect impacts:

- Opens up new areas to development
- Redistributes economic activity
- Affects livability, community character, local mobility

Develop local mitigation plans and strategies:

- Right size and redesign the old bypassed roadway
- Access management along connecting roadways and around interchanges
- Land use and network plans in areas between the community and the bypass

TECHNICAL SUPPORT



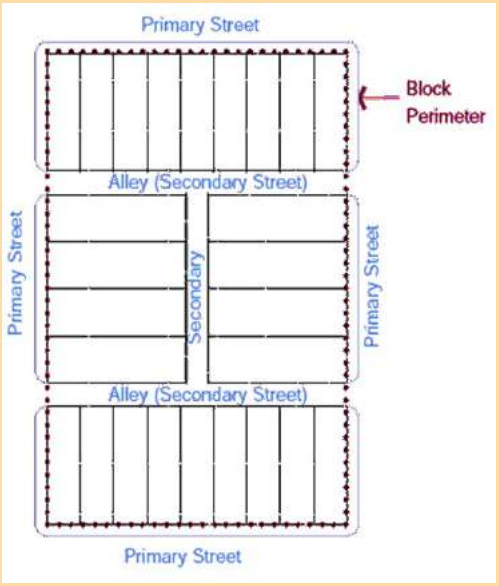
Download a Bypass Basics brochure and presentation:
Bypass Basics brochure
Considering a Bypass white paper
Bypass webinar presentation

Managing the Indirect Impacts of Bypasses on Small and Medium-Sized Communities in Florida

Karen Seggerman and Kristine Williams

Local Plans and Ordinances

Manage access with:



Source: Orange County, FL

- Street network plans and standards
- Form based codes
- Transit oriented development
- Mixed-use activity centers
- Overlay zoning
- Performance standards
- Parking lot cross access
- Complete streets projects
- Mid-block pedestrian crossings
- Driveway spacing standards
- Median policies
- ⋯And much more!

Local governments have broad authority to manage land use and transportation. Working with state and regional transportation agencies, communities can use the resources in the toolkit to achieve economically vibrant places with safe and convenient transportation options.

MESSAGING

Studies show that most communities engage in access management for economic and livability reasons.

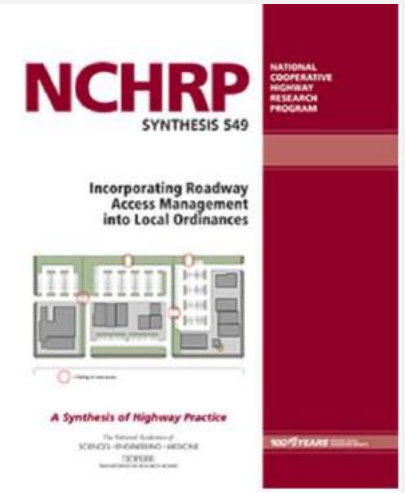
–NCHRP Synthesis 549

These reasons include attracting economic development, improving roadway and bicycle/pedestrian safety, increasing chances of receiving funding from the state or MPO for major roadway improvements, and enhancing community character.

Download and adapt this brochure

"We don't want to be another 'so and so' " is a common response, as more and more communities see the adverse impacts of poorly managed access down the road.

TECHNICAL SUPPORT



NCHRP Synthesis 549

10 Ways To Manage Access.pptx

Resources include model ordinances, PowerPoints, guidance documents, and brochures you can use to update and explain your program.

The Case for Access Management

Communicating the benefits is not easy. This toolkit can help you tell the story.

What we do improves **economic** sustainability.

- The Story on Business Impacts
- Preserves Market Area
- Protects Public Investment

What we do improves **safety**.

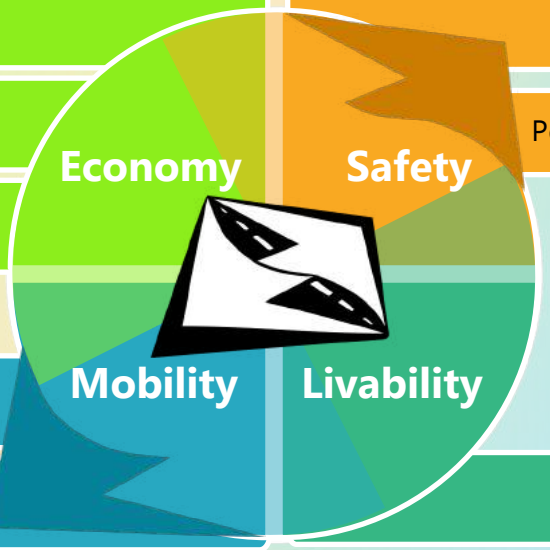
- Fewer crashes.
- Pedestrians
- Bicycles
- Motor vehicles

What we do improves **mobility**.

- Reduces Delay
- Moves Freight
- Increases Reliability

What we do improves **livability**.

- Improves Accessibility
- Encourages Placemaking

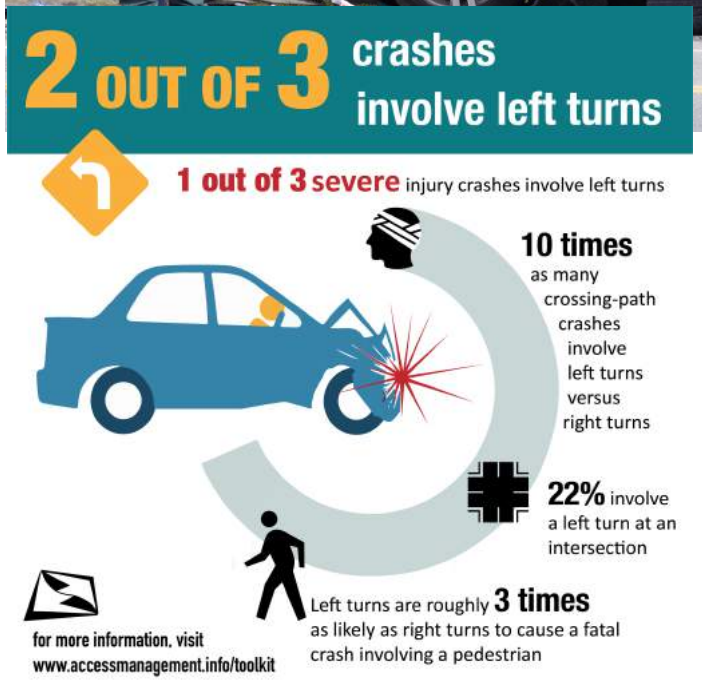


These are crosscutting issues. Fewer and less severe crashes improve the economy, decrease delay and make communities more livable. Network connectivity makes businesses more accessible, sustainable, and supports placemaking. Medians expand market area, improve aesthetics, and support pedestrian mobility.

Our Tools

Safety

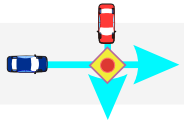
Source: Citrus County Chronicle; B. Thompson



What we do improves safety.

- Each driveway introduces conflict points for drivers, pedestrians, and cyclists.
- Access spacing limits and separates conflict points. The more driveways along a corridor, the higher the likelihood of crashes.
- Medians improve safety by limiting left-turns to well-planned, designated locations.
- Turn lanes remove turning traffic from through lanes, reducing rear-end collisions.

A majority of driveway-related crashes involve left-turns.

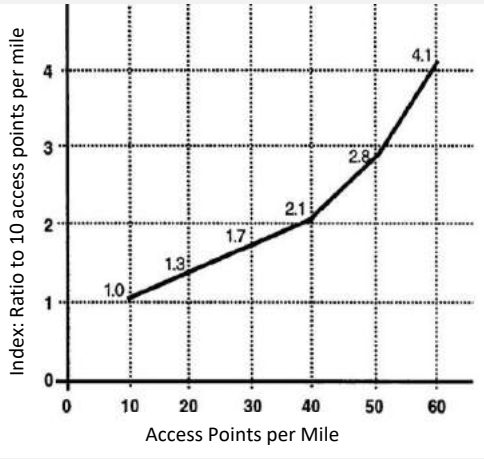


Crossing/Angle

T-bone Video

Source: Insurance Institute for Highway Safety, Arlington, Virginia USA. www.iihs.org

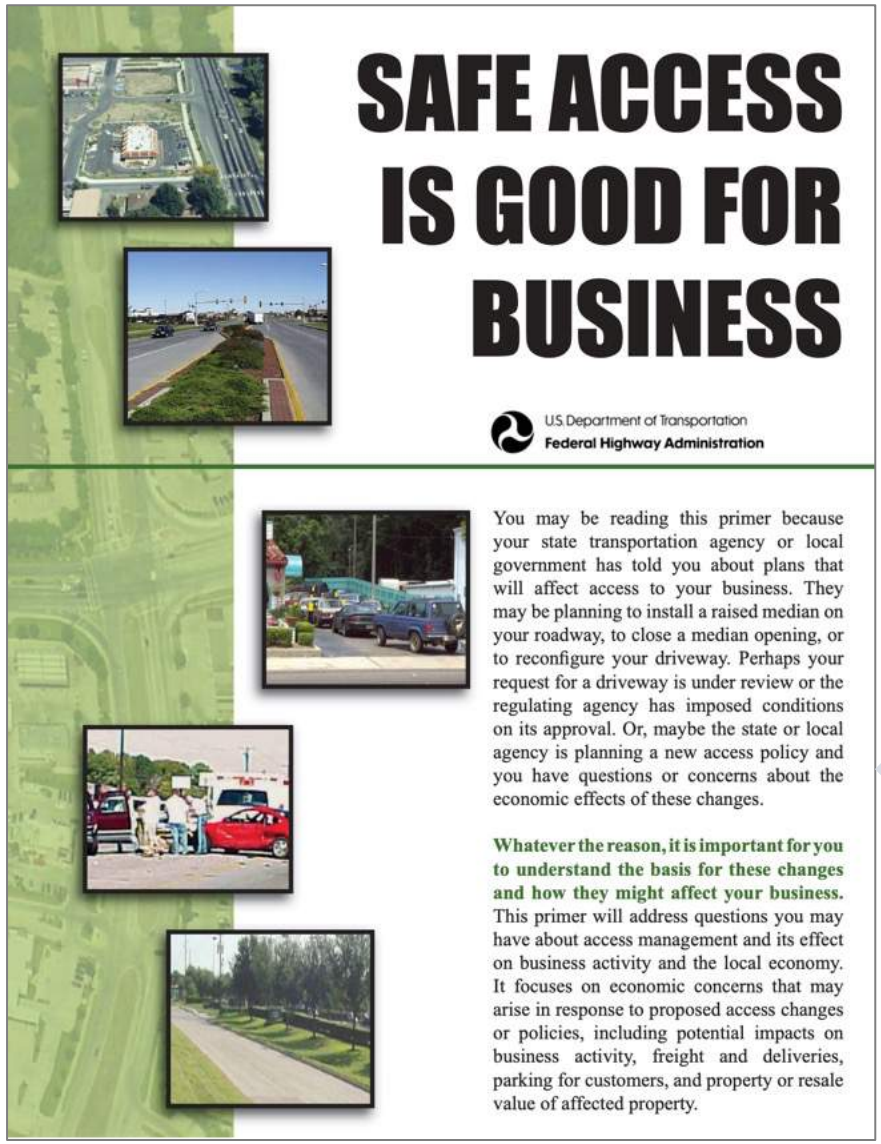
The type and spacing of driveways and other intersections can significantly impact the number and severity of crashes. Research shows a clear correlation between crashes and access density.



Source: NCHRP Report 420
(Indices estimated from various sources, see p. 42 for more details.)

See page 65 for links to safety tools

Economy



MESSAGING

What we do improves the economy.

Preserving Market Area

- Access management helps preserve the market area of retail businesses by preserving the efficient flow of traffic. Even only a 10% increase in travel time can decrease market area by about 19%.

Moving Freight

- Inefficient transportation in supply chain links results in increasing transportation costs, which affects product pricing, production cycles, competitive position in the marketplace, and can make a state or region a less economically efficient location for new business ventures.

Protecting Public Investment

- Managing access and providing a road network for local circulation helps transportation corridors operate safely and efficiently over a longer period, preventing or delaying the cost and major disruption of adding lanes.

Safe access is good for business.

The Story on Business Impacts

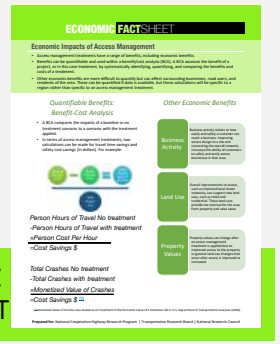
- Good access management improves the economic environment for a corridor and despite concerns, medians have not been shown to hurt businesses. Most business impacts happen during roadway reconstruction and can be mitigated by proactively maintaining vehicular, bicycle and pedestrian access during construction.

TECHNICAL SUPPORT

Freight and Market Area Impacts

Delay can increase shipping and distribution costs proportionally; that is, a 10% increase in travel time along a corridor can increase shipping costs by up to 10% for that segment.

Reduction in Avg System Speed	Market Area Relative to Previous Size
0%	100%
10%	81%
20%	65%
30%	45%
40%	36%
50%	25%



ECONOMIC **FACT**SHEEET

Economic Fact Sheet.pdf

Mobility


Source: Utah DOT

Managing and retrofitting access reduces crashes and delay, making travel times more reliable. This short video demonstrates the how medians can preserve market area.

MESSAGING

What we do improves mobility.

Reduced Delay

- Right- and left-turn lanes increase intersection capacity and decrease delay. When drivers must turn left from a through lane, for example, those following in the lane can experience lengthy delays as they wait.
- By managing the spacing and location of traffic signals, we can move traffic more efficiently at appropriate speeds and with less delay.

Signals have a profound adverse impact on travel time throughout the network.

- Each individual driveway creates measurable delay.
- Managing and retrofitting driveway access reserves curb space for transit, pedestrians, and bicyclists.
- Decreasing the density of driveways improves conditions for pedestrians and bicyclists.

Improved Accessibility

- Connected street networks, pedestrian connections into developed sites, and midblock crossings support mobility for pedestrians, cyclists, and persons with disabilities. Local traffic can better circulate without using major roads.
- Moving driveways away from signalized intersections improves the ease of access to and from corner businesses by reducing the chances that the driveway will be blocked and improving on-site circulation.

TECHNICAL SUPPORT

Spreadsheet

AM_Mobility_Tools Final Modules.xlsx

Major roadways in urban areas require a coordinated signal system to maintain the efficient movement of traffic. Poorly located signals lead to delay that cannot be reduced by signal coordination. This type of delay is often caused by the installation of traffic signals for new developments at locations where progression may not be maintained.

Access points introduce conflicts and friction into the traffic stream as vehicles enter and leave the through traffic lanes. The typical reduction in free-flow speed (for one direction) is approximately 0.25 mph per access point and 0.005 mph per right-turning movement per hour per mile of road.

Measure the economic value of mobility

ECONOMIC **FACT**SHEEET

Economic Fact Sheet.pdf

Livability

Photo by J. Malone

Managing and retrofitting access is a key part of revitalizing commercial corridors.

These photos show how Bridgeport Way, in University Place, Washington was transformed into a safer, more livable main street for the community.
http://pedbikesafe.org/PEDSAFE/casestudies_detail.cfm?CM_NUM=22&CS_NUM=17

MESSAGING

What we do improves livability.

- Reducing delay and congestion reduces emissions and fuel consumption.
- Making a corridor safer for non-motorized users benefits the environment, and supports social priorities like Safe Routes to School, Vision Zero, and Complete Streets.
- A 4-lane road with good access management may delay or even prevent the need for a 6-lane road that decreases the livability of a community.

Here?

Where would you want to live or do business?

Or here?


Photo by J. Malone

TECHNICAL SUPPORT

Access management aligns with the objectives for a sustainable transportation system:

- Allows the basic access needs of individuals, companies and societies to be met safely and in a manner consistent with human and ecosystem health, and promotes equity within and between generations;
- Is affordable, operates fairly and efficiently, offers choice of transport mode, and supports a competitive economy, as well as balanced regional development; and
- Limits emissions and waste within the planet's ability to absorb them, uses renewable resources at or below their rates of generation, and uses non-renewable resources at or below the rates of development of renewable substitutes, while minimizing the impact on the use of land and the generation of noise.

European Ministers Council of Transport

Program Success Factors

Legislation and Policy	Strong authority, derived from legislation and/or regulations, is the foundation for a successful access management program.
Access Classification System (ACS)	An ACS provides a framework for implementing access management on a systemwide basis.
Institutional Commitment	Access management is most successful when an agency has the institutional commitment to implement the program and integrate it into their daily business functions.
Staffing	Implementation works best when transportation agencies can dedicate staff to access management.
Access Champion	Programs are often not successful without a champion to advance the access management agenda.
Legal Case History	State DOTs with a strong case history of winning court cases are more empowered in making future access-related decisions.
Case Studies	Case studies that illustrate the benefits of access management are instrumental in convincing decision makers of its merits.
Education and Training	Ongoing access management training for agency staff is crucial.
Outreach Activities	Elected officials, the development community, and the general public need to be educated about the rationale and benefits of access management to understand its public value.
Stakeholder Cooperation	A defining characteristic of a successful access management plan or process is the level of cooperation and coordination achieved among affected property owners and the agencies involved.
Access Review Committee	Having a review committee and written variance review process provides flexibility, while helping maintain consistency of policy during implementation.
Monitoring and Evaluating	Any access management program will benefit greatly from continuous monitoring and evaluation to identify issues and resolve problems.

MESSAGING

TECHNICAL SUPPORT

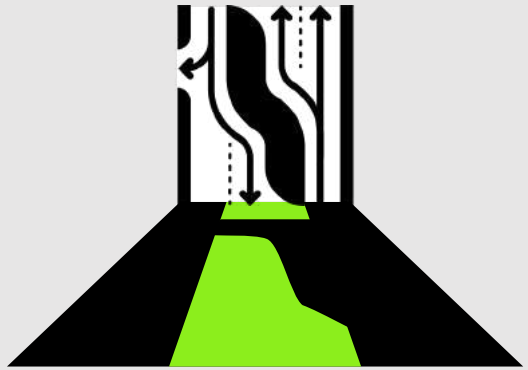
"Because it does not meet our standards" is **NOT** a sufficient explanation for denying an access request.

- If you cannot find agreement, be sure that your decision is based on solid traffic engineering, as well as safety principles.
- Allow more flexibility on roadways that are less critical and more strongly enforce standards on the higher priority network.

References:

Gluck, J. (2010). NCHRP Synthesis 404: State of the Practice in Highway Access Management, Washington, D.C.: Transportation Research Board of the National Academies.

Medians and Median Openings



MESSAGING

Safety	Economy	Mobility	Livability
 Source: J. Malone	 Source: Map Data © 2019 Google	 Source: Map Data © 2019 Google	 Source: F. Broen
Medians improve safety by limiting left-turns and crossings to well-planned locations and providing a refuge for pedestrians to cross a major roadway.	Median treatments may increase the value of property by enhancing the appearance of a transportation corridor and increasing the flow of traffic into the area. Any treatment that improves traffic flow can benefit the economy in a variety of ways.	Installing a median often reduces through-traffic delay by reducing crashes and the amount of deceleration related to turns and crossing maneuvers.	Medians provide space for landscaping, art, and other aesthetic treatments that improve the character of a roadway corridor or gateway to a community.

Safety

Source: St George News, Utah

Medians improve safety by reducing left-turn crashes and conflicts.

Converting a TWLTL to a raised median reduces yearly pedestrian crashes by **46%**

Converting a TWLTL to a raised median reduces yearly crashes by **27%**

Median Type and Driveway Density

Reducing Left-Turn Conflicts

- Medians reduce left-turn conflicts between motor vehicles and with other roadway users. More than two-thirds of all access-related collisions involve left-turning vehicles. Left turns represent the highest injury and fatality crashes on at-grade arterials.

Increasing Pedestrian and Bicycle Safety

- Medians increase pedestrian and bicycle safety by reducing left-turn conflicts and by incorporating safe crossing refuges into the median design.

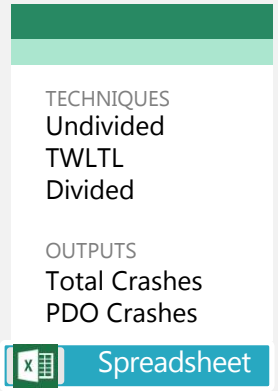
Spreadsheet

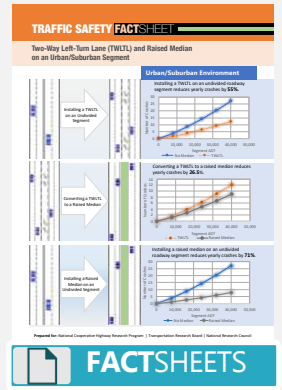
MedianTypeDwyDensity.xlsx

Calculates reduction in crashes by installing a raised median on an undivided roadway or roadway with a two-way left-turn lane (TWLTL).

Impact of Median Installation:	
Total Crashes (All Severities)	2.76
PDO Crashes	7.22
Base Condition: Absence of raised median.	

Use spreadsheet to calculate your own values

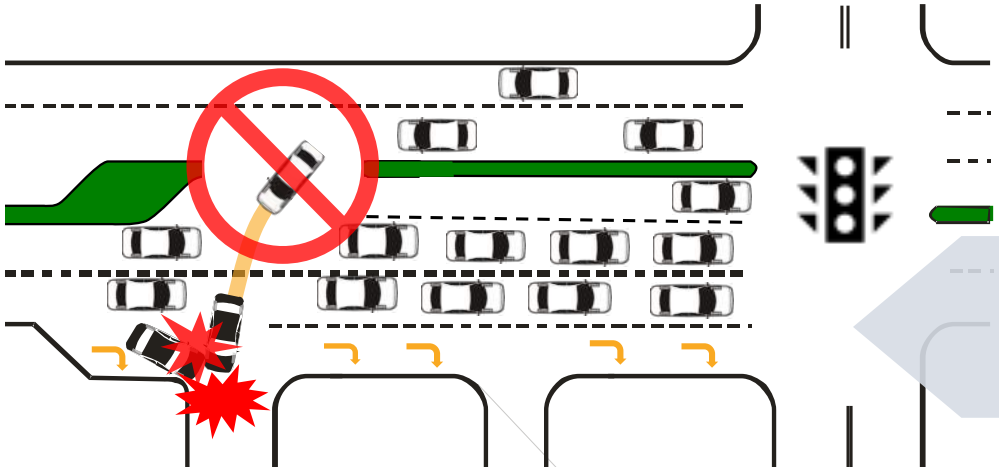




Median and TWLTL Fact Sheet.pdf

Median Openings

When median openings are too closely spaced, they cause a variety of safety and operational problems.



Median openings across turn lanes and near signals are a crash waiting to happen.

MESSAGING

- Directional median openings offer opportunities for left-in, left-out, and/or U-turn movements, while reducing mid-block and severe crashes often associated with full openings that allow all movements.
- Too many driveways near a median opening with heavy turning volumes increase the frequency of vehicle conflicts and the potential for crashes.

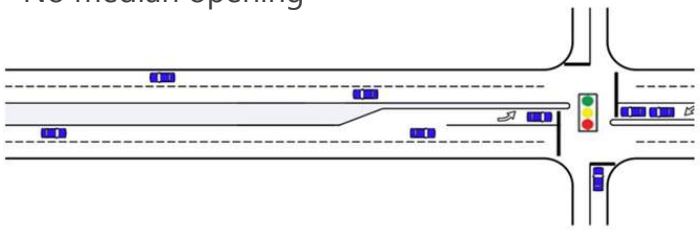
-NCHRP 929

TECHNICAL SUPPORT

Dixon, K., et al. (2020). *Unsignalized Full Median Openings in Close Proximity to Signalized Intersections*. NCHRP Report 929. Transportation Research Board of the National Academies.

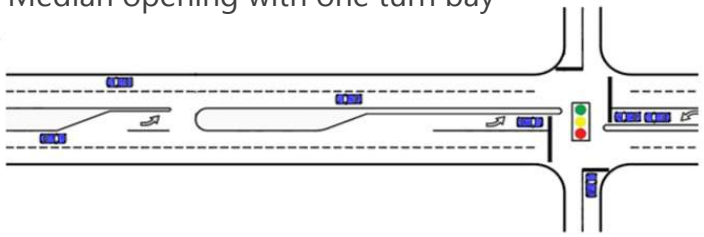
Safety of Median Openings

No median opening



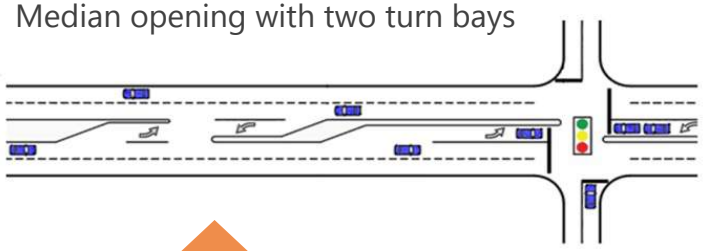
3 crashes

Median opening with one turn bay



5 crashes

Median opening with two turn bays



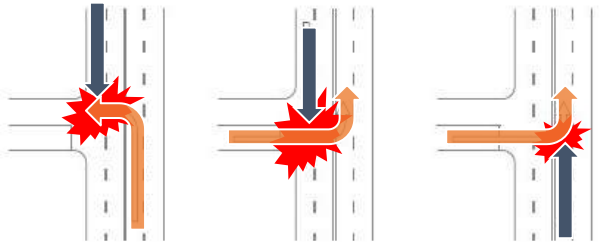
7 crashes

223% increase

Crashes with 2 turn bays versus no median opening

Median Openings Near Signalized Intersections

- Full movement median openings that allow left-turns in and out of driveways can be dangerous.
- Left-turns out are the most dangerous maneuver resulting in the most serious injuries
- Left-turns in are the second most dangerous



28% Left-turns in

44% Left-turns out

About 72% of all driveway crashes involve left turns.
Source: FHWA, Access Management in the Vicinity of Intersections, FHWA-SA-10-002.

Managing median openings near signals reduces crashes.

Spreadsheet

Median Opening Near Signalized Intersection.xlsx

Calculate number of crashes for median openings near signalized intersections for:

- No median opening
- Median opening with one turn bay
- Median opening with two turn bays

Outputs:

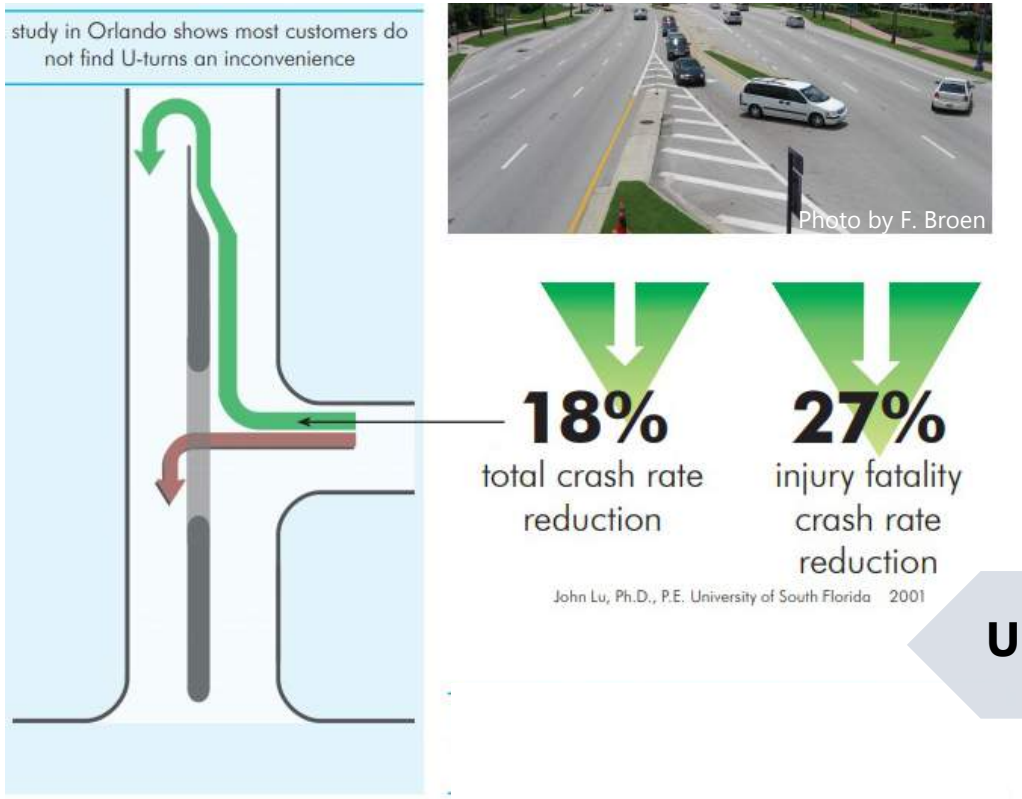
Total Number of Crashes	3.23

MedianOpening NearSignalized Intersection.xlsx

Spreadsheet | Fact Sheets

Median Opening Signal Int Fact Sheet.pdf

Safety of U-turns



Right turns followed by U-turns are often much safer than direct left-turns from a driveway, especially on high-volume, high-speed, or congested roadways.

MESSAGING

Medians support safe U-turns

- Studies show that on busy multilane arterial roadways, U-turns are a safer alternative to direct left-turns.
- Injury crashes were reduced by 27% with right-turns followed by U-turns, instead of direct left-turns out of driveways.

U-Turns are safer than direct left turns.

- Many new intersection types provide safe U-turn opportunities.
  - Roundabout
  - Bowtie
  - Michigan U-turn
  - Jughandle
  - Restricted Crossing U-Turn (RCUT)

TECHNICAL SUPPORT

A Florida study of 250 sites where drivers could either make a direct left-turn (DLT) out of a driveway or a right-turn followed by a U-turn (RTUT) at the next intersection or opening found that on six-lane arterials, RTUTs had an 18% lower crash rate and 27% lower injury and fatality rate than DLTs and U-turning drivers experienced less delay than those making direct left-turns from a driveway under high volume conditions. The findings were statistically significant at a 95% confidence level.

References:

Lu, J., S. Dissanayake, N. Castillo, and K. Williams. (2001). *Methodology to Quantify the Effects of Access Management on Roadway Operations and Safety.* (3 volumes). Florida Department of Transportation.

Economy

Source: City of Charlotte, NC – Charlotte WALKS Pedestrian Plan

Economic Value of Safety

- **Median projects reduce the number of crashes** and improve overall safety, reducing this cost to society.
- **Crashes represent a cost to society** in dollars from injuries, fatalities, and property damage.

What is the value of a life? Is it less than a direct left-turn into a business?

- Median treatments may increase the value of property by enhancing the appearance of a transportation corridor and by improving the efficiency of traffic flow through the area.
- Business activity may also increase, due to improvements in accessibility and traffic flow.

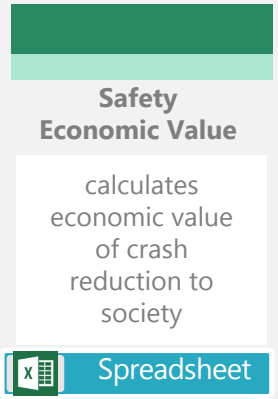
Spreadsheets

Safety and Mobility Economic Value.xlsx
MedianTypeDwyDensity.xlsx

The Safety and Mobility Economic Value spreadsheet tool calculates the cost savings of crash reductions calculated using other spreadsheet tools.

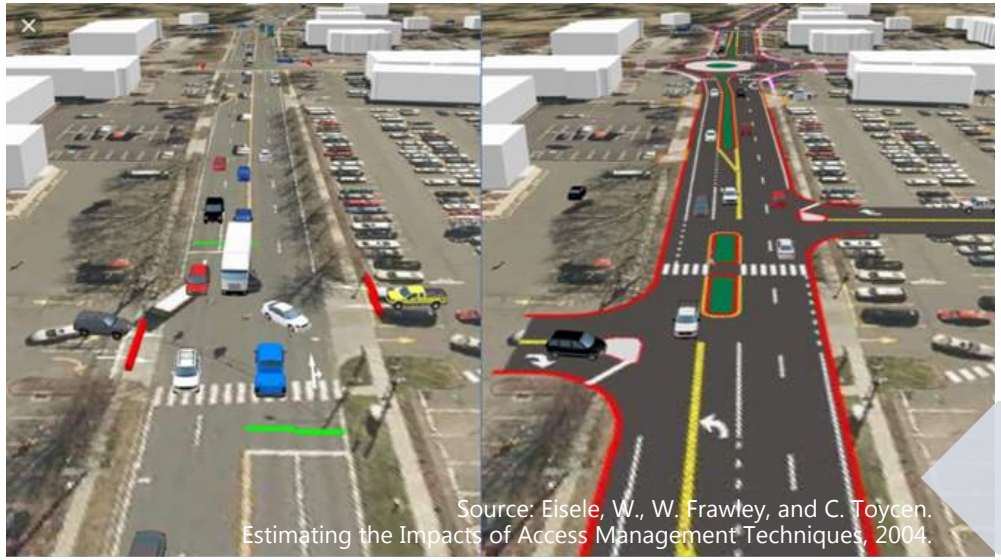
Costs to society:

- Medical
- Lost work time
- Impact to family
- Property damage
- Decreased mobility



Economic Fact Sheet.pdf

Mobility



Source: Eisele, W., W. Frawley, and C. Toycen. Estimating the Impacts of Access Management Techniques, 2004.

Source: Stratford Complete Streets Plan; Stratford, NC

MESSAGING

- Installing a **raised median** on an undivided roadway may reduce delay to through traffic.
- A raised median and TWLTL yield similar delays to arterial drivers (although the raised-curb median yields slightly higher delays than the TWLTL at the highest left-turn and through volume levels).
- Simulation modeling is the most effective and most expensive method to demonstrate the proposed operational impact of adding a median.

By reducing crashes, travel time reliability is improved.

Medians simplify mid-block crossings for pedestrians, cyclists, and other users.

- It's not just about autos, it is also about pedestrians and cyclists.
- A raised median can improve the ability of pedestrians and cyclists to cross multilane roadways by supporting the design of a refuge in the middle of the roadway at key pedestrian crossings.

TECHNICAL SUPPORT

When a raised median is installed on an undivided roadway and left-turn lanes are provided at median openings, through traffic will experience less delay, because vehicles stopped to make a left-turn will no longer block through vehicles.

The installation of a raised median may have a similar effect on buses as for motor vehicles.

A median can be designed with a bus-only turn lane to mitigate a potential negative impact to bus turning movements.

There are methods in Highway Capacity Manual (HCM6) for measuring the value of medians to mobility, include estimating:

- The change in motor vehicle free-flow speed resulting from converting an undivided roadway or TWLTL to a raised median.
- The change in average bus speeds and bus LOS resulting from improvements in midblock running speed due to the installation of a non-traversable median.

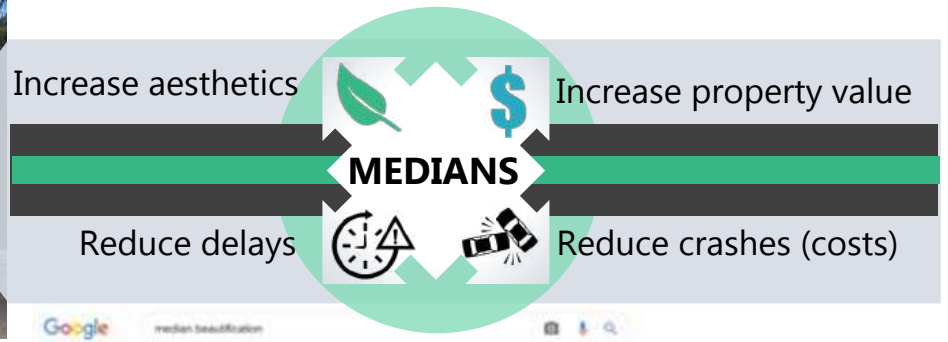
Livability

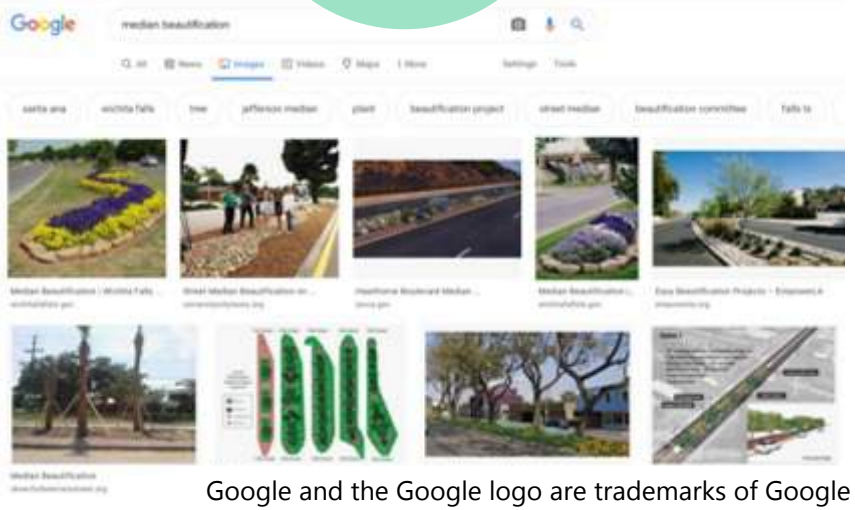
The appearance and safety of an area is important to customers and investors, as it affects property values.

SEARCH: "median beautification" for more ideas

MESSAGING

- **Medians provide space** for landscaping, art, and other aesthetic treatments that improve the character of a major roadway corridor.
- Medians can also create an attractive gateway into a community or business district, especially when combined with a roundabout for sign placement.





TECHNICAL SUPPORT

FACTSHEETS

Livability Fact Sheet.pdf

Livability

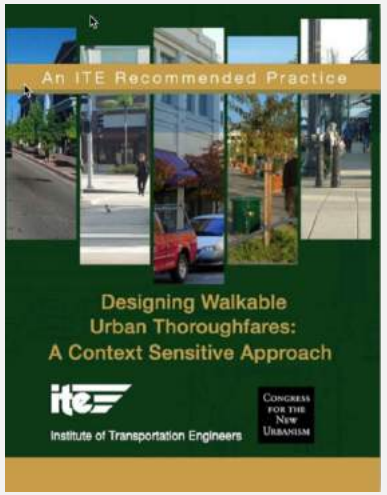
StreetPlan.net is a free web-based tool for creating Complete Streets in just minutes. StreetPlan analyzes your design as you make it, giving you **Red / Yellow / Green** Best Practice guidance from ***"Designing Walkable Thoroughfares."***

Another popular cross-section tool is Streetmix.net Streetmix

Communicate livability benefits of medians using cross-section tools.

Free tools are available online that allow anyone to quickly generate ideas for redesigning a street. These tools can be used to explore alternatives, like medians versus continuous two-way left-turn lanes and communicate the relative impacts on livability. They can also help stakeholders more readily understand the access needs of different modes of transportation and and the trade-offs involved when right-of way is limited.

Cross section tools can show how medians add to complete streets and placemaking.

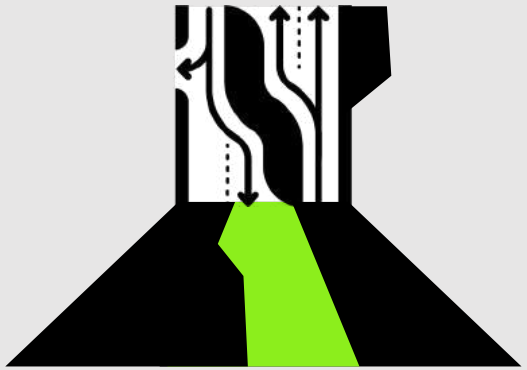


Guidance Based on ITE/CNU Best Practices

Introduction to StreetPlan.net

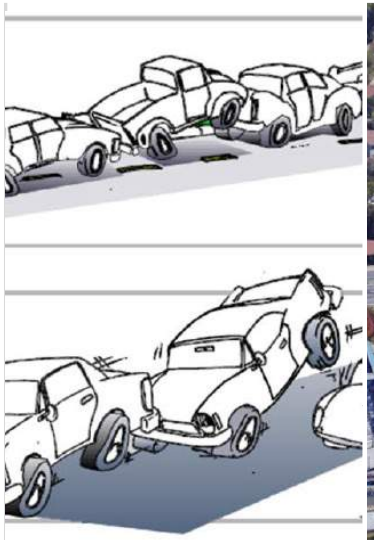
5 min tutorial

Turn Lanes



MESSAGING

Safety



Excessive Deceleration

Source: Florida DOT

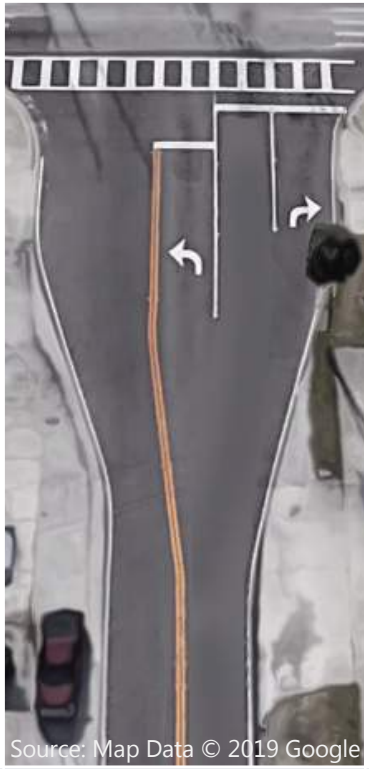
Excessive deceleration in the through lane by left-turning vehicles can increase crashes and the speed differential with through vehicles.

Economy

Source: Map Data © 2019 Google

Auxiliary lanes provide potential economic benefits by easing the flow of traffic resulting in travel time savings, improving safety, and reducing the likelihood of crashes, which results in safety cost savings.

Mobility



Source: Map Data © 2019 Google

A left- or right-turn lane increases intersection capacity and decreases delay.

Livability

Turn lanes reduce the need for drivers to decelerate in response to turning vehicles and then accelerate to continue forward. This reduces fuel consumption and emissions.

Safety

Left-turn Lanes

Photo by P. Demosthenes

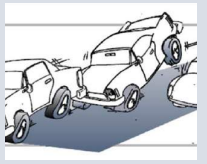
In dense urban areas where turn lanes are not possible, **hardened-centerline treatments** can reduce conflicts between left-turning vehicles and pedestrians by **70%,** and slow down left-turning traffic at intersections.

Hardened-Centerline Treatment

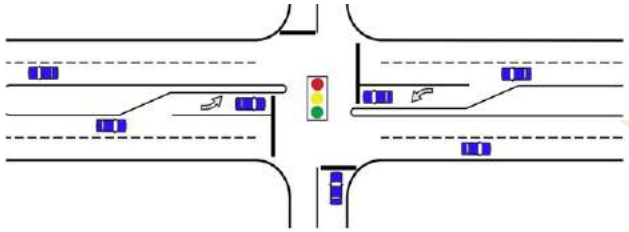
Source: Insurance Institute for Highway Safety, Arlington, Virginia USA. www.iihs.org

Left-Turn Lanes

Turn lanes reduce the risk of serious rear-end collisions.

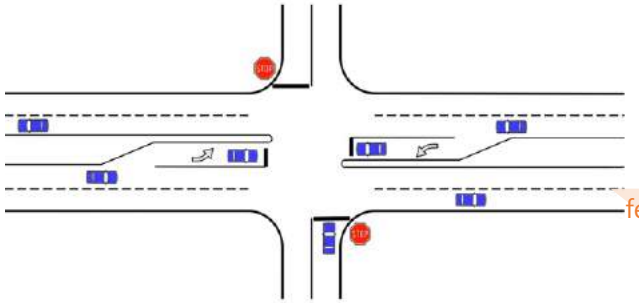


Signal Controlled Intersection



19% fewer crashes

Stop Controlled Intersection



47% fewer crashes

Examples represent urban/suburban 4-leg, AADT Major=40,000 vpd and AADT Minor= 1000 vpd, left-turn bay on two approaches

Spreadsheets

LT_3LegIntersections.xlsx
LT_4LegIntersections.xlsx

Spreadsheets estimate predicted crashes of adding a left-turn lane for different roadway and intersection types and traffic volumes.

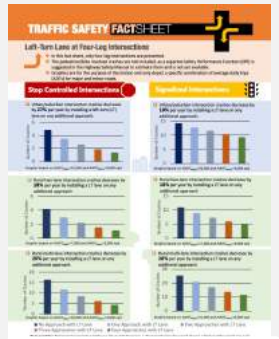
Outputs:	
Total Number of Crashes	2.27
Safety Effect of LT Lane Installation:	
Total Crashes (All Severities)**	2.05

- Urban/Suburban- Signalized- 4-Leg
- Urban/Suburban- Stop Controlled- 4-Leg
- Rural Two Lane-Signalized- 4-Leg
- Rural Two Lane-Stop Controlled-4-Leg
- Rural MultiLane-Signalized- 4-Leg
- Rural MultiLane-Stop Controlled-4-Leg

TECHNIQUES
Urban
Rural
4-Leg
Signalized
Stop Controlled

OUTPUTS
Total Crashes

Spreadsheet



FACTSHEETS

Four-Leg | Three-Leg

Safety

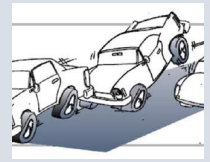
Turn lanes reduce the potential for high-speed rear-end collisions by **removing stopped or slower turning vehicles from the through lanes**.

The difference in speed between vehicles on the roadway network or "**speed differential" is a key predictor of crash potential.**

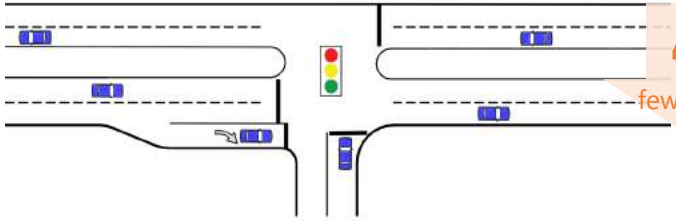
This risk of crashes increases exponentially as the travel speed on a roadway increases. A speed differential of 20 mph increases the likelihood of a crash by 3.3 times compared to a speed differential of 10 mph. A speed differential of 35 mph makes the likelihood of a crash 90 times greater.

Right-Turn Lanes

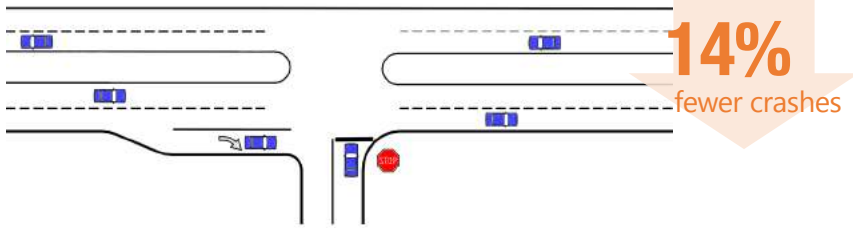
Turn lanes reduce the potential for rear-end crashes between turning and through vehicles.



Urban **Signal Controlled Intersection**



Rural Multi-Lane **Stop Controlled Intersection**



Examples represent AADT Major= 40,000 vpd and AADT Minor = 1000 vpd

Spreadsheets

RT-3LegIntersections.xlsx
RT-4LegIntersections.xlsx

Spreadsheets estimate predicted crashes of adding a right-turn lane for different roadway and intersection types and traffic volumes.

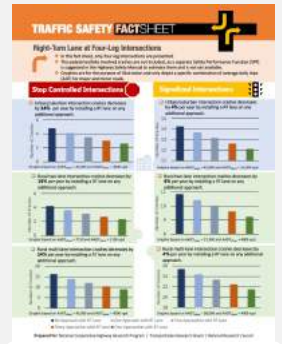
Outputs:	
Total Number of Crashes	6.44
Safety Effect of RT Lane Installation:	
Total Crashes (All Severities)	5.54

Urban/Suburban- Signalized- 3-Leg
Urban/Suburban- Stop Controlled- 3-Leg
Rural Two Lane-Stop Controlled- 3-Leg
Rural MultiLane-Stop Controlled- 3-Leg

TECHNIQUES
Urban
Rural
3-Leg or 4-Leg
Signalized
Stop Controlled

OUTPUTS
Total Crashes

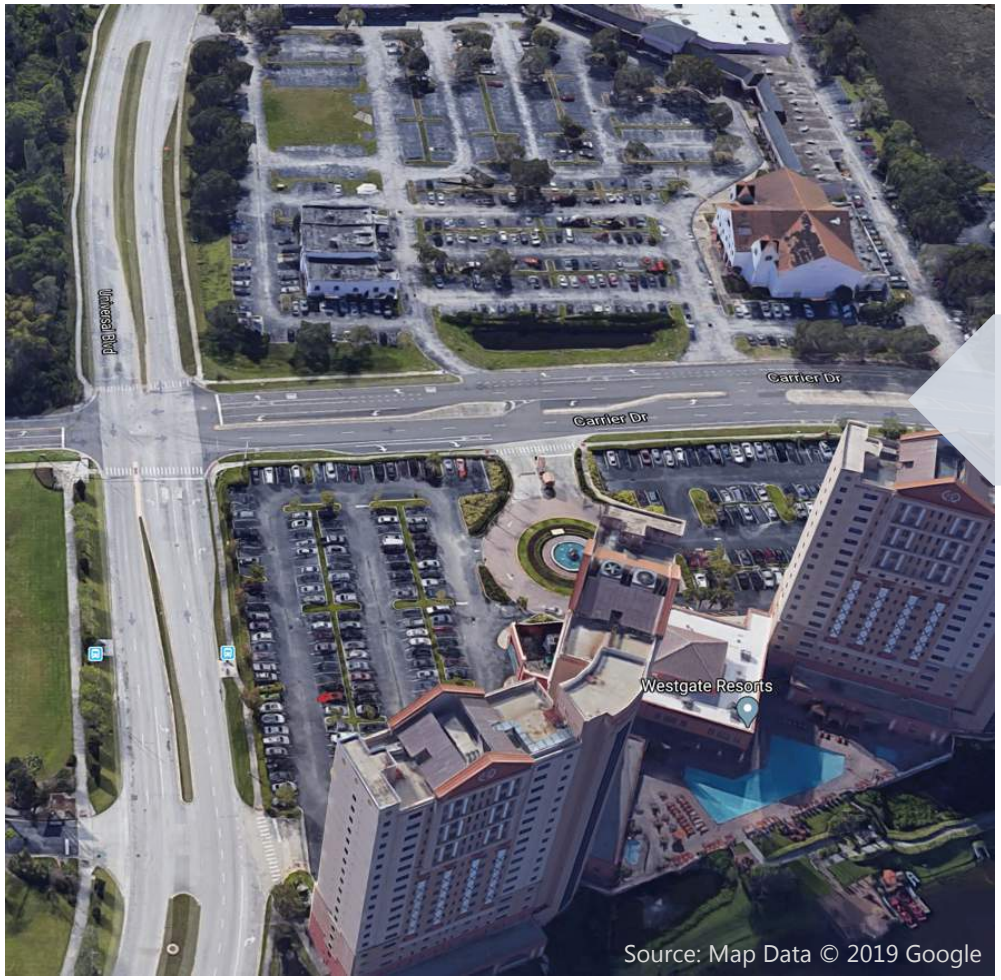
Spreadsheet



FACTSHEETS

4-Leg RT | 3-Leg RT

Economy



MESSAGING

- Turn lanes benefit the economy by easing the flow of traffic into a site, reducing through traffic delay, and reducing the likelihood of crashes. These benefits can be represented in dollars as cost savings.

Turn lanes provide customers with safe and convenient access.

- **Use this spreadsheet tool** to evaluate the cost savings associated with fewer crashes when installing turn lanes.

TECHNICAL SUPPORT

Spreadsheet

Safety and Mobility Economic Value.xlsx

Transportation impact studies evaluate the need for turn lanes and require they be installed where indicated as part of the development plan. Many state and local agencies require applicants to install the turn lanes needed for safe access into a site as part of the development project. The latest warrants for auxiliary lanes recommended for agency use are based on benefit-cost analysis and can be found in the TRB Access Management Manual (Williams, et al., 2014).

Left-turning traffic is challenging to manage where demand is high. Alternative intersection designs (e.g., roundabout, Michigan U-Turn, RCUT, etc.) can address this issue by rerouting left-turns or accommodating them at locations where turning conflicts would be reduced.

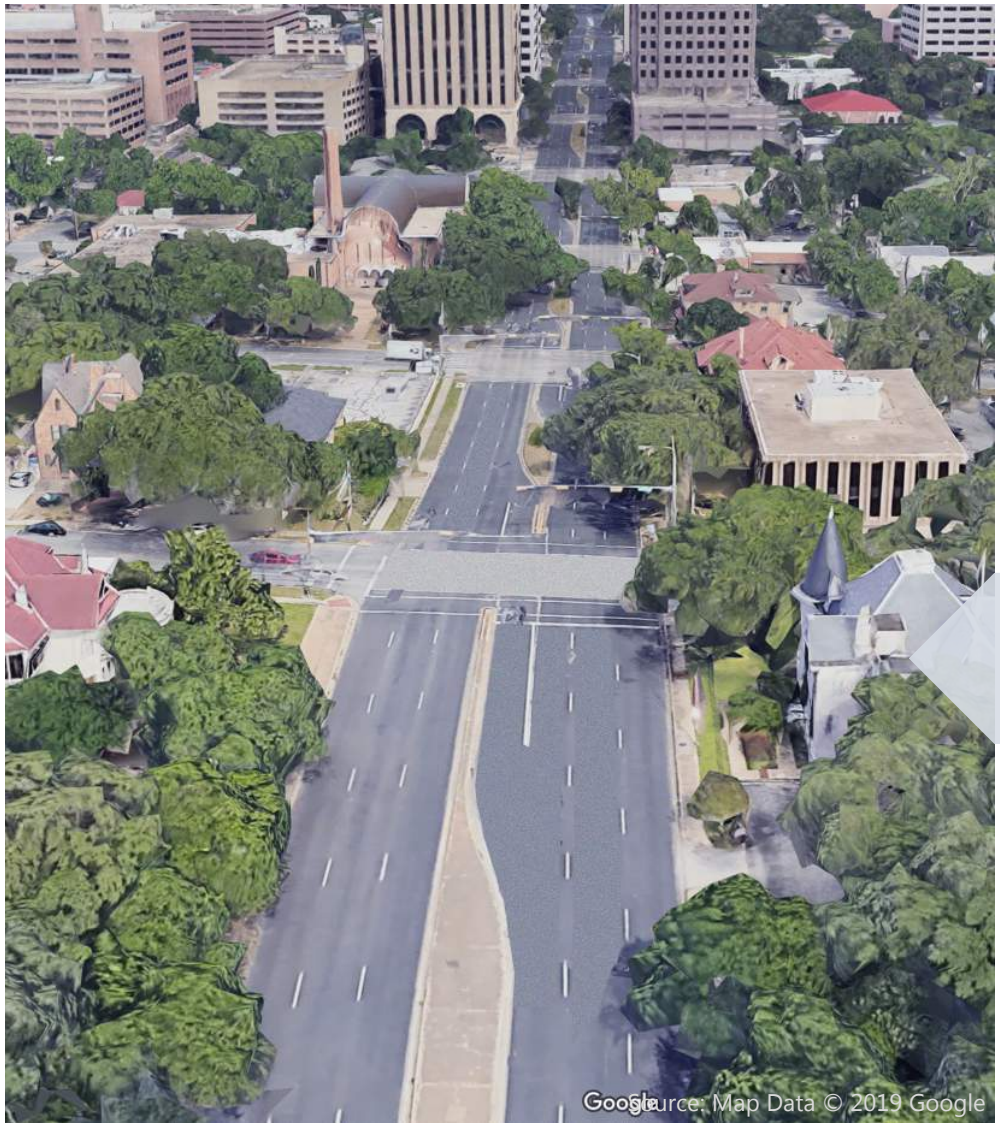
Safety and Mobility Economic Value.xlsx

Spreadsheet

Fact Sheets

Economic Fact Sheet.pdf

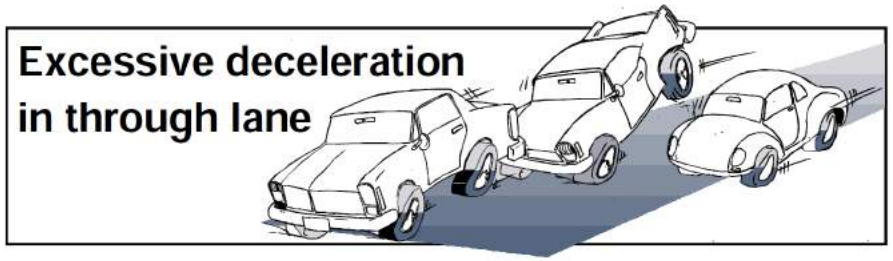
Mobility



Left-Turn Lanes

- When left-turns are made from a through lane, following vehicles are blocked and **significant delay** can occur.
- A left-turn lane increases intersection capacity and decreases delay.
- One of the basic principles of access management is the removal of slow-moving turning vehicles from faster moving through traffic. The difference in speed between vehicles on the roadway network or "speed differential" is a key predictor of crash potential.

Left-turn lanes decrease delay to through traffic.



Spreadsheets

AM_Mobility_Tools Final Modules.xlsx

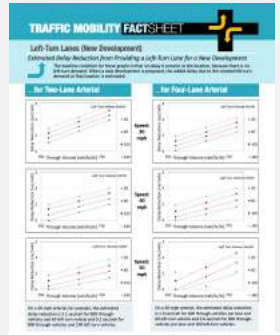
Spreadsheet options estimate predicted delay based on the presence of a left-turn lane

Outputs

Estimated intersection delay reduction for existing site	1.3	Seconds per Vehicle
Estimated intersection delay reduction for new development	2.6	Seconds per Vehicle

TECHNIQUES
Left-Turn Lane

OUTPUTS
Delay per vehicle

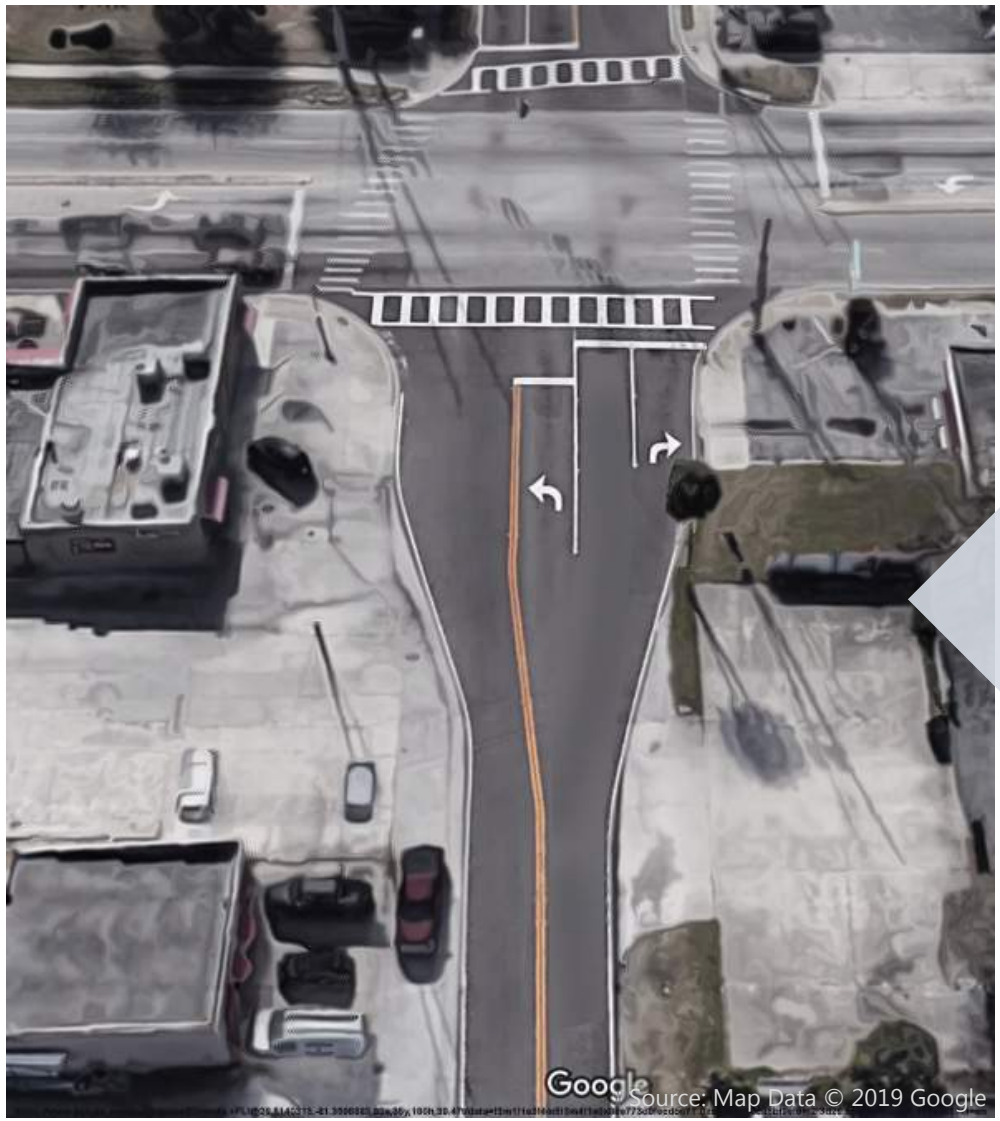


Spreadsheet

FACTSHEETS

Mobility Fact Sheets Left-Turn Lanes (Existing Intersection-Driveway).pdf

Mobility Fact Sheets Left-turn Lanes (New Development).pdf



Right-Turn Lanes

- When right-turns are made from a through lane, following vehicles are blocked and significant delay can occur.
- A right-turn lane increases intersection capacity and decreases delay by allowing right-turning vehicles to turn right and proceed through the intersection.

Turn lanes increase intersection capacity and decrease delay for right-turning vehicles.

Based on a peak-hour volume of 800 through vehicles, providing a right-turn lane on a two-lane roadway would reduce peak-hour delay by 30 minutes. If there are 4 peak hours per day (*e.g.,* 2 morning and 2 afternoon), the **daily peak period reduction in delay would be 2 hours**.

Spreadsheets

AM_Mobility_Tools Final Modules.xlsx

Spreadsheet options estimate predicted delay based on the presence of a right-turn lane.

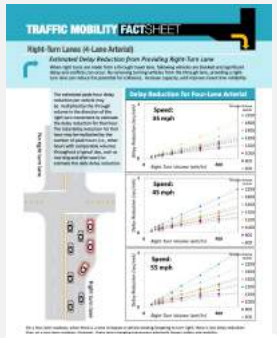
Outputs

Estimated delay reduction for through vehicles	0.57	Seconds per through vehicle
Additional delay reduction due to pedestrian crossings (3)	1.69	Seconds per through vehicle
Total delay reduction (3)	2.26	Seconds per through vehicle

TECHNIQUES
Right-Turn Lane

OUTPUTS
Delay per vehicle

Spreadsheet



FACTSHEETS

Mobility Fact Sheets Right-Turn Lanes (2L-arterial).pdf

Mobility Fact Sheets Right-Turn Lanes (4L-arterial).pdf

Livability

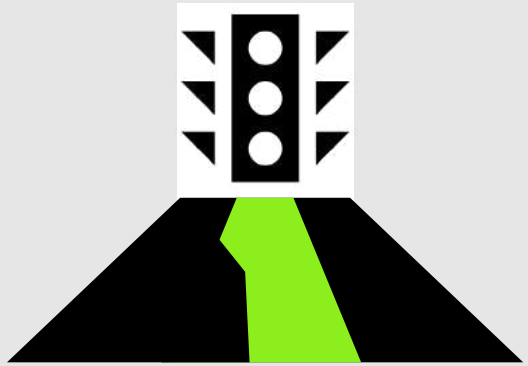
MESSAGING

- Turn lanes reduce the need for drivers to decelerate in response to turning vehicles and then accelerate to continue forward. This reduces fuel consumption and emissions.
- At a driveway, right-turn lanes improve pedestrian safety by allowing turning vehicles to safely stop or slow down for pedestrian crossing movements.
- Keep in mind that left- or right-turn lanes at a signalized intersection increase pedestrian crossing distances. On wider roadways, longer pedestrian crossing signals, pedestrian islands, or other treatments may be needed for pedestrian safety and mobility.

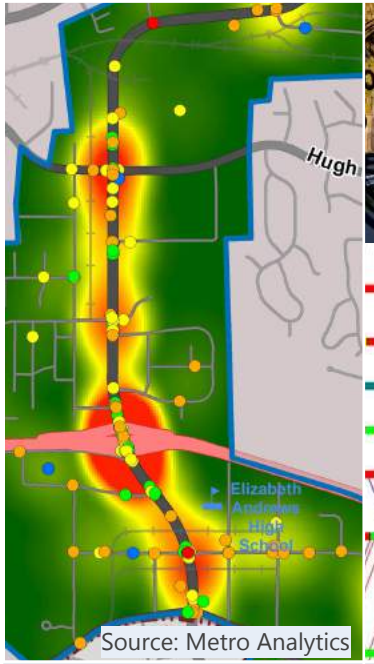
Roundabouts safely accommodate left or right turns, U-turns, and through movement with enhanced aesthetics.

TECHNICAL SUPPORT

Signalized Access Spacing



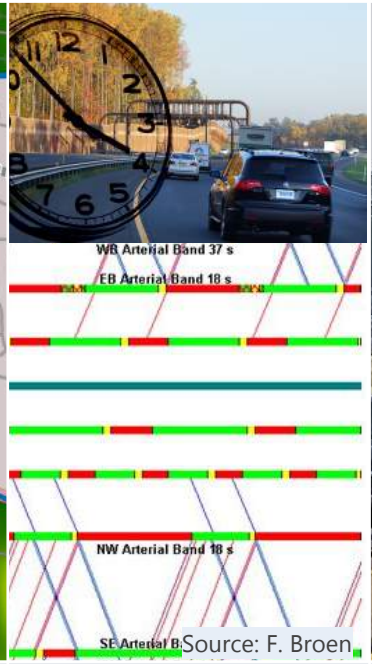
Safety



Source: Metro Analytics

Several studies have found that the number of crashes and crash rates increase as the frequency of traffic signals increases. Signals close to interchange off-ramps can also cause dangerous back-ups onto Interstate freeways.

Economy



Source: F. Broen

Improved flow of people and goods due to signal spacing results in cost savings from less delay and fewer crashes. Commercial areas are more vital and have better market reach when roadways have reliable travel times. Too many signals on major roadways can stifle the economy of a state or region.

Mobility

Source: F. Broen

Long and uniform signal spacing can move traffic efficiently during both peak and off-peak traffic conditions. As signal frequency increases on major roadways, traffic progression becomes less efficient and congestion and delay increases. This is especially damaging to freight movement and commuting.

Livability

Source: Map Data © 2019 Google

Managing the spacing of signalized and unsignalized access can reduce the need to widen major roadways. Signal spacing improves signal coordination, greatly reducing emissions and fuel consumption, which spike when vehicles decelerate and accelerate.

Safety

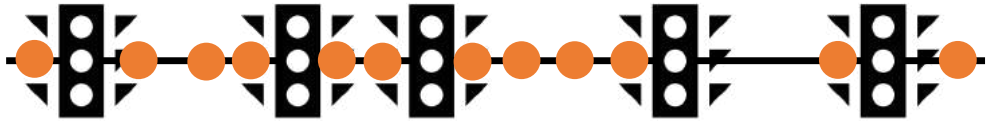
Photo by F. Broen

Signalized Intersection Density

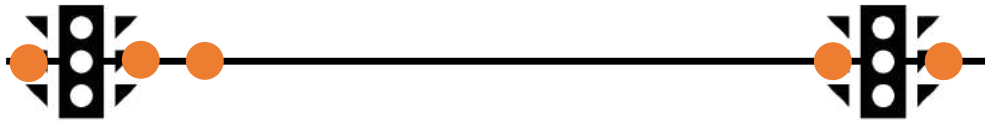
Crash rates increase as signal density increases.

Several studies have found that the number of crashes and crash rates increase as the frequency of traffic signals increases.

Crash rates increase as signal density increases.



Crashes = 13



Crashes =5

Spreadsheets

SignalizedIntersectionDensity.xlsx

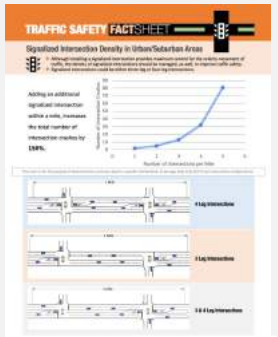
This spreadsheet shows the safety effect of changing the number of signals. Use the text to change the infographic.

Outputs:	
Total Number of Current Intersection Crash	5.13
Safety Effect	
Total Crashes (All Severities)**	12.86

TECHNIQUES
Number of Signals

OUTPUTS
Total Crashes

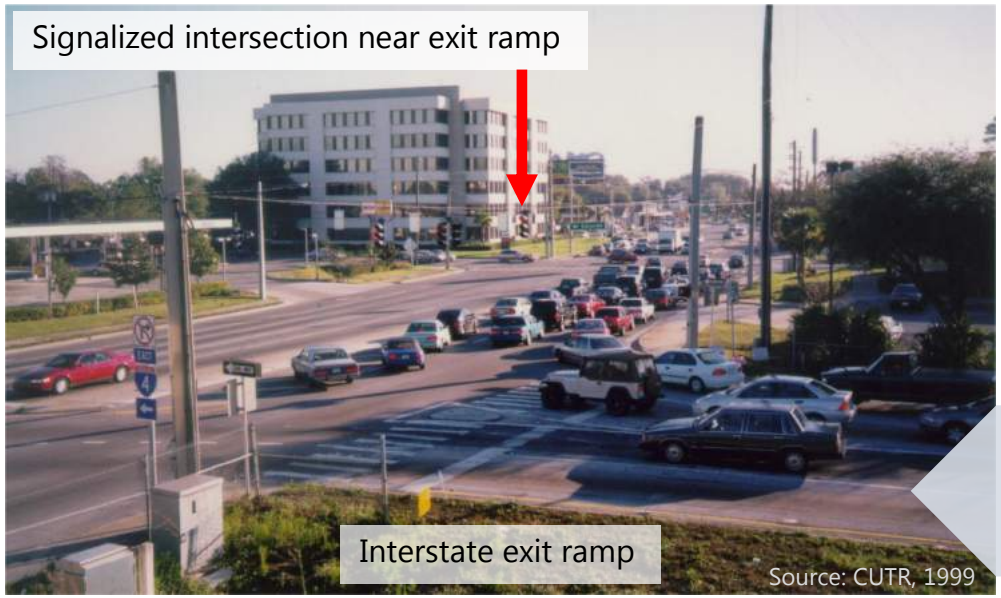
Spreadsheet



FACTSHEETS

Signal Density Safety Fact Sheet.pdf

Safety



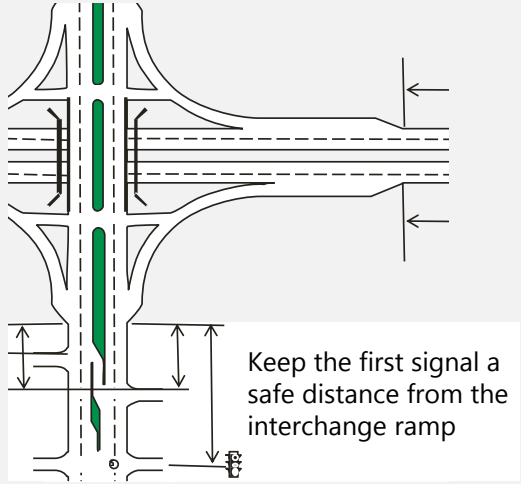
Traffic merging onto major road from interchange ramp too close to signalized intersection frequently backs onto the high-speed freeway.

A roundabout can be a viable solution.

Why we separate signals from interchanges

- Signalized intersections too close to interchange ramps cause heavy volumes of weaving traffic, complex traffic signal operations, and traffic queues that impact mainline safety and operations. These problems cannot be solved by traffic signal coordination.
- Driveway access and median openings near interchange ramps compound these problems.

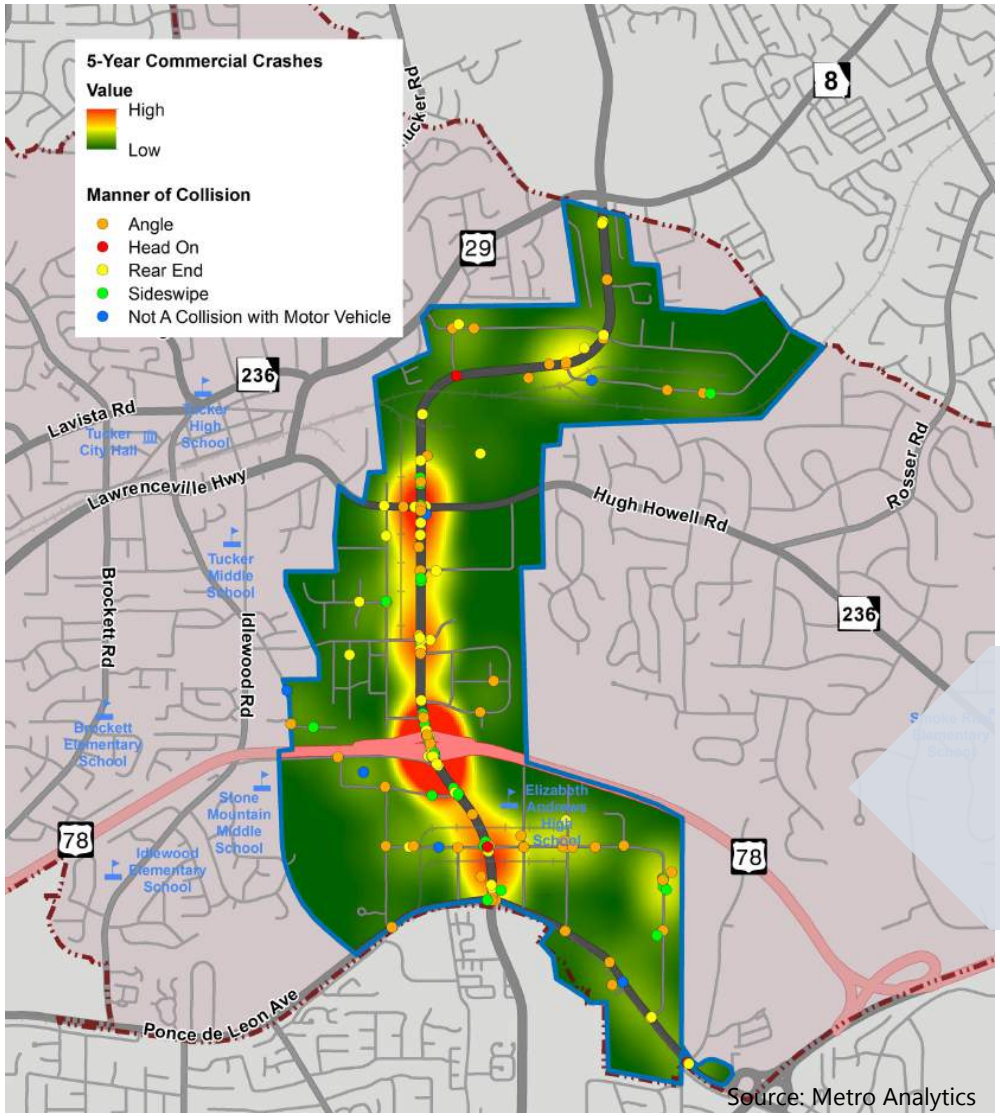
Signals too close to interchange ramps can cause dangerous back-ups on Interstates.



References:
CUTR, (1999), Land Development and Access Management Strategies for Florida Interchange Areas.

VALUE OF SIGNALIZED ACCESS SPACING

Economy



MESSAGING

- Improvements in traffic flow from managing signal spacing will result in **travel time savings** (in dollars) – time that could be better spent in productive activities.
- Improvements in highway safety from managing signal spacing will result in **cost savings to society** from fewer crashes (in dollars);
- Travel delay is **especially costly to the freight industry** in terms of wasted fuel, equipment costs, and labor – costs that are passed on to the consumer.
- Increases in travel time can explain why some **commercial areas have deteriorated** (resulting in declining property values), while others have prospered.

Without supporting network, arterials often become riddled with signals and driveways, delaying freight movement and shrinking retail market area.

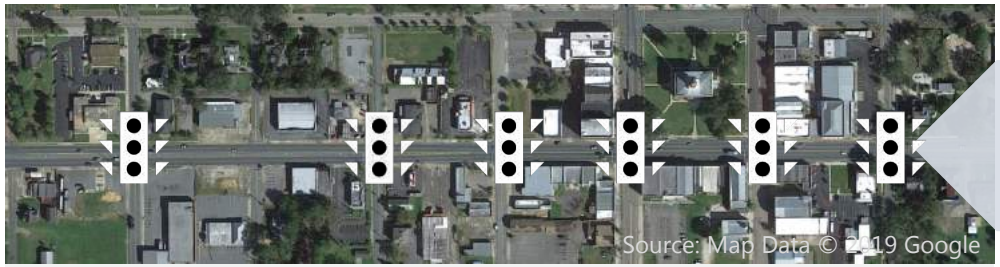
TECHNICAL SUPPORT

Changes in travel time on different parts of the roadway network result in unstable land use activity patterns. This helps explain differences in commercial vitality on a corridor and shifting economic relationships between small towns and urban centers.

Reference: Stover and Koepke, (2002), Transportation and Land Development, Institute of Transportation Engineers, pp. 1-13 to 1-29.

VALUE OF SIGNALIZED ACCESS SPACING

Mobility



6 Signals = 15 mph

Progression Speed

2 Signals = 40 mph

Progression Speed

Signal Progression and Signal Spacing

Signals can have a profound adverse impact on travel time.

- **Long and uniform signal spacing** allows timing plans that can move traffic efficiently during both peak and off-peak traffic conditions.
- As signal frequency increases on major roadways, traffic progression becomes less efficient and delay increases.
- By managing the spacing and location of traffic signals, we can move traffic more efficiently at appropriate speeds and with less delay.
- Two tools are included in the Mobility spreadsheet module for estimating impacts of adding new signals – Signal Progression and Signal Spacing.

Spreadsheets

AM_Mobility_Tools Final Modules.xlsx

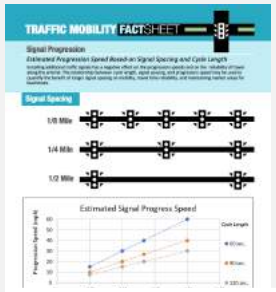
- The Signal Progression spreadsheet estimates progression speed when signals are closely or irregularly spaced.
- The Signal Spacing spreadsheet estimates travel time increases as signal density increases.
- Both tools are for planning level estimates. Detailed analysis is required for specific projects.
- Do not count the first signal when using these tools

Example Output: Signal Progression

		Units
Estimated Progression Speed	20	Miles per Hour

TECHNIQUES
Number of Signals

OUTPUTS
Progression Speed



Spreadsheet

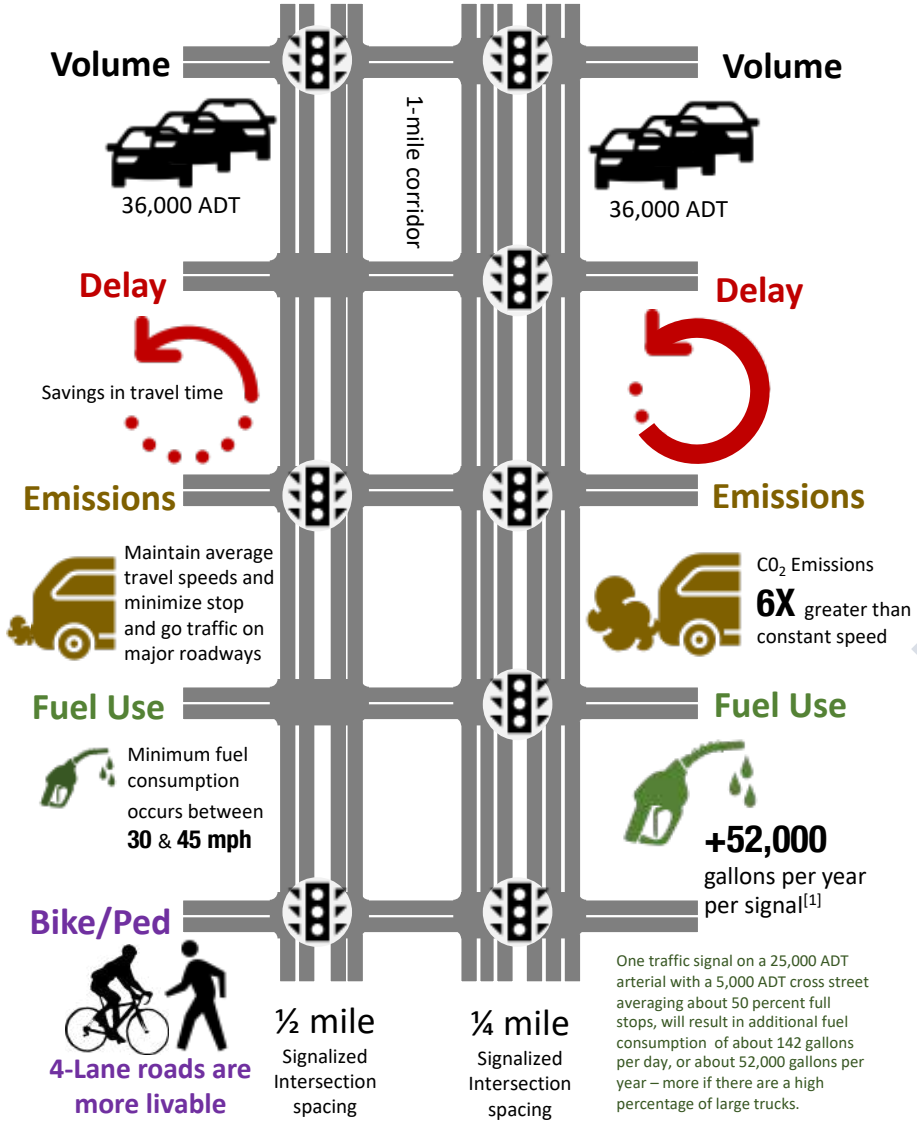
FACTSHEETS

Mobility Fact Sheets Signal Progression.pdf

Mobility Fact Sheets Signal Spacing.pdf

VALUE OF SIGNALIZED ACCESS SPACING

Livability



MESSAGING

Fewer Travel Lanes and Lower Emissions

A four-lane roadway with ½-mile signalized intersection spacing can carry the same volume as six lanes with ¼-mile signal spacing.

- Four-lane roadways pose less of a barrier to bicycles and pedestrians and are more conducive to community activity. Safe mid-block crossings between signalized intersections can help further reduce pedestrian travel distances.
- Reducing emissions and fuel usage are important to the environment. Each signal added to the roadway system adds to fuel consumption and emissions.

Signals on major roadways increase emissions, energy use, crashes and delay.

- In dense urban core areas, or where an arterial must double as "main street" in a town or village center, block size often determines signal spacing. Crossings are more frequent and traffic must slow down to accommodate pedestrian activity.
- In downtown environments, one-way streets can allow effective signal coordination where needed to increase throughput.

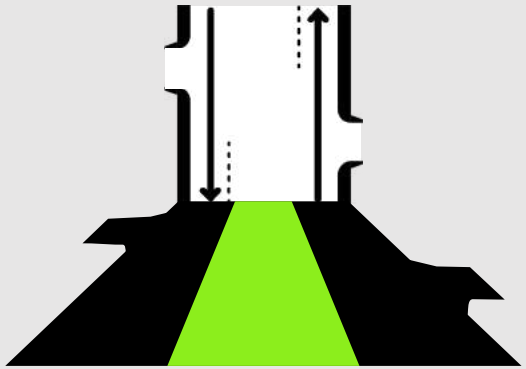
TECHNICAL SUPPORT

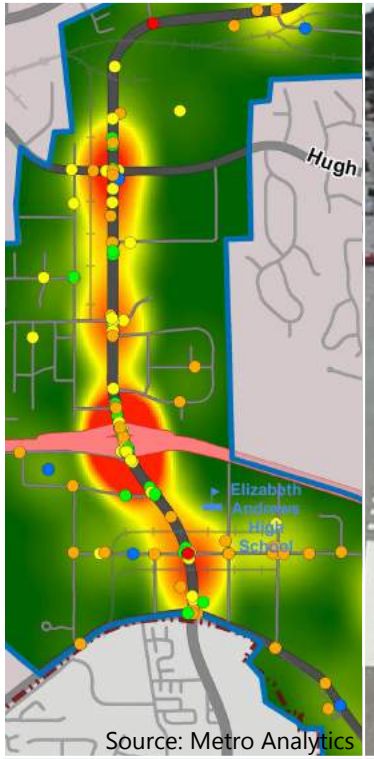
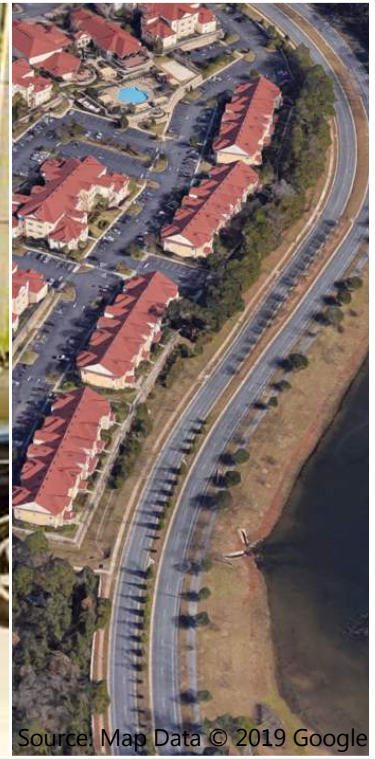
Fuel consumption increases rapidly as speeds decrease to less than 25 mph, and increases modestly up to 62 mph.
- Rakha, H. and Ding, Y. 2003. "Impact of stops on vehicle fuel consumption and emissions, *Journal of Transportation Engineering*, 129(1), pp. 23–32.

Research indicates that for every 1000 speed change cycles, braking to a stop from 30 mph results in excess fuel consumption of 9.5 gallons, whereas a reduction in speed from 30 mph to 20 mph results in 3.0 gallons excess fuel consumption – a 6.5 gallon savings (Dale 1981). At an initial speed of 50 mph, reducing speed by 10 mph saves 12.5 gallons for every 1000 speed change cycles compared to breaking to a stop.

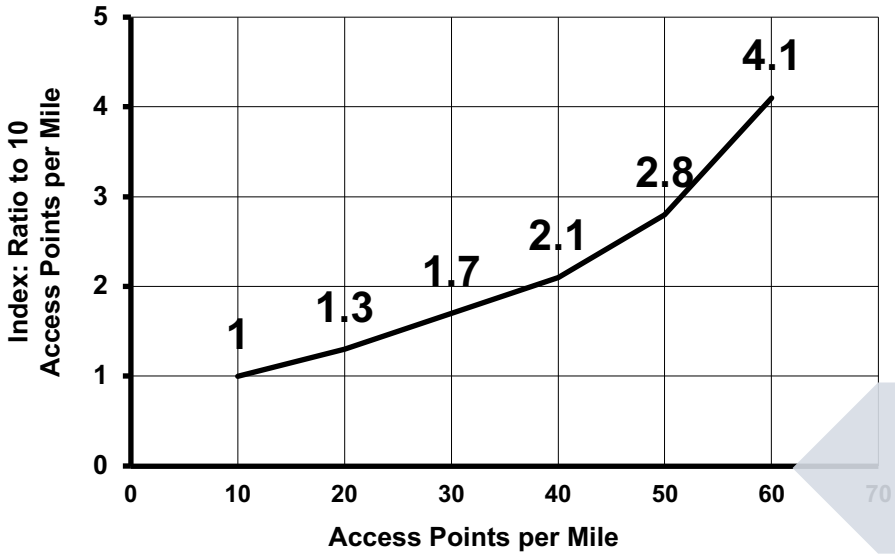
- Dale, C. W. (1981). "Procedures for Evaluating Traffic Engineering Improvements." *ITE Journal*, Institute of Transportation Engineers.

Driveway and Unsignalized Access Spacing



Safety	Economy	Mobility	Livability
 Source: Metro Analytics	 Source: F. Broen	 Source: T. Petritsch	 Source: Map Data © 2019 Google
As access density increases, crash rates increase. Closely spaced driveways and side streets can result in increased crashes involving pedestrians and cyclists.	Corridors with too many driveway access points cost society by increasing crashes. This cost can be measured using the spreadsheets in this toolkit.	Too much driveway access leads to delay on major roads needed for longer distance trips. They cause turbulence in the traffic stream, as vehicles enter and leave through traffic lanes. They also reduce the quality of service for cyclists and pedestrians.	Fewer access connections increase the area for landscaping and enhance the appearance of major corridors. Landscaping also provides a buffer between vehicular traffic and pedestrians.

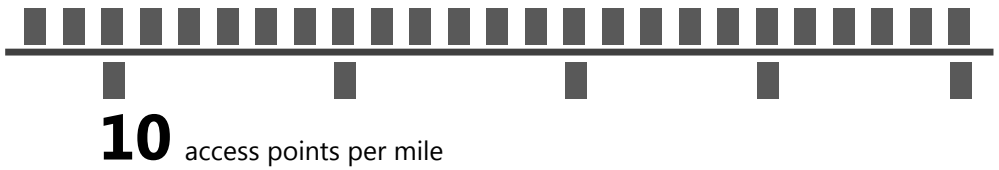
Safety



As access density increases, crash rates increase. In urban areas, a density of **60 or more access points per mile is associated with a crash rate that is 4.1** times greater than for a similar roadway with 10 access points.

NCHRP Report 420

Every driveway introduces conflict points and potential crashes on an arterial.



Unsignalized Intersection and Driveway Density

Closely spaced driveways and side streets:

- **Intensify traffic conflicts** on major roads and can lead to driver information overload, increasing the potential for a crash.
- **Make pedestrian and cyclists more vulnerable** to conflicts with turning vehicles.

- In rural areas, an increase from fewer than 15 access points to 30 access points per mile is associated with a 65% higher crash rate.

410% increase in crashes

From 10 to 60 access points per mile on urban 4 lane with TWLTL

Spreadsheets:

UnsignalizedIntersectionDensity.xlsx

Spreadsheets estimate crashes for unsignalized intersections and driveways.

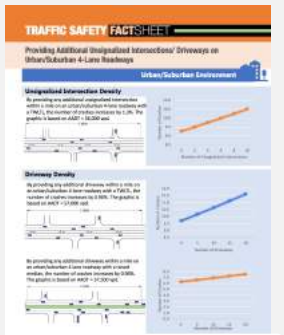
Example Outputs (Unsignalized Intersection Density):

Outputs:	
Total Number of Crashes for the Current Condition*	**10.19**
*Driveway related crashes are not included.	
Safety Effect of Increasing Driveway Density	
Angle, Fixed object, Head on, Rear end, Run off road, Sideswipe, Single vehicle	**14.61**

INPUT
TWLTL or Median
AADT
Segment length
Intersections/mi

OUTPUTS
Crashes

Spreadsheet



FACTSHEETS

Driveway Density Fact Sheet.pdf

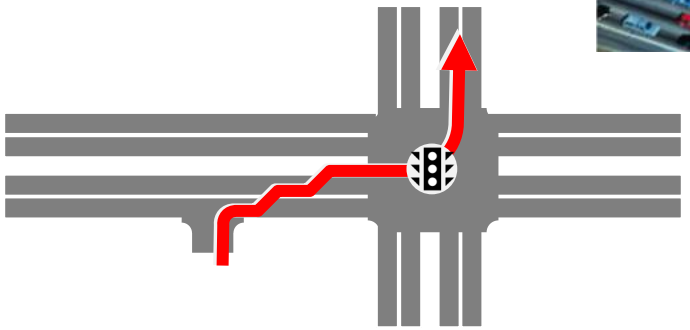
Safety

These driveways are too close to the intersection

L. Gattis

Photo by J. Gattis

It is also difficult for drivers to turn right out of a driveway near a signal and then weave safely and quickly to make a left turn at the intersection.



MESSAGING

Corner Clearance

Driveways should not be located close to signalized intersections. The potential for conflicts and crashes is especially great if driveway maneuvers overlap with intersection turning movements.

Driveways near signalized intersections are especially hazardous.

Photo by P. Demosthenes

Move driveways as far away from intersections as possible.

TECHNICAL SUPPORT

Distances vary based on the type of road and whether a driveway is upstream or downstream from a signal.

If you must permit access in the functional area of an intersection, try these strategies to reduce the safety and operational impacts:

- Add permit conditions that restrict site traffic volume;
- Install a median or bollards at the intersection;
- Locate the driveway at the edge of the property;
- Share access with the adjacent site.

MESS

COST

SAFETY CONCERN	Low	Moderate
High frequency of right-angle crashes attributed to:		
nearby driveways	A2,B12,C1,C2,C4	A1
traffic from minor street	B12,C1,C2,C4,D2	D1
skewed intersection		
poor sight distance	C1,C2,C4,H3	D1
drivers misjudging gaps	D2,H3	D1
not enough gaps for drivers	D3	
driver unaware of intersection	E1,E5-E9,E10,E11	E3
nighttime conditions	E10	
failure to yield at stop or yield sign	E1,E4-E9,E11	G1
possible signal location		
heavy but balanced traffic flow	F2	
speed differentials of vehicles	H3	H1,H2
High frequency of rear-end crashes attributed to:		
left turning vehicles hit from behind	B4	B1,B2
left opposing vehicles hit from behind		
trucks and RVs entering divided highway		B5
speed differential of entering vehicles		B5,B9
right turning vehicles hit from behind		B6,B7
appoaching vehicles hit from behind		B10
no left turn lane and high opposing traffic	B11,B12	
driver unaware of intersection	E1,E5-E9,E10,E11	E3
nighttime conditions	E8,E10	
speed differentials of vehicles	H3	H1,H2
High frequency of left-turn crashes attributed to:		
left turn vehicles hit by opposing traffic	C2	B1,B17
trucks and/or RVs entering divided highway		B5
no left turn lane and high opposing traffic	B11,B12	B17
nighttime conditions	E10	
heavy but balanced traffic flow	F2	
Poor sight distance	C2, B11, B12	B17
High frequency of sideswipe crashes attributed to:		
speed differential of entering vehicles		B9
vehicles within intersection	I1,I2	
vehicles approaching intersection	I3	
High frequency of run off road crashes:		
approaching intersection		B10
High frequency of pedestrian/bicycle crashes:		
Address overall safety issues:		
violation of traffic laws	G2	

TECHNICAL SUPPORT

The **Unsignalized Intersection Safety Strategies** quick reference brochure created by FHWA shows multiple options for addressing safety. Many are low cost solutions with high returns on investment. Click the link to explore the strategies:

https://safety.fhwa.dot.gov/intersection/other_topics/fhwasa08008/intersectionguide12.pdf

Many low-cost countermeasures can be used to increase safety and access.

Economy

Bridgeport Way in University Place, Washington

Photo by J. Malone

Multimodal corridor access improvements on Bridgeport Way in University Place, Washington yielded a 60% crash reduction, 8% increase in sales tax receipts following each construction phase, better pedestrian connections to transit, and a revitalized, more livable corridor. A local street network was also built off of the highway offering better access to businesses in a new town center, as shown in this image.

Business Activity

- Business activity relates to how easily and safely a customer can reach a business. Improving access design to a site and connecting the overall network, increases the ability of customers to safely and easily access businesses in that area.

Land Use

- Overall improvements to access, such as improved local street networks, can support new land uses, such as retail and residential. These land uses provide tax revenue from property and sales taxes.

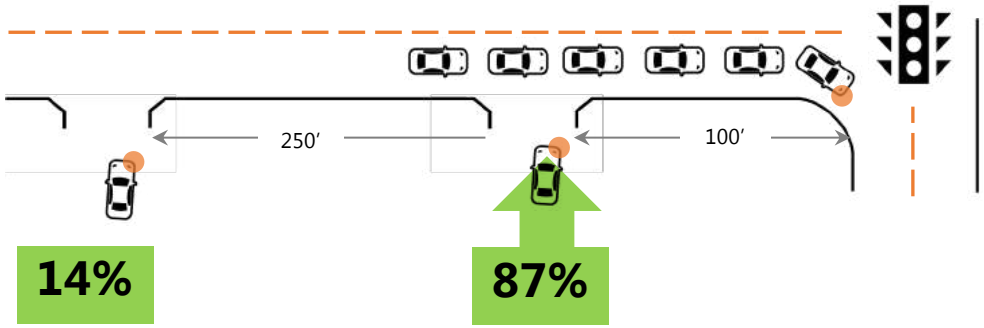
Property Values

- Property values can change after an access management treatment is applied due to improved access to the property or general land use changes that occur after access is improved or increased.

Economic Fact Sheet.pdf

Economy

Photo courtesy of the Record-Journal



87% of time this car would not be able to exit the driveway

Corner Clearance

Corner Clearance

- Separating driveways from signalized intersections or consolidating driveways will improve the safety and ease of access to these business sites by reducing the chances that a driveway will be completely blocked or not adequately designed to handle the flow of traffic into and out of a business site.

Access that is frequently blocked may result in a loss of customers.

Estimated percentage of cycles during which a driveway in proximity to a signalized intersection will be blocked

Corner Clearance	50	100	250
Estimated percent of signal cycles during which the driveway will be blocked	98%	87%	14%

Spreadsheet

AM_Mobility_Tools Final Modules.xlsx

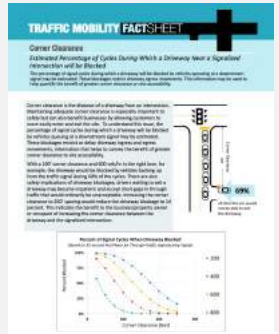
- Spreadsheet estimating frequency of driveway blockage near signalized intersection

Outputs

Estimated percent of signal cycles during which the driveway will be blocked	87%

TECHNIQUES
Corner clearance

OUTPUTS
% driveway blocked



Spreadsheet

FACTSHEETS

Mobility Fact Sheets Corner Clearance.pdf

Mobility

Few driveways and good internal circulation improve the mobility of this shopping area.

Driveway Spacing

- Inadequate control of access spacing on major roadways contributes to delay on rural and urban arterials.
- Uncontrolled development along a rural highway may produce multiple access points in a relatively short distance, and the need to lower the posted speed at this location, delaying long distance trips. A better option is to create an internal network.

Building on an internal network provides access without impeding through traffic.

Spreadsheet:

AM_Mobility_Tools Final Modules.xlsx

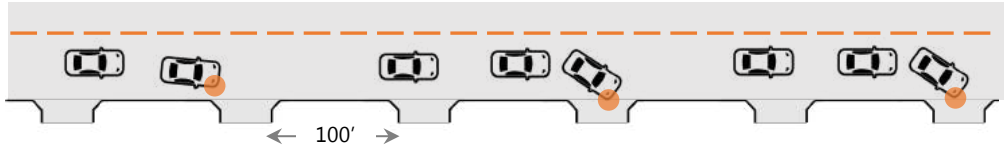
- Spreadsheet estimates 3 different mobility outcomes.

Outputs:

Driveway Spacing	100 ft
% of right-lane, through-vehicles affected at a single driveway	6.3%
% of right-lane, through-vehicles affected at least once per 1/4 mile	57.9%
% of vehicles impacted by another driveway	63.5%

Estimated impact of driveway spacing on right-lane, through-vehicle mobility

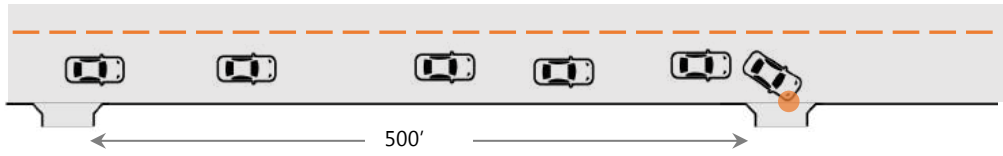
58% of these cars must slow down at least once per ¼ mile



% of right-lane, through-vehicles affected at least once per 1/4 mile

58% @ 100 ft.

Only 16% of these cars must slow down at least once per ¼ mile

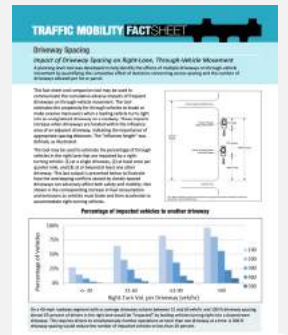


% of right-lane, through-vehicles affected at least once per 1/4 mile

16% @ 500 ft.

TECHNIQUES
Driveway spacing

OUTPUTS
% Through-vehicles affected



Spreadsheet

FACTSHEETS

Mobility Fact Sheets Driveway Spacing.pdf

Livability


Source: Florida DOT

Each driveway connection takes the sidewalk for motor vehicle use and reduces space for landscaping.

Where would you want to live?

Reducing driveways, installing landscaped medians, and buffering parking lots from adjacent roadways creates a visually pleasing and functional corridor that attracts investment and protects property values.


Photo by T. Petritsch

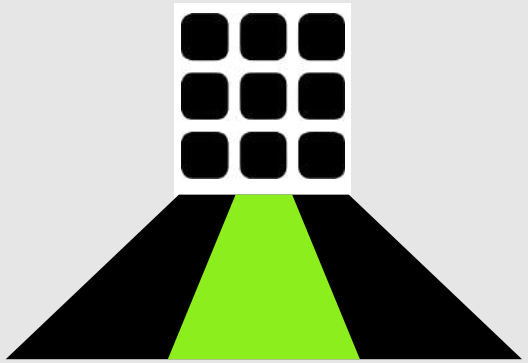

Source : Florida DOT

Photo by K. Williams

Aesthetics with (top) and without (bottom) access management.

Showing images of roadways where access is properly managed and where it is not is an easy yet effective way to show how access management improves livability.

Network Connectivity



MESSAGING

Safety

Supporting network reduces the need for driveway access onto major roadways, thereby greatly improving safety of the major roadway and sidewalk for all users.

Economy

Providing shared access may improve on-site circulation and may increase the percentage of the site that is usable for development, on-site circulation, and parking.

Mobility

Connected street networks allow motorized vehicles, cyclists, and pedestrians to easily circulate within neighborhoods, while reducing the need for vehicles to use a major roadway for short local trips.

Livability

Organizing land uses into activity centers on a connected street network improves access for all modes. These same strategies promote more livable places, by reducing driveways and strip development on major roadways.

Safety

MESSAGING

- **Supporting street networks** reduce the need for driveway access onto major roadways, greatly improving safety of both the major roadway and the sidewalk.
- Local street networks allow safe access to major roadways at traffic signals and well-planned side street locations.
- Interconnected commercial development can give even small businesses access to a traffic signal and safer left-turns.
- Local streets and alleys have less traffic and lower speeds than major roadways and can provide a safe travel alternative for bicyclists, including potential locations for bicycle boulevards.
- Signalized mid-block crossings support safe pedestrian movement across suburban corridors with higher speed traffic and improve pedestrian access to transit stops.

Well-planned networks provide safer travel options for all users.

TECHNICAL SUPPORT

Connected street networks provide options for all modes to travel safely.

VALUE OF NETWORK CONNECTIVITY

Economy

Source: Utah DOT

Connected, supporting networks improve through movement on major roadways, and provide more opportunities to access businesses from the surrounding area. Better traffic flow means greater market reach.

MESSAGING

- **Providing shared access often** improves on-site circulation and can increase the percentage of the site that is usable for development, on-site circulation, and parking.
- Internal network can increase the development potential of interchange areas by providing access to interior lands within interchange area quadrants.
- Similarly, network along major corridors creates more activity centers for business that can connect into surrounding neighborhoods, as opposed to strips that are segregated and less accessible.

Networks can be improved through public-private partnerships to support profitable, high-value mixed-use developments.

- Bicycle and pedestrian improvements that provide connections to adjacent properties and integrate the network increase livability, which can lead to an increase in the value of those properties.

TECHNICAL SUPPORT

Complete networks could result in more intensive development and increased tax base and property values.

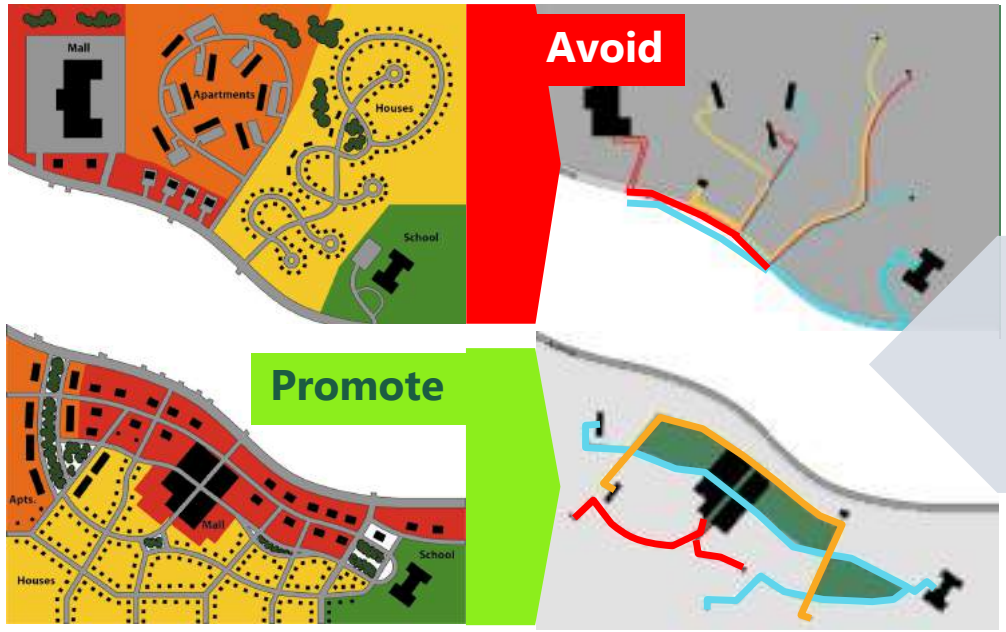
Improvements to the entire network or localized access improvements can make locations more desirable and therefore increase their overall value.

Property values may increase at varying rates depending on the treatment.

VALUE OF NETWORK CONNECTIVITY

Mobility

Vehicles use **major roadway** to circulate



Local traffic uses **internal circulation** network

MESSAGING

- **Connected street networks** provide more direct routes, shorter trip lengths and encourage non-motorized travel.
- Vehicles have less need to use major roadways for short local trips, improving the ability to move traffic.
- A robust network improves separation of motorized and non-motorized circulation.
- Promoting dense, connected local street and sidewalk networks and regular spacing of major streets are principles of access management and smart growth.

When neighborhoods lack a network, cars pile onto major roads even for very short trips.

- Closing gaps in sidewalks and bike lanes, and connecting sidewalks to developments and transit stops, provides a continuous network that improves bicycle and pedestrian mobility and access for persons with disabilities.
- Safe arterial mid-block crossing opportunities, such as pedestrian islands and signalized crossings, support pedestrian access at logical locations, such as transit stops, schools, parks, and shopping centers.

TECHNICAL SUPPORT

Access management promotes accessibility while preserving local and regional mobility.

Accessibility = land use proximity + network connectivity.

Mobility = ability to move around via multiple alternative paths and modes

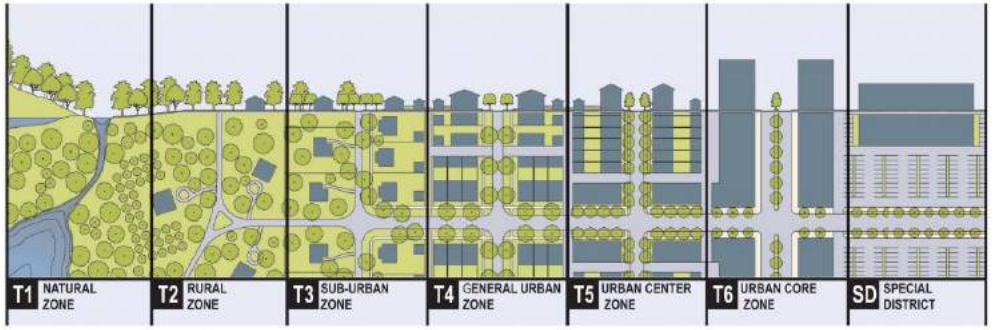
Access = ability to enter and exit a site.

The blue area is where you can reach the center in a five-minute walk. Click on the graphic for more information.

Source: Dan Zack/plannerdan.com

Livability

Context matters! Access management strategies vary by land use context. Livability is enhanced regardless of context. Although this image is highly urban, rural and suburban areas also benefit from good access management.



Source: Duany Plater-Zyberk & Company 2003

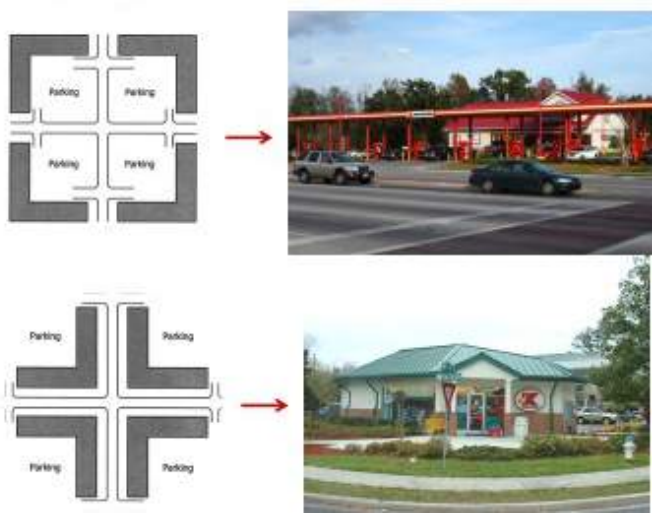
MESSAGING

Placemaking on a network

- Access management can be achieved through land use strategies that discourage strip development and promote activity centers organized on a street network. This creates a more accessible built environment that supports bicycle, pedestrian, and transit mobility.
- Pedestrian and transit access can be improved by orienting buildings to front on the street with parking in garages or at the side or rear of sites.

Dense and connected networks can support livable, walkable centers.

Buildings are more accessible to pedestrians and transit when they are closer to the curb. Parking can be placed in the rear of the property.

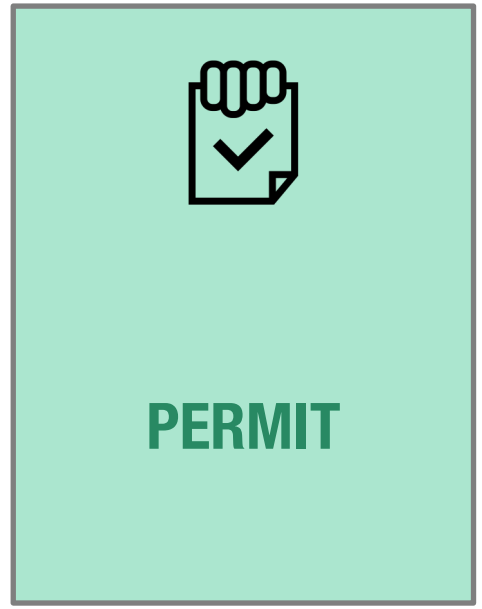


Photos courtesy of City of Gainesville, FL

TECHNICAL SUPPORT

In rural and coastal areas, poorly planned access roads and driveways can damage scenic landscapes and sensitive ecosystems. Working together on a network plan can preserve the natural beauty of these areas.

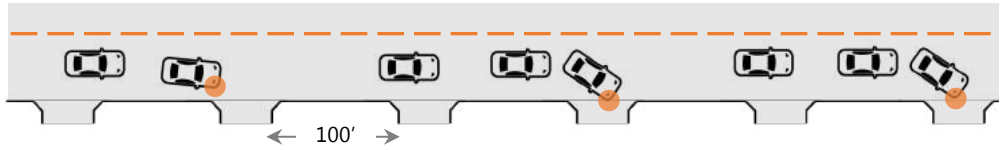
Case Examples



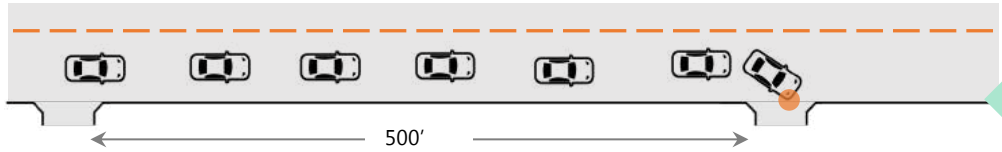
Driveway Spacing & Safety

This example illustrates how driveway density impacts safety. When establishing driveway spacing standards, planning agencies can use this spreadsheet to demonstrate the safety implications of different levels of access spacing. For example, an average driveway spacing of 500-feet would decrease the crash rate an estimated 61% over 100-feet driveway spacing on a 1-mile road with a TWLTL and 35,000 AADT.

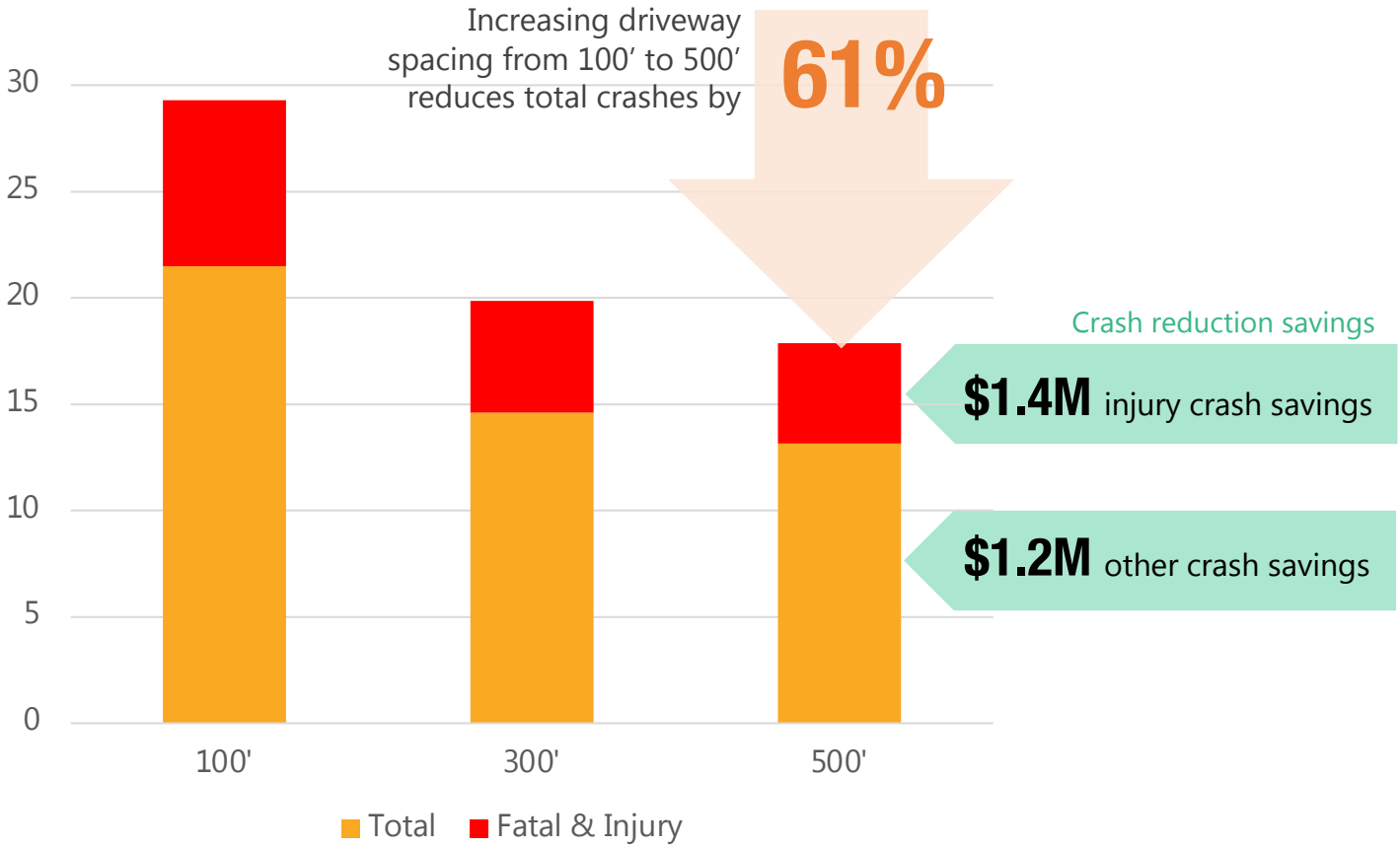
100' driveway spacing shows 29 crashes with 8 Fatal & Injury crashes



500' driveway spacing reduces crashes, savings $2.6M yearly



Safety of Driveway Spacing



$2.6M total savings over 100' driveway spacing

Driveway Spacing & Delay

This example illustrates the cumulative adverse impacts of driveways on delay and traffic flow. A planning agency could use this tool along with other methods to reinforce the importance of good driveway spacing. Each vehicle turning into a driveway can cause following vehicles to brake or change lanes to avoid a collision. This cumulative impact is a proxy for delay and can be demonstrated using the mobility tool for driveway spacing. For example, on a 50-mph roadway segment with an average driveway volume of 40 vehicles per hour and 100-foot driveway spacing, about 58% of drivers in the right lane would be impacted (need to brake or change lanes) by leading vehicles turning right into a downstream driveway. 500-foot driveway spacing significantly improves traffic flow.

Mobility of Driveway Spacing

Higher access spacing on major roadways not only improves safety – it reduces delay.

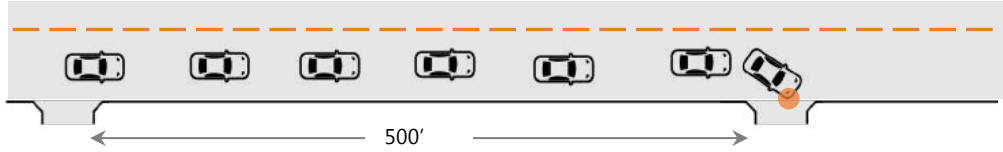
58% of these cars must slow down at least once per ¼ mile

% of right-lane, through-vehicles affected at least once per 1/4 mile

58% @ 100 ft.

@100' driveway spacing

Only 16% of these cars must slow down at least once per ¼ mile



% of right-lane, through-vehicles affected at least once per 1/4 mile

16% @ 500 ft.

@500' driveway spacing

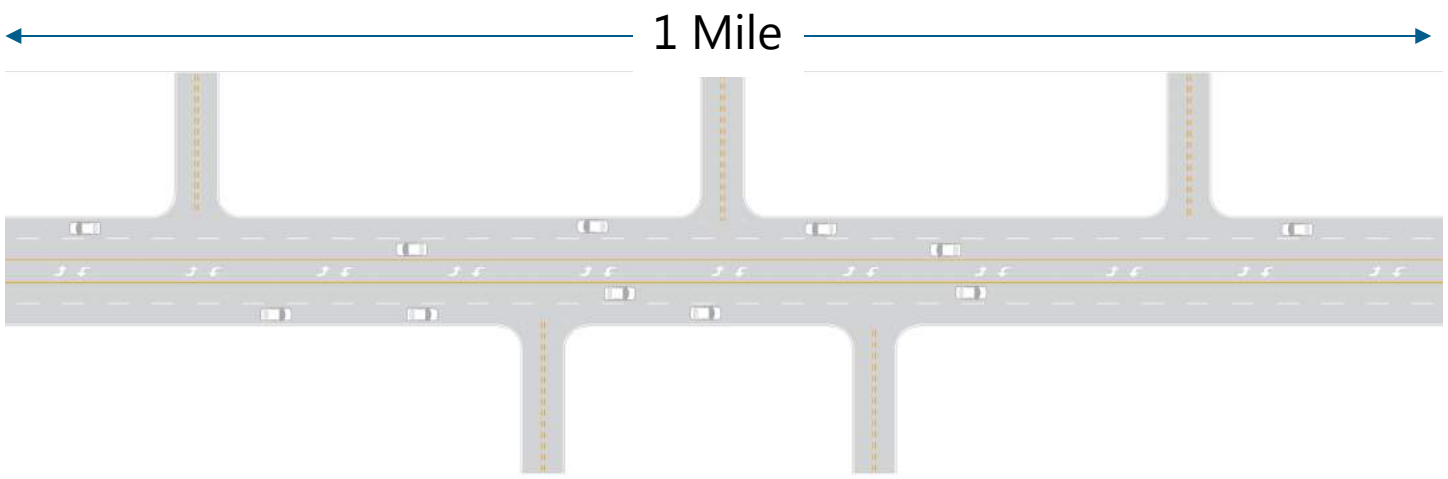
Unsignalized Intersections

The density of unsignalized street intersections directly impacts roadway safety. When developing an access management plan for a corridor, an agency can use the safety tool for unsignalized intersections to demonstrate the safety performance of different levels of unsignalized intersection density. This example is for a one-mile urban/suburban corridor segment with four through lanes and a continuous two-way left-turn lane (TWLTL,) a 35-mph speed limit, and average annual daily traffic (AADT) of about 60,000 vehicles per day. This example illustrates how five unsignalized intersections would influence safety performance (in contrast to none).

For an urban/suburban corridor similar to the study site, the agency can anticipate 10.86 or about 11 crashes in comparison to no unsignalized intersections. The affected crash types include angle, fixed object, head-on, rear-end, sideswipe, and other single vehicle crashes. The monetized value of these crashes is $1.5 million per year.

UnsignalizedIntersectionDensity.xlsx
Safety Economic Value case studies.xlsx

Safety of Unsignalized Street Intersections



Safety Effect of Increasing Unsignalized Intersection Density	
Angle,Fixed object,Head on,Rear end,Run off road,Sideswipe,Single vehicle	10.86

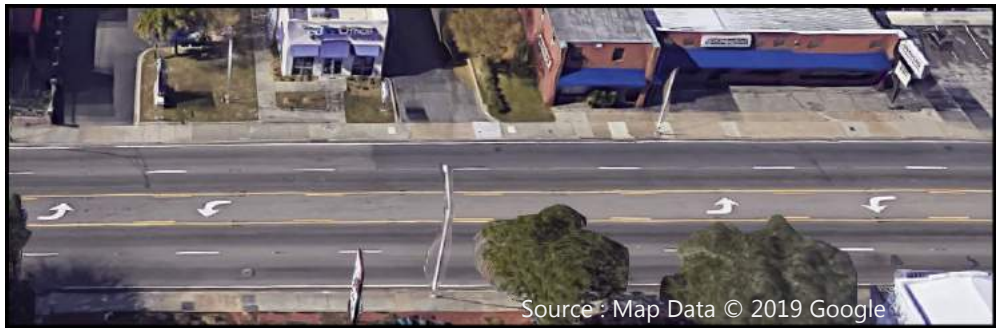
These 5 intersections would experience

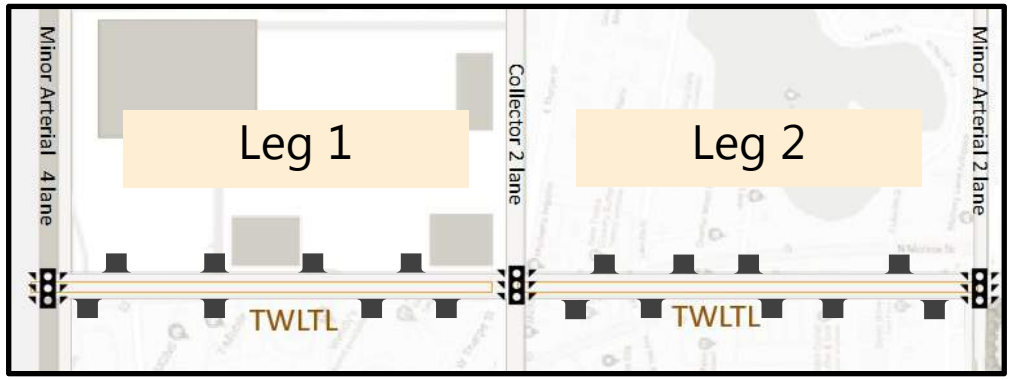
11 crashes

The affected crash types include angle, fixed object, head-on, rear-end, sideswipe, and other single vehicle crashes. The monetized value of these crashes is

$1.5 million per year

TWLTL TO MEDIAN





Configuration	AADT (vpd)	Length – Leg 1 (mi)	Length – Leg 2 (mi)
Existing TWLTL Section	35,000	0.25	0.25
Proposed Continuous Median	35,000	0.25	0.25
Number of Driveways:		2 major commercial 6 minor commercial	9 minor commercial

A five-lane suburban arterial has two lanes in each direction and a two-way left-turn lane (TWLTL). The segment is ½-mile long with traffic signals at the beginning, middle (¼-mile point), and end.

Medians vs TWLTL (Two-Way Left-Turn Lane)

	Segment #1 (crashes / yr)	Segment #2 (crashes / yr)	Total Roadway Segment (crashes / yr)	Total Number of Crashes	Number of Fatal and Injury Crashes	% Reduction
Existing TWLTL Configuration						
Total crashes:	5.50	5.04	10.54	10.54		
Fatal and Injury Crashes:	1.46	1.33	2.79		2.79	
Proposed Continuous Median						
Total crashes:	2.21	2.13	4.34	– 4.34		
Fatal and Injury Crashes:	0.61	0.58	1.19		– 1.19	**6.20/ 10.54**
Predicted Reduction in Crashes (replace TWLTL with Raised Median)						
Reduction in total crashes:	3.29	2.91	**6.20**	**= 6.20**		
Reduction in fatal + injury crashes:	0.85	0.75	**1.60**		**= 1.60**	**=58.82%**

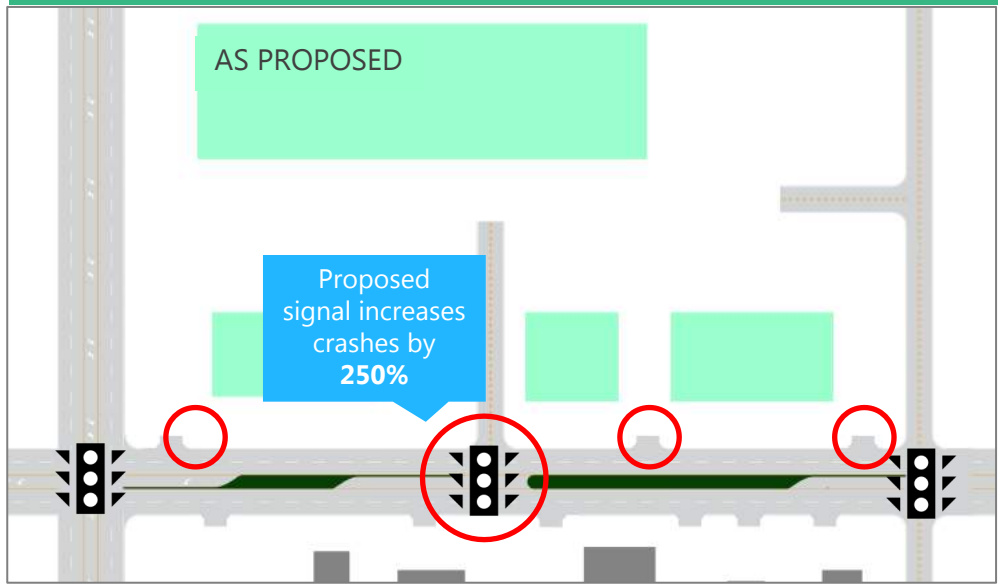
Summary of Findings: Converting a TWLTL to a continuous raised median for each ¼ mile segment shown can reduce total crashes by about 6 crashes per year and reduce the number of fatal and injury crashes by about 2 serious crashes per year.

The monetized value of these crashes is **$1.5** million per year.

Converting the TWLTL to a raised median reduces yearly crashes by **59%**

Permit Review

Permit Case Study



Objective:

Communicate the safety and mobility impacts of this permit request and propose alternatives that represent good access management practices, using the tools in the toolkit.

Initial Request:

A developer has requested an access permit for a major retail development with several outparcels, each with a driveway connection. The request is to add a median opening for a signalized driveway and three additional unsignalized driveways on a major arterial.

Safety Impacts of Traffic Signal Spacing

- **Signal Spacing:** For a half-mile segment, the addition of a traffic signal can be expected to **increase the number of crashes by 250%.**

Outputs:		
Total Number of Current Intersection Crashes per year	16.61	70 sec Cycle length 1320 ft spacing
Safety Effect of Changing the Number of Signalized intersections per Mile		
Total Crashes (All Severities)**	**41.65**	70 sec Cycle length 660 ft spacing

Outcome A:

Using the safety tool to assess the signal request, the reviewing agency demonstrates that the proposed signal would more than double the number of crashes, indicating permit denial.

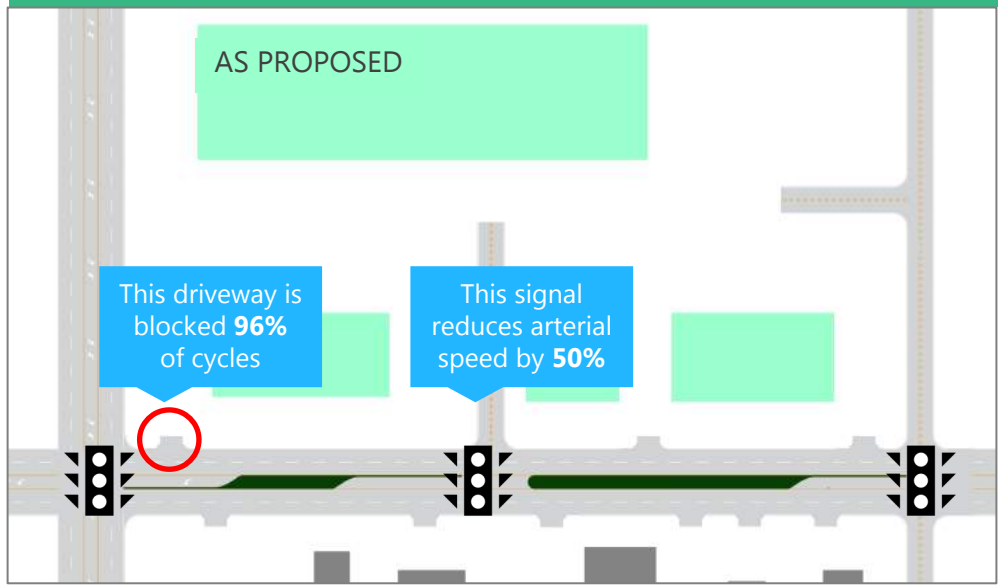
Example infographic for this scenario

Adding a traffic signal increases crashes by **250%**

At an additional cost of almost **$3.4 million**

Permit Review

Permit Case Study



Outcome B:

The reviewing agency also uses the mobility tools to help show the impact of the proposed signal on progression speed of the arterial, and how the proposed corner driveway would be blocked much of the time.

Additional cost to society = **$750,000** in travel delay

Traffic Signal Progression Corner Clearance

- **Signal Progression:** For a half-mile segment, adding a traffic signal can be expected to reduce progression speed from 26 mph to 13 mph.

Outputs — 70 sec Cycle length, 1320 ft spacing

			Units
1	Estimated Progression Speed	26	Miles per Hour

Outputs — 70 sec Cycle length, 660 ft spacing

			Units
1	Estimated Progression Speed	13	Miles per Hour

Maintaining the same number of traffic signals and progression speed translates to greater reliability in travel time, preventing market area erosion for businesses.

Speed reduced **50%** by signal

- **Corner Clearance:** A driveway with only 50-feet of corner clearance can be expected to be blocked **96%** of the cycles in this example. At a 225-ft corner clearance, the driveway would only be blocked **14%** of the cycles. At 250-feet, it would be blocked only **8%** of the cycles.

Outputs — Driveway 50' from corner

1	Estimated percent of signal cycles during which the driveway will be blocked	96%

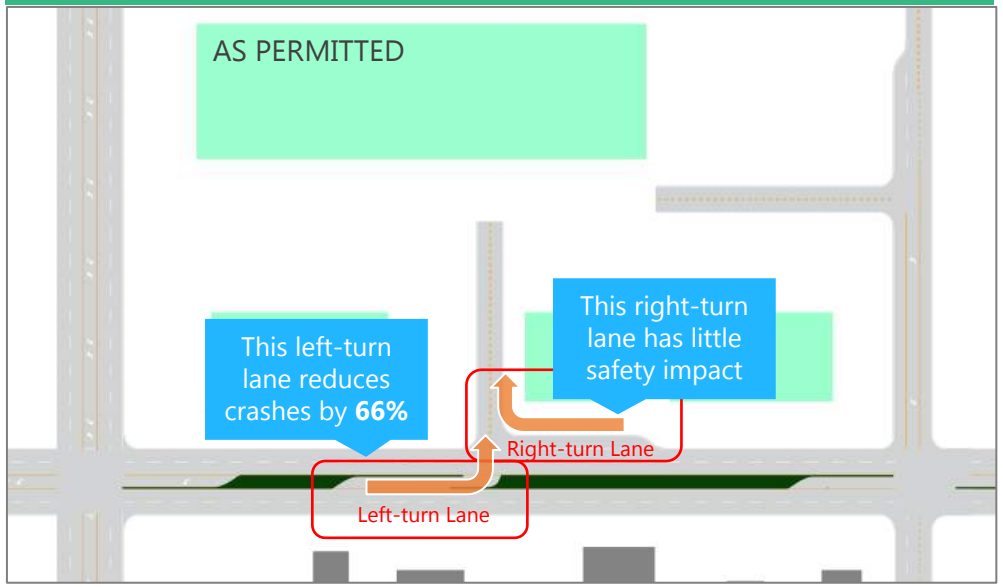
Outputs — Driveway 225' from corner

1	Estimated percent of signal cycles during which the driveway will be blocked	14%

Driveway blocked **96%** of cycles

Permit Review

Permit Case Study



Outcome C:

The applicant next requests a median opening instead of a signal. After a traffic analysis study verified the planning assumption shown by the tools, the agency decides to allow a directional opening with a left-turn lane into the site based on the safety benefits. A right-turn lane is also encouraged.

Safety Impacts for Installation of a Right-Turn Lane
Safety Impacts for Installation of a Left-Turn Lane

- **Right-turn Lane**: In this scenario, installing a right-turn lane had only a slight safety benefit.

Safety Effect of RT Lane Installation:	
Total Crashes (All Severities) w/Right-Turn Lane	3.55
Total Crashes (All Severities) w/o Right-Turn Lane	4.12
Base Condition: Intersection without right-turn lanes on major-road approaches.	

The right-turn lane has little safety impact in this example.

- **Left-turn Lane:** In this scenario, a new development with no existing left-turn demand, installing a left-turn lane can be expected to **reduce crashes by 66%.**

Safety Effect of Left-Turn Lane Installation	
Total Number of Crashes w/ Left-turn lane	2.76
Total Number of Crashes w/o Left-turn lane	4.12

The values shown are for a single driveway. If the applicant requested 5 driveways, then the total would be about 5 crashes (one per driveway) for similar traffic volume conditions, each with an estimated value of $137,600

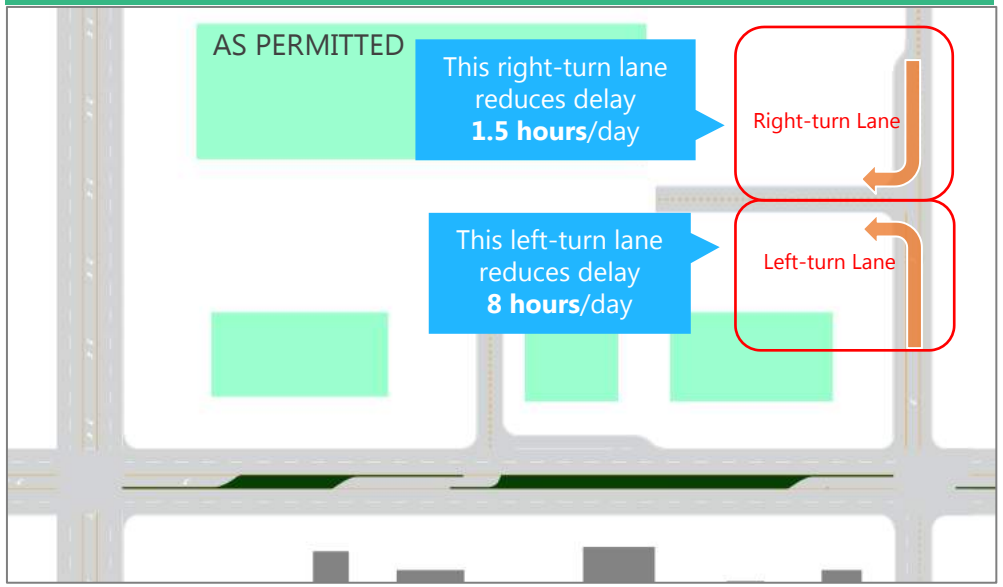
Example infographic for this scenario

Adding a left-turn lane reduces crashes by **66%**

Saving almost **$.3 million**

Permit Review

Permit Case Study



Outcome D:

Encouraged to provide better alternative access, the permit applicant was asked to add a driveway on the collector road with a right-turn lane and left-turn lane into the site at that location, as the collector was a two-lane road with a high volume of pedestrian traffic. On the arterial, only one primary driveway was approved for safety reasons.

Mobility Impacts for Installation of a Right-Turn Lane
Mobility Impacts for Installation of a Left-Turn Lane

Right-turn lane: The installation of a right-turn lane can be expected to reduce delay by as much as **1.5 hours/day**.

Adding a right-turn lane reduces delay by **1.5 hrs**

Outputs:

			Units
1	Estimated delay reduction for through vehicles	0.6	Seconds per through vehicle
2	Additional delay reduction due to pedestrian crossings (3)	1.0	Seconds per through vehicle
3	Total delay reduction (3)	1.6	Seconds per through vehicle

The delay reduction per vehicle is multiplied by the through volume in the direction of the right-turn movement where a right-turn lane would be provided to estimate the delay reduction for the peak hour. Based on a peak-hour volume of 800 through vehicles, providing a right-turn lane would reduce peak-hour delay 30 minutes. If there are 4 peak hours per day (e.g. 2 am and 2 pm), the daily peak period reduction would be 2 hours.

Left-turn lane: The installation of a left-turn lane can be expected to reduce delay **about 8 hours/day**.

Adding a left-turn lane reduces delay by **8 hrs**

Outputs:

			Units
1	Estimated intersection delay reduction for existing site	2.5	Seconds per Vehicle
2	Estimated intersection delay reduction for new development	4.7	Seconds per Vehicle

The estimated peak-hour total intersection volume is 1,640 vehicles (700 northbound through, 800 southbound through, and 140 southbound right turns). For a new development with no existing left-turn demand, providing a left-turn lane would result in a peak-hour delay reduction of about 2 hours. If there are 4 peak hours per day (e.g. 2 am and 2 pm), the daily peak period reduction would be about 8 hours.

Economic Talking Points

TALKING POINTS

For build-to-suit (build / flip) development

Profitability is important in determining priorities, as is safety, mobility, and aesthetics.

Refusal to thoughtfully consider access connections, intersection controls, and off-site improvements could expose developers and buyers to liability from increased crashes.

For smaller build-to-suit, "mom & pop" development

Thoughtful consideration of connections:

- Helps keep you and your customers safe.
- Helps maintain your market area over time.
- Means more options for your employees and customers to reach you.

While the initial costs of such thoughtfulness may be higher than a status quo approach to development, the gain is in greater employee and customer comfort, and better sustained property value over time.

For national, investment-grade development

Thoughtful consideration of access design:

- Helps attract and retain higher quality occupants.
- Helps stabilize revenue streams over time.
- Improves resilience against economic downturns by providing more modal options and more aesthetically pleasing spaces.

While the initial costs of such thoughtfulness may be higher than a status quo approach, the gain is in higher and better sustained property values.

Economic impacts, such as changes in gross sales, are dependent upon the type of businesses located along the corridor and the local economy. In this instance, the treatment contributed to a change in the industries present along the corridor. The number of retail businesses grew by 2, professional and business services grew by 1, and other services decreased by 1, **netting a gross sales impact of more than $6.5 million** to the corridor.

Year	Industry Description	Gross Sales	Outlet Count
2020	Retail Trade	4,076,830	+2
2020	Professional and Business Services	3,118,015	+1
2020	Hospitality and Leisure	0	
2020	Other Services	-655,709	-1
2020	Other	*	
	Net Change in Sales (constant dollars)	**$6,539,135**	

Site Design Expenses

Economic Values

Failure to thoughtfully consider access connections and off-site improvements results in "death by a thousand cuts". The network loses its ability to support market area.

Safety Value

Multiple driveways do not increase property value, and may even damage it by reducing area for parking, circulation and landscaping. The ability to efficiently move traffic into a site and to accommodate higher roadway traffic volumes at a reasonable level of service does increase property value.

Economic Value

While a signal increases the value of adjacent retail properties, the trade-off is a significant loss of market area and increasing congestion and delay.

Property Values

Thoughtful consideration of things like transit stops, space for rideshare drops, and walkability provides more opportunities for people to move about in the area. More bicycle and pedestrian activity on the street translates into more potential customer traffic.

Community Values

Additional Resources

National Manuals and Guidelines

- Williams, K., Stover, V.G. Dixon, K., Demosthenes, P., Broen, F., Brown, L., Huntington, D. Layton, R. & Seggerman, K. (2014). Access Management Manual, 2nd Edition. Transportation Research Board of the National Academies, Washington D.C.
- Dixon, K., Layton, R., Huntington, D., Gattis, J. L. Brown, L., Butorac, M., & Ryus, P. (2016). Access Management Application Guidelines. Transportation Research Board of the National Academies, Washington D.C.
- Butorac M., Bonneson J., Connolly K., Paul Ryus; Schroeder B., Williams K., Wang Z., Ozkul S., Gluck, J., National Academies of Sciences, Engineering, and Medicine. 2018. Guide for the Analysis of Multimodal Corridor Access Management. Washington, DC: The National Academies Press.

Federal Highway Administration

- FHWA. (2018). Safety Evaluation of Access Management Policies and Techniques. Publication No. FHWA-HRT-14-057
- FHWA. Proven Safety Countermeasures. https://safety.fhwa.dot.gov/provencountermeasures/
- FHWA. "Access Management: Driveways." n.d. Local and Rural Road Safety Briefing Sheets. FHWA-SA-14-080.
- FHWA, Technical Summary: Access Management in the Vicinity of Intersections, FHWA-SA-10-002 (Washington, DC: 2010).

NCHRP Reports

- Bonneson, J. and P. McCoy. (1997). NCHRP Report 395: Capacity and Operational Effects of Mid-block Left-turn Lanes. Transportation Research Board, National Research Council, Washington, D.C.
- Duncan, C. et al. (2019). NCHRP Report 917: Right-Sizing Transportation Investments: A Guidebook for Planning and Programming. Transportation Research Board of the National Academies, Washington, DC.
- Fitzpatrick, K., et al. (2013). NCHRP Report 745: Left Turn Accommodations at Unsignalized Intersections. Transportation Research Board of the National Academies, Washington, D.C.
- Gluck, J. & Lorenz, M. (2010). NCHRP Synthesis 404: State of the Practice in Highway Access Management. Transportation Research Board of the National Academies, Washington, D.C.
- Gattis, J., et al. (2010). NCHRP Report 639: Guide for the Geometric Design of Driveways, Transportation Research Board of the National Academies, Washington, D.C.
- Gluck, J., H. Levinson, and V. Stover. (1999). NCHRP Report 420: Impacts of Access Management Techniques, Transportation Research Board of the National Academies, Washington, D.C.
- Potts, I.B., et al. (2004). NCHRP Report 524: Safety of U turns at Unsignalized Median Openings, Transportation Research Board, Washington, D.C.
- Williams, K. (2004). NCHRP Synthesis 337: Cooperative Agreements for Corridor Management, Transportation Research Board, Washington, D.C..
- Williams, K (2002). NCHRP Synthesis 304: Driveway Regulation Practices, Transportation Research Board, Washington, D.C.

Local Government Programs

- Williams, K. (2020). NCHRP Synthesis 549 Incorporating Roadway Access Management into Local Ordinances. Washington, D.C.: Transportation Research Board of the National Academies.
- Williams, K. & Barber, J. (2017). Model Access Management Policies and Regulations for Florida Cities and Counties, 2nd Edition. Center for Urban Transportation Research.

State Manuals (recently updated)

- Florida Department of Transportation. (November 2019). Access Management Guidebook.
- Minnesota Department of Transportation. (March 2016). MnDOT Access Management Manual.
- Nevada DOT. (2017). Access Management Systems and Standards.

Go to www.accessmanagement.info for more resources and helpful information!

Toolkit Resources

Reports

NCHRP 1032 Final Report

Web Only Document

PowerPoints

Economic Value of Access Management.pptx

Livability Value of Access Management.pptx

Mobility Value of Access Management.pptx

Safety Value of Access Management.pptx

Ten Ways to Manage Roadway Access.pptx

Top 10 AM Issues.pptx

Value of Access Management Policies.pptx

Value of Managing Driveway and Unsignalized Access.pptx

Value of Medians and Median Openings.pptx

Value of Network Connectivity.pptx

Value of Signal Spacing.pptx

Value of Turn Lanes.pptx

Spreadsheets

MOBILITY TOOLS:

AM_Mobility_Tools Final Modules.xlsx

ECONOMY TOOLS:

Safety and Mobility Economic Value.xlsx

SAFETY TOOLS:

LT_3LegIntersections.xlsx

LT_4LegIntersections.xlsx

MedianOpeningNearSignalizedIntersection.xlsx

MedianTypeDwyDensity.xlsx

RT-3LegIntersections.xlsx

RT-4LegIntersections.xlsx

SignalizedIntersectionDensity.xlsx

UnsignalizedIntersectionDensity.xlsx

Brochures

10WaysToManageAccess 0205.pptx

Access Management Brochure 2020.pdf

Safe Access is Good for Business FHWA.pdf

Fact Sheets

Economic Fact Sheet.pdf

Four-leg LT Lane Safety Fact Sheet.pdf

Four-leg RT Lane Safety Fact Sheet.pdf

Livability Fact Sheet.pdf

Median and TWLTL Fact Sheet.pdf

Median Opening Signal Int Fact Sheet.pdf

Signal Density Safety Fact Sheet.pdf

Three-Leg LT Lane Safety Fact Sheet.pdf

Three-leg RT Lane Safety Fact Sheet.pdf

Unsignalized Driveway Density Fact Sheet.pdf

Mobility Fact Sheets Corner Clearance.pdf

Mobility Fact Sheets Driveway Spacing.pdf

Mobility Fact Sheets Left-Turn Lanes (Existing Driveway).pdf

Mobility Fact Sheets Left-turn Lanes (New Development).pdf

Mobility Fact Sheets Right-Turn Lanes (2L-arterial).pdf

Mobility Fact Sheets Right-Turn Lanes (4L-arterial).pdf

Mobility Fact Sheets Signal Progression.pdf

Mobility Fact Sheets Signal Spacing.pdf