


















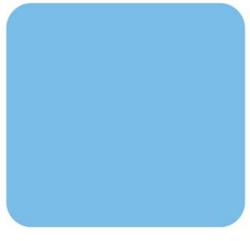






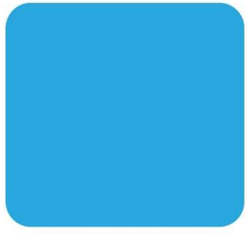

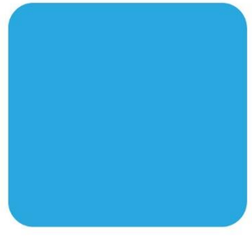

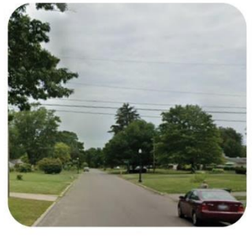

**DRAFT**

**3/23/2021**

# Slow Streets: Speed Management for Grid Network Neighborhoods

*City of Columbus*

*Department of Public Service*

*Division of Traffic Management*

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## Summary

The City of Columbus Department of Public Service (DPS) receives hundreds of traffic calming requests and speeding concerns yearly. While roadway characteristics vary, speeding concerns are consistently about safety, primarily for children, pedestrians, cyclists, and property. *Slow Streets Columbus* is intended to improve neighborhood traffic safety and walkability through design. The purpose of this study is to develop solutions to residents' concerns about transportation safety within their communities, analyze alternative solutions and develop an action plan for implementation.

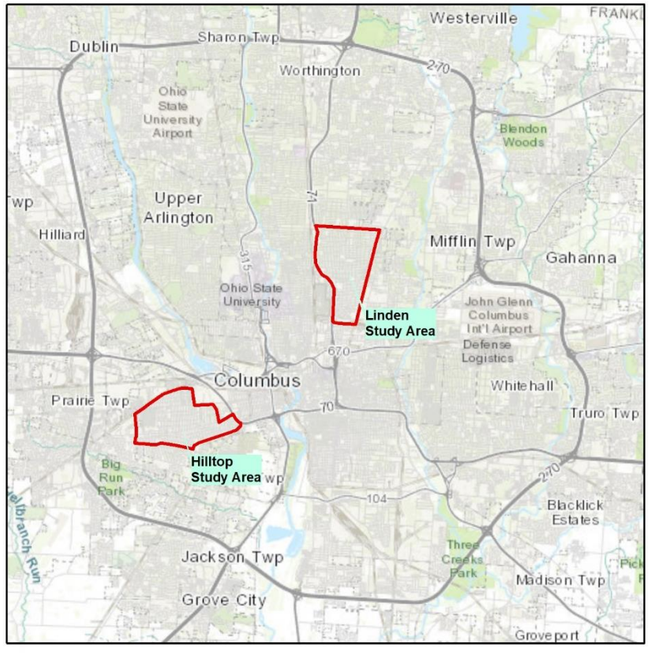
Traffic calming goals can be grouped into 3 general categories:

1. Concerns about speeding motorists
2. Concerns about the volume of vehicles and 'cut-through' traffic
3. Concerns about the safety of vulnerable users (pedestrians, bicyclists and motorcyclists)

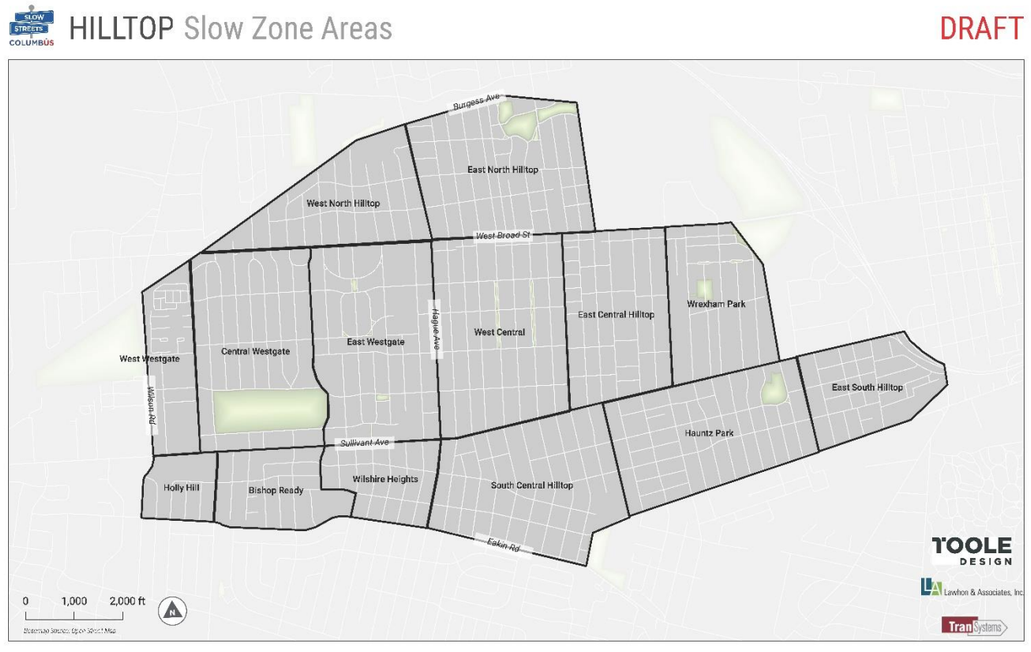
**Slow Streets presents recommendations in the form of an action plan, monitoring methods, and optional interventions. This report will also identify key gaps in available data and process improvements for future neighborhood evaluations.**

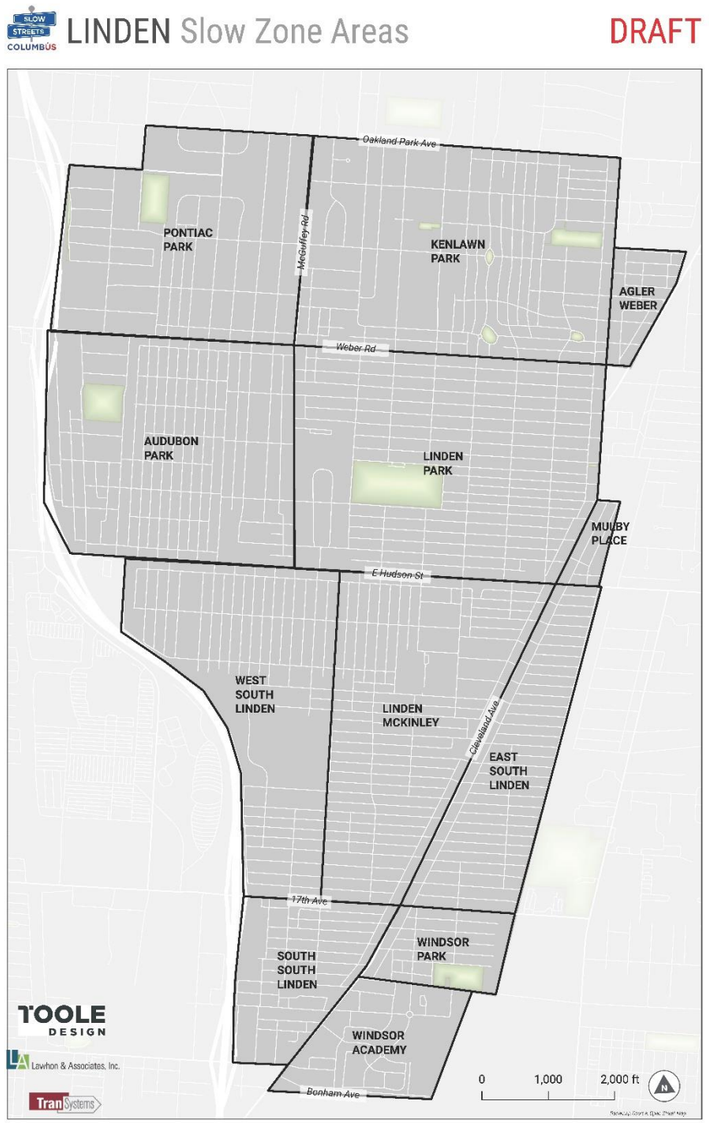
## 1. Background and Introduction

This report addresses the traditional, ***grid-network neighborhoods*** of Linden and The Hilltop. While, generally, these neighborhoods contain grid streets, the density and style of development can vary street to street. For development that occurred before WWII, garages and parking tend to be accessed by alleys, and sidewalk systems tend to be more complete. For postwar housing, neighborhoods were selected for study because they had largely been converted to one-way streets in past decades to promote faster travel through neighborhoods. The 1972 South Linden Area Plan recommended converting more streets to one-way only movements to improve traffic flow (efficiency/speed). Cities must now reconcile with this past trend. While one-way streets can reduce conflicts with pedestrians (pedestrians only check for traffic in one direction), other unintended consequences may occur. These unintended consequences include higher vehicle speeds, wrong way drivers, wayfinding issues and inefficient travel patterns.




At the beginning of the analysis process, the project team recognized that each neighborhood covers a large area and has a diverse roadway network that cannot receive a single comprehensive set of speed control recommendations. To manage the large array of input data and implement modifications that are relevant to smaller sections of each neighborhood, the project team divided each neighborhood into ***subareas***. The subareas have similar roadway characteristics, are comprised of low-volume residential streets, and are bounded by higher-use roadways. These subareas have been dubbed ***"Slow Zone"*** areas to correlate with similar programs launched in New York City, Boston, and Philadelphia. A detailed explanation of Slow Zone characteristics is found in Chapter 3. The following figures identify the Slow Zones that this study used for analyzing the Hilltop and Linden neighborhood data which are referenced extensively throughout the document. The boundaries of these zones are flexible and can be modified based on public input and transportation network needs.






The 2005 Linden Area Traffic Management Plan[1], as well as the One Linden Plan (2019)[2], recommend exploration of one-way to two-way conversion for local streets. *Slow Streets* takes that recommendation and expands it with a baseline feasibility analysis, as well as pilot project.

**YIELD STREETS**

Yield streets are streets that have curb-to-curb widths of between 24-28 feet, which includes on-street parking. These streets allow for two-way circulation but are narrow enough that vehicles must yield to one another to pass. Yield streets are typically low volume (fewer than 1,500 vehicles per day) access streets and do not have striped lanes. Traffic calming elements can be used to force cars to yield to each other but should not constrict overall mobility on the street or inhibit oversized vehicles.

The consideration of converting a one-way street to a two-way street is a large component of this study, but it is not the only tool in the toolbox. Conversions back to a two-way roadway can mimic other courtesy/yield street conditions that exist in other Columbus neighborhoods that have calmer traffic and lower vehicle speeds. These streets have slower typical speeds due to friction created where opposing vehicles must negotiate sharing a narrower travel way width.[3]

Other recommended tools beyond one-way to two-way conversion included in this report rely on altering driver behavior. These techniques may include gateway treatments, pavement markings, signage, placemaking, crosswalks, flexible posts/bollards and potentially more traditional vertical and horizontal traffic calming where indicated. Methods recommended and piloted because of *Slow Streets* may ultimately be applied in other neighborhoods citywide with similar land use context and roadway characteristics.

This report also acknowledges that there are reasons to promote speed management, in addition to neighborhood concerns and perceptions of safety. Other potential benefits of speed management include:

- Positive public health impacts: easing concerns about walking and biking, promote short trips by foot or bike
- Mode shift and supporting transit access: choosing ***active transportation*** for short trips or to access transit stops
- Air quality and Sustainable Columbus goals: *Bloomberg 2020 American Cities Climate Challenge and Sustainable Columbus goals*

Speeding concerns are indicative of increased discomfort for non-motorists, impacting both perceived and real safety, emphasizing the vulnerability of pedestrians and cyclists of all ages. Unresolved speeding concerns contribute to walkers or pedestrians, bicyclists and motorcyclists' injury and death. Between 2008 and 2017, pedestrian deaths

[1] 2005 Linden Area Traffic Management Plan
[2] One Linden Community Plan

[3] Columbus Street Design Guide Draft

increased by 35.4% nationally, while vehicle miles traveled (VMT) increased by 8.1%. In Central Ohio, there was a 62% increase in pedestrian fatalities from 2013 – 2017.

Nearly 30% of all fatal traffic crashes nationally are a result of speeding. A disproportionate amount of these fatalities occurs in census tracts with high levels of poverty. Columbus is not immune to this trend, and data shows that census tracts in Columbus with a poverty rate greater than 25% experience a pedestrian death rate of 10.7 people per 100,000. This rate is nearly double the national average of 4.5 deaths per 100,000 for census tracts with a less than 15% poverty rate.[4] While speeding impacts many communities, underserved and impoverished communities are far more susceptible to vulnerable user roadway deaths.

By easing safety concerns, residents would be more comfortable and confident in making short trips by foot or bike, improving public health by increasing physical activity while reducing greenhouse gas emissions. Addressing neighborhood traffic safety concerns may also reduce barriers for residents to access transit stops. The City of Columbus seeks to increase level of comfort on neighborhood streets to improve multimodal transportation options, enhance livability and quality of life in neighborhoods by reducing motorist travel speeds and promote neighborhood connectivity.

Neighborhood streets that are safe, livable, and appealing for walking and biking not only strengthen a sense of community but also promote active transportation for mobility and exercise. Calmer streets may activate an unknown demand for residents to walk, bike, and access transit where they may otherwise be deterred by traffic volumes and/or speeds. Short trips can be shifted to other modes when it is more comfortable for people to walk and bike, while residents with disabilities can more safely travel through their neighborhoods.

While this study focuses on recommendations for the Linden and Hilltop Communities, the purpose is also to develop a methodology for traffic calming recommendations that can be applied to other residential areas. These recommendations may be most effective when applied to similarly laid-out and designed neighborhoods, however certain elements of this strategy may also apply to residential streets with a more suburban design or local streets that range from 26-28 feet in width.

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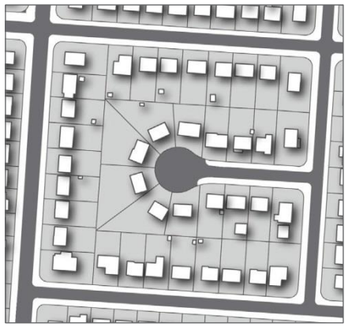
[4] Mike Maciag. Governing, 2014, pp. 2–4, *America's Poor Neighborhoods Plagued by Pedestrian Deaths*.

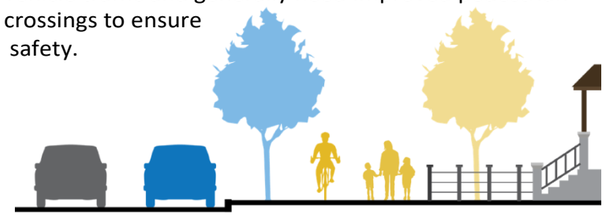
**GENERAL URBAN**

***General urban areas*** have a compact, urban feel, but are not within the Urban Center. Streets within these areas may have commercial, residential, or mixed land uses, and buildings are generally located close to the street. Densities in these areas may be lower, and more neighborhood scale.

**SUBURBAN**



***Suburban areas*** typically serve low density employment centers, institutional areas, or residential land uses where buildings are set back from the road and spread farther apart. These areas are dominated by motor vehicle traffic and generally need improved pedestrian crossings to ensure safety.



## 1.1 Envision Hilltop and One Linden Neighborhood Plans

The One Linden Plan (2018) and Envision Hilltop Plan (2020)[5] both solidify the importance of Slow Streets and the selection of these two neighborhoods for study.

Both neighborhoods were developed in similar time periods and are denser and more compact compared to the City of Columbus average. The pattern of development in Hilltop and Linden is advantageous in promoting active transportation for neighborhood mobility. Further, community surveys indicated a strong preference for promoting safe mobility for pedestrians and bicyclists.

Both neighborhoods also have a higher average of one-car and no-car households, leading to a reliance on alternative means of transportation, specifically walking, cycling, and using public transportation. Given this context, the neighborhoods have a high number of vulnerable roadway users and are therefore more susceptible to traffic violence.

[5] Envision Hilltop Plan 2020

Community responses from The One Linden Plan and the Envision Hilltop Plan noted a high degree of concern for neighborhood safety. The Linden community noted residential speeding as a major weakness for the community, while the Hilltop Community ranked concerns of speeding above gun violence and drug activity. Both communities expressed strong support for slowing speeds on their residential streets and providing safe mobility for all residents regardless of their means of transportation.

## 1.2 Aligned Initiatives

### Vision Zero Columbus

The City of Columbus announced its commitment to Vision Zero, a nationally recognized approach to promoting traffic safety, in March of 2020. Vision Zero includes the ethical belief that “everyone has the right to move safely in their communities, and that system designers and policy makers share the responsibility to ensure safe systems for travel”.

Speed management will be an integral part of Vision Zero Columbus, as speeding directly effects neighborhood quality of life and livability, perception, and safety. As the Vision Zero Columbus Action Plan is developed, a “High-Injury Network” will be completed that shows locations where there are have been serious injury and fatal traffic crashes as well as vulnerable roadway user crashes.

A ***vulnerable roadway user*** includes pedestrians, wheelchair users, motorcyclists, and bicyclists; or generally people using the roadways and sidewalks that are not protected by being contained inside a motorized vehicle. These users are significantly over-represented in fatal and serious injury crashes compared to the total number of crashes. Vision Zero Columbus data indicates that bicyclists are approximately 6 times more likely than a motorist to die or be seriously injured in a crash; pedestrians are 14 times more likely, and motorcyclists are 16 times more likely. Pedestrians accounted for less than 1% of the units involved in all crashes, but they represented more than 12% of all fatal and serious injury crashes in the Central Ohio Region. More than 20% of all pedestrian crashes resulted in a fatality or serious injury, while more than 19% of all motorcycle crashes and nearly 10% of all bicycle crashes resulted in a fatality or serious injury.[6]

### Speed Management Framework

The Department of Public Service and Mid-Ohio Regional Planning Commission (MORPC) (see appendix D, Map 1) are currently developing a broad speed management and traffic calming framework to assist in prioritizing among the various residential areas. This framework will include methods for project prioritization and project boundary selection methods for existing local streets as well as collector and arterial roadways. Ultimately, this framework will allow for traffic calming to be planned in a consistent, neighborhood-wide fashion, rather than spot treatments which may result in unintended impacts on adjacent streets.

### Neighborhood Equity

Neighborhoods are the top priority of Mayor Andrew Ginther, who has launched several initiatives to promote the health, safety, and wellbeing of all Columbus residents regardless of the neighborhood they call home. His neighborhood focus was further solidified in February 2020 when Mayor Ginther launched his equity agenda. Recognizing that residential speeding is a concern across our city of neighborhoods, focusing on speed management through an equitable perspective is vital. As previously discussed, low income and minority communities have a higher statistical probability of being a victim of traffic violence, largely because many of the households rely on forms of transportation other than a single occupancy vehicle.

[6] Central Ohio Transportation Safety Plan (2019) pg 24, Figures 7 & 8

### Central Ohio Transportation Safety Plan (2019)[7]

The Mid-Ohio Regional Planning Commission issued the *Central Ohio Transportation Safety Plan* in 2019 which identifies the most significant causes of serious injuries and fatalities on the local roadway system. One of the resulting goals was to reduce the number of non-motorized fatalities and serious injuries by 8% from 2017 to 2025. Lowering the speed of motor vehicles will help achieve this goal.

Vehicle speed has a significant influence on the survival rate of pedestrians struck in a collision. Speed influences stopping distance – the delay between when a driver sees a pedestrian or cyclist and when they can stop the vehicle. When a motor vehicle travelling at 20 mph strikes a pedestrian, that pedestrian has a 90% chance of survival. When the speed of that motor vehicle doubles to 40 mph, the pedestrians' chance of survival drops to 10%. This demonstrates why vehicular speeds over 25 mph in neighborhoods can discourage residents from choosing active transportation options for short-distance trips or to access nearby transit modes.

### Cleveland Avenue Pedestrian Improvement Project

The City of Columbus initiated a design project to upgrade seven pedestrian crossings on Cleveland Avenue in North Linden between 5th Avenue and Lehner Avenue. The project will provide five crossings with Rectangular Rapid Flashing Beacons and two crossings with Pedestrian Hybrid Beacons. In conjunction with the pedestrian improvements, the City is launching an outreach and educational campaign on pedestrian safety. As the project installation approaches, the City will team with schools, libraries and recreation centers to perform outreach on using the new crossing devices.

## 1.3 Desire for more active transportation options

Communities – including historically car-centric communities – are increasingly seeking improved access to active transportation options. Support of and investment in active transportation is an overall net positive. Studies have shown that increased use in active transportation results in several positive community impacts. These include better air quality[8] stronger housing values[9] and positive health effects.[10] It is essential to support safe, accessible active transportation, especially for historically marginalized and at-risk communities.

## 1.4 Perceptions, Data, and Success

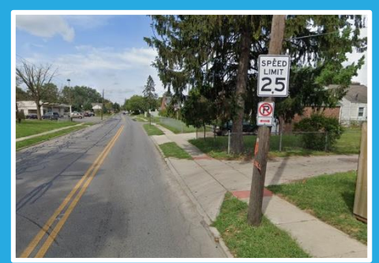
Acknowledging that all streets, even those with calming treatments, still experience drivers speeding over the posted limit or driving faster than conditions should allow, how do we determine success?

Prior to measuring success, the following two points must be considered:

1. **People believe that speeding is only defined as travelling above the posted speed limit.[11]**
   For years, transportation officials have aimed to bring driver speeds down to the posted speed limit, as opposed to below the posted speed limit. However, the posted speed limit should be the *maximum* travel speed in optimal conditions on any given roadway. When optimal conditions (i.e. dry roadway surface, clear sight lines) are not present, or there are other given roadway attributes (yield streets, school zones, pedestrian or bicyclist activity), the driver should be expected to adjust their travelling speed to below the posted speed limit to accommodate increased hazards. The posted speed limit should not seem appropriate under sub-optimal conditions.
2. **Streets that already have traffic calming and optimal complete street conditions still experience some degree of speeding.**
   While speeding and reckless driving can be reduced significantly, it is impossible for jurisdictions to eliminate it. Poor driver behavior, even when greatly reduced, can still result in negative outcomes which impact both vulnerable users and private property. Strategies exist to combat poor driver behavior, but it must be recognized that even under the best conditions and under the best speed management practices speeding is still likely to occur. The goal of this initiative, as well as the other previously mentioned aligned initiatives, is to encourage the safest behaviors from all roadway users in our Columbus communities.

A review of the Columbus Service Center requests, also known as ***"311" requests***, made by residents compared to available speed data reveals that the requests alone do not reliably show where speeding is happening most frequently. The tables on the following page show crash and speed ranking by Slow Zone area, compared to each Zone's 311 ranking. Many factors influence why some locations tend to have more 311 requests than others, including community cohesion, residential density, language barriers, awareness, and trust in the 311 system, and available resources to contact 311 (time, phone or internet access, effort).

Locations that would receive the greatest benefit from traffic calming interventions should be identified based on data-driven decision-making, such as reviewing the actual crash reports and ***85th percentile speeds*** for the roadway segment. The 85th percentile speed is one at or below which 85% of vehicles are traveling; it is typically considered the speed at which most drivers are comfortable operating on a specific roadway. Residents may perceive that their area is experiencing speed-related or crash concerns that are not reflected by data. For instance, in the Hilltop area, the location with the highest rate of crashes per mile of roadway and with the second highest recorded 85th percentile speed is ranked in the middle of the 311 requests. However, the Hilltop area with the most 311 requests is in the lower third for crashes per mile of roadway and in the middle of the 85th percentile speed ranking. In Linden, the area with the highest crash rate and highest recorded 85th percentile speed was ranked 7 out of 12 subareas for 311 requests. A process that uses data to identify appropriate countermeasures and implementation schedules will make the most of limited resources while also addressing the areas experiencing the most problematic behaviors.




**85th Percentile Speed**

When speed and volume data are collected for a given roadway segment, the 85th Percentile Speed is the speed at or below which 85 percent of drivers are travelling. For example: on a 35-mph roadway if 85% of motorists are driving at or below 38 mph the 85th Percentile speed would be 38 mph.

[7] Central Ohio Transportation Safety Plan 2019
[8] Safe Routes to School Research: Air Quality and Environment
[9] Urban Land Institute: Active Transportation and Real Estate: The Next Frontier. Washington, D.C.: The Urban Land Institute, 2016
[10] Saelens B, Sallis J, Black J, Chen D. Neighborhood-based differences in physical activity: an environment scale evaluation. American Journal of Public Health 2003;93(9):1552-1558
[11] FHWA Synthesis of Safety Research Related to Speed and Speed Management

| Hilltop Slow Zone Area Data Rankings | | | |
|---|---|---|---|
| *Subarea Name* | Crash ranking | 85th %tile speed ranking | 311 ranking |
| *South Central Hilltop* | 1 | 2 | 6 |
| *West Central Hilltop* | 2 | 6 | 2 |
| *East Central Hilltop* | 3 | 13 | 3 |
| *Wrexham Park* | 4 | 12 | 4 |
| *Wilshire Heights* | 5 | 3 | 10 |
| *West North Hilltop* | 6 | 5 | 7 |
| *Holly Hill* | 7 | 11 | 13 |
| *Hauntz Park* | 8 | 4 | 5 |
| *East North Hilltop* | 9 | 8 | 8 |
| *Central Westgate* | 10 | 7 | 1 |
| *East Westgate* | 11 | 1 | 9 |
| *East South Hilltop* | 12 | 14 | 11 |
| *Bishop Ready* | 13 | 9 | 14 |
| *West Westgate* | 14 | 10 | 12 |

| Linden Slow Zone Area Data Rankings | | | |
|---|---|---|---|
| *Subarea Name* | Crash ranking | 85th %tile Speed Ranking | 311 ranking |
| *West South Linden* | 1 | 1 | 7 |
| *Pontiac Park* | 2 | 6 | 1 |
| *South South Linden* | 3 | 2 | 8 |
| *Linden Park* | 4 | 9 | 2 |
| *Linden McKinley* | 5 | 7 | 5 |
| *Windor Academy* | 6 | 8 | 11 |
| *East South Linden* | 7 | 5 | 6 |
| *Audubon Park* | 8 | 4 | 3 |
| *Kenlawn Park* | 9 | 3 | 4 |
| *Windsor Park* | 10 | n/a | 10 |
| *Agler Weber* | 11 | 10 | 9 |
| *Mulby Place* | 12 | n/a | 12 |

Both tables indicate that public feedback does not always correlate to driver behavior or problems experienced on the roadways. However, public input from area residents can provide very useful guidance about issues that are not easily quantified, such as lack of comfort for active transportation users.

[12] Hilltop Community Mobility Plan Executive Summary

Traffic volume, such as ***Average Daily Traffic (ADT),*** or the number of vehicles present during hours of peak pedestrian demand should also be part of the decision-making process. Streets with higher traffic volume may experience lower speeds but increase pedestrian exposure to motorized traffic. Lower volume streets are likely to experience higher vehicular speeds and may require a different type of calming approach.

## 2. Existing Conditions and Legacy Traffic Calming Plans

### 2.1 Previous Efforts in Hilltop and Linden

Community Mobility Plans were developed more than a decade ago to recommend possible treatments in both the Linden and Hilltop study areas.[12] These plans called for spot treatments for traffic calming, such as speed humps, traffic circles, speed tables and chicanes. However, these plans did not address funding strategies for long-term implementation and construction. Therefore, a small number of spot treatments from the original plans were installed with limited funding. Since not all aspects of the plan were applied consistently, neighborhood-wide results were not achieved.

When DPS assessed citywide excess-speed concerns based on available data and 311 requests in 2017-2018, it became apparent that a trend was emerging in grid network one-way streets. A review of these concerns also noted wrong-way drivers, sidewalk gaps, and other concerns including a desire for street lighting.

In the Linden study area, previous traffic calming treatments include the installation of 12-ft, 14-ft and 22-ft speed humps, chicanes, intersection speed tables, medians, and traffic circles. Mapping indicates that these installations focused on higher volume "***local collectors***" or local roads such as McGuffey Road, Oaklawn Street, Minnesota Avenue, and Hiawatha Park Drive. A general overview of the existing traffic calming device mapping for the Linden area shows a focus on calming specific corridors, with a handful of individual devices on a select number of blocks adjacent to the primary calming corridors. A few intersection tables are located near pedestrian hot spots of Linden Park/Recreation Center and Linden McKinley High School.

In the larger Hilltop study area, previous traffic calming treatments include 12-ft, 14-ft and 22-ft speed humps, chicanes, intersection speed tables and traffic circles installed on a very limited number of higher-volume local roads. Devices were installed on some streets, such as S. Roys Avenue, N. Eureka Avenue, and S. Whitethorne Avenue. There is one chicane on Lechner Avenue where it becomes one-way south of Floral Avenue. The existing mapping for the Hilltop area indicates that traffic calming was focused on specific corridors that tended to be used as "cut-through" routes between the ***arterial corridors***, particularly if they were adjacent to pedestrian destinations such as parks and schools. There were no devices installed on roadways adjacent/parallel to any of the corridors treated.

Research has shown that a ***spot-treatment approach*** to traffic calming has undesired or unintended consequences. Placing too few devices, either improperly spaced or not covering the entire area of concern, can have the effect of encouraging speeding between installations or redirecting the problem to adjacent blocks. Targeting speed reduction in a very limited area gives the impression that speeding is not a concern on blocks that do not have calming in place, leaving some residents with a feeling that their speeding concerns are not being addressed.[13]

A lack of comprehensive traffic calming measures can lead to frustration for both drivers and residents. Approaching traffic calming on a street-by-street basis can disrupt the sense of community for the surrounding neighborhood by changing the character of traffic on adjacent streets. Creating routes within residential neighborhoods that favor

[13] *Traffic Calming: State of the Practice*, Chapter 3 ITE/FHWA, August 1999

vehicular traffic more than other streets can have non-traffic related impacts such as discouraging active transportation, suppressing interaction between neighborhood residents, and encouraging non-residents to intrude on neighborhood areas.

## 2.2 Previous Citywide Methods for Traffic Calming

In addition to the community mobility plans developed for Hilltop and Linden, similar plans were also developed for Weinland Park and Strawberry farms. The community mobility plans had various levels of implementation which were often spot treatments prioritized and funded out of UIRF funding (Urban Infrastructure Recovery Funds). Because of incomplete implementation, evolving best practices, cost and maintenance barriers, the Slow Streets and Traffic Calming Toolkit update was initiated.

Prior to DPS's current effort to develop a broad framework for prioritization, locations of traffic calming projects were primarily identified based on complaints and/or petition drives. In some circumstances, small numbers of residents used the 311-reporting system to log numerous complaints for the same location. The practice of lodging repetitive complaints required city staff resources to research and provide timely and appropriate feedback with each complaint filed, not with each location. This resulted in DPS personnel responding multiple times to an identical report. Residents also use petition drives to direct attention to their location. Petition drives can have the effect of focusing efforts on a highlighted location, without consideration for similar locations with greater issues.

Equity concerns arise from setting priorities based upon repetitive complaints and petition drive locations. For example, some residents may not feel comfortable using the reporting system due to language barriers, computer/internet access issues, or being unfamiliar or uncomfortable with interacting with government agencies. The petition drive approach requires residents to recruit a critical mass of neighbors to attract attention to their area. That type of neighborhood connection is stronger in some parts of the study areas compared to others, meaning that the more-connected neighborhoods were more likely to benefit from this approach.

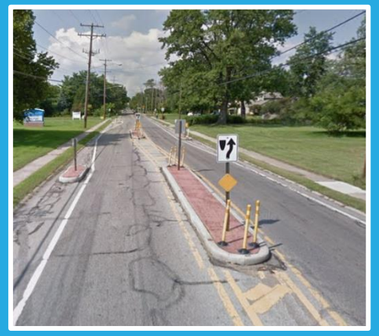
## 2.3 Lessons Learned

Streets in many areas of the city, not just in Linden and Hilltop, were converted to one-way streets many years ago while other streets remained two-way. Some streets were only partially converted, having both one-way and two-way segments. This can create confusion for visitors and non-compliance with residents when a destination is visible yet requires navigation through a series of one-way streets. While driving the wrong way for a portion of a residential block may not seem like a serious infraction, it presents issues for other drivers as well as pedestrians and cyclists who are not expecting wrong-way traffic.

As previously noted, past plans relied on the installation of horizontal and vertical deflections such as speed humps and bump outs. ***Horizontal deflections*** (ie. traffic circles, medians, curb extensions, and chicanes) require consideration of infrastructure costs and maintenance such as drainage fixes, curb reconstruction, landscaping maintenance, and sign replacement***. Vertical deflections*** (ie. speed humps and intersection tables) tend to be lower in cost and require less frequent maintenance. Speed humps tend to only need periodic maintenance that occurs with other street resurfacing projects.

Because many of the recommended horizontal deflections were inconsistently applied as funding allowed, they have led to increased infrastructure costs without the intended neighborhood-wide results.

An example of this outcome in Linden are the chicanes on Hamilton Avenue and Maize Road, and median islands at Weber Road & Medina Avenue, and Weber Road & Ontario Avenue. An example of a properly operating chicane is on Lechner Avenue in Hilltop. Resident concerns persist because these traffic calming measures have a temporary impact at a particular site, but some motorists speed up after passing through the device.



### MAIZE ROAD CHICANE

The Maize Road chicanes were installed between Norris Drive and East Cooke Road as an outcome of the 2010 Community Mobility Plan. The chicanes were removed in 2011 after numerous community complaints and motorists/vehicles hitting the chicanes and veering into surrounding properties. A common complaint was that drivers would speed through the chicanes in order to make the lights at the intersections to the north and south.

### MEDINA AVENUE MEDIAN ISLAND

Medina Avenue median island, installed as a result of the 2005 Community Mobility Plan. While most motorists slow to make the turn at this location, the median is also run over frequently, and the sign is knocked down regularly. The City also receives concerns from EMS and Refuse drivers about the ease of making this turn in large vehicles.

### LECHNER AVENUE CHICANE

Lechner Avenue chicane, installed as a result of the 2010 Community Mobility Plan. This chicane is effective, but is the only calming device along this roadway, leading to speeding concerns along the rest of the street. This also marks the beginning of a one-way street that directly connects two arterial thoroughfares (Broad Street to Sullivant Avenue).

# 3. A New Approach to Speed Management

Methods for speed management have varied over the years and include actions such as converting two-way streets to one-way streets, altering stop sign locations, and installing various traffic calming devices such as speed humps and intersection tables. Most of these measures are implemented in reaction to citizen requests or crash experiences. As previously mentioned, while past efforts have been made in good faith, they have been shown to result in unintentional and negative consequences. Effective speed management must be neighborhood focused so that it compliments a sense of place, holistic to ensure the proper tools are being implemented, and most importantly equitable.

Cities throughout the United States have developed Slow Zone programs often in conjunction with their Vision Zero programs. In New York City, where Neighborhood Slow Zones have been implemented, there has been a 10-15% decrease in speeds, a 14% reduction in crashes with injuries, and a 31% reduction in vehicle injuries.[14] Key elements of other slow zone processes and implementation include:

- Slow Zone gateway treatments, including signage and branding.
- A reduction in the speed limit from 25mph to 20mph.[15]
- A community-led approach. The community must submit an application that defines a potential slow zone area and demonstrated local support for traffic calming measures. The city or DOT then works with the community to develop a traffic calming plan. Many citizens want safer streets but can be upset if a program is implemented without their input or knowledge, leading to complaints and pushback. Community support is vital to the success of these programs and can foster better relationships between communities and government entities if done properly.
- A context-sensitive application of traffic calming measures. Traffic calming devices are determined based on community input, community amenities, and available data.
- Vertical deflection, such as speed humps or raised crosswalks, is the predominant device used to address speeding. Vertical deflection often has a more significant impact on speed reduction than other traffic calming devices.

The methodology for defining a slow zone area and developing a traffic calming plan presented in Sections 3.3 and 3.4 were created for neighborhoods within the City of Columbus, OH, and based on the following case studies:

**New York City, NY - Neighborhood Slow Zones**

https://www1.nyc.gov/html/dot/html/motorist/slowzones-list.shtml

**Boston, MA – Neighborhood Slow Zones**

https://www.boston.gov/transportation/neighborhood-slow-streets

**Philadelphia, PA – Vision Zero: Neighborhood Slow Zones**

http://visionzerophl.com/uploads/attachments/cjnf3viet0cxrszd6t9fpvpc5-file-slowzoneapp.pdf

[14] New York City DOT, Neighborhood Slow Zones

[15] In Ohio, Section 4511.21 of the Ohio Revised Code sets speed limits for all roadways throughout Ohio. An engineering study is necessary to reduce the speed limit.

## 3.1 Neighborhood Approach

Traffic calming strategies were still evolving when the Community Mobility Plans were created. Current best practices and approaches have shifted as outcomes have become available both locally and nationwide.

Previous practices consisted of identifying streets that had problematic vehicular behavior and applying devices to discourage that behavior. This approach often resulted in a shift of the problematic behavior to similar adjacent streets, without a plan for mitigating that impact. Experience from early projects indicated that traffic calming should be implemented "on an areawide basis, but not over such a wide area that it becomes difficult to achieve consensus on a plan."[16]

Rather than focusing on single routes or streets, a neighborhood sensitive approach to traffic calming is considered more appropriate. Treating all neighborhood residential streets as "equal" helps maintain the sense of place (important for walkable neighborhoods) and guides drivers to find "local collector" routes to travel outside of the neighborhood area.

A neighborhood approach to traffic calming requires that the street network has an established hierarchy of use. Most streets will be focused on providing access to and from residential properties within the neighborhood. Specific streets, typically on the boundary of the Neighborhood Slow Zone, support traffic entering and exiting the Slow Zone while also providing a route around the Zone for vehicular through traffic. These streets typically support neighborhood businesses and have a higher level of traffic control devices, such as traffic signals or 4-way stop-controlled intersections, than the streets located inside the Zone. The "boundary" streets usually connect to arterial roadways that provide access outside of the Slow Zone.

## 3.2 Equitable Allocation of Resources

To ensure an equitable application of funds, DPS is establishing a data-driven approach to selecting residential neighborhoods for implementing traffic calming plans. This approach may review measurable issues related to traffic calming needs, such as current travel speeds, traffic volume, crash history, pedestrian exposure to traffic, and presence of pedestrian/cycling routes and/or destinations. The purpose of using a data-driven approach is to ensure that areas of need are not overlooked because they lack a vocal advocate or a critical mass of residents raising their concerns.

An equitable approach identifies preferred neighborhood travel patterns for vehicles traveling in and around the residential areas and establishes traffic calming installations that treat all similar streets with the same level of calming.

[16] Traffic Calming: The State of the Practice ITE/FHWA, 1999; Chapter 3, pg 63

## 3.3 How to Define a Neighborhood Slow Zone Area

Slow Zones Areas are defined as residential areas where safety measures are implemented to change driver behavior. The goal of the Slow Zone Areas is to lower the frequency and severity of crashes. Slow Zones also hope to improve residents' quality of life by creating safe and comfortable streets for all roadway users. A Slow Zone can be defined by city staff or by the community and, in both instances, should have strong community support. Community engagement can also help city staff determine key community amenities and possible data gaps discussed in Steps 2 and 3.

**Step 1: Determine Slow Zone Extents**

Slow Zones should:

- Be made up of residential streets only
- Be one-lane, one-way streets and/or two-way streets without a ***painted centerline***
- Be approximately a quarter to a half-mile in total area,
- Not include major commercial areas or industrial sites.

Slow Zones boundaries can be defined as:

- Busy streets, including collectors, arterial roads, parkways, highways, and interstates. These can be generally defined as streets with painted center lines and/or multi-lane one-way streets.
- Large parks or cemeteries
- Railroad tracks or embankments
- Large commercial developments or industrial sites
- Large bodies of water

**Step 2: Identify Community Amenities**

Community area destinations within or on the boundary of the Slow Zone may include any of the following:

- Schools;
- Columbus Metropolitan or community libraries;
- Parks & recreation sites;
- Senior housing and/or public housing communities;
- Groceries, markets, or convenience stores;
- Religious institutions;
- Hospitals, clinics, police stations, and/or firehouses.

**Step 3: Collect Available Data and Identify Gaps**

Collect existing data to inform the traffic calming implementation plan and to determine if additional data collection is necessary. Data should include:

- Columbus 311 reports related to speeding
- Crash data
- Existing traffic calming devices
- Multimodal traffic control patterns
- Motor vehicle traffic speed and volume data where available
- Parking studies

Often, Columbus 311 reports and crash data are the first indications that speeding or safety issues exist. These sources may lay the groundwork for defining a slow zone and implementing a traffic calming plan. 311 reports and crash data may also help determine the appropriate type and level of treatments based on crash or complaint types. However, Columbus should consider a broad spectrum of data sources that balance various communities' needs, rather than emphasizing a single input. For example, in lower-income areas and neighborhoods of color, speeding is likely underreported in 311 data. Over the long-term, this could lead to biased implementation in favor of more affluent communities and a scarcity of traffic calming measures where they are most urgently needed in under-resourced neighborhoods. Like its Vision Zero initiative, Columbus should take a proactive approach to Slow Zone data collection to ensure an equitable allocation of transportation funding. 311 data and other sources listed above should be supported with ongoing community engagement to understand residents' safety and mobility concerns. Regular “spot” speed studies should also be considered to determine whether lower-income areas and neighborhoods of color are disproportionately affected by speeding. In addition, because of the inherent bias in 311 data, it should not be used in project prioritization methods.

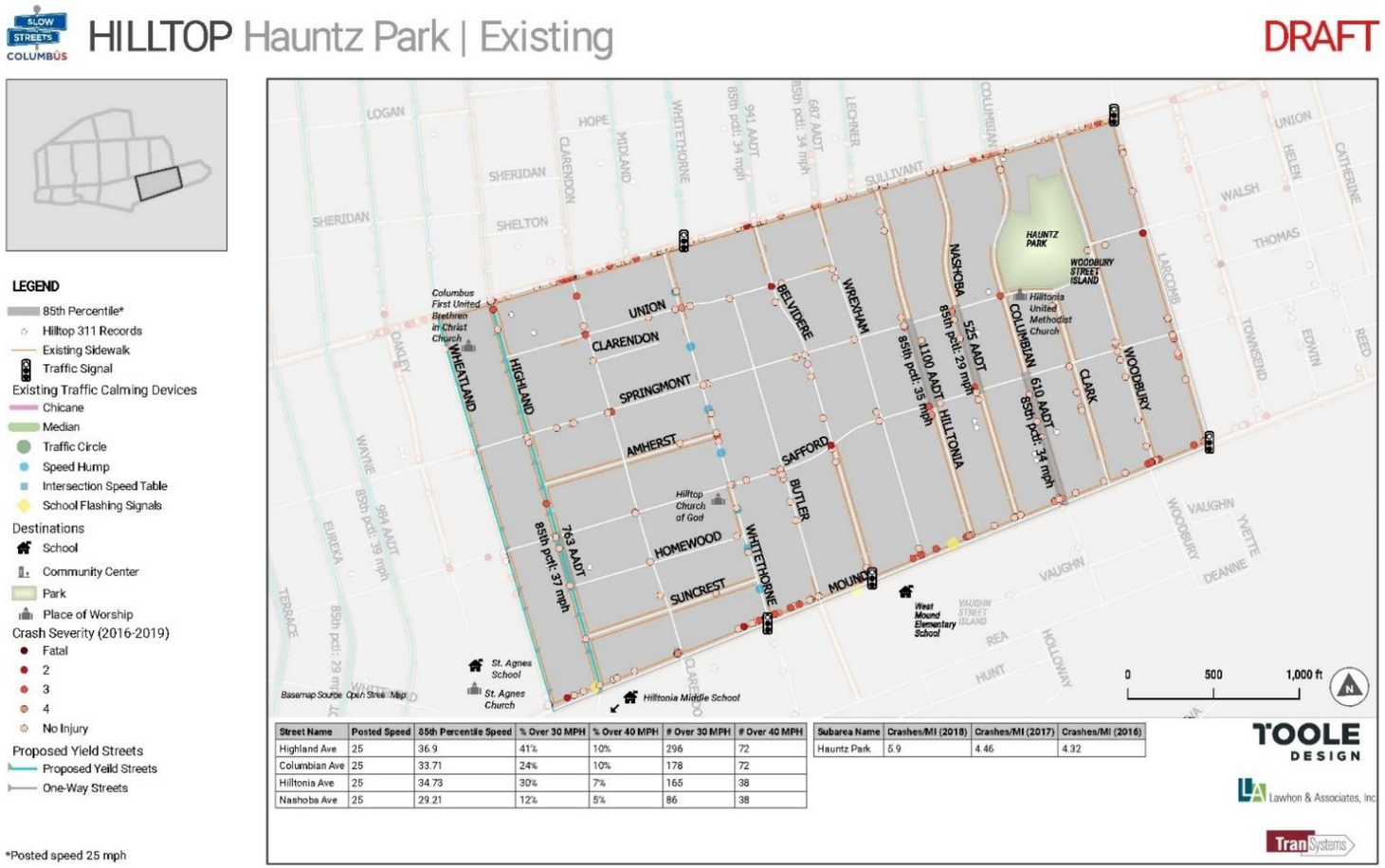
Existing traffic calming devices and traffic control patterns will influence driver behavior and should be considered. Additionally, if most intersections are two-way controlled and only one direction receives a stop (e.g. all east/west streets are stop-controlled while north/south streets are uncontrolled), higher speeds may occur on the streets that are uncontrolled.

It is not always necessary or feasible to collect speed data for every street. Streets that are physically alike and provide similar connections should be grouped together (i.e., streets with the same destinations, streets connected to the same collector or arterial roadways). Once grouped, ensure that speed data is available or collected for at least one street representative of the group. It can be generally assumed that if speeding is present on any one of a group of streets, speeding is present under existing conditions or will become an issue if traffic calming devices are implemented on only one or some of the grouped streets. As discussed in previous sections, when traffic calming measures have been installed, speeding issues often shift to another street if that street serves a similar purpose and is available without traffic calming devices. Engineering judgment should be applied and documented when grouping streets and making assumptions based on available data.

In some instances, motor vehicle traffic volumes may be necessary to determine if a traffic calming measure is appropriate. For example, advisory shoulders and yield streets should not be implemented over a set volume threshold (see sections 4.3 and 4.5 for more information on these treatments). As the traffic calming plan is developed, it may be necessary to collect motor vehicle traffic volume data to evaluate some traffic calming devices' feasibility.

On-street parking can also have a traffic calming effect when there is sufficient parking use throughout the day. When parking occupancy drops below 40%, speeds may increase due to the perceived increase in available street width and lack of vertical friction. Parking data can help to inform why drivers speed and what types of traffic control devices may be appropriate (e.g. bump outs/pinch points to fill underutilized space).

Example: Hauntz Park Slow Zone – Hilltop Neighborhood




| Street Name | Posted Speed | 85th Percentile Speed | % Over 30 MPH | % Over 40 MPH | # Over 30 MPH | # Over 40 MPH |
|---|---|---|---|---|---|---|
| Highland Ave | 25 | 36.9 | 41% | 10% | 296 | 72 |
| Columbian Ave | 25 | 33.71 | 24% | 10% | 178 | 72 |
| Hilltonia Ave | 25 | 34.73 | 30% | 7% | 165 | 38 |
| Nashoba Ave | 25 | 29.21 | 12% | 5% | 86 | 38 |

| Subarea Name | Crashes/MI (2018) | Crashes/MI (2017) | Crashes/MI (2016) |
|---|---|---|---|
| Hauntz Park | 5.9 | 4.46 | 4.32 |

Figure 1 - Hauntz Park Existing Conditions (See Appendix C for full image)

**Step 1: Define Slow Zone Area**

The Hilltop subarea identified as Hauntz Park is bounded by Mound Street, Wheatland Avenue, Sullivant Avenue, Larcomb Avenue (Figure 1). Mound Street and Sullivant Avenue are both minor arterials, according to ODOT TIMS.[17]

Wheatland Avenue was identified as the western border due to the large green space at Saint Agnes that breaks the grid, the signal at Mound Street, and the change in the street grid to the west.

To install a traffic signal, typically the intersection requires a certain threshold of motor vehicles and/or pedestrians and bicyclists, indicating that more users will likely access the neighborhood at signalized locations. West of Wheatland Avenue, streets either bend between Sullivant Avenue and Mound Street or do not connect. A change in the horizontal geometry can provide a traffic calming effect; therefore, it may function differently than in the Hauntz Park Area.

Larcomb Avenue was identified as the eastern border due to the signal at Sullivant Avenue. As this is the only signalized connection to Sullivant Avenue for residents east of the Hauntz Park area, it is an access point to the neighborhood.

**Step 2: Identify Community Amenities –** Key community amenities for the Hauntz Park Area are identified in Figure 1.

**Step 3: Available Data and Data Collection**

While speed data is available for several north/south streets that have similar functions (e.g. Whitethorne Avenue, Belvidere Avenue, Wrexham Avenue, Hilltonia Avenue, Nashoba Avenue, Columbia Avenue, Woodberry Avenue, Larcomb Avenue), there is no speed data available for Springmont Avenue or Safford Avenue. Both streets are narrow uncurbed roadways without sidewalks. They do not connect to any major streets and appear to primarily provide connections within the neighborhood. Speed data should be collected for at least one of these streets.

It was observed through aerial imagery and Google Street View™ that street parking varied greatly along some existing yield streets. Parking volumes vary throughout the day, and it is possible that speeding coincides with times where parking volumes are low. Actual parking data could be collected to evaluate if bump outs/pinch points could be installed to maintain the yield street effect when occupancy is low while still providing enough parking during peak demand.

[17] ODOT Transportation Information Mapping System

## 4. Tools in the Toolbox

This Chapter contains a compilation of neighborhood speed management strategies that may be considered within the City of Columbus's future traffic calming efforts. Methods to modify driver behavior include enforcement and education, yield streets, vertical calming devices, horizontal calming devices, and placemaking strategies. Specific tools within each category are described in the following sections, with magnitude of cost and relative ease of implementation.

This information will assist in developing traffic calming strategies for particular areas, beginning with the least intrusive, fastest to implement elements. The resulting effects on driver behavior can be evaluated before proceeding with additional measures which are more costly or intrusive.

These potential tools were compiled from multiple sources, including:

- Prior studies by City of Columbus and consultants
- Federal, state, and local Governments
    - Federal Highway Administration (FHWA)
    - Institute of Traffic Engineers (ITE)
- National planning and engineering organizations
    - NACTO
- Vendors
    - Pavement Surface Coatings

Specific references are included as footnotes and in References at the end of the document.

### 4.1 Enforcement and Education; Other E's to Consider

Education on the importance of safe driving behavior is a multi-pronged approach that requires a variety of resources and partnerships. This can include soft items (e.g. marketing materials) as well as hard items (e.g. radar speed trailers). Education activities typically involve community outreach/engagement, in addition to providing direct information to drivers. Radar Speed Trailers are a short-term feedback device that can be used to educate motorists on their actual travel speeds and how they compare to the posted speed limit. While this information is helpful in instantly getting drivers to modify their behavior, a longer-term education approach is helpful for drivers to understand why slower speeds in areas of high pedestrian activity are necessary. Recently, the Department of Public Service, through a grant from the Ohio Department of Transportation, began work on a major pedestrian safety and education framework. Further, in March of 2020 the city's Vision Zero program was launched. Both items have ideal applicability to Slow Streets and the important educational component of safe driving behavior.

It should be fully recognized that there are communities that have a complicated relationship with law enforcement. Additionally, enforcement can have a potentially detrimental impact on communities of concern – particularly low-income and minority communities. The status quo of enforcement and alternatives will be explored as a part of the city's Vision Zero initiative. Slow Streets will support these outcomes and the suggestions that are included in the Vision Zero Action Plan.

Toole Design has introduced another set of E's to the conversation: Ethics, Equity and Empathy. These are community values that should be reflected in transportation decision-making, which requires "hold(ing) paramount the safety, health, and welfare of …all users of the roadway" including pedestrians and other vulnerable users.

- Ethical decisions do not prioritize one mode's mobility above a different mode's safety.[18]
- Equitable decisions consider each type of transportation user's needs today while addressing the inequities of past decision-making. "Equity is providing what is truly needed for anyone in any situation to have access to mobility option that allow them to move freely and flourish." Incorporating equity into the decision-making process involves knowing the history and existing conditions of the location to understand how existing systems serve or fail to serve marginalized groups. It also involves engaging with the public on their terms and collaborating with them as they lead the decision-making process.[19]
- "Empathy is the capacity to understand by seeing, hearing, and feeling another person's experience, from within their frame of reference, not our own." Empathy in transportation decision-making involves considering how an end user's transportation needs intersect with other areas of their lives like housing, personal safety, health, education, and employment.[20]

A successful plan that will be embraced by the community it serves should include these E's during its development.

[18] Toole Design: Ethics
[19] Toole Design: Equity
[20] Toole Design: Empathy

## 4.2 Yield Streets: One-way to Two-way Conversions

A few local streets in Linden and The Hilltop have one-way traffic flow within the residential area. A consideration for traffic calming implementation on these streets is the possibility of introducing "friction" with opposing vehicles to encourage drivers to slow down. Yield streets are one type of countermeasure that could be used as a part of a larger overall traffic calming effort for the Slow Streets Columbus program. Yield streets are designed to prioritize local access and community livability. Research has shown that narrow streets and lanes have been linked to lower vehicular travel speeds.[21] These streets are roughly 24-28 feet wide with parking on both sides that allow for an approximately 10- to 12-foot travel lane that handles traffic in both directions.

A local street could be considered a good candidate for conversion when considering three preliminary screening criteria: total street width, on-street parking demand, and appropriate cross-corner sight distance at major roadway intersections.[22]

***Total street width***: Street widths greater than or equal to 22 feet could be converted to two-way traffic operations while maintaining parking on both sides of the street. This width provides a minimum of two, 7-foot parking lanes and one, 8-foot travel lane to be shared by both directions of traffic. Street widths less than 20 feet could be converted to two-way traffic operations while maintaining parking on only one side of the street.

***Parking demand***: Parking demand is considered during the yield street screening to determine if there is adequate space to support "pull-over" areas for vehicles to yield to oncoming traffic. The mechanism that supports traffic calming on a yield street is the need for drivers to watch for oncoming traffic and be able to decide when and where to pull out of the travel way. NACTO indicates parking demand that exceeds 60% of the block length may not provide sufficient pull-over areas to support vehicles passing each other in opposite directions.[23] However, yield streets that have nearly all the available on-street parking occupied can still provide for adequate yielding locations when taking into consideration no-parking areas such as driveways, alleys, pedestrian crossing areas, and other no parking areas (i.e. – fire hydrants). Additionally, marked and signed no parking areas can be added where appropriate.

***Sight distance at major roadways***: New turning movements at local street intersections with major roadways may be counter-indicated at locations where adequate cross-corner sight distance is not available for those movements. A review of turning-movement sight triangles and stopping sight distance is recommended to ensure that traffic calming measures on local streets do not create new conflicts that increase the likelihood of a crash at major roadways.

Overall, yield streets are effective because they provide natural traffic calming with their traditional (narrower) neighborhood street designs. These are the neighborhood streets that currently exist throughout Columbus and are arguably the most desirable streets to live on. Yield streets provide safe and inviting places for multimodal travel, with safe access to residences, schools, parks, and other community destinations.

**Yield Streets**

A yield street (or courtesy street) is a two-way residential street that is roughly 20-28 feet wide with parking either on one or both sides of the roadway. Drivers must yield to each other to pass.

| | |
|---|---|
| Cost | $1,500-5,500 |
| Time | Rapid |

| Pros: | Cons: |
|---|---|
| *Safer for pedestrians*<br>*Speed reduction*<br>*Resident accessibility*<br>*Low cost* | *Extra care when snow plowing* |

[21] NACTO Urban Street Design Guide, Street Design Elements, Street Widths
[22] NACTO Urban Street Design Guide, Streets, Yield Streets
[23] NACTO Urban Street Design Guide, Streets, Yield Streets

## 4.3 Vertical calming devices

Vertical calming devices incorporate a slight change in pavement elevation that forces a vehicle to slow down while traversing the device. Common vertical devices include speed humps, intersection tables, and raised crosswalks. Each device has specific characteristics that guide the selection for implementation.

***Speed Humps/Speed Tables***

Speed humps are placed midblock and cross all travel and parking lanes. They may be installed in varying widths, depending on the severity of vertical deflection the driver is intended to feel. They may be flat on top or have a curved shape. Narrower humps are less favored because they can resemble the older speed bumps that are less effective, but wider humps are more costly to install. The City of Columbus has 12-, 14- and 22-foot humps installed in these study areas. The FHWA e-Primer indicates that speed humps that are 20 feet in length (or greater) and flat on top are speed tables. The purpose of a speed hump is to produce enough discomfort to a motorist driving above the speed hump design speed to discourage speeding. A series of speed humps may be needed to retain slower speeds over long distances.

***Intersection Tables/Raised Intersections***

Intersection tables raise the elevation of the intersection area pavement to slow vehicles while also making vehicles and pedestrians within the intersection more visible to approaching vehicles. Intersection table layouts vary depending on the approaching roadway design, including the presence of curb, sidewalks, existing curb ramps, existing drainage features, etc. Some speed tables only impact the pavement area located between the edge of pavement for the intersecting streets, while others incorporate the pedestrian crosswalk area to provide visibility for those using the sidewalks. The FHWA ePrimer includes the crosswalk area in its description of Raised Intersections. Pavement markings and textured pavement typically draw attention to the intersection table and highlight the presence of roadway users crossing the travel way.

***Raised Crosswalks***

A raised crosswalk is basically a 22-foot speed table that incorporates pedestrian crosswalk markings across the flat top. At locations with curbs, the top of the crosswalk is typically level with the curb. They can also be installed on non-curbed streets with the addition of ADA compliant ramps on the raised crosswalk. They provide greater visibility for active transportation users who are crossing the vehicular travel way while also providing vehicular speed reduction. Raised crosswalks can be installed at mid-block crossings where drivers may not typically expect to encounter crossing pedestrian traffic, or they can be installed at traditional intersection crossing locations. Raised crosswalks can be effective when installed near pedestrian-related land uses such as parks, recreation centers, and school buildings or near high-volume transit stops and facilities.

### Speed Humps / Speed Tables

Speed humps/speed tables are placed midblock across all travel and parking lanes. They may be installed in varying widths of 14 or 22 feet.

| | |
|---|---|
| Cost | Humps - $1,500-5,500; Tables - $2,500-8,000 |
| Time | Moderate |

| Pros: | Cons: |
|---|---|
| *Speed reduction* | *Signage costs and aesthetics* |
| *Low cost* | *Extra care when snow plowing* |
| | *Increased roadway noise* |
| | *Maintenance costs* |

### Intersection Tables / Raised Intersections




Intersection tables raise the elevation of the pavement through the intersection to slow vehicles and make vehicles and pedestrians more visible to approaching vehicles.

| | |
|---|---|
| Cost | $50,000-200,000 |
| Time | Moderate |

| Pros: | Cons: |
|---|---|
| *Speed reduction* | *Need curb & gutter on all approaches* |
| *Improved pedestrian safety* | *Signage costs* |
| *Calms two streets at once* | *Increased roadway noise* |
| | *Maintenance costs* |

### Raised Crosswalks



Raised crosswalks can be installed midblock or at intersections and are a variation of a 22-foot speed table.

| | |
|---|---|
| Cost | $5,000-15,000 |
| Time | Moderate |

| Pros: | Cons: |
|---|---|
| *Speed reduction* | *Signage costs* |
| *Low cost* | *Extra care when snow plowing* |
| *Improve pedestrian safety* | *Increased roadway noise* |
| | *Maintenance costs* |

## 4.4 Horizontal Calming Devices

Horizontal calming devices extend into the normal travel way and require a vehicle to modify its path, with the intention of reducing vehicular speed. Traffic circles and chicanes are types of horizontal devices present in the study area. Horizontal traffic calming devices can be created using pavement markings, surface treatments, and signage in addition to physical barriers such as curbing and delineators.

***Traffic Circles***

Traffic circles, which should not be confused with modern roundabouts, are very small, raised islands placed in the center of unsignalized local street intersections. Traffic circles deflect the vehicular path within the intersection area and eliminate the ability to make a left-turn or through movement without going around the circular feature. While the main purpose of modern roundabouts is to facilitate efficient traffic flow from multiple roadway approaches, the main purpose of a traffic circle is to reduce vehicular speeds and force drivers to be vigilant within the neighborhood setting. Traffic circles may require more right-of-way than a typical street intersection but can be designed to fit within the existing intersection area. Heavy vehicles such as emergency vehicles, commercial trucks, and transit busses are usually unable to circulate counterclockwise around a traffic circle, which impedes their ability to complete a left-turn movement through the intersection. The FHWA ePrimer indicates that traffic circles are most effective at reducing speeds when several are used in series instead of ad hoc locations.

***Chicanes***

Chicanes are a type of horizontal shift that requires a driver to change the vehicle path at least twice. The shift requires an S-shaped curved path that is intended to reduce the speeds the driver is comfortable travelling through the device. A chicane can be created with curb extensions or other physical barriers. It can also be created by alternating on-street parking on a narrow street from one side to the other, provided there is sufficient parking demand to maintain occupied spaces during times of day when speed reduction is desired. For the City of Columbus, horizontal calming devices in neighborhoods have been unpopular due to the signage requirements and impacts to parking. **These devices have been avoided in the current Hilltop and Linden recommendations.**

## 4.5 Street Width Reduction

Street width reduction controls the driver's perception of the roadway environment by creating "friction" with oncoming traffic or roadside features. This friction encourages the driver to reduce speeds to maintain an acceptable level of comfort and safety.  Street width reductions present in the study areas include curb extensions, median islands, and on-street parking.

***Corner Extensions/Bulbout***

Curb extensions are horizontal devices used to narrow the street width. They can be used in conjunction with pedestrian crossings to bring sidewalks closer to the travel way, shorten pedestrian crossing distances, and provide pedestrian visibility in areas near on-street parking. Curb extensions installed at intersections are called corner extensions or bulbouts. A lesser impact of corner extensions is reduced corner turning radii that slow down vehicles making a turn at the intersection. Corner extensions can be used with raised crosswalks to make pedestrians more visible and have a greater influence on vehicular speeds. Design/installation issues include accommodating drainage facilities. Traffic bollards or delineators can be used to quickly create the outline of feature for rapid implementation.

### Traffic Circles

Traffic circles are used for intersections of low volume residential streets. They require left turning vehicles to go around the circle, which slows traffic. This can be used in place of a four-way stop.

| | |
|---|---|
| Cost | $6,000-12,000 |
| Time | Moderate |

| Pros: | Cons: |
|---|---|
| *Speed reduction* | *Does not slow right turners* |
| *Vehicular collision reduction* | *Signage costs* |
| *Aesthetics* | *Impedes heavy vehicle left turns* |
| | *Used in series for greatest impact* |

### Chicanes

Chicanes involve narrowing the roadway on alternating sides of the street to make drivers slow down to navigate a curvilinear path. This effect can be created with curbs, landscaped areas, or alternating parking areas.

| | |
|---|---|
| Cost | $10,000-30,000 |
| Time | Moderate |

| Pros: | Cons: |
|---|---|
| *Speed reduction* | *Signage costs* |
| *Discourage cut-through traffic* | *Aesthetics* |
| *May improve appearance* | *Impacts drainage* |
| | *Maintenance costs* |

### Corner Extension/Bulbout

Corner Extensions create a narrower intersection width that improves pedestrian visibility and causes turning vehicles to slow down.

| | |
|---|---|
| Cost | $2,000-20,000 |
| Time | Moderate |

| Pros: | Cons: |
|---|---|
| *Pedestrian visibility* | *Extra care when snow plowing* |
| *Speed reduction* | *Drainage considerations* |
| *Can be used with raised crosswalks* | |
| *Rapid implementation options* | |

*Choker/Neck Down*

Curb extensions placed midblock are called chokers or neck downs. Other terms sometimes used include pinch point and constriction. Its purpose is to narrow the roadway to reduce vehicle speeds within the block, and it should be at least 20 feet long to match the length of a car. Chokers can be used on one-lane or two-lane streets. They are sometimes used to narrow a two-way, two-lane roadway to one lane, which requires vehicles in opposing directions to take turns passing through the pinch point. A one-lane choker can be parallel to the travel way or placed at an angle to cause vehicles to divert their travel path much like a chicane operates. Chokers can be installed at a midblock crossing location and can be used in conjunction with raised crosswalks. Chokers can be created by curb extensions or edge islands. Traffic bollards or delineators can be used to quickly create the outline of feature for rapid implementation.

*Median Islands*

Median islands are installed between opposing traffic streams along the roadway centerline. They prevent turning movements, reduce the street width, and can be used as a pedestrian refuge for street crossings. They are typically installed in midblock areas but can be used within intersections to prohibit turning movements from the main roadway and/or through movements from the side street. Median islands placed at neighborhood entrances can provide visual cues that indicate a change in vehicle speed or neighborhood characteristics such as increased bike and pedestrian presence. Median islands placed downstream of an intersection can force vehicles to make slower turning movements instead of swinging wide at a higher speed. In the City of Columbus, any median feature that incorporates vegetation requires a maintenance agreement with a neighborhood association.

*On-street Parking*

On-street parking is a tool that is sometimes overlooked in relation to traffic calming on local streets. On-street parking is typically expected to be present in residential areas and its effect on vehicular speeds is not always considered. Properly locating and allowing on-street parking on narrower streets can be an effective tool for creating friction that is useful for encouraging slower speeds. Proper placement and utilization of on-street parking as a traffic calming tool should consider corner clearance concerns related to both sight distance issues and turning maneuverability. The location of parked vehicles should also consider the safety of pedestrians who need to enter the vehicular travel way. On very narrow streets, marked passing zones may be useful and necessary to accommodate two-way traffic in the presence of on-street parking.

[24] FHWA ePrimer, Table 3.2. Approximate Implementation Cost for a Traffic Calming Measure

**Choker/Neck Down**

Chokers are installed at midblock locations to narrow the width of the roadway speed reduction. They can be used in conjunction with crosswalks to improve pedestrian visibility.

| | |
|---|---|
| Cost | $10,000-25,000[24] |
| Time | Moderate |

| Pros: | Cons: |
|---|---|
| *Speed reduction* | *Extra care when snow plowing* |
| *Pedestrian visibility* | *Increased roadway noise* |
| *Can be used with crosswalks* | *Drainage considerations* |
| *Rapid implementation options* | |

**Median Islands**

Median islands narrow the roadway width by designating areas for non-vehicular use. They reduce vehicular speeds and can be used as pedestrian refuges and/or as gateway features.

| | |
|---|---|
| Cost | $250,000 per 100 LF |
| Time | Moderate |

| Pros: | Cons: |
|---|---|
| *Speed reduction* | *Signage costs and aesthetics* |
| *Pedestrian refuge* | *Extra care when snow plowing* |
| *Gateway treatment* | *Maintenance costs* |
| | *On-street parking impacts* |

**On-street Parking**

On-street parking uses parked cars to visually narrow the travel lanes and create friction that encourages drivers to slow down. It is most effective as a traffic calming tool where parking demand is consistent and at least 50% of the block face to create the appropriate effect.

| | |
|---|---|
| Cost | $1,500-5,500 |
| Time | Rapid |

| Pros: | Cons: |
|---|---|
| *Speed reduction* | *Need >50% of block face occupied* |
| *Low cost* | *Less effective on 1-way street* |
| *Provides sidewalk buffer* | |

## 4.6 Placemaking

Placemaking traffic calming measures are features that draw drivers' attention to the presence of the non-motorist environment and encourage a reduction in speed. Neighborhood signage incorporated into gateway features, high-intensity pavement markings, speed feedback signs, and streetscaping are types of placemaking traffic calming measures that can influence driver behavior. These devices rely on the driver's ability to perceive them and make the decision to comply. They may also require enforcement to encourage regular compliance. They tend to have a lower installation cost and can be deployed more quickly than horizontal, vertical, and roadway narrowing devices, which leads them to be used as a first step in an overall traffic calming plan.

***Marked Crosswalks***

Marked crosswalks indicate to motorists the potential presence of pedestrians and other active transportation users. This cues motorists to be more aware of their surrounding and to prepare for the presence of a pedestrian in the marked crossing. This can have the effect of encouraging motorists to lower their speeds. Marked crosswalks also encourage pedestrians to cross at a designated location that provides them better visibility than crossing at random locations along the street. Not all intersections can or should have marked crosswalks, but increasing the number of locations can be beneficial for both pedestrians and motorists. The Columbus Street Design Guide states "More frequent crossing locations support a walkable place and encourage more people to walk."[25] The guide recommends marked pedestrian crossings every 800 feet, on average, in General Urban areas and within 300 feet of nearest bus stop. Locations that should be considered include primary school walking routes outside of the established school zone and all-way stop intersections.

***Enhanced Crosswalks***

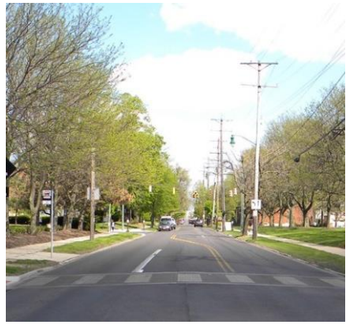
Enhanced Crosswalks include additional signage, markings, or devices to provide greater visibility and protection for pedestrians. Enhanced signage may include ***Rectangular Rapid Flashing Beacons (RRFBs)*** on crosswalk warning signs or ***Pedestrian Hybrid Beacons (PHBs)*** to indicate when vehicles should yield to pedestrians in the crosswalk. Enhanced markings may include "shark teeth" yield lines to indicate where vehicles should stop prior to a crosswalk marking or words on the pavement alerting the driver to an upcoming crossing. In-pavement crossing devices could include pedestrian refuge islands, corner extensions or mid-block neckdowns (see section 4.5 Street Width Reduction for more information).

***Marked On-Street Parking***

On residential streets, marked on-street parking both physically narrows the existing travel lane for motor vehicles as well as visually narrows the street. This physical and visual narrowing can result in lower travel speeds by motor vehicles. Marked on-street parking also provides a buffer between moving motor vehicle traffic and pedestrians along a sidewalk

[25] Columbus Street Design Guide Draft

### Marked Crosswalk



A ladder style of marked crosswalk provides higher visibility than traditional parallel lines.

| | |
|---|---|
| Cost | $600-5,700 |
| Time | Rapid |

| Pros: | Cons: |
|---|---|
| *Speed reduction*<br>*Low cost*<br>*Pedestrian protection* | *Maintenance costs* |

### Enhanced Crosswalk

Crosswalk enhancements may be considered where improved visibility is needed. Examples include pedestrian refuge islands, pedestrian hybrid beacon (PHB) and rectangular rapid flashing beacons (RRFB).

| | |
|---|---|
| Cost | $2,500-$52,000 per installation[26] |
| Time | Moderate |

| Pros: | Cons: |
|---|---|
| *Speed reduction*<br>*Pedestrian protection* | *Signage costs and aesthetics*<br>*Maintenance costs* |

### Marked On-street Parking

Marked on-street parking both physically and visually narrows the existing street which can result in lower motor vehicle travel speeds.

| | |
|---|---|
| Cost | $10,000-15,000 per mile |
| Time | Rapid |

| Pros: | Cons: |
|---|---|
| *Speed reduction*<br>*Low cost* | *Maintenance costs* |

[26] FHWA Pedestrian Safety Guide and Countermeasure Selection System

*Bike Sharrows and Bike Boulevards*

Bike sharrows and bike boulevards are more commonly used on residential streets. They are a pavement marking that alerts drivers to the greater potential for bicyclists using the travel lane. This visual cue can signal drivers to be more alert of their surroundings and travel speed. Columbus has implemented several neighborhood bikeways across the City. The addition of bike sharrows and bike boulevards should be comprehensive in scope and preferably tie into or expand upon existing networks.

*Bike Lanes*

Bike lanes use pavement striping and symbols, and sometimes colored pavement, to designate a specific area within the roadway for bicycle use. The inclusion of bike lanes on an existing roadway usually means the reduction in number of motor vehicle travel lanes. Further, the pavement markings visually narrow the roadway. These have shown to reduce motorist speed. Standard bike lanes can be added to residential, collector and arterial streets. The addition of bike lanes should be approached comprehensively and tie into existing bike networks.

*Protected Bike Lanes*

Protected bike lanes are dedicated, street level lanes that have a physical barrier between the bike lane and the motor vehicle travel lane. These physical barriers can take a variety of forms. Incorporating a protected bike lane both visually and physically narrows the roadway, encouraging lower travel speeds of motor vehicles. Protected bike lanes are more commonly used on collector and arterial streets where higher speed limits are present. The addition of protected bike lanes should be approached comprehensibly and tie into existing bike networks.

**Bike Sharrows & Bike Boulevards**

Bike sharrows are pavement markings which cue to drivers the presence of a shared space on the street for both vehicles and bicyclists.

| | |
|---|---|
| Cost | $6,000 per mile |
| Time | Rapid |

| Pros: | Cons: |
|---|---|
| *Speed reduction*<br>*Low cost* | *Maintenance costs* |

**Bike Lanes**

Bike lanes often require the removal of a travel lane and provide a visual narrowing of the road, both of which contribute to lower motorist speed.

| | |
|---|---|
| Cost | $14,000 per mile |
| Time | Moderate |

| Pros: | Cons: |
|---|---|
| *Speed reduction*<br>*Low cost* | *Narrow or remove travel lane(s)*<br>*Maintenance costs* |

**Protected Bike Lanes**

Protected Bike lanes create a physical separation between motor vehicle and bicycle traffic which both physically and visually narrows the road.

| | |
|---|---|
| Cost | $150,000 per mile |
| Time | Moderate |

| Pros: | Cons: |
|---|---|
| *Speed reduction*<br>*Low cost*<br>*Increased cyclist safety* | *Narrow or remove travel lane(s)*<br>*Maintenance costs*<br>*Requires wider right-of-way* |

***Advisory Shoulder***

Advisory shoulders mark a shoulder for bicyclist/pedestrian users on a two-way road that has low volumes (preferred under 3,000 AADT) and speeds (preferred 25mph or under). A two-way center travel lane is maintained for motorists, who may need to encroach into the advisory shoulder when passing another vehicle. An advisory shoulder currently requires an approved Request to Experiment from FHWA.

***Radar Speed Signs***

Radar speed signs provide real-time feedback to motorists. This reinforces to motorists an awareness of their travel speed and can influence speeding motorists to reduce it towards the posted speed limit. Radar speed signs are suited for areas outside of residential neighborhoods. They are best used along collector and arterial roadways, especially in commercial areas where there are high numbers of pedestrians. Further, radar speed signs should not be proliferated but instead be used tactically.

***Gateway Treatments***

Gateway treatments are placed at locations where a vehicle is transitioning from a through-way environment to a neighborhood environment. The purpose of gateway treatments is to call attention to the new environmental conditions to modify the driver's behavior. Gateway treatments can be located on the major roadway and/or the local roadway and may consist of either or both non-intrusive or intrusive (vertical, horizontal, or width-narrowing) calming devises. Gateway treatments may incorporate pedestrian/cycling facilities, speed-feedback devices, or place-making elements such as neighborhood signage or landscaping. Gateway treatments can include striping out no parking area near an intersection in combination with slow zone signs to notify motorists they are entering a slow zone. The choice of specific gateway features should be based on the behavior targeted for modification, the existing roadway characteristics of both major and local streets, the adjacent land uses and transportation modes that will be supported/affected, and the message that the gateway is intended to convey.

Type 1 Gateway treatments include signage and infrastructure improvements such as curb extensions, median islands/pedestrian refuge islands, and raised crosswalks. Costs for Type 1 Gateway treatments are medium to high, based on the treatments selected. Type 2 Gateway treatments are low-cost implementations at locations where space is limited and infrastructure improvements such as curb extensions are not feasible.

**Advisory Shoulder**

Advisory shoulders designate a space for cyclists and pedestrians on a 1-lane, 2-way roadway but allow motorists to encroach on the shoulder for passing other vehicles

| | |
|---|---|
| Cost | $14,000 per mile |
| Time | Rapid |

| Pros: | Cons: |
|---|---|
| *Speed reduction*<br>*Resident accessibility*<br>*Low cost* | *Maintenance costs* |

**Radar Speed Signs**


Radar speed signs provide real-time feedback to motorists on the speed they are travelling.

| | |
|---|---|
| Cost | $25,000 |
| Time | Rapid |

| Pros: | Cons: |
|---|---|
| *Speed reduction*<br>*Instant driver feedback* | *Less suited for residential areas* |

**Gateway Treatments**

Gateway treatments provide a visual cue to motorists that they are transitioning from a through-way environment to a neighborhood environment. This visual que is to signalize to motorists a needed change in driver behavior.

| | |
|---|---|
| Cost | Varies based on specific need |
| Time | Rapid to Moderate |

| Pros: | Cons: |
|---|---|
| *Speed reduction*<br>*Site-specific treatment*<br>*Multi-modal solution* | *Can be higher cost* |

# 5. Data and Methodology

**Data available/provided by others**

The Slow Streets team used data from existing sources when available. Data sources include Ohio Department of Transportation's (ODOT) Transportation Information Management System (TIMS), ODOT's GIS Crash Analysis Tool (GCAT), and City of Columbus traffic volume and speed collection reports. TIMS is a GIS mapping portal that contains a variety of transportation infrastructure information, which the Slow Streets team used to identify street classifications within the two study areas. GCAT is a GIS interface that queries the Ohio Department of Safety's crash report database for crash information associated with the requested location. The City of Columbus uses Hi-Star traffic analyzer devices to non-intrusively collect traffic data such as volumes, vehicle classifications, and vehicular speeds and maintains those reports for future use. Most traffic data collection locations were selected based in 311 requests from local citizens, although the City collected data at a small number of locations specifically for analysis in this study.

**Data collected for this study**

The Slow Streets team collected parking utilization data on one-way streets with high resolution drone photography during mid-day and early evening time periods. The team collected street-level data such as roadway width, sidewalk locations and width, driveway locations, and traffic control devices using Google Earth mapping.

**Limitations of data**

GCAT accesses crash data from the Ohio Department of Public Safety (ODPS) crash report data base. The data includes crash types, specific locations, number of injuries, etc., but the scope of this study did not include performing a full-scale safety analysis. Basic crash data was used to compare subarea crash experiences; a more in-depth analysis could provide additional insight into appropriate traffic calming techniques to consider in specific subareas.

A desk-top review of roadway conditions using software such as Google Earth allows for a low-cost and quick collection of measurements and inventories. What is gained in speed and cost-savings is given up in precision and ability to verify exact conditions that are currently in place. The precision of roadway measurements is adequate for this phase of decision-making, but more detailed data will be needed as improvement plans are developed and implemented. Similarly, in-person field reviews are needed to confirm that conditions on the ground require and will benefit from potential improvements.

**Identified data gaps**

Traffic speed and volume locations were mostly based on 311 requests, which do not necessarily represent the critical locations within the subareas. The calls typically related to perceived speeding issues, but public concern about speeding at a specific location does not necessarily represent the worst speeding issues or highest volumes in the subarea. Other streets may be experiencing higher traffic volumes and/or greater degree of speed differentials. Parking Utilization analysis focused on one-way streets only. Parking utilization data would be helpful for preparing traffic calming recommendations on two-way streets as well.

[27] US DOT, FHWA, "Highway Functional Classification Concepts, Criteria and Procedures" 2013 Edition, Chapter 2

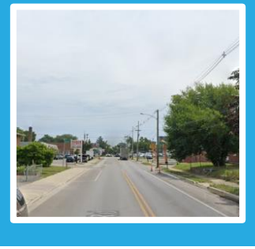
## 5.1 Street Classifications

The Federal Highway Administration provides guidance for classifying streets based on the type of travel objective for the roadway within the overall roadway system network. This functional classification informs how vehicles are expected to operate and interact with adjacent land uses. ***Street classifications*** are based on how the roadway supports both mobility and access. The general roadway classification categories include Arterials, Collectors, and Locals. These categories are applied to streets within a network of interdependent roadways to define how the street segment supports the flow of traffic through the roadway network. Arterials are roadways that are expected to provide a high level of mobility; they tend to have high traffic volumes, support travel between activity centers, and are expected to provide low travel friction along their corridors. Locals are roadways that are expected to provide a high level of accessibility; they provide many opportunities for entry and exit from adjacent land uses and they have high travel friction. Collectors provide a balanced blend of mobility and access; they connect Arterials and Locals while also providing some level of direct access to adjacent land uses.[27]

The three general categories of functional classification have additional layers to define the range of mobility and access functions the roadways serve. Arterials include Interstates, other freeways & expressways, other principal arterials, and minor arterials. The first two subcategories describe roadways that have extremely limited access and abutting land uses are not directly served by them. This study does not include analysis of roadways under these two classifications. In contrast, both study areas contain Principal Arterials and Minor Arterials. Principal Arterials serve major activity centers and longer trips and provide a high degree of mobility. They usually have multiple lanes, signalized intersections with other Arterials and Collectors, and a limited number of driveway access points. Minor Arterials serve smaller activity centers and medium length trips and provide connectivity to the higher Arterial system.[28]

**Principal Arterials**

Principal arterials serve major activity centers and longer trips and provide a high degree of mobility. They usually have multiple lanes, signalized intersections with other Arterials and Collectors, and a limited number of driveway access points.



**Minor Arterials**

Serve smaller activity centers and medium length trips and provide connectivity to the higher Arterial system.

[28] US DOT, FHWA, "Highway Functional Classification Concepts, Criteria and Procedures" 2013 Edition, Chapter 3

Collectors gather traffic from Locals and direct them to the Arterial network. This category is subdivided into Major Collectors and Minor Collectors. Major Collectors tend to provide more mobility and serve longer trips and higher traffic volumes. Minor Collectors tend to provide more access and serve shorter trips and lower traffic volumes. This distinction is relatively new for urban environments; neither study area contains any roads designated as Minor Collectors.[29]

**Major Collectors**

Major Collectors tend to provide more mobility and serve longer trips and higher traffic volumes.

**Minor Collectors**

Minor Collectors tend to provide more access and serve shorter trips and lower traffic volumes. This distinction is relatively new for urban environments; neither study area contains any roads designated as Minor Collectors.

Local roads provide the greatest level of direct access to adjacent land. They are typically designed and intended to discourage through traffic and do not serve long-distance travel. Their role is to provide connections between land uses and higher roadway systems.[30]

Street classifications for this study area based on data provided by ODOT TIMS. The following table lists the classified Arterials and Collectors. The remaining streets in both study areas are classified as Locals. Functional Classification mapping for the City of Columbus is included in the Appendices.

| Study Area Road Classification Examples | | |
|---|---|---|
| Road Classification | Hilltop Study Area | Linden Study Area |
| Principal Arterials | West Broad St (US 40) | Cleveland Ave (n/o Westerville Rd) |
| Minor Arterials | Sullivant Ave<br>Mound St (e/o Hague Ave)<br>Wilson Rd<br>Demorest Rd (s/o Sullivant Ave)<br>Hague Ave (n/o Mound St) | Cleveland Ave (s/o Westerville Rd) (SR 3)<br>Westerville Rd (SR 3)<br>Oakland Park (Maize Rd-Westerville Rd)<br>Maize Rd (North Broadway-Oakland Park)<br>North Broadway (w/o Maize Rd)<br>Weber Rd<br>Hudson St<br>17th Ave<br>11th Ave |
| Major Collectors | Hague Ave<br>Eakin Rd (e/o Demorest Rd) | McGuffey Rd (Hudson St-Oakland Park) |

Due to the large study areas, criteria such as traffic volumes, vehicular speeds, traffic control devices, and connections to higher level roadways were used to define a hierarchy of local roads to create the neighborhood Slow Zones. Local roads that have higher volumes, have signalized intersections with Major Collectors or Arterials, and provide through routes between discreet residential areas were typically designated as boundary roads for Slow Zones, and referred to as “Local Collectors” to differentiate them from officially classified Collectors. It is possible that some of these boundary roads may qualify as Minor Collectors, and the City should consider if it would be appropriate to apply that designation when reviewing its Functional Classification system in the future.

[29] US DOT, FHWA, “Highway Functional Classification Concepts, Criteria and Procedures” 2013 Edition, Chapter 3

[30] US DOT, FHWA, “Highway Functional Classification Concepts, Criteria and Procedures” 2013 Edition, Chapter 3

## 5.2 Crash Data

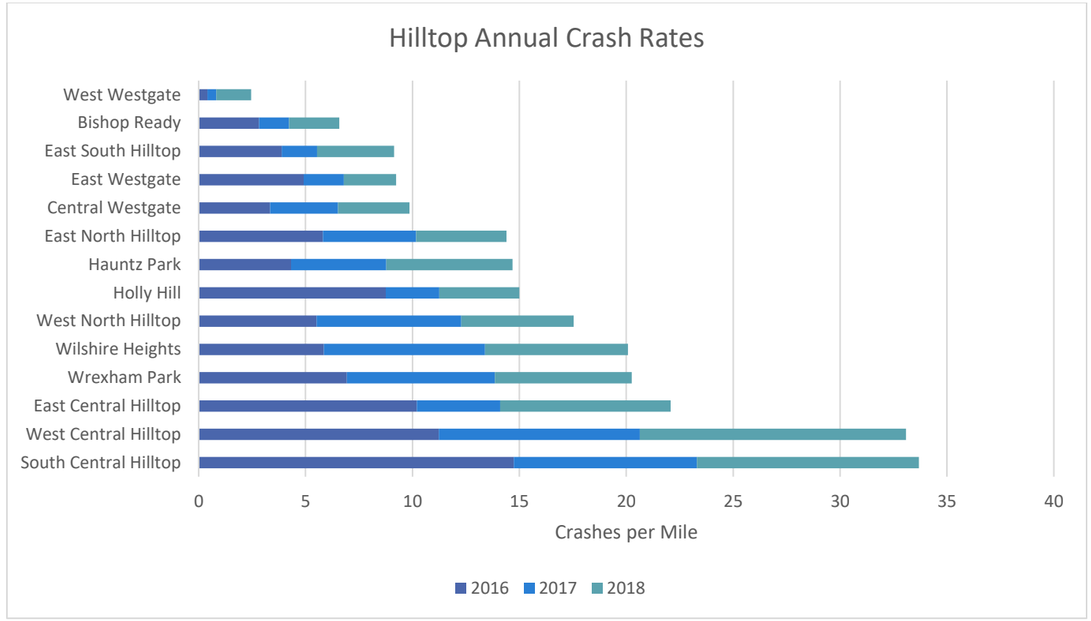
ODOT's GCAT tool provided crash reports for the study areas. Crash data was collected for 2016-2018. Analysis of the crash data was limited due to the scope of this project and should not be considered a comprehensive approach to identifying crash patterns or specific safety improvements. The City of Columbus also provided previously compiled collision diagrams for some intersections within the study areas.

Crash data was identified by year and Slow Zone. The number of crashes per year in each Slow Zone was divided by the number of roadway miles in each to create Slow Zone crash rates for 2016, 2017, and 2018. These rates help put into context the existing safety concerns experienced by each neighborhood unit. The total number of crashes for each Slow Zone does not fully explain the issue because they do not cover the same area size, do not contain the same amount of roadway, and do not have the same number of intersections. A per-mile rate provides a level basis for comparing crash information among the subareas.

Crash data included in this analysis is derived from crash reports filed with the Ohio Department of Public Safety (ODPS) by the City of Columbus. This data does not include crashes not reported to the police and does not account for incidents that did not result in a collision (such as near-misses). The nature of the data source means that there may be locations that have safety concerns that are not reflected in the data provided by public agencies. A summary of the crash reports is included in the appendices.

### 5.1.1 Hilltop Crash Data

The three Central Hilltop Slow Zones have the highest crash rates in the Hilltop study area. Central Hilltop is bounded by Hague Avenue, Wayne Avenue, West Broad Street, and Eakin Road.

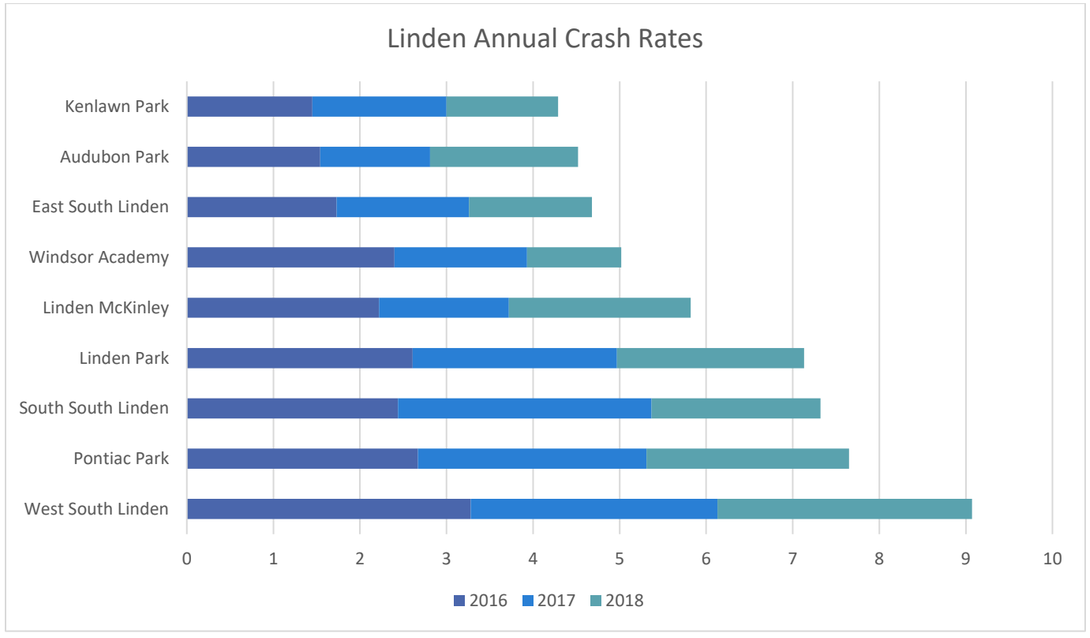



| Hilltop Crash Rates by Slow Zones | | | | |
|---|---|---|---|---|
| Slow Zone/Subarea | Crashes per Mile | | | |
| | 2016 | 2017 | 2018 | Total |
| South Central Hilltop | 14.74 | 8.57 | 10.38 | 33.68 |
| West Central Hilltop | 11.23 | 9.40 | 12.45 | 33.09 |
| East Central Hilltop | 10.20 | 3.90 | 7.98 | 22.08 |
| Wrexham Park | 6.93 | 6.93 | 6.40 | 20.27 |
| Wilshire Heights | 5.86 | 7.53 | 6.69 | 20.08 |
| West North Hilltop | 5.51 | 6.77 | 5.26 | 17.54 |
| Holly Hill | 8.75 | 2.50 | 3.75 | 15.00 |
| Hauntz Park | 4.32 | 4.46 | 5.90 | 14.68 |
| East North Hilltop | 5.81 | 4.36 | 4.23 | 14.40 |
| Central Westgate | 3.34 | 3.18 | 3.34 | 9.87 |
| East Westgate | 4.91 | 1.88 | 2.45 | 9.24 |
| East South Hilltop | 3.88 | 1.66 | 3.60 | 9.14 |
| Bishop Ready | 2.82 | 1.41 | 2.35 | 6.57 |
| West Westgate | 0.41 | 0.41 | 1.63 | 2.45 |

### 5.2.2 Linden Crash Data

West South Linden, Pontiac Park, and South South Linden have the three highest crash rates for the Linden study area. These Slow Zones are adjacent to the I-71 interchanges within the study area. In fact, Audubon Park is the only Slow Zone that contains interchange access to I-71 and does not fall in the top half of crash rates; this Zone is located between Hudson Street and Weber Road. The remaining higher-crash Slow Zones include Linden Park, Linden McKinley, and Windsor Academy. These locations have school- or recreation-based pedestrian generators that are impacted by safety concerns.

| Linden Crash Rates by Slow Zones | | | | |
|---|---|---|---|---|
| Slow Zone/ Subarea | Crashes per Mile | | | |
| | 2016 | 2017 | 2018 | Total |
| West South Linden | 3.28 | 2.85 | 2.94 | **9.07** |
| Pontiac Park | 2.67 | 2.64 | 2.34 | **7.65** |
| South South Linden | 2.44 | 2.93 | 1.95 | **7.32** |
| Linden Park | 2.61 | 2.36 | 2.16 | **7.13** |
| Linden McKinley | 2.22 | 1.50 | 2.10 | **5.82** |
| Windsor Academy | 2.40 | 1.53 | 1.09 | **5.02** |
| East South Linden | 1.73 | 1.53 | 1.42 | **4.68** |
| Audubon Park | 1.54 | 1.27 | 1.71 | **4.52** |
| Kenlawn Park | 1.45 | 1.55 | 1.29 | **4.29** |



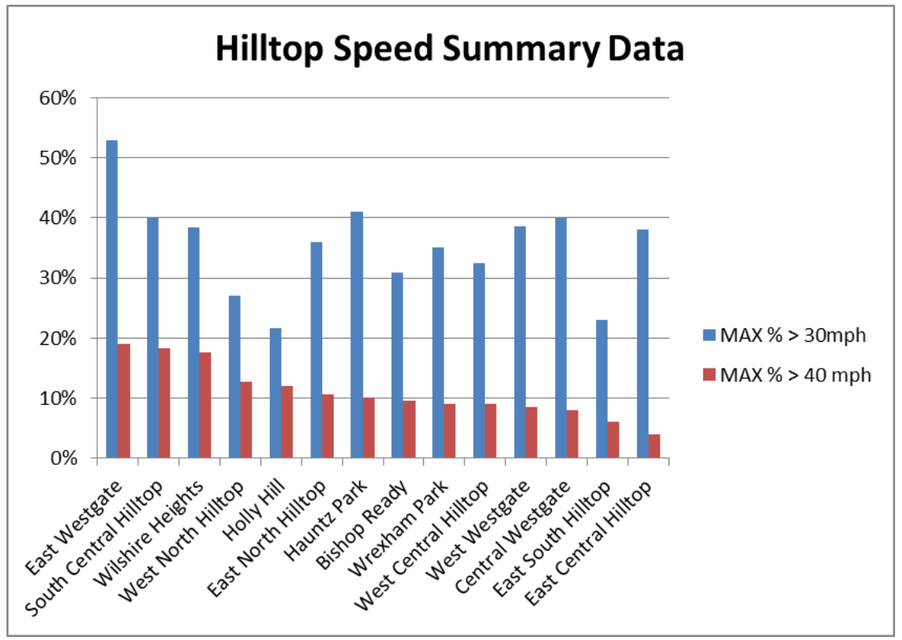
## 5.3 Speed and Volume

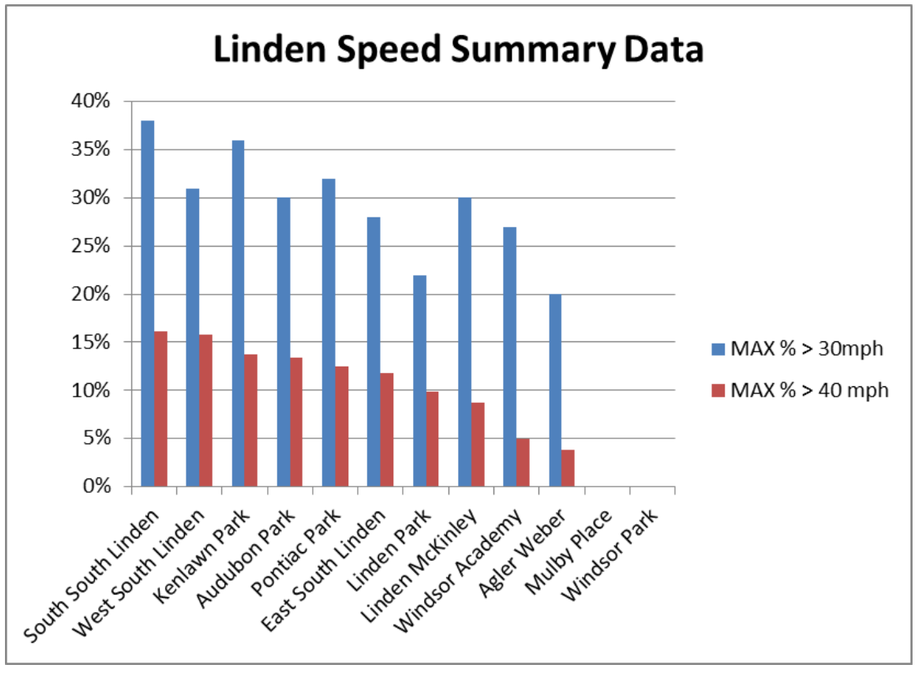
Speed and volume data for select roadways within the study area were collected by the City of Columbus staff using HiStar data collection devices. Data used in this study was collected between June 2015 and June 2019. Locations were typically selected based on 311 requests or needs identified by either City staff or the Slow Streets project team. The speed and volume data used for this study should not be considered a comprehensive collection for each Slow Zone. During preparation of final implementation plans for each Slow Zone, collection of additional traffic data may be justified to provide a well-rounded understanding of traffic patterns in the area. The purpose of this analysis was to review the streets where speeds and volumes are the most problematic for each Slow Zone and use those to prioritize Slow Zone action plans within the study area. Reports for each location usually included traffic counts binned by vehicle classification and speed data binned in 5-mph groups. The reports also included AADT and 85$^{th}$ percentile speeds.

### 5.3.1 Speed Data

All data analyzed in this section were collected for streets with a posted speed limit of 25 mph. Speed data collected in each Slow Zone were analyzed to determine the percent of vehicles travelling faster than 30 mph and the percent travelling faster than 40 mph. These data points indicate the risk to pedestrians as related to vehicular speeds during a crash. A pedestrian has a 40% chance of death or severe injury in a 30-mph crash and has a 73% chance of death or severe injury in a 40-mph crash. These thresholds help identify speed-related concerns for each Slow Zone. The following charts list the Slow Zones in order of highest percent of vehicles traveling over 40 mph; the percentage traveling over 30 mph are shown at the same time.

In both study areas, the Slow Zone that has the highest percentage of vehicles traveling over 40 mph also has the highest percentage traveling over 30 mph. However, this relationship does not necessarily hold true for all. Some Slow Zones have a very high percentage (30% to 40%) of vehicles traveling over 30 mph but have fewer than 10% traveling over 40 mph. This relationship indicates that while drivers do not feel compelled to follow the posted speed limit, they are not necessarily comfortable with excessive speeding. These Slow Zones may respond well to more visual-based traffic calming instead of intrusive tools. Slow Zones that have high percentages of vehicles traveling above 40 mph indicate that drivers are comfortable with excessive speeding; these Slow Zones are more likely to benefit from traffic calming techniques that disrupt the level of comfort with speeding on those roads.



### 5.3.2 Volume data

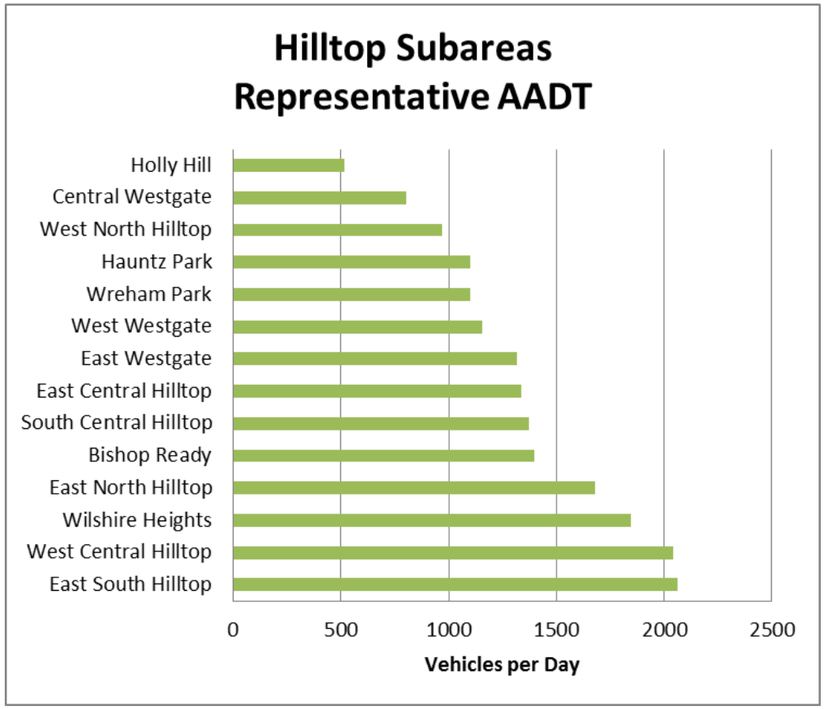
Daily traffic volumes are typically referred to as Annual Average Daily Traffic (AADT). AADT is not necessarily the maximum volume of traffic that a roadway segment will experience, but instead reflects seasonal shifts in traffic and is intended to represent an "average" day's volume. Traffic counts were collected on roadway segments that received specific types of 311 requests or were selected by the project team to provide information in areas where data was lacking. The locations may not contain the heaviest volume of traffic on the local streets, and this data should not be considered a definitive picture of traffic patterns for either study area.

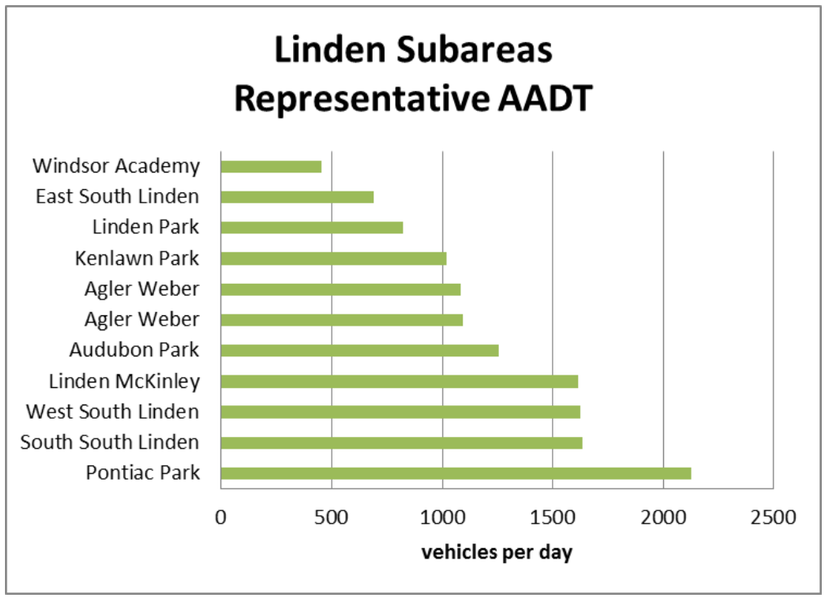
For Slow Zone analysis, the project team focused on traffic volumes on the Local streets that are interior to the Zones. Boundary streets (sometimes referred to as "local collectors") were not included in this comparison because traffic calming measures are not appropriate in those locations. Recommendations to implement traffic calming are being made on a network basis for each Slow Zone, which means the highest volume of traffic within a Zone should be considered representative of that network. Not every roadway segment within the network will experience that volume of traffic but impacts to the highest volume road are likely to shift some of that traffic volume to adjacent streets unless all streets are treated with a similar traffic calming approach.

Most of the Hilltop Slow Zones have representative AADT ranging between 1,000 and 2,000 vehicles per day. These are low-volume, 1- or 2-lane roads that support either one-way or two-way traffic. The lower volume Slow Zones, Holly Hill, Central Westgate, and West North Hilltop have few or no "through roads" in their interior roadway networks; this means that they are less likely to experience cut-through traffic on streets that should only serve traffic related to adjacent land uses. The Slow Zones with the highest volumes have "through roads" that parallel Major Collectors or Arterials, which are most likely used as diversion routes to avoid traffic control or congestion on those higher-level roadways. East South Hilltop is located adjacent to the Sullivant Avenue interchange with I-70. West Central Hilltop is located directly west of Hague Avenue between West Broad Street and Sullivant Avenue. East North Hilltop is located directly north of West Central Hilltop. Wilshire Heights and Bishop Ready surround the parochial Bishop Ready High School, which is a significant vehicular and pedestrian traffic generator.

Most of the Linden Slow Zones have representative traffic volumes ranging between 1,000 and 1,650 vehicles per day. The highest outlier, Pontiac Park, is adjacent to both the North Broadway and Weber Road interchanges with I-71 and may be taking on a high amount cut-through traffic from both access points. On the other end of the spectrum, Windsor Academy and East South Linden have fewer "through roads" that provide alternative routes to adjacent Collectors and Arterials. Finally, Windsor Park and Mulby Place did not have volume data collected during the study period and are not shown on this graphic.

Traffic counts for the study areas can be found in Appendix B.



## 5.4 Parking Utilization

The Slow Streets project team took high-resolution drone photography of the one-way streets during October 2018 to collect mid-morning and early-evening parking utilization information. This photography was used to count the number of cars parked on each side of the street on each block for the time periods in question. The analysis understood that this data was a "snapshot" of the parking conditions and does not necessarily reflect average parking usage throughout the day or year.

The purpose of determining parking utilization was to determine if there are sufficient areas for vehicles to pull over or pass each other in Yield Street conditions where the travel-way width is not wide enough to accommodate two lanes of traffic. ***Parking demand*** defines that amount of available parking space that is used during peak parking times. NACTO states that "parking demand more than 60% may create insufficient pull-over opportunities. The guidance indicates that this situation should consider marking designated passing areas every 200-300 feet.[31]

As Yield Street recommendations were developed for the existing one-way streets in both study areas, the project team recognized that "parking demand" did not account for existing passing zones located in mid-block areas where parking is restricted. These restricted parking areas include roadway features such as driveway approaches, fire hydrant locations, and alley intersections. In that context, "parking utilization" identifies the percent of the entire block length used for parking. Identifying this percentage creates a value for the "area available for passing" which is the combined total of restricted parking areas and unused parking spaces. The final analysis of parking utilization also includes identifying the intervals of available passing zones to ensure they are located at intervals recommended by FHWA, which is every 200-300 feet. If the intervals meet this guideline, the restricted parking locations can be considered reserved pull-over areas and eliminate the need for new designated pull-over areas.

Based on the parking studies conducted in both study areas, all streets fell within the desired parking demand or had restricted parking areas that provide yield areas. Further discussion regarding recommendations related to parking utilization and passing areas can be found in the Yield Street discussion in Chapter 6. **Maps of parking data and data tables identifying parking utilization are included in the Appendices.**

In Hilltop neighborhood, most streets have enough available safe passing zones because of no parking areas such as driveways, alley intersections, or not excessive parking demand. Harris Avenue north of Sullivant Avenue, N Burgess Avenue north of W Broad Street, and S Eureka Avenue south of W Broad Street would require designated passing zones to be converted to Yield Streets. In Linden, all of the existing one-way streets have enough existing safe passing zones based on the field data collected.

A lesson learned during development of traffic calming recommendations for existing two-way streets is that parking utilization data would be helpful for that process. This planning study did not include collecting parking data for existing two-way streets, so it was not available for consideration.

[31] NACTO Urban Street Design Guide, Streets, Yield Streets

# 6. Development of Recommendations

Using the concept of neighborhood-based Slow Zones (Chapter 3), traffic calming recommendations are developed using the Tools in the Toolbox (Chapter 4) and the data collected (Chapter 5). This chapter provides the framework for the recommendation process.

## 6.1 Approach

Once a Slow Zone is defined by the residents and city personnel, the interested parties should identify traffic calming goals that guide the decision-making process. The purpose of the goals is to help identify what types of traffic calming tools will be successful in the Slow Zone. Chapter 4 provides information about the purpose and usefulness for the different types of tools, and they should be selected for the type of driver behavior(s) that the project is attempting to modify.

To facilitate selection of appropriate tools, an iterative approach is recommended. Use rapid implementation strategies where possible, consisting of items such as pavement markings, signage, portable speed feedback signs, temporary delineators, temporary curbing, and temporary speed humps. Monitor/evaluate the efficacy of the rapid implementation strategies by gathering traffic data during the implementation period. Determine if these have provided the intended calming effect, or if modifications to the plan are required. Replace temporary installations with permanent devices where they would be effective.

In addition to this iterative approach, some Slow Zones could benefit from a two-stage process of traffic calming implementation. Converting one-way streets to two-way Yield Streets can be the first stage of Slow Zone traffic calming and would occur in the first step of the iterative process. During the monitor/evaluation step, recommendations for additional traffic calming implementation may be justified. At that point, rapid implementation of additional traffic calming tools could be considered.

## 6.2 Yield Street Methodology

Toole Design reviewed design guidance and research discussing yield streets prior to establishing a screening methodology for one-way conversion to yield streets. The National Association of City Transportation Officials' *Urban Street Design Guide*, the Federal Highway Administration's (FHWA) *Small Town and Rural Design Guide*, and *Residential Streets* published by the Urban Land Institute, National Association of Home Builders, American Society of Civil Engineers, and Institute of Transportation Engineers discuss criteria for and the application of yield streets. FHWA defines yield streets as roadways that serve bidirectional traffic without lane markings in the roadway travel area. In addition, the traveled way should be narrow to encourage slow travel speeds and require courtesy yielding when vehicles traveling in opposite directions approach. Three common factors to consider are discussed in the referenced texts:

- street type
- street width and/or traveled way width
- parking demand or passing areas

### 6.2.1 Yield Street Screening Methodology

The consideration of one-way to two-way conversions within the Linden and Hilltop neighborhoods started with a screening process to identify streets that would make good candidates for conversion. The initial criteria that were considered while screening neighborhood streets were street type, street width, parking demand, and sight distance evaluation with large arterial street intersections. Sources and guidelines used while determining these criteria include AASHTO, FHWA, ODOT TIMS; ULI, NAHB, ASCE and ITE's Residential Streets; and NACTO's Urban Street Design Guide.

The first criterion considered was that yield streets should only be implemented on local streets. One-way streets within the study area are classified as residential local streets according to ODOT's Transportation Information Mapping System (TIMS) and meet this initial standard for yield street conditions.

The next criterion considered was street width. If the street being considered was greater than or equal to 22' wide, then the street could be converted to a two-way yield street with parking on both sides. If the street being considered was less than or equal to 20' wide, then the street could be converted to a two-way yield street with parking on one side. Values were based on yield street criteria discussed in ULI, NAHB, ASCE and ITE's Residential Streets and NACTO's Urban Street Design Guide.

Parking demand was also considered as a criterion for yield street screening. NACTO states that if parking demand exceeds 60% then there may be insufficient pull-over areas for passing. A parking study was conducted on a block-by-block basis for each side of the street to determine if there was available space for vehicles to yield to opposing traffic. On blocks where parking demand was high and little to no restricted parking areas were present, passing areas were designated every 200-300ft. Passing area spacing was based on FHWA's recommendation.

New turning movements onto major roads were the final criteria considered while screening streets for conversion to yield streets. At any intersections with major roadways, sight distance triangles were checked for right and left turn movements using Google imagery and ESRI shapefiles available through the county auditor. At this step, potential turning restrictions were identified. Stopping sight distance was not evaluated at this stage due to the study area being flat.

### 6.2.2 Yield Street Screening Methodology Refinement

During the development of the screening methodology, the factors were refined and applied to the final recommended screening methodology. The final refined screening methodology included identifying traveled way width instead of roadway width, removing sight distance analysis from the screening process, and identifying areas available for passing (instead of amount of parking demand).

The width of traveled way, not the total roadway width, determines if vehicles will need to slow and yield to opposing traffic. The traveled way is the roadway width less any width dedicated to parked cars. The design team recommended updating this criterion to focus on the traveled way width and not the roadway width based on FHWA's *Small Town and Rural Design Guide*'s yield streets criteria.

The sight distance analysis does not impact the determination of whether a street could operate as a yield street, but instead is more relevant to block-by-block design recommendations. The study team recommended that sight distance analysis be moved to the preliminary design portion of a yield street conversion process.

Parking demand identifies the proportion of the street that is used for parking on a typical day. When determining if vehicles will be able to find space to pull over, a more meaningful metric was to determine the percent of the block that is available to pull over. This value included the entire length of the block excluding the percent that is used for parking. By looking at the area available, designers captured both restricted parking areas and unused parking areas. Additionally, if any existing restricted parking areas were located at intervals recommended by FHWA (every 200-300 feet), these locations were considered reserved pull-over areas and eliminated the need for additional newly designated pull-over areas.

### 6.2.3 Recommended Yield Street Screening Methodology

From the literature review, project screening, and lessons learned, the following three checks are recommended to evaluate if a street is a good candidate for the yield street traffic calming measure.

*Check A - Street Type*

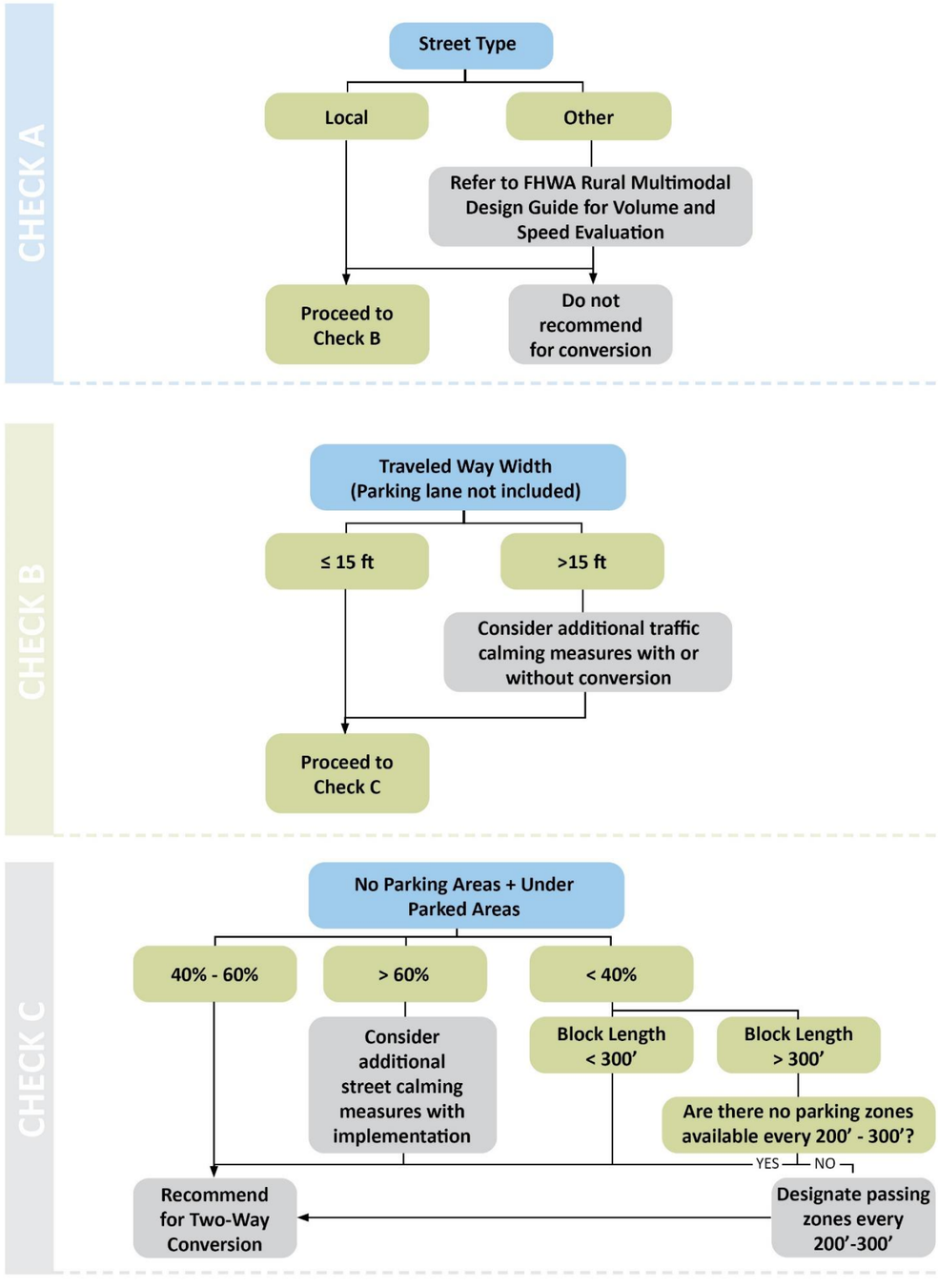
Designers should begin the screening process by evaluating the roadway type. Yield Streets currently exist in many residential areas throughout the City as well as within the study area. They are most appropriate in residential areas as they are low volume and traffic is familiar with prevailing road conditions (see Figure 1). They are not an appropriate traffic calming measure for larger volume collector or arterial streets. Designers can refer to FHWA's Small Town and Rural Design Guide for specific guidance on the recommended ADT and speed for specific scenarios when a roadway is classified as other than a local road, but volume and speeds suggest that it may be a good candidate for one-way to two-way yield operations.

*Check B - Traveled Way Width*

For existing streets, the traveled way width determines if a vehicle must yield when opposing traffic is present. The traveled way is defined as the curb-to-curb width excluding the parking lane(s) width. A vehicle will be able to yield by pulling over in the parking lane area, in a restricted parking area, or in a designated passing area. In a residential area, a 7-foot-wide parking lane is sufficient for parked cars which still providing a modest buffer to passing vehicles. If the traveled way width is less than 15 feet wide, a vehicle will need to pull over to allow for passing. Narrower lanes and bidirectional travel reduce a driver's comfort and encourage lower speeds. Greater than 15 feet and drivers are not inclined to slow down and yield. Additional traffic calming measures should be considered on streets with greater than 15 feet traveled way width to attain the desired traffic calming effect.

*Check C – Pull-over Areas*

The final portion of the screening process is to check that enough pull-over areas will be available. All yield streets, excluding alleyways, have parking on at least one side of the roadway. In addition, many streets have restricted parking areas such as driveways and fire hydrants within each block. The total portion of the block that is either not used during peak parking hours or is parking restricted should be determined. Peak parking is likely to occur in the AM hour after third shift workers are home or in the evening when traditional 9AM to 5 PM employees are home. Each residential area will vary, and exact parking times may be adjusted to best capture parking demand. Ideally, parking demand will be between 40-60% according to NACTO. If there is less than 40% available, designers should check if the restricted areas are spaced such that they can act as pull-over areas or designate areas for cars to pull over as specified by FHWA. If there is greater than 60% space available, designers should consider bump outs or other design tactics that prohibit two cars from passing at relatively high speeds in the absence of parked cars. Figure 3 provides a visualization of the Check C process and final recommendation.




## 6.3 Traffic Calming Plan Methodology

### 6.3.1 Slow Zone Ranking Methodology

To determine Slow Zones priority for traffic calming measures in Hilltop, multiple criteria were analyzed according to a measured priority rating system based on point values. Criteria that were taken into consideration when calculating the point values for each zone were speed, volume, crash history, pedestrian generators, roadway geometry, residential density, and sidewalks. This methodology was originally developed to rank individual roadways/segments for traffic calming. Lawhon & Associates adapted the process to reflect the roadway network

concept that is part of this planning study. Zones were scored according to these criteria and then ranked to determine which neighborhoods had the greatest need for traffic calming measures.

Speed data was analyzed for each zone to determine the percentage of vehicles exceeding 25 MPH, 30 MPH and 40 MPH in posted 25 MPH speed limit zones. The point values were then calculated using these averages, with one point assigned to every 5% above 30 MPH and one point assigned to every 5% above 40 MPH. Volume data was quantified by analyzing the average daily traffic (ADT) data for each zone. The points for each zone were calculated using the largest ADT found within each zone, and one point was given for every 200 vehicles counted in the ADT.

Crash history data was analyzed for each zone to determine how many crashes occurred from 2016 to 2018. The total roadway miles within each zone were also calculated. One point was given for every annual crash per mile of roadway. The number of crashes involving non-motorists, crashes resulting in injuries, crashes resulting in fatalities, and crashes involving speeding were included as part of the total crashes in each zone, but their specific values were included in the analysis to aid in understanding the nature and severity of crashes that occurred in each zone.

Pedestrian generator data was analyzed for each zone by determining the amount of schools, bus routes, parks, and community centers within 500 feet of the project area. Other pedestrian generators that were taken into consideration included any retail, commercial, or other institutional uses existing within 500 feet of the project area. Four points were given for every elementary or middle school, two points were given for every other school, bus route, park, or community center, and for any retail, commercial, or other institutional use existing within 500 feet of the project area.

Roadway geometry data was analyzed for each zone by determining which zones contained street parking, streets having a width greater than 30 feet, streets with driveways on roads, streets with 1000 to 1500 feet between uncontrolled stops, and streets with at least 1500 feet between uncontrolled stops. The point values for each zone were calculated by assigning two points to any streets with on-street parking, two points to any streets having a width greater than 30 feet, two points for streets with driveways on the road, two points for streets with at least 1500 feet between uncontrolled stops, and one point for streets with 1000-1500 feet between uncontrolled stops.

Residential density data for each zone was analyzed by determining the number of dwellings per mile. The point values for each zone were calculated by assigning one point for every 25 dwelling units per mile. Sidewalk data for each zone was analyzed by determining where there were continuous sidewalks on at least one side of the street. The point values for each zone were calculated by assigning five points if there was no continuous sidewalk on at least one side of the street.

### 6.3.2 Slow Zone Traffic Calming Planning

The Toolkit described in Section 4 lists multiple traffic calming treatment types and applicability. All traffic calming treatments should be implemented simultaneously to have the greatest impact. When it is not feasible to implement all proposed traffic calming devices due to available funds, some traffic calming devices, such as pinch points or curb extensions, can be implemented with paint and flex posts. These lower-cost implementations also allow for monitoring and adjustments as needed before investing in the device's full construction.

***Step 1: Identify Priority Streets and Streets with No Expected Speeding Issues***

- Identify priority streets within the focus area. Priority streets may have any of the following characteristics:
  - Connection to amenities,
  - Speed concerns (the 85$^{th}$ percentile is over the posted speed limit or 311 complaints),
  - Low parking occupancy on yield streets, and/or
  - Wide and straight geometry with little or no traffic control.
- Identify streets that may need no traffic calming measures (e.g. a non-through street or street with existing traffic calming treatments).

***Step 2: Develop and Implement a Traffic Calming Plan***

The traffic calming plan should be developed in collaboration with the community. At a minimum, public input should be sought before implementing traffic calming measures.

- Identify, evaluate, and implement any one-way streets that are good candidates for a yield street conversion (see Section 4.5). Yield streets may address speeding concerns without additional traffic calming devices.
- Identify and implement locations for gateway treatments on priority streets that meet the Slow Zone area boundary.
- Identify and implement at least one vertical and/or horizontal deflection traffic calming device per block on priority streets, which includes intersection treatments. Blocks exceeding 500 feet may need more than one traffic calming devices.[32,33] Horizontal and vertical deflection is preferred, though street width reductions are acceptable given context.

***Step 3: Monitor***

After implementing the initial traffic calming plan, speeds should be monitored in the focus area for up to one year. Public feedback should also be gathered on the traffic calming implementation to inform what is working and what could be improved. Based on the monitoring period, adjustments to the traffic calming plan should be made as needed. Additional treatments may not be necessary if the initial traffic calming implementation addresses the speeding and safety issues observed in the existing conditions.

***Step 4: Refine the Traffic Calming Plan***

- Add traffic calming treatments based on the monitoring data. Reducing the spacing between devices can help to address continued speeding in the Slow Zone area.[34]
- Construct traffic calming devices previously implemented with only low-cost measures (example: a curb extension of paint with flexible delineators could be upgraded to a concrete curb with a planting/landscape).

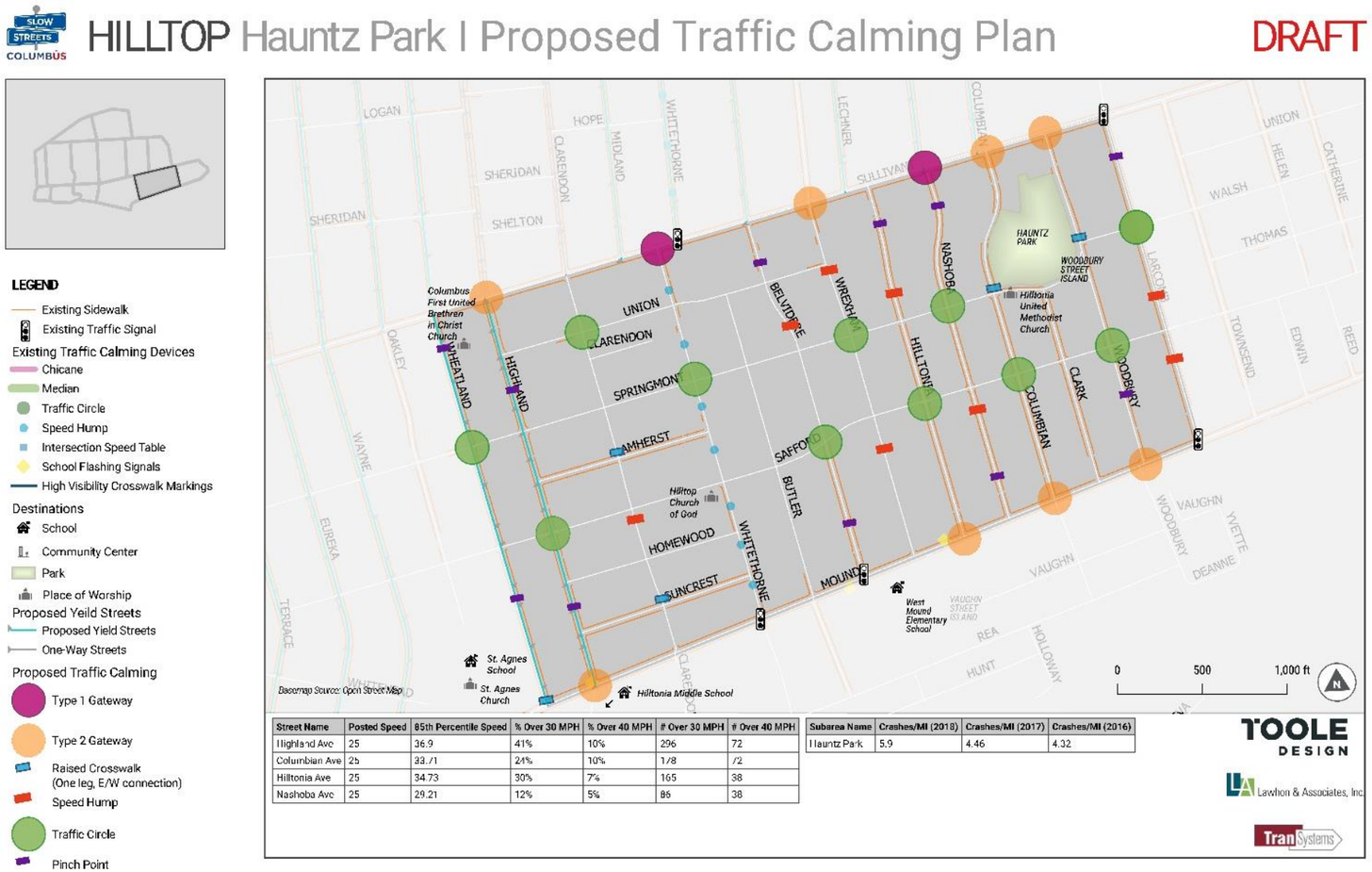
***Step 5: Monitor***

After refining the original traffic calming plan and implementing additional measures as needed, continue to monitor speeds. If speeding issues continue, repeat steps 4 and 5.

[32] ITE Guidelines for the Design and Application of Speed Humps
[33] FHWA. Traffic Calming ePrimer – Module 3.

[34] ITE Guidelines for the Design and Application of Speed Humps

## Example: Hauntz Park Slow Zone – Hilltop Neighborhood




| Street Name | Posted Speed | 85th Percentile Speed | % Over 30 MPH | % Over 40 MPH | # Over 30 MPH | # Over 40 MPH |
|---|---|---|---|---|---|---|
| Highland Ave | 25 | 36.9 | 41% | 10% | 296 | 72 |
| Columbian Ave | 25 | 33.71 | 24% | 10% | 178 | 72 |
| Hilltonia Ave | 25 | 34.73 | 30% | 7% | 165 | 38 |
| Nashoba Ave | 25 | 29.21 | 12% | 5% | 86 | 38 |

| Subarea Name | Crashes/MI (2018) | Crashes/MI (2017) | Crashes/MI (2016) |
|---|---|---|---|
| Hauntz Park | 5.9 | 4.46 | 4.32 |

Figure 2 - Hauntz Park Slow Zone Traffic Calming Plan (See Appendix C for full image)

***Step 1: Identify Priority Streets and Streets with No Expected Speeding Issues***

Priority streets:

- Highland Avenue (85th percentile 12 mph over posted speed, one-way street)
- Wrexham Avenue (Connects to school)
- Hilltonia Avenue (85th percentile 10 mph over posted speed)
- Columbian Avenue (85th percentile 9 mph over posted speed, connects to park)
- Woodbury Avenue (connects to park)
- Springmont Avenue (one of two E/W through streets in focus area, connect to park)
- Safford Avenue (one of two E/W through streets in focus area)

Streets with no traffic calming needs:

- Butler Avenue (not a through street in the focus area)
- Clark Avenue (dead ends into park, not a through street)

***Step 2: Develop and Implement a Traffic Calming Plan***

In this example, the existing data and map aerials were used to develop a traffic calming treatment plan. The following captures the decision-making process used to develop the proposed plan shown in Figure 2:

- Both Highland Avenue and Wheatland Avenue are the only existing one-ways and were determined to be good candidates for a yield street conversion (see Yield Street memorandum). Yield streets create "friction" between opposing vehicles and can slow down motor vehicle traffic. When one-ways are present, the first step is to evaluate if a conversion to yield street is appropriate, which may alleviate the need for additional traffic calming measures.
- Connections between priority streets and boundary streets were selected for gateway treatments. The primary gateway type identified for this area is gateway type 1 (see section 4.5) which includes striping to prevent parking near crosswalks and signage to alert drivers that they have entered a neighborhood zone where bicycles and pedestrians are expected. Gateways were spaced evenly throughout the neighborhood entrance zones and prioritized on streets that connected to community amenities such as Hauntz park.

- Traffic calming treatments at intersections can work to resolve speeding issues in both directions. There is no speeding data for Springmont Avenue or Safford Avenue. These roadways are east/west connections without sidewalks. Pedestrians may be walking along the street, increasing their exposure risk. See other considerations at the end of this example for interim sidewalk solutions to improve pedestrian connectivity. Traffic circles were selected as a horizontal deflection that can slow traffic and can be implemented with paint and flex posts if desired. Speeding should be monitored along these roadways, given the traffic pattern change, and adjusted in step 4 as needed.
- Based on traffic circles' locations, at least one traffic calming device was selected for every block 500 feet or less that did not currently include a traffic calming device. Additional traffic calming devices were considered for blocks greater than 500 feet. Placement and device type were determined as follows:
    - Raised crossings were proposed near amenities where pedestrian activity was expected, such as at parks and schools.
    - Bump outs/pinch points to visually narrow roadway near edges of the Slow Zone area to indicate to motorists they are entering a Slow Zone. Bump outs/pinch points can be implemented with low-cost materials and later formalized with more permanent materials such as concrete curb and planting/landscaping.
    - Speeds humps to slow speeds, particularly on straight roadways with no or little traffic controls.

***Step 3: Monitor***

Hauntz Park Slow Zone should be monitored for up to a year to determine if speeding issues continue or alleviated by the implemented traffic calming measure. In addition, public input should be obtained to determine if adjustments are needed.

***Step 4: Refine the Traffic Calming Plan***

Using monitoring data and community input, the initial traffic calming plan should be refined. If speeding continues, decreasing the distance between traffic calming devices should be considered. Where low-cost traffic calming devices have been implemented, and speeding has been reduced, permanent traffic calming treatments should be constructed.

***Step 5: Monitor***

After refining the initial traffic calming plan in step 4, speeds should be monitored to assess necessary adjustments. Repeat steps 4 and 5 as needed.

***Other Considerations***

In addition to slowing speeds, connecting people to the places they are trying to get to via walking and biking in a safe and comfortable way is a focus of Slow Streets. There are many gaps or no sidewalks throughout the Hauntz Park Slow Zone. Currently, there are no sidewalks for pedestrians traveling east or west through the neighborhood. Sidewalks should be prioritized along Springmont Avenue and Safford Avenue. As an interim measure, advisory shoulders should be considered until sidewalks can be constructed. If an advisory shoulder is added, additional traffic calming measures as appropriate to keep speeds low along Springmont and Safford should also be studied.

### 6.3.3 Recommendations

Yield street evaluations have been completed for each subarea as shown on the mapping presented in Appendix C. The maps note one-way streets that were screened with the yield street methodology and identified as being suitable to convert to two-way traffic flow. Recommendations for further development of traffic calming options have not been developed at this time.

*Yield Street Conversions*

The revised yield street methodology was used to identify streets or blocks that could benefit from being converted from one-way traffic flow to two-way flow. Following that process, the study team made preliminary design recommendations by reviewing the traffic control at every street intersection, the need for marking yield areas on blocks with high parking demand, and the sight distance triangles at major intersections. These recommendations are based on desk-top reviews and should be field-verified before moving forward with implementation.

The proposed Subarea Exhibits in Appendix C identify the streets that are recommended for conversion.

*Linden Park Slow Zone Pilot Area*

The study team identified a ***Pilot Area*** in the Linden neighborhood for testing yield street conversions and gathering data and public feedback. The Pilot Area is in the Linden Park Slow Zone. This location was selected to facilitate community access to the new Linden Park Recreation Center. The Pilot Area encompasses the existing one-way streets of Arlington Avenue, Myrtle Avenue, Briarwood Avenue, Republic Avenue, and Loretta Avenue between Hamilton Road/Linden Park and Cleveland Avenue.

The Implementation Plan for the Pilot Area includes intersection signage and pavement marking installations needed to facilitate two-way traffic flow. While developing the implementation plan, Toole Design reviewed intersection sight distances at major intersections and made recommendations regarding turn restrictions, traffic control modifications, or opting out of converting specific blocks. Recommended changes also include allowing parking on both sides of the street on Briarwood Avenue. Parking associated with the new recreation center may require providing marked yield areas; parking on Briarwood should be monitored once the recreation center is open to the public to determine if this should be implemented.

The four Pilot Area streets were converted to two-way operation between the weeks of September 8 and September 21, 2020. The neighborhood was canvassed with flyers and the City of Columbus Project Manager engaged with community and city staff stakeholders prior to implementing the traffic pattern change. Community stakeholders included the North Linden and South Linden Area Commissions, community faith organizations, and human services organizations that operate in the Linden neighborhood.

After the two-way conversion, the City collected vehicle speed and volume data to compare to pre-implementation data. The City also reviewed reports from crashes that occurred during the Pilot study period to determine if safety issues increased with two-way traffic flow. The results of this data analysis and a discussion of lessons learned is presented in Chapter 7.

# 7. Pilot Area Monitoring Methods and Preliminary Outcomes

City of Columbus collected existing vehicular speed and volume data for the four Pilot Area streets in August 2020 to have a baseline for data comparison after implementation. Post-implementation data was collected during two different 24-hour periods in November to determine if the conversion led to driver behavioral changes. The City collected additional data on one street, Loretta Avenue, in January 2021 because of inconsistencies in the street's November results. In addition to vehicular speed and volume data, the City reviewed crash reports for the Pilot Project period of September 2020 – December 2020 and compared them with crash reports prior to implementation.

***Vehicular Speed Data*** indicates that converting to two-way traffic reduced both average speeds and 85$^{th}$ percentile speeds on Briarwood Avenue and Republic Avenue. Myrtle Avenue did not experience any significant change to average speeds or 85$^{th}$ percentile speed, however this streets baseline average speed was below the posted 25 MPH speed limit. The first set of data collected on Loretta Avenue in November 2020 was the same as the August baseline data, while the second set of data collected in November showed a significant speed increase. Because these two data collections varied so much, the City collected an additional set of data in early January. The January data for Loretta Avenue was similar to the data collected for Briarwood Avenue and Republic Avenue, indicating a decrease in average speed and 85$^{th}$ percentile speed.

***Vehicular Volume Data*** collected shows a noted increase in traffic volumes for each street between pre-implementation and post-implementation data collection.

***Crash Reports*** post-implementation do not show any changes in crash type, crash contributing factors, or number of crashes for any of the Pilot Area Streets. None of the crashes reported indicated that they were related to two-way traffic being present on the street. The most common crashes involved existing issues of sideswiping parked cars, failure to stop at posted stop signs, and reckless driving.

An important item of note is that the Pilot Project was implemented during the ***COVID-19 pandemic*** when emergency measures were in place to protect the public and vulnerable populations. These measures, including remote-only learning for Columbus City Schools and restrictions to certain workplace environments such as work-from-home policies or limitations on workplace operations, impacted traffic patterns in the study area. In addition to traffic patterns impacts, the pandemic limited the number of traffic data collection opportunities available to City workers. Finally, construction projects on the Linden Recreation Center and on streets adjacent to the streets that were converted occurred during the study timeframe.

## 7.1 Adjustment period for residents and motorists

It took a while for residents to adjust their parking habits after the two-way conversion. A month after implementation, all four streets still had most vehicles on both sides of the street parked in the same direction as the former one-way operation. Residents also tended to park too close to stop signs in the new direction, which caused cross-corner sight distance issues for vehicle driving the "against" the former one-way direction. It appears that motorists quickly adapted to yielding to oncoming traffic, since crash reports do not reflect those conflicts as contributing factors.

## 7.2 Challenges and Lessons Learned

***Engagement***

Additional engagement activities with residents (beyond canvassing the neighborhood with flyers) would be beneficial to ensure that each household has adequate notification of the traffic pattern changes and how they will need to modify their behaviors. The City should consider sending a mailer to each property that borders the streets being converted and/or other creative communication solutions. Communication should be initiated with enough time to allow for adequate two-way communication between residents affected and the City prior to the conversion. These communications should include information on how to adjust habits, such as parking in the direction of travel for the side of the street on which the car is parked and parking the mandatory distance from driveways and intersections.

Increased coordination with internal Department of Public Service stakeholders is advised to ensure that the Project Manager is coordinating in advance with the work crews who are in the field. Finally, advance collaboration with the Division of Police would help them function as a partner in the public engagement process after conversion occurs. The Department of Public Service can provide the local precinct with educational materials that can be used in lieu of ticketing during the acclimation period while also creating a defined date for when warnings will shift to ticketing for non-compliance of parking regulations.

***Parking Utilization***

The parking utilization data used in the conversion screening process should be collected well in advance of the implementation period. City staff should conduct AM and PM site visits in the early stages of conversion planning to assess current parking patterns and determine the need to include dedicated pull-over areas.

***Data Collection***

Identify a select number of street segments for pre- and post-conversion data collection when using this process on larger areas. Implement conversions in the spring when possible and no later than early fall to allow for at least two post-conversion data collections.

***Signage***

Consider adding more, possibly temporary, signage that indicates the change from one-way to two-way traffic flow. The City received complaints about signage not being clear or posted with enough frequency to convey the change. Corner clearance signage to ensure vehicles do not park too close to intersections would address some of the safety concerns of Yield Street intersections.

***Yield Streets as a Standalone Traffic Calming Measure***

Data collected in the Pilot Area indicates that Yield Street operations have an impact on speed reduction. Since the cost to implement is low and the time to implement is rapid, it is a reasonable tool to use for traffic calming. However, additional measures on select streets – both short and long term – should be considered in addition to directional conversion.

The copy of the Slow Streets Linden Pilot memo will be available on the city's website.

## 8. Public Engagement

The goal of the Columbus Slow Streets program is to improve neighborhood traffic safety and walkability. This current study focused on Linden and Hilltop. The project team developed an engagement strategy to educate the public and provide background information about Slow Streets Columbus, obtain input on areas where residents have neighborhood traffic safety concerns, and to share information about project recommendations (currently not completed). This section describes the public engagement approach and specific outreach activities conducted. A summary of the comments received through those public outreach activities is provided and identifies lessons learned that could be applied to improve public engagement for future Slow Streets Columbus programs.

### 8.1 Public Involvement Activities

#### 8.1.1 Public Meeting Pop-ups

Several "pop-up" style public meetings were held in each neighborhood during the Spring of 2019. The purpose of these pop-up meetings was to provide background information about Slow Streets Columbus and to gather input from community members about issues and areas of concern. Pop-up public meetings are less formal than traditional public meetings. These are small scale meetings that involve a small number of staff (2 to 3 people) and materials that can be quickly set up in a small space. The pop-up public meeting approach was used to try to reach people where they already were. It is often difficult to get many people to attend a formal, traditional public meeting. Details about the pop-up meeting dates, times, and locations are provided below:

*Hilltop*

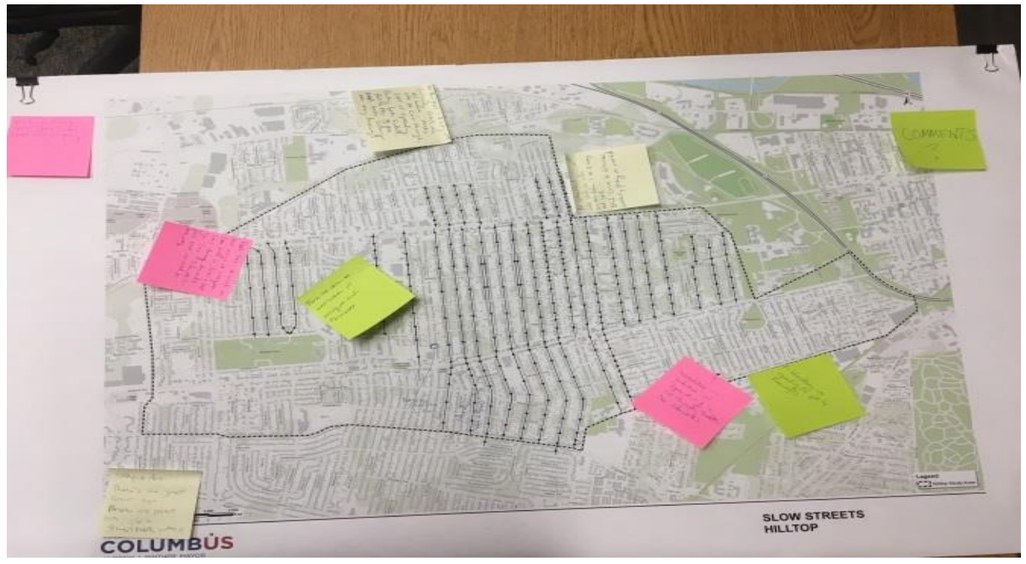
- February 23, 2019, 9:00 am, Glenwood Community Recreation Center on Fairmont Avenue (Slow Streets table set up at Hilltop Community Plan public meeting)
- April 3, 2019, 3:30 pm, Hilltop Library on Hague Avenue
- April 6, 2019, 10:00 am, Glenwood Community Recreation Center on Fairmont Avenue
- May 2, 2019, 5:00 pm, La Michoacana on Sullivant Avenue

*Linden*

- April 4, 2019, 5:00 pm, Linden Library on Cleveland Avenue
- April 6, 2019, 1:00 pm, Linden Community Center Briarwood
- May 1, 2019, 3:00 pm, Cooks IGA on Oakland Park

The project team developed postcard advertisements to notify the public about the meetings. Postcards were mailed to local libraries, community centers, recreation centers, youth centers, YMCA's, places of worship, Salvation Army, Friends of the Hilltop, Columbus Metropolitan Housing Authority, and various cafes. Included in this summary are maps and tables that outline and display the public comments received at the pop-up meetings. Each comment has a number identification corresponding to a location on the map that displays streets, intersections, and landmarks where residents have voiced concerns.


Above: Linden public pop-up meeting outside of Cook's IGA on Oakland Park Avenue




Above: Participants from the Hilltop pop-up meeting provided comments on sticky notes that were then placed on the map related to the comment or area of concern.

### 8.1.2 Area Commission Meetings

Slow Streets project team members attended monthly meetings of the Greater Hilltop, North Linden, and South Linden Area Commissions between January and May 2019. The purpose of attending the area commission meetings was to provide background information about the Slow Streets project, collect input from area commission and audience members, and work with the area commissions to promote upcoming Slow Streets public engagement opportunities in their neighborhoods. Project team members attended the following Area Commission meetings:

- Greater Hilltop Area Commission
    - January 8, 2019
    - March 5, 2019
    - April 2, 2019
    - May 7, 2019
- North Linden Area Commission
    - January 17, 2019
    - March 21, 2019
    - April 18, 2019
    - May 16, 2019
- South Linden Area Commission
    - February 19, 2019
    - March 19, 2019
    - April 16, 2019
    - May 21, 2019

### 8.1.3 Phone and Email

Contact information for the City of Columbus project manager was included on all project fact sheets and public meeting notices that were distributed. In addition, the City of Columbus also set up a webpage for the project on its website that included the project manager's contact information. The comments received through phone and emails were shared with the Slow Streets project team and are summarized within this report.

### 8.1.4 WikiMaps[35]

The City of Columbus Department of Neighborhoods partnered with the Neighborhood Design Center (NDC) to develop *Envision Hilltop*, a community plan for the Hilltop neighborhood. As part of the *Envision Hilltop* planning process, NDC set up a ***WikiMap*** that allows residents to provide input on an online community map (https://WikiMapping.com/WikiMap/Hilltop-Community-Plan.html). All comments shared through the Hilltop community plan WikiMap were provided to the Slow Streets project team. The Slow Streets project team set up a similar WikiMap for the Linden neighborhood (https://WikiMapping.com/Slow-Streets-Linden.html) to provide an opportunity for Linden residents to submit comments online as well.

### 8.1.5 City of Columbus 311 Service Requests

The City of Columbus Department of Public Services provided data to the project team for all 311 service requests related to traffic calming in Hilltop and Linden. 311 service requests including reports of speeding in a residential area, requests for new crosswalks, speed limit change requests, street widening requests, and traffic calming requests from 2015 to 2019 were provided to the project team.

[35] This report summarizes and categorizes unique WikiMap comments that relate to the Slow Streets project. Numerous comments were submitted through the Hilltop WikiMap that do not directly relate to the Slow Streets project because the WikiMap was set up for a different, more comprehensive neighborhood planning process. The Hilltop WikiMap comments were filtered to focus on the comments that addressed any topics related to speeding, traffic calming, traffic safety, traffic flow, multimodal access and mobility, or parking. There were several comments submitted outside of the study area on the Linden WikiMap, with a concentration of comments between Oakland Park and East Cooke. This public involvement summary is focused on the WikiMap comments that were submitted within the project study area.

## 8.2 Summary of Public Comments Received

Public comments were collected throughout the Slow Streets planning process from pop-up events, area commission meetings, email, phone, and online WikiMaps for the Hilltop and Linden neighborhoods. The project team also reviewed 311 calls[36] received by the city during the public outreach period for the Slow Streets project if the calls were related to traffic calming and speeding in the Hilltop or Linden neighborhood. A summary of the types of comments submitted and the major concerns identified within each neighborhood is provided below. Maps and corresponding tables in Appendix A show the locations of concern and provide more details about the comments.

### Hilltop

- Public Meeting Pop-ups, Area Commission Meetings, Phone, and Email – The project team received a combined 48 comments from attendees at the Pop-ups and Advisory Committee meetings, phone calls, and emails (see Map 1 and Table 1). The comments touched on a range of issues including speeding in the neighborhood, requests for traffic calming, traffic flow, access, enforcement, parking, and general safety issues. Many of the comments addressed multiple issues. Of the 48 comments received, 32 raised concerns about speeding in the neighborhood. Specific comments related to speeding included concerns about residential streets being used for cut-through traffic, people not stopping at stop signs and/or running through red lights, a lack of stop signs or traffic signals, and the need for more education and enforcement to address speeding. Also, three of the commenters noted that they did not agree with converting one-way streets to two-ways to address speeding.
- WikiMap - There were 209 comments related to the Slow Streets project submitted through the Hilltop WikiMap that was set up by NDC during the development of the Hilltop community plan (see Map 2 and Table 2). Many of the comments touched on multiple issues. Many of the comments (139) discussed issues related to speeding, identified specific places where speeding is a problem, or identified specific places where traffic calming is needed. The topic that had the next highest number of comments was pedestrian infrastructure needs (37) with many of those comments noting places where sidewalks are missing or in disrepair, crosswalks are needed, or pedestrians generally do not feel safe. Other topics that were frequently addressed in the comments included traffic flow (22), traffic safety (12), and parking (9).

### Linden

- Public Meeting Pop-ups, Area Commission Meetings, Phone, and Email – The project team received a combined 27 comments from attendees at the Pop-ups and Advisory Committee meetings, phone calls, and emails (see Map 3 and Table 3). Most of the comments (18) either identified places where speeding is an issue or discussed speeding/traffic calming in general. Other topics addressed in the comments included pedestrian safety, traffic flow, signage, and education.
- WikiMap – A total of 27 unique comments within the Linden study area were submitted through the Linden WikiMap, 16 of which identified places where speeding is an issue (see Map 4 and Table 4). Seven of the WikiMap comments discussed pedestrian safety issues such as lack of sidewalks and crosswalks. The remaining five comments related to the issues of transit access, traffic flow, and parking.

[36] This public involvement summary considers 311 calls related to the Slow Streets project that were submitted during the development of the Slow Streets plan. It should be noted that the project team also reviewed 311 information provided by the City of Columbus that was submitted prior to the start of this planning process. That 311 data is not summarized in this report because the input was provided prior to the start of this project.

## 8.3 Lessons Learned and Conclusions

The Slow Streets project team developed a multi-faceted public involvement strategy for the Slow Streets program to reach a broad and diverse audience within both the Linden and Hilltop study areas. The purpose of the public involvement for this planning process was to both provide information about the Slow Streets program and solicit input from community members about concerns related to neighborhood traffic safety.

The pop-up style public meetings allowed the project team to reach individuals who may not have attended a traditional public meeting. However, these pop-up style meetings were not well attended in general. In addition, because the meetings were set up at public places such as grocery stores and libraries that draw from a larger geographic area, many of the people who did attend and interact with the project team lived outside of the neighborhood(s) and did not have feedback specific to the respective study area(s).

The WikiMaps were helpful in providing a flexible and convenient method for participants to provide input. One of the challenges is that it is easy for individual commenters to make repetitive comments that may skew the interpretation of the data. Another issue is that it required filtering to focus on comments relevant to the study and within the study areas. This is because the Hilltop WikiMap was set up for a different, more comprehensive planning process and the Linden WikiMap allowed comments to be entered outside of the study area.

Through a variety of public involvement activities, the Slow Streets project team was able to collect considerable input from the residents of the Hilltop and Linden study areas. However, some of the activities were more efficient at reaching the community than others. The pop-ups were utilized because of the challenges associated with traditional, formal public meetings which also tend to be inefficient at reaching large numbers of residents and are costly. However, the pop-ups did not reach as many individuals as intended or did not reach individuals that reside inside the study areas. For this reason, the project team would recommend modifying the approach to either (1) reach a larger overall number of people (like attending community events such as the Hilltop Business Associations' Bean Dinner) or (2) reach a smaller, but more targeted audience by canvassing streets. For logistical purposes, canvassing may be difficult to implement in large study areas but would be effective for more targeted sub-area outreach. The project team recommends door-to-door canvassing to reach out to residents in the areas where the initial Slow Streets project recommendations will be implemented.

## 8.4 Next Steps

### Door-to-door Outreach for Briarwood Pilot Project

As part of the Columbus Slow Streets Project, the City of Columbus proposes to convert Briarwood Avenue in Linden to a yield street, allowing bi-directional traffic to use the roadway, as a Pilot Project for potential future street conversions in Linden and Hilltop. Yield streets require drivers to slow down and be cautious of oncoming traffic in the opposite direction for vehicles traveling in both directions to safely pass each other. The City of Columbus plans to conduct door-to-door outreach prior to implementation of this Pilot Project to inform residents of the upcoming change and provide more information about the overall Slow Streets project. The project team prepared a door hanger fact sheet that can be left with residents during the door-to-door outreach or left on the doorknobs at homes where no one comes to the door. The door hanger includes a description of the pilot project, the Slow Streets program, and contact information for the City of Columbus project manager.

## Glossary of Terms

**85th percentile speeds** – Speed at or below which 85% of vehicles are traveling; it is typically considered the speed at which most drivers are comfortable operating on a specific roadway.

**"311" requests** - Also known as Columbus Service Center requests. This phone number provides a single point of contact for requesting all non-emergency City services.

**Active transportation** - Any self-propelled, human-powered mode of transportation, such as walking or bicycling.

**Advisory shoulder** - A shoulder for bicyclist/pedestrian users on a two-way road that has low volumes and speeds.

**Annual Average Daily Traffic (AADT)** - Total volume of vehicle traffic of a road for a year divided by 365 days.

**Arterial corridors** - roadways that are expected to provide a high level of mobility; they tend to have high traffic volumes, support travel between activity centers, and are expected to provide low travel friction along their corridors.

**Average Daily Traffic (ADT)** - Volume or number of vehicles passing through a given location on an average weekday.

**Bike sharrows/Bike Boulevards** - pavement markings which cue to drivers the presence of a shared space on the street for both vehicles and bicyclists.

**Chicanes** - An S-shaped curved path or road that is intended to reduce speeds.

**Choker/neck down** – A curb extension placed midblock.

**Corner extension/bulbout** – Sidewalk extensions into the parking lane to narrow the roadway and provide additional pedestrian space at key locations.

**Gateway Treatments** - A treatments to call attention to the new environmental conditions to modify the driver's behavior.

**General urban area** - Areas that have a compact, urban feel, but are not within the Urban Center. Streets within these areas may have commercial, residential, or mixed land uses, and buildings are generally located close to the street.

**Grid-network neighborhood** - A neighborhood in which streets run at right angles to each other, forming a grid.

**Intersection tables** – An intersection in which the pavement is raised to slow vehicles while also making vehicles and pedestrians within the intersection more visible to approaching vehicles.

**Local collectors** - Collect traffic from local roads and distribute it to arterials. Traffic using a collector is usually going to or coming from somewhere nearby.

**Marked on street parking** – A street that is marked for parking by signage, pavement marking, or a parking meter.

**Median islands** - Narrow the roadway width by designating areas for non-vehicular use. They can be used as pedestrian refuges and/or as gateway features.

**Neighborhood traffic calming plan** - identifies where individual traffic calming measures will be implemented and can cover an entire neighborhood or a single street.

**Painted centerline** – The line down the center of roads to separate lanes for opposing traffic.

**Parking demand** - The amount of parking that is estimated to be used at a particular time, place, and price.

**Pedestrian Hybrid Beacons (PHBs)** - A traffic control device to increase motorists' awareness of pedestrian crossings at uncontrolled marked crosswalk locations. PHBs are only activated by pedestrians when needed.

**Pilot area** - Small scale preliminary study area conducted to test performance prior to implementation of a full-scale project.

**Raised crosswalks** – A large variation of a speed table that incorporates pedestrian crosswalk markings across the flat top.

**Radar speed signs** - An interactive sign that displays vehicle speed as motorists' approach.

**Rectangular Rapid Flashing Beacons (RRFBs)** - high-intensity signal heads that flash in a rapid flickering pattern to alert drivers of crossing pedestrians.

**Sight distance** – The length of roadway visible to a driver.

**"Slow Zone" Area** – Also referred to as "subarea" within this document. The area has streets with similar roadway characteristics, are comprised of low-volume residential streets, and are bounded by higher-use roadways.

**Speed humps/speed tables** – Vertical deflection technique to produce enough discomfort to a motorist to discourage speeding.

**Spot-treatment approach** – Improvements done one at a time or on an as needed basis instead of a comprehensive approach.

**Street classifications** – Classification of a street based on the type of travel objective for the roadway within the overall roadway system network

**Subareas** - Also referred to as "slow zone" areas within this document. The area has streets with similar roadway characteristics, are comprised of low-volume residential streets, and are bounded by higher-use roadways.

**Suburban areas** – Areas that typically serve low density employment centers, institutional areas, or residential land uses where buildings are set back from the road and spread farther apart.

**Traffic calming measures/device** - The individual traffic calming elements that are implemented on a roadway.

**Traffic circles** - Very small, raised islands placed in the center of unsignalized local street intersections.

**Vulnerable roadway user** – Pedestrians, wheelchair users, motorcyclists, and bicyclists; or generally people using the roadways and sidewalks that are not protected by being contained inside a motorized vehicle.

**WikiMap** – Mapping tool that allows residents to provide input on an online community map.

## References:

### Plans

- Envision Hilltop 2020
- One Linden Community Plan
- Hilltop Community Mobility Plan Executive Summary
- Linden area Transportation Mgmt Plan (DOMO)
- 2005 Linden Area Traffic Plan
- Central Ohio Transportation Safety Plan 2019
- Columbus Street Design Guide Draft

### Articles, Guides, Website Resources

- Ohio Revised Code Section 4511 Speed Limits
- Synthesis of Safety Research Related to Speed and Speed Management
- Mike Maciag. Governing, 2014, pp. 2–4, *America's Poor Neighborhoods Plagued by Pedestrian Deaths*.
- Safe Routes to School Research: Air Quality and Environment
- Urban Land Institute: Active Transportation and Real Estate: The Next Frontier. Washington, D.C.: The Urban Land Institute, 2016
- Saelens B, Sallis J, Black J, Chen D. Neighborhood-based differences in physical activity: an environment scale evaluation. American Journal of Public Health 2003;93(9):1552-1558
- FHWA Synthesis of Safety Research Related to Speed and Speed Management
- ITE/FHWA Traffic Calming: State of the Practice
- New York City DOT, Neighborhood Slow Zones
- ODOT Transportation Information Mapping System
- Toole Design Guide: Ethics
- Toole Design Guide: Equity
- Toole Design Guide: Empathy
- NACTO Urban Street Design Guide, Street Design Elements
- NACTO Urban Street Design Guide, Streets
- FHWA Traffic Calming ePrimer
- US DOT, FHWA, "Highway Functional Classification Concepts, Criteria and Procedures" 2013 Edition
- ITE Guidelines for the Design and Application of Speed Humps

### Other Resources

- MORPC Complete Streets Policy
- CAPs Residents Guide to Neighborhood Traffic Issues
- ODOT LTAP Traffic Calming course
- Strategies for Safer Speeds – FHWA Pedestrian and Transportation University Course
- ITE Traffic Calming Measures – Lots of this info was developed based on Eprimer
- Draft Traffic Calming Policy (CoC)
- Resident's guide to neighborhood traffic issues, City of Columbus CAPS
- Speck, Jeff. 2012. Walkable city: how downtown can save America, one step at a time. New York: Farrar, Straus and Giroux.
- School Zone Ohio Revised Code and Regulations
- Safe Routes to School Guide: Engineering Around the School
- SRTS Briefing Sheet – The Use of Traffic Calming Near Schools
- RadarSign Best Practices in School Zone Traffic Calming

## Appendices: