Hanover Village: West High Street Corridor Final Report

(Area of focus)

Introduction

Hanover village has brough together the fundamental resources they need to develop a progressive and unique future for the community. Hanover council has developed a comprehensive plan titled, “Forward Together” in order to coherently create a transparent design of what is wanted and needed for advanced future growth in the village. LCATS has been brought forth to assist them in reading the levels of traffic growth that are seen today, what can be expected in the coming decades. Through the use of sophisticated traffic pattern devices and careful mathematical precision we are able to provide projections that give an unbiased model of what could be seen given Hanover’s ambitions.

The goal of this report is to evaluate current and future traffic volume projections involved with the land use for future economic and demographic growth of Hanover village. From collecting all the data of vehicle turning movements of various intersections, the volume of traffic that can be seen on the roads today, and observing the existing conditions of roadways, sidewalks, and signage we are able to assess our projections thoroughly. This report will be separated into multiple sections that specialize in presenting data that trails to final recommendations and predictions. This report will discuss thorough ways to achieve the goals that Hanover has set to complete in the coming years.

The current council of Hanover plans to make their village a place that inspires new economic growth while still maintaining the comforts of living in a small town. To achieve this, Hanover wishes to incorporate the use of greener spaces, walkable communities, local businesses, affordable housing, decorative lighting, and safer roadway intersections so that their village is not only a place worth visiting but also staying. Planners and visionaries of Hanover have compiled a map that carefully draws the boundaries around where they wish to grow and what they plan to establish in those parameters. These ideas take the form of new residential housing for small and larger families, open and healthy parks to enjoy outdoor activities, comforting shops and restaurants to unwind after long days, and a spectacular village center that brings culture and sociability to life.

The two principal aspects to play into this report have to do with civilian walkability and drivability. This could come in the form of people using the roads to travel to work each morning, or children walking on the sidewalks to school every day. Transport can take many shapes, and many physical elements can disturb the efficiency of that transference. If sidewalks and roadways are not adequate then this discourages people from walking more and being safe on the drive home.

The first part of LCATS’ study was to collect data from MetroCount traffic collectors and several field audits of the existing space. We were able to assess the roadway conditions, signage and sidewalks on W High St corridor that acts as the main artery of the village. Visual aids with the help of drone footage and field observations helped us recognize the flow and volume of traffic in these areas. Lastly, there is further details with this report by analyzing the slope of sidewalks, reflectivity of crosswalk signs, and indentation of the roads themselves just to list a few brief examples.

The second part of this report establishes future vehicle trip projections in specified areas of the village. This displays the volumes that could be expected in the coming decades. It involves the future lad use that was established by the village of Hanover, how traffic would be affected, how it would grow and how it can be improved. This also includes the number of walkability trips that could reduce the number of drivability trips.

Lastly, we have the final section that involves the resolutions to every issue that we had observed, every remedy for our future predictions, and attentive refined suggestions that will support Hanover into accomplishing their progressive determinations. This will include focused solutions to modern problems that were observed in our field inspections. This will also include advised future development projects that are dependent on the amount of traffic projected, the amount of walkability desired, probable intersection congestion, and desired frugal esthetics made for the image that Hanover wishes to uphold. These plans were developed in the mindset for the betterment of villagers who inhabit Hanover today, and for those who plan to raise their families for generations to come.

Section One
Existing Conditions

Introduction

Between August and November 2022, the Licking County Area Transportation Study (LCATS) examined the intersections on Licking Valley Road in the Village of Hanover. The intersections rest between Hainsview Drive and Licking Valley Road, and between Panther Drive and Scenic Drive. The first intersection sets at the entrance of Licking Valley High School and Licking Valley Primary, and the second sets at the entrance of Licking Valley Middle School. The purpose of this report is to assess viable solutions to increased traffic volumes Hanover is experiencing.

Background

With new land use happening in the village of Hanover, the populations have been showing a significant increase over the years. This has resulted in poor levels of road services which hasn't been able to accommodate fast enough for growing traffic. One way the Hanover Comprehensive Plan aims to assist with the growing population by redesigning roadways into forms that better manage large traffic volumes with the assistance of LCATS. Hanover also plans to manage their future land use in a way that strengthens educational expansions for future employment opportunities for youth, active pedestrian accessibility for the village neighborhoods and storefront buildings, and updated controlled waterline and sewage systems that extend beyond central residential. Hanover plans to accomplish while also maintaining a balance of development accommodations and rural character.

Methodology

LCATS used MetroCount traffic counters that used rubber tubing to collect the volume and speed of various vehicles traveling east and west on Licking Valley Road, north and south of Hainsview Drive. LCATS used a Mavic 2 DJI drone to capture footage of the two intersections. Jamar TMC boxes were used to collect vehicle turning movement counts at the two intersections during the peak traffic hours of the morning and evening.

Our first turn movement count session took place during the morning hours of 7:00AM to 9:00AM at the intersection of Licking Valley Road and Hainsview Drive. The second morning session was taken at the intersection of Licking Valley Road and Panther Drive. The evening session was conducted at the hours of 2:00PM to 6:00PM at the intersection of Licking Valley Road and Hainsview Drive, and again at the intersection of Licking Valley Road and Panther Drive.

LCATS conducted two field audits along W High Street starting at the crosswalk intersection near Legacy Park entrance heading east and west on W High Street. We examined the roadways, sidewalks, storm water drains, and signage along this roadway. Sidewalk measurements, stormwater drain examinations, sign placement inspections, and road evaluations were made during field studies. Many pictures were taken to classify the conditions of each subject to evaluate future beneficial proposals.

Observations and Analysis

Roadways

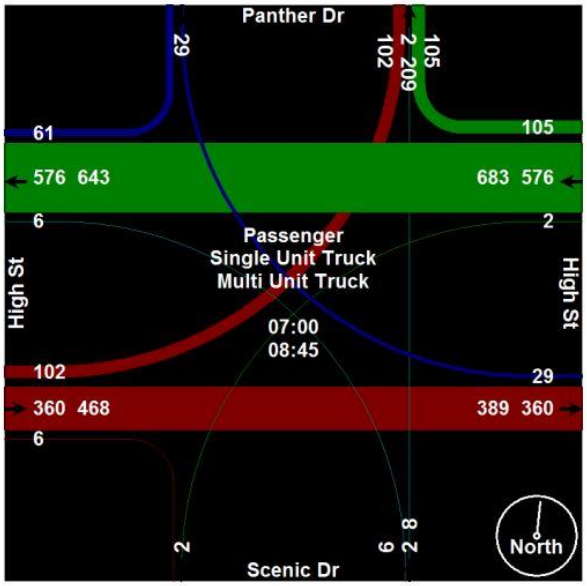
Licking Valley Road / Hainsview Drive Intersection traffic lane measurements showed conflicting results after field audits. Traffic lanes east of Licking Valley Road / Hainsview Drive Intersection measured to the road regulation standard width, but traffic lanes west of Licking Valley Road / Hainsview Drive were inconsistent and not regulation standard. Westbound traffic lanes need to be at standard width for safe traffic movement.

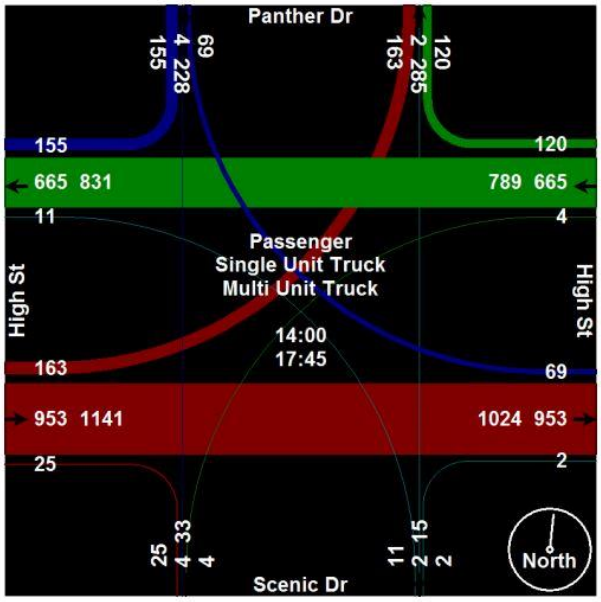
The intersection of Licking Valley Road and Hainsview Drive is equipped with a four-way traffic control light that is set on a scheduled timer. The second intersection of Licking Valley Road Scenic Drive, and Panther Drive is equipped with a turning lane. After receiving our data from the MetroCount traffic counters we found that peak hours of heavy vehicle volume are 7:15am-8:30am, 2:00pm-3:30pm, and 5:00pm-6:00pm at both intersections.

Site Location	Peak Hour Volume/Time	24 Hour Total Volume
Licking Valley Road West of Scenic Drive	**681** *6:00PM*	**5519**
Licking Valley Road West of Hainsview Drive	**605** *7:00AM*	**6247**
Hainsview Drive North of Licking Valley Road	**350** *7:00AM*	**2235**
W High Street West of Hickman Road	**420** *7:00AM*	**4392**
Hainsview Drive South of Panther Drive	**187** *7:00AM*	**1618**

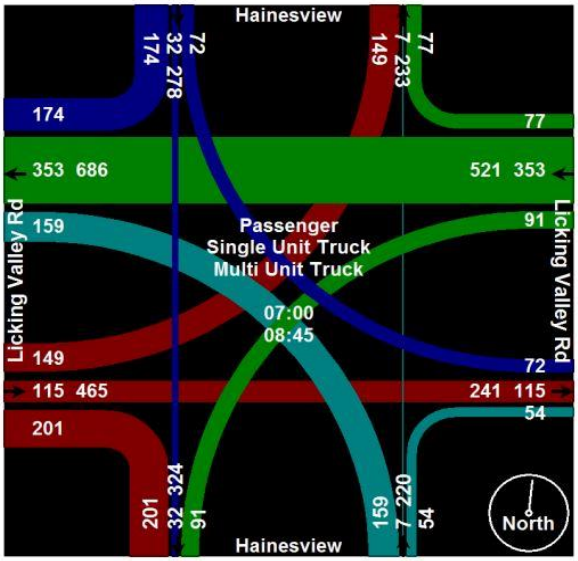
(Counter locations)

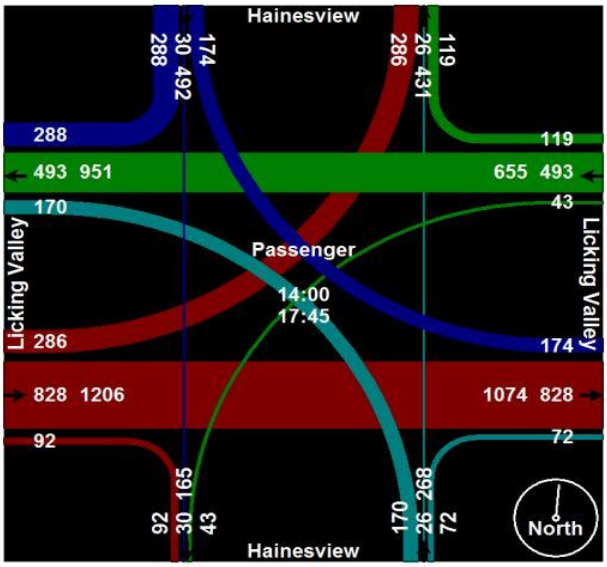
These high traffic volumes in the morning and evening are creating a queuing of vehicles that stretches between east and west corridor of Licking Valley Road. At Middle school intersection of Licking Valley Road, Scenic and Panther Drive traffic queuing appears at 2:15pm. Traffic turning right into the middle school create a line of traffic that interferes with through traffic on Licking Valley Road. Given the proximity of the residences on Scenic Drive, students can be seen crossing the intersection with no proper sidewalk nor crosswalk. Traffic turning left onto Panther Drive have no choice but to stay in center turn lane on Licking Valley Road.





Traffic queuing near the intersection has been observed beginning at 2:37pm west of High Street/Licking Valley Road. Traffic builds up at 3:15pm south of Hainsview Drive and east of High Street/Licking Valley Road. Traffic from east High Street/Licking Valley Road turning right onto north Hainsview Drive interferes with traffic turning left onto Hainsview Drive. Traffic from north Hainsview Drive turning right onto west Licking Valley Rd/ High Street interferes with east bound traffic. Intersections become congested with vehicles due to opposing traffic.





Sidewalks

Problems

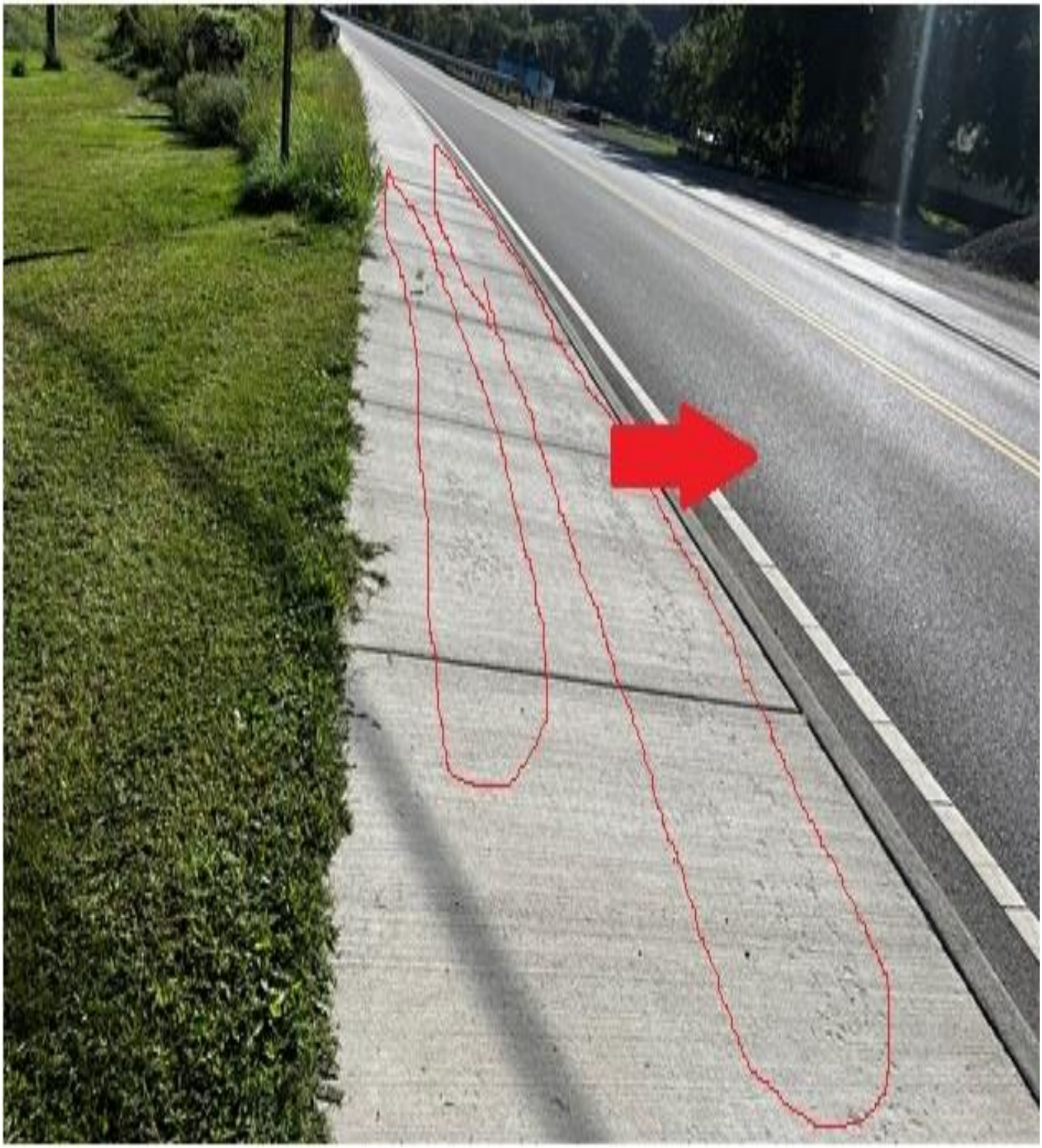
Areas of sidewalk have shown results of premature degradation, slopping irregularities, and flora overgrowth. Sections of sidewalk measured at a 3 percent incline as opposed to needing to be 2 percent incline, with some wear from possible salt distributions blemishes on the surface. Sidewalks near the intersection of Licking Valley Highschool and Primary school have heavy overgrowth of grass and soil making pathway 3.5 feet in width, as opposed to 5-foot ADA standard. Same sidewalk shows signs of heavy chipping and disintegration. Sidewalk on the bridge near Hanover Storage Units and Licking Valley Little League baseball field needs updated to proper modern standard. The same bridge over Rocky Fork creek has a 7-inch gap between railing and sidewalk that can cause a wheel trap for wheelchair pedestrians.

Solutions

The use of a higher grade of sidewalk cement could resolve the issue with premature degradation, or perhaps the use of a brine rather than salt crystals to make is less dissolvable. Proper reevaluations with engineers can resolve the issue with slopping to the standard 2 percent incline that will make it much safer for wheelchair bound pedestrians and comfortable for others. Removal of grass and earth overgrowth onto sidewalk in specified areas must be done for the safety of students who may travel this route to go to and from school. Simple landscaping can widen the sidewalk to its original state, and expanding the measurement in future renovation projects to 5-foot ADA standard width is advisable.

The sidewalk on the bridge over Rocky Fork creek needs not only widened the ADA standard of 5-feet but also updated with modern standard P.C. concrete with leveled subsurface underneath. This widening could also fix the 7-inch gap seen between the walkway and railing. Creating a buffer between the railing, or redesigning the railing itself could be viable options as well.

(Overgrowth on path)



(Sidewalk chipping and disintegration / Road deformation and aggregate polishing)

(6-7-inch gap between guardrail and sidewalk)

(Bridge over Rocky Fork creek)

Problem

The bridge over Rocky Fork creek has been appraised by engineers of being 4/9 grade appraisal. This means the bridge itself is in poor condition.

Solution

The bridge needs to be brought to a modern standard of safety grade of 5/9 or higher with proper maintenance of the superstructure, substructure and deck of the bridge, and proper communication with the county will need to be made.

Problem

Sidewalk drain grate at Darla Drive flows parallel with the sidewalk itself. What water that is taken from main roadway and sidewalks could potentially be draining into nearby riverway. Aggregate polish and indentation have been seen on W High Street. Road conditions that show aggregate polish and sagging tire paths need to be brought to the attention of engineers. This way they can make recommendations depending on traffic volume and traffic type.

Solution

The sidewalk drain grate at Darla Drive needs to be turned ninety degrees to avoid inabilities for wheelchair pedestrians. This also can be said for many of the other drain grates along the main corridor. Drainage routes from the sidewalk and roadways needs to be discussed with county officials to know the location of the drainage. If it is towards the main waterway of Rocky Fork creek than this could pose for an ecological issue with ODNR.

Aggregate polish and indentation indicate that the base layer underneath the roadway may need to be evaluated. The type of asphalt needed for this corridor likely needs to be a much higher grade to support the larger amounts of traffic that is seen today and that is expected in the coming years. This may result in a total reconstruction of the road. LCATS would suggest core boring the roadway to at least six feet in several locations to determine if there are base deficiencies.

(Potential wheel trap for wheelchair pedestrians)

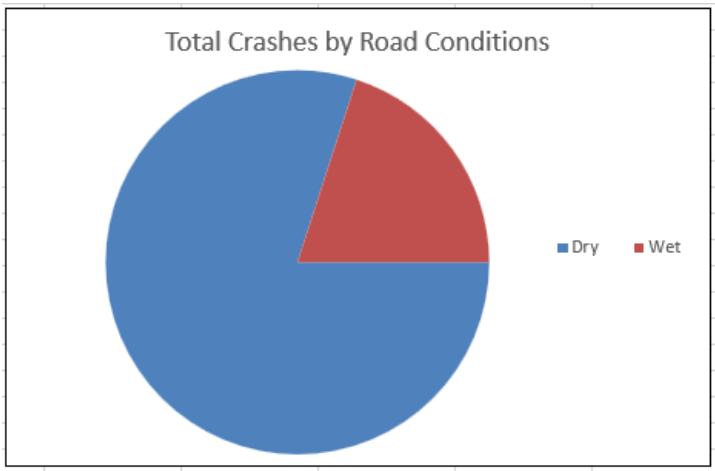
(Drain cover near baseball field is facing against the flow of right-hand traffic)

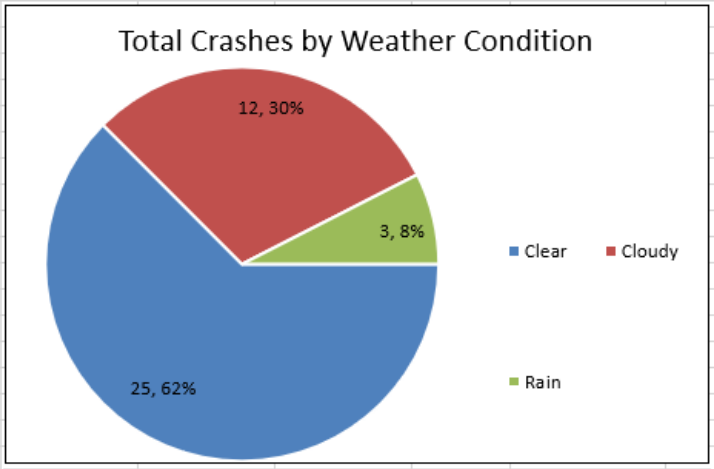
(Road deformation and aggregate polish)

(Center of lane raised 3 degrees higher than rest of road)

Safety Issues

With smoothed aggregate on the roadway this raises the risk of hydroplaning on wet roads and results in higher collision rates due to reduced tire grip to the dry road. From the data LCATS has collected in the past, we can see a larger percentage of crashes happen in this area in dry weather conditions alone. This can only be expected to be higher for both wet and dry conditions with smoothed aggregate roadways.





Road Condition	Total Crashes	Fatalities	Serious Injuries
Dry	32	0	1
Wet	8	0	0
Grand Total	40	0	1

Weather	Total Crashes	Fatalities	Serious Injuries
Clear	25	0	1
Cloudy	12	0	0
Rain	3	0	0
Grand Total	40	0	1

(Source: Crash Analysis Module Tool)

Signs/Guardrails

Problem

Stop sign near exit point of Licking Valley does not meet seven feet to the bottom height standard. Reflectivity is diminished on the stop sign. Licking Valley Primary and Highschool crosswalk signs are not of proper height or reflectivity.

Solution

Reflectivity must be to a proper and legal grade around all crosswalk signs, stop signs, and roadway name signs. The stop sign near Licking Valley Little League field needs to be properly raised to a legal height of 7 feet from the bottom of the sign to the ground. This can be said for the crosswalk signs near the Licking Valley Primary school and high school intersection. The height requirements are not set to standard regulation height nor modern reflectivity.

"School Zone" signs seem to be missing from the approaching area. This needs to be corrected by installation of said signs with proper reflectivity and height in mind. Flashing crosswalk signs in the intersection near the Primary and high school would be strongly advised for early morning or late evening traffic. Proper street lighting in this area, near Rocky Fork creek bridge and along main W High Street corridor needs reassessed into a form suited to Hanover's 2022 Compressive Plan.

Problem

Guardrails along Licking Valley Road between Panther Drive and Bolen Road needs desperate, and near immediate, replacement. Guardrail standards dictate that height measurements should be thirty-six inches above the roadway, where there are certain areas that just below nineteen inches in height. Guardrail blocks and posts are either rotted completely or nonexistent in specific areas.

Solution

All the guard railing needs to be replaced with modern materials and design. Height needs proper measurements made to make sure cars do not pass over or under the railing if a crash were to occur. Guardrail blocks need to be replaced and anchored properly into the ground.

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(Guardrail under 2 feet in height as appose to 3-foot standard)

(Damaged railing)

(Rotted posts and blocks)

(Rotted, dislocated, and/or missing posts)

Problem

Intersection near entrance of Licking Valley Middle school on Panther Drive does not show alignment with Scenic Drive. Turning lane from Licking Valley Road onto Panther Drive is nine feet, nine inches, as appose to standard ten-foot width. Far right turning lane coming from Panther Drive shows signs of vehicles turning into lawn, possibly due to traffic queuing in mornings and evenings, and narrow travel lanes.

Solution

Panther Drive middle school entrance needs to be widened to accommodate for turning traffic and legal standard. To fix alignment issues with Panther Drive, Scenic Drive may need to be widened out as well. More drastic recommendations would also have Scenic Drive remade to better align with Panther Drive.

Crosswalks may need to be installed due to number of students who cross this road in the morning and evenings. This area also requires "Entering School Zone" signage to specify to traffic.

Problem

Drainage off of Licking Valley Road, and near intersection of Bolen Road, has seemed to create an overgrowth in wetland foliage. Culvert is not visible from roadway and appears to be covered by wetland foliage. This needs to be cleared and maintained so proper runoff can occur off the road to avoid erosion of soil underneath roadway.

Solution

Clearing out the foliage and making sure proper water runoff is being drained into a debris freed culvert. If there is no culvert in this area one needs to be installed.

(Culvert overgrown or missing)

Problem

The crosswalk signs in front of Legacy Park need reviewed. There are 5 crossing signs as this crosswalk is approached by eastbound traffic and 6 crossing signs for the westbound approach. The eastbound approach has

4 W11-15 yellow-green, diamond, bike and pedestrian crossing signs and 1 R1-5 white, square yield to pedestrian sign. The westbound approach has 4 W11-15 yellow-green, diamond, bike and pedestrian crossing signs, 1 R1-5 white, square yield to pedestrian sign, and 1 outdated (previously W5-2) yellow-orange pedestrian crossing sign. In summation, there are 11 signs specifically for this crossing, all within 130 feet or less of this crosswalk.

Solution

These signs need to be at correct distance of 4 feet from the edge line of the road, if possible, reduce the redundant and outdated dark yellow signs in specified locations, and be placed in the correct and worthwhile locations as mentioned before in past reports.

Summary of Observations

- High traffic volumes in the morning and evening are creating a queuing of vehicles that stretches between east and west corridor of Licking Valley Road.
- Licking Valley Road / Hainsview Drive Intersection traffic lane measurements showed conflicting results after field audits.
- Areas of sidewalk have shown results of premature degradation, slopping irregularities, and flora overgrowth.
- Bridge over Rocky Fork creek has a 7-inch gap between railing and sidewalk that can cause a wheel trap for wheelchair pedestrians.
- Sidewalk and road drain grates need proper replacing to avoid tire damage for drivers and wheelchair pedestrians.
- Aggregate polish and lane indentation has been seen on W High Street creating unleveled roadways.
- Bridge over Rocky Fork creek is in poor condition, and would need to be reassessed after communication between Village and County governments.
- Stop sign near exit point of Licking Valley does not meet seven feet to the bottom height standard.
- Guardrails along Licking Valley Road between Panther Drive and Bolen Road needs desperate, and near immediate, replacement.
- Intersection near entrance of Licking Valley Middle school on Panther Drive does not show alignment with Scenic Drive.
- Drainage off of Licking Valley Road, and near intersection of Bolen Road, has seemed to create an overgrowth in wetland foliage.
- The crosswalk signs in front of Legacy Park need to be replaced and moved to appropriate standard settings as advised from previous reports on the subject.

Section Two
Future Traffic Projections

Introduction:

After the existing conditions was reported along with the traffic volumes on the West High Street corridor, LCATS now needed to present the future traffic volume projections of what could conceivably be determined for Hanover's growth.

Background:

After discussing the current traffic volumes, turning movements near focused intersections of interest, and revealing our field observations on West High Street corridor with Hanover council members, LCATS needed to generate the future growth of the roadway under observation. To determine this, we needed to notice the traffic volumes as they are now and compare them to the average growth that has been observed in the past studies. After comparing the traffic increases by yearly rise, we were able to determine an average of 5% per year. This would act as the platform for which we complete our calculations for Background growth without significant land use change.

Methodology:

LCATS used MetroCount traffic counters that used rubber tubing to collect the volume and speed of various vehicles traveling east and west on Licking Valley Road, north and south of Hainsview Drive. The following data displayed was calculated using Trip Generation handbooks developed by the Institution of Transportation Engineers dependent on current and future land use.

Current Traffic Volumes:

(Traffic volume trips over 24-hour period)

Here we are able to see the number of vehicles traveling to and from West High Street as the main route of transportation. We are also able to determine the number of vehicles traveling to and from Hainsview Drive to the north near Licking Valley high school at 2235 trips. 5519 trips in front of the Licking Valley middle school, 6247 trips generated on W High Street in front of the intersection new Licking Valley primary school, and 4392 trips collected in front of the Legacy Park entrance. The trips observed near the E High Street intersection were smaller in volume but showed a significant pattern that aided us later in the study. With 1002 trips shown on Hickman Road to the north, 961 going south on South Main Street, and lastly 1506 trips generated on East High Street.

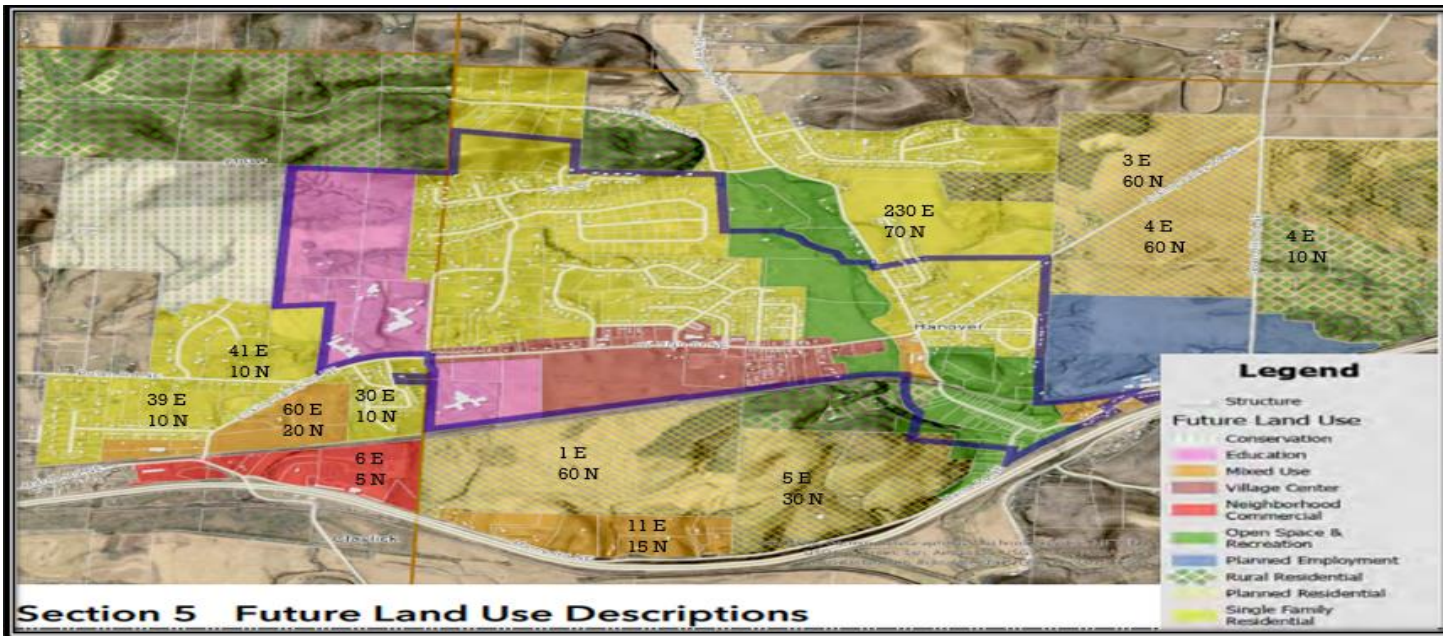
Background Traffic Growth:

The chart above shows the change in traffic volumes over the years in Hanover village. Through careful calculations, we were able to see an average of 5% increase of traffic per year that can be seen displayed on the map. These numbers determine what traffic volume growth will look like if there is no substantial change happening to the surrounding area. By taking the average that we determined from the chart presenting the history of growth in the village, we can expect current traffic volumes to nearly double in the next forty years. Given our study's focus on the main corridor of Hanover village, these numbers reflect what became relevant to our work. These numbers would act as the foundation for the low and high projections that would reflect a significant change according to the Comprehensive Plan established by Hanover engineers and representatives.

Existing and New Community Parcels:

(Existing and potential new number of habitable parcels within Hanover village)

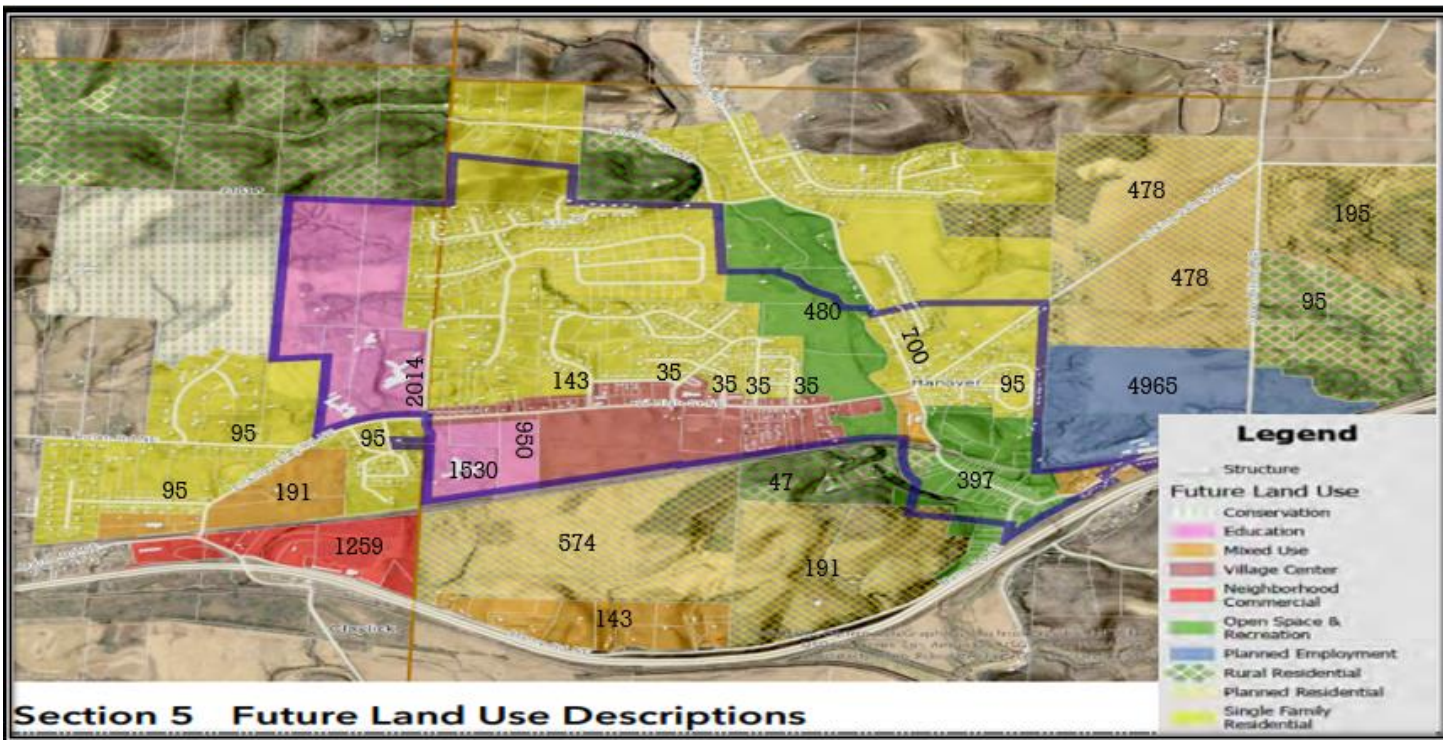
To determine the number of current and future trips, we had to look where the current residences of Hanover was amassing from and where they could be generated in the years to come. To do this, we had to assess the number of current houses and living units that were physically within Hanover today, and determine the area of land that plans to hold residential parcels in the future. By measuring the land that currently hold residential housing and counting the number of units in those measurements LCATS generated the number of new parcels that could be seen within the village. We were able to focus on four major areas in which traffic was being generated from and produced numbers correlating to those regions.



(Existing and potential new number of habitable parcels outside of Hanover village. Future Land Use map taken by Village of Hanover Comprehensive Plan 2022: Forward Together)

The map shown above takes the same concept we practiced within the current village of Hanover: looking at current residential parcels and measuring the land to determine the number of new parcels that land could encompass. The land in question was derived from the Future Land Use map given to us by Hanover's 2022 Comprehensive Plan that illustrates the potential for territorial annexation. We focused on the land that was used specifically for family housing for this section and was able to determine the numbers that are on display; separating them into two categories of existing and new parcels.

New Trips Generated:



Once LCATS had determined the number of residential parcels we could then direct our focus towards the number of new future trips from each area on display of the Future Land Use map. This was determined by observing the roadways that feed into West High Street and calculating the number of trips that each roadway would create depending on land use. What is shown on the map in yellow and yellow-grid signifies Single Family Residential and Planned Residential. These new trips were calculated using the ITE Trip Generation handbook's national average of 9.57 trips a day for each residential household. This gave us the number that we have displayed on the map for each appropriate sector.

The pink sectors represent Education or school zones. These areas were slightly more difficult to determine given their relevance to single residential trips and area of land use. The orange, red, and blue regions on the map represents Mixed Use, Neighborhood Commercial, and Planned Employment. Due to the ambiguity of possible outcomes for these areas, LCATS was able to calculate the average number of trips by using acreage and parcel numbers. Hanover's Comprehensive Plan stated several potential uses, including warehouses, company stores, and apartment living quarters, so LCATS was able to make fair calculations to disclose the average number of trips appropriate to the size and use of these areas.

The green areas on the map represent Open Spaces & Recreation parks. These were fairly simpler to determine using the Trip Generation handbook that states the average number of trips to parks and recreational zones is 4.57 trips per acre. LCATS measured the acreage of each zone to come up with the average daily trips that each region could potentially experience. Lastly, we have the Village Center, displayed on the map in a light maroon, that require special focus given its multipurpose design.

Proposed Use of Land

We examined the ambitious project of the Village Center and were able to break it into three sectors: Multifamily housing, recreational park, and walkable shopping center. This required a combination of measuring the acreage of the intended land use, counting the number of parking spaces and multiplied that number by the average of 9.57 trips, and determining the area of each shopping zone to come up with the most accurate display of potential trips LCATS could assemble. After close consideration of many factors, LCATS was able to determine that this village center would bring 12,200 new vehicular trips to the main corridor of West High Street. Let it be said that this design is meant to inspire a walkable community, and the numbers displayed are strictly vehicular in nature.

High and Low Traffic Growth Projections:

HANOVER VILLAGE TRAFFIC GROWTH

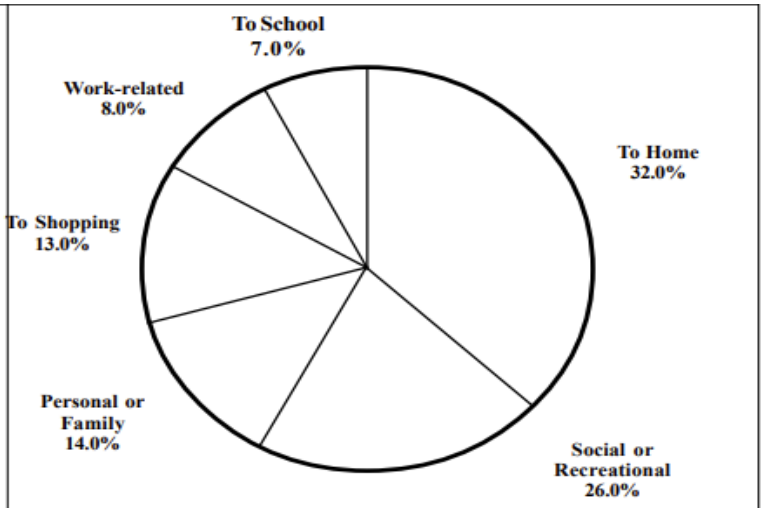
Roadway	Existing	Back Ground	Low Projection	High Projection
Licking Valley Rd / Scenic Dr	5500	11200	15922	19422
Licking Valley Rd/ Hainsview Dr	2200	4490	21527	25027
W High St / Valley Blvd	4300	8800	14832	23332
Hickman Rd/ W High St	1009	2004	3785	9760
E High St / W High St	1506	3012	5661	11347
S Main St / W High St	961	1922	3648	7148

Our final projections for the high and low expected volume came from a lengthy process that incorporated all the elements we created from our original collected data. First, we needed to observe the Background numbers we had generated from the original existing counts we had taken before we started our report. Then we needed to look back at all the new trips generated from the roadways that fed directly into W. High Street, and determine the percentage of trips would be affecting these Background numbers. Afterwards we could then determine how many trips are going each direction towards each intersection, Background number, and draw a low projection from all those numbers added together. Lastly, we created our high projection from taking our low projection and adding 3500 trips to each figure. The 3500 trips that was used as the buffer was the product of the difference in previous projections made in the past when comparing the growth rate of Hanover traffic over the years.

(Low and high projections displayed near our collected counts.)

Walkable Trips Generated:

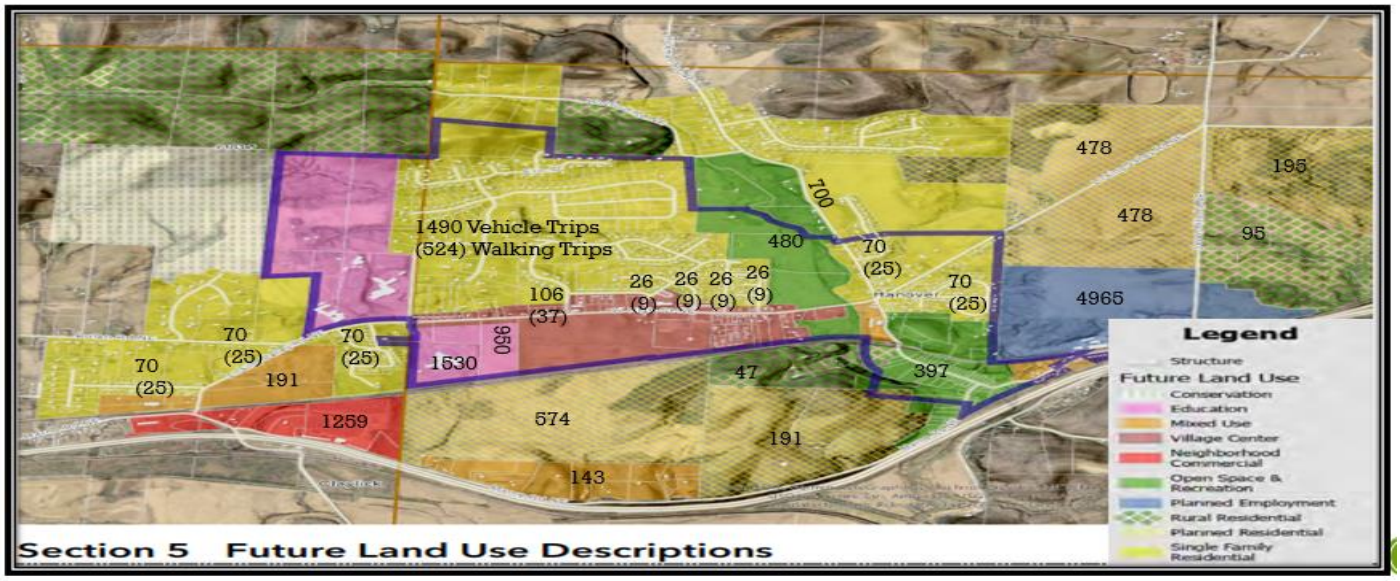
*Walking Trips in Urban Areas**



Source: U.S. Department of Transportation, *1995 Nationwide Personal Transportation Survey* (Washington, DC, 1997). *Data for Metropolitan areas of population similar to the MARC region.

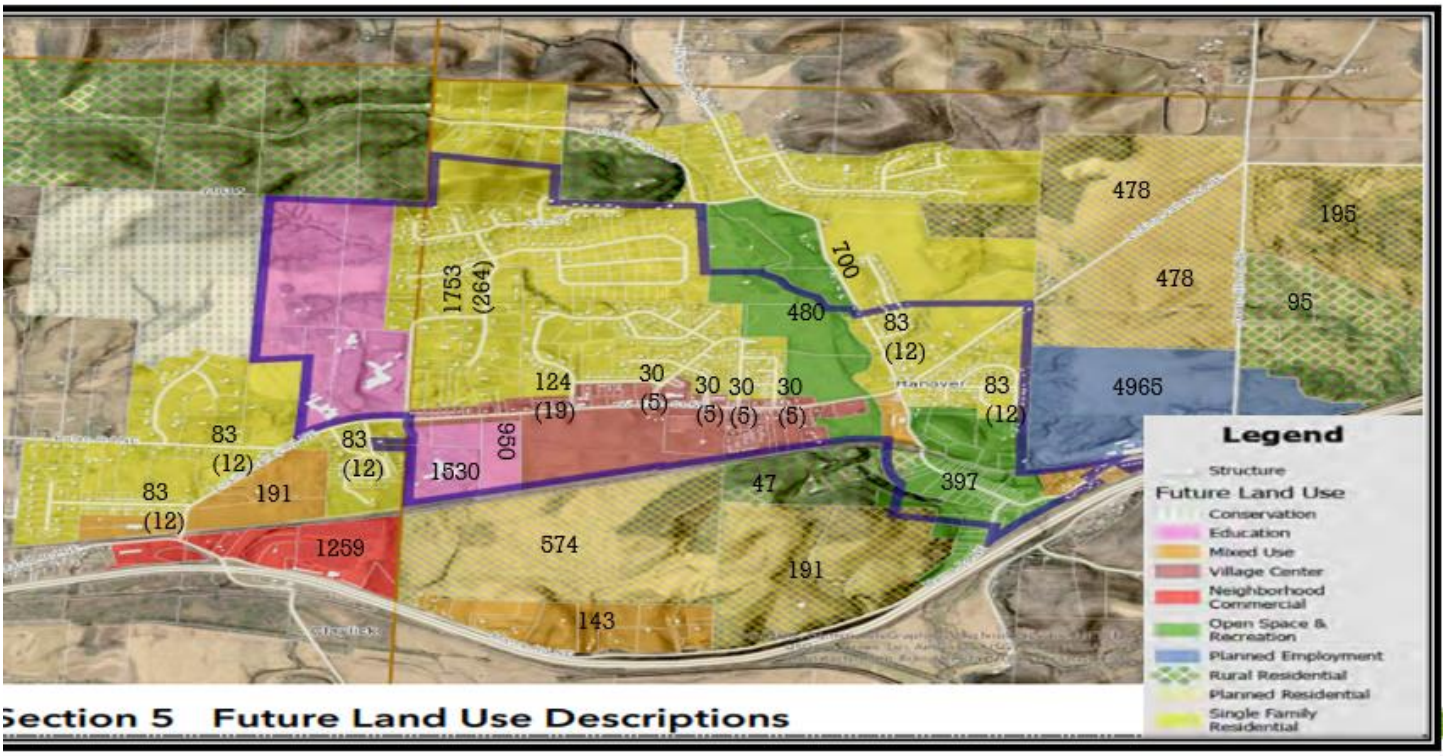
Hanover's vision for the future of the village involves promoting a walkable community that inspires more people to stay active and not rely on motored transportation. This requires a reinvention of many sidewalks, bike lanes, and trail routes that center of bicycles and hikers. The chart displayed in this report demonstrates the national percentages of trips people are willing to make in urban environments. According to the MARC's *Creating Walkable Communities* guide, an average person is only willing to walk 1.25 miles, or 20 minutes, from their place of origin. This includes everything in the chart above, from walking to school or finding a local park to walk to. What makes things more complex is the fact that people will typically find ways to make that distance shorter or time frame smaller, so planning for these types of communities is important in many ways.

NEW TRIPS GENERATED VEHICLE VS WALKING TRIPS: WALKING TO PARKS/RECREATION



LCATS was able to use the numbers from the chart to help determine a rough estimate of the number of walking trips that could be produced from each residential roadway. LCATS broke the walking trips into three separate types that would best represent the goals that Hanover had for its future inhabitants. The first volume represents that number of walking to trips to parks and recreational zones. LCATS managed to subtract the number of walking trips from the driving trips and displayed them both on the map. Each residential roadway is best distributed according to the percentage used to extract the values, but realistically some numbers could be much higher depending on their proximity to parks, schools, or shopping centers.

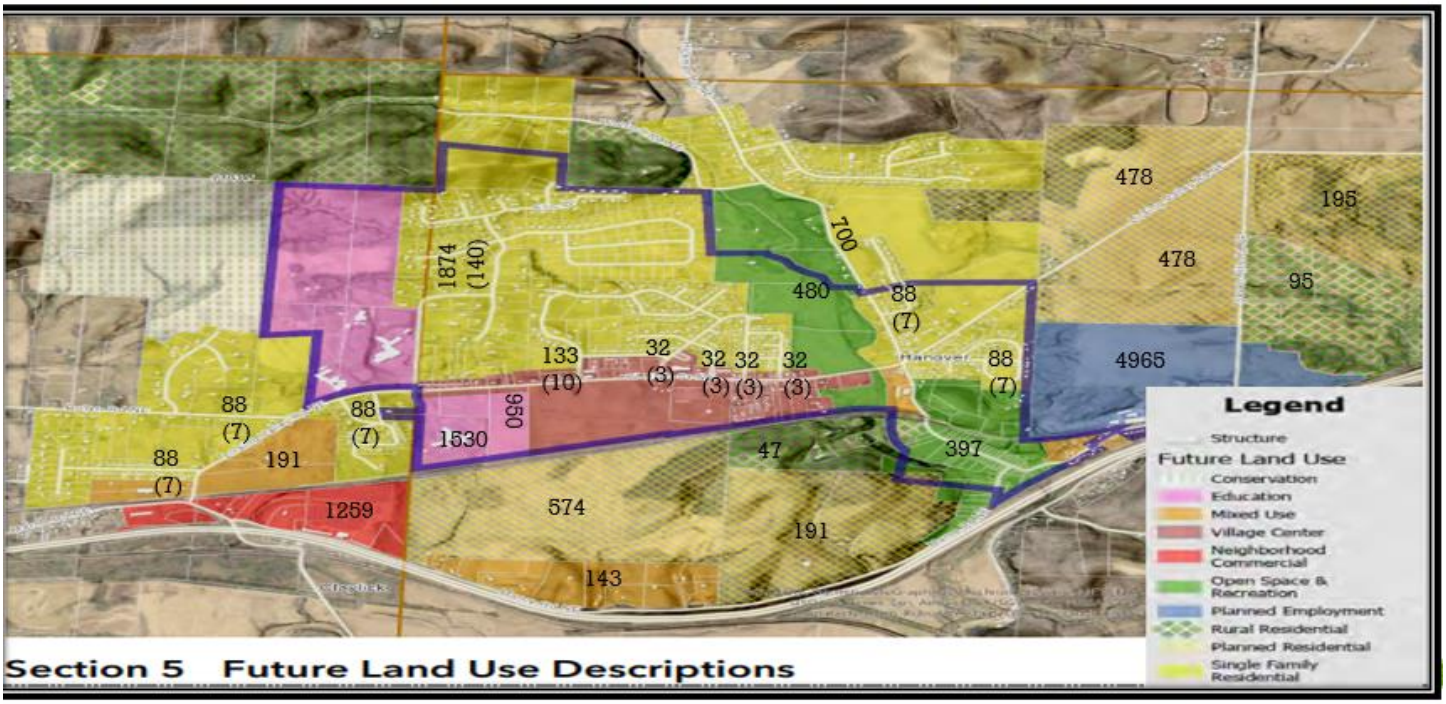
NEW TRIPS GENERATED: WALKING TO SHOPPING CENTER



Section 5 Future Land Use Descriptions

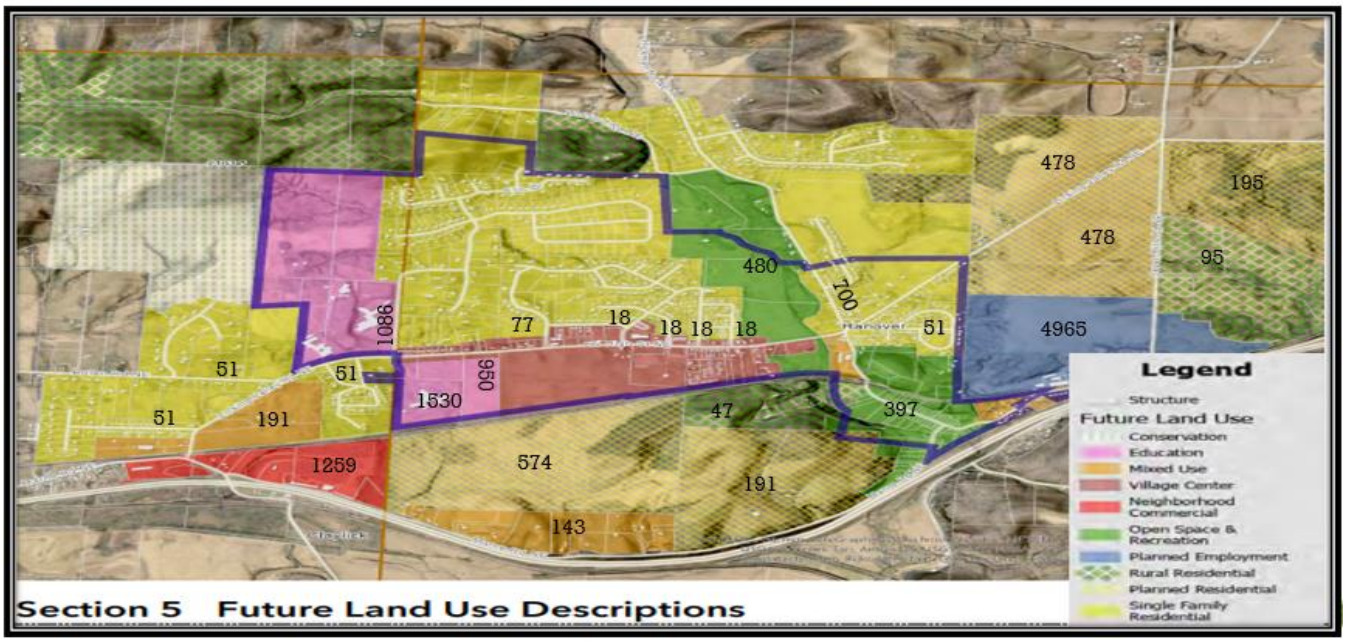
The second map represent the number of people walking to shopping centers in the village. Again, LCATS extrapolated the percentages found from the national average of urban areas and measured a 1.25-mile radius from expected shopping sectors. LCATS was able to create appropriate values and compare them to how they would face against vehicular trips. The values represented may also be subjected to change depending on reasonable proximity.

NEW TRIPS GENERATED: WALKING TO SCHOOL

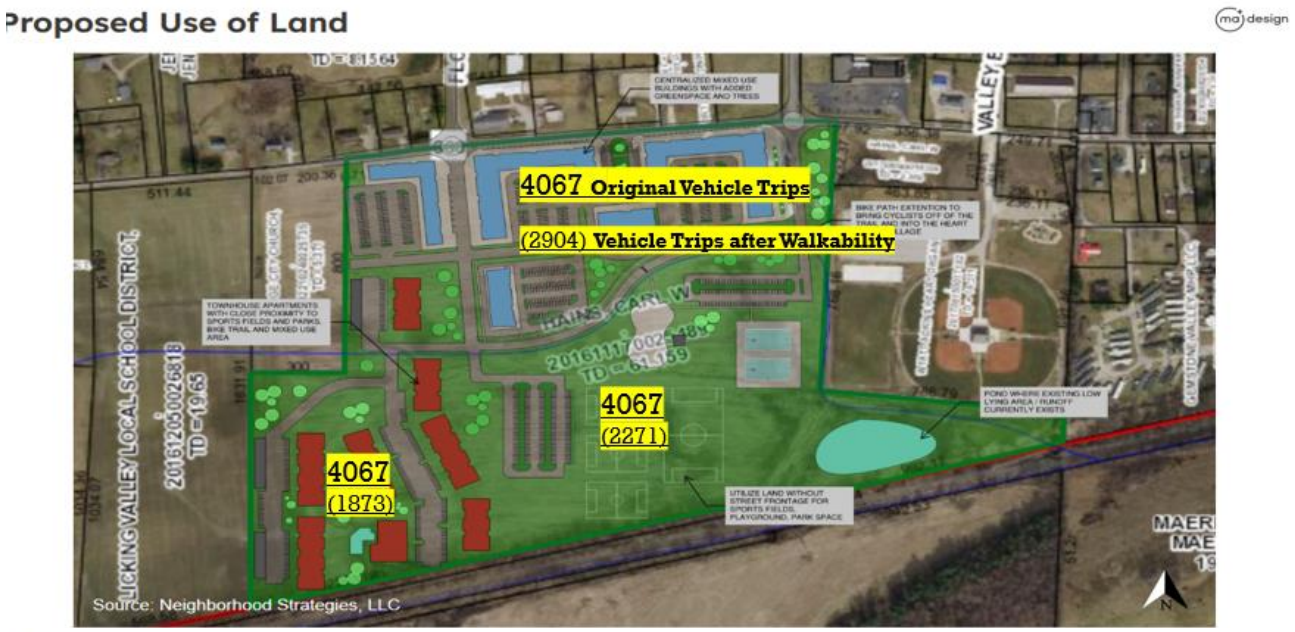


Lastly, LCATS created a map that shows the number of students who could potentially walk to their school. Each student could walk to the Primary, Middle or Highschool depending on several factors that all lead to safety. The students would need appropriate sidewalks and crosswalk for various intersections located near the school zones, and parking for bicycles so they could have the option to bike to school. Hanover plans to have an extensive route for bikes that runs through the village center where many new students could flow from.

NEW VEHICLE TRIPS GENERATED (RELATIVE TO LAND-USE) AFTER WALKABILITY



What this ultimately leads to is the reduction of vehicular drivers off the main corridor of W. High Street. The map displayed above shows the total reduction of vehicular trips from each roadway that flowed into W. High Street. These walkable trips could turn a lot of stress off the roads themselves and control level of traffic. However, it must be brought forward that walkability is reliant on several factors that warrant these trips, such as weather, time of year, safety and design to list a few. A significant drop from not only these roads but also can be expected form the Village Center concept.



(New total of vehicle trips after subtracting walking trips.)

The Village Center concept generated the most vehicular trips onto W. High Street dwarfing many of the rest even when combined. But if we apply the same walkability trip practice, we can see significant reduction of those vehicular volumes. LCATS distributed the total volumes into three equal regions of the Village Center concept to have a better understanding of how much walkable reduction was needed to be applied. LCATS first

reduced the amount of people who could walk to the shopping center and recreation zones from other areas in Hanover like what was presented earlier in the report. Then LCATS added the factor of multifamily housing, or apartments, that would be fitted into the Village Center concept and subtracted the number of students leaving for school, and people walking to the shops and parks. Finally, once the subtractions were made to the original traffic volumes, LCATS was able to reduce the overall number of vehicle trips into a new value.

HANOVER VILLAGE TRAFFIC GROWTH AFTER WALKABILITY

Roadway	Existing	Back Ground	Low Projection	High Projection
Licking Valley Rd / Scenic Dr	5500	11200	13984	17484
Licking Valley Rd/ Hainsview Dr	2200	4490	17884	21384
W High St / Valley Blvd	4300	8800	12424	15924
Hickman Rd/ W High St	1009	2004	3034	6534
E High St / W High St	1506	3012	4591	8091
S Main St / W High St	961	1922	2952	6452

The inclusion of walkable trips also made changes to the low and high projections we could calculate. After looking at the possible reduction of vehicular trips, LCATS had to calculate how the projections would look with the same formula as before. Though the projections for the coming decades are still high we did see a significant drop in quantity of volume. Depending on future roadway and walkway strategies these numbers could change.

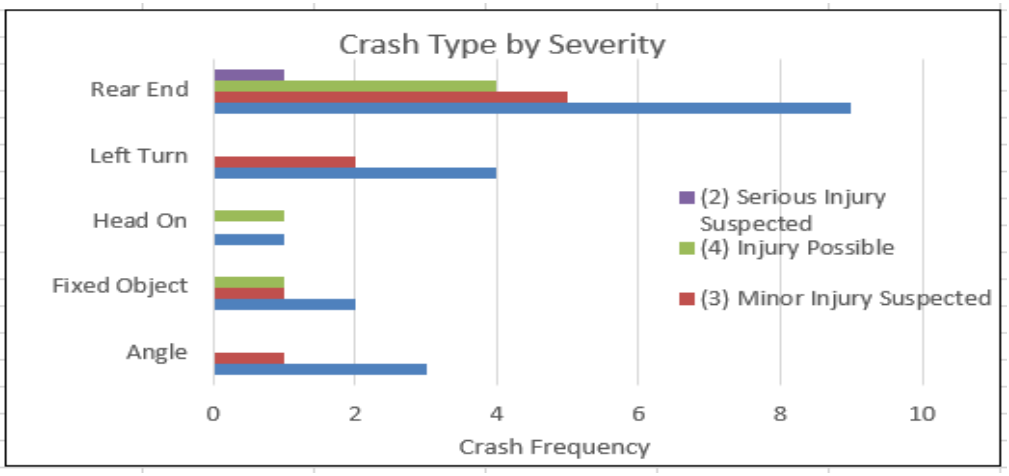
HANOVER VILLAGE TRAFFIC GROWTH LOW AND HIGH PROJECTIONS: YEAR 2042+

Section Three
Proposed Solutions

Introduction:

As before mentioned in Section 1 of the report, singular solutions to current issues are made to accommodate them in the coming years. The proposed solutions in this current section of the report reflect the larger issues and questioned concerns that Hanover has brought LCATS to examine and assess.

Crash Severity and Counter Locations:



(Source: Crash Analysis Module Tool)

Crash Types Near our Counter Locations

Nearly every injury and rear-end collision happens close to where LCATS had placed our traffic counters. These areas are the primary focus of our study to establish probable solutions that could reduce the severity and frequency of such vehicular crashes. One such solution comes in the form of various roundabout designs.

Total Crashes	Injury Level				
Crash Type	(2) Serious Inju	(3) Minor Injury	(4) Injury Possi	(5) PDO/No Inj	Grand Total
Rear End	1	5	4	9	19
Left Turn	0	2	0	4	6
Angle	0	1	0	3	4
Fixed Object	0	1	1	2	4
Head On	0	0	1	1	2
Backing	0	0	0	1	1
Animal	0	0	0	1	1
Sideswipe - Passing	0	1	0	0	1
Other Object	0	0	1	0	1
Pedestrian	0	1	0	0	1
Grand Total	1	11	7	21	40

(Source: Crash Analysis Module Tool)

Roundabout Solutions

Project Name:	*Hanover High Street*
Project Number:	*Study Alternatives*
Location	*Hainesview Dr / Licking Valley Rd PM*
Date	May 15, 2023

Traffic Volume Demand						
	Volume (Veh/hr)				Percent (%)	
	U-Turn	Left	Thru	Right	Truck	Volume Growth
Eastbound	0	54	185	43	4.40%	33.60%
Westbound	0	18	116	26	4.40%	50.20%
Southbound	0	31	11	57	1.15%	167.00%
Northbound	0	112	15	42	1.15%	59.20%
Adjustment Factor	0.80	0.95		0.85		
Suggested	**0.80**	**0.95**		**0.85**		
Truck to PCE Factor				**Suggested = 2.00**	2.00	
Critical Lane Volume				1600		

Equivalent Pasenger Car Volume				
	Volume (Veh/hr)			
	U-Turn	Left	Thru	Right
Eastbound	0	75	258	60
Westbound	0	28	182	41
Southbound	0	84	30	154
Northbound	0	180	24	68

(Source: USDOT Federal Highway Administration; Capacity Analysis for Planning of Junctions CAP-X)

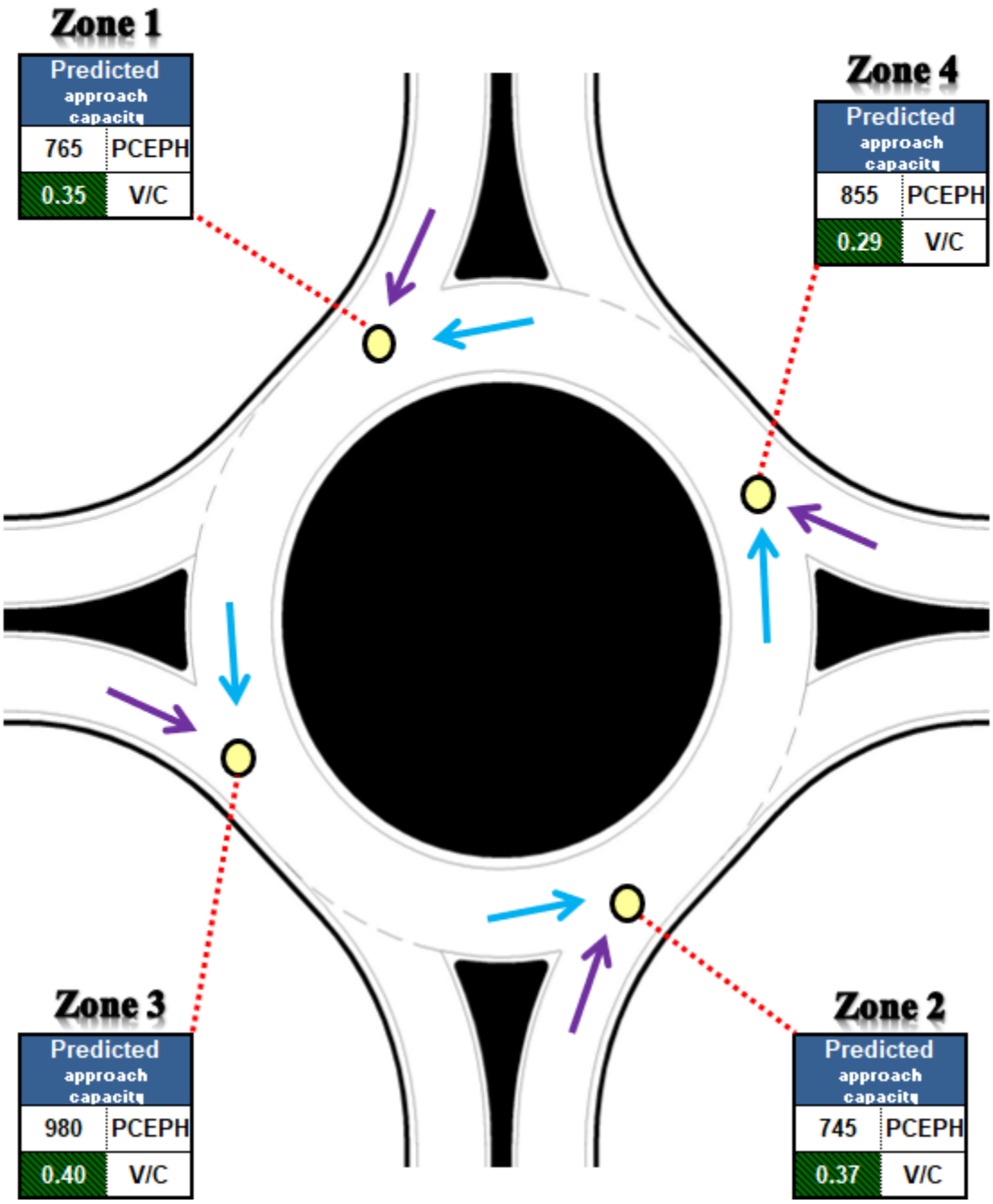
We managed to examine the peak evening hour along the intersection of Hainsview Dr and Licking Valley Rd. Then we compared these hourly numbers to the Low Projection that we calculated earlier in our report. We were able to create a percentage increase by determining what the hourly rate would be for our Low Projection number. Each turning lane for each direction of movement can be seen broken down in the chart above.

Roundabout Designs Recommended

1 NS x 1 EW Roundabout

Design and Results

		Critical Lane Volume Sum				
Project Name:	*Hanover High Street*	< 1200	1200 - 1399	1400 - 1599	≥ 1600	
Project Number:	*Study Alternatives*	VOLUME / CAPACITY RATIO:	Zone 1	0.35	Zone 4	0.29
Location	*Hainesview Dr / Licking Valley Rd PM*		Zone 3	0.40	Zone 2	0.37
Date	May 15, 2023					



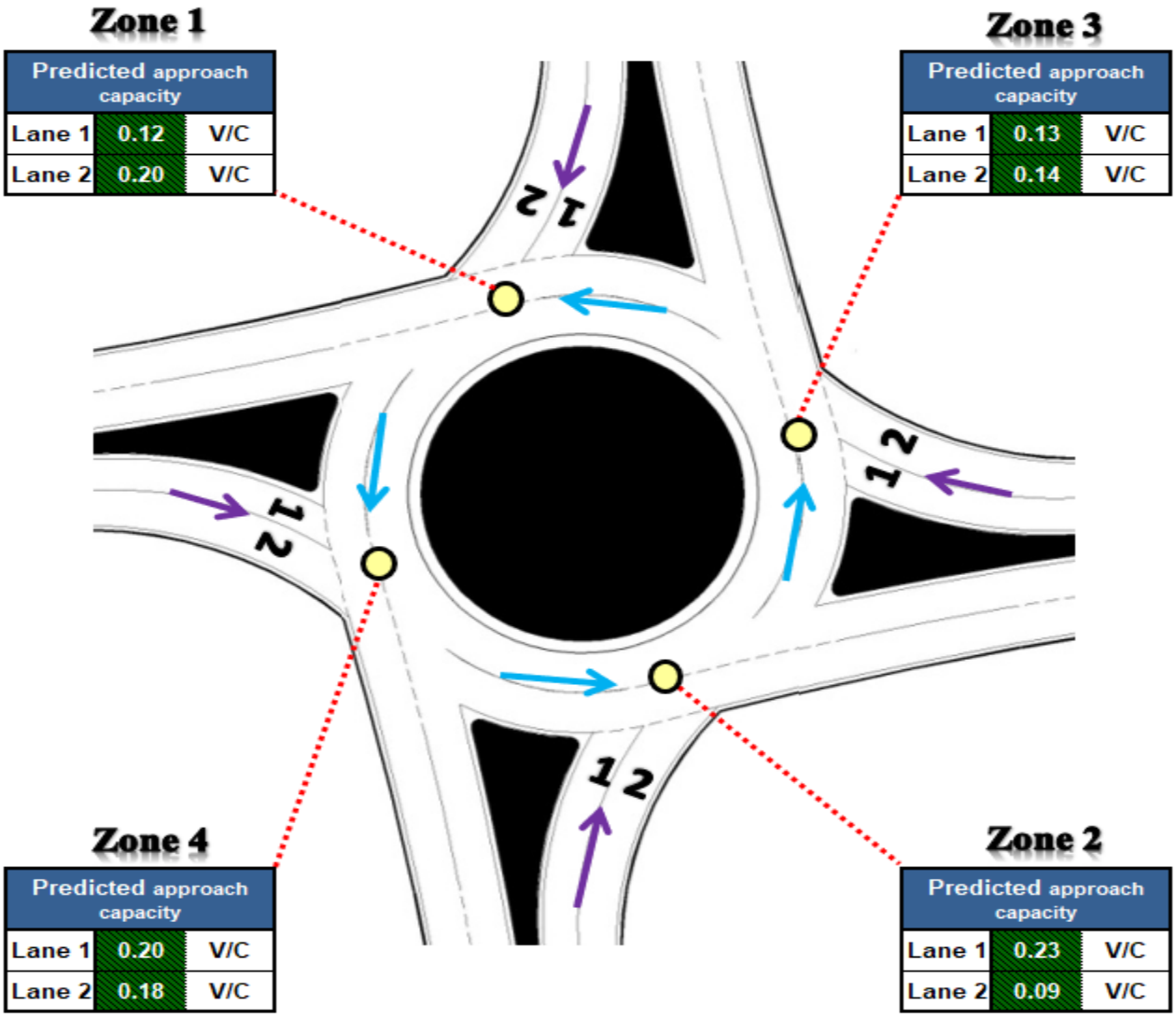
The roundabout design above shows a single lane function that would be best suitable for the intersection located near Licking Valley High Primary and Highschool. This type of design would suffice for the coming years but not 30 years from now given what we had calculated for the future low and high traffic projections. Hanover must build for a single lane roundabout in the near future, but plan for a double lane roundabout in the coming decades. To do this, it is best if Hanover acquires the land prior to any construction so that way when the time does in fact come the village will be ready to expand the roundabout an extra lane.

2 NS x 2 EW Lane Roundabout

Design and Results

Project Name:	*Hanover High Street*
Project Number:	*Study Alternatives*
Location	*Hainesview Dr / Licking Valley Rd PM*
Date	May 15, 2023

Critical Lane Volume Sum				
< 1200	1200 - 1399	1400 - 1599	≥ 1600	
VOLUME / CAPACITY RATIO:	Zone 1	0.20	Zone3	0.14
	Zone 4	0.20	Zone 2	0.23



Examples below demonstrate what this type of roundabout would look like in real time. A single lane design allows for traffic to move in a fluid and nearly uninterrupted motion.

Splitter islands allow for safe passage of all forms of pedestrian travel. With proper coloration and signage in the appropriate areas, walkable and handicapped pedestrians can move safely without sever risk of high-speed traffic collisions.

Designs of splitter islands can be as wide and as green as one wishes to design them. For example, Newark uses vibrant greenery and rustic brick work to not only serve the function of safety for cars and people, but to add radiant aesthetics to the city environment. Both function and fashion mustn't conflict however; Safety is the number one priority here. If the aesthetic gets in the way of function, then reevaluations must be made. Materials must not be able to trip or hinder pedestrians from crossing a road safely. The same must be said for decorative foliage, yet more for vehicular traffic. Trees in the center of a roundabout mustn't block the view so much that drivers merging into the roundabout can't see other drivers or crossing pedestrians.

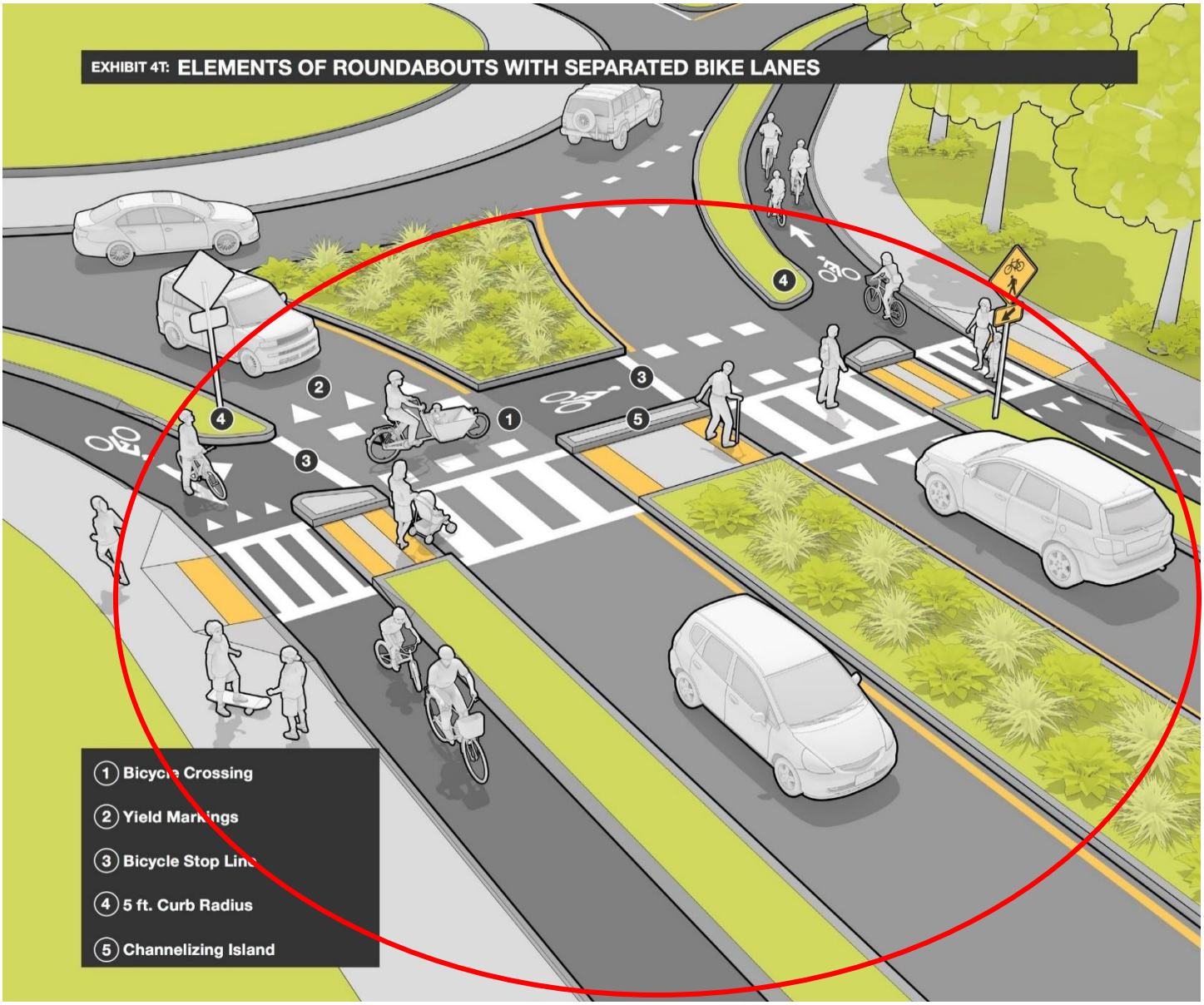
Roadways

The roadways throughout Hanover needs to mirror the same solution proposed when designing the roundabouts for various intersections: Plan and design for multiple lanes, but for now build for the singular lanes. Given what Hanover has planned for the Village Center concept, it is advisable to even design for a two-way physically separated bike lane for villagers of Hanover. As stated in the Hanover Compressive plan, biking and walkability is something that they wish to strive forward with.

Separated Bike Lanes – Alta Planning + Design (altago.com)

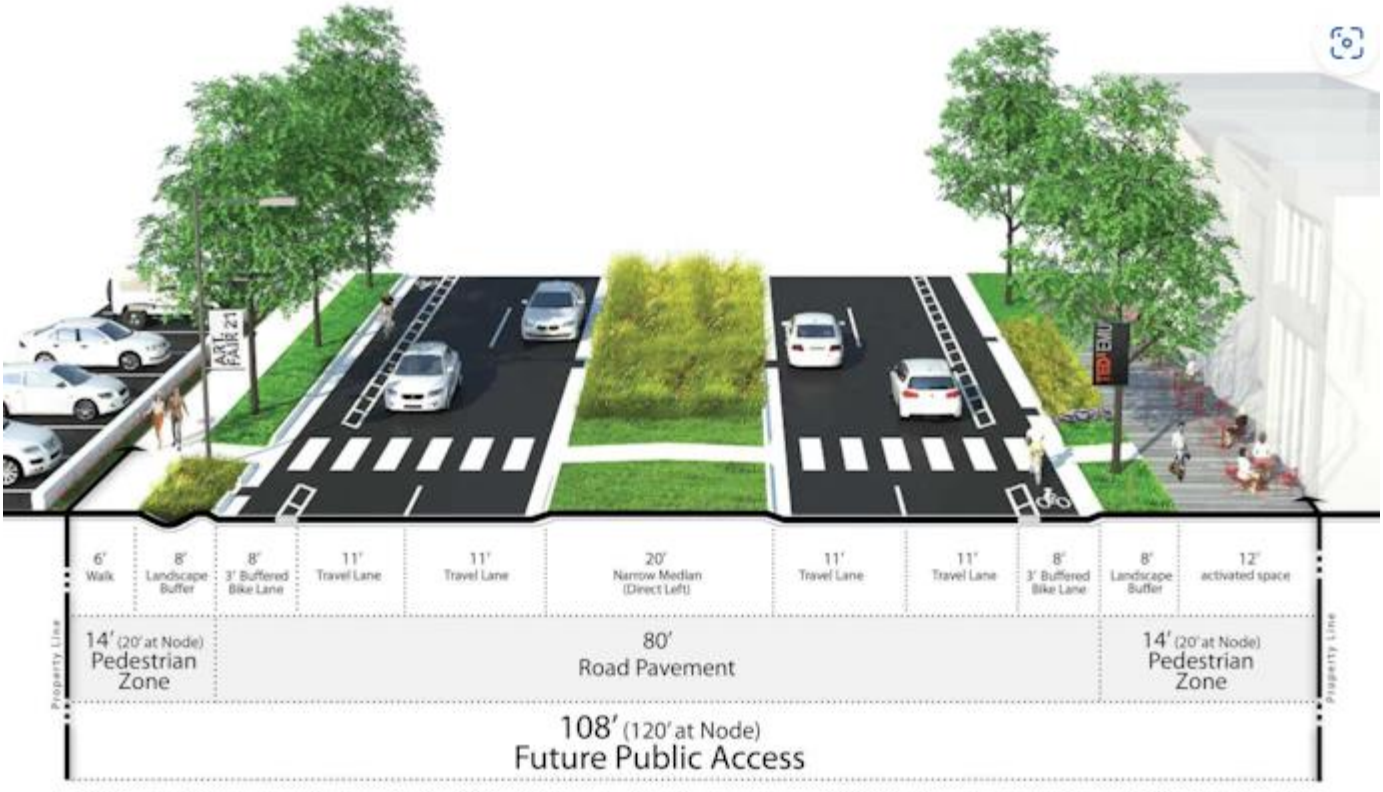
Two-way protected bike lanes are physically separated bike lanes that allow bicycle movement in both directions on one side of the street. These aren't are not as desirable on two-way streets due to challenges for roadway user expectancy at intersections and driveways. They are typically placed along streets where more destinations are on one side thereby reducing the need to cross the street and along streets with few conflicts such as driveways or cross-streets on one side of the street. Here we have some benefits to these types of bike lanes.

- On one-way streets, increases the density of the bicycle network, improving connectivity and directness of bicycle routes
- When connecting to shared use path facilities, provides an extended trail-like experience
- Dedicated and protected space for bicyclists makes it an attractive facility for riders of all levels and ages
- Lower implementation cost compared to street reconstruction by making use of existing pavement and drainage
- Reduces or eliminates risk and fear of collisions with opening parked car doors and overtaking vehicles
- Discourages double parking in the bike lane
- Improves perceived safety for bicycle riders



Source: (The MassDOT Separated Bike Lanes manual; Roundabouts That Work for Cyclists and Pedestrians — Ptown Insider)

Circled is the suggested short-term design of W High Street



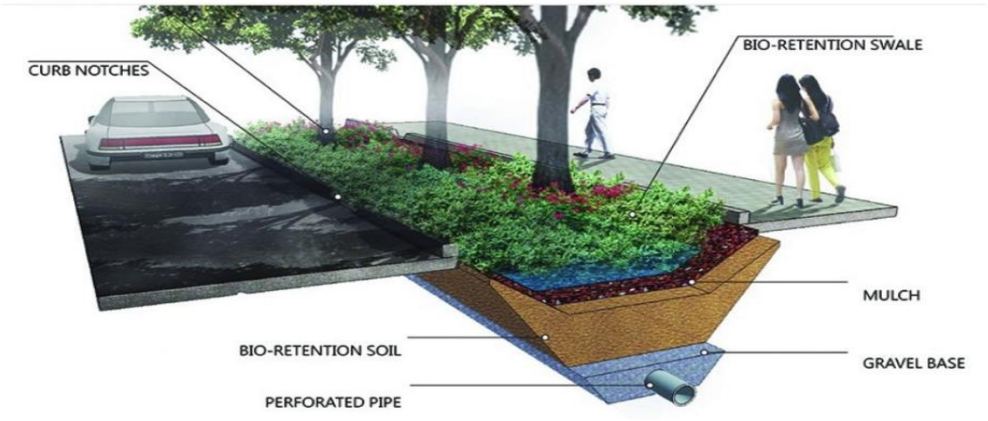
(Source: Design flexibility proposal is first step in FHWA's effort to promote innovative highway solutions | Equipment World)

The image above represents an idea of what we recommend the W High St roadway should look in the decades to come. Preparations for this design need to be made now, systems such as electrical, drainage, acquiring the land, and zoning, but given the steady growth of the village's population building a singular lane is acceptable.

Drainage

With greater numbers of vehicular traffic comes many things along with it. Road pollution happens to be a hazardous byproduct that effects our streams and rivers. But with the use of bioswales these landscape features can collect polluted stormwater runoff, soak it into the ground, and filter out pollution before it reaches the rivers. Newark has several examples of these as displayed in the images below. Hanover could benefit greatly with the establishment of these bioswales near the roundabouts, and for the planned Village Center to filter contaminants and add serene flora to any busy cityscape. Design can come in many forms depending on the purpose and location, but here is a basic idea of how bioswales function.

Bioswale



(Bio-Swales | JPAlandscapeblog (wordpress.com))

Some bioswales can even take various forms either in the center of the traffic lanes or closer to the sidewalks. Drainage systems can be designed to accommodate high levels of storm water. Once that is collected in the soil, nature takes care of the rest. No expensive filtration systems to separate pollutants from the water, just earth and other materials found in nature. These swales can secondarily beckon more villagers to walk around their village and admire the natural beauty they have to offer.

Village Center Walkability

Hanover plans to install a Village Center in the near future which promotes a more walkable community. Many of the designs that Hanover wishes to implement have various living examples found in Newark. Hanover has the idea of utilizing roughly 20 feet of usable sidewalk dedicated to pedestrians and storefronts and greenery. This plan is absolutely feasible given the right steps are made to make it happen. Proper zoning and purchasing of the land will help prepare for this type of ambitious project. The area in which they plan to utilize should be able to withstand the amount of development, and with making plans for a 4-lane roadway, this will accommodate for future expected traffic growth.

As seen in the image above, Newark shows examples of how much space can be utilized for walkability, storefront parking, and wheelchair accommodations. Brick walkways give an attractive and flexible stepping path, and benches sit firmly under serene trees for shade. This type of model is recommended for what Hanover wishes to accomplish for their village center in the coming years. The roadway is free of obstructions, many people use the walkway to go to many local businesses, and available parking helps drivers go to where they need to be with ease.

In Summary:

- Roundabouts are highly recommended in areas where we see high densities of rear-end collisions on W High Street.
- The intersections that would be adopting the roundabout design should be built for a singular lane in the short term, but planned to eventually be reconstructed to a double lane for future traffic growth.
- Roadways must be treated the same way as the roundabouts: Can build for singular lanes but plan to expand for 4 lanes. Road designs can include green spaces for splitter islands, curbs, and center islands, and incorporate viable bike lanes. This way the roadway expansion in the future can easily accommodate high levels of future traffic growth.
- Drainage systems can incorporate bioswales to help with harmful road runoff. These create natural filters for any toxins that could enter ground water and be used for pleasant greenspaces.

These suggested solutions LCATS presents to the village of Hanover have been carefully contemplated and calculated. Each one is direct in execution and transparent in function. Each area of the report is broken into various sections that could be categorized as short, moderate, and long-range planning with the amount of small and large projects that can be performed. This report proposes solutions that resemble in part with what can be found in the 2022 Comprehensive Plan made by Hanover. Meaning that Hanover council only has to slightly reassemble their focus for future development of the village to accommodate for the future growth that is expected to amass in the coming decades. This report was made in mind for the best viable solutions for the betterment of Hanover's people and their future advancements.