Louisville/Superior Joint Issues Committee Meeting

Tuesday, February 19, 2019
Superior Town Hall, Boardroom
124 E. Coal Creek Drive
Superior, CO 80027
7:30 A.M.

Discussion Items:

- Airport Noise Update
- Update on Downtown Superior
- Transportation Update
    - Louisville TMP Update
    - Superior Widening of 88th (from Rock Creek Parkway North)
- Update/Coordination on Louisville Library
- Louisville Rec Center Renovation and Expansion Update
- Broadband Study Update
- Discussion of Youth Sports & Field Time in Both Communities

City of Louisville
COLORADO • SINCE 1878

Town of Superior

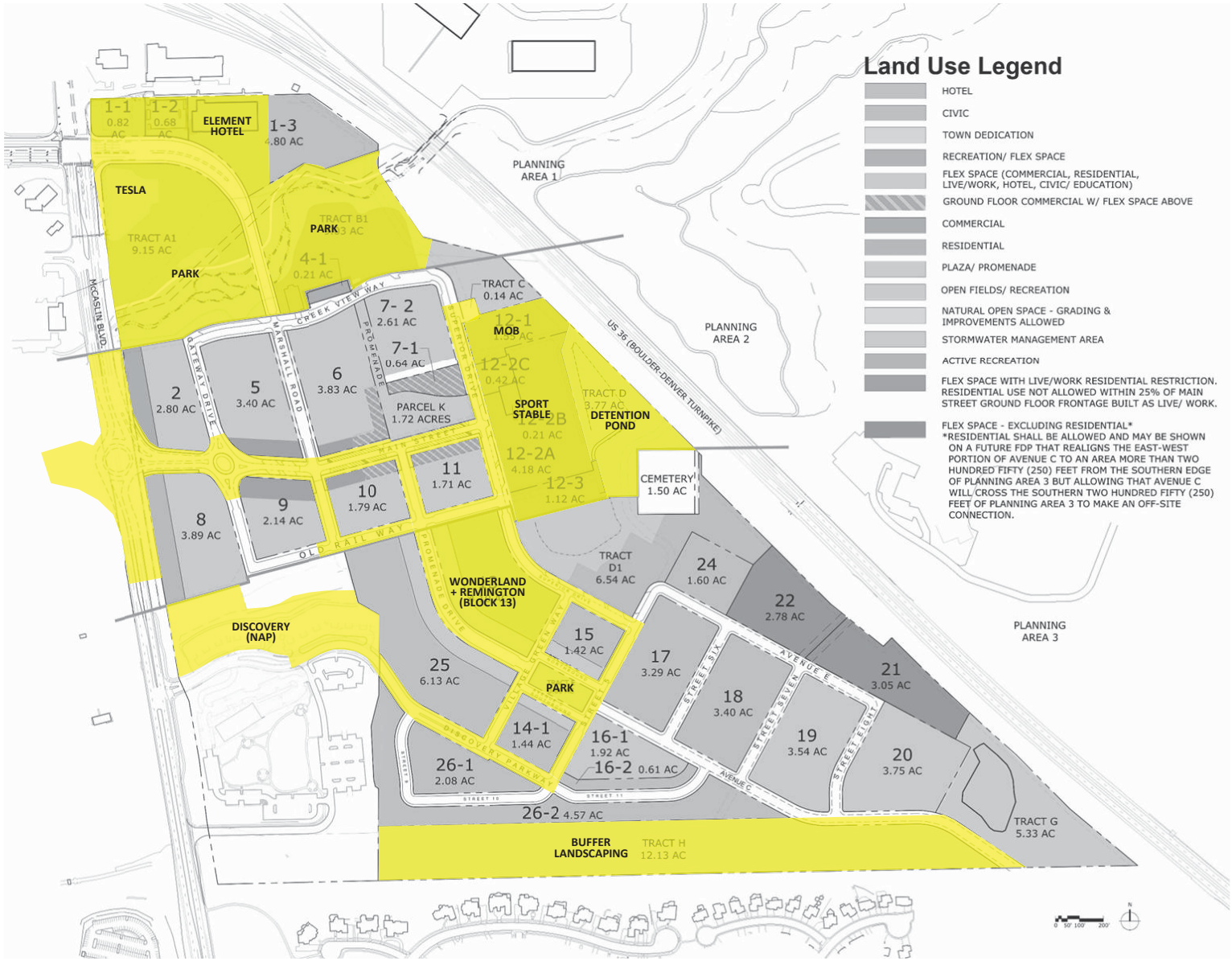
Downtown Superior Update

DOWNTOWN

Superior

FINAL DEVELOPMENT PLANS

APPROVED FDP'S



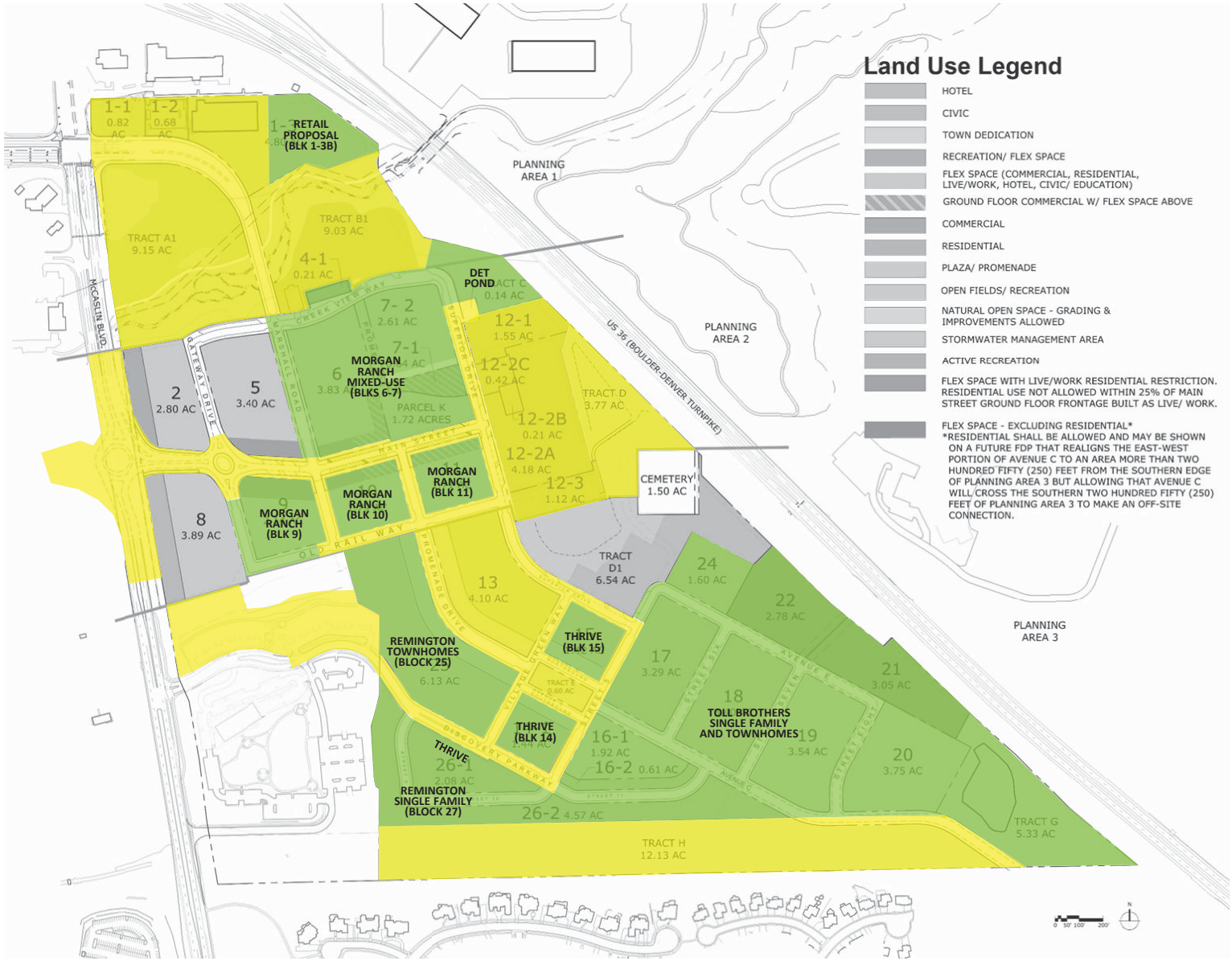
DOWNTOWN Superior

FINAL DEVELOPMENT PLANS

APPROVED FDP'S

FDP'S IN-PROCESS
(TARGET 2019 APPROVAL)

ALL FDP'S IN-PROCESS ARE CURRENTLY UNDER SALES CONTRACTS CONTINGENT ON APPROVALS.



DOWNTOWN Superior

Public Plaza From Above the Intersection of Main Street & Superior Drive (Looking Northwest)

Main Street From the Intersection of Main Street & Superior Drive (Looking West)

CAT

SUPERIOR ELECTRIC VEHICLE SERVICE & SALES | 04.09.2018

PEDESTRIAN EXPERIENCE FROM MARSHALL RD

ARCHITECTURE
URBAN DESIGN
INTERIOR DESIGN

OLD RAIL
PROMENADE
HOMES FROM
THE 1900s

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Town of Superior

Transportation Update

City of Louisville
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CITY COUNCIL COMMUNICATION
AGENDA ITEM 8B

SUBJECT: **DISCUSSION/DIRECTION – TRANSPORTATION MASTER PLAN UPDATE**

DATE: **JANUARY 22, 2019**

PRESENTED BY: **ROBERT ZUCCARO, PLANNING & BUILDING SAFETY DIRECTOR**
LISA RITCHIE, SENIOR PLANNER

SUMMARY:
Staff and the City's consultant, TEI, are presenting the draft Data and Trends Report, an overview of the Conceptual Plan and recommendation themes, including a highlight of Key Preliminary Recommendations, and a summary of next steps in the process.

The TMP is an opportunity to improve the transportation network comprehensively and based on community priorities for all modes of transportation throughout Louisville.

DISCUSSION:
This update follows previous discussions by City Council on August 7, 2018 and October 2, 2018. On August 7, 2018, TEI provided Council with an initial project briefing and discussion on project goals and outcomes. City Council Members provided input regarding the overall process and goals they would like for the TMP to achieve, along with recommendations to ensure a wide variety of groups are engaged in the community involvement process. On October 2, 2018, TEI presented the draft goals for the TMP:

Louisville's transportation network will:

- Operate efficiently and safely for all users
- Be a cohesive and layered system of streets and trails for walking, biking, transit, driving, and recreation
- Provide local and regional travel options that balance needs for Louisville residents, employees, and visitors
- Utilize new technologies to provide safe, reliable, clean and convenient transportation choices

- Increase mobility options and access for people of all ages, abilities and income levels
- Provide complete streets that are inviting, enhance livability and reflect the City's small-town atmosphere
- Support economic opportunities and businesses
- Improve environmental and community health by reducing emissions, and supporting mode share and sustainability

Since the October 2nd meeting, TEI developed the attached draft Data and Trends Report, which will become a component of the final TMP. This report discusses existing conditions and future trends that the final TMP should consider and account for. This document, coupled with the public comments, informed the Conceptual Plan and Key Preliminary Recommendations. These are not the final or only components that will be included in the final TMP, rather the project team is presenting them for the City Council to confirm the direction of the Conceptual Plan.

The Conceptual Plan includes five major components:

- A network of great streets
- Primary corridor enhancements
- Walkable places
- Bike network
- Transit vision

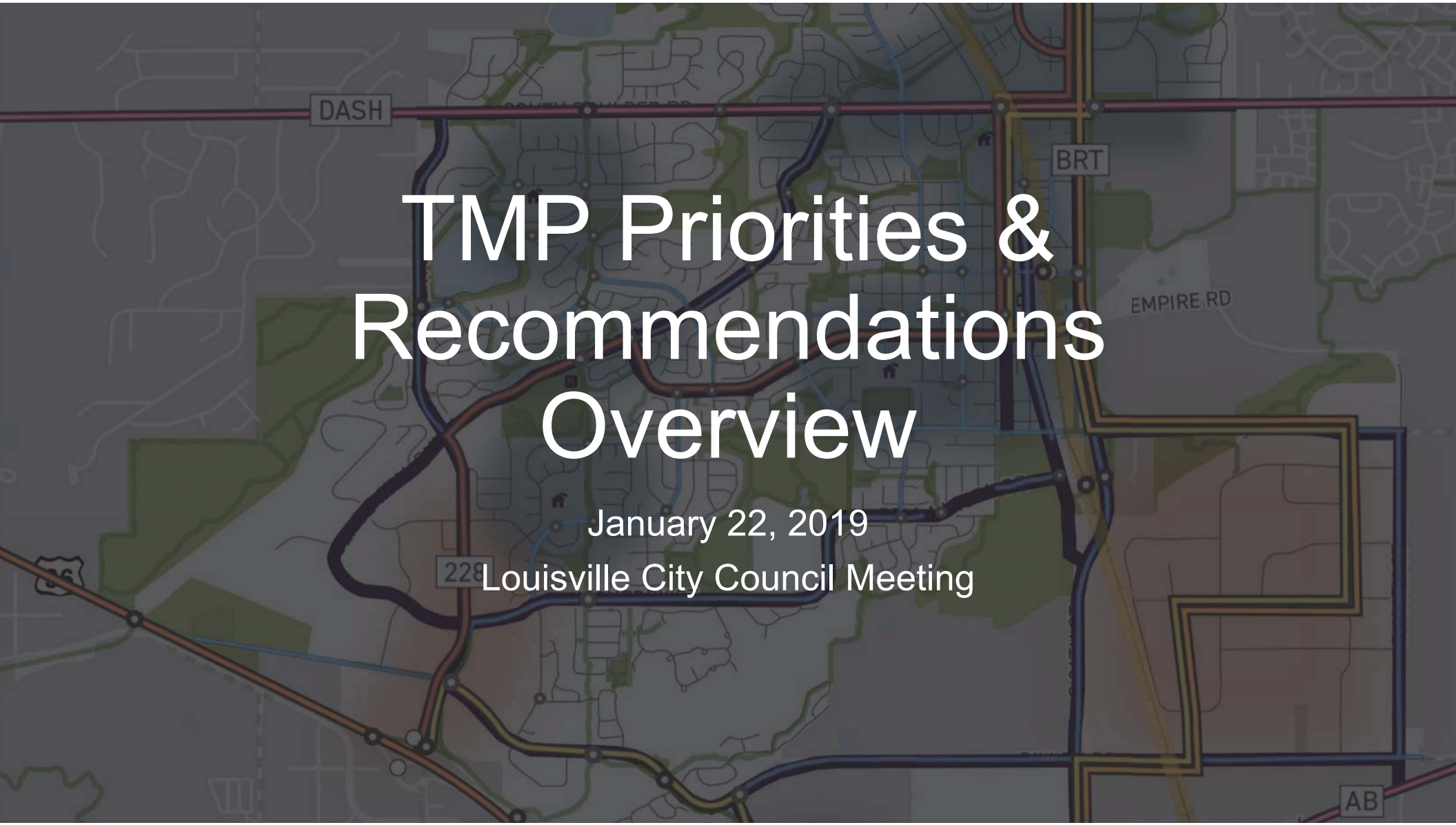
The Key Preliminary Recommendations cover the following areas:

- SH 42
- Dillon Road corridor
- South Boulder Road
- Via Appia
- McCaslin Boulevard
- Identifying locations for walkable places
- Focus areas for bike network
- Pilot project for trail connection between the Rec Center and Downtown

The project team is seeking feedback on the Conceptual Plan and Key Preliminary Recommendations. Next steps will include further development of the concepts into final draft recommendations as part of the draft final TMP. The final draft of the TMP will include projects, policies, and programs, along with implementation strategies and metrics for measuring TMP goal attainment. The final draft will be presented to the public, City Boards and Commissions, regional partners and other stakeholders for feedback prior to the final draft TMP presentation to City Council later this spring.

ATTACHMENT(S):

1. Presentation
2. Draft Data and Trends Report



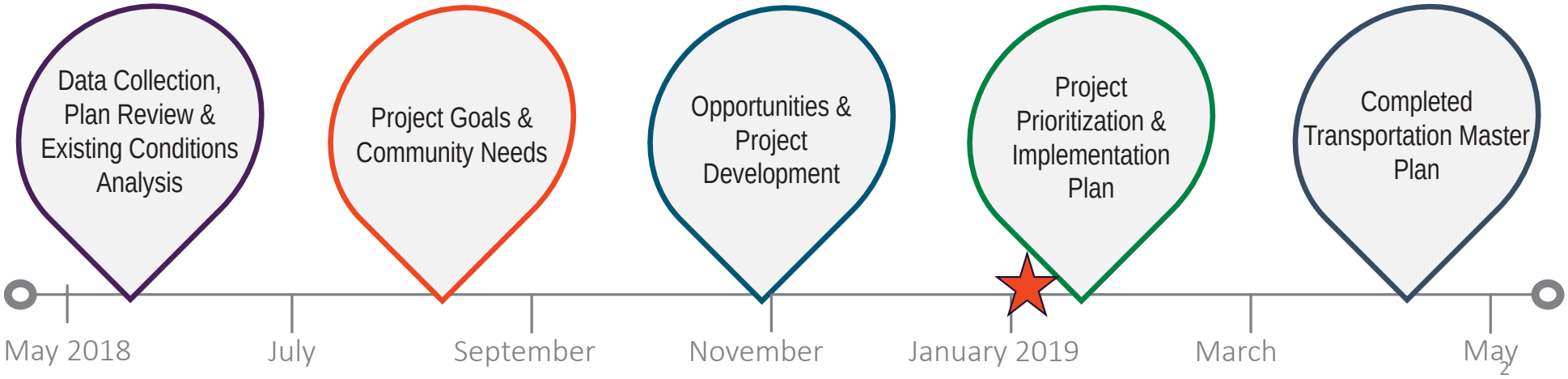
TMP Priorities & Recommendations Overview

January 22, 2019

Louisville City Council Meeting

Today's Objectives

- Review of Data & Trends and community feedback
- Provide overview of conceptual plan and recommendation themes
- Highlight key preliminary recommendations
- Identify next steps

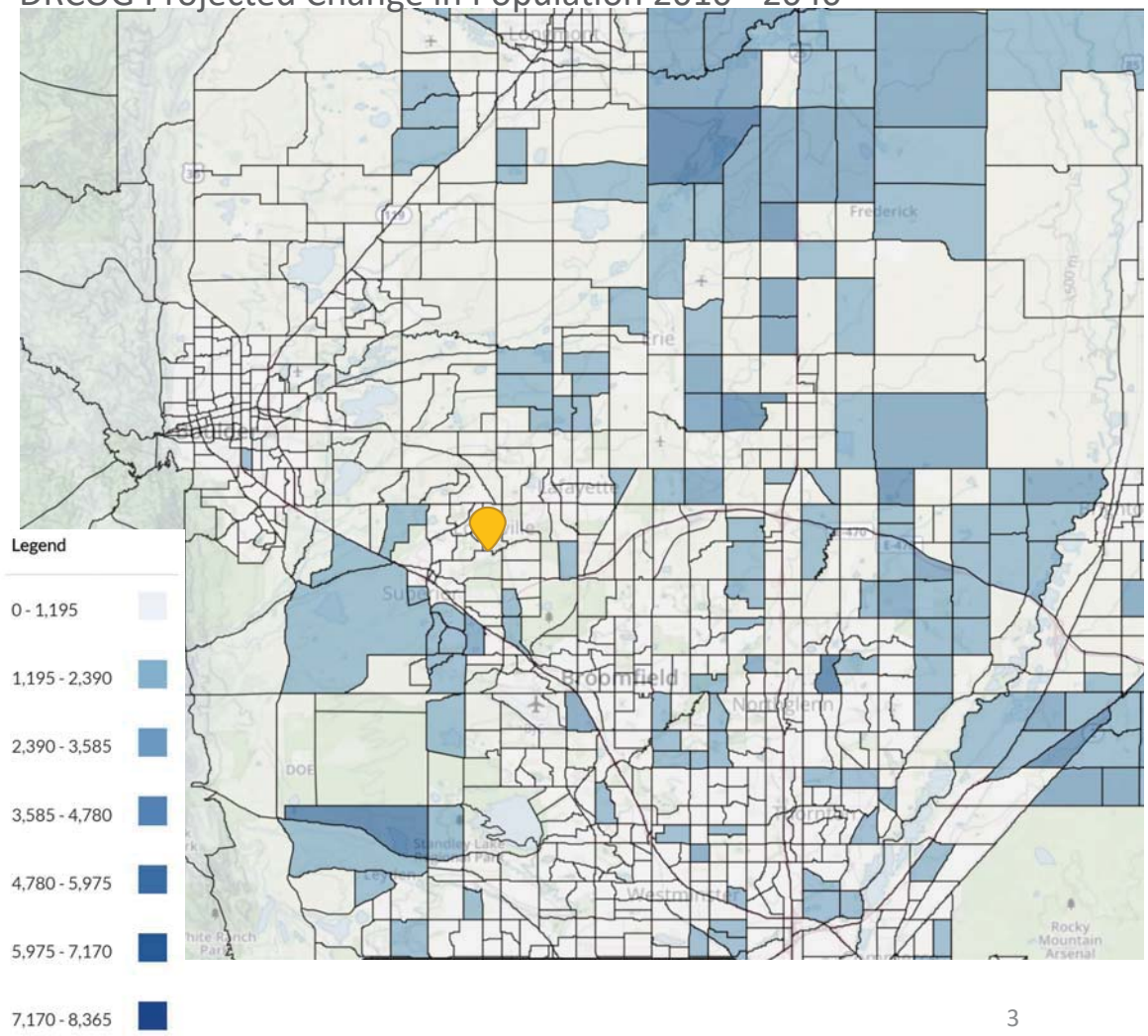


Population Projection

- Most significant population growth occurring outside of Louisville

	Population
2015	21,208
2040 Forecast	23,708

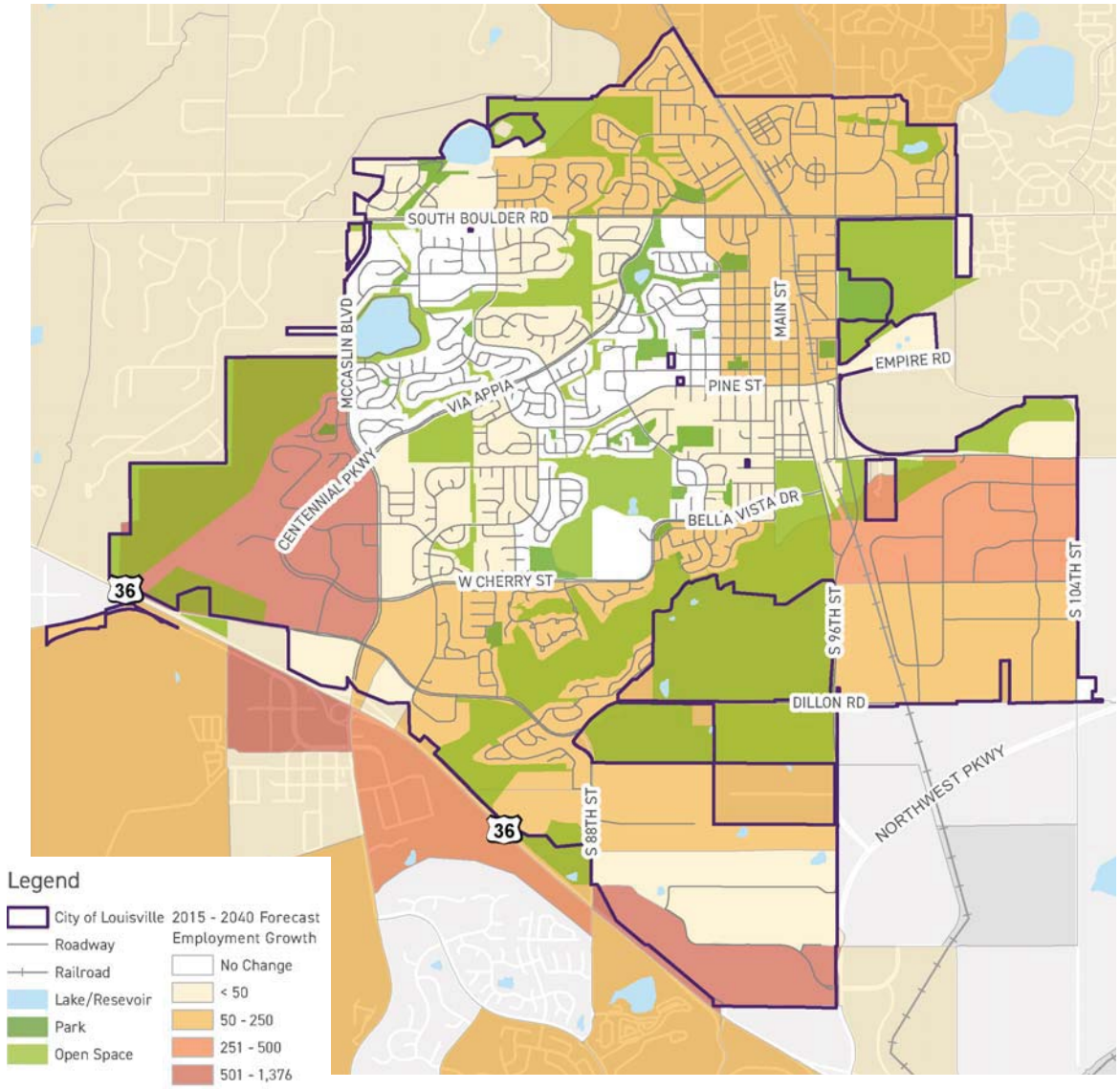
DRCOG Projected Change in Population 2010 - 2040



Employment Projection

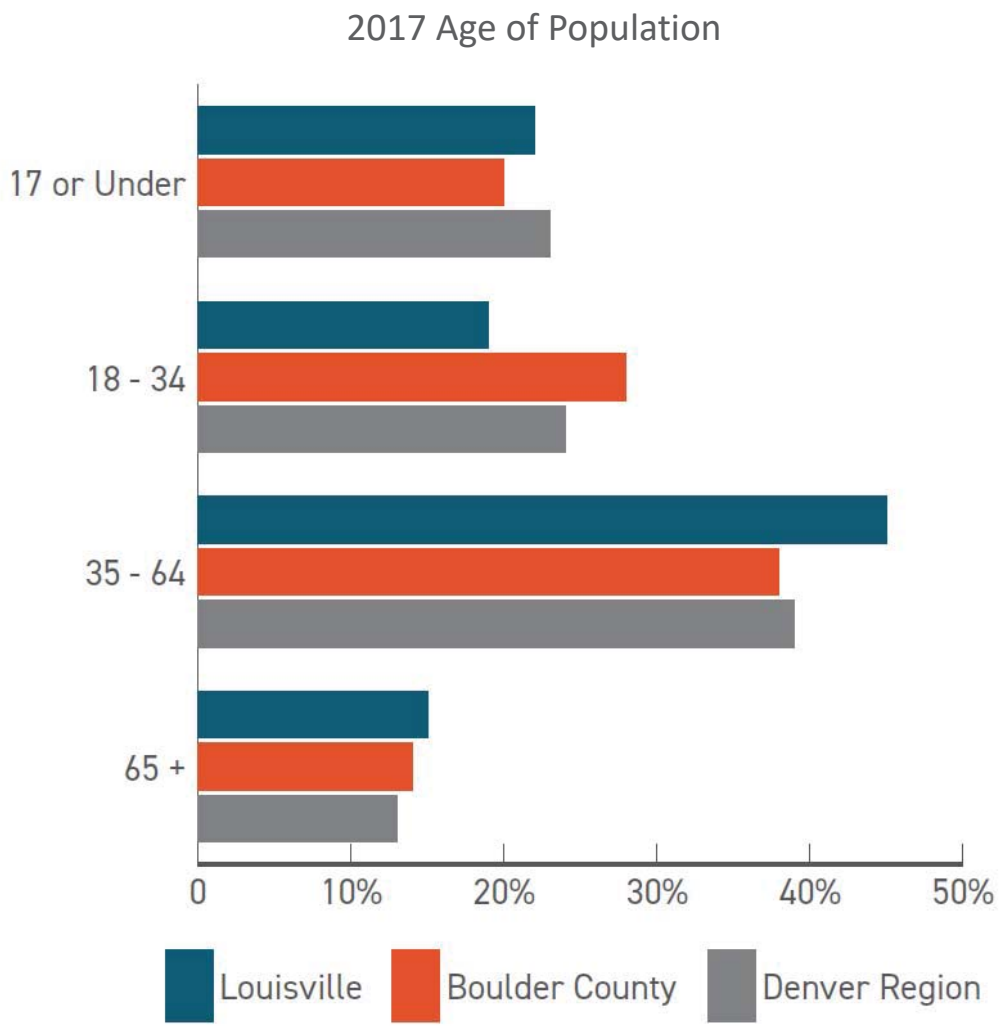
- Employment growth projected within and around Louisville
- Growth is primarily in commercial/industrial areas on the periphery

	Employment
2015	15,036
2040 Forecast	19,136



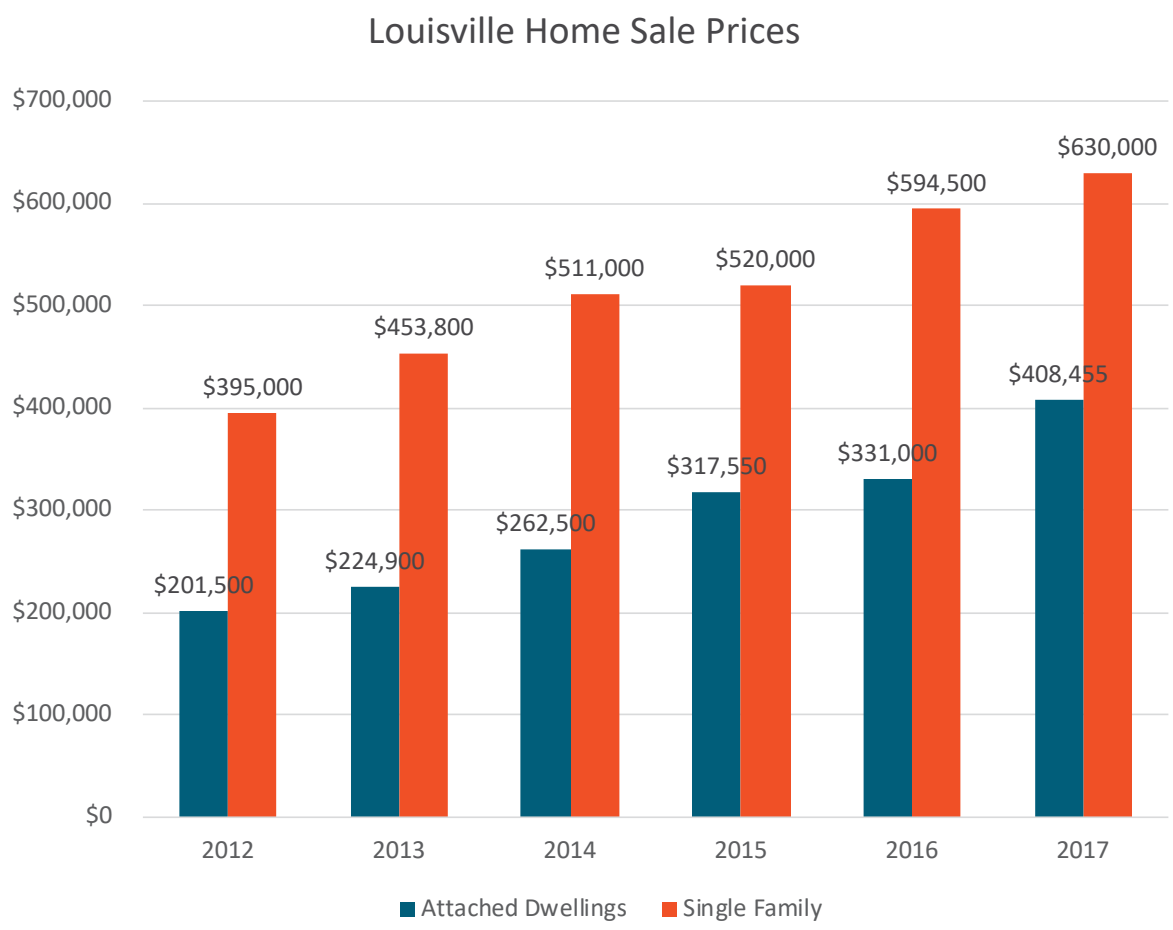
Demographic Trends

- Since 2000, the age 55+ population has grown from 12% of the Louisville population to 32%.
- Growth in older residents will increase need for options to age in place
  - Housing and mobility options are linked



Rising Housing Costs

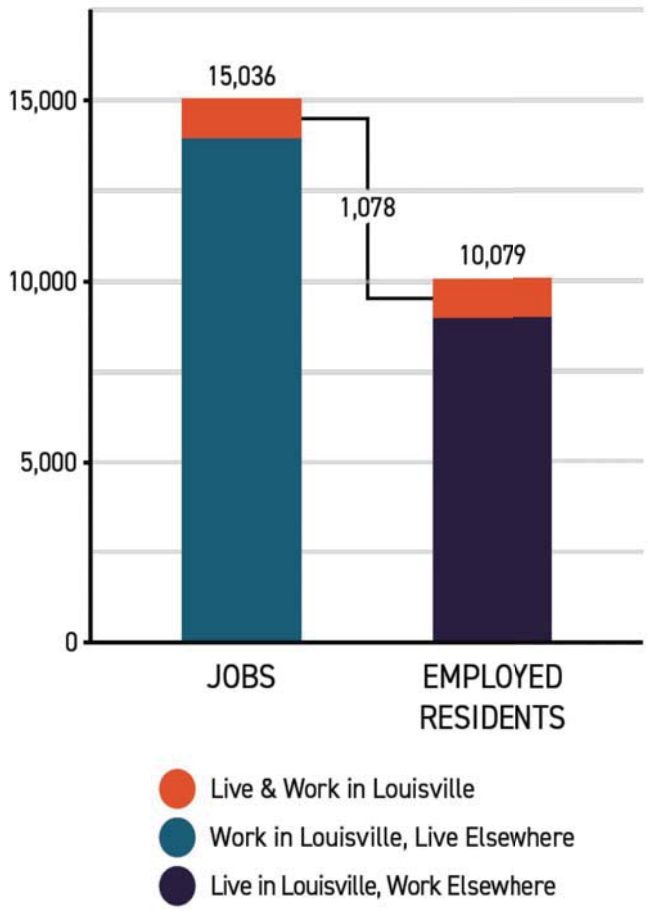
- From 2012-2017 median single family home sales have increased 60% in price.
- Increased housing costs are driving population growth further out requiring increased driving to employment and destinations



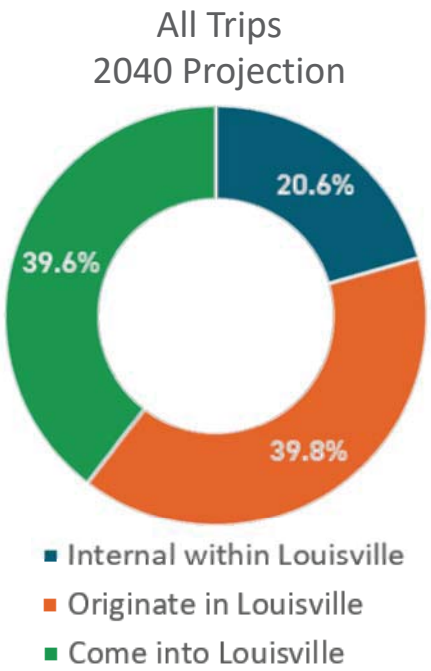
Travel Patterns and Demand

- Over the past 15 years, commute trips into and out of Louisville are consistently around 90%
- Trips into and out of Louisville for all purposes are expected to increase
- As housing increases further from employment areas, VMT and regional travel is increasing

Commuting Inflow & Outflow



Future Trip Origins & Destinations



Commuting Mode Share

2017 Commute Trips

	Drive Alone	Carpool	Transit	Bike	Walk	Work at Home	Other
City of Louisville	72.3%	4.7%	5.9%	2.3%	1.7%	12.7%	0.5%
City of Boulder	51.3%	4.9%	8.3%	10.3%	11.4%	12.5%	1.2%
Boulder County	65.2%	7.6%	5.0%	4.4%	5.3%	11.3%	1.3%
Denver Region	74.8%	8.5%	4.4%	1.2%	2.5%	7.5%	1.0%

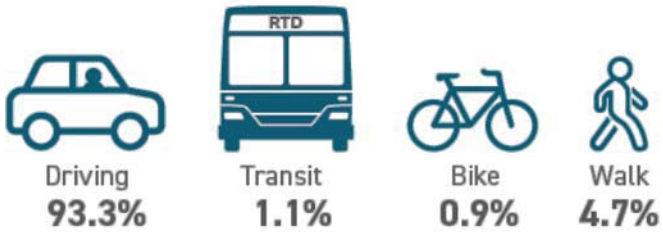
Over the last 5 years:

- Slight decreases in driving and carpooling
- Transit, bike use, and working at home have increased

Mode Share for All Trips

- Non-commute trips are typically shorter
- Short trips are typically easier to make via walking or biking
- Nearly double the amount of people walk for non-commute trips

2017 Trips



60 % of trips in Louisville are not work-related

31 % of all trips are 3 miles or less

Implications for Future Transportation

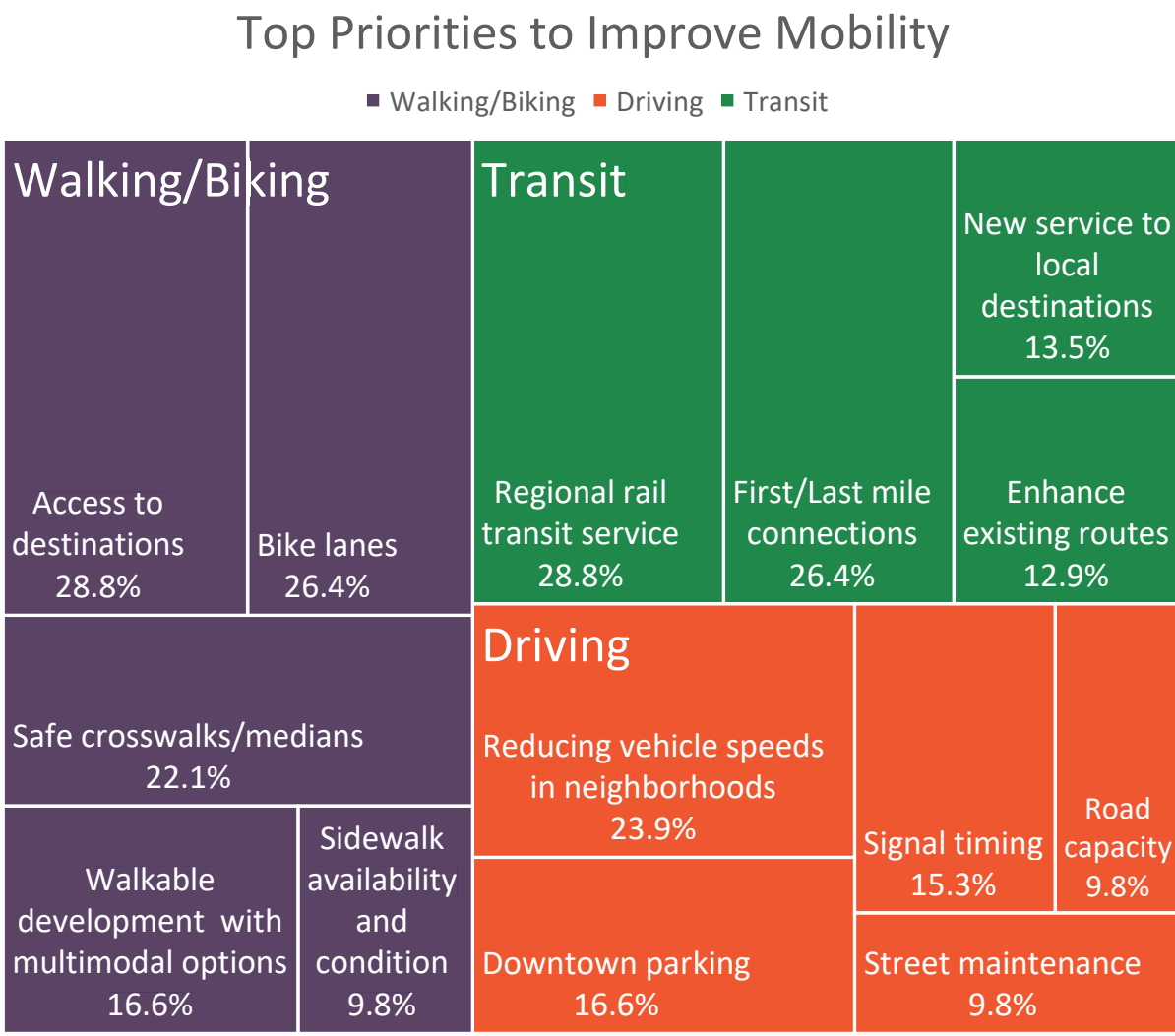
1. With increased VMT, regional corridors will see increased demand
2. As cost of housing rises and as the population ages, multimodal and low-cost mobility options will gain more importance in the network
3. Linking housing to destinations or mixed-use development can help reduce VMT and support the City's goals
4. Leveraging and building upon existing assets and infrastructure will help provide options for mobility and growth
5. Technology is rapidly changing, but ensuring people of all ages and abilities can understand and utilize mobility options will be important

Community Input Update

Events + Meeting + 163 Online Survey responses + 200 Interactive Map Features + 3 Focus Groups

Survey Info

- 83% of survey respondents drive frequently in Louisville
- Crossings, connectivity to destinations, and protected bike lanes would most encourage walking/biking
- More routes and increased frequency would encourage more transit use
- Speeding and traffic congestion are the top issues for driving

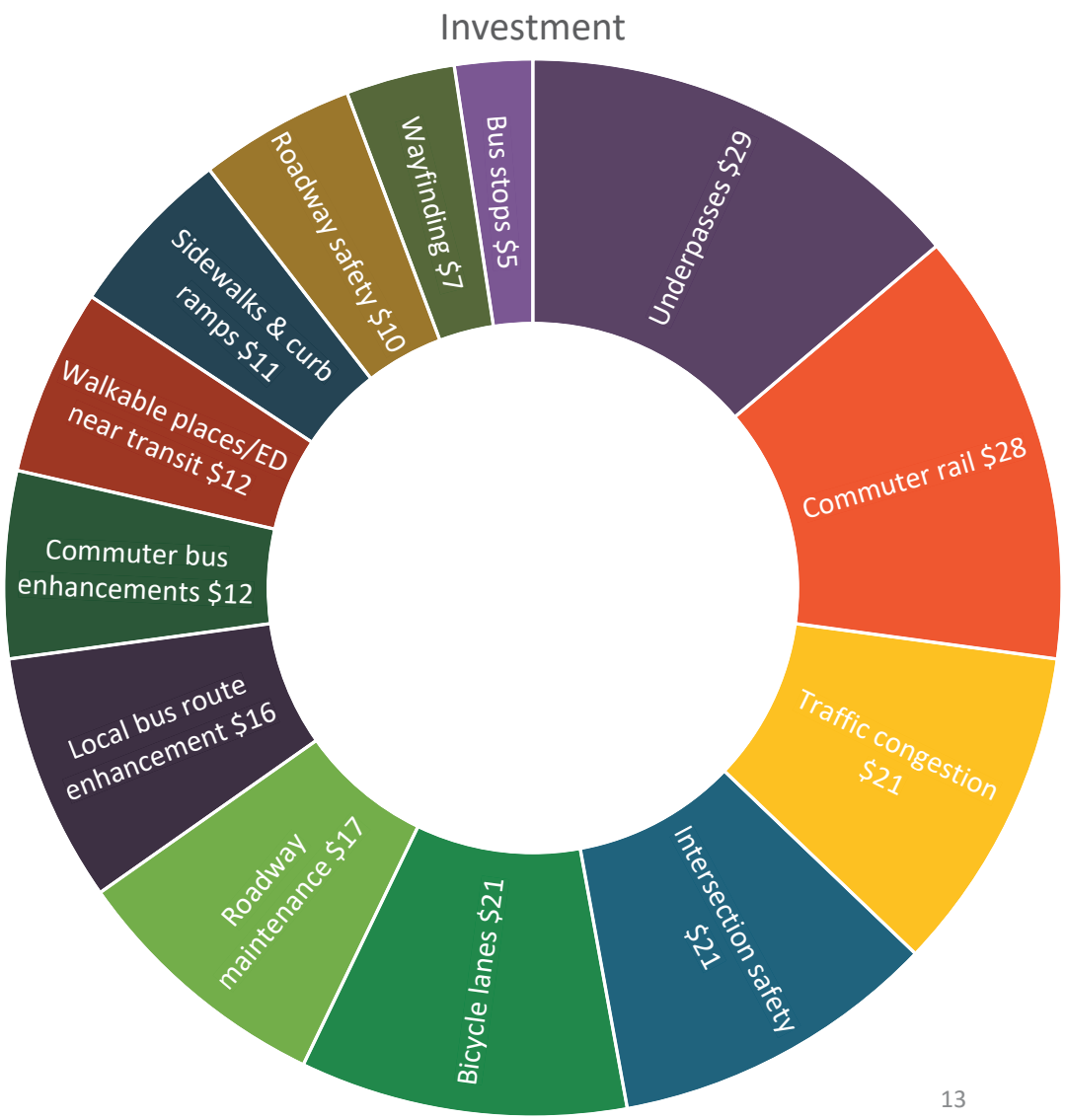


Survey Info

Top Spending Priorities

- Underpasses
- Commuter Rail
- Traffic Congestion
- Intersection Safety
- Bicycle Lanes

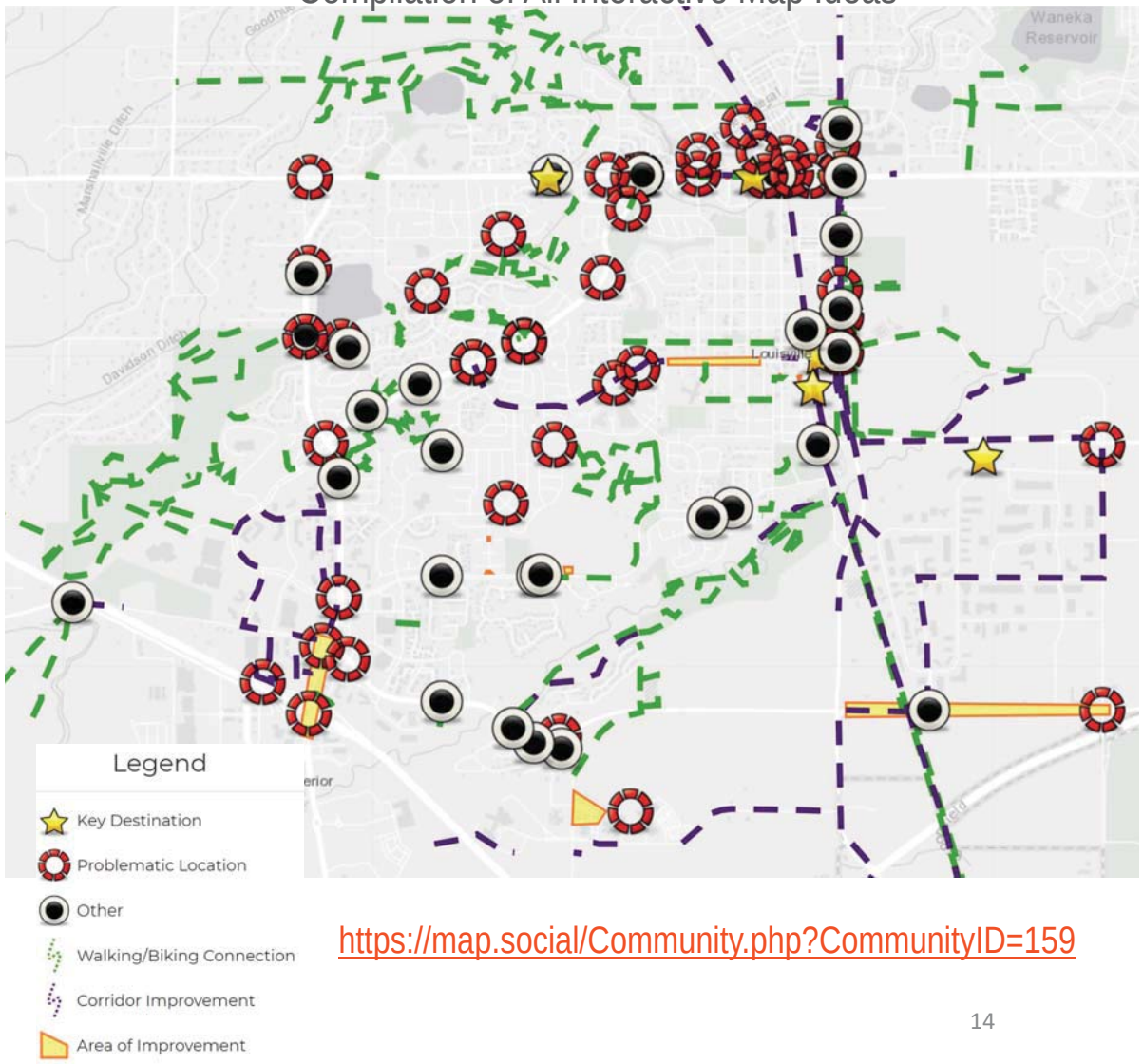
*Survey data represents a sample of the population and is not statistically valid



Interactive Map

- Significant number of intersections/crossings identified
- New connections are highly desired
- 200+ ideas drawn
  - 213 likes of ideas
  - 12 dislikes of ideas
- Used to identify recommendations

Compilation of All Interactive Map Ideas



https://map.social/Community.php?CommunityID=159

Focus Groups

Major themes:

- Crossings are important for safety of all ages and accessing destinations
- More connections to destinations are needed for walking/biking
- Transit to CTC is a high priority
- People driving and biking prefer to separate bikes and vehicles where possible
- More funding for VIA transit services and improve local transit options
- Education & communication is valuable for changes, new facilities, and safety
- Make sure that recommendations are feasible and implementable

Conceptual Plan

Input → Goals → Guiding Concepts →

Key Preliminary Recommendations

TMP Goals

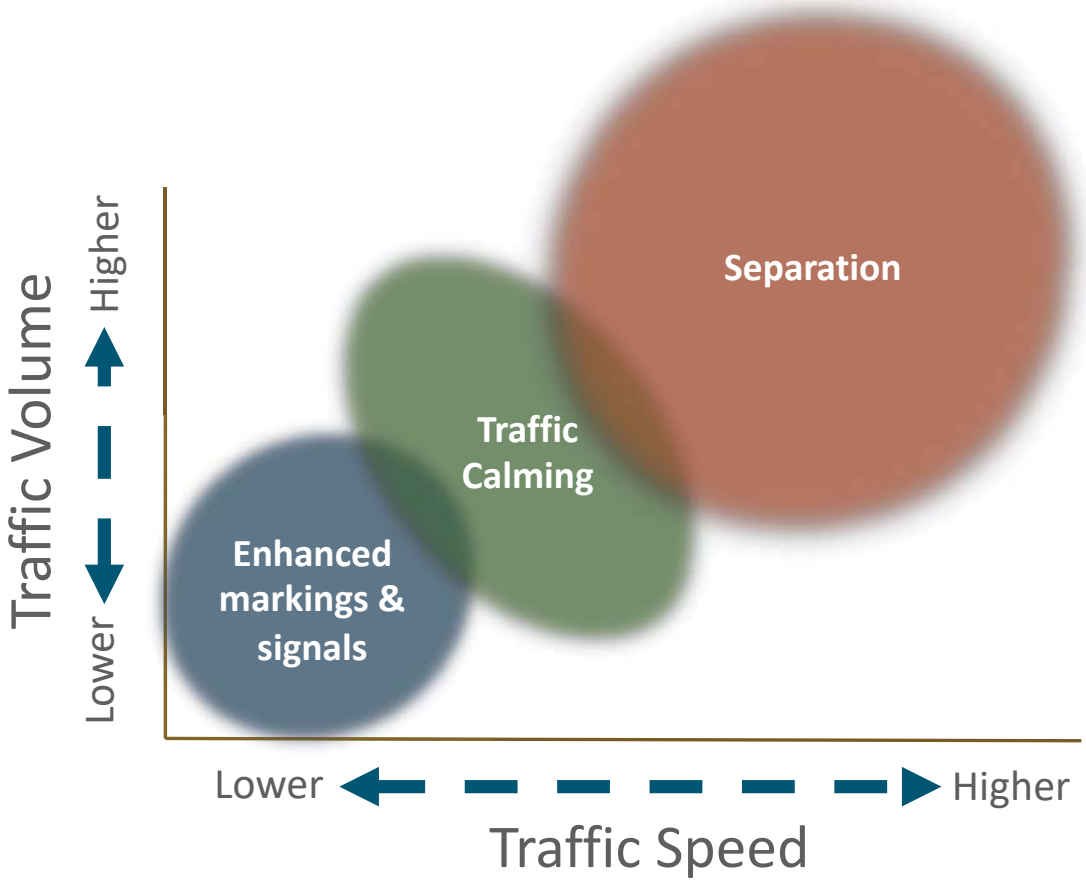
Louisville's transportation network will:

1. Operate **efficiently and safely** for all users.
2. Be a **cohesive and layered system** of streets and trails for walking, biking, transit, driving, and recreation.
3. Provide **local and regional travel** options that balance needs for Louisville residents, employees, and visitors.
4. Utilize **new technologies** to provide safe, reliable, clean and convenient transportation choices.
5. Increase **mobility options and access** for people of all ages, abilities and income levels.
6. Provide **complete streets** that are inviting, enhance livability and reflect the City's small-town atmosphere.
7. Support **economic opportunities** and businesses.
8. Improve **environmental and community health** by reducing emissions, and supporting mode share and sustainability.

Focus on All Ages and Abilities

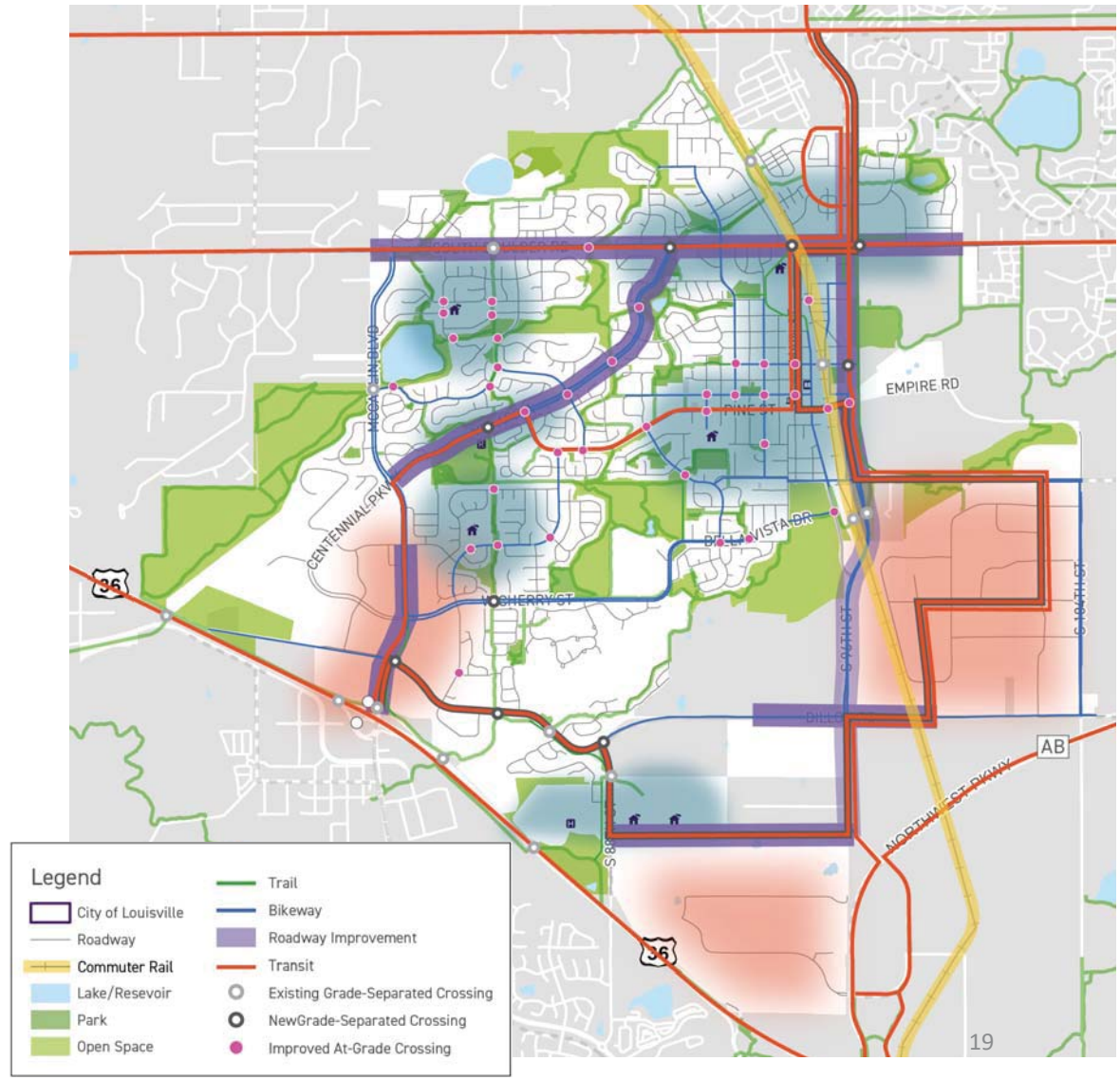
Network built around *mobility and access* for *all ages and abilities* regardless of mode

- Prioritizes safety
- Increases travel options
- Supports sustainability
- Good for businesses



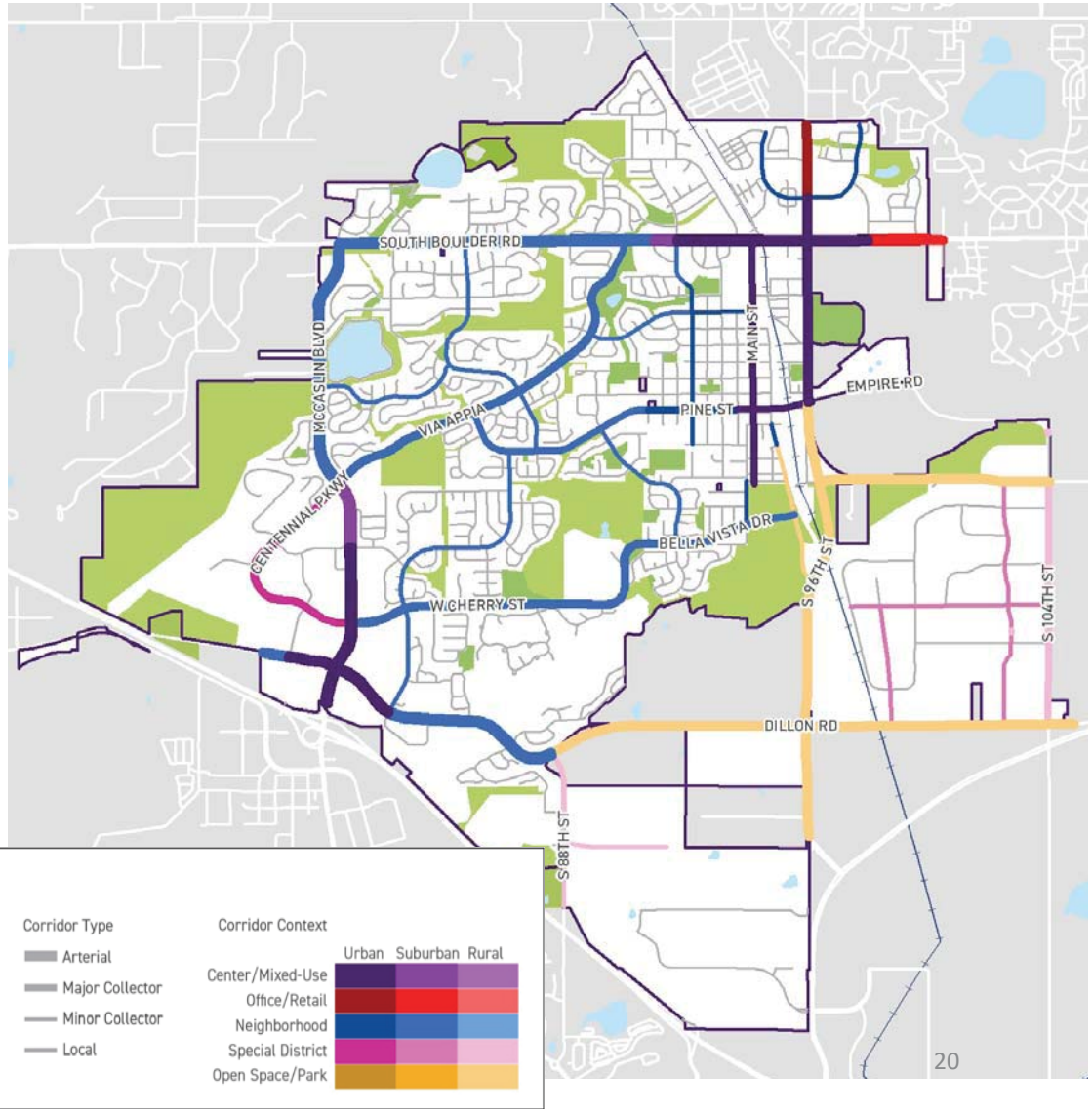
Conceptual Plan

- Prioritized street investments
- Bike network that builds on the trails
- Prioritized areas for pedestrian improvements
- Crossings that improve safety and access
- Enhanced local and regional transit options



1. Network of Great Streets

- Street Plan defines types of roadways
  - Incorporates surrounding context and character
- Basis for design improvements
- Coordinates with the Comprehensive Plan



Legend

- City of Louisville
- Roadway
- Railroad
- Lake/Resevoir
- Park
- Open Space

Corridor Type

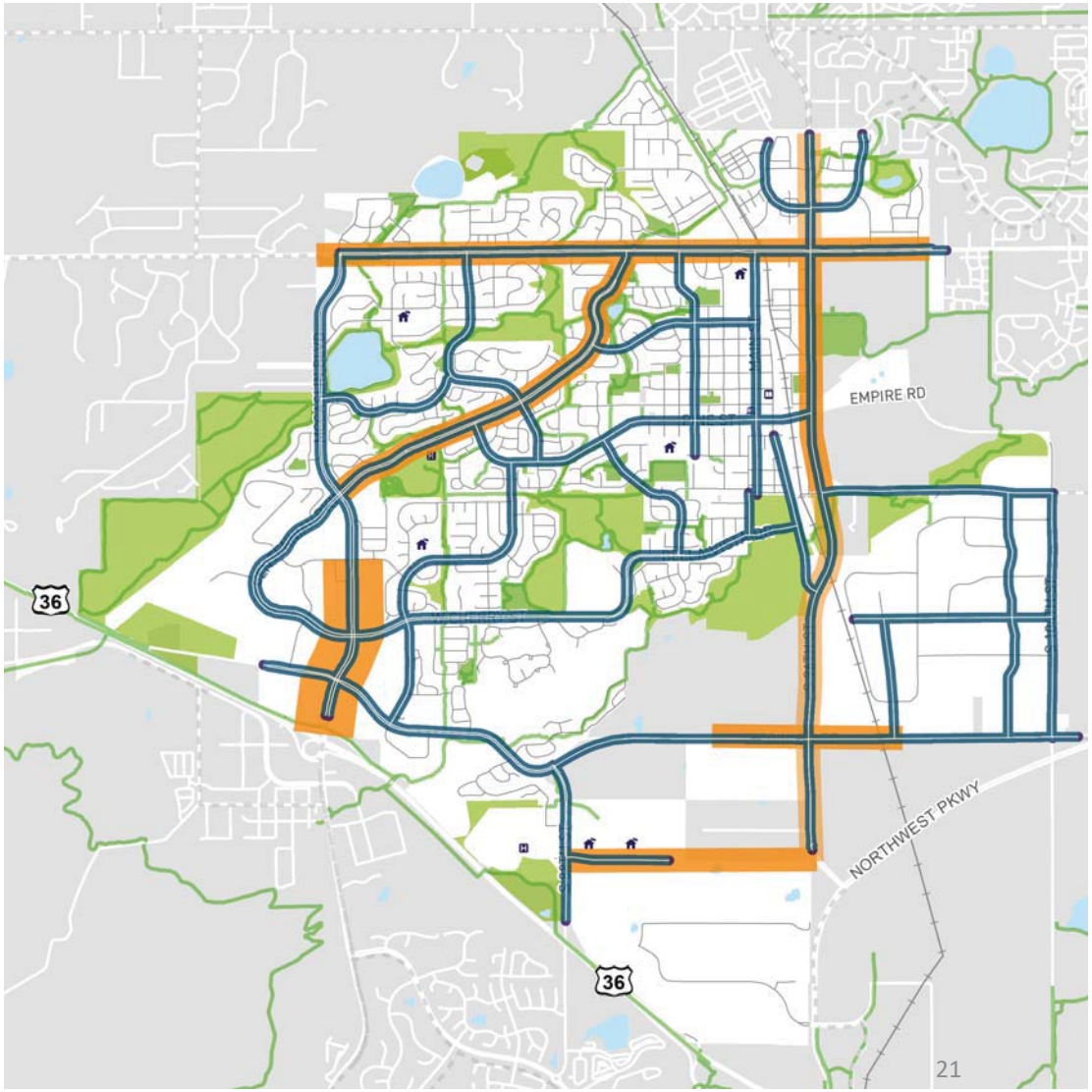
- Arterial
- Major Collector
- Minor Collector
- Local

Corridor Context

	Urban	Suburban	Rural
Center/Mixed-Use			
Office/Retail			
Neighborhood			
Special District			
Open Space/Park			

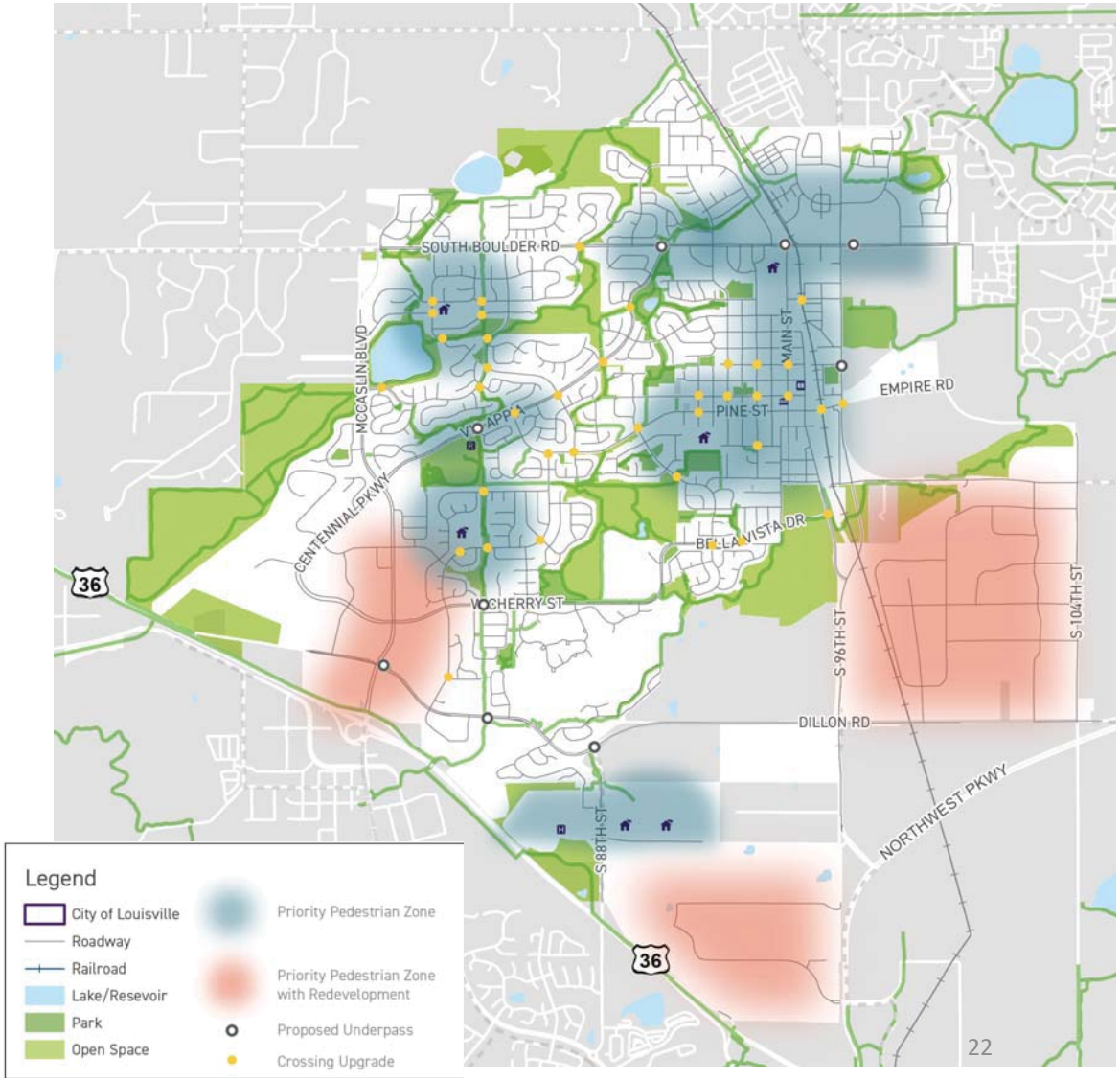
2. Primary Corridor Enhancements

- Existing network is well maintained
- Travel within Louisville functions well
- Regional corridors must balance mobility with local access



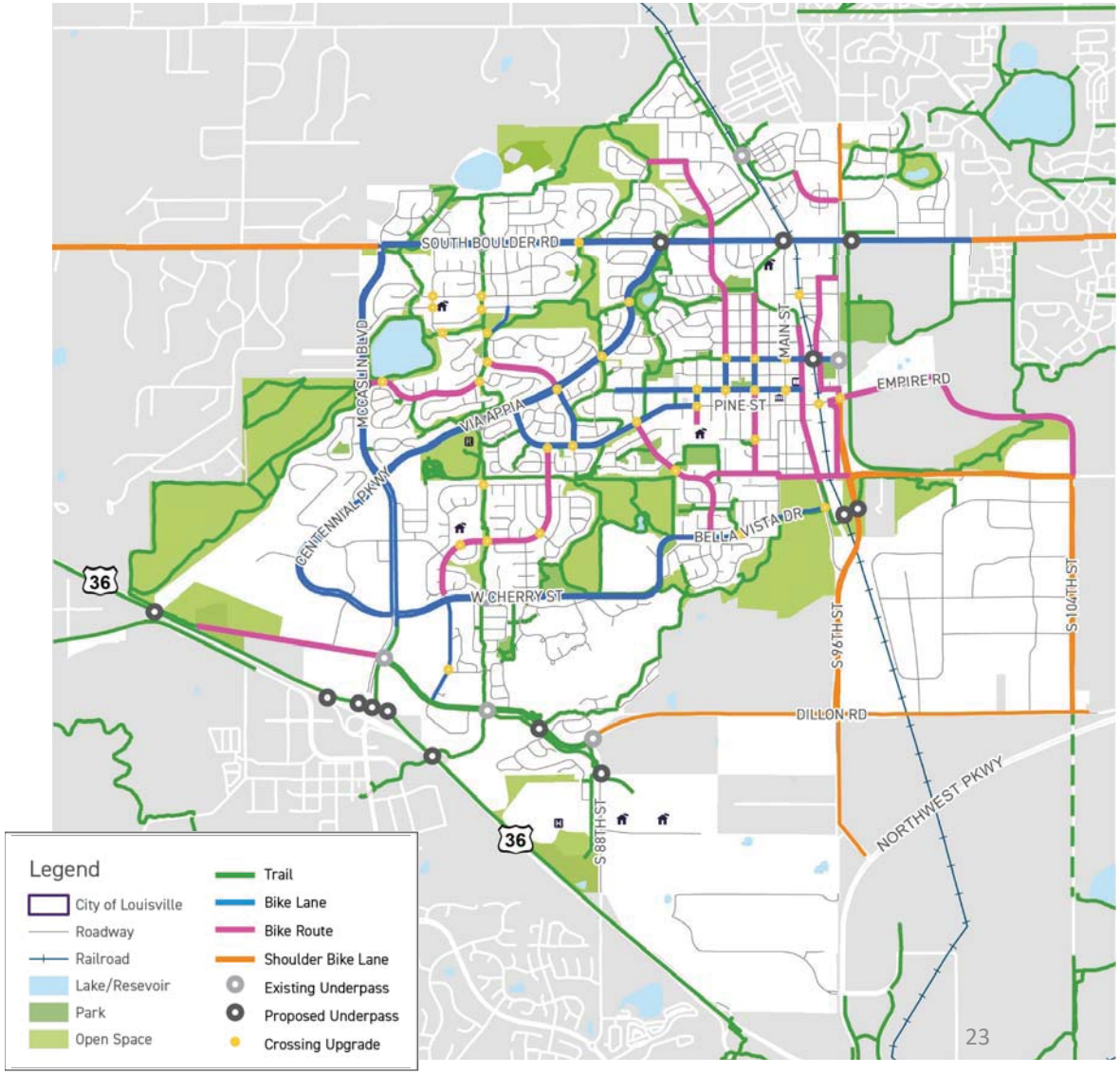
3. Walkable Places

- Improve pedestrian realm and walkability
- Focus on walkable destinations
  - Around schools
  - At key transit points
  - Future redevelopment
- High traffic volumes



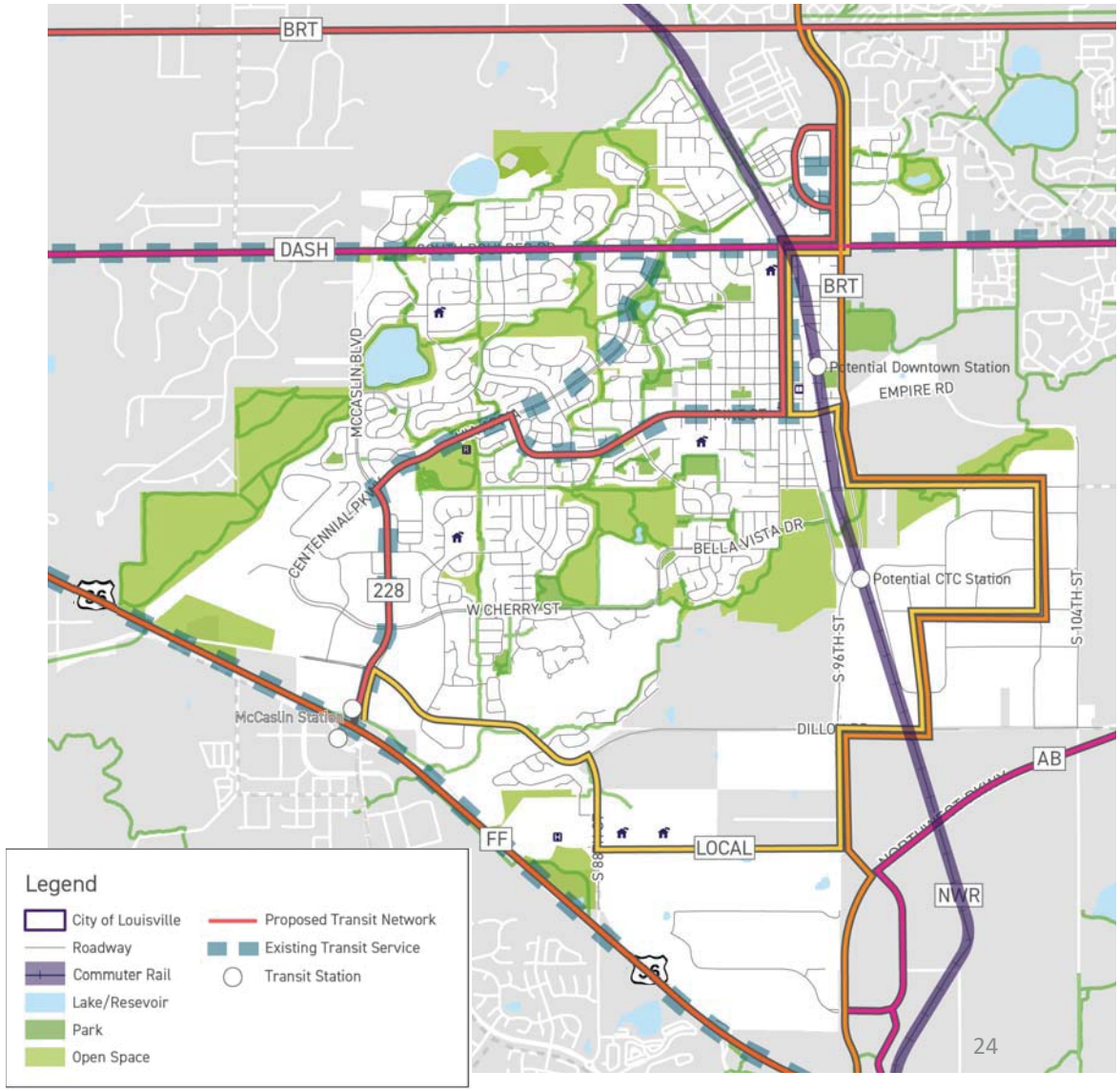
4. Bike Network

- Expand on the trail network to connect more destinations and neighborhoods
- Focus on closing gaps
- Upgrade existing facilities
- Improve crossings for bikes and pedestrians



5. Transit Vision

- Service to more areas
  - CTC
  - Hospital & schools
  - Downtown to McCaslin link
- Increased frequency
- More regional and BRT options
- Leverage future rail investment



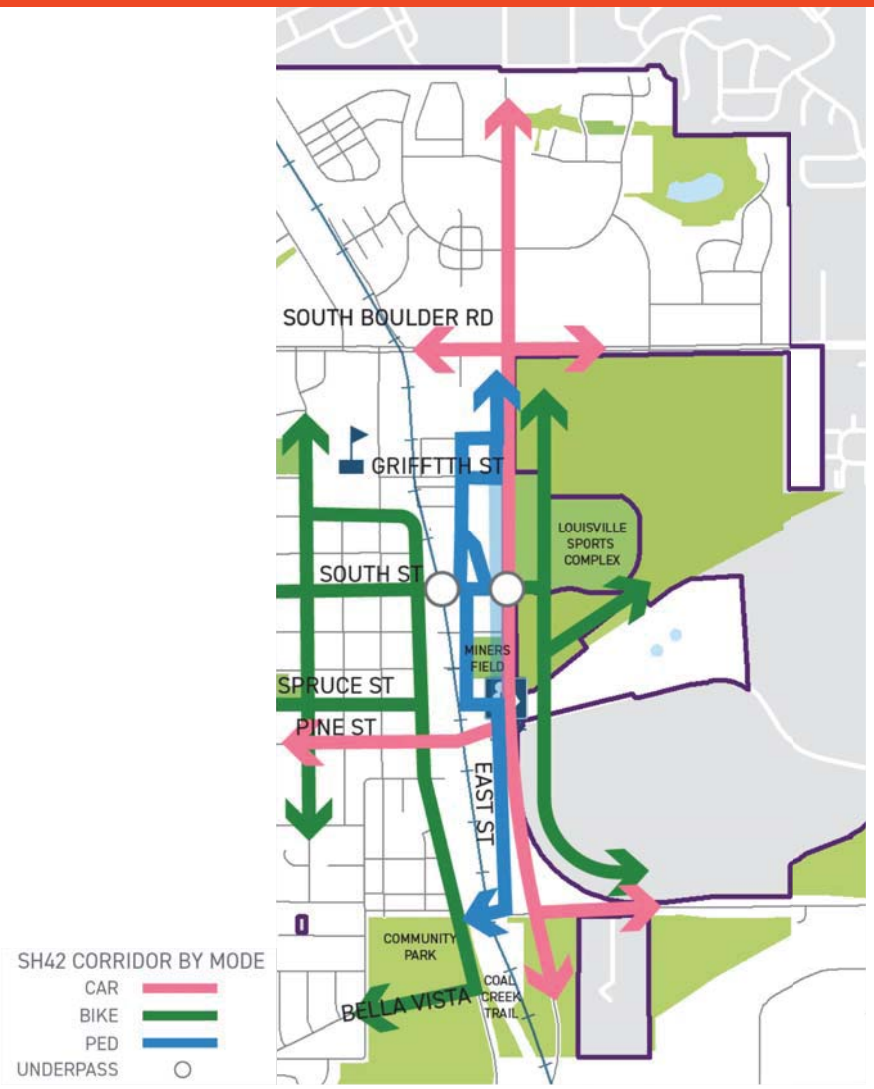
Key Preliminary Recommendations

Key Preliminary Recommendations → Detailed Recommendations

(Next Steps)

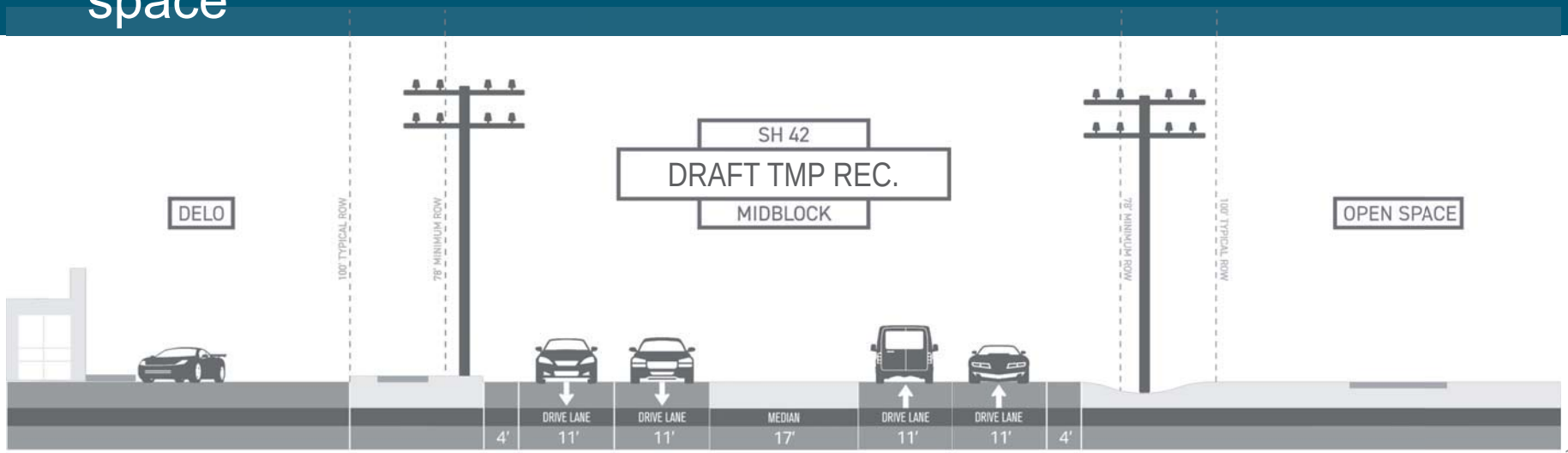
SH 42

- Primary function is for vehicle access
  - Includes sidewalks but no bike lanes
- Delay most significant between Pine and South Boulder Road
- Ability to accommodate future transit



SH 42

- 5 lanes (4 lanes with left turn lanes)
- Sidewalk on west side to access destinations
- Off street trail beyond the ROW on east side leveraging open space



Dillon Road Corridor

- Move forward with 2018 Dillon Rd Corridor Study Recommendations
  - Capacity improvements around 96th St. the railroad tracks
  - Ensure ADA access is included in any improvements
  - Enhance existing bike facility with signage and striping
- Extend Campus Drive to 96th St
  - Improves functioning of Dillon Rd, better serves schools and hospital

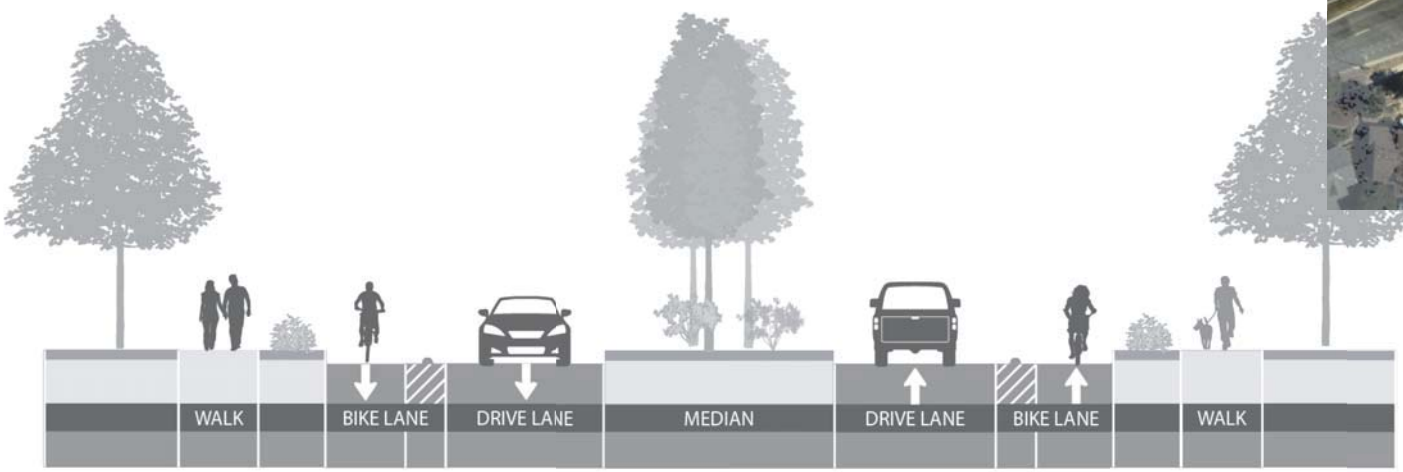
Capacity Improvement ADA Accessibility Future Signal

South Boulder Road

- Serves multiple needs
- Short term focus:
  - Pedestrian crossings
  - Congestion and access at SH 42
- Long-term: Study for redesign of the corridor
  - Best allocation of ROW
  - Regional consistency for modes

Via Appia

- Reconfigure to prioritize multimodal access
  - Rec Center construction shows no negative impacts with one lane
  - Safety issues at intersections



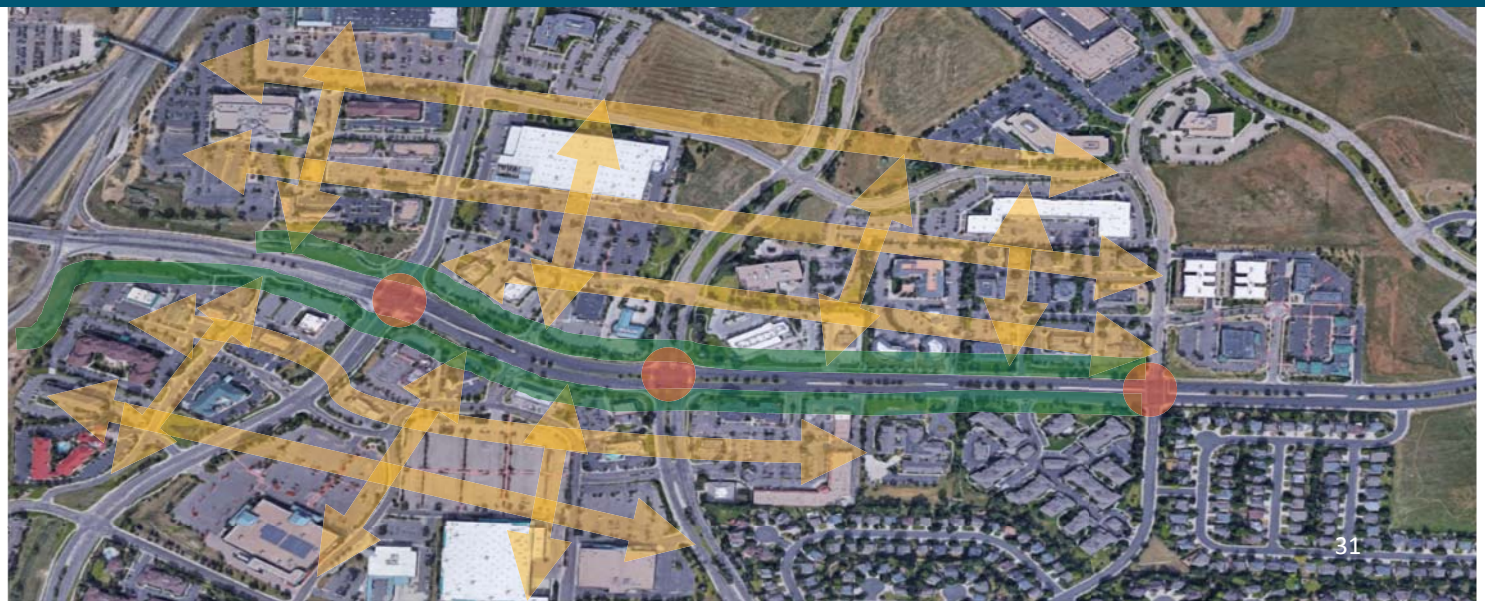
McCaslin Boulevard

- Overall traffic flows well
- Separate bikes from traffic, especially south of Centennial Pkwy
- Multimodal secondary network in areas of redevelopment

Multimodal secondary network grid

Off-street path

Intersection enhancements

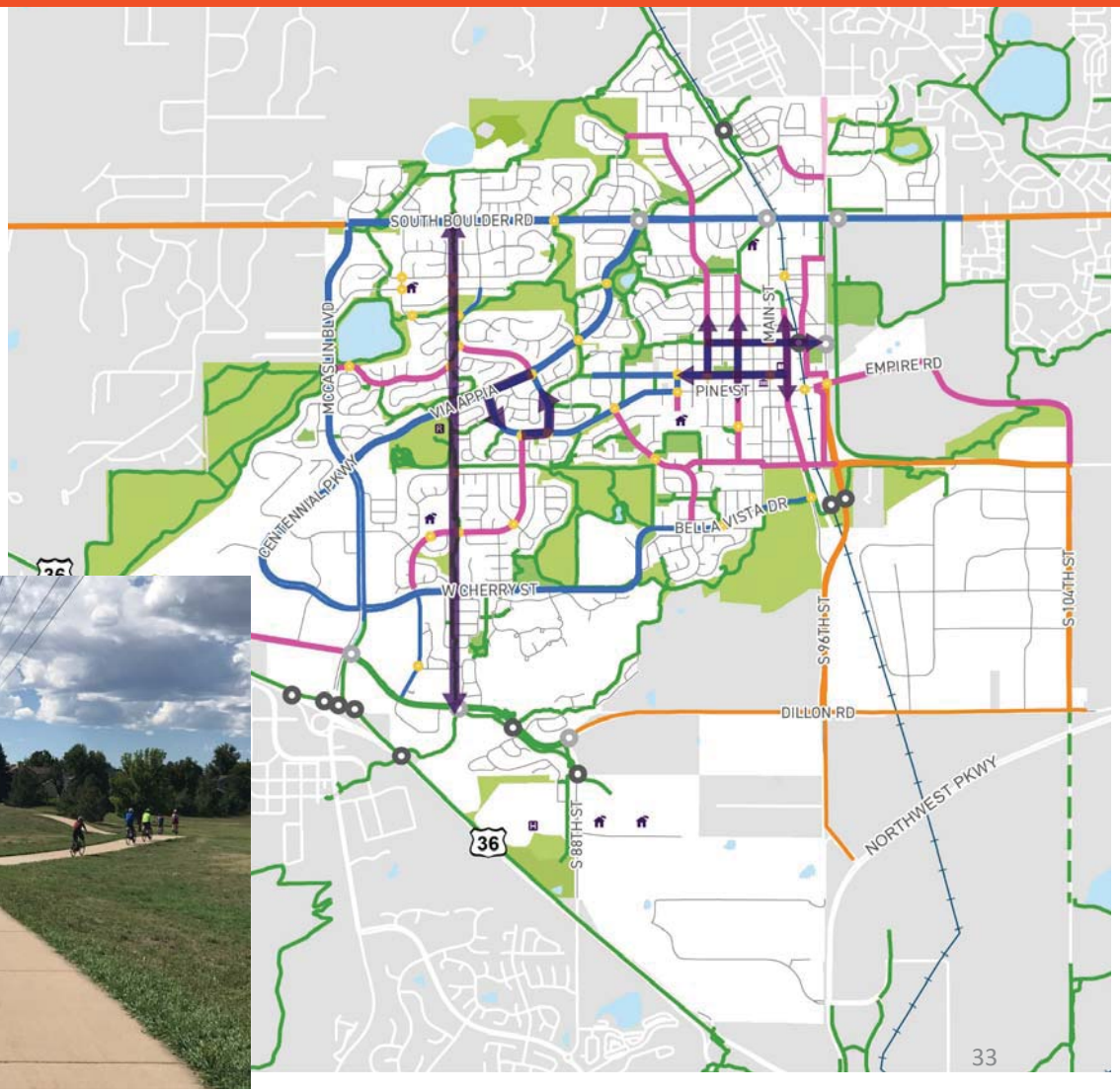


Identify Locations for Walkable Places

- Wide, buffered sidewalks
- Narrow & visible crossings
- Lighting & trees/shade
- Benefits:
  - Attract commercial activity
  - Generate higher retail sales & obtain higher rents
- Walk Score
  - Downtown 82 vs 32 for City overall

Focus Areas

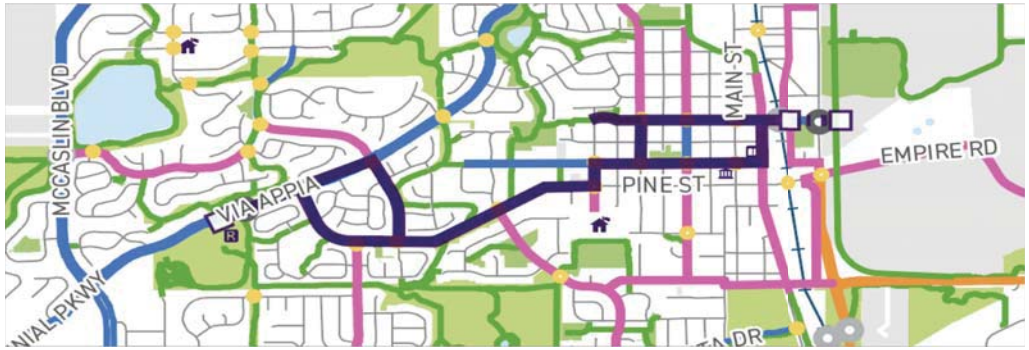
- Powerline Trail
- Downtown linkages to neighborhoods and trails
- Opportunity around Pine and Via Appia to activate the street

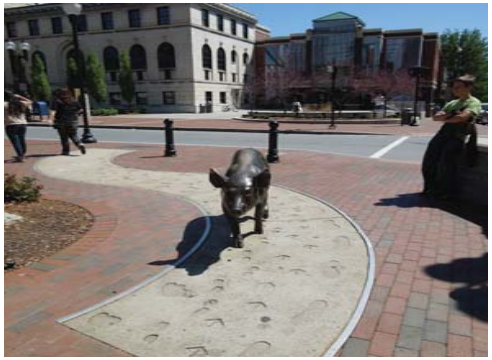


Pilot Project

Rec. to Town urban trail

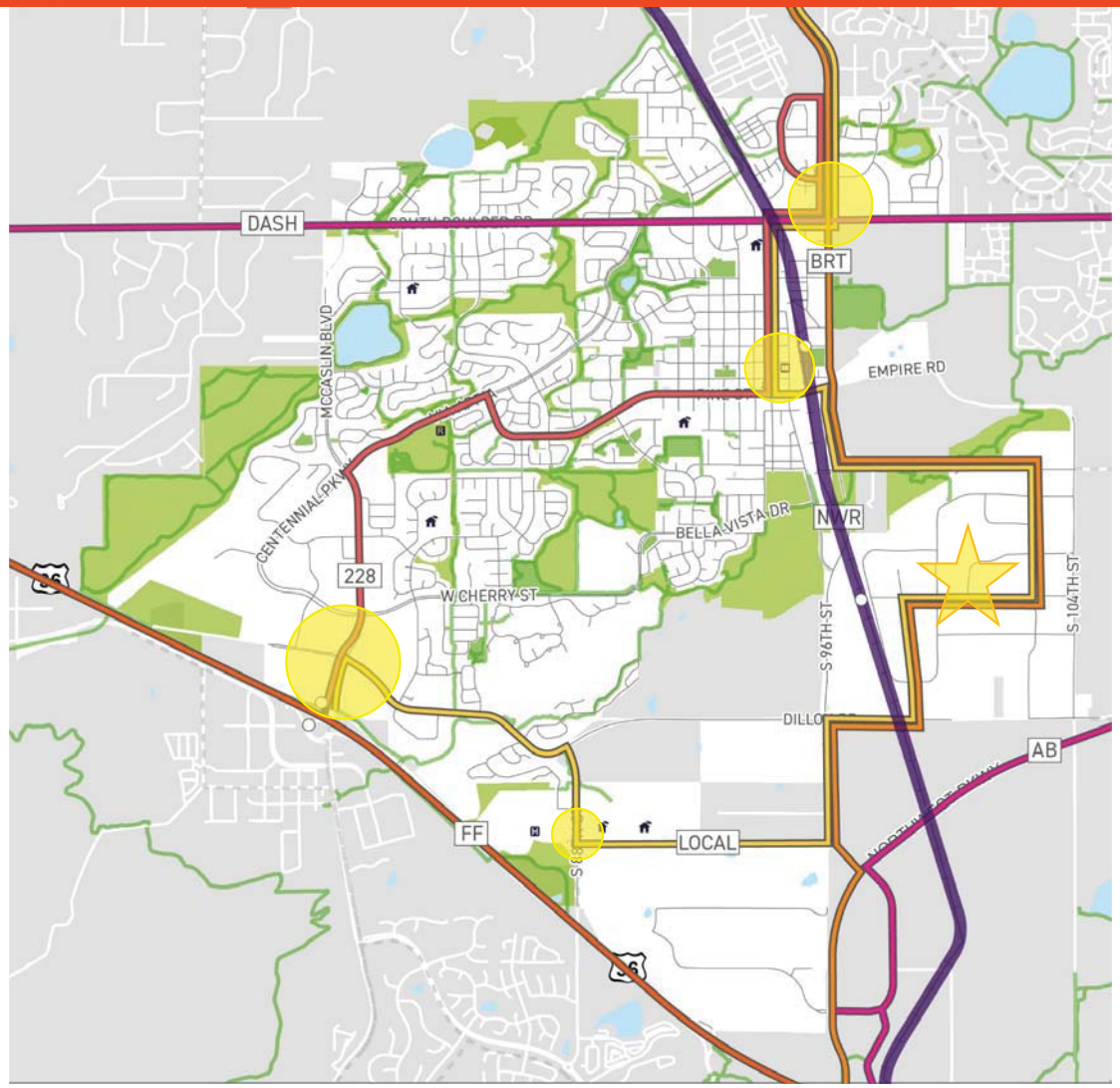
- Link the rec center with the pool, downtown, and ball fields (future)
- Comfortable facility for all ages and abilities
- Incorporate other elements of activity or interest along the trail





Service Enhancements

- Call & Ride service improvements
- Prioritize service to CTC
- First Mile/Last Mile connections to transit
- Improve stops and amenities at key locations
- Restructure local service to reach more destinations
- Faster trips on Dash
- Plan for Rail



Leveraging External Investment to Realize Local Economic Benefit

- Where could Louisville generate the greatest leverage?
  - CTC has more potential for new office space
  - Downtown already successful
- New office development locating within half mile of transit
  - 61% of office development has been within transit areas (since 2005 for Metro Denver)
  - Anticipated to capture 74% of future employment development

Next Steps

- Develop recommendations from conceptual to draft form
- Prioritize opportunities and investments
- Obtain community input
- Develop Implementation Plan with targets, metrics, cost estimates, and funding opportunities

DATA & TRENDS

DRAFT

TRANSPORTATION DATA & TRENDS

Over the last two decades, Louisville has been consistently ranked as one of the top cities to live in America, one of the best small towns, and one of the best cities in Colorado to raise a family. Residents are highly engaged in the community, reflecting the high rankings seen year after year.

Louisville prides itself on supporting a healthy, outdoor lifestyle with community amenities. This includes extensive bike and walk paths that provide exercise opportunities and contribute to environmental sustainability. Louisville also provides a variety of public services that contribute to residents' quality of life, including the Louisville Public Library, police and fire stations, a community arts center, a recreation and senior center, and more.

ABOUT LOUISVILLE

The City of Louisville has a rich history that dates back to its incorporation in 1882. Originally a mining town, the area has grown and evolved to an active community that is lauded as a great place to live and raise a family. With a range of businesses, an expansive trail system, and community events, Louisville provides a variety of destinations and activities for residents, employees, and visitors.

The City's ability to attract businesses and accommodate community needs is rooted in its ability to manage and respond to pressures of growth and change. Recent growth in Louisville and the broader Denver region has increased the number of residents and businesses in the area. This poses both opportunities and challenges for the City as it strives to maintain its high quality of life and meet the needs of the community.

DRAFT

Transportation Master Plan Purpose

The Transportation Master Plan (TMP) is a tool for the City that will act as a road map for maintaining and improving the transportation network and mobility options over time. This plan represents a collaborative effort between the City and the community to understand current needs and issues and develop a shared vision and priorities for the future.

The TMP is the first effort conducted by the City to look comprehensively at transportation conditions and options throughout Louisville. The TMP is also a holistic look at transportation for all modes and is inclusive of the infrastructure projects, policies, and programs that impact the use and safety of the transportation network. More specifically, the TMP aims to:

- Guide future transportation decision making and facilitate coordination among partnering agencies, jurisdictions, and the community;
- Identify applicable best practices and guidelines for transportation policy and facility design;
- Develop transportation-related goals and integrate them into a prioritized plan of short- and long-term projects; and
- Utilize strategies and metrics paired with measurable outcomes, focusing implementation of the plan on achieving intended goals.

Previous Planning Efforts

Louisville has completed multiple planning efforts that have focused on transportation in a particular part of the community, a specific corridor, or touched on transportation as part of other broader efforts. Many of these efforts have identified goals, strategies, or project recommendations. The TMP takes into account these past plans with a thorough review and analysis to identify applicability of previous goals, strategies, and recommendations. It is important that the planning for the TMP understands community input and recommendations of past efforts in order to identify future applicability of those plans and recommendations. Some recommendations may be validated and further recommended through this planning process, while others may no longer be appropriate based on the overarching goals set through the TMP. The past planning efforts include:

- Sustainability Action Plan 2016
- Comprehensive Plan
- Downtown Parking & Pedestrian Action Plan
- McCaslin Blvd Small Area Plan
- Northwest Area Mobility Study (RTD)
- 42 Gateway Alternative Analysis
- Dillon Road Corridor Study
- 2040 Metro Vision RTP (DRCOG)
- South Boulder Road Small Area Plan
- Trail and Wayfinding Master Plan
- Regional Housing Strategy
- Affordable Rentals (Boulder County)
- US 36 First & Final Mile Study
- SH 7 Planning & Environmental Linkages
- Boulder County Age Well Plan

Overall, the past planning efforts provide insight into previous community efforts and priorities for transportation planning and projects. There are many overlapping themes and goals that relate to transportation from these plans. These will be considered as part of this planning effort and will act as a basis for developing future goals, along with input from the community and the City staff.

Louisville's Comprehensive Plan, developed in 2013 identified the following core value around transportation:

"A Balanced Transportation System...where the City desires to make motorists, transit customers, bicyclists and pedestrians of all ages and abilities partners in mobility, and where the City intends to create and maintain a multimodal transportation system to ensure that each user can move in ways that contribute to the economic prosperity, public health, and exceptional quality of life in the City."

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STUDY AREA

The City of Louisville comprises approximately eight square miles. There are several community facilities and amenities in the city, including an expansive trail network. The roadway network consists of major collectors and arterials that connect with local streets. There are three elementary schools, two middle schools, and one high school in the city. The City limits define the study area for the TMP.

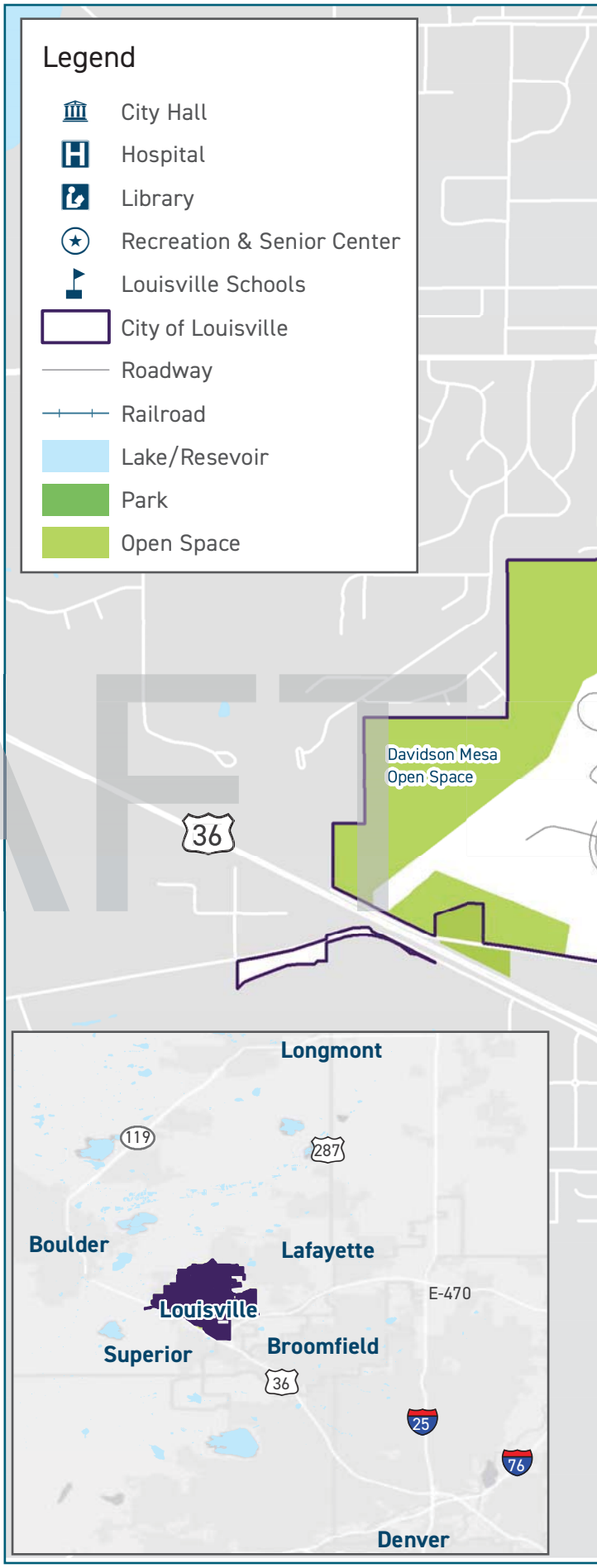
Regional Context

Located immediately northeast of the US 36 corridor connecting downtown Denver and downtown Boulder, Louisville is situated in the midst of a rapidly growing multicentered metropolitan region.

Louisville directly borders three other incorporated jurisdictions: the City of Lafayette to the northeast, the City and County of Broomfield to the southeast, and the Town of Superior to the southwest. Unincorporated Boulder county borders Louisville to the west.

The city also lies within a number of larger jurisdictions. It is located in Boulder County, which encompasses nine other cities and towns including Boulder, Lafayette, Erie, and Superior. Louisville, its neighbors, and Boulder County are members of the Denver Regional Council of Governments (DRCOG), the Metropolitan Planning Organization (MPO) responsible for developing coordinated transportation plans and allocating federal transportation funds throughout the nine-county region. The city is located in CDOT Region 4. Louisville also lies in the northwestern sector of Denver's Regional Transportation District (RTD), which runs transit service in Denver, Boulder, and surrounding areas.

Given Louisville's small size and close proximity to other jurisdictions, the transportation networks and travel patterns of Louisville, its neighbors, and the surrounding region are closely intertwined.



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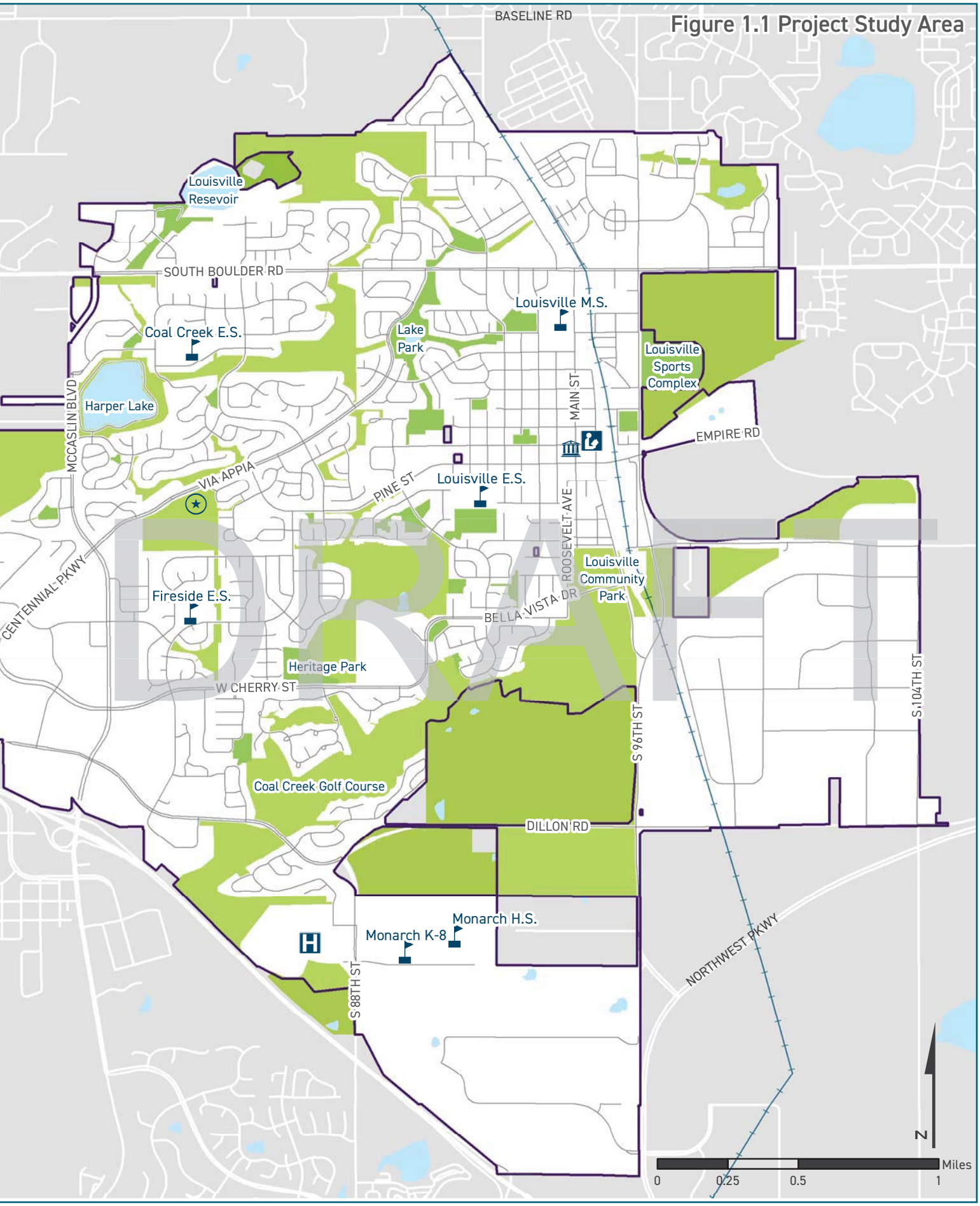

Figure 1.1 Project Study Area

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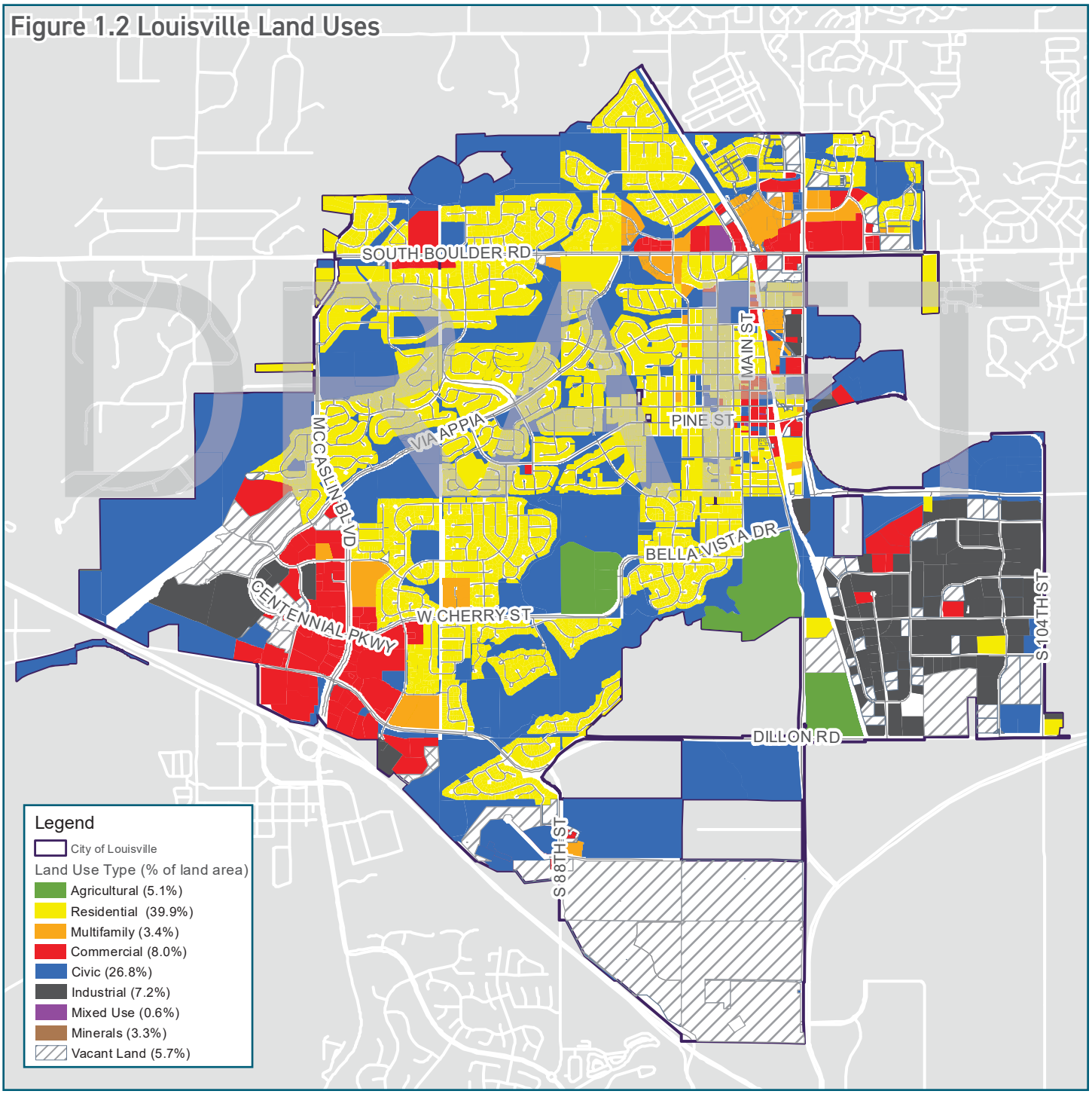
LAND USE

Louisville's primary land uses are residential and civic development, shown in yellow and blue, respectively, in Figure 1.2. Civic land use consists of parks, open space, schools, and other tax-exempt land. Residential land makes up the core of the city, while commercial and retail land uses are located primarily in the southwest and northeast areas of Louisville, including Downtown. A majority of housing is single-family residential, but there is a small percentage of land that has multifamily units, mainly in the areas of South Boulder Road and Highway 42, and near McCaslin Boulevard. The Colorado Tech Center (CTC) is where a majority of industrial uses are located. Louisville does have some vacant land, primarily in the southern part of the city and in the CTC. Since Louisville is largely built out, much of the traffic growth will come from outside the city.

Figure 1.2 Louisville Land Uses



Key Land Use and Market Changes

Office: There is currently 1.66 million square feet of office space in Louisville. Three new office buildings have been added in the City since 2008, totaling nearly 108,000 square feet. Two of these buildings, totaling 91,000 square feet, were completed in 2018. Office vacancy rates have averaged 6% since 2014, while vacancy was 12% in the second quarter of 2018. This is likely higher due to new inventory added during this time.

Retail: There is currently 1.57 million square feet of retail space in Louisville. Six new retail buildings have been constructed in the City since 2008, adding 71,000 square feet to the inventory. Rental rates for retail space have increased by over $3.00 per square foot over this time, and are currently nearly $20. Retail vacancy was very high during and after the recession (averaging 19% from 2010-2012), but decreased to between 5-6% in 2016-17. Retail vacancy is currently just over 13%; however 3 new buildings have come online since 2016, likely contributing to this high number.

Industrial/Flex: There is currently 4.3 million square feet of industrial/flex space in Louisville. 17 new industrial/flex buildings have been constructed in the City since 2008, adding 1.1 million square feet of inventory. Most of this new development has come since 2014—in this time 15 new buildings have added 1 million square feet to the City's inventory. The demolition of the former StorageTek facility, now referenced as Conoco Phillips, reduced the City's industrial inventory by 1.7 million square feet—almost half of the total industrial space in Louisville at the time.

Rental rates for industrial/flex space have fluctuated since 2008. Rates are higher for flex space (currently averaging $12.76 per square foot) than industrial space (currently $8.13 per square foot), and these rates are close to what they were in 2008. Vacancy in industrial buildings has consistently averaged over 10%, ranging from a low of 10.5% in 2008 to a high of 31.5% in 2011. Flex vacancy was consistently over 10% until 2016, and has averaged 8.7% over the past two years.

Multifamily: The City has seen a significant increase in multifamily housing since 2013. Prior to 2013 there were approximately 500 apartment units (in purpose-built apartment structures) in the City, with no new construction since 1999. Since 2013, nearly 700 new units have been constructed (51% of total housing unit growth). Apartment rents have increased as well over this time, currently averaging just over $1,500 per unit, or $1.81 per square foot. Almost all new and existing apartments are in the area along South Boulder Road.

Louisville exhibits small-town charm and character central to its high desirability and quality of life. It is anchored by its Main Street, lined with historic architecture, a variety of small businesses and shops, such as the State Mercantile, and locally-owned restaurants. At the same time, Louisville boasts a growing economy that's a mix of big business and small entrepreneurs, providing a varied economic base.

Housing options range from apartments and condos to charming bungalows and Victorians. Neighborhoods feature streets with sidewalks and trails , with most being an easy walk to a park or open space.

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Land Use Characteristics

As Louisville is a predominantly residential community with a strong employment base that has grown and changed over time, there are a variety of housing types, industries, office and retail areas within the city. The following images capture examples of each type of land use for illustrative purposes and to highlight the variety of building and land use characteristics within Louisville.

Apartments north of South Boulder Road adjacent to Alfalfa's

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Single-family housing north of West Cherry near McCalsin Blvd

Townhouses north of Dillon near McCaslin Blvd

Apartments in DELO

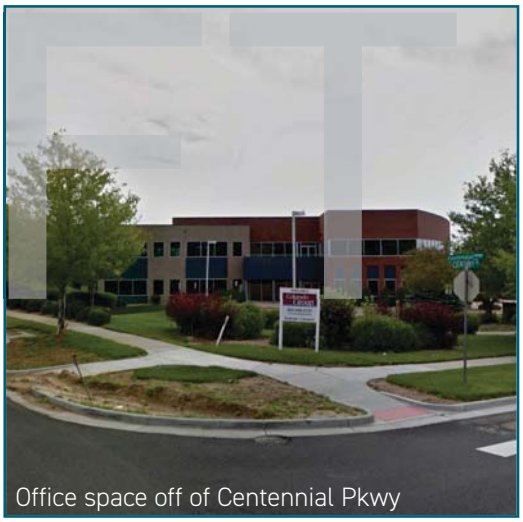
Multi-family housing in Kestrel

Newer building in CTC

EVO fitness gym and Red Garden restaurant and brewery in CTC highlight the new types of uses within the CTC

Avista Hospital off of S 88th St

Electric charging station in CTC


Office space off of Centennial Pkwy

Downtown buildings along Main Street

Office and flex space in DELO

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Activity Centers

Activity centers are locations that draw a high number of people to them. Typically these areas have higher amounts of office or retail space or have a mix of uses. Figure 1.3 highlights the locations of activity centers in Louisville. These areas fall along major corridors and are employment hubs. These high activity areas accounted for 41% of City employment in 2001, and increased to a capture of 59% of City employment in 2017.

From 2001 to 2007 employment declined in Louisville outside of these areas, while nearly 1,500 jobs were added in the activity centers. Two-thirds of City job growth in this time took place in the Colorado Technology Center (CTC), and another 25% of growth occurred in the McCaslin area. Since 2011, 75% of job growth in Louisville has been in these areas, with total growth of nearly 3,200 jobs. 40% of all City job growth in this time has been in the CTC; 18% in the Health Campus; and almost 12% in Downtown. The CTC now accounts for 28% of all jobs in the City.

Approximately one third of the City's existing office space is located in the activity centers, with most of this space (19% of the City inventory) in the McCaslin area. New office space in these areas since 2010 has only been developed in the CTC, with 8% of new City office development since 2010 (17,000 of 209,000 new square feet). An additional 109,000 square feet of office space is currently proposed for CTC.

Over half of the City's retail inventory is located in the activity centers, with 26% in the McCaslin area alone. South Boulder Road accounts for another 23% of the City's retail space. 82% of retail space in Louisville was built prior to 2000. Of the space constructed since then, 36% has been built in the McCaslin area and 14% in the South Boulder Road areas.

The CTC is the only Activity Center with industrial-flex space, containing two-thirds of the City's existing inventory. This area also has 78% of industrial-flex space currently under construction in the City, and 500,000 square feet of proposed space (the only proposed industrial-flex space currently in the City).

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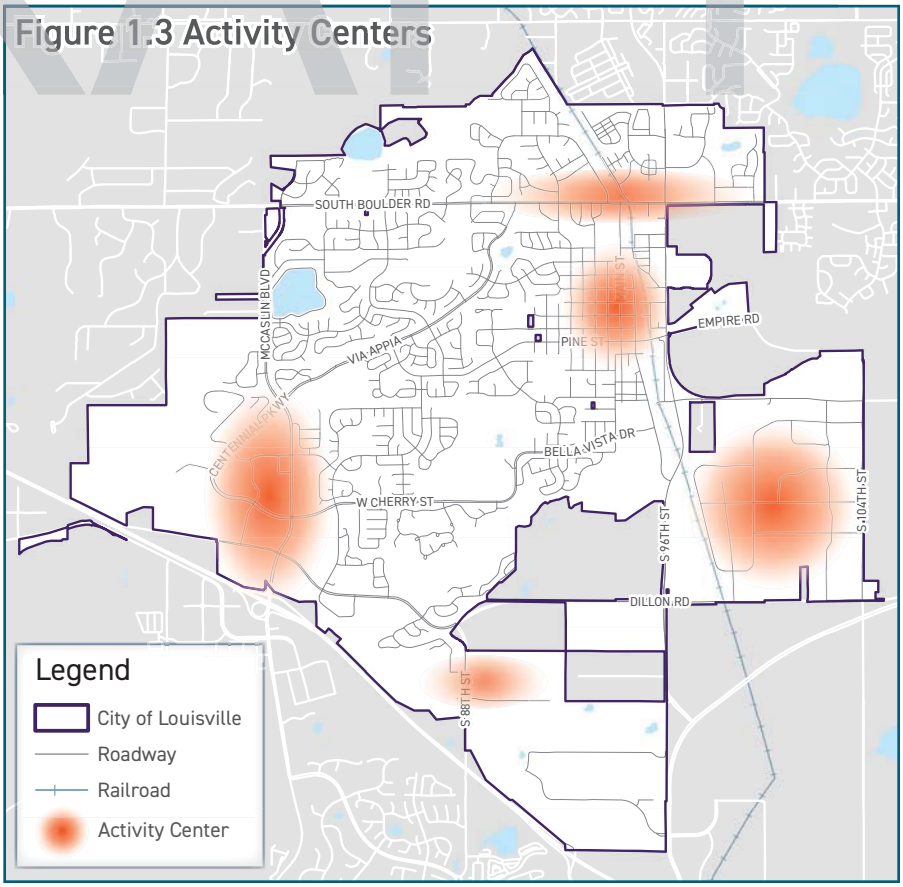
Figure 1.3 Activity Centers



Future Development Potential

Figure 1.4 identifies where vacant land is located in Louisville. Vacant properties provide the highest development potential, and account for 5.7% of land in the city. This does not include the 3.3% of land that is part of the old Storage Tek campus site between South 88th Street and South 96th Street on the southern side of Louisville. The 432-acre site represents the largest potential for development within Louisville. Development of this parcel could have significant impacts on the transportation network. The multiple vacant parcels within the CTC also provide significant development opportunities for employment. Neither of these districts are accessible by transit, and biking options are limited. Other small parcels throughout Louisville offer additional opportunities for development. They are located near existing transit and biking options and are less likely to significantly impact the transportation network due to their size.

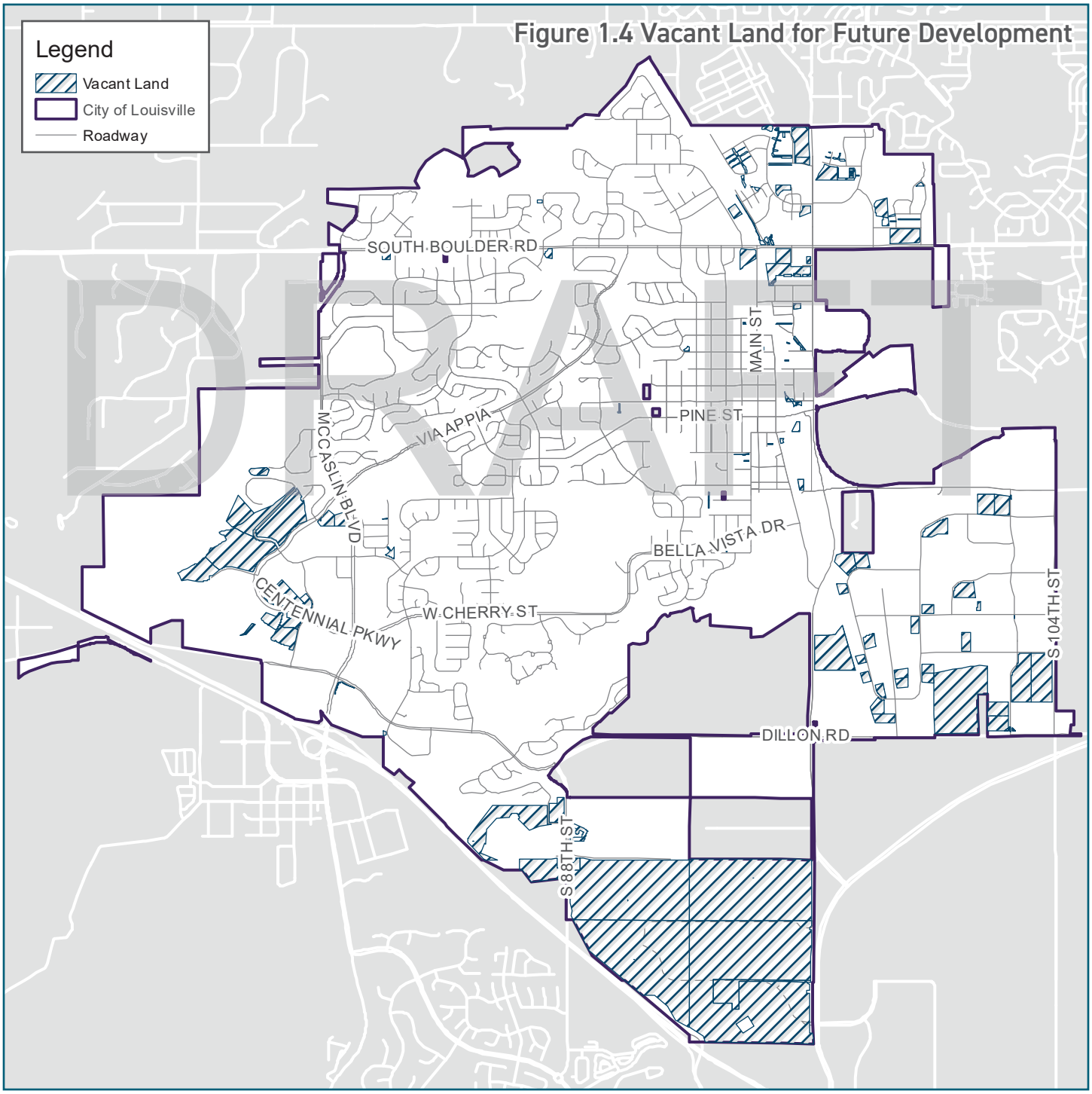


Figure 1.4 Vacant Land for Future Development

LOUISVILLE COMMUNITY DATA

POPULATION & EMPLOYMENT

Identifying characteristics of the population that lives and works in Louisville is an essential piece of understanding travel patterns, community mobility, and demand for transportation facilities. The following sections highlight demographic information about the people that live and work in Louisville.

Louisville Residents

A demographic analysis was conducted for the City of Louisville. The demographics of the city provide a picture of the types of households and individuals living in the City. A total of 21,208 people live in Louisville, comprising 8,681 households. Louisville is an affluent residential community with a median household income of $94,971 and only 7% of households living in poverty.

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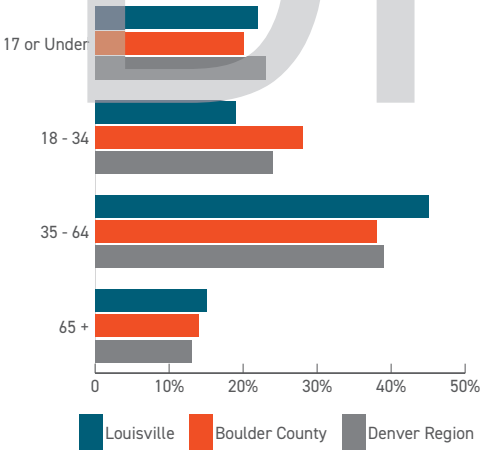
Figure 1.5 Age of Residents (2017)



Age of the population can be an indicator for housing and travel preferences or needs. Millenials (born between 1981 and 1996), for example, often prefer living in walkable, higher-density neighborhoods with urban amenities and near activity centers. Baby Boomers (born between 1946 and 1964) are also starting to show preferences towards amenities and lifestyles found in more urban areas, particularly those looking to downsize their homes after their children have grown and moved away. What helps a community become and remain more attractive to seniors is often also what makes it attractive to younger people, such as access to services, transportation choices, parks and activities, for example.

Louisville is a very family-friendly city with good schools and a high amount of trails and recreation opportunities. The city has a higher percentage of adults age 35–64 than Boulder County and the Denver region likely because of the housing types and amenities available. The median age in Louisville is 42.4 years, 5 years older than the Colorado median age of 37.3 years. Since 2000, adults age 55 and older has grown from 12% of the Louisville population to 32%. This trend is anticipated to further increase. On the opposite side, the percentage of children under age 18 has decreased in the same period from 28% to 22%. It is projected that the percent of adults age 55+ will increase at a rate of approximately 3% per year while the population under age 18 will increase at less than 1% per year over the next 30 years.

Louisville is less ethnically and racially diverse than Boulder County and the Denver region. Fully 85% of Louisville residents identify as White and non Hispanic, compared to 78% in Boulder County and 64% in the Denver region.

Figure 1.6 Louisville and Comparison Area Demographic Data

	Louisville	Boulder County	Denver Region*
Total Population	21,208	333,953	3,203,332
Households	8,681	132,801	1,255,009
Average Household Size	2.43	2.43	2.52
Median Household Income	$94,971	$76,802	$72,297
Unemployed	2.5%	3.6%	3.3%
Below Poverty Line (2016)	7%	13%	10%
% Zero auto households (2016)	5%	6%	6%
% Own	75%	64%	62%
% Rent	25%	36%	38%
Vacancy	2%	4%	4%
Single Family Detached (2016)	6,265	79,023	718,711
Single Family Attached (2016)	578	9,597	97,067
Apartment 2 - 9 Units (2016)	435	16,495	116,271
Apartment 10 - 49 Units (2016)	669	14,640	174,978
Apartment 50+ Units (2016)	284	7,519	87,740
Other (2016)	111	3,768	22,099
% Hispanic	8%	14%	23%
% White (non Hispanic)	85%	78%	64%
% Black (non Hispanic)	1%	1%	5%
% Asian (non Hispanic)	4%	4%	4%
% Other (non-Hispanic)	3%	3%	3%
% 17 or Under	22%	20%	23%
% 18 - 34	19%	28%	24%
% 35 - 64	45%	38%	39%
% 65+	15%	14%	13%
% No High School	1%	2%	4%
% Some High School	1%	3%	5%
% High School Graduate	9%	13%	20%
% Some College	12%	15%	19%
% Associate Degree	5%	6%	8%
% College Degree	38%	32%	28%
% Graduate School	35%	29%	17%

Source: 2018 ESRI

**Includes Adams, Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas, and Jefferson counties*

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Zero automobile households are typically strongly correlated with transit usage and lower incomes. Millenials have become a component of zero auto household rates as they are increasingly forgoing vehicle ownership as a choice. Whether by choice or not, households with no vehicles are more reliant on public transportation, biking, and walking, and new technologies like care-share or transportation network companies (Uber, Lyft) to access jobs, and services. Louisville only has 5% of households that are without a vehicle, compared to Boulder County and the Denver region at 6% each.

Most households within Louisville that do not own a vehicle have access to local transit. However, these routes are infrequent and may act as a barrier to access to jobs for low income households.

Approximately 75% of homes in Louisville are owner-occupied, while 25% are renter-occupied. This is higher than homeownership rates in Boulder County and the Denver region. Louisville has a very low housing vacancy rate of 2% compared to 4% in Boulder County and the Denver region.

The City has seen a significant increase in multifamily housing since 2013. Prior to 2013 there were approximately 500 apartment units (in purpose-built apartment structures) in the City, with no new construction since 1999; since 2013, nearly 700 new units have been constructed. The Downtown East Louisville (DELO) development located between South Street and Griffith Street on the west side of Hwy 42 is an example that has been recently completed with apartments, townhomes, retail, and office space. Higher density housing, like apartments and townhomes, can be complementary to transit stops and decreasing reliance on automobiles for trips in areas that are walkable with a variety of uses in close proximity.

A lack of affordable and senior housing are issues in Louisville, just as in many other communities in the Denver region. Recently, the Boulder county Housing Authority opened a new housing development in Louisville, the Kestrel neighborhood. The community is income-restricted and includes 129 townhouses for individuals and families and 71 apartments for seniors ages 55 and older. Kestrel is located East of Highway 42 and just north of South Boulder Road. For lower-income individuals and families, transportation is an important issue. Access to a vehicle is not always possible, so mobility choices and connections to transit and biking are important. The Kestrel development has access to bike trails, commercial and retail services, and transit along South Boulder Road and within the development along Hecla Drive.

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New development, Downtown East Louisville (DELO), connected to Downtown Louisville by a pedestrian and bicycle underpass.

Recent Population Changes

Louisville's current population is 21,208. Since 2010, the City has grown by 2,800 residents, representing 15% overall growth or 1.8% growth per year. This is much stronger growth than was seen between 2000 to 2010, where the city declined 4% in population and saw only 2% growth in households. The location of this recent growth within the City is shown in Figure 1.7.

Similar to population growth, the City has had much stronger housing growth in the past eight years than from 2000 to 2010. Since 2010, housing stock has increased by 12%, or almost 1,000 new housing units. The areas of population and household growth are near major corridors and place added demand on the transportation network.

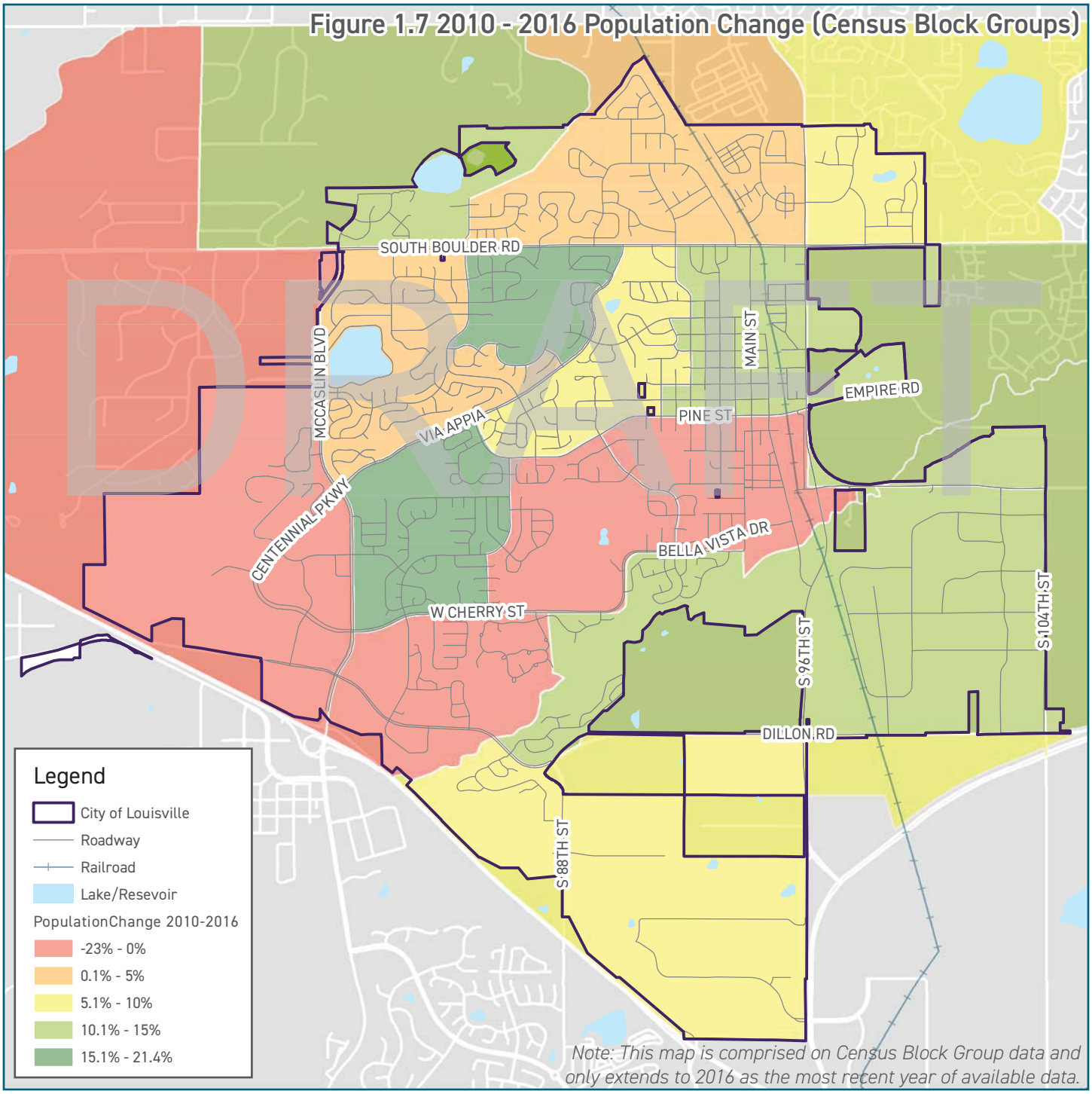
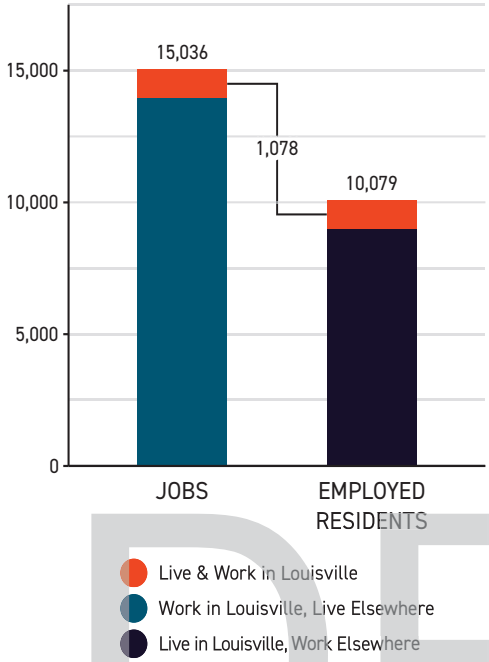


Figure 1.7 2010 - 2016 Population Change (Census Block Groups)

Louisville Employment

Louisville has a healthy employment sector, providing a variety of jobs to people living in the city as well as the region. Louisville has many competitive advantages, including its proximity to Boulder, Bus Rapid Transit (BRT) service along US 36, and high overall quality of life that allow it to continue to attract business. The neighborhoods and workforce are largely single-family, affluent, and educated in Louisville and adjacent areas. This provides a desirable workforce within a small area that supports growing employment. Access to surrounding cities and the overall region is important for businesses and employees within Louisville.

Figure 1.8 Inflow and Outflow of Residents and Employees



Louisville employs just over 15,000 people across a range of industries. Jobs outnumber employed residents by 50%, meaning that more people commute into Louisville for work than commute from Louisville to elsewhere in the region. As Figure 1.8 illustrates, a large majority (93%) of people who work in Louisville commute into the city, just as most Louisville residents work elsewhere. However, more than 1,000 people—11% of Louisville's employed residents and 7% of its workers—both live and work in Louisville. Commuting patterns place added stress and congestion on the transportation network, particularly during peak periods, i.e. the morning and afternoon.

Employment Growth and Changes

Louisville has experienced significant changes in employment and the types of industries in recent decades. The city added 4,700 jobs between 2001 and 2017, a 44% increase. Nearly all of this employment growth, 4,200 jobs, has come since 2011.

This recent growth has created a more diversified and balanced employment base. In 2001, five industries accounted for 77% of jobs in Louisville, with the manufacturing sector accounting for 40% of employment. By 2017, those same 5 industries accounted for 71% of Louisville employment, but jobs were more evenly distributed among manufacturing (21%), professional, scientific & technical services (14%), retail trade (9%), and health care (16%).

The overall employment characteristics have diversified and changed in Louisville since 2001, but the overall composition has remained similar. While it still makes up the largest sector of Louisville's employment, manufacturing jobs declined significantly from 2001 to 2011, while jobs in professional, scientific & technical services more than tripled. From 2007 to 2011, most industries lost employment with the exception of information and accommodation & food services, which grew by more than 100 jobs.

Wages

Louisville has a larger share of jobs that pay over $3,333 per month than Boulder County or the Denver Region. The average wage in Louisville in 2017, across all employment industries, was $68,000. Jobs in information had the highest average wage (nearly $105,000), followed by professional, scientific & technical services ($103,400) and manufacturing ($92,800). The lowest-paying jobs in the City are in accommodation & food services, with average wages of $20,400 per year.

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Regional Employment Comparison

Industry employment in Louisville has had a similar composition to the Boulder/Broomfield area, with a few notable exceptions. Louisville has consistently had a higher share of jobs in manufacturing and health care than the region, and in 2017 also had a higher share of jobs in construction. At the same time, the city has consistently had a lower share of jobs in education than the region overall.

While Louisville is a small city, it is a strong component of regional employment. Louisville experienced stronger employment growth than the Denver Metro Area (Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas, and Jefferson Counties) overall from 2001 to 2007, with the city seeing 2.0% average annual employment growth compared to 0.1% annually for the Metro Area. While Louisville was hit harder during the recession, experiencing a 1.9% average annual decrease in employment (compared to 0.6% annual decrease across the Metro Area), the city's growth since 2011 has outpaced the strong growth across the region, with 5.6% average annual employment growth in Louisville, compared to 3.1% annually in the Metro Area.

Figure 1.9 Largest Employment Sectors for Growth (2011-2017)

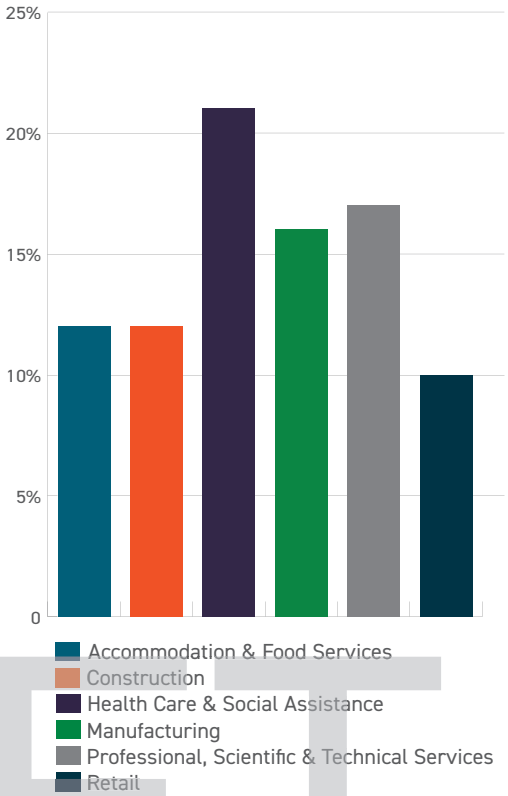

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Figure 1.10 Wage and Employment Data

	City of Louisville	Boulder County	Denver Region*
Total Jobs	15,036	163,040	1,561,979
$1,250 or less per month	14.4%	19.7%	20.3%
$1,251-$3,333 per month	27.7%	29.5%	31.1%
More than $3,333 per month	57.9%	50.8%	48.7%
Manufacturing	25.2%	11.8%	5.8%
Health Care & Social Assistance	13.8%	12.2%	12.3%
Professional, Scientific, & Technical Services	13.0%	16.5%	10.1%
Retail Trade	8.5%	9.6%	10.3%
Information	7.8%	5.1%	3.7%
Accommodation & Food Services	7.1%	9.5%	9.2%
Construction	5.8%	3.1%	5.4%
Wholesale Trade	4.1%	3.7%	5.2%
Finance & Insurance	3.2%	2.5%	5.2%
Administration & Support, Waste Management	3.0%	4.3%	6.5%
Other Sector	8.6%	21.7%	26.4%

Source: 2015 LEHD Origin-Destination Employment Statistics

*Includes Adams, Arapahoe, Boulder, Broomfield, Clear Creek, Denver, Douglas, Gilpin, and Jefferson counties

Where Louisville Residents Work

To better understand the travel patterns of residents within the study area, an analysis of where residents work was conducted and is summarized in Figure 1.11. Longitudinal Employer-Household Dynamics (LEHD) data from the US Census was used and Journey to Work flows were based on the density of residents working in each Block Group. Areas with a darker color have a larger density of residents working in that area.

The majority of residents work within Boulder County, with a high number also working in Denver and lesser amounts spread throughout the region. The highest areas of employment for Louisville residents are in the Cities of Boulder (28%) and Denver (14%). Approximately 89% of employed residents work outside of Louisville. This data helps identify key commuting corridors such as US 36, US 287, and Highway 119.

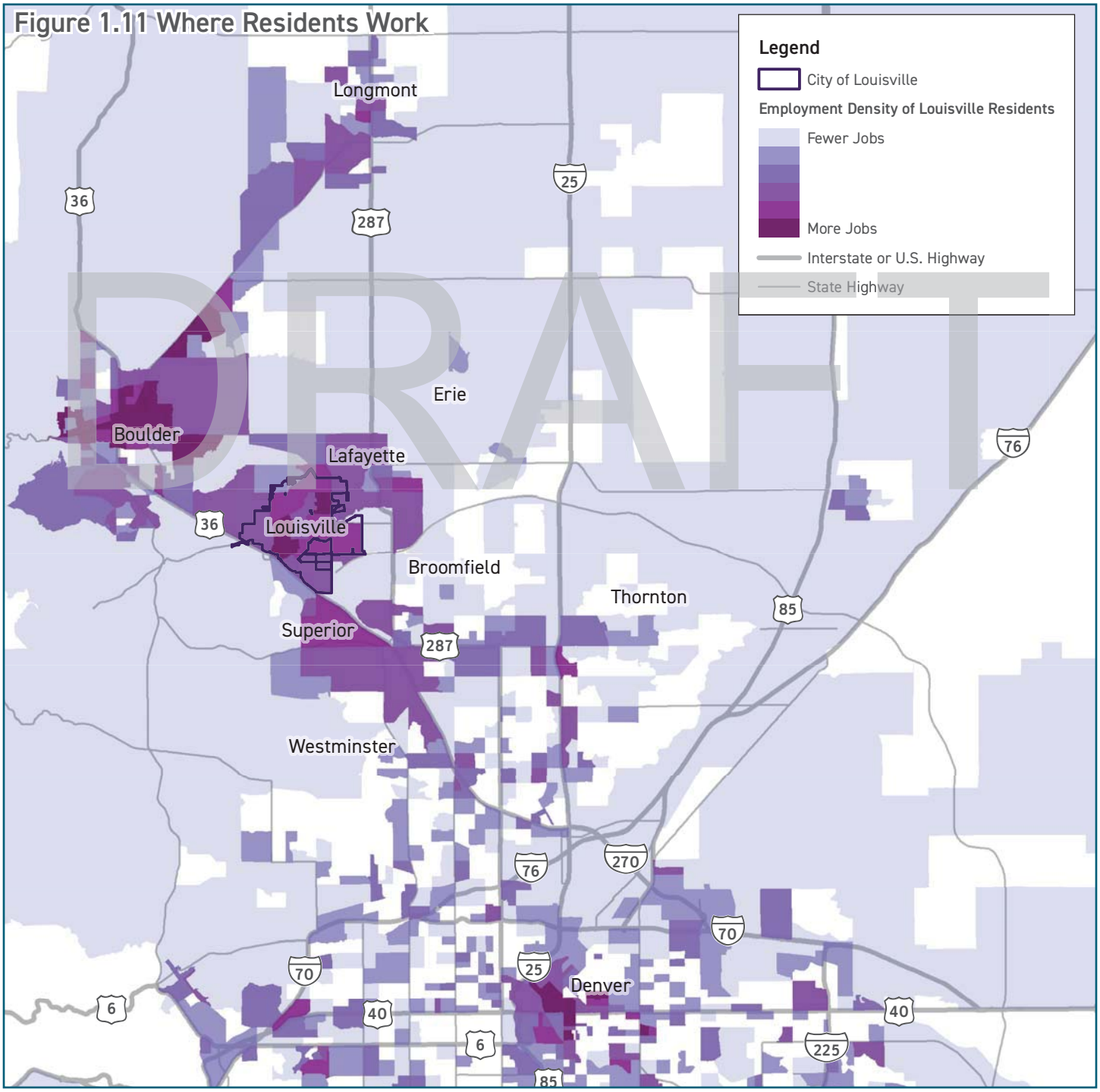
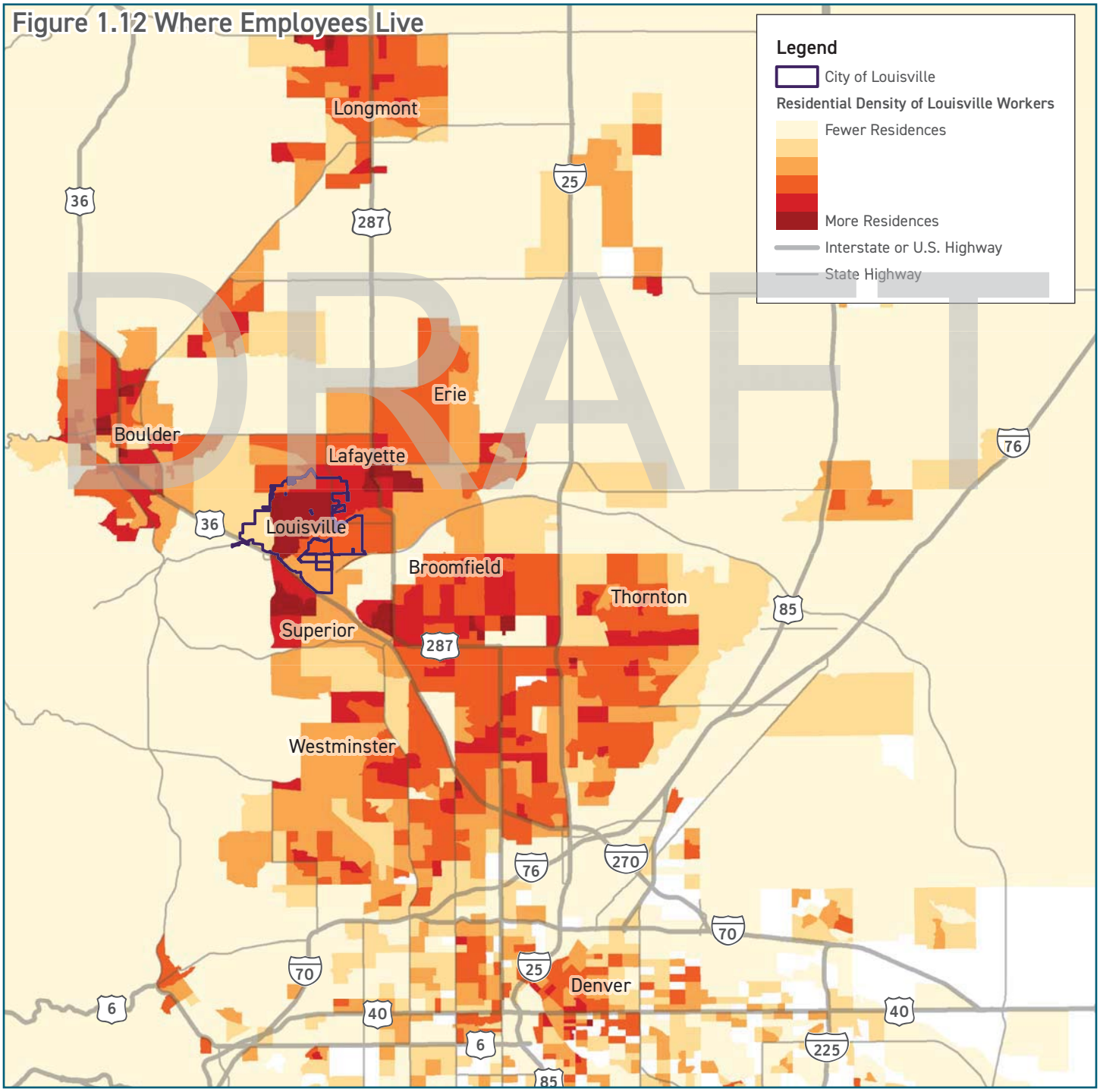


Figure 1.11 Where Residents Work

Where Louisville Employees Live

Figure 1.12 maps the location of where Louisville employees working in Louisville live. Employees in Louisville live in cities across the region. Approximately 7% of workers live in each of Denver, Broomfield, Boulder, Louisville, and Westminster, and another 6% of workers live in each of Thornton and Lafayette. Strong regional corridors and connections allow Louisville to attract employees who live in other locations throughout the Denver region. Direct access through Northwest Parkway, US 36, US 287, and Highway 7 provide key connections to Louisville. Approximately 93% of employees live outside of Louisville.

Figures 1.11 and 1.12 depict the daily inflow and outflow of jobs within Louisville. While employment is strong in Louisville, it is overall a residential community. This mismatch between jobs available within the city and residents who live there places added stress on the transportation network and increases in commuting.



Area Population Growth

The Denver Regional Council of Governments (DRCOG) uses modeling to estimate future growth in population and employment. Modeling is used to provide insight in where growth could occur based on existing zoning and development information, potential impacts it will have on the transportation network, and improvements that may best accommodate the changes. Between 2015 and 2040, Louisville is forecast to add 2,500 new residents in 1,300 households. This was an overall growth of 12-15% for the City. Figure 1.13 identifies where that growth is likely to occur in and around Louisville. Areas of growth are anticipated to be in the downtown area, the northeast, and southern parts of the city. More significant growth is projected to occur in the areas around Louisville, particularly to the west and south in unincorporated Boulder County and Superior. This growth outside of the city will likely impact key travel corridors for people coming into and through Louisville.

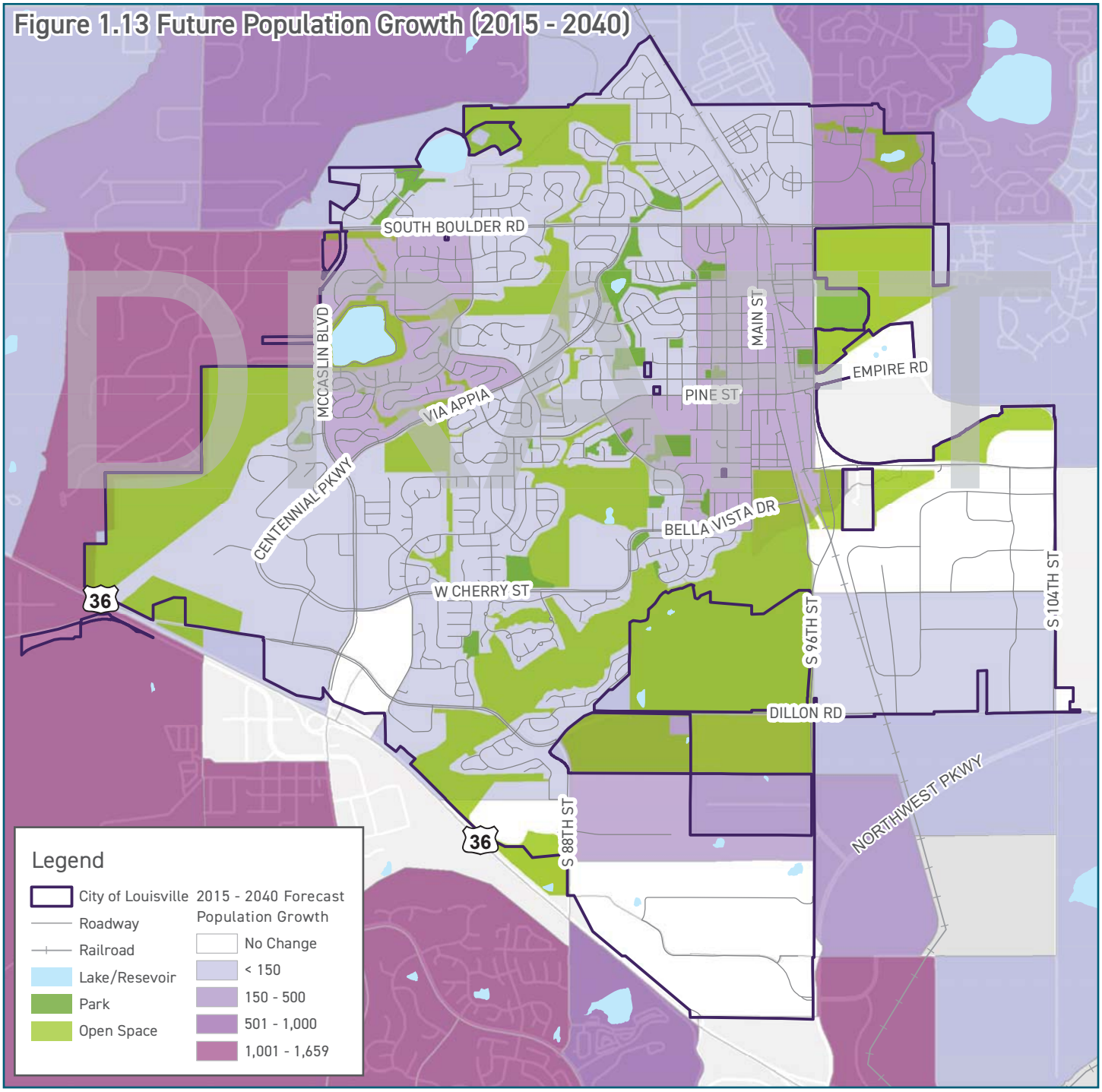


Figure 1.13 Future Population Growth (2015 - 2040)

Area Employment Growth

While many parts of Louisville are not anticipated to have significant housing growth, the city will see greater levels of employment growth. Louisville is forecast to capture 0.63% of employment growth in the Denver Region to 2040, adding 4,100 jobs. This represents a 28% increase over 2015 employment levels. Moderate areas of employment growth are predicted largely in the northern and downtown parts of the city, as well as south of West Cherry Street. The highest growth is anticipated west of McCaslin Boulevard, in the Colorado Tech Center and in the very southern portion of the City between US 36 and Northwest Parkway. This growth, along with employment growth south of Louisville in Superior will likely spur additional trips to and within Louisville and place additional commuting stress on the network.

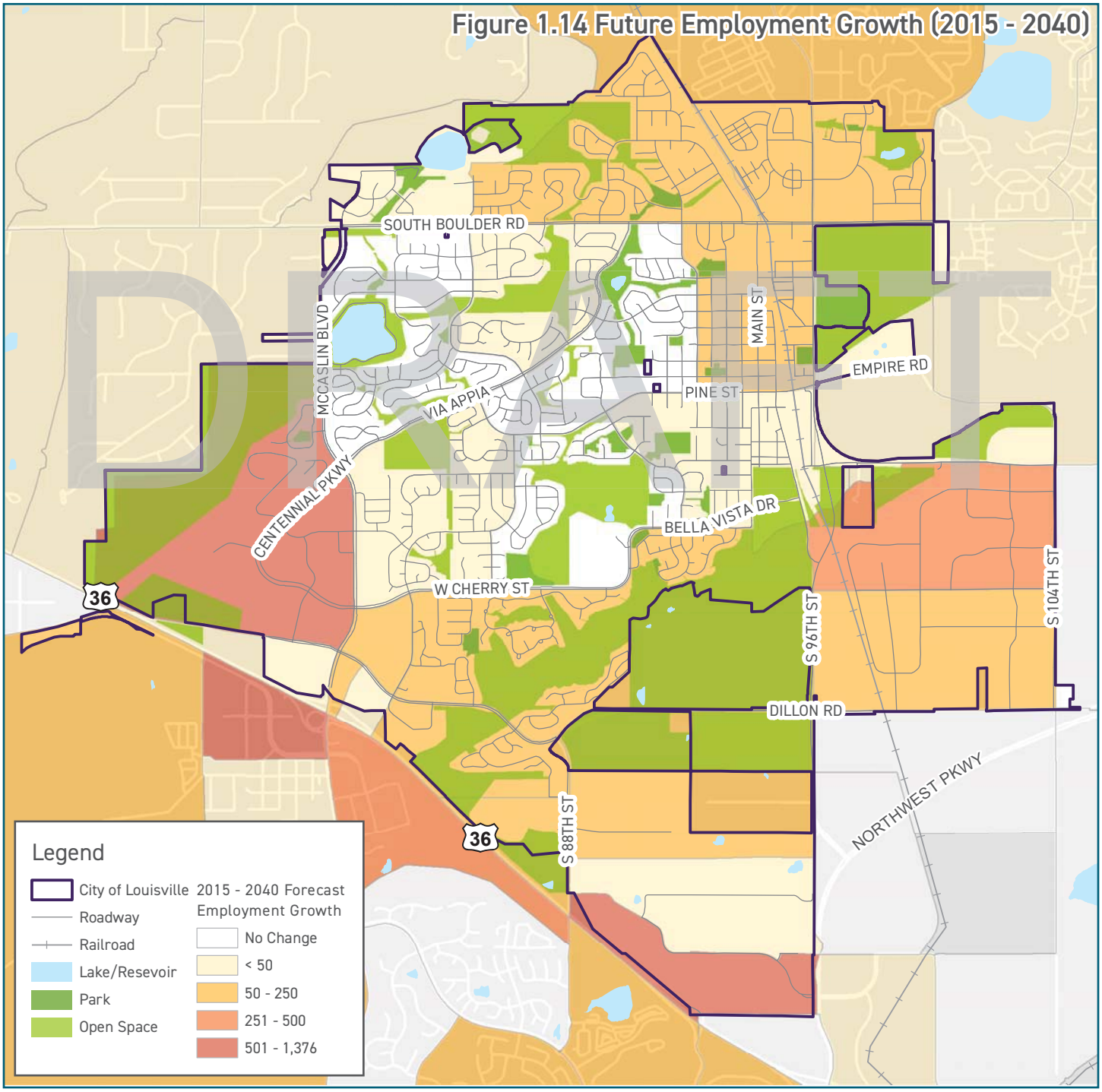


Figure 1.14 Future Employment Growth (2015 - 2040)

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HOW PEOPLE MOVE IN LOUISVILLE

What is a Travel Demand Model?

The Denver Regional Council of Governments (DRCOG) develops a travel demand model (TDM) that estimates trip types, origins and destinations, modes, and trip lengths for all trips occurring in the region. This information is based on population, employment and development patterns, and multiple surveys estimate travel patterns. The TDM is a useful tool to help understand current and future demand and impacts on the transportation network.

Linking Trips and Land Use

Many factors impact the transportation network and the how people make trips. As housing costs continue to rise, more growth is occurring further out in the region, resulting in increased commuting. Local and regional trends show people traveling further to get to work and other destinations. This places additional stress on the transportation network leading to increased congestion. Trends counteracting this involve changes in development patterns that include mixed-use and higher density that is supportive of transit service. Mixed use and transit areas are able to accommodate a variety of trips without the need for driving, therefore reducing stress on the transportation network

TRAVEL DEMAND ANALYSIS

This section uses Census data paired with TDM data from DRCOG to identify trip types and modes for travel occurring within Louisville.

Trips in Louisville

The TDM separates travel into two key types based on the origin and destination and are then divided into work-based and nonwork-based trips. The TDM is an activity based model that factors in all trips made between an origin and destination. For example a trip that begins at home, stops for coffee, and goes to a school before traveling to work would ultimately be counted as a work-based trip. A trip that begins at home, goes to the gym, goes to the grocery store, then back home would be classified as a nonwork-based trip.

Currently, only 40.1% of all trips made within, to, or from Louisville are work related. While the number of work trips is expected to increase by 2040, the overall share of work related trips is projected to generally stay the same at 39.5%. This leaves a significant portion of trips occurring on the network not related to commuting to work.

Transportation planning is often is focused on commute trip needs. But, to adequately plan for other types of trips, it is important to address the variety of trip types as well as take into account trips that vary in distance. Commuting trips are some of the longest trips that people make on a regular basis, and are therefore more likely to be completed by car than by walking or biking. Nonwork-based trips, however are typically much shorter. Focusing on these shorter trips for improving mobility options and expanding mode share, particularly walking and biking, can be key to maintaining mobility levels for the future as the number of trips grow on the transportation network.

Short Trips

Short trips are most able to be made by a mode other than driving. Shifting short trips out of cars by providing high-quality choices for using other modes can reduce the demand on existing roadways and ease congestion. Adequate infrastructure that feels safe and attractive to a broad range of people will support walking and biking.

Currently, 31% of trips within, to, or from Louisville are 3 miles or less in distance. Three miles equates to an approximate 15 minute bike ride at average speed. The share of short trips is predicted to remain constant through 2040. As the total number of trips in Louisville is projected to increase by 25% between today and 2040, shifting a portion of the short trips from driving alone to another mode could result in meaningful impacts to overall travel conditions.

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Mode Share

The table below lists the percentage of workers in Louisville and nearby geographies who commute via different modes. The single-occupant vehicle is the predominant mode of commuting in Louisville, and the share of Louisville-based commuters driving alone to work is comparable to that of the regional workforce.

Although driving alone is the most common mode of commuting, a significant portion of Louisville-based workers reach their job via other modes. Roughly one in ten workers commute via transit, biking, or walking—a larger share than in the Denver region more broadly. However, other communities achieve a much greater share of people walking and biking to work than Louisville. In the City of Boulder, for example, one in every five workers walks or bikes to work, compared to only one of every 25 workers in Louisville. The high rates of active transportation in Boulder County suggest that Louisville has the potential to increase the share of trips made by walking and biking through investments in pedestrian and bicycle infrastructure.

While the census estimates provide a useful starting point for understanding how communities rely on different modes of transportation, it tends to overestimate the share of all trips made by car relative to other modes. This is due to the reporting only of primary modes for commute trips and not identifying all modes used, or how people get to destinations other than work. The DRCOG TDM provides an estimate of trips by walking, biking, and riding transit that is for all trips, not just commuting. The TDM estimates that 4.7% of people walk, 1.1% ride transit, and only 0.9% bicycle for transportation trips in Louisville. Based on transportation conditions, trip types, and planned infrastructure improvements, the number of people using these alternative modes in 2040 is expected to remain relatively consistent. Changes in the transportation network and providing realistic mobility options will be key to increasing the overall mode share within the city.

What is a Mode?

A mode of transportation is most simply a term that distinguishes the various ways that people make trips. For purposes of this report, a mode is defined as driving, walking, bicycling, or riding public transit (includes bus, rail and ferries). Walking, biking, and riding public transit are sometimes referred to as alternative modes as they do not make up the majority of trips historically in most cities. Driving traditionally the primary mode of most communities.

What is Mode Share?

Mode Share is the percentage of trips that are taken by each mode. Increasing mode share means diversifying the modes used for trips in a community and increasing the share of alternative modes in relation to driving.

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Figure 1.15 Louisville and Comparison Area Commute Mode Share

	Drive Alone	Carpool	Transit	Bike	Walk	Work at Home	Other
City of Louisville	72.3%	4.7%	5.9%	2.3%	1.7%	12.7%	0.5%
City of Boulder	51.3%	4.9%	8.3%	10.3%	11.4%	12.5%	1.2%
Boulder County	65.2%	7.6%	5.0%	4.4%	5.3%	11.3%	1.3%
Denver Region	74.8%	8.5%	4.4%	1.2%	2.5%	7.5%	1.0%

Source: 2012-2016 American Community Survey 5-Year Estimates

KEY CORRIDORS

This section highlights primary travel corridors in Louisville, designed uses, surrounding context, and connectivity.

What are Key Corridors?

The main backbone of any transportation network is the major corridors. These corridors provide the connectivity and access to neighborhoods, businesses, recreation, and more. The design and surrounding context of corridors impacts the demand on the corridor and travel modes that people utilize.

Corridor Characteristics & Context

South Boulder Road is a four lane divided boulevard that is the major east-west roadway in northern Louisville. The roadway has high traffic volumes, local transit service, on street bike lanes, and a number of foot traffic generators, including parks, retail and neighborhoods. Some challenges along the corridor are drivers speeding downhill, limited pedestrian crossings, a freight line, and cut-through traffic from Boulder and Lafayette.

McCaslin Boulevard is the busiest corridor in Louisville. It has upwards of 30,000 vehicles per day at the southern end, where there is retail activity and access to US 36. There is a bike lane along the entirety of the corridor within Louisville, and some wide sidewalks along the southern segment.

Via Appia Way is a central roadway that connects many neighborhoods to South Boulder Road, McCaslin Boulevard and Downtown via Pine Street. There are two vehicle lanes, and a bike lane in each direction of the very wide roadway. The roadway is served by both the Dash and 228. Travel speeds are high given the surrounding context of mostly single-family homes and the Rec Center.

Centennial Parkway is a continuation of Via Appia Way west of McCaslin Boulevard loops back to form W Cherry east of McCaslin. The surrounding land use along the corridor is mostly commercial. There are bike lanes, as well as rarely used on-street parking.

W Cherry Street/Bella Vista Drive is an east-west roadway that runs from McCaslin Boulevard to County Road on east side of town. There is an ever-changing cross-section with two- and three-lane portions, bike lanes or shared bikeways, some on street parking, some discontinuous sidewalks, and a wide-ranging right-of-way. While much of the adjacent property is single family homes, there is some retail in the McCaslin area, as well as parks and other open space.

Dillon Road is a busy street throughout Louisville, serving retail near McCaslin Boulevard, Monarch High School and the Hospital off of S 88th Street, and both Highway 287 and Northwest Parkway to the east. There are wide, bikeable sidewalks through the residential areas near the school, and shoulders in the more rural portion to the east.

Pine Street is a connection to neighborhoods and into southern Downtown from both Via Appia Way and SH 42. The wide two-lane roadway is served by the Dash, but does not have a dedicated bike facility. There are pedestrian refuges near downtown, where there is also a school zone.

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SH 42 is a two-lane state facility, with varying shoulder widths, that is a regional north-south connection on the east edge of town. Traffic volumes cause delays in the Downtown area, especially at the South Boulder Road signal. There are open space and parks to the east, but they are difficult to reach on foot and by bike due to a lack of crossings.

Main Street is a busy two-lane road that is central to Downtown and connects to South Boulder Road. Main Street is lined with retail and parking in Downtown and provides direct access to Louisville Middle School.

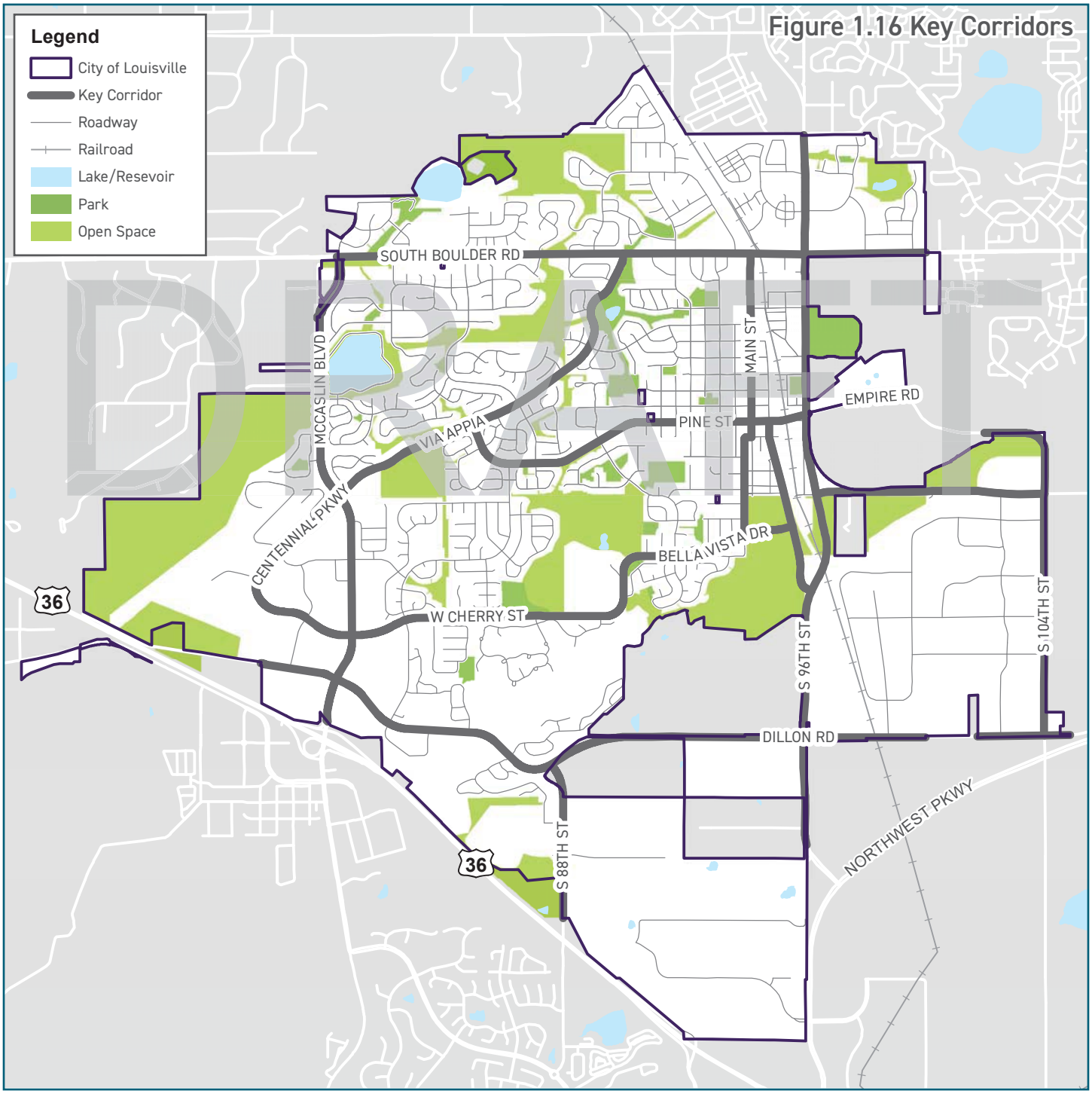

Figure 1.16 Key Corridors

Corridor Connectivity

Intersection density is a useful indicator of the degree of street connectivity in an area. Neighborhoods with greater intersection density tend to have more interconnected and duplicative street networks, which provide multiple routes to travel between any two points. Places where parallel streets connect to the same sets of destinations present opportunities to prioritize different modes of transportation on different corridors. As the map below shows, Downtown and the recent Steel Ranch development are the neighborhoods with the greatest intersection density in Louisville.

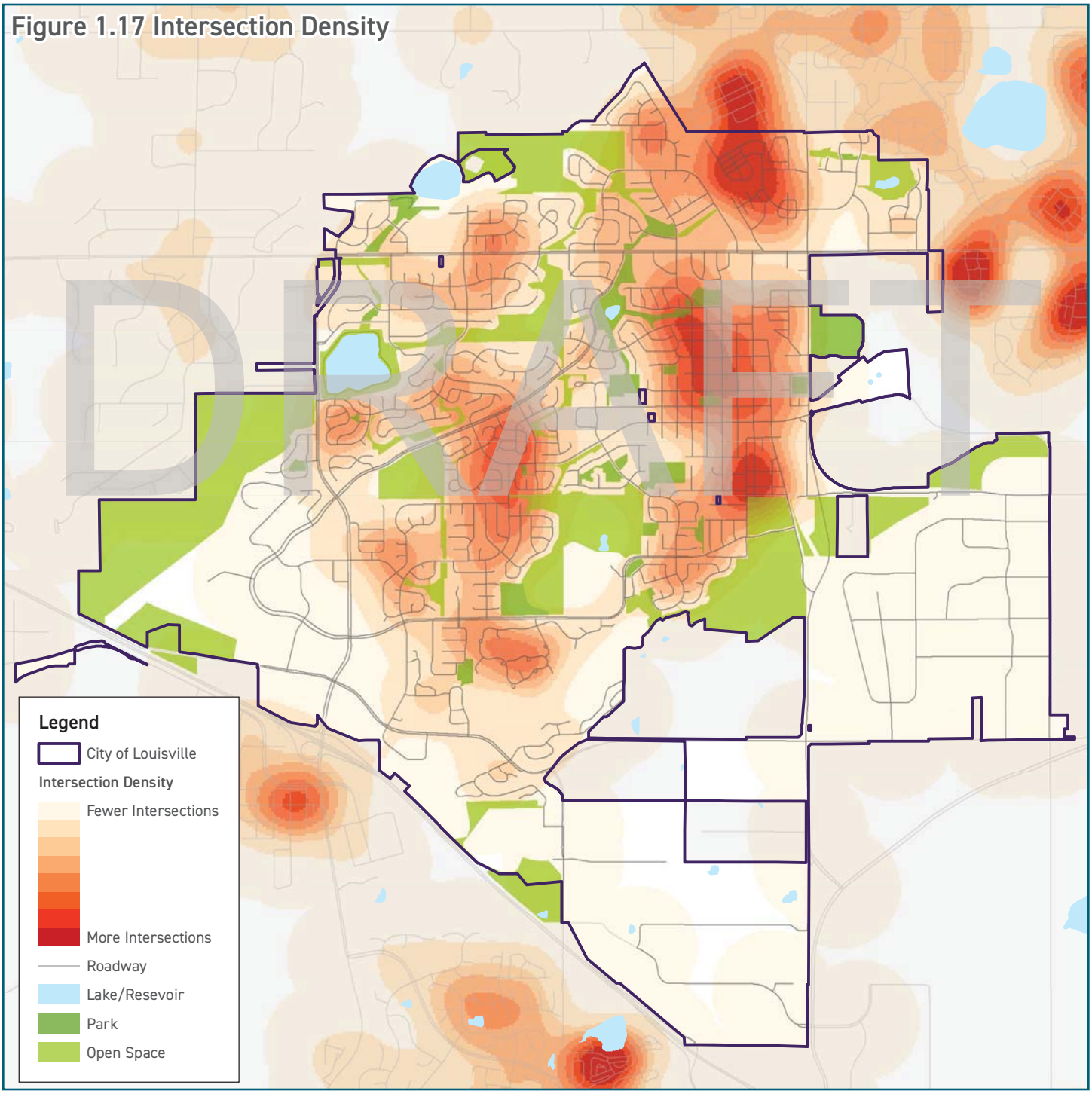

Figure 1.17 Intersection Density

CORRIDOR TRAVEL

As vehicle travel is the primary means of transportation in Louisville, analysis of traffic volumes and delay along key corridors was conducted. These analyses help to identify issues impacting operation of the corridors and locations that may be most impactful to focus on for potential improvements.

Growth and changes in travel patterns impact the use of different corridors over time. However, as Louisville has only a few major corridors, it will be difficult to shift travel patterns to lesser-traveled corridors that could help handle additional future capacity if needed. Ensuring that the corridors can operate efficiently and move people to, from, and within the city will be important as growth continues within the region. Intersection improvements and using technology to improve operation of corridors are key strategies that can make meaningful impacts without significant costs or adding capacity to corridors.

The following analyses of traffic volumes, existing level of service, and observed delay will provide a basis for identifying future improvements for Louisville to ensure access and mobility is at an acceptable level.

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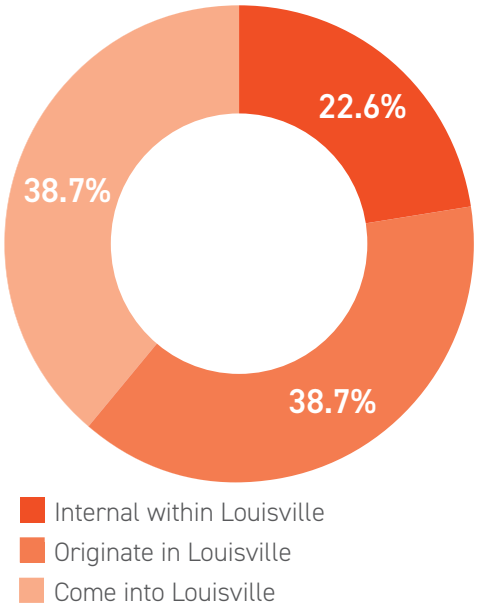
Trips on Louisville Roadways:

Currently, only 22.6% of transportation trips stay within Louisville. A majority of trips either begin in Louisville with a destination outside of the city (38.8%) or enter into Louisville from another point of origin (38.7%). These trips are most likely using the major corridors, placing regional travel pressures on the Louisville roadway network.

Figure 1.24 Trips Made in Louisville

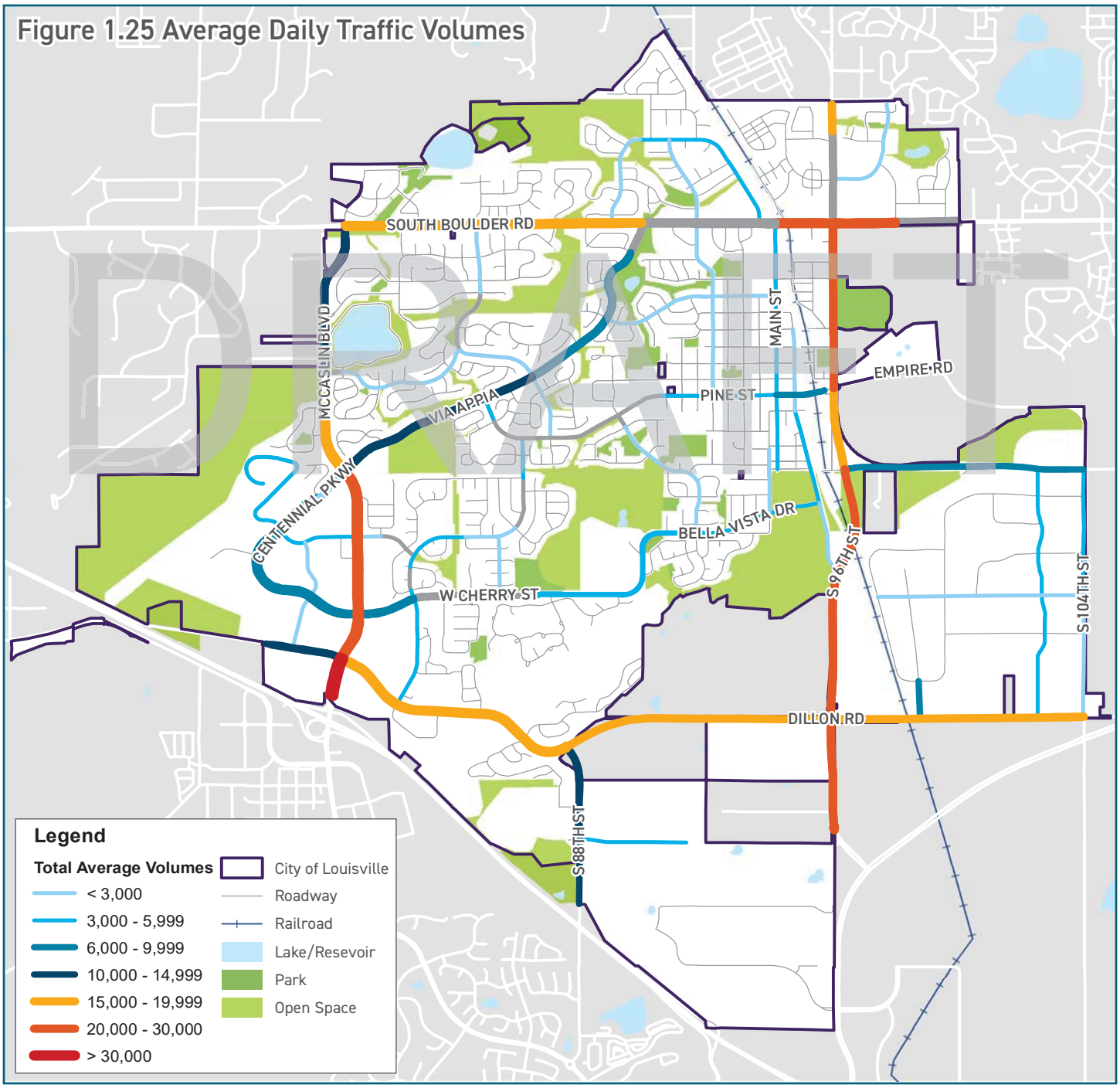


Source: 2015 Trips from DRCOG TDM

Hwy 42 traffic during the evening

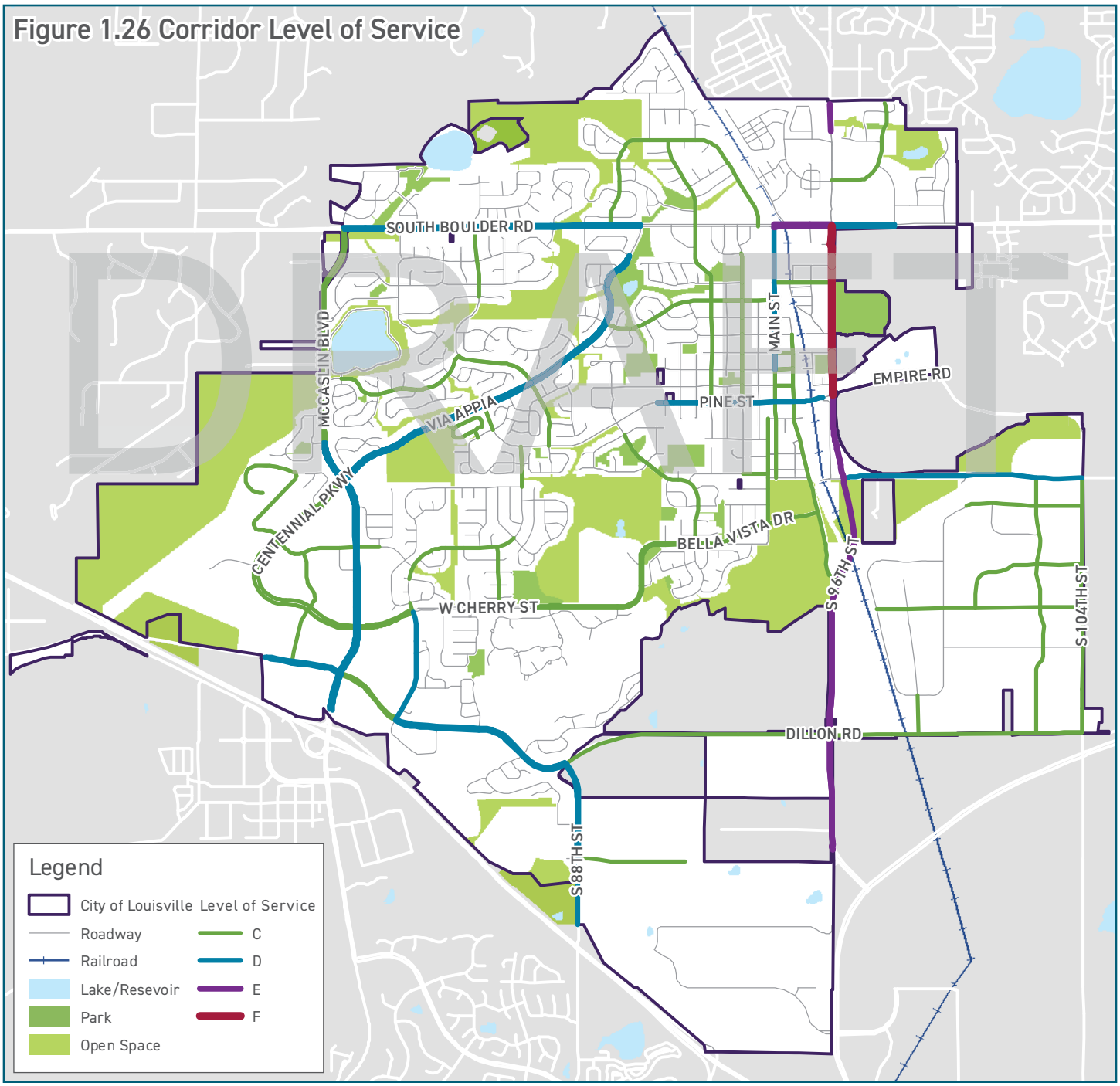
Corridor Traffic Volumes

Figures 1.25 and 1.26 highlight the demand placed on major corridors and collector streets in Louisville, and how those corridors perform in accommodating the traffic volumes (Level of Service or LOS). Overall, there are four key corridors that incur the greatest amount of travel within the city: McCaslin Boulevard, South Boulder Road, Dillon Road, and Hwy 42/S 96th Street. These are the two primary east-west corridors and two primary north-south corridors that provide access to activity centers in Louisville and surrounding jurisdictions. Traffic volumes shown on the map are the average daily volumes for both travel directions combined. Traffic volumes are not uniform in both directions all day, however. South Boulder Road in particular experiences greater traffic volumes traveling west in the morning and east in the evening peak periods as it is a key travel corridor for accessing Boulder.



Corridor Level of Service

Corridor Level of Service (LOS) is a classification system which uses the letters A, B, C, D, E, and F to convey vehicle capacity, and describe how well traffic flows in the transportation network. The LOS analysis used factors pertinent to each corridor including the number of travel lanes, corridor speed limits and observed speeds, traffic volumes, and the surrounding context of the street. The methodology estimates flow on the corridors, however, further study of turning movements and signal timing may give a more accurate operations of individual intersections. LOS A represents free flowing traffic, while LOS F considerable congestion that significantly increases travel time. Most of Louisville is estimated to operate at a LOS of C or D, with some delays during peak travel times. South Boulder Road west of Highway 42 to Main Street operates at a LOS E, South 96th Street is a LOS E, and Highway 42 near DELO is estimated to be LOS F, with significant travel time delay in the peak periods. LOS C or D is reasonable for an urban/suburban area. A low LOS can indicate that a road is overbuilt for the demand.



What is a Travel Time Run?

Travel time runs are where a particular route is driven along a corridor with GPS technology that collects speed and travel distance data for each second. This provides consistent data that is able to be analyzed based on how long it takes to go specific distances along the route.

Conducting travel time runs is a useful way to identify how long it takes to travel along a corridor and the level of travel delay that is experienced compared to the base travel time. The empirical data and observations are able to highlight key intersections where travel delay is occurring, how significant the delay is, and how long it lasts. Travel time runs also help to identify where key improvements may be best utilized to help alleviate excessive travel delay.

Peak Period Delay

Travel time runs were conducted to understand how the roadway network is impacted during peak hours. All data were collected on the same day, a Monday while Boulder Valley Schools were in session. The corridors chosen were among those believed to see the most rush hour impacts and are McCaslin Boulevard from US36 to South Boulder Road, South Boulder Road from McCaslin Boulevard to SH 42, and SH 42/S 9th Street from South Boulder Road to Northwest Parkway. A total of three runs were conducted in each direction for a Midday (1PM to 2PM) baseline, while five runs were conducted in each direction during the AM Peak (7AM to 9AM) and PM Peak (4PM to 6PM). Data was collected in a series of clockwise and counterclockwise loops that included all three segments measured.

Figures 1.30 and 1.31 show a relatively similar travel time for the midday time-frame, but demonstrate the variation experienced due to turning vehicles and traffic signal delays. Both the AM Peak (Figures 1.28 and 1.29) and PM Peak (Figures 1.32 and 1.33) confirm that delay and maximum travel times are experienced during these periods.

While more traffic was clearly observed on McCaslin Boulevard in peak hours, the delays experienced were minimal, under 60 seconds for both directions in both peaks. On South Boulder Road, delays were also minimal, with the exception of eastbound PM. Those runs had a median delay of 1 min 7 sec, and were observed to be most impacted between Main Street and SH 42. By far the greatest delays measured were on SH 42/S 96th Street. There was a modest delay in the AM peak for northbound travel. PM peak travel was delayed for both directions with a median delay of 1 min 29 sec for northbound, and 3 min 27 sec delay for southbound runs. Figure 1.27 identifies the observed delays.

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Figure 1.27 Travel Time Delay by Corridor

Corridor	Direction	AM*	Midday*	PM*	AM Delay	PM Delay
McCaslin Blvd	NB	04:24	04:02	04:26	22 sec	24 sec
McCaslin Blvd	SB	04:15	03:41	04:00	34 sec	19 sec
South Boulder Rd	EB	03:17	04:08	05:15	none	1 min 7 sec
South Boulder Rd	WB	03:54	03:39	03:49	15 sec	10 sec
SH 42	NB	05:29	04:46	06:15	43 sec	1 min 29 sec
SH 42	SB	04:24	04:52	08:19	none	3 min 27 sec

** This is the median travel time for all travel runs for the given time period.*

Route 1 consisted of a clockwise route beginning at Hwy 36 and McCaslin Boulevard, traveling north to South Boulder Road, proceeding east to SH 42, then traveling south and continuing on South 96th Street to Northwest Parkway.

Route 2 consisted of a counter-clockwise route beginning at Northwest Parkway and South 96th Street, continuing on SH 42 to South Boulder Road, proceeding west to McCaslin Boulevard, then traveling south to Hwy 36.

Figure 1.28 AM Peak Route 1

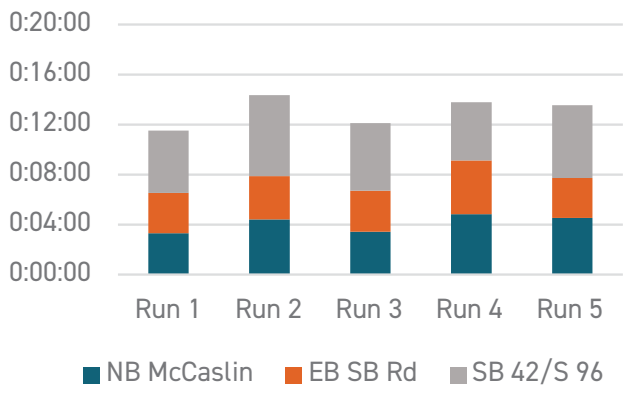


Figure 1.29 AM Peak Route 2

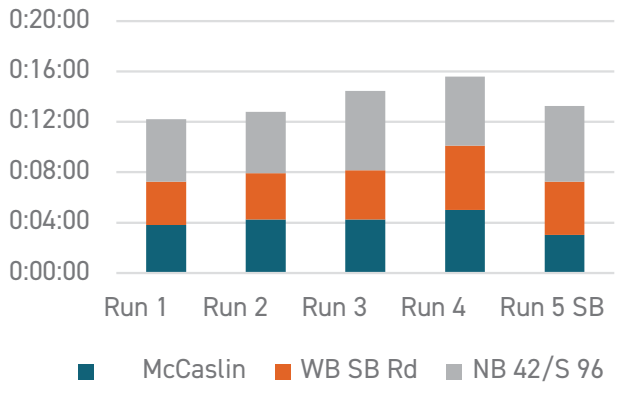


Figure 1.30 Midday Route 1

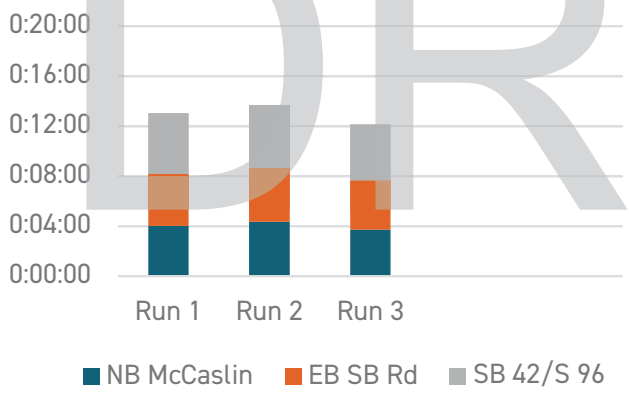


Figure 1.31 Midday Route 2

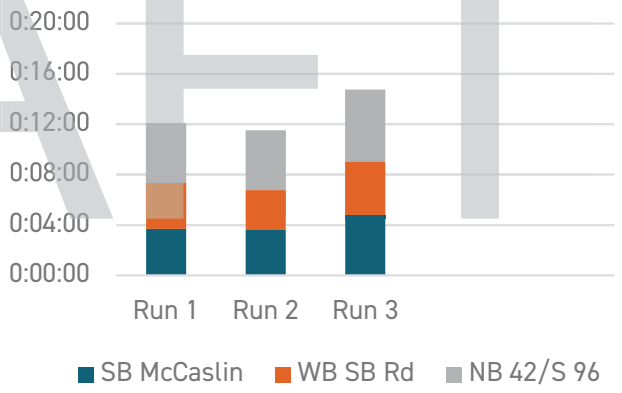


Figure 1.32 PM Peak Route 1

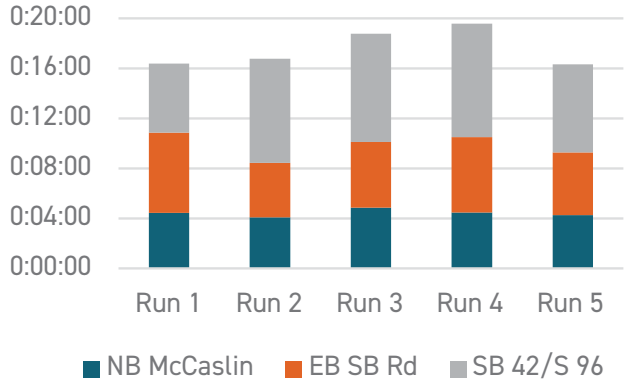
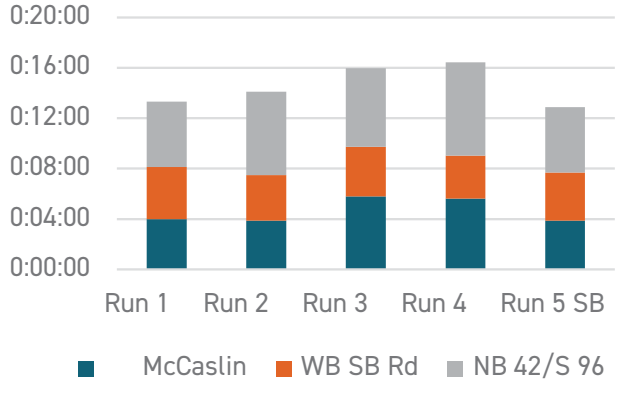


Figure 1.33 PM Peak Route 2



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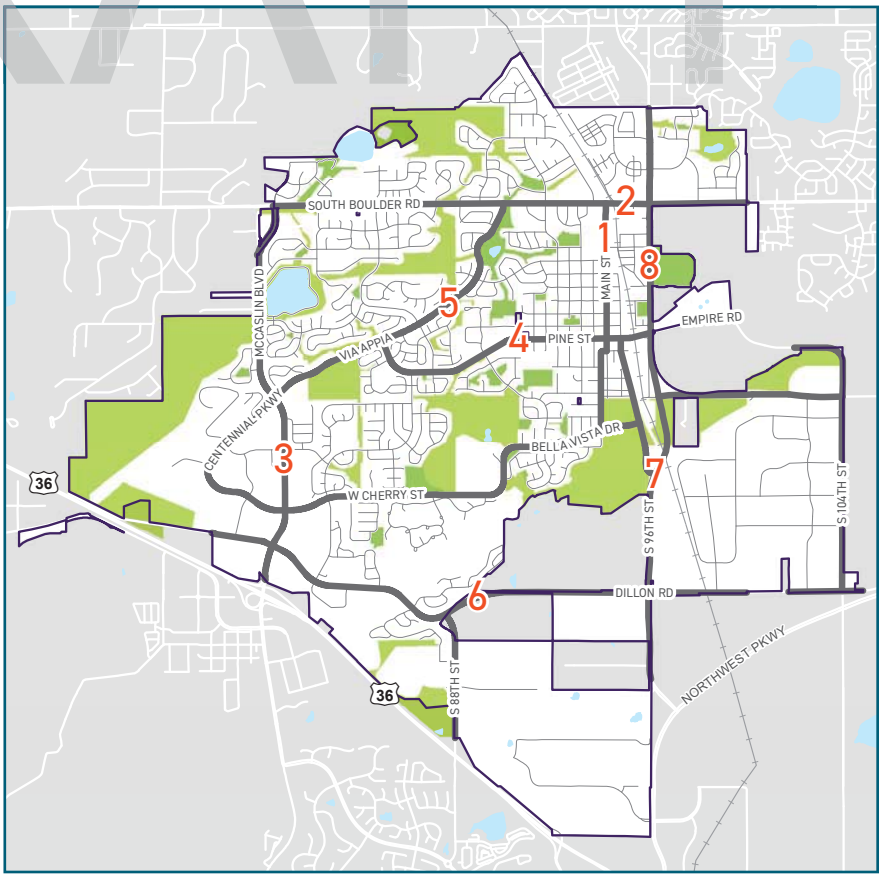
KEY FINDINGS ON MAJOR CORRIDORS

Based on the traffic volumes, speed data, LOS analysis, and travel time runs, several key findings regarding the major corridors in Louisville were developed and are identified below.

1. Main Street is signed as a 25 mph roadway, and while there is some speeding near Louisville Middle School, most cars travel well under the speed limit within Downtown. To the South, on County Road, speeding has been observed.
2. South Boulder Road experiences peaks during typical commute hours, with considerable eastbound delays in the PM, especially between Main Street and SH 42. In the AM approximately 60% of cars are traveling westbound, towards Boulder, while the split is reversed in the PM. Speeding is most problematic for eastbound vehicles traveling down the hill east of Washington Ave.
3. McCaslin Boulevard is the busiest corridor in Louisville with 15,000 vehicles per day on the north end by South Boulder Road, and upwards of 35,000 by US 36 on the south end. Travel time delays were observed in the peaks, but were not significant. Speeding is most prevalent for southbound vehicles as they approach US 36.
4. Pine Street has considerably more vehicular traffic than parallel east-west corridors into Downtown.
5. Via Appia Way has approximately 10,000 vehicles a day and with two lanes is capable of moving the current traffic volumes. Speeding cars have been documented throughout the corridor, but are most common near Tyler Ave.
6. Dillon Road has nearly 20,000 vehicles per day along the corridor and operates at an acceptable LOS. Most vehicles near McCaslin travel under the speed limit, likely due to the number of driveways. Volumes near South 88th Street peak more than anywhere else in the city because of the high school travel patterns. Mobility is somewhat constricted on the east portion of the roadway, as it narrows to two lanes.
7. The speed limit on South 96th Street is 40 mph, however most cars travel well over that. Vehicles tend to slow down north of Empire, as they continue on SH 42.
8. SH 42 is signed for 45 mph, however the number of vehicles and turning movements often limit travel speeds to less than the posted speed limit. With only two lanes, turning vehicles often cause delays, and with over 20,000 vehicles, the highway operates at LOS F according to the Highway Capacity Manual. Travel times along S 96th and SH 42 between South Boulder Road and Northwest Parkway were measured. Both AM and PM peaks were considerably delayed. Southbound PM travel times were nearly double that of the midday base, with nearly all of the delay observed near DELO.



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SAFETY

Safety is a major concern within the City of Louisville, and is an important factor for transportation planning and infrastructure investments. Traffic crashes have a significant impact on the health and mobility of a community. Intersections in particular are key areas where there are a significant number of conflicts between people and vehicles. Whether an intersection or corridor has a documented record of crashes, or there is a perception of safety problems by the community, the desire to use the corridor diminishes and mobility, particularly for those who are not driving, can decrease.

Safety in relation to schools is also a key factor in mobility and health. Safe Routes to School programs aim to make it safer for students to walk and bike to school and encourage more walking and biking where safety is not a barrier. Most schools within Louisville have trails and sidewalks to connect schools to the surrounding neighborhoods and provide safe options for children. Louisville Middle School is located in an area with a significant amount of travel for multiple purposes and exhibits a higher amount of crashes in the surrounding area than most schools. Monarch K-8 and High Schools, while accessible with trails and sidewalks, are located along corridors with higher travel speeds and volumes posing potential risks.

Within Louisville, the hierarchical road network funnels traffic onto a select number of corridors designed to carry a large volume of vehicles relatively quickly. Crashes are prevalent along faster, busier roads and intersections. Figure 1.34 shows the most recent thee years of available crash data for all modes to highlight areas of higher safety concern.

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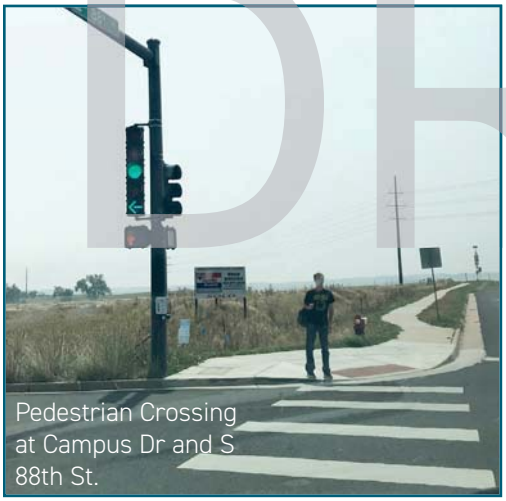

Pedestrian Crossing at Campus Dr and S 88th St.

Wide intersection and crossings with blind spots along Via Appia Way at Pine St

Traffic calming neck-downs by Fireside Elementary

Medians with pedestrian refuges along Pine St

Crash Hotspots

The map below shows the concentration of crashes over a span of three years. The areas around the intersection of McCaslin Boulevard and Dillon Road, the intersection of South Boulder Road and Highway 42, and the intersection of Front Street and Main Street stand out for their especially high concentration of crashes. Notably, the crash hotspots correspond with the three urban centers identified in the Comprehensive Plan, which were classified as such due in part to their high traffic volumes and associated retail potential. The intersection of McCaslin Boulevard and Marshall Road in Superior also experiences a high volume of crashes. Although beyond the Louisville city limits, this intersection plays a key role in how residents and visitors enter Louisville and access key destinations such as the US 36 and McCaslin Station.

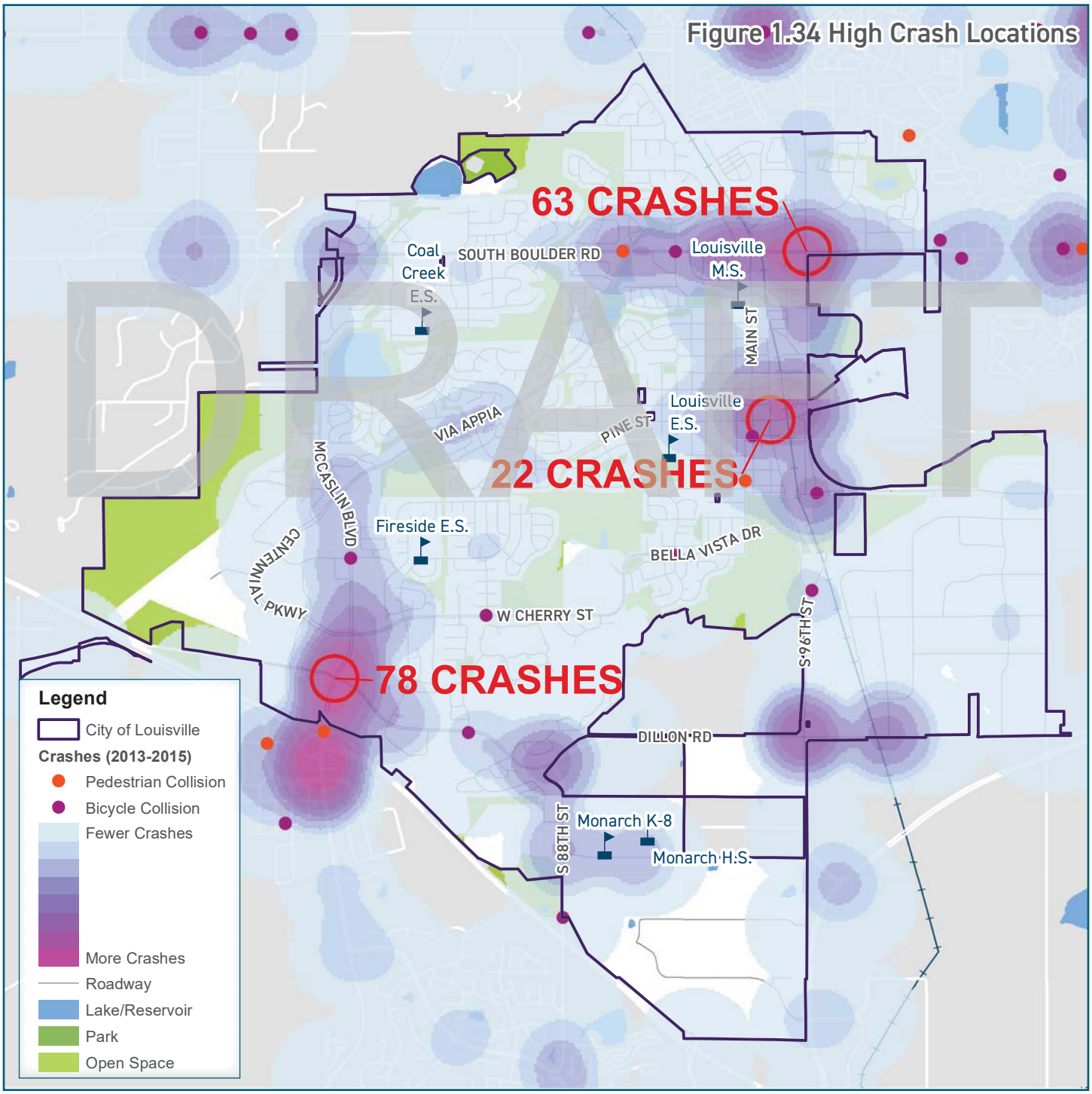

Figure 1.34 High Crash Locations

THE MULTIMODAL NETWORK

The needs of all citizens, employees, and visitors are essential to consider to improve the Louisville transportation network. A sustainable and equitable system must serve all people, regardless of age, physical ability or income. A complete transportation network will also afford people the option to make trips using a variety of modes, whether it is driving, walking, bicycling or riding transit.

To better understand the transportation options available, the network it has been broken down by mode of travel. A glance at each individual network shows the key corridors, busiest areas, reveals gaps in the network, and begins to identify areas of opportunity. A strong understanding of each modal network is important before assessing the performance of transportation in Louisville as a whole. While considering all modes, there will be areas where different modes of transportation are competing for resources, such as space within the right-of-way or priority at intersections and other crossings. This is where tradeoffs will have to be considered, and some give and take will be needed to best accomplish the goals of the TMP.

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Benefits to multimodal transportation options extend beyond increased access and vehicle emission reduction. Community health is benefited in multiple ways by a high-quality and accessible multimodal network. From reduced risks of asthma, heart disease, obesity, and more, studies consistently show that active transportation options are a key component of healthy communities.

The Center for Disease Control and Prevention (CDC) recommends promoting physical activity by implementing a combination of transportation and land use strategies that include street design and connectivity, walking and biking infrastructure, mixed land uses, transit access, increased density, parks and recreational areas, and more.

Pedestrian walking along McCaslin Boulevard. There are three vehicle lanes and one 5-foot bike lane along this section.

WALKABILITY

The walkability of an area is heavily influence by the quality of the pedestrian environment. To ensure sidewalks are accessible for all, they should be a minimum of five-feet in width and six-feet along arterials. Other considerations, such as buffering the sidewalk from the edge of the street, lighting to enhance visibility, seating, trash cans, and the presence of shade trees and other landscaping can improve safety and make walking for comfortable for all users. Scale, setback, and orientation of buildings in relation to pedestrian was can also impact the pedestrian experience. Overall, much of Louisville is walkable, however facility conditions vary and direct access to destinations can be difficult in some locations where roadways are wider and traffic is moving faster. Consistent, high-comfort facilities help make walking a safe possibility for people of all ages and abilities.

While many of the roadways within Louisville are lined with sidewalks on both sides, there are areas with substandard corridors and segments. Much of the older sidewalks are narrow and many of them have no buffer between the sidewalk and the street. Curb ramps are generally consistent at intersections, which improves the overall accessibility for people walking or using mobility devices such as wheel chairs. Walking directly to destinations in some parts of Louisville, such as around McCaslin Boulevard requires crossing wide roadways and large parking lots to reach destinations. However, areas like Downtown Louisville have narrower streets and pedestrian-friendly buildings with parking on the street or in adjacent small lots. Many intersections and crossings in Louisville have signage and striping aimed to increase the visibility of pedestrians.

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Raised crosswalk at Dillon and McCaslin

Pedestrian crossing sign at the Main and Spruce intersection

New curb ramp along Centennial Pkwy

Pedestrian crossing South Boulder Road at Main Street

One measure of an area's walkability is the Walk Score, an online tool that measures walkability of an area. The methodology analyzes many walking routes between a variety of locations, while also weighing destinations, population, and roadway factors. The City of Louisville as a whole has a score of 38 out of 100, which carries the description of "car dependent," meaning most errands require a car. However, there are wide variations throughout the city.

The heart of Downtown Louisville has a score of 82 and is considered "very walkable" and that most errands can be accomplished on foot, while the McCaslin Station area has a score of 47 and is considered "car dependent." The area around Polk Avenue and Pine Street in the center of Louisville has a score of 20, primarily because there are few destinations within a walkable distance beyond parks and schools. Access to destinations is a primary driver of walkability and areas with a variety of land uses are naturally considered more walkable due to the variety of activities available within a short distance. Figure 1.18 highlights this factor for multiple locations within Louisville.

Pedestrians crossing Spruce along Front St.

Crossing along Washington

Curb ramp near Downtown

New curb ramps at Short and Front Streets.

Curb ramp and sidewalk near downtown

Pedestrians crossing Main St. at Spruce St.

DRAFT

Walksheds

The map below shows the area within a five-, ten-, and fifteen-minute walk of key nodes in each of the urban centers identified in the Comprehensive Plan. The walk sheds indicate the zones where people are most likely to reach the central destination by foot, especially in the presence of mixed-use development patterns and a strong pedestrian realm. Many of Louisville's neighborhoods are well beyond walking distance of these urban centers, and will likely travel to and from these destinations via other modes.

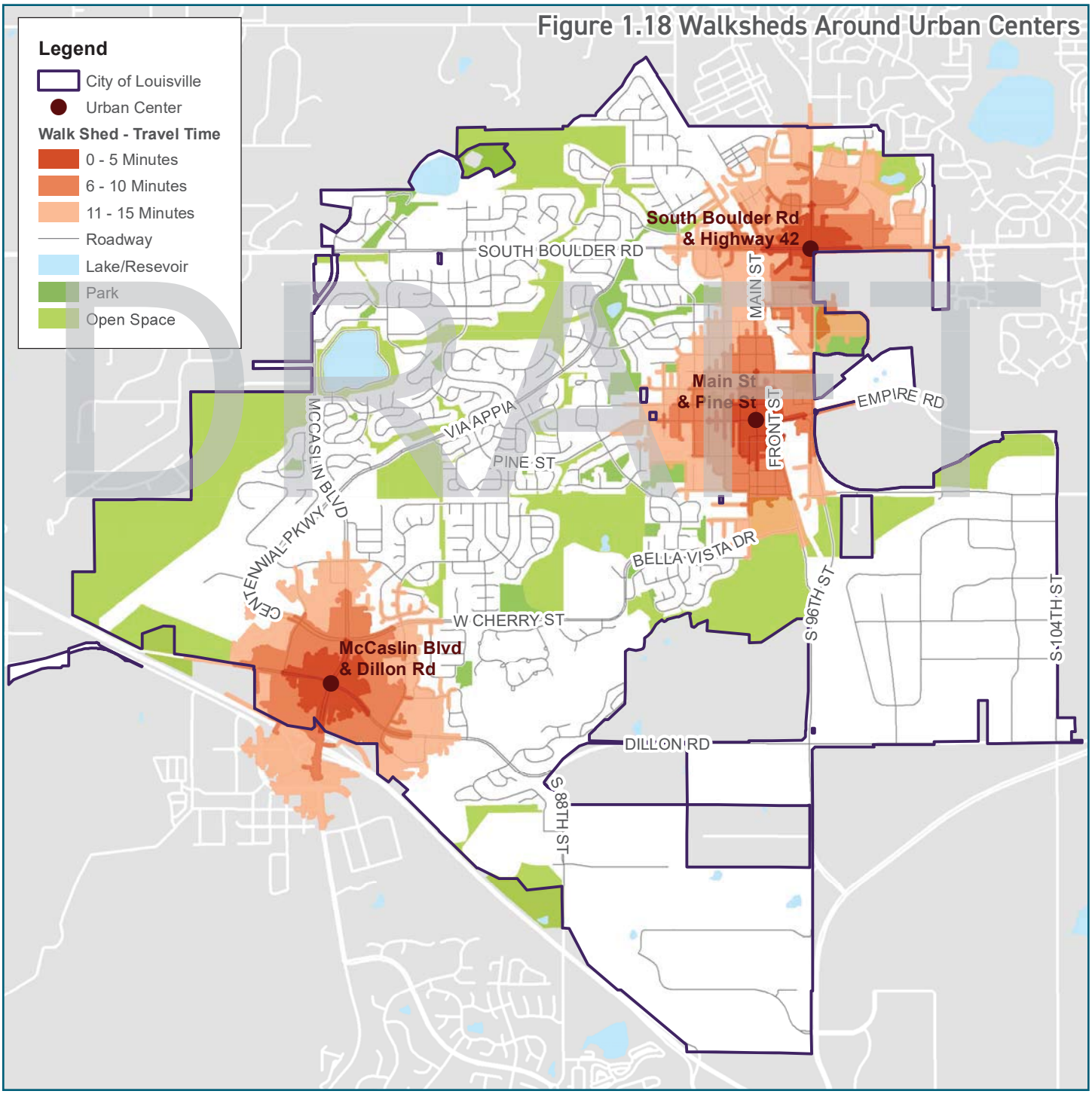


Figure 1.18 Walksheds Around Urban Centers

BIKING

For Louisville to have a bicycle network with broader appeal and a diverse set of users, it not only needs to reach all parts of the city, but also needs to feel safe for riders of all abilities. A bikeway that feels safe for an experienced rider may not feel comfortable to a child riding to school, or a family riding together. Expanding the bicycle network with safe facilities will not only reach more destinations, but also serve more people.

A comprehensive look at the bicycle network requires looking at each segment and the type of bicycle facility in place, such as bike routes, bike lanes, or shared paths. Each type of facility provides different protections for the cyclists, whether it is paint delineating space for bikes, a physical separation like a curb or bollard, or a path that completely separates the cyclist from vehicular traffic.

The type of facility, however is not the only factor that determines how comfortable a bikeway is. For example, while South Boulder Road has a dedicated on-street bike lane, it runs along a very busy roadway with vehicles traveling at high speeds. This environment feels threatening for many potential riders. On the other hand, a signed neighborhood bike route with nothing more than occasional wayfinding signs and pavement marking may appeal to larger share of potential riders if it has very few vehicles and they are traveling at slow speeds. To best assess existing and potential bikeways an understanding of both facility type and context is needed. A look a these factors results in a bikeway Level Of Comfort (LOC), with LOC 1 being most comfortable and LOC 4 the least. This scoring system indicates the likely appeal of a facility to a broad set of riders.

LOC 1 – Typically a bike route on a calm neighborhood street, a wide bike lane with low vehicle volumes, or a wide path without too many roadway crossings.

LOC 2 – Similar to an LOC 1 facility, but with more or faster moving vehicles for on-street facilities, or more frequent crossings for a trail.

LOC 3 – An on street facility with less dedicated bike space, often on a roadway with more lanes, vehicles, and higher travel speeds, or a narrow off-street facility with many crossings.

LOC 4 – On-street facility with considerable parallel traffic and crossings, or an off-street path with many challenging crossings.

What is a network for "all ages and abilities?"

NACTO (National Association of City Transportation Officials) has developed best practice design guidelines for developing a bicycle network that is aimed at being safe, comfortable, and an equitable mode. Bikeways are encouraged to be designed with potential users in the surrounding community in mind, including children, seniors, women, low-income riders, people with disabilities, and more.

Best practices are utilized to provide options for bicycling within a community that encourages and facilitates active transportation options.

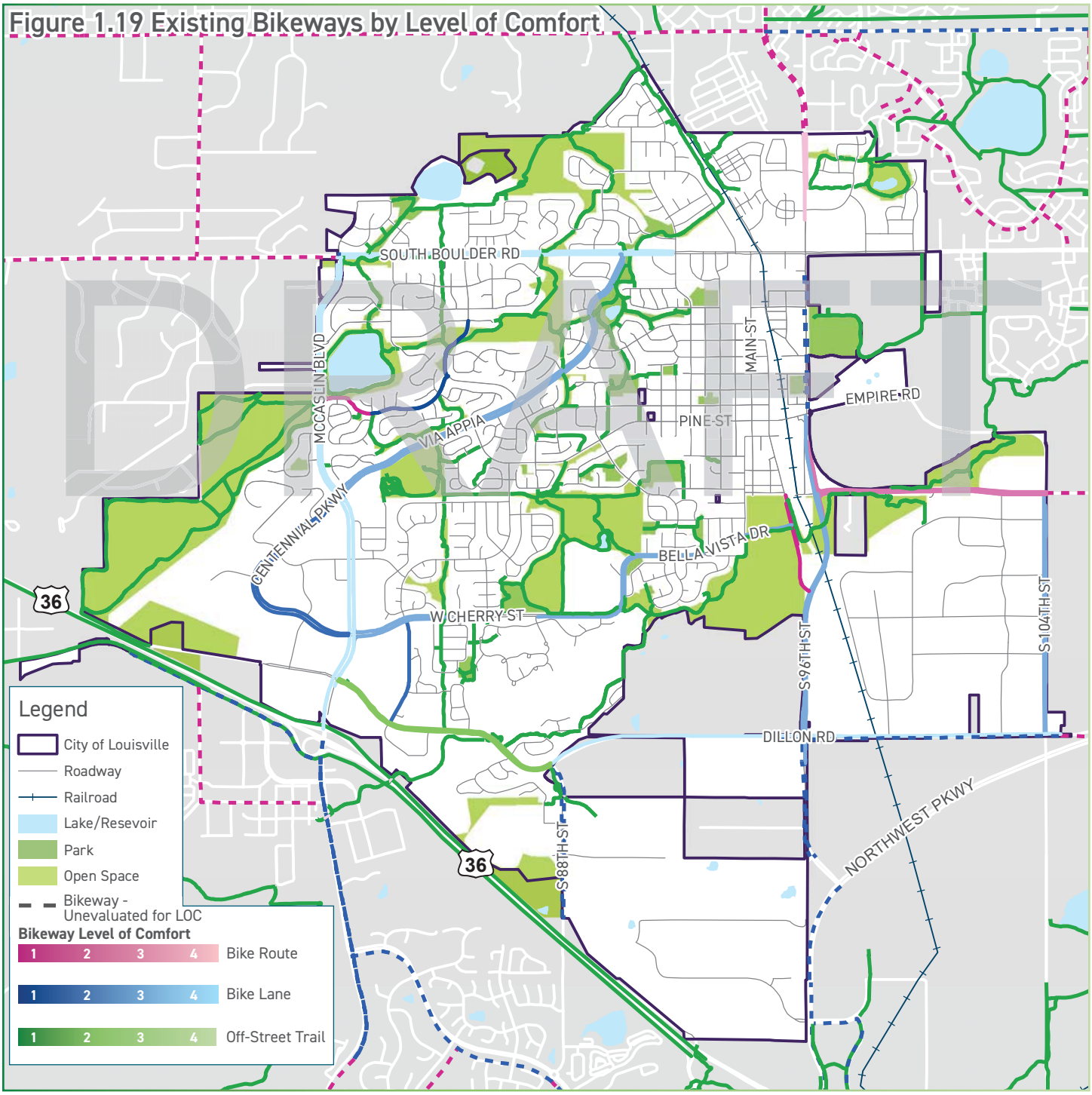
DRAFT

Coyote Run Trail at Via Appia Way

Existing Bike Network

Figure 1.19 shows the existing bike network with Level of Comfort shown for the multiple bikeway types. Louisville has a strong trail system that connects many parts of the city and on-street bikeways along many major corridors. However, bike connectivity is missing or is low comfort in many of the City's activity centers, such as Downtown Louisville, the CTC, along South Boulder Road, and the McCaslin Station area. Bicycling to or within these areas may be perceived as difficult or less safe for people who are uncomfortable riding on the street or around vehicles traveling at higher speeds. Many of the on-street bike lanes are low comfort. Additionally, there are few recognized, high-comfort bike routes within the City. Bicycle route designation along low-speed and low-volume corridors can help people of all ages and abilities access destinations in a way that feels safe and comfortable.

Figure 1.19 Existing Bikeways by Level of Comfort



The images presented here highlight the various bicycle facilities within Louisville.

US 36 bike trail with access to McCaslin Station

Bicyclist riding along Main Street

Powerline Trail

Bicyclist riding in the bike lane along W Cherry St

Bike lane along Washington St

DRAFT

Lake to Lake Trail along Davidson Mesa

Shared roadway signage along Bella Vista Dr

Bikes parked at Fireside Elementary along the Powerline Trail

Bikeway on shoulder along Dillon Rd

New bike lane with parking to the right side along Centennial Pkwy

Biking Access Shed

Figure 1.20 shows the areas within a five-, ten-, and fifteen-minute bike ride of key nodes in each of the urban centers identified in the Comprehensive Plan. Although very few neighborhoods are within walking distance of these nodes, the vast majority of Louisville (along with parts of neighboring jurisdictions) is within a short bike ride of at least one urban center. These short travel times indicate that biking is a convenient way for people living and working in Louisville to access local destinations—and that people are likely to make trips by bike if safe, comfortable, and attractive facilities connect to the places they wish to go.

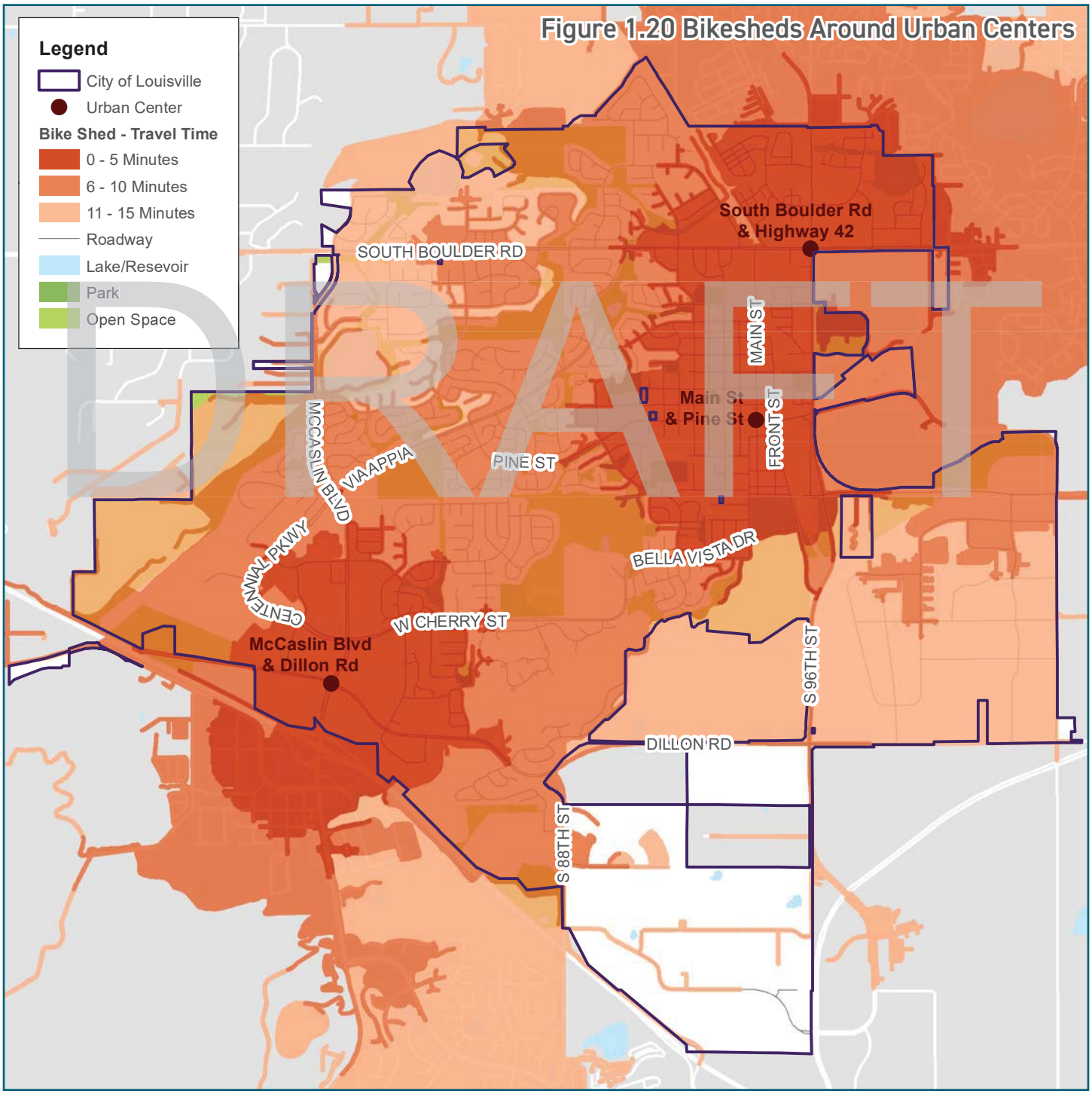


Figure 1.20 Bikesheds Around Urban Centers

TRANSIT

Louisville is inside the service area of the Denver Regional Transportation District (RTD), which runs a variety of rail, bus, and paratransit service in Denver, Boulder, and nearby cities. Transit in Louisville takes two predominant forms: Bus Rapid Transit (BRT) and fixed-route local bus service.

Bus Rapid Transit

The **Flatiron Flyer** operates along US 36 between downtown Boulder and downtown Denver. The route's frequent service and fast travel times make it a convenient option for traveling along the US 36 corridor. Buses arrive at the McCaslin station every 5-15 minutes, depending on the time of day. Buses may travel on the shoulder of the highway (exclusive to buses), allowing the buses to maintain high speeds and avoid traffic congestion. The Flatiron Flyer reaches downtown Boulder in approximately 20 minutes and Denver's Union Station in about 30 minutes.

Local Bus Routes

Two local bus routes operate through Louisville: the **228 Broomfield/ Louisville** route and the **DASH Boulder/Lafayette via Louisville** route. Route 228 runs from its northern terminus at South Boulder Road and Garfield Street along Via Appia Way and McCaslin Boulevard before continuing southeast through Superior and Broomfield. The DASH runs along South Boulder Road for approximately seven miles between Boulder and Lafayette, but deviates from the roadway to circulate through Louisville along Via Appia Way, Pine Street, and Main Street.

The local bus routes in Louisville arrive much less frequently than the BRT. The DASH arrives every 15 minutes at peak commuting times and every 30 minutes throughout the day, while the 228 arrives every 30 minutes at peak times and hourly throughout the day.

Planned Transit Projects

Transit is a need that has been recognized within Boulder County in multiple previous planning efforts. Most specifically, the Northwest Area Mobility Study (NAMS) identified several needs and priorities for future transit service that could provide additional or enhanced service to Louisville. These priorities and potential projects include:

Northwest Rail Line from Denver to Boulder to Longmont with a station near Downtown Louisville

US 287 BRT from Longmont to Broomfield

South Boulder Road transit improvements from Lafayette to Boulder

Arapahoe Rd/Hwy7 transit improvements from I-25 to Boulder

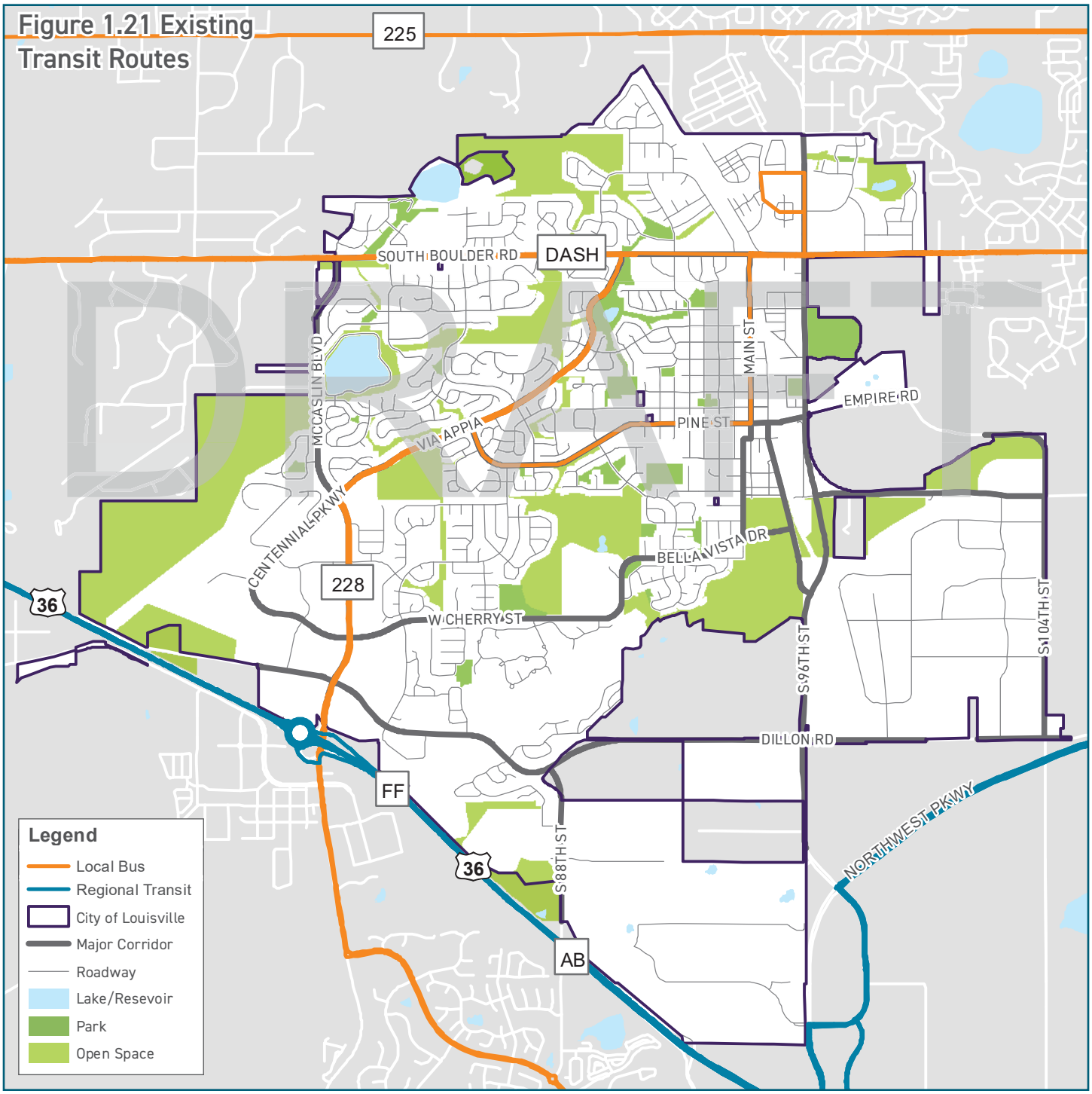
Hwy 42 new service from Broomfield to Arapahoe

DRAFT

McCaslin Station shelter with amenities

Transit Service

Transit service is an important component of a multimodal network, particularly for certain populations including people with no automobiles, low-income households, children, elderly, and disabled residents. Most people who ride the Flatiron Flyer from the McCaslin Station drive to the station, with some accessing the station by bike. However, those who ride the local 228 and DASH routes typically walk or bike to the bus stop. The bus routes cover some of the major corridors within Louisville and connect some of the activity centers. Transit service is missing, however from the CTC and the area south of Dillon Road that connects to the hospital and schools. Additionally, an hourly or better bus route, AB, connects Denver International Airport to Louisville's McCaslin Station.



FlexRide & VIA

Additional services are available to supplement the traditional, fixed route service in Louisville. FlexRide service is a call and ride service that allows riders to reserve a trip online or by mobile device. The service has an advance reservation time of approximately 10 minutes, and costs the same as a local fare. It helps serve areas with less direct fixed service, and connect them to the rest of the network

Via is a non-profit organization that provides a range of transportation services for older adults, people with disabilities, and other mobility limitations. Via helps improve the quality of life for users, by providing responsive and direct transportation services.

Stop Amenities

McCaslin Station has multiple amenities including shelters, bike parking, next bus arrival information, and a pedestrian bridge over US 36 that connects to the eastbound stop in Superior with similar amenities. However, the local bus routes throughout Louisville are typically marked with a bus stop sign and no other amenities, such as shelters or benches, and sometimes do not meet ADA requirements. With the lower frequency of the local routes, waiting for the bus can become uncomfortable. The images below show the conditions of bus stops within the study area.

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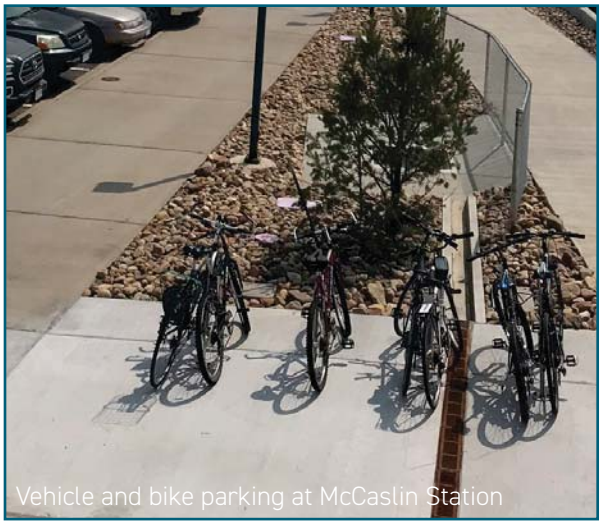
Bus stop along Main St north of Short St

Bus stop with no pad or shelter on McCaslin Blvd north of Dillon Rd


Vehicle and bike parking at McCaslin Station

Bus stop on Main St at Spruce St in Downtown

Transit Use

The RTD's Flatiron Flyer—a Bus Rapid Transit (BRT) service that connects Denver, Boulder, and other cities along the US 36 corridor—is by far the most utilized transit service in Louisville. The US 36 and McCaslin station experiences more than 1,600 boardings and alightings on a typical weekday—69% more transit activity than occurs at all other bus stops in Louisville combined. Apart from the BRT station, transit boardings and alightings concentrate in downtown and near the intersection of Via Appia Way and South Boulder Road. Overall, the local bus routes have low ridership numbers, but provide important connections to regional destinations. In Downtown, there are approximately 58 boardings and alightings per day at Main Street and Pine Street. Boardings on South Boulder Road near Via Appia Way have just over 50 boardings and alightings per day.

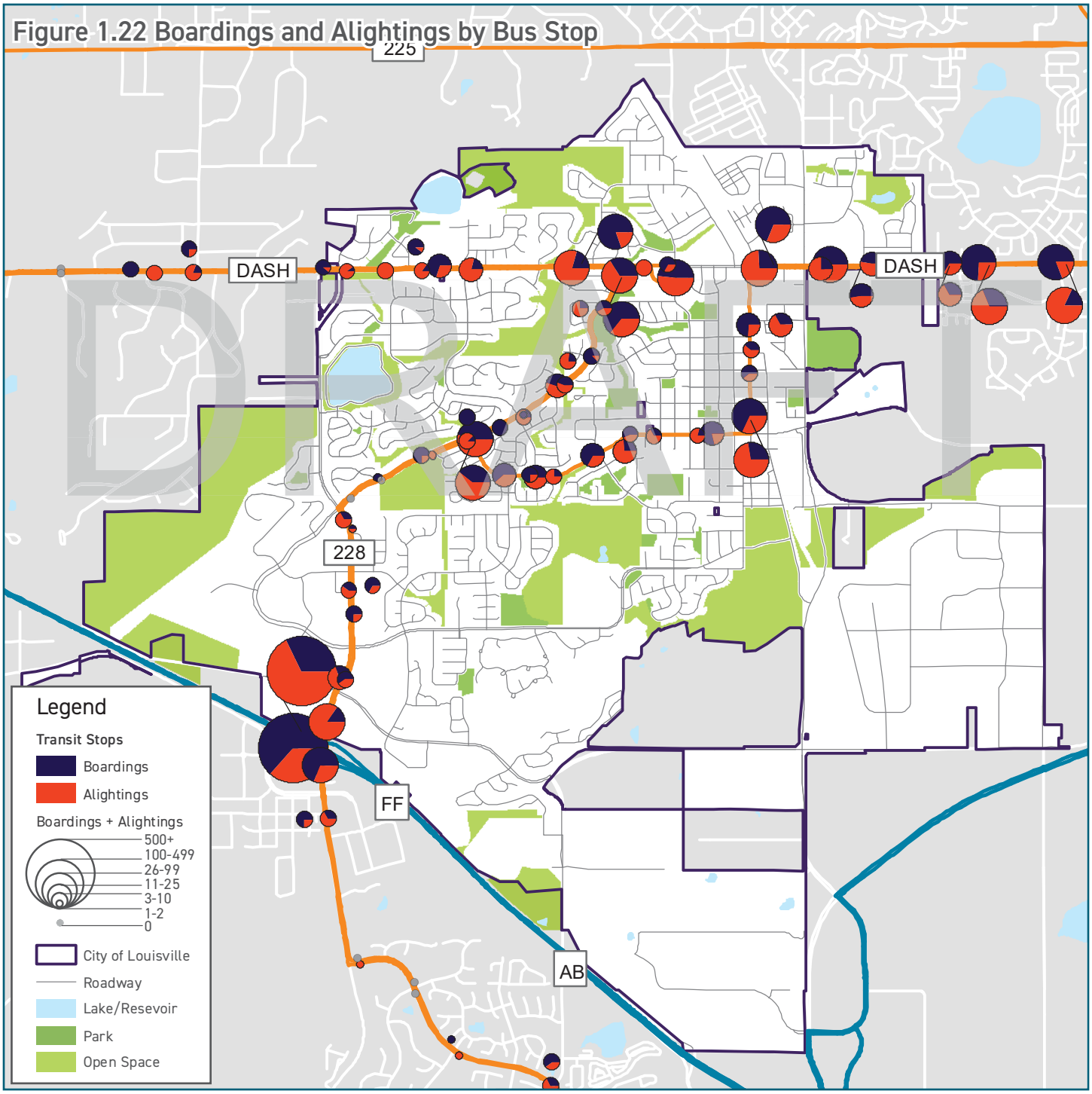


Figure 1.22 Boardings and Alightings by Bus Stop

Access to Transit

Figure 1.23 depicts the areas within a five- and ten-minute walk of RTD bus stops in and around Louisville. It can be seen that much of the residential areas in Louisville are able to access a bus stop within a ten-minute walk. One of the City's largest employment areas, the CTC, however is wholly inaccessible to transit as is the hospital and schools around South 88th Street. Connections to transit from these areas could be of significant benefit to students, those with medical needs, and employees. In addition to walking, First and Last Mile access to transit can be accomplished through bicycling, ride share apps, and FlexRide.

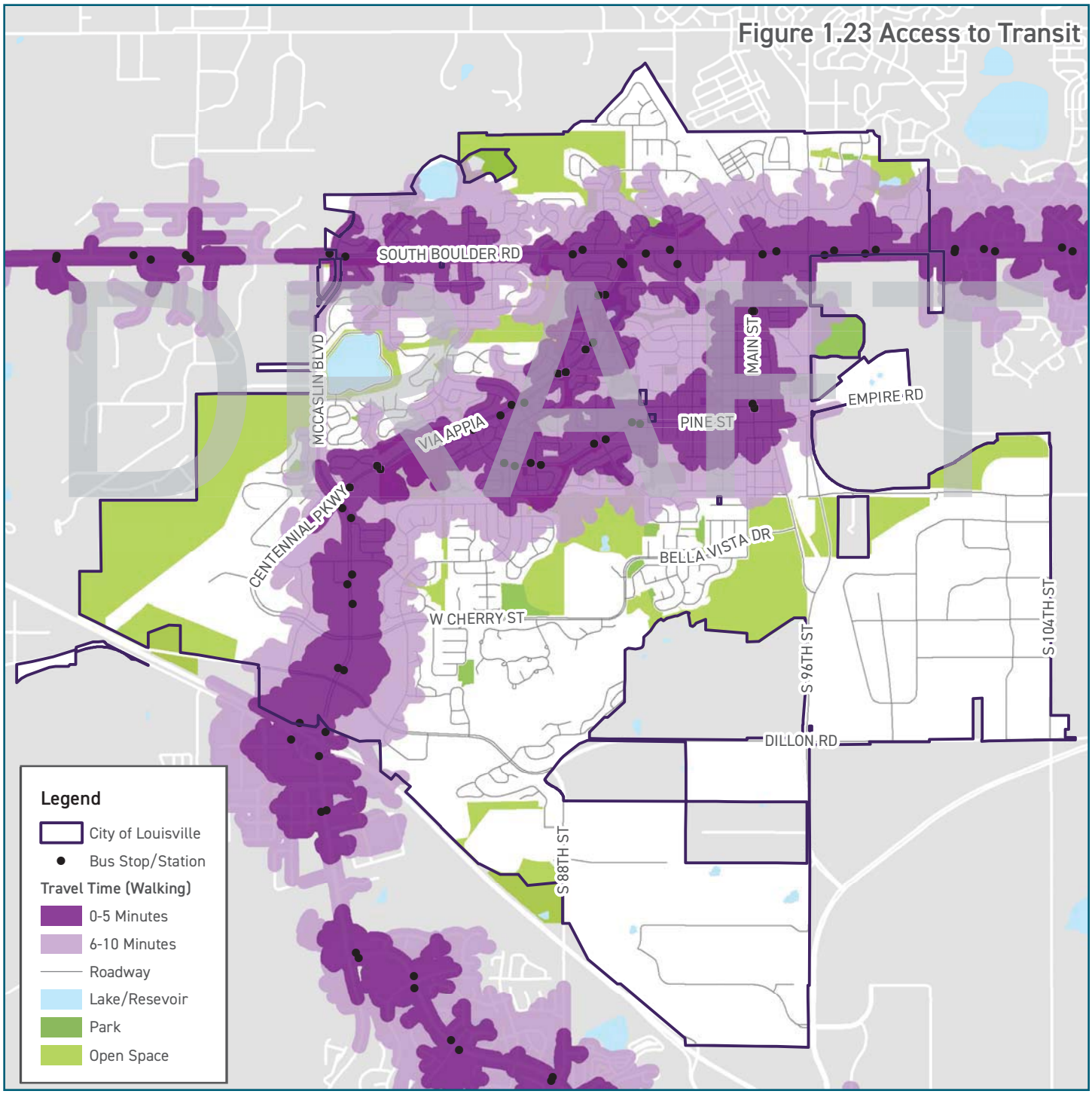


Figure 1.23 Access to Transit

City of Louisville
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Town of Superior

Library Update

LOUISVILLE PUBLIC LIBRARY: 2018 STATISTICS	Total	Total	Superior Total	Superior % of total
CIRCULATION	**2017**	**2018**	**2018**	**2018**
Total Checkouts & Renewals	464,558	446,849	88,795	19.90%
FLC Holds Received	44,189	47,851		
Prospector Holds Received	6,214	6,071		
Prospector Loaned	5,987	5,378		
Hours Open	3,014	2,928		
Average Transactions Per Hour	154	153		
PATRONS				
Registered Patrons	28,125	28,429	5,200	18.30%
New Registrations	3,184	3,103	584	18.82%
Visitors	230,884	222,089		
ELECTRONIC RESOURCES				
Database Searches	45,786	22,497		
E-book Downloads	34,540	42,562		
Library Website Page Views	223,743	236,910		
Library Unique Web Page Views	177,349	185,775		
PC / WiFi USAGE				
PC: Number of User Sessions	29,118	24,728		
PC: Number of Hours	16,227	15,309		
WiFi: Number of Distinct Clients	21,175	18,331		
WiFi: Daily Avg. Clients	123	98		
PROGRAM ATTENDANCE				
Number of Adult Programs	137	152		
Attendance	1,541	1,631		
Number of Teen Programs	191	230		
Attendance	1,289	1,800		
Number of Children's Programs	635	638		
Attendance	18,912	19,496		

Louisville/Superior 2019 Programs

Harry Potter Star Stories
Thursday June 27, 2-3 p.m.
Louisville Library
Many of the Harry Potter characters are named after stars, constellations and other celestial objects. Learn the origin of your favorite characters' names, and some fun tidbits about the objects they represent. Parks & Open Space & Louisville Library are teaming up to highlight the stars and their stories! Designed for families with children ages 6-16, but anyone is welcome. Registration required at _____.

Nature Detectives in the Field: Moon Mysteries
Tuesday July 9, 2-3 p.m.
Louisville Library
Celebrate the upcoming 50th anniversary of the first human moon landing by increasing your knowledge of our favorite night light! Take part in hands-on demonstrations of moon phases and discover other fascinating moon facts. Registration required. Designed for families with children ages 6-16, but anyone is welcome. Registration required at _____.

iNaturalist for Teens
Wednesday June 12, 10 a.m.-Noon
Location provided to registrants
Youth ages 10-18 and interested parents will take a short hike on the **Coal Creek Trail** to practice increasing observational skills, and learn how to use the iNaturalist app to capture what you see. Discover how to be part of the Boulder County Wildlife project on iNaturalist and help record wildlife sightings. Prizes awarded on June 18 at 10:30 a.m. at the Louisville Library. Registration required at _____. More details provided to registrants.

Nature Detectives in the Field: Moon Mysteries Night Walk
Tuesday July 16, 8:30-10:30 p.m.
Coalton Trailhead, Superior
Celebrate the upcoming 50th anniversary of the first human moon landing by increasing your knowledge of our favorite night light! Enjoy a moonlit walk while discovering fascinating facts about the moon. Registration required. Designed for families with children ages 6-16, but anyone is welcome. Registration required at _____.

Harry Potter Star Stories After Dark
Friday August 16, 8-10 p.m.
Superior Community Park
Many of the Harry Potter characters are named after stars, constellations and other celestial objects. Learn the origin of your favorite characters' names, and some fun tidbits about the objects they represent. Take fandom to the next level and search for them on a hike under the light of the moon! Designed for families with children ages 6-16, but anyone is welcome. Registration required at _____.

iNaturalist for Teens
Tuesday September 24 (time)
Superior Location (not finalized)
Youth ages 10-18 and interested parents will take a short hike to increase observational skills, and learn how to use the iNaturalist app to capture what you see. Discover how to be part of the Boulder County Wildlife project on iNaturalist and help record wildlife sightings. Prizes awarded on October 1 , (time) at (location). Registration required at _____. More details provided to registrants.

City of Louisville
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Town of Superior

Broadband Study Update

SEPTEMBER 2018

City of Louisville, Colorado

Broadband Feasibility Study Report

Prepared By:

Vantage Point Solutions

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1. Executive Summary

Vantage Point Solutions (VPS) was awarded a competitively bid contract to conduct a Broadband Assessment and Feasibility Study for the City of Louisville, Colorado. The main purpose of the Study was to determine what (if any) are the broadband problems facing residents, businesses and the City government in Louisville.

To conduct the feasibility assessment, VPS gathered data and information by:

- Engaging with City staff
- Meeting with incumbent providers of Century Link and Comcast
- Holding stakeholder outreach meetings with citizens
- Meeting with neighboring jurisdictions
- Conducting a residential and business survey
- Analyzing Information provided by the City and
- Researching information obtained through publicly available sources

When discussing broadband, it is important to understand the definition. The Federal Communications Commission (FCC) currently defines broadband as speeds that reach a minimum of 25mbps downstream and 3mbps upstream (25/3). Other FCC programs for high cost rural areas through the Connect America Fund, only require minimum speed of 10mbps downstream and 1mbps upstream (10/1). Practically speaking, even the current FCC definition of broadband is far behind what most customers perceive to be adequate for residential use. However, for purposes of this report – high-speed broadband is internet speeds that meet or exceed the federal definition of broadband.

This report provides a comprehensive analysis on the findings of the feasibility study including presenting three Fiber-to-the-Premise (FTTP) network models, two middle-mile network models and other broadband best practice options for the City to consider. There are multiple key findings to highlight:

- Unlike many Colorado communities in rural areas, the City of Louisville is currently served by multiple providers with 100% penetration. This means that every resident in Louisville has the ability to access high-speed broadband. Not every resident may be purchasing high-speed broadband, but the services are available to those who choose to purchase them. The result of the surveys and the stakeholder outreach confirms this conclusion.

- Louisville homes and businesses have multiple choices for internet or bundled service providers that offer a variety of pricing options. However, there is only one provider (Comcast), that offers gigabit service.

- According to the business survey results, the business community is relatively satisfied with their current broadband service. However, when asked, many respondents could not say what speeds they were currently getting or what it cost them for service.

- According to the residential survey results, cellular telephone service is relatively good in Louisville. However, there are some areas such as Fireside, South Louisville and Coal Creek where cell service is less reliable. Unfortunately, improving service in these gap areas is solely dependent on the cellular carriers making a decision to take action. While it is a good idea for the City to reach out to the cellular carriers to bring the gaps to the attention of the carriers and to proactively facilitate discussions, it is up to the carriers to resolve the problem.

- City residents believe the City has a role in improving broadband but there are mixed feelings as to what should be done. For example, while 38% of respondents believe that the City should use public funds to finance and build a municipal network, an equal number of respondents either think the private sector is meeting the need for broadband or they are not sure what the City should do. The remaining 24% believe that the City should step in if current providers are not able to improve service.

Based on all the information and data obtained through the data collection efforts, the network models developed and analyzed, VPS makes three recommendations to the City of Louisville.

- VPS does not recommend that Louisville move forward with any of the FTTP network options. The results of the Study show that the City does not have a residential or business high-speed broadband access problem. In addition, with multiple providers already in Louisville, the take rates for a new City network would be lower and the risk and cost of building a network would be too great.

- VPS does recommend that Louisville consider building a middle-mile network with a Wi-Fi component that serves the public in the Historic Downtown area and key parks throughout the City. The current middle-mile network in the City has a low strand count and is not a redundant ring – meaning that if something happens on a portion of the network, the entire network is at risk for loss. Building a middle-mile network with a ring would create the redundancy needed to protect the network. The Feasibility Study results showed that there is a need to improve and enhance the City's current middle-mile network that serves City facilities.

    - As a part of the Study, VPS and City staff met with Boulder County and the City of Boulder, the City of Longmont, the City of Lafayette, and the Town of Superior. Each jurisdiction expressed an interest in exploring ways to partner on the deployment of a middle-mile network that could either share resources and reduce costs through economies of scale and/or result in a regional middle-mile network that could interconnect multiple municipalities.

- VPS also recommends that Louisville consider implementing broadband best practices as needed that are discussed in Section 9. The goal with these best practices is to ensure that the City has the proper processes in place to comply with new FCC rulings, federal legislation and is able to create internal and external efficiencies for permitting and other activity that occurs in and around the City Right-Of-Way (ROW) with respect to public and private broadband deployment.

2. Glossary

Below are key terms found in this Report. An expanded discussion the various technology types is found in Appendix A.

Broadband: Defined per the FCC as internet speeds that reach a minimum of 25mbps downstream and 3mbps upstream (25/3).

Backbone: A high-fiber count fiber optic mainline that provides connectivity to the internet. Connections to buildings from the backbone are called lateral connections.

Conduit: A means by which something is transmitted. The conduit houses the fiber.

Dark Fiber: Refers to fiber optic cable that has been installed and is available to use but is not connected to any electronic devices and not transmitting any data. *Also referred to as excess capacity.*

Demand Aggregation: Strategy employed by network owners to determine the neighborhoods in the community that are most likely to purchase service in order to build there first.

Fiber-to-the-Premise (FTTP) or Fiber-to-the-Home (FTTH): A last-mile network that connects all buildings (residential, business and government) in a community.

Indefeasible Right of Use (IRU): Commonly used in the industry to provide long-term access to assets. Conduit and fiber deployed is leased through an agreement called an IRU.

Last-Mile Network: Network that provides services directly to homes and businesses in the community.

Middle-Mile Network: Typically defined as a network that serves community anchor institutions (i.e. Schools, libraries, government buildings, public safety agencies, hospitals, etc.) but does not directly serve homes and businesses.

Open-Access Network: A network where the infrastructure assets (conduit and fiber) are made available through leases to multiple non-network owners that meet the terms and conditions set.

Outside Plant (OSP): Commonly used to refer to the engineering and construction of fiber infrastructure assets.

Over the Top: Television provided over a data stream but utilizing the existing wiring to the household

Public-Private Partnerships (PPPs): A legal partnership created by two or more public and private partners that balances and apportions risk, benefit and control of a last-mile network.

3. Existing Infrastructure

One of the first tasks in conducting a broadband feasibility study is to undertake an evaluation of the current competitive landscape in the municipality. This includes looking at what existing infrastructure is present as well as researching what current providers are offering residents and businesses in terms of services and pricing. This section explores what private and public infrastructure can be found in Louisville. The main purpose of this task is to take inventory of assets and to see if any existing network components (fiber, copper, towers) could be available to be leveraged by the City in a network build to offset deployment costs.

3.1 Private Infrastructure

There are several types of private infrastructure in the City. The first type is fiber or network assets of the current residential broadband providers – Comcast and Century Link. Unfortunately, neither Comcast or Century Link will provide a map of their infrastructure under the grounds that it is confidential and proprietary. Both companies assert they have 100% coverage in Louisville, so we must assume there is substantial provider infrastructure in the City. This is more fully detailed in Section 4.

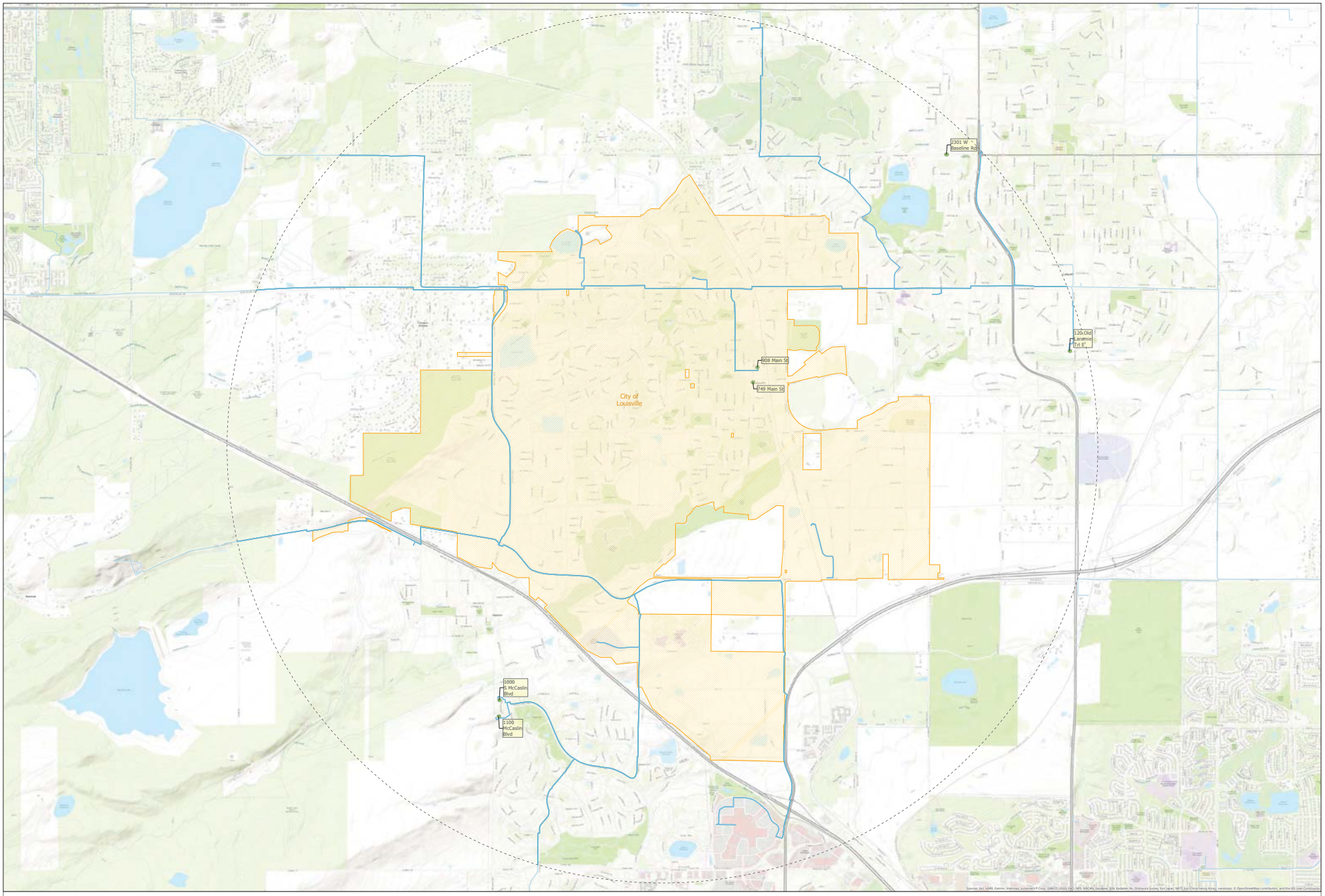
It is important to note that while there is significant provider infrastructure in Louisville, providers generally do not make their infrastructure available to be leveraged for a City-network build. Instead, the providers will only offer leased or lit services to a City. In other words, in order for the City to build a FTTP network, it would have to overbuild existing Comcast and Century Link infrastructure.

The second type of private infrastructure is network assets owned and deployed by wholesale or business enterprise providers. In Louisville, there is one carrier in this category by the name of Zayo. Unlike Comcast and Century Link, Zayo makes their infrastructure maps public on their website. In addition, the City currently leverages some Zayo fiber and has a contract in place with Zayo.

The last type of private infrastructure are cell towers. In a suburban community, the cell towers are secondary to underground fiber assets since most communities are looking to build a fiber network and not a wireless network. To determine what cell towers are in the City, VPS searched both the FCC and FAA databases while deleting duplicate towers. The FAA database is only for submitted tower applications, and the Google Earth imagery is a bit dated, so it is difficult to confirm if these towers were truly constructed or not without physically going to the locations.

Maps of private infrastructure found on the following pages include:

- Zayo Fiber Network maps for a 3-mile view
- Zayo Fiber Network maps for a 5-mile view
- Zayo Fiber Network maps for a 10-mile level view
- Private Cell Towers in the greater Louisville area



NOTE AREA-

Legend

- ZAYO ON-NET BUILDING
- ZAYO NORTH AMERICA NETWORK EXTERNAL
- ZAYO DARK FIBER - METRO BACKBONE
- ZAYO DARK FIBER - METRO LATERAL
- City Boundary
- 3 Mile Radius

0 0 0 0 6

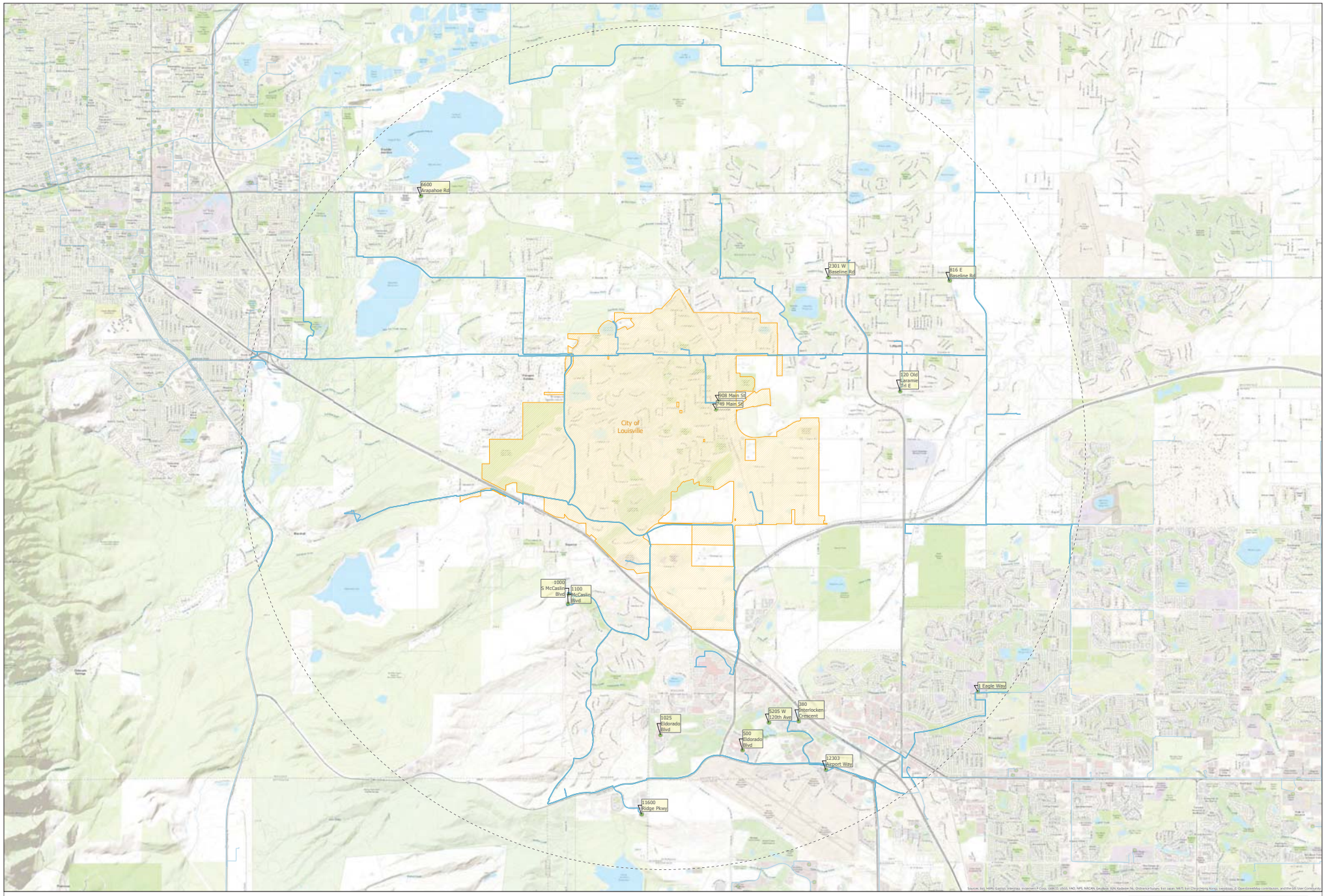
N

ZAYO Network Fiber within 3 Miles

City of Louisville

Revised: 6/20/2018	Scale 1:12,500

VANTAGEPNT.com 605-995-1777
2211 N Minnesota Street Mitchell SD 57301



NOTE AREA-

Legend

- ZAYO ON-NET BUILDING
- ZAYO NORTH AMERICA NETWORK EXTERNAL
- ZAYO DARK FIBER - METRO BACKBONE
- ZAYO DARK FIBER - METRO LATERAL
- City Boundary
- 5 Mile Radius

0 0 0 0 6

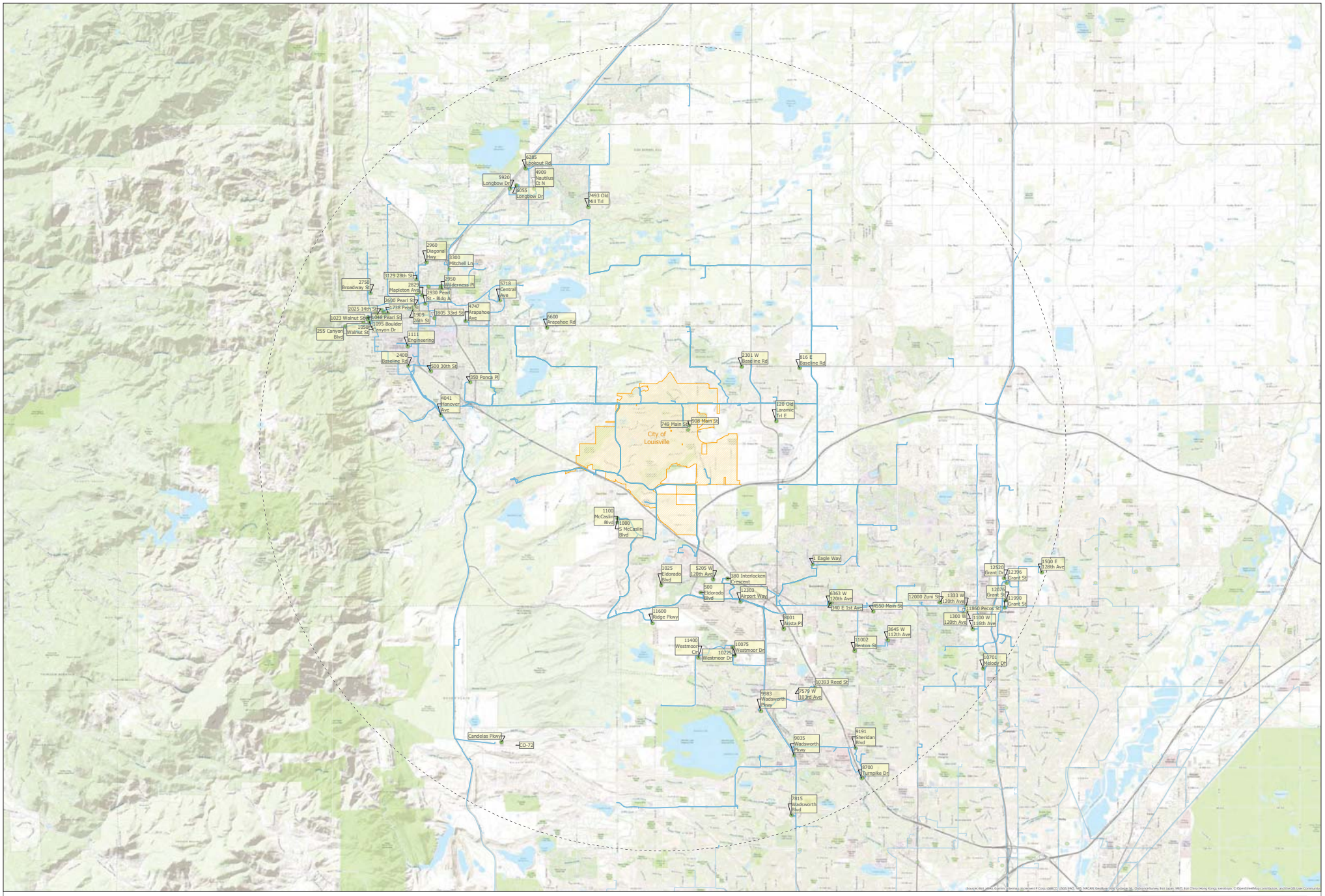
N

ZAYO Network Fiber within 5 Miles

City of Louisville

Revised: 6/20/2018	Scale 1:21,500

VANTAGEPNT.com 605-995-1777
2211 N Minnesota Street Mitchell SD 57301



NOTE AREA-

Legend

- ZAYO ON-NET BUILDING
- ZAYO NORTH AMERICA NETWORK EXTERNAL
- ZAYO DARK FIBER - METRO BACKBONE
- ZAYO DARK FIBER - METRO LATERAL
- City Boundary
- 10 Mile Radius

0 2 4 6 8 10

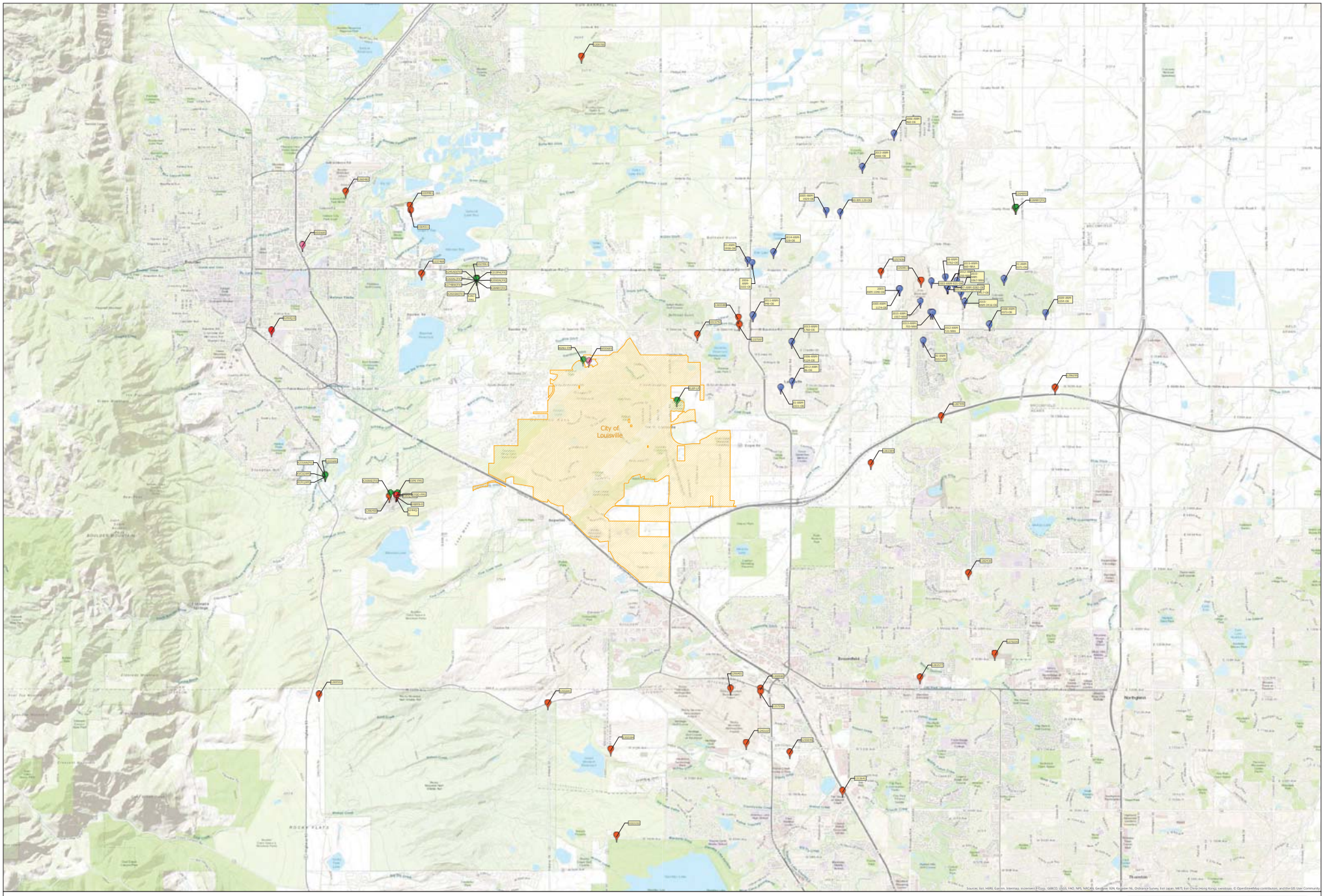
N

ZAYO Network Fiber within 10 Miles

City of Louisville

Revised: 6/20/2018	Scale 1:45,000

VANTAGEPNT.com 605-995-1777
2211 N Minnesota Street Mitchell SD 57301



NOTE AREA-

Legend

- FAA Tower
- FCC FM Tower
- FCC TV Tower
- FCC ASR Tower
- FCC Microwave Tower
- City Boundary

0 0 0 0 6

FCC & FAA Tower Sites

City of Louisville

Revised: 6/19/2018	Scale 1:30,000

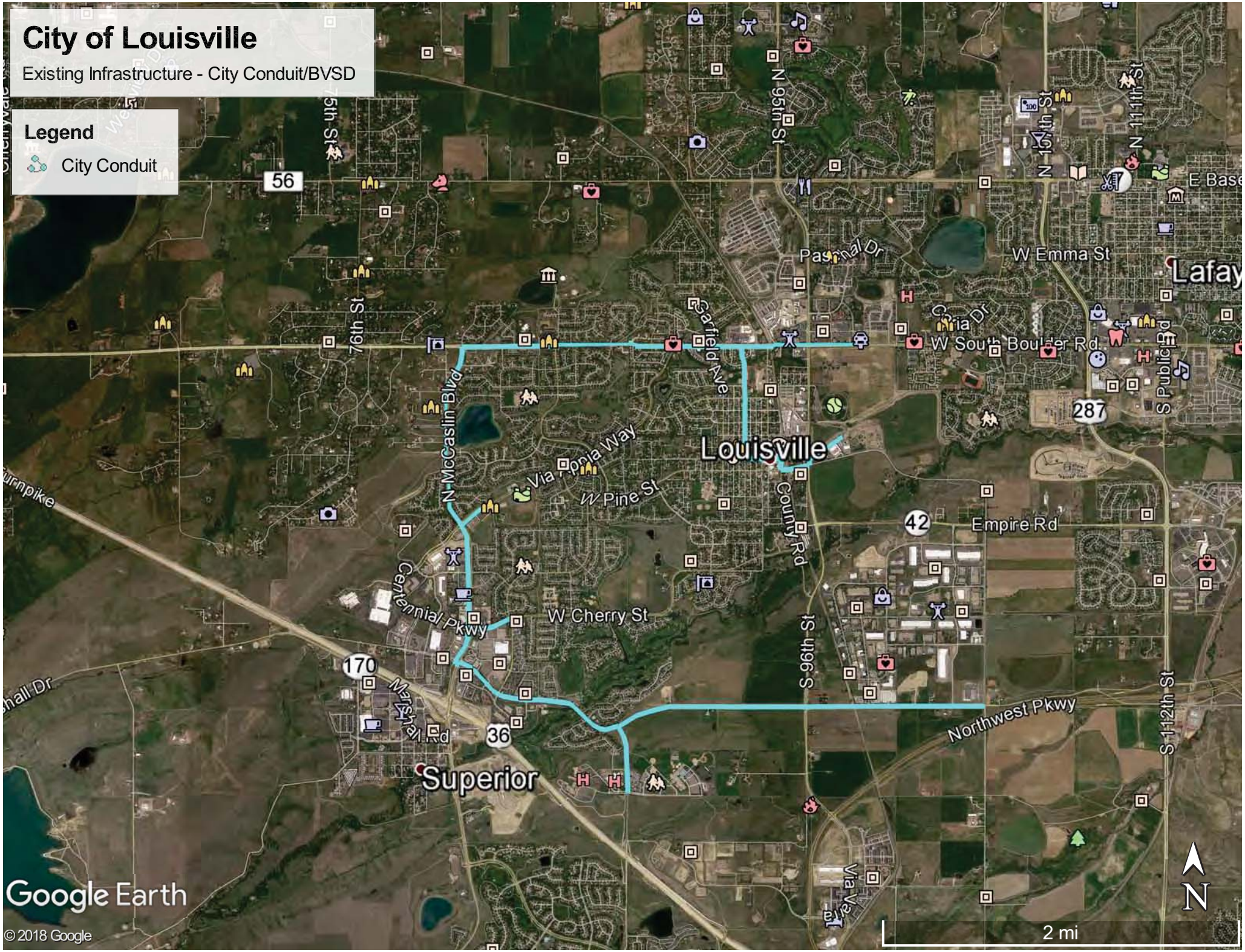
VANTAGEPNT.com 605-995-1777
2211 N Minnesota Street Mitchell SD 57301

3.2 Public Infrastructure

The City has a partial and limited middle-mile network in place. The current City network is not a redundant network. In other words, the network is not constructed in a ring architecture where there are two independent paths that protect against fiber cuts or other failures. The City also shares network components with the Boulder Valley School District in addition to Zayo. The current network also does not reach all city facilities.

City staff notes that in many places, there is low strand count fiber limiting how the network can be used. In addition, in some places, the City network is currently reliant on inferior multi-mode fiber and these sections would need to be replaced with single-mode fiber.

Currently, the City does not have a GIS map of the City network. The map on the following page is an overview of the current City middle-mile network.


City of Louisville
Existing Infrastructure - City Conduit/BVSD
Legend
City Conduit
56
76th St
N 95th St
N 111th St
E Base
W Emma St
Lafay
Pastoral Dr
Garfield Ave
Coria Dr
W South Boulder Rd
S Public Rd
287
Louisville
N McCaslin Blvd
Via Appia Way
W Pine St
County Rd
42
Empire Rd
Centennial Pkwy
W Cherry St
S 96th St
170
Marshall Rd
36
Superior
Northwest Pkwy
S 112th St
Via Vale
Google Earth
© 2018 Google
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4. Competitive Landscape in Louisville

VPS looked at the variety of service offerings, packages that are currently available through existing providers to Louisville residents and businesses. This Section will detail meetings with the service providers, provide some information on regional municipal network offerings, and analyze the results.

4.1 Competitive Provider Analysis Data

The data will be presented through tables showing:

- Competitive data
- Residential and business price lists by carrier
- Residential and business bundled services price lists by carrier

The following caveats apply to this data:

- Only competitors who have greater than 2% coverage have been included in this analysis.

- Providers often offer promotional pricing and alter pricing structures based on contract length and duration. The data included in this report is representative of having at least a 12-month contract with the provider. When possible, pricing included excludes any promotional pricing offers in order to accurately represent total cost to potential customers.

- Bundled services pricing has been included. There are many different options for bundled services. In an effort to provide clear and concise data, only standard bundled pricing options have been included.

4.1.1 Competitive Data Summary

This table serves as a summary overview of the number of providers in Louisville, type of technology, coverage area, and customer rating.

Residential				
Provider	**Type**	**Coverage %**	**Fastest Available Speed**	**Customer Rating***
CenturyLink	DSL and Fiber	91.4%+	100 Mbps	2
Rise Broadband	Fixed Wireless	100%	5 Mbps	2
DirectLink	Fixed Wireless	94.9%+	15 Mbps	-
XFINITY from Comcast	Cable	93.2%+	400 Mbps	2.5
HughesNet	Satellite	100%	25 Mbps	1.5
Viasat Internet	Satellite	100%	100 Mbps	2
Business				
CenturyLink Business	DSL and Fiber	100%	100 Mbps	2
Rise Broadband	Fixed Wireless	100%	5 Mbps	2
DirectLink	Fixed Wireless	100%	15 Mbps	-
MHO Networks	Fixed Wireless	100%	10 Mbps	-
Comcast Business	Cable	72.7%+	250 Mbps	2.5
Electric Lightwave	Copper	6.9%+	20 Mbps	3
Birch Communications	Copper	6.5%+	50 Mbps	2.5
NewCloud	Copper	2.0%+	10 Mbps	3.5

*On a scale of 1-5 with 5 being the highest rating attainable. Data obtained from Broadbandnow.com

4.1.2 Residential and Business Price Lists by Carrier

The next two tables detail the residential and business pricing for the services offered by each carrier.

Residential Pricing

Provider	Speed (Mbps)	Price/Month
CenturyLink	Up to 20 Mbps	$45.00
	Up to 40 Mbps	$55.00
	Up to 80 Mbps	$55.00
	Up to 100 Mbps	$65.00
Rise Broadband	Up to 5 Mbps	$42.95
DirectLink	Up to 6 Mbps	$49.90
	Up to 15 Mbps	$69.90
XFINITY from Comcast	Up to 15 Mbps	$29.99
	Up to 60 Mbps	$39.99
	Up to 150 Mbps	$54.99
	Up to 250 Mbps	$69.99
	Up to 400 Mbps	$84.99

HughesNet	Up to 25 Mbps / 10GB	$49.99
	Up to 25 Mbps / 20GB	$69.99
	Up to 25 Mbps / 30GB	$99.99
	Up to 25 Mbps / 50GB	$29.99
Viasat Internet	Up to 12 Mbps	$70.00
	Up to 25 Mbps	$100.00
	Up to 50 Mbps	$150.00
	Up to 100 Mbps	$200.00

Business Pricing

Provider	Speed (Mbps)	Price/Month
CenturyLink Business	Up to 100 Mbps	$ 65.00
Rise Broadband Business	Up to 25 Mbps	$ 69.95
DirectLink Business	Up to 5 Mbps	$ 79.95
	Up to 15 Mbps	$ 119.95
MHO Networks	Up to 10 Mbps	No Published Data
Comcast Business	Up to 25 Mbps	$ 69.95
	Up to 75 Mbps	$ 99.95
	Up to 150 Mbps	$ 139.95
	Up to 300 Mbps	$ 199.95
Electric Lightwave / Zayo	Up to 20 Mbps	No Published Data
Birch Communications	Up to 50 Mbps	No Published Data
NewCloud	Up to 10 Mbps	No Published Data

4.1.3 Bundled Services Pricing Lists by Carrier

Comcast and Century Link both offer bundled services. We have split the data by carrier and listed the bundled offerings for each.

4.1.3.1 Comcast Bundled Services

Internet - TV			
Broadband Speed	**Channel Offering**	**Price**	**Add-Ons**
Up to 60 Mbps	10+	$44.99	-
Up to 60 Mbps	10+	$44.99	HD & Cloud DVR
Up to 60 Mbps	130+	$44.99	60+ Spanish-Language Channels
Up to 150 Mbps	10+	$ 59.99	-
Up to 150 Mbps	10+	$74.99	HD & Cloud DVR
Up to 150 Mbps	140+	$79.99	-
Up to 150 Mbps	200+	$79.99	60 Spanish-Language Channels
Up to 150 Mbps	140+	$99.99	Speed Good for 11 Devices
Up to 150 Mbps	220+	$114.99	Starz & Speeds Good for up to 11 Devices
Up to 150 Mbps	260+	$134.99	+ Movie Channels & X1 DVR & 11 Devices
Up to 250 Mbps	10+	$74.99	-
Up to 250 Mbps	10+	$89.99	+ Streaming and Cloud DVR
Up to 250 Mbps	140+	$109.99	Speed Good for 12+ Devices
Up to 250 Mbps	260+	$134.99	+ Movie Channels & X1 DVR
Internet - TV - Phone			
Broadband Speed	**Channel Offering**	**Price**	**Add-Ons**
Up to 150 Mbps	140+	$ 89.99	Best Call Clarity
Up to 250 Mbps	140+	$119.99	-
Up to 400 Mbps	220+	$139.99	+ Starz
Up to 400 Mbps	260+	$159.99	+ Movie Channels & X1 DVR
Internet - TV - Phone - Home Security			
Broadband Speed	**Channel Offering**	**Price**	**Add-Ons**
Up to 1000 Mbps	260+	$189.99	+ Movie Channels & DVR & 24/7 Security Monitoring

**Note: Other pricing and bundle options are available. Standard options are shown for representation.*

4.1.3.2 Century Link Bundled Services

Anyone wishing to purchase Century Link bundled services with television, must also subscribe to Direct TV. Century Link does not offer video services to Louisville customers. Century Link does offer "Price for Life" for any customer on any of their packages meaning – they select the price/package for Price for Life and the cost does not change.

Internet			
Service	**Rate**	**Price**	**Description**
20 Mbps	*Base Rate*	$45.00	--
40 Mbps	*Base Rate*	$55.00	--
80 Mbps	*Base Rate*	$55.00	--
Phone - *Must be added on to 80 Mbps Base Rate*			
Phone	*Add an Additional*	$20.00	--
Phone	*Add an Additional*	$40.00	Ultd. USA Long Distance
Television			
Television	**Add an Additional*	$35.00	155+ Channels
Television	**Add an Additional*	$40.00	160+ Channels
Television	**Add an Additional*	$45.00	185+ Channels
Television	**Add an Additional*	$50.00	235+ Channels
Television	**Add an Additional*	$55.00	250+ Channels

**Note: Price for television doubles after the first 12-month period*

4.1.4 Meetings with the Carriers

As the incumbent providers in Louisville, VPS and City Staff held in-person meetings with Comcast and Century Link. The primary purpose of these meetings was to discuss:

- Current service offerings and Louisville footprint of each carrier;
- Plans for upgrading facilities and offerings;
- Discuss ways to collaborate to improve broadband in Louisville.

Below is a summary of the key points from the meetings with each carrier based on the information they provided in the meetings.

4.1.4.1 Century Link

Century Link asserts that they serve 100% of Louisville meaning that anyone with a Louisville address within City limits, can obtain service. Century Link shared with us a map showing their coverage, but it was deemed confidential and proprietary, and we were not able to keep it or develop a coverage map using the data.

While Century Link does have a fiber backbone and fiber connections to the node - the connection from the node to the home is through a copper wire. Copper technology is more limiting than fiber in that those closest to the node will have the best speeds and the maximum speed available is 140 Mbps. Those furthest away from the nodes will not be able to obtain 140 Mbps.

Presently, Century Link does not have any plans to upgrade facilities in Louisville including replacing the copper drops to the homes with fiber connections. In fact, when a copper drop breaks or becomes damaged, Century Link will replace the line with another copper wire. However, Century Link will build fiber connections to the home for new developments. This is happening in a new development just north of Steel Ranch.

Regarding service offerings, Century Link does not currently offer a video service. Century Link partners with Direct TV for those customers that wish to purchase television services. However, Century Link is working on an Over-the-Top video (television provided over a data stream but utilizing the existing wiring to the household) service to be launched in the near future that would be provided directly through their current system to interested subscribers.

4.1.4.2 Comcast

Comcast also asserts that they have 100% coverage within the City limits of Louisville. However, should any gaps exist, Comcast will look into building a connection to the missed home or business. Comcast did not share any maps of their infrastructure and we were unable to obtain copies as they were deemed confidential and proprietary.

Currently, Comcast is in the middle of what they are calling an “Advanced Fiber Project”. This is a significant upgrade to their current facilities that is a multi-million dollar investment in Louisville. Comcast is just at the beginning of these advanced fiber projects nationwide and Louisville/Superior combined are the 3rd and 4th locations in Colorado where this is taking place. Comcast will be doing upgrades in other neighboring towns on the Front Range as well. Arvada and Westminster projects are already complete.

The purpose of the Advanced Fiber Project is to upgrade fiber, and reduce the number of homes that are served by each node which is a better network design. This will help prepare the system for symmetrical gigabit service (same speed download as upload) in the near future. The project is not replacing the coaxial cable that extends from a node to the customer premise. However, the coaxial cable does not need to be upgraded for the customer to obtain faster speeds. While our internet research was not able to confirm this, Comcast said that a customer can subscribe to gigabit service for a price of $89 a month with a three-year contract.

Comcast also has several programs that offer heavily discounted services for those that have difficulty affording an internet connection. The Internet Essentials program is for families whose children obtain free and reduced meals through the school system. This program is co-marketed with BVSD. There is also a program for Community College students that is available in Colorado and only a few other states.

Comcast did express an interest in working with the City on economic development and smart city strategies including solutions for Wi-Fi coverage in the City.

4.2 Regional Municipal Provider Data

In addition to the incumbent carriers, VPS also looked at the service offerings for two regional municipal broadband networks – in Longmont, and Centennial to gain comparison information on what municipal networks are offering for packages and pricing.

4.2.1 NextLight – the City of Longmont

Through its electric utility, the City of Longmont constructed a Fiber-to-The Home Network and is offering services available to all residents. Below is the pricing VPS obtained to be used in a comparison to what is being offered by providers in the City of Louisville.

High Speed Internet			
Service Offering	**Speed**	**Price**	**Description**
Standard	(1Gbps/1Gbps)	$69.95	Broadband Only
Loyalty/Gig City Member	(1Gbps/1Gbps)	$59.95	Broadband Only
Charter Member	(1Gbps/1Gbps)	$49.95	Broadband Only
25 Mbps Tier	(25Mbps/25Mbps)	$39.95	Broadband Only
Wireless Gateway AC	--	$8.95	--
Bundles			
Standard Bundle	(1Gbps/1Gbps)	$94.95	Internet & Home Phone
Standard Plus Long Distance	--	$97.95	Add Unlimited Long Distance
Loyalty/Gig City Bundle	(1Gbps/1Gbps)	$ 84.95	Internet & Home Phone
Loyalty Plus Long Distance	--	$87.95	Add Unlimited Long Distance
Charter Member Bundle	(1Gbps/1Gbps)	$74.95	Internet & Home Phone
Charter Plus Long Distance	--	$77.95	Add Unlimited Long Distance
25 Mbps Tier Bundle	(25Mbps/25Mbps)	$64.95	Internet & Home Phone
25 Mbps Plus Long Distance	--	$ 67.95	Add Unlimited Long Distance

4.2.2 Centennial Ting

The City of Centennial has created a public-private partnership with a company by the name of Ting. Essentially, Ting will be investing in the construction of drops to the home or business from a City-built middle-mile network in order to provide services.

While currently in the implementation phase, residents can currently "pre order" a connection for a $9 fee. Once Ting receives a threshold percentage of pre-orders in a certain area, Ting will schedule construction to that area. However, there is no guarantee that Ting will build to an area and the pre-order fees are refundable if Ting chooses not to pull fiber to an area.

VPS reached out to the company and spoke with a customer service representative. The representative was unable to obtain concrete information on when and where service would be available in Centennial, and encouraged us to create an account and cast a "vote" for where to bring service. The representative did confirm that the monthly fee for gigabit service will be $89.00 a month in addition to a $198 install fee which can be waived if the customer "pre-orders" service.

4.3 Competitive Provider Broadband Observations

Overall, there is significant amount of private infrastructure in and around the City of Louisville. Based on the information gathered, VPS provides the following observations:

- According to the providers - residents and businesses can purchase high-speed broadband from anywhere in City limits.
- Louisville homes and businesses have multiple choices for internet or bundled service providers that offer a variety of pricing options.
- Comcast has the most-robust service available including gigabit service offerings.
- While Longmont's Next Light offers a less expensive gigabit service than Comcast, pricing is competitive.

5.1 Survey and Stakeholder Outreach Results

The biggest question a municipal feasibility study needs to answer is "what is the problem we need to solve?" As such, the most critical task of a feasibility study is to conduct outreach in the community in order to talk to as many stakeholders as possible. Stakeholders represent key groups of potential end-users of a municipal network such as citizens, businesses and government agencies. The purpose is to obtain feedback regarding current levels of service, future needs and concerns.

In order for the stakeholder outreach to be as comprehensive as possible, VPS utilized a variety of methods to collect the data and information including holding citizen meetings with citizens, one-on-one meetings with key groups, and conducting a residential and business survey.

5.1 Stakeholder Meetings

VPS conducted stakeholder meetings with a variety of outside groups including:

- Citizens
- Providers (Comcast and Century Link)
- Chamber of Commerce
- Neighboring localities

The results of these meetings are discussed below except for Comcast and Century Link meetings which were detailed in Section 4.1.4. City staff participated in all of these meetings except for the one with the Chamber of Commerce.

5.1.1 Citizen meetings

VPS conducted two open meetings with citizens. Meetings were held in the evening and in the morning in order to give residents the option of attending whichever meeting best met their schedule. Staff promoted the events in the City monthly newsletter and members in the community listed the meetings on social media pages. A total of 14 people attended the two meetings.

While the agenda was the same for both meetings, the tenor and tone of each one was vastly different. The evening meeting attracted 12 people and for the most part attendees were there to advocate for the City of Louisville to do what Longmont did and build a FTTP network. In addition, the evening attendees expressed the following opinions:

- Current providers charge too much
- The City should "fight the system" against the current providers
- 5G should be a priority
- The City needs better service from providers
- Current providers should have a local office in Louisville
- Cable franchise agreements should be short – just a few years and the City should revoke them if possible
- Net neutrality is a concern
- Despite not liking current providers, current service is good
- Cellular service is good

The morning meeting attracted just 2 participants and while Longmont came up as an option for Louisville to consider, the meeting was almost entirely focused on encouraging the City to bridge the digital divide by focusing on seniors and helping those with lower income levels purchase internet access.

5.1.2 Organizational and Regional Discussions

5.1.2.1 Louisville Chamber of Commerce

VPS met with the Chamber of Commerce to learn what the Chamber was hearing from their members about their current broadband needs and concerns. The answer was "nothing." The Chamber indicated that they do not hear any complaints nor is it ever a topic of discussion with their members. The Chamber offered to help distribute the informal business survey to their members.

5.1.2.2 BVSD

The City of Louisville already has a long-term partnership with BVSD. BVSD does not have any Louisville fiber needs that are not being addressed by current agreements. BVSD just completed a year long partnership pilot in Lafayette to bring internet to the homes of students in need. The project connected 32 homes and negotiations are starting to create a long-term PPP to allow this solution to happen district-wide. BVSD has also completed a full Wi-Fi upgrade that runs on their fiber network to allow for 2 devices per student to be connected in every classroom.

5.1.2.3 Neighboring Locality Meetings

VPS and City staff met with the Town of Superior, the City of Longmont, and the City of Lafayette to discuss regional broadband issues and coordination. In all cases, the neighboring jurisdictions are interested in exploring regional solutions that could include an interconnected middle-mile network. Neither Superior or Lafayette have plans to move forward with building a FTTP network at this time.

The City also met with Boulder County and the City of Boulder. Boulder County is potentially interested in a middle-mile solution that can assist with connecting to the unincorporated areas of the County. The County would be interested in regional collaboration.

For the last several years, the City of Boulder has explored a variety of options for improving broadband access and connectivity in the City including conducting a broadband feasibility study and interviewing potential providers possibly interested in forming a public-private partnership with the City. The City has also investigated options for becoming a municipal electric utility through purchasing Xcel assets located in the City. After reviewing all of its options, the City has decided to move forward with building a middle-mile dark fiber backbone that could serve as a base for a Fiber-To-The-Premise network in the near future. The project goal is city-wide access to a state-of-the-art network. The City is interested in regional collaboration opportunities as well.

Overall, the Front Range communities would be open to opportunities for regional collaboration.

5.2 Residential Survey Results

VPS conducted a residential market demand survey to obtain key data points regarding current level of service, satisfaction with current providers, resident's willingness to switch providers, and what price do residents consider to be reasonable for high-speed broadband. This Section details the results of the survey.

5.2.1 About the Survey

The survey itself contained a total of 32 questions (9 of which were demographic related) and was hosted on the online platform of Survey Monkey. VPS worked with National Research Council (NRC) to target a random sampling of 3000

households. NRC then mailed 3 communications from the City (City-approved) to each of the 3000 households encouraging them to complete the survey. VPS received 797 survey responses for an exceptional total response rate of 27%.

In order to enable all residents to participate in the survey, VPS hosted a second identical informal survey to allow for all residents to record their opinions if they desired to do so. The City communicated the informal survey link via the City newsletter. VPS kept the two group responses separate in order to preserve the data obtained in the official market demand survey responses. This is mainly due to avoid the skewing of results of biased responses. In other words, individuals who choose to respond to the informal survey are usually more interested in the subject and may have stronger opinions than those who are randomly selected to participate.

VPS received a total of 150 additional responses to the informal survey. As expected, the informal survey did end up with some results different from the official survey in that a higher percentage of respondents indicated dissatisfaction with current providers and more wanted the City to build a FTTP network.

5.2.2 General Survey information

The official survey data and analysis is presented below broken down by topic. The raw survey data is attached as Appendix B.

5.2.2.1 Respondents by City area

Respondents identified themselves as being from 9 different areas of the City. Percentages were broken down as follows:

City Area	Percentage
Fireside	20.99%
Coal Creek	13.15%
Old Town	12.52%
Davidson Mesa	10.24%
North Louisville	9.48%
Hecla	9.23%
South Louisville	8.98%
Hillside	8.22%
Lake Park	7.21%

5.2.2.2 Household Services Purchased and Ranking by Importance

Respondents purchase a variety of communications services for their household, but they are not purchased equally. For example:

- 99% purchase internet
- 94% purchase cellular/mobile service
- 60% purchase cable or satellite television
- 38% purchase land-line telephone service

When asked to rank the services from 1-4 with 4 being the most important, internet was overwhelmingly the most important with the following weighted average:

- 3.49 for internet
- 3.07 for cellular/mobile telephone
- 2.17 for television
- 1.33 for land line telephone

5.2.3 Television

Cord cutting is the term given to households that stop purchasing traditional television services and instead utilize their internet connection to stream television content. While cord cutting is a national trend, broadband providers have found that television service is a necessary offering in order to help drive subscription rates – in part due to discount rates for bundled service packages (TV, internet and phone). The survey asked several questions about television to determine what Louisville residents are doing with cord-cutting. The key metric is highlighted in red below.

Respondents reported that:

- 63% stream content over the internet (including Netflix, Hulu, Vudu, etc..)
- 48% purchase cable television
- 27% obtain television content free - over the air with an antenna
- **14% only stream shows using the internet and do not subscribe to any other television service**
- 11% purchase satellite television such as Direct TV
- 6% don't purchase any television service

The 14% of cord cutters in Louisville are in line with the national average. Interestingly, 38% of the cord-cutters in Louisville comprise the 35-44 age range with the next biggest at 25% in the 45-54 age group. Only 14% of Millennials in Louisville are cord-cutters but represent only 7.7% of all respondents to the survey.

Another interesting data point is that 34% of those that do purchase television, bundle their services with internet and/or telephone. Thus, over a third are buying bundled packages to save money. Overall the data tells us that almost 2/3 of respondents are purchasing services (cable or satellite) and also streaming shows.All of this data indicates that a new provider in Louisville may need to provide some sort of television offering in order to compete with existing providers.

5.2.4 Cellular Telephone

Since the feasibility study also looked at cellular broadband, the survey asked a few questions about resident's cell phone experiences.

Overall 94% purchase cellular telephone service. By a margin of over 2-1, respondents purchase cellular service through Verizon. Percentages of identified carriers are as follows:

- 47% Verizon
- 21% AT&T
- 14% T-Mobile
- 5% Sprint

Only 7% of those that purchase cellular telephone service indicated that “the cell signal is weak at my house and it's very difficult to use my cell phone at home.” Another 13% indicated that they need to move around the house in order to make or receive a call. The biggest percentage (under 25%) of these respondents reside in Fireside. The next biggest problem area is South Louisville (under 15%) and Coal Creek (under 12%).

Overall, based on the data, the cellular coverage in Louisville is relatively good and reliable.

5.2.5 Internet

Almost 99% purchase internet services in Louisville. Only 8 respondents indicated that they do not purchase internet due to cost, not a need for the household or they go to the Library to use the internet. Not surprisingly, 75% of respondents are Comcast customers with 24% subscribing to Century Link. The remaining respondents are purchasing fixed wireless with 3 respondents stating they still purchase dial-up service.

Again, almost 1/3 of respondents purchase internet through a bundled package with phone and/or television so it’s difficult to determine how much those respondents are just paying for internet. However, the remainder that do purchase internet as a stand-alone service:

- 25% are paying $41-$60 dollars a month
- 20% are paying $61-$80 dollars a month
- 11% are paying $81-$100 dollars a month
- 9% paying less than $40 dollars a month
- 6% are paying over $100 dollars a month

The survey did not ask respondents to test their speed due to the fact that speed tests are dependent on the time of day they are tested, and it can create confusion for the respondents in the middle of a survey. However, the data presented in Section 4 details the pricing and packages available for Louisville residents by carrier and it appears that over 90% are purchasing speeds that exceed the federal definition of broadband, while all have the ability to purchase speeds that exceed the federal definition of broadband.

5.2.5.1 Satisfaction of Current Providers

The next set of questions explore how satisfied internet subscribers are with their current provider and service.

Overall, 54% of respondents are either very satisfied or satisfied with their current provider. Just under one-fourth are neither satisfied nor dissatisfied with 23% either dissatisfied or very dissatisfied.

Delving a bit deeper into the various aspects of their internet service, respondents indicated on a weighted average with 1 being very satisfied and 5 being very dissatisfied that:

- Price of services was the biggest concern with a 2.96 average
- Technical support was the next biggest concern with a 2.77 average
- Customer service followed closely behind technical support with a 2.72 average
- Reliability and speed had the lowest amount of concern with 2.28 and 2.26 average respectively

Interesting to note that according to respondents, reliability and speed are the most important features for internet service, with price coming in third. Yet, price is the biggest complaint from respondents. This means that a new provider

would need to be able to offer a service priced lower than what respondents are currently paying and at least be equally as reliable and fast.

5.2.5.2 Willingness to Switch from Current Providers

Keeping in mind what respondents are currently paying for internet service, the survey asked respondents what is the most they would pay if a new provider offered gigabit service.

Amount	Currently Paying	Most Would Pay for New Provider
Under $20	.1%	Not an option offered
$21 - $40	9%	18%
$41 - $60	25%	33%
$61- $80	20%	25%
$81 - $100	11%	14%
Over $100	6%	5%

Over 87% of respondents indicated that they would switch providers at the price selected above and 12% would not switch providers no matter what the price. This data confirms the prior conclusion that a new provider would need to offer service at price less than what current respondents are paying in order for a majority of respondents to switch providers.

5.2.5.3 One-time Hookup Fees

The Survey asked respondents what is the most you would pay for a one-time hookup/connection fee if it were required by a new provider that offered a reliable, robust, high-speed internet connection (up to 1 gig)? The purpose of this question is to explore partial funding mechanisms for deploying a network. Any hook-up fees can help offset some or a significant portion of the deployment fees depending on the amount.

Louisville residents do not have much tolerance for hook-up fees. Presumably because respondents already have a high-speed connection at the house.

- 17% would refuse to pay a fee at all
- 75% would pay $100 or less

5.2.6 City Action

The survey asked one question regarding respondents' opinion of the role of the City in improving broadband.

Statement	Which Statement Do You Most Agree With
The City should use public funds to finance and build a City-owned broadband network to serve government facilities, residents and businesses.	38%
The City should consider using public funds to finance a network of some kind if current providers are not able to improve broadband services in Louisville.	24%
The City has a role in improving broadband services, but you aren't sure what the City should do.	19%

Current providers are meeting the need for broadband in Louisville and there isn't a need for the City to do anything.	19%

Almost 40% agree with the statement that the City should build a FTTP network. An equal amount of respondents either are not sure what the City should do or do not think the City needs to do anything.

5.3 Business Survey Results

The business survey was informal, and the link was distributed via email by the Louisville Chamber of Commerce. There were 32 responses collected. Highlights from the survey are detailed below. The raw data from the business survey can be found in Appendix C.

5.3.1 General Data

Overall, 62% of businesses that responded were located in the Historic Downtown area or the McCaslin corridor. Just over 75% have less than 10 workers and identify themselves as being in the professional services sector.

Exactly 25% indicated that they have a home-based business.

5.3.2 Internet

Similar to the split in the residential survey, almost 72% have Comcast service with 22% subscribing to Century Link. There is some uncertainty regarding the level of service (speed) and what respondents are currently paying. For example:

- 44% do not know what speed they are purchasing
- Just over 1/3 think they are getting 50mbps or less
- 9% are purchasing a gigabit
- 9% aren't sure what they pay
- 46% are paying less than $100/month
- 30% are paying between $100-$200/month
- 9% are paying between $200-$400/month

Overall, business respondents have a higher level of satisfaction with their current providers than residential service – with 56% being very satisfied or satisfied. There is also a higher level of dissatisfaction at 34% with only 9% unsure.

Regarding pricing – business respondents indicated that they would be willing to pay a little bit more for robust (gigabit) service than what they are currently paying.

- 39% said they would pay $50-$99/month
- 29% said they would pay $100-$149/month
- 13% said they would pay $150-$199/month
- 6% said they would pay $200 - $299/month
- 3% said they would be willing to pay $1000+/month

At these prices, 81% indicated that they would switch providers with 16% unsure. This may seem like a high number, but keep in mind that there are 44% who do not know what they are currently getting for internet.

Also similar to the residential survey, businesses are not very likely to pay a large hook-up fee to get a better connection with 72% willing to pay less than $100.

5.4 Key Take-Aways From the Surveys

A summary of the top 10 key findings of the survey is provided below:

- Over half of Louisville residents are satisfied with their current service.
- Given the number of providers in Louisville, the speeds available and current satisfaction levels, take rates are estimated to be between 30-35% but would depend largely on offerings, and pricing.
- A new provider would need to offer more speed with better service for less cost in order to achieve the estimated take rates.
- Only 14% of respondents are cord-cutters and given the incumbents ability to provide television and offer discounted packages, any new provider should provide an option for television in order to reach and increase take rates.
- Over a third of respondents currently purchase bundled services in order to obtain better pricing.
- A new provider would not be able to charge more than $100 for a one-time hook up fee in order to help offset deployment costs.
- According to the residential survey results, cellular telephone service is relatively good in Louisville. However, there are some areas such as Fireside, South Louisville and Coal Creek where cell service is less reliable. Unfortunately, improving service in these gap areas is solely dependent on the cellular carriers making a decision to take action. While it is a good idea for the City to reach out to the cellular carriers to bring the gaps to the attention of the carriers and to proactively facilitate discussions, it is up to the carriers to resolve the problem.
- The business community is relatively satisfied with their current broadband service. However, when asked, many respondents could not say what speeds they were currently getting or what it cost them for service.
- The business community will pay more for better service.
- City residents believe the City has a role in improving broadband but there are mixed feelings as to what should be done. For example, while 38% of respondents believe that the City should use public funds to finance and build a municipal network, an equal number of respondents either think the private sector is meeting the need for broadband or they are not sure what the City should do. The remaining 24% believe that the City should step in if current providers are not able to improve service.

6. Municipal Network Model Overview

Now that the existing infrastructure, provider offerings and stakeholder outreach results have been presented and analyzed, the next step in the process is to understand what the various network models are and to explore the pros and cons of each. This Section first discusses the various network models and details what it would cost for the City of Louisville to build out each model.

6.1 Network Models

There are two main types of municipal networks that serve end-users (other than networks built exclusively for internal government use) and they are most commonly referred to as last-mile and middle–mile. For purposes of this discussion, the term network is inclusive of all technologies including fiber and/or wireless.

6.1.1 Last-Mile Network Models

A last-mile network (also known as Fiber-to-the-Premise or FTTP) is one that is designed to provide service directly to homes and businesses in the community. Last-mile networks can also serve government buildings and other community anchor institutions.

Last-mile networks are the most expensive to deploy but can provide the biggest benefit to the community. However, municipal FTTP networks are also more-rare due to the cost it takes to deploy the infrastructure and the need to have an operator/provider who can run and manage the network. For this reason, most of the municipal last-mile networks in existence are in communities that also have a municipal electric utility. This is because the local government (through its municipal utility) already owns utility pole infrastructure that can be leveraged to offset deployment costs. Municipal electric utilities also have operating and billing systems already in place to serve customers. Therefore, they have experience in serving customers and can more easily shift gears to offer a broadband service as a new offering rather than having to create an operational system greenfield.

The other key factor is that last-mile networks usually require a take-rate that is between 40-60%. This means that the network operator needs to obtain 40-60% of the residential subscriptions available in the community in order to recoup the capital investment, make a profit and be sustainable. Examples of FTTP networks – both those that have a municipal electric utility and those that do not - are provided below. The municipal electric networks are all very similar and so only one Colorado example is provided.

Muni Electric FTTP Network Examples	
Longmont, CO	Longmont's "NextLight" is a gigabit fiber network owned and operated by the city and its power utility, Longmont Power & Communications (LPC). In 2013 Longmont supported the network build at a 70% level, approving a $40.3 million bond issuance to cover the startup costs of the Internet service. Even the $40 million price tag would have been significantly higher if not for the existing asset of an 18-mile fiber loop within the City's limits. Longmont has 38,000 premises and 92,000 residents within its approximately 30 square miles. NextLight offers symmetrical gigabit service at $50/month for those who signed up early. This $50 rate is for both the lifetime of the home as well as the owner should he/she move within city limits. Late in 2016 the City voted to increase LPC's budget by $7 million, sourced from the Electric and Broadband Utility Fund balance to hire staff needed to support take rates significantly higher as initially predicted. Current take rates average 53%.
Non-Muni Electric FTTP Network Examples	
Rio Blanco, CO	Rio Blanco County utilized county funds and Colorado DOLA grant funds to construct an FTTP network serving its rural community. The technologies deployed are a mix of fiber and wireless. Rio Blanco is building a fiber to the premises network in its main two population centers (Meeker and Rangley) and a shared fixed wireless solution designed to reach all other addresses. Additionally, Rio Blanco is building middle-mile fiber available for carriers to lease in the county.
Ammon, ID	The City of Ammon Idaho has a very unique model. Ammon has built an open access network that lets multiple private ISPs offer service to customers over city-owned fiber. The City self-funded a portion of the network. However, Ammon is using a model similar to Google Fiber's "Fiberhoods," in which construction happens first in neighborhoods where a majority of residents commit to buying service. Those who opt-in have the option to pay either an upfront fee of $3000 or pay the amount gradually over a 20 year period, excluding an additional utility fee of $16.50 a month. Should a home-owner sell their house prior to the $3000 fee being paid off – it would be the responsibility of the new home-owner to continue those payments. Conversely, should a homeowner move after paying the upfront free – the new homeowner would have the benefit of the network connection without needing to pay the connection fee. This model has been touted as the "model of the future" but it is far from being complete. Success is yet to be determined the fee structure may not be appropriate for many communities.
Fairlawn, OH	The City of Fairlawn established FairlawnGig as a forward-thinking, economic development strategy founded on the belief that business growth, innovation, and community transformation will follow with every connection. The build cost approximately $10 million dollars (paid for by bond) and the City will connect every home and business. The City is not looking to the network to become a profit-making revenue stream. The City felt that FairlawnGig was a necessity for the community at large. The network has a take rate of just over 50% and is looking at expanding to neighboring towns.

6.1.1.1 City of Louisville Last-Mile Models

VPS developed the following three last-mile models for the City of Louisville:

- A last-mile FTTP network deployed to 100% the premises
- A last-mile FTTP network deployed to 60% of the premises
- A last-mile FTTP network deployed to 30% of the premises

It should be noted that the estimates provide a high-level capital cost estimates only for the design, construction and implementation of a fiber-optic network.[1] These models have not been scoped or put out to bid. In addition, these models do not include costs associated with the operational structure that would be needed to support each network option. Operational structures will be discussed in Section 7.

The below table shows the 10 basic assumptions made in the development for each model detailed in this Section.

	Assumption
1	Last-mile costs include costs to serve middle-mile
2	Costs only include town boundary routes
3	Assumes serving all locations from 5 existing buildings
4	Location counts assume only residential locations and other community anchor institutions
5	Estimates include engineering and overhead
6	Costs assume 100% buried construction but does not include variable costs for rocky soil conditions
7	Electronics and fiber management costs assume GPON architecture
8	Does not include costs for any ROW acquisition
9	Middle Mile estimates do not include any costs where Zayo or City/BVSD network currently exists
10	Costs do not include RF or IP video expenses, switching costs, data network equipment or transport to exchange

In addition, VPS did not analyze whether any aerial construction would be feasible by obtaining a pole attachment agreement with Xcel Energy. However, should the City select one of these models, aerial construction could be an option to explore in the engineering phase that could reduce costs in areas where pole attachments are possible.

With all of these last-mile options, it is important to note that the City of Louisville does not have a municipal electric utility. As previously discussed, a municipality that has publicly owned electric utility infrastructure can leverage that system to significantly offset and lower construction deployment of a broadband network. Since this is absent from Louisville, and there is very little existing infrastructure that could be leveraged, the network must be built greenfield.

These last-mile network models detail the costs for a FTTP network with 3 different penetration rates. Penetration rates refer to the percentage of households that are connected or passed by the network. Penetration does not equal subscriber take rate percentages – only the percentage of households that could potentially subscribe to the network if a drop were connected from the home to the network.

[1] Note: VPS was not tasked to develop a full business plan around one or all of the models at this phase of the project. We do not recommend conducting a business plan until a network design and operating model are selected. This may or may not include the selection of a provider to manage the network.

The following chart summarizes the total estimated costs of the three FTTP options. These values are based on the corresponding penetration percentage of both mainline miles and locations. Each estimate assumes a 100% take rate.

	100% Penetration	60% Penetration	30% Penetration
OSP and Electronics Cost	$32,406,000	$19,472,000	$9,766,000
Total Locations	7,299	4,387	2,203
Mainline Miles	135.3	81.2	40.6
Drop Miles	248.8	149.6	75.1

The difference between the three models is in the percentage of mainline miles, drop miles and number of locations reached. Each model accounts for a 100% take rate within the portion constructed even though only 60% or 30% of the total locations in the City might be reached.

Although take rates vary greatly from project to project, it is common to achieve between 30% to 60% in areas where existing broadband speeds are lacking. As discussed in Section 5, with the number of providers already in Louisville, take rates for Louisville, are estimated to be between 30-35%. Therefore, even if the network passes 100% of the households – only about 1/3 of the homes are estimated to subscribe to the network. So the question becomes – can a provider have a viable and sustainable network if the penetration rates are reduced to 30% to reduce costs and account for a 30% take rate within that footprint?

The biggest issue in deploying a network that is less than 100% penetration is determining which 30% or 60% may be the most interested in subscribing to the network. If a provider builds to the wrong 30%, take rates will be even lower than what is projected. The decision to build to 100% versus 60% or 30% depends on the financial analysis and take rate estimates.

For this reason, many networks utilize a technique called Demand Aggregation. Demand Aggregation refers to a deployment strategy wherein residents are encouraged to commit to sign up for service and may even be required to pay a small fee ($10-$20). This is what Ting is doing in the City of Centennial. When the percentage of residential sign-ups in an area reaches 60% or greater, construction commences in that neighborhood. This enables a provider to find the most interested subscribers and bring in revenue in high-subscription areas before building out the entire system. Google utilized this technique very effectively in their buildout strategy by establishing Google “Fiber-hoods”. In essence, this technique enables a phased-in construction plan with the goal of exceeding take rate estimates and eventually achieving 100% penetration in steps.

The details for each of these three network options are provided on the following pages. Below is a key provided to assist with understanding the terminology and reading the models.

Key for Understanding Network Models

Terminology		Description
	CO Electronics	This includes the electronics, spares, miscellaneous materials needed for network operations, installation, and Optical Network Terminals (ONTs) that are attached to each premise. Installation (10%) means that it costs roughly 10% of the cost of equipment. "CO" means Central Office which is the buildings where the main electronics will be housed.
	Installation (10%)	
	ONTs	
	ONT Installation	
OSP		OSP stands for Outside Plant
	Cable	This includes the cost of the fiber, conduit, miscellaneous materials needed for the construction of the network. Drops refers to the cost of fiber drops to each premise. These cost estimates also include the cost of construction (labor) and engineering.
	Drops	
	Fiber Management	
Number of Locations		Number of housing and premises included in the network design
Mainline miles		This refers to miles of backbone built
Drop miles		This refers to miles of drops direct from the backbone to the customer premise

City of Louisville	
PROPOSED FTTP HIGH LEVEL ESTIMATE - 100% PENETRATION	
Electronics	**Buried**
CO Electronics	**$990,000**
Installation (10%)	**$99,000**
ONTs	**$2,943,000**
ONT Installation	**$1,635,000**
Outside Plant	
Cable	**$17,139,000**
Drops	**$8,759,000**
Fiber Management	**$841,000**
Total	**$32,406,000**
Mainline Miles	135.3
Drops Miles	248.8
Total Miles	**384.1**
Total Locations	**7,299**

Assumptions:

- **Locations assume only residential locations and Anchor Institutions.**
- **Last Mile costs include costs to serve Middle Mile.**
- **Does not include RF or IP video expenses, switching costs, data network equipment, or transport to exchange.**
- **Installation estimated at 10% of equipment.**
- **Assumes serving all locations from 5 existing CO buildings. Therefore, no building or land costs are included.**
- **Assumes 100% penetration (by mainline mileage and locations).**
- **Assumes 100% take rate.**
- **Estimates include engineering and overhead.**
- **Does not include any costs where Zayo or City conduit currently exists.**
- **Does not include any costs for right-of-way acquisitions.**
- **OSP costs do not include any costs for rocky soil conditions.**
- **OSP costs assume all buried construction.**
- **Drop costs assume 180' buried drop.**

Notes:

We make every attempt to have our estimates be within +/- 10% of the actual project cost, which is normally the case. However, it is still an estimate, there are many factors outside of our control that could result in the actual cost differing by more than 10%, such as material or labor charges, design changes since estimate, inflation, construction delays, etc. Please keep this in mind when budgeting for this project.

City of Louisville	
PROPOSED FTTP HIGH LEVEL ESTIMATE - 60% PENETRATION	
Electronics	**Buried**
CO Electronics	**$600,000**
Installation (10%)	**$60,000**
ONTs	**$1,769,000**
ONT Installation	**$983,000**
Outside Plant	
Cable	**$10,284,000**
Drops	**$5,265,000**
Fiber Management	**$511,000**
Total	**$19,472,000**
Mainline Miles	81.2
Drops Miles	149.6
Total Miles	**230.7**
Total Locations	**4,387**

Assumptions:

- **Locations assume only residential locations and Anchor Institutions.**
- **Last Mile costs include costs to serve Middle Mile.**
- **Does not include RF or IP video expenses, switching costs, data network equipment, or transport to exchange.**
- **Installation estimated at 10% of equipment.**
- **Assumes serving all locations from 5 existing CO buildings. Therefore, no building or land costs are included.**
- **Assumes 60% penetration (by mainline mileage and locations).**
- **Assumes 100% take rate.**
- **Estimates include engineering and overhead.**
- **Does not include any costs where Zayo or City conduit currently exists.**
- **Does not include any costs for right-of-way acquisitions.**
- **OSP costs do not include any costs for rocky soil conditions.**
- **OSP costs assume all buried construction.**
- **Drop costs assume 180' buried drop.**

Notes:

We make every attempt to have our estimates be within +/- 10% of the actual project cost, which is normally the case. However, it is still an estimate, there are many factors outside of our control that could result in the actual cost differing by more than 10%, such as material or labor charges, design changes since estimate, inflation, construction delays, etc. Please keep this in mind when budgeting for this project.

City of Louisville	
PROPOSED FTTP HIGH LEVEL ESTIMATE - 30% PENETRATION	
Electronics	**Buried**
CO Electronics	**$307,000**
Installation (10%)	**$31,000**
ONTs	**$889,000**
ONT Installation	**$494,000**
Outside Plant	
Cable	**$5,142,000**
Drops	**$2,644,000**
Fiber Management	**$259,000**
Total	**$9,766,000**
Mainline Miles	40.6
Drops Miles	75.1
Total Miles	**115.7**
Total Locations	**2,203**

Assumptions:

- **Locations assume only residential locations and Anchor Institutions.**
- **Last Mile costs include costs to serve Middle Mile.**
- **Does not include RF or IP video expenses, switching costs, data network equipment, or transport to exchange.**
- **Installation estimated at 10% of equipment.**
- **Assumes serving all locations from 5 existing CO buildings. Therefore, no building or land costs are included.**
- **Assumes 30% penetration (by mainline mileage and locations).**
- **Assumes 100% take rate.**
- **Estimates include engineering and overhead.**
- **Does not include any costs where Zayo or City conduit currently exists.**
- **Does not include any costs for right-of-way acquisitions.**
- **OSP costs do not include any costs for rocky soil conditions.**
- **OSP costs assume all buried construction.**
- **Drop costs assume 180' buried drop.**

Notes:

We make every attempt to have our estimates be within +/- 10% of the actual project cost, which is normally the case. However, it is still an estimate, there are many factors outside of our control that could result in the actual cost differing by more than 10%, such as material or labor charges, design changes since estimate, inflation, construction delays, etc. Please keep this in mind when budgeting for this project.

6.1.2 Middle-Mile Networks

A municipal middle-mile network is typically defined as a network that serves community anchor institutions (i.e. schools, libraries, government buildings, public safety agencies, hospitals, etc.) but does not directly serve homes and businesses. A middle-mile network could either be operated directly by the municipality or outsourced to a network operator.

The purpose of middle-mile networks is generally to build a high fiber count (fiber cables with strand counts of 144 and above) backbone[2] that provides direct lateral connections to key institutions and enables infrastructure assets to be leveraged and leased by others including businesses and private providers. Although, there are middle-mile networks that are built to support internal government needs only (closed network).

Middle-mile networks are much more commonly constructed by municipalities than last-mile networks due to the significantly lower cost of deployment and operations and reduced risk. Middle-mile networks can be a tremendous asset to a community in that it can generate revenue, and provide critical infrastructure needed to support government operations.

Examples of middle-mile networks are provided below.

Middle-Mile Municipal Network Examples	
Kent County, MD	Kent County, Maryland is a rural county on the Eastern shore of the state. Kent County determined a few years ago that they wanted to invest in middle-mile infrastructure that they could own as an asset. The County decided not to finance the network build through a bond, but rather paid for it entirely out of general funds. The County now has a 110- mile network completed and have made the assets available to be leased and leveraged by others.
Centennial, CO	The City of Centennial (107,000 residents) is in the process of building a fiber backbone. The City is self-funding the middle-mile portion of the network build and will own the assets. Centennial has selected Ting to be the FTTP service provider, who is currently taking signups for residential service for $89/month range for symmetrical gigabit speeds. While the network is the property of the City and eventually an "open network," Ting partnerships typically feature an "exclusive right to operate network" term of multiple years. While the build is the responsibility of the respective cities, Ting will lease and light the fiber and provide all equipment and Internet access. Funding the build is a $5.7 million allocation from the general fund. The city council led by the fiber subcommittee looked at this funding as an infrastructure investment removing the expectation that this funding would be directly paid back.
Northwest Colorado Broadband (NWCB); Steamboat Springs, CO	The City of Steamboat Springs teamed with Routt County, Yampa Valley Electric Association, Yampa Valley Hospital, Chamber of Commerce and the Steamboat Springs School System to legally form a nonprofit. The partners supplied some of the capital along with DOLA grant funds to build a middle-mile network through Steamboat Springs. NWCB selected Mammoth Networks as its network operator who will manage, operate the network and lease fiber to interested and qualified applicants. NWCB is also talking with the City of Craig and Moffat County about being the Network Operator for a regional network.

[2] A backbone is literally the spine of the network. Backbone's are usually built along main corridors and provide transport to and from the hub site where the electronics are located to the connected entity.

6.1.2.1 Middle-Mile Network Models for the City of Louisville

VPS developed the following two middle-mile models for the City of Louisville:

- A middle-mile network that connects to 19 City institutions only
- A middle-mile network that connects the 19 City institutions and has a public Wi-Fi component

A middle-mile option is the most cost effective of all the self-funded network options. While a middle-mile network would not directly connect or provide residential or commercial services, the proposed middle-mile network in Louisville would span a total of 20.9 miles with 9.1 miles of new build connecting to 11.8 existing miles and 19 City institutions.

Item	Cost
Electronics	$31,000
OSP	$1,115,000
Total Cost	$1,146,000
Total New Build	9.1 miles

With 11.8 miles of existing network, only 9.1 miles would be needed to close a network loop and reach all 19 City institutions.

As discussed above, another benefit of a middle-mile network is that excess fiber and conduit capacity could be leased for revenue to providers or businesses and the network can provide backhaul fiber needed for wireless antennas and smart city applications. This is discussed in more detail in Section 6.2.

In addition, a middle-mile network would provide the backbone connectivity needed for any of the last-mile network options previously discussed. A middle-mile network could be phased in and/or enable the City to phase-in a FTTP network at a later time.

Locations identified as City institutions on existing fiber with equipment:

1) City Hall
2) Parks and Recreation Building
3) Library
4) Museum
5) Center for Arts
6) Coal Creek Golf Course
7) City Services
8) Rec/Senior Center
9) Police Stations
10) Wastewater Treatment Plant
11) Sid Copeland Water Treatment Plant
12) Howard Berry Water Treatment Plant

Locations identified as anchor institutions for parks:

1) Louisville Community Park

2) Cottonwood Park
3) Louisville Sports Complex
4) Memory Square
5) Pirates Park

Locations identified as anchor institutions on wish list:
1) Public Safety Facility FM Radio Site (1200 Courtesy Road)
2) RV Dump

Below is the proposed middle-mile map and model.

City of Louisville
PROPOSED MIDDLE MILE HIGH LEVEL ESTIMATE

	Buried
Electronics	
CO Electronics	**$16,000**
Installation (10%)	**$2,000**
ONTs	**$8,000**
ONT Installation	**$5,000**
Outside Plant	
Cable	**$1,078,000**
Drops	**$23,000**
Fiber Management	**$14,000**
Total	**$1,146,000**

Existing Miles	11.8
Proposed Miles	8.5
Drop Miles	0.6
Total Miles	**20.9**

Total Locations	**19**

Assumptions:

- **Routes to only the Anchor Institutions in Middle Mile KMZ.**
- **Does not include RF or IP video expenses, switching costs, data network equipment, or transport to exchange.**
- **Installation estimated at 10% of equipment.**
- **Assumes serving all locations from an existing CO building. Therefore, no building or land costs are included.**
- **Estimates include engineering and overhead.**
- **Electronics & fiber management costs assume GPON.**
- **Does not include any costs for right-of-way acquisitions.**
- **Does not include any costs where Zayo or City conduit currently exists.**
- **OSP costs assume all buried construction.**
- **OSP costs do not include any costs for rocky soil conditions.**

Notes:

We make every attempt to have our estimates be within +/- 10% of the actual project cost, which is normally the case. However, it is still an estimate, there are many factors outside of our control that could result in the actual cost differing by more than 10%, such as material or labor charges, design changes since estimate, inflation, construction delays, etc. Please keep this in mind when budgeting for this project.

The second middle-mile network option looks at the costs of deploying a middle-mile network with Wi-Fi installed in the historic downtown area and key parks in the City of Louisville including:

- Louisville Sports Complex
- Community Park
- Memory Square
- Pirates Park
- Cottonwood

The previous middle-mile network model only needs to be slightly expanded to include fiber drop estimates for each of the proposed W-Fi sites. The estimate represents an increase of $13,000 dollars and .4 miles of new build for the middle-mile network component.

The new middle-mile network estimate is provided below.

Item	Cost	With Wi-FI
Electronics	$31,000	$31,000
OSP	$1,115,000	$1,128,000
Total Cost	$1,146,000	$1,159,000
Total New Build	9.1 miles	9.5 miles

This model is dependent upon the middle-mile network being constructed with fiber drops to each of the Wi-Fi equipment locations. The high-level budgetary estimates provided for the wireless consider only the Wi-Fi equipment, engineering and professional installation of the Wi-Fi equipment itself. The wireless estimates do not include any costs associated with site/building specific leasing, licensed electrical contractors or civil/architectural sitework. For this initial high-level estimate, VPS did not conduct an on-site survey or perform Radio Frequency engineering (propagation) analysis to determine the optimal locations for the wireless equipment. Based on the proposed Wi-Fi site locations in the VPS wireless report, the City of Louisville should also consider budgetary costs for the following:

- Fiber backhaul estimates proposed by VPS
- Additional cost of leasing if site locations are not City-owned property
- Connectivity costs or licensed electrician installations
- Civil or Architectural sitework

If the City desires to move forward with this option, the next steps would be for this project to be properly scoped and engineered with an on-site survey to generate a true cost-estimate. Any changes to the initially selected Wi-Fi equipment locations would require fiber to be built to those locations and could change the cost to the middle-mile network estimate provided above.

Below is a chart detailing the cost estimate for the Wi-Fi component only. The two options (Vendor A/B) provide a range of equipment costs.

Louisville - City Wi-Fi Project Projected Capital and Operational Expenses				
		Vendor A		Vendor B
	# AP's	11		11
Network Equipment				
Tower / Site	$	3,163	$	3,163
Antennas and Lines (Including On-Site Installation)	$	11,880	$	7,502
AP Radio Equipment	$	23,507	$	10,307
Backhaul	$	-	$	-
Data Network Equipment	$	8,997	$	11,805
Network Equipment Spares (Including On-Site Installation)	$	2,287	$	937
Engineering & Gen. Project Mgmt. Services	$	8,300	$	5,200
CapEx Total	**$**	**58,134**	**$**	**38,914**
Annual Software Licensing, Maintenance and Support	$	2,000	$	825
OpEx Total	**$**	**2,000**	**$**	**825**
Grand Total	**$**	**60,134**	**$**	**39,739**

The full report on the Wi-Fi model including maps, and detailed costs is attached as Appendix D.

6.2 Open Access Middle-Mile Networks

An open access network is one where the infrastructure assets (conduit and/or fiber) are made available under certain policies and procedures to multiple non-network owners. Most middle-mile networks are usually open networks and most last-mile networks are usually closed, particularly those built by providers.[3] Publicly funded grant programs offered by the federal and state government sometimes require networks to be open access.

Middle-mile networks that lease dark fiber and conduit are designed to be open access. With middle-mile networks – the more users, the bigger the benefit to the network and the more revenue it generates. A private provider that is considering building in a community may have an interest in leasing middle-mile assets because it helps with reducing their costs of deployment. A provider, then, would only need to invest in the lateral connections to homes and businesses and would not have to build the backbone. Larger businesses and those with multiple office locations may also be interested in leasing fiber assets to help connect an internal network or obtain better broadband.

[3] Open access is a hotly debated topic particularly as it relates to last-mile networks because the greater the number of providers, the harder it is for a new-entrant provider to meet its take-rate goals and make a profit. This will be of particular concern for providers that are also making a financial investment. Will a provider be able to meet take rates of 40-60% while other providers are invited to compete for the same customers? Ultimately, the open access question will be determined by all the investors and stakeholders.

In most cases, excess[4] conduit and fiber deployed can be leased through an agreement called an Indefeasible Right of Use (IRU). IRUs are commonly used in the industry to provide long-term access to assets. The term of an IRU typically runs between 10-20 years.

6.2.1 Conduit Leasing

Conduit is something that is generally (except in extreme circumstances) part of every underground network fiber build. The most expensive part of a deploying a broadband network is the construction. The cost of the actual assets (fiber and conduit) are a tiny portion of the overall budget. Therefore, if engaging in a network build, it is cost-effective to install larger or extra conduit banks and install high-count fiber during the initial construction phase to cover all current and future needs. It is not cost-effective to have to dig more than once.

There are a variety of conduit sizes that can accommodate one or more fiber cables. Often, the network owner will install a larger size conduit than what is needed in order to lease excess space to other providers that want to install fiber. Sometimes a network owner will install multiple conduits side-by-side instead of having one larger conduit bank because some providers prefer to have exclusive rights to a single conduit for security reasons.

Conduit pricing is usually based on a per-foot basis. Pricing varies based on demand in the region and amount of conduit available. Below is a chart that provides examples of three different pricing structures for conduit:

Location	Price	IRU Term	Total Cost
Boulder, Co	$5.50 per foot	20 years	$722,271 in a one-time payment
Lincoln, NE	$65,000 per year	20 years	$1.3 million paid monthly over 20 years with an escalation clause not exceed CPI.
Baltimore, MD	$3.00 per foot (appx)	Negotiable	Depends on how much leased. City requires any new conduit built by provider to be owned by City

Investing in conduit without building a fiber network is actually a strategy that several localities have successfully implemented. This is not being recommended for the City of Louisville, but the examples below are provided in order to show the value of the asset.

In 2012, the City of Lincoln invested $700,000 into building an extensive conduit system. Restrictions on municipal broadband prevented them from building a fiber network, so they limited the infrastructure to conduit. The conduit was leased for several years to multiple providers including Level 3 and NebraskaLink. In 2014 the city launched a free Wi-Fi initiative with backhaul provided by NebraskaLink. In 2015, the city announced that the conduit project had attracted Allo Communications, who planned to lease the conduit and undertake a massive FTTP buildout with the goal to serve every home and business in Lincoln. As of September 2018, the project is nearly complete. Allo plans to have the project completed no later than early 2019. Allo charges competitive pricing with 1 gigabit service costing approximately $90 per month, and 300 Mbps costing approximately $65 per month.

Atlanta BeltLine is a nonprofit organization that was established to help ignite economic development in an urban area of central Atlanta. The BeltLine owns an old railroad Right-of-Way (ROW) that is a natural loop around the City. The Beltline has been building a conduit system to run under the land around the entire ROW. The BeltLine is moving forward with plans to lease the conduit to interested broadband providers and they have recently hired a company to assist them with the marketing and management of the system.

[4] Conduit and fiber strands that will not be used by the municipality.

Dark Fiber Leasing

Dark fiber refers to fiber optic cable that has been installed and is available to use but is not connected to any electronic devices and not transmitting any data. Dark fiber is also referred to as excess capacity. Fiber optic cable comes in strand counts ranging from 12 strands to 1400+ strands. Any strands not in use by the owner (or other entity) are considered dark fiber strands that can leased.

Similar to conduit, dark fiber pricing is subjective and includes but is not limited to the following criteria:

- Availability of dark fiber in the area
- Market rate of other dark fiber in the area (sometimes very difficult to ascertain)
- Number of strands to be leased (minimum of two)
- Amount of footage to be leased (per mile)
- Term of years requested
- Payment up-front versus over time
- Amount of strands remaining that may not be marketable (i.e. if an entity only leases a portion of a route, the corresponding strands on the remainder of the route may not be usable. Often providers require the entire route to be leased for this reason.)

Unlike conduit, dark fiber is not based on price per foot but rather based on a per-strand, per mile, per month basis. Prices can range from $5-$750 per pair of strands with a typical IRU term of 10-20 years. Similar to conduit, payments can be made on monthly, annually or on a one-time payment. One-time payments require less administrative work and book keeping. It also provides a large infusion of cash. However, smaller entities may not be able to provide one-time payment and it is difficult to estimate market value over the course of twenty years. Ultimately, all of these considerations are discussed in the negotiating process.

Maintenance can be included in the cost of the IRU or added as an additional fee. Maintenance fees range from about $200-700 per mile, per year. The below chart shows what a rate schedule would look like for a price per pair of strands ranging from $10 - $100 exclusive of any up-front or maintenance fees.

Rate Schedule Based on Flat Fee Per Pair of Strands										
Per Pair	**Per Mile**	**Per month**	**Per Year**	**10 Yrs**	**20 Yrs**	**Per Mile**	**Per month**	**Per Year**	**10 Yrs**	**20 Yrs**
$10	1	$10	$120	$1,200	$2,400	10	$100	$1,200	$12,000	$24,000
$20	1	$20	$240	$2,400	$4,800	10	$200	$2,400	$24,000	$48,000
$30	1	$30	$360	$3,600	$7,200	10	$300	$3,600	$36,000	$72,000
$40	1	$40	$480	$4,800	$9,600	10	$400	$4,800	$48,000	$96,000
$50	1	$50	$600	$6,000	$12,000	10	$500	$6,000	$60,000	$120,000
$60	1	$60	$720	$7,200	$14,400	10	$600	$7,200	$72,000	$144,000
$70	1	$70	$840	$8,400	$16,800	10	$700	$8,400	$84,000	$168,000
$80	1	$80	$960	$9,600	$19,200	10	$800	$9,600	$96,000	$192,000
$90	1	$90	$1,080	$10,800	$21,600	10	$900	$10,800	$108,000	$216,000
$100	1	$100	$1,200	$12,000	$24,000	10	$1,000	$12,000	$120,000	$240,000

In addition, in Colorado, we have received data regarding a recent dark fiber leasing agreement. The agreement resulted in an up-front payment of $300,000 for 2 strands of dark fiber priced at $156 per pair of strands. The term of the agreement was for 10 years and the entity received a discount in exchange for an up-front payment.

6.2.2 Other Conduit and Dark Fiber Leasing Considerations

When leasing conduit and dark fiber, the owner of the infrastructure must take into account the following considerations:

- A map (GIS ideally) and inventory of all assets leased and available to be leased must be kept current and active. There are several companies that offer cloud-based cutting-edge fiber management software solutions.

- Maintenance of the conduit and the fiber generally falls to the network owner and so the owner must have policies and procedures in place to meet any service level agreements (SLAs) that the lessee's have in place. In other words – the network owner must be able to repair fiber cut within an emergency window to prevent downtime outages to the network customers.

- The network owner must have a plan in place for third-party network access.

- The network owner must have a process in place for interested third-party applications as well as templates for legal agreements and other documents.

7. Network Ownership and Operational Costs

The data presented in Section 6 provided high-level capital costs for the deployment of different network options that included design, engineering, electronics, materials and construction for each model. However, when considering network options, understanding the operating costs and developing the right ownership and operating model are critical for success. This Section provides a high-level overview of operating costs as well as explores the variety of network ownership and operating models for municipal networks.

7.1 Operating Costs

If and when a network model is selected, the next phase would be to develop a full business and financial plan that would include operating costs. Since a model has not been selected yet, we wanted to provide a rough overview of what operating costs would look like for the various options.

7.1.1 Last-Mile Operating Costs

For any of the last-mile FTTP network options, operating costs to build into a business plan would include but would not be limited to the following items:

- Personnel
- Customer service for residential customers (call center, technicians, etc..)
- Back office billing and administrative systems
- Operational vehicles
- Electronics and equipment warranty and support
- Insurance
- Electricity/utilities
- Transport/bandwidth cost
- Marketing
- Professional services - legal/consulting/accounting;
- Depreciation
- Maintenance and repair

A full Business and Financial Plan would include:

- 10 Year Forecast
    - Estimated market penetration, service offering rates and information
    - Capital expenditure costs and depreciation
    - Balance sheet, income statement (operating revenues, expenses) and cash flows

- Forecasted financial Schedule:
    - Projected balance sheet
    - Projected income statement
    - Projected cash flow and revenue
    - Projected rate of return (ROR) on investment

- Projected Capital Expenditures

- Projected Depreciation Schedule
- Projected Personnel Expenses
- Projected Operating Expenses
- Budget and Funding Plan

The full business plan will also determine the pricing for offerings such as video, phone, and broadband services. Pricing of services should not be developed without a business plan.

Based on VPS experience in developing business plans for providers across the country, operating costs can range between $90 and $160 dollars per location/per month. To put that into perspective utilizing the Louisville FTTP models, this is a very rough estimate for operating costs.

	100% Penetration	60% Penetration	30% Penetration
OSP and Electronics Cost	$32,406	$26,412	$21,914
# of Households passed	7299	4387	2203
Operating Costs Range	$656,910 - $1,167840	$394,830 - $701,920	$198,270 - $352,480

7.1.2 Middle-Mile Operating Costs

The operating costs for a middle-mile network run by the City would be significantly less than what is discussed above. To generate true costs, the network plan would need to be scoped. However, when comparing the operating costs of an FTTP with a middle-mile network, it is clear that for a middle-mile network:

- Personnel will be significantly less and could be as few as one or two individuals
- Customer service (call center, technicians, etc..) would not be needed
- Back office billing and administrative systems could be rolled into existing City systems
- Operational vehicles would probably not need to be purchased
- Electronics and equipment warranty and support will be significantly less
- Network insurance will be significantly less and might be covered by current City Insurance policy
- Electricity/utilities will be significantly less
- Transport/bandwidth cost will be significantly less
- Marketing will only be needed if the City wants to lease its conduct or dark fiber
- Professional services - legal/consulting/accounting would be significantly less
- Maintenance and repair including locates will be significantly less (less fiber miles to manage)

If the City decided to build a backbone network that did not connect to any City institutions, the capital costs and the costs to operate the network would be even less. This option is not recommended unless the City decides to make the backbone an open-access network which would provide some benefit to the City through leasing revenue.

If the City were to consider extending the middle-mile network beyond what is proposed with the 19 City institutions, to include a few additional facilities (i.e. schools, hospital), the capital costs to build the network extensions would increase while the operating costs would relatively stay the same.

If the City were to build an open-access middle-mile network there could be a few additional costs for the City to set-up and manage the conduit and dark fiber leasing program. However, there have been models where the City outsources

these tasks to a vendor who pays the City commission on fees generated from leased assets. This kind of model helps to offset some of the operating costs of a dark fiber leasing program.

7.2 Ownership Models

There are multiple kinds of ownership and operating models for municipal networks.

7.1.1 Publicly-Owned and Operated Network

This is a municipal network that is almost 100% self-provisioned. In other words, the municipality solely owns, and internally manages and operates the network and may only need to hire a few contractors for things like locates, and installations. Networks that are self-provisioned are most likely to be municipal electric utility broadband networks such as Longmont NextLight because they already have the back-office systems, trucks, and experience to add on a broadband service. However, FairlawnGig previously discussed in Section 6 is a rare example of a greenfield municipal network that is 100% self-provisioned without having an electric utility.

7.1.2 Publicly-Owned and Privately-Operated Network

In this model, the municipality owns the assets, and provides oversight, but outsources the management and operations to a third-party entity who also provides the services. This is a more common model for municipal networks and is appealing for localities that do not wish to directly become a service provider. An example of this type of operating structure is Hudson Oaks, Texas previously discussed in Section 6. Hudson Oaks owns the infrastructure and is leasing access to a local ISP who is serving as the service provider.

7.1.3 Hybrid

Another option is to create a hybrid model that combines one or more of the above options. This includes:

- Public-Private Partnership (PPP)
- Creation of a non-profit or reginal entity

7.1.3.1 Public Private Partnerships (PPPs)

Public-private partnerships (PPPs) are a relatively young phenomenon in broadband. A PPP is a legal partnership wherein the partners balance and apportion risk, benefit and control. Recently, more and more municipalities are exploring establishing a PPP for deploying and operating last-mile networks. There are many different types of PPPs.

They include but are not limited to the following:

- An investment entity that steps forward to provide funding for the network in exchange for a long-term payback on their investment. This is a traditional PPP. The investment entity usually requires an ownership stake in the assets and sets other conditions such as requiring the municipality to provide a credit backstop to guarantee investments. The municipality generally may or may not need to provide cash contributions. An investment entity is only likely to be drawn to projects that cost a minimum of $15 million dollars. An investment entity also generally works with another partner that is the service provider.

- A partnership wherein both the municipality and provider contribute funding and resources to the project. Both may share in ownership of the assets. For example, the municipality owns the middle-mile infrastructure, but the provider owns the drops from the middle-mile network to the customer premise.

The type of PPP depends on a number of factors, including:

- Whether the provider can make a profit with take rates that justify an investment;
- The sum total amount of financial resources the municipality can provide;
- Whether the municipality is willing to be flexible on asset ownership;
- Whether there is a private-entity that is interested and viable;
- Whether the municipality and private partner can come to agreement on terms and requirements.

Some ISPs would prefer to own their own infrastructure -including the middle-mile backbone in order to control the infrastructure. On the other hand, other ISPs need the municipality to build the middle-mile to offset deployment costs.

Despite the fact that PPPs are widely pursued as options for last-mile municipal broadband networks[5], a PPP is difficult to establish. This is particularly true in rural areas where the cost of the build is high and the number of potential customers makes it difficult to justify the investment. This is also true in suburban areas where there are existing incumbent providers with a broad footprint that have a market share of subscribers.

7.1.3.2 Joint Authority or Non-Profit Entity

For networks that may involve more than one municipality or financial contributions that are coming from more than one entity, a good option to consider is to create some kind of joint-authority entity or nonprofit. For example, Northwest Colorado Broadband that was more fully discussed in Section 6 created a nonprofit entity with six founding members that included the City, County, school system, electric association, Chamber of Commerce, and hospital. Several of the partners contributed funding and/or own assets that were part of the project to build a middle-mile network through Steamboat Springs. The founding members serve on the Board of the nonprofit and the nonprofit is responsible for overseeing the network build, and operations. Since the nonprofit does not have any staff, the nonprofit hired a network operator to manage the network, and manage the dark fiber leasing and marketing.

The nonprofit may also pursue grants, and expand services into the region. By establishing a nonprofit it increases the ability to share resources, share costs and create economies of scale for smaller networks that may better entice network partners. A regional entity could also more easily deploy and manage options for programs including Wi-Fi deployment, smart city applications and dark fiber leasing.

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[5] A recent trend by communities interested in exploring PPPs, is for the municipality to issue a Request for Information (RFI) to invite potential interested partners to submit proposals. To date, this has not yet proven to be an effective strategy in the establishment of a PPP. This is due to a few key reasons. First, there are instances where the RFI itself has created confusion and significant delay in network planning – particularly where the RFI is issued prematurely, is open ended, vague, or includes too many difficult to meet requirements.[5] In some cases, this has resulted in situations where a community has had to re-issue the RFI with new requirements and/or hold multiple rounds of interviews. Vendors are wary of the RFIs that lead to nowhere. A much more effective strategy is to hold meetings with providers and explore this option before issuing out any RFIs or RFPs.

8. Broadband Best Practices

Around the country, there are a number of best practices that communities have implemented to assist with broadband access and deployment. These policies and procedures can be explored whether or not the City desires to move forward with deploying a municipal broadband network. The goal with these best practices is to ensure that the City has the proper processes in place to comply with new FCC rulings, federal legislation and is able to create internal and external efficiencies for permitting and other activity that occurs in the City Right-Of-Way (ROW).

Examples of local government best practices include the following:

- Dig Once: Dig Once refers to a practice wherein the municipality requires conduit/and or fiber to be placed in the Rights of Way (ROW) anytime that a road or ROW is excavated, or a new development is built. The bulk of the cost of broadband deployment is in construction and so it makes sense to take advantage of those situations where an area is being excavated. However, before implementing this practice, there needs to be a careful plan for the placement and tracking of facilities. Otherwise, the municipality will end up with conduit or fiber in random places that do not connect to one another. Not having a clear plan will negate the benefit of having a Dig Once requirement.

- Clear and transparent permitting requirements and process overviews that are easily accessible online for providers. For example, creating an online portal for the electronic uploading of permit applications with an application, checklist, and information on what the applicant can expect in terms of process and timeframes. Managing expectations with clear communication goes a long way to alleviating issues and uncertainty on the provider side.

- GIS Tracking and mapping of all facilities to encourage collocation of wireless technologies. The City should also have a GIS map of all its facilities and infrastructure for tracking, and for locates so that valuable assets are not inadvertently damaged by other construction projects.

- Setting policies to require land developers to provide a plan for telecommunications facilities as a part of their development package. This could include requiring developers to meet with the broadband and cellular wireless carriers before any construction commences. New developments that are built without consideration to cellular technology needs can overburden an already taxed system and result in a significant depleting of cellular signals to the entire area. If you ask the carriers, they will tell you that quite often, they do not hear about a new development until it’s almost complete. Cellular carriers would much prefer to be part of the planning process because it’s easier and better to build a new antenna while the entire development is under construction than after the fact when residents have moved in. In addition, the developer could be required to place conduit and fiber at the same time as constructing other underground facilities such as water or sewage.

- All of these examples above require City inter-departmental coordination to ensure that departments are working together on public or private land-development projects, permit applications, and other projects. For example, implementing a Dig Once policy requires public works, public safety, IT, planning and zoning to be in the loop on permit applications for public or private road excavation projects.

Overall, the City should evaluate its processes to ensure that telecommunications are a part of any short or long/term planning by the City. Carriers and providers will not ensure that City needs are being met.

9. Funding and Financing

A key component in developing the business plan for the selected model is to identify all potential funding sources. This last section briefly discusses possible funding options for municipalities separate from any private-sector partner contributions that could be possible. Depending on the amount of funding needed to support the selected model, one more of the below options could be utilized.

One thing to keep in mind is that a City usually has a different need for building a network than a private sector provider. For example, a private provider is largely profit driven and must generate revenue for the network to be sustainable. Municipal networks – particularly those that are middle-mile usually serve a different purpose. The City is building the network for internal connectivity to anchor institutions, to generate cost savings, or to use for economic development purposes. Therefore, in many cases, City networks cannot rely on network-generated revenue as a mechanism to support a bond payment or loan.

9.1 Public Self-Funding

The first funding option to consider is through City general fund set-aside. Depending on the amount of funding needed, the City may be able to entirely fund a network build by either shifting funds or budgeting for them. Kent County, Maryland funded their entire 100-mile network build by paying for it directly out of their general funds. A City may also set-aside general funds to pay back a revenue bond if partially or fully funding a network out of general funds is not feasible.

9.1.1 Revenue Bonds

Aside from allocating capital project funds as part of the budget process, bond funding is something municipalities can utilize to assist with funding network construction, and to support startup and maintenance costs. This is traditionally what many municipalities have used to finance their broadband network. Bonds can be repaid either by revenue generated from the network or through other funds. Bonding agencies have supported this movement because a fiber network is a valuable asset to a community.

If revenue from the network is expected to be relied upon as funds to pay back the bond, the business plan must support that expectation. In addition, the City should have a contingency in place in the event the identified funds for paying back the bond do not materialize. For example, the State of Kentucky ended up with an $11 million-dollar shortfall for bond repayment because a source of funding to pay back the bond fell-through.

9.1.2 Taxation

Taxation is another source of funding that local governments can consider. Some municipalities have either obtained approval to utilize other taxation revenues already in place or have opted to place a referendum on the ballot for residential approval to establish a special taxation district. These strategies are typically utilized in high-dollar builds when millions of dollars of funding is needed.

9.1.3 Inter-governmental Loans

The City of Fairlawn, Ohio financed their greenfield FTTP network through the Development Finance Authority of Summit County, OH which offers fixed rate/bond fund, conduit/non-bond fund, PACE program and tax credit financing arrangements for businesses located in Summit County, OH. This type of funding is like an intergovernmental loan.

Loans are not typically utilized in the public-sector.

9.1.4 Connection Fees/Liens

Another mechanism for partially funding a last-mile network is to charge a large connection fee to every home that wishes to connect to the network. The City of Ammon, Idaho has funded a significant part of their network by charging a $3000 connection fee payable either in lump sum or over a twenty-year period to every home that wishes to purchase service. The connection fee operates like a lien. If a resident moves, the payment stays with the house and applies to the next home-owner. If money is still-owed, the new resident will be expected to pay the remaining funds due.

9.2 Federal and State Funding Opportunities

Currently, there are no funding federal or state grant or program funding opportunities for the City of Louisville. Most programs are strictly designated for rural areas that are either completely unserved or have less than 10/1 speeds.

9.3 Third-Party Funding

Municipalities looking to build a FTTP network often seek a PPP in order to off-set the costs and share the financial risk with a private sector partner. Unfortunately, Louisville is not likely to attract a private investor due to the fact that the community has multiple providers and residents already have the option of purchasing gigabit service.

10. Feasibility Analysis and Recommendations

Based on all the information detailed in this Report, this Section analyzes the network models presented Section 6 including the non-network options and provides recommendations for the City.

10.1 Last-Mile Models

Unlike many Colorado communities in rural areas, the City of Louisville is currently served by multiple providers with 100% penetration. Every resident in Louisville has the ability to access high-speed broadband. Not every resident may be purchasing high-speed broadband, but the services are available to those who choose to purchase them. The result of the surveys and the stakeholder outreach confirms this conclusion.

Comcast is also in the process of a network upgrade that represents a multi-million-dollar investment to their infrastructure. Comcast is also continuing to work on rolling out new services and including speed enhancements including gigabit service. Louisville is the 3rd community in Colorado where this infrastructure is occurring.

With current satisfaction levels of existing providers and the fact that there are multiple providers in Louisville, the take rates for a FTTP network are estimated to be between 30-35% - which is low for a network to be sustainable. In order to maximize take rates, a new provider would need to:

- Offer faster, better, service at a much lower price
- Provide an option for television to allow for discounted bundled packages

Longmont's NextLight is able to offer gigabit service for a low price ($59/month or cheaper if the customer is a charter member) in large part because they are a municipal electric utility and the cost of deploying a FTTP network in Longmont was significantly less than what it would cost in Louisville. For comparison – Longmont's population is just over 92,000 people. The initial bond approved to fund their network was $43 million. Longmont underestimated take rates and needed to obtain some additional funding. However, even assuming it cost approximately $50 million, it is still significantly less per subscriber than the estimated $32 million it would take to build a full FTTP network in the City of Louisville with a population of just over 20,000.

Additionally, the City would not be able to dictate the gigabit price offering to ensure it provides more bandwidth for less money than what residents are currently paying. Price is dictated by what the network needs to sustain itself as determined by the completion of the business plan. It could be $59 a gigabit or it could end up being $89 a gigabit which is what Ting just announced they will be offering residents in Centennial.

Speed to market and other factors also impact take rates. For example, it would most likely be a minimum of 24-36 months before a FTTP network could be built and ready to provide service. In that time, current providers could offer better packages and lower pricing and require a commitment of a year or two which has happened in other communities planning network builds. Contracts that lock customers into a term of a year or more impact the customer ability to change providers even if desired.

A 100% penetration FTTP network places too much financial risk on Louisville. For these same reasons, and given that multiple providers are in Louisville, this option is also unlikely to attract potential PPP providers who could invest in a FTTP network and share some of the financial burden.

In looking at the three options below – even a lesser build network and places too much financial risk on the City because it reduces the pool of potential subscribers to a level that may or may not be sustainable.

	100% Penetration	60% Penetration	30% Penetration
OSP and Electronics Cost	$32,406,000	$19,472,000	$9,766,000
Total Locations	7,299	4,387	2,203
Mainline Miles	135.3	81.2	40.6
Drop Miles	248.8	149.6	75.1

As previously discussed, the purpose of a feasibility study is to determine what the problem is that the City needs to solve. In Louisville, the problem is not access to high-speed broadband. Could providers offer better pricing and services? Absolutely. However, the risk is too great for the City to invest in a FTTP network.

Recommendation #1

VPS does not recommend that Louisville move forward with any of the last mile FTTP network options.

10.2 Middle-Mile Network Models

Middle-mile networks cost less to deploy because they are only designed to reach anchor institutions. In Louisville, there are 19 total facilities to connect to with a middle-mile network. BVSD is adequately serving its schools and there would not be a need for a Louisville middle-mile network to serve the schools.

There is a need for the City to improve and enhance its middle-mile network whether or not the City wishes to additionally implement open access policies and generate revenue from conduit or dark fiber leasing. As discussed previously, the current City network is not a redundant ring. Currently there are no GIS resources to map the network. This would be a necessity for the City to locate (mark location when digging occurs) it's network and protect its assets.

The benefits of a middle-mile network are substantial and would enable the City to:

- Deploy critical infrastructure that will serve City needs for the next 30+ years
- Overlay the middle-mile network with Wi-Fi to enhance the Historic Downtown area and 5 parks around the City very cost-effectively
- Enable the City to deploy smart city applications with control over its own network
- Own a network with an investment cost that is much smaller with a risk much less significant than a last-mile network
- Build fiber to towers to better encourage wireless technology deployment
- Reduce costs in providing direct service to the anchor institutions
- Lease excess fiber and conduit to generate revenue and encourage private provider investments.

Another benefit of a middle-mile network is the City could coordinate with neighboring communities including the Town of Superior and could interconnect multiple middle-mile networks which would increase the benefits and allow for economies of scale. For example:

- A larger inter-governmental regional middle-mile network provides more fiber that could be leased to third-parties with longer routes (i.e. leasing from Superior to Lafayette rather than just within the City limits of Louisville).

- A non-profit entity could be formed to oversee and manage the regional networks together which would save operating costs and maximize resources.

- A non-profit entity could more easily deploy smart city applications, launch pilot projects, and generate economic development on a regional level.

Finally, the question to answer is this – what is the problem the City needs to solve? The answer is that the City could benefit from more middle-mile fiber to deploy Wi-Fi, explore options for smart city applications and other things including public safety interoperability, and enhance government services. The City could benefit from investing in critical infrastructure at a fraction of the cost of a last-mile network that could be a valuable asset for decades to come. A middle-mile network could be coordinated with neighboring jurisdictions and the benefits outweigh the risks.

Recommendation #2

VPS recommends that Louisville consider building a middle-mile network with Wi-Fi. This could be done all at once or phased in over time.

10.2 Broadband Best Practices

In addition to exploring implementing the best practices options discussed in Section 8 of this Report as needed, VPS recommends that the City review its wireless permitting processes.

In late September, the FCC released a Declaratory Ruling and Third Report and Order that significantly limits state and local management of small wireless infrastructure deployment and associated fees for use of the rights of way.

With Louisville's population density and a Historic Downtown area that is a destination for residents and tourists, the City of Louisville is a prime candidate to see carriers apply for small cell and 5G wireless facilities applications. The new FCC ruling could impact the City's ROW code provisions that are currently being updated.

Recommendation #3

VPS recommends that Louisville consider implementing the best practices that are referenced herein as needed.

Appendix A – Technology Background

For background and as a Broadband 101 primer, it's important to understand the definition of broadband as well as the different types of technologies referenced in this Report. Broadband technologies can be broken down into two main categories – wireline and wireless. This Appendix provides an overview of each and helps define some the terms that will be utilized in this report.

Wireline Technologies

Wireline technologies rely on a physical cable for transmission of the communication signal. These cables usually transport an electrical signal on a copper cable or an optical signal on a fiber optic cable. There are three common wireline technologies used by wireline companies today. These are:

- Digital Subscriber Line (DSL) – This wireline technology overlays a broadband signal on existing twisted pair copper cables. Broadband speeds on DSL networks are dependent on the customer's distance from electronics in remote terminals or central offices. Modern DSL technologies can typically provide 1 Mbps to 2 Mbps download speeds, depending upon the quality and size of the copper cable. However, for customers served by copper cable that exceeds 18,000 feet in length, the distortion caused by the capacitance of the cable renders the cable unsuitable for quality voice. Telephone companies have historically provided voice service over twisted pairs of copper cable. Consequently, millions of miles of twisted pair copper cables have been deployed throughout the country. However, most service providers have concluded that DSL is near the end of its useful life and will not be a long-term solution for broadband delivery. Therefore, they have been looking to fiber technology to meet the increasing customer demand.

- Coaxial Cable (DOCSIS) – Coaxial cable can also be used to provide wireline broadband services with typical speeds of 160 Mbps downstream and 120 Mbps upstream that can be shared by a large number of subscribers. Most Cable Television (CATV) providers like Comcast rely on COAX cables. The CATV industry has implemented standards called Data Over Cable Service Interface Specifications (DOCSIS), which defines how the COAX network can be used to deliver broadband services to their customers. It is important to note that the CATV coax networks are shared – meaning a single cable leaving the CATV headend is split many times to serve many customers. Often, a single cable will provide broadband and/or video to hundreds of customers. This architecture worked well for broadcast video services, since it was a "one-to-many" service, but has limitations when delivering services such as broadband, where each customer requires their own unique connection.

- Fiber to the Premises (FTTP) – This wireline technology serves all customers by a fiber optic cable. Most FTTP equipment allows between 70 Mbps and 1 Gbps of broadband to each customer and is capable of serving customers that are more than twelve miles from the central office or electronic field terminal locations.

Wireless Technologies

Wireless technologies transmit the communication signal "over the air" on a radio frequency (RF) carrier. There are four common wireless technologies used by providers today. These are:

- Fifth Generation (5G) – The Third Generation Partnership Program (3GPP) organization is in process of defining the 5G standards, expected circa 2019. Per the GSM Association, 5G will be targeting user throughputs of 10 Gbps peak, a hundred times that of 4G networks. Although inherently a mobile technology, the first wave of 5G

will be utilized for the fixed delivery of wireless broadband services. 5G is anticipated to incorporate higher-order spatial diversity (MIMO schemes, beam forming, cell splitting, etc.), self-organizing networks to minimize self-interference and new user interfaces to support the Internet of Things (IoT).

- Fourth Generation (4G) – Utilizes Long Term Evolution (LTE) licensed spectra to provide wireless broadband services, as defined by the 3GPP organization, with duplexing methodology of both time (TD-LTE) and frequency Divisions. Although inherently a mobile technology, today, nearly all terrestrial wireless providers have standardized on Long Term Evolution (LTE) with fixed Customer Premises Equipment (CPE), as the Wireless Metropolitan Area Network (WMAN) broadband technology of choice. All major cellular providers in the U.S. have deployed LTE and continue to expand their LTE footprints.

- Unlicensed Operations – Unlicensed operations on unlicensed spectra can also be used to provide wireless broadband services. Systems operating on unlicensed spectra typically utilize vendor proprietary air interfaces, Institute of Electrical and Electronics Engineers (IEEE) 802.11, or another variant of the IEEE standards. Operations in the unlicensed spectra inherently are utilized for the fixed delivery of wireless broadband services, as the utilization of fixed devices allow for additional deployment efforts to overcome interference inherent within the unlicensed bands.

- Satellite - Satellite-based broadband is not considered a viable broadband alternative due to the high latency which makes it unsuitable for many applications and unable to provide reliable, high-quality voice connectivity.

Some believe that wireless can be a substitute for terrestrial wireline connections that may be too costly to construct. While wireless can be part of the solution and should be considered for deployment in very rural areas – there are considerations that should be taken into consideration.

- Wireless technologies must be replaced every 5-7 years and they can be very costly to maintain.
- Wireless is not suited for growth. For example – since bandwidth is shared among subscribers, available bandwidth per subscriber decreases as density of subscribers or devices increases.
- Available bandwidth decreases as distance of subscriber from access point increases.
- Broadband speeds are more limited. 4G technologies might allow customers to burst up to 10 or 20 Mbps for short periods of time.
- Not well suited for large bandwidth needs and often discouraged by carriers by only allowing a limited amount of data per month.
- Geography and atmospheric conditions can and will impact service delivery for technologies that need to be in sight of each other in order to transmit a signal. Mountains, hills, valleys, buildings, and trees interfere with the propagation of the wireless signal. Some technologies such as LTE can provide non-line-of-site service (NLOS) to some extent, but at significantly reduced throughput compared to direct LOS. These terrain issues and obstacles can mean that some customers cannot receive the broadband signal or that additional towers (and investment) are required.

Wireline vs. Wireless Technology

Both wireless and wireline broadband service providers have benefited from technology advances, but *wireline* technologies have historically been capable of speeds many times faster than the best *wireless* technologies. Fiber optic cable has been used by service providers for more than forty years to build high-speed broadband networks, primarily for long haul transport routes. Over the last ten to fifteen years, fiber has also been used to increase broadband speeds to

the customer because no other technology can deliver as much broadband speed. With FTTP,[6] the broadband speed provided is not dependent upon cable length, but electronics, and each new generation of FTTP electronics allows service providers the ability to offer significantly higher broadband speeds over greater distances without having to make significant changes to their outside plant architecture. There is no foreseeable end to the amount of bandwidth that can be provided over fiber cables.

There are many reasons why fiber is the best technology to construct modern network or upgrade existing networks. Fiber is immune to electromagnetic interference, provides the most reliable services, and minimizes operational expenses. Therefore, it delivers the best voice and broadband services available for today and the foreseeable future. Over the last several years, increases in copper prices, advances in technology, and growth in broadband demand have all worked together to make FTTP a more economical wireline technology for providing broadband. Not only is a fiber network less expensive to deploy, maintain, and upgrade than other wireline technologies, but it has superior broadband capabilities, such as being able to offer telecommuting, telemedicine services, and telepresence. All of these factors make it clear that copper is a dying technology in the telecommunications industry. It would be unwise for companies to utilize copper in their network deployments going forward, except in certain very limited situations.

Once fiber infrastructure is in place, service providers are able to increase the broadband by simply upgrading the electronics on the fiber cable, which represents a relatively small portion of the overall fiber network investment. Fiber technology will allow higher speeds to be delivered to customers over time with minimal incremental investment, making it the best technology for meeting future broadband service needs.

The amount of bandwidth per customer is significantly greater for a FTTP network when compared to a wireless network. Using the technologies available today, the bandwidth delivered to a customer can be more than 100 times greater than what is possible over a wireless network under similar conditions. The bandwidth advantage for FTTP will increase significantly in the coming years due to technology advances with the electronics.

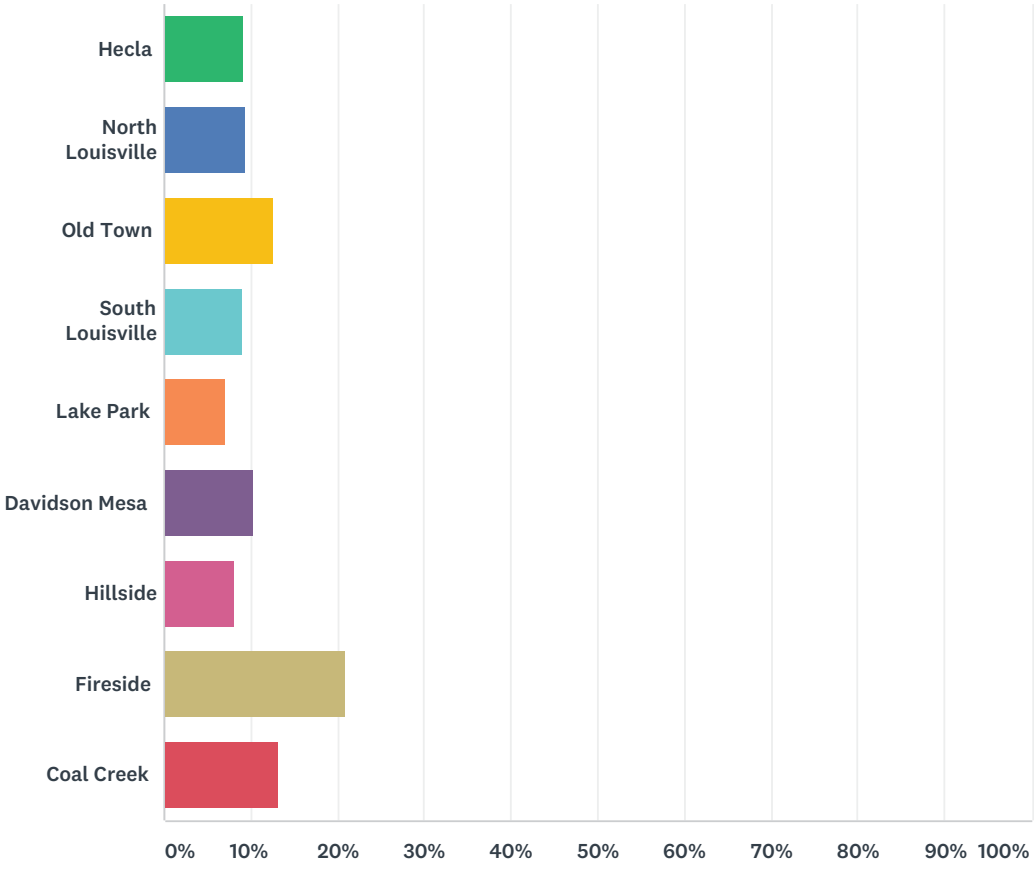
Fiber optic cable is the most-costly to construct. However, it is also an enabling technology that allows for growth. A lion's share of the FTTP investment is the placement of the cable facilities, which typically has a 30-year life, compared to the wireless infrastructure, which has a greater portion of the investment associated with faster-depreciating infrastructure. When placement costs are included over a 30-year life, the cost savings for a wireless network are significantly reduced or eliminated.

[6] Fiber-to-the-Premises is sometimes referred to as Fiber-to-the-Home (FTTH).

Appendix B – Residential Survey

Q1 Based on the below map, please select the approximate area of Louisville where you reside.

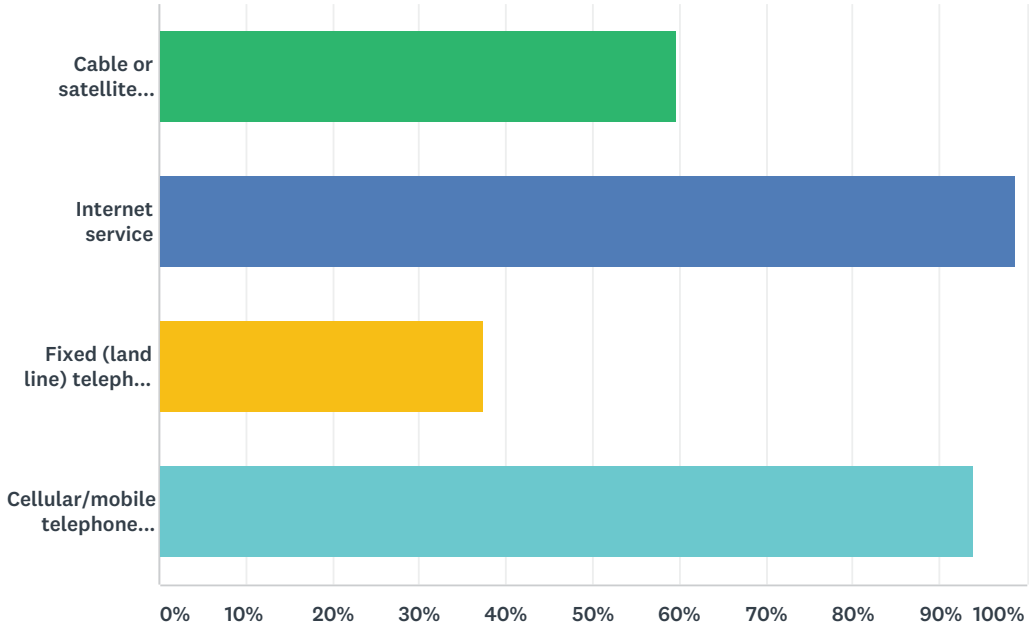
Answered: 791 Skipped: 6



ANSWER CHOICES	RESPONSES	
Hecla	9.23%	73
North Louisville	9.48%	75
Old Town	12.52%	99
South Louisville	8.98%	71
Lake Park	7.21%	57
Davidson Mesa	10.24%	81
Hillside	8.22%	65
Fireside	20.99%	166
Coal Creek	13.15%	104
TOTAL		791

Q2 Which of the following services does your household purchase? (check all that apply)

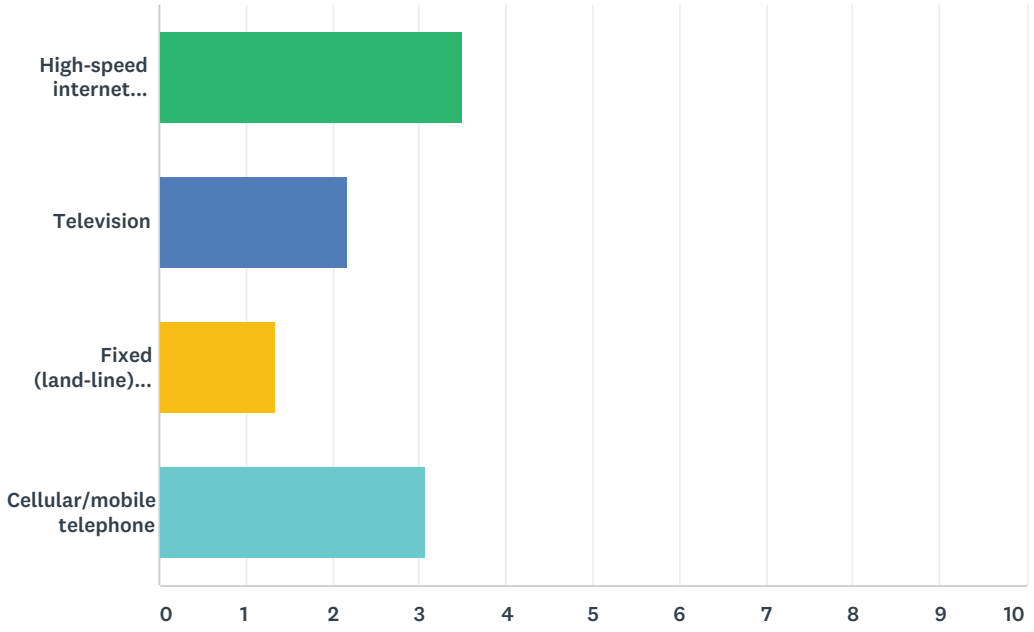
Answered: 794 Skipped: 3



ANSWER CHOICES	RESPONSES	
Cable or satellite television	59.57%	473
Internet service	98.74%	784
Fixed (land line) telephone service	37.53%	298
Cellular/mobile telephone service	93.95%	746
Total Respondents: 794		

Q3 Please rank the following services by order of importance to your household, with 1 being the most important and 4 being the least important.

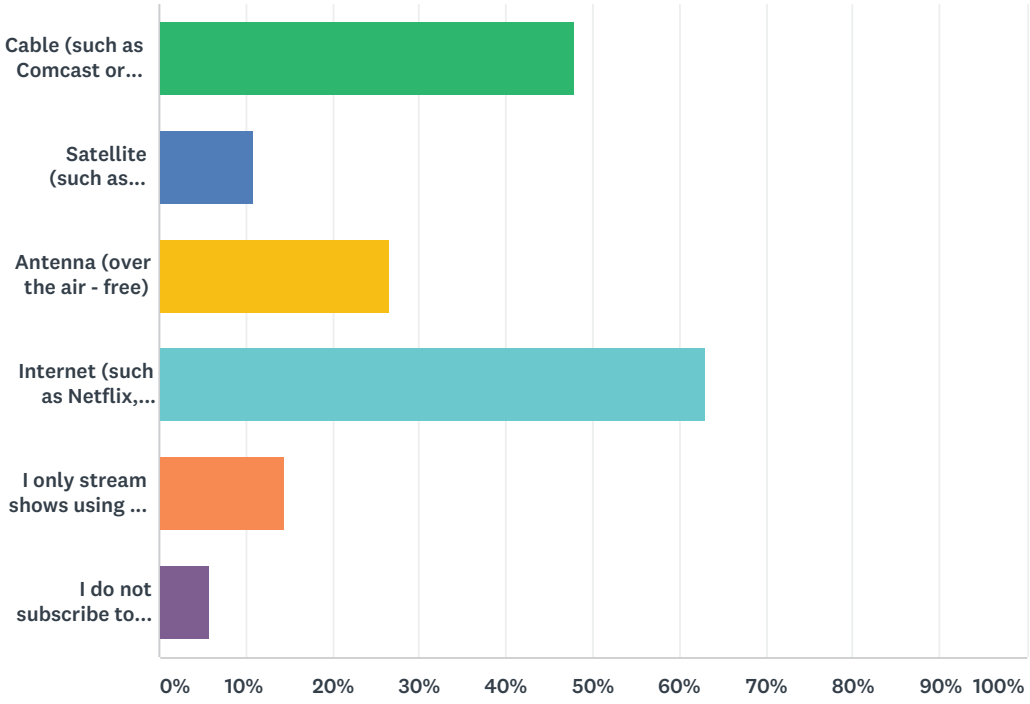
Answered: 795 Skipped: 2



	1	2	3	4	TOTAL	SCORE
High-speed internet connection	61.07% 466	29.36% 224	7.21% 55	2.36% 18	763	3.49
Television	8.27% 62	12.93% 97	66.67% 500	12.13% 91	750	2.17
Fixed (land-line) telephone	4.24% 32	3.05% 23	14.30% 108	78.41% 592	755	1.33
Cellular/mobile telephone	29.13% 231	53.85% 427	11.48% 91	5.55% 44	793	3.07

Q4 What kind of television service does your household subscribe to? (check all that apply)

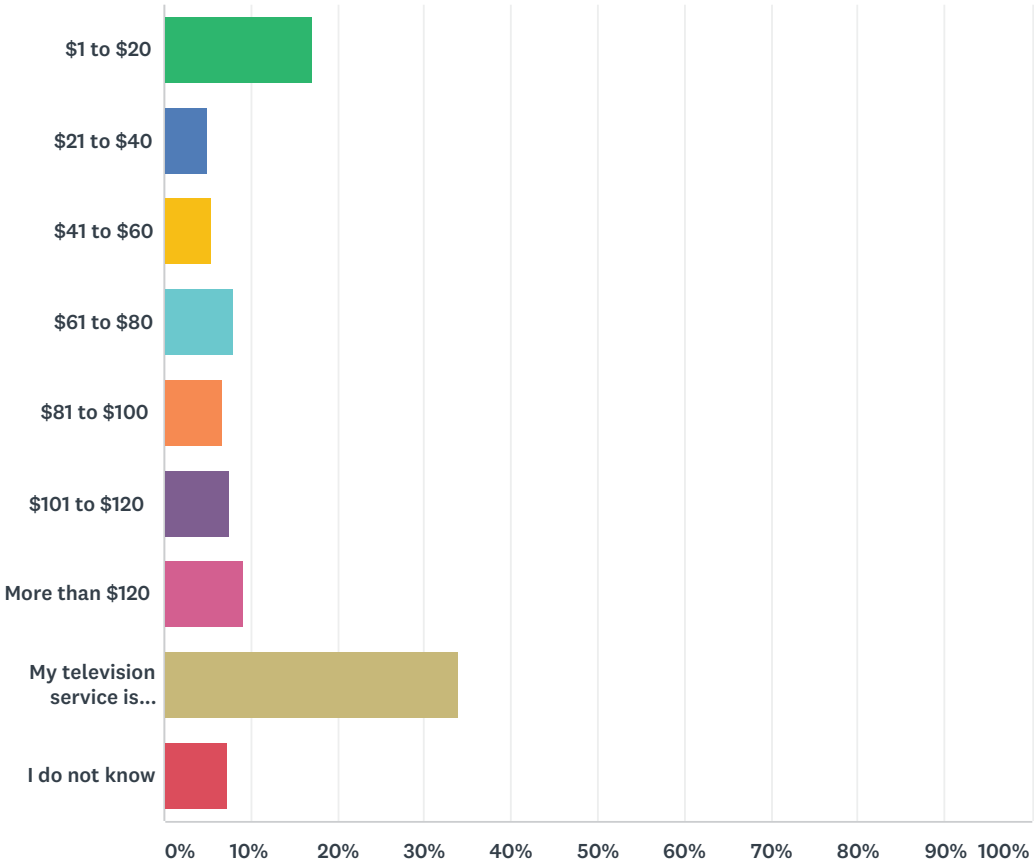
Answered: 795 Skipped: 2



ANSWER CHOICES	RESPONSES	
Cable (such as Comcast or Century Link)	47.92%	381
Satellite (such as DirecTV)	10.82%	86
Antenna (over the air - free)	26.67%	212
Internet (such as Netflix, Hulu, Vudu)	63.02%	501
I only stream shows using the internet and I do not subscribe to another television service	14.34%	114
I do not subscribe to any television service	5.79%	46
Total Respondents: 795		

Q5 Approximately how much does your household currently pay per month for cable or satellite television service (not including internet or phone)?

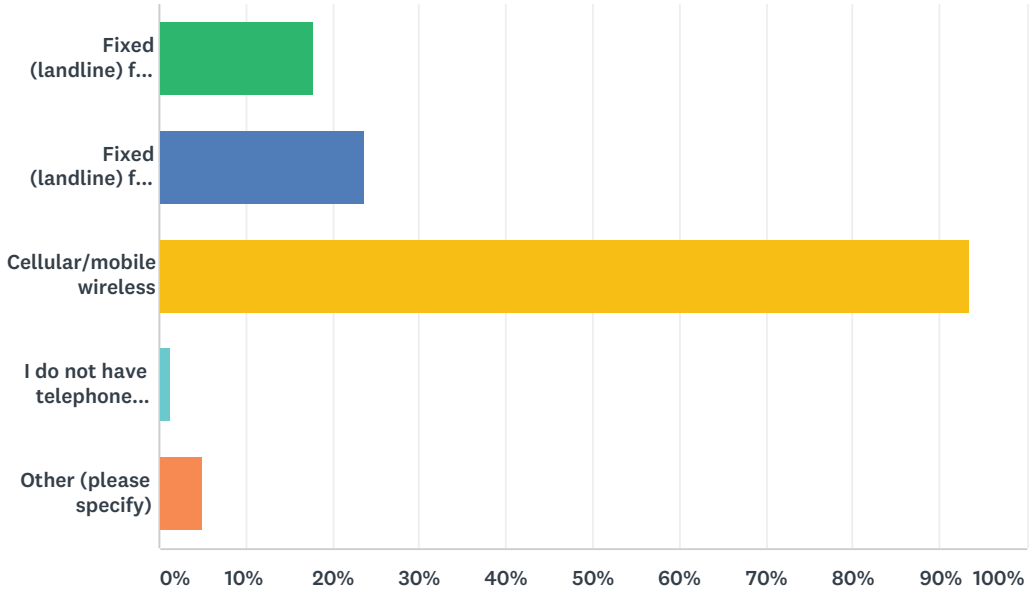
Answered: 709 Skipped: 88



ANSWER CHOICES	RESPONSES	
$1 to $20	17.21%	122
$21 to $40	4.94%	35
$41 to $60	5.36%	38
$61 to $80	7.90%	56
$81 to $100	6.77%	48
$101 to $120	7.48%	53
More than $120	9.17%	65
My television service is bundled with internet or phone	33.85%	240
I do not know	7.33%	52
TOTAL		709

Q6 Please indicate which type(s) of telephone services your household purchases: (check all that apply)

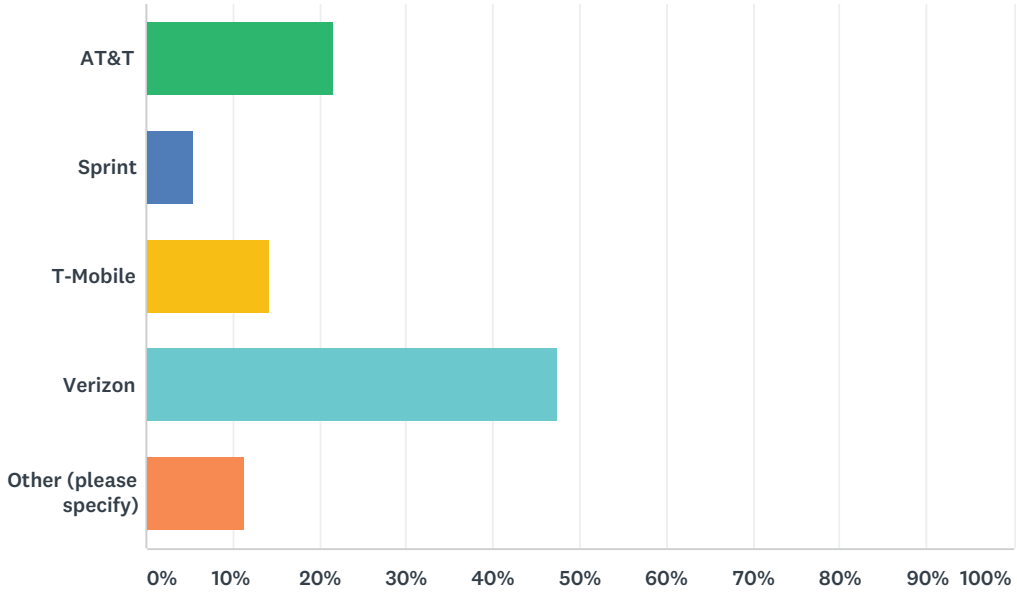
Answered: 784 Skipped: 13



ANSWER CHOICES	RESPONSES	
Fixed (landline) from my telephone provider	17.73%	139
Fixed (landline) from my cable provider	23.72%	186
Cellular/mobile wireless	93.49%	733
I do not have telephone service	1.28%	10
Other (please specify)	5.10%	40
Total Respondents: 784		

Q7 If you subscribe to a cellular/mobile wireless service - who is your carrier?

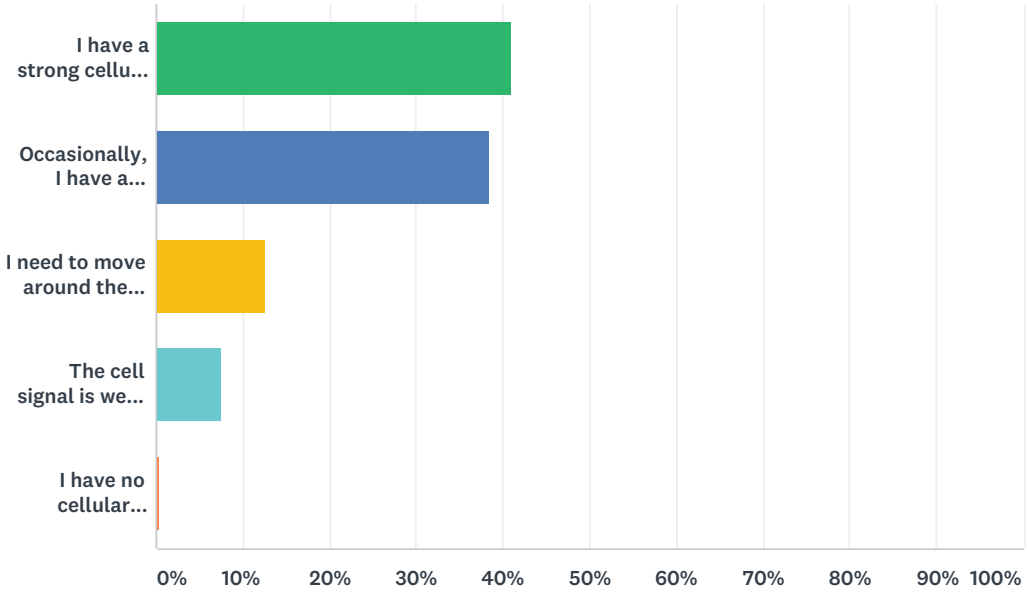
Answered: 782 Skipped: 15



ANSWER CHOICES	RESPONSES	
AT&T	21.48%	168
Sprint	5.37%	42
T-Mobile	14.32%	112
Verizon	47.44%	371
Other (please specify)	11.38%	89
TOTAL		782

Q8 If you subscribe to a cellular/mobile wireless service - how would you describe the cellular signal at your house?

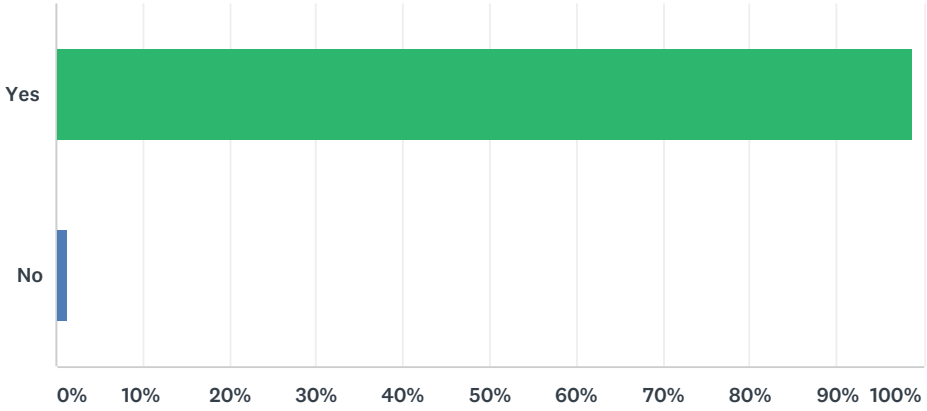
Answered: 781 Skipped: 16



ANSWER CHOICES	RESPONSES	
I have a strong cellular signal at my house and can always make/receive phone calls without an issue.	40.97%	320
Occasionally, I have a problem with my cell signal, but most of the time it is strong enough for me to make/receive calls without an issue.	38.54%	301
I need to move around the house in order to find the best place to make/receive a call.	12.55%	98
The cell signal is weak at my house and it's very difficult to use my cell phone at home.	7.55%	59
I have no cellular service at my house.	0.38%	3
TOTAL		781

Q9 Do you purchase home internet service?

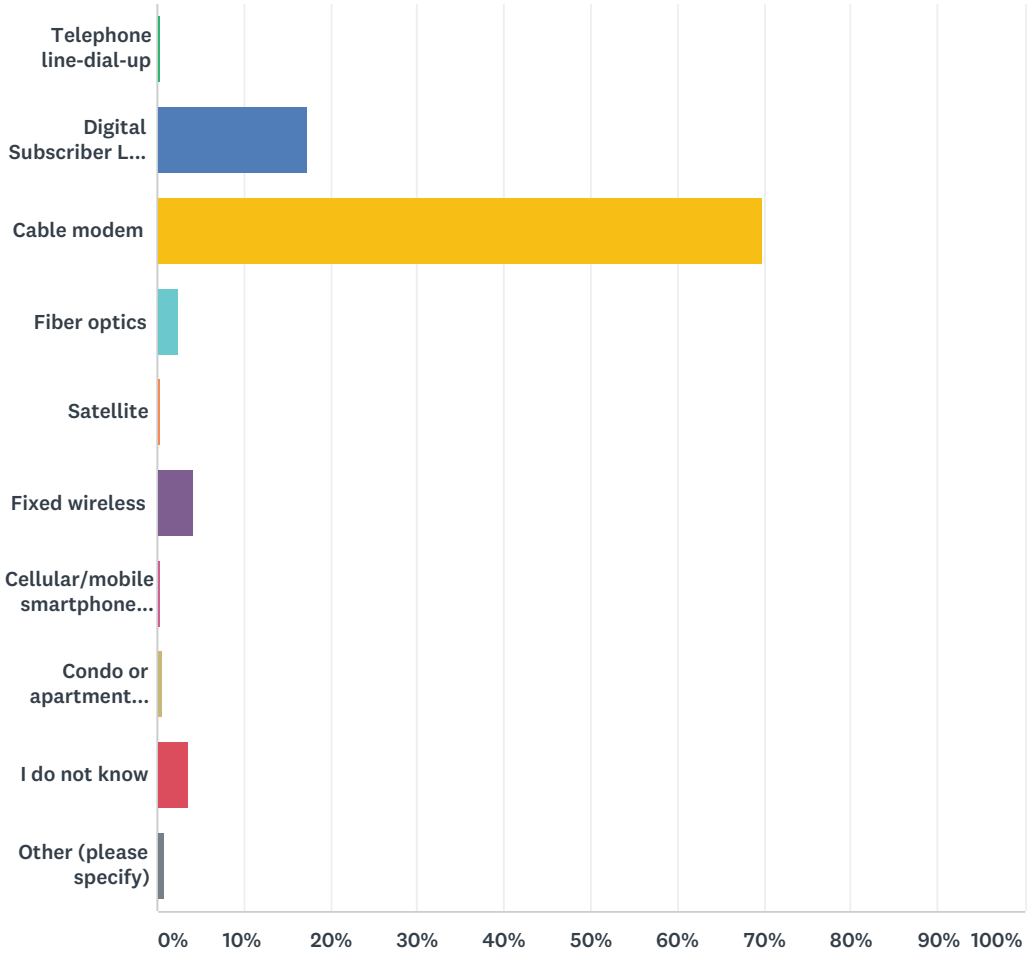
Answered: 787 Skipped: 10



ANSWER CHOICES	RESPONSES	
Yes	98.73%	777
No	1.27%	10
TOTAL		787

Q10 You indicated your household purchases internet service. What kind of connection do you have?

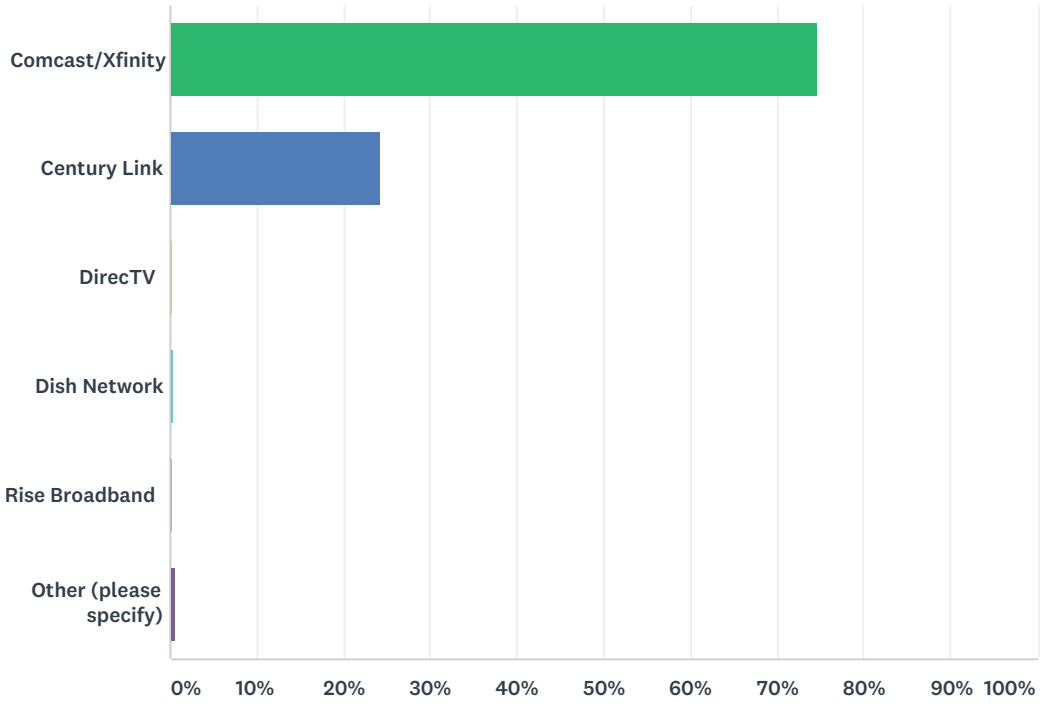
Answered: 761 Skipped: 36



ANSWER CHOICES	RESPONSES	
Telephone line-dial-up	0.39%	3
Digital Subscriber Line (DSL)	17.35%	132
Cable modem	69.78%	531
Fiber optics	2.50%	19
Satellite	0.39%	3
Fixed wireless	4.20%	32
Cellular/mobile smartphone internet	0.39%	3
Condo or apartment association internet	0.66%	5
I do not know	3.55%	27
Other (please specify)	0.79%	6

Q11 Who is your current primary home internet service provider?

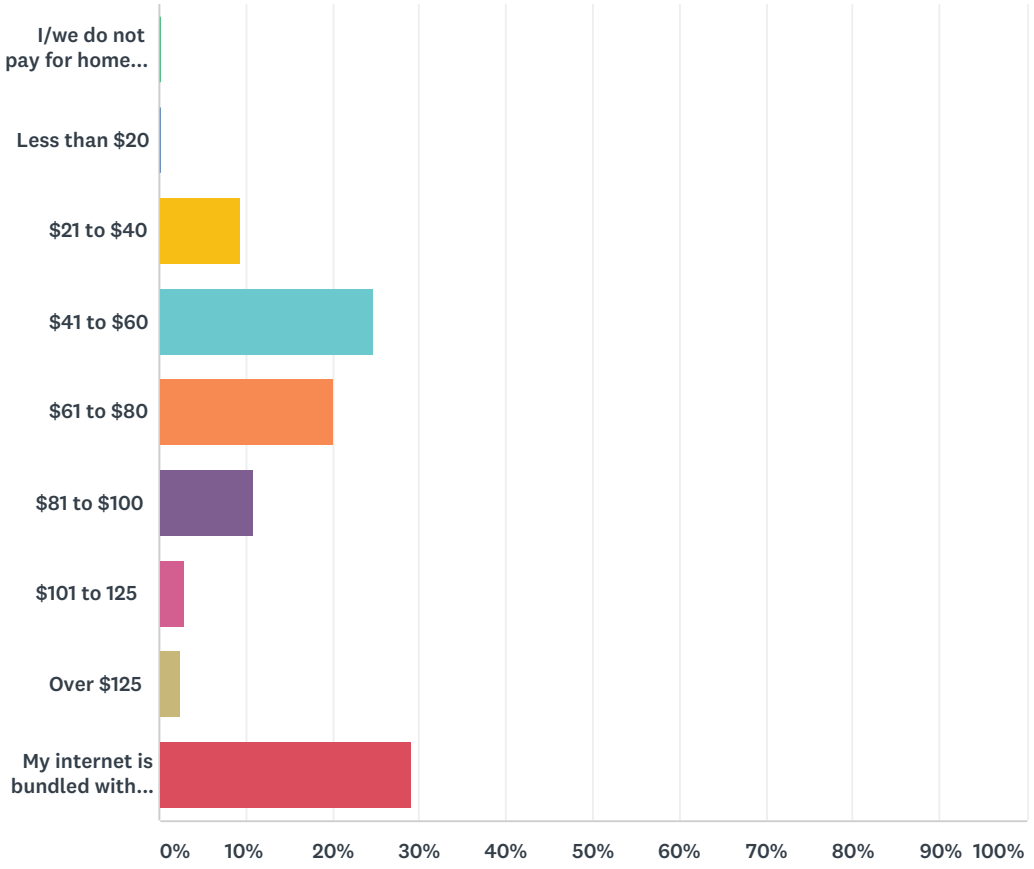
Answered: 761 Skipped: 36



ANSWER CHOICES	RESPONSES	
Comcast/Xfinity	74.64%	568
Century Link	24.18%	184
DirecTV	0.13%	1
Dish Network	0.39%	3
Rise Broadband	0.13%	1
Other (please specify)	0.53%	4
TOTAL		761

Q12 Approximately how much does your household currently pay per month for internet service only (not including television or phone)?

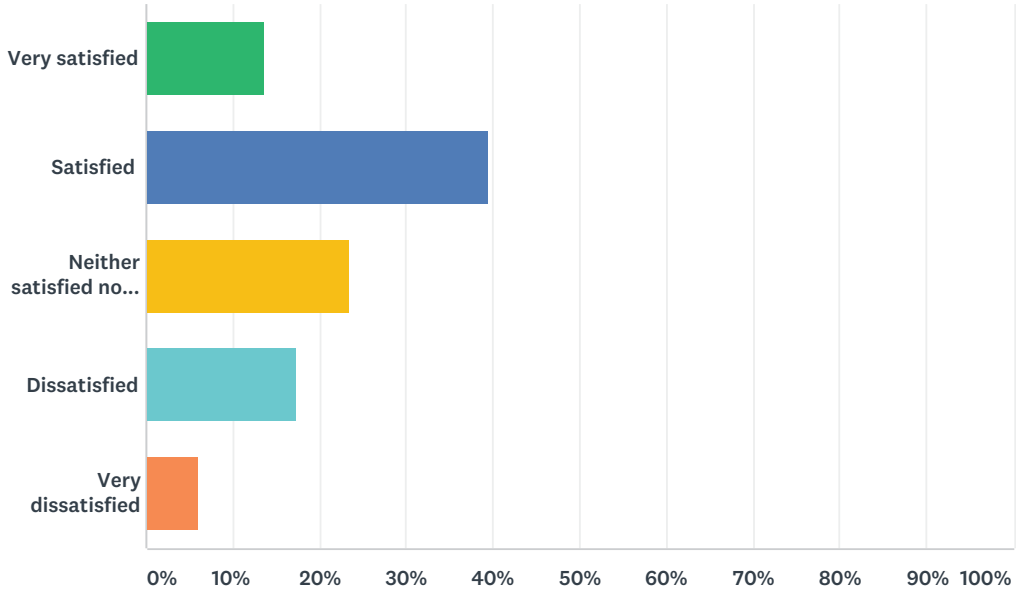
Answered: 760 Skipped: 37



ANSWER CHOICES	RESPONSES	
I/we do not pay for home internet service.	0.13%	1
Less than $20	0.13%	1
$21 to $40	9.34%	71
$41 to $60	24.74%	188
$61 to $80	20.13%	153
$81 to $100	10.92%	83
$101 to 125	3.03%	23
Over $125	2.50%	19
My internet is bundled with other services and I do not know	29.08%	221
TOTAL		760

Q13 How satisfied are you with the service you receive from your current internet provider?

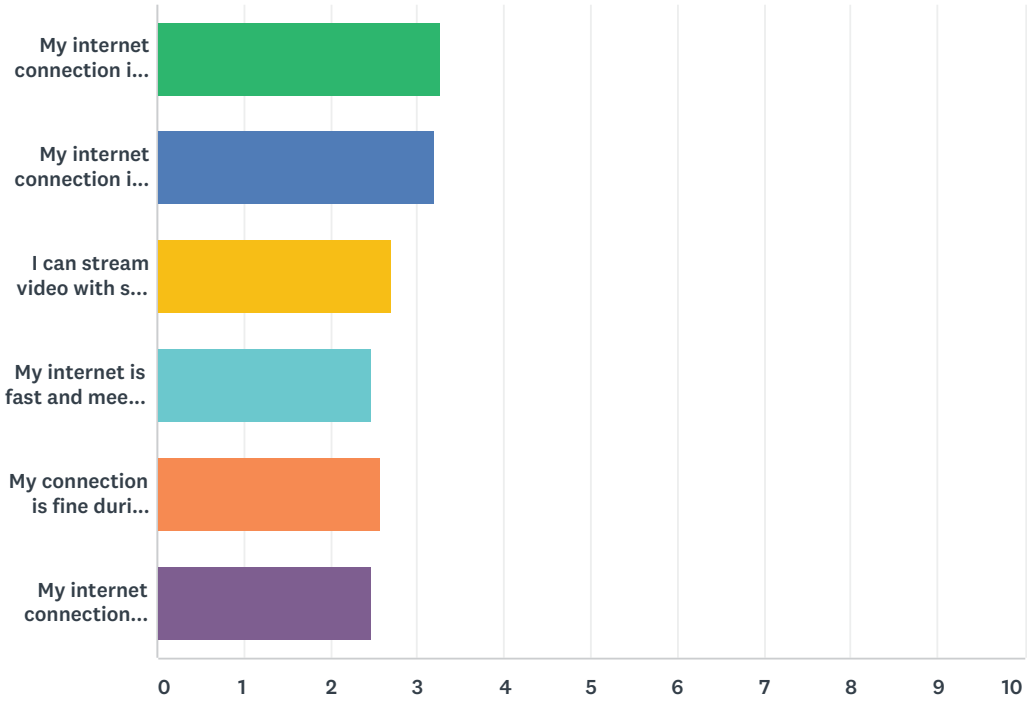
Answered: 762 Skipped: 35



ANSWER CHOICES	RESPONSES	
Very satisfied	13.52%	103
Satisfied	39.63%	302
Neither satisfied nor dissatisfied	23.49%	179
Dissatisfied	17.32%	132
Very dissatisfied	6.04%	46
TOTAL		762

Q14 Following are statements regarding your current home internet service. Please indicate the degree of agreement/disagreement with each.

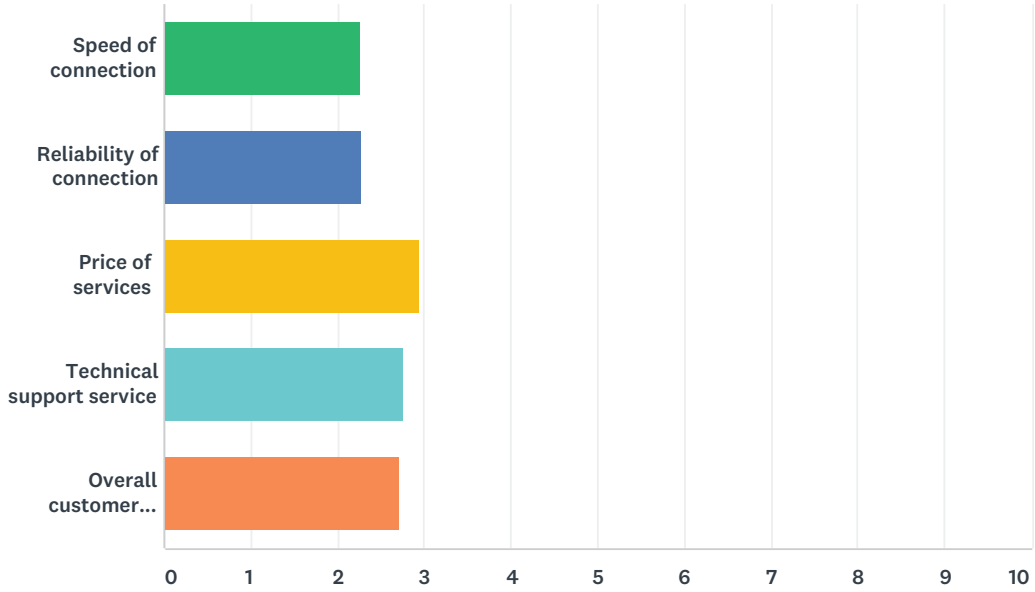
Answered: 759 Skipped: 38



	STRONGLY AGREE	AGREE	NEITHER AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE	TOTAL	WEIGHTED AVERAGE
My internet connection is so slow it is difficult to do anything other than view web pages	2.12% 16	5.17% 39	10.73% 81	46.75% 353	35.23% 266	755	3.26
My internet connection is adequate, but I cannot stream video	2.01% 15	3.76% 28	15.03% 112	50.07% 373	29.13% 217	745	3.21
I can stream video with some delays and buffering	5.62% 42	35.34% 264	18.47% 138	25.44% 190	15.13% 113	747	2.69
My internet is fast and meets all of my needs, including video streaming	13.58% 102	34.49% 259	21.30% 160	21.57% 162	9.05% 68	751	2.47
My connection is fine during certain times of the day, slow during peak periods	9.88% 74	33.24% 249	26.30% 197	20.29% 152	10.28% 77	749	2.57
My internet connection slows down when there are multiple internet users streaming/doing tasks online at the same time	13.98% 104	33.33% 248	28.63% 213	16.40% 122	7.66% 57	744	2.46

Q15 How satisfied are you with the following aspects of your current home internet access?

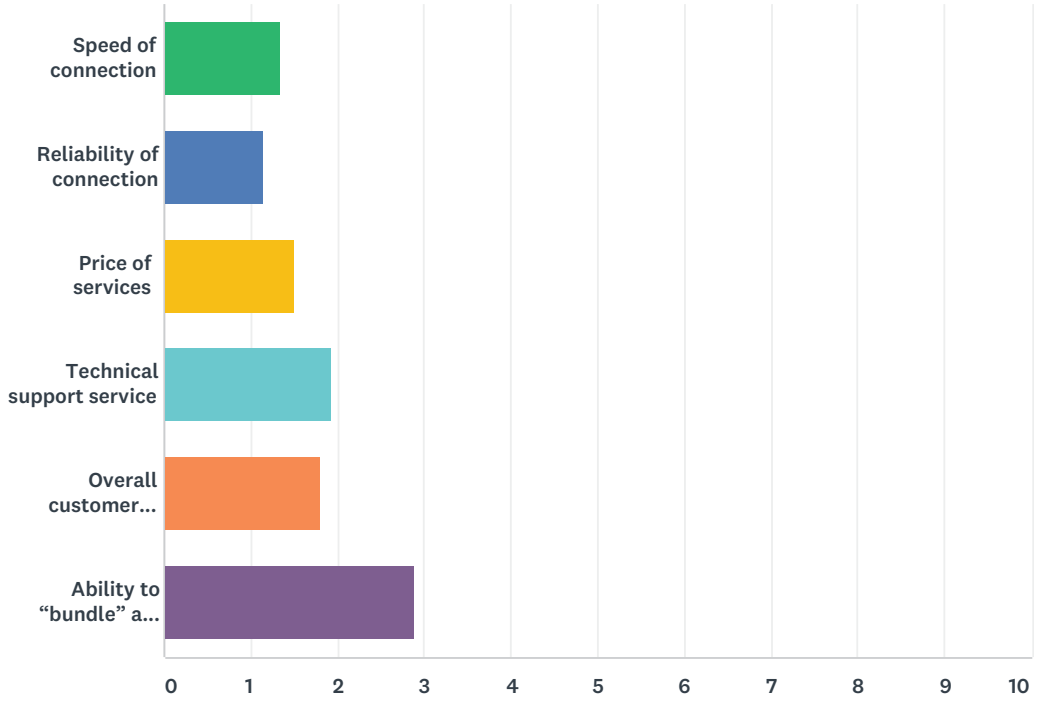
Answered: 759 Skipped: 38



	VERY SATISFIED	SATISFIED	NEITHER SATISFIED OR UNSATISFIED	UNSATISFIED	VERY UNSATISFIED	TOTAL	WEIGHTED AVERAGE
Speed of connection	16.30% 119	44.93% 328	18.63% 136	16.16% 118	3.97% 29	730	2.26
Reliability of connection	14.32% 108	48.94% 369	16.58% 125	14.72% 111	5.44% 41	754	2.28
Price of services	4.12% 31	16.09% 121	22.74% 171	36.70% 276	20.35% 153	752	2.96
Technical support service	5.17% 39	25.43% 192	39.60% 299	17.35% 131	12.45% 94	755	2.77
Overall customer service	5.82% 44	28.44% 215	35.71% 270	17.46% 132	12.57% 95	756	2.72

Q16 How important are the following aspects of home internet service to you?

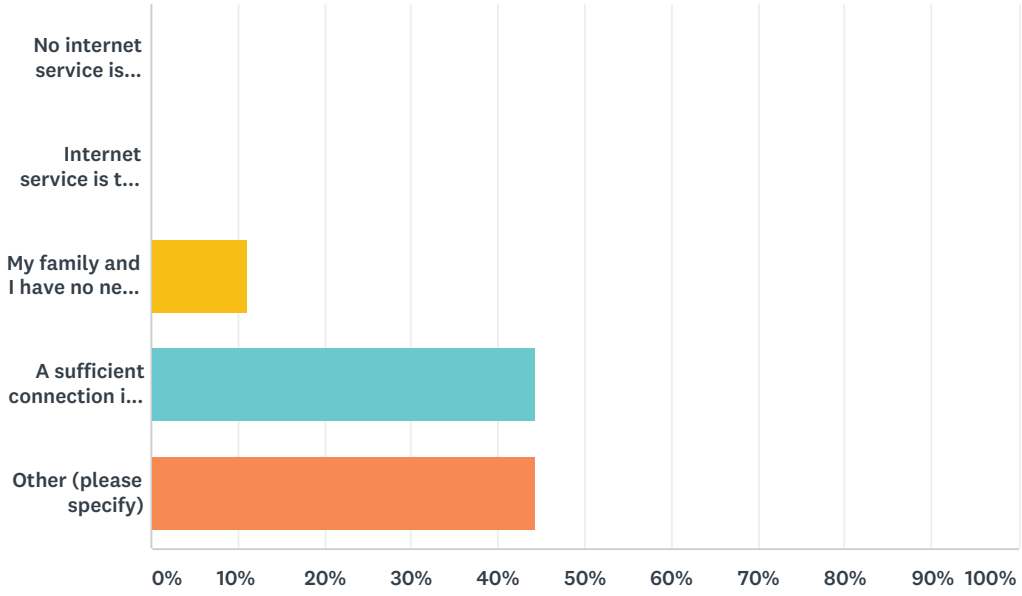
Answered: 760 Skipped: 37



	VERY IMPORTANT	IMPORTANT	NEITHER IMPORTANT OR UNIMPORTANT	UNIMPORTANT	VERY UNIMPORTANT	TOTAL	WEIGHTED AVERAGE
Speed of connection	69.60% 522	27.87% 209	2.13% 16	0.13% 1	0.27% 2	750	1.33
Reliability of connection	86.69% 658	12.25% 93	0.66% 5	0.13% 1	0.26% 2	759	1.15
Price of services	54.55% 408	40.51% 303	4.28% 32	0.40% 3	0.27% 2	748	1.51
Technical support service	31.05% 236	46.84% 356	17.11% 130	4.21% 32	0.79% 6	760	1.92
Overall customer service	35.18% 267	49.80% 378	12.78% 97	1.84% 14	0.40% 3	759	1.80
Ability to "bundle" a package with television and phone service	10.67% 81	15.02% 114	25.82% 196	22.66% 172	25.82% 196	759	2.89

Q17 You indicated that your household does not currently purchase internet services. Please tell us why:

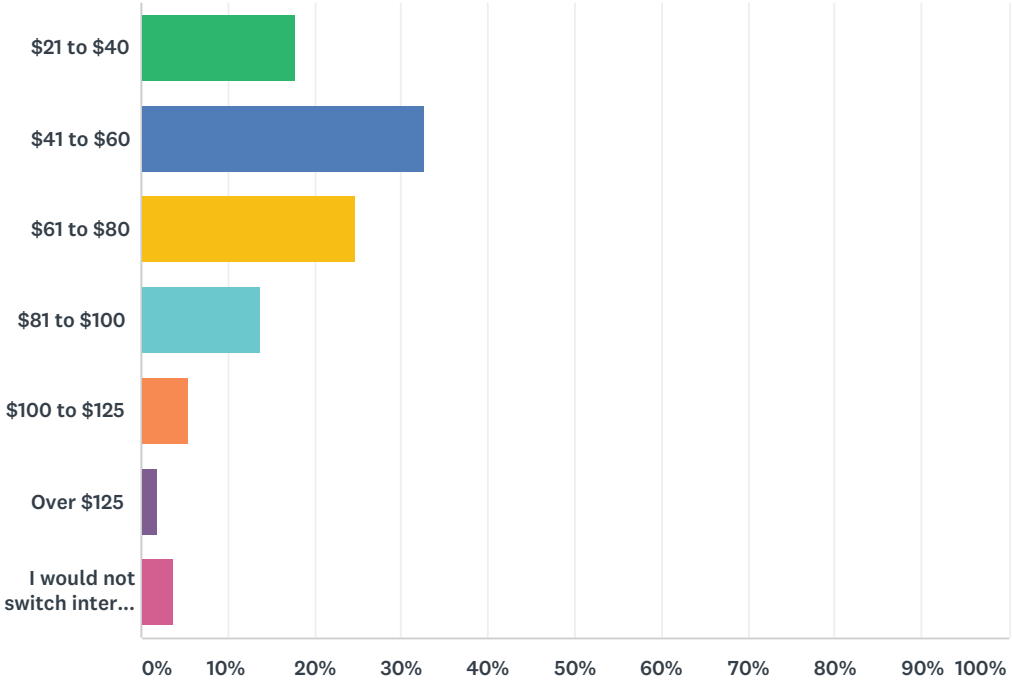
Answered: 9 Skipped: 788



ANSWER CHOICES	RESPONSES	
No internet service is available at our location	0.00%	0
Internet service is too slow to purchase	0.00%	0
My family and I have no need for the internet	11.11%	1
A sufficient connection is too expensive	44.44%	4
Other (please specify)	44.44%	4
TOTAL		9

Q18 If a new provider offered a reliable, robust, high-speed internet connection (up to 1 gig), what is the most you would pay monthly for internet service?

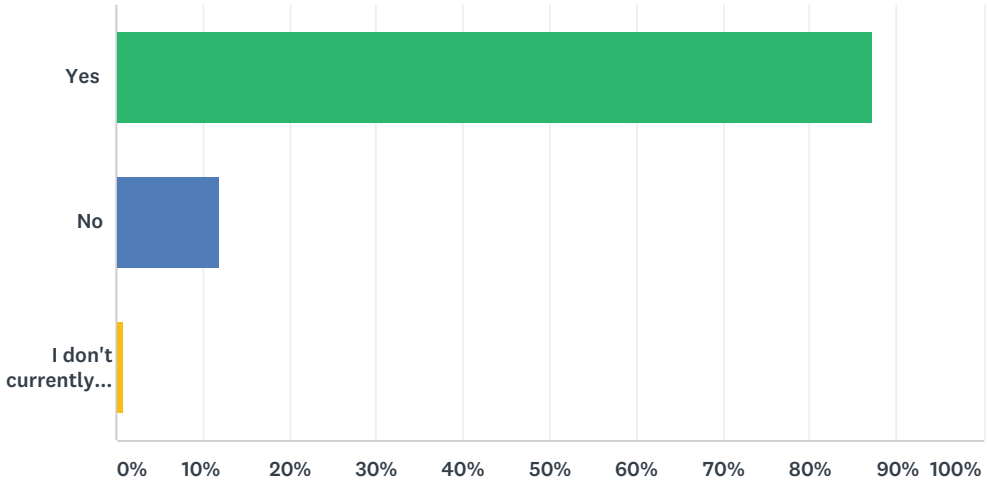
Answered: 756 Skipped: 41



ANSWER CHOICES	RESPONSES	
$21 to $40	17.86%	135
$41 to $60	32.67%	247
$61 to $80	24.74%	187
$81 to $100	13.76%	104
$100 to $125	5.42%	41
Over $125	1.85%	14
I would not switch internet providers no matter what the price	3.70%	28
TOTAL		756

Q19 If a new provider offered a reliable, robust, high-speed internet connection (up to 1 gig), at the price you selected in the previous question, would you switch providers?

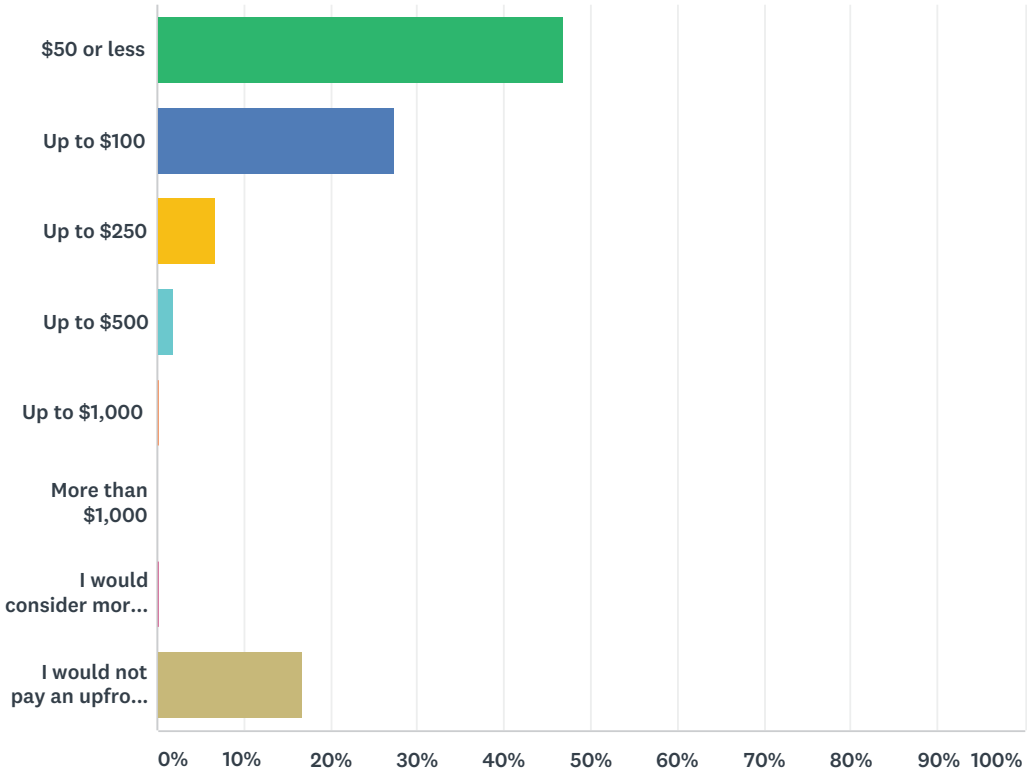
Answered: 746 Skipped: 51



ANSWER CHOICES	RESPONSES	
Yes	87.27%	651
No	11.93%	89
I don't currently purchase internet, but I would subscribe to a new provider	0.80%	6
TOTAL		746

Q20 What is the most you would pay for a one-time hookup/connection fee if it were required by a new provider that offered a reliable, robust, high-speed internet connection (up to 1 gig)?

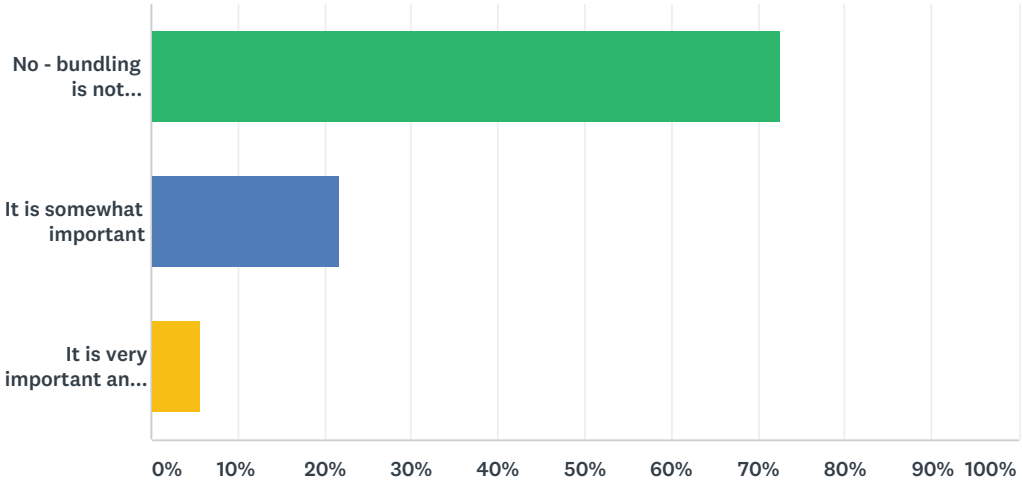
Answered: 757 Skipped: 40



ANSWER CHOICES	RESPONSES	
$50 or less	46.76%	354
Up to $100	27.48%	208
Up to $250	6.61%	50
Up to $500	1.85%	14
Up to $1,000	0.26%	2
More than $1,000	0.00%	0
I would consider more than $1000 if it could be paid off over time.	0.26%	2
I would not pay an upfront hook-up fee	16.78%	127
TOTAL		757

Q21 Is it important for you to receive television and internet services from the same provider?

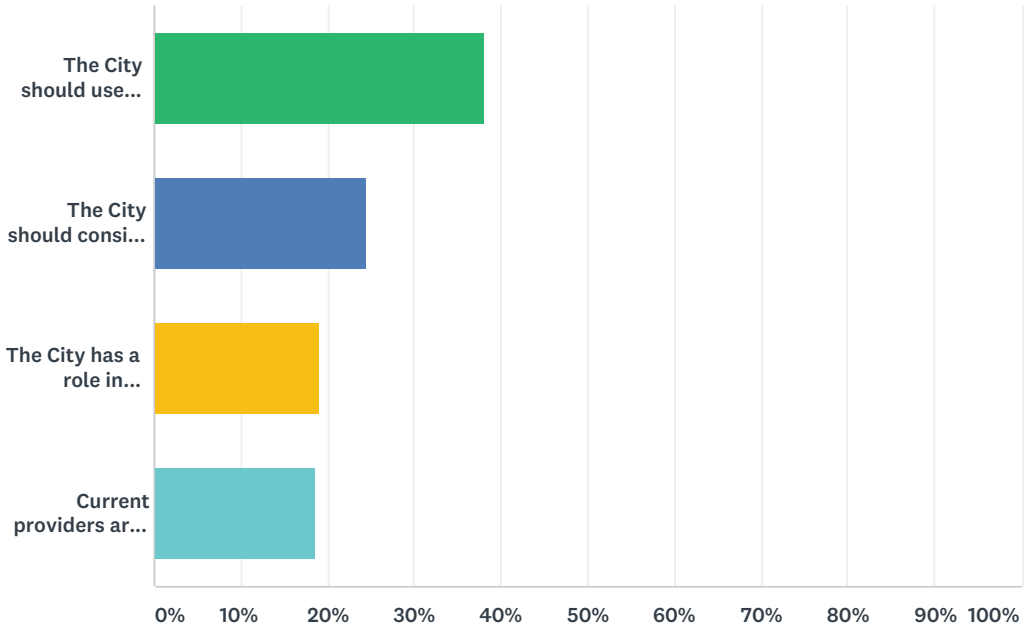
Answered: 761 Skipped: 36



ANSWER CHOICES	RESPONSES	
No - bundling is not important to me	72.54%	552
It is somewhat important	21.81%	166
It is very important and I want both services from the same provider	5.65%	43
TOTAL		761

Q22 Which below statement do you most agree with?

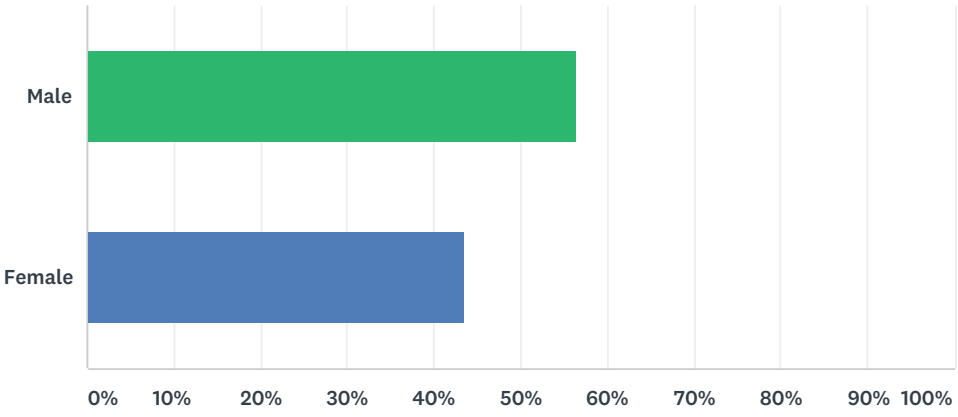
Answered: 759 Skipped: 38



ANSWER CHOICES	RESPONSES	
The City should use public funds to finance and build a City-owned broadband network to serve government facilities, residents and businesses.	38.08%	289
The City should consider using public funds to finance a network of some kind if current providers are not able to improve broadband services in Louisville.	24.37%	185
The City has a role in improving broadband services but you aren't sure what the City should do.	18.97%	144
Current providers are meeting the need for broadband in Louisville and there isn't a need for the City to do anything.	18.58%	141
TOTAL		759

Q23 The person completing this questionnaire is:

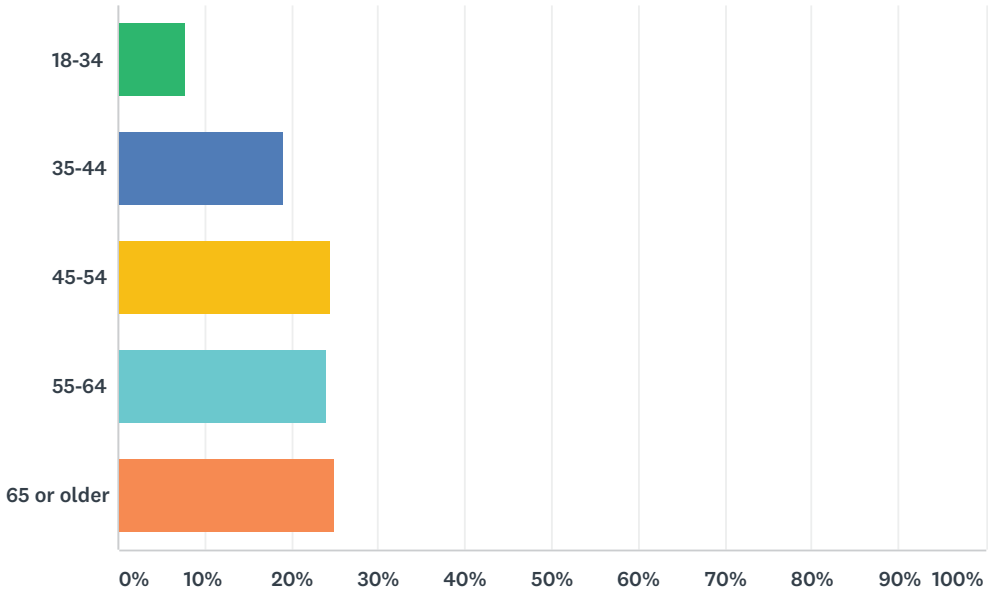
Answered: 752 Skipped: 45



ANSWER CHOICES	RESPONSES	
Male	56.38%	424
Female	43.62%	328
TOTAL		752

Q24 Age Group

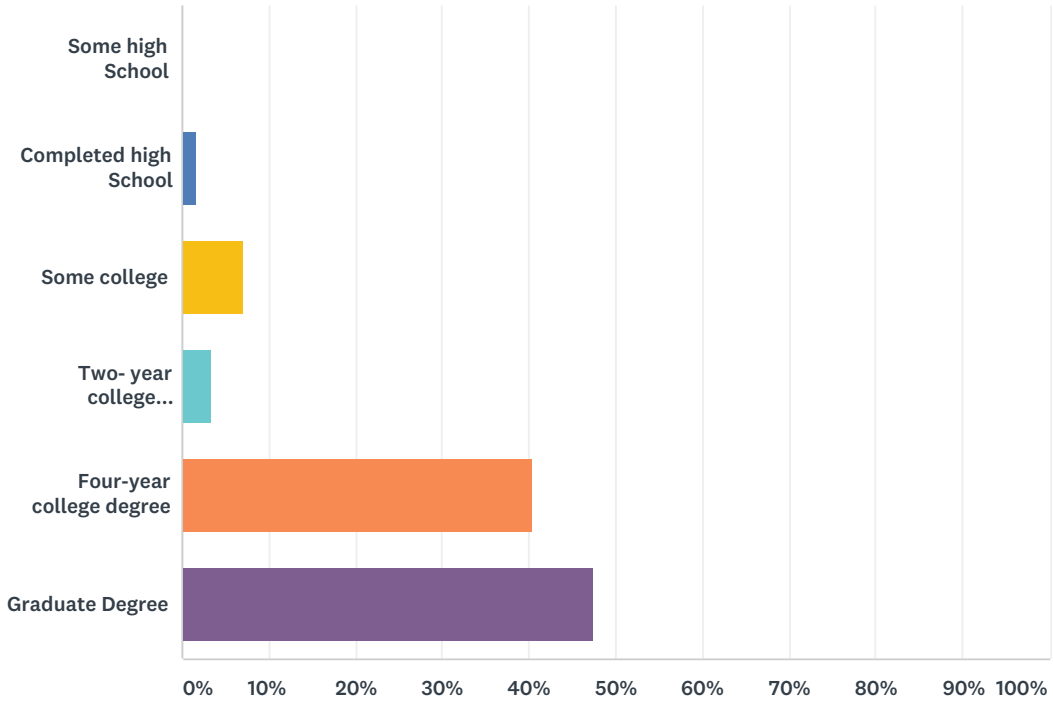
Answered: 755 Skipped: 42



ANSWER CHOICES	RESPONSES	
18-34	7.68%	58
35-44	18.94%	143
45-54	24.50%	185
55-64	23.97%	181
65 or older	24.90%	188
TOTAL		755

Q25 What best describes your highest level of education? "

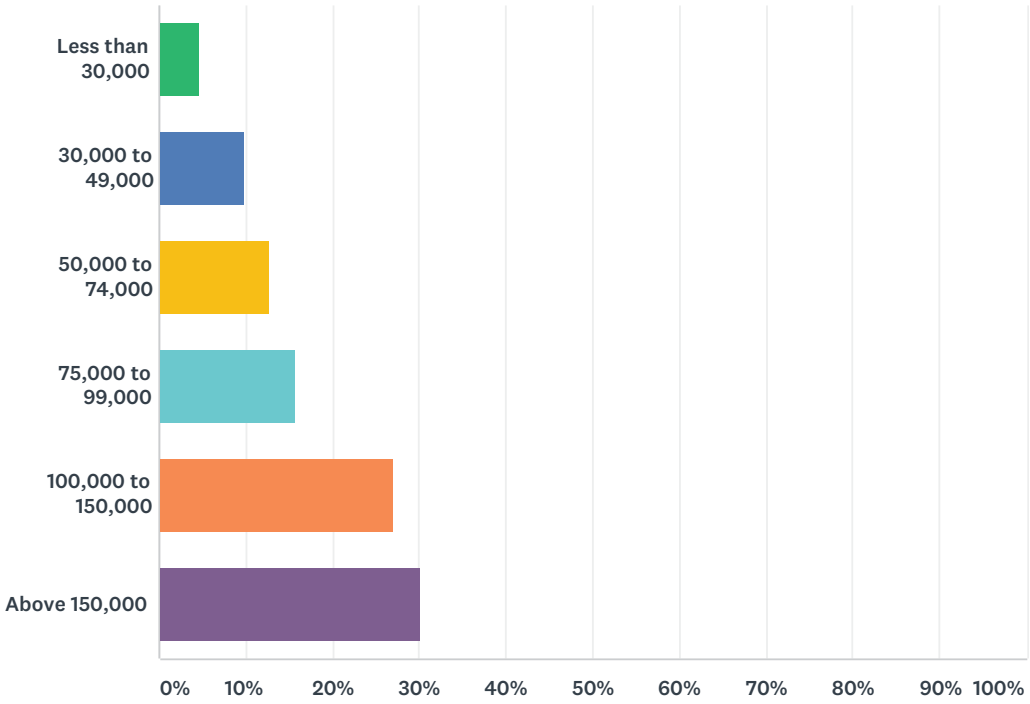
Answered: 755 Skipped: 42



ANSWER CHOICES	RESPONSES	
Some high School	0.00%	0
Completed high School	1.72%	13
Some college	7.02%	53
Two- year college associate or technical degree	3.44%	26
Four-year college degree	40.40%	305
Graduate Degree	47.42%	358
TOTAL		755

Q26 What was your approximate household income in 2016? "

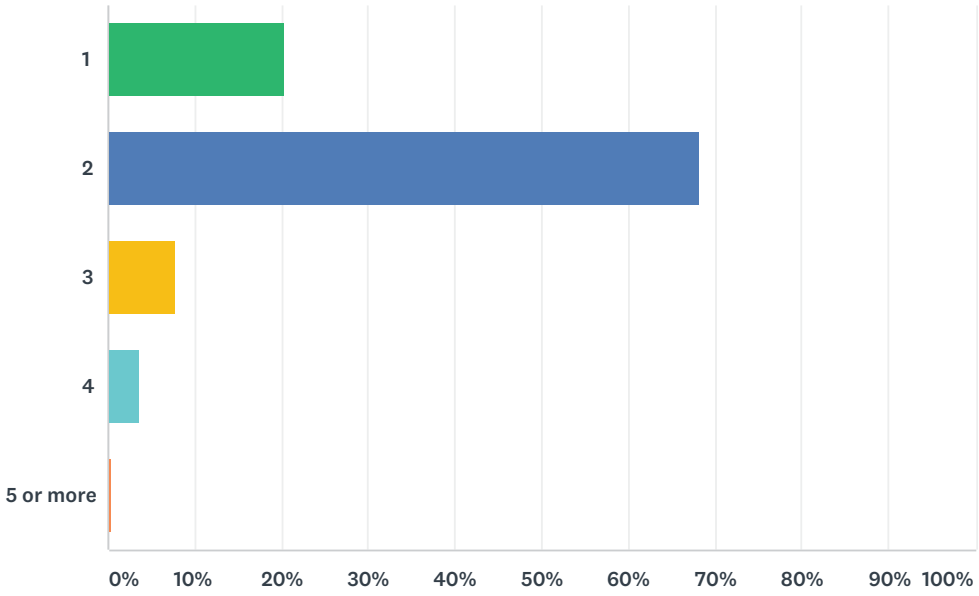
Answered: 716 Skipped: 81



ANSWER CHOICES	RESPONSES	
Less than 30,000	4.61%	33
30,000 to 49,000	9.92%	71
50,000 to 74,000	12.71%	91
75,000 to 99,000	15.78%	113
100,000 to 150,000	26.96%	193
Above 150,000	30.03%	215
TOTAL		716

Q27 How many adults 18 years or older reside in your household? "

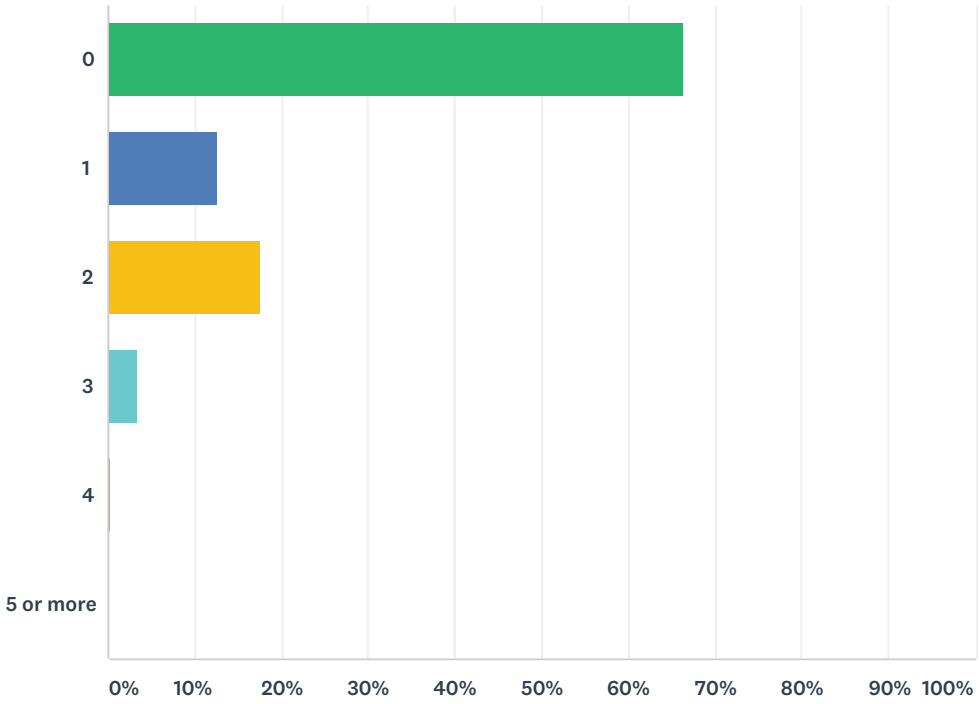
Answered: 753 Skipped: 44



ANSWER CHOICES	RESPONSES	
1	20.32%	153
2	68.13%	513
3	7.70%	58
4	3.45%	26
5 or more	0.40%	3
TOTAL		753

Q28 How many children under the age of 18 reside in your household? "

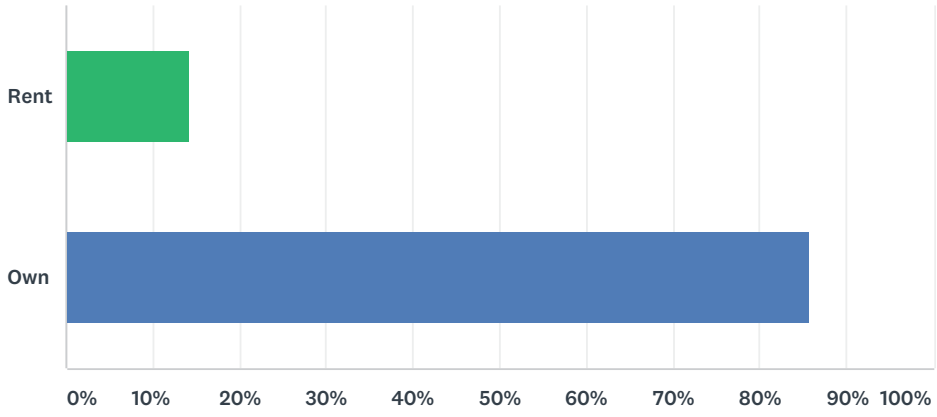
Answered: 754 Skipped: 43



ANSWER CHOICES	RESPONSES	
0	66.31%	500
1	12.47%	94
2	17.64%	133
3	3.32%	25
4	0.27%	2
5 or more	0.00%	0
TOTAL		754

Q29 Do you rent or own your home? "

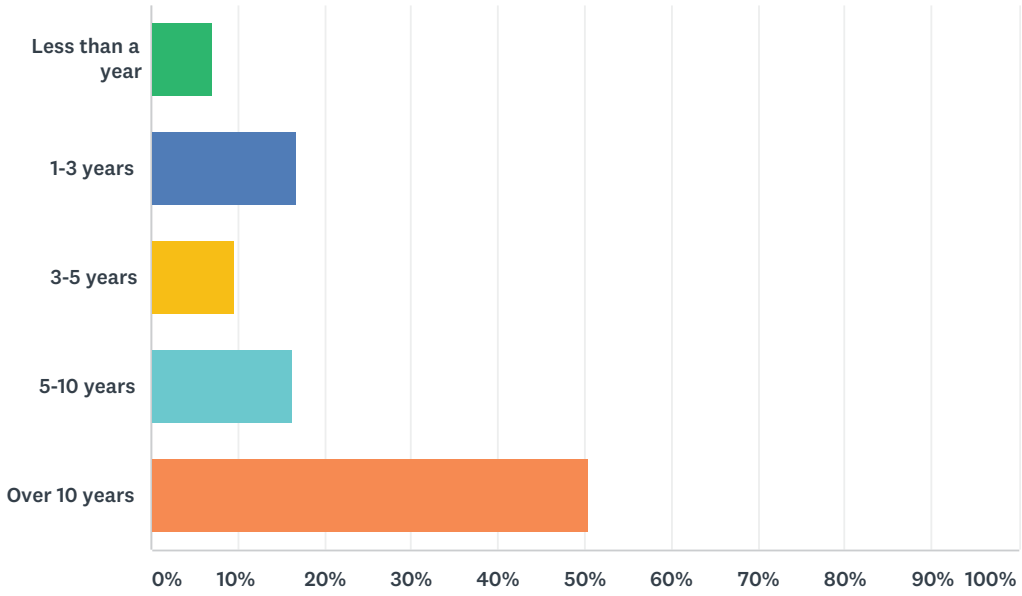
Answered: 754 Skipped: 43



ANSWER CHOICES	RESPONSES	
Rent	14.32%	108
Own	85.68%	646
TOTAL		754

Q30 How long have you lived in your current home?

Answered: 755 Skipped: 42

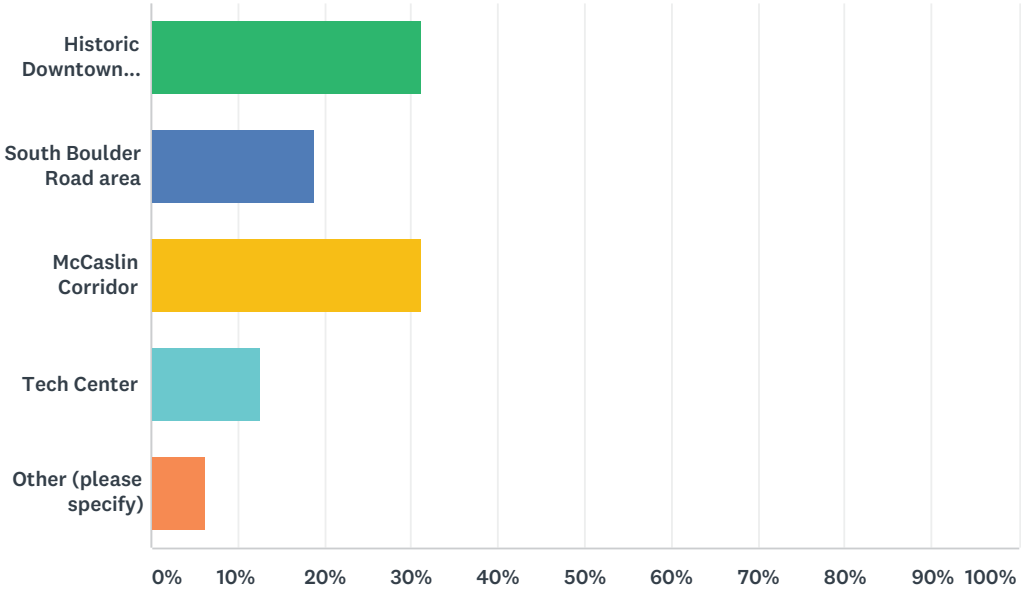


ANSWER CHOICES	RESPONSES	
Less than a year	7.02%	53
1-3 years	16.69%	126
3-5 years	9.54%	72
5-10 years	16.29%	123
Over 10 years	50.46%	381
TOTAL		755

Appendix C – Business Survey

Q1 Where in Louisville is your business generally located?

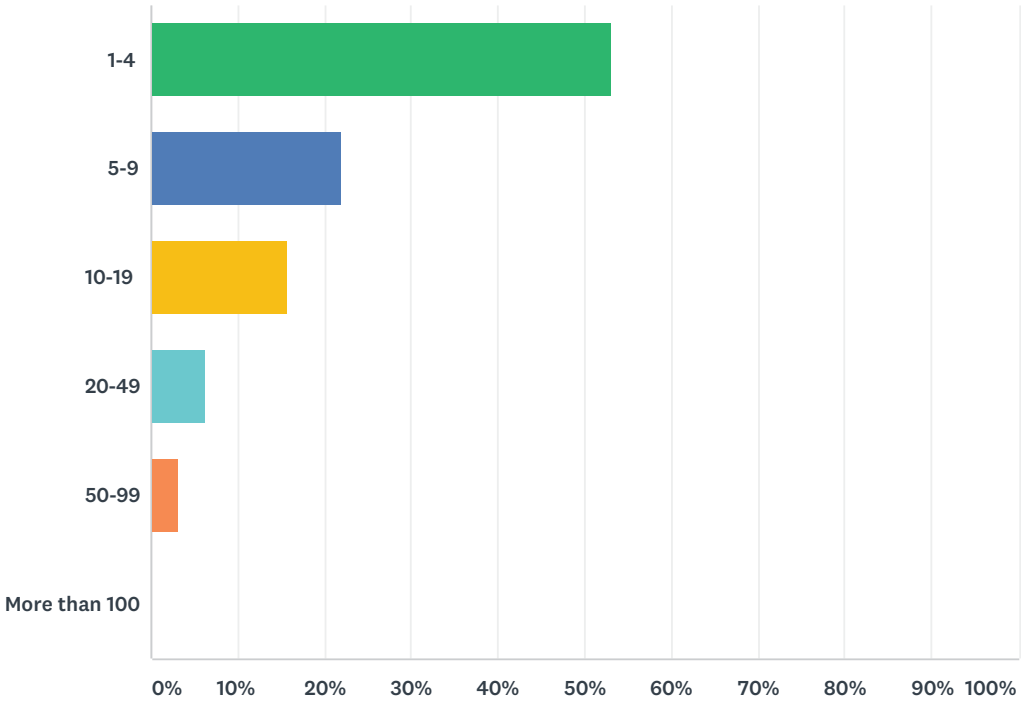
Answered: 32 Skipped: 0



ANSWER CHOICES	RESPONSES	
Historic Downtown Louisville	31.25%	10
South Boulder Road area	18.75%	6
McCaslin Corridor	31.25%	10
Tech Center	12.50%	4
Other (please specify)	6.25%	2
TOTAL		32

Q2 How many employees are in your company?

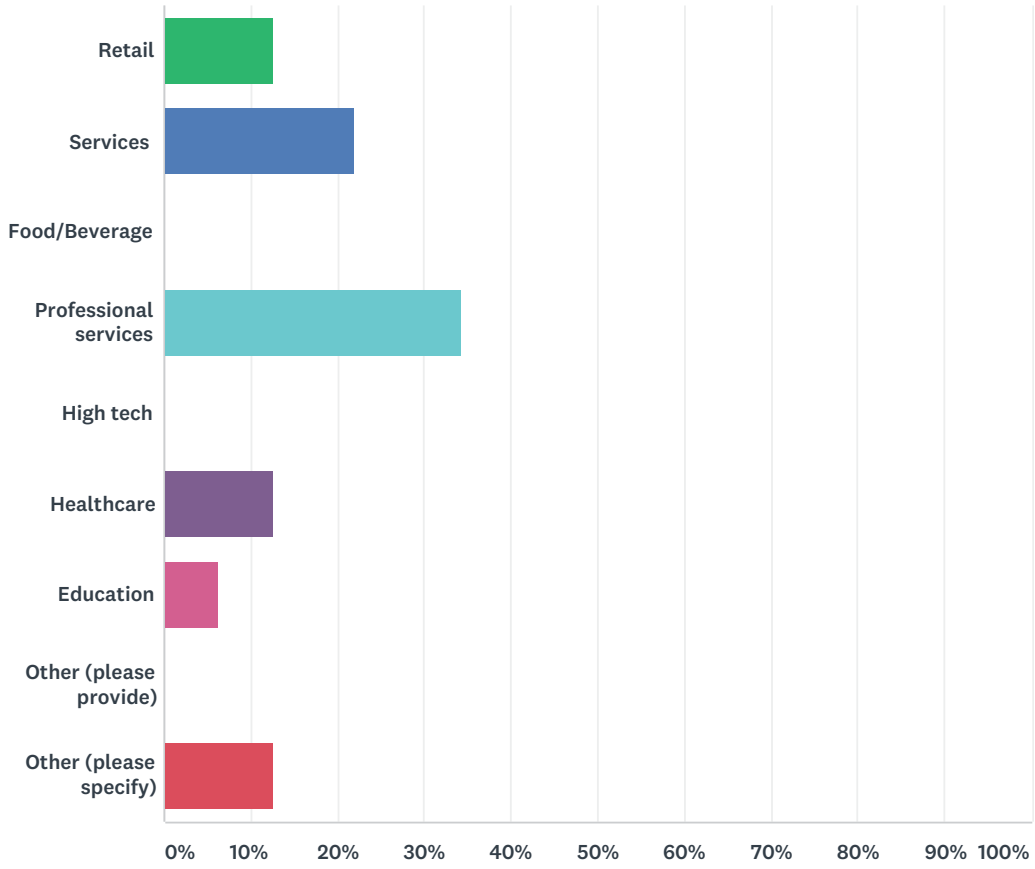
Answered: 32 Skipped: 0



ANSWER CHOICES	RESPONSES	
1-4	53.13%	17
5-9	21.88%	7
10-19	15.63%	5
20-49	6.25%	2
50-99	3.13%	1
More than 100	0.00%	0
TOTAL		32

Q3 In which industry is your business?

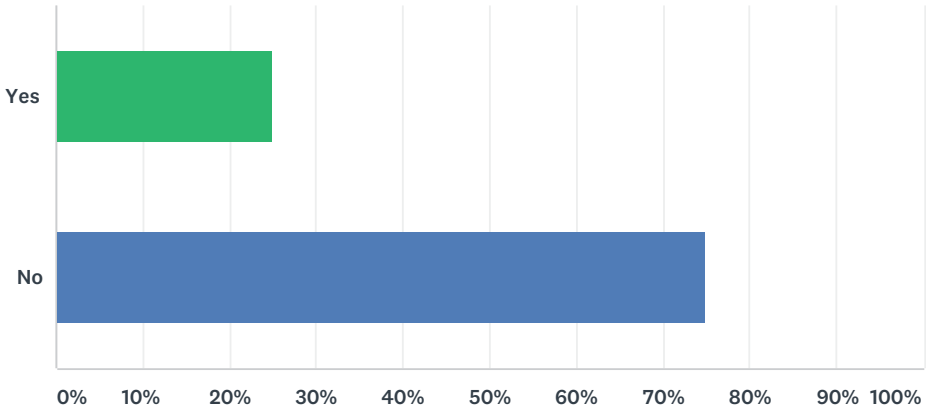
Answered: 32 Skipped: 0



ANSWER CHOICES	RESPONSES	
Retail	12.50%	4
Services	21.88%	7
Food/Beverage	0.00%	0
Professional services	34.38%	11
High tech	0.00%	0
Healthcare	12.50%	4
Education	6.25%	2
Other (please provide)	0.00%	0
Other (please specify)	12.50%	4
TOTAL		32

Q4 Do you have a home-based business?

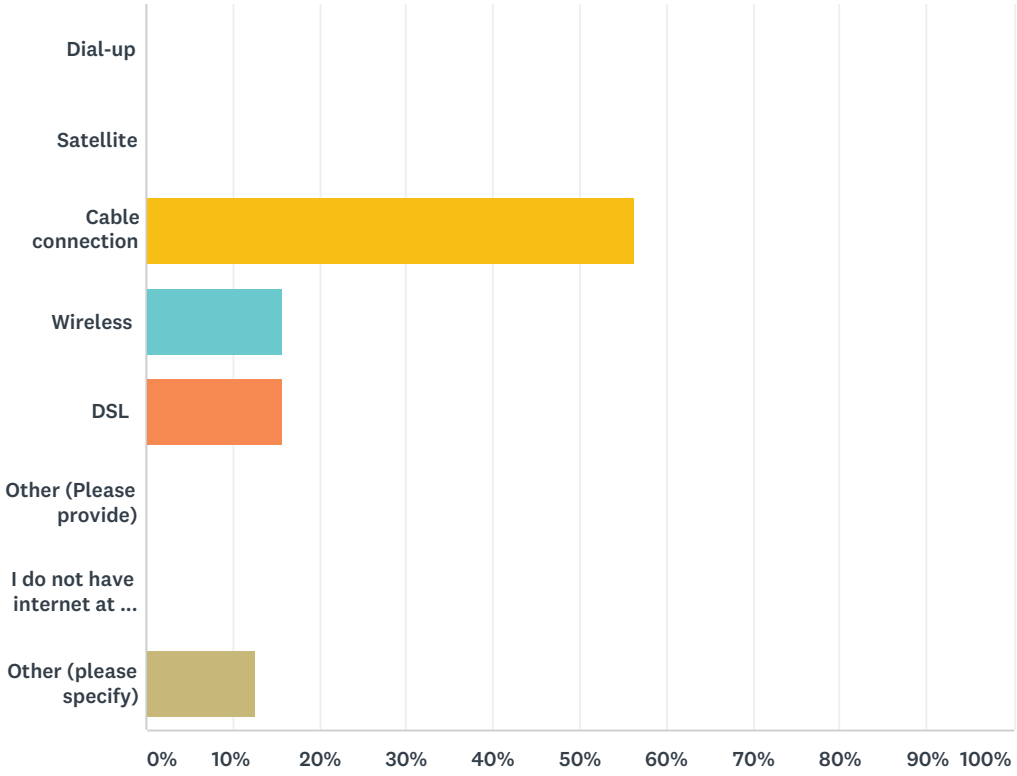
Answered: 32 Skipped: 0



ANSWER CHOICES	RESPONSES	
Yes	25.00%	8
No	75.00%	24
TOTAL		32

Q5 What kind of internet connection do you have at your place of business?

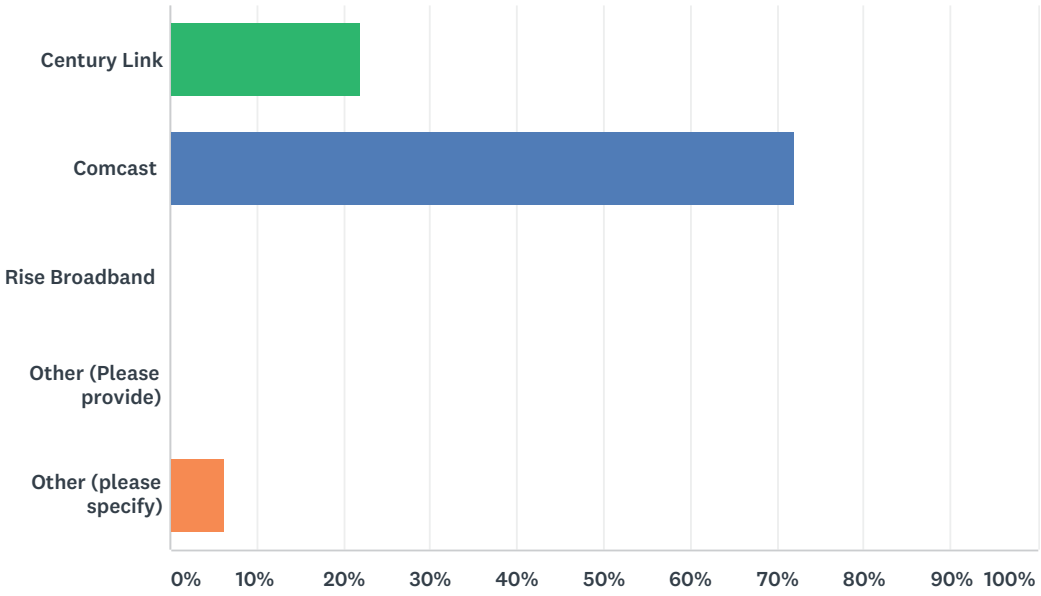
Answered: 32 Skipped: 0



ANSWER CHOICES	RESPONSES	
Dial-up	0.00%	0
Satellite	0.00%	0
Cable connection	56.25%	18
Wireless	15.63%	5
DSL	15.63%	5
Other (Please provide)	0.00%	0
I do not have internet at my place of business	0.00%	0
Other (please specify)	12.50%	4
TOTAL		32

Q6 Who is your internet provider?

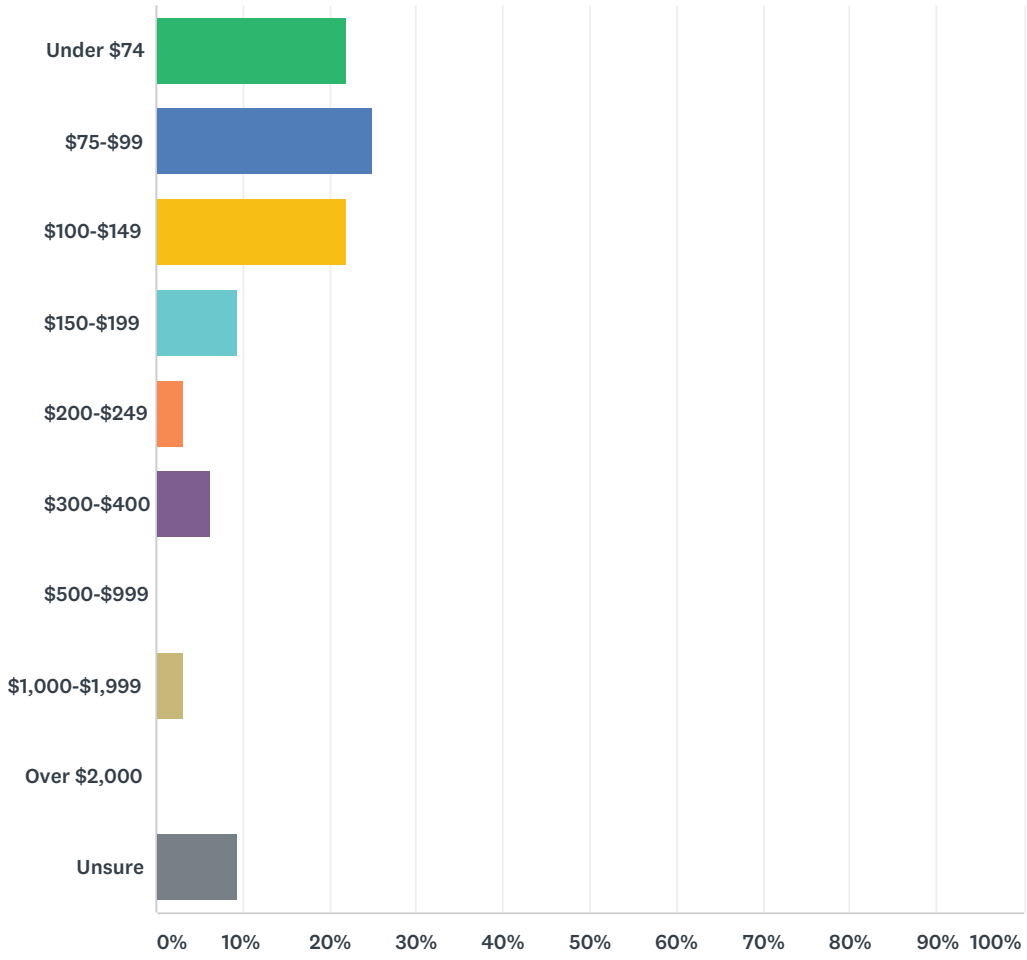
Answered: 32 Skipped: 0



ANSWER CHOICES	RESPONSES	
Century Link	21.88%	7
Comcast	71.88%	23
Rise Broadband	0.00%	0
Other (Please provide)	0.00%	0
Other (please specify)	6.25%	2
TOTAL		32

Q7 How much do you pay per month for internet service only?

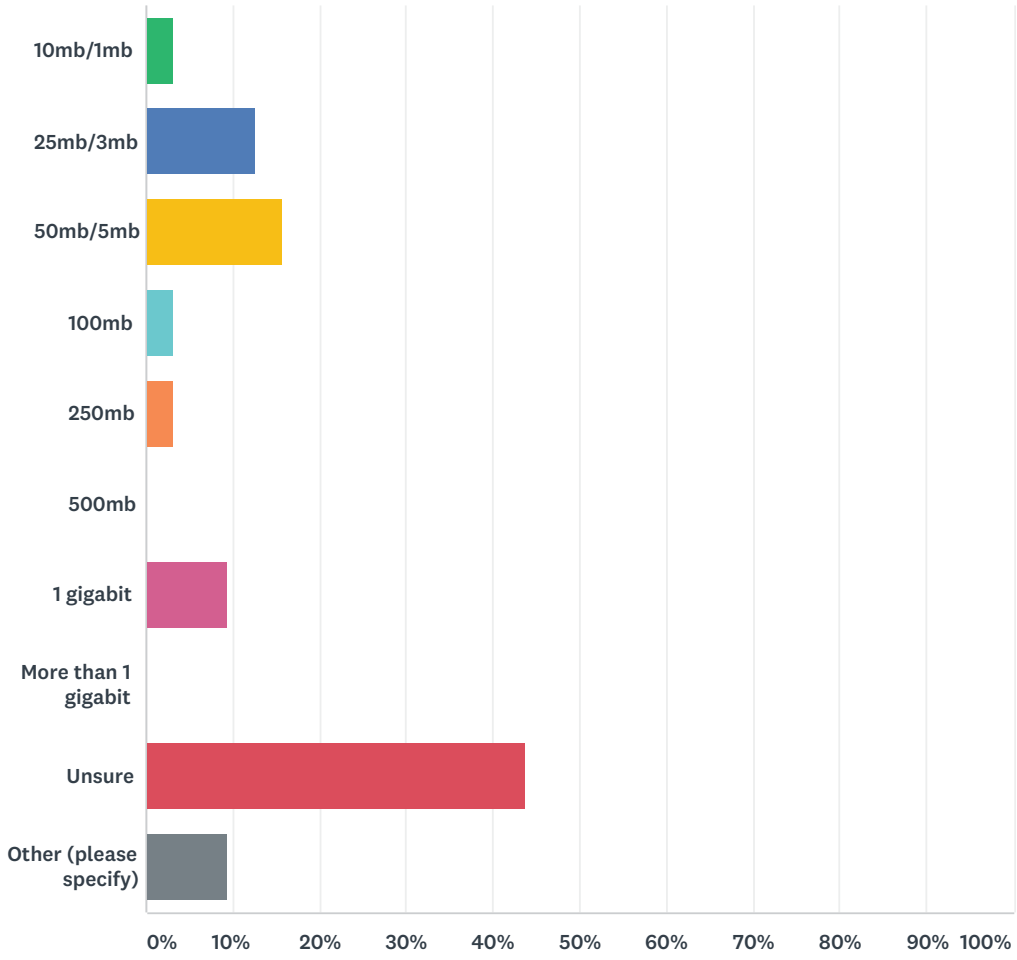
Answered: 32 Skipped: 0



ANSWER CHOICES	RESPONSES	
Under $74	21.88%	7
$75-$99	25.00%	8
$100-$149	21.88%	7
$150-$199	9.38%	3
$200-$249	3.13%	1
$300-$400	6.25%	2
$500-$999	0.00%	0
$1,000-$1,999	3.13%	1
Over $2,000	0.00%	0
Unsure	9.38%	3
TOTAL		32

Q8 What is your current package for bandwidth?

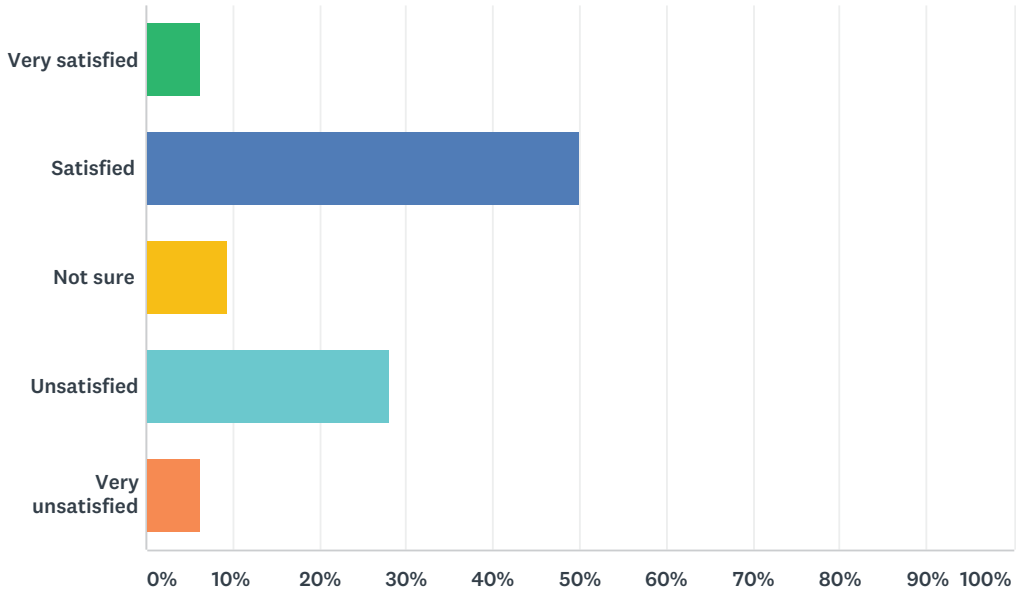
Answered: 32 Skipped: 0



ANSWER CHOICES	RESPONSES	
10mb/1mb	3.13%	1
25mb/3mb	12.50%	4
50mb/5mb	15.63%	5
100mb	3.13%	1
250mb	3.13%	1
500mb	0.00%	0
1 gigabit	9.38%	3
More than 1 gigabit	0.00%	0
Unsure	43.75%	14
Other (please specify)	9.38%	3
TOTAL		32

Q9 What is your satisfaction level with your current internet service?

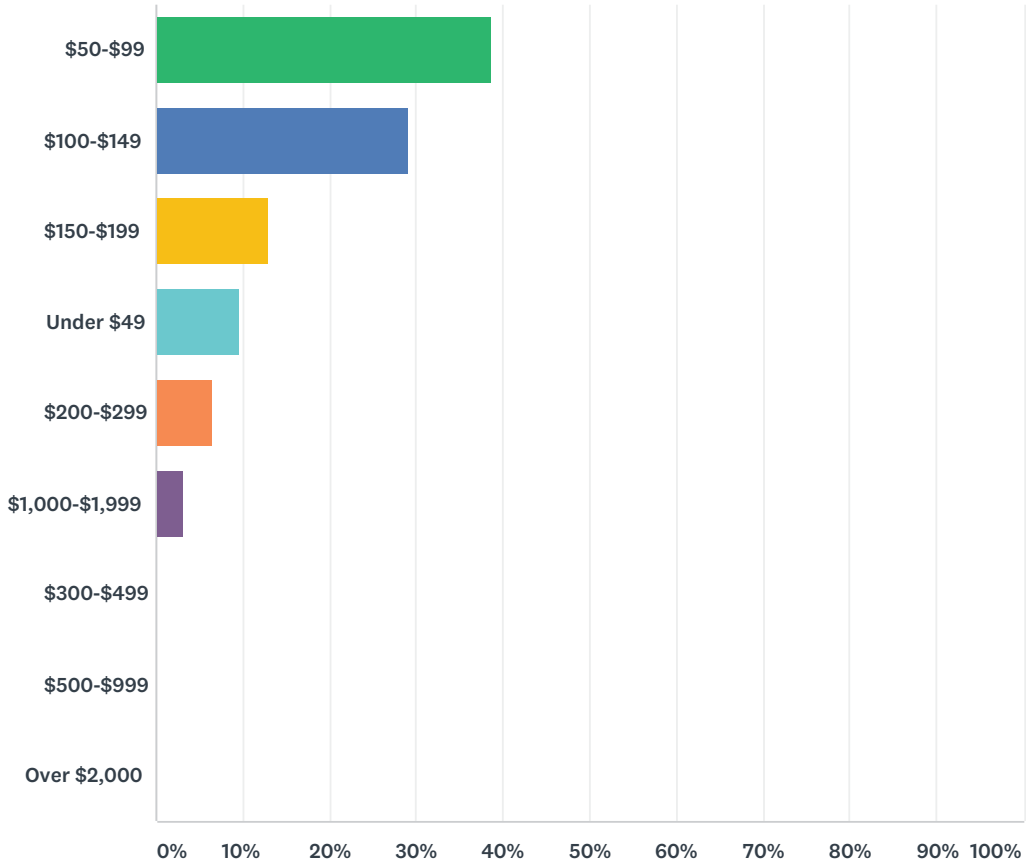
Answered: 32 Skipped: 0



ANSWER CHOICES	RESPONSES	
Very satisfied	6.25%	2
Satisfied	50.00%	16
Not sure	9.38%	3
Unsatisfied	28.13%	9
Very unsatisfied	6.25%	2
TOTAL		32

Q10 What is the maximum amount you would be willing to pay for Internet service that was robust, extremely fast, and allowed you to do everything you wanted to do online?

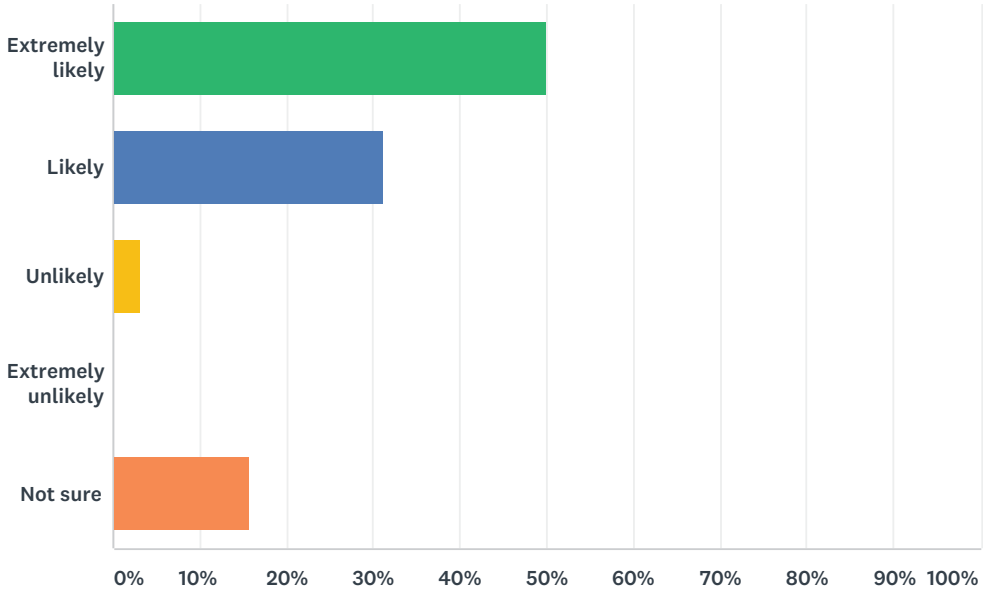
Answered: 31 Skipped: 1



ANSWER CHOICES	RESPONSES	
$50-$99	38.71%	12
$100-$149	29.03%	9
$150-$199	12.90%	4
Under $49	9.68%	3
$200-$299	6.45%	2
$1,000-$1,999	3.23%	1
$300-$499	0.00%	0
$500-$999	0.00%	0
Over $2,000	0.00%	0
TOTAL		31

Q11 How likely would you be to switch providers if you could obtain internet service at the price you selected in the prior question?

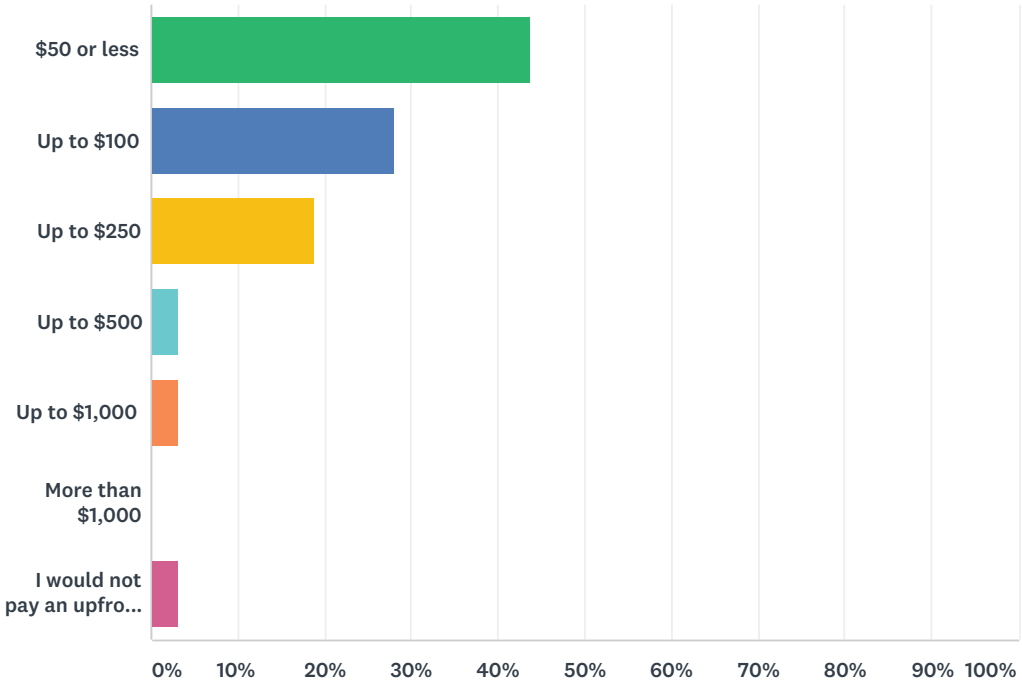
Answered: 32 Skipped: 0



ANSWER CHOICES	RESPONSES	
Extremely likely	50.00%	16
Likely	31.25%	10
Unlikely	3.13%	1
Extremely unlikely	0.00%	0
Not sure	15.63%	5
TOTAL		32

Q12 In order to obtain a reliable, robust, high-speed internet connection (up to 1 gigabit or more) from a new provider, how much would you be willing to pay for an initial one-time hookup fee, if required?

Answered: 32 Skipped: 0



ANSWER CHOICES	RESPONSES	
$50 or less	43.75%	14
Up to $100	28.13%	9
Up to $250	18.75%	6
Up to $500	3.13%	1
Up to $1,000	3.13%	1
More than $1,000	0.00%	0
I would not pay an upfront hook-up fee	3.13%	1
TOTAL		32

Appendix D – Wi-Fi Model

City of Louisville, Colorado
Wi-Fi Solutions
Vendor Budgetary CapEx / OpEx Inputs

Prepared by:

Vantage Point Solutions

VANTAGEPNT.com 605-995-1777
2211 N Minnesota Street Mitchell SD 57301

1. Introduction

As a part of the City of Louisville Broadband Feasibility Study, Vantage Point Solutions explored options for a Wi-Fi solution, to serve the City's historic downtown district and five designated park areas. For this, VPS developed a high-level engineering assessment to derive likely cost estimates based on a developed Access Point (AP) site count to be utilized as input assumptions to the feasibility study.

VPS utilized the following assumptions:

- Downtown historic district and five designated parks provided by the City of Louisville.
- AP radio equipment:
    - Based on latest Wi-Fi 802.11a/b/g/n/ac technology.
    - Cloud based with remote provisioning, maintenance and alarm monitoring.
    - Customizable splash pages for access to City Wi-Fi network.
    - Optional billing interface to charge for access or use.
- Antennas:
    - Dual-band antennas covering the 2.4GHz and 5GHz unlicensed bands.
    - OMNI (360°) coverage.
    - Mounting height of at least 20 ft. above ground level considering existing light poles or building rooftops.
- CapEx and OpEx:
    - Site locations are assuming all City owned property and no leasing will be required.
    - Fiber backhaul and electric facilities are assumed at each AP site location. Connectivity costs or licensed electrician installation are <u>not</u> included.
    - Professional on-site installation services for the AP radios, antennas and data networking equipment are included.
    - Engineering and Project Management services are included.
    - 1-year Annual software licensing, maintenance and support are included.

2. Wi-Fi Solutions & Spectrum

The proposed Wi-Fi equipment will be operating under unlicensed spectrum, open to use by any device that has been certified by the FCC as conforming to its Part 15 rules. Unlicensed wireless technologies do not require permission, so long as products and users comply with the rules associated with that unlicensed band. Unlicensed wireless technologies are, by nature, vulnerable to interference. These sources of interference can have a detrimental effect on the usability of wireless networks. The proposed Wi-Fi solutions use automated RF optimization that ensure the APs create the best possible environment for user experience.

3. AP Coverage Estimations

VPS utilized a typical Wi-Fi OMNI coverage radius of 328 feet for the 2.4GHz band and 150 feet for the 5GHz band. Capacity and data throughputs were not considered as part of this initial high-level assessment. All proposed AP installations are assumed at a minimum mounting height of 20' to maximize line-of-sight to user devices and reduce obstructions such as foliage, buildings, vehicles, etc., which can attenuate Wi-Fi signals. VPS distributed the typical AP radius required for coverage of arbitrary site locations to determine a likely necessary site count, such that the estimated coverage rings depicted would allow the City of Louisville to provide Wi-Fi service in these designated areas. VPS then compiled CapEx and OpEx estimates shown in Tables 1-3 for the radio equipment required to meet the target coverage areas. An actual RF study and spectrum screen for interference is recommended if/when the City should decide to proceed with the Wi-Fi deployment using the final selected site locations. This will ensure the mounting height, location and frequencies selected are optimal and will provide the best coverage for the area and end users.

4. Historic Downtown District

An arbitrary geographical distribution of typical AP coverage radii providing sufficient outdoor Wi-Fi coverage over the historic downtown district is depicted in Figure 1. Four Wi-Fi AP locations have been assumed for this deployment. The Museum, Library and City Hall locations are proposed as existing rooftop AP installations. An existing City light pole is proposed for the Pine Street AP location.

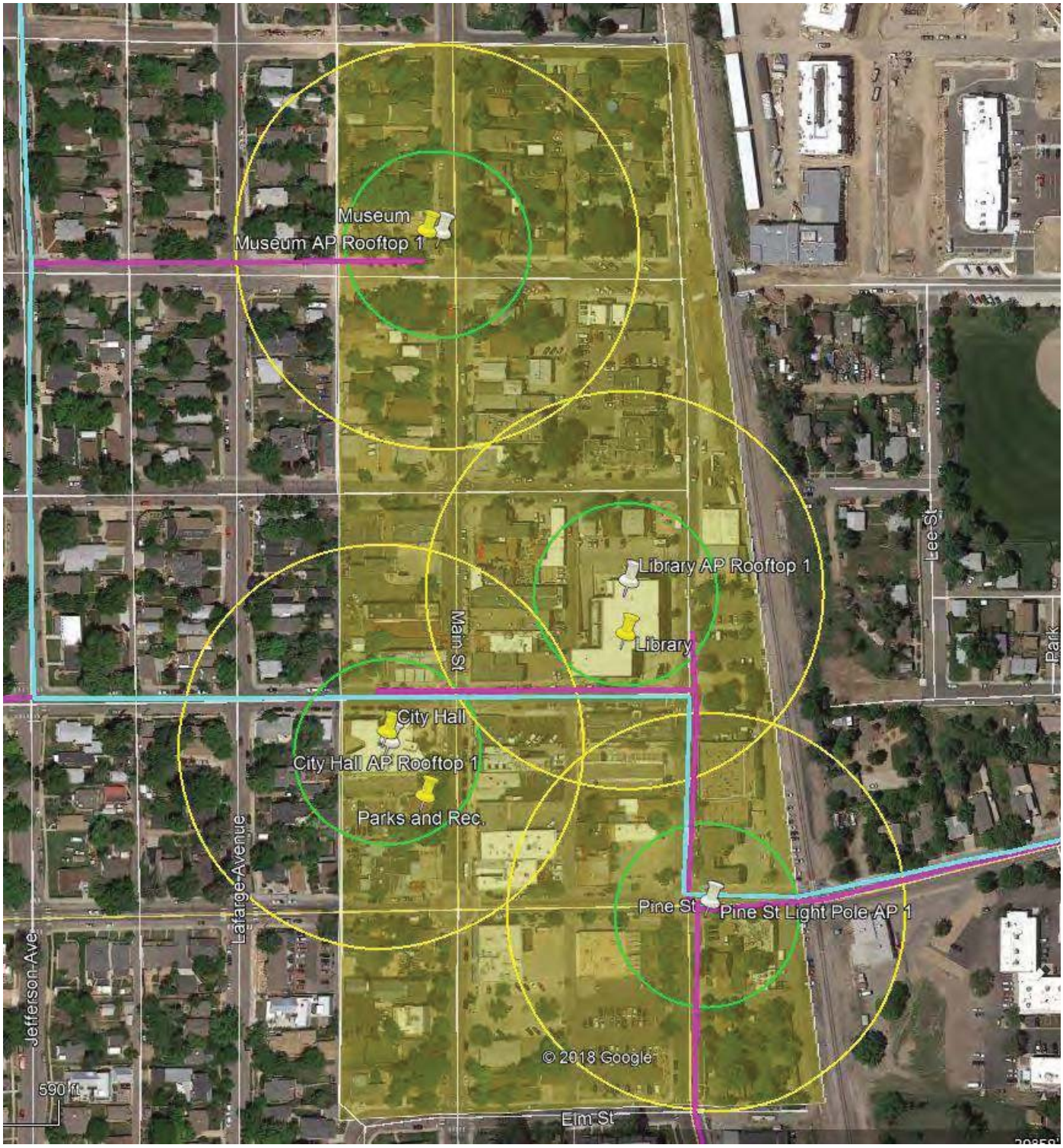


Figure 1 – Proposed Wi-Fi Solution Example (2.4GHz Yellow Radius / 5GHz Green Radius)

5. Louisville Sports Complex

An arbitrary geographical distribution of typical AP coverage radii providing sufficient outdoor Wi-Fi coverage over the Louisville Sports Complex is depicted in Figure 2. Two Wi-Fi AP locations have been assumed for this deployment. Two existing light poles are proposed for the AP site locations.

Figure 2 – Proposed Wi-Fi Solution Example (2.4GHz Yellow Radius / 5GHz Green Radius)

6. Community Park

An arbitrary geographical distribution of typical AP coverage radii providing sufficient outdoor Wi-Fi coverage over the Community Park is depicted in Figure 3. Two Wi-Fi AP locations have been assumed for this deployment. An existing light pole and rooftop are proposed for the AP site locations.

Figure 3 – Proposed Wi-Fi Solution Example (2.4GHz Yellow Radius / 5GHz Green Radius)

7. Memory Square

An arbitrary geographical distribution of typical AP coverage radii providing sufficient outdoor Wi-Fi coverage over the Memory Square is depicted in Figure 4. One Wi-Fi AP mounted on an existing rooftop is proposed for this deployment.

Figure 4 – Proposed Wi-Fi Solution Example (2.4GHz Yellow Radius / 5GHz Green Radius)

8. Pirates Park

An arbitrary geographical distribution of typical AP coverage radii providing sufficient outdoor Wi-Fi coverage over the Pirates Park is depicted in Figure 5. One Wi-Fi AP mounted on an existing light pole is proposed for this deployment.

Figure 5 – Proposed Wi-Fi Solution Example (2.4GHz Yellow Radius / 5GHz Green Radius)

9. Cottonwood

An arbitrary geographical distribution of typical AP coverage radii providing sufficient outdoor Wi-Fi coverage over the Pirates Park is depicted in Figure 6. One Wi-Fi AP mounted on an existing rooftop is proposed for this deployment.

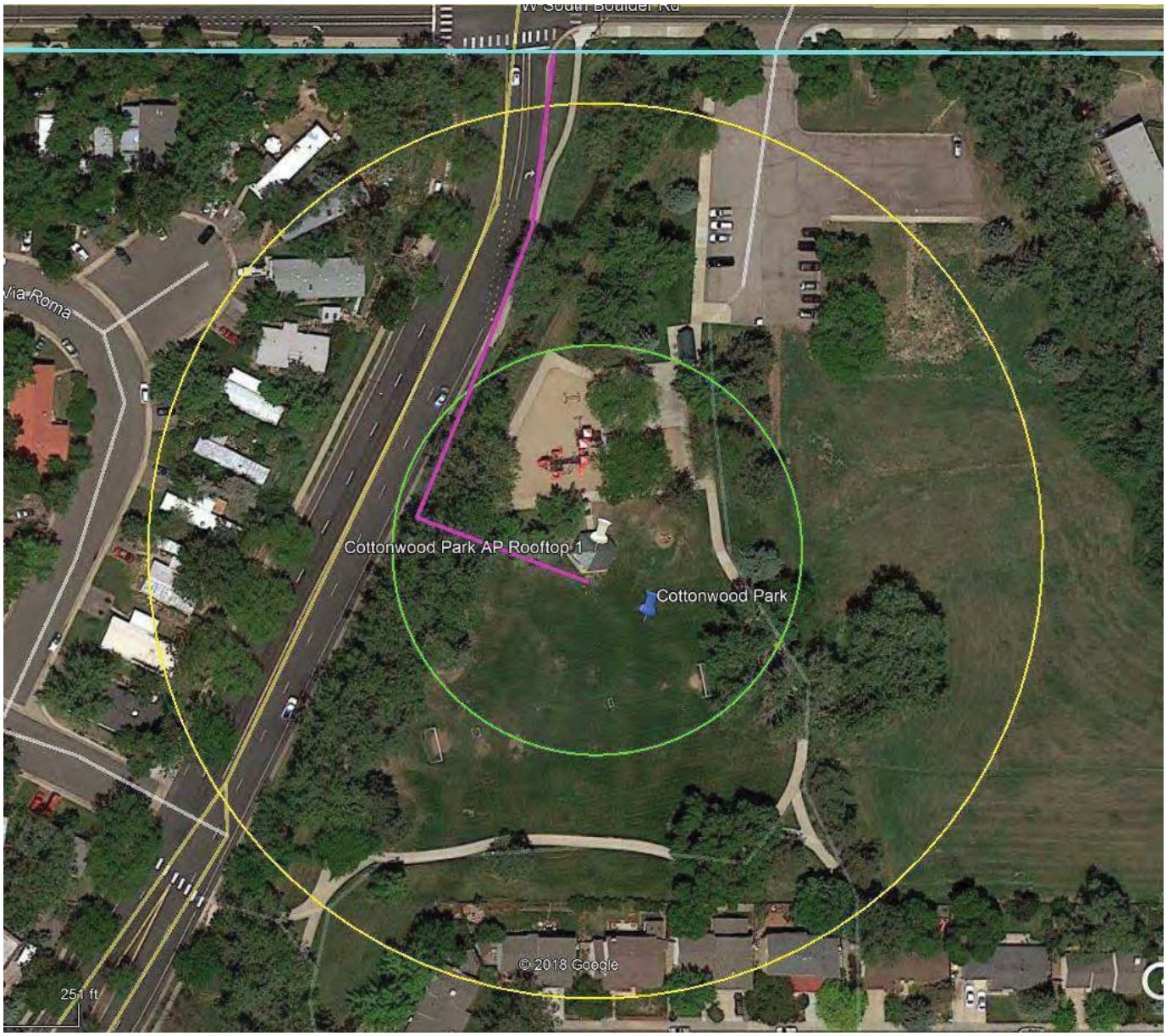


Figure 6 – Proposed Wi-Fi Solution Example (2.4GHz Yellow Radius / 5GHz Green Radius)

10. A Note on Wireless

Wireless networks in general do not share the relative simplicity, consistency, predictability, capacity or future-proofing of their fiber access network counterparts. Wireless deployments require more complex coverage and capacity planning, along with constant management and upgrade once constructed. Wi-Fi standards are constantly evolving and require updating radio equipment every 3-5 years realistically to keep up with user demand and device evolution.

There are two reasons for this. The first is because of the very scarce wireless capacity compared to wired networks – a precious resource that must be carefully planned for sharing among wireless users.

The second reason is because of wireless native radio environment, which, unlike wired access networks, is ever at the mercy of noise and interference that is difficult or even impossible to control. This is especially true in unlicensed spectrum where there is no FCC-recognized incumbency or recourse to interference from others whatsoever, and yet it *directly* and *significantly* affects the system's modulation efficiency and resulting capacity – and hence the business case, often without warning. Simply put, wireless capacity is a direct function of signal to noise ratio; so, the most "carrier class" solutions will be those in which the latter can be controlled, but which comes at a price. Also, unlike fiber, wireless resources consumed by one user with poor signal conditions will rob from the capacity available for all others and must be carefully controlled. Wireless networks therefore must be constantly managed, and also will require upgrades more often than wireline networks, to attempt to meet the relentlessly growing user broadband demand.

» Conclusion, Next Steps

The above inputs can be used by the City of Louisville for any comparative business case it may wish to consider for determining the feasibility of Wi-Fi to serve the community of Louisville, Colorado. VPS will be happy to assist with any scaling or other "what-if" iterations that the City of Louisville may wish to see for its analysis.

Should the City of Louisville wish to proceed with a Wi-Fi deployment, a detailed RF design should be crafted for the targeted solution based on the final selected site locations.

» Table 1: Vendor CapEx & OpEx Summary

VantagePoint
An Employee Owned Company

Louisville - City Wi-Fi Project

Projected Capital and Operational Expenses

	Vendor A "High Range"	Vendor B "Low Range"
# AP's	11	11
Network Equipment		
Tower / Site	$ 3,163	$ 3,163
Antennas and Lines (Including On-Site Installation)	$ 11,880	$ 7,502
AP Radio Equipment	$ 23,507	$ 10,307
Backhaul	$ -	$ -
Data Network Equipment	$ 8,997	$ 11,805
Network Equipment Spares (Including On-Site Installation)	$ 2,287	$ 937
Engineering & Gen. Project Mgmt. Services	$ 8,300	$ 5,200
CapEx Total	**$ 58,134**	**$ 38,914**
Annual Software Licensing, Maintenance and Support	$ 2,000	$ 825
OpEx Total	**$ 2,000**	**$ 825**
Grand Total	**$ 60,134**	**$ 39,739**

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» Table 2: Vendor A "High Range" CapEx & OpEx

VantagePoint
An Employee Owned Company

Louisville - City Wi-Fi Project
Projected Capital & Operational Expense:

	Vendor A: Proposed Discrete AP Reading (Capex)	Vendor A: Proposed Lifetime AP Reading (Capex)	Vendor A: Proposed Off-Hold AP Reading (Capex)	Vendor A: Proposed Rate % AP Rate (Capex)	Vendor A: Proposed Monthly AP Reading (Capex)	Vendor A: Proposed Monthly AP Rate (Capex)
Network Equipment						
Tower / Site	$ 287.50	$ 287.50	$ 287.50	$ 287.50	$ 287.50	$ 287.50
Outdoor Enclosure	$ 287.50	$ 287.50	$ 287.50	$ 287.50	$ 287.50	$ 287.50
Antennas and Lines	$ 1,000.00	$ 1,000.00	$ 1,000.00	$ 1,000.00	$ 1,000.00	$ 1,000.00
On-Site Installation	$ 640.00	$ 640.00	$ 640.00	$ 640.00	$ 640.00	$ 640.00
Antennas	$ 500.00	$ 500.00	$ 500.00	$ 500.00	$ 500.00	$ 500.00
Transceivers/Line & Hardware	$ 42.00	$ 42.00	$ 42.00	$ 42.00	$ 42.00	$ 42.00
AP Radio Equipment	$ 2,237.00	$ 2,237.00	$ 2,237.00	$ 2,237.00	$ 2,237.00	$ 2,237.00
Dual Band, 4 Radio, Outdoor Access Point 2x2MIMO	$ 1,599.00	$ 1,599.00	$ 1,599.00	$ 1,599.00	$ 1,599.00	$ 1,599.00
1G SFP Transceiver Module	$ 139.00	$ 139.00	$ 139.00	$ 139.00	$ 139.00	$ 139.00
Gigabit Ethernet Media Converter with PoE	$ 499.00	$ 499.00	$ 499.00	$ 499.00	$ 499.00	$ 499.00
Backhaul	$ -	$ -	$ -	$ -	$ -	$ -
Data Network	$ 8,997.00	$ -	$ -	$ -	$ -	$ -
10 Port 1G Fiber Aggregation Switch	$ 5,750.00	$ -	$ -	$ -	$ -	$ -
1G SFP Transceiver Module	$ 1,415.00	$ -	$ -	$ -	$ -	$ -
On-Site Installation & Provisioning	$ 1,840.00	$ -	$ -	$ -	$ -	$ -
Network Equipment Spares	$ 5,287.00	$ -	$ -	$ -	$ -	$ -
Engineering & Geo, Project Mgmt. Services	$ 2,000.00	$ 600.00	$ 600.00	$ 600.00	$ 600.00	$ 600.00
Site CapEx Subtotals	$ 17,888.00	$ 4,104.00	$ 4,104.00	$ 4,104.00	$ 4,104.00	$ 4,104.00
Network OpEx	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00
Annual Software License & 24/7 Enterprise Class Support	$ 500.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00
Site OpEx Subtotals	$ 500.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00
Vendor A - Complete Total						
$ 90,150						

» Table 2 (Continued): Vendor A "High Range" CapEx & OpEx

VantagePoint
An Employee Owned Company

	Vendor A Proposed LicensePtP AP Rooftop (MPS)	Vendor A Proposed LicensePtP AP1 Rooftop (MPS)	Vendor A Proposed LicensePtP AP2 Pole (MPS)	Vendor A Proposed SpectCpt AP1 Pole (MPS)	Vendor A Proposed SpectCpt AP2 Pole (MPS)
Network Equipment					
Tower / Site	$ 287.50	$ 287.50	$ 287.50	$ 287.50	$ 287.50
Outdoor Enclosure	$ 287.50	$ 287.50	$ 287.50	$ 287.50	$ 287.50
Antennas and Lines	$ 1,080.00	$ 1,080.00	$ 1,080.00	$ 1,080.00	$ 1,080.00
On-Site Installation	$ 840.00	$ 840.00	$ 840.00	$ 840.00	$ 840.00
Antennas	$ 900.00	$ 900.00	$ 900.00	$ 900.00	$ 900.00
Transmission Line & Hardware	$ 42.00	$ 42.00	$ 42.00	$ 42.00	$ 42.00
AP Radio Equipment	$ 2,137.00	$ 2,137.00	$ 2,137.00	$ 2,137.00	$ 2,137.00
Dual Band, 4 Radio, Outdoor Access Point 2x2(MIMO)	$ 1,390.00	$ 1,390.00	$ 1,390.00	$ 1,390.00	$ 1,390.00
1G SFP Transceiver Module	$ 129.00	$ 129.00	$ 129.00	$ 129.00	$ 129.00	
Gigabit Ethernet Media Converter with PoE	$ 600.00	$ 600.00	$ 600.00	$ 600.00	$ 600.00
Backhaul	$ -	$ -	$ -	$ -	$ -
Data Network	$ -	$ -	$ -	$ -	$ -
16 Port 1G Fiber Aggregation Switch	$ -	$ -	$ -	$ -	$ -
1G SFP Transceiver Module	$ -	$ -	$ -	$ -	$ -
On-Site Installation & Provisioning	$ -	$ -	$ -	$ -	$ -
Network Equipment Spares	$ -	$ -	$ -	$ -	$ -
Engineering & Gen. Project Mgmt. Services	$ 600.00	$ 600.00	$ 600.00	$ 600.00	$ 600.00
Site CapEx Subtotals	$ 4,104.50	$ 4,104.50	$ 4,104.50	$ 4,104.50	$ 4,104.50
Network OpEx	$ 100.00	$ 100.00	$ 100.00	$ 100.00	$ 100.00
Annual Software License & 24/7 Enterprise Class Support	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00
Site OpEx Subtotals	$ 150.00	$ 150.00	$ 150.00	$ 150.00	$ 150.00

Vendor A - Complete Total
$ 66,154

» Table 3: Vendor B "Low Range" CapEx & OpEx

VantagePoint
An Employee Owned Company

Louisville - City Wi-Fi Project
Projected Capital & Operational Expenses

	Vendor B Proposed Mesonic AP Rooftop (Metro)	Vendor B Proposed Ekinex AP Rooftop (Metro)	Vendor B Proposed CitiMesh AP Rooftop (Metro)	Vendor B Proposed Plus N AP Pole (Metro)	Vendor B Proposed Ekinex OQ AP Rooftop (Metro)	Vendor B Proposed PlusNet AP Pole (Metro)
Network Equipment						
Tower / Site	$ 287.50	$ 287.50	$ 287.50	$ 287.50	$ 287.50	$ 287.50
Outdoor Enclosure	$ 287.50	$ 287.50	$ 287.50	$ 287.50	$ 287.50	$ 287.50
Antennas and Lines	$ 682.00	$ 682.00	$ 682.00	$ 682.00	$ 682.00	$ 682.00
On-Site Installation	$ 640.00	$ 640.00	$ 640.00	$ 640.00	$ 640.00	$ 640.00
Antennas	$ -	$ -	$ -	$ -	$ -	$ -
Transmission Line & Hardware	$ 42.00	$ 42.00	$ 42.00	$ 42.00	$ 42.00	$ 42.00
AP Radio Equipment	$ 937.00	$ 937.00	$ 937.00	$ 937.00	$ 937.00	$ 937.00
Dual Band Outdoor Access Point, 3x3 MIMO	$ 199.00	$ 199.00	$ 199.00	$ 199.00	$ 199.00	$ 199.00
10 SFP Transceiver Module	$ 129.00	$ 129.00	$ 129.00	$ 129.00	$ 129.00	$ 129.00
Gigabit Ethernet Media Converter with PoE	$ 609.00	$ 609.00	$ 609.00	$ 609.00	$ 609.00	$ 609.00
Backhaul	$ -	$ -	$ -	$ -	$ -	$ -
Core Network	$ 11,894.00	$ -	$ -	$ -	$ -	$ -
Firewall with Layer 7 Traffic Shaping	$ 2,898.00	$ -	$ -	$ -	$ -	$ -
24 Port 10 Fiber Aggregation Switch	$ 7,750.00	$ -	$ -	$ -	$ -	$ -
10 SFP Transceiver Module	$ 1,415.00					
On-Site Installation & Provisioning	$ 1,849.00	$ -	$ -	$ -	$ -	$ -
Network Equipment Spares	$ 937.00	$ -	$ -	$ -	$ -	$ -
Engineering & Gen. Project Mgmt. Services	$ 2,298.00	$ 380.00	$ 380.00	$ 380.00	$ 380.00	$ 380.00
Site CapEx Subtotals	$ 16,848.00	$ 2,186.00	$ 2,186.00	$ 2,186.00	$ 2,186.00	$ 2,186.00
Network OpEx	$ 810.00	$ -	$ -	$ -	$ -	$ -
Annual Software License & 24/7 Enterprise Class Support	$ 815.00	$ -	$ -	$ -	$ -	$ -
Site OpEx Subtotals	$ 815.00	$ -	$ -	$ -	$ -	$ -

Vendor B - Complete Total
$ 36,714

Table 3 (Continued): Vendor B "Low Range" CapEx & OpEx

VantagePoint
An Employee Owned Company

	Vendor B Proposed CoreaPtk AZ Backhaul (MDU)	Vendor B Proposed CoreaPtk AZ Backhaul (HRN)	Vendor B Proposed CoreaPtk AZ Pole (MDU)	Vendor B Proposed SpotCpu AZ Pole (MDU)	Vendor B Proposed SpotCpu AZ Pole (HRN)
Network Equipment					
Tower / Site	$ 287.50	$ 287.50	$ 287.50	$ 287.50	$ 287.50
Outdoor Enclosure	$ 287.50	$ 287.50	$ 287.50	$ 287.50	$ 287.50
Antennas and Lines	$ 682.00	$ 682.00	$ 682.00	$ 682.00	$ 682.00
On-Site Installation	$ 640.00	$ 640.00	$ 640.00	$ 640.00	$ 640.00
Antennas	$ -	$ -	$ -	$ -	$ -
Transmission Line & Hardware	$ 42.00	$ 42.00	$ 42.00	$ 42.00	$ 42.00
AP Radio Equipment	$ 937.00	$ 937.00	$ 937.00	$ 937.00	$ 937.00
Dual Band, Outdoor Access Point, 3x3MIMO	$ 399.00	$ 399.00	$ 399.00	$ 399.00	$ 399.00
1G SFP Transceiver Module	$ 129.00	$ 129.00	$ 129.00	$ 129.00	$ 129.00
Gigabit Ethernet Media Converter with PoE	$ 409.00	$ 409.00	$ 409.00	$ 409.00	$ 409.00
Backhaul	$ -	$ -	$ -	$ -	$ -
Core Network	$ -	$ -	$ -	$ -	$ -
Firewall with Layer7 Traffic Shaping	$ -	$ -	$ -	$ -	$ -
10 Port 10 Fiber Aggregation Switch	$ -	$ -	$ -	$ -	$ -
1G SFP Transceiver Module					
On-Site Installation & Provisioning	$ -	$ -	$ -	$ -	$ -
Network Equipment Spares	$ -	$ -	$ -	$ -	$ -
Engineering & Gen. Project Mgmt. Services	$ 399.00	$ 399.00	$ 399.00	$ 399.00	$ 399.00
Site CapEx Subtotals	$ 3,206.50	$ 3,206.50	$ 3,206.50	$ 3,206.50	$ 3,206.50
Network OpEx	$ -	$ -	$ -	$ -	$ -
Annual Software License & 24/7 Enterprise Class Support	$ -	$ -	$ -	$ -	$ -
Site OpEx Subtotals	$ -	$ -	$ -	$ -	$ -

Vendor B – Complete Total
$ 39,738