MOBILITY SERVICES AND FIXED-ROUTE TRANSIT NETWORK ANALYSIS

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To: COIC, Project Management Team

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Subject: Fixed-Route Transit Network Analysis, First-Last Mile Needs and Mobility Hub Strategy (Bend TMP Scope Task 5 and 6)

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INTRODUCTION

This memorandum builds upon previous work that analyzed travel demand patterns in Bend and identified areas in Bend that are underserved by transit and/or have gaps in pedestrian and bicycle access. The memorandum:

- **Provides context to help identify mobility options for underserved areas**, including information about mobility service options that are currently operating in Bend or that are operating nationally, as well as relevant research.
- **Analyzes the fixed-route transit network** in Bend to identify where CET should prioritize fixed-route transit service in the future and identifies opportunities to integrate transit technology. The fixed-route network considered includes both existing transit corridors and new potential connections. The analysis will inform the fixed-route transit service planning and the Transit-Oriented Development recommendations of the CET Transit Master Plan which will identify where the City of Bend could prioritize transit-supportive land use policies that encourage land use development practices and urban form that can support high-frequency service.
- **Analyzes first-last mile strategies** that can be applied in underserved areas to help get people to and from the transit system efficiently. These strategies include mobility hubs, technology, microtransit, micromobility, and pedestrian/bicycle access enhancements. Some of these strategies are directly supportive of transit, while others can be applied in areas that lack sufficient density, demand, or street connectivity to justify providing frequent (or even a basic level of fixed-route service), or at particular times of the day, such as later evening.

MOBILITY SERVICES OVERVIEW

EXISTING OR PLANNED MOBILITY SERVICE OPTIONS IN BEND

This section summarizes mobility service options that are currently operating or under consideration in Bend, as well as relevant services that are operating nationally.

BIKE SHARE

OSU-Cascades offers a Zagster station-based bike share system with 8 dock stations and 55 total bikes around the OSU-Cascades campus and central Bend. Seven dock stations are currently operational (shown in Figure 1), and one is being relocated.[1] OSU-Cascades students and employees get free bike share membership. Hourly, monthly, and annual memberships are available to the general public. The system launched in 2016 with 30 bikes at 3 stations on or near OSU-Cascades campus. Private sponsorship allowed the expansion of the program to the general public in 2017.

OSU-Cascades expects to add dockless capability to the bikeshare system, and has asked the City for funding to help with this expansion. A timeline for dockless bike additions has not been established.[2]

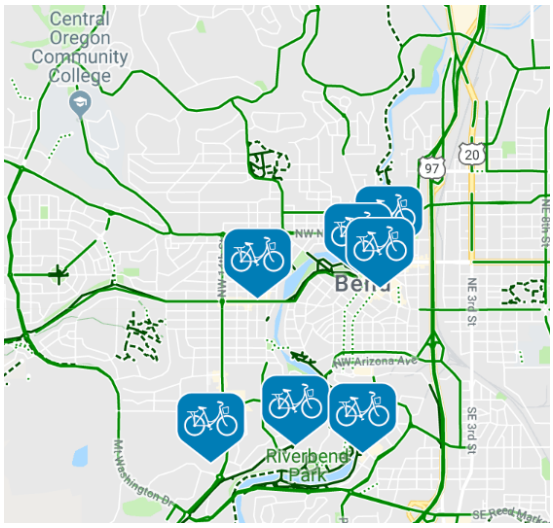


Figure 1: Bike Share Stations
Source: OSU-Cascades/Zagster

SCOOTER SHARE

In April 2019, the Bend City Council deferred moving ahead with allowing shared scooters to operate in the city.[3] The City is considering an e-scooter pilot beginning in spring 2020.[4]

RIDE BEND

Ride Bend was a free summer shuttle operated by CET in 2017 and 2018 with 15-minute headways serving Downtown Bend, the Old Mill District, OSU-Cascades, and destinations along Galveston Avenue. Ride Bend was introduced to reduce parking demand and congestion within the areas that see the most traffic during the summer months.

During the summer of 2019, the service was run as a demand-responsive microtransit service operated by a company named Downtowner, LLC to see if this model would be more productive. Both services operated multiple vehicles (two vehicles on the previous shuttle, and three 10-passenger vans on the 2019 microtransit service) and provided approximately the

[1] Conversation with OSU-Cascades Transportation Services.
[2] Conversation with OSU-Cascades Transportation Services.
[3] https://www.bendsource.com/bend/city-not-ready-for-e-scooters-yet/Content?oid=10026317
[4] Conversation with OSU-Cascades Transportation Services.

same hours of service (12:00 p.m. to 8 p.m., 9 p.m. on weekends) and service area with the exception that the microtransit service would also take people to/from Hawthorne Station.

A comparison of the productivity of these two service models will be completed once the 2019 data is available. The ridership, hours, and productivity of the prior summer shuttle are provided in Figure 41. In 2018 the service averaged approximately 5.2 rides per revenue hour, which was a decline from the prior year. Ridership dropped slightly from 2017 to 2018 despite an increase in service hours.

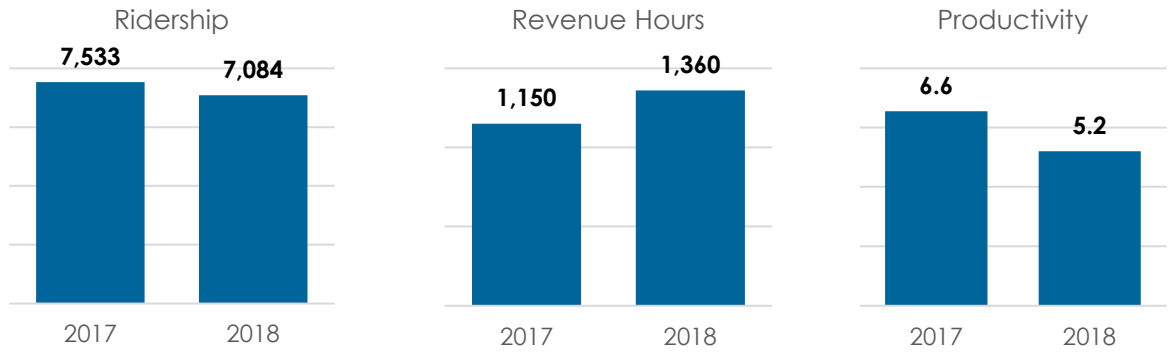


Figure 2: Ride Bend Ridership, Revenue Hours, and Productivity, 2017-2018

The 2019 pilot offered on-demand point-to-point transit service, with rides scheduled either through a smart phone app or by calling ahead. This pilot study is being conducted by the Mobility Lab at OSU-Cascades. The service is still offered free of charge and is available to anyone. Riders may use the service to and from any points within the service area; rides may also begin or end at Hawthorne Transit Station to connect with CET buses. The initial service area for summer 2019 is shown in Figure 3.

Service is provided via three 11-passenger vans, one of which is ADA accessible. All are equipped with bike racks, and dogs are welcome on board. The Ride Bend service is funded by the City of Bend, Visit Bend, the Bend MPO, St. Charles Health System, OSU-Cascades, and COIC. Current cost per vehicle hour is $49, including vehicles, technology, and labor. Operating hours on most days were 12:00 PM to 8:00 PM, though for several weeks in August operating hours were extended to 9:00 PM Thursday-Sunday.

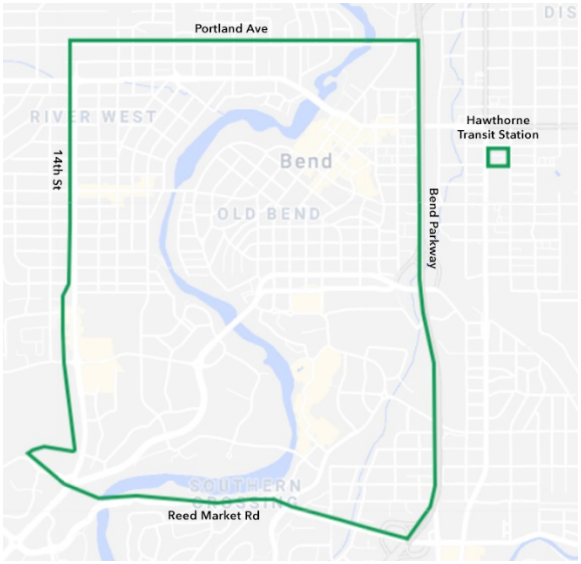


Figure 3: Ride Bend Service Area, Summer 2019

Source: OSU-Cascades

Initial operating figures for the July 1 – September 4 pilot period are shown below:

- 4,249 total rides, or approximately 65 rides per day
- Highest ridership day was August 17, with 239 rides provided
- Average trip distance 1.27 miles
- Average vehicle occupancy 2.07 passengers
- 293 rides to/from Hawthorne Station, or 7% of all rides
- 3 rides for passengers using wheelchairs
- Average wait time under 6 minutes

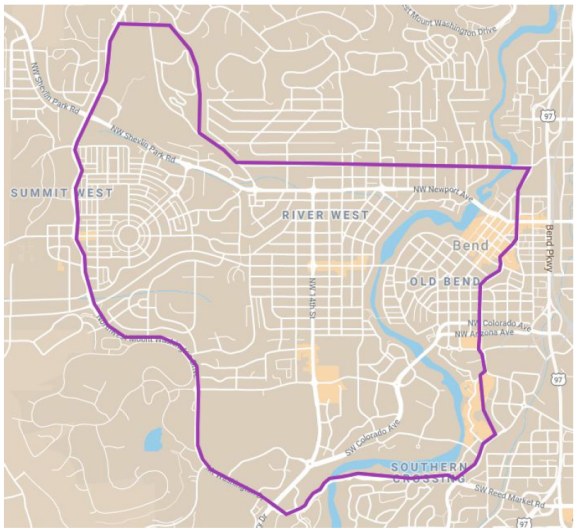


Figure 4: Ride Bend Service Area, Fall 2019
Source: Ride Bend/OSU-Cascades

In conjunction with the resumption of fall classes at OSU-Cascades, the service area will expand substantially on September 23, 2019 to include areas west of 14th Street/Century Drive, as shown in Figure 4. Operating hours will be 7:00 AM to 6:00 PM.

Pickup and dropoff locations for summer 2019 operations are shown in Figure 5 and Figure 6. Pickups were scattered throughout the service area, with loose clusters along Newport Avenue on the west side, the Old Mill District, and Downtown Bend. Dropoffs were more closely grouped in Downtown Bend.

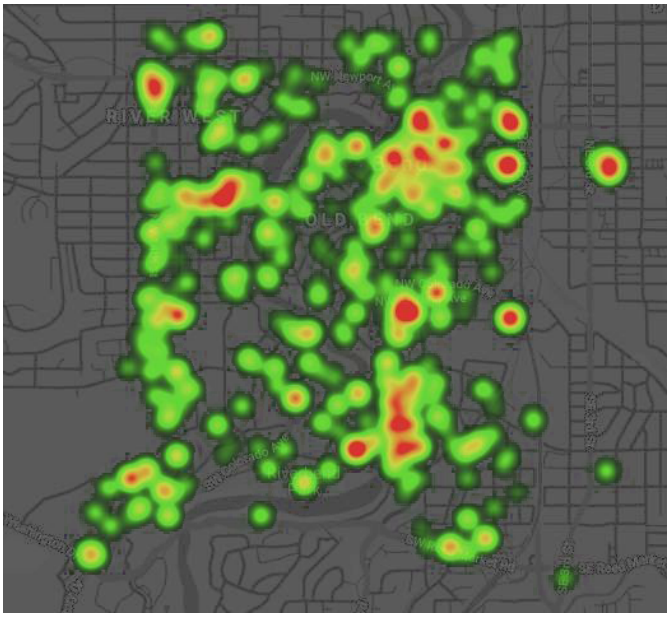


Figure 5: Summer 2019 Ride Bend Pickup Locations
Source: Ride Bend/OSU-Cascades

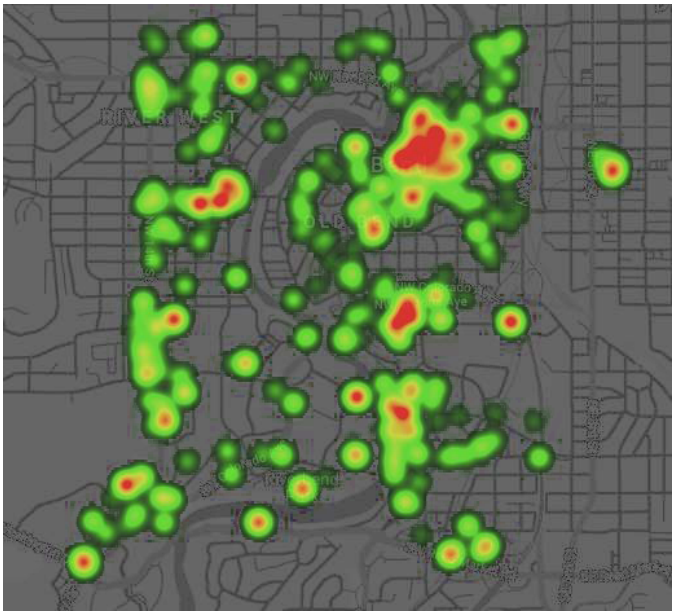


Figure 6: Summer 2019 Ride Bend Dropoff Locations
Source: Ride Bend/OSU-Cascades

CAR SHARE

OSU-Cascades hosted Zipcar stations until August 2019. Car share usage was low, and the Zipcar stations were not providing the minimum revenue required by Zipcar to continue providing the service.[5]

TAXI CABS

Numerous taxi companies operate in Bend.

VANPOOL AND CARPOOL

Commute Options for Central Oregon coordinates vanpool programs (offered by Enterprise and V-Ride).

RIDE HAILING

Uber and Lyft operate in the city of Bend. Lyft's service area covers the entire city of Bend, in addition to Prineville, Redmond, Sisters, Three Rivers, and La Pine. Uber does not show a service area map for comparison. An off-peak ride from High Desert Middle School in southeast Bend to Central Oregon Community College in northwest Bend costs about $23 on either Lyft or Uber. Both Lyft and Uber offer standard sedans for up to 4 passengers, or the "XL" services, featuring larger vehicles that can seat up to 6 passengers. Neither Lyft or Uber offers their shared ride services (Lyft Line and UberPool) in Bend, which offer cheaper rides by combining rides for passengers making similar origin-destination trips.

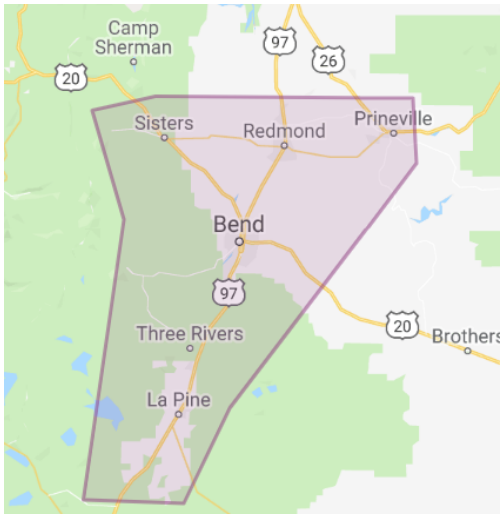


Figure 7: Lyft Service Area
Source: Lyft

NATIONAL MOBILTY SERVICES INFORMATION

MOBILITY HUBS

The term "mobility hub" refers to strategies to centralize mobility services in public spaces, including integrating a broader range of mobility options into existing transit centers and park-and-rides. These mobility services – including public transportation – facilitate convenient, safe, and accessible transfers between modes and expand travel options available to travelers.

Metrolinx, the regional transportation agency in the greater Toronto area, offers this definition:

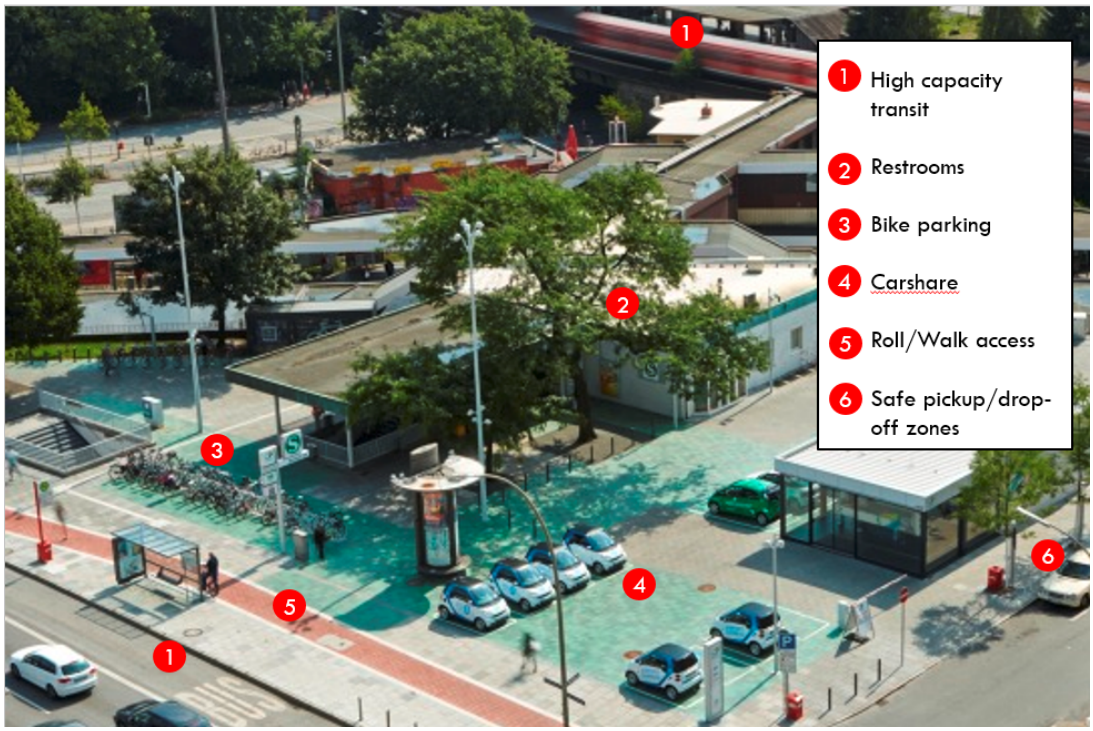
> *"A mobility hub is more than just a transit station. Mobility hubs consist of quality transit stations and the surrounding area. They serve a critical function in the*

[5] Conversation with OSU-Cascades Transportation Services.

regional transportation system as the origin, destination, or transfer point for a significant portion of trips."[6]

Figure 8 illustrates an example of a large mobility hub, with key mobility and placemaking elements.

Figure 8 Mobility Hub Concept: Hamburg, Germany

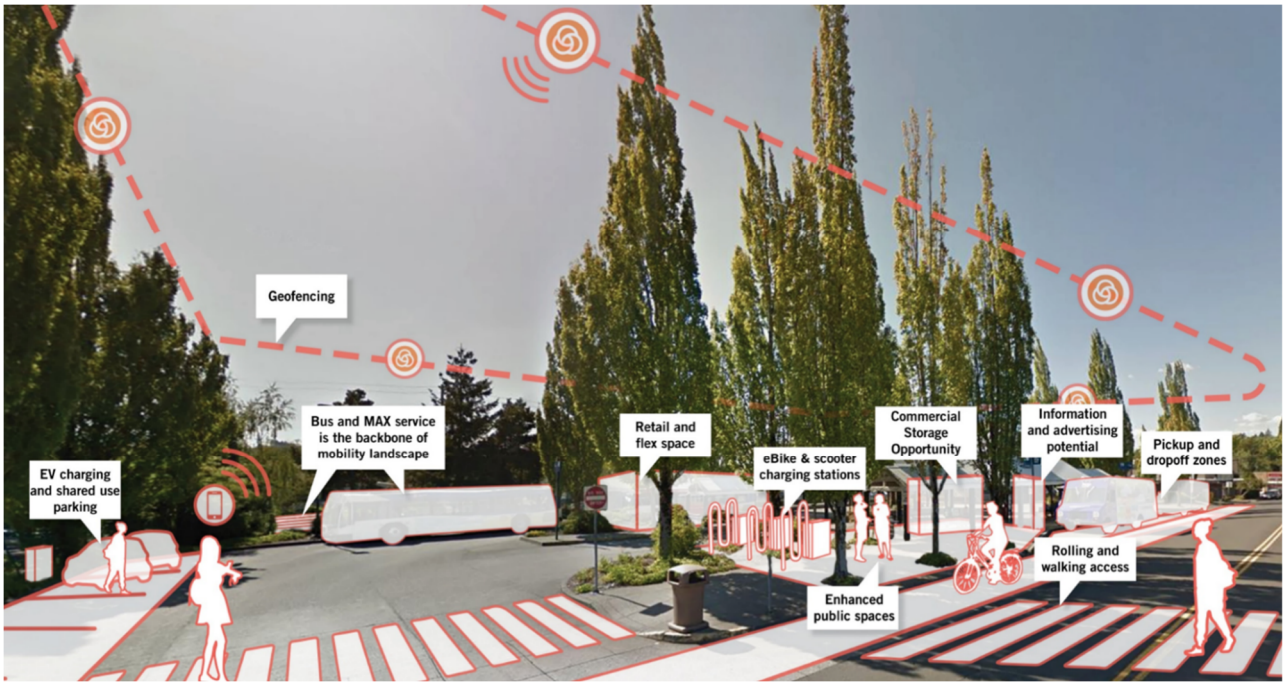


Source: Hamburg Mobility Point

TriMet (transit provider in the Portland Metro region) recently studied new mobility services and strategies available to the agency. Mobility hubs were included as one strategy to program existing station areas in ways that provide customers more mobility options while providing safe pedestrian and vehicle movements to and from the hub. Figure 9 illustrates how mobility hub features may be incorporated, including geofencing, charging stations, enhanced walking and rolling access, pickup and dropoff zones, and commercial storage opportunities.

[6] Metrolinx (2011). Mobility Hub Guidelines for the Greater Toronto and Hamilton Area. Retrieved from http://www.metrolinx.com/en/regionalplanning/mobilityhubs/01SectionsI-II.pdf

Figure 9: Mobility Hub Concept: Portland, Oregon



Source: Nelson\Nygaard, TriMet New Mobility Report, Final Presentation, June 2018

MICROTRANSIT

This section summarizes national research and data on microtransit services.

TCRP Synthesis 141: Microtransit or General Public Demand–Response Transit Services: State of the Practice

TCRP Synthesis 141 defines microtransit as a term coined in 2014 to describe:

> *the types of services offered by private sector transportation service companies such as VIA, Bridj, and Chariot that provide what some might call a middle ground between taxis and public transit. This middle ground is defined as one in which passengers crowdsource minibus and van rides by requesting rides on their smartphones through an app provided by the private company, much like UberPool or Lyft Line. The private carrier's scheduling software then uses its algorithms to optimize the vehicle's route in real time to serve the most amount of people as efficiently as possible. The passenger is notified when the vehicle will pick up.*[7]

Table 1 summarizes ridership and cost information for various microtransit-type services operated by public transit agencies. Most services carried approximately 2.4 to up to 4.7 riders per vehicle hour.

[7] Transit Cooperative Research Program, TCRP Synthesis 141, p. 1.

Table 1: Ridership and Operating Costs for General Public Demand Response Services

Transit Agency	Contract or In house	Cost per Vehicle Service Hour	Passengers per Vehicle Service Hour	Cost per Passenger Trip
AC Transit	In house	$214.00 (fully allocated)	3	$71.00
Cherriots	In house	$65.00	3.5	$18.57
DART (Dallas)	Contracted. DART provides vehicles and facilities but not fuel.	$46.00	2.5 for original DRT service and 3.5 for new GoLink service.	$18.40 $13.14
Greater Dayton RTA	In house and contracted	RTA pays Lyft and taxis and uses in-house paratransit.	Not applicable	$13.00
Denver RTD	Contracted	$83.00	3.8	$21.84
HART	Contracted	HART pays contractor by trip and not by hour.	3.5	$10.00
Houston METRO	In house	$75.00	2.4	$31.25
Kitsap Transit	In house	$130.72	3.66	$35.68
LYNX	Contracted	$41.17	3.3	$12.60
MST	Contracted	$54.18	4.03	$13.44
NVTA	Contracted	$44.48	2.6	$17.00
NCTD	Contracted	$97.00	2.7	$36.00
TDU	Contracted and in house	$34.69	4.7	$7.34

Note. The numbers are self-reported figures from agencies that responded.

Source: TCRP Synthesis 141, Table 4

Key Lessons Learned

Agency staff were surveyed about their experiences implementing microtransit service. Responses are summarized below by topic area.

Goal Setting and Ridership Expectations

- Seven passengers per service hour may be the upper limit of productivity, above which point trip denials are common.
- Ensure that staff and oversight boards are informed regarding the targeted level of service, and why the existing model needs to change.

Operations Considerations

- Set small service zones. When the structure of a service zone is designed around a schedule point at a major hub, the service zones should be approximately 5-7 square miles.
- Study the market and assess potential ridership. Ensure that service is configured to meet passenger needs based on existing travel patterns.

- It is difficult to balance on-demand and call-ahead/subscription riders with the same service. Trips booked ahead limit the ability of the system to respond to on-demand requests. However, limiting one or the other option can limit productivity.
- Prioritize timed connections to other services and ensure they are met.

Marketing and Customer Service

- Marketing is extremely important – the greatest challenge is teaching people how to use the service. Current and potential riders may have difficulty in translating the description of the demand-response concept into a positive customer experience.
- Offer free travel training for paratransit customers transitioning to flex/microtransit services.
- A higher level of personal customer service is important with microtransit. Using drivers who have experience driving paratransit services may help, because they may be more sensitive to people's needs.
- Use the same fare structure and fare media as fixed route service.

Contractor Considerations

- The agency must have control over the mobile application data. When the contractor owns the data, this does not allow for proper monitoring of the service. Agencies may wish to request a data dashboard for ongoing monitoring.

MICROMOBILITY

National trends around micromobility, which NACTO defines as "shared-use, fleets of small, fully, or partially human-powered vehicles such as bike, e-bikes, and e-scooters," include:

- Dockless pedal bikes are disappearing, largely replaced by e-scooters
- E-bikes have emerged as a popular option
- Boston expanded its fleet of bikes by 40%, leading to 30% increase in ridership
  - 85% of Boston residents are now within 5-7 minute walk of Bluebike station
- Usage patterns differ depending on user/pass types:
  - Monthly or annual pass users tend to ride during AM and PM peak hours, suggesting heavy use for commuting
  - Day/single trip users are more likely to ride during mid-day or on the weekend, and for longer periods of time, suggesting social/recreational trips
- E-scooter usage more closely mirrors social/shopping/recreational bike share usage. Average e-scooter peak usage begins around mid-day and continues into the evening, with highest use on the weekends.
- People using station-based bike share are more likely to use it for commute trips, and to connect with transit
- Nationwide, the bikes that get the highest use, measured in rides/bike/day, are e-bikes. E-bikes are used twice as frequently as pedal bikes.
- Bike share companies are rapidly adding e-bikes to their fleets
- Across all vehicle types, usage ranges from roughly one ride/vehicle/day to four rides/vehicle/day.
- Ridership is impacted by factors such as availability of low-stress bike lanes, station density, how well bike/scooter share is integrated into the wider transportation network, and the extent of rider outreach and education undertaken by the vendors.

- Smaller station-based bike share systems, with low station density and fewer available vehicles, have the lowest rides/vehicle/day.[8]

TRIP PLANNING PLATFORMS

There is increasing interest in developing "one-stop shop" online trip planning platforms outside of large urban areas. These types of platforms help customers navigate the range of services available in mobility hubs including micromobility. Examples include:

- Vermont is developing a statewide trip planner that incorporates flexible transit options, such as dial-a-ride, ride hail, and deviated fixed-route services
- Agencies and community groups in Tompkins County, NY (Ithaca) are developing a basic level of "mobility as a service" by integrating information, booking, and payment for various mobility providers in one online platform. Providers include on-demand services provided by the county's social services department, fixed-route service, and several volunteer transportation organizations.

[8] NACTO Shared Micromobility in the U.S.: 2018 https://nacto.org/shared-micromobility-2018/

FIXED-ROUTE TRANSIT NETWORK ANALYSIS

PRIMARY TRANSIT NETWORK

OVERVIEW

The concept of primary transit corridors, which was introduced in the Bend Transit Plan (2012), identifies the roadway segments that are most significant for transit. Figure 10 is a map of the current Primary Transit Network from the 2012 plan.

These corridors are not bus routes or a service plan, but a policy tool to help the City of Bend and CET manage and coordinate land use, public infrastructure, and transit service provision. Primary transit corridors are a mechanism to coordinate transit and land use to achieve land use characteristics that can support a high level of transit service (e.g., as frequent as every 15 minutes) along Bend's most important arterial transit corridors by:

- **Securing a commitment from the transit provider (CET)** to maintain the highest level of transit service, and focus future investments in service capacity, frequency, and amenities along identified, mutually agreed-upon corridors where the City will focus land use planning.
- **Influencing the City's zoning and development policies** to encourage intensification of land use and plan utility infrastructure (sewer, water, etc.) to support higher-intensity development along the identified arterial transit corridors. Designating primary corridors provides a statement to the community that the City will seek to update land use plans where arterial transit corridors are currently not built or zoned for transit-supportive densities, but might be.
- **Providing direction to City engineers and planners about where street rights-of-way should be designed and managed** to help maintain transit operating speed and reliability. This enables transit to provide the best possible user experience, prevents timed-transfer connections from breaking down, and allows transit operating resources to be spent on improving service.
- **Coordinating with City, ODOT, or other vested partners** regarding operational or maintenance support agreements for connected devices or infrastructure.
- **Encouraging dense and/or transit-intensive land uses to locate on primary corridors**, or at a minimum, along the supporting network. Primary transit corridors communicate preferred locations for uses that generate high transit demand and/or that desire to have transit service. For example, if a planned land use that is known to require transit, such as a social services office or school, chooses not to locate on a primary corridor, it does so with the knowledge that it may not get the best transit service. When such uses locate away from transit, they inevitably create pressure for the transit agency to provide service where it cannot be done efficiently.

It is important to emphasize that while Bend should prioritize the highest-quality transit service in primary transit corridors, some transit routes serving primary corridors will also provide transit coverage outside of those primary corridors.

Two tiers of corridors are recommended—definite and candidate—to categorize the potential for future transit demand and likely phasing of particular corridor segments:

- **Definite corridors.** These are the most densely developed corridors and/or have the greatest development potential and connect key destinations that generate transit demand. They have the highest potential to warrant transit service investments (e.g., more frequent or more direct).
  Candidate corridors. These may be less densely developed corridors that have longer-term development potential. They could be elevated to a primary transit corridor as land uses become more transit-supportive and destinations that generate transit demand develop.

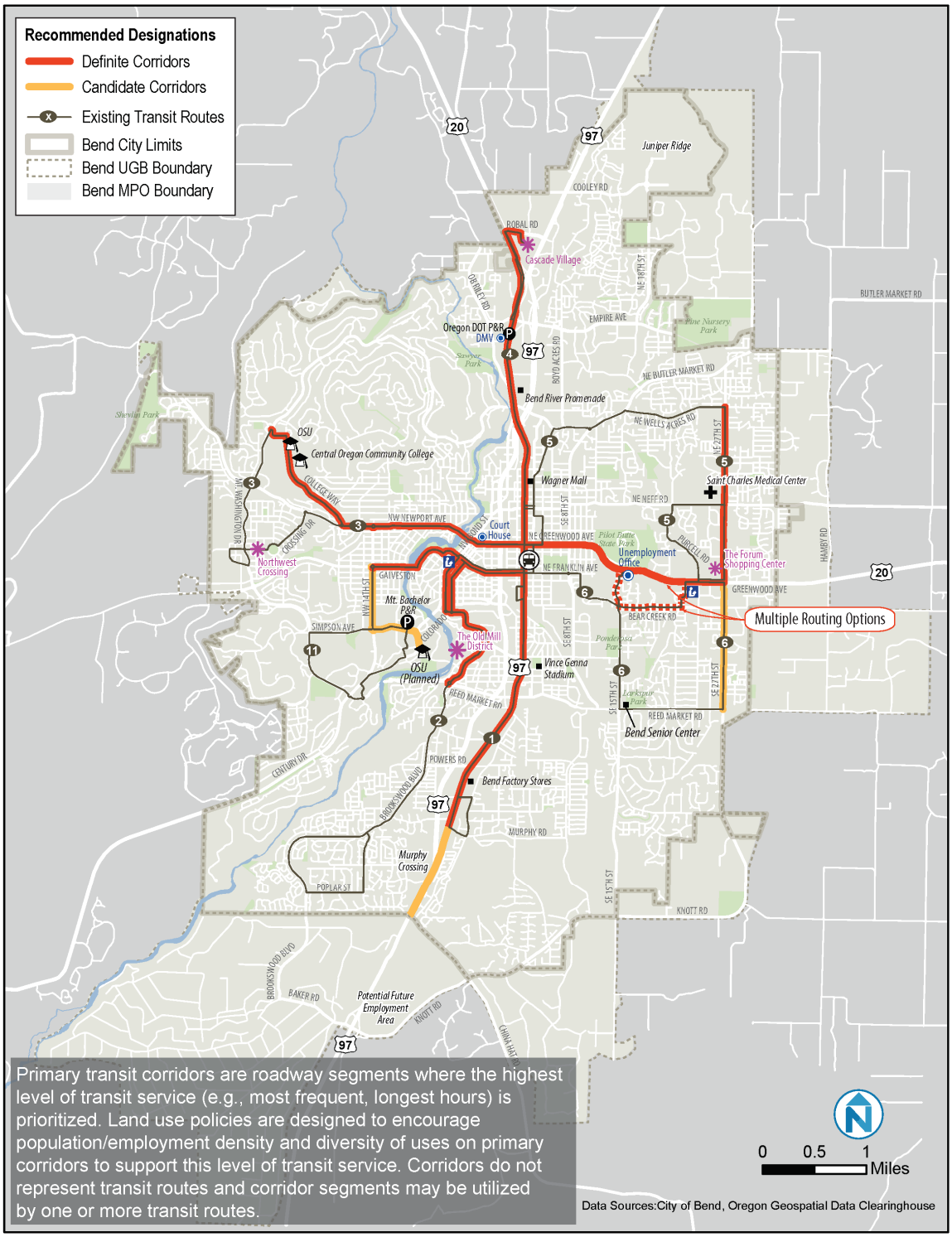


Figure 10: Primary Transit Network, 2012

Source: Bend Transit Plan, 2013, Figure 7-4

UPDATED ANALYSIS AND RECOMMENDATIONS

The Primary Transit Network from the 2012 plan along with additional segments of potential interest for transit were reanalyzed to identify current and future population and employment density, along with the low-income population density (based on a 200% of poverty definition). These segments were identified in part drawing on analysis of population, employment, and travel patterns from the Bend MPO travel demand model (see Existing Conditions Supplement Memo – Bend Employment Centers).

- Figure 11 illustrates the segments that were analyzed.
- Figure 12 illustrates future population density
- Figure 13 illustrates future employment density
- Figure 12 illustrates combined future population and employment density
- Figure 15 illustrates low-income population density (200% of poverty)

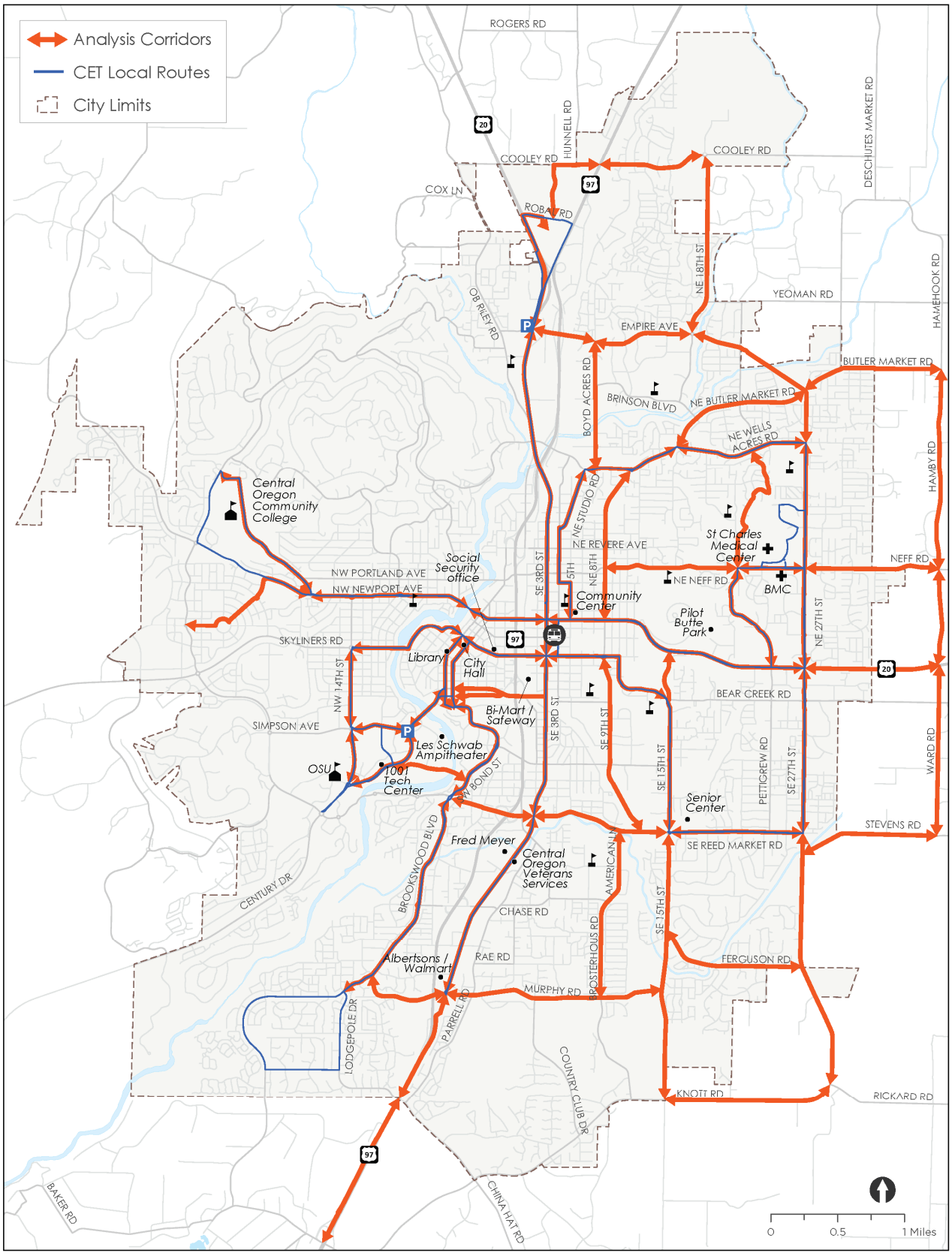


Figure 11: Segments Evaluated for Primary Transit Network Update

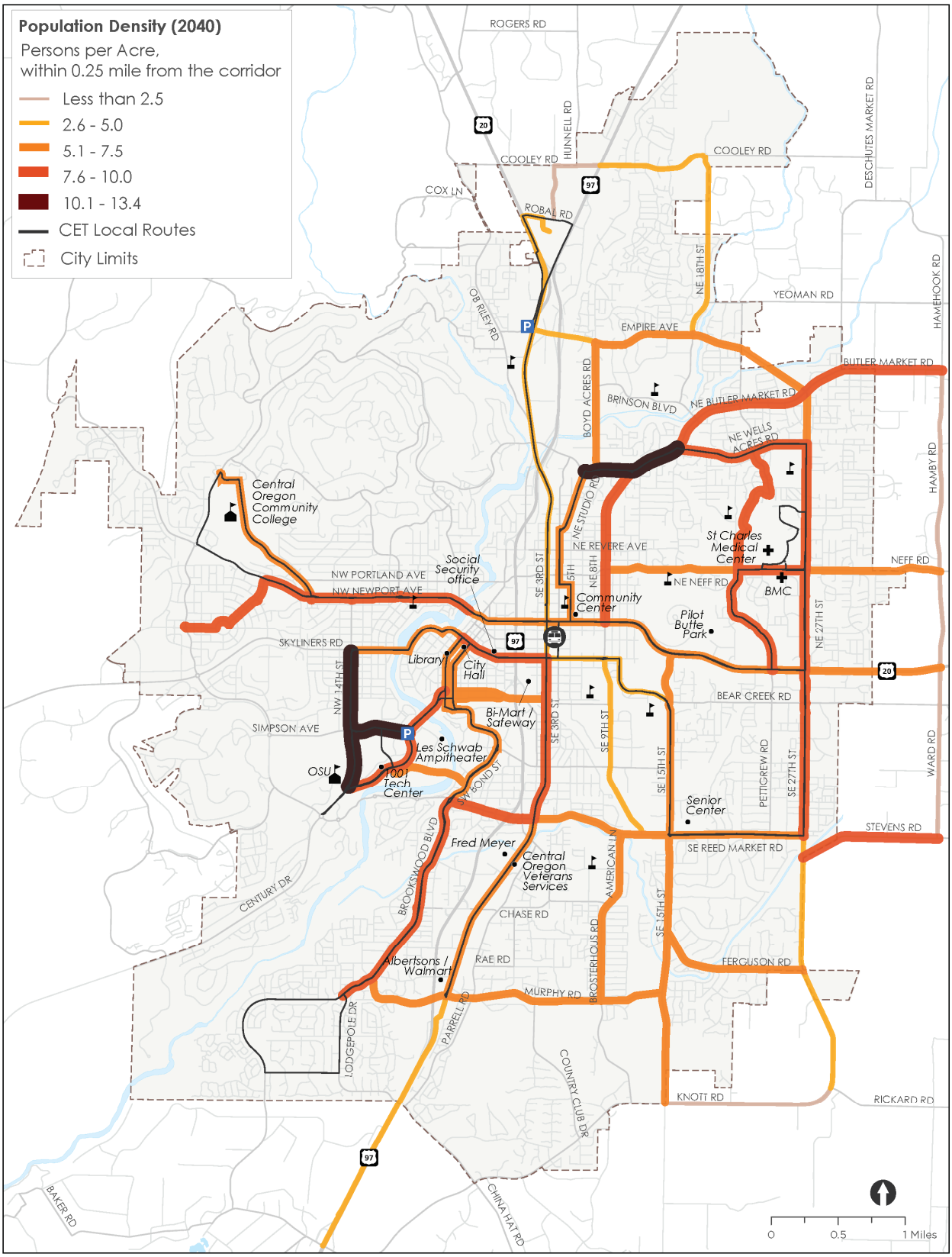


Figure 12: 2040 Population Density by Corridor Segment

Note: Within a quarter-mile straight-line buffer. Data from Bend MPO projections.

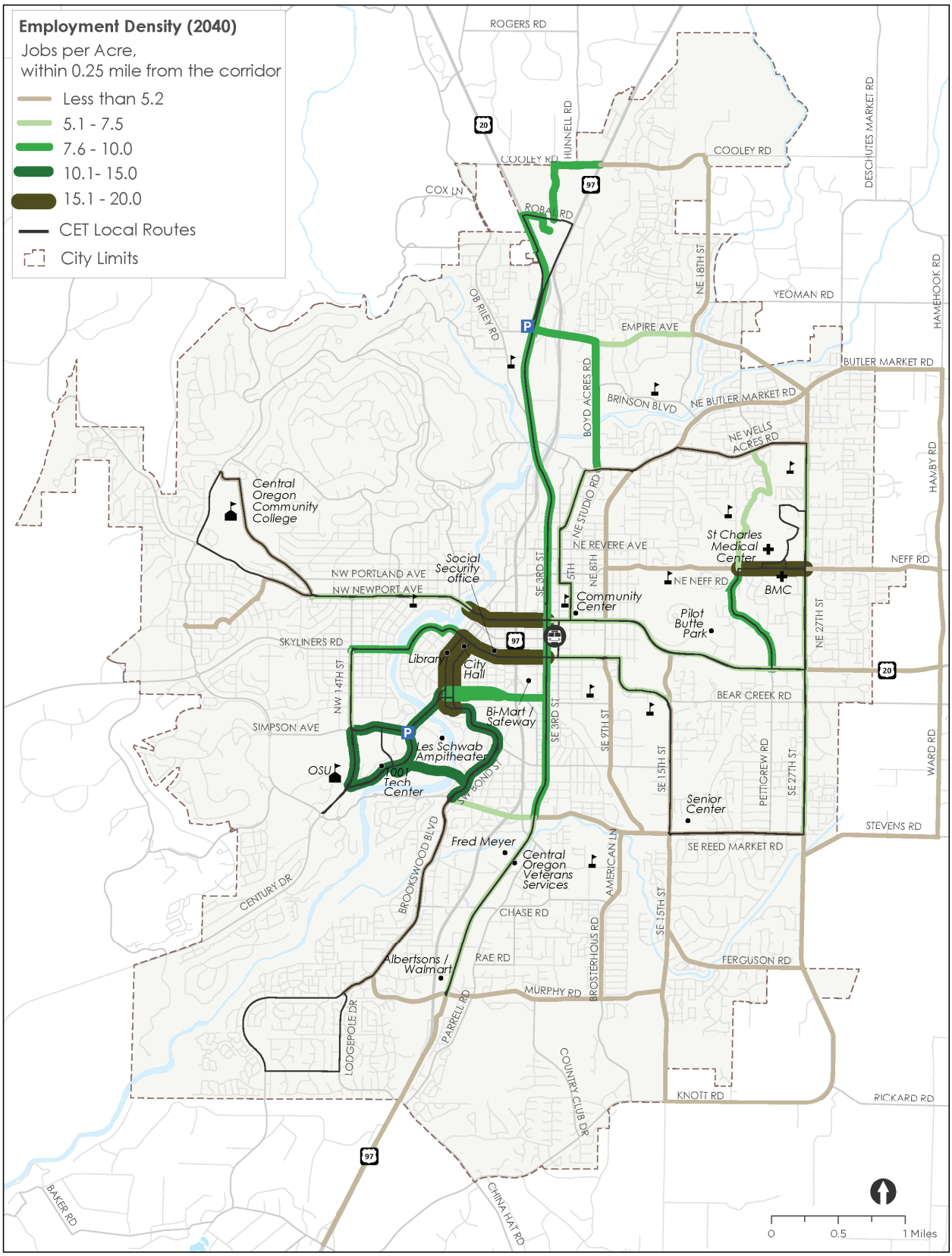


Figure 13: 2040 Employment Density by Corridor Segment

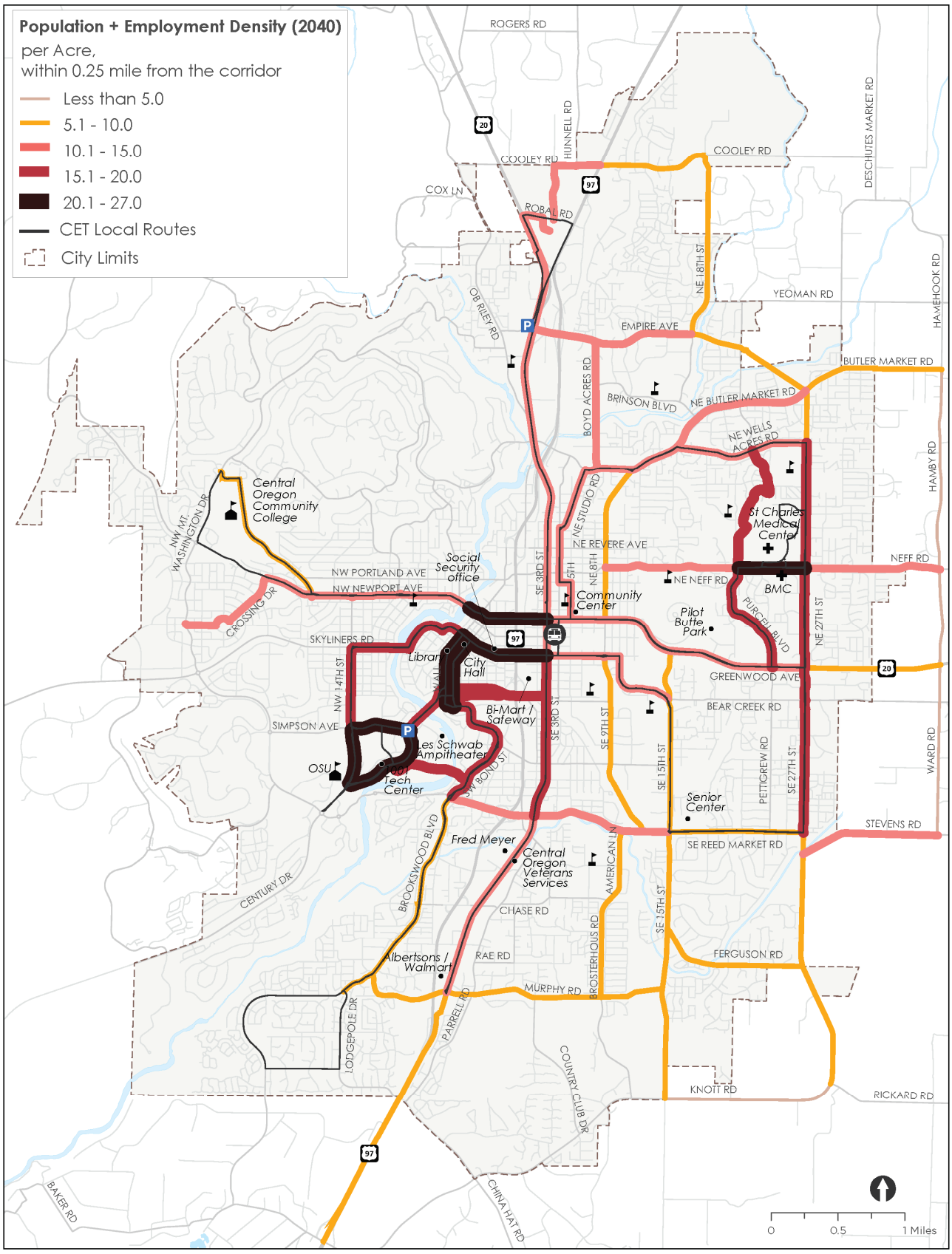


Figure 14: 2040 Combined Population and Employment Density by Corridor Segment

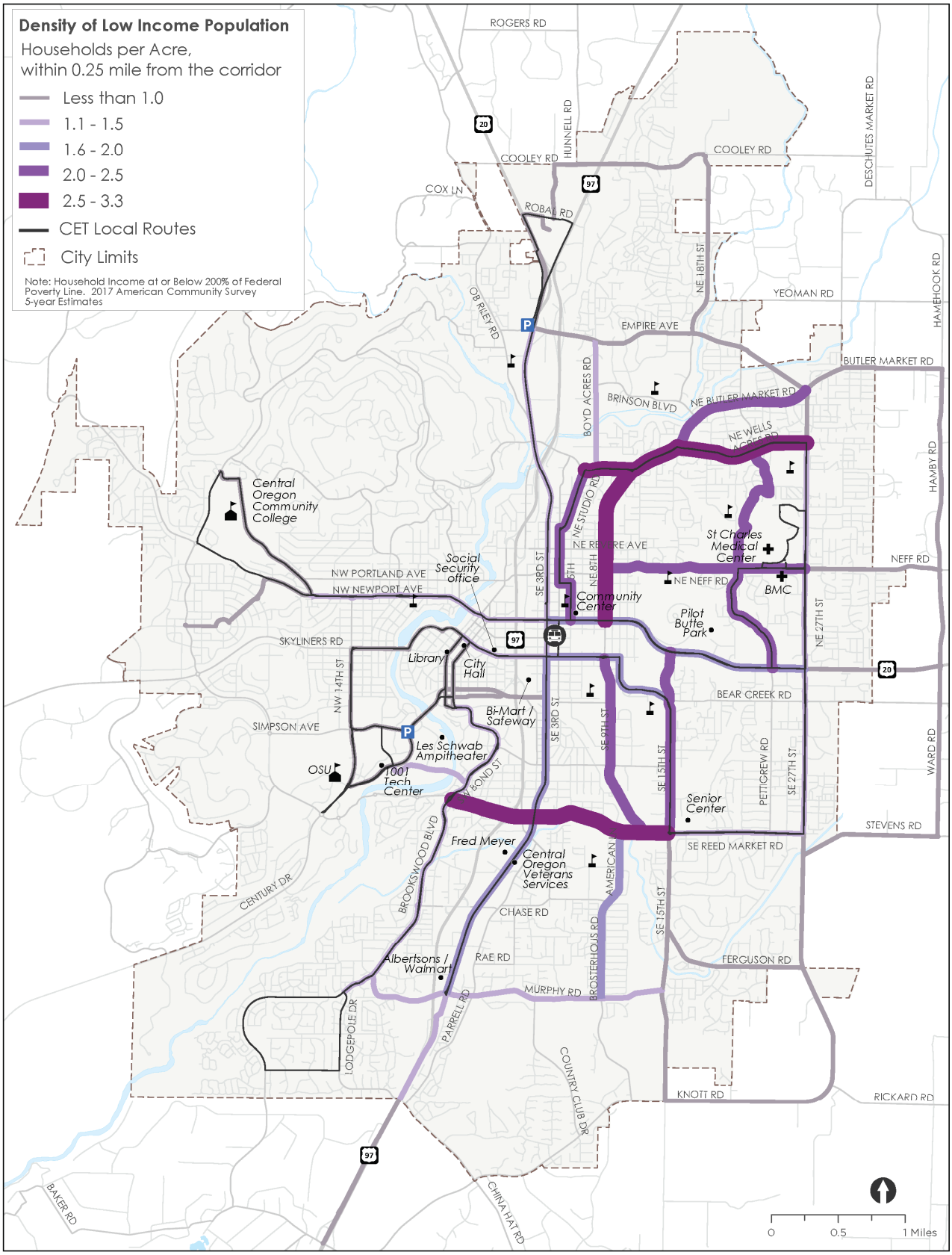


Figure 15: 2017 Low-Income Population (200% of Federal Poverty Level) Density by Corridor Segment

RECOMMENDED PRIMARY TRANSIT NETWORK

Figure 16 illustrates the recommended Primary Transit Network corridor designations, based on thresholds for density of population and employment required to support frequent transit service (see Figure 1 of the Existing Conditions Supplement Memo – Bend Employment Centers) as well as system considerations for the transit network in Bend. Similar to the 2012 map, corridor segments were classified as:

- **Definite corridors** with the highest land use density and ridership potential can support relatively frequent service based on current or near-term conditions. These include the following corridors or areas:
  - Downtown Bend, including Newport Avenue, Franklin Avenue, and Wall/Bond Streets.
  - The OSU Cascades campus and adjacent employment areas.
  - The COCC campus, including Newport Avenue
  - Greenwood Avenue, NE 27th Street, and the St. Charles Medical Center area.
  - 3rd Ave, between Cascade Village and Walmart
- **Candidate corridors** with more moderate land use density and current or future potential for moderately frequent service (possibly only in the peak periods). In some areas and corridors, the ability to support more frequent transit service depends on how land use and urban form actually develop in the near- to longer-term. These include corridors with:
  - Existing fixed-route service
  - Potential for new fixed-route service
- **Future service areas** may be considered for either fixed-route or other service models

Table 2 summarizes Primary Transit Network corridor characteristics (densities) and designations. Population and employment density is based on a quarter-mile straight-line distance around the corridors.[9] Combined densities for the "Definite" corridors range from about 7 to 15 persons+jobs per acre currently and about 13 to 24 persons+jobs per acre by 2040.

A Transit-Oriented Development Strategies memorandum developed for the CET Transit Master Plan will identify policies that the City of Bend and other local agencies in CET's service area can implement to encourage transit-supportive densities and urban form along planned Primary Transit Corridors.

[9] The 2012 plan used a quarter-mile walking distance, based on existing or conceptual stops. A straight-line distance assumes that stops could be moved or street connectivity could be improved in the future.

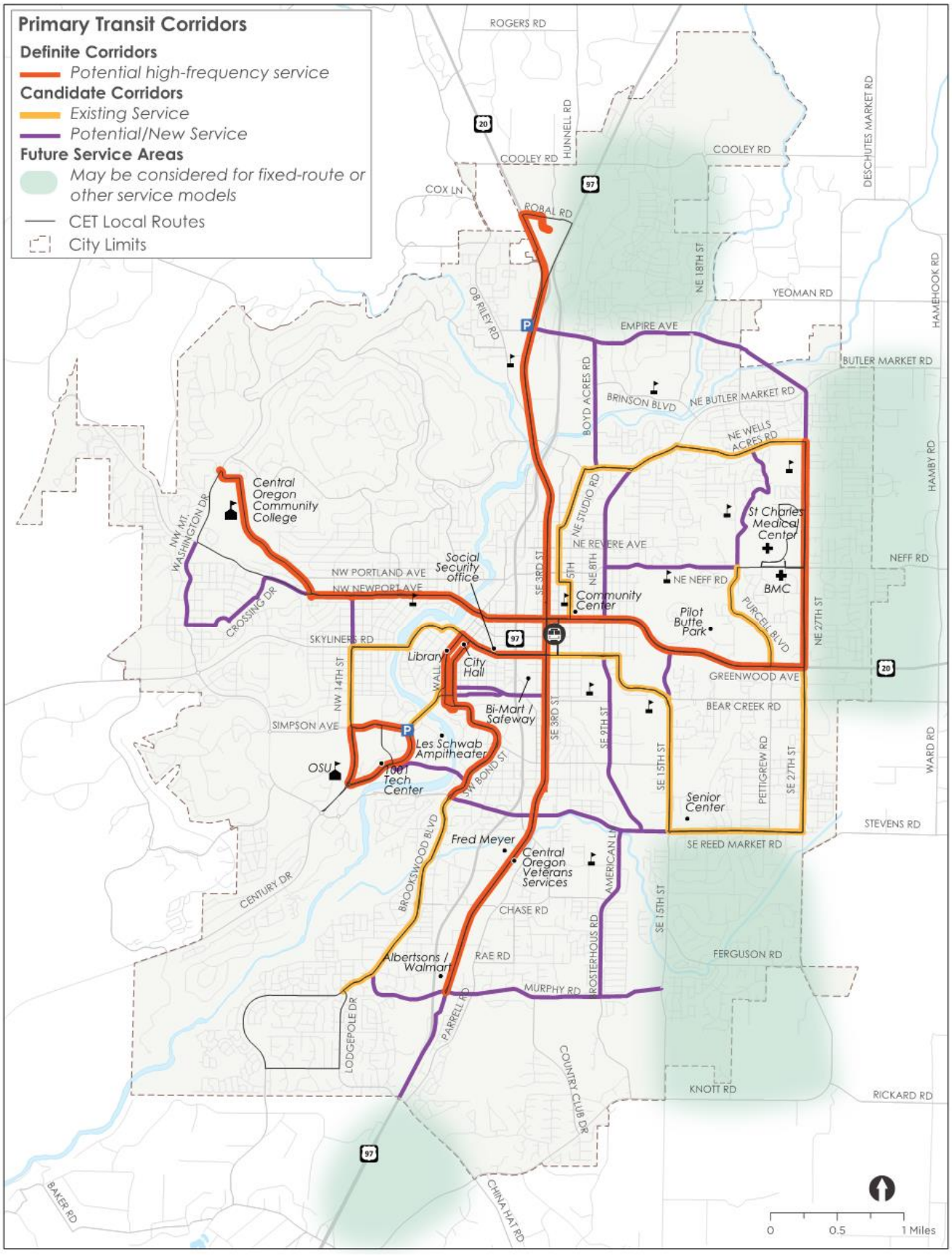


Figure 16: Recommended Primary Transit Network

Table 2 Recommended Primary Transit Network Classifications and Corridor Characteristics (Density - per Acre)

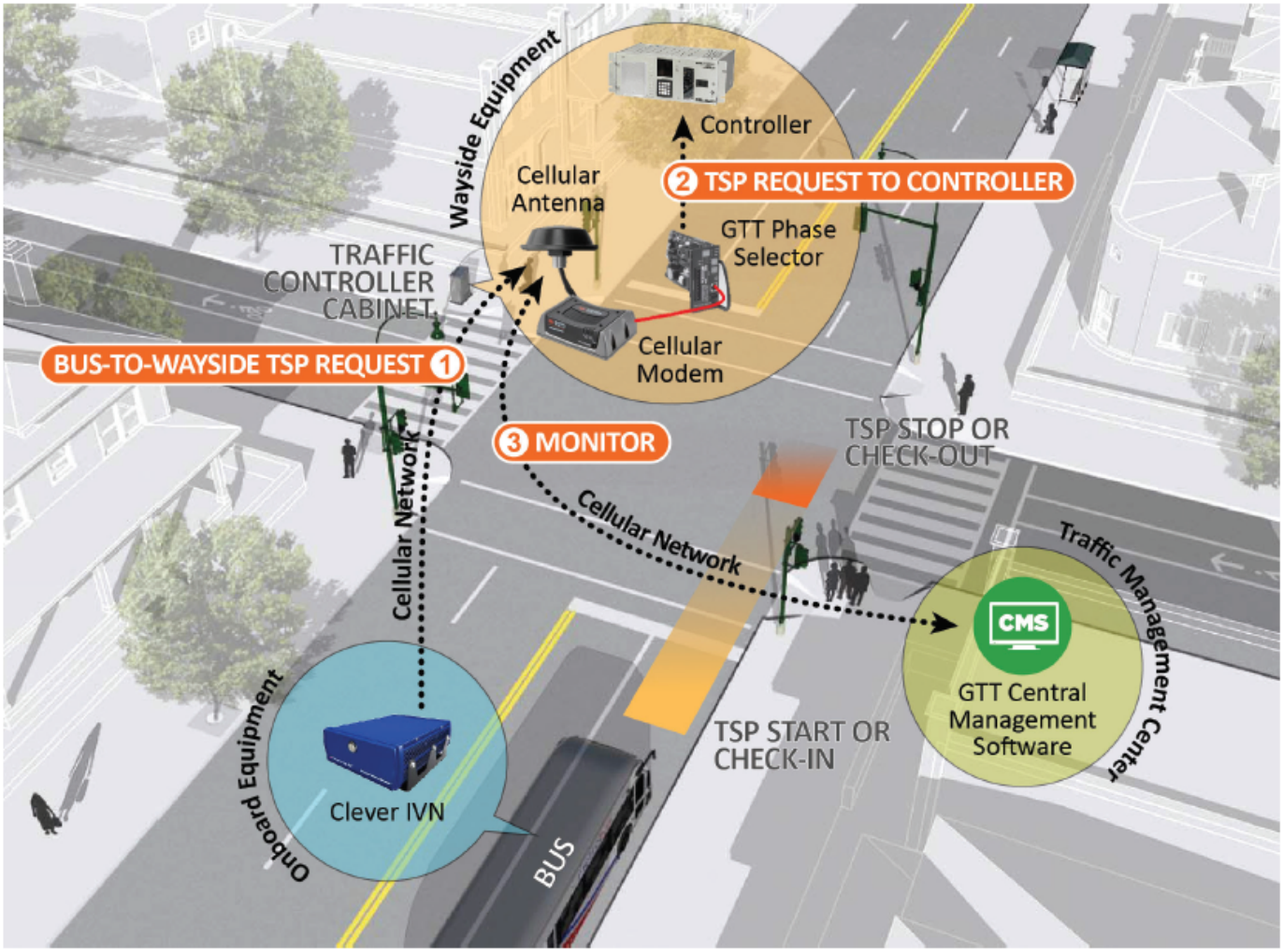
Corridor	Population Density [1]		Low-Income Population Density [2]	Employment Density [3]		Combined Population and Employment Density	
	2010	2040	2017	2010	2040	2010	2040
Definite							
Franklin Avenue	3.5	7.5	1.2	11.4	16.3	15.0	23.8
OSU Area (Simpson/Century/Colorado	0.9	10.8	0.4	6.0	10.9	6.9	21.7
Wall/Bond Streets	3.8	6.3	1.1	9.7	14.3	13.4	20.6
Greenwood Avenue	3.7	7.0	1.8	7.5	10.2	11.3	17.1
27th Street	4.8	8.8	1.5	4.5	6.6	9.3	15.4
Newport Avenue	5.7	7.9	1.5	5.2	7.1	10.8	15.0
South 3rd Street	3.8	7.0	1.9	4.5	6.9	8.3	13.9
North 3rd Street	1.6	4.2	0.9	6.0	9.4	7.6	13.6

Sources: [1] Bend MPO projections and [2] American Community Survey, 2013-2017 5-Year Average

PRIMARY TRANSIT NETWORK TECHNOLOGY OPTIONS

Transit Signal Priority (TSP) should be considered for all corridors on the primary transit network. Transit Signal Priority is a general term for a set of operational improvements that use signal controller technology to reduce the wait time for buses at traffic signals by holding the green time and reducing the red time when a bus is detected. This can be done at all times or just when the bus is running late and may be implemented at individual intersections or across corridors or entire street systems. This is particularly valuable on routes with schedule adherence issues (such as Route 4: North 3rd Street) and can help reduce the travel time variability. Reduction in travel time variability allows agencies to tighten schedules, reduce travel time, and improve system reliability.

Individual locations considered for TSP will need to also consider items such as roadway geometry, transit stop locations, nearby driveway interaction, or other features that may impact how TSP could be implemented.



Clever Devices/GTT TSP System in Washington Metro Area (Source: Kittelson & Associates, Inc.)

Figure 17: Example Distributed TSP System

Transit Signal Priority can be planned for the entire primary transit network; however, there are different system architectures and technologies which must be identified in advance in order for each agency to implement their piece of the system. For example, the architecture could be centralized or distributed. A central system organizes and manages requests for priority from many vehicles across the entire system whereas in a distributed system priority decisions are made at the intersection level. Identifying viable technology to implement transit signal priority requires engagement with the traffic signal owners and operators (e.g., ODOT, City of Bend) and the transit agency staff responsible for the vehicle fleet's communication, automatic vehicle location, and other technological systems to select an architecture and technology. Both existing infrastructure and future technology needs should be considered for both the vehicle and traffic system technologies.

CET should work with the City of Bend and ODOT to develop a Transit Signal Priority Concept of Operations that would provide guidance on the architecture and technology for Transit Signal Priority in Bend. This would allow implementation of a demonstration corridor (such as Route 4) that could be expanded to the rest of the primary transit network as needed. The City of Bend's draft ITS Plan already explicitly includes TSP, as required for federal funding eligibility.

OTHER TECHNOLOGY NEEDS

Separate from Transit Signal Priority, the following additional technology needs have been identified for potential inclusion in the Transit Master Plan; funding for technology improvements has been included in Deschutes County's STIF plan for FY 2021:

- Automated stop announcements and displays on buses (eliminating the need for the drive to make stop announcements)
- Upgraded communication equipment for drivers and operations staff
- Online app maintenance
- Computers and tablets
- Real-time arrival information at bus stops (see transit hubs)
- Improved Dial-A-Ride dispatch/scheduling system (see Bend Dial-A-Ride section)

FIXED-ROUTE FREQUENCY AND RIDERSHIP POTENTIAL

The CET TMP service plan will analyze the following frequency scenarios for the Primary Transit Network, including ridership implications (based on both elasticity and TBEST analysis), operating and capital costs, and other measures of benefits (number of trips to residents, jobs, and 200% of poverty population):

- 15-minute peak/30-minute off-peak
- 20-minute peak/40-minute off-peak

ENHANCED TRANSIT SERVICE CORRIDORS

Routes 1 and 4 along Third Street each serve over 60,000 rides per year and have the highest ridership and rides per hour (over 16) compared to other Bend fixed routes. This is followed by Routes 3 – Newport and Route 7 – Greenwood.

The transit corridors on the primary transit network streets that are forecast to be most productive in the future (such as those along Routes 1, 3, 4, and 7) should be designated as higher order transit streets that should be planned as enhanced transit corridors. These designations should be determined through the alternatives analysis as the ridership sensitivity to route frequency evaluated (as described above) and route reconfigurations are considered (see following section below).

Enhanced transit corridors may have decreased headways, system improvements such transit signal priority and/or bus-only lanes at intersections, real-time arrival information at key stops/mobility hubs, off-board fare payment systems, and front and rear loading.

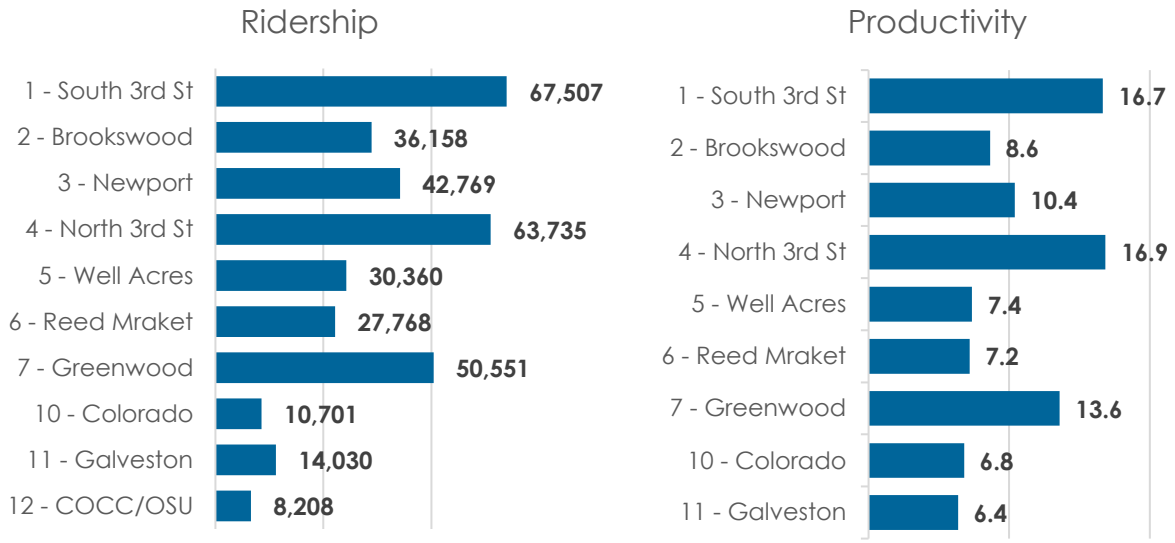


Figure 18: Bend Fixed-Route Ridership and Productivity, 2017

ADDITIONAL FIXED-ROUTE SERVICE OPTIONS

This section identifies new routing options for the primary transit network, designed to reduce the number of trips for which transfers are required. Although well-designed, convenient transfers are an essential part of any transit system, the current route design and central transit hub location in Bend result in a very high number of transfers. This section:

- Summarizes major travel patterns (identified in Existing Conditions Supplement Memo – Bend Employment Centers) and their potential application to the fixed-route network design including conceptual options that will be considered in the CET TMP service plan, such as:
  - Extending one or more current routes to provide a direct eastside to downtown connection, which may include a brief stop at Hawthorne Station or an alternative eastside transit center location, such as extending Route 7 along Newport Avenue to Wall/Bond Streets and the Old Mill and/or OSU Cascades campus.
  - Interlining local fixed-route routes, i.e., a single physical bus serves one route before "turning into" another route, which may be done for scheduling reasons or to provide a more convenient single-seat connection for passengers.
  - Interlining Community Connector routes with selected local route trips in Bend, e.g., Redmond-Bend Community Connector (Route 24) interlines with a Route 7 trip to St. Charles Medical Center or a Route 3/10/11 trip to downtown and OSU or COCC.
- Identifies considerations related to the location of the main transit center in Bend, i.e., Hawthorne Station.

EVALUATION OF FIXED-ROUTE OPTIONS BASED ON ORIGIN-DESTINATION ANALYSIS

Table 3 summarizes major travel patterns identified through the Origin-Destination analysis and identifies potential connections and route interlining options that could be considered.

Table 3: Fixed-Route Options to Enable New Transit Connections

Area / Corridor	Existing Routes	Market Assessment / Travel Pattern Findings	Potential New Connections	Potential Interlining Options
West	3	▶ Growth in travel within westside area, potentially including between COCC/Northwest Crossing areas and OSU area	▶ North-south connections with OSU/Old Mill areas along 14th Street or through downtown	▶ No specific option identified
Downtown	2, 3, 10, 11	▶ Relatively even distribution of trips around city ▶ No direct transit connection for people traveling from east of Bend Parkway	▶ Extension of Route 7 to serve downtown (e.g., along Newport, Wall, and Bond Avenues)	▶ Routes 2, 3, 10, and/or 11 with routes serving eastside

Area / Corridor	Existing Routes	Market Assessment / Travel Pattern Findings	Potential New Connections	Potential Interlining Options
OSU Area	10, 11	▶ Large forecasted growth in trips, particularly within surrounding area and with southwest area, south 3rd, Cascade Village, central eastside, and St. Charles Medical Center areas	▶ Connection along Reed Market ▶ Connection to Newport Avenue along 14th Street	▶ Routes 10 and/or 11 with routes serving eastside
Old Mill Area	2, 10	▶ Highest growth to/from south, southeast, downtown, central eastside and and OSU areas	▶ Enhanced connections with downtown and OSU areas	▶ No specific option identified
Southwest / Brookswood	2	▶ Strong demand to/from downtown ▶ Strong east-west along Murphy Road	▶ Extension of Route 2 along Murphy Road	▶ Route 7
South/3rd	1	▶ East-west connections to corridor rather than between north and south 3rd ▶ Highest growth is to downtown, central eastside, southwest, and OSU areas	▶ Extension of Routes 1 or 2 east-west along Murphy Road to connect 3rd with southeast and/or southwest areas ▶ East-west connection along Reed Market Road	▶ No specific option identified
Southeast	None	▶ Highest growth to southwest, south 3rd, Old Mill, and OSU areas	▶ Potential east-west connections to existing routes along Reed Market and/or Murphy Roads	▶ N/A
Central Eastside	All	▶ Travel patterns well-served by existing routes. ▶ With a potential westside transit center, key patterns to maintain include Old Mill, OSU, and south 3rd areas	▶ N/A	▶ N/A

Area / Corridor	Existing Routes	Market Assessment / Travel Pattern Findings	Potential New Connections	Potential Interlining Options
East	5, 6, 7	▶ Within eastside area (well-served by existing routes) ▶ Between medical center and other areas, with concentration to/from downtown ▶ Growing demand to Empire Ave and Cascade Village areas	▶ Connection of Empire Avenue and 27th Street using new roadway connection ▶ Enhanced connections with downtown and OSU areas	▶ Route 7 and any route serving downtown
Northeast	None	▶ Within northeast and to/from Cascade Village, Juniper Ridge, and St. Charles Medical Center areas	▶ Potential extension of Route 4 and new connection along Empire Avenue	▶ No specific option identified
North/3rd	4	▶ Highest growth to/from northeast (including Juniper Ridge), downtown, and OSU areas ▶ North-south connections along 3rd do not appear to be the dominant travel pattern	▶ Extension of Route 4 to Juniper Ridge ▶ New connection between Cascade Village and St. Charles Medical Center area via Empire Avenue	▶ Route 4 and Route 2 or any other route serving downtown

NEW ROUTE OPTIONS

Table 4 (table) and Figure 19 (map) identify various potential routing options that could be used to provide more direct travel options for Bend residents and workers.

Table 4: New Potential Service Options or New Connections

Map Identifier	Category	Description
1	Barriers / New Connections	A connection of the Colorado/Arizona Couplet (e.g., extension of Aune) is under consideration in the Bend TSP. This connection would help CET to transition a more grid-like system and would support a potential westside transit center.
2	Barriers / New Connections	A pedestrian/bike overcrossing of the Bend Parkway at Hawthorne Avenue has been previously identified in the Bend TSP.
3	New Routing Option	Route 7 (Greenwood) could connect across the Bend Parkway to Newport and use Wall/Bond (or an alternative street) to connect through downtown to the Old Mill District and/or OSU-Cascades campus, providing a single-seat ride. The route could continue to stop at Hawthorne Station (or alternatively, a mobility hub in the central eastside).
4	New Routing Option	Service on Newport Avenue (e.g., Route 3) could connect to the OSU-Cascades campus via NW 14th St. Alternate routes would need to serve COCC and Northwest Crossing.
5	New Routing Option	Restore service to Northwest Crossing. Options include: (a) one-way loop using Mt. Washington Drive. (b) Route 3 trips (with increased frequency, e.g,. every 15 minutes) alternate between Northwest Crossing and COCC.
6	New Routing Option	Reed Market could provide a new east-west connection through south-central Bend to the Old Mill District, Downtown Bend, and/or the OSU-Cascades campus.
7	New Routing Option	New connections using Murphy Road could be integrated with Route 1 (South 3rd), Route 2 (Brookswood), or a new route.
8	New Routing Option	New service on American Lane / Brosterhous Road.
9	New Routing Option	New service on 9th Street as a possible alternative to 15th Street as part of a new route in Southeast Bend
10	Barriers / New Connections	An at-grade BNSF railroad crossing on Reed Market Road west of 9th Street creates significant operational issues to providing an east-west connection on Reed Market Road (see #6 and #11) and creating north-south connections in Southeast Bend (e.g., American Lane and SE 9th or SE 15th Streets).
11	New Routing Option	Possible reconfiguration of Route 6 to connect to the Old Mill District, downtown Bend, and/or the OSU-Cascades campus via Reed Market Road (see #6). This could complement a future westside transit center.
12	New Routing Option	Alternative routing options to be explored for serving the area bounded by Pilot Butte, SE Purcell Road, NE Wells Acres Road, and east of NE 8th Street, including potential service on Neff Road
13	New Routing Option	Possible new routing option using Purcell between NE Neff and Wells Acres Roads.
14	Alternative Service Models	Explore alternative service models for serving new development east of NE 27th Street.
15	New Routing Option	Possible new connection using Empire Avenue and NE 27th Street.
16	New Routing Option	Potential for new service on NE 8th Street and/or Boyd Acres Road.
17	Alternative Service Models	Alternative models to be explored for northeast Bend and the Juniper Ridge area.

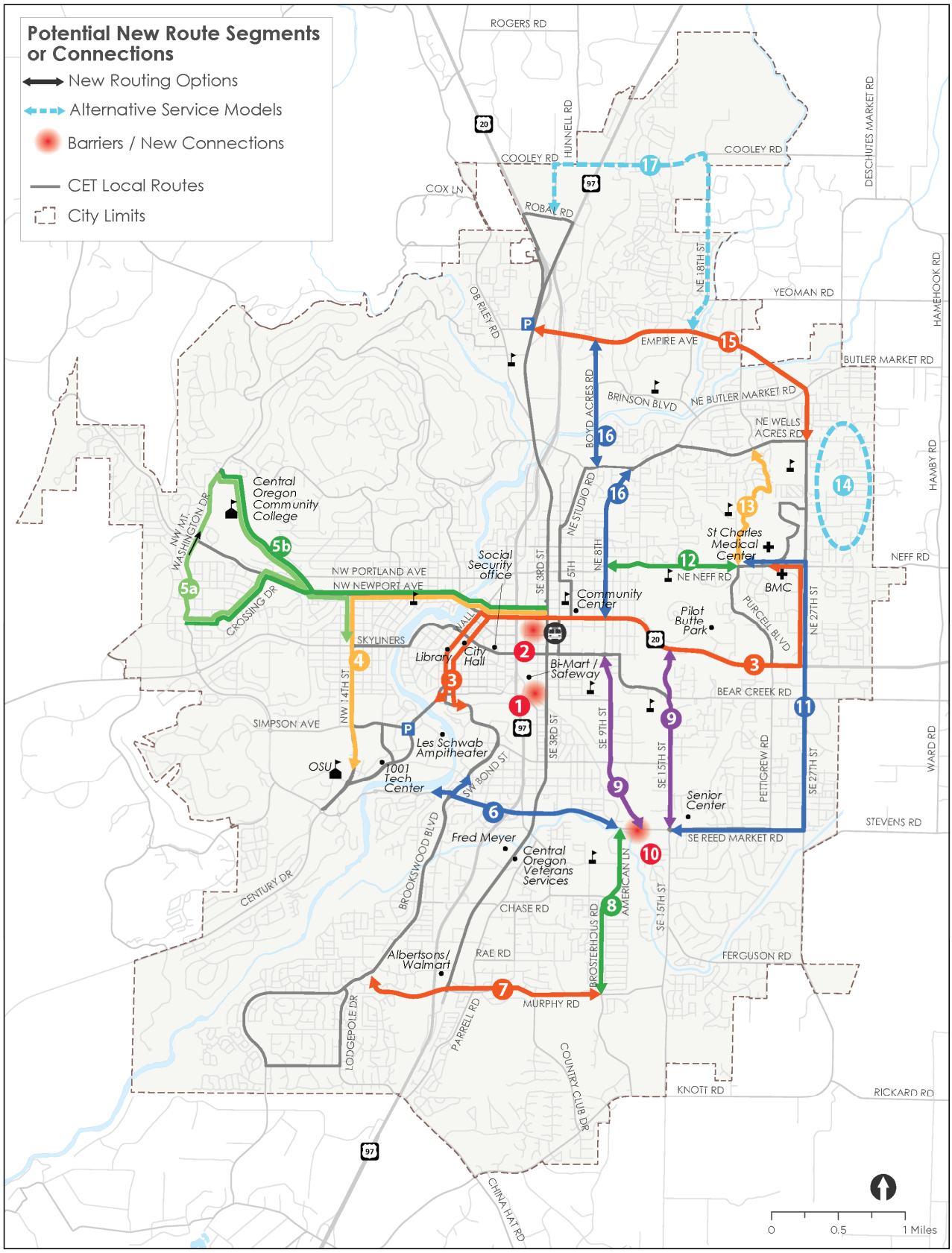


Figure 19: Potential New Route Segments or Connections

TRANSIT CENTER LOCATION IMPLICATIONS

Hawthorne Station, the current transit center in Bend for the CET system with connections to intercity services outside of the CET service area, is a relatively new facility owned by COIC, with restrooms and an indoor passenger waiting area. It serves local, Community Connector, and longer-distance intercity services and is an effective hub for routes serving Bend's eastside. However, it has disadvantages including:

- Beyond comfortable walking distance to downtown destinations (0.75 miles or more) and lacks significant transit demand generators in close proximity, which lead to a high rate of transfers in the CET Bend fixed-route system.
- Adjacent street environment along 3rd Street is not particularly pedestrian-friendly or conducive to walking (although these conditions have and are likely to continue to improve)
- Congestion on 3rd Street can delay transit vehicles and 4th Street is narrow and not optimal for transit vehicles.
- Capacity to support future expansion is limited.

Table 5 below provides a high-level qualitative assessment of two conceptual options to replace Hawthorne Station and implications for connections between the eastside and downtown Bend. The assessment does not consider interlining or other routing strategies, which could be employed irrespective of the transit center location.

Option 1: Relocate the transit center, maintaining an eastside location (assume vicinity of Hawthorne Ave between Bend Parkway and 3rd Street/US 97 Business, ideally in conjunction with a Hawthorne Avenue bike/pedestrian crossing of the Bend Parkway as proposed in the Bend Transportation System Plan (TSP).

- A new bike/pedestrian crossing of the Bend Parkway would provide a more direct, pedestrian and bicycle-friendly connection to downtown from an eastside transit center.
- Routes 1, 4, 5, 6, and 7 do not provide a direct connection between the eastside and downtown (similar to today).
- Routes 2, 3, 10, and 11 continue to provide a direct connection between the eastside and downtown (similar to today).
- Community Connector routes do not provide a direct connection to downtown.

Option 2: A westside transit center in close proximity to downtown and/or the Old Mill District; generally, in the vicinity of Colorado/Arizona between Bend Parkway and the Bond/Wall couplet. One or more mobility hubs in the central eastside could be created to facilitate transfers between routes.

- Routes 1, 4, 5, and 6 could be redesigned to provide a direct connection to downtown; this might increase travel times for some passenger currently traveling on the east side of the Bend Parkway.
- Route 7 could logically be extended to serve a westside transit center, likely primarily benefiting existing riders.
- Routes 2, 3, 10, and 11, which currently cross the Bend Parkway, would likely end at the westside transit center. Passengers wishing to travel between the westside and eastside would need to transfer; however, most of these passengers likely need to do so today as well.

- Community Connector routes would be able to provide more direct service to downtown; however, similar to today, passengers traveling to other destinations would likely need to transfer.

Table 5: Transit Center Implications

Area / Corridor	Primary Network?	Option 1: Relocate Transit Center - Maintain Eastside Location	Option 2: Relocate Transit Center to a Westside Location
Local Fixed-Routes			
1 – South 3rd St	Yes	▶ Does not provide direct access to downtown area	▶ Could provide direct access to downtown area
2 – Brookswood	Yes (north of Old Mill)	▶ Currently routed through downtown (no change from today)	▶ Would require a transfer to access eastside destinations beyond the central eastside (similar to today).
3 – Newport	Yes	▶ Currently routed through north end of downtown (no change from today)	▶ Would require a transfer to access eastside destinations beyond the central eastside (similar to today).
4 – North 3rd St	Yes	▶ Does not provide direct access to downtown area (no change from today)	▶ Could provide direct access to downtown area
5 – Well Acres	No	▶ Does not provide direct access to downtown area (no change from today)	▶ Could provide direct access to downtown area
6 – Reed Market	No	▶ Does not provide direct access to downtown area (no change from today)	▶ Could provide direct access to downtown area
7 – Greenwood	Yes	▶ Does not provide direct access to downtown area (no change from today)	▶ Could provide direct access to downtown area
10 – Colorado	Yes (Downtown and OSU)	▶ Currently routed through downtown (no change from today)	▶ Would require a transfer to access eastside destinations beyond the central eastside (similar to today).
11 – Galveston	Yes (Downtown and OSU)	▶ Currently routed through downtown (no change from today)	▶ Would require a transfer to access eastside destinations beyond the central eastside (similar to today).
Community Connector			
North: Redmond (24), Madras (22), Prineville (26), Sisters (28/29), Warm Springs (20)		▶ Does not provide direct access to downtown area	▶ Would provide more direct access to downtown destinations.
South: La Pine (30)		▶ Does not provide direct access to downtown area	▶ Would provide more direct access to downtown destinations.

Note: Shaded cells indicate routes where a westside transit center would provide the potential for direct access to downtown.

FIRST-LAST MILE STRATEGIES

OVERVIEW

First-last mile strategies refer to services, programs, and facilities aimed at increasing access to transit – primarily by walking and biking. This section defines how CET might apply mobility hubs, microtransit, micromobility, and pedestrian/bicycle enhancement strategies to enhance first and last mile access to public transit.

APPLICATION OF MOBILITY HUBS

As noted above, mobility hubs are places (typically but not necessarily public spaces) where multimodal mobility services like public transportation are designed to facilitate convenient, safe, and accessible travel options and transfers between modes. Mobility hubs can include a variety of infrastructure and mobility service elements and are adaptable to a range of transit facilities existing or planned in Bend. Table 6 identifies different types of transit centers and mobility hubs, including characteristics such as existing transit service and land use context, applicable mobility services, and technology features that make access to these services seamless and easy-to-navigate. Figure 20 illustrates potential mobility hub locations in Bend. Locations are conceptual. The need for additional park and ride locations will be considered as the network planning moves forward.

Local stops would generally not be considered a mobility hub – they provide access to transit but not necessarily transfers between routes or modes. However, they may have some similar infrastructure such as bike racks and as such are included in Figure 20.

Transit Centers are the primary locations where bus routes converge, and buses can layover between trips. In Bend, Hawthorne Station is the primary transit center and provides shelters and an indoor waiting area with restrooms. It facilitates transfers to/from Community Connector routes as well as longer-distance intercity services.

Secondary Transit Hubs may function as secondary hubs that provide additional transfer and layover locations outside of the main transit center.

Major transit stops provide a higher level of amenities at major stop locations.

Park and ride facilities may be co-located with transit centers and secondary hubs and allow passengers to access transit by motor vehicle, be dropped off, or access shared rides (carpools or vanpools) to local or regional worksites. Park and rides may be located at public facilities or may be established through a cooperative agreement with a private landowner.

APPLICATION OF MICROTRANSIT

Microtransit could be considered as an alternative to fixed-route transit service for lower-density areas (e.g., less than 2 to 10 residents and/or 2 to 5 jobs per acre) or lower demand times of day (such as late evenings, or outside of peak commute time in lower-density areas). See Bend Dial-A-Ride section for discussion of opening Bend Dial-A-Ride to the general population for areas outside of the fixed-route transit network.

APPLICATION OF MICROMOBILITY

Micromobility could be considered for low density areas within one mile of a fixed route stop (including a neighborhood mobility hub) to increase the access area for a transit route.

Table 6: Mobility Hub Types and Typical Characteristics

Type	Example Locations	Context (Transit and Land Use)	Mobility Services	Technology Features
Transit Center	▶ Hawthorne Station (or future replacement in central eastside)	▶ Central transit hub with multiple local and Community Connector routes	▶ Context-sensitive park-and-ride ▶ Drop-off area ▶ Car sharing ▶ Micromobility ▶ Short-term and long-term/secure bike parking	▶ Real-time information ▶ Off-board fare payment
Secondary Hub	▶ Cascade Village (North) ▶ Walmart (South) ▶ OSU (West) ▶ St. Charles (East) ▶ Hawthorne Station (if Transit Center is relocated) ▶ South Downtown Bend/Old Mill (vicinity of Colorado / Arizona); upgrade if transit center is relocated	▶ Major activity center with 2+ connecting routes ▶ Potential Community Connector stop	▶ Context-sensitive park-and-ride ▶ Drop-off area ▶ Car sharing ▶ Micromobility ▶ Short-term and long-term/secure bike parking	▶ Real-time information ▶ Off-board fare payment
Major Activity Center	▶ North Downtown Bend (vicinity of Newport/Hawthorne) ▶ COCC ▶ Forum Shopping Center ▶ Major employment areas	▶ High ridership stop	▶ Micromobility ▶ Short-term and/or long-term/secure bike parking	▶ Real-time information ▶ Off-board fare payment
Local Neighborhood	▶ Local route terminus ▶ Neighborhood stop (fixed-route or deviated route)	▶ Low-to-medium density residential land uses ▶ Can be employed with micromobility where urban form limits transit access	▶ Drop-off area ▶ Micromobility ▶ Bike parking (basic rack)	▶ Real-time information
Local stops	▶ Typical stop	▶	▶ Bike parking (basic rack)	
Park-and-ride lots (major or minor)	▶ ODOT P&R ▶ Mt. Bachelor	▶ City edge for unstructured parking ▶ Structured parking opportunities in central city, dense mixed use development areas	▶ Micromobility ▶ Bike parking ▶ Drop off area	▶ Real-time information

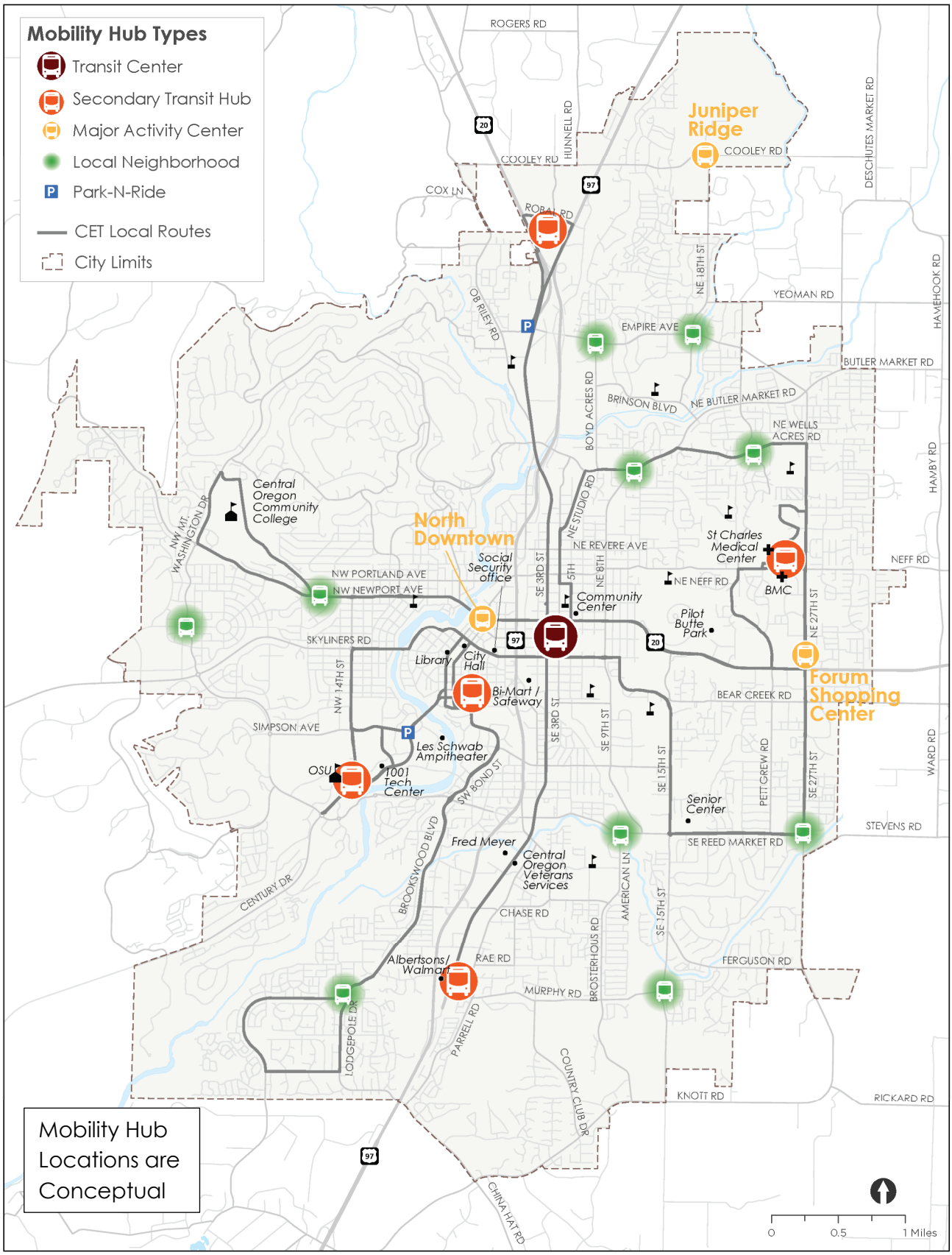


Figure 20: Conceptual Mobility Hub Locations

APPLICATION OF BICYCLE/PEDESTRIAN TRANSIT ACCESS ENHANCEMENTS

In some areas that are served by existing transit routes, there are areas beyond a typical ¼ to ½ mile walking distance of a transit stop where improved pedestrian and bicycle connections can expand access to existing transit stops. Improving walking and biking routes along and across roadways around bus stops makes it safer and more comfortable to access transit. Pedestrian and bicycle connection gaps within ¼- and ½-mile CET bus stop walksheds along major Bend roadways were identified in previous work leading to this analysis.

Table 7 identifies those pedestrian and bicycle connection gaps that fall outside of the ¼- and ½-mile walksheds, but specific to the potential service areas outlined in previous underserved areas assessments. The table briefly describes each potential service area, takes into consideration how the population or employment densities change in each area, and includes a preliminary assessment of potential services appropriate for each area that specifically discusses the viability of low stress active transport supporting such service areas.

Figure 21 and Figure 22 provide visual aids for the material presented in Table 7. As shown in Figure 19 and Table 4, new transit routes are proposed in some underserved areas and redesigned routes or microtransit options will be considered to better serve some of these areas. The low-stress active transportation needs should be considered to support those routes. As shown earlier in Figure 20, mobility hubs are proposed within the underserved areas listed in Table 7, including:

- Juniper Ridge (#2)
- North of Empire/Boyd Acres (#3)
- Northwest Crossing (#7)
- Old Farm/Murphy/Brosterhous (#13)

Table 7: Viability of Low Stress Active Transport to Support Future Transit Service Areas

#	Potential Service Area	Description	Change in Population Density	Employment Density Change	Potential Services (Preliminary Assessment of Feasibility)						
			2010 to 2040	2010 to 2040	Fixed route		Deviated fixed-route (flex-route) or Shuttle		Micro-mobility	Low stress active transport	
					Assessment	Time Frame	Assessment	Time Frame		Assessment	Viability to Support Future Transit Service Areas
1	North Triangle	Low density future growth	+5.2	+4.6	✓	Future	✓	Future	✓	-	▶ Few existing streets ▶ Fixed-route service not easily supported by walking/biking currently but possibly in future ▶ Flex-route and/or micro mobility more appropriate service types currently ▶ Key sidewalk gaps identified along Hunnel Rd
2	Juniper Ridge	Emerging employment	+0.1	+9.0	✓	Future	✓	Current	✓ with fixed-route ext.	-	▶ Few existing streets ▶ Fixed-route service not easily supported by walking/biking currently but possibly in future ▶ Flex-route and/or micro mobility may be more appropriate service types currently ▶ LSN key routes, w/existing partial bike facilities, designated to Cooley Rd and NE 18th St
3	North of Empire (Boyd Acres)	Moderate density residential	+2.9	+0.2	✓	Future	✓	Current	✓	✓	▶ Moderately dense and connected street network ▶ Fixed-route service possibly supported by walking/biking currently ▶ LSN key routes, w/no existing bike facilities, designated to Boyd Acres Rd and NE 18th St ▶ Key sidewalk gaps identified along Cooley Rd, NE 18th St, Yeoman Rd, and Purcell Blvd
4	Northwest	Low density population	+1.3	+0.1	-	N/A	✓	Current	✓	-	▶ Low-density and moderately connected street network ▶ Fixed-route service not easily supported by walking/biking currently ▶ Flex-route and/or micro mobility more appropriate service types currently and in future ▶ LSN key routes, w/no existing bike facilities, designated to NW Wall St/NW Harriman St/NW Lakeside Pl ▶ Key sidewalk gaps identified along NW Putnam Rd, NW Archie Briggs Rd, OB Riley Rd, NW 12th St, and NW Awbrey Rd
5	South of Empire	Emerging employment area	0.0	+6.5	✓	Future	✓	Current	✓	✓	▶ Low-density and moderately connected street network ▶ Fixed-route service possibly supported by walking/biking currently and in future ▶ LSN key routes, w/existing partial bike facilities, designated to Boyd Acres Rd, NE Butler Market Rd, and NE Purcell Blvd ▶ Key sidewalk gaps identified along Boyd Acres Rd, Brinson Blvd, Empire Blvd, and NE Purcell Blvd
6	Northeast Butler Market Rd	Moderate residential beyond existing fixed route	+2.6	+0.9	-	N/A	-	N/A	✓	✓	▶ Moderately dense and connected street network ▶ Fixed-route service moderately supported by walking/biking currently ▶ Flex-route and/or micro mobility more appropriate service types currently and in future ▶ LSN key routes, w/no existing bike facilities, designated to NE Purcell Blvd ▶ Key sidewalk gaps identified along Boyd Acres Rd, NE Butler Market Rd, and NE Purcell Rd
7	Northwest Crossing	Moderate residential	+2.4	+0.9	✓	Current	✓	Current	✓	-	▶ Dense and well-connected street network ▶ Fixed-route service easily supported by walking/biking currently and in future ▶ LSN key routes, w/existing bike facilities, designated to Skylinders Rd
8	Neff Road, north of Pilot Butte	Moderate residential beyond existing fixed route	+2.3	+0.3	✓	Current	✓	Current	✓	✓	▶ Moderately dense and connected street network ▶ Fixed-route service moderately supported by walking/biking currently and in future ▶ Key sidewalk gaps identified along NE Revere Ave, NE 8th St, and NE Neff Rd
9	East of 27th	Future residential	+3.0	+0.2	-	N/A	✓	Future	✓	-	▶ Dense and well-connected street network west of Eagle Rd; few existing streets east of Eagle Rd ▶ Fixed-route service easily supported by walking/biking, currently and in future, west of Eagle Rd but not east ▶ Flex-route and/or micro mobility more appropriate service types currently and in future ▶ LSN key routes, w/existing bike facilities, designated to NE Neff Rd ▶ Key sidewalk gaps identified along Butler Market Rd, NE Neff Rd, and Bear Creek Rd
10	West of Bond / Brookswood	Moderate residential beyond existing fixed route	+3.1	+1.5	-	N/A	-	N/A	✓	✓	▶ Somewhat dense and connected street network ▶ Fixed-route service possibly supported by walking/biking, currently and in future ▶ Flex-route and/or micro mobility more appropriate service types currently and in future ▶ LSN key routes, w/no existing bike facilities, designated to Blakely Rd/SW Silver Lake Blvd/SW Chamberlain St/SW Roosevelt Ave/SW Taft Ave/SW Pelton Pl

#	Potential Service Area	Description	Change in Population Density	Employment Density Change	Potential Services (Preliminary Assessment of Feasibility)						
					Fixed route		Deviated fixed-route (flex-route) or Shuttle		Micro-mobility	Low stress active transport	
			2010 to 2040	2010 to 2040	Assessment	Time Frame	Assessment	Time Frame		Assessment	Viability to Support Future Transit Service Areas
11	Kiwanis Park	Moderate residential beyond existing fixed route	+1.6	+0.6	-	N/A	✓	Current	✓	✓	▶ Dense and mostly connected street network ▶ Fixed-route service moderately supported by walking/biking currently and in future ▶ Flex-route and/or micro mobility more appropriate service types currently and in future ▶ LSN key routes, w/proposed bike project, designated to SE Wilson Ave ▶ Key sidewalk gaps identified along SE Wilson Ave
12	Larkspur	Moderate residential beyond fixed route	+3.5	+0.4	-	N/A	✓	Current	✓	✓	▶ Moderately dense and somewhat connected street network ▶ Fixed-route service possibly supported by walking/biking currently and in future ▶ Flex-route and/or micro mobility more appropriate service types currently and in future ▶ LSN key routes, w/proposed bike project, designated to Bear Creek Rd
13	Old Farm (Murphy / Brosterhous)	Moderate residential	+4.0	+0.4	✓	Current	✓	Current	✓ with fixed-route ext.	-	▶ Moderately dense and connected street network ▶ Fixed-route service moderately supported by walking/biking currently and in future ▶ LSN key routes, w/partial existing bike facilities, designated to Murphy Rd ▶ Key sidewalk gaps identified along American Ln, Brosterhous Rd, Chase Rd, Murphy Rd, Parrell Rd, and Country Club Dr
14	South of Reed Market	Low residential beyond fixed route	+0.9	+0.2	-	N/A	✓	Current	✓	✓	▶ Low-density and moderately connected street network ▶ Flex-route and/or micro mobility more appropriate service types currently and in future ▶ Key sidewalk gaps identified along SE 15th St
15	Stevens Road	Future residential area	+9.4	+1.3	✓	Future	✓	Future	✓	-	▶ Few existing streets ▶ Fixed-route service not easily supported by walking/biking currently but possibly in future ▶ Flex-route and/or micro mobility more appropriate service types currently ▶ LSN key routes, w/existing bike facilities, designated to SE 27th St
16a	South 15th Street – North zones	Future residential or mixed-use area	+5.0	+0.9	✓	Future	✓	Future	✓	✓	▶ Moderately dense and somewhat connected street network ▶ Fixed-route service supported somewhat by walking/biking currently and moderately in future ▶ LSN key routes, w/partial existing bike facilities and proposed bike projects, designated to SE 15th St, Murphy Rd, and Diamondback Ln ▶ Key sidewalk gaps identified along SE 15th St and Ferguson Rd
16b	South 15th Street – South zones	Future employment area	+4.2	+7.3	✓	Future	✓	Future	✓	✓	▶ Few existing streets ▶ Fixed-route service not easily supported by walking/biking currently but possibly in future ▶ Flex-route and/or micro mobility more appropriate service types currently ▶ LSN key routes, w/existing bike facilities, designated to SE 15th St and future roadways ▶ Key sidewalk gaps identified along SE 15th St and Knott Rd
17	South US 97	Future employment area	+3.5	+10.2	✓	Future	✓	Future	✓	✓	▶ Few existing streets ▶ Fixed-route service not easily supported by walking/biking currently but possibly in future ▶ Flex-route and/or micro mobility more appropriate service types currently
18	Deschutes River Woods	Low density residential area	+0.4	0.0	-	N/A	✓	Current	✓	-	▶ Low-density and somewhat connected street network ▶ Flex-route and/or micro mobility more appropriate service types currently and in future

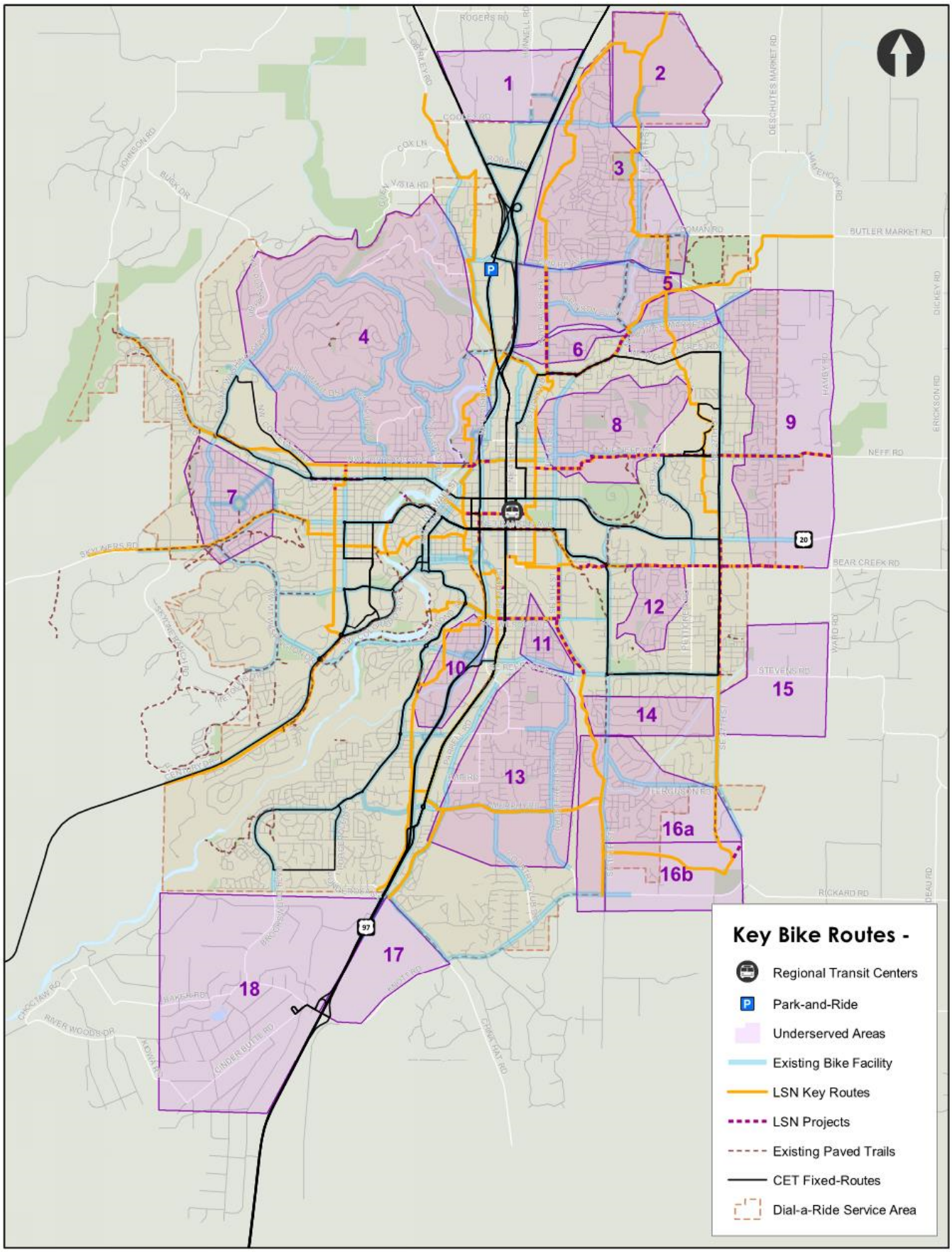


Figure 21: Bicycle Connections and Gaps within Future Transit Service Areas

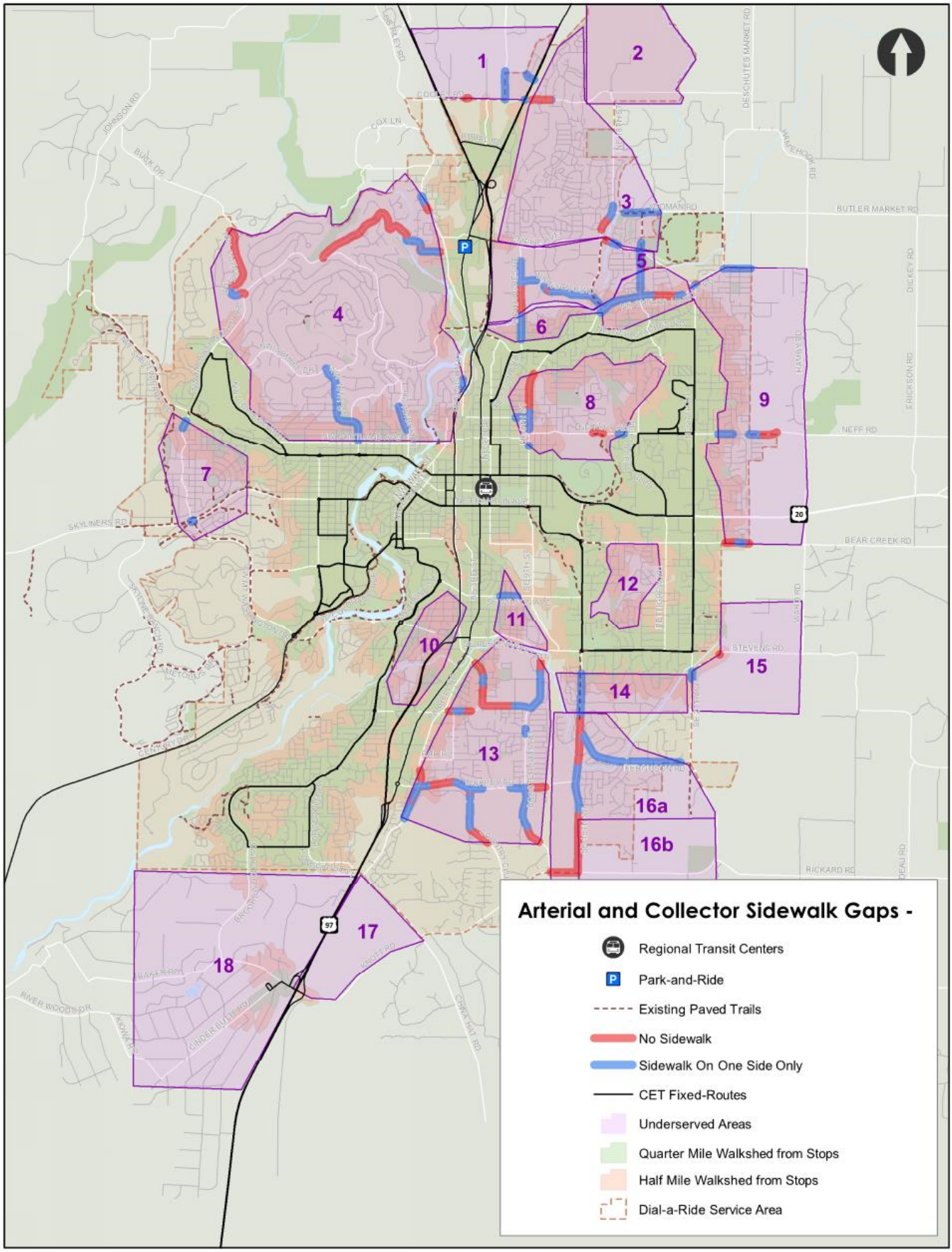


Figure 22: Pedestrians Connections and Gaps within Future Transit Service Areas

CONCEPTUAL COSTS AND SCENARIO EVALUATION MEASURES

UNDERSERVED AREAS

This section evaluates conceptual costs and benefits for using alternative mobility strategies to serve selected underserved areas (see Needs Analysis and TOD Strategies Memo, Bend Supplement for definitions of these services and underserved areas in Bend). Northeast Bend was selected as a representative example.

Northeast Bend

The area east of US 97 and north of Wells Acres Road is currently not served by transit. Options for serving this area include:

- **1. Fixed-route extension.** A potential route along Boyd Acres Road was used as a representiatve example. It could extend existing CET service that ends at Cascade Village, connecting to the central transit center and downtown Bend. A route could also connect to future service to the St. Charles Medical Center/Forum Shopping Center are using along Empire Avenue and NE 27th Street along a new street connecting these roadways. Mobility hubs and micromobility could be employed at selected locations to increase transit access, depending on the street network and land use. As described above, mobility hubs include features such as secure bicycle parking and micromobility services to enable riders to connect to homes and businesses that are beyond a short walking distance to and from a bus stop. An illustration is provided in Figure 23, showing a ¼ mile area around the conceptual route.
- **2. Fixed-route extension with deviations.** This option is similar to #1, but could include a deviation off the route. This would increase the travel time for all riders, but would provide additional stops serving more people. An illustration is provided in Figure 23, showing a ¼ mile area around the conceptual route.
- **3. Microtransit or a shuttle** connecting to the central transit center and/or secondary transit hubs (such as at Cascade Village or St. Charles Medical Center/Forum Shopping Center). In this case, Cascade Village was assumed. This service could operate during peak hours only or all day; all-day service was assumed. An illustration is provided in Figure 23, using a ½ mile area around a conceptual route to show the potential service area.
- **4. Bicycle/pedestrian connectivity enhancements** that would improve access to existing or extended routes include:
  - Providing a shared-use path, buffered bike lanes, standard bike lanes, or shared-lane markings adjacent to/along Cooley Road and NE 18th Street (#2 – Juniper Ridge)
  - Providing standard bike lanes or shared-lane markings along Boyd Acres Road and NE 18th Street; filling in sidewalk on one side of the road along Cooley Road and NE 18th Street or filling in all sidewalk gaps along Cooley Road, NE 18th Street, Yeoman Road, and Purcell Boulevard (#3 – North of Empire/Boyd Acres)
  - Providing buffered bike lanes or standard bike lanes along Boyd Acres Road, NE Butler Market Road, and NE Purcell Boulevard; filling in sidewalk on one side of the road or filling in all sidewalk gaps along Boyd Acres Road, Brinson Boulevard, Empire Boulevard, and NE Purcell Boulevard (#5 – South of Empire)
  - Providing buffered bike lanes, standard bike lanes, or shared-lane markings along NE Purcell Boulevard; filling in sidewalk on one side of the road along NE Butler Market Road or filling in all sidewalk gaps along Boyd Acres Road, NE Butler Market Road, and NE Purcell Boulevard (#6 – Northeast Butler Market Road)

- This option is analyzed in conjunction with core routes along Cooley Road (potentially an extension of Route 4 from Cascade Village) and Empire Avenue (potentially as part of a new route connecting Cascade Village and St. Charles Medical Center, using a new connection of Empire and 27th) that do not circulate the northeast neighborhood. These are assumed to at higher frequency (conceptually, every 30 minutes).

  (a) Option 4a in Figure 23 shows a ¼ mile distance from these routes, representing a typical walk to/from a bus stop.

  (b) Option 4b represents an increased access distance to bus stops, e.g., using enhanced bike/ped connections, mobility hubs, and micromobility.

Conclusions from this analysis include that:

- A higher number of residents and employees would have access to microtransit in a given service area compared to a fixed-route.
- Incremental operating costs for a fixed-route extension are comparable to a single vehicle microtransit operation, even assuming an hourly cost that is double that of microtransit.
- Given typical productivity (riders per service hour) for fixed-route transit and microtransit, these services could carry a similar number of passengers.

However, if demand for the microtransit service exceeds the capacity of a single vehicle to provide timely, reliable pickups and drop-offs, operating costs would exceed those of fixed-route service.

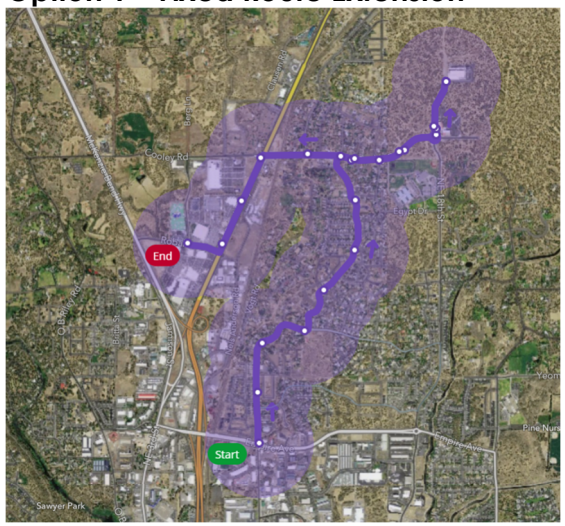
Table 8: Conceptual Evaluation of Mobility Service Options, Northeast Bend Service Area, Order-of-Magnitude Estimates

Service Areas Considered and Evaluation Measures	1. Fixed-Route Extension	2. Fixed-Route Extension with Deviations	3. Microtransit / Shuttle Feeder to Secondary Transit Hub	4a. Core (non-Neighborhood) Routes	4b. Core (non-Neighborhood) Routes with Bicycle Pedestrian Enhancements, Mobility Hubs, and Micromobility
Assumptions	• 13 hours per day, Hourly Frequency • $100 per service hour (similar to CET) • Productivity of 7-10 riders per service hour (similar to lowest-performing CET routes)		• Up to 13 hours per day, on-demand • $50 per service hour (similar to RideBend) • Range of 1 to 2 vehicles • Productivity of 3 to 5 passengers per service hour	• 13 hours per day, 30 minute frequency (could also vary between peak and off-peak) • $100 per service hour (similar to CET) • Productivity of 10 riders per service hour (similar to lowest-performing CET routes)	• Same as 4a but with enhanced bike/ped connections, mobility hubs and micromobility
Transit Access: # of Residents (2017)	1,800	2,000	4,000	2,000	3,500
Transit Access: # of Jobs (2017)	400	45	1,000	600	850
Low-Income Residents (200% of Poverty, 2017)	100	150	300	150	250
Annual Operating Cost	$85,000 (extension)	$120,000 (extension)	$100,000 to $200,000	$450,000	$450,000
One-Time Capital Cost	Existing Fleet or $50,000 to $100,000 for a new bus		$50,000 to $100,000 for 1 to 2 vehicles	Existing Fleet and $100,000+ for a new bus	
Potential Annual Riders	6,000 – 8,000	8,000 – 10,000	6,000 to 20,000	Up to 40,000	Up to 70,000
% of local trips from NE Bend travel demand model zone to/from/within Bend	0.4% to 0.5%	0.5% to 0.7%	0.5% to 1.3%	2.8%	4.4%
Operating Cost per Rider	$10 to $14	$10 to $14	$10 to $16	$10	$6
Bicycle/Pedestrian Connectivity Enhancements	Similar needs (described above) for all scenarios for the major roadways to provide access to transit stops				Bike/ped access enhancements focused on key stops and mobility hubs)

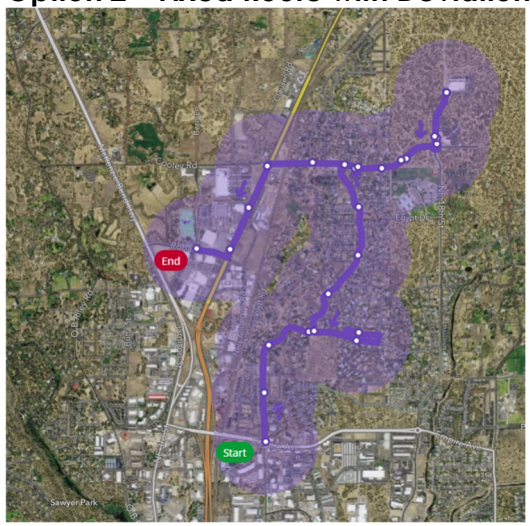
Notes: Based on conceptual analysis for Northeast Bend including several zones (3, 5, and 6) that were identified as underserved.

Figure 23: Conceptual NE Bend Service Areas

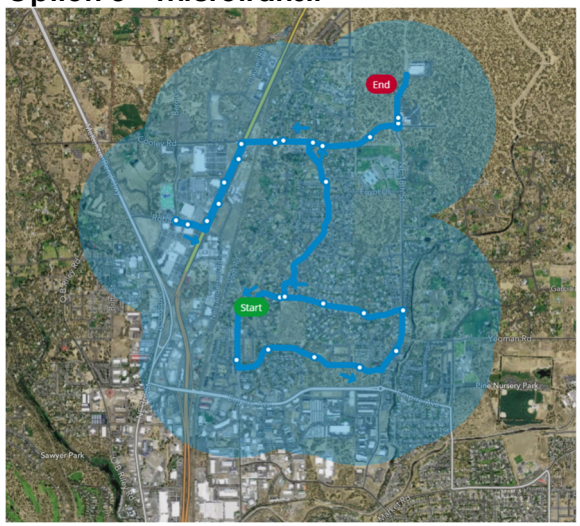
Option 1 – Fixed Route Extension



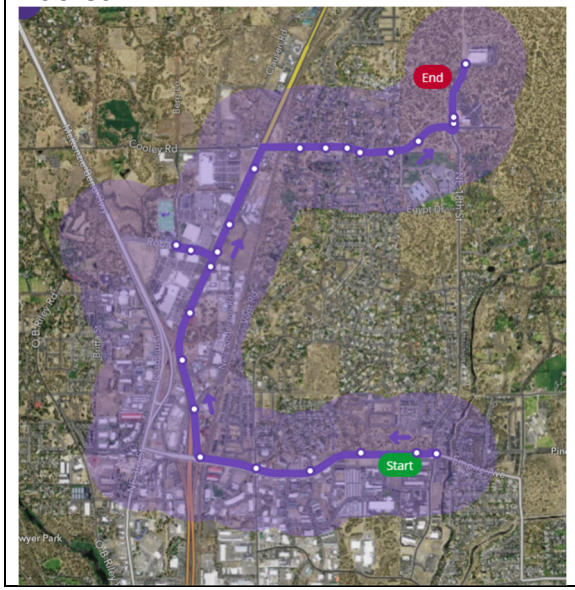
Option 2 – Fixed Route with Deviation



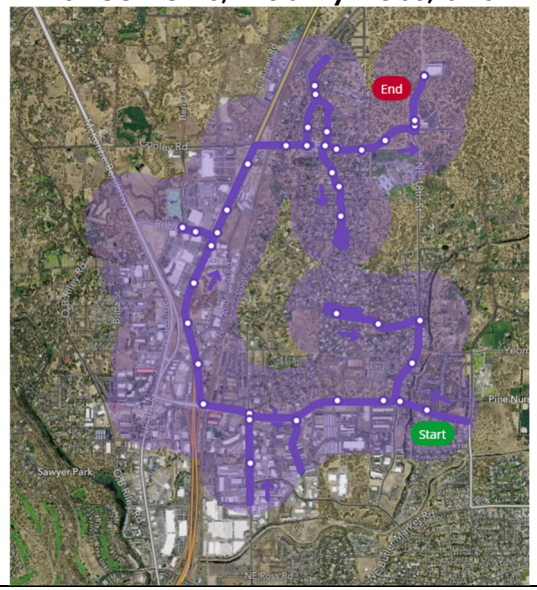
Option 3 – Microtransit



Option 4a – Core (non-Neighborhood) Routes



Option 4b – Core (non-Neighborhood) Routes with Bicycle/Pedestrian Enhancements, Mobility Hubs, and Micromobility



BEND DIAL-A-RIDE AND RIDEBEND

BEND DIAL-A-RIDE

CET offers a demand-responsive transit service in the Bend area referred to as "Bend Dial-A-Ride." It is the complementary paratransit service required by the Americans with Disabilities Act (ADA), within a ¾ mile distance of fixed-route service for individuals who are unable to ride the service due to a disability. Bend Dial-A-Ride also serves low-income senior citizens within Bend city limits who do not live near CET fixed-route bus service. To schedule a ride, eligible individuals can make a request from one day to 14 days in advance, but rides can only be scheduled based on availability. If service is not available for the day and time requested, the reservation is held in a queue while ride schedulers check availability daily. CET does not accommodate same-day rides or changes. Bend Dial-A-Ride offers some flexibility in its service for trips to medical appointments. If the appointment end time is unknown, a rider can request a "will call," which must be reserved at least 24 hours in advance; the will-call list is full when five will-call requests are received. Once the appointment is finished, the rider calls to request a pick-up; the driver then has up to one hour to pick up the rider. Those desiring to utilize Bend's Dial-A-Ride transit service are required to complete an application provided on CET's website to secure eligibility.

SERVICE CHARACTERISTICS

Table 9 shows service characteristics for Bend Dial-A-ride service, and **Table 10** shows on-time performance.

Table 9: 2018 Bend Dial-A-Ride Service Statistics

	2018 (through December 13)	
Number of customers	572	
Annual trips per customer	48	
Average runtime per trip	16 minutes	
Total trips	27,544	
	Category	Proportion
Funding source[1]	Self-pay	42%
	ADA/Disability	32%
	Medicaid and Low-income senior	16%
	Contract	10%
Ambulatory vs. mobility device [2]	Ambulatory	78%
	Mobility device	22%

[1] Funding source and ambulatory status are calculated from fall 2018 ride data. [2] Includes a small number of car seats.

Table 10: 2018 Bend Dial-A-Ride On-time Performance

	Number	Proportion of All Trips
On-time	12,297	45%
Early	4,504	16%
Late	10,743	39%
Total	**27,544**	

RIDERSHIP PATTERNS

The majority of trips on Bend dial-a-ride are between locations in downtown Bend and locations in east Bend. There are relatively few trips that begin or end on Bend's west side.

Figure 24 shows the most common trip patterns aggregated by zone, showing only those origin/destination zone pairs with 5 more or trips per week.

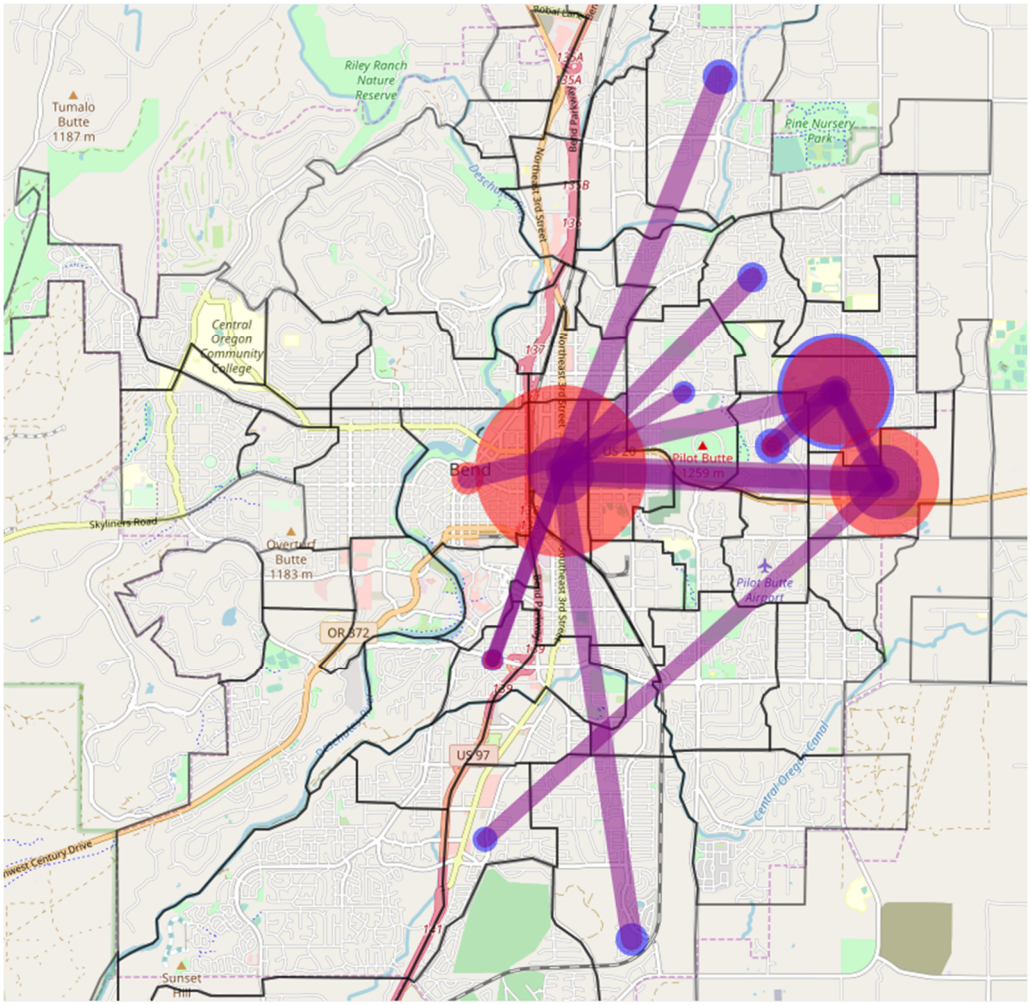


Figure 24: Bend Dial-A-Ride Trip Patterns, 2018, Origins and Destinations by Zone

Table 11 shows the average number of weekly trips to and from the primary individual origins and destinations within the city of Bend. These include Fresenius Kidney Care in east Bend, and Hawthorne Station, Norton Avenue Apartments, and Possibilities Thrift Store in central Bend.

Table 11: Weekly Trip Totals for Major Trip Locations in Bend

Location	Average Number of Weekly Trips To/From
Possibilities Thrift Store	133
Hawthorne Station	44
Fresenius Kidney Care	39
Norton Ave Apartments	31
East Lake Village Apartments	22
Abilitree Admin. Office	17

RIDERSHIP AND PRODUCTIVITY

Figure 25 provides ridership, revenue hours, and productivity for demand-responsive service in Bend for 2014-2017. Highlights of the figure include the following:

- Ridership on demand-responsive service in Bend has declined from a high of more than 51,000 rides in 2014 to 38,620 rides in 2017.
- While ridership has declined over the past four years, the number of revenue hours of demand-responsive service has increased each year, peaking at more than 15,000 revenue hours in 2017.
- The diverging trends in ridership and revenue hour trends has resulted in a drop in productivity (rides per revenue hour), to a low of 2.5 rides per hour in 2017.

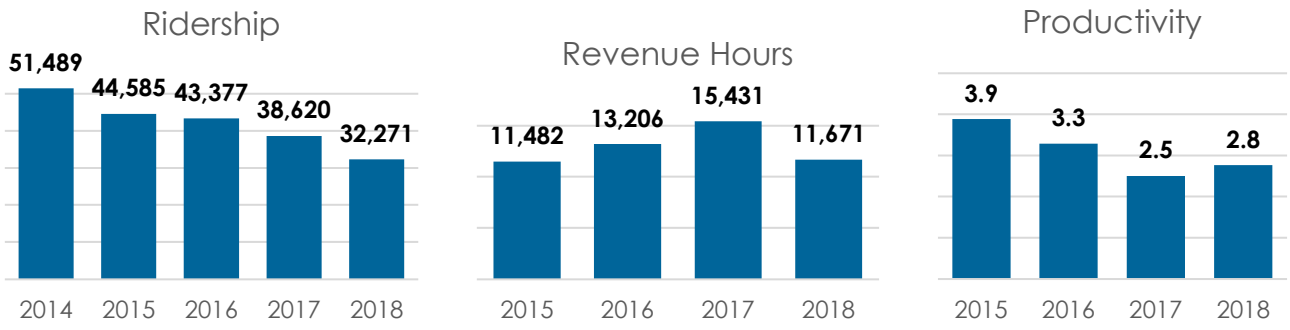


Figure 25: Ridership, Revenue Hours, and Productivity, 2014-2017

BEND DIAL-A-RIDE NEEDS

Dial-A-Ride trips are more expensive to operate per ride ($26.90 per trip[10]) than traditional fixed-route transit ($7.17[11]); therefore most transit agencies seek to reduce the demand on their complementary paratransit Dial-A-Ride services by trying to shift people to fixed-route transit as feasible through travel training and route adjustments. Bend's Dial-A-Ride has seen declining

[10] Specific to Bend Dial-A-Ride for 2017.
[11] Specific to Bend Fixed Routes for 2017.

ridership as alternative options such as Uber and Lyft have become more available resulting in a decline in ridership and productivity (although three passengers per service hour is a typical productivity for most paratransit services[12]).

To increase productivity (Rides per Hour), CET would need to increase the efficiency of Dial-A-Ride service (allowing more rides per hour) with improved scheduling technology. Upgrading their scheduling and dispatch software will improve the route scheduling and capacity to handle more rides as well as the customer experience through more flexible scheduling (online and mobile device, same day requests, etc.). This is likely to result in an increase in demand over time as CET's services are more economical for the customer ($2.50 per ride currently) than commercial alternatives.

To further increase demand, CET could increase their eligibility such as to all seniors over a specific age regardless of income or to the general population for locations that are not currently within a specific walking distance (1/4 to ½ mile) from fixed route transit.

RIDE BEND ENHANCEMENTS

As described in the first section of this memorandum, RideBend has evolved from a fixed-route shuttle initially to a demand-responsive microtransit service currently. Microtransit service should be more convenient for tourists compared to a fixed route shuttle because it will pick you up and drop you off anywhere within its service area; however, the lack of stops can reduce the visibility of the service. The following provides potential opportunities to increase ridership on RideBend, applicable to either service option.

- Marketing
  - Expand marketing to visitors including to lodging both inside and outside (park-and-ride) the service area.
  - Consider longer nighttime hours (e.g., until midnight) on the weekends for visitors who are doing activities outside Bend during the day but are out dining/drinking in downtown in the evening. (Ridership trends should be evaluated from the 2019 data.)
- Encourage Park-and-Ride
  - Ridership could be increased on the shuttle service with a stop serving the downtown parking garage and signage and schedules in the parking garage encouraging people to visit other destinations via the shuttle rather than driving.
  - Ridership could be increased on both service options by promoting park-and-ride at any locations where this would be desirable. This could reduce traffic from visitors who drive into Bend from lodging that is outside of the service area.
- Price Parking
  - Long-term parking is already priced in downtown Bend. Pricing for short-term parking in downtown as well as in other popular destinations within the service area would increase the incentive to utilize the shuttle.

[12] For example, productivity among all agencies offering demand-response services is approximately two riders per revenue hour based on the 2017 National Transit Database. Considering only ADA Paratransit trips, productivity is approximately 1.8 riders per revenue hour.