



NEEDS ASSESSMENT SUPPLEMENT MEMO - BEND TRIP PURPOSE ANALYSIS

Date: August 19, 2019 Project #: 23805
To: COIC, Project Management Team
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Subject: Needs Assessment Supplement Memo – Bend Trip Purpose Analysis (Bend
TMP Scope Task 4.1 and 4.2)

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INTRODUCTION

This memorandum provides insight into potential transit needs within the Bend MPO area by evaluating the following:

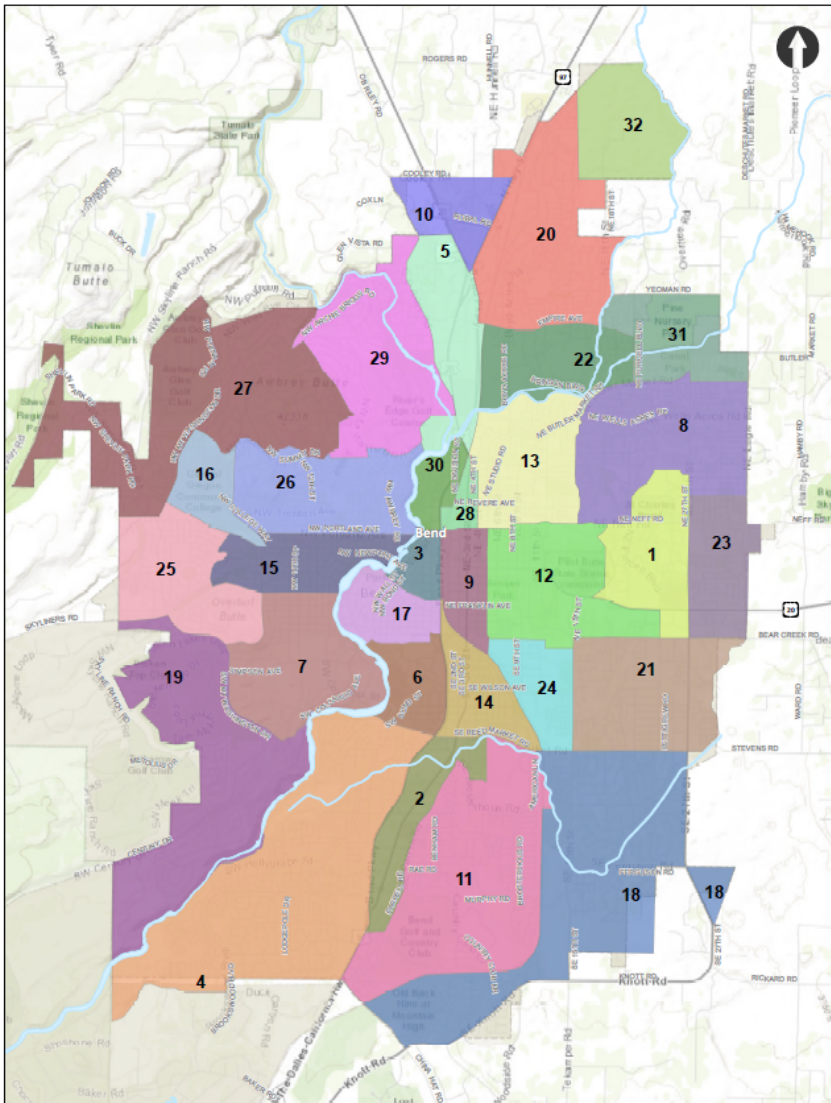
- ▶ Bend's local and intercity vehicle trip origins and destinations using trip tables from the travel demand model including
 - ▶ Bend local trips (start and end in Bend)
 - ▶ Trips between Bend and Redmond
 - ▶ Trips between Bend and the other cities served by CET
- ▶ Trip purpose data from the 2017 American Household Survey
- ▶ Airport travel information including
 - ▶ Flight schedules for arrivals and departures to identify travel patterns to/from the airport
 - ▶ Air traveler origin-destinations in Central Oregon
 - ▶ Opportunities and costs to provide service to the airport via new or modified routes

ORIGIN – DESTINATION STUDY

Bend's current and future travel patterns were examined using vehicle trip information from the Bend MPO region travel demand model. The analysis considered vehicle trips that started and ended in Bend, trips between Bend and Redmond, and trips between Bend and the other cities served by CET. Vehicle trip data was used to form a comprehensive understanding of travel patterns. Projected transit trips reflect existing routes only and do not identify unserved trip patterns.

BEND LOCAL TRIPS (START AND END IN BEND)

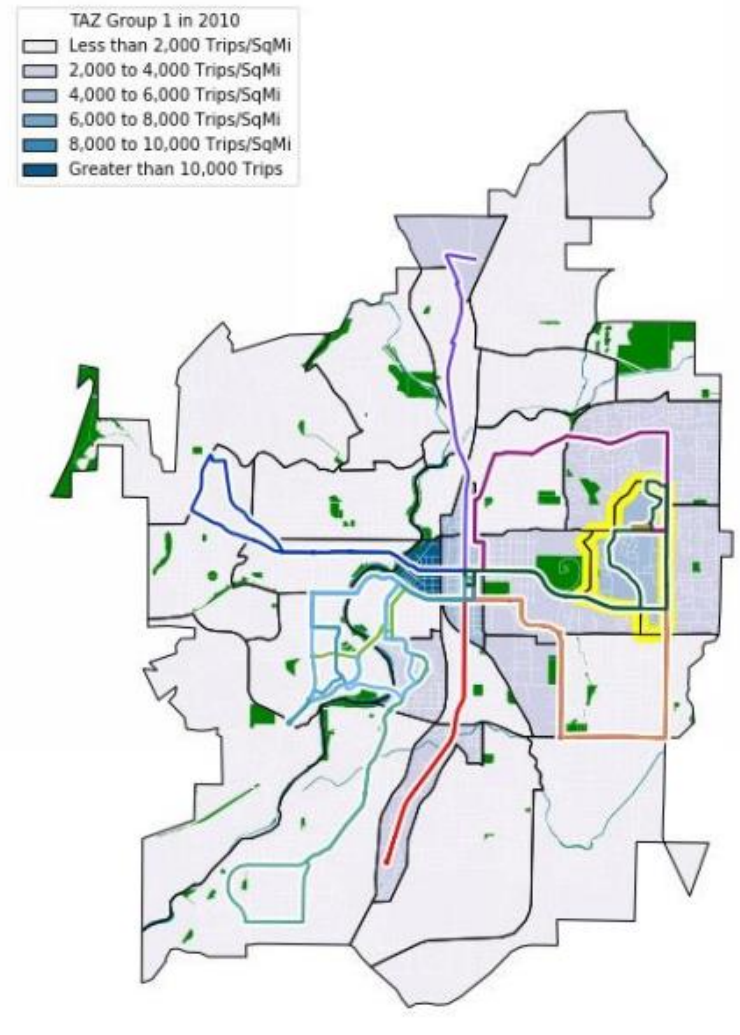
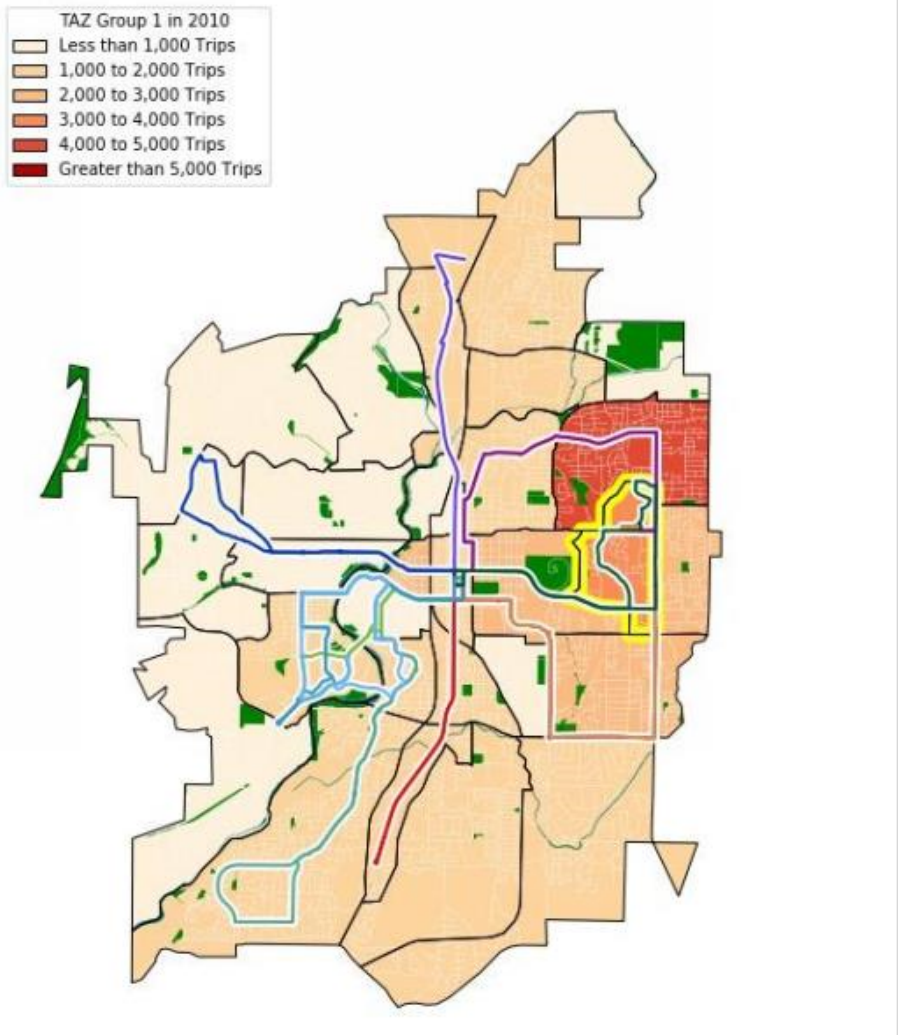
For the analysis of trips with origins and destinations in Bend, the Bend area Transportation Analysis Zones (TAZs) from the travel demand model were grouped into 32 larger geographic areas to help visualize the data. The groups were formed by combining similar land uses, areas that comprised the same general location, and natural and built environmental factors such as rivers, highways, and railroads. The groups and their identification number are presented in Figure 1; the identification numbers reflect each group's ranking based on the total number of daily trips starts and ends, with group with 1 having the largest number of daily trips and group 32 having the least.

Figure 1: Bend TAZ Groups used in Origin-Destination Analysis

The analysis produced a set of figures that summarize the trip patterns for each TAZ group. Figure 2 provides the 2010 trip origins and destinations for trips with one end in the medical center (TAZ group 1, outlined in yellow). The base year in the Bend-Redmond Model is 2010, which is consistent with the base year model being used in other local planning efforts including the ongoing Bend Transportation System Plan Update. The map on the left shows the total daily trips to/from each group while the map on the right shows the total daily trips normalized by trips per acre. The full set of figures includes year 2010 and 2040 information for each TAZ group and is included in *Attachment A*.

Tables summarizing the data are included in *Attachment B*. They are organized with the TAZ groups that generated the greatest number of trips in 2010 located at the top (origins) and left (destinations) of the table. There are three tables: (1) vehicle Trips in the 2010 model, (2) vehicle Trips in the 2040 model, and (3) Change in trips between 2010 and 2040.

Figure 2: Trip Distribution to/from Group 1: Medical Center (2010)



FINDINGS

- ▶ **Medical Center (Group 1)** – The medical center generated the most total trips and is well connected by transit to the immediate areas around the hospital. It is less well connected to the area west of Highway 97, including Downtown Bend. In 2010, the model showed that 11 percent of trips to/from the medical center are from downtown. These trips require a transit rider to transfer at Hawthorne Station.
- ▶ **Downtown Bend (Group 3)** – In the 2010 model, Downtown Bend generated the third most trips of all the TAZ groups. Due to the smaller size of the TAZ group, trip starts and ends are among the most concentrated (most trips per acre) compared to other TAZ groups. Compared to other TAZ groups, trips to and from Downtown Bend are more evenly distributed throughout the city. The area is served by four bus routes that connect it to the west and southwest parts of the city. There is no direct transit access for people traveling from east of Highway 97; they must transfer at Hawthorne Station.
- ▶ **Retail/Commercial Corridors along Highway 20-3rd Street (Groups 2 and 9)** – Retail and commercial areas on the north and south side of the city generate a large number of trips. The model shows that travel to the corridor is largely east/west (there are few trips that cross from between the north and southside of the city to access the corridor). Trips from adjacent residential areas east and west of the corridor are not well served by transit (or don't have direct transit access such as between Brookwood Boulevard and South 3rd Street which is one of the highest trip origin-destination pairs in the Bend model).
- ▶ **Oregon State University-Cascades (Group 7)** – Between 2010 and 2040, the TAZ group that includes OSU-Cascades is projected to generate more than 50 percent more trips. The growth is projected to largely occur in the area immediately around the campus (daily trips within the TAZ group are projected to increase from 1,690 to 7,464). Transit currently serves this area. Still, the large increase in trips may justify increased bus frequency as well as other improvements to facilitate non-motorized trips.
- ▶ **Oregon State University-Cascades (Group 7)** – The model also projects a significant increase in trips from the OSU-Cascades area (Group 7) to the Brookwood Boulevard area (most likely as a significant location of off-campus student and employee housing) with the highest concentration of trips to downtown and the Old Mill District (potentially as housing location and destinations for those living on campus).
- ▶ **Juniper Ridge (Group 32)** – Trips to and from the northeast corner of Bend are projected to grow by the largest percent of any of TAZ groups between 2010 and 2040. Depending on the scale of development at the site, the growth could justify extending transit service from the North 3rd Street route to connect it to Cascade Village Shopping Center.

CONSIDERATIONS

- ▶ The model indicates that there is demand for improved east/west connections between Downtown and areas east of Highway 97. Some of this demand could be served by extending the Greenwood or other routes from Hawthorne Station to terminate in Downtown Bend. This would provide a one-seat ride between the Hospital and Downtown, for example, and would provide additional service between Hawthorne Station and Downtown.
- ▶ The trips density maps indicate that the current "hub and spoke" transit network is effective for providing a transit option for the major origin-destination trip pairs. Looking forward, the growth of the OSU-Cascades campus and the Brookwood Boulevard and South 3rd Street corridors may generate demand for a new service that connects the southwest and southeast sides of the city without going through the center of the city.

- ▶ The alternatives analysis phase of the project should consider if locating the center of the current “hub and spoke” system from Hawthorne Station to an area west of Highway 97 near Downtown and the Old Mill District would increase the number of single-seat rides and/or reduce the amount of out-of-direction travel for transfers.

TRAVEL DEMAND BETWEEN BEND AND REDMOND

In the 2010 Bend-Redmond model, there are approximately 13,600 total weekday trips between Bend and Redmond. The model projects that the number of trips between the cities will grow by approximately 65 percent by 2040 to 22,500. As a result, vehicle travel patterns in 2010 and 2040 were evaluated to understand travel between the two cities and identify if intercity service can be improved with additional stops on the Connector Routes in Bend or Redmond or if they would be best served by a local fixed route service in Redmond.

The analysis in this section identifies all trips that start in either Bend or Redmond and end in the other city. The trips were analyzed separately for Bend and Redmond. One analysis looked at all trips to identify what TAZ they connect to in Redmond (e.g. where people traveling from Bend go to in Redmond). The other analysis identified where the trips are associated with in Bend (e.g. where people traveling from Redmond go to in Bend). By aggregating trips at the city level we can identify specific locations with higher demand that could benefit from improved regional or local transit service.

For each city in 2010 and 2040, large numbers of trips travel to TAZs located at the edge of each city. However, trips are most densely concentrated along the major corridors and downtowns for each city. This may indicate a pattern of people traveling from residential locations on the edges of each city to large trip generators in the other city, such as job centers, the medical center, airport, etc.

BEND

Figure 3 and Figure 4 below show the number and density of trips to each TAZ in Bend from Redmond. The maps demonstrate:

- ▶ In 2010, intercity trips with Redmond are most concentrated in the Cascade Village area, various places along 3rd Street north of Downtown, Downtown Bend, Old Mill, Central Oregon Community College (COCC), and the medical center.
- ▶ Existing bus service in Bend provides a connection from Hawthorne Station to Downtown Bend, Old Mill, COCC, OSU-Cascades, and to the medical center. To ride transit to these destinations requires a rider to transfer at Hawthorne Station. Trips to Downtown Bend and Old Mill could be potentially be served directly by extending Route 24 from Hawthorne Station to a stop west of Highway 97.
- ▶ Between 2010 and 2040, the locations in Bend that generate more intercity trips with Redmond remain relatively unchanged, with one exception. In 2040, trips increase to the TAZ that includes the OSU-Cascades campus.

Figure 3: Bend Trips that connect to Redmond (Total Trips per TAZ)

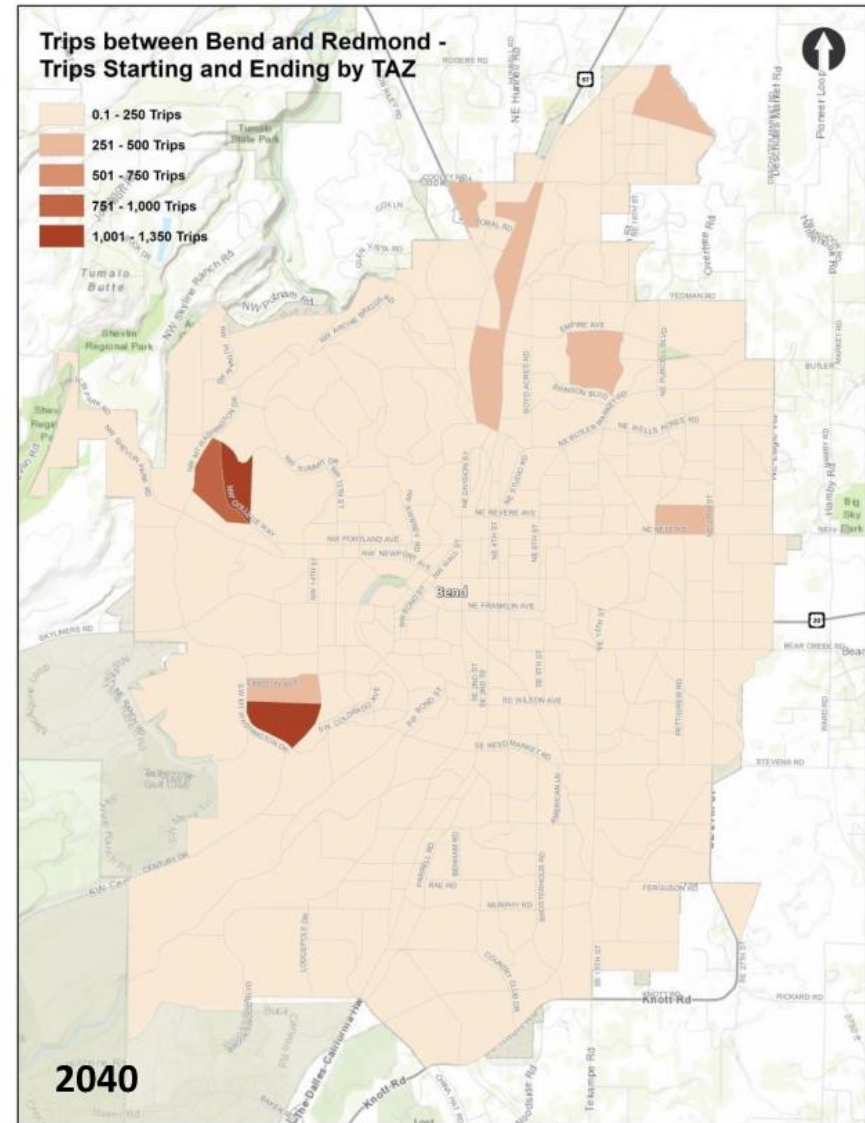
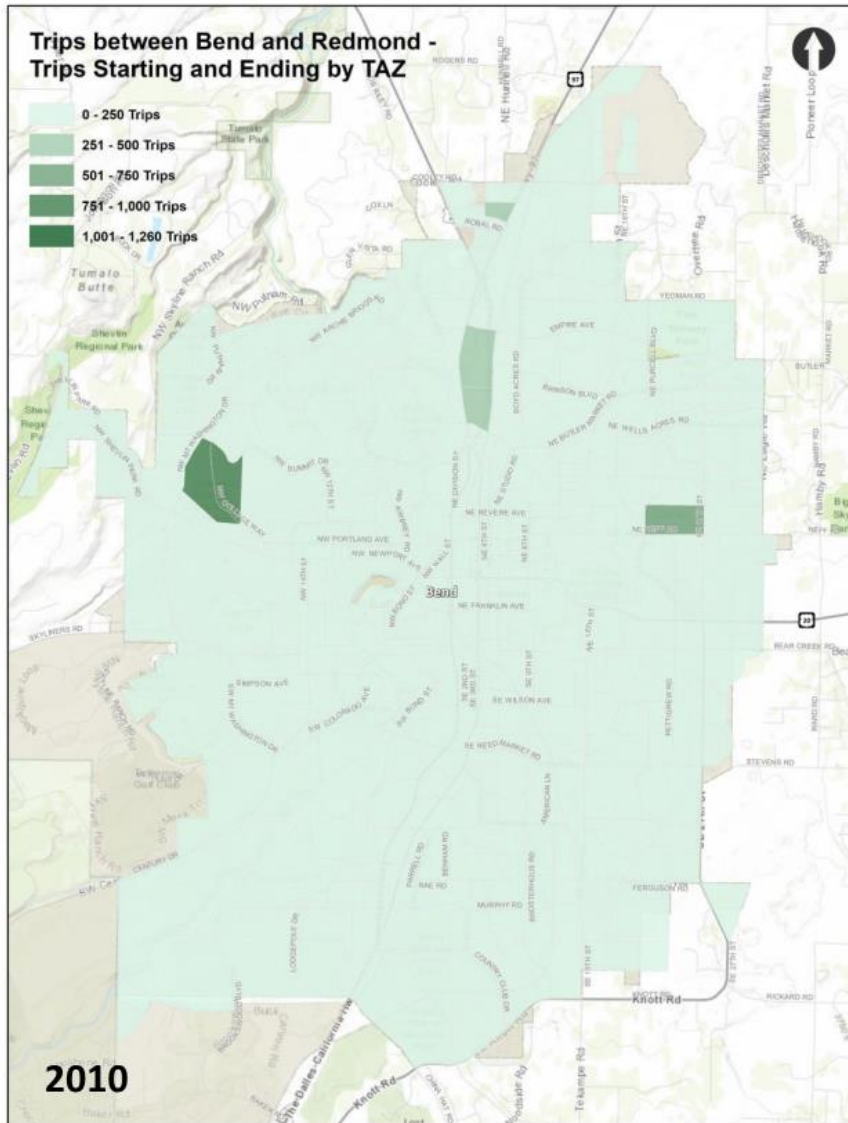
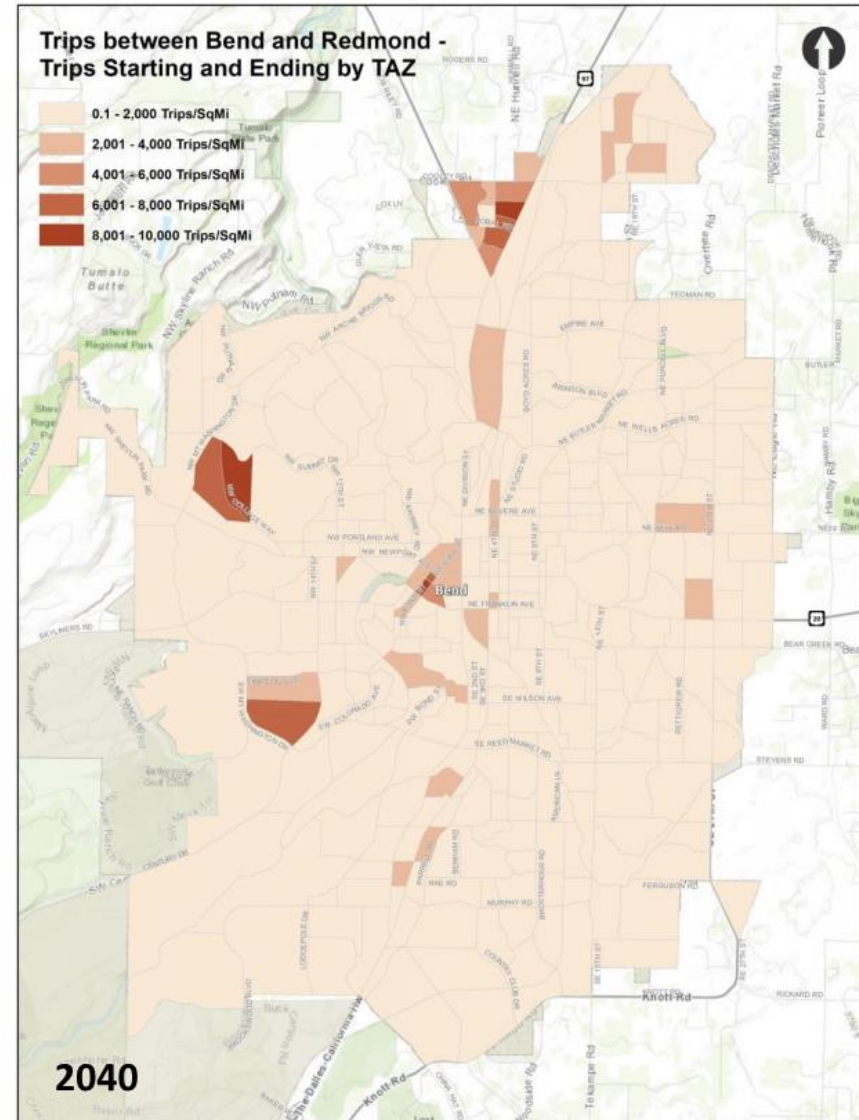
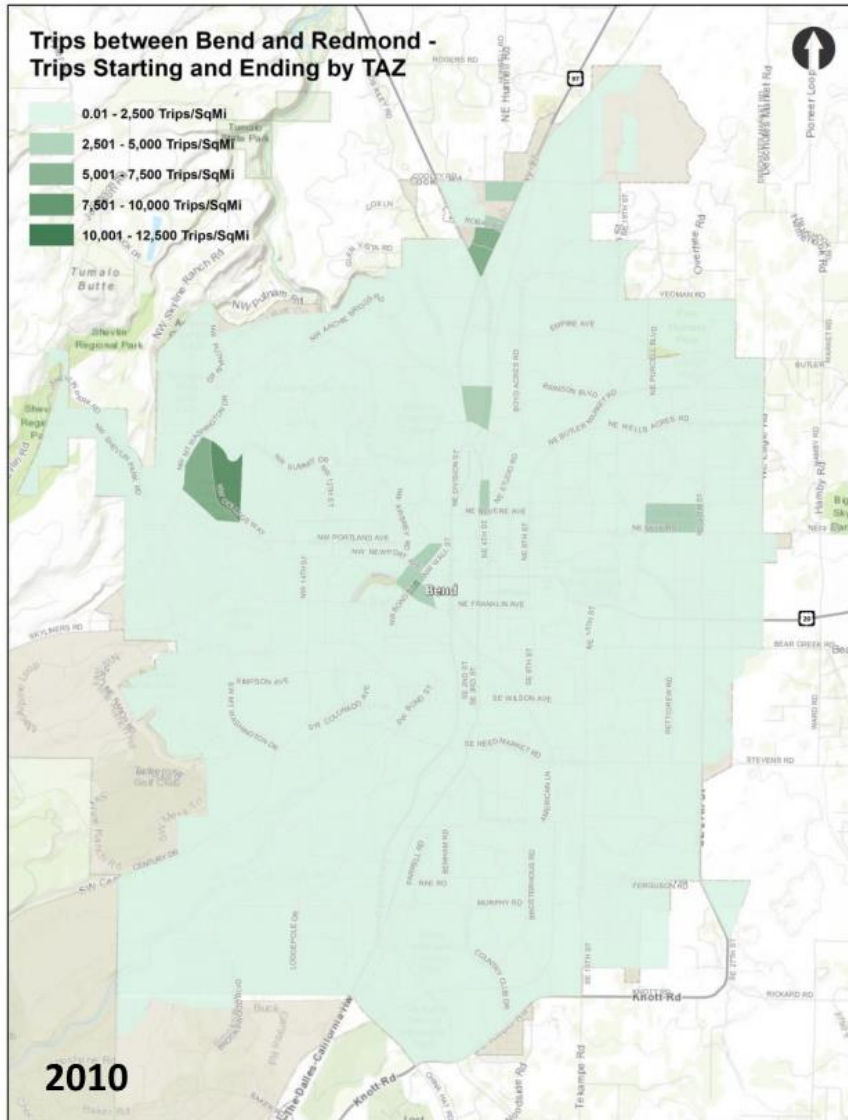


Figure 4: Bend Trips that connect to Redmond (Trips per SqMi)



REDMOND

Figure 5 and Figure 6 show the number and density of trips to each TAZ in Redmond from Bend. The maps demonstrate:

- ▶ Intercity trips with Bend are concentrated in Redmond along Highway 97 and near the airport (most likely representing destinations for trips from Bend such as work trips) but are also widely distributed throughout Redmond (indicating residential trips from Redmond headed to Bend for work, shopping, medical trips, etc.).
- ▶ Trips to the airport from Bend are currently served by private shuttle providers; however, there may be potential to serve the airport with Route 24 or provide a transit connection from downtown Redmond to the Airport.

Figure 5: Redmond Trips that connect to Bend (Total Trips per TAZ)

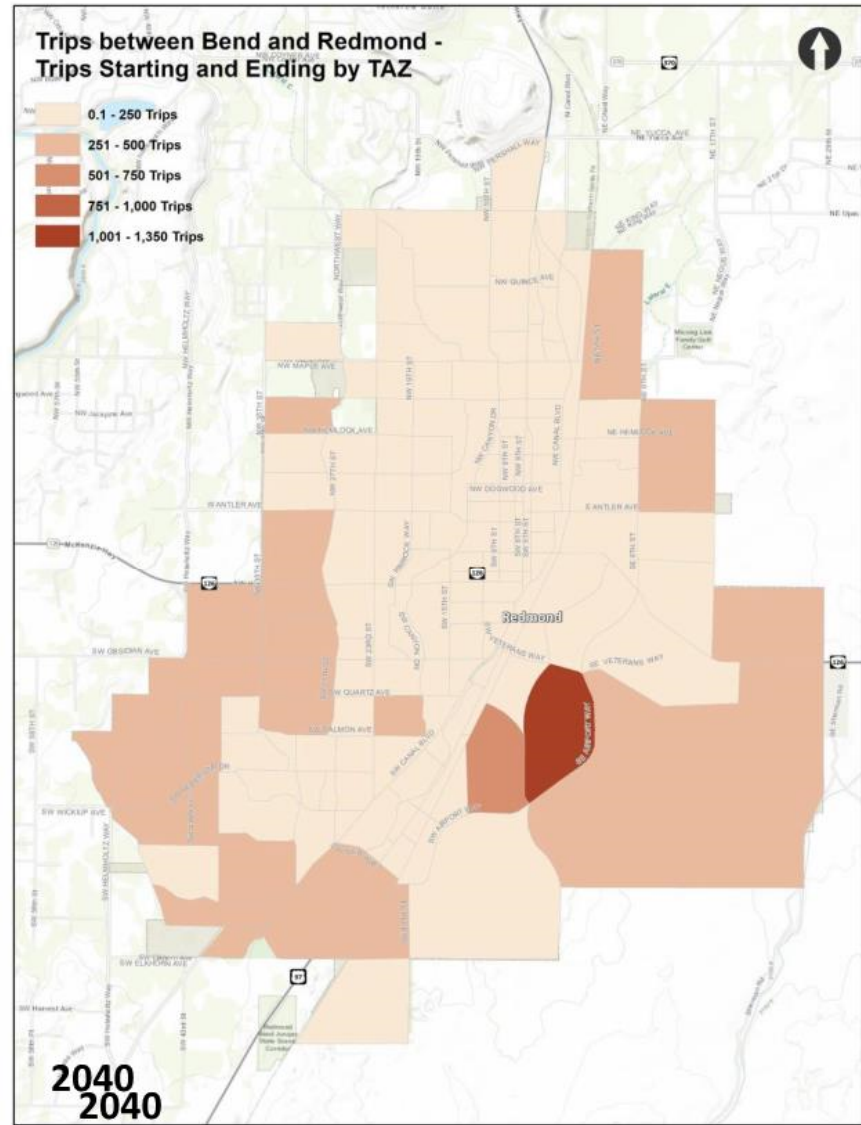
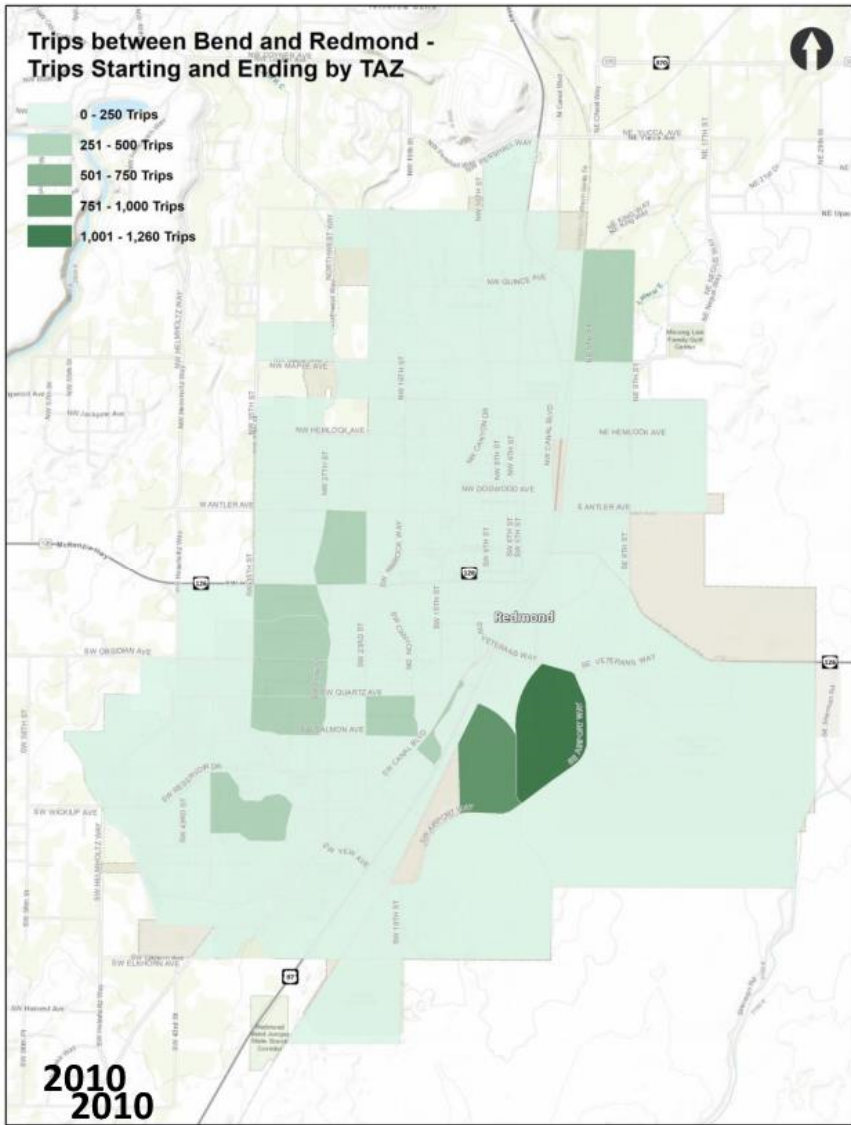
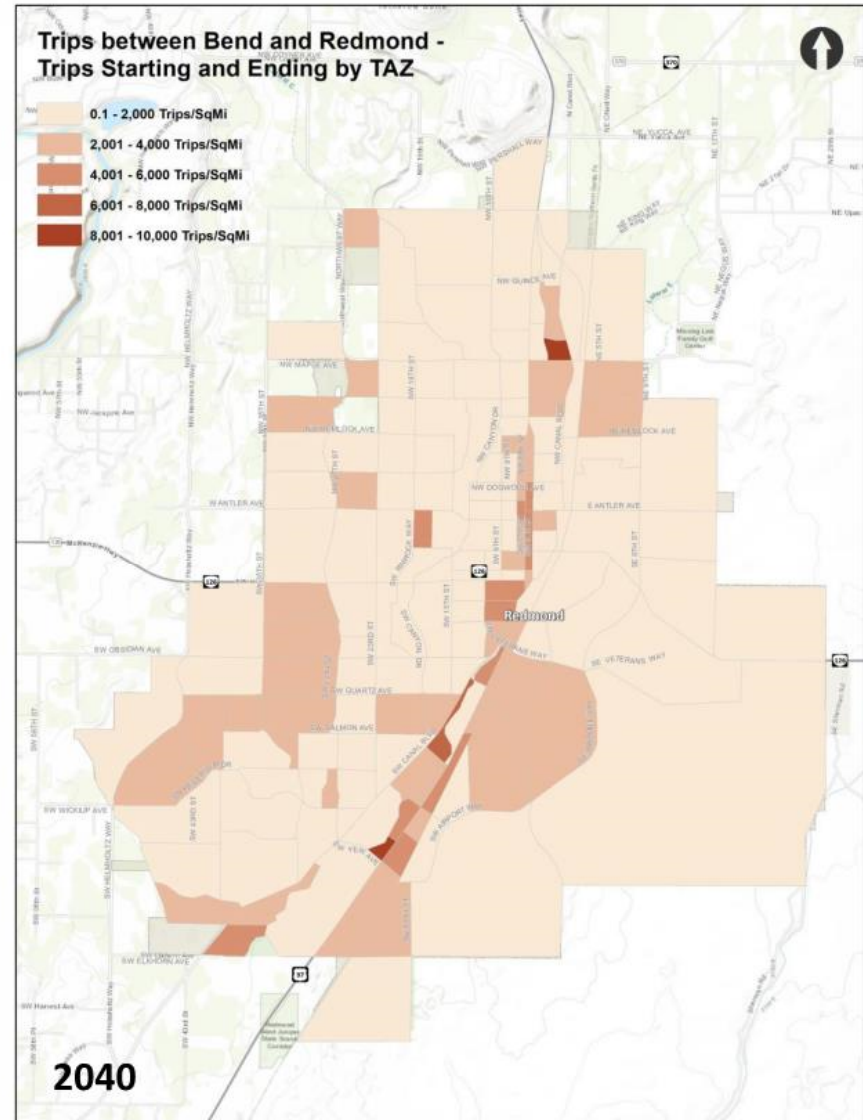
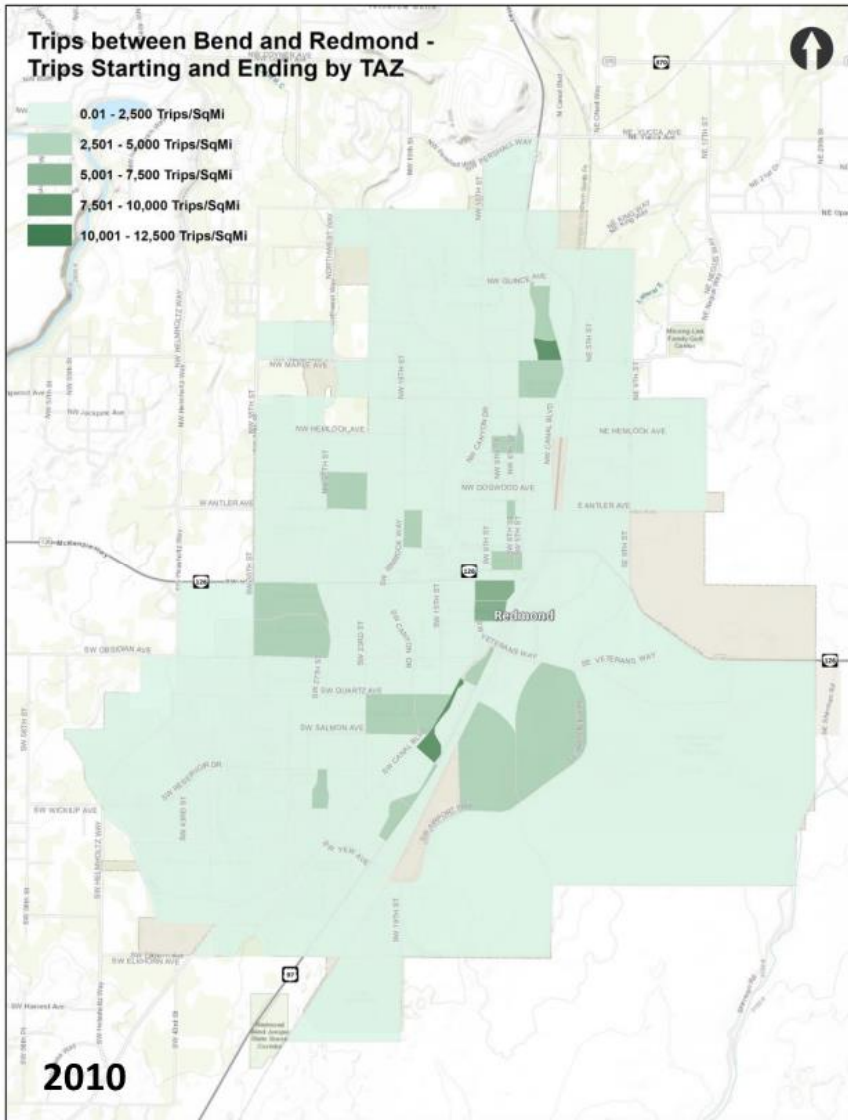


Figure 6: Redmond that connect to Bend (Trips per SqMi)

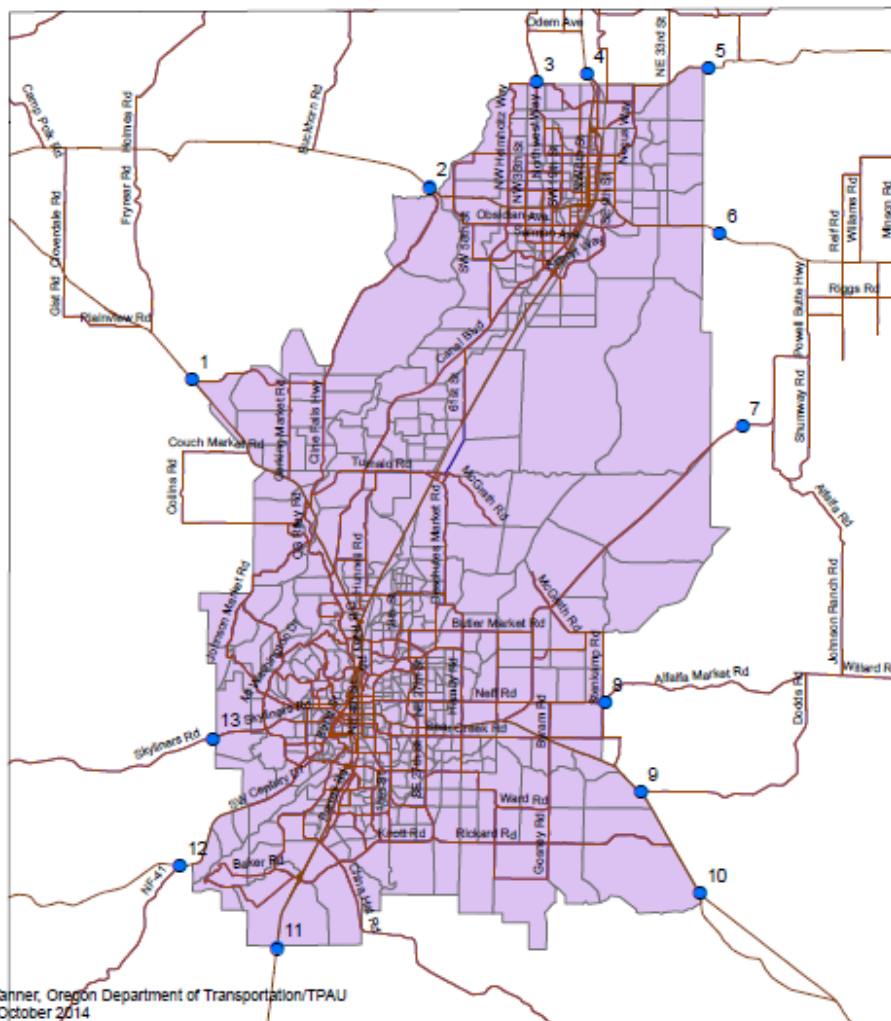


INTERCITY TRAVEL DEMAND

Origins and destinations for intercity trips to or from locations within the Bend-Redmond model to or from locations outside of the model area were evaluated for model years 2010 and 2040. Between 2010 and 2040, the Bend-Redmond model predicts that intercity trips to the Bend-Redmond model area will grow from 45,310 to 65,991 trips per day (a 45 percent increase).

In the Bend-Redmond model, trips are assigned to gates on major roadways entering the model area. These external gates are show in Figure 7 as blue dots. The origin or destination outside of the Bend-Redmond model area for trips with an origin or destination within the model area may be the immediate cities outside of the model area, such as Madras, Sisters, and LaPine; however, they can also be from greater distances away such as Salem and Portland. As a result, these external trips to/from the model area are referred to as "trips to and from the direction" of the nearest city. The full set of figures showing the Bend-Redmond origin or destination of the external trips to/from the area in the year 2010 and 2040 for each of the external areas is included in *Attachment C*. Example figures for trips to/from the direction of Madras/Warm Springs and Prineville are shown in Figures 8 and 9, respectively.

Figure 7: Bend-Redmond Model External Areas



The four directions that generate the most intercity trips to the Bend-Redmond model area are LaPine/Sun River, Warm Springs/Madras, Prineville, and Sisters. Data for these locations are summarized in Table 1.

Table 1: Total Daily Regional Trips to and from Bend and Redmond

Direction of Travel	2010		2040	
	Bend	Redmond	Bend	Redmond
LaPine / Sun River	9,009	353	11,567	653
Warm Springs / Madras	4,806	7,051	7,326	8,195
Prineville	3,591	4,734	5,147	6,124
Sisters	5,029	2,700	7,424	3,870

The following summarizes the travel patterns for trips to/from outside of the model area with an origin or destination in the Bend-Redmond model area based on the maps in Figure 8 and 9 and in *Attachment C*.

- ▶ Intercity trips are not clearly concentrated in a specific pattern in Bend and Redmond. Generally, the TAZs that receive the most intercity trips are either along the primary highway corridors in Bend and Redmond or larger residential areas.
- ▶ In 2010, each location generates over 3,500 daily trips to Bend. In 2040, the number increases to 5,100. Of note, Warm Springs / Madras direction generates a comparable number of trips to Bend as to Redmond in 2040 (as shown in Figure 8).
- ▶ Prineville generates a comparable number of trips to Bend as to Redmond in 2010 and 2040.
- ▶ The model estimates very few trips from the LaPine/Sun River direction to Redmond in 2010 and 2040.

Figure 8: Trips to and from Warm Springs / Madras Direction

★ Star indicates where model assigned external trips

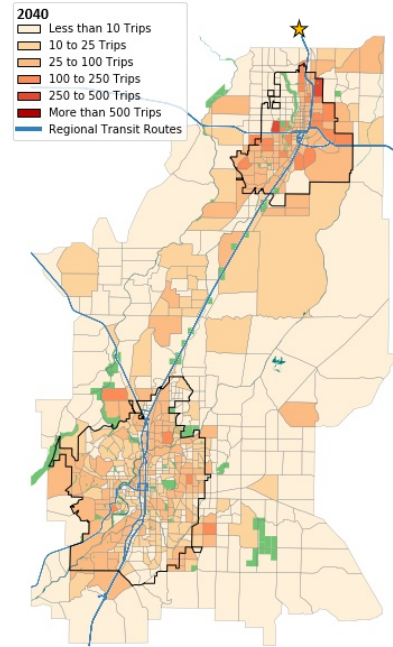
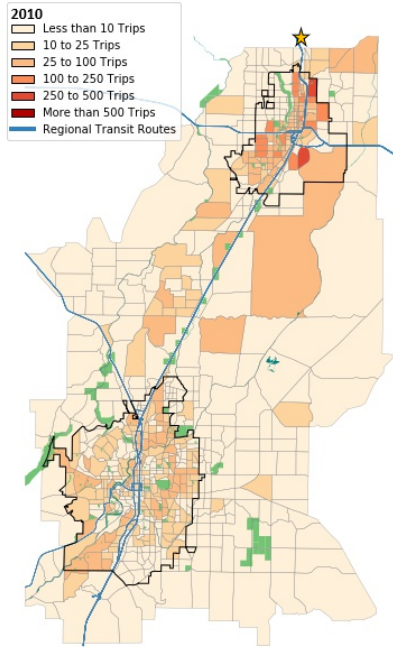
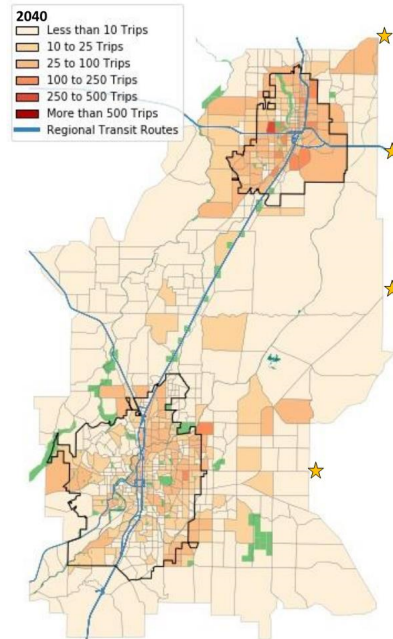
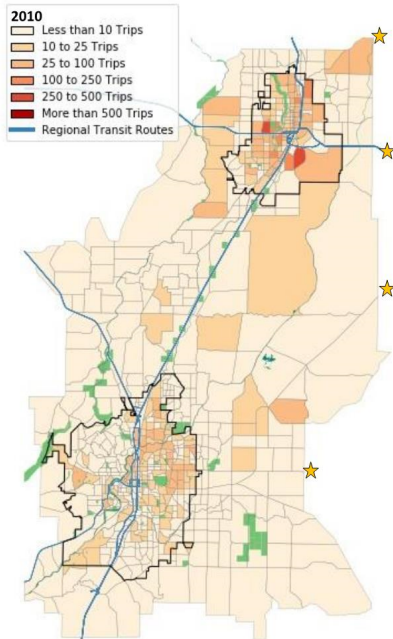


Figure 9: Trips to and from Prineville Direction

★ Star indicates where model assigned external trips



EXISTING MODE SPLIT

Data from the 2017 American Community Survey (ACS) was evaluated to identify the existing mode split for work trips for workers 16 and over by county. ACS work mode split summarizes the primary mode of transportation reported by residents within a particular area for work trips only. Table 2 summarizes the reported mode split for work trips by county. As shown, Deschutes County has the highest transit mode split. Jefferson County has the highest carpool mode split. Crook County has the highest walk mode split.

Table 2: Existing Mode Split for Work Trips (2017 ACS)

County	Mode						
	Drive Alone	Carpool	Bus	Bicycle	Walk	Other	Work at Home
Crook	77%	11.0%	0.0%	0.3%	4.0%	0.9%	6.5%
Deschutes	75%	9.3%	0.4%	1.8%	2.7%	0.8%	10.4%
Jefferson	75%	14.8%	0.1%	0.6%	2.9%	0.6%	6.0%

REDMOND MUNICIPAL AIRPORT

This section evaluates the feasibility of adding a transit route or stop to existing routes that serve the Redmond Municipal Airport (RDM) based on airport arrival and departure statistics as well as airport employee information.

ARRIVALS AND DEPARTURES

The flight data aggregator website, flightradar24.com, provides flight arrival and departure data in 15-minute intervals along with aircraft type. Table 3 lists the arriving and departing aircraft at RDM between Sunday, June 23 and Saturday, June 29, 2019 – capturing flight patterns for each day of the week – and the estimated number of passengers onboard each. Overall traffic did not vary noticeably between days of the week.

Table 3: Maximum Passengers by Aircraft Type Serving RDM

Aircraft Type	Number of Passengers Assumed Onboard
E75L/E75S	75
CRJ7	70
CRJ2	50
DH8D	80
A319	160

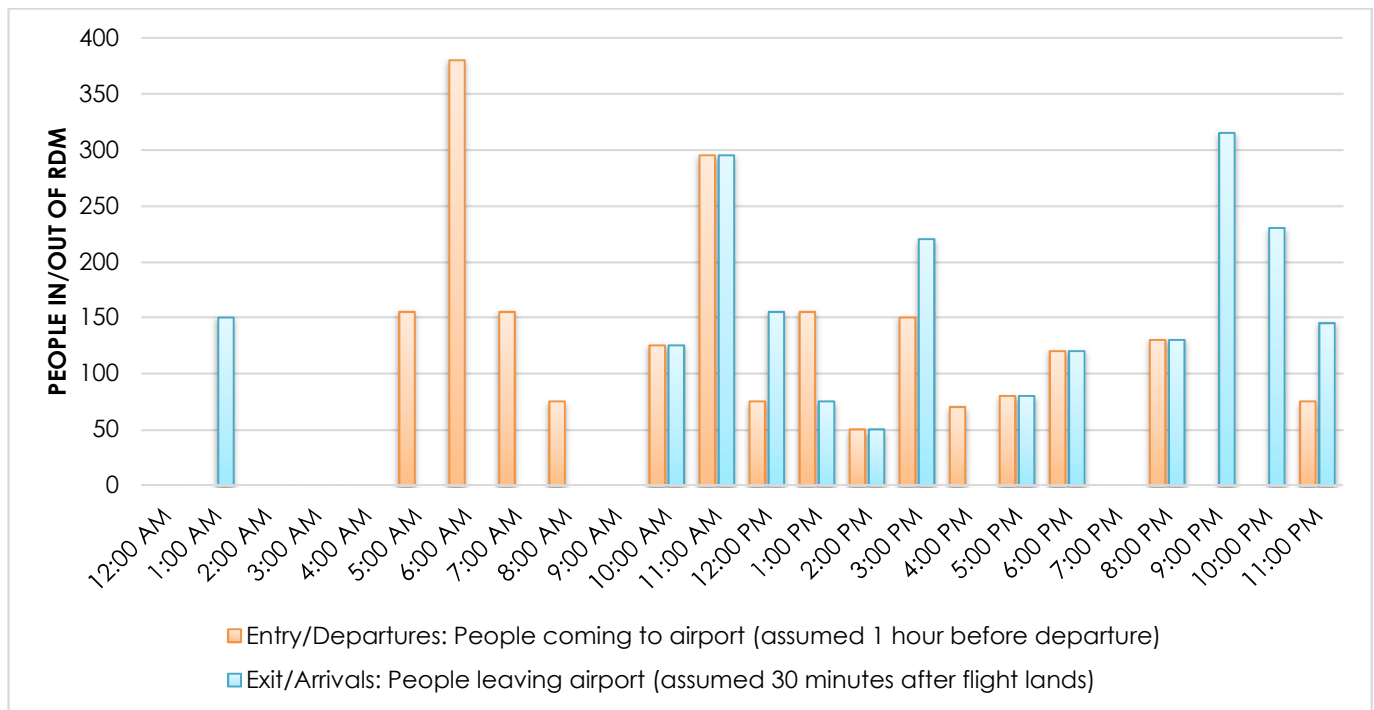
The number of passengers entering and exiting the airport were analyzed by hour blocks using the Monday travel data to represent typical weekday travel patterns (e.g. all passengers entering RDM between 6:00 and 6:59 a.m. were categorized as the 6:00 a.m. group). It was assumed that passengers arrive at the airport one hour prior to flight departure and leave the

airport 30 minutes following flight arrival. It was also assumed that each plane arriving at and departing RDM were at capacity.

According to RDM, 38,528 passengers departed the airport in May 2019, compared to an estimated full-capacity volume of 40,830. The full-capacity estimate is based on day-of-the-week data from June 2019 and was seasonally adjusted by 0.89. Given the ratio between actual departing passengers and estimated departing passengers is over 0.94, the analysis relied on the estimated passenger volume.

Based on the analysis, the number of passengers entering RDM peak (greater than 200 per hour) during the 6:00 a.m. and 11:00 a.m. blocks, with steady entries throughout other times of the day. The number of passengers exiting RDM peak (greater than 200 per hour) during the 11:00 a.m., 3:00 p.m., 9:00 p.m., and 10:00 p.m. blocks, with fewer passengers exiting throughout the late morning and all afternoon. Combined passengers' entries and exits peak (greater than 300 per hour) during the 6:00 a.m., 11:00 a.m., and 3:00 p.m. These patterns are shown in Figure 7. CET Redmond service hours as of July 2019 are Monday-Friday, 6:30am-6:00pm.

Figure 10: Monday RDM Passenger Entry/Exit



While this data was recorded the week of June 23rd, 2019, flight patterns vary at RDM by season. Utilizing 2018 Enplanement/Deplanement statistics from RDM, seasonal adjustment factors were calculated by month to adjust the above data; see Table 4. Because the data were collected in June, the seasonal adjustment factor for June is 1.00. Arrivals and departures both peak in July and August and reach their lowest count in January and February.

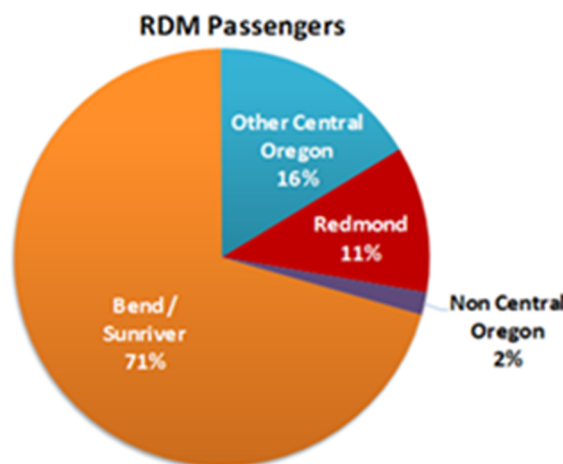
Table 4: RDM Seasonal Passenger Data

Month	Departures Seasonal Adjustment Factor	Arrivals Seasonal Adjustment Factor
January	0.79	0.71
February	0.75	0.72
March	0.84	0.82
April	0.84	0.82
May	0.89	0.89
June	1.00	1.00
July	1.16	1.13
August	1.14	1.10
September	0.96	0.92
October	0.98	0.92
November	0.92	0.90

Additionally, traffic in and out of RDM increases annually, and in recent years, has grown at approximately 12.1% per year, based on 2018 and 2019 enplanement data for March (10.2%), May (7.6%), and June (18.5%). This annual growth may complicate long-term use of the above seasonal adjustment factors when comparing RDM entry/exit traffic between different years.

The Redmond Airport provided data on passengers utilizing RDM and from where they travel. Figure 8 shows a general breakdown by percentage of passengers being served from the Bend/Sunriver area, Redmond, “other” Central Oregon cities and towns, and those not traveling within Central Oregon. As shown, a majority of passengers served at RDM travel between the airport and the Bend/Sunriver area.

Figure 11: RDM Passenger Origins and Destinations



In contrast, the Bend MPO travel demand model, which includes vehicle trips between Bend and RDM and Redmond and RDM, shows that the majority of vehicle trips move between Redmond and RDM. The trips disperse throughout the City limits, but are densest along US 97, Canal Boulevard, and the Downtown core. This origin-destination data likely illustrates the employees that work at RDM who reside in Redmond; it may speak to the needs of RDM employees traveling to and from work that might benefit from routine transit service to the airport.

AIRPORT EMPLOYEES

Redmond Municipal Airport provided the following shift information of employees working at the airport, with 16 employers at RDM; shift information of the following groups is listed below:

- ▶ SP Plus three shifts: 12 a.m. to 8 a.m., 8 a.m. to 4 p.m., 4pm-12am
- ▶ TSA: 3am - last departure flight (typically 11:15pm)
- ▶ Ground crews: 3am - 1 hour after last flight arrival (typically 1:30am)
- ▶ Air mechanics: 7pm-7am
- ▶ Pub employees: 4:30am-8:30pm
- ▶ Retail employees: 3:30am-8:30pm
- ▶ Five rental car companies: Begins 7:30am, leaves 1:00am
- ▶ Security five shifts: 5am-1pm, 10am-5pm, 2pm-10pm, 5pm-12am, 10pm-6am
- ▶ Airport administration: 7am-4:30pm
- ▶ Airport custodial staff: 4am-2am
- ▶ Airport operations: 4am-11pm (summer), 4am-1am (winter)
- ▶ Others: 5am-7pm

According to RDM, the 16 employers listed above employ approximately 370 staff. This does not include airfield staff, such as FBO, flight school staff, etc. Therefore, the number of employees is greater than the 370 staff working for the above employers.

AIRPORT TRANSIT NEEDS

Based on the passenger entry and exit analysis and the existing and future travel demand within CET's service area, the following preliminary service additions will be considered during the next phase of the project to better serve those flying into and out of Central Oregon as well as those who work at RDM:

- ▶ New fixed route connection between Hawthorne Station in Bend, the Redmond Transit Hub in Redmond, and RDM.
 - ▶ Hours of operation could serve 6:00 a.m. and 11:00 a.m. flight departures as well as 11:00 a.m. and 3:00 p.m. arrivals (all other peak times served by dial-a-ride transit).
 - ▶ Circulate Community Connector throughout Redmond between flight departures and arrivals.
 - ▶ Annual service cost is approximately \$460k at \$106/hour for 12 hours a day 365 days a year
- ▶ New stop added to the Community Connector Route 24 (Redmond-Bend)
 - ▶ Leave Redmond Transit Hub at 5:00 a.m. and final arrival to Redmond Transit Hub at 9:02 p.m.
 - ▶ Additional annual service cost is approximately \$58k for operating an extra 90 minutes a day 365 days a year

Appendix A Origin-Desintation Maps by TAZ Group for 2010 and 2040

Appendix B Origin-Desintation Tables by TAZ Group for 2010 and 2040

Appendix C Regional Trips Maps for 2010 and 2040