DRAFT 09/15/14

Powell-Division Transit and Development Project — Transit Technical Memo

Introduction

The Powell-Division corridor is one of the highest transit ridership corridors in the region. Extending from downtown Portland to Troutdale and including Gresham, Oregon's fourth most populous city, the corridor is home to a large, diverse population and a significant employment base, and includes prominent educational institutions, major retail centers, and many other transit attractors. Most of the corridor consists of an urban environment, with some of the region's oldest neighborhoods that developed around streetcar lines in the late 19th and early 20th centuries to the west, and some of the fastest growing communities in the region to the east. The geography and road network accommodate direct radial east-west service between the outer corridor and downtown Portland along with a grid network that connects passengers across the corridor between north and south.

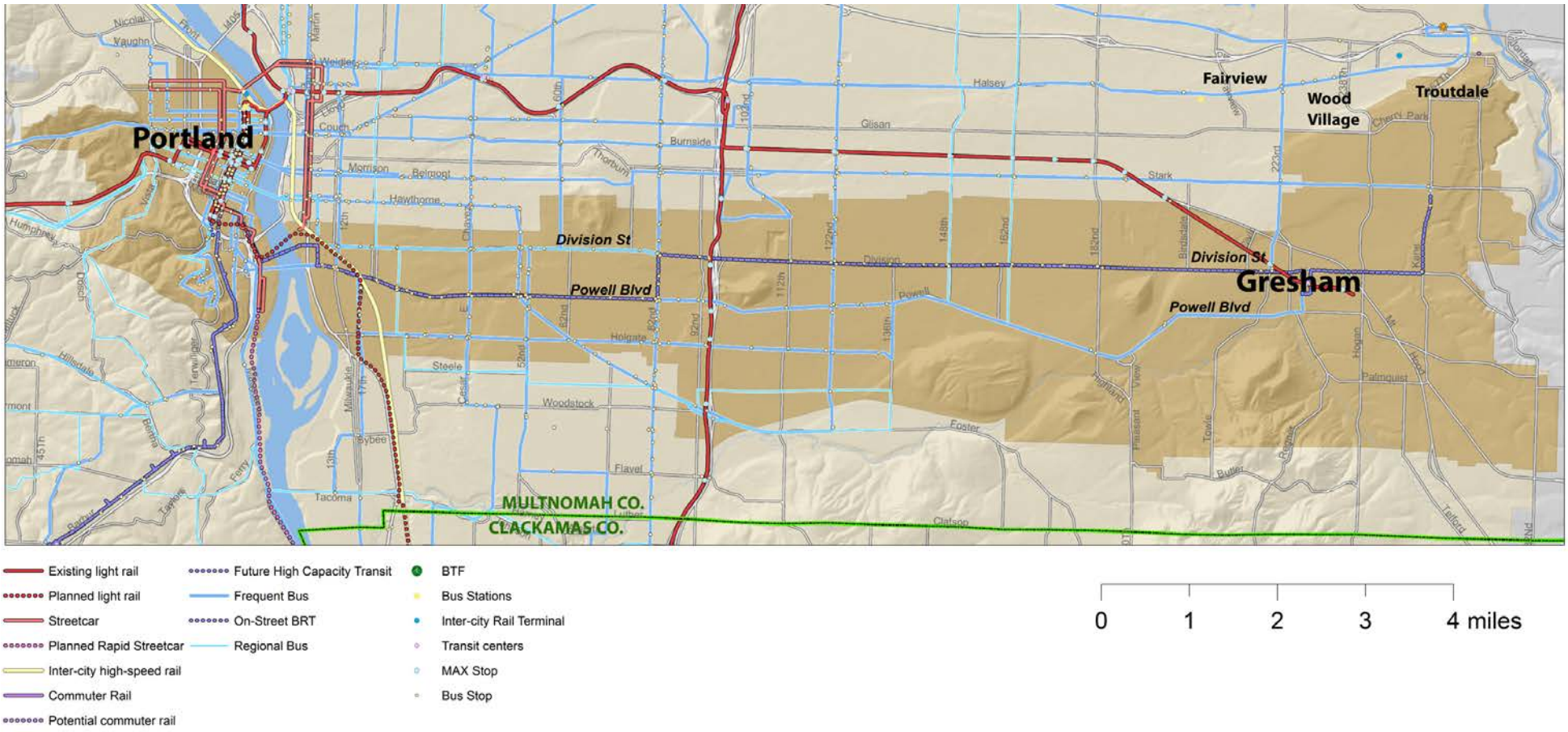
The corridor is served by two MAX lines: the Blue Line travels between downtown Portland and downtown Gresham via a route north of the corridor, running alongside I-84, I-205, and Burnside Street. The MAX Green line provides north-south service through the corridor parallel to I-205. The Portland to Milwaukie Light Rail Transit project (MAX Orange Line) is under construction and will operate within a small portion of the corridor, providing service to stations at OMSI/SE Water Avenue, Clinton and 12th Avenue, Rhine and 17th Avenue, and Holgate and 17th Avenue. Lines 4-Division and 9-Powell are the primary east-west bus lines running directly through the corridor, and both currently have some of the highest ridership in the region. Other supplementary east-west lines in and around the corridor include lines 20, 17, 14, and 10. Several bus lines run north-south through different parts of the corridor, including lines 33, 19, 70, 75, 71, 72, 87, and 21, but there are limited north-south transit options between 122nd and 182nd Avenues.

There is one designated transit center in the corridor, located in downtown Gresham. The transit center is served by the MAX Blue Line and several bus lines, including the 4-Division and 9-Powell. Within the corridor there are five park and ride lots ranging in capacity from 24 to 417 vehicles, including two in Gresham, two along I-205, and one near Holgate Boulevard and Foster Road, all with a total capacity of about 1,350 vehicles.

Figures 1 and 2 show the existing and assumed future TriMet transit networks in the corridor.

Figure 1. Existing TriMet Transit System

Figure 2. 2035 transit network (Regional Transportation Plan)



Section 1: Summary and opportunities

Summary

The Powell-Division corridor is one of the strongest transit corridors in the region, and the frequent service lines 4-Division and 9-Powell are the workhorse bus lines. Both are among the highest ridership, most productive bus lines in the TriMet system. Both experience high ridership throughout the day—peak hours, mid-day, and into the evening, indicating that they serve a complex set of trip purposes beyond commute trips.

Both lines, however, are sometimes strained by the strong demand and by unreliable traffic conditions and congestion on Division Street and Powell Boulevard. Passenger loads are high throughout the corridor with standing-room only conditions common, and at-capacity buses sometimes forced to pass by stops with waiting riders. These conditions are not isolated to peak periods, but occur throughout the day in this corridor.

Bus speeds are significantly slower in peak periods compared to mid-day conditions, and on-time performance suffers at times. Typically in the TriMet system on-time performance issues occur during the PM peak in the outbound direction. In this corridor, however, there are reliability issues in both directions along Powell Boulevard during the mid-day and evening and in both directions along Division Street all day.

Access to transit is problematic in significant portions of the corridor, with sidewalk gaps especially prevalent from I-205 to the Gresham city boundary along Powell Boulevard and along many local streets that provide pedestrian access from neighborhoods to both Powell Boulevard and Division Street.

Population and employment growth in the corridor are expected to continue, especially in the East Portland and Gresham areas. Transit ridership is projected to grow by over 70% on lines 4-Division and 9-Powell by 2035, with relatively long trips being the norm. But as the area grows and traffic increases, conditions for corridor transit riders are at risk of deteriorating. Passenger load projections show transit capacity assumed in future plans would be inadequate to serve the peak demand, and increased future congestion will slow buses and increase transit travel times.

Opportunities

Upgrading transit service and the operating environment can increase transit demand and the capacity to accommodate that demand, and improve conditions for riders. **Capacity issues** can be addressed by increasing service frequency or by introducing larger capacity vehicles. Higher frequency service, however, could result in more problems. Existing headways during the peak in the corridor are as low as 3-5 minutes; adding more trips may create a bus bunching problem where multiple buses approach a stop simultaneously. Larger capacity vehicles can add capacity without adding additional trips.

Reliability and travel time problems can be addressed in several ways. Exclusive transit right-of-way, such as exclusive lanes for LRT or BRT, allow transit to avoid congestion but can result in significant property or traffic impacts in a developed corridor such as the Powell-Division corridor. Queue jumps, business access and transit (BAT) lanes, and signal priority can speed buses past congestion and intersections.

Increased **stop spacing** along the lines would result in faster travel times by reducing boarding/deboarding and merging time. The mean walking distance from home to local bus stations across the whole TriMet system is just over a quarter of a mile. With a total distance of about 12 miles from the river to downtown Gresham, the number of stops could be reduced to around 50 with quarter-mile stop spacing, compared to the 75-80 corridor stops in each direction along each line today. With high capacity transit service, stop spacing could be increased even further because people are willing to walk farther to an HCT station than to a local bus stop (see Appendix 5). The mean walking distance between home and MAX/WES stations is just over half a mile. Half-mile to 1/3-mile stop spacing with HCT could serve a broader area with only about 15 to 30 stations between the Willamette River and Gresham, thus greatly improving travel time. A high capacity transit capital project would include investments in the sidewalk grid in the corridor, which would improve **access to transit**.

HCT vehicles can also improve corridor travel times by expediting boarding and deboarding with multiple doors, low-floors, and off-board payment.

A list of the options for improving transit travel times is included in Appendix 6.

Transit amenities can be improved to improve accessibility, safety, and comfort of riders. Especially on Powell Boulevard between I-205 and Gresham, the addition of sidewalks to fill existing gaps would improve the built environment for pedestrians whether they are accessing transit or not. Upgrading stops that have only bus signs to include shelters and benches would improve rider experience and attract new transit riders. Curb extensions would improve safety at stops and improve transit travel times by decreasing merging.

Interstate MAX provides an example of the potential effects of many of these treatments. The project introduced exclusive transit right of way, higher capacity vehicles, increased stop spacing, and improved station amenities. Average weekday ridership on Interstate MAX increased by 70% in one year over ridership on the bus line it replaced, and daily ridership on all corridor transit routes increased by over 8,000 without significant changes to headways.

Potential transit improvements, though, must consider potential impacts to the corridor's highly developed environment, the cost of construction, and the time required for implementation.

Section 2: Current Conditions

Lines 4-Division and 9-Powell service frequencies (headways)

Both lines 4-Division and 9-Powell are frequent service lines. Figures 3 and 4 show the current weekday, Saturday, and Sunday headways for each line. During the weekday AM and PM peaks, line 4-Division buses operate approximately every 8-9 minutes and line 9-Powell buses operate every 12-13 minutes. Midday service during the week runs about every 15 minutes for both the 4-Division and the 9-Powell. Both lines have less frequent service on the weekends, with minimum headways of 15 minutes for line 4-Division and 21 minutes for line 9-Powell.

Figure 3: Line 4-Division headways

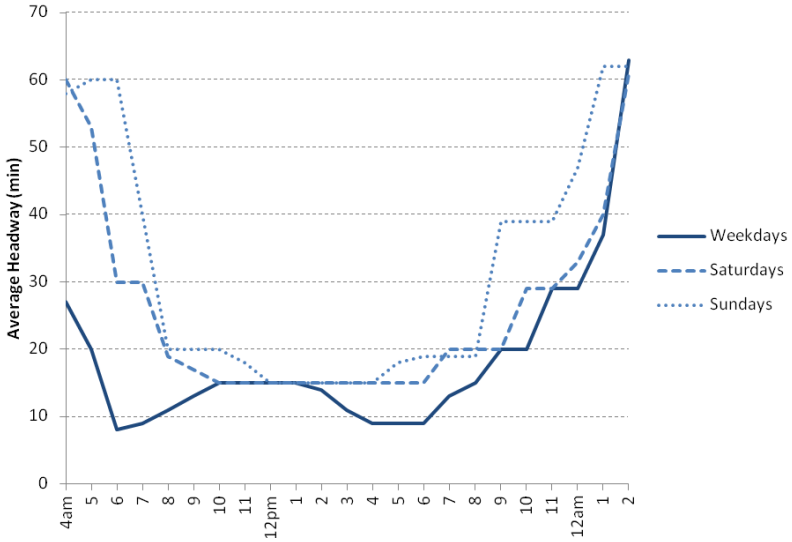
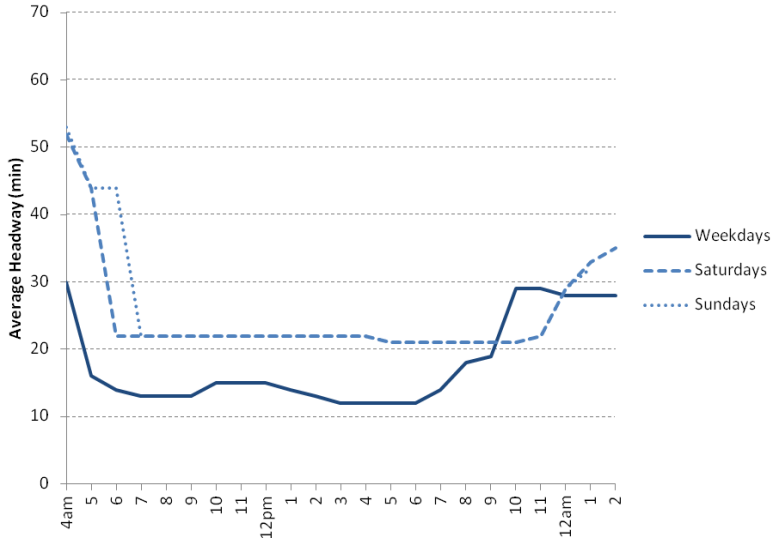


Figure 4: Line 9-Powell deadways

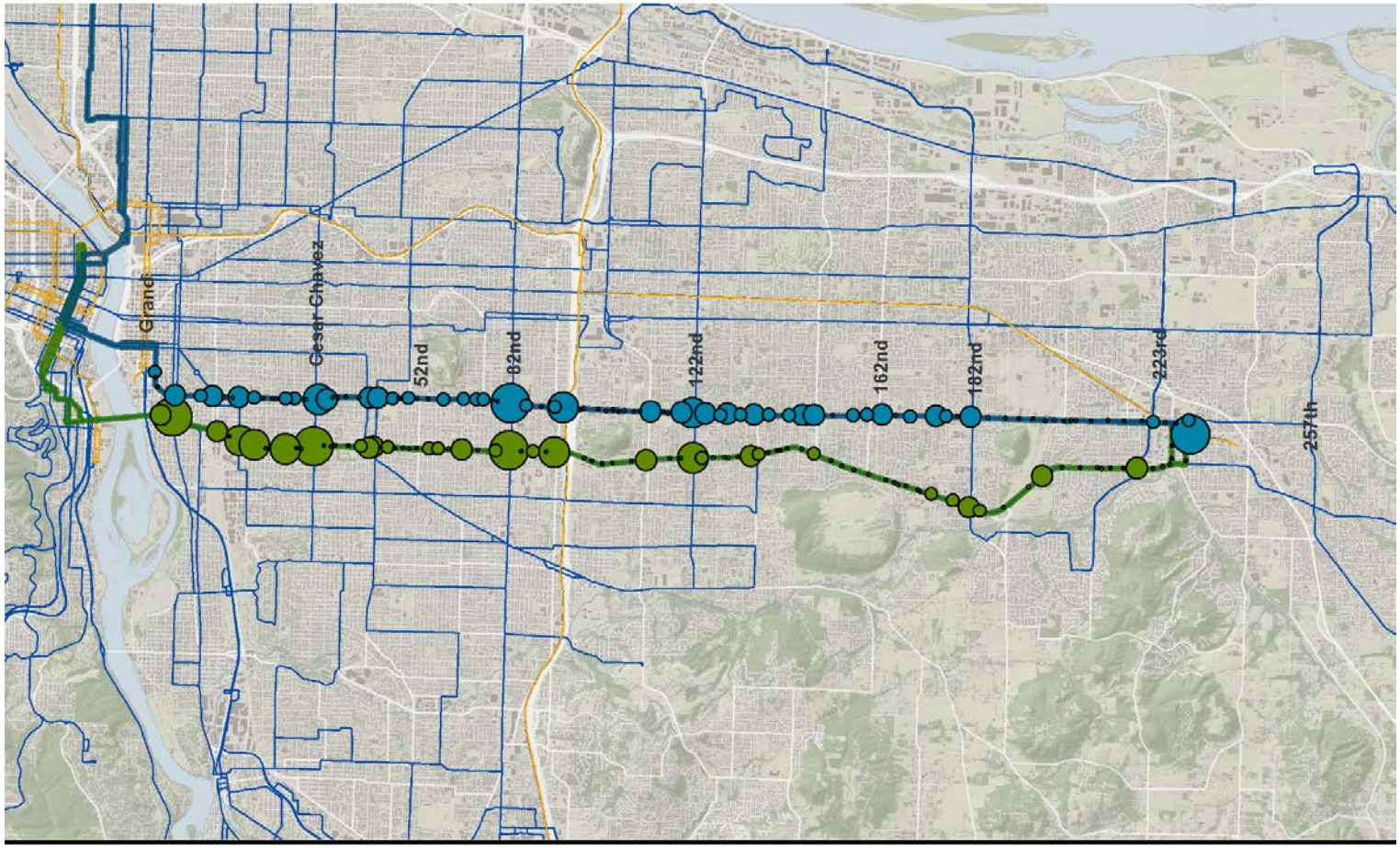


For more detailed headway information refer to Appendix 1.

Lines 4-Division and 9-Powell ridership

Lines 4-Division and 9-Powell rank 4th and 8th, respectively, among the most productive bus lines in the TriMet system (measuring boarding rides compared to vehicle hours). Line 4-Division carries over 9,000 average weekday riders and 9-Powell carries over 8,700 average weekday riders. High ridership stops are distributed along the entire corridor (figure 5), with busiest stops between downtown Portland and SE Cesar Chavez Boulevard, between SE 82nd and SE 92nd Avenues, at SE 122nd Avenue, and at the Gresham Transit Center.

Figure 5. Daily weekday boardings on Lines 4 and 9



Lines 4-Division and 9-Powell passenger loads

Both bus lines experience high daily passenger loads and crowding throughout the corridor. Highest passenger loads occur in the following locations:

- 4-Division westbound – SE 122nd to SE 98th Avenue, SE 76th to SE 60th Avenue, SE Cesar Chavez Boulevard to Hawthorne Bridge;
- 4-Division eastbound – Hawthorne Bridge to SE 33rd Avenue, I-205 to SE 138th Avenue;
- 9-Powell westbound –SE Powell Garage Drive (near I-205), SE 24th to SE 21st Avenue, SE 43rd to SE 9th Avenue;
- 9-Powell eastbound – Ross Island Bridge to SE 28th Place.

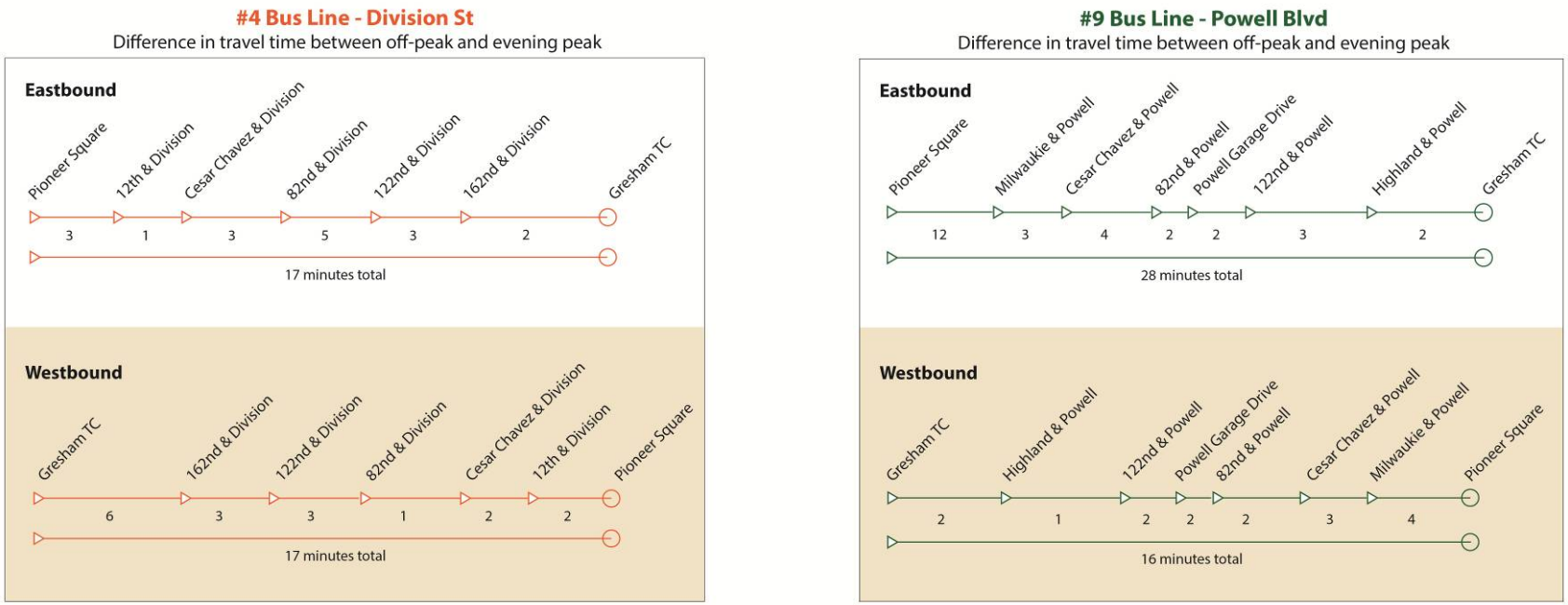
Line 4-Division eastbound buses experience near- or over-capacity conditions in the PM peak period both in inner SE Portland and east of I-205. Line 9-Powell is over capacity in the westbound direction during the AM peak in inner SE Portland.

For more detailed descriptions of peak load areas, including time of day, refer to Appendix 2.

Lines 4-Division and 9-Powell travel times

Travel times for both lines vary greatly between peak and off-peak conditions. Traffic congestion on both SE Division Street and SE Powell Boulevard degrades transit travel time and travel time reliability that must be accounted for in transit schedules. Figure 6 shows the variances in transit travel time between evening peak and off-peak conditions for each line. For line 4-Division in both directions, and for line 9-Powell westbound, it takes 16-17 minutes longer to travel through the corridor in the evening peak compared to mid-day. For 9-Powell eastbound (outbound), a trip through the corridor takes nearly ½ hour longer in the evening peak compared to mid-day. Additional travel time data can be found in Appendix 3.

Figure 6. Difference in travel time between evening peak and off-peak conditions



On-time performance

TriMet has established measures and standards for on-time performance of bus, MAX light rail and WES commuter rail service. For bus and MAX service, on-time is defined as vehicle arrivals no more than one minute before to five minutes after scheduled time at all points. TriMet's on-time performance objective is 90 percent or greater. A few time segments on Lines 4 and 9 meet this standard, however, while transit scheduling considers unreliable traffic conditions in the corridor, heavily utilized bus routes on often-congested streets are prone to lose adherence to bus schedules. Lines 4-Division and 9-Powell experience less than 90% on-time performance in the following time periods (by direction):

- Line 4-Division (inbound): All day;
- Line 4-Division (outbound): AM Peak through the evening;
- Line 9-Powell (inbound): AM Peak through the evening;
- Line 9-Powell (outbound): AM Peak through the evening.

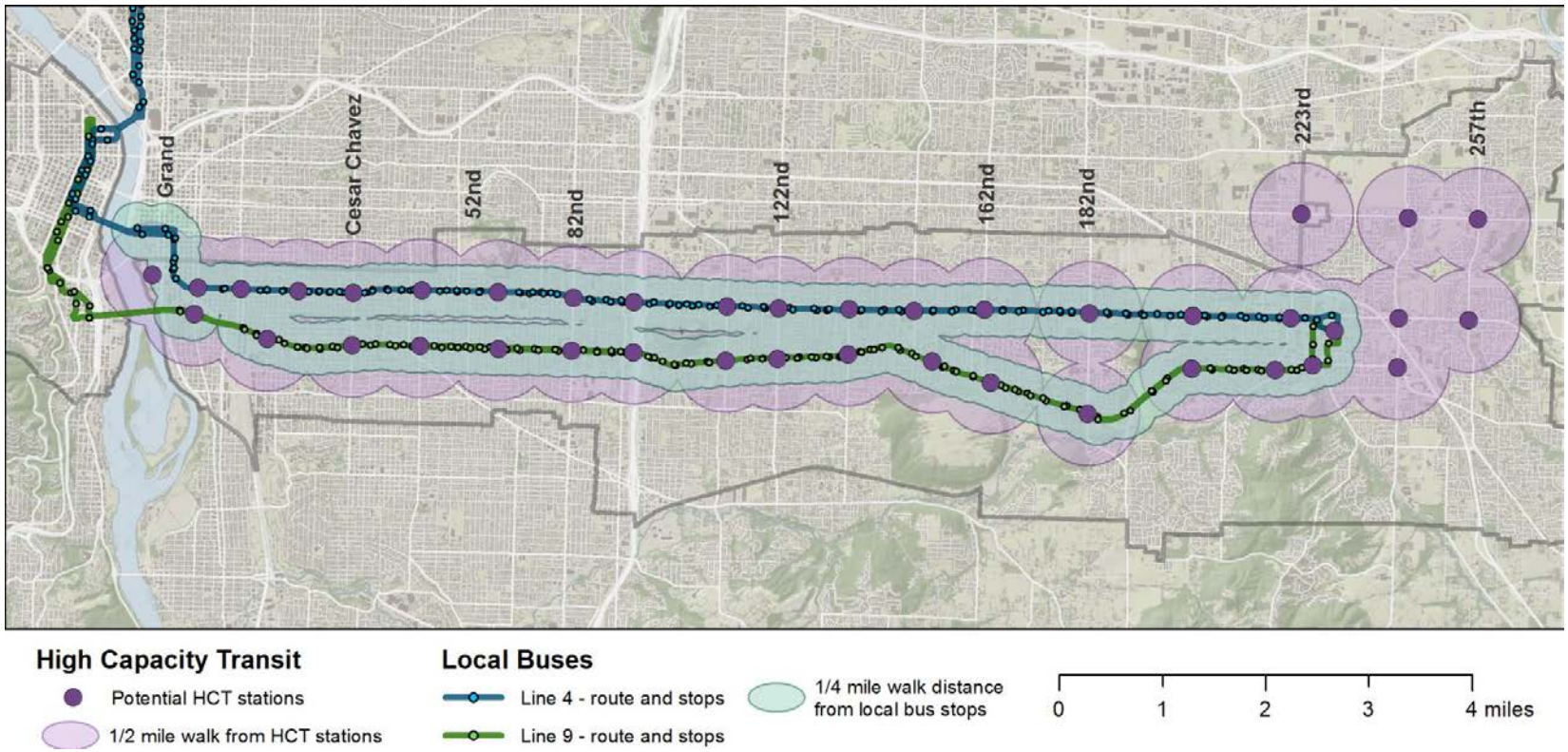
For complete information regarding the two bus lines' on-time performance, including percent early, percent late, and headway adherence, and wait times, refer to Appendix 4.

Stop spacing and access to transit

Along both the 4-Division and 9-Powell bus routes, many stops are spaced as closely as two blocks apart (figure 7). This close spacing results in a total of about 75-80 stops in each direction along each line between the Willamette River and downtown Gresham. The high number of stops can slow buses due not only to the frequent boardings and deboardings, but also to time spent merging into traffic.

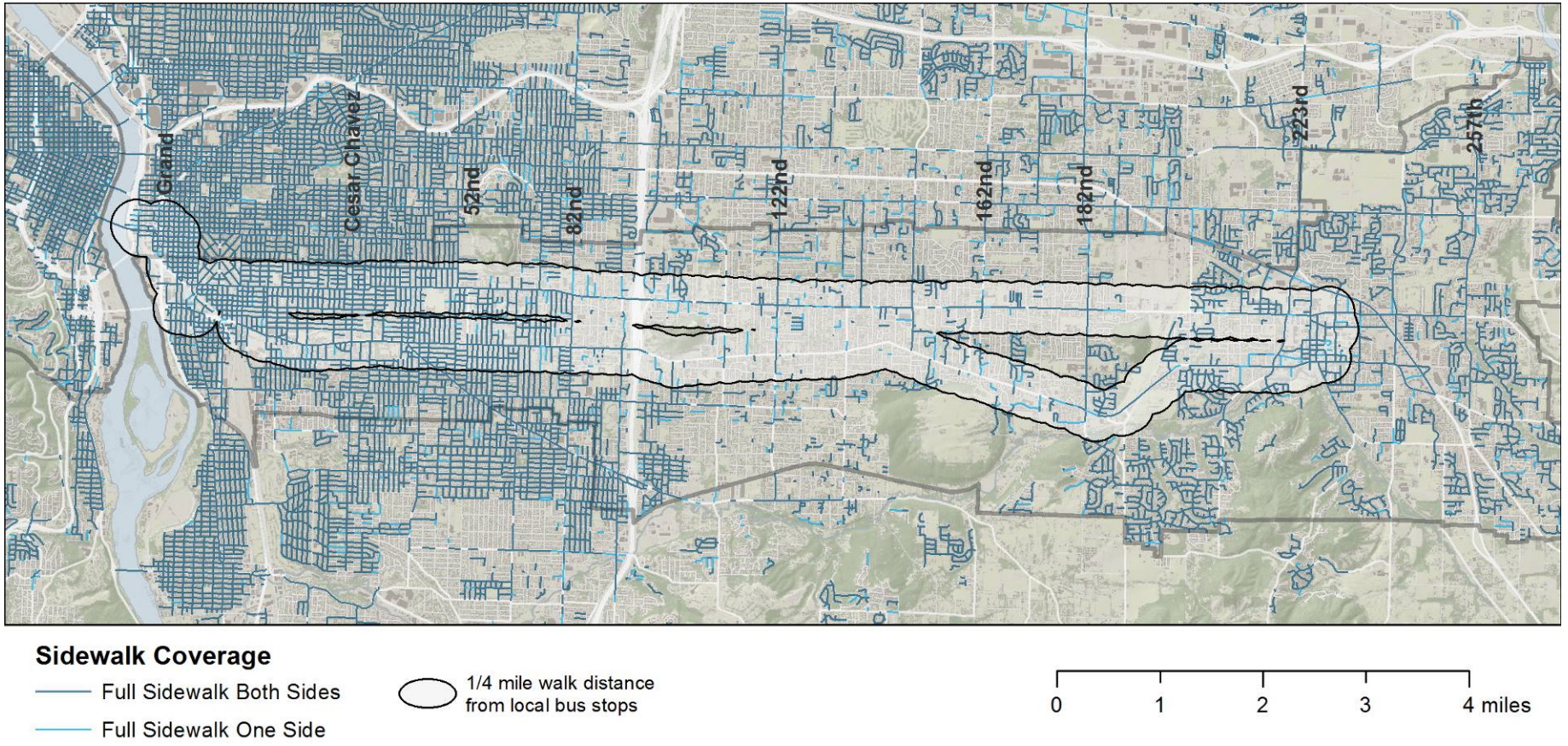
The 2011 Oregon Household Activity Survey(OHAS) research shows that TriMet riders walk further to reach more frequent and higher capacity service transit like MAX and WES than to local bus service. Figure 8 compares a ¼ mile walkshed buffer for the existing local bus service to the ½ mile walkshed buffer that would be typical for high capacity transit service. For a more detailed summary of OHAS transit walk data, refer to Appendix 5.

Figure 7. Current stop spacing and hypothetical ½ mile stop spacing



Full sidewalk coverage is one of the most important aspects of high quality transit access. The adequacy of pedestrian facilities varies greatly throughout the corridor, ranging from dense areas with full sidewalk coverage to more rural stretches with limited sidewalks. Figure 7 below shows the existing sidewalk network in the corridor. Sidewalk coverage is relatively high west of I-205, both on Powell Boulevard and Division Street, as well as within the local street network. Between I-205 and downtown Gresham, Division Street has few major sidewalk gaps with the exception of the segment between 182nd Avenue and Birdsdale Avenue, while Powell Boulevard has only a handful of short sidewalk segments through the entire stretch from I-205 to the Gresham city boundary. In this area, many local streets surrounding Powell Boulevard and Division Street lack sidewalks. About 22 percent of stops along line 9-Powell lack sidewalks, while only one percent of line 4-Division stops lack sidewalks (Table 1).

Figure 8. Sidewalk coverage and ¼ mile walk distance from line 4 and 9 bus stations



Station amenities

Bus stop amenities vary widely throughout the corridor. While some bus stops have a shelter with benches, there are others with only a lone bus stop sign on a gravel shoulder (Figure 9). Table 1 shows the percentage of lines 4-Division and 9-Powell stops with front landing pads, sidewalks, benches, and shelters. Only about a third of the stops along each route have shelters, and roughly half have benches. Twenty percent of line 9-Powell stops have neither a sidewalk nor a front landing pad.

Figure 9. Bus stop amenities along line 9

Table 1. Station amenities provided at line 4 and 9 bus stops. (Note: includes only line 4 stops from the Rose Quarter Transit Center to Gresham.)

Route	Front Landing Pad	Sidewalk	Bench	Shelter	No SW/FLP
4	96%	99%	51%	31%	0%
9	75%	78%	45%	33%	20%

Section 3: Future Conditions

Future ridership and passenger load projections, and service level assumptions

As population and employment in the region and corridor are projected to increase, transit ridership on Powell and Division bus lines is expected to grow. Year 2035 average weekday ridership demand is projected to be 17,400 for line 4-Division and 13,300 for line 9-Powell in the corridor east of the Willamette River. The combined 30,700 daily ridership represents a greater than 70% increase over the approximately 17,700 daily trips on the two bus lines in the corridor today.

The 2035 Regional Transportation Plan (RTP) includes assumptions for future transit service frequencies in the corridor. The RTP assumes more frequent service compared to today's headways for lines 4-Division and 9-Powell. However, ridership projections indicate that the assumed level of service would be insufficient to meet demand on both bus lines (Table 2).

Table 2. 2035 Average weekday headways and peak loads

Bus Line	Assumed Peak Headway	Assumed Off-peak Headway	1 Hour Peak Load[1]	Peak Hourly Bus Capacity[2]	Headwy Meets Demand?	Peak Headway to Meet Demand
Line 4 - Division						
West of SE 92nd:	5	12	576[3]	660	yes	5.45
East of SE 92nd:	10	15	364[4]	330	no	8.57
Line 9 - Powell	10	15	445[5]	330	no	6.67

[1] PM peak hour, peak direction peak load point

[2] hourly frequency multiplied by single bus capacity (55)

[3] east of SE 12th Ave.

[4] east of SE 92nd Ave.

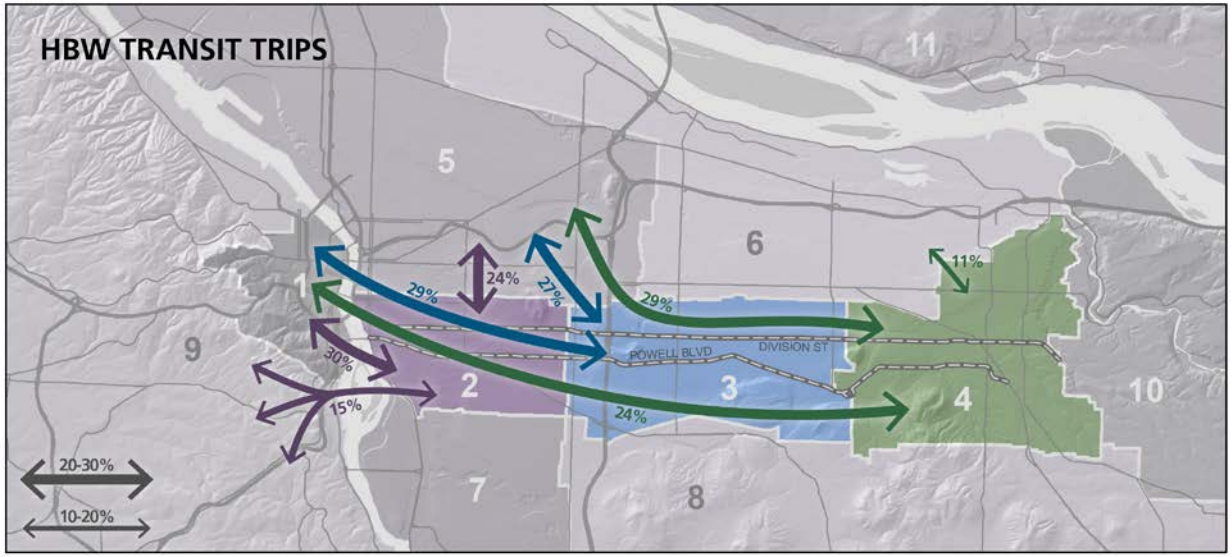
[5] east of SE 26th Ave.

For line 4-Division, the assumed headways would provide sufficient capacity to accommodate the PM peak load for the line near SE 12th Avenue. However, east of SE 92nd Avenue, where the line is assumed to operate less frequently, headways would need to be improved to 8.5 minutes (7 buses per hour) instead of the modeled 15 minutes (4 buses per hour) in the peak to accommodate the peak load near SE 92nd Avenue. The line 9-Powell would also require more frequent service to meet the projected peak load near SE 26th Avenue. The assumed 10 minute headway (6 buses per hour) would need to be improved to better than 7 minutes (9 buses per hour) to carry all passengers.

Future projected transit travel patterns and trip lengths

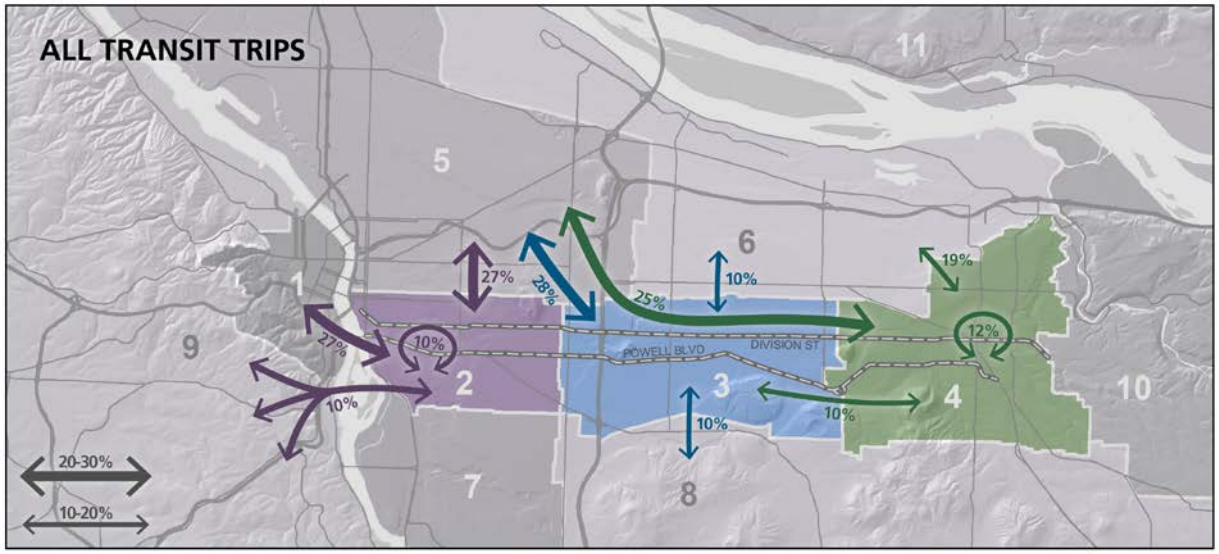
The strongest market for corridor work trips via transit produced in the corridor in 2035 is projected to be the downtown Portland/OHSU area (figure 10). With the corridor east of the Willamette divided roughly into thirds, 37% of work trips from the western segment, 40% of work trips from the central segment, and 35% of transit work trips from the eastern segment would travel to downtown Portland/OHSU. Strong transit work trip markets also would occur north of the corridor. For all purposes, the downtown Portland/OHSU area is also the strongest market for corridor transit trips, but additional strong markets occur to the north of the corridor and internally within both the eastern segment and the western segment (figure 11). The average trip length in 2035 is projected to be 5.9 miles on line 4-Division and 6.4 miles for line 9-Powell.

Figure 10. Projected 2035 corridor home-based work transit trips



	1	2	3	4	5	6	7	8	9	10	11
2	30%	4%	4%	3%	24%	5%	6%	7%	15%	0%	4%
3	29%	6%	3%	4%	27%	8%	5%	8%	8%	0%	2%
4	24%	5%	6%	5%	29%	11%	3%	7%	6%	0%	3%

Figure 11. Projected 2035 transit trips – all purposes



	1	2	3	4	5	6	7	8	9	10	11
2	27%	10%	6%	2%	27%	4%	7%	5%	10%	0%	2%
3	19%	8%	8%	5%	28%	10%	5%	10%	5%	0%	1%
4	15%	5%	10%	12%	25%	19%	3%	7%	4%	0%	2%

For more detailed maps illustrating projected travel patterns for transit trips specifically on lines 4-Division and 9-Powell, refer to Appendix 6.

Section 4: Considerations for Transit Investment in the Corridor

High capacity transit mode options

There are four different mode options under consideration for future transit investment in the Powell-Division corridor: light rail, rapid streetcar, dedicated busway, and frequent service plus bus. Each mode has a range of advantages and disadvantages based on cost, time to build, carrying capacity, and right-of-way impacts (figure 12).

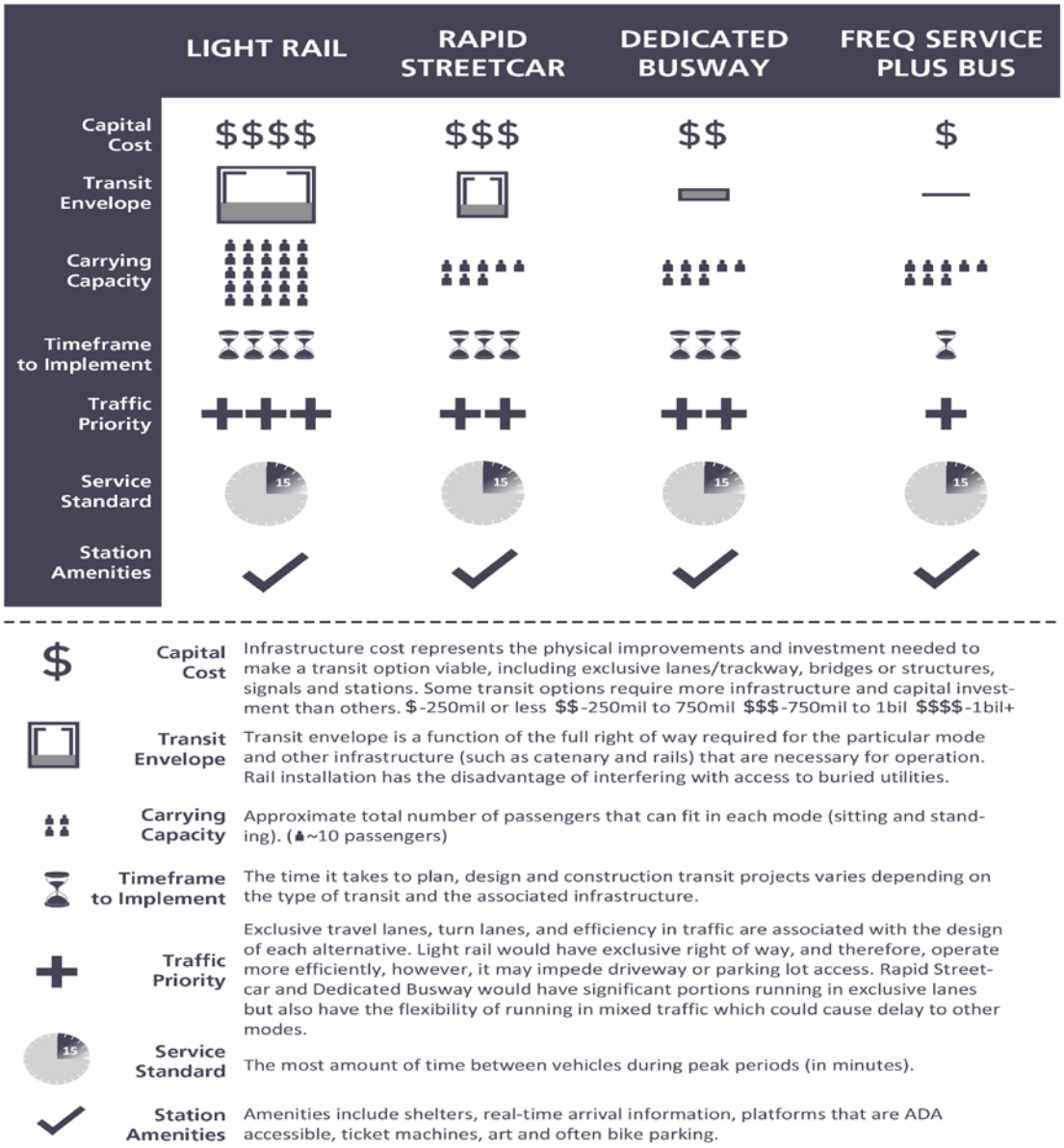
Light rail would run entirely in dedicated lanes and provide the highest carrying capacity of the four modes (266 passengers), but would also be the most costly, have the greatest right-of-way impacts, and require the longest time to plan, design, and construct. Rapid streetcar would run mostly in dedicated lanes with a slightly narrower footprint than light rail, but would be more expensive than either of the bus options with approximately the same carrying capacity (81 passengers). Like streetcar, dedicated busway would operate mostly in exclusive right-of-way and with a carrying capacity of about 80, but would be less costly to plan, design, and construct. Frequent service plus bus would provide the same carrying capacity as streetcar and dedicated busway, but would operate mostly in shared automobile travel lanes.

All four mode options would include upgraded station amenities, including shelters, real-time arrival information, ADA-accessible platforms, ticket machines, art, and often bike parking. Stations would be spaced approximately ½ mile apart for streetcar and ½ to 1 mile apart for all other modes, both of which would provide significant travel time savings over the current bus routes with more closely spaced stops. All modes would feature other improvements to decrease travel time, such as signal priority at stop lights where available.

Right-of-way constraints

In planning new transit investments in the corridor it is important to maximize use of the existing infrastructure while minimizing impacts to residences, utilities, businesses, and the roadway network. Because Powell Boulevard and Division Street both run through already developed communities, there are several areas with limited available right-of-way to expand the roadway width. The most physically constrained area of the corridor is along inner SE Division Street between SE 12th Avenue and SE 59th Avenue, where existing curb-to-curb right-of-way is as narrow as 36 feet with only one travel lane and one parking lane in each direction. In contrast, there are other segments of outer Division and Powell as wide as 80 feet from curb to curb, where the roadway includes two travel lanes in each direction, bike lanes, parking, and a turn lane.

Figure 12. Transit modes comparison



Appendices

Appendix 1: Service Frequency (headways)

The service frequency table shows the current weekday, Saturday, and Sunday headways for lines 4 and 9. During the weekday AM and PM peaks, line 4 buses run approximately every 8-9 minutes and line 9 buses run every 12-13 minutes. Midday service during the week runs about every 15 minutes for both the 4 and the 9. Both lines have less frequent service on the weekends, with minimum headways of 15 minutes for line 4 and 21 minutes for line 9.

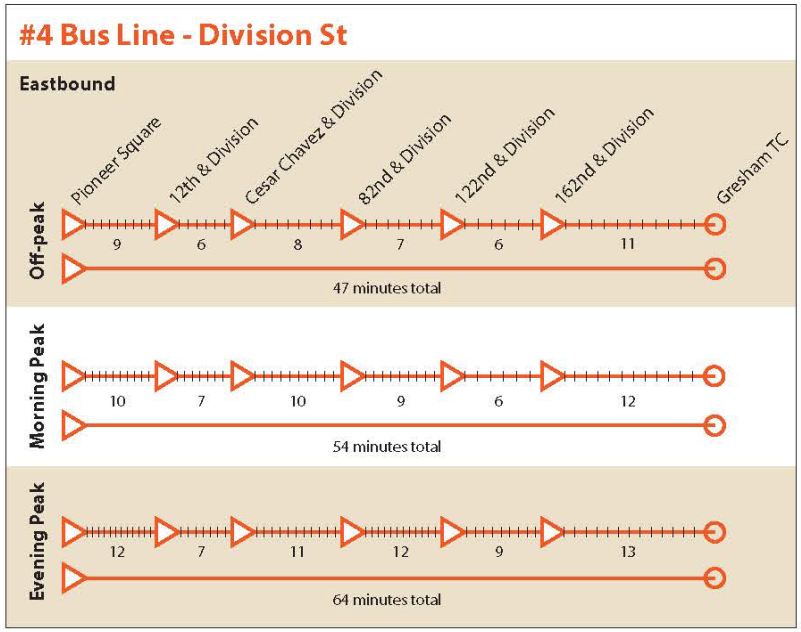
	Weekdays		Saturdays		Sundays	
	Line 4	Line 9	Line 4	Line 9	Line 4	Line 9
4-5am	27	30	60	52	58	53
5-6	20	16	53	44	60	44
6-7	8	14	30	22	60	44
7-8	9	13	30	22	40	22
8-9	11	13	19	22	20	22
9-10	13	13	17	22	20	22
10-11	15	15	15	22	20	22
11-12	15	15	15	22	18	22
12-1pm	15	15	15	22	15	22
1-2	15	14	15	22	15	22
2-3	14	13	15	22	15	22
3-4	11	12	15	22	15	22
4-5	9	12	15	22	15	22
5-6	9	12	15	21	18	21
6-7	9	12	15	21	19	21
7-8	13	14	20	21	19	21
8-9	15	18	20	21	19	21
9-10	20	19	20	21	39	21
10-11	20	29	29	21	39	21
11-12	29	29	29	22	39	22
12-1am	29	28	33	29	47	29
1-2	37	28	40	33	62	32
2-3	63	28	61	35	62	-

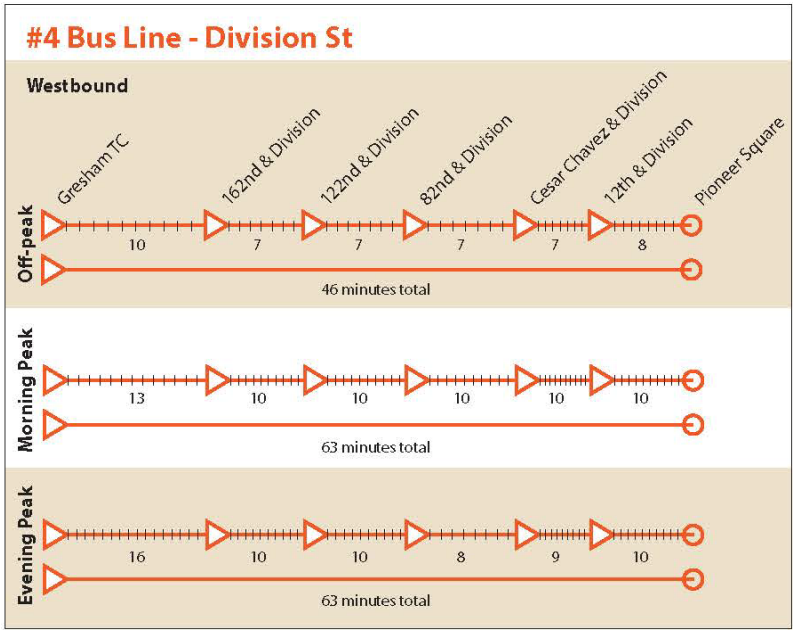
Appendix 2: Passenger Loads

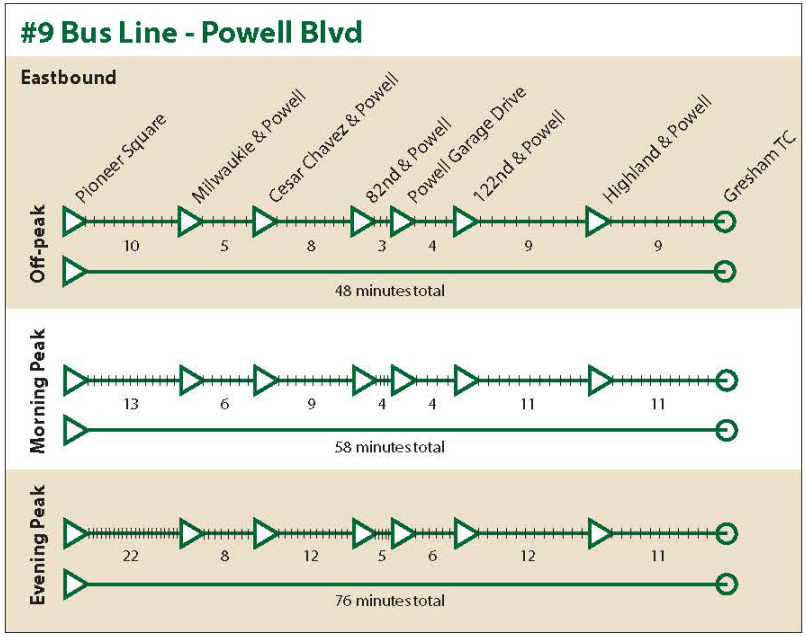
The passenger loads table illustrates the times and locations of high passenger loads for both bus lines.

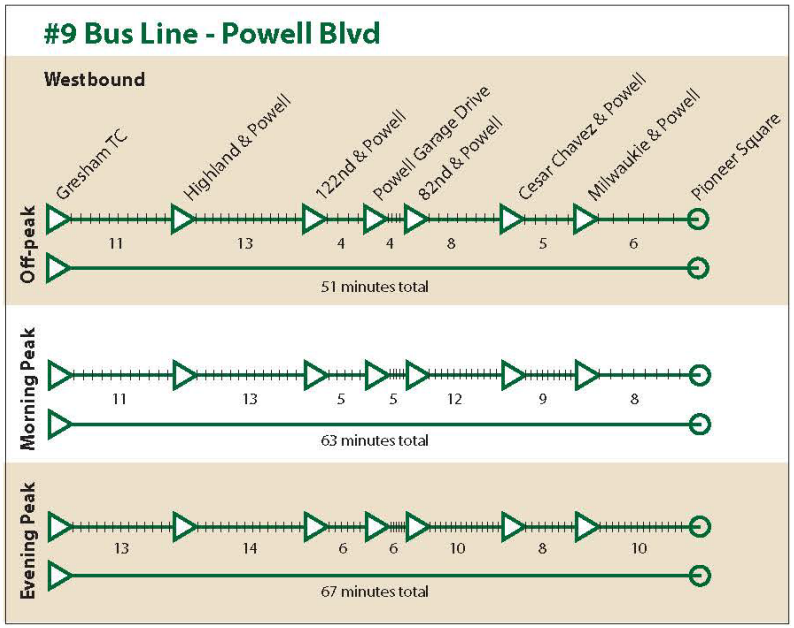
Route	Direction	Span	Time Segment	Existing Headway	Highest load segments	Add. load comments
Line 4	Westbound (Leaving Gresham during the Peak Hour)	AM Peak	6:30am-7:30am	3.75	SE Division/Cesar Chavez Blvd & Hawthorne Bridge; SE Division/76th-60th; SE Division/122nd-98th;	
		PM Peak	3:30pm-4:30pm	15	SE Division/122nd-98th; SE Division/34th - Hawthorne Bridge;	
	Eastbound (Leaving North Portland during peak hour)	AM Peak	7:00am-8:00am	7.5 - 15	Hawthorne Bridge	
		PM Peak	4:15pm-4:30pm	3.75 - 7.5	Hawthorne Bridge - SE Division/33rd; SE Division/I-205 - 138th;	Crush Loads
			4:30pm-4:45pm			Approaching Capacity
			4:45pm-5:00pm			Approaching Capacity
			5:00pm-5:15pm			
Line 9	Westbound (Leaving Gresham during peak hour)	AM Peak	6:30am-6:45am	5 - 15	SE Powell/43rd - 9th	
			6:45am-7:00am			
			7:00am-7:15am			
			7:15am-7:30am			Crush Load/Overload
		PM Peak	4:00pm-5:00pm	7.5 - 15	SE Powell/24th - 21st; SE Powell/Powell Garage Dr;	
	Eastbound (Leaving DT in the peak hour)	AM Peak	7:00am-8:00am	7.5 - 15	SE Powell/Milwaukie - 24th	
		PM Peak	4:15pm-5:15pm	5 - 7.5	Ross Island Bridge - SE Powell/Milwaukie; SE Powell & 21st - 28th Pl;	

Appendix 3: Transit Travel Times









Appendix 4: On-time performance needs by time of day

The Time of Day Performance Report shows performance of both bus lines. For line 4-Division, on-time performance drops below 80% in both directions in the PM peak. For line 9-Powell, on-time performance drops below 80% in the outbound direction during the PM peak.

Time of Day Performance Report - Weekdays - Spring 2014

Route Number	Route Name	direction	Time of Day	Daily Trips	On-Time	Early	Late	Scheduled Headway	Headway Adherence	Excess Wait (min.)
4	Division/Fessenden	Inbound	Early AM	10	86%	5%	9%	16:29	94%	2:22
4	Division/Fessenden	Inbound	AM Peak	17	77%	5%	18%	9:04	73%	1:16
4	Division/Fessenden	Inbound	Midday	30	72%	5%	23%	13:56	79%	1:25
4	Division/Fessenden	Inbound	PM Peak	10	65%	4%	31%	11:41	69%	1:48
4	Division/Fessenden	Inbound	Night	25	80%	3%	17%	18:29	90%	0:52
4	Division/Fessenden	Outbound	Early AM	6	91%	4%	5%	22:36	99%	0:15
4	Division/Fessenden	Outbound	AM Peak	10	80%	5%	15%	11:25	82%	1:02
4	Division/Fessenden	Outbound	Midday	29	74%	7%	19%	14:32	85%	1:02
4	Division/Fessenden	Outbound	PM Peak	17	70%	4%	26%	8:52	65%	2:12
4	Division/Fessenden	Outbound	Night	24	79%	4%	17%	19:11	87%	1:22
9	Powell Blvd	Inbound	Early AM	6	96%	2%	2%	17:01	99%	0:09
9	Powell Blvd	Inbound	AM Peak	15	87%	5%	8%	10:31	87%	0:40
9	Powell Blvd	Inbound	Midday	30	89%	5%	6%	14:45	95%	0:27
9	Powell Blvd	Inbound	PM Peak	8	88%	4%	8%	17:16	93%	0:35
9	Powell Blvd	Inbound	Night	19	81%	4%	15%	25:50	96%	0:44
9	Powell Blvd	Outbound	Early AM	5	90%	4%	6%	23:33	100%	0:13
9	Powell Blvd	Outbound	AM Peak	9	88%	4%	8%	16:04	95%	0:28
9	Powell Blvd	Outbound	Midday	33	79%	7%	14%	13:41	88%	0:51
9	Powell Blvd	Outbound	PM Peak	16	65%	9%	25%	8:58	70%	1:48
9	Powell Blvd	Outbound	Night	20	75%	6%	18%	21:50	95%	0:42

Appendix 5: Analysis of Oregon Household Activity Survey walk data

OHAS Transit Walk Analysis Nov 2013

November 15, 2013

Current Model Assumptions:

Coverage Buffer Dist:	0.20 mi (bus)
	0.35 mi (streetcar
	0.50 mi (MAX / WES)
Walk link dist:	0.13 mi (typical)
	0.26 mi (long walk)

OHAS Findings (Unweighted Obs):

1. Distances calculated between reported trip origin / destination and reported boarding / alighting stops
2. Distance units in decimal miles
3. Straight-Line Distance is euclidean distance between reported walk trip segment endpoints
4. Route Distance is result of walk trip segment assigned to GIS pedestrian network between reported or inferred endpoints.

* Small sample size ... use with caution

Walk to/from Transit - All Purposes and Submodes	n=3532 Route Dist	n=3517 Straight-Line Dist
MEAN	0.276	0.208
25th Percentile	0.096	0.073
MEDIAN	0.190	0.145
60th Percentile	0.246	0.187
70th Percentile	0.315	0.235
75th Percentile	0.356	0.262
80th Percentile	0.409	0.289
85th Percentile	0.480	0.348
90th Percentile	0.602	0.441
95th Percentile	0.807	0.600
99th Percentile	1.376	1.041

Walk between Home and Transit - All Submodes	n=1165 Route Dist	n=1157 Straight-Line Dist
MEAN	0.360	0.268
25th Percentile	0.130	0.094
MEDIAN	0.260	0.190
75th Percentile	0.455	0.314
85th Percentile	0.623	0.458
90th Percentile	0.760	0.579
95th Percentile	1.021	0.755
99th Percentile	1.743	1.593

Walk between NonHome and Transit - All Submodes	n=1198 Route Dist	n=1993 Straight-Line Dist
MEAN	0.240	0.182
25th Percentile	0.084	0.067
MEDIAN	0.176	0.132
75th Percentile	0.318	0.240
85th Percentile	0.434	0.307
90th Percentile	0.499	0.374
95th Percentile	0.675	0.531
99th Percentile	1.207	0.920

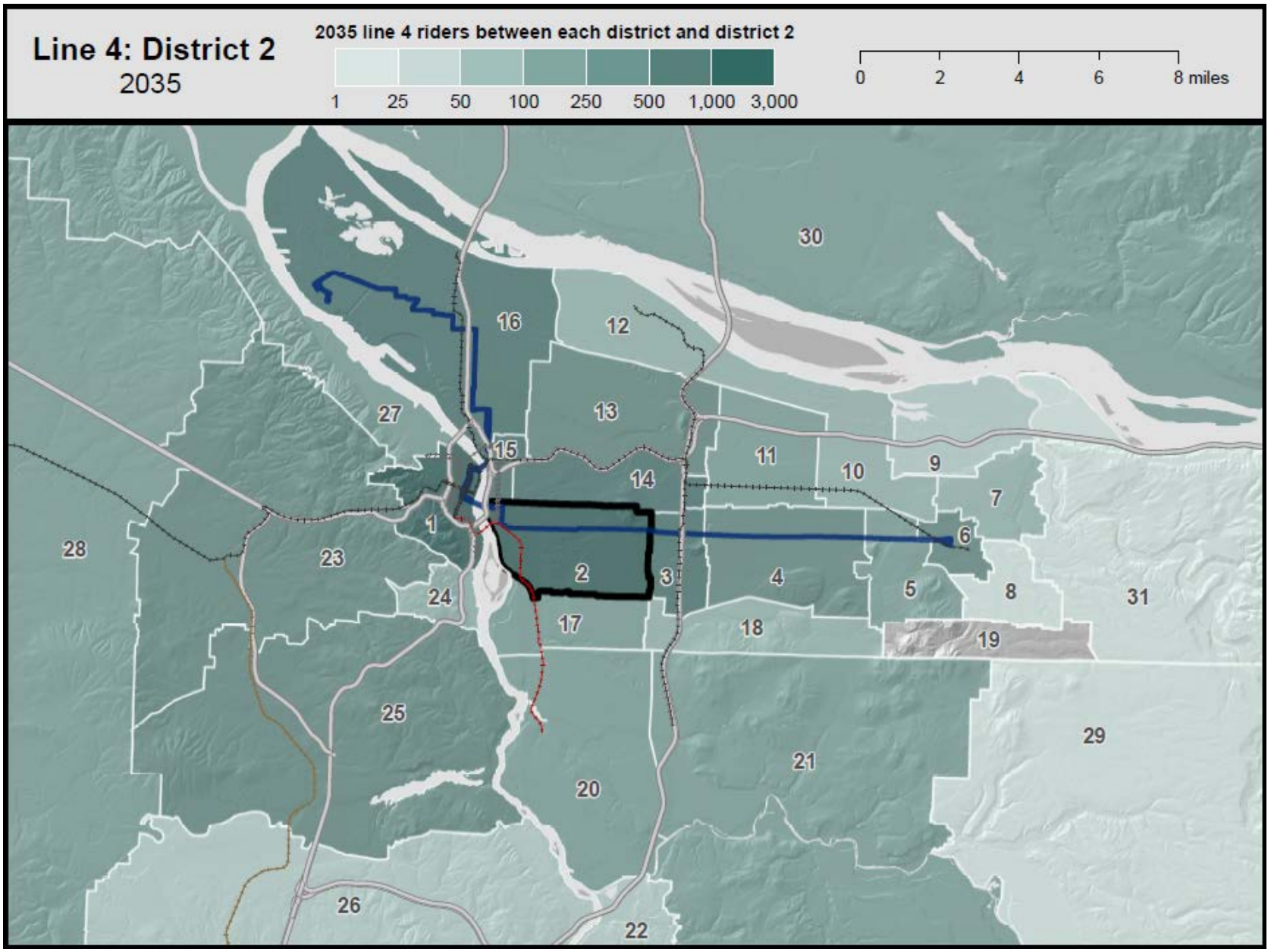
Walk to/from Local Bus (TM & CT)	n=728 Route Dist	n=722 Straight-Line Dist
MEAN	0.273	0.198
25th Percentile	0.091	0.072
MEDIAN	0.190	0.138
75th Percentile	0.355	0.246
85th Percentile	0.483	0.314
90th Percentile	0.590	0.414
95th Percentile	0.762	0.535
99th Percentile	1.370	1.019

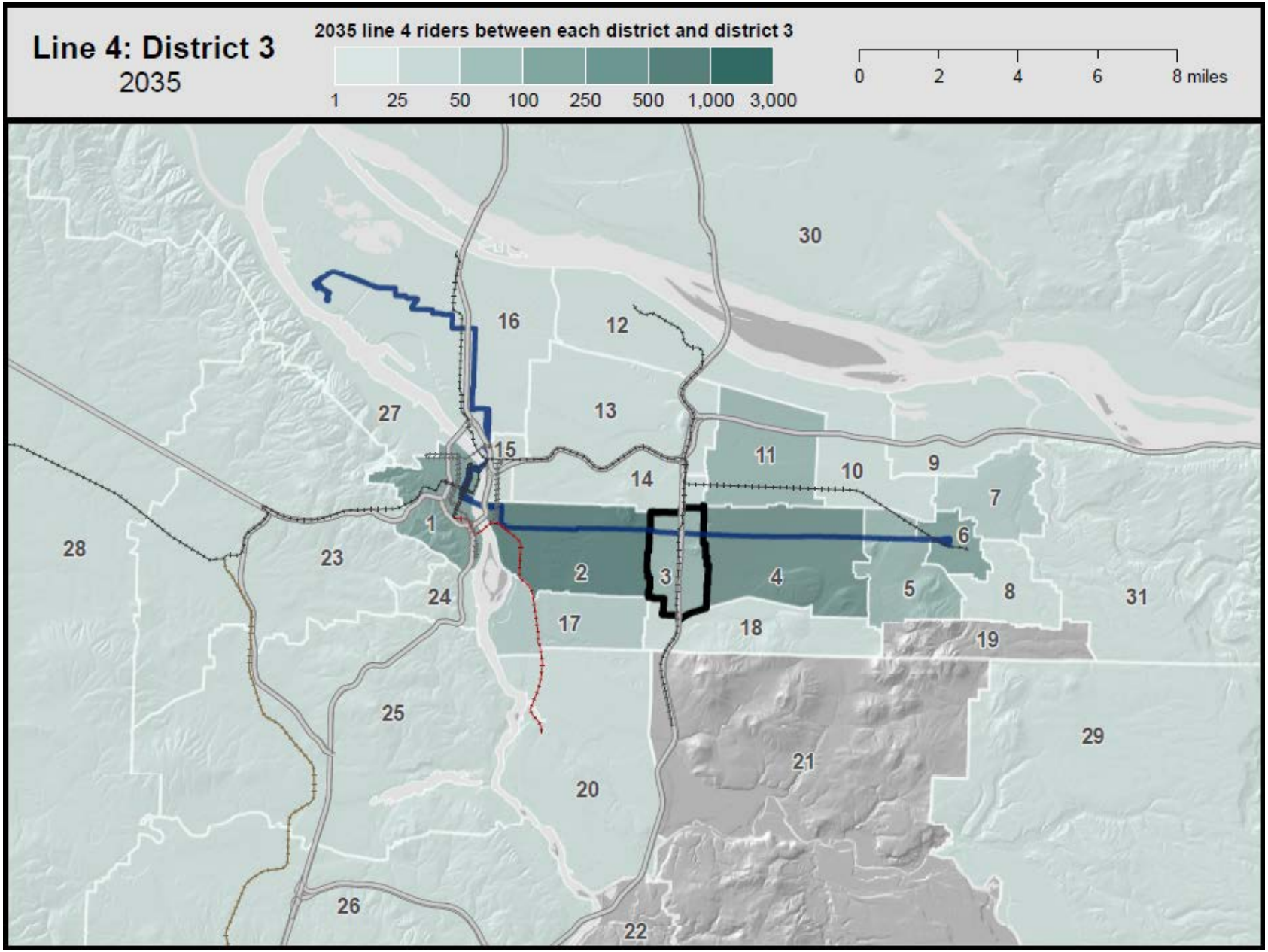
Walk to/from TriMet Frequent Bus	n=600 Route Dist	n=597 Straight-Line Dist
MEAN	0.230	0.175
25th Percentile	0.076	0.062
MEDIAN	0.164	0.122
75th Percentile	0.330	0.256
85th Percentile	0.411	0.307
90th Percentile	0.497	0.373
95th Percentile	0.645	0.505
99th Percentile	0.931	0.708

Walk to/from MAX / WES	n=607 Route Dist	n=606 Straight-Line Dist
MEAN	0.326	0.256
25th Percentile	0.120	0.089
MEDIAN	0.217	0.169
75th Percentile	0.382	0.292
85th Percentile	0.561	0.404
90th Percentile	0.744	0.576
95th Percentile	1.021	0.748
99th Percentile	1.578	1.318

Walk between Home and MAX / WES	n=231 Route Dist	n=230 Straight-Line Dist
MEAN	0.563	0.425
25th Percentile	0.271	0.211
MEDIAN	0.432	0.280
75th Percentile	0.724	0.559
85th Percentile	0.963	0.696
90th Percentile	1.152	0.908
95th Percentile	1.382	1.230
99th Percentile	2.783	2.218

Appendix 6: Projected 2035 corridor travel patterns for lines 4-Division and 9-Powell




Line 4: District 3
2035
2035 line 4 riders between each district and district 3
1
25
50
100
250
500
1,000
3,000
0
2
4
6
8 miles
30
16
12
27
13
15
11
10
9
14
7
1
6
28
23
2
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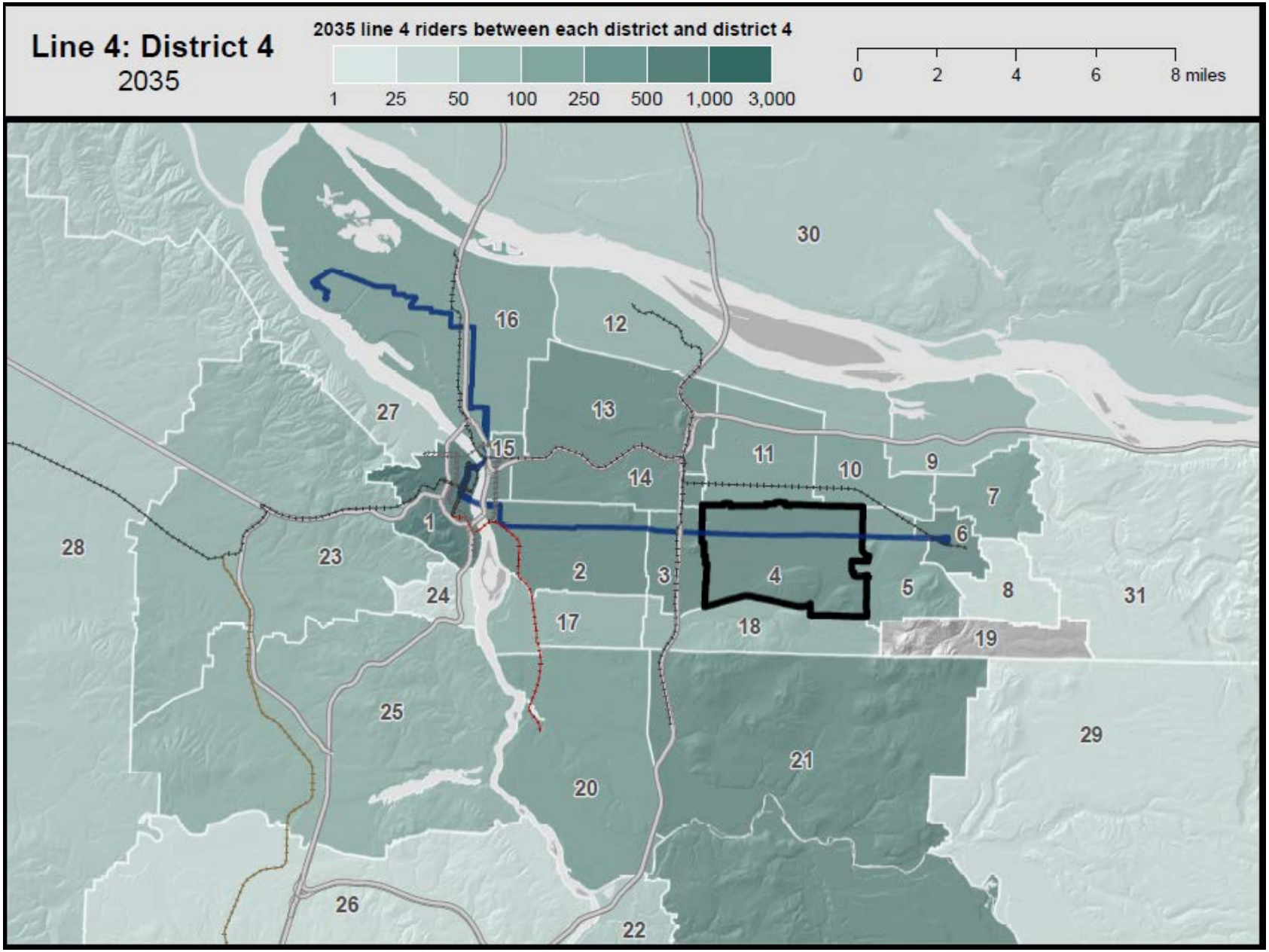
4
5
8
31
24
17
18
19
25
29
21
20
26
22


Line 4: District 4
2035
2035 line 4 riders between each district and district 4
1
25
50
100
250
500
1,000
3,000
0
2
4
6
8 miles
30
16
12
27
13
15
11
10
9
14
7
1
6
28
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2
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17
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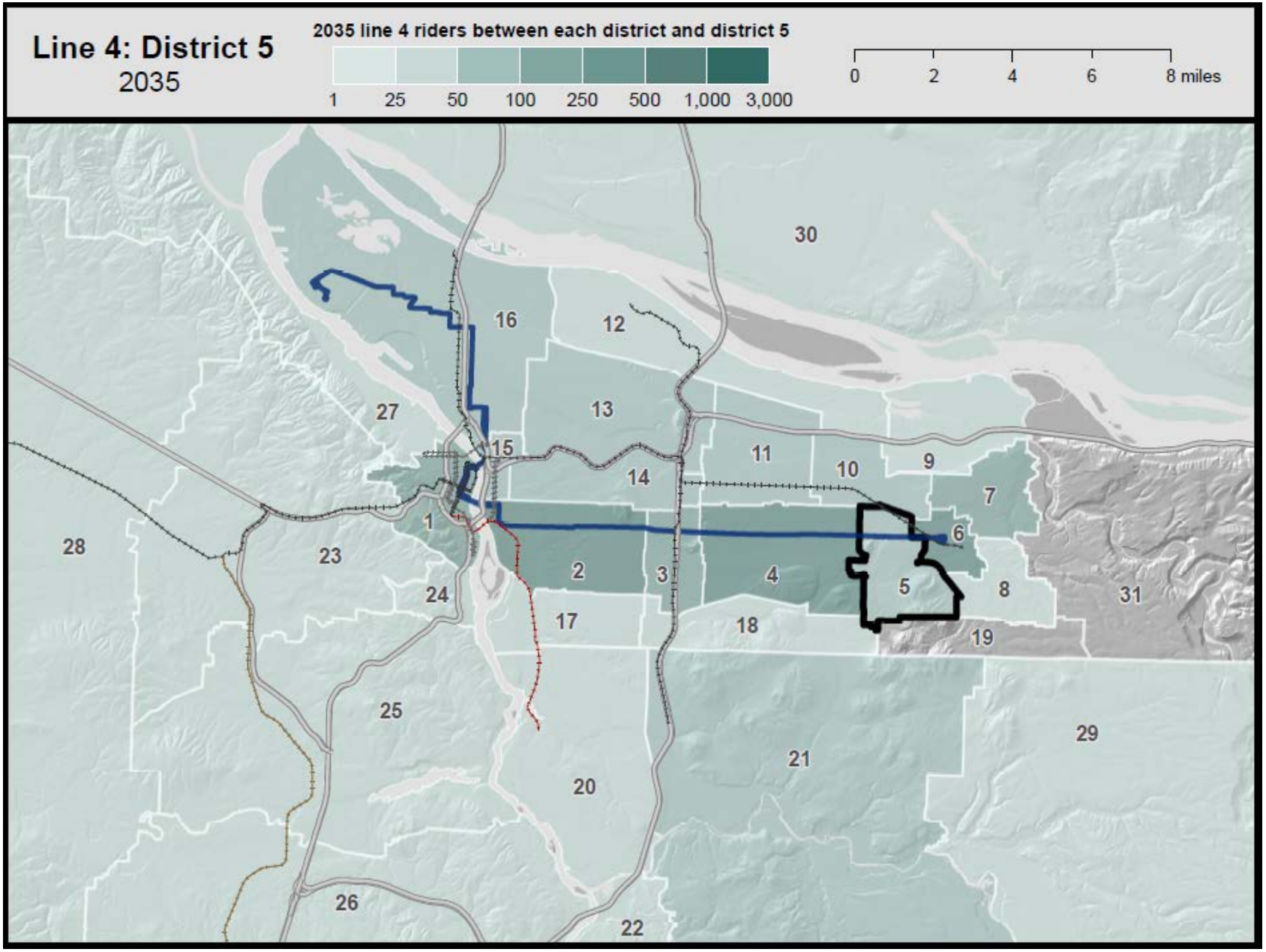
20
26
22


Line 4: District 5
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2035 line 4 riders between each district and district 5
1
25
50
100
250
500
1,000
3,000
0
2
4
6
8 miles
30
16
12
27
13
15
11
10
9
14
7
1
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28
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8
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24
17
18
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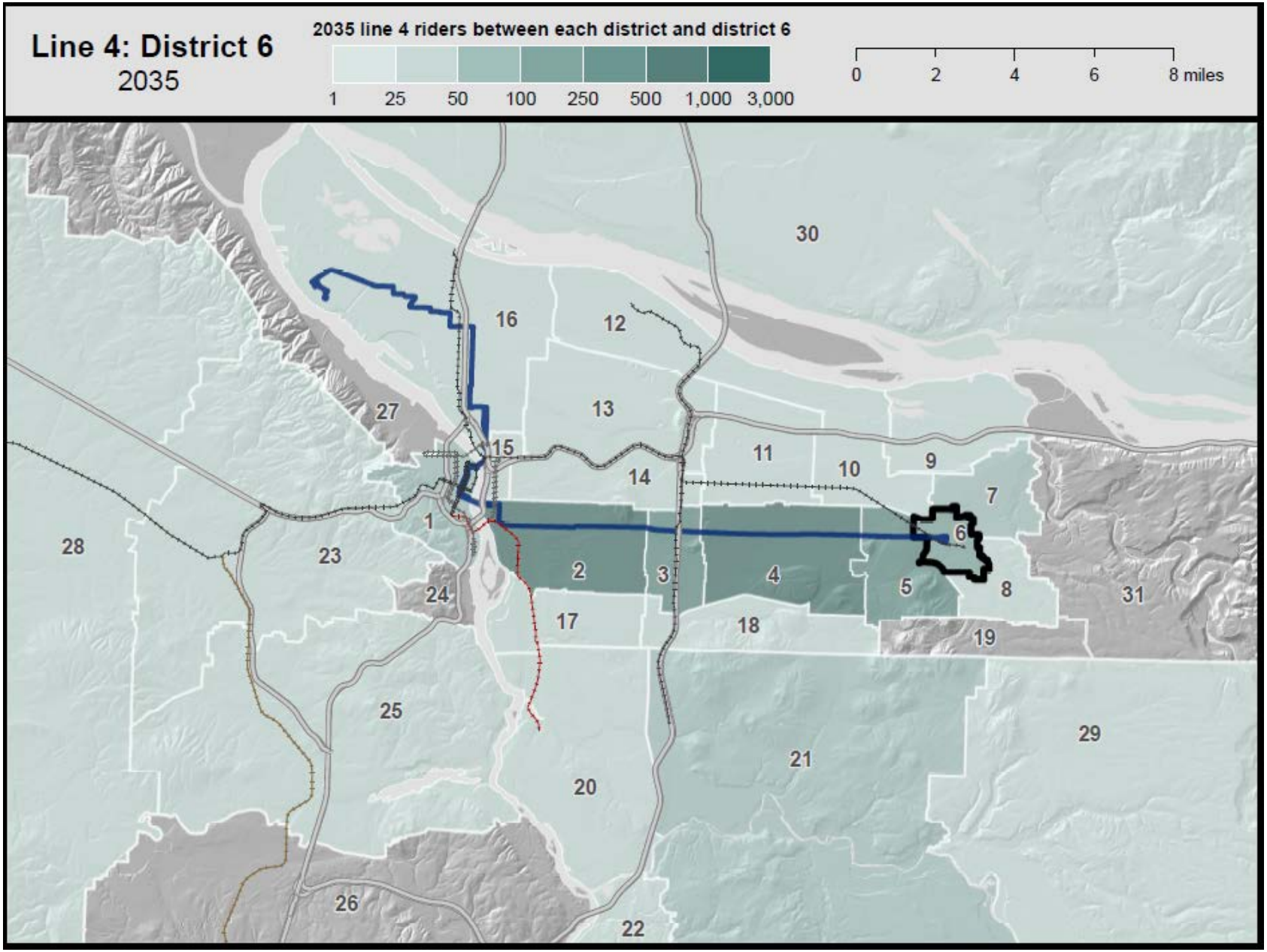
25
29
21
20
26
22


Line 4: District 6
2035
2035 line 4 riders between each district and district 6
1
25
50
100
250
500
1,000
3,000
0
2
4
6
8 miles
30
16
12
27
13
15
11
10
9
14
7
1
6
28
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2
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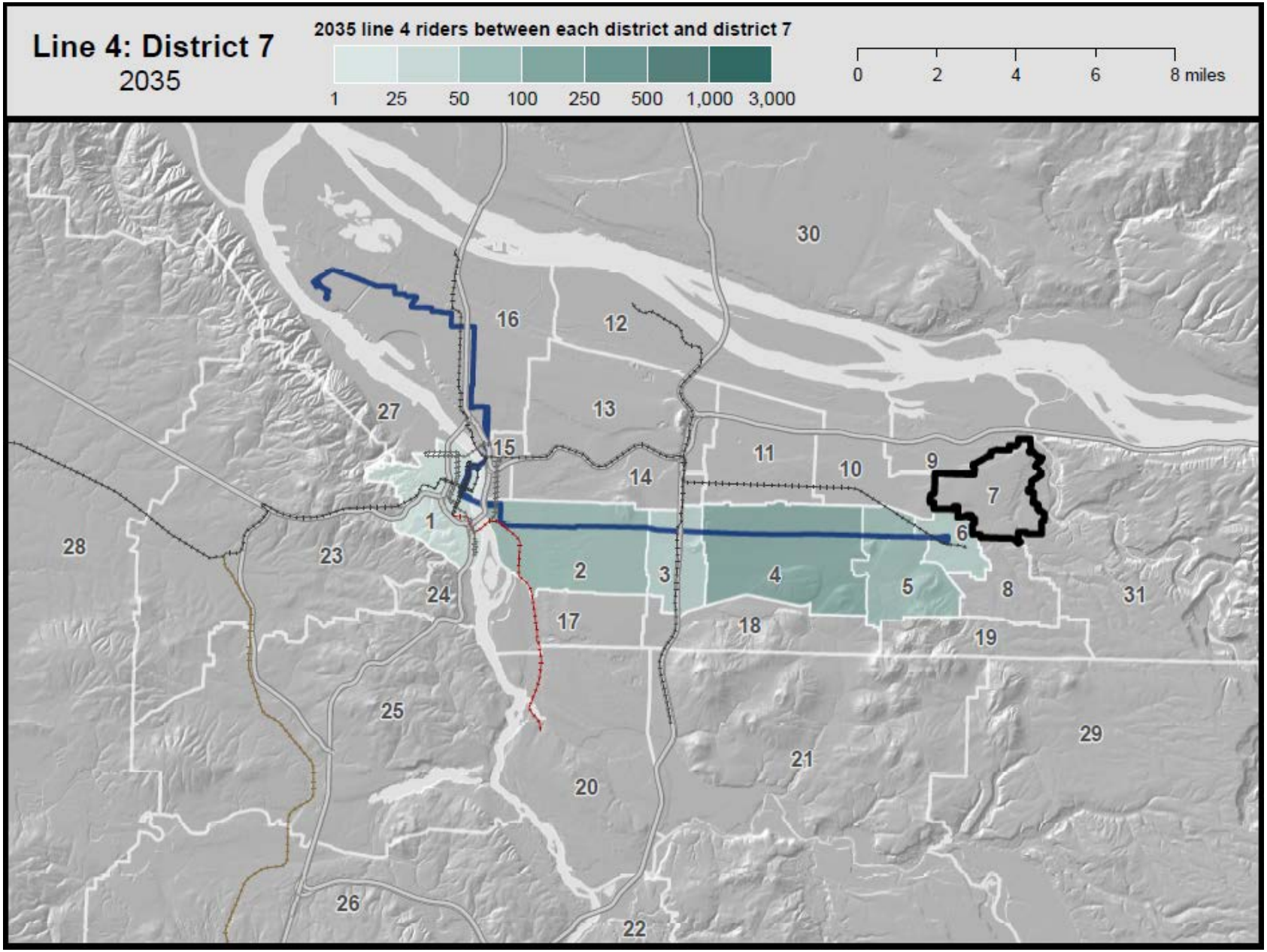
26
22


Line 4: District 7
2035
2035 line 4 riders between each district and district 7
1
25
50
100
250
500
1,000
3,000
0
2
4
6
8 miles
30
16
12
27
13
15
11
10
9
7
14
1
6
28
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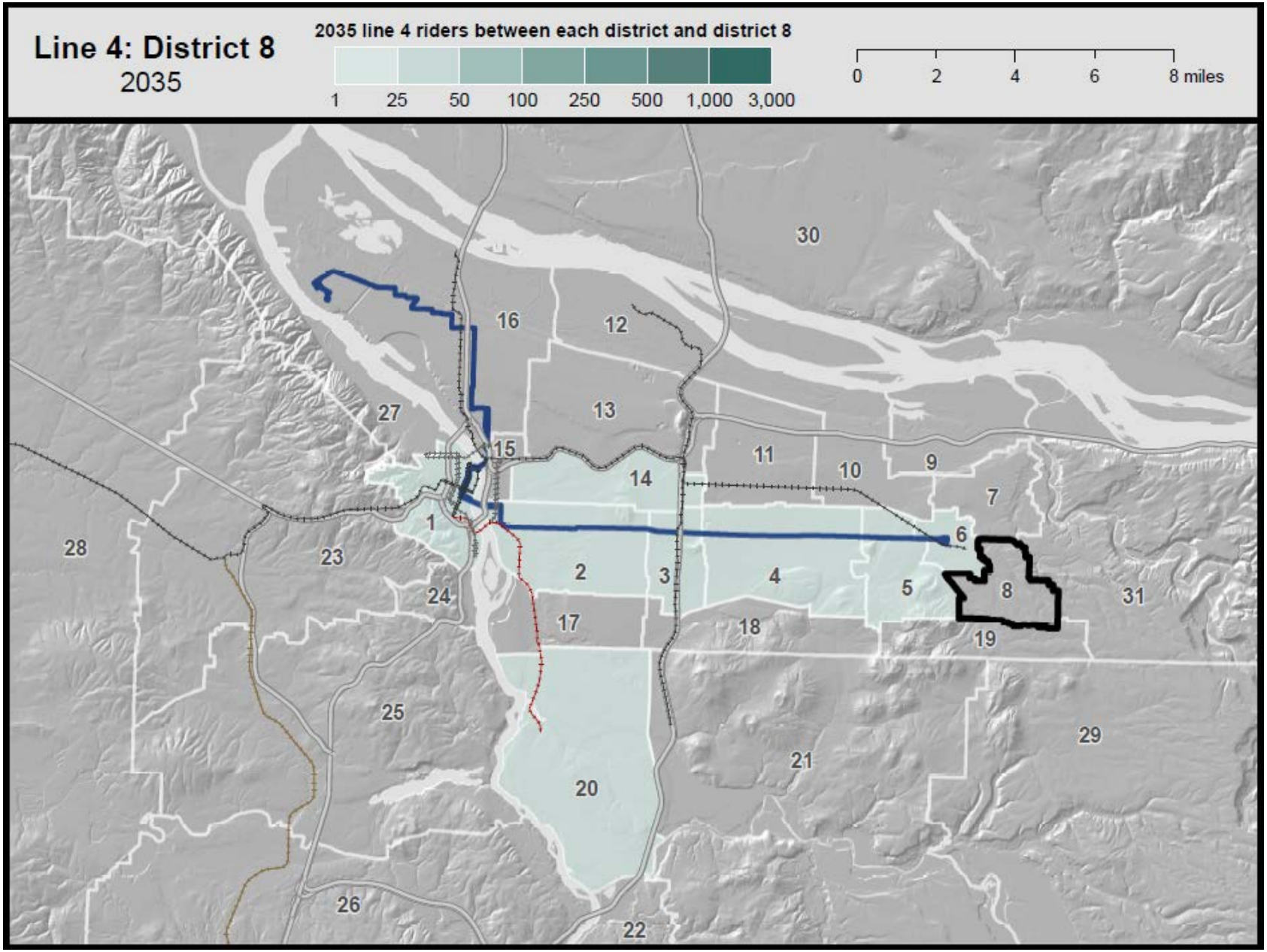
Line 4: District 8
2035
2035 line 4 riders between each district and district 8
1
25
50
100
250
500
1,000
3,000
0
2
4
6
8 miles
30
16
12
27
13
15
11
10
9
14
7
1
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23
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29
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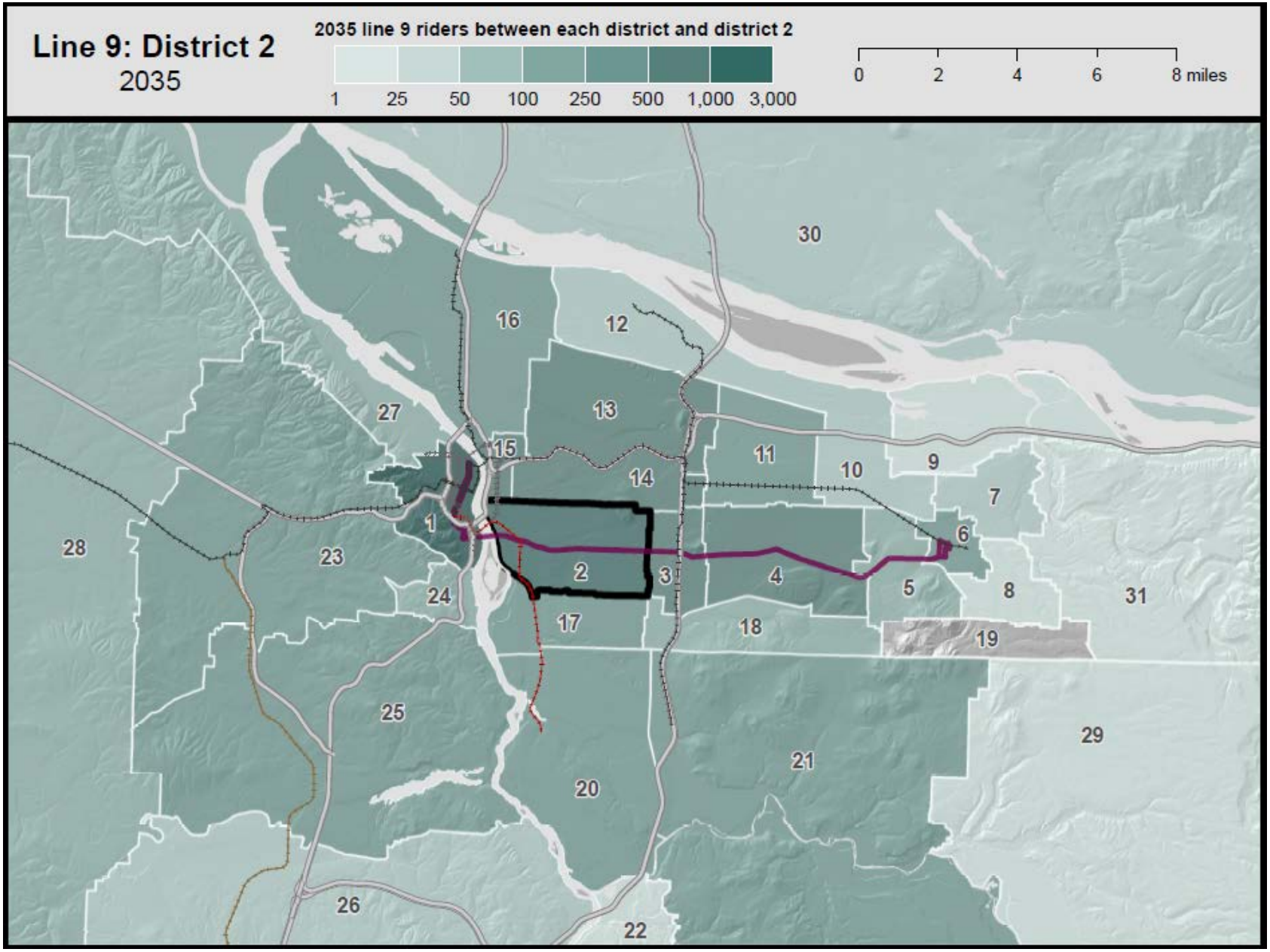
26
22


Line 9: District 2
2035
2035 line 9 riders between each district and district 2
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25
50
100
250
500
1,000
3,000
0
2
4
6
8 miles
30
16
12
27
13
15
11
10
9
14
7
1
6
28
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2
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8
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24
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19
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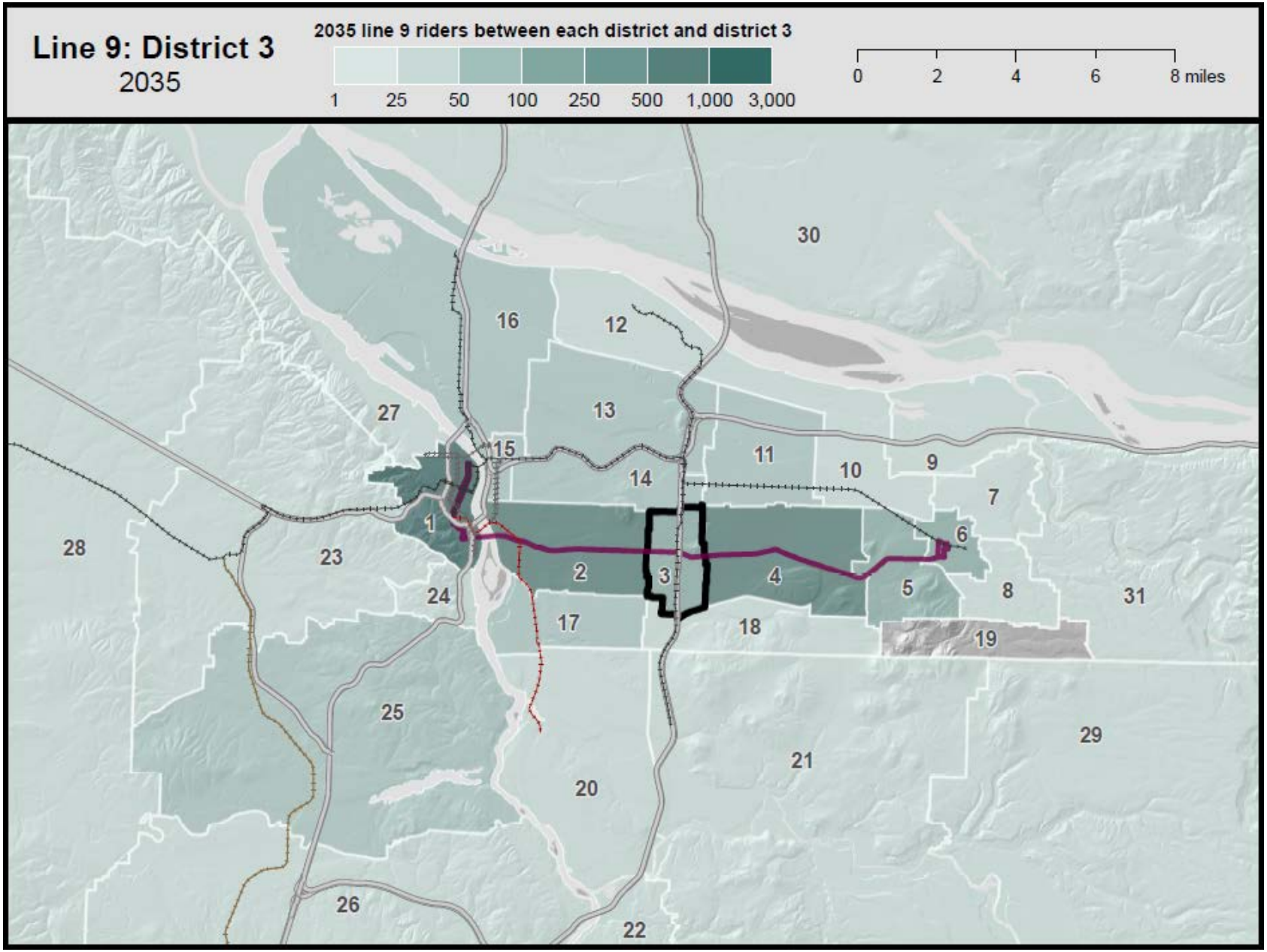
26
22


Line 9: District 3
2035
2035 line 9 riders between each district and district 3
1
25
50
100
250
500
1,000
3,000
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2
4
6
8 miles
30
16
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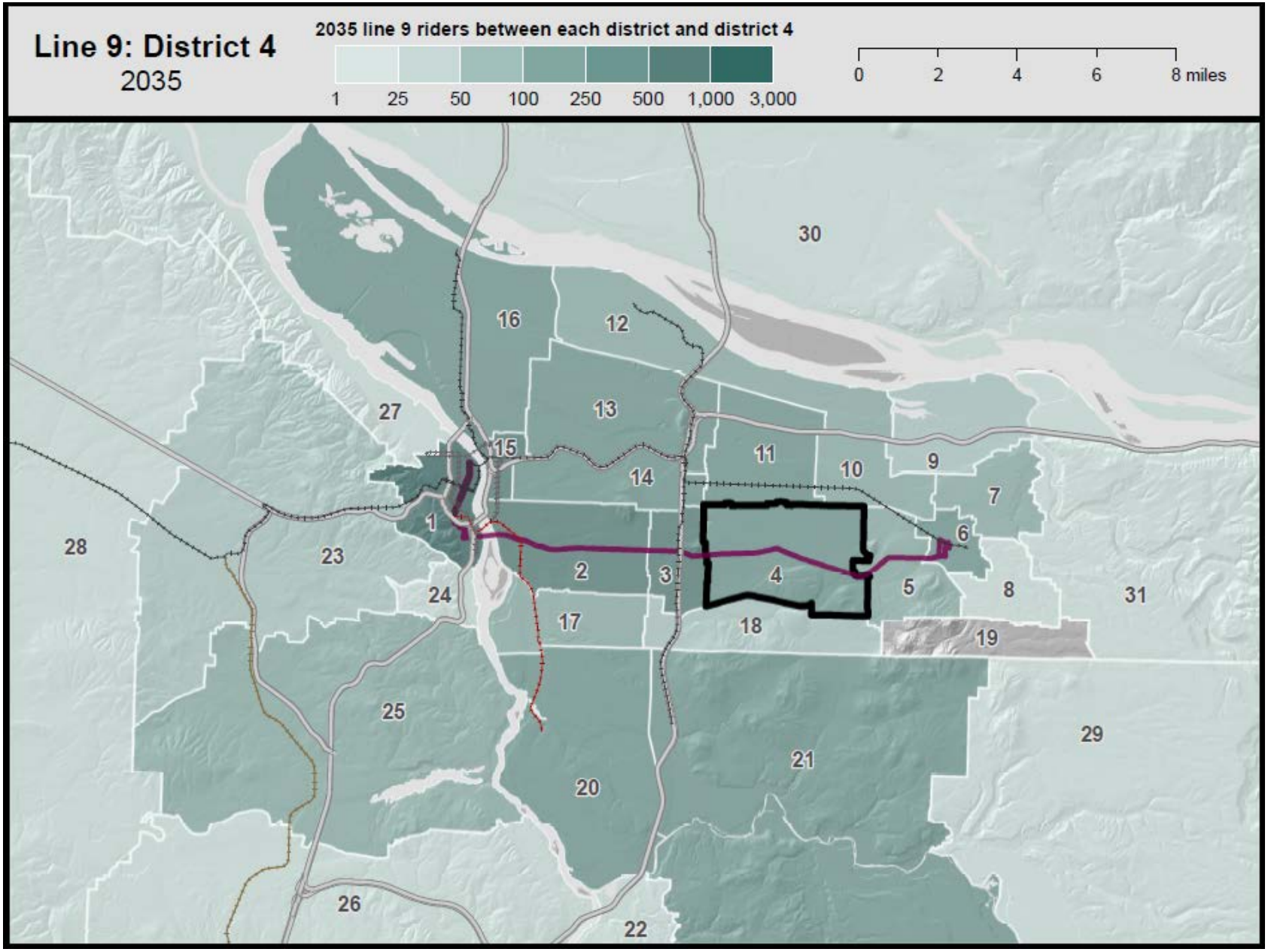
Line 9: District 4
2035
2035 line 9 riders between each district and district 4
1
25
50
100
250
500
1,000
3,000
0
2
4
6
8 miles
30
16
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27
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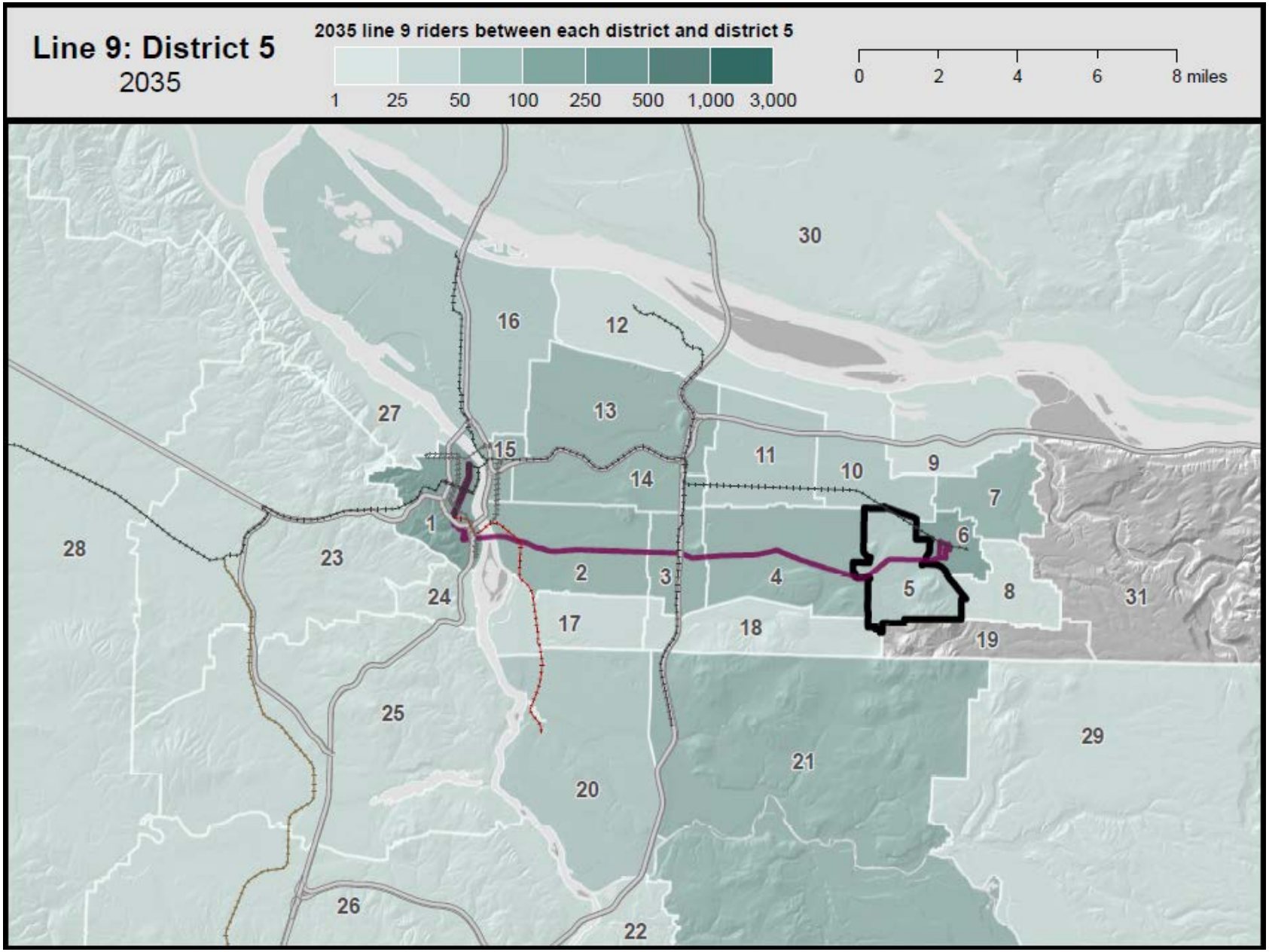
Line 9: District 5
2035
2035 line 9 riders between each district and district 5
1
25
50
100
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3,000
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8 miles
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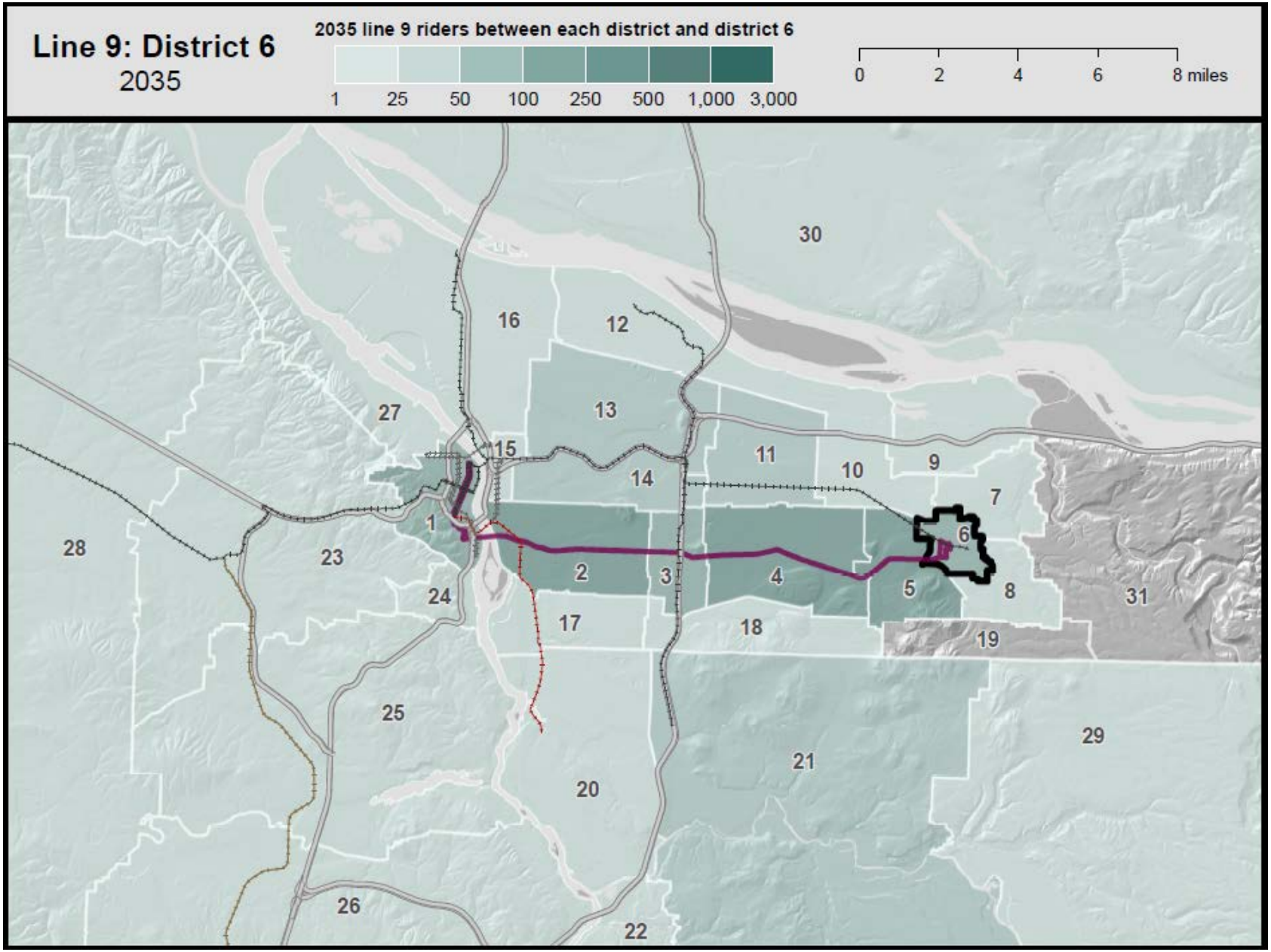
Line 9: District 6
2035
2035 line 9 riders between each district and district 6
1
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8 miles
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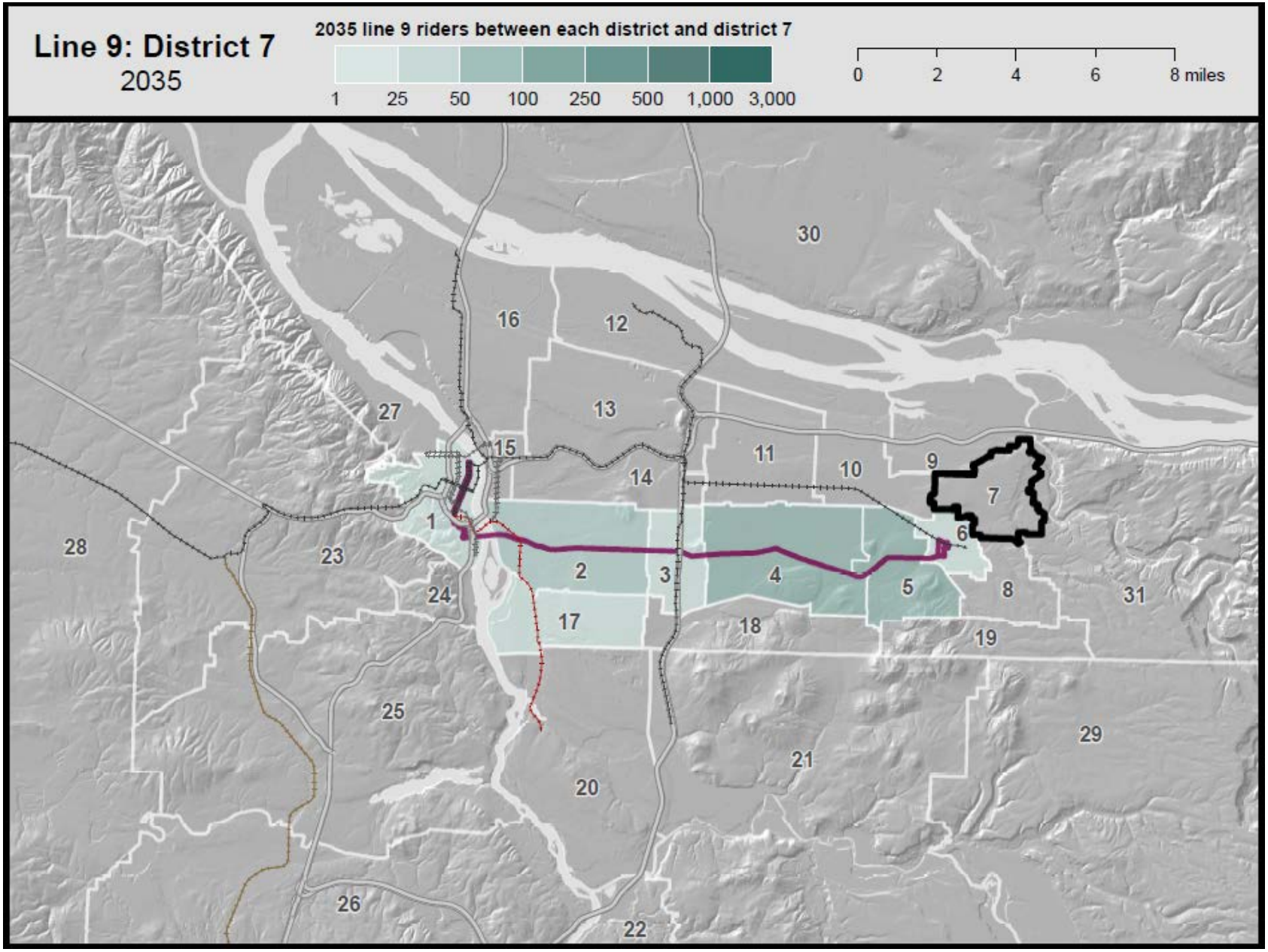
Line 9: District 7
2035
2035 line 9 riders between each district and district 7
1
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3,000
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8 miles
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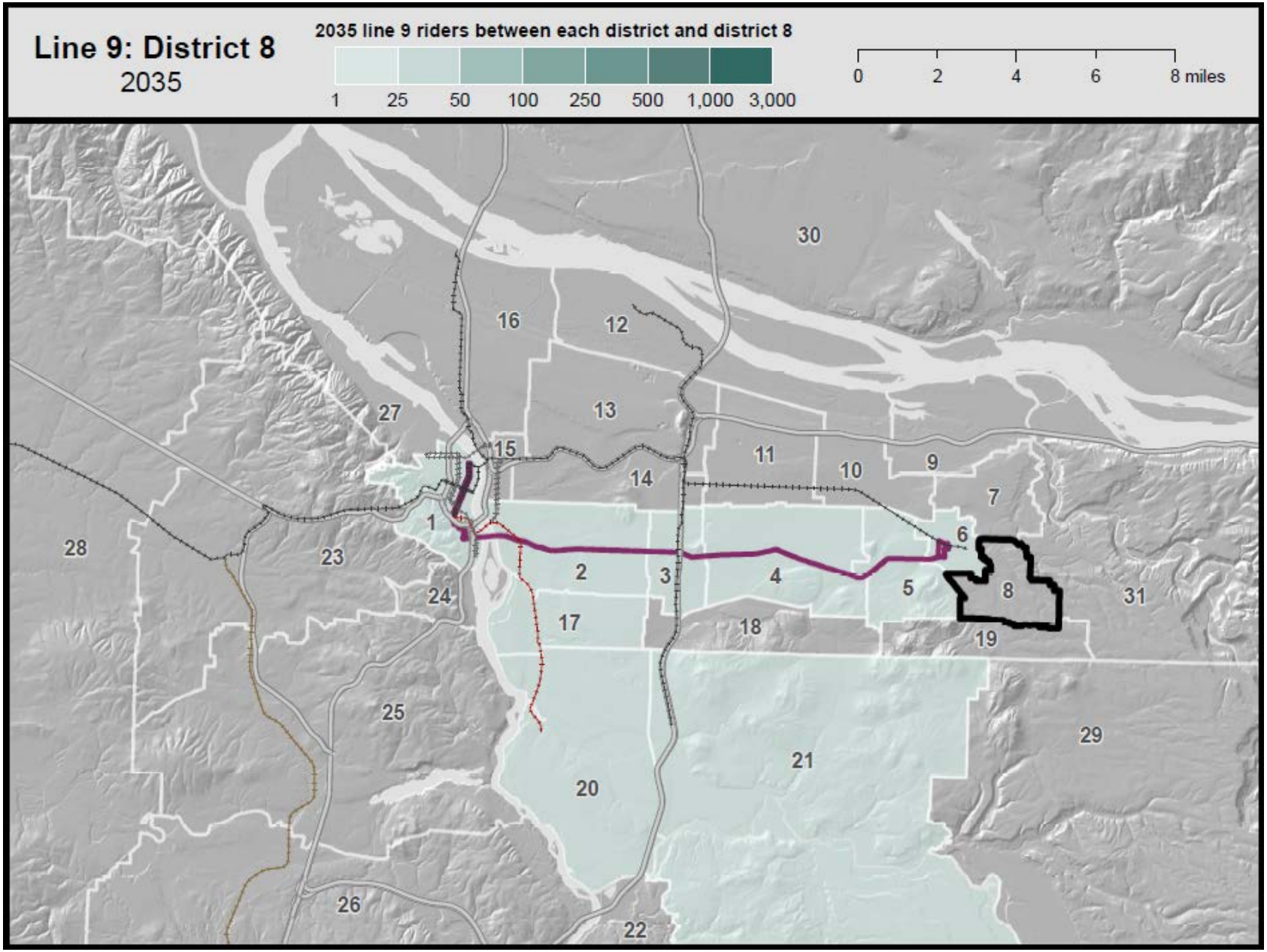
Line 9: District 8
2035
2035 line 9 riders between each district and district 8
1
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3,000
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8 miles
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Appendix 6: Travel time toolbox

DRIVING	CONGESTION	QUEUE
	Bus lanes BAT lanes Parking control Access control	Queue jumps Bus lanes BAT lanes Signal Priority
SIGNAL	**MERGING**	**BOARDING**
Signal priority Queue jumps Bus lanes BAT lanes	Curb extensions Queue jumps Bus lanes BAT lanes	Station layout Reduce stops Multiple door boarding Electronic fare Curb extensions Low floor Optimize bike boarding Quick wheelchair berth