Seattle Department of Transportation

EXISTING AND FUTURE TRUCK MOBILITY AND ACCESS APPENDIX B

WSP | PARSONS BRINCKERHOFF

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BACKGROUND

This document summarizes existing and future conditions related to truck movement in and through the City of Seattle. It builds on broader economic trends affecting all modes of freight that were addressed in the Economy and Freight Technical memo[1]. This memo identifies current issues affecting truck mobility, including access to industrial lands, truck flows, gaps in the truck system, potential improvement needs and recent city actions that affect freight on city streets, particularly Major Truck Streets. It also projects future truck flows and resultant conditions and needs.

In order to augment the data collected and freight analysis conducted, and to better understand the key issues, needs and concerns of the freight community, SDOT conducted outreach efforts with representatives from the Duwamish Manufacturing & Industrial Center (MIC) and the Ballard-Interbay Northend Manufacturing & Industrial Center (BINMIC). These meetings, along with additional individual interviews and an online survey, were used to collect feedback on business concerns and solicit ideas on how freight mobility might be improved in Seattle. Results are documented in the "Online Survey - Summary of Feedback Received" and the "Stakeholder Interview Summary" documents, which are attached as Appendices A and B. Feedback related to existing conditions is included as appropriate throughout this technical memorandum.

MAJOR THEMES FROM STAKEHOLDERS

The online survey received 60 total responses. Key overall themes that emerged included:

- Congestion is cited as the number one challenge affecting urban goods delivery in the city.
- Business operations schedule are bound to customers' needs and there is often not flexibility to adjust deliveries to off-peak hours.
- Conflicts with other modes of traffic (predominantly bike traffic) and turning movements/curb radius are cited by over 50% of respondents as being the top safety concerns relating to freight mobility.
- Although the City's Major Truck Streets are sometimes used by two thirds of respondents, almost 40% didn't know the designations existed.
- Google maps is the most used resource for determining alternate routes, but City and state traffic cameras are also valuable.
- There is an underlying feeling of resentment among some towards the perception that the City is not giving freight traffic priority and that conditions are getting worse.

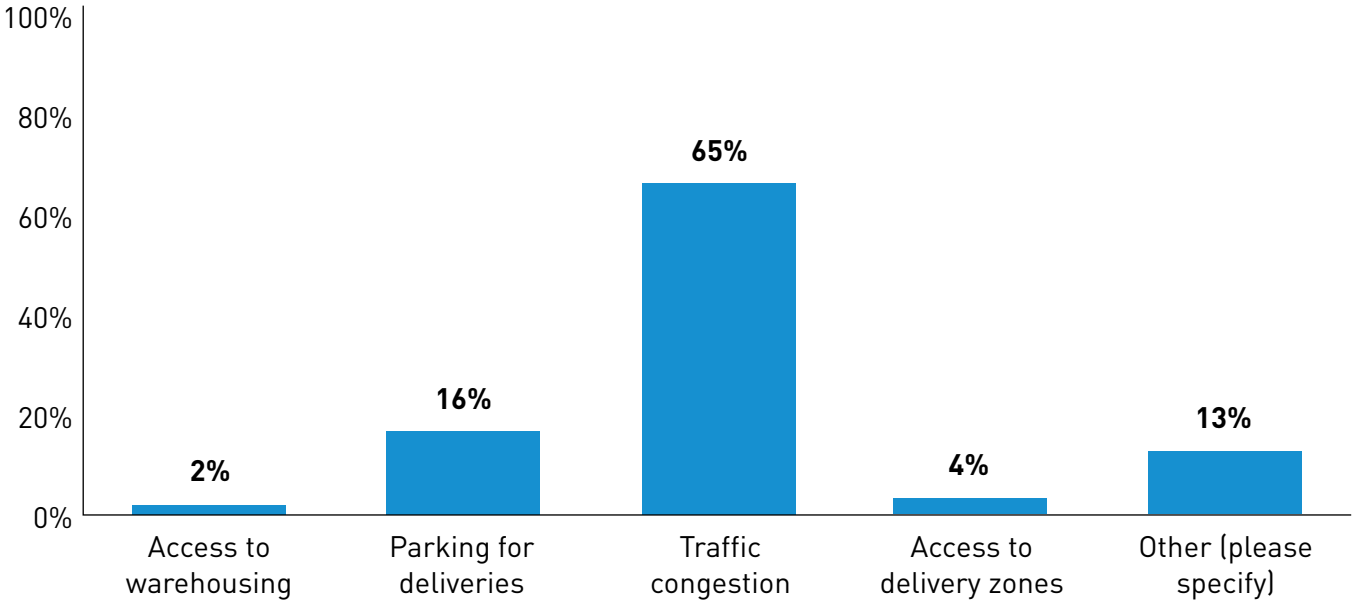
However, others believe that the challenges facing urban freight movements are simply products of a strong economy and good business.

[1]WSP | Parsons Brinckerhoff, December 12, 2014.The Role of Freight in Seattle's Economy.

Stakeholder Overview of Challenges

Figure 1 outlines the largest perceived challenges that freight stakeholders identified through the Online Survey. The largest concern for stakeholders by a wide margin is traffic congestion. Parking for deliveries was also a concern, particularly in the Center City area. In the "other" category, truck-bicycle conflicts were identified several times.

FIGURE 1: ONLINE STAKEHOLDER SURVEY - BIGGEST CHALLENGE FOR URBAN GOODS DELIVERY



The in-person stakeholder interviews mirrored the on-line survey results and identified the following major themes:

- Traffic congestion is the number one challenge affecting interviewees' businesses.
- Freight businesses would move deliveries to off-peak hours if they could, but there are a variety of reasons that prevent them from doing so, including: difficulty of maintaining staff who will work graveyard shifts, customer needs, customer facilities are not open off-hours, increased costs, and night-time noise ordinances.
- There is a general desire among interviewees for designation, and protection of, freight streets.
- Conflicts with other modes of traffic (especially bicyclists and pedestrians) are generally cited as the top safety concern relating to freight mobility.
- The lack of parking and loading zones for deliveries, especially in the downtown area, is consistently cited as a major concern for safety, reliability, and efficiency of freight mobility.
- Finding and maintaining well qualified employees is cited often as one of the major challenges affecting freight dependent industries in the city.

SEATTLE'S TRUCK FREIGHT SYSTEM AND PATTERNS OF MOVEMENTS

The freight system in Seattle is a complex network of supply chain logistics, intermodal connectivity, and linkages to the regional transportation network. This infrastructure and its operations benefits both residents of Seattle and its businesses by providing jobs, delivery of products, and multi-modal shipping options.

HIGHWAY AND ROAD SYSTEM

Figure 2 shows the average daily traffic volumes (year 2014) on Seattle's major roadways. Seattle has an 1100+ mile system of roadways, including Interstate highways, state highways, and arterial and non-arterial roadways that connect the ports, intermodal facilities, residences and businesses to the region. Of those roads, 142 miles are designated as Major Truck Streets by the city (See Figure 3). I-5 and SR-99 (Aurora Avenue) are the major north-south highway connections for the region. I-90 and SR-520 are the major east-west highway connections. Together, these facilities comprise the major roadway connections between Seattle and the rest of the region and country.

Because of severe geographic and topological constraints, including multiple bodies of water and steep terrain, Seattle's roadway network is generally funneled through several major routes that connect areas and neighborhoods to the rest of the metro area.

I-5 is the key north-south interstate facility, which carries over 230,000 total vehicles and 13,000 trucks per day in some segments.

- I-90 is the major east-west interstate facility carrying around 133,000 total vehicles and 10,000 trucks per day.
- SR-520 is a parallel east-west bridge across Lake Washington which serves about 62,000 total vehicles and 4,000 trucks per day.
- SR-99 provides an important north-south connection between key locations within the city, including access between the Duwamish MIC, Seattle CBD, and Ballard/Interbay/Northend MIC.
- Spokane Street and the Spokane Street Viaduct/West Seattle Bridge are major facilities that connect I-5 to Harbor Island and West Seattle.
- SR-519 connects I-5 and I-90 with the SoDo neighborhood at the north end of the Duwamish MIC as well as to the Washington State Ferry terminal at Colman Dock.
- SR-509 is an important connection between the Duwamish MIC and the SeaTac International Airport. 15th Ave W/Elliott Avenue/Alaskan Way/East Marginal Way S is also a major freight facility that connects the Duwamish MIC to the Ballard/Interbay industrial areas. E Marginal Way S also provides access to Boeing Field. It is also the "over-legal" vehicle route through downtown Seattle (see Figure 4).

FIGURE 2: YEAR 2014 DAILY TRAFFIC VOLUMES

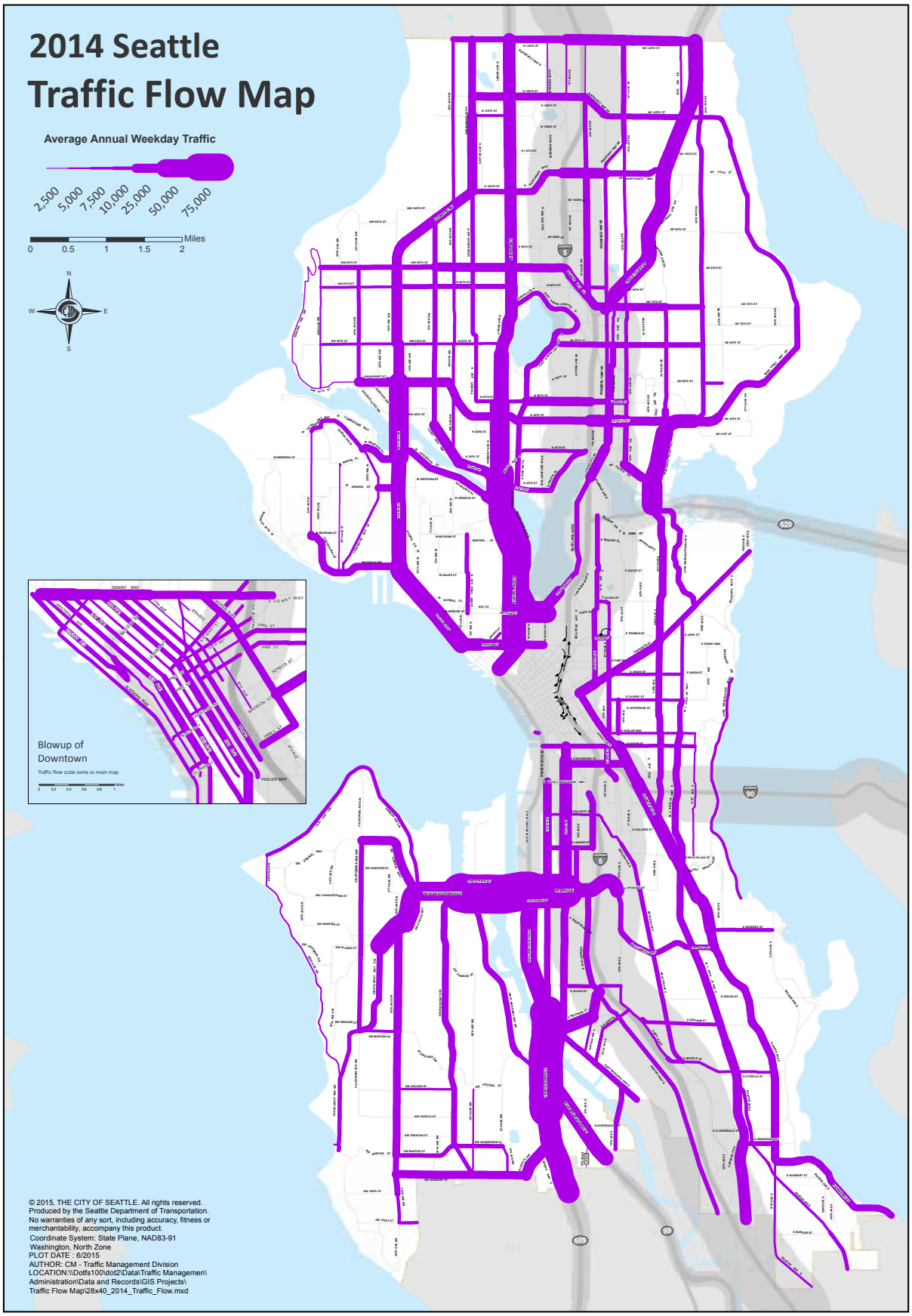


FIGURE 3: SEATTLE'S 2005 MAJOR TRUCK STREET NETWORK

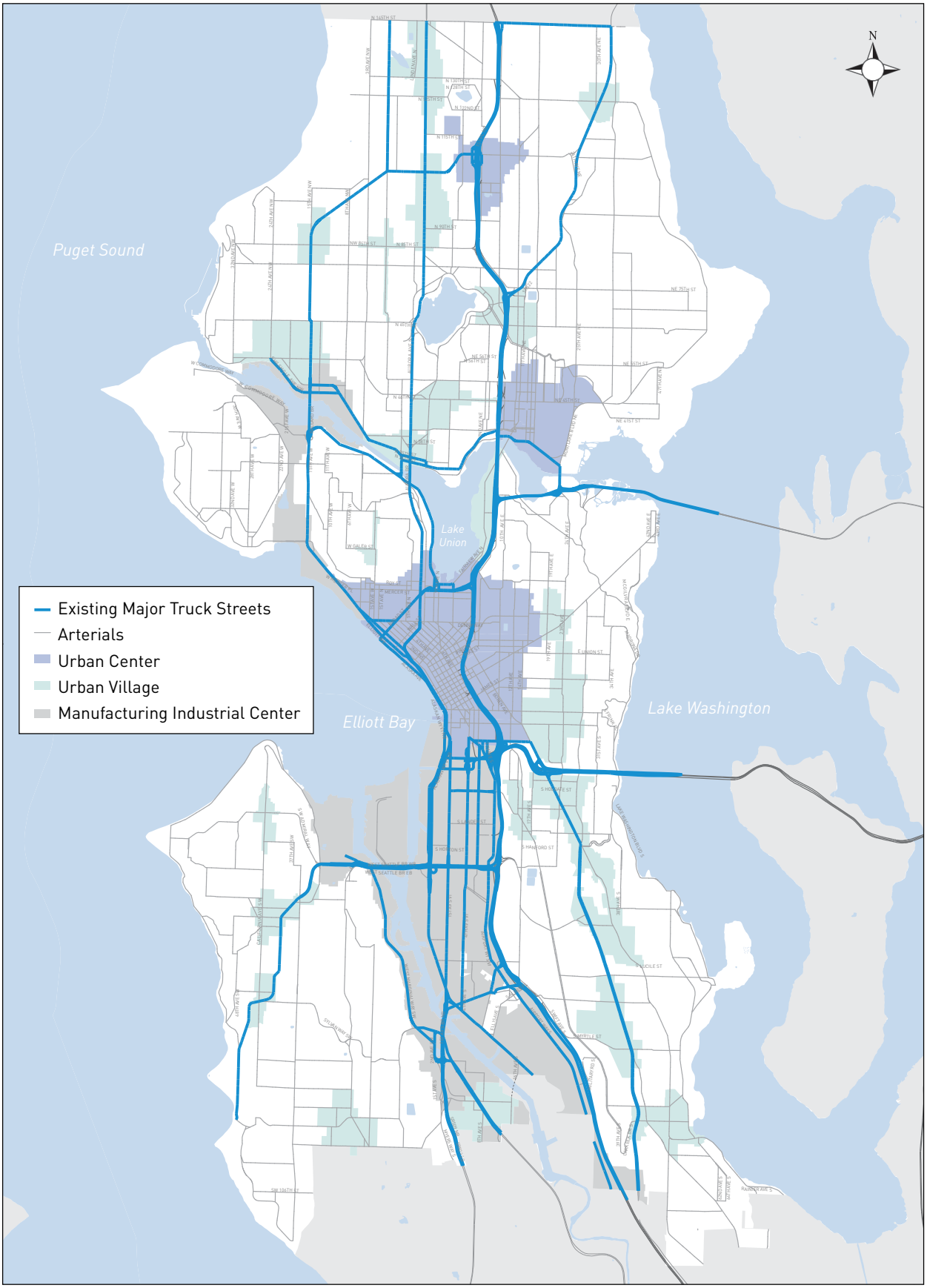


Figure 3 shows the City of Seattle's Major Truck Street (MTS) Network that was adopted as part of the City's 2005 Transportation Strategic Plan (TSP). Also shown in Figure 3 are activity centers within the city that typically generate freight trips—Manufacturing Industrial Centers (MICs), Urban Centers, and Urban Villages. The Major Truck Streets designation is defined by the City as follows:

> *"The Seattle Comprehensive Plan calls for the designation of a network of Major Truck Streets to serve as primary routes for the movement of goods and services. The specific network of Major Truck Streets is defined in Seattle's Transportation Strategic Plan (TSP) and is illustrated on the Major Truck Streets network map. A Major Truck Street is a street classification for an arterial street that accommodates significant freight movement through the City, and to and from major freight traffic generators. Some state routes and highways are also designated as Major Truck Streets on the network map. SDOT uses the designation as an important criterion for street design, traffic management decisions, and pavement design and repair."*[2]

Supplementing the MTS, and distributed throughout the city, are specific routes that we provide for oversized and overweight trucks, referred to as "over-legal." The over-legal network is shown on Figure 4. These routes can accommodate trucks with larger loads that require a 20-foot-wide by 20-foot-high envelope.

Until recently, every vehicle that met the over-legal specifications, which included an exceedance of the maximum height, width, and/or length as specified by state and city laws, was required to obtain a permit to transport goods using the City's street network.

The Washington State Freight and Goods Transportation System (FGTS) is used to classify roadways, freight railroads and waterways according to the annual freight tonnage they carry. Truck tonnage values are derived from actual or estimated truck traffic count data that is converted into average weights by truck type. The FGTS classifies roadways using five truck gross tonnage classifications, T-1 through T-5, as follows:

- T-1 more than 10 million tons per year
- T-2 4 million to 10 million tons per year
- T-3 300,000 to 4 million tons per year
- T-4 100,000 to 300,000 tons per year
- T-5 at least 20,000 tons in 60 days and less than 100,000 tons per year

The FGTS, shown in Figure 5 for the Seattle street network, is primarily used to establish funding eligibility for Freight Mobility Strategic Investment Board (FMSIB) grants, fulfill federal reporting requirements, support transportation planning processes, and plan for pavement needs and upgrades. At a minimum, WSDOT updates the list of T-1 and T-2 roadways every two years to assist in maintaining FMSIB strategic freight corridor designations.

[2]www.seattle.gov/transportation/freight.htm#majorTrucks

FIGURE 4: SEATTLE'S OVER-LEGAL NETWORK

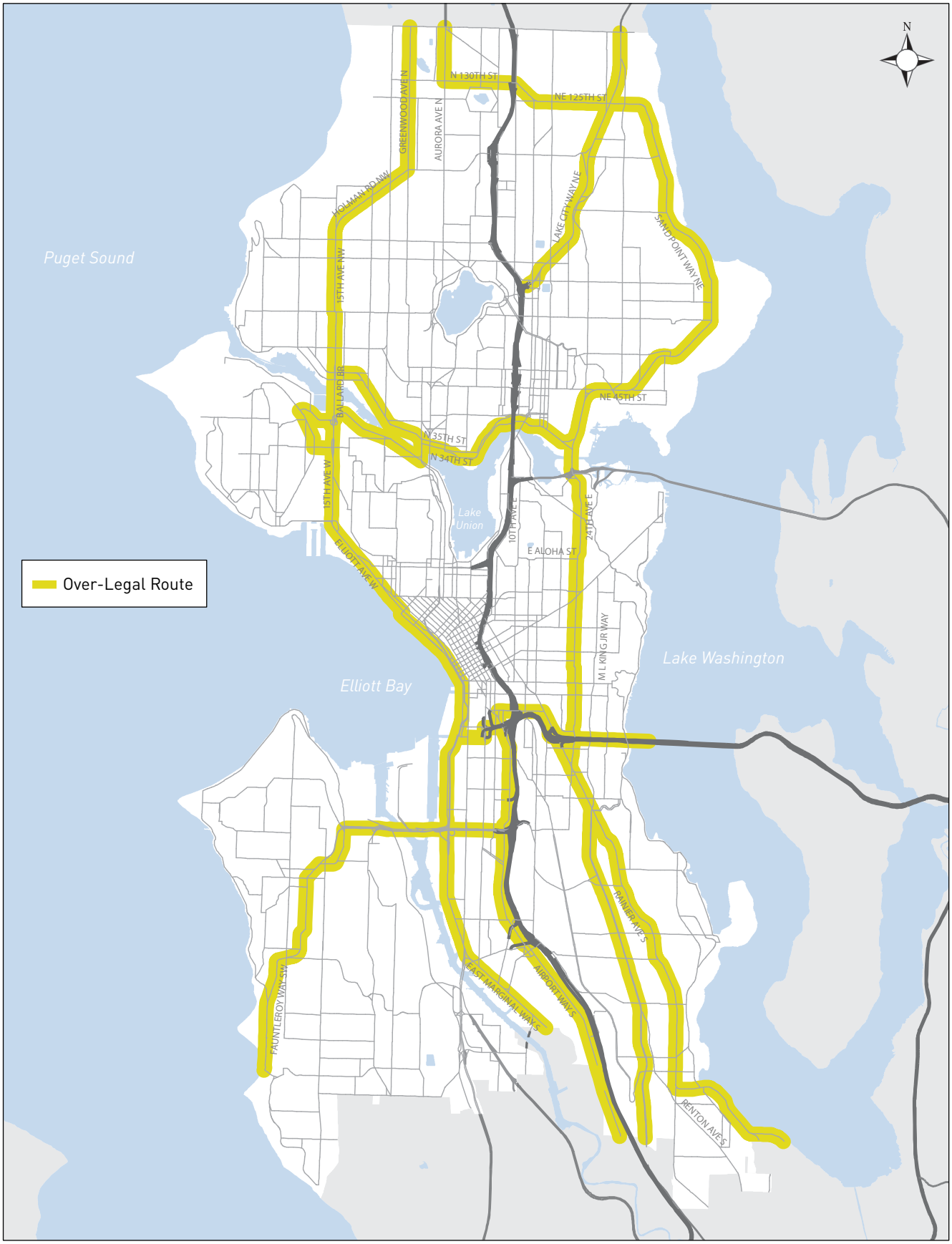
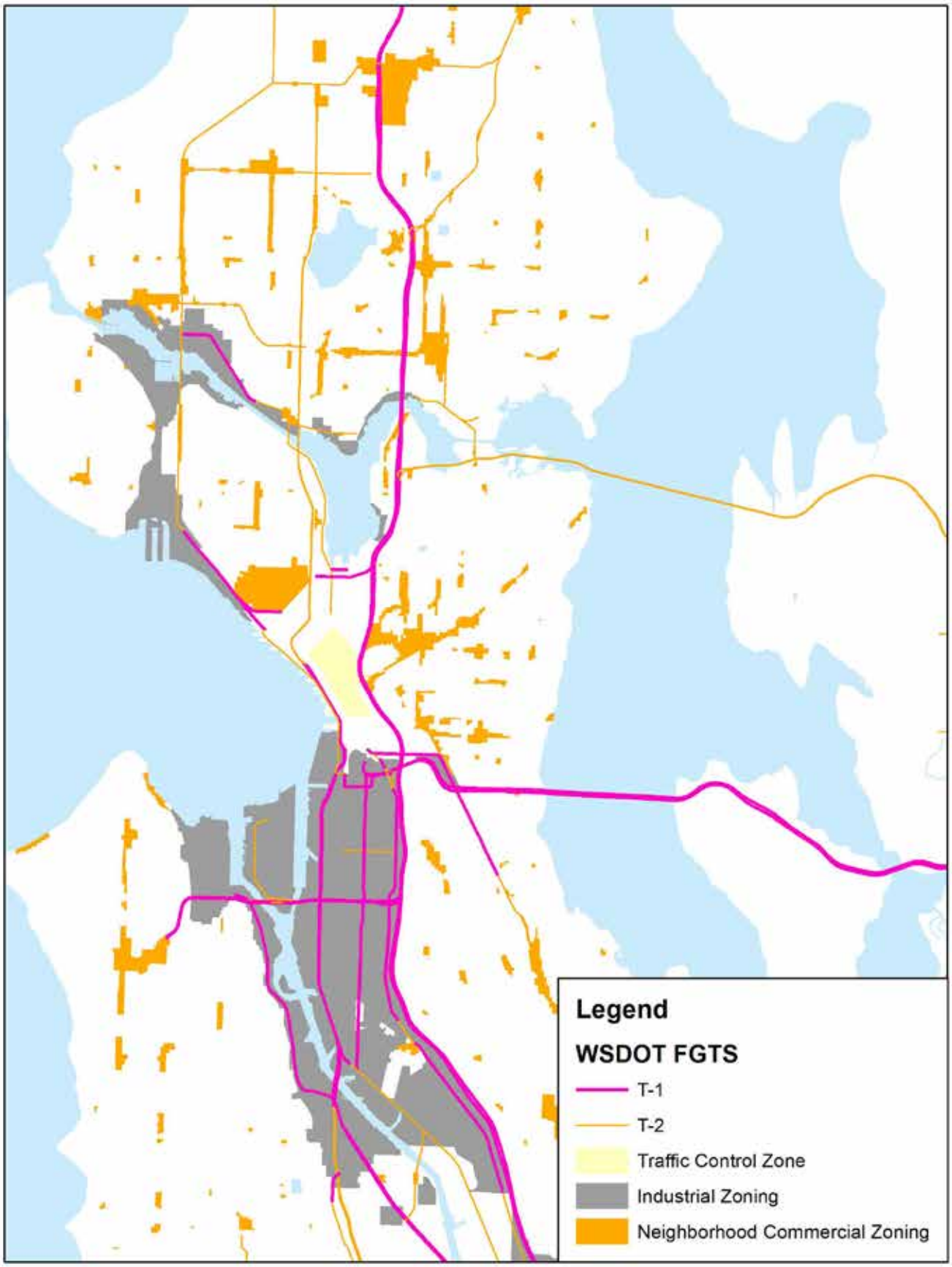


FIGURE 5: WSDOT FREIGHT AND GOODS TRANSPORTATION SYSTEM



Stakeholder Input

The current Major Truck Street system covers many of the main arterials that can be used to access key freight origins and destinations. However, stakeholders also identified streets commonly used by trucks that are not a part of the current Major Truck Street designation, including the following:

- Denny Way (Partially in the current system, certain length trucks are prohibited)
- Dexter Avenue N
- Stewart Street
- Fairview Avenue N
- Stone Way N
- 23rd Avenue E
- Northlake Way N
- N/NE 45th Street
- N 50th Street
- 3rd Avenue NW

Observations about these streets include the following:

- Many of these streets are in areas with no nearby designated Major Truck Streets. These include Stewart Street, Fairview Avenue N, 23rd Avenue E, N/NE 45th Street, and N 50th Street. Many of these streets provide a shortcut compared to using the Major Truck Street system to key facilities or destinations such as I-5 or downtown Seattle.
- Some of these streets are also included in other city modal plans. They will be discussed later on in this memo.
- A few of these streets are parallel to Major Truck Streets including Dexter Avenue N., Stone Way N, N Northlake Way, and 3rd Avenue NW. These roadways are local connections serving businesses and other localized truck destinations.

TRUCK TRAFFIC VOLUMES

The City of Seattle has an ongoing traffic count program to collect counts on city streets via tube count devices and pucks. The City has also made limited use of video counts in selected locations. These counts are used to monitor traffic patterns throughout the city by hour of day and day of week. The count devices record traffic at each location for approximately one week at a time. The City is able to perform truck volume counts at 780 locations over a four year period as a part of the programmed citywide traffic counting effort.

Truck traffic on Seattle streets fluctuates throughout the year based on street location, street type, and truck type as the data has shown. It also varies by day of the week and time of day. Because of this variability, it is important to adjust traffic count data if it is going to be reported as average weekday traffic (AWDT). This adjustment normalizes the count to a "typical weekday" so that the reported counts are not over- or under-stating the traffic based on a count that captured traffic conditions for only a limited time. Ideally, to develop adjustment factors, traffic counts would be taken continuously throughout the city, so that these variations can be measured and accounted for. Unfortunately, this is not realistic given the limited traffic counting devices available, and the cost associated with installing permanent counters city-wide.

WSDOT has permanent traffic counters located on state owned facilities. In the Seattle metro area, this includes 21 Interstate count locations and 13 State Route count locations. These counts were used to generate representative adjustment factors by truck type, year, and month for city streets.

Other published truck-specific seasonal factors were used to account for the difference between highways and arterials. Ohio State DOT provided adjustment factors for interstates, expressways, arterials, and local roads. Because the state also has a number of Ports along Lake Erie and is heavily freight dependent, it was assumed that the WSDOT interstate adjustment factors would relate to arterial and local road factors in a manner similar to the Ohio data.

The resulting adjustment factors, shown in Appendix C, were used to develop year 2014 average weekday truck volumes shown in Figure 6. These are generalized typical conditions for an average weekday, but may not reflect conditions on any single day. Only roadways with truck volume counts are shown on the map. Additional data from recent and ongoing studies was also added to the dataset. These studies include the City of Seattle's Freight Access Project and the Port of Seattle's Container Terminal Access Study. As can be seen, the highest daily truck volumes in the city are experienced on E Marginal Way and Aurora Avenue N. First Avenue S and 4th Avenue S also carry a high volume of trucks to and from the Duwamish MIC to surrounding industrial areas and highways.

City arterials that carry over 1500 trucks day are all part of the Major Truck Street network and include:

- N 145th Street west of I-5
- 4th Avenue S in Duwamish MIC area.
- West Marginal Way SW south of the West Seattle Bridge.
- 1st Avenue S in Duwamish MIC area.
- 15th Avenue W south of the Ballard Bridge.
- Greenwood Avenue N north of Holman Road.
- Holman Road NW west of I-5.

Other city arterials that are not a part of the currently designated Major Truck Street network, but still carry 1000+ trucks per day include:

- NE 65th Street east of I-5.
- 85th Street between SR-99 and 15th Avenue NW.
- SW Roxbury Street west of Delridge Way SW.
- Fremont Avenue N north of the Fremont Bridge.
- E Olive Way east of I-5.
- SW Admiral Way west of the West Seattle Bridge.
- N 46th Street west of SR-99.
- N 50th Street west of I-5.
- NE 125th Street east of I-5.
- NW Leary Way west of 15th Avenue NW.

While not on the existing Major Truck Street network, these streets provide logical connections between major facilities. These streets should be considered for addition to the freight network, at some level, when the truck street classification system is revised as part of this plan.

Finally, there are some Major Truck Streets that have less than 1000 trucks per day, including:

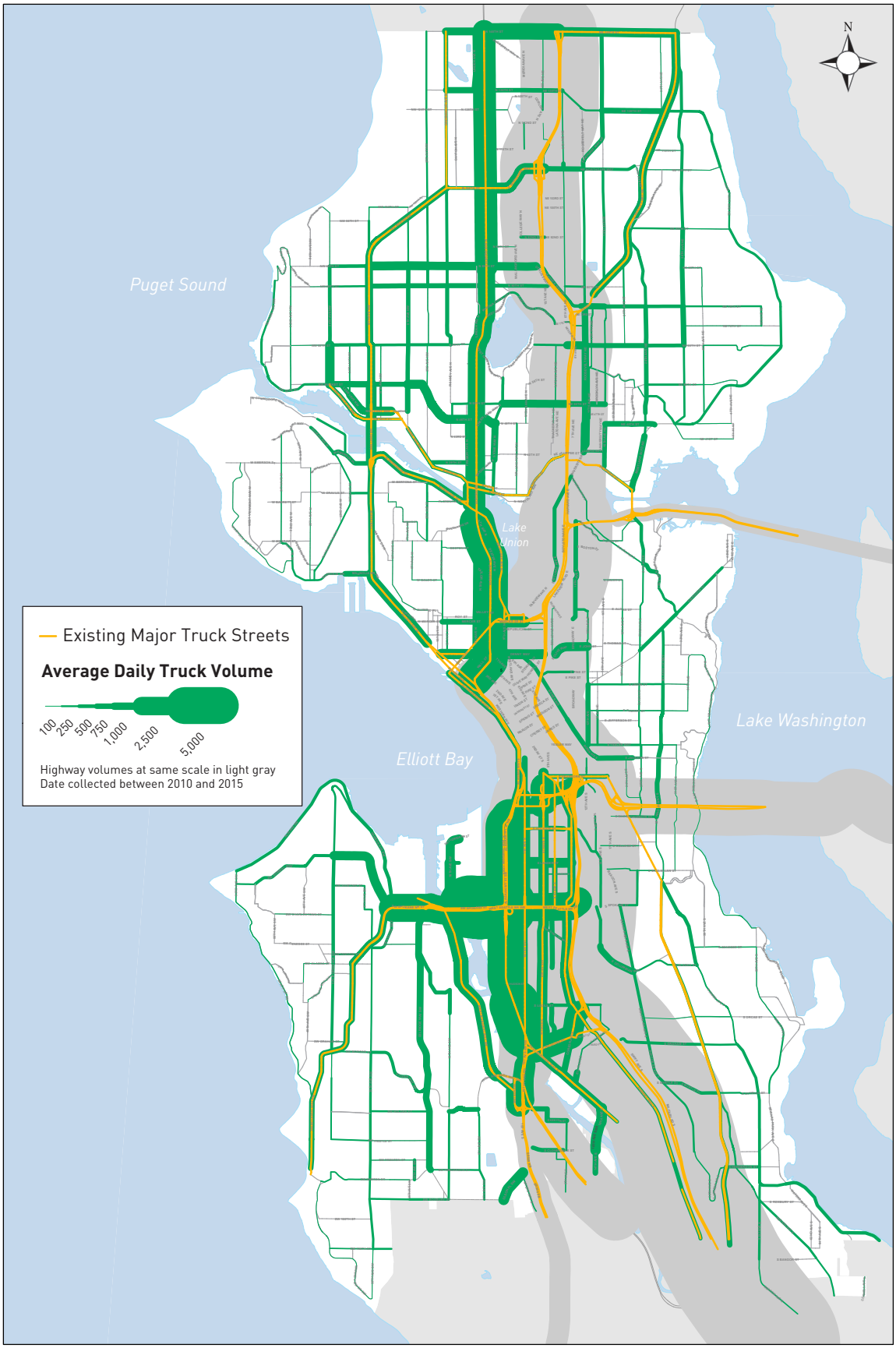
- Rainier Avenue S south of I-90
- N Northlake Way west of I-5

Peak Travel Times for Trucks

On weekdays, there are typically two peak travel periods for all vehicles. This is primarily based on trip patterns of autos, and in particular the AM and PM peak commute periods. For truck trips however, travel patterns can vary, as exhibited in Figure 7 that shows truck flow characteristics on ten city streets[3] with high truck volumes. For example, truck trips on freight access facilities serving the Port of Seattle, such as the Spokane Street Viaduct, typically peak in the morning, but then stay at a relatively high level until tapering off prior to or during the PM peak period. However, other city arterials, such as Aurora Avenue N, serve a more diverse freight market reflecting more retail use and deliveries and experience peak truck flows during the afternoon peak period. When combining the hourly traffic volumes from these ten high truck volume arterials (Figure 8), we see generally high overall truck traffic throughout the day.

[3]This is combined typical weekday traffic on 15th Ave NW, 4th Ave S, Aurora Ave N, Boren Ave, Delridge Way SW, N 85th St, NE 125th St, NW Market St, SW Spokane St, and W Marginal Way SW. They were selected based on being the highest truck counts in the SDOT database for single, double and triple unit truck counts.

FIGURE 6: AVERAGE WEEKDAY TRUCK VOLUMES



FUTURE TRAFFIC

Future freight volumes are largely determined by employment growth in the city. As further detailed in The Role of Freight in Seattle's Economy[4], freight generating industries drive freight growth. Based on that analysis, freight is expected to growth between 1.6 and 2.5% a year for the next 20 years.

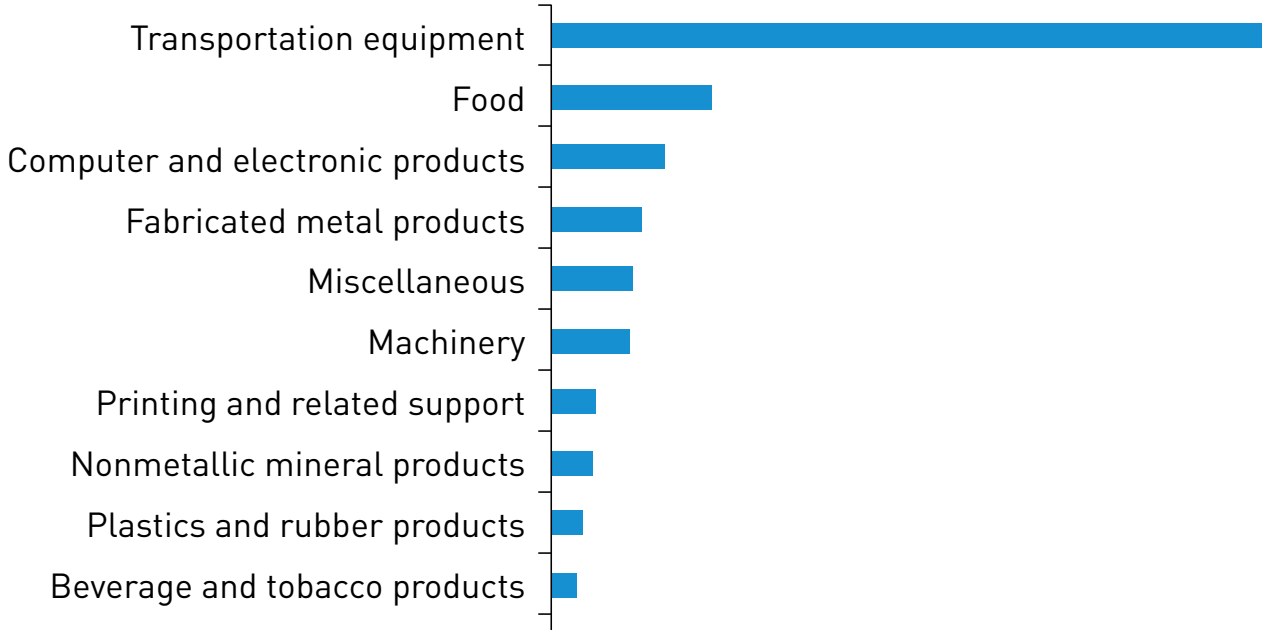
To assign where truck growth will go, we evaluated where key sectors of employment are growing. This provided insight to regions where truck volumes will increase above or below the expected average growth. While the full description of the future truck volumes projection process is described in *Appendix D: Future Conditions Analysis Methodology*, the following four steps in the approach are briefly summarized below:

1. Start with the existing truck volume flow map based on current truck counts.
2. Create distinct geographic districts within the city based on land use and natural travel barriers.
3. Generate district level annual growth factors based on employment and population forecasts.
4. Calibrate specific locations based on more detailed studies.

1. Existing Truck Volumes

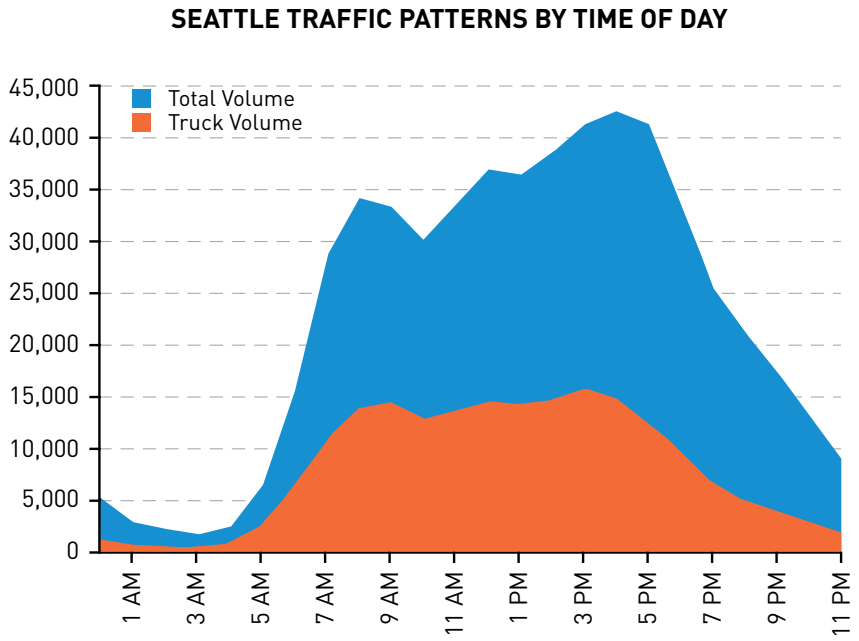
As discussed previously, city wide truck volumes have been measured primarily using tube counters, but also video and other methods. The truck forecasting process starts with these existing counts and then an annual growth factor is developed to project them to year 2040 estimates.

FIGURE 7: TRUCK TRAFFIC BY HOUR ON SELECTED STREETS



[4]WSP | Parsons Brinckerhoff. December 2014.

FIGURE 8: COMBINED TIME OF DAY TRAFFIC AND TRUCK FLOW PATTERNS FOR SELECTED CITY ARTERIALS[5]



2. Growth Districts

Thirteen geographic districts were created based on areas that have consistent land uses and by identifying travel barriers like waterways, freeways, and other natural breakpoints. Figure 9 shows the districts. The purpose of districts is to aggregate the city into reasonable regions that can each have a single growth factor to represent truck growth traveling through the area. The districts were also defined so that they are comprised of Forecast Analysis Zones (FAZs) used by PSRC in development of their population and employment forecasts. The population and employment forecasts for each of the FAZs within a single district were reviewed to ensure that they are expected to grow at similar rates in future.

3. Growth Factors

Truck activity growth factors for each district were based on PSRC Population and Employment forecasts. The PSRC data is based on the "2013 Land Use Baseline, Central Puget Sound Region - Maintenance Release 1 (MR1) Update" which was first released in July 2013 and revised in April 2014.

As described in detail in *The Role of Freight in Seattle's Economy*[6], retail trade, wholesale trade and manufacturing are the primary freight generating employment sectors. The employment forecasts for these three employment sectors were aggregated into the 13 forecast districts to reflect the level of growth in truck activity each district is expected to experience.

Based on these results, each district was then assigned one of four representative annual levels of growth - 1.0%, 1.6%, 2.0%, or 2.5%, which represent very low, low, med, or high growth, respectively. Figure 10 shows the employment growth by district.

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[5]These volumes represent a summation of traffic counts across ten city arterials experiencing high truck volumes. These include the following: 15th Ave NW, 4th Ave S, Aurora Ave N, Boren Ave, Delridge Way SW, N 85th St, NE 125th St, NW Market St, SW Spokane St, and W Marginal Way SW.
[6]WSP | Parsons Brinckerhoff, December 12, 2014.

FIGURE 9: CITY OF SEATTLE FORECAST DISTRICTS

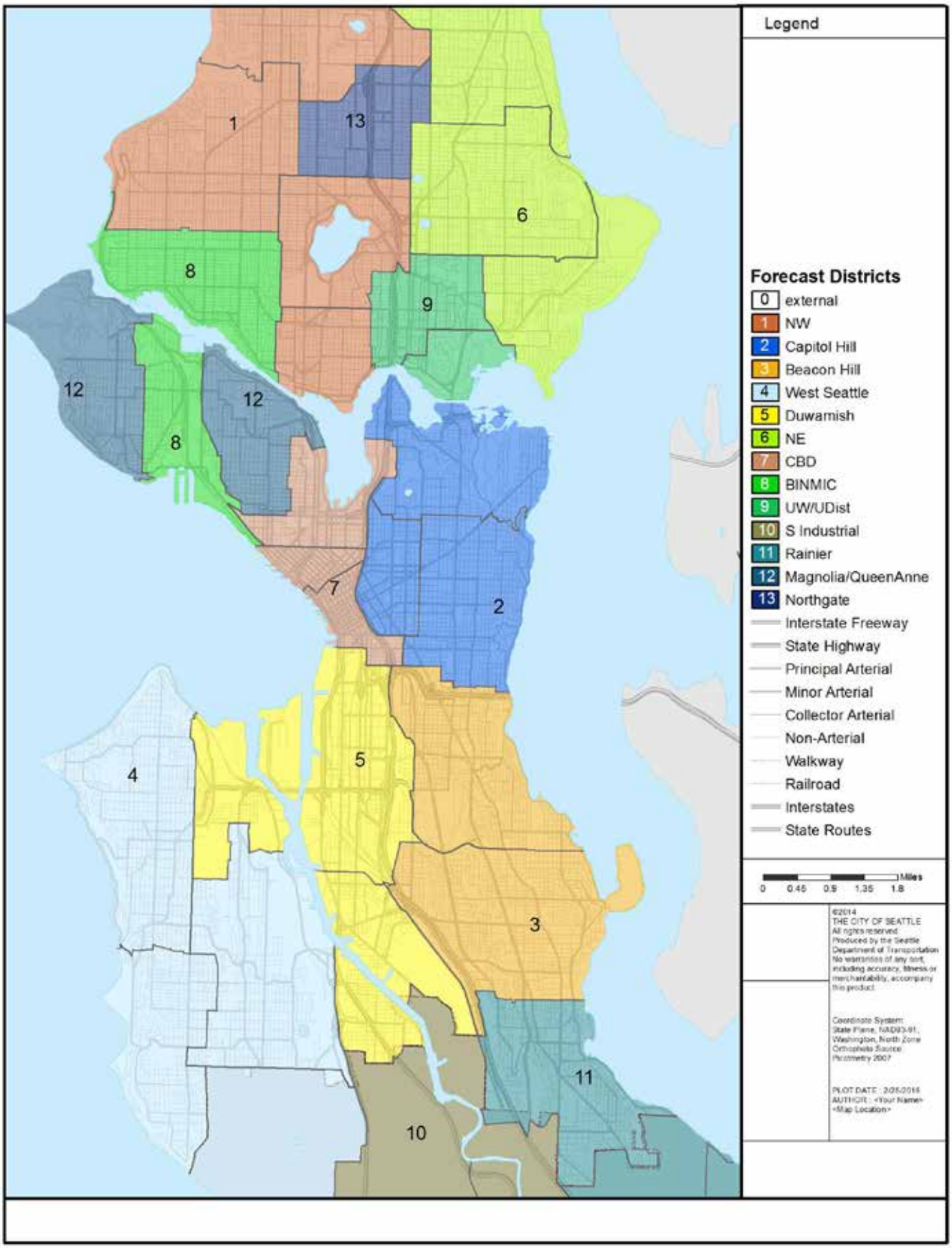


FIGURE 10: PROJECTED ANNUAL EMPLOYMENT GROWTH BY DISTRICT

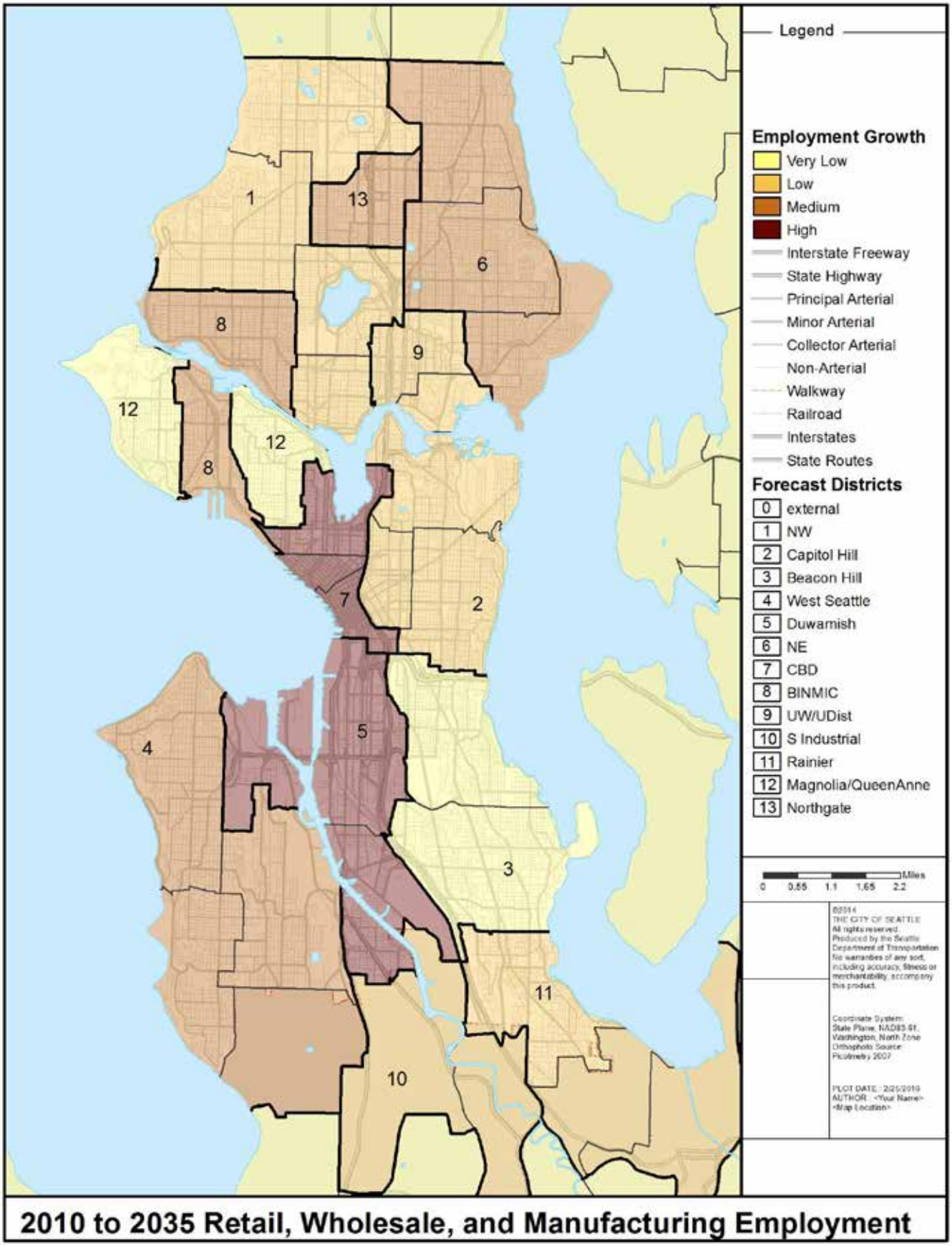


FIGURE 11: PROJECTED ANNUAL POPULATION GROWTH BY DISTRICT

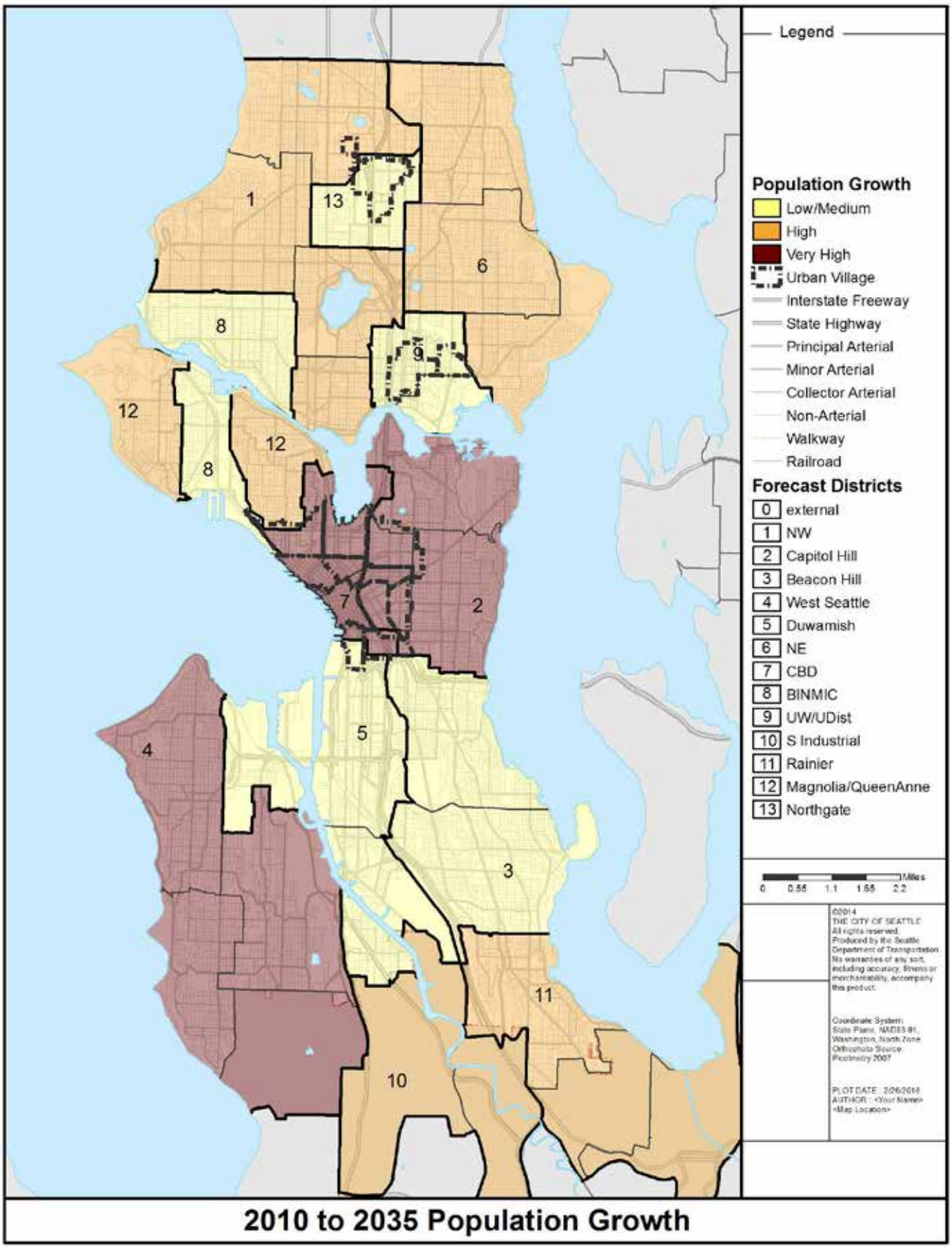
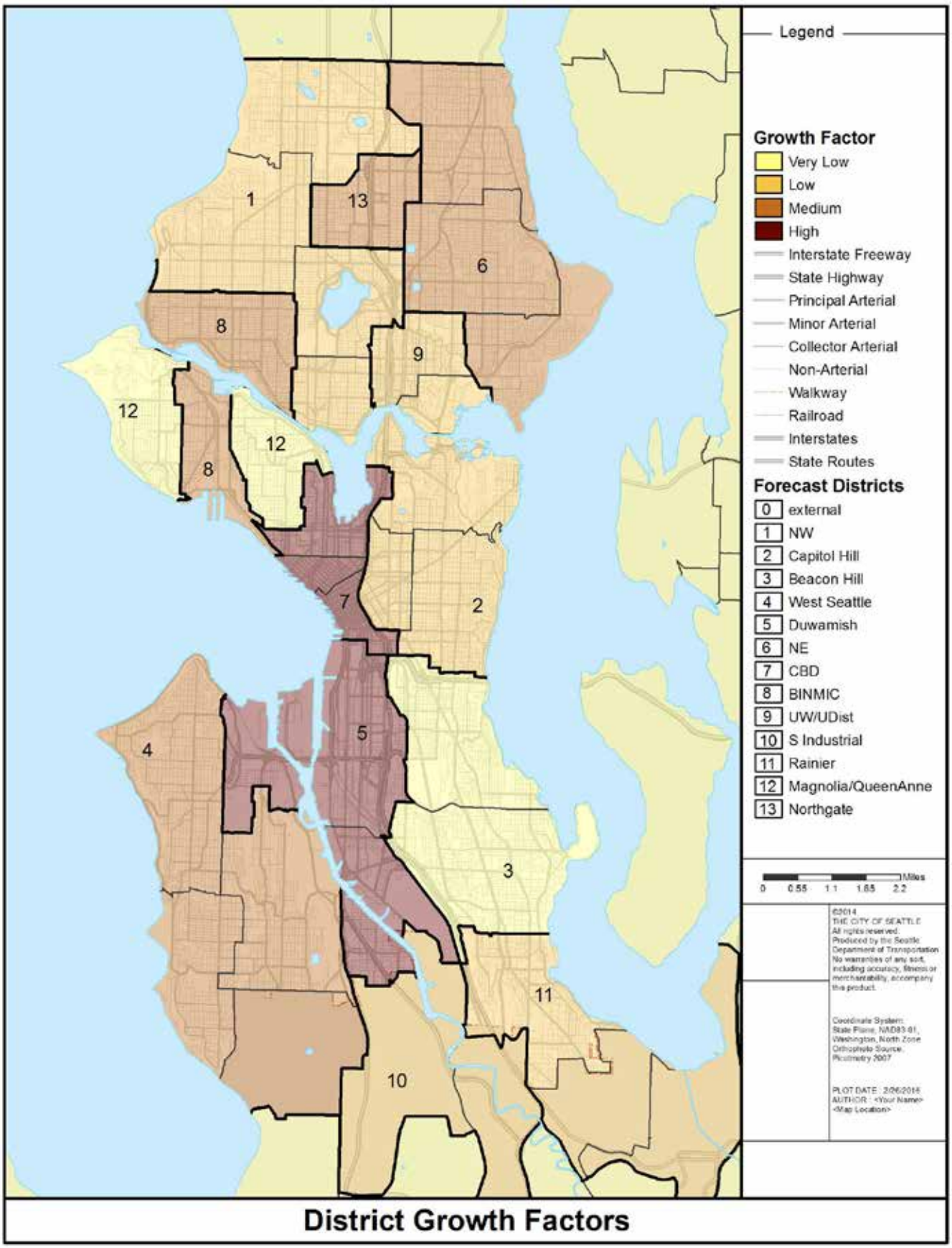


FIGURE 12: FREIGHT GROWTH FACTORS BY DISTRICT



The population growth projections were then reviewed for each district (Figure 11). Because very high population growth could result in substantially more trucks in a district, to make deliveries to homes and local commercial/retail districts, it was determined that districts with population growth of more than 15,000 and/or the presence of urban centers or urban center villages would be moved up into the next highest growth category.

- Districts with urban center / urban center village developments: 2, 7, 9, and 13.
- Districts with growth of more than 15,000 people: 2, 4, and 7.

Figure 12 shows the resulting proposed annual freight growth factors for each district. As a result of the analysis of high growth population areas, districts 2 (Capitol Hill) and 9 (University District) moved from a designation of very low to a designation of low growth. Districts 4 (West Seattle) and 13 (Northgate) moved from low growth to medium growth designations. District 7 (CBD) already had high employment growth and thus remained in the high category.

4. Calibration

The PSRC regional model does a reasonable job quantifying truck volumes on major roadways as they move to major destinations in and outside the region. The regional model's existing and future projected truck volumes were reviewed and used to estimate expected truck growth on highways and principle arterials. State routes and highways are represented on Figure 13 for simplicity, however, the model also contains all principal arterials as well. These volumes and growth rates give regional context to the projections developed from the land use growth since they reflect the larger freight movements within, and through, the City. Annual growth factors were determined by using the growth in volumes between the base year and future year models. This growth was then applied to the regional facilities within the city's transportation network.

Finally, other freight studies with targeted analysis of future truck flows, including the Port of Seattle Container Terminal Access Study and the City's Freight Access Project, were reviewed and the results integrated into the future truck volume analysis. With more refined focus areas and different timelines, these studies have differing base year data and future projections. These studies also provide additional traffic counts that were incorporated into the City of Seattle truck count database. Roads that provide direct connection between the Port of Seattle and the Interstate facilities are projected to experience higher growth in truck volume than other facilities in the city. Incorporating this growth resulted in a growth factor of 3.5% per year, or Very High Growth.

The projected daily truck volumes for year 2035 are shown in Figure 14. Overall, the map indicates a significant growth in truck traffic on many facilities within the City, corresponding with the overall average of 2% per year projected growth in freight volumes outlined in the *Role of Freight in Seattle's Economy* memo. Some of the highest areas for truck growth also correspond to streets that have the highest current truck volumes. The Duwamish MIC is anticipated to have significantly more growth than the rest of the region. Aurora Avenue N is also expected to have large increases in truck traffic in the future.

FIGURE 13: ANNUAL TRUCK VOLUME GROWTH FACTORS FOR PSRC REGIONAL ROADWAYS

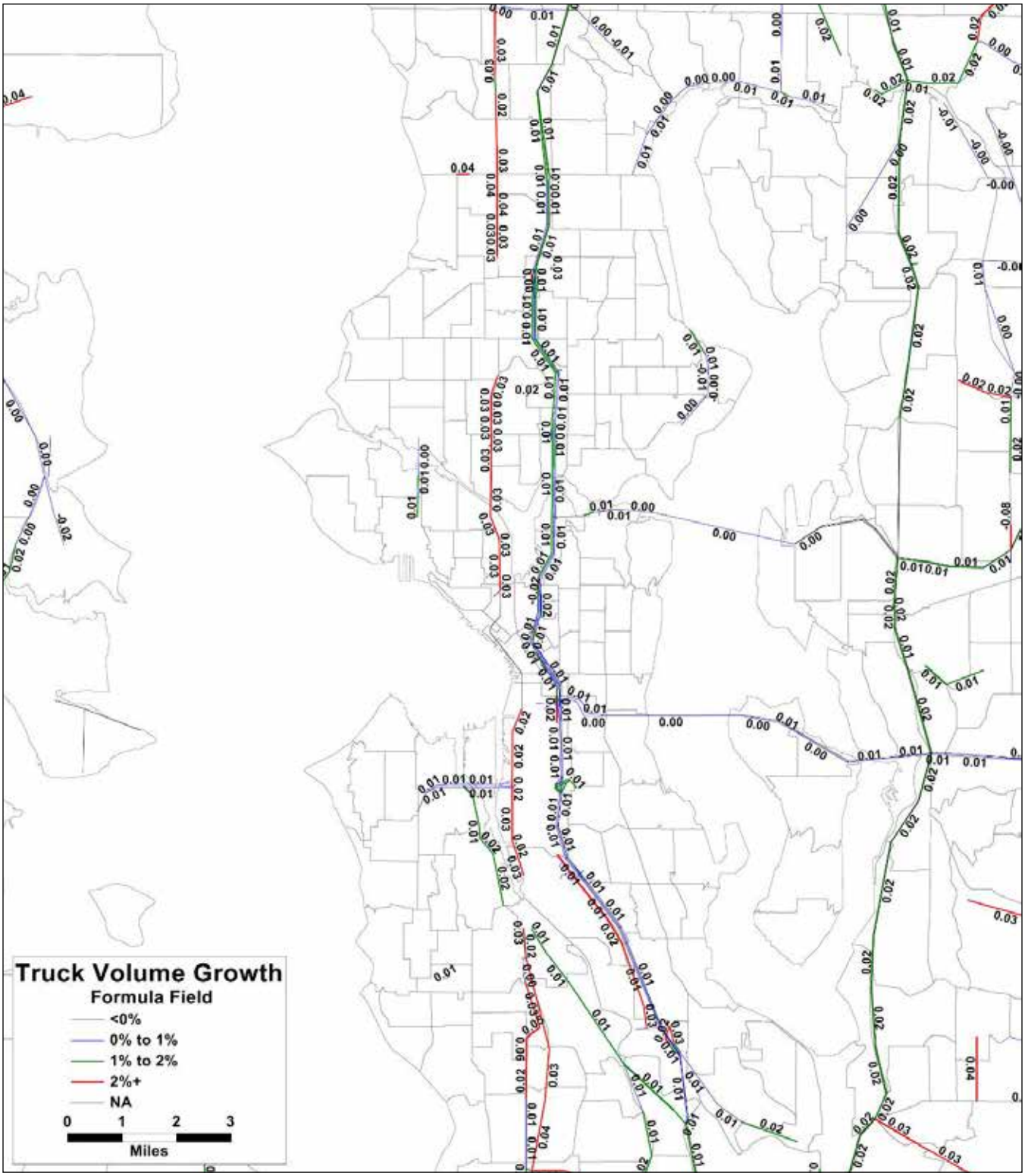


FIGURE 14: PROJECTED 2035 AVERAGE DAILY TRUCK VOLUME

TRUCK MOBILITY AND ACCESSIBILITY

Seattle area shippers and receivers depend on trucks to provide timely, reliable service. However, most roadways in the metro area experience some level of overall congestion, particularly in the AM and PM peak travel periods. This congestion increases cost and decreases reliability of truck service.

ROADWAY CONGESTION

Traffic conditions, including all vehicles, are often shown as Level of Service (LOS) or Volume to Capacity (V/C) ratios. V/C ratios will be used here to evaluate traffic congestion on arterials and highways. They were calculated using the 2010 Puget Sound Regional Council (PSRC) travel demand model calibrated for the SR-99 Phase 1 Investment Grade Tolling Traffic and Revenue Project. This includes a more refined zone system and a more detailed street network within the City of Seattle. It also includes additional features to more accurately reflect conditions in downtown Seattle. The model reflects typical weekday travel patterns and does not account for special events.

Roadway capacities are defined by a combination of the facility type, speed limit, lane width, intersection spacing, as well as other factors. It should be noted that congestion worsens significantly as volumes increase towards capacity. For example, a street with V/C = 0.80 may experience some slowdown below speed limits, but the same street at V/C = 0.90 will likely have breakdown in traffic flow, with highly variable speeds including stop and go conditions. The model is calibrated and validated to ensure that it produces traffic volumes that are representative of observed traffic.

Figure 15 and Figure 16 show city roadways currently experiencing congestion in the AM (7-8) and PM (5-6) peak hours, respectively. Facilities shown in orange are estimated to have V/C ratios of between 0.80 and 0.89 and those in red have V/C ratios of 0.90 or greater. Facilities with V/C rations of less than .80 have been faded out for readability.

The volumes from the model represent all vehicle types, including trucks. The model was used to understand how the overall system is performing currently and where demand is exceeding capacity. It also was used to identify current bottlenecks in the system. The bottlenecks, particularly those located on streets with heavy truck use, will be used to inform planners and engineers where to look for possible solutions during later tasks in the planning process.

Stakeholder input was also used to identify or confirm bottleneck locations. Many trucking and shipping businesses are aware of daily bottlenecks, roads with demand higher than capacity and no reasonable alternative routes, and allow extra time for deliveries or take alternate routes. Some plan operations so that trucks can be on the roads during off peak times. They will often rely on driver knowledge or on-line real-time electronic maps to provide traffic conditions and decide on optimal routing.

Comparing the AM and PM congestion patterns shows that many facilities experience excess demand in both the AM and PM peak periods, including most bridges because they typically funnel traffic from multiple roadways into one crossing.

FIGURE 15: EXISTING AM PEAK HOUR ROADWAY CONGESTION

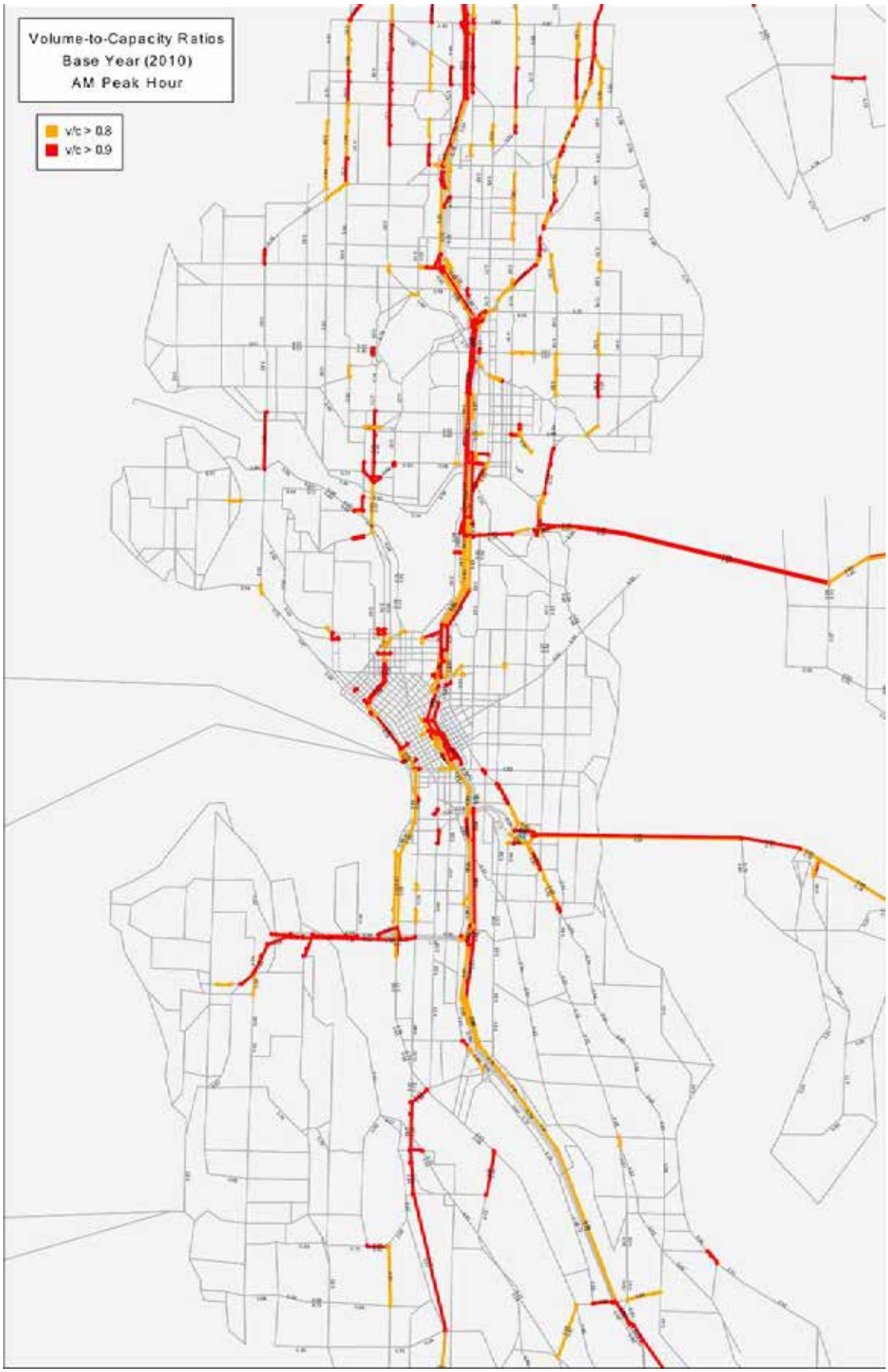
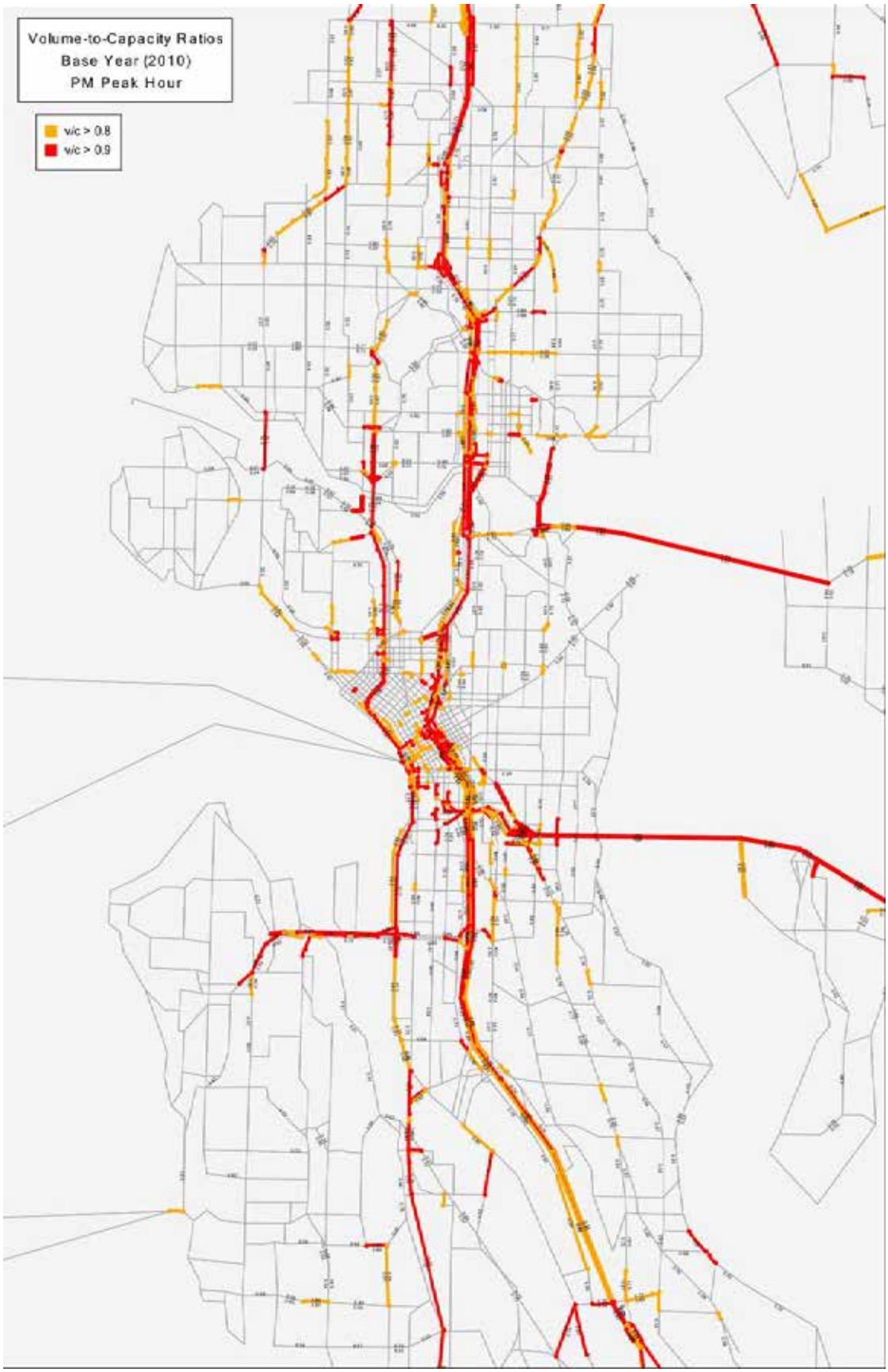


FIGURE 16: EXISTING PM PEAK HOUR ROADWAY CONGESTION



Notable bottleneck points include the following bridge crossings:

- Ballard Bridge
- Fremont Bridge
- University Bridge
- Montlake Bridge
- West Seattle Bridge (
- First Avenue S Bridge
- I-90 Bridge
- SR-520 Floating Bridge

Because the bridges serve as a singular crossing point for a number of arterial streets, congestion at these locations has major downstream effects that impact not only the primary roadway served by the bridge but also many additional side roads and interchanges. For example, congestion on the Ballard Bridge can cause backups on Nickerson Street, Market Street, and other nearby arterials. This situation is exacerbated by bridge openings. Although openings are restricted during peak periods on most bridges (with a few exceptions including the Spokane Street Swing Bridge), the openings in off-peak periods hinder freight movements which occur throughout the day. See Table 9 for details on opening restrictions for moveable bridges and related discussion in the Truck Mobility Constraints section.

All major Interstate and State highways are at or near capacity for the peak periods. This means that not only is local traffic and truck mobility impacted, but longer-distance through-trips are delayed as well. I-5 and to a lesser degree SR-99, are congested throughout the city. Other facilities commonly used by trucks that currently operate with high levels of peak hour congestion include:

- Lake City Way (SR-522)
- Fauntleroy Avenue SW south of the Alaska Junction
- Fremont Avenue N north of the Fremont Bridge
- Portions of Greenwood Avenue N in north Seattle.

As indicated in the preceding section, these facilities all carry truck volumes in excess of 500 trucks per day.

The majority of bottleneck locations citywide are on roads that are a part of the Major Truck Street network. Congestion on these key freight corridors of the city negatively impacts reliability of service for trucks. As mentioned above, many of these locations have physical barriers, such as lakes, which make adding additional capacity very costly or infeasible altogether. In most cases, improving mobility will need to be done not by widening or building new roads, but rather by improving operations using other strategies that optimize traffic operations such as ITS, signal coordination, ramp metering, congestion pricing, and transit improvements.

Stakeholder Input

Impaired mobility overall is also reflected in responses from freight stakeholders who indicated that traffic congestion was by far the number one challenge for urban goods movement and delivery in the city. Reliability, being able to accurately predict travel times, is a related concern to freight stakeholders as well. The following themes related to mobility and accessibility were identified during freight stakeholder interviews.

- All truck operations are heavily influenced by traffic congestion and the lack of alternative truck routes.
- Drivers do their best to avoid morning (7am-9am) and afternoon peak hours (3pm-6pm); however, larger and noisier trucks are often prevented from making deliveries in off hours due to the night time noise ordinance.
- Businesses, especially near SoDo and the Port, are particularly impacted by special events at the stadiums such as sports events and concerts. Incoming and outgoing deliveries all revolve around event start and finish times on event days.

- Drivers largely rely on their own knowledge for route finding; however GPS, Google Maps, and traffic cameras are routinely cited as useful tools, even though their use is marginalized because drivers are typically not allowed to look at GPS or cell phones while driving.
- A few participants suggested creating one website that consolidates all traffic conditions on city roadways. Driver access to real time traffic analytics was suggested as an idea for improving congestion and reliability issues for freight mobility.

In addition to general concerns about congestion, stakeholder interviews identified additional bottleneck facilities affecting freight which were not necessarily obvious by looking at peak hour volume to capacity ratios from the travel demand model. This could be due to a variety of reasons, including because the congestion is episodic and not tied to daily peaks, the model may have under-assigned volumes to these roadways, or there are bottleneck constraints that are not adequately recognized by the model. For example, some of the facilities have restrictions regarding trucks during certain hours. Stakeholders identified the following additional streets as being bottlenecks for freight:

- W Nickerson Street
- Mercer Street
- Elliott Avenue
- Denny Way
- Dexter Avenue N
- Stewart Street
- Fairview Avenue N

All of these streets, except Elliott Avenue south of Denny Way, are either transit or bike corridors, or both. Elliott Avenue is a truck facility, but it is in a very urban setting with many signalized intersections, and the access connection to the Alaskan Way Viaduct is a very short ramp which is often backed up from congestion on the viaduct. All of these factors make Elliott Avenue difficult to navigate for larger trucks.

Stakeholders also identified "Problem Areas" that are not necessarily traffic bottlenecks, but present a challenge for freight movement regardless. While these facilities may not experience major congestion, they are still considered by stakeholders to be difficult for truck drivers to use. These problem area locations have a range of unique attributes that affect trucks. These include geometric issues such as turning radii, grade, acceleration/deceleration lane lengths, location of access points, sightlines, mode conflicts, and others. Many of these bottleneck and problem area locations are created by the geography and topography of the City, such as across waterways, which constrain flow for all traffic. The additional problem areas identified by stakeholders include the following:

- SW Spokane Street between West Seattle and Harbor Island
- Spokane Street Viaduct
- Pier 91
- S Alaska Street light rail crossing at Rainier Avenue S
- S Holgate Street
- Lack of northbound access to I-5 from 85th Avenue NW

ACCESS TO INDUSTRIAL LANDS

A separate study, the Seattle Industrial Areas Freight Access Project (FAP), focused specifically on maintaining and improving access to the City's industrial lands. It identifies truck -freight transportation infrastructure investments needed over the next 20 years to keep Seattle's industrial lands—the Manufacturing/Industrial Centers (MICs) of the Greater Duwamish and the Ballard/Interbay Northend—vibrant and productive to meet the challenges of the future and to keep Seattle moving. The Freight Access Project serves as a building block for the key policy, programmatic, and technical issues to be fully examined in the Seattle Freight Master Plan (FMP).

FUTURE MOBILITY AND ACCESSIBILITY

There are several considerations for truck movements throughout the city in the future. Key truck facilities, traffic congestion, bottlenecks, and safety issues were identified in order to prioritize which routes are performing adequately, and which need improvements. This analysis is presented below.

Truck street designations

While trucks are allowed on all streets within the City of Seattle (with a few exceptions), there are certain streets that are particularly critical to the freight and goods movements system, some of which are not currently designated as a Major Truck Street (MTS). Additionally, the current MTS designation does not recognize local freight movements to and from commercial centers, or provide alternate routes in some cases. Also, with logistics trends moving to smaller and more disbursed warehouse and distribution centers, and in keeping with Seattle's Urban Village Strategy, a multifaceted freight network with multiple designations was determined to better meet the city's freight mobility needs.

Based on freight planning best practices, and input from stakeholders and regional and national experts, the following four designations for Seattle's freight network were developed:

- **Limited Access Facility** – Limited access facilities support through movements and/or long-distance trips. These facilities include interstate and state highways, such as Interstate 5 (I-5) and Highway 99.
- **First/Last Mile Connector** – These are defined as locations where short truck movements are required for access to and from key freight activity centers, such as Port facilities, and intermodal terminals. These connections are all within the Manufacturing and Industrial Centers (MICs).
- **Major Truck Street** – This is now a subset in the overall freight network. As defined previously, a major truck street is an arterial street serving connections between and through industrial land use (MICs and intermodal terminals), commercial districts and urban centers.
- **Minor Truck Street** – A minor truck street provides connections to and from urban villages and commercial districts, and secondary connections to major truck streets.

The criteria used to determine whether a street should be part of the recommended freight network, and what is appropriate level should be include the following: primary freight purpose of the facility, supported land use, street functional classification, and daily truck volumes. Figure 17 summarizes these criteria for each of the four freight network designations. The recommended freight network is shown in Figure 18 . More details on the methodology of this classification was outlined in the July 2015 CAC meeting and is fully documented in the *Truck Street Designation Memo*.

FUTURE TRAVEL FORECAST

Future traffic conditions were analyzed by using predictive travel demand models. The Puget Sound Regional Council (PSRC) travel demand model calibrated for the WSDOT SR-99 Phase 1 Investment Grade Traffic and Revenue Project. This model utilizes the PSRC population and employment forecast to model future traffic. This future model includes all funded future road and transit projects, as well as future toll and managed lanes projects.

Projected levels of congestion on city streets were estimated based on calculated volume to capacity (v/c) ratios. Figure 19 and Figure 20 show projected v/c ratios for the AM and PM peak periods respectively. Congestion typically occurs when the v/c ratio is 0.8 or higher, meaning that 80 percent or more of the roadway's capacity is being used. Moderate congestion, shown with an orange highlight on the map, reflects v/c ratios

FIGURE 17: TRUCK STREET CRITERIA BY DESIGNATION

LIMITED ACCESS

Purpose: Long distance trips

Land use: Connections between the city and the rest of the region

Roadway classification: Highway

Truck volumes: All

MAJOR TRUCK STREET

Purpose: Through trips

Land use: Connections to MICs, intermodal facilities, Urban Centers, and the regional system

Roadway classification: Minor arterial or higher

Truck volumes: 500+ trucks per day

MINOR TRUCK STREET

Purpose: To/From trips

Land use: Connections to and from urban villages and commercial districts, provides secondary through routes and network resiliency

Roadway classification: Collector arterial or higher

Truck volumes: 500+ trucks per day

FIRST/LAST MILE CONNECTORS

Purpose: Industrial trips

Land use: Connections within the Manufacturing and Industrial Centers (MICs)

Roadway classification: Minor arterial or lower, including non-arterial streets

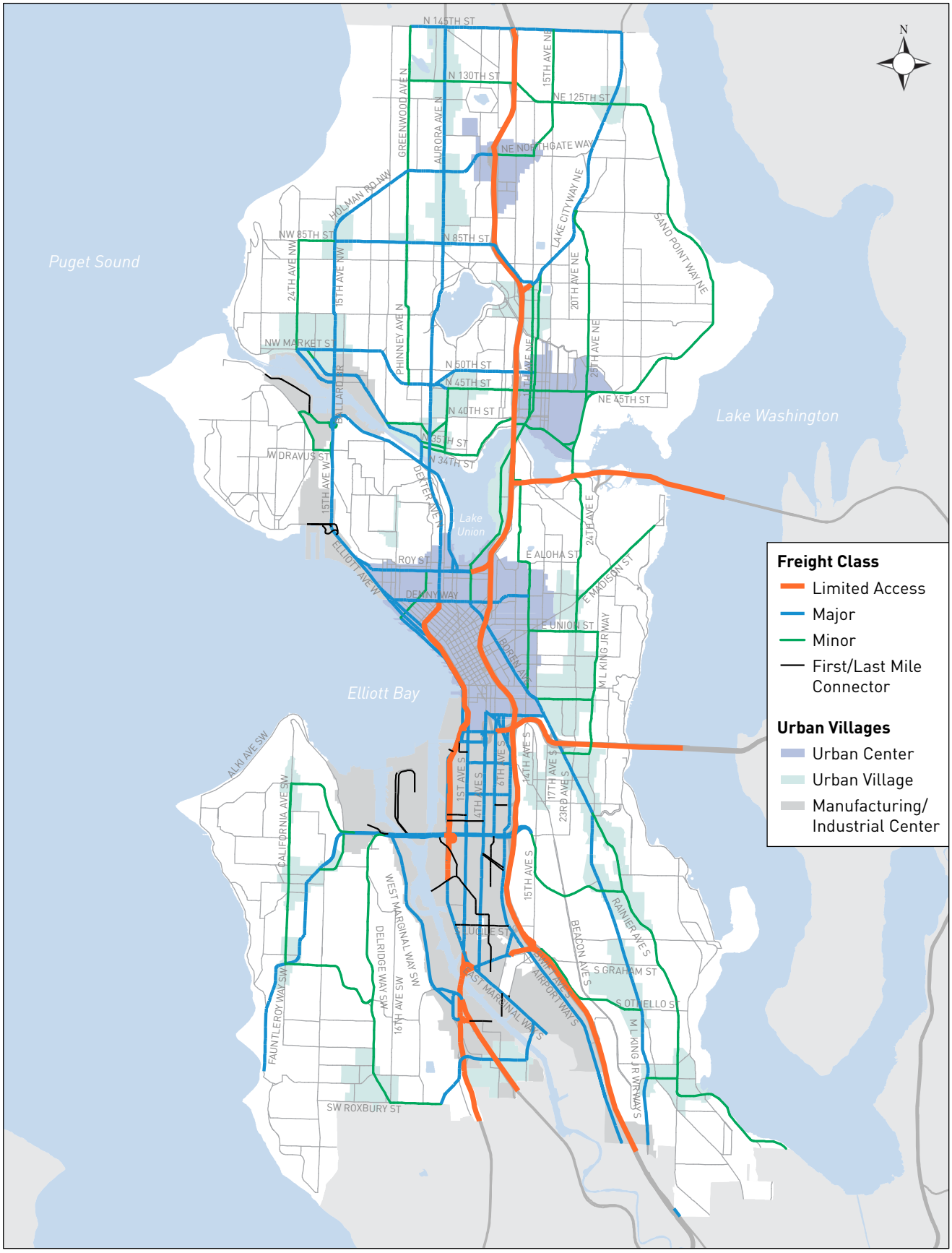
Truck volumes: 250+ trucks per day

from 0.8 to 0.9, while more severe congestion is where v/c ratios are 0.9 or higher, and are shown with a red highlight. The current forecasts show traffic congestion worsening throughout the city, particularly true in the AM and PM peak hours, where the majority of highways and major arterials in the city are expected to experience congestion. In these very congested conditions, the model will often show streets that have volumes that exceed capacity. Trips on these streets would either not be able to use the facility within the one hour time period estimated by the model and would spread into the next hour, or they would simply find an alternative route to take.

AM Peak hour congestion is expected to worsen city-wide in 2030 when compared to 2010. All areas that were congested in 2010 remain congested, but additionally, many north-south arterials entering the city from the north are also expected to experience moderate to heavy levels of congestion. These roads include:

- 3rd Avenue NW between NE 145th Street and Holman Road
- Greenwood Avenue N from north of the city limits to Holman Road
- Meridian Avenue N from north of the city limits to Northgate Way
- 1st Avenue NE between NE 145th Street and NE 92nd Street
- 5th Avenue NE from north of the city limits to Northgate Way
- Roosevelt Way NE between NE 130th Street and NE 75th Street
- Eastlake Avenue E across the Ship Canal
- 15th Avenue NE from north of the city limits to NE Ravenna Blvd
- Lake City Way NE from north of the city limits to I-5

FIGURE 18: RECOMMENDED TRUCK STREET DESIGNATION MAP



Also, several main roads that come into the city from the southeast are projected to experience moderate to heavy congestion, including:

- Rainier Avenue S between S Graham Street and Downtown Seattle
- Martin Luther King Jr Way S between S Othello Street and Rainier Avenue S
- Beacon Avenue S between S Orcas Street and S Columbian Way
- Roads in the Queen Anne area, Ballard area, and UW district are also showing additional congestion, including the following:
- Gilman Dr W between 15th Ave W and 11 Ave W
- W Dravus St east of 15th Ave W
- W Nickerson St between 15th Ave W and the Fremont Bridge
- Elliott Ave W between Denny Way and the Magnolia Bridge
- N 36th St between Fremont Ave and Leary Way
- N 45th/46th St between Fremont Ave and Stone Way
- N 50th St between Phinney Ave and Stone Way
- NE 45th St between I-5 and Sand Point Way
- 11th Ave NE between Eastlake Ave and NE 45th St

The PM Peak hour is still projected to be the most congested hour in 2030. Notable new areas of congestion beyond what were noted for AM peak conditions include:

- Westlake Ave N between the Fremont Bridge and Mercer St
- Dexter Ave N between the Fremont Bridge and Mercer St
- E Greenlake Dr N between NE Ravenna Blvd and Winona Ave N

Bottlenecks and Issues

As congestion worsens citywide, freight movement will become more challenging both in terms of mobility and travel time reliability. Since congestion worsens at an exponential rate, in a congested network relatively small day to day variations in traffic flows can cause a disproportionately large increase in travel time delays. Because congestion is widespread during peak periods and will continue to get worse in the future, it was important to identify the congestion areas that have the most impact on truck travel. To do this, locations of projected future traffic congestion were identified and overlaid on a map of projected 2035 truck volumes. Bottlenecks were classified from low to severe as shown in Figure 21. Locations that had both high levels of congestion and high truck volumes were considered to be *severe freight bottlenecks* (see Figure 22). Conversely, locations with low traffic congestion and low truck volumes were considered to be *low freight bottlenecks*. The information on bottlenecks will be used to help identify areas that need improvements in the future to improve traffic flow.

The threshold ranges used to determine the levels of congestion and truck activity are as follows:
Truck volumes:

- High – 2000 or more trucks per day.
- Medium – 1000 to 1999 trucks per day
- Low – Less than 1000 trucks per day.

Congestion:

- High – Modeled volume to capacity ratio (V/C) of 1.2 or greater
- Medium – V/C ratio between 1.05 and 1.2
- Low – V/C ratio between 0.9 and 1.05

FIGURE 19: 2030 AM PEAK HOUR CONGESTION

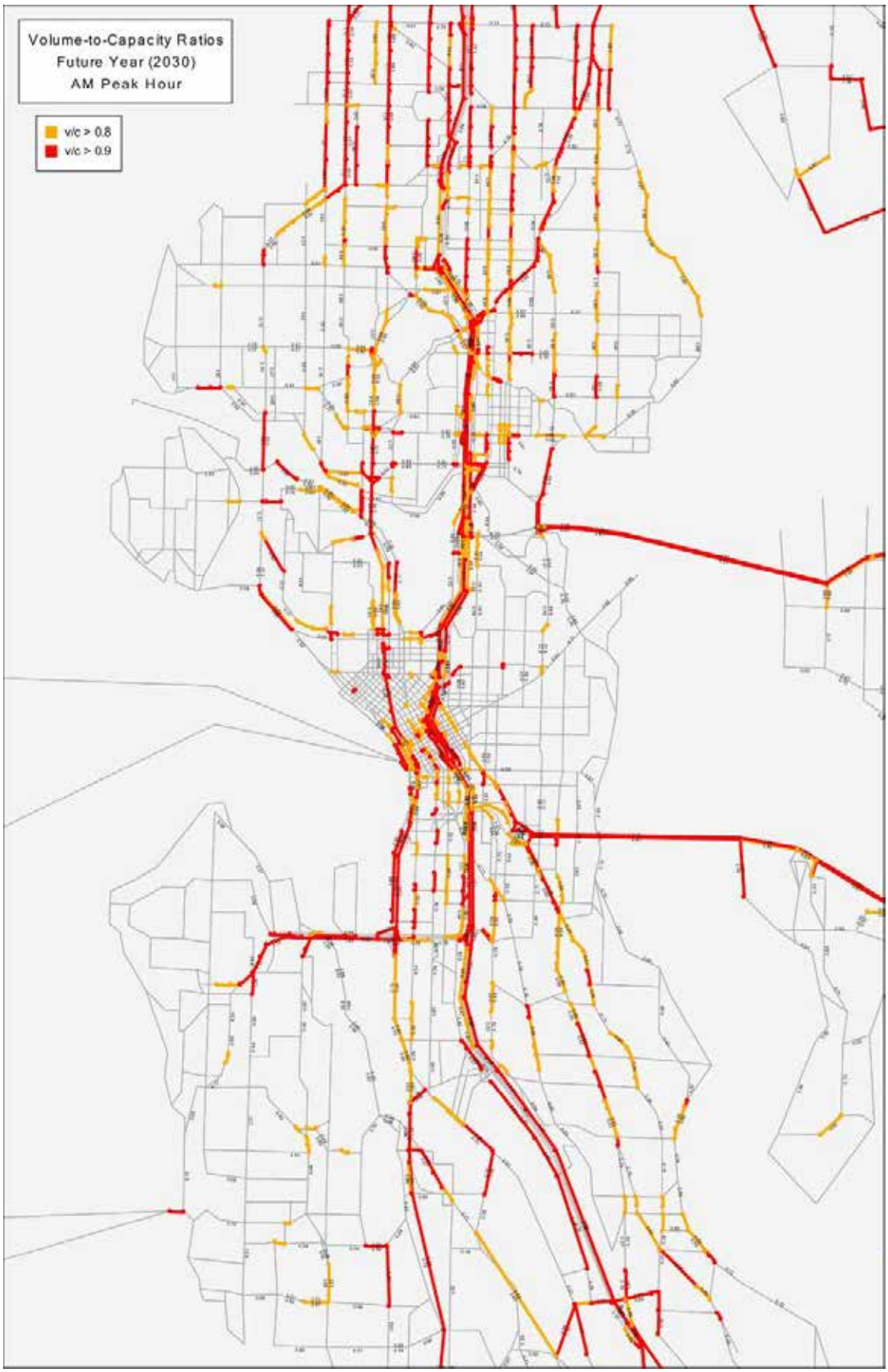


FIGURE 20: 2030 PM PEAK HOUR CONGESTION

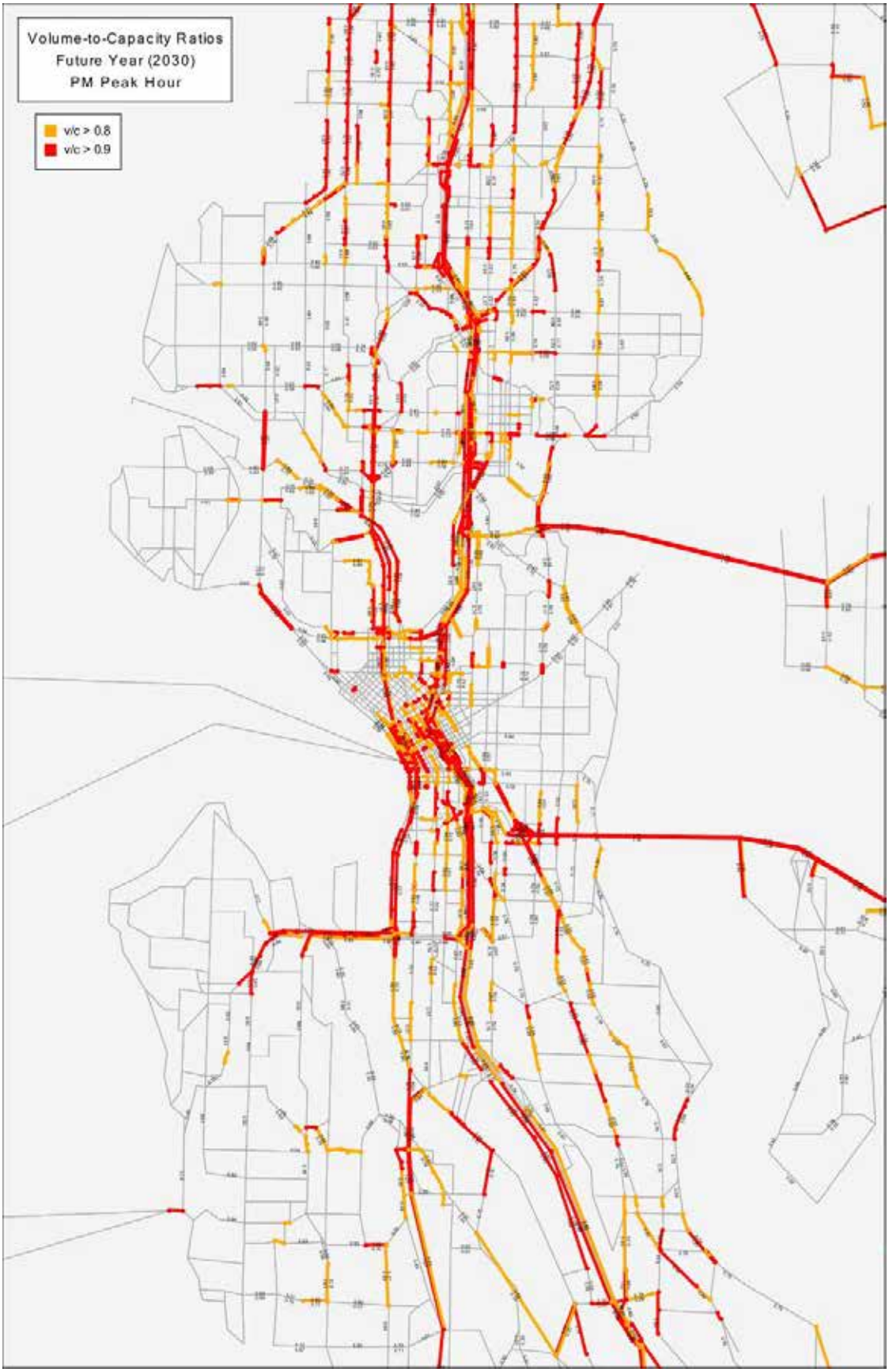
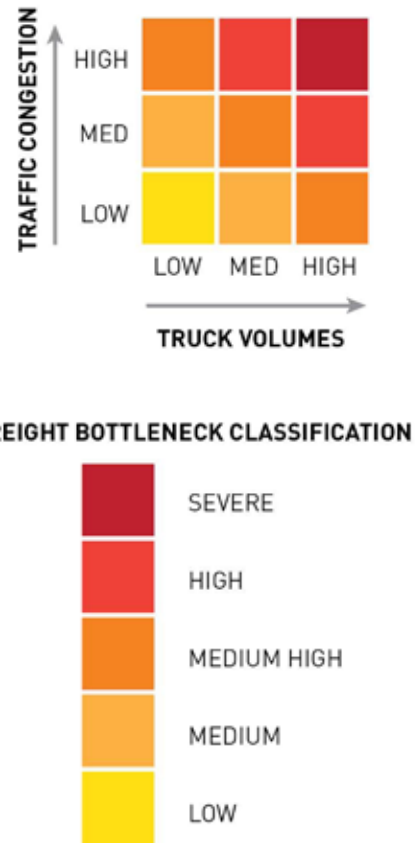


FIGURE 21: FREIGHT BOTTLENECK CLASSIFICATIONS



Congestion used for this evaluation is from the AM Peak hour because the AM period is typically more critical for freight movement. The congestion measure includes volume to capacity ratios that are greater than 1 which means there is more demand for these facilities than is currently able to be served by the existing roadway for the time period in question and, as noted in the previous section, this means in reality these vehicles would likely use an alternate route or wait until traffic is moving again before using the road. In congested areas, it is common that there is more demand than capacity for some roads.

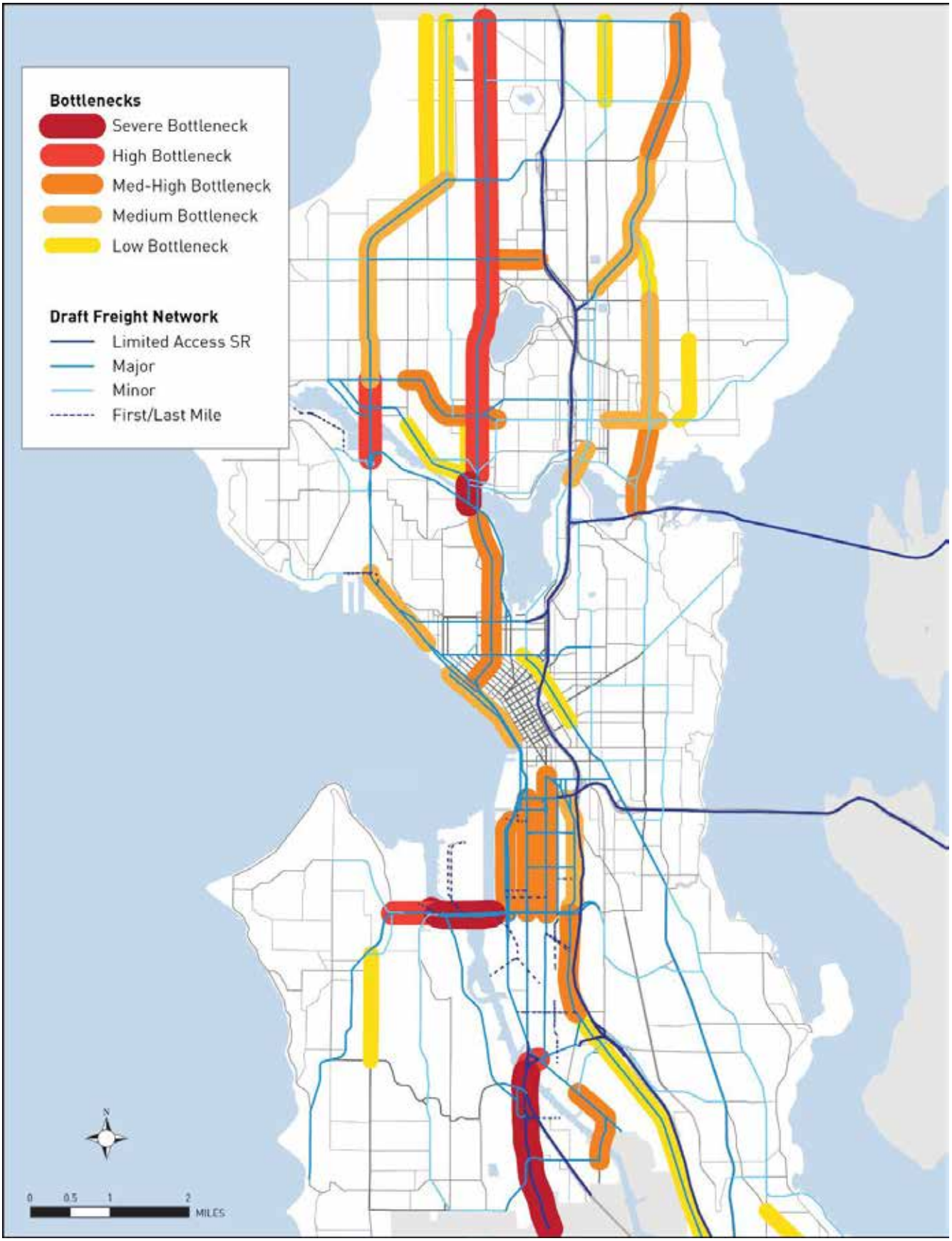
This analysis helped identify and rank severity of the traffic bottlenecks as it pertains to freight movement throughout the city. Results are shown in Table 1 and mapped in Figure 22: Truck Bottlenecks & Issues.

These bottlenecks show areas with high need of freight improvements. These were then combined with locations that experience safety issues related to truck travel to identify other sites that may need improvements to facilitate truck movements. Safety is discussed in detail in the next section; however, it is notable that many of the highest truck related crash locations also correspond with the most congested corridors.

TABLE 1: BOTTLENECKS ON SEATTLE'S TRANSPORTATION NETWORK

Severity and Location	
Severe	
Fremont Bridge	1st Ave S Bridge
West Seattle Bridge	S Spokane St
High	
15th Ave/Ballard Bridge (Nickerson St to Market St)	Aurora Ave N (north City limits to Ship Canal)
Medium-High	
E Marginal Way	N 85th St
Airport Way S	N 46th St
Montlake Blvd NE	16th Ave S
Lake City Way NE	1st Ave S
4th Ave S	15th Ave W
Montlake Bridge	Aurora Avenue N (south of Ship Canal)

FIGURE 22: TRUCK BOTTLENECKS & ISSUES



SAFETY

Vehicle collisions occur throughout the city and they have a high cost for all roadway users. The State of Washington has a Target Zero plan in place for highways with the goal of zero traffic fatalities and zero serious injuries by the year 2030. SDOT is implementing a similar plan called Vision Zero. Collisions involving trucks are perhaps even more of a concern, in that due to the relative size of vehicles, collisions can be disproportionately damaging.

A recent study conducted by SDOT, "Seattle Industrial Areas Freight Access Project", indicates that in the city's industrial areas, truck collision rates (measured in number of collisions per million vehicle miles travelled (MVMT)) are slightly lower than all vehicle collision rates. Though analysis performed for the Freight Master Plan indicates that on a city wide level, truck collision rates are relatively similar to all vehicle collision rates.

CITY WIDE COLLISION STATISTICS

Table 2 summarizes collisions in the city for all vehicle types by severity category over the past five and one-half years. Over this period, while the number of collisions by individual category per year fluctuates, the overall number of collisions has remained relatively constant. This is likely due to a number of reasons, but the fact that total vehicle miles of travel (VMT) has also not increased significantly over this timeframe is probably the most substantial reason.

Over the past five and one-half years, over 60% of total collisions in the city resulted in vehicle damage only, meaning there were no reported injuries as a result of the crash. Roughly a quarter of the collisions resulted in an injury, though less than 0.2% of total collisions involved a fatality.

TABLE 2: ALL MOTOR VEHICLE COLLISIONS BY YEAR AND SEVERITY

Year	Fatality	Serious injury	Injury	Property Damage Only Collision	Unknown	Grand Total
2009	24	200	3377	8354	1317	13272
2010	18	177	3228	7523	1151	12097
2011	10	140	3096	7810	1364	12420
2012	19	177	3464	7446	1861	12967
2013	22	156	3320	7582	1754	12834
2014*	6	59	1394	3373	169	5001
Grand Total	**99**	**909**	**17879**	**42088**	**7616**	**68591**
% of Total	**0.14%**	**1.3%**	**26.1%**	**61.4%**	**11.1%**	

*Through June 7, 2014

Table 3 summarizes truck collisions in the City. It shows that truck collisions have actually increased very slightly in 2013 compared to the previous years, which may correspond to increased goods movement as a result of the economic recovery. Over 78% of truck collisions resulted in property damage only (compared to 60% for all vehicles) and just less than 20% resulted in injuries (compared to 25% for all vehicles). However, while those numbers compare favorably to all vehicle collisions there were proportionately more fatalities as a result of truck collisions (about 0.3% of total truck collisions). The slightly greater propensity for fatalities in collisions involving trucks may be due to the sometimes significant differences in sizes of vehicles involved in truck collisions, particularly truck collisions with other modes (i.e., passenger cars, bicycles or pedestrians).

TABLE 3: TRUCK COLLISIONS BY YEAR AND SEVERITY

Year	Fatality	Serious injury	Injury	Property Damage Only Collision	Unknown	Grand Total
2009	1	4	99	502		606
2010	1	8	87	448	1	545
2011		5	85	391		481
2012	4	8	92	449	2	555
2013	2	6	124	311	38	481
2014*		1	44	101	8	154
Grand Total	**8**	**32**	**531**	**2202**	**49**	**2822**
% of Total	**0.3%**	**1.1%**	**18.8%**	**78.0%**	**1.7%**	

*Through June 7, 2014

Table 4 shows truck collisions by type of truck. Collisions involve all types of trucks, but over 60% of incidents are smaller trucks. This corresponds to data from the regional Travel Demand Forecasting model that indicates that single unit trucks account for approximately two-thirds of the truck vehicle miles traveled (VMT) within the City of Seattle.

TABLE 4: TRUCK COLLISIONS BY TRUCK TYPE AND SEVERITY

Collision Severity	Truck (Flatbed, Van, etc)	Truck and Trailer	Truck Tractor	Truck Tractor and Semi-Trailer	Double Trailer Combinations	Grand Total
Fatality	4	1		2	1	8
Serious Injury	24	3		5		32
Possible or Evident Injury	360	35	13	119	4	531
Property Damage Only	1330	186	66	601	19	2202
Unknown	28	8	1	11	1	49
Grand Total	**1746**	**233**	**80**	**738**	**25**	**2822**
% of Total	**62%**	**8%**	**3%**	**26%**	**1%**	

Table 5 shows the percentage of total collisions (all vehicles) that involved trucks by severity type. Overall, collisions involving trucks range from 4 to 5 percent of all collisions in the city. This is also generally consistent with results from the regional Travel Demand Forecasting model which indicates that trucks account for just over 4 percent of the VMT traveled in the city.

There was a relatively high share of truck collisions that resulted in fatalities in 2012 and 2013. While these stick out as outliers that warrant further investigation, there does not seem to be a pattern or vicinity more prone to these fatal collisions. The total 5 ½ year period results indicate that on average trucks represent a higher proportion of fatal collisions (8.1 percent) as compared to overall traffic than any other type of collision. As discussed earlier, this may be due to the sometimes significant differences in sizes of vehicles involved in truck collisions. Freight stakeholders noted the challenges of interacting with other modes, particularly in terms of predictability in terms of their movements.

TABLE 5: PERCENTAGE SHARE OF TRUCK COLLISIONS WITH RESPECT TO OVERALL COLLISIONS

	Fatality	Serious Injury	Injury	Property Damage Only Collision	Unknown	Grand Total
2009	4.2%	2.0%	2.9%	6.0%	0.0%	4.5%
2010	5.6%	4.5%	2.7%	6.0%	0.1%	3.9%
2011	0.0%	3.6%	2.7%	5.0%	0.0%	4.3%
2012	21.1%	4.5%	2.7%	6.0%	0.1%	3.7%
2013	9.1%	3.8%	3.7%	4.1%	2.2%	3.1%
2014*	0.0%	1.7%	3.2%	3.0%	4.7%	4.1%
Grand Total	**8.1%**	**3.5%**	**3.0%**	**5.2%**	**0.6%**	**4.5%**

*Through June 7, 2014

Location Specific Collisions

Figure 23 shows locations of truck collisions in the city that occurred from 2009 through mid-2014, and specifically identifies those that occurred between trucks and non-motorized modes—bicycles and pedestrians. Each dot in the figure represents one collision. As shown in the figure, while truck collisions occur throughout the city, incidents that involve trucks and either bicycles or pedestrians are particularly concentrated in the CBD and University District, as well as other neighborhood centers such as Fremont, Belltown, SoDo, Capitol Hill (along Broadway) First Hill (along 12th Avenue), and Columbia City (along MLK Jr. Way S and Rainier Avenue S). These and other urban village areas are where there are generally high numbers of walkers and bicyclists in combination with high truck traffic volumes.

Figure 24 identifies truck collisions city wide by intersection or other conflict point for 2009 through mid-2014. As represented by the two largest circles in the figure, high truck collision locations (with greater than 1 collision per year average across the 6 year period) include the following:

- Holman Road NW/Greenwood Avenue N
- Valley Street/Fairview Avenue N
- SR 99 and the Western/Battery Street ramps
- SR 99 north of the WOSCA detour (near Main Street)
- SR 99 south of the WOSCA detour (near Edgar Martinez Drive S)
- S Horton Street/4th Avenue S
- SW Spokane Street/West Marginal Way SW
- S Spokane Street/East Marginal Way S/SR 99
- S Spokane Street/1st Avenue S
- S Spokane Street/4th Avenue S
- Diagonal Avenue S/SR 99
- S Dawson Street/4th Avenue S
- East Marginal Way S/SR 99/1st Avenue S
- S Michigan Street/East Marginal Way S

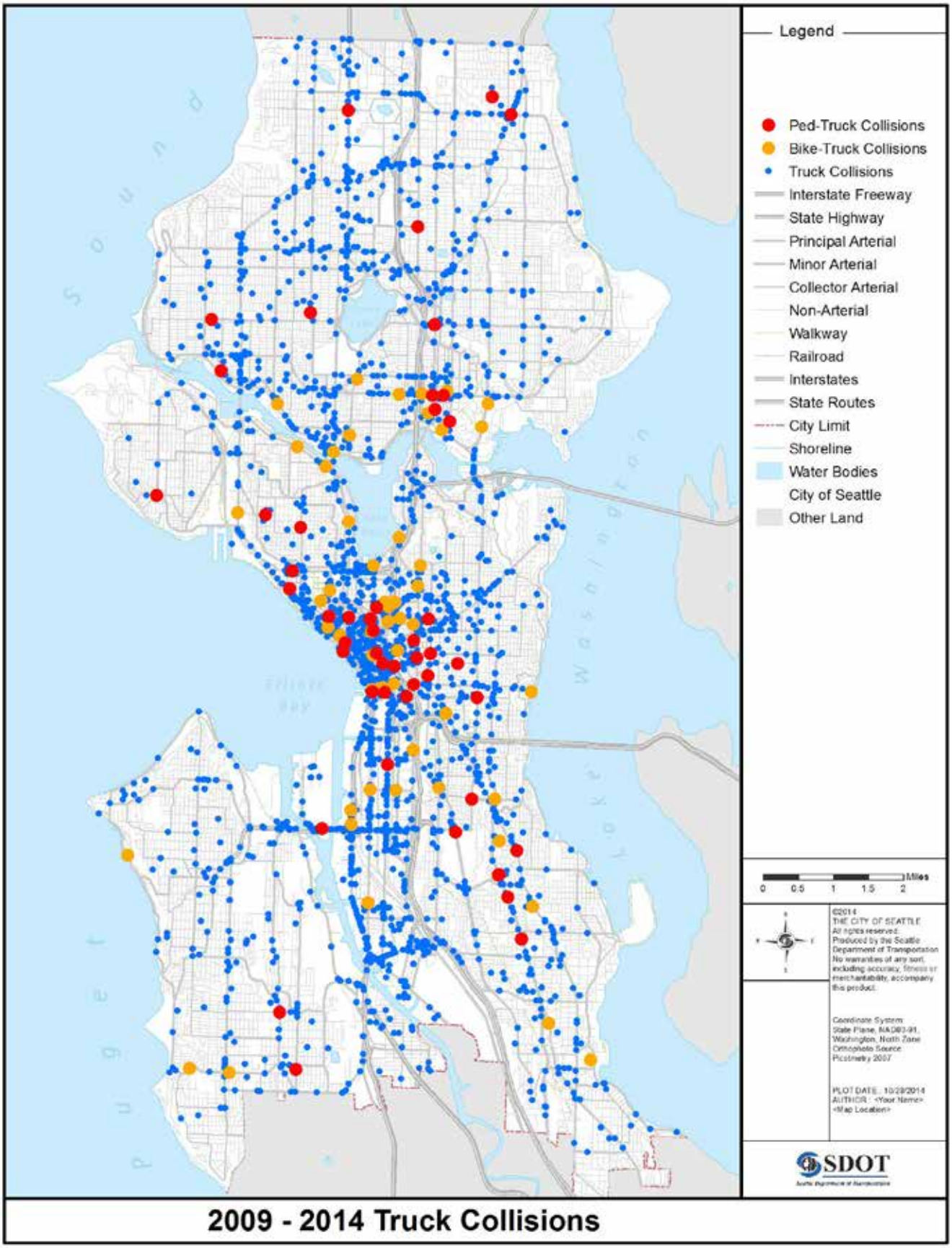
Corridors or sub-areas experiencing a relatively high concentration of truck collisions (with 10 or more collisions within a half block) are shown in Table 6.

TABLE 6: TRUCK COLLISION – HIGH CONCENTRATION SEGMENTS

Segment
North
15th Avenue NW*
NW Market Street* and NW Leary Way northwest of Ballard Bridge
NE 50th and NE 45th Streets near I-5
Aurora Ave north of Greenlake
Downtown Area
Mercer*/Roy/Broad/Valley Streets between 5th Avenue N and Fairview Avenue N
Boren Avenue between Denny Way and Pike Street
1st Ave S / Yesler Way
I-5 ramps/James Street
South
S/SW Spokane Street between Delridge Way SW and I-5
1st Ave S / South Holgate St
SR 99 between S Dawson Street and First Avenue S Bridge*
S Michigan Street between SR 99 and I-5

*Segment includes a top ten crash location listed in Figure 24.

FIGURE 23: TRUCK COLLISIONS BY MODAL TYPE BY LOCATION – 2009 THROUGH MID-2014



Many of these corridors correspond to areas with high truck activity as shown on the daily truck flow map (Figure 6), such as the Duwamish and Ballard/Interbay MICs. These high collision segments are also shown graphically in Figure 24.

Areas with high concentrations of truck collisions without high truck activity (less than 1000 trucks per day) include:

- NE 45th Street near I-5
- Broad Street between Denny Way and Alaskan Way
- Wall St between 4th and Alaskan Way

These locations merit further investigation as to the cause of the higher concentration of truck collisions.

In order to further understand the potential causes of truck collisions, the truck crash locations were overlaid on collisions involving all vehicles. Collisions by intersection over the same time period for all vehicles in comparison to those involving trucks are shown in Figure 25 and Figure 27 for north Seattle plus the CBD, and for south of the CBD, respectively.

Aggregating crash incidents at intersections and conflict points highlights some areas and corridors that have relatively high truck crash incidents. In general, high truck crash locations correspond with high vehicle crash locations except in industrial areas such as Duwamish where high truck volumes exist.

Overall, locations with high truck collisions correspond to facilities that also have a high volume of trucks. To identify more specifically high truck collision locations relative to the amount of truck activity at that particular location, a truck collision index was calculated. The index is a function of the number of collisions at a given intersection or conflict point divided by daily truck volumes through that location. Table 7 lists high crash locations and their corresponding collision index. Figure 28 shows these locations on a map, in combination with the high collision segments discussed previously.

TABLE 7: HIGH TRUCK COLLISION INDEX LOCATIONS

Rank	Annual Trucks	Truck Collisions Per Year	Collisions Per Million Trucks	Site Description
1	146,000	1.66	11.4	Fairview Ave N & Valley St
2	365,000	2.03	5.4	SR-99 & Diagonal Ave S
3	255,500	1.29	4.9	15th Ave W & NW Market St
4	292,000	1.47	4.8	Yesler Way & James St
5	365,000	1.66	4.7	S Jackson St & Alaskan Way S
6	182,500	0.74	4.0	University St & 6th Ave
7	547,500	1.66	3.1	SR-99 & SR-509 Junction
8	255,500	0.74	3.0	S Dearborn St & Rainier Ave S
9	365,000	1.10	3.0	SR-99 & S Idaho St
10	511,000	1.47	2.9	Highland Park Way & 2nd Ave SW

FIGURE 24: TRUCK COLLISIONS BY INTERSECTION – ENTIRE CITY – 2009 THROUGH MID-2014

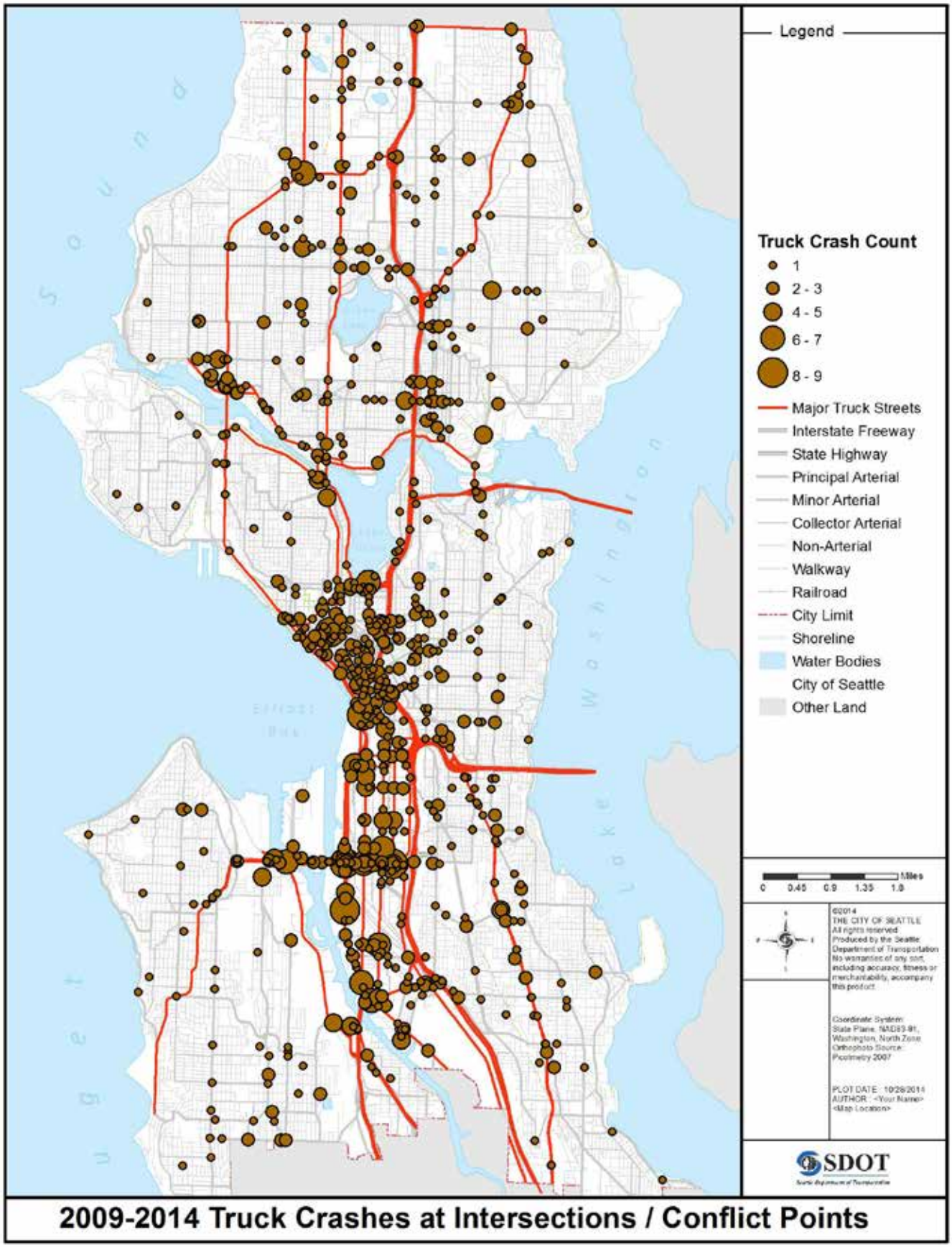


FIGURE 25: TRUCK AND ALL VEHICLE COLLISIONS BY INTERSECTION – CBD AND NORTH – 2009 THROUGH MID-2014

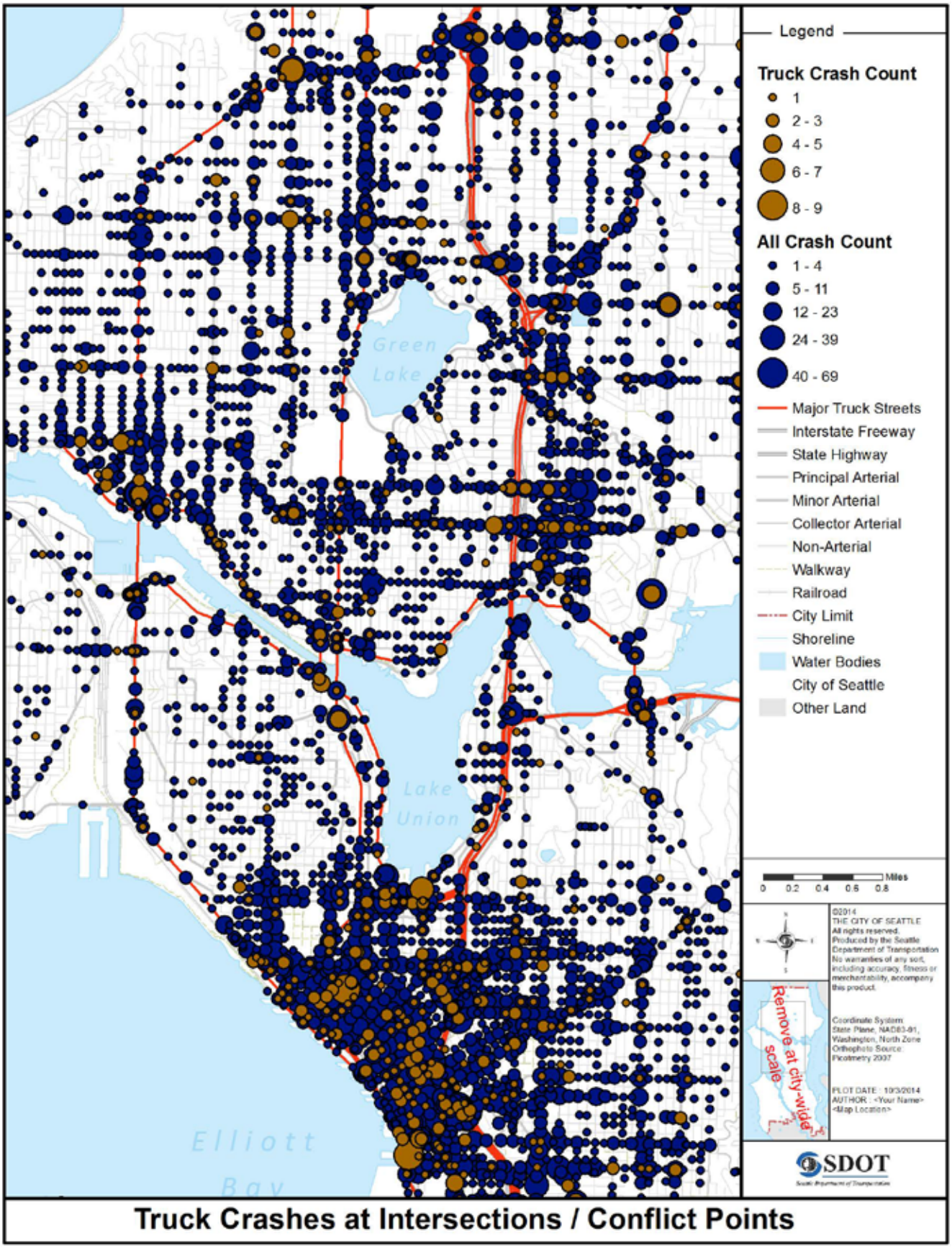


FIGURE 26: TRUCK AND ALL VEHICLE COLLISIONS BY INTERSECTION – CBD – 2009 THROUGH MID-2014

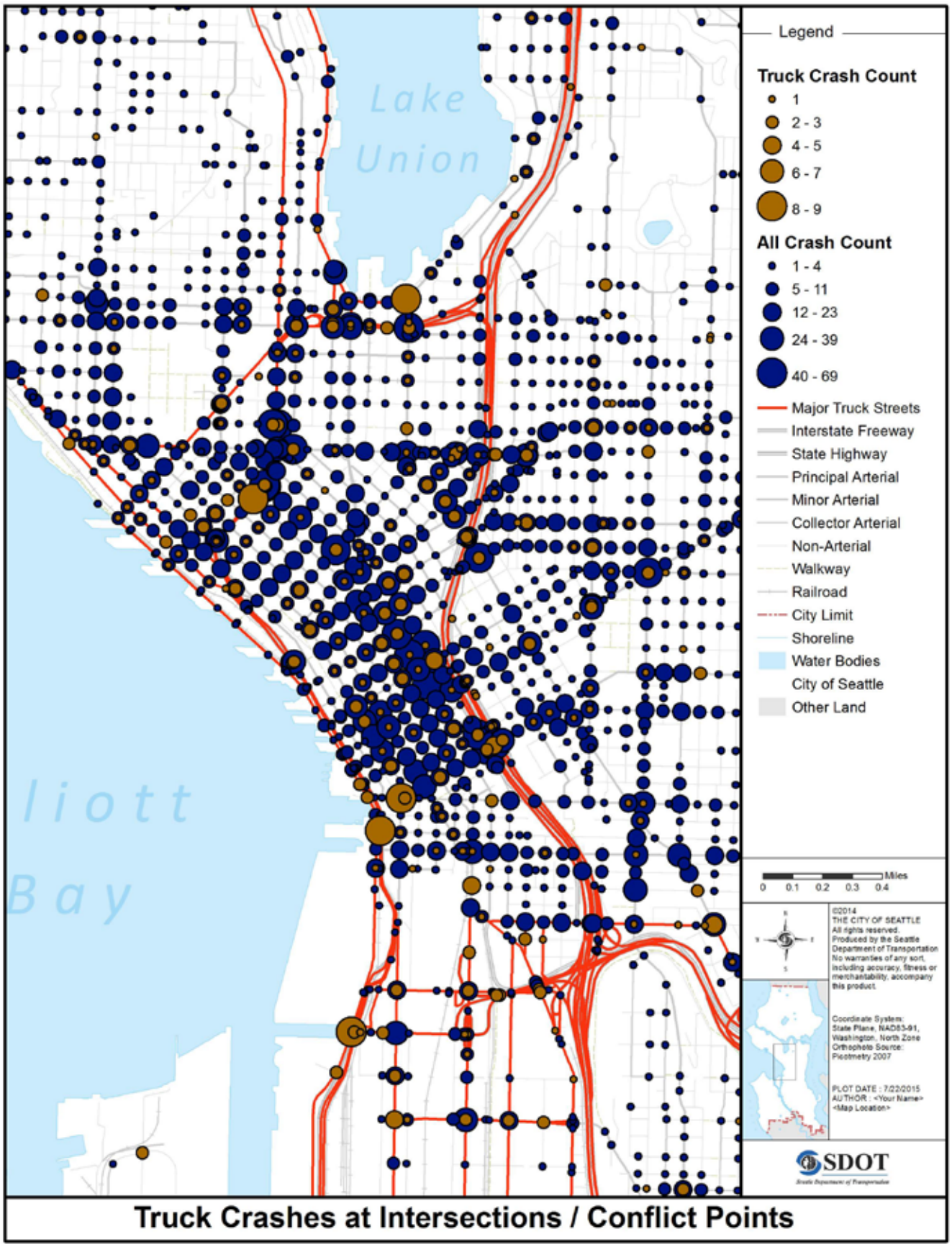


FIGURE 27: TRUCK COLLISIONS BY INTERSECTION – SOUTH OF CBD – 2009 THROUGH MID-2014

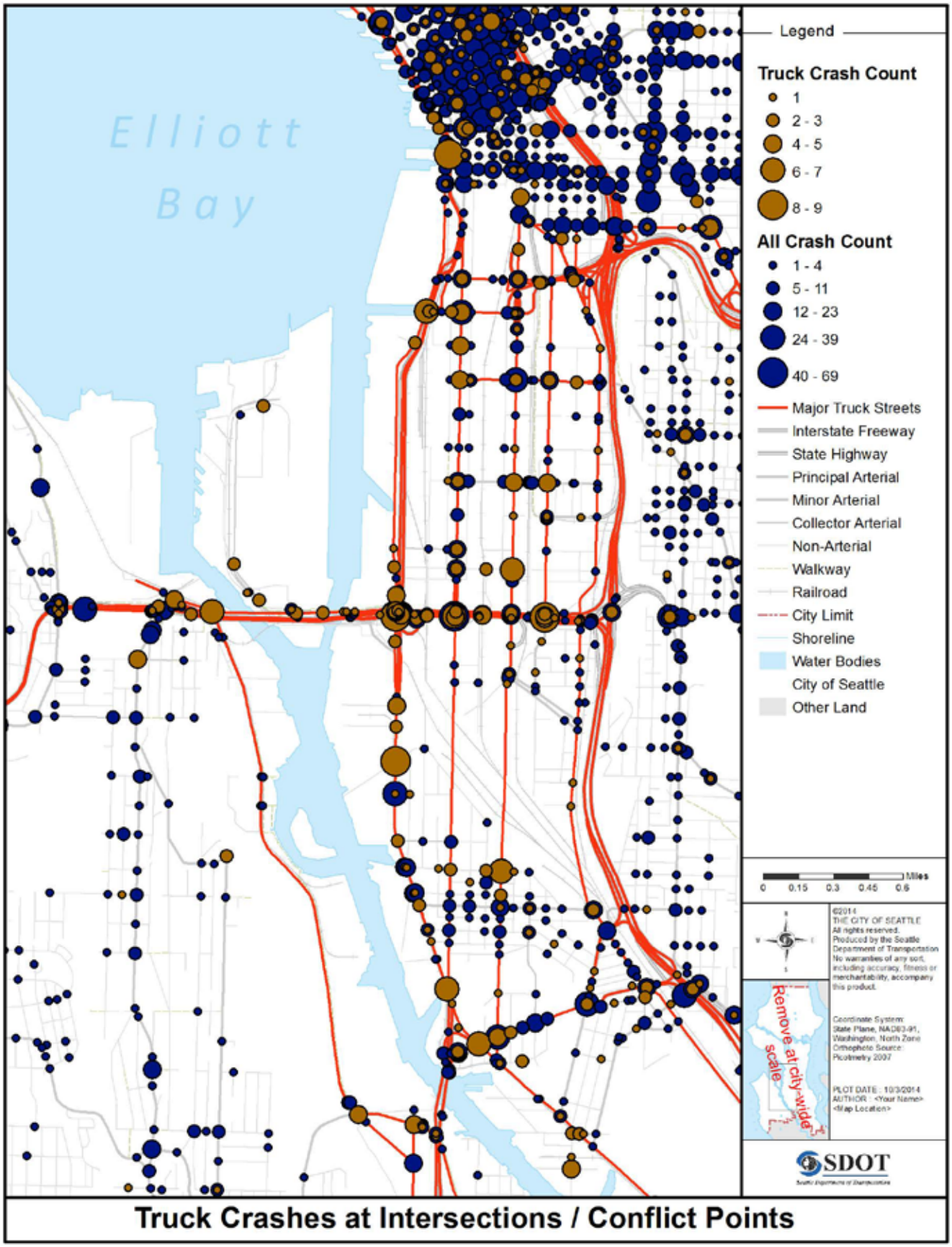


FIGURE 28: HIGH TRUCK COLLISION SEGMENTS AND TRUCK COLLISIONS PER MILLION TRUCKS

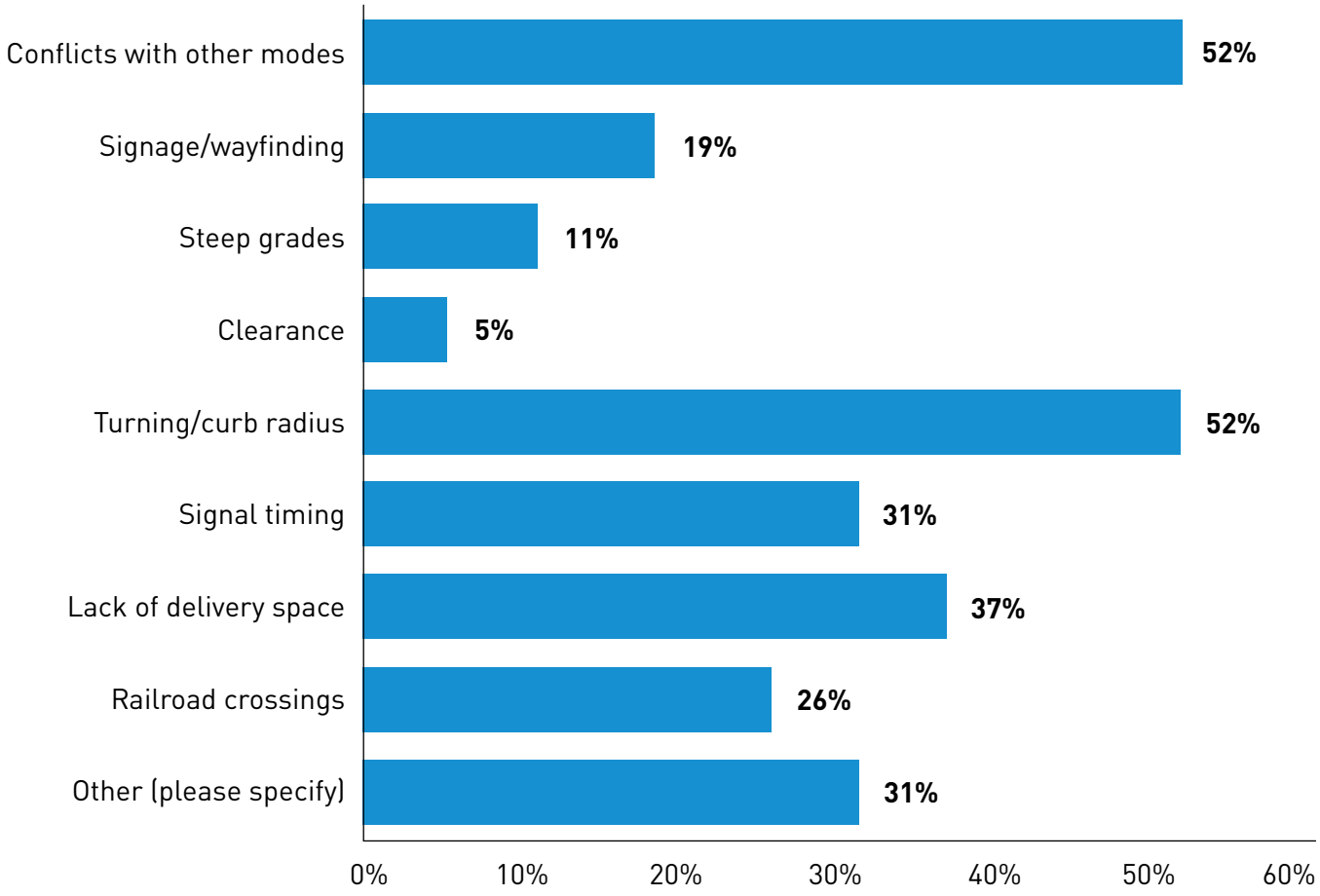
Location numbers reflect rankings as shown in Table 7

As can be seen, the site with the highest index, based on collisions per million trucks, is Fairview Avenue N at Valley Street. This intersection was formerly part of the westbound couplet to eastbound Mercer Street, and vehicles were required to make a succession of turns from I-5 to Valley Street, which may have contributed to additional sideswipe collisions involving trucks. The Mercer East project completed this past year has converted Mercer Street to two-way operation and reconfigured the Fairview Avenue N/Valley Street intersection. Therefore, it is likely that truck-related collisions at this location will decline due to these changes. Additionally, several locations on SR-99 are among the highest crash locations in the city. These include intersection with Diagonal Avenue S, SR-509 and S Idaho Street. These locations are located in a 1.5 mile long section south of the West Seattle Bridge. All have over 3000 trucks per day at the intersections.

Stakeholder Input

Stakeholder concerns about safety, summarized in Figure 29, primarily relate to conflicts with other modes and the adequacy of turning/curb radii. Curbs and turning radii are often cited as an issue in congested areas like the CBD, as trucks have limited space to make turns into lanes that are narrow. This can be a safety concern if drivers have to use the entire street to make a turn. It also can be concern if traffic has to come to a stop in an unexpected place while a truck negotiates into loading/unloading position.

FIGURE 29: STAKEHOLDER ONLINE SURVEY: TOP SAFETY CONCERNS



BICYCLE AND PEDESTRIAN CONFLICTS WITH TRUCKS

Regarding other modes, truck conflicts with bicycles and pedestrians are a primary safety concern. A review of crash data reveals that there were 2822 total truck collisions within the city of Seattle between 2009 and 2014, and of these 8 resulted in a fatality. Of these, 55 were truck-bicycle collisions, and one of those involved a fatality (see Table 8); while there were 51 truck-pedestrian collisions, with four of those resulting in a fatality (see Table 9).

TABLE 8: TRUCK & BIKE COLLISIONS

Truck-Bike Collisions	Fatality collision	Serious injury collision	Possible or evident injury collision	Property Damage Only Collision	Unknown	Grand Total
2009			4	1		5
2010		1	5			6
2011		1	3	3		7
2012		1	10	1		12
2013	1	2	15	1		19
2014			4	1	1	6
Grand Total	**1**	**5**	**41**	**7**	**1**	**55**
All Truck Collisions	**8**	**32**	**531**	**2202**	**49**	**2822**
Share	**13%**	**16%**	**8%**	**0%**	**2%**	**2%**

TABLE 9: TRUCK & PEDESTRIAN COLLISIONS

Truck-Ped Collisions	Fatality collision	Serious injury collision	Possible or evident injury collision	Property Damage Only Collision	Grand Total
2009	1		4	1	6
2010	1	2	8		11
2011		2	5		7
2012	1	1	4		6
2013	1	1	13		15
2014			6		6
Grand Total	4	6	40	1	51
All Truck Collisions	**8**	**32**	**531**	**2202**	**2822**
Share	**50%**	**19%**	**8%**	**0%**	**2%**

TABLE 10: BIKE AND PEDESTRIAN COLLISIONS BY INJURY TYPE

2009-2014	Fatality collision	Serious injury collision	Possible or evident injury collision	Property Damage Only Collision	Grand Total
Bike/Ped-Truck Collisions	**5**	**11**	**81**	**8**	**106**
All Truck Collisions	8	32	531	2202	2822
Share	63%	34%	15%	0%	4%

There were about 4000 bike and pedestrian collisions in Seattle in the 5 ½ years of data. 6% of collisions of all vehicle types involve bikes or pedestrians. As seen in Table 10, bikes and pedestrian collisions with trucks make up 4% of the total number of truck collisions.

These incidents resulted in 63% of the fatal truck collisions and 34% of the serious injury collisions, which is real cause for concern. It is not surprising to see when there are collisions between trucks and non-motorized road users, there are often injuries or even fatalities.

Regardless of fault, if any, the laws of physics mean that most if not all of these injuries or deaths are incurred by the walker or biker, rather than the truck driver.

To address these serious concerns, the plan should include recommendations to improve multi-modal safety. In addition to recommendations regarding physical modifications, driver/rider/walker education awareness and education programs should be considered. These programs can provide big benefits throughout the City at a relatively low cost.

OTHER CHALLENGES TO FREIGHT MOBILITY

SIGNAGE

Three types of truck-specific signage are used within the city: regulatory, guide, and warning signs. Guide signs are mostly focused on the Major Truck street system as shown in Figure 30. Regulatory signs include loading zone designations, parking restrictions, and weight restrictions. Examples of warning signs include bridges with height restrictions, tight turns, and steep grades. Some stakeholders mentioned signing as a safety issue in different ways: 1) if wayfinding signs are not adequate, truckers unfamiliar with the area can get lost and wind up on streets not fit for trucks, potentially creating safety issues; 2) parked cars along freight routes can impede truck travel and present safety issues. Placing and enforcing 'no parking' signage would help; and 3), one stakeholder stated that pedestrians and cyclists not paying attention while traveling are most at risk, e.g., when they have headphones on, etc. Placing signs to warn pedestrians and cyclists of heavy truck activity in the area, and encouraging them to remove their earbuds and pay attention may improve safety.

Over one third (37%) of respondents to the freight stakeholder survey were not aware of the Major Truck Street system (Figure 31) This suggests that more information for truck drivers and more on-street signage could make the Major Truck Streets more easily utilized and navigated.

Both the online and in-person stakeholder interviews indicated that signage and way-finding complications were a safely concern, particularly for drivers unfamiliar with Seattle that may find themselves in areas not suited for trucks if way-finding is lacking. Finally, stakeholders were also concerned about detour routes for construction and how easily navigable they are for truck drivers.

The Major Truck Street System should be well known to the truck drivers. Improved or additional signage that is consistent throughout the city may assist way finding for the drivers. Major truck industries should also be informed of the system and its purpose.

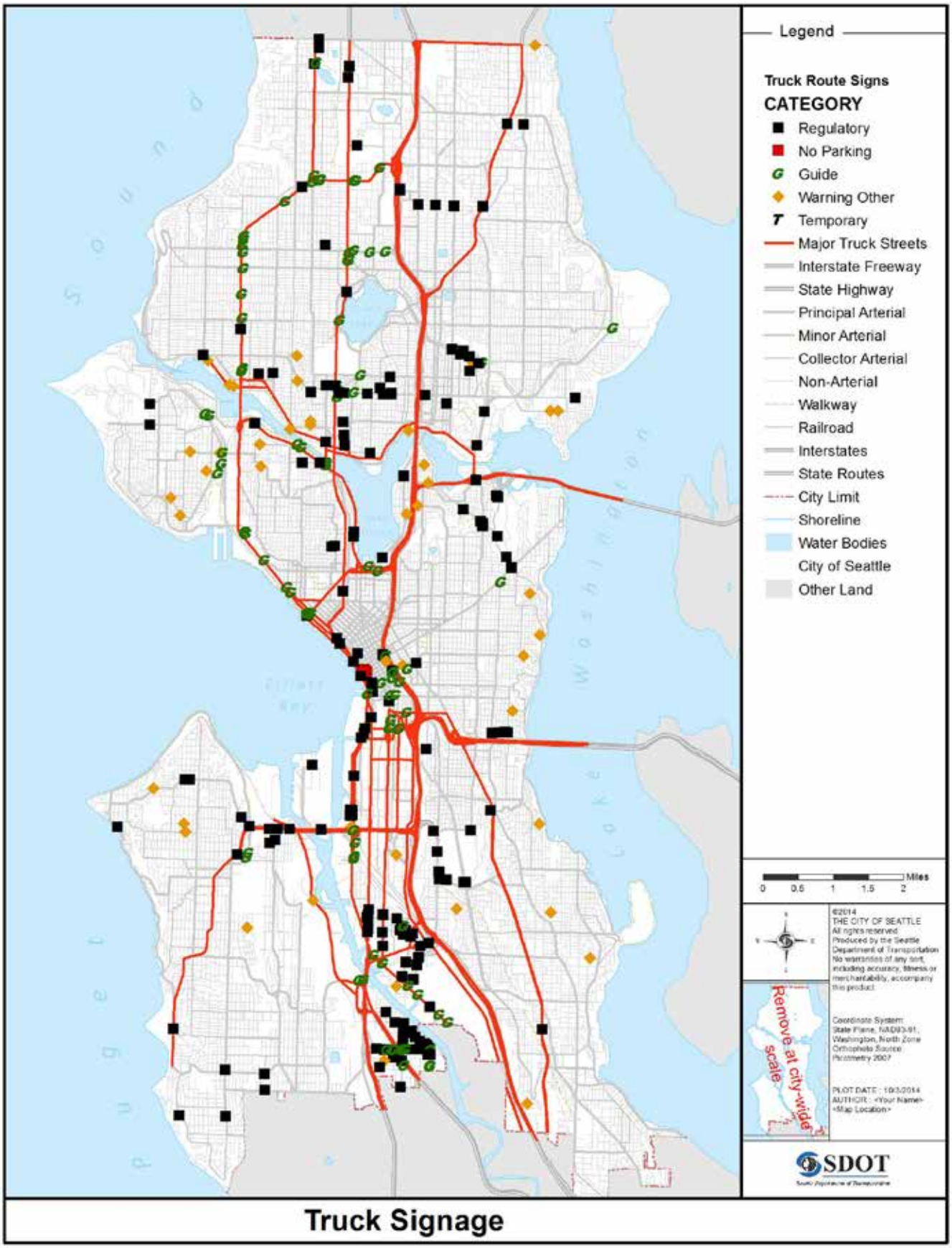
TRUCK MOBILITY CONSTRAINTS

Moveable Bridges

There are six bascule (draw) bridges and one swing bridge that can disrupt vehicular traffic on major arterials in Seattle. Four of these bridges—Montlake (WSDOT Owned/operated), University, Fremont and Ballard—cross the Lake Washington Ship Canal, and are a bottleneck to all north-south traffic between downtown and north Seattle. Three of the bridges—Spokane Street, First Avenue S and South Park—cross the Duwamish River. The South Park Bridge is owned by King County, but is operated by SDOT.

When bridges are open to allow a vessel to pass through, they can cause very long vehicle queues and lingering congestion. This is most prevalent during the "boating season" (late spring, summer, and early fall) when a larger number of recreational private sailboats require bridge openings. Those that cross the Ship Canal will not open for vessels under a certain size during the weekday peak commute hours. Table 11 summarizes the restrictions on each bridge. Since trucks travel throughout the day (to meet delivery times or avoid peak period congestion, when possibly), they are affected by off-peak bridge opening delays.

FIGURE 30: TRUCK SIGNAGE



Truck Signage

FIGURE 31: ONLINE STAKEHOLDER SURVEY - USAGE OF MAJOR TRUCK STREETS

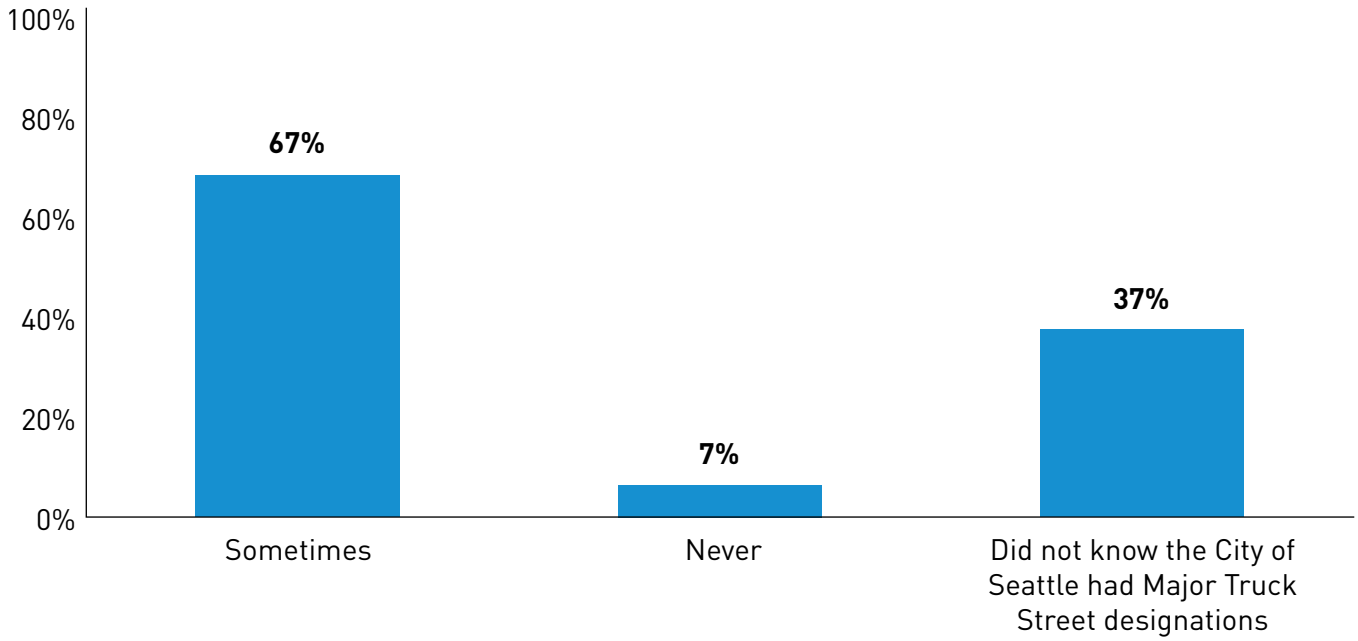


TABLE 11: SEATTLE'S MOVEABLE BRIDGES

Bridge	Owner	Weekday Restricted Period[a]	Summer Restricted Period	Exceptions for Vessels[b]
Montlake Bridge	WSDOT	7:00 -9:00 AM 3:30 – 6:30 PM	7:00 -10:00 AM 3:30 – 7:00 PM	>1,000 tons
University Bridge	City	7:00 -9:00 AM 4:00 – 6:00 PM	Same	>1,000 tons
Fremont Bridge	City	7:00 -9:00 AM 4:00 – 6:00 PM	Same	>1,000 tons
Ballard Bridge	City	7:00 -9:00 AM 4:00 – 6:00 PM	Same	>1,000 tons
Spokane Street Swing Bridge	City	No Restrictions	No Restrictions	
First Avenue S Bridge	WSDOT	6:00-9:00 AM		
3:00-6:00 PM	No Restrictions	>5,000 tons		
South Park Bridge	King County (Operated by SDOT)	6:30-8:00 AM		
3:30-5:00 PM	No Restrictions			

a. Bridge will not open for vessels during restricted period unless they exceed the exception vessel size.
b. Bridges will open, even during restricted periods, for vessels that exceed this size.[7]

[7]CFR 33 Chap. I, sub chap J, 117.1041 and 117.1051

Downtown Traffic Control Zone and Denny Way Restrictions

Trucks longer than 30 feet are prohibited from entering the Downtown Traffic Control Zone between 7:00 AM and 7:00 PM except with a permit (Seattle Municipal Code (SMC) Ordinance 108200 Section 11.14.165). The Downtown Traffic Control Zone extends from Yesler Way on the south to Lenora Street on the north and from 8th Avenue on the east to 1st Avenue on the west. The SMC also prohibits large trucks (over 30-feet long, 8 feet wide, or 32,000 pounds gross weight) from using the following three streets during the commuter peak periods (7:00 to 9:00 AM and 4:00 to 6:00 PM) (SMC 11.62.120):

- Aurora Avenue North. From the north City limits to Denny Way.
- Boren Avenue and Boren Avenue South. From Virginia Street to South Jackson Street; and
- Denny Way between Western Avenue and Olive Way;

Over-legal permit and/or validation number is required for movement within the Downtown Traffic Control Zone between the hours of 7 PM and 6 AM.

Height/Weight Restrictions

Bridge and traffic control zone travel restrictions for trucks as well as dynamic message signs are shown in Figure 32, including several bridge weight restrictions for trucks throughout the city. Most are not on Major Truck Streets, but still need to be considered for trucks making deliveries to local businesses and residences. Additionally, there will be restrictions on trucks hauling hazardous or flammable materials in the new Alaskan Way Viaduct tunnel, similar to restrictions in the current Battery St tunnel.

Rail Crossings

There are many at-grade rail crossings throughout the city, which are also shown in Figure 32. A more detailed look at the crossings, as well as the rail lines through the city, is shown in Figure 33. At-grade rail crossings can be a barrier to truck movements, with particularly large impacts in high truck activity areas such as the Duwamish MIC and Broad St crossing. For example, studies of the South Holgate Street railroad crossing have documented that the average amount of time the train gates are closed is between 11 and 13 minutes per hour throughout the day[8]. However rail movements are also vital for freight movement to/from the Port; hence prioritizing one over the other creates difficult trade-off decisions. One example of conflicts between rail and truck freight activities relates to the drayage of containers from Terminal 46 to the Seattle International Gateway (SIG) yard to load them on trains. The most direct route between Terminal 46 and the SIG is via South Atlantic Street. However, loading the trains at SIG requires the use of a tail track that crosses Atlantic Street. This blockage has lasted for up to 30 minutes in the past and has significantly impeded the drayage movements. As part of the Alaskan Way Viaduct Program however, a grade separated bypass over the tail track was built which is now used by trucks whenever the tail track is occupied by trains, greatly reducing delay to trucks.

While this one issue has been resolved, other conflicts remain. Stakeholders are particularly concerned with the number of at-grade rail crossings in the SoDo and Port areas—such as the rail crossing of South Holgate Street. They would like to see select crossings grade separated to make travel times more reliable for freight trucks.

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[8]South Holgate Street Railroad Crossing Study – Phase II Final Report, SDOT, January 2010.

Geometric Constraints

Stakeholders have said that geometric constraints are one of the top two safety concerns within the city. Some respondents indicated that many of the conflicts drivers face were due to rerouting onto local streets in an attempt to avoid congestion. These roads are often narrow and are not always designed with large trucks in mind. An example common on some local streets would be traffic calming devices like neighborhood traffic circles or cars parked too close to the intersections.

This concern would need to be addressed carefully and balance the needs of freight against residential livability. While all streets need to allow local deliveries, many local arterial streets are not appropriate for very large trucks. It would be appropriate to prioritize improvements to arterials that are on the truck network in order to encourage large trucks to stay on those facilities. Detours during construction or due to collisions should consider truck mobility of all sizes, especially if the detour is off of a Major Truck Street.

Curbspace (Delivery)

Stakeholders noted the lack of loading zones and other curbside spaces as a major challenge for goods delivery in some areas. Drivers often circle the block looking for spaces to unload. This seems to primarily be an issue in downtown Seattle, the University District, and Capitol Hill. Figure 34 shows the loading zones in Downtown Seattle. Note that alleyways are also usable for deliveries in some cases but are most critical for waste management trucks.

As can be seen, there is fairly limited space in downtown for any type of parking. Office towers usually have their own loading space underneath the building, but that is not always the case. Often, loading zones are limited to the on-street designated 30-minute load spaces. Typically there are at least 1 or 2 and sometimes up to 6 designated loading areas around a city block. But there are some cases where there are not any on-street designated loading zones. An example would be at Westlake Center between 4th and 5th Avenues, Pine Street, and Olive Way.

Due to the serious stakeholder concerns and the severe limits on curbspace loading zones, this issue merits further exploration. Specific locations of high concern should be identified as part of this plan. Additionally, SDOT should consider further work regarding the restrictions and locations throughout the city, perhaps as part of other on-going studies.

INTERFACE/CONFLICTS WITH OTHER MODAL PLANS

City streets designated as Major Truck Streets often have been recommended as priority streets for other modes as well. Generally, freight corridors are major arterials that are also ideal routes for transit because they provide fast, direct access between key activity centers. Conflict points between buses and trucks could potentially occur at bus stops where there may be inadequate room for buses to stop and trucks to pass. Additionally, pedestrians walking to and from the bus stop may need to cross the street which could result in modal conflicts as well.

Figure 35 shows modal recommendations of city streets and where truck street designations overlap with other modes. Streets designated as both freight and transit corridors include:

- 1st Avenue S
- 4th Avenue S
- 15th Avenue W
- N 105th Street
- Aurora Avenue N
- Fauntleroy Way SW
- Greenwood Avenue N
- Leary Way NW
- Westlake Avenue N

FIGURE 32: FREIGHT MOBILITY CONSTRAINTS

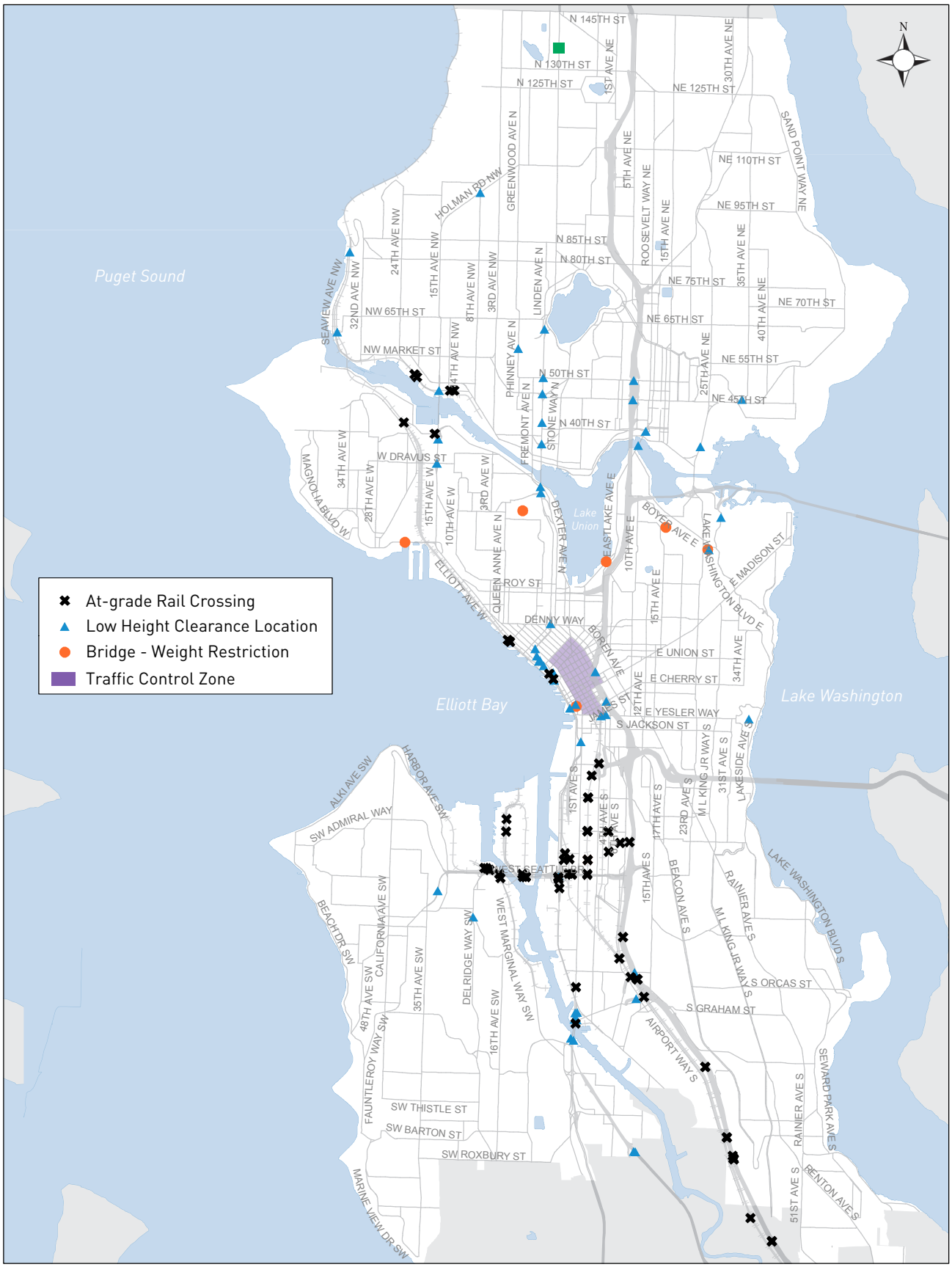
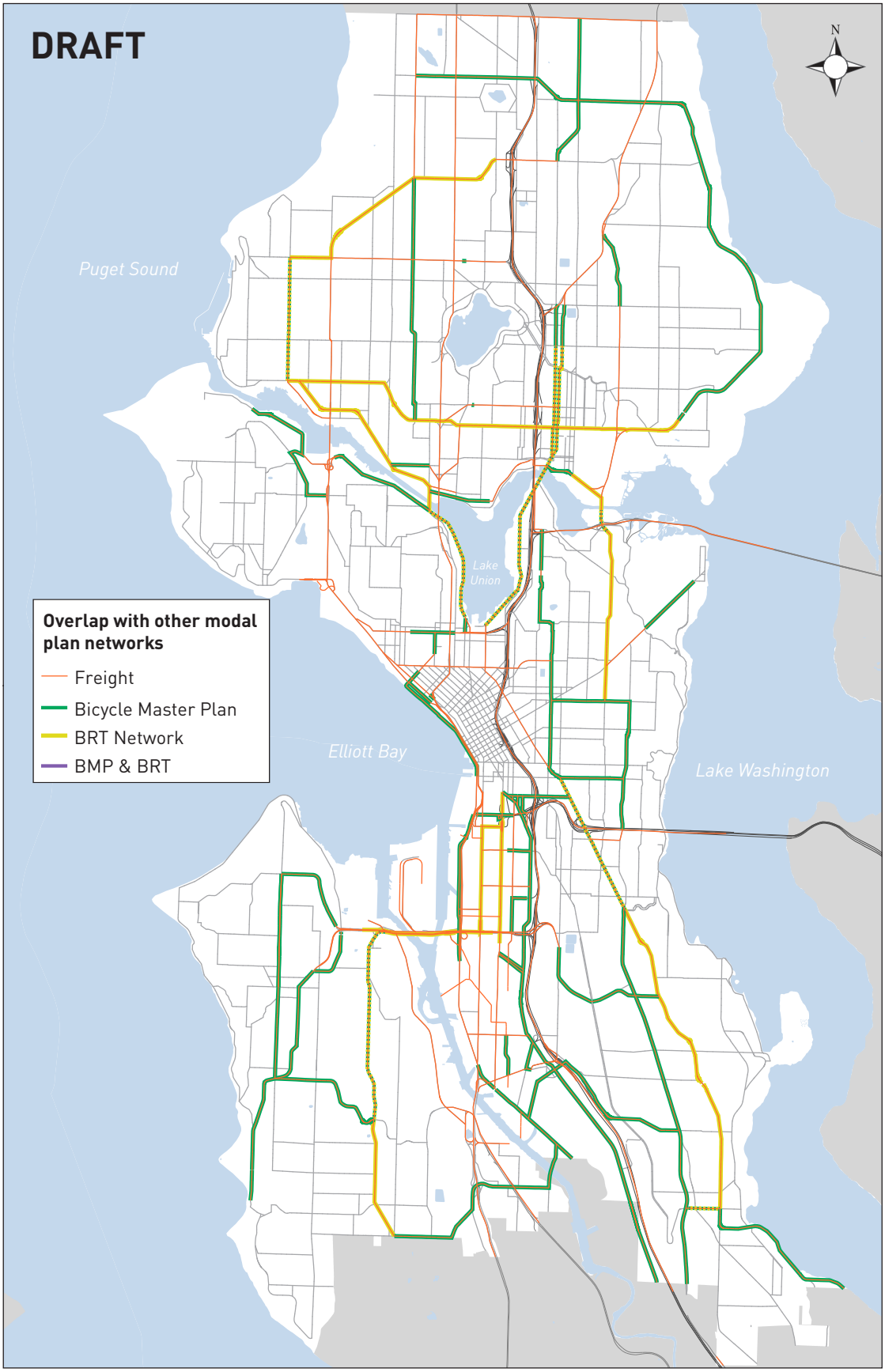


FIGURE 33: RAIL CROSSINGS AND FACILITIES

FIGURE 34: DOWNTOWN SEATTLE LOADING ZONES

FIGURE 35: STREETS BY MODAL DESIGNATION



Occasionally, bike facilities are on the same street as truck routes. This may not always be optimal for bicyclists as trucks require more space on the road and have numerous blind spots. Safety concerns, whether real or even imagined, will prevent some bicyclists from using these facilities. Protected bicycle lanes on a street that is also a designated Major Truck Street would provide the most predictability of movement of both modes. This could be accomplished by providing adequate buffers, or curb-separated bicycle lanes, between the travel lane and the bicycle facility.

Streets recommended as both freight and bicycle routes include:

- Alaskan Way
- Airport Way S
- Fauntleroy Way SW
- Rainier Avenue S
- Westlake Avenue N (parking lot areas for bicyclist and not the travel lanes)

Streets recommended as corridors for all three modes (freight, bicycle and transit) can present even further challenges. These facilities include:

- M L King Jr Way S
- W Nickerson Street

These facilities should be considered further in this plan. Where serious concerns have been identified, it would be appropriate to consider resolution of conflicts through establishing modal priorities or proposing projects to resolve conflicts.

Stakeholders also commented about several streets that are both major truck streets and designated in other modal plans. Transit corridors cited included Denny Way, 1st Avenue S, 4th Avenue S, 23rd Avenue E, and N/NE 45th Street. Bicycle Facilities mentioned included Dexter Avenue N, Stewart Street, 4th Avenue S, Stone Way N, and 3rd Avenue NW. Because these streets are identified in multiple modal plans, and hence encouraged for primary use by multiple modes, particular care needs to be given to their design and operation so as to facilitate safe and efficient operations for each of the prioritized modes.

ROADWAY RECHANNELIZATION (NICKERSON CASE STUDY)

The City recently performed a safety corridor improvement project on W Nickerson Street on the north side of Queen Anne Hill. Prior to Rechannelization there were two travel lanes in each direction, and crosswalks had been taken out as they were no longer meeting safety requirements for a four-lane cross section and contributed to potential multiple threats for pedestrians. The street was reconfigured to one lane in each direction and a two-way left turn lane in the center with bike lanes added with the leftover space. The purpose of the project was to reduce speeding incidents and improve safety. Lane width was increased as part of the project, and two new marked crosswalks were installed in order to meet safety standards.[9] This project was completed in August 2010.

A concern about the road diet was that it would limit throughput and therefore limit truck flows as well. As discussed, stakeholders have voiced their concern over reducing travel lanes and giving them to other modes. This type of project is appropriate when certain criteria are met, including daily traffic volumes below 20,000 vehicles per day and left turn movements occurring throughout the corridor. It has been demonstrated that under these conditions, road capacity is not reduced, and safety is increased for all roadway users. Assessment of the traffic counts taken before and after the project, shown in Table 12, suggest that while overall traffic decreased by over 10 percent, the daily truck total actually increased slightly on Nickerson after the road was restriped.It is not surprising that trucks

[9]www.seattle.gov/transportation/docs/Nickerson%20before%20and%20after%20study_FINAL.pdf

would stay on the facility as they may not have other choices. It may also be that there has been an increase in overall demand for freight in this area or that truckers find the new configuration easier to navigate, or it could be a result of economic improvement along the corridor and destinations served by the corridor (e.g., Ballard, north end of Interbay).

Stakeholders interviewed recently indicated the changes were not as bad as they anticipated after the project was completed. This response and the data support the possibility that, in this particular instance, restriping did not worsen truck flow, while walkers received a safer, more visible space. Review of more extensive counts and stakeholder interviews would be needed to confirm this potential finding.

TABLE 12: NICKERSON STREET ROAD DIET - BEFORE AND AFTER DAILY VOLUMES BY VEHICLE CLASS

	Cars and Trailers	Trucks	Buses	Motor Bike
Aug 2010 BEFORE	**13,563**	**2,993**	**211**	**62**
	80.59%	17.79%	1.25%	0.37%
Dec 2010 AFTER	**11,790**	**3,141**	**311**	**45**
	77.13%	20.55%	2.03%	0.29%
Feb 2011 AFTER	**11,694**	**3,004**	**261**	**55**
	77.89%	20.01%	1.74%	0.36%

SUMMARY CONCLUSIONS

MAJOR ISSUES AFFECTING FREIGHT MOBILITY

Based on the existing and future conditions data and stakeholder input, the key major issues facing freight operations in the City of Seattle include the following:

- Citywide traffic congestion, particularly on key freight routes during peak periods, and the fact that this congestion is growing.
- Truck volumes throughout the city and region are growing as well, which will place additional demands on already constrained roadways.
- Bottlenecks, particularly at bridge locations.
- Conflicts between trucks and non-motorized roadway users.
- Wayfinding via Major Truck Streets to key destinations.
- Truck restrictions on some facilities.

Traffic congestion, which affects all roadway users, is the top concern of many freight stakeholders.

FREIGHT FACILITY GAPS

Issues or elements of the system that represent or create gaps in the freight network include the following:

- Limited capacity on Major Truck Streets
- Grade separations with rail, particularly in the Greater Duwamish MIC/SoDo area.
- Improve wayfinding signage for Major Truck Streets.
- Safety improvements especially in conflict areas with other modes of travel.

Many roads experience congestion under peak conditions. As areas become denser, in both population and employment, some key freight corridors will need improvements to optimize flow for freight vehicles. Some key areas that are already at or over capacity, as discussed in the Roadway Congestion chapter, include the Ballard Bridge, SR-99 through downtown, the West Seattle Bridge, and SR-509 south of the Duwamish area.

As noted in the Rail Crossings section, some additional grade separation in the Duwamish MIC area between highly used truck facilities and rail crossings would minimize mode conflicts and travel delays.

37 percent of freight stakeholders that participated in the online survey were not aware of the Major Truck Street system. There are also several east-west routes that have a high level of truck traffic that are not included in the Major Truck Streets system. Other gaps include the University of Washington area and Capitol Hill, where there are not any designated truck routes.

Some corridors are designated freight routes but are also key or recommended routes for transit, bikes, and pedestrians. These facilities may need additional safety elements so all road users can use the roadway with minimal conflicts and greater predictability of all modes.

FREIGHT NEEDS AND PRIORITIES

Based on the findings of this document, the following needs and priorities are identified:

- Maintain or enhance freight capacity along designated truck streets.
- Thoughtful design that provides predictability of all modes when modal recommendations overlap.
- Inform and educate freight drivers about freight street designations.

- Develop materials to educate other modes about safe interaction with trucks.
- Develop and prioritize projects to address bottlenecks and safety issues.
- Keep existing freight priority in Greater Duwamish MIC area, including through SoDo region, and provide additional priority where possible.
- Maintain or improve/add to commercial vehicle load zones and truck load zones throughout the city.

The effect that increased traffic congestion has on freight mobility has been the number one issue raised by freight stakeholders. Major Truck Streets have been compromised in many places due to increased congestion and/or redesigns that remove truck capacity in favor of providing for other modes. Policies should be established that give priority to truck mobility on major freight corridors and maintain or improve capacity for trucks on these streets. Since many trucks travel during midday hours, having coordinated signal timings during off-peak hour periods would improve conditions for trucks.

Additional safety elements may be necessary on roads that are key connections for multiple modes of transportation. Some examples might include: bus and rail stops that have well-lit pedestrian crossings or separated/protected bike lanes. Further, designing intersections on truck routes that provide good sight lines so truck drivers can better see pedestrians or bikes that might be nearby. Only allow controlled pedestrian crossings on Major Truck Streets. Finally, awareness and education programs that promote safe multi-modal interactions should be further explored and implemented.

Major Truck Streets may need some additional signage in some areas, including routing to key destinations like major highways and MICs. Stakeholder communication with maps of the system might also encourage drivers to use the system. Some east-west roads that already serve high volumes of trucks between I-5 and key origins/destinations could be added to the Major Truck Street network.

Finally, keeping freight a priority in MIC areas is important. This may include adding grade separations for some rail crossings, redesigning existing roads with freight as the primary consideration and with large trucks in mind, and building facilities that minimize conflicts with pedestrians going to and from the stadiums.

APPENDIX A - ONLINE SURVEY - SUMMARY OF FEEDBACK RECEIVED

SDOT Freight Master Plan
Online Survey - Draft Summary of Feedback Received
September 2014

INTRODUCTION AND BACKGROUND

The Seattle Department of Transportation (SDOT) maintains a freight program to improve freight mobility and safety in Seattle, in conjunction with other department efforts to make it easier to move people and goods, across a range of transportation modal opportunities.

Currently, the City of Seattle is developing a Freight Master Plan (FMP) to address the unique characteristics, needs, and impacts of freight mobility, within the broader context of how freight movement and industrial lands contribute to the city's, and the region's, overall economy. The Freight Master Plan will primarily focus on urban truck freight movement to support Seattle's increasing demand for goods and services in a safe and resilient manner. The plan will outline the critical role that freight movement has on meeting the City's goals for social equity, economic productivity, sustainability, and livable neighborhoods.

To develop a Freight Master Plan that represents the needs and priorities of freight stakeholders requires meaningful and substantive input from those stakeholders. To better understand the key issues, needs and concerns of the freight community, SDOT began outreach efforts by meeting with representatives from the Manufacturing & Industrial Center (MIC) and the Ballard-Interbay Manufacturing & Industrial Center (BINMIC). These meetings, along with additional individual interviews, were used to collect feedback on the concerns of businesses and solicit ideas on how freight mobility might be improved in Seattle.

To collect additional feedback, SDOT developed an online survey. The survey was distributed to those who participated in the initial stakeholder meetings, as well as the groups and organizations listed below. The target audience for the survey was primarily businesses that rely on urban truck movement to deliver goods and services in Seattle. In addition to distribution by email and in person at the stakeholder meetings, the survey was also posted to SDOT's website, and stakeholders were invited to share the survey with their contact lists as well.

The survey was distributed to the following constituents:

- Participants in SDOT's Commercial Vehicle Load Zone process
- Seattle Freight Advisory Board (FAB) listserv
- Major truck street listserv
- Port of Seattle
- Port of Seattle truckers listserv Washington Trucking Association
- Seattle Office of Economic Development (OED), OED commissions and Maritime and Manufacturing Summit participants
- Greater Seattle Chamber of Commerce
- Puget Sound Regional Council (PSRC) Freight Mobility Roundtable

SURVEY METHODOLOGY

The survey asked a mix of multiple choice and narrative response questions ranging from how businesses cope with traffic congestion to what larger scale economic trends are affecting freight mobility in Seattle. The survey was live on the web between August 1, 2014, and September 21, 2014.

MAJOR THEMES

The survey received 60 total responses. Key overall themes that emerged included:

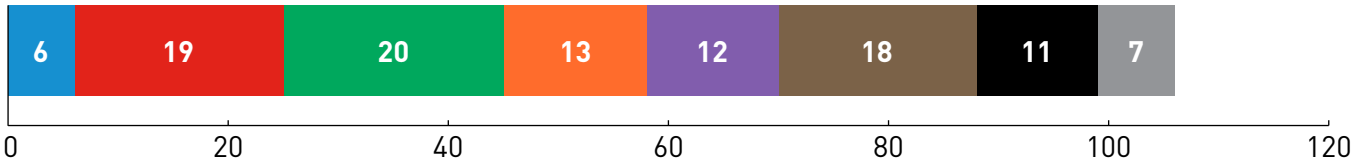
- Congestion is cited as the number one challenge affecting urban goods delivery in the city.
- Business operations schedule are bound to customers' needs and there is often not flexibility to adjust deliveries to off-peak hours.
- Conflicts with other modes of traffic (predominantly bike traffic) and turning movements/curb radius are cited by over 50% of respondents as being the top safety concerns relating to freight mobility.
- Although the City's Major Truck Streets are sometimes used by two thirds of respondents, almost 40% didn't know the designations existed.
- Google maps is the most used resource for determining alternate routes, but City and state traffic cams are also valuable.

There is an underlying feeling of resentment among some towards the perception that the City is not giving freight traffic priority and that conditions are getting worse. However, others believe that the challenges facing urban freight movements are simply products of a strong economy and good business.

SURVEY RESPONSES

Q1: What type of freight does your business handle?

The top three types of freight handled by survey respondents included containers destined to or from the Port of Seattle; freight related to the manufacturing/maritime sector, and containers destined to or from local distribution centers. It is important to note that respondents were free to select multiple types of freight.



- Construction
- Manufacturing/maritime/industrial
- Containers destined to/from Port of Seattle
- Containers destined to/from local distribution centers
- Inventory for local stores or businesses
- Delivery services to businesses and residences
- Dependent on receiving freight
- Other

Q2: Have your business operations changed based on congestion at certain times of day? How? Would it be possible to promote delivery to occur during off-peak hours?

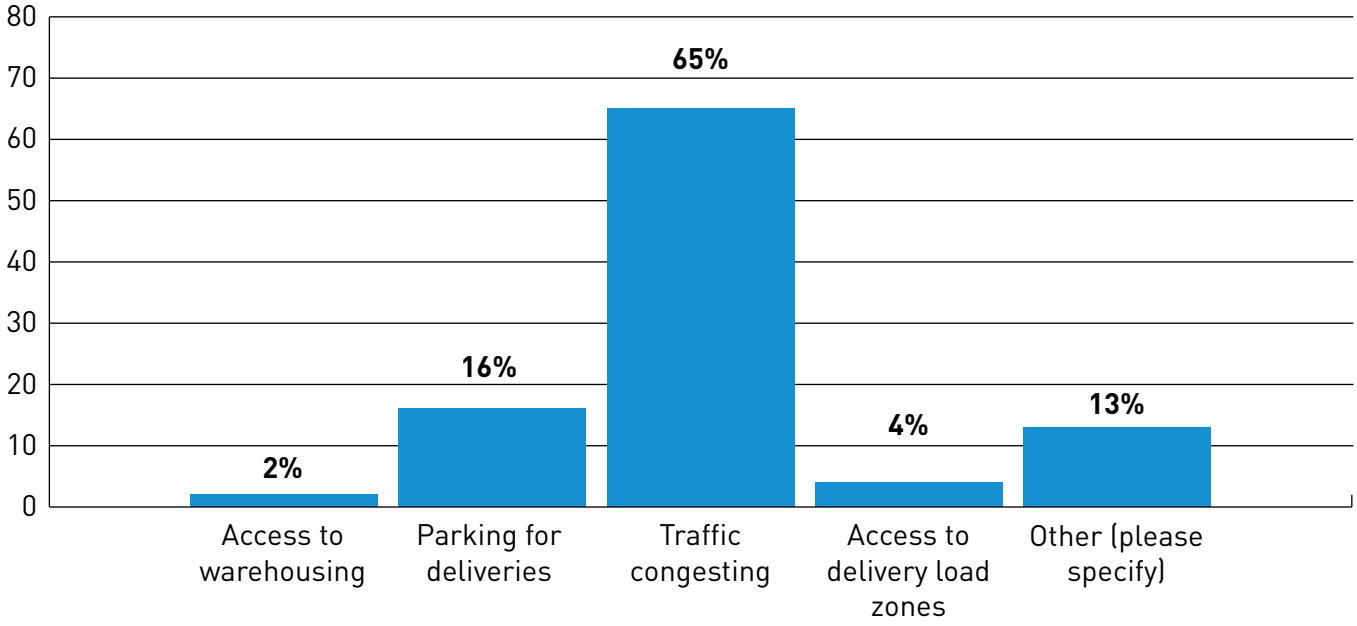
Overall: Businesses try to adjust their operations based on congestion, but options are limited. Schedules revolve around client needs for outgoing deliveries or shipping times for incoming deliveries and cannot always be adjusted.

Sample responses

- "Moved to night shift for maintenance crews, increased carpool slots, instituted compressed work week, reduced number of meetings at John Stanford Center for Educational Excellence (JSCEE)
- "Yes, particularly with freeway closures/ bridge closures close to aircraft departure times like the recent presidential and vice-presidential visits. Delivery at off-peak hours is not likely due to huge additional cost of labor work force needed to implement."
- "Yes, delivery times can take twice as long. It is not possible to perform deliveries in off-peak hours due to the requirements of the Union and legal amount of hours a driver is allowed."
- "The adjustment of freight delivery times to businesses should be considered. Also, tax and other incentives to businesses who utilize off-peak hours for receiving deliveries is one idea for relieving congestion."

Q3: What is the biggest challenge for urban goods delivery in the city?

Responses indicated that traffic congestion is seen as the biggest challenge for urban goods delivery in the city with nearly 2/3 of respondents citing this issue. The second most cited challenge was parking for deliveries; cited by 16% of respondents. Of the 13% (seven respondents) who responded with "other", three cited conflicts with bicyclists as the biggest challenge.



Q4: What is one thing the City can do to help your business move goods more efficiently and reliably?

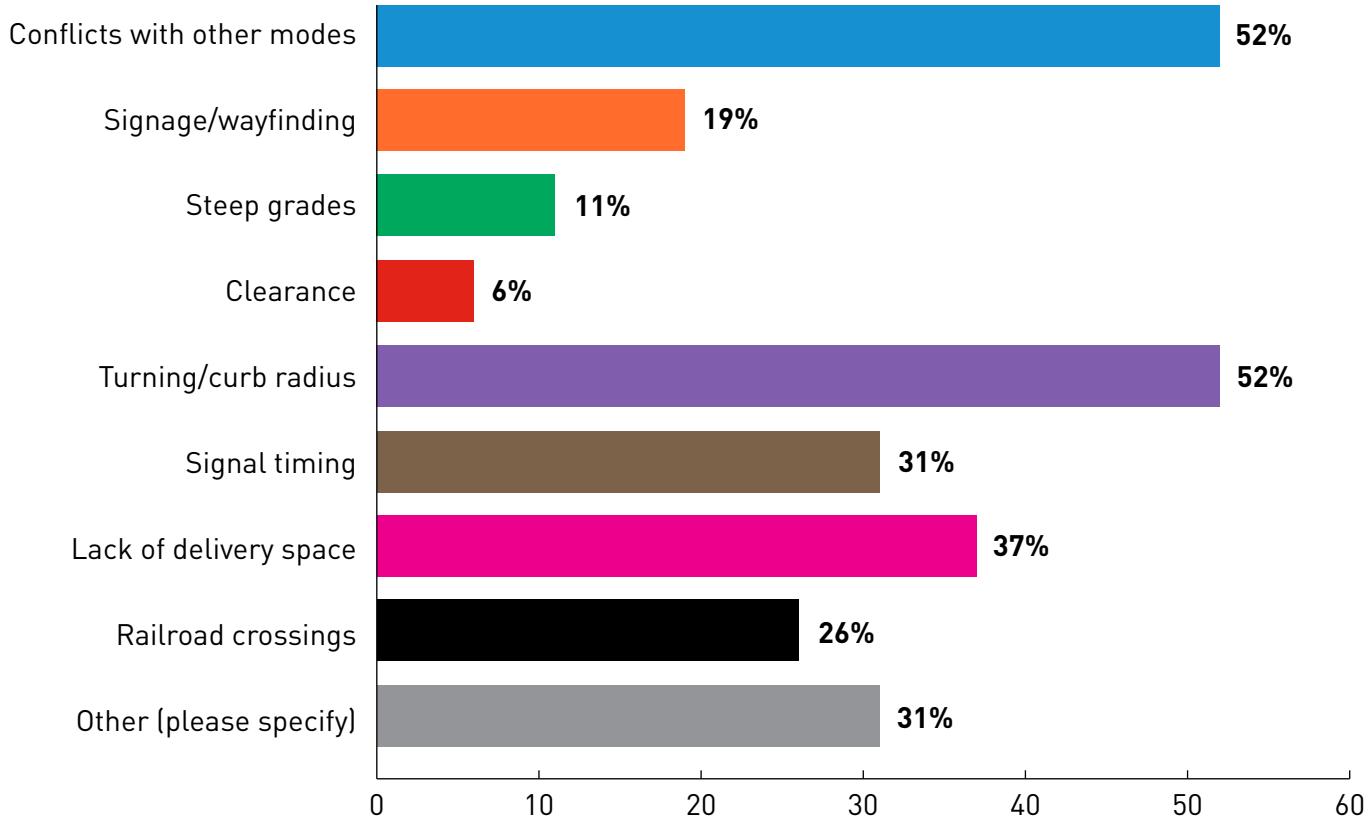
Overall: Respondents gave a mix of answers, mostly relevant to their respective location. Bike lanes and conflicts with other modes of traffic, prioritizing ingress/egress from the Port of Seattle, and load zone issues such as adding new load zones and maintaining access to current ones were all mentioned. Other secondary responses included: improving signalization, petitioning congress/USCG to change their rules for Ballard bridge openings, and reducing congestion overall

Sample responses

- "If the city simply petitioned Congress/U.S. Coast Guard to rewrite the Ballard Bridge rules to limit openings to certain times of the day for non-commercial water traffic the traffic in North Seattle would be much better."
- "Move other small movement vehicles to parallel streets when possible - presume all arterials are needed to move trucks."
- "Get Unions of longshoremen to not act like organized crime syndicates, truckers are not paid by the hour like them. City can get Port workers and their protective unions [to] work in much more efficient manner so that truckers they work with do not have to suffer and pay with their income. Port longshoremen and workers are the single most difficult causes of traffic congestion that directly impact truckers."
- "Quit taking lanes away from vehicles on main thorough fares. Bike lanes & bus only lanes have done nothing but make Seattle one of the worst cities in the United States for traffic congestion. By reducing the amount of lanes, SDOT is doubling the amount of emissions (CO) produced by gasoline autos that idle for hours in their daily commute."
- "Bridging additional crossings in SoDo would be a big improvement. The more grade separations between rail and other surface traffic, the better. Also, ingress/egress to the Port of Seattle is critical. SDOT must continue to work with WSDOT and other stakeholders on improving freight mobility to/from the Port of Seattle."

Q5: What are the top three safety concerns you see relating to freight mobility?

Over 50% of respondents cited turning movements/curb radius and conflicts with other modes as a top safety concern. Although not cited as a major challenge for urban goods delivery, lack of delivery space was cited by almost 40% of respondents as a top safety-related concern. Nearly one third of respondents cited railroad crossings, signal timing, and lack of delivery space as top safety concerns. Of the 31% that cited "other" issues as top safety concerns, conflicts with bicycles/inadequate separation of bicycles and freight traffic and unrestricted openings of the Ballard Bridge were dominant themes.



Q6: What are major choke points (specific locations or neighborhoods) in Seattle, from your perspective?

Overall: Major choke points cited included anywhere where there is narrowing of the road, such as Ballard Bridge/Nickerson Street, Mercer Street, I-5 through downtown, SR99 approaching downtown (either direction). Various corridors where there are multiple modes of traffic such as the Mercer Corridor and 1st-5th Avenues downtown were also cited as choke points.

Sample responses

- Anywhere road narrowing and addition of different modes of transportation are added (i.e. bike lanes, trolley lanes, restricted lanes (especially no flammable materials allowed in the new tunnel); I-5 NB off of 90; sites of perpetual construction such as Mercer, HWY 99; bridges that open, toll bridges, Elliott, Nickerson
- Ballard Bridge (multiple responses)
- Ingress/Egress points to freeways
- Mercer corridor, particularly eastbound since the change to two-way; Denny and Dexter, Stewart, and Fairview.
- SR 99 (multiple responses)

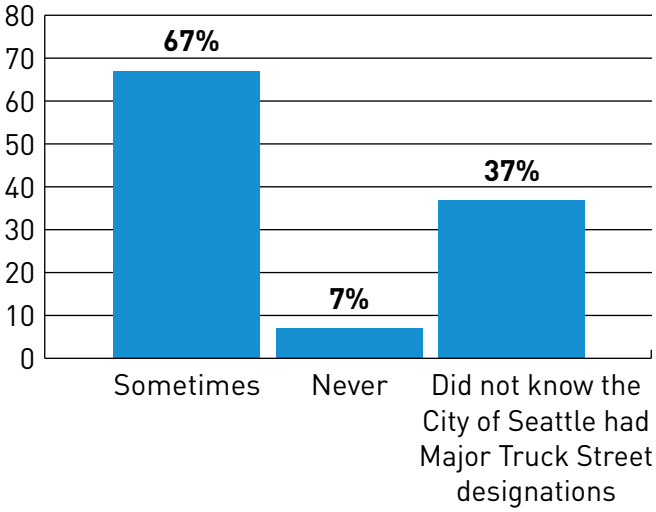
Q7: How do the choke points affect your route planning?

Overall: Since the choke points are known to most businesses, drivers indicated that they either allow more time to make deliveries or to try and take alternate routes. If possible, businesses will plan to operate in off-peak times.

Sample responses

- "We mostly just allow more time and try to avoid rush hour."
- "Can have a major impact with regards to making deadlines and cutoffs for marine terminals and steamship lines. Many drivers will avoid these areas especially at the end of the day where they could get stuck in traffic."
- Alternate routes (multiple responses)

Q8: Do you move goods via the City's Major Truck Street designated streets?
Two-thirds of respondents indicated that they sometimes use the City's Major Truck Streets. However, as 37% were not aware that designated Major Truck Streets existed, some respondents only discovered through taking the survey that they were already using them.



Q9: If you answered "sometimes" or "never" in response to Question 8, what are the primary routes / streets you use to move freight?

Overall: Respondents cited streets that are already designated as Major Truck Streets.

Sample responses

- Mercer, Elliott, Nickerson, Alaskan Way, Westlake, Marginal Way, SR 99, I-5
- "Everyday going south I use 15th Ave to Elliot Ave to Viaduct to Harbor Island. Coming back northbound I go 99 to the western off ramp up Western to Elliot back to 15th and Leary back to the yard."

Q10: If the primary route is unavailable, how do you determine which secondary routes to take to deliver goods?

Overall: Most respondents indicated that they use Google maps or left it up to the driver to determine which secondary route to take. Three respondents stated that for certain routes, there are no secondary routes available.

Sample responses

- Google
- Trial and error
- Driver knowledge
- "We don't have the luxury of 'secondary routes'."
- "Secondary routes are not a viable option on the 15th Ave W corridor."
- Talk radio traffic reports

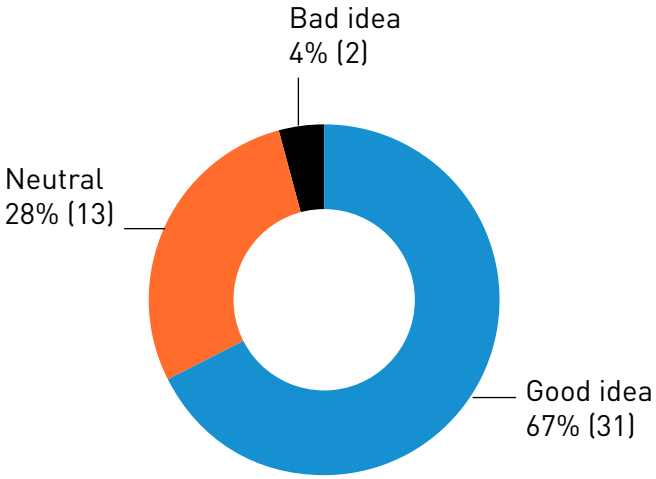
Q11: What tools do your dispatchers and drivers use to predict travel times, find alternate routes, and get directions?

Overall: Drivers and dispatchers use a mix of tools for getting directions and predicting travel times including: Google Maps, city and state DOT traffic cameras, and GPS. Often it is left up to the driver and their knowledge of streets to find alternate routes.

Sample responses

- Google Maps/Mobile apps
- "WSDOT traffic website, SDOT traffic website, and telephone calls to colleagues in tall buildings with views out their windows."
- "Have access to terminal websites and can gauge what types of backups and congestion for each. Use SDOT's website as well."
- "Railroad calls trucking companies and coordinates times for delivering containers from Waterfront to rail yards. Intelligent Traffic Signs helpful."
- Anecdotal/local knowledge

Q12: What do you think about truck drivers using Business Access and Transit (BAT) lanes during the time that buses use them with the acknowledgement that buses have priority?



Q13: What economic trends do you see affecting your industry / business?

Overall: Although there was no single definite trend, there seems to be an underlying feeling of resentment due to a perception that the City is not giving freight traffic priority and that congestion is becoming worse. However, other respondents commented that the larger economic trends that are affecting urban freight movement, both positive and negative, are simply the product of a strong economy which in turn means increased demand for deliveries of goods and services.

Sample responses

- "Seattle is not business friendly. Our trucks and customers can't move without delays, parking is slowly becoming extinct and what there is of it is costly, there are taxes on everything that add up to gutting small business' bottom line, and now the City wants to tell us how much to pay our employees, how much benefits are required to be provided, etc. We want to do business, we want to pay our employees, but the City is skimming all the cream and half the milk from our operations."
- More traffic congestion (multiple responses)
- "Difficult to say but I know that access to the ports and rails are greatly affected by the stadium traffic. Also the city's push of moving more retail and non-industrial uses of SODO area is a big problem for freight mobility. Many warehouses and business complain of illegally parked cars, and inability to have truck access to their buildings because of this crush of retail and office density."
- "Without a strong, trade supportive commitment by SDOT to improve upon freight mobility in and around the Port of Seattle, the economy of Seattle, Washington State, and the Pacific Northwest stands to suffer. Canada continues to make strides in trade infrastructure and freight mobility, the Panama Canal widening project is progressing as well as other important trade infrastructure projects in other parts of the USA. Seattle SDOT must think and act as progressively on freight as they do on social issues. Hopefully, Mayor Murray realizes the importance of trade, trade infrastructure, and being able to obtain permitting for improvement projects in a timely fashion. If he doesn't, Seattle and the region fall further behind our trade competitors."
- "Because transportation is so bad in Seattle, prices of all our goods have been increased to reflect our increased costs."
- "The more time I have to sit in traffic the more fuel I burn. The more times I get stopped at every single light down one street is more wear and tear on the truck trying to get it back up to speed. All these repairs cost money that we should be able to save to customers."

Q14: Other comments?

Overall: Only 18 of 60 respondents answered this question. There again seems to be a feeling that the city does not prioritize freight. Although not a consensus, the most commented upon subject was the safety of having multiple modes of traffic (especially bikes) sharing the road.

Sample responses

- "Our government has decided that cars and therefore roads are evil so I expect matters to get a lot worse."
- "I think that the BAT lanes on Aurora are a very selfish use of transportation capacity and should be modified to allow and encourage additional uses. The toll on the 520 bridge is excessive and should be reduced significantly to encourage greater use."
- "Need streets that support heavy truck traffic to be designed for heavy truck traffic. Many of them are not, particularly in SODO area. Need to get ahead of "Drone Paranoia" early in the game and get business friendly but effective rules of the road in place. We will use drones, but they do need to be flown safely and they need good, sensible rules for usage."
- "The city of Seattle simply has not made freight and goods movement a priority and does not understand its importance within our economy. Not enough concentration on business and industry that produce large revenue and good jobs for the region. This leads to loss of middle class and a 2-class system with great income disparity."
- "Companies that buy load zone permits should be able to also purchase "temporary" load zone permits for drivers of theirs who rent vehicles for delivery. Large rental vehicles have limited options for load/unload parking and I feel there should be a way to support the load zone system and extend the ability to use the system to drivers in rentals. There should be no requirement of a "minimum" number of drivers to get this temporary tag. If your business supports the system by buying the permit, your co-deliverers should be able to also use the system via temporary/one-off permits."
- "The City of Seattle should value small business in the city and reward those businesses which pay a higher price for continuing to stay here."
- "Seattle is the ONLY west coast port city without an overweight corridor! So stupid."

APPENDIX B - STAKEHOLDER INTERVIEW SUMMARY

SDOT Freight Master Plan
Stakeholder Interview Summary (DRAFT)
October 2014

INTRODUCTION AND BACKGROUND

The City of Seattle is developing a Freight Master Plan (FMP) to address the unique characteristics, needs, and impacts of freight mobility. The FMP will primarily focus on urban truck freight and will outline the critical role that freight movement has on meeting the City's goals for social equity, economic productivity, sustainability, and livable neighborhoods.

To better understand the key issues, needs and concerns of the freight community, SDOT outreach efforts began by meeting with representatives from the Duwamish Manufacturing & Industrial Center (MIC) and the Ballard-Interbay Manufacturing & Industrial Center (BINMIC). These meetings were followed by individual stakeholder interviews that were used to collect feedback on the needs and concerns of freight-dependent businesses and solicit ideas on how freight mobility might be improved in Seattle.

STAKEHOLDER INFORMATION

Stakeholder interview participants were identified by SDOT staff and were intended to be representative of a variety of industries and freight uses. Stakeholders include business owners, truck drivers, and operations managers of businesses that depend on efficient goods movement within and throughout Seattle. Volunteers represented a number of organizations, including:

Organization/Entity
Amtrak
CSR Marine
Darigold
Dunn Lumber
Franz Bakery
Fremont Brewing
Georgetown Brewing Company
King County International Airport
MacMillan Piper
Martin Family Orchards
Nelson Trucking
Ocean Beauty
Pacific Fishermen Shipyard
Peddler Brewing
Salish Sea Trading Cooperative
Seattle Public Schools
Skagit Transportation
Terminal 91 tenant
Total Terminals
Trident Seafood
Turner Construction
UW Consolidated Laundry
VanDyke
Vigor Shipyards

GROUP INTERVIEWS

Before individual stakeholder interviews were conducted, SDOT met with representatives from the MIC (Group One) and the BINMIC (Group Two). The groups were asked many of the same questions as those asked during the individual stakeholder interviews. Feedback received was recorded and summarized by the project team and key discussion themes are captured below.

Group One Interview

July 28, 2014
Manufacturing Industrial Council

Organization/Entity
Amtrak
Ballard Oil
Boyer Towing
Charlie's Produce
City of Tukwila
Manufacturing Industrial Council
Manufacturing Industrial Council Board, Freight Advisory Board, BNSF
Nucor Steel
Port of Seattle
Seattle Mariners
Seattle Public Schools
WSDOT

Group Two Interview

July 29, 2014
Ballard-Interbay-Northend Manufacturing & Industrial Center

Organization/Entity
Ballard Oil
Ballard Partnership Urban Design Transportation Team
BINMIC
Coastal Transportation
Consultant to Block Builders
Port of Seattle

INTERVIEW METHODOLOGY

Interviews were conducted by SDOT and consultant staff. Following a brief overview of the purpose and goals of the FMP process, interviewers asked participants for their feedback on a variety of topics and questions, ranging from how businesses cope with traffic congestion to what larger-scale economic trends are affecting freight mobility in Seattle. The interviews were completed between July 29, 2014, and September 19, 2014.

INTERVIEW QUESTIONS

A standard set of interview questions were developed by the project team based on identified key issues and project information needs. These questions were divided into eight categories: Information about the organization, safety, reliability, efficiency, resiliency, economic vibrancy, environment, and how to share information.

General themes for the questions included:

- Key issues that should be addressed by the FMP
- Future vision of freight transport in Seattle
- Ideas for informing and engaging the public in conversation

[See Appendix XX for full list of stakeholder interview questions]

MAJOR THEMES

Thirty-two representatives from twenty-three different organizations were interviewed. Major themes that emerged through the stakeholder interviews included:

- Traffic congestion is consistently cited as the number one challenge affecting interviewees' businesses.
- Freight businesses would move deliveries to off-peak hours if they could, but there are a variety of reasons that prevent them from doing so, including: maintaining staff who will work graveyard shifts, customer needs, customer facilities are not open off-hours, increased costs, and night time noise ordinances.
- There is a general desire among interviewees for a dedicated freight corridor.
- Conflicts with other modes of traffic (especially bicyclists and pedestrians) are generally cited as the top safety concern relating to freight mobility.
- Interviewees largely feel that the importance of their respective industries to the local economy is too often overlooked by the City.
- The lack of parking and loading zones for deliveries, especially in the downtown area, is consistently cited as a major concern for safety, reliability, and efficiency of freight mobility.
- Finding and maintaining well qualified employees is cited often as one of the major challenges affecting freight dependent industries in the city.

RESPONSES TO KEY QUESTIONS

The stakeholder interviews provided insight into key concerns stakeholders have about urban freight mobility and how they envision freight transport in the future. Key themes of feedback received by topic area are listed below.

Safety

Participants routinely cited conflicts with other modes of traffic, particularly pedestrians and bicycles, as the biggest safety concern affecting their industry.

- Many participants cite the need for better signage for getting to and from designated truck routes.
- Line of sight is an issue for larger trucks and could be alleviated in part by better trimming of overhead vegetation.
- Breweries are especially concerned with the quality of pavement on major arterials (shakes up their kegs).
- Route-finding difficulties, especially during peak congestion hours, are compounded by construction related closures and unreliable sources of information about their impacts.
- Many participants suggested more education of general purpose drivers, pedestrians and bicyclists regarding the rules of the road and interaction with other modes of traffic, particularly freight trucks.

Reliability

- Participants generally stated that all truck operations are heavily influenced by traffic congestion and the lack of alternative truck routes.
- Drivers do their best to avoid morning (7am-9am) and afternoon peak hours (3pm-6pm). Larger and noisier trucks are prevented from making deliveries in off hours due to the night time noise ordinance.
- Businesses, especially near SODO and the Port, are particularly sensitive to sporting events at the stadiums. Incoming and outgoing deliveries all revolve around game times on those days.

- Drivers largely rely on their own knowledge for route finding, however GPS, Google Maps, and traffic cameras are routinely cited as useful tools.
- A few participants suggested creating one website that consolidates all traffic conditions and impacts. Real time traffic analytics was suggested as an idea for improving congestion and reliability issues for freight mobility.

Efficiency

- Similar to other categories, congestion is cited as the biggest factor affecting the efficiency of freight mobility.
- Many participants cite the lack of loading zones and other curbside spaces as a major challenge for freight delivery. Drivers often circle the block looking for spaces to unload.
- Participants routinely cited that vehicle lanes are being taken away for bike lanes, which to them indicates that the City doesn't prioritize freight in urban planning.
- Unreliable information about construction impacts makes way finding and route planning difficult, especially for out of town drivers.

Resiliency

- Most participants stressed the need for more designated freight routes, especially north-south routes, and preservation of existing routes.
- Some participants expressed a desire for state and local transit authorities to have on-site response teams citing the excessive length of time it takes to clear an accident.
- When primary routes are congested in urban areas and the driver is able to detour to alternate routes, traffic circles are often cited as a concern.
- A few businesses have had success in using smaller, more efficient, and more agile trucks to make urban deliveries. It was suggested to remove large trucks from the city altogether by having them deliver to node points outside the city then have smaller trucks make the urban deliveries.
- It is becoming increasingly hard to find young drivers as the older generation retires. As traffic congestion has gotten worse and businesses try to shift delivery times to off-peak hours, it becomes harder to find good drivers to work those off hours.

Economic Vibrancy

- An aging workforce was cited as one of the major concerns for the future economic vibrancy of the industry. As the cost of housing rises, freight industry workers are pushed farther to the periphery, and it becomes harder to find qualified workers near Seattle based businesses.
- Many participants cited concerns about the $15 minimum wage affecting their retention of staff.
- Participants that represented smaller businesses generally stated that they felt Seattle was not small business friendly given the tax structure and are concerned about their future in the City.
- Most cited the strong economy and demand for goods and services as the major driver of their industry. As long as Seattle is attracting more people, there will be a demand for goods, and deliveries will be made regardless of congestion.

Environment

- Idling, primarily due to congestion, was cited by participants as the area that could be most improved upon.
- Participants suggested that anything that can be done to reduce idling would reduce emissions (more roundabouts instead of stop signs/lights, higher clearances in key nodes for more direct routes, better signal timing, signage, real time traffic signs.etc.)

- Many businesses have instituted their own policies to reduce their environmental footprint due to customer demand.
- Switching to smaller or more efficient vehicles/fuel is a common practice taken by businesses. Cost is also a driver.

Public participation process

- Although only the final three interviews asked participants about how best to communicate with businesses and the public, all stated that they would like to stay involved in the FMP process in some capacity. Those same three participants all identified email as the best way to keep them and the public informed. Other suggestions to keep the public informed included informational YouTube videos, billboards, postcards, and social media.

NEXT STEPS

Feedback received through the stakeholder interviews will be shared with the project team, SDOT leadership and policy staff. Input will be incorporated into the development of the Freight Master Plan existing conditions report, particularly the gaps and needs. It will also help inform identification of solutions. Finally, suggestions will be utilized for future outreach and engagement efforts.

APPENDIX C - TRUCK SEASONAL FACTORS

Single Unit Truck Seasonal Factors												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Interstate	1.26	1.24	1.21	1.21	1.22	1.15	1.16	1.14	1.13	1.18	1.22	1.25
Freeway/ Expressway	1.37	1.30	1.27	1.26	1.25	1.20	1.23	1.17	1.21	1.24	1.33	1.34
Major Arterials*	1.52	1.42	1.32	1.22	1.15	1.14	1.18	1.37	1.28	1.07	1.15	1.26
Minor Arterials/ Collectors/Local*	1.16	1.16	1.02	1.07	1.08	1.19	1.13	1.13	0.97	1.00	1.12	1.17

Double Unit Truck Seasonal Factors												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Interstate	2.22	1.44	1.15	1.20	1.17	1.01	1.24	1.61	1.97	1.43	1.57	1.66
Freeway/ Expressway	1.56	1.42	1.38	1.36	1.33	1.28	1.25	1.20	1.23	1.27	1.44	1.50
Major Arterials*	2.67	1.64	1.25	1.21	1.11	1.01	1.26	1.94	2.24	1.31	1.49	1.67
Minor Arterials/ Collectors/Local*	2.05	1.34	0.96	1.06	1.04	1.05	1.21	1.59	1.69	1.21	1.44	1.56

Triple Unit Truck Seasonal Factors												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Interstate	2.19	1.36	1.16	1.23	1.31	1.16	1.37	1.85	1.87	1.39	1.60	1.70
Freeway/ Expressway	1.68	1.47	1.40	1.35	1.38	1.32	1.37	1.16	1.23	1.35	1.62	1.70
Major Arterials*	2.64	1.55	1.26	1.24	1.24	1.16	1.40	2.24	2.13	1.27	1.52	1.71
Minor Arterials/ Collectors/Local*	2.02	1.27	0.97	1.08	1.16	1.20	1.34	1.84	1.61	1.18	1.47	1.59

*calculated factors by comparison Ohio DOT factors for interstates to arterials, other local roads.

TRUCK ANNUAL ADJUSTMENT FACTORS

Single Unit Truck Annual Adjustment Factors	
Year	**Factor****
2010	1.00
2011	1.01
2012	1.00
2013	1.00

Double Unit Truck Annual Adjustment Factors	
Year	**Factor****
2010	1.07
2011	1.04
2012	1.00
2013	1.00

Triple Unit Truck Annual Adjustment Factors	
Year	**Factor****
2010	1.07
2011	1.05
2012	1.00
2013	1.00

**Annual Adjustment to 2013

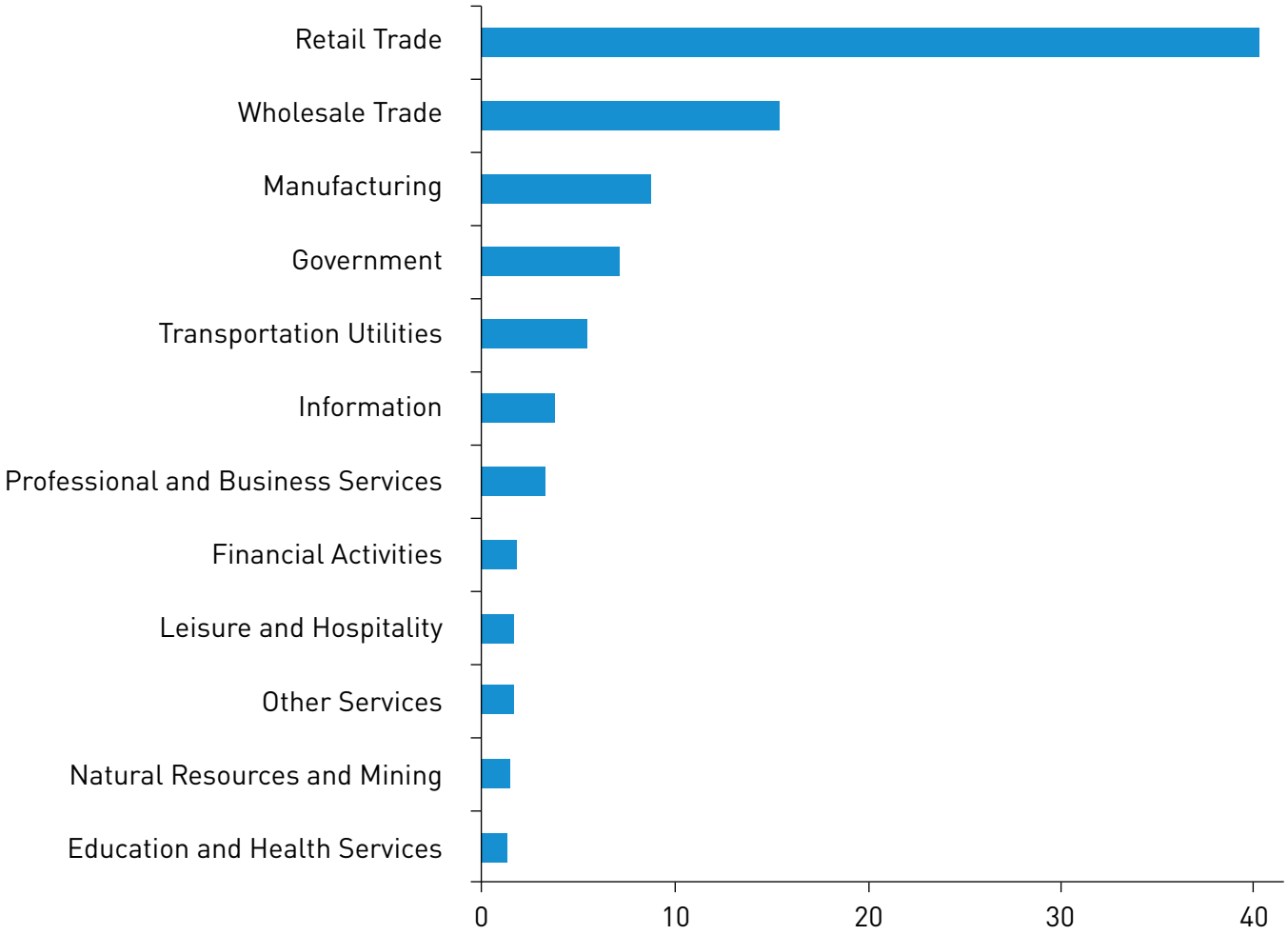
APPENDIX D - FUTURE CONDITIONS ANALYSIS METHODOLOGY

INTRODUCTION

The freight trends were analyzed in detail in the WSP | Parsons Brinckerhoff, The Role of Freight in Seattle's Economy technical memorandum (December 12, 2014). The document focused on global economic indicators as well as local employment growth and trade in Seattle in order to develop a future truck forecast for the City. This document concluded that the expected truck growth in the Seattle area will be between 1.6% and 2.5% compound annually with the likely growth to be about 2% per year, or about 55% overall by 2035.

The technical memorandum identified the top three freight generating employment sectors, wholesale and retail trade and manufacturing. As shown in Figure 1, these three industries account for the vast bulk of trucking and warehousing service demand.

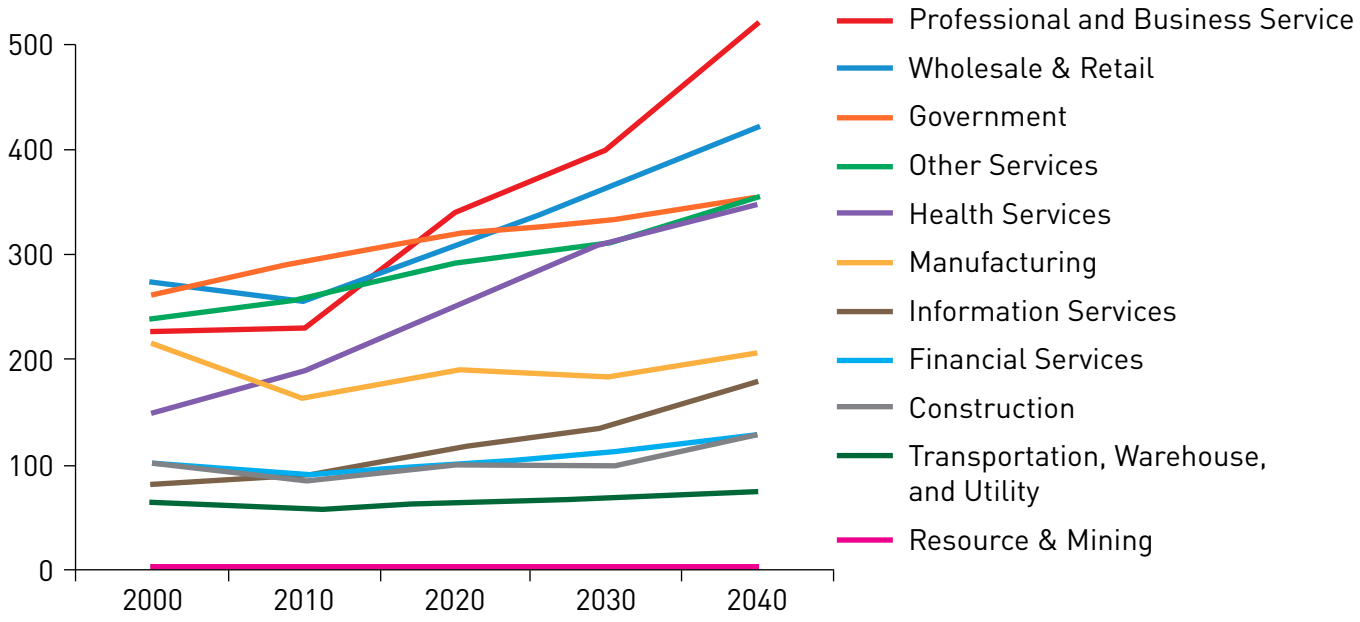
FIGURE 1: UNITED STATES INDUSTRY USE OF TRUCKING AND WAREHOUSING SERVICES ($BILLIONS)



Source: US Bureau of Economic Analysis and WSP | Parsons Brinckerhoff Analysis

Figure 2 shows the expected growth for all employment sectors between 2010 and 2040 based on PSRC projections. The biggest freight generating industries, wholesale and retail trade, are expected to grow at a slightly faster rate than total employment in the region. Between 2010 and 2040, wholesale and retail trade are expected to grow 64% while total employment is expected to grow 58%. This implies freight may grow somewhat faster than the overall employment growth which is equivalent to 1.6% annually during this period.

FIGURE 2: PUGET SOUND 2012 ECONOMIC FORECAST - EMPLOYMENT BY MAJOR SECTOR (THOUSANDS)



Source: Puget Sound Regional Council

Based on the greater than average growth in major freight generating industries, and the expectation that productivity increases will continue in manufacturing, it may be expected that increases in freight volume related to local regional economic growth will be a minimum of 1.6% annually between 2010 and 2040. Actual growth is likely to be higher, especially in the short term.

The Role of Freight in Seattle's Economy memorandum also considers the impact of trade growth on freight in Seattle. Due to the importance of the Ports of Seattle and Tacoma to the economy, international trade plays a significant role on the local freight forecast. The technical memorandum discusses the greater impact on the economy and freight of transportation services sectors in Seattle as compared to most cities in the US. As such, US imports, as represented by GDP components, can be expected to drive freight in Seattle. There is a short term spike in imports related to pent up residential demand coming out of the recession. These trends are expected to level off and imports are expected to grow at about 1.6% in the long term as shown in Figure 3. Those trends ands and relationships are discussed in more detail in the technical memo.

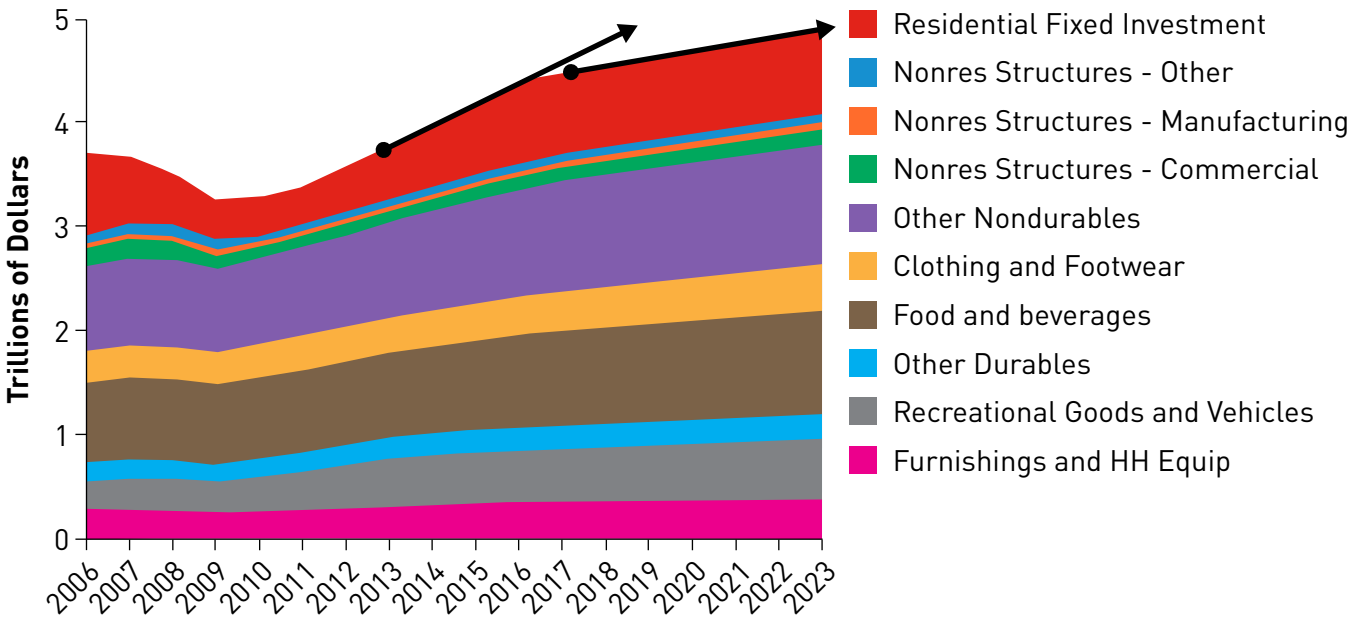
Citywide growth in both population and employment will are linked to future truck trips. However, employment in freight generating industries is a much better indicator of truck trips, when compared to population. And, when considering truck movements, overall population growth will be correlated with retail employment growth. While there is a growing movement

toward online shopping and direct home delivery, the emergence of omni-channel retail where retail stores serve as mini-distribution centers is reinforcing the linkage between freight and retail employment. These trends are discussed in more detail in *The Role of Freight in Seattle's Economy* technical memorandum, but are likely to result in increases in shorter truck trips in both retail and residential areas.

Other Freight Studies with Forecasts

Other recent projections of freight for the Seattle region and Washington State were reviewed as shown in Table 1. Although they encompass different time periods, geographic boundaries and methodologies, they generally support the 2% growth over the 2014-2035 timeframe. Forecasts with an earlier start or end point than the one developed for this study tend to be higher as they are more affected by the current post recession surge in imports.

FIGURE 3: TOTAL OF REAL GDP COMPONENTS



Source: WSP | Parsons Brinckerhoff

TABLE 1: RECENT REGIONAL AND STATE FREIGHT FORECASTS

Source	Time Period	Estimate and Assumptions
WSDOT Freight Mobility Plan	2011-2030	Statewide truck annual growth = 3.1%
FHWA Freight Analysis Framework (FAF3)	2012-2035	Annual domestic freight for City of Seattle = 2.4%
FHWA Freight Analysis Framework (FAF3)	2012-2040	Annual domestic freight for City of Seattle = 2.16%
Cambridge Systematics for Freight Access Project based on FAF3	2011-2035	Annual domestic freight for City of Seattle = 2.7%
American Trucking Association	2013-2024	Annual national total general and bulk TL, LTL and private carrier = 2.0%

TRUCK GROWTH ALLOCATION METHODOLOGY

To allocate projected truck growth throughout the city, it is necessary to evaluate geographically where employment, and in particular, key sectors, are growing. This provides insight to regions where truck volumes will increase above or below the expected average growth.

Overview of projection approach:

1. Update the existing truck flow map using current truck counts. This provides the basis for future projections.
2. Create geographic districts based on land use.
3. Generate district level growth factors based on employment and residential forecasts.
4. Calibrate specific locations based on more detailed studies.

1. Truck Volumes

Truck volumes have been measured throughout the city using primarily tube counters, but also video and other counting methods.[10] These counts are the starting point of the analysis. Figure 4 is the Existing Truck Flow Map developed by the City of Seattle to daily truck volumes on city streets.[11] All counts will subsequently be projected to 2035 estimates as part of the future freight forecast.

2. Districts

Thirteen geographic districts were created based on areas that have relatively consistent land uses as shown in Figure 5. The purpose of districts is to aggregate the city into reasonable regions that can each have a single growth factor to represent truck growth for that area. The districts were also defined so that they are comprised of Forecast Analysis Zones (FAZs) used by PSRC in development of their population and employment forecasts. The population and employment forecasts for each of the FAZs within the 13 districts were reviewed to ensure that each of the FAZs within a defined district are expected to grow at a similar rate in future.

3. Growth Factors

Growth were determined by using the current PSRC Population and Employment forecasts. This data is a product of the "2013 Land Use Baseline, Central Puget Sound Region - Maintenance Release 1 (MR1) Update" This data was first released in July 2013 and revised in April 2014.

The employment forecasts for the three major freight generating employment sectors—retail trade, wholesale trade and manufacturing—were aggregated to the 13 districts shown in Figure 6. Aggregating these employment categories by district provides a means of identifying where to expect truck trips to be concentrated.

Each district was then assigned one of four levels of growth - 1.0%, 1.6%, 2.0%, or 2.5%, which represent very low, low, med, or high growth, respectively. The population growth projections were then reviewed for each district (Figure 7). Because very high population growth could result in substantially more trucks in a district, to make deliveries to homes and local commercial/retail districts, it was determined that districts with population growth of more than 15,000 and/or the presence of urban centers or urban center villages would be moved up into the next highest growth category.

- Districts with urban center / urban center village developments: 2, 7, 9, and 13.
- Districts with growth of more than 15,000 people: 2, 4, and 7.

[10]This process if further described in SDOT's Existing Freight Conditions Report.
[11]The truck flow map includes only regular count locations where counts will be repeated.

FIGURE 4: EXISTING TRUCK FLOW MAP

Source: City of Seattle

FIGURE 5: CITY OF SEATTLE FORECAST DISTRICTS

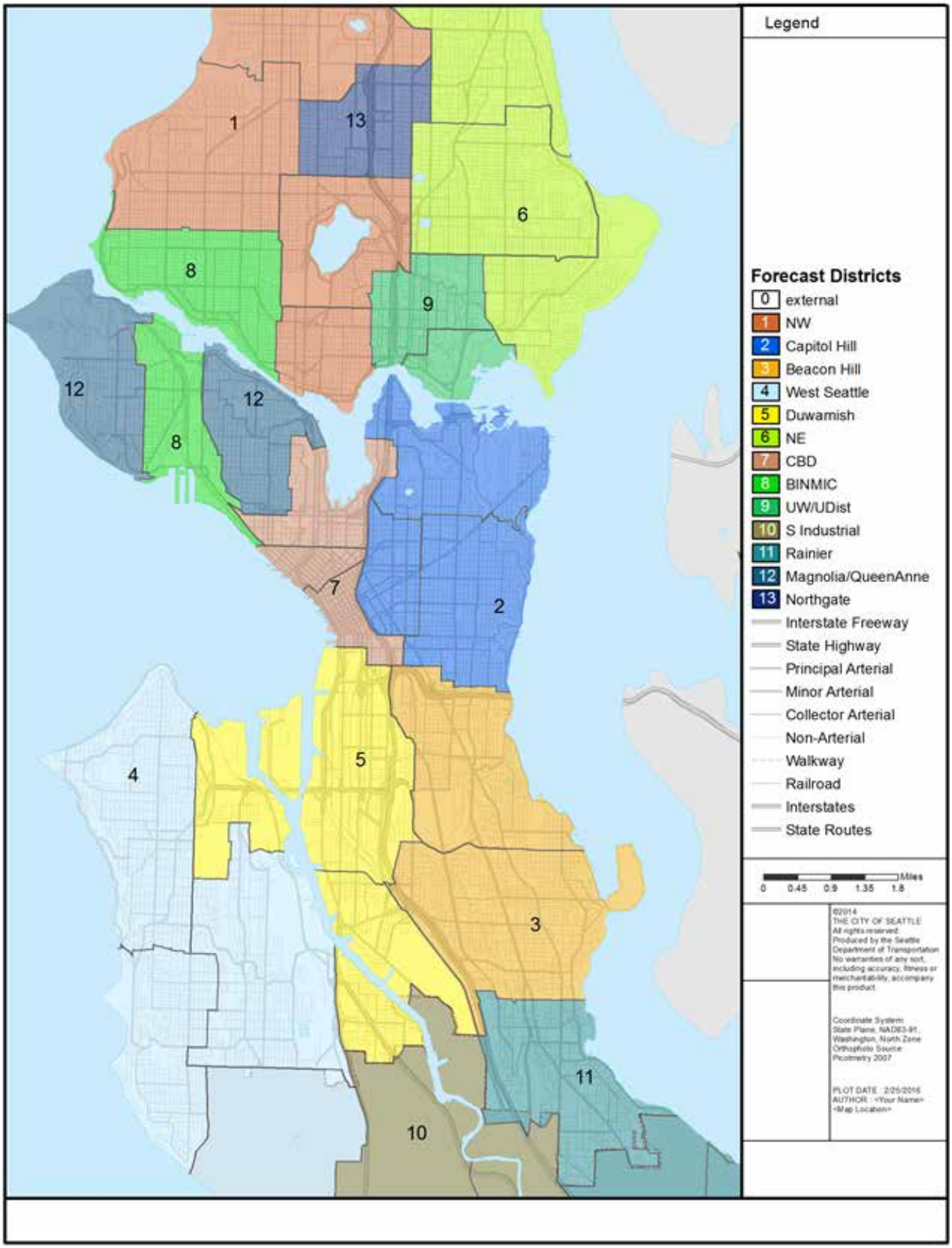


FIGURE 6: EMPLOYMENT GROWTH BY DISTRICT

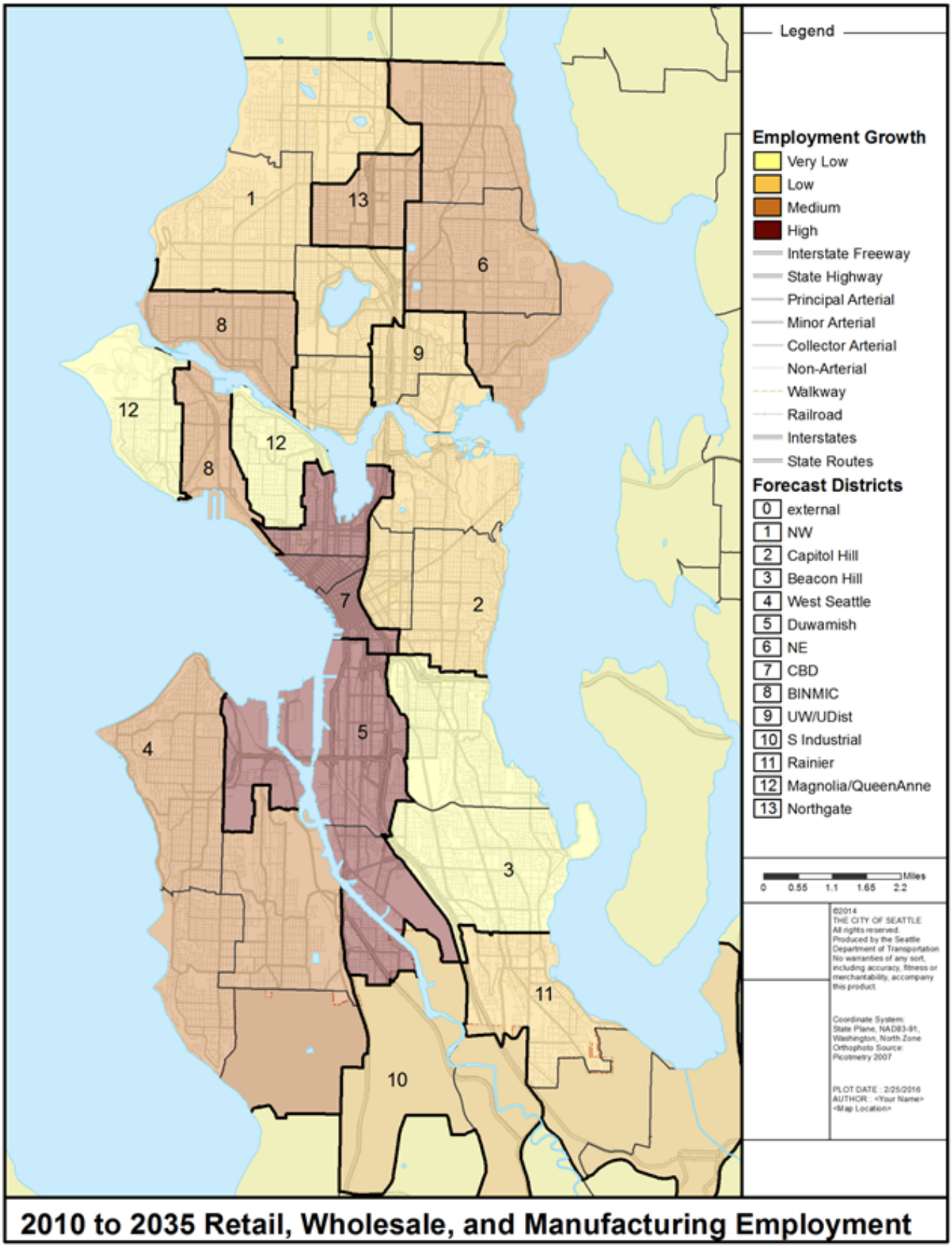


FIGURE 7: CITY OF SEATTLE POPULATION GROWTH 2010-2035

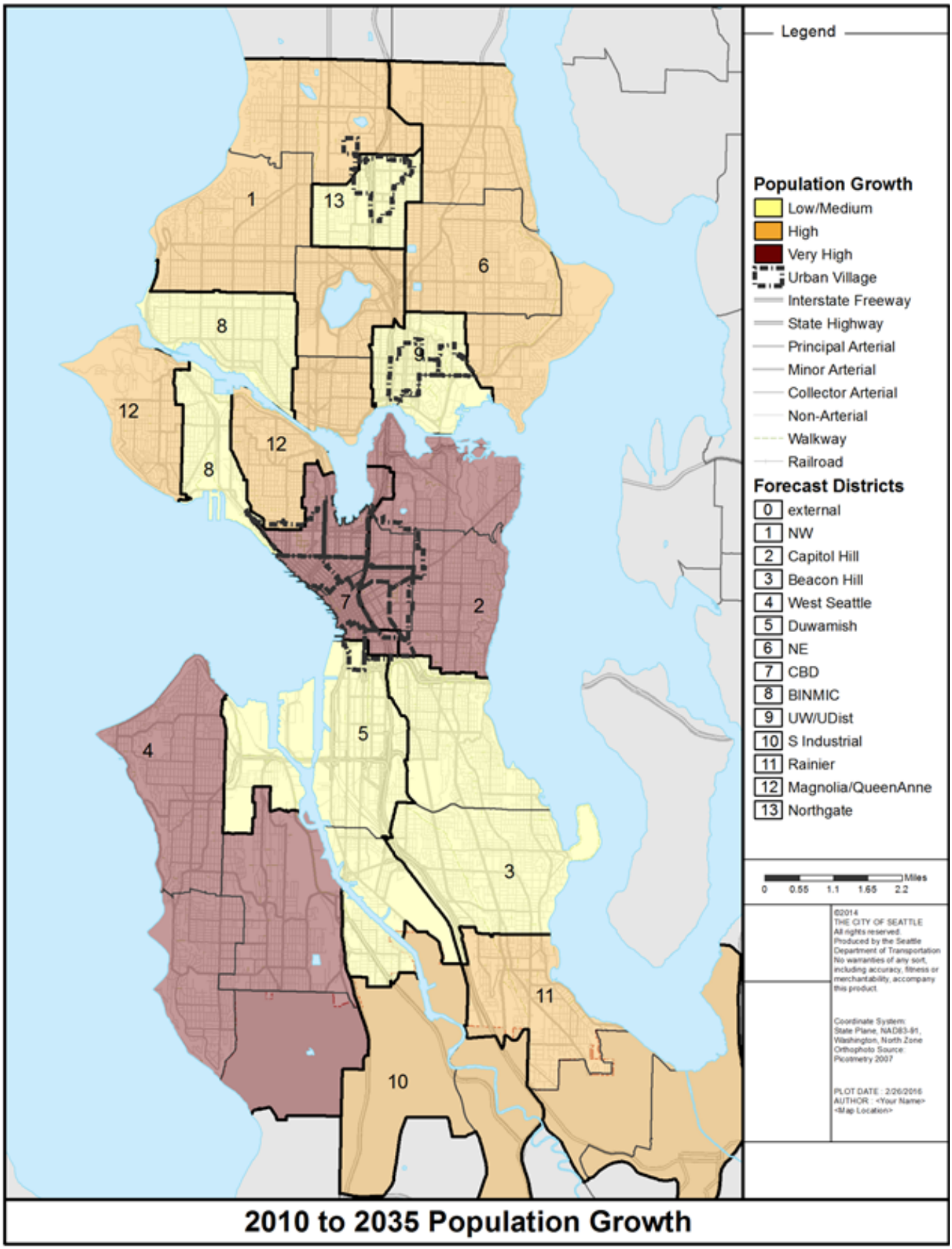


Figure 8 shows the resulting proposed freight growth factors for each district. As a result of the analysis of high growth population areas, districts 2 (Capitol Hill) and 9 (University District) moved from a designation of very low to a designation of low growth. Districts 4 (West Seattle) and 13 (Northgate) moved from low growth to medium growth designations. District 7 (CBD) already had high employment growth and thus remained in the high category. Forecasted population and employment growth by individual FAZ as well as by district is listed in Table 2.

4. Calibration

The PSRC regional model is relatively accurate in representing truck volumes on major roadways as they move to major destinations in and outside the region. The model's truck volumes were reviewed for truck growth on highways and principle arterials. State routes and highways are represented on the model output map in Figure 9. Incorporating these growth rates for regional facilities provides regional context to the truck forecast projections.

These facilities reflect the larger freight movements within the City. Annual growth factors were determined by using the growth between the base year and future year models. This growth was then applied to the regional facilities throughout the transportation network.

Finally, other freight studies with targeted analysis of future truck flows were reviewed and the results integrated. These included the Port of Seattle Container Terminal Access Study and the City of Seattle's Freight Access Project. With more refined focus areas, they will likely have differing base year data and future projections. These studies also provided additional traffic counts that can be incorporated into the City of Seattle truck count database. Roads that provide direct connection to and from the Port of Seattle to Interstate facilities will be allowed to grow at the "very high" growth rate of 3.5% per year.

FIGURE 8: FREIGHT GROWTH FACTORS BY DISTRICT

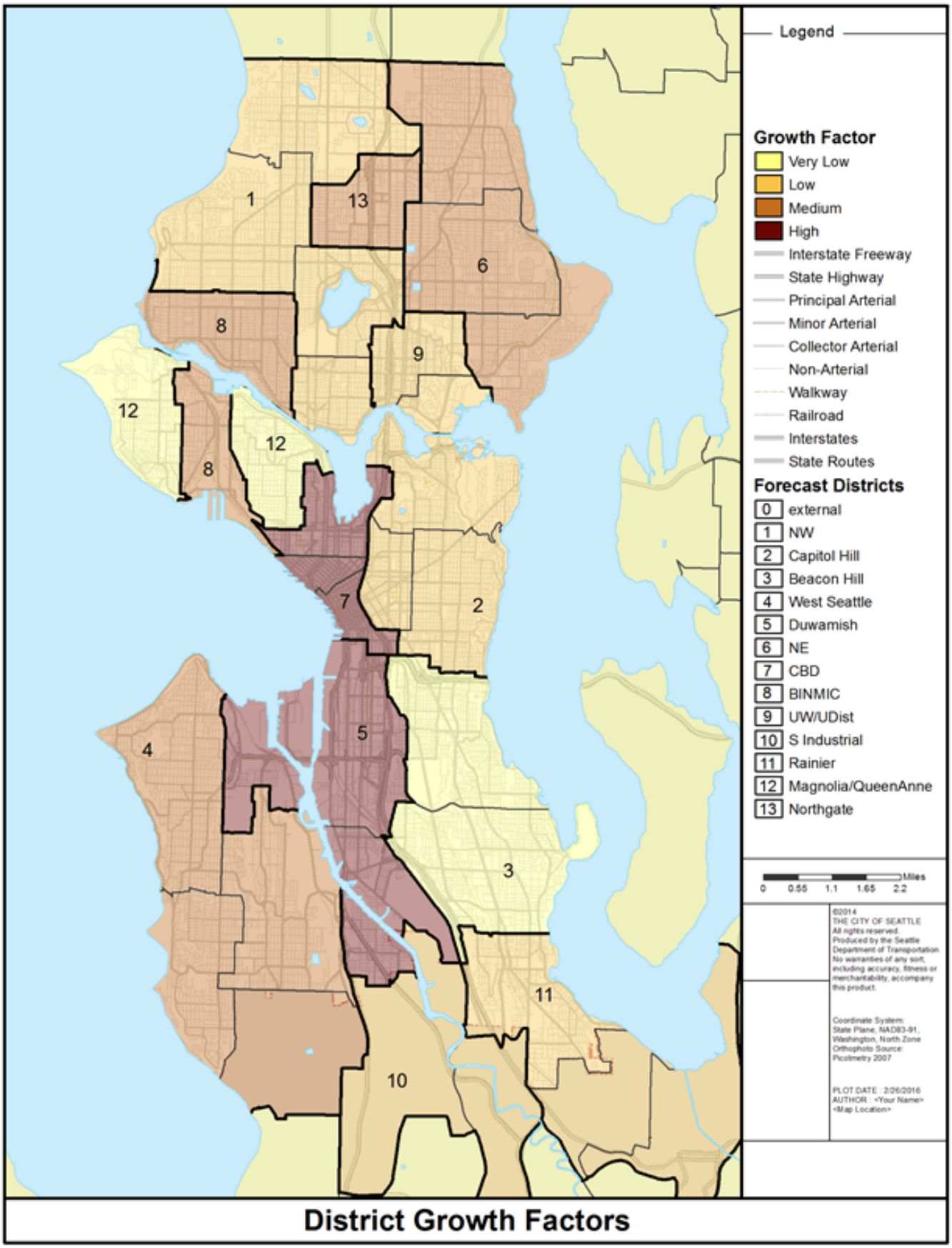


FIGURE 9: FREIGHT GROWTH FACTORS BY DISTRICT

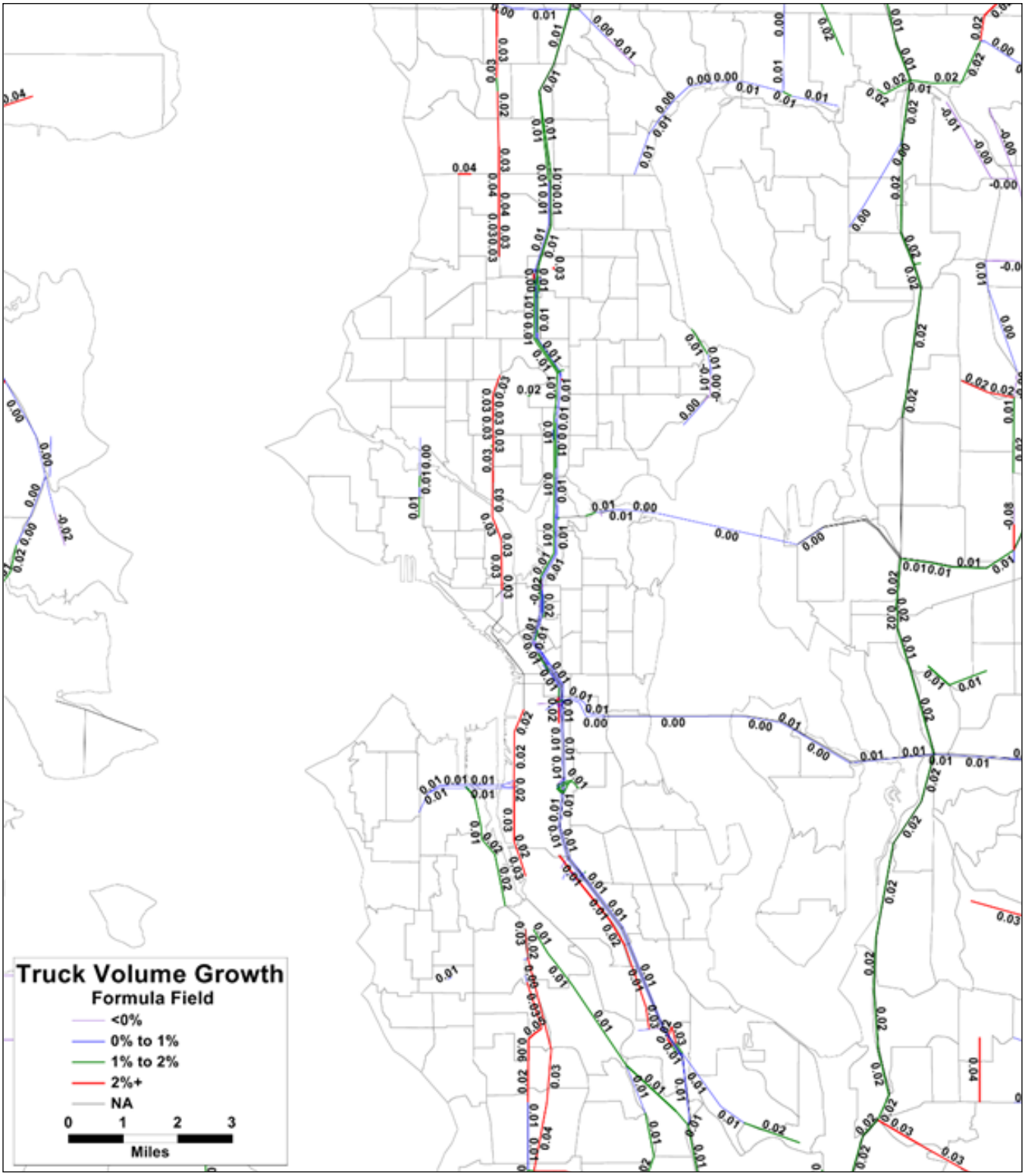


TABLE 2: POPULATION AND EMPLOYMENT FORECASTS BY FAZ AND CORRESPONDING FMP DISTRICTS

PSRC FAZ Forecast			Population		INDIV FAZ	DIST TOTAL	INDIV FAZ	DIST TOTAL	Big 3 Employment		INDIV FAZ	DIST TOTAL	INDIV FAZ	DIST TOTAL	
District	FAZ10	Location	POP2010	POP2040	chg	distChg	POP40gr	POP40gr	RWM2010	RWM2040	chg	distChg	RWM40gr	RWM40gr	GrFact
1	6213	Wallingford - Fremont	18,077	20,431	2,354	11,982	0.4%	0.4%	4,890	4,505	(385)	1,462	-0.3%	0.4%	2.0%
1	6224	Green Lake	20,551	24,018	3,467	11,982	0.5%	0.4%	1,972	2,178	206	1,462	0.3%	0.4%	2.0%
1	6325	Greenwood - Crown Hill	35,518	38,570	3,052	11,982	0.3%	0.4%	2,375	2,535	160	1,462	0.2%	0.4%	2.0%
1	6326	Broadview - Haller Lake	24,441	27,550	3,109	11,982	0.4%	0.4%	2,216	3,697	1,481	1,462	1.7%	0.4%	2.0%
2	6113	First Hill - Broadway	32,399	49,961	17,562	27,090	1.5%	0.9%	na*	na*	na*	680	na*	0.5%	1.6%
2	6114	East Capitol Hill - Central Area	33,366	38,394	5,028	27,090	0.5%	0.9%	2,988	3,295	307	680	0.3%	0.5%	1.6%
2	6115	North Capitol Hill - Madison Park	20,812	25,312	4,500	27,090	0.7%	0.9%	1,427	1,800	373	680	0.8%	0.5%	1.6%
3	5916	South Beacon Hill – Columbia	37,738	39,179	1,441	3,190	0.1%	0.2%	1,527	2,245	718	485	1.3%	0.2%	0.5%
3	5925	North Beacon Hill - Mount Baker	24,712	26,461	1,749	3,190	0.2%	0.2%	7,649	7,416	(233)	485	-0.1%	0.2%	0.5%
4	3816	White Center - Shorewood	22,261	28,353	6,092	15,745	0.8%	0.5%	959	1,770	811	2,942	2.1%	1.1%	2.0%
4	5715	Fauntleroy - Arbor Heights	16,950	19,232	2,282	15,745	0.4%	0.5%	423	631	208	2,942	1.3%	1.1%	2.0%
4	5716	Delridge - Highland Park	26,048	27,645	1,597	15,745	0.2%	0.5%	2,742	4,223	1,481	2,942	1.4%	1.1%	2.0%
4	5720	Alki - Admiral	35,743	41,517	5,774	15,745	0.5%	0.5%	3,341	3,783	442	2,942	0.4%	1.1%	2.0%
5	5815	Lower Duwamish - Boeing Field	5,278	5,623	345	4,338	0.2%	0.9%	14,171	19,684	5,513	15,399	1.1%	1.4%	3.5%
5	5825	Industrial District	3,843	5,597	1,754	4,338	1.3%	0.9%	13,515	22,343	8,828	15,399	1.7%	1.4%	3.5%
5	5826	Upper Duwamish - Harbor Island	4,161	6,400	2,239	4,338	1.4%	0.9%	3,357	4,415	1,058	15,399	0.9%	1.4%	3.5%
6	6216	Windermere - Laurelhurst	15,766	16,565	799	8,610	0.2%	0.4%	864	1,423	559	4,321	1.7%	2.5%	2.0%
6	6223	Lake City	26,953	30,619	3,666	8,610	0.4%	0.4%	1,695	4,545	2,850	4,321	3.3%	2.5%	2.0%

TABLE 2: POPULATION AND EMPLOYMENT FORECASTS BY FAZ AND CORRESPONDING FMP DISTRICTS (CONTINUED)

PSRC FAZ Forecast			Population		INDIV FAZ	DIST TOTAL	INDIV FAZ	DIST TOTAL	Big 3 Employment		INDIV FAZ	DIST TOTAL	INDIV FAZ	DIST TOTAL	
District	FAZ10	Location	POP2010	POP2040	chg	distChg	POP40gr	POP40gr	RWM2010	RWM2040	chg	distChg	RWM40gr	RWM40gr	GrFact
6	6226	Wedgwood - View Ridge	30,144	34,289	4,145	8,610	0.4%	0.4%	1,437	2,349	912	4,321	1.7%	2.5%	2.0%
7	6010	Seattle CBD	12,027	22,213	10,186	37,229	2.1%	2.1%	16,275	21,784	5,509	18,287	1.0%	1.5%	2.5%
7	6020	Denny Regrade	14,993	28,135	13,142	37,229	2.1%	2.1%	7,788	15,142	7,354	18,287	2.2%	1.5%	2.5%
7	6123	Lake Union - Seattle Center	16,192	30,093	13,901	37,229	2.1%	2.1%	8,760	14,184	5,424	18,287	1.6%	1.5%	2.5%
8	6125	Interbay	9,918	11,718	1,800	5,676	0.6%	0.4%	3,478	5,950	2,472	5,664	1.8%	1.4%	2.5%
8	6316	Ballard	30,806	34,682	3,876	5,676	0.4%	0.4%	7,358	10,550	3,192	5,664	1.2%	1.4%	2.5%
9	6214	University Of Washington	5,706	7,907	2,201	5,278	1.1%	0.5%	na*	na*	na*	879	na*	0.5%	1.6%
9	6215	Ravenna - University District	29,177	32,254	3,077	5,278	0.3%	0.5%	5,728	6,607	879	879	0.5%	0.5%	1.6%
10	3825	Boulevard Park	17,773	23,515	5,742	9,301	0.9%	1.0%	2,429	4,192	1,763	1,763	1.8%	2.0%	1.6%
10	3905	North Tukwila - Riverton	8,910	12,469	3,559	9,301	1.1%	1.0%	na*	na*	na*	1,763	na*	2.0%	1.6%
11	4005	Skyway - Bryn Mawr	12,118	19,266	7,148	10,481	1.6%	0.6%	327	753	426	2,823	2.8%	2.7%	2.0%
11	4130	Renton Airport - CBD	17,061	19,219	2,158	10,481	0.4%	0.6%	na*	na*	na*	2,823	na*	2.7%	2.0%
11	5915	Rainier Beach	20,230	21,405	1,175	10,481	0.2%	0.6%	1,486	3,883	2,397	2,823	3.3%	2.7%	2.0%
12	6124	Queen Anne	26,499	31,499	5,000	7,193	0.6%	0.6%	4,218	4,138	(80)	173	-0.1%	0.1%	0.5%
12	6126	Magnolia	11,562	13,755	2,193	7,193	0.6%	0.6%	912	1,165	253	173	0.8%	0.1%	0.5%
13	6225	Northgate	19,253	24,758	5,505	5,505	0.8%	0.8%	4,095	6,106	2,011	2,011	1.3%	1.3%	2.0%

na* = PSRC develops employment forecasts based on Forecast Analysis Zones (FAZs). Some FAZs do not have employment values for the base year due to confidentiality issues, and also do not have projections.