



# **SEATTLE *SMART*: DIGITIZING THE LAST MILE OF URBAN GOODS TO IMPROVE CURB ACCESS AND UTILIZATION**

**University of Washington**

**Urban Freight Lab**

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# FORWARD

In Spring 2023, the Seattle Department of Transportation (SDOT) was awarded a Stage-1 grant under the Strengthening Mobility and Revolutionizing Transportation (SMART) Grants Program by the US DOT. The University of Washington's Urban Freight Lab (UFL) partnered with SDOT to develop the methodological approach and analysis for the SMART project, titled "Last-mile freight curb access: digitizing the last-mile of urban goods to improve curb access and utilization," and determine key research discoveries that contribute to the existing body of work and support development for a SMART Stage-2 grant. This technical report describes the research study, data collected, and findings from analysis of those data.

The report is organized in order of the scope of work "tasks". Task 1: Technology selection, deployment, and assessment — for which a technical report was not required and is therefore not included herein— was related to technology selection. Tasks 2 and 3 are combined, having both related to collecting baseline data and establishing baseline conditions. Task 4 includes the collection of study area data and analysis of activities in Commercial Vehicle Load Zones (CVLZs). Task 5: document carrier's practices draws on interviews of last mile carriers operating in Seattle to better understand parking behavior and CVLZ permit usage. Tasks 6 and 7 are based on a survey of a larger sample of area carriers to qualitatively assess existing parking challenges and estimate the behavioral impacts of future parking policy and pricing strategies. This report constitutes the final task: recommendations and evaluations.

The tasks included in the UFL's scope of work are listed in their entirety below for reference.

Task 1: Technology selection, deployment, and assessment

Task 2: Build and gather baseline data layers

Task 3: Establishing baseline conditions: Analysis of existing permit holders and parking transactions

Task 4: Developing a data collection study for observing behaviors at commercial vehicle load zones and synthesize overall behavioral results

Task 5: Document carriers' practices on parking payments

Task 6: Future scenario development

Task 7: Qualitatively understand potential impacts of scenarios

Task 8: Recommendation development and evaluation

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## INTRODUCTION

Approximately 11 percent (~5.83 miles) of existing curb in the Seattle central core is allocated to commercial vehicles. Commercial Vehicle Load Zones (CVLZs) are curb spaces that are allocated for loading/unloading for a 30-minute maximum dwell time upon the purchase of an annual \$250 permit or paying for each parking event individually at pay stations or via PayByPhone. This project tested a Vehicle-to-Curb (V2C) technology that investigated the digitization of the existing CVLZ permit and to potentially enable pricing strategies.

While parking pricing policies have been successful to manage passenger vehicle demand and their parking behaviors, the response of commercial vehicles to parking pricing is not sufficiently understood, and little information is available to predict their behavioral response.

The overarching goals of this project were to: (1) pilot test the effectiveness of a V2C technology to enable the digitization of the existing Seattle CVLZ permit system and (2) to qualitatively understand the role parking pricing and permitting programs play in affecting drivers' ability to find and utilize authorized parking within the context of north downtown Seattle.

This project utilized multiple data sources: V2C observed data, carrier interviews, and carrier surveys. Analysis of each data source produced key findings that will inform SDOT's permit policy decisions in the future. The findings further contextualize urban freight parking activity in a dense urban core as well as empirically describing competition for parking infrastructure. Below are some important findings from each segment of the overall project.

### Key findings from establishing baseline conditions (Tasks 2 & 3)

- The number of CVLZ permits has steadily declined since 1997. This can occur for many reasons including price sensitivity, gradual changes to the composition of businesses operating in Seattle that require permits, changes to fleets or consolidation efforts, or even lack of awareness of the program. Despite declining numbers in total permits, around 90% of permit holding *companies* retain those permits on a year-to-year basis.
- The CVLZ permit program is the main revenue source from CVLZ activity. The program accounts for 57% of total revenue compared to PayByPhone transactions (5%) and citations for unauthorized parking in CVLZs (38%).

### Key findings from analysis of observation data (Task 4)

- Commercial vehicles with CVLZ permits as well as commercial vehicles without permits are both most likely to find parking in a CVLZ compared to other curb space types (e.g., PLZ, long-term parking, alley, etc.). Permit holders found parked in CVLZs at a higher rate than non-permit holders (61% of events vs. 47%). Permit holders were also more likely to park in an authorized zone.

- Commercial vehicles account for just 16.8% of CVLZ parking events; only 21.5% of CVLZ parking events were authorized by a permit or payment (this includes passenger vehicles with a CVLZ permit). This means 78.5% of the parking events in CVLZs during the study period were unauthorized. From a dwell time standpoint, 60.3% of CVLZ usage was unauthorized by either permit or PayByPhone transactions.

#### **Key findings from carrier interviews (Task 5):**

- For most companies, CVLZs are perceived as necessary to efficiently perform operations in Seattle's downtown, especially for those using larger vehicles and with longer dwell times.
- Enforcement is a key factor in permit valuation and everyday decision-making, but not in the way it was expected. Companies report getting very few tickets in general. Consequently, the risk of getting a ticket is not listed as the primary reason for purchasing CVLZ permits. Instead, companies are asking for more enforcement of the CVLZs, as they are frustrated when other vehicles (especially smaller food delivery/passenger vehicles like TNCs) park at CVLZs even if they do not have a permit.

#### **Key findings from carrier survey and choice modeling (Tasks 6 & 7):**

- On average, permit holders make more stops per route than non-permit holders. Most activities occur during the day for both permit and non-permit holders. However, 50% of non-permit holders reported operating off-peak, compared to only 24.61% of permit holders.
- The stated preference survey data shows that as the annual permit price increases, the proportion of respondents selecting to buy the annual permit decreases, and more respondents indicate they will choose not to pay for parking. The share of respondents choosing the pay-per-use option remains mostly constant despite changes to the price of the annual permit. This suggests that demand for the annual permit is price elastic, with higher prices potentially leading to a shift to alternative options.

In addition to quantifying curb activity by multiple road users (delivery vehicles, service vehicles, TNCs, and personal vehicles, this research provides a basis for Stage 2 SMART work in Seattle. This work will use the findings from this research to make data-driven updates to SDOT's parking policies and permit programs, while also making information about curbspace more accessible to road users.

## **PART I**

# **TASKS 2 AND 3: ESTABLISHING BASELINE CONDITIONS**

# PART I - TASKS 2 AND 3: ESTABLISHING BASELINE CONDITIONS

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## I-1 Introduction

Part I summarizes the results from the analysis of existing data obtained from public sources and from the Seattle Department of Transportation (SDOT) to address the research question:

*What are the existing commercial vehicle parking behaviors in Seattle's north downtown, particularly related to parking payments?*

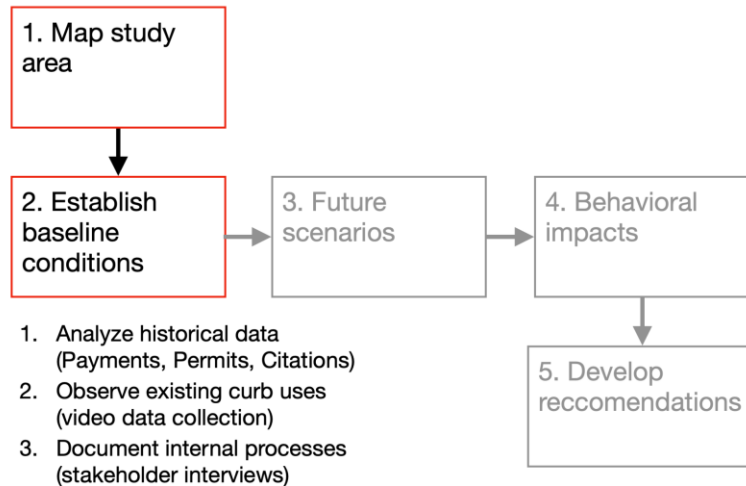
To address the above question, Tasks 2 and 3 of the SMART-SDOT project **analyze the study area**, map and measure the existing infrastructure supporting demand and supply of urban freight transportation, and **gather and process historical data on how commercial operators interacted with the infrastructure**, including pay-per-use parking transactions, purchased permits, issued citations and reported collisions where commercial vehicles were involved. Table 1 provides an overview of the data sources analyzed in this report.

Appendix I contains a more detailed description of the data layers and their variables.

**Table 1.** Description of main data layers used and sources

| Dataset(s)                 | Description                                                                                                                                           | Source                |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Infrastructure data layers | Geospatial data layers describing curb allocation, bus lanes, bike lanes, blocks, blockfaces, travel lanes, and building footprints in the study area | SDOT Open Data Portal |
| Freight generators         | List of establishments generating freight trips and their location, including restaurants, cafes, bars, apartment buildings located in the study area | Google Places API     |
| Parking transactions       | PayByPhone payments for Commercial Vehicle Load Zones (CVLZs) located within the study area, from January 3 to October 31, 2023                       | SDOT                  |
| Permit holders             | List of CVLZ permits issued and the respective permit holders from 1994 to 2024                                                                       | SDOT                  |
| Citations                  | Citations that were written within the study area from January 2017 to December 2022.                                                                 | SDOT                  |

Tasks 2 and 3 of the project SoW represent the first steps in **establishing baseline conditions** in analyzing the effect of parking pricing on commercial vehicle behaviors. Figure 1 provides an overview of the project scope of work and the current milestones reported in this document.



**Figure 1.** Project overview (current tasks addressed in this report are highlighted in red)

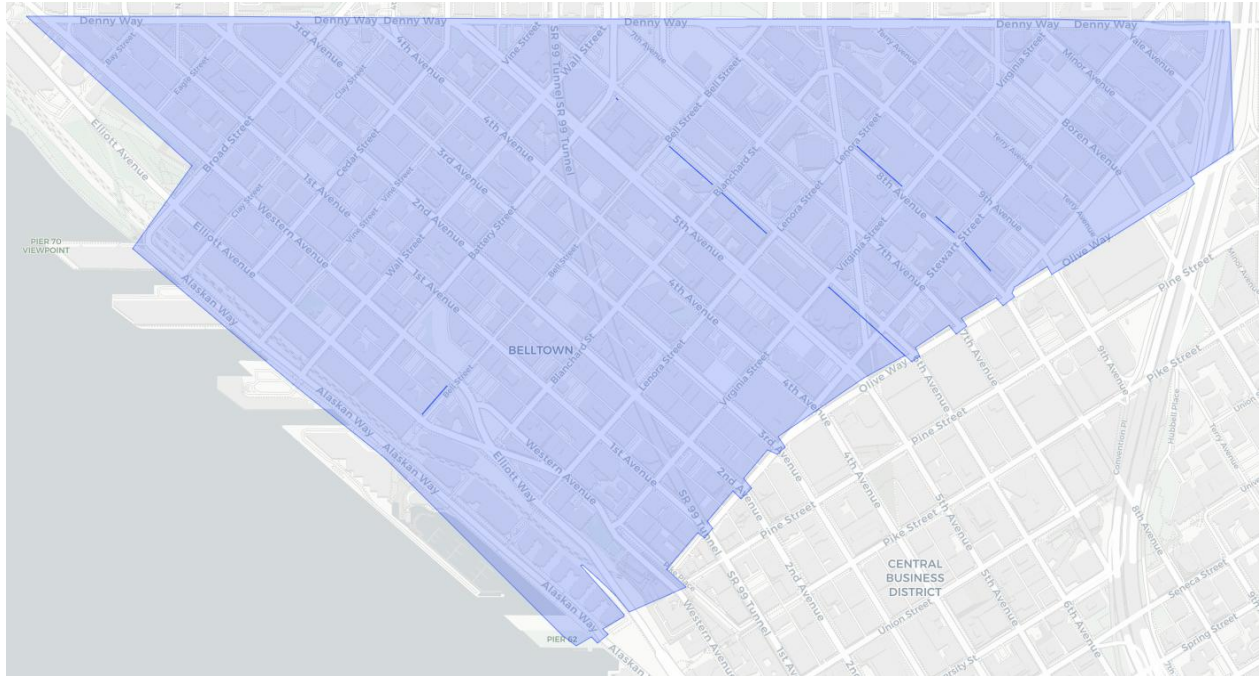
## I-1.1 Key Findings from Tasks 2 and 3

- The CVLZ permit program is a significant source of revenue. On average, each linear foot of CVLZ space in the study area generates \$60 of revenue per year.
- Companies who purchase CVLZ permits typically repeat this behavior for many consecutive years. From 1994 to 2018 year-to-year retention of CVLZ permits hovered around 90%. This rate dropped to 45% in 2018 but recovered to 80% the following year.
- Enforcement of unauthorized use of CVLZs – in the form of citations being issued is low, with few outliers. An average of 14 citations per year are issued per CVLZ based on 2022 records.

## I-2 Study area

### I-2.1 Study area overview

The project study area is located in the north downtown Seattle neighborhood, which includes the districts of Belltown and Denny Triangle. The study area, depicted in Figure 2, is bounded on the north by Denny Way, on the east by a short segment of the Interstate-5 (I-5), on the southeast by Olive Way, which merges into Stewart Street, and on the southwest by the Alaskan Way.



**Figure 2.** Study area boundaries.

The study area measures 0.54 square miles (1.39 square km). For the purpose of analysis, the area was subdivided into a hierarchy of geospatial objects--blocks, buildings, establishments, blockfaces, and curb zones--defined in Table 2.

**Table 2. Hierarchy of spatial objects in study area (last update: February 2024)**

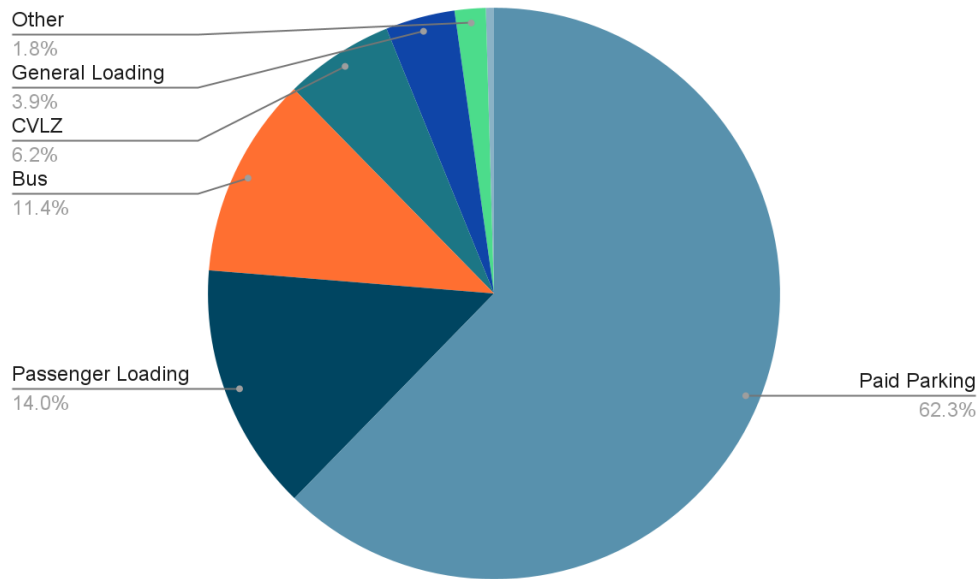
| Object                                 | Definition                                                                                                                                                                                 | No. objects in study area                                                                                                               |
|----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Block<br>- Building<br>- Establishment | An urban block is the smallest group of building lots that is surrounded by streets. Blocks contain buildings, within which are located establishments of different natures                | The study area contains 120 blocks, 620 buildings, and 1,665 establishments                                                             |
| Block segment                          | The street boundaries of a block, including both sides of the street are referred to as a block segment                                                                                    | The study area contains 225 block segments                                                                                              |
| Blockface                              | The street boundary of a block on one specified side of the street is referred to as a blockface                                                                                           | The study area contains 450 blockfaces                                                                                                  |
| Curb zone                              | Most blockfaces contain a curb lane. The curb lane of each blockface can be subdivided into different curb zones, which are portions of the curb lane allocated by SDOT for different uses | Blockfaces in the study area are subdivided into 8,223 curb zones (of various lengths), of which 2,831 are allocated to vehicle parking |

### *I-2.1.1 Curb allocation*

The total curb length in the study area is 161,463 ft (30.5 miles). Of this curb space, the majority is designated as “no parking” or “no stopping,” comprising 98,471 ft (61%) of the total curb, leaving 62,992 ft (11.9 miles) allocated for vehicle parking.

Curb allocation across all uses is depicted in the pie chart in Figure 3. Excluding the no-parking and no-stopping zones, approximately 3,900 ft (6.2%) is designated as Commercial Vehicle Load Zones (CVLZs), 8,826 ft (14%) is allocated for Passenger Loading Zones (PLZs), and 2,473 ft (3.9%) is allocated for loading zones that are not CVLZs or PLZs.

Table 3 compares the study area curb allocation distribution to the one in Seattle downtown. We observe a similar distribution.



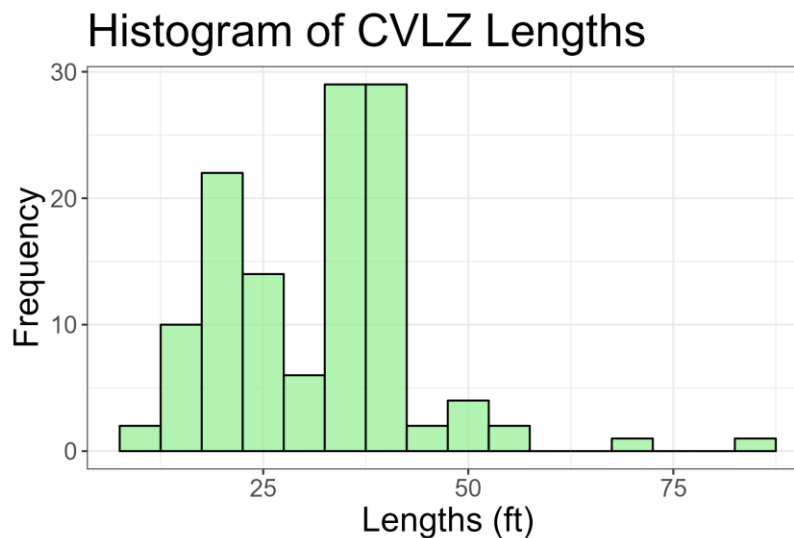
**Figure 3.** Distribution of allocated curbs for parking by purpose in the study area

**Table 3.** Comparison of the allocated curb for parking by purpose in the study area vs. Seattle downtown

| Allocation                  | Study Area              | Seattle Downtown        |
|-----------------------------|-------------------------|-------------------------|
| Bus                         | 7,175 ft (11.4%)        | 36,555 ft (12.6%)       |
| CVLZ                        | 3,899 ft (6.2%)         | 13,718 ft (4.7%)        |
| Disabled Access             | 288 ft (0.4%)           | 2,532 ft (0.9%)         |
| General Loading Zones       | 2,473 ft (3.9%)         | 24,719 ft (10.0%)       |
| Other                       | 1,105 ft (1.8%)         | 9,098 ft (3.1%)         |
| Paid Parking                | 39,256 ft (62.3%)       | 168,916 ft (58.1%)      |
| Passenger Loading           | 8,826 ft (14.0%)        | 35,433 ft (12.2%)       |
| <b>Total allocated curb</b> | <b>63,022 ft (100%)</b> | <b>78,201 ft (100%)</b> |

### I-2.1.2 Commercial Vehicle Load Zones (CVLZs)

The average length of a CVLZ curb zone is 32 ft. The distribution of CVLZ lengths in the study area is shown in the histogram in Figure 4.



**Figure 4.** Empirical distribution of CVLZ length (ft)

Figure 5 maps the curb allocation in the study area. 110 out of 450 blockfaces (24.4%) have at least 1 CVLZ. 12 blockfaces have more than 1 CVLZ. 88 out of 245 (35.9%) block segments, including both sides of the street in the study area, have at least 1 CVLZ. 28 block segments (11%) have more than 1 CVLZ, with exactly one block segment having a maximum of 4 CVLZs.



**Figure 5.** Map of allocated curb in the study area

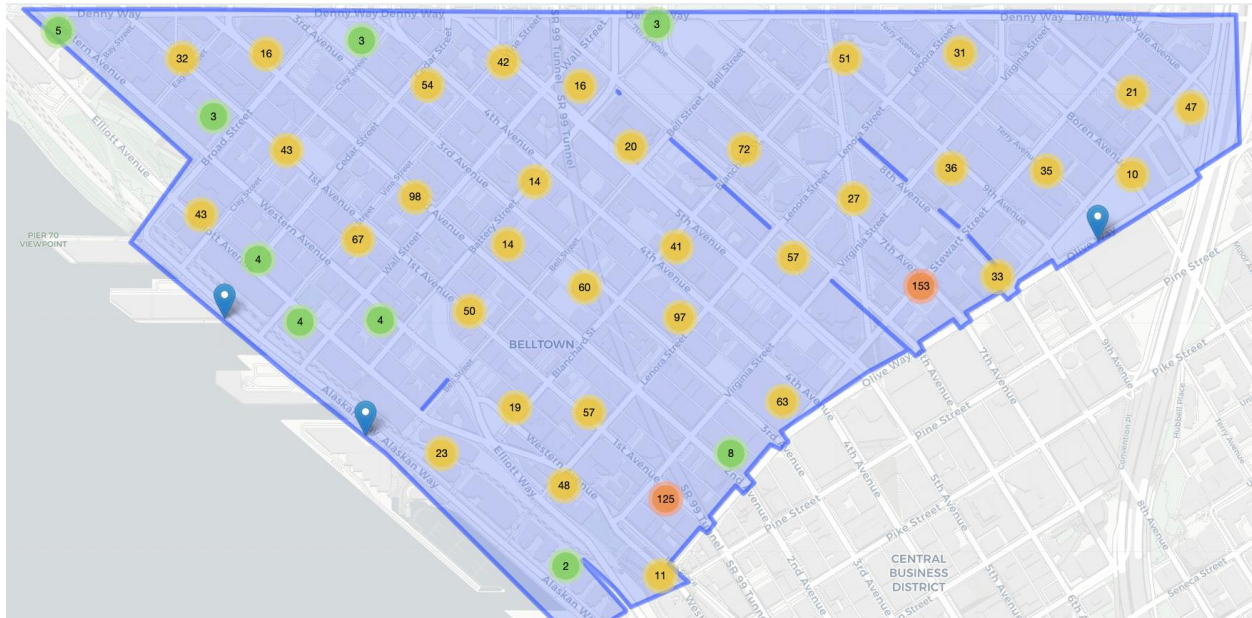
### I-2.1.3 Establishments

Establishments generating freight trips in the study area were identified by scraping Google Maps Places API. The following establishment types were considered:

**Table 4. Establishment types**

|                   |                    |                   |                    |
|-------------------|--------------------|-------------------|--------------------|
| Hardware_store    | Accounting         | Store             | Roofing_contractor |
| Shoe_store        | Gas_station        | Electronics_store | Plumber            |
| Pharmacy          | Veterinary_care    | Florist           | Car_repair         |
| Bicycle_store     | Gym                | University        | Moving_company     |
| Home_goods_store  | Real_estate_agency | Library           | Lawyer             |
| Shopping_mall     | Funeral_home       | School            | Spa                |
| Supermarket       | Beauty_salon       | Doctor            | Laundry            |
| Liquor_store      | Post_office        | Dentist           | Hair_care          |
| Clothing_store    | Bank               | Hospital          | Locksmith          |
| Jewelry_store     | Police             | Physiotherapist   | Electrician        |
| Book_store        | Courthouse         | Bar               | Painter            |
| Pet_store         | Local_gov_office   | Bakery            | Storage            |
| Furniture_store   | Embassy            | Restaurant        | Insurance_agency   |
| Car_dealer        | Atm                | Cafe              | Travel_agency      |
| Convenience_store | Fire_station       | Church            | Tourist_attraction |
| Car_rental        | Museum             | Mosque            | Art_gallery        |
| Bus_station       | Movie_theater      | Transit_station   | Night_club         |
| Apartment         | Hotel              | Condominium       | Residence          |

A total of 1,665 establishments were recorded in the study area. Figure 6 shows a map with establishments' clusters and their respective size.



**Figure 6.** Map with establishments in the study area. Each dot represents a cluster of establishments reporting the total number of establishments within each cluster

### I-3 Curb use behaviors

Figure 7 provides an overview of curb behaviors analyzed in this report. Consider a vehicle  $i$  arriving at a blockface  $j$  and looking for parking. We assume two vehicle types: commercial and passenger vehicles. The following two curb behaviors take place.

Payment behavior consists of the choice of paying for parking in the following forms:

- Purchase a CVLZ parking permit
- Pay per one-time use
- No payment

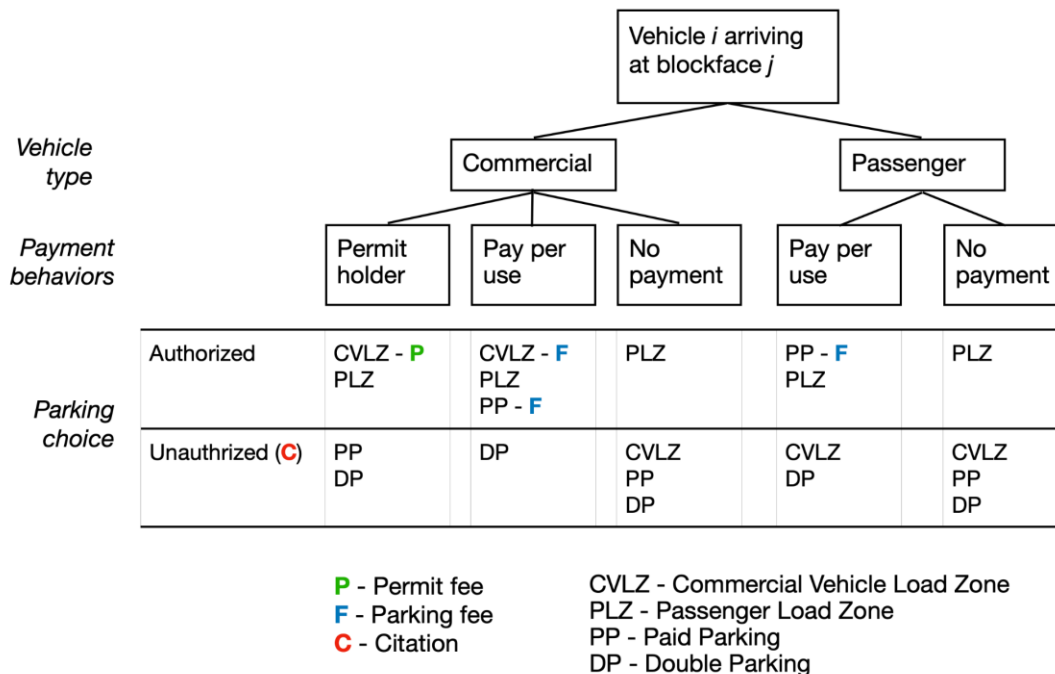
Parking choice consists of the choice of parking infrastructure among:

- Commercial vehicle load zone
- Passenger load zone
- Paid parking
- Double parking (i.e. park in the travel lane)

According to the parking choice and payment behavior, the final outcome is either an authorized parking event, or an unauthorized parking event. The possible transactions that can take place are:

- Permit fee (**P**)
- Parking fee (**F**)
- Citation (**C**)

Note that we are not considering dwell time at this point.



**Figure 7.** Overview of curb behaviors

We then consider the following three transactions for the study area:

- CVLZ - **P**: Commercial vehicle that carries a valid permit and chooses to park at a CVLZ
- CVLZ - **F**: Commercial vehicle not carrying a permit that chooses to park at a CVLZ and pay a one-time parking fee
- CVLZ - **C**: Commercial vehicle not carrying a permit that chooses to park at a CVLZ

Table 5 summarizes the number of transactions and total revenue generated for each of the three cases described above.

**Table 5.** Annual no. of CVLZ-related transactions and respective revenue for study area

| Transaction type | No. transactions | Tot. revenue (%)                 | Revenue per feet of CVLZ |
|------------------|------------------|----------------------------------|--------------------------|
| CVLZ - <b>P</b>  | Unknown          | \$134,040.6 (57.0%) <sup>2</sup> | \$34.4                   |
| CVLZ - <b>F</b>  | 13,080           | \$11,400.0 (4.8%)                | \$2.9                    |
| CVLZ - <b>C</b>  | 1,697            | \$89,941.0 (38.2%)               | \$23.1                   |
| <b>Total</b>     | <b>Unknown</b>   | <b>\$235,381.6</b>               | <b>\$60.4</b>            |

1. we use 2022 as reference year
2. the total revenue from permit purchases is multiplied by the total share of CVLZs in study area wrt total CVLZ length

## I-4 CVLZ permit holders

### I-4.1 CVLZ permit regulations

A commercial vehicle (defined as a motor truck, station wagon, or van that carries no more than 3 seated passengers, has been properly licensed as a truck, and is displaying the name of the business registering it) can be parked at a CVLZ for no more than 30 minutes upon either<sup>1</sup>:

- Paying at a pay station for a single parking event or,
- Purchase a CVLZ permit

A person or entity that possesses a valid City of Seattle business license can purchase one CVLZ permit for each operated commercial vehicle. The permit is uniquely tied to a vehicle license plate, has to be affixed to the lower left-hand corner of the vehicle's windshield (see Figure 8), and is valid for up to one year.



**Figure 8.** CVLZ permits attached to a commercial vehicle windshield

### I-4.2 Permits issued and revenue generated

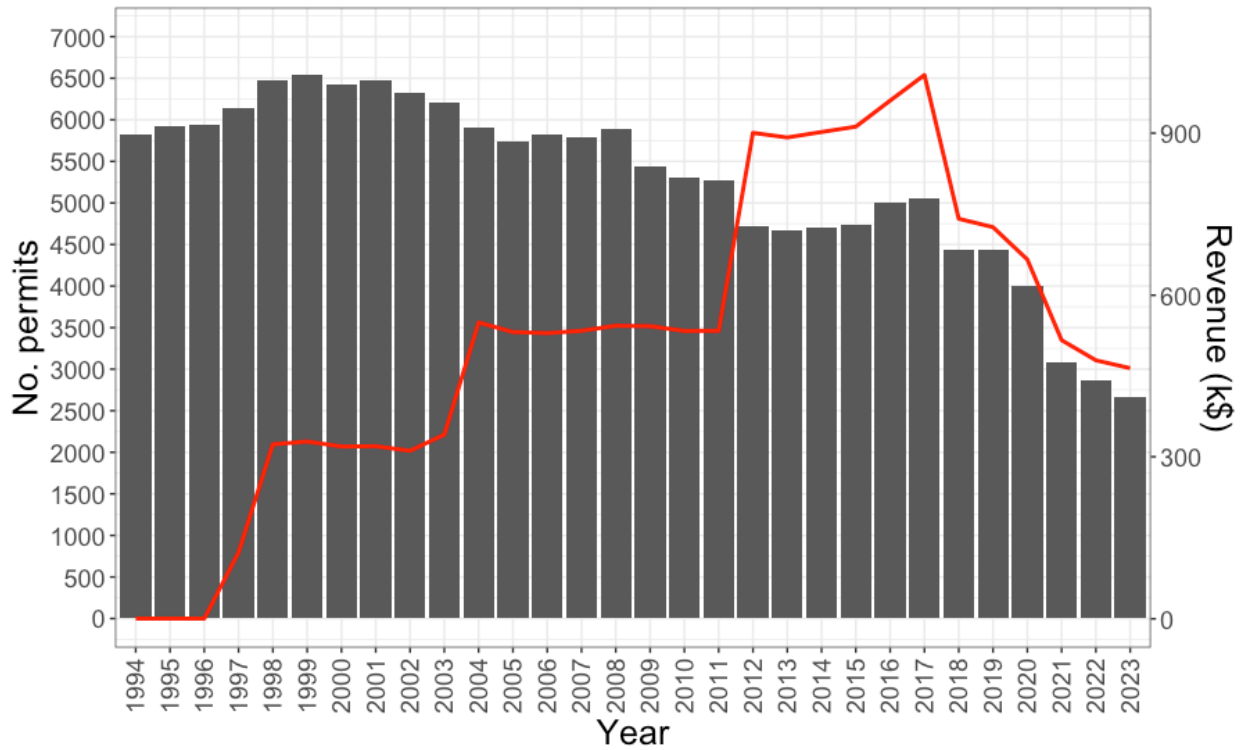
Table 6 and Figure 9 show summary statistics of permit holder data between 1994 and 2024. In the following analysis, we exclude the reporting of the year 2024 as, at the time of data gathering, not all 2024 permits had been issued yet. The total number of permits issued per year ranges from a minimum of 2,663 (in 2023) to a maximum of 6,539 (in 1999). On average, **5,260 permits** were issued each year.

The yearly total revenue generated by the permit purchases ranges from 0\$ (1994 to 1996 permits were free of charge) to a maximum of 1008 k\$ (in 2017). On average, a **yearly revenue of 517.6 k\$** was generated.

<sup>1</sup> See Condition of Use for CVLZ permits: <https://www.seattle.gov/transportation/permits-and-services/permits/atp-commercial-vehicle-load-zone>

**Table 6.** Summary statistics of permit holder data per year

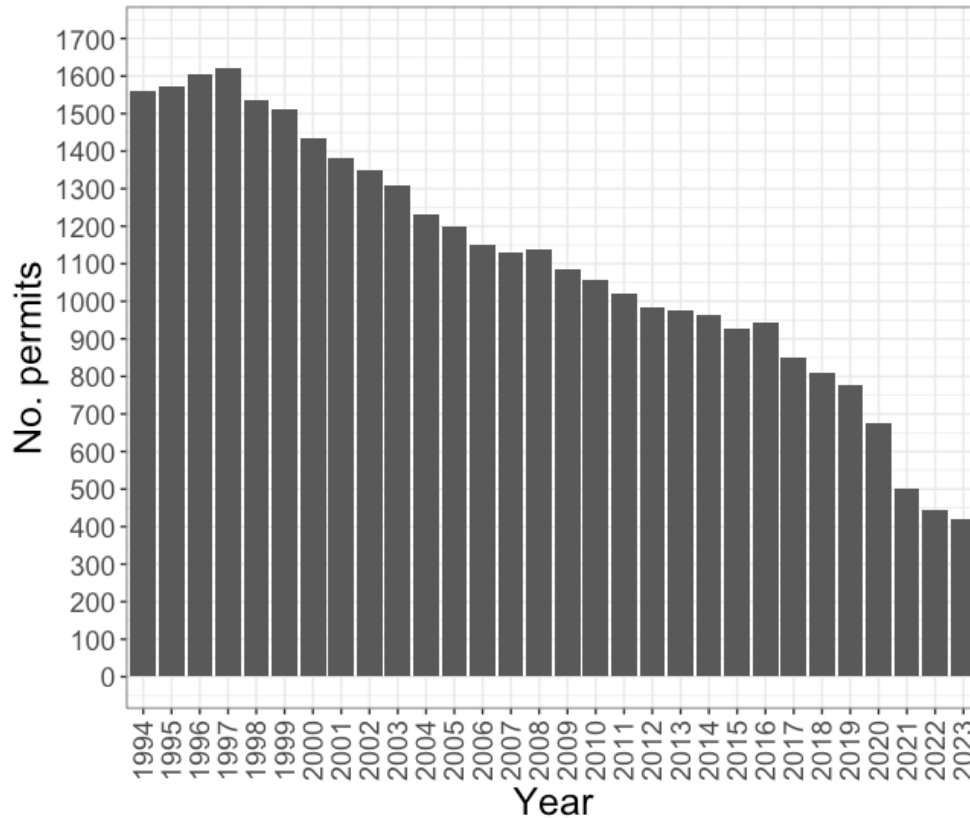
| Year  | No. permits issued | Tot. revenue (k\$) | No. permit holders | Mean no. permits |
|-------|--------------------|--------------------|--------------------|------------------|
| 1994  | 5,823              | 0.0                | 1,562              | 3.6              |
| 1995  | 5,921              | 0.0                | 1,572              | 3.7              |
| 1996  | 5,933              | 0.0                | 1,603              | 3.7              |
| 1997  | 6,144              | 122.9              | 1,623              | 3.8              |
| 1998  | 6,474              | 323.1              | 1,535              | 4.2              |
| 1999  | 6,539              | 328.3              | 1,511              | 4.3              |
| 2000  | 6,430              | 319.1              | 1,433              | 4.5              |
| 2001  | 6,481              | 319.6              | 1,383              | 4.7              |
| 2002  | 6,330              | 311.1              | 1,349              | 4.7              |
| 2003  | 6,213              | 341.2              | 1,309              | 4.7              |
| 2004  | 5,907              | 549.1              | 1,233              | 4.8              |
| 2005  | 5,731              | 531.3              | 1,198              | 4.8              |
| 2006  | 5,818              | 529.3              | 1,152              | 5.1              |
| 2007  | 5,783              | 533.7              | 1,132              | 5.1              |
| 2008  | 5,882              | 543                | 1,139              | 5.2              |
| 2009  | 5,442              | 542.2              | 1,085              | 5                |
| 2010  | 5,300              | 533.4              | 1,059              | 5                |
| 2011  | 5,269              | 533.7              | 1,022              | 5.2              |
| 2012  | 4,721              | 900.7              | 985                | 4.8              |
| 2013  | 4,676              | 892.1              | 976                | 4.8              |
| 2014  | 4,705              | 902.3              | 965                | 4.9              |
| 2015  | 4,743              | 912.2              | 928                | 5.1              |
| 2016  | 4,999              | 960.5              | 945                | 5.3              |
| 2017  | 5,057              | 1008               | 849                | 5.7              |
| 2018  | 4,434              | 741.4              | 808                | 5.4              |
| 2019  | 4,442              | 725.8              | 777                | 5.6              |
| 2020  | 4,001              | 665.8              | 675                | 5.8              |
| 2021  | 3,075              | 516.3              | 502                | 6                |
| 2022  | 2,860              | 478.9              | 446                | 6.3              |
| 2023  | 2,663              | 464.3              | 418                | 6.1              |
| 2024* | 536                | 91.4               | 162                | 3.1              |



**Figure 9.** Total number of vehicle permits issued and revenue generated per year

### I-4.3 Permit holders

The number of permit holders ranges from 418 in 2023 to a maximum of 1623 in 1997. On average, **1,105 organizations** applied for at least one permit each year. Figure 10 shows the number of yearly permit holders. We notice a slow decline since 1997, with a steeper decline in 2020 and 2021.



**Figure 10.** Number of permit holders (1994-2023)

On average, permit holders purchased a median of 2 permits per year, ranging from a minimum of 1 permit to a maximum of 179 permits. 95% of permit holders purchased 20 or less permits yearly.

Table 7 shows the top 10 permit holders over 1994-2023 and their primary business sector (obtained from their NAICS code). Jointly, they purchased 17% of all permits over that time period. [Appendix A-I-1](#) provides the top 10 permit holders for each year from 2017 to 2023.

**Table 7. Top 10 permit holders (1994-2023)**

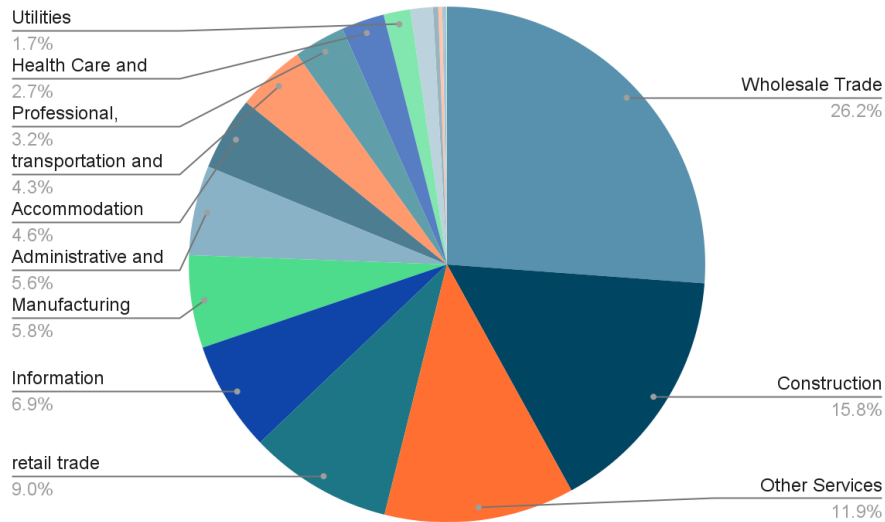
| Rank | Permit holder               | Primary business sector               | No. permits |
|------|-----------------------------|---------------------------------------|-------------|
| 1    | Macdonald Miller            | Other Services (except Public Admin.) | 2,267       |
| 2    | Mckinstry                   | Other Services (except Public Admin.) | 2,088       |
| 3    | Puget Sound Energy          | Utilities                             | 2,082       |
| 4    | United Parcel Service (UPS) | Transportation and warehousing        | 2,038       |
| 5    | Columbia Distributing       | Wholesale Trade                       | 1,961       |
| 6    | Postal Express              | NA*                                   | 1,721       |
| 7    | K&L Distributors            | Wholesale Trade                       | 1,534       |
| 8    | King Broadcasting Company   | Information                           | 1,518       |
| 9    | Food Services of America    | Wholesale Trade                       | 1,454       |
| 10   | Alpac Corporation           | Wholesale Trade                       | 1,300       |

\* Postal Express was a top 10 permit holder until 2015. The authors could not find the NAICS code for this company

Table 8 and Figure 11 show the market segmentation of permit holders by number of permits for the period 2017-2023. The business sector for each organization was obtained by identifying the respective NAICS code. We were able to find the NAICS code for most organizations representing 89% of all permits purchased during that time period. More than half of the permits issued are held by businesses working in three sectors: wholesale trade, construction, and service sectors.

**Table 8.** Permit issued and percentage by primary business activity type (2017-2023)

| Primary business activity type                        | No. issued permits | Percentage issued permits |
|-------------------------------------------------------|--------------------|---------------------------|
| Wholesale Trade                                       | 6488               | 26.2%                     |
| Construction                                          | 3925               | 15.8%                     |
| Other Services (except Public Administration)         | 2951               | 11.9%                     |
| Retail trade                                          | 2227               | 9.0%                      |
| Information                                           | 1710               | 6.9%                      |
| Manufacturing                                         | 1439               | 5.8%                      |
| Admin. Support, Waste Manag. and Remediation Services | 1394               | 5.6%                      |
| Accommodation and Food Services                       | 1146               | 4.6%                      |
| Transportation and warehousing                        | 1069               | 4.3%                      |
| Professional, Scientific, and Technical Services      | 801                | 3.2%                      |
| Health Care and Social Assistance                     | 665                | 2.7%                      |
| Utilities                                             | 416                | 1.7%                      |
| Real Estate and Rental and Leasing                    | 348                | 1.4%                      |
| Public Administration                                 | 82                 | 0.33%                     |
| Arts, Entertainment, and Recreation                   | 61                 | 0.25%                     |
| Agriculture, Forestry, Fishing and Hunting            | 29                 | 0.12%                     |
| Educational Services                                  | 28                 | 0.11%                     |
| Finance and Insurance                                 | 17                 | 0.07%                     |



**Figure 11.** Market segmentation of permit holders by no. permits

#### I-4.4 Retention analysis

In this section we provide performance metrics relative to the amount of permit holders or permits that are retained on a yearly basis. A retained permit holder is defined as an organization that purchased at least one permit during the reference year and the previous year as well. Similarly, a retained permit is defined as a permit that was renewed last year.

*Permit holder retention rate* is measured as follows:

$$PHR_t = \frac{PH_t - New\ PH_t}{PH_{t-1}} \quad (1)$$

Where

- $PHR_t$  is the permit holder retention rate at time  $t$
- $PH_t$  and  $PH_{t-1}$  are the total number of permit holders during reference years  $t$  and  $t - 1$  respectively
- $New\ PH_t$  is the number of new permit holders at reference year  $t$

The *permit retention rate* is measured in a similar way to the permit holder retention rate, with the only differences that the total number of permits are used (instead of number of permit holders) and the “new permits” are permits either purchased by a new organization or additional permits that were purchased by a previous permit holder.

Figure 12 reports the obtained permit holder and permit retention rates (in %), and Table 9 reports the rates together with the number of new permits and permit holders.

**Table 9.** Yearly retention rates and no. of new permits and permit holders

| Year | No. permits | New permits | Permit retention rate | No. permit holders | New permit holders | Permit holder retention rate |
|------|-------------|-------------|-----------------------|--------------------|--------------------|------------------------------|
| 1995 | 5,921       | 725         | 90.4                  | 1,572              | 140                | 91.7                         |
| 1996 | 5,933       | 652         | 90.7                  | 1,603              | 130                | 93.7                         |
| 1997 | 6,144       | 762         | 90.8                  | 1,623              | 143                | 92.3                         |
| 1998 | 6,474       | 949         | 90                    | 1,535              | 94                 | 88.8                         |
| 1999 | 6,539       | 847         | 87.9                  | 1,511              | 96                 | 92.2                         |
| 2000 | 6,430       | 742         | 87                    | 1,433              | 92                 | 88.8                         |
| 2001 | 6,481       | 817         | 88.1                  | 1,383              | 90                 | 90.2                         |
| 2002 | 6,330       | 575         | 88.8                  | 1,349              | 73                 | 92.2                         |
| 2003 | 6,213       | 648         | 87.9                  | 1,309              | 75                 | 91.5                         |
| 2004 | 5,907       | 555         | 86.1                  | 1,233              | 60                 | 89.6                         |
| 2005 | 5,731       | 451         | 89.4                  | 1,198              | 56                 | 92.5                         |
| 2006 | 5,818       | 597         | 91.1                  | 1,152              | 47                 | 92.3                         |
| 2007 | 5,783       | 579         | 89.4                  | 1,132              | 59                 | 93.1                         |
| 2008 | 5,882       | 630         | 90.8                  | 1,139              | 91                 | 92.6                         |
| 2009 | 5,442       | 453         | 84.8                  | 1,085              | 58                 | 90.2                         |
| 2010 | 5,300       | 435         | 89.4                  | 1,059              | 66                 | 91.5                         |
| 2011 | 5,269       | 519         | 89.6                  | 1,022              | 56                 | 91.2                         |
| 2012 | 4,721       | 380         | 82.4                  | 985                | 55                 | 91.0                         |
| 2013 | 4,676       | 553         | 87.3                  | 976                | 73                 | 91.7                         |
| 2014 | 4,705       | 491         | 90.1                  | 965                | 69                 | 91.8                         |
| 2015 | 4,743       | 644         | 87.1                  | 928                | 75                 | 88.4                         |
| 2016 | 4,999       | 783         | 88.9                  | 945                | 100                | 91.1                         |
| 2017 | 5,057       | 390         | 89.6                  | 849                | 10                 | 88.7                         |
| 2018 | 4,434       | 2,184       | 45                    | 808                | 320                | 57.4                         |
| 2019 | 4,442       | 634         | 85.5                  | 777                | 75                 | 86.9                         |
| 2020 | 4,001       | 316         | 82.1                  | 675                | 42                 | 81.4                         |
| 2021 | 3,075       | 205         | 71.8                  | 502                | 33                 | 69.4                         |
| 2022 | 2,860       | 350         | 80.9                  | 446                | 31                 | 82.6                         |
| 2023 | 2,663       | 268         | 82.2                  | 418                | 40                 | 84.7                         |

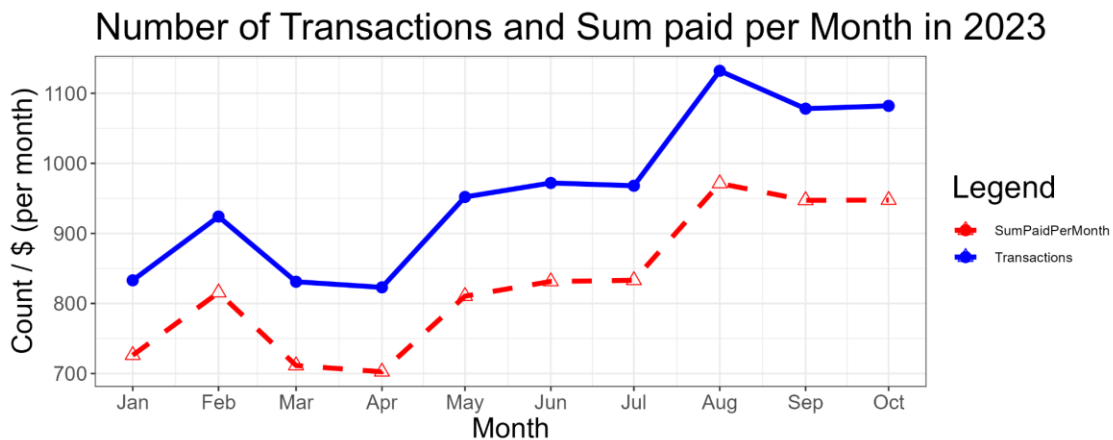


**Figure 12.** Yearly permit holder and permit retention rates

## I-5 Infrastructure usage

### I-5.1 Pay-per-use analysis

**Total transactions and revenue generated in the study area.** The total number of parking transactions at CVLZs from January 3, 2023, through October 31, 2023, was 9,595. Most of these transactions were at the rate of \$1 per 30 minutes, with a 30-minute maximum parking time, though some transactions were a shorter length of time. In total, the revenue generated was \$8,296 over the 10 months, with an average revenue of \$829.60 per month, maximum revenue generated in August at \$971.23, and minimum revenue generated in April at \$702.50. We generally see revenue increase over the course of the year. The same trend is seen in the number of transactions each month. The number of transactions and revenue generated each month is shown in Figure 13.



**Figure 13.** Total number of parking transactions for CVLZs in study area overtime, and related revenue generated

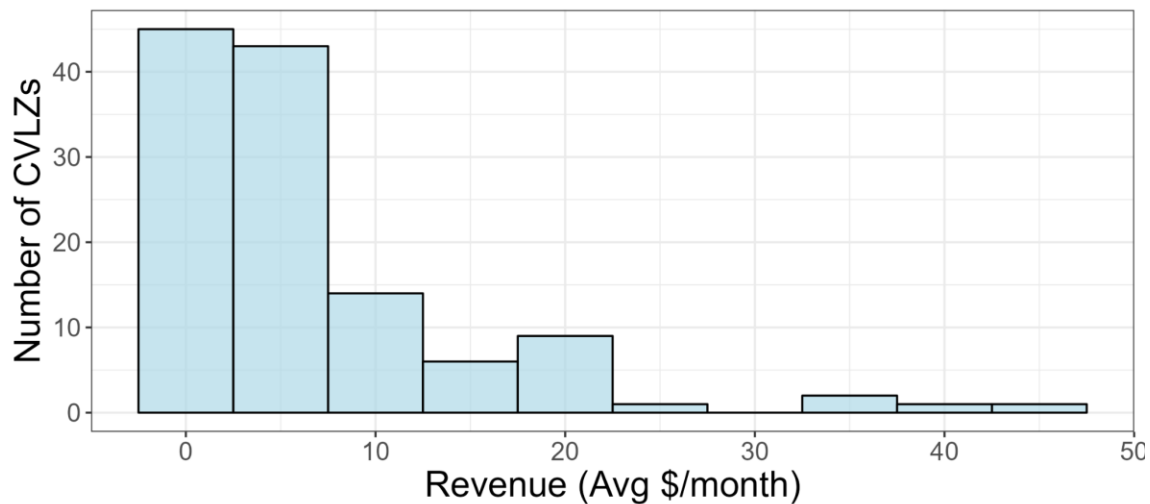
**Transactions per CVLZ.** In the past 10 months, the maximum revenue generated by a CVLZ (independently of its length) is \$457.10, generated from the CVLZ at the intersection of Western Avenue and Lenora Street. The average revenue generated over 1 month for a single CVLZ is \$6.79.

75% of CVLZs earned less than \$85 in the last 10 months. The number of CVLZs with 0 transactions over the last 10 months was 24 (19.6% of CVLZs in the study area).

Note: PaybyPhone signs at CVLZs were installed between January and August 2023, with all signs installed in August.

The distribution of revenues across CVLZs, in dollars per month, is shown in Figure 14.

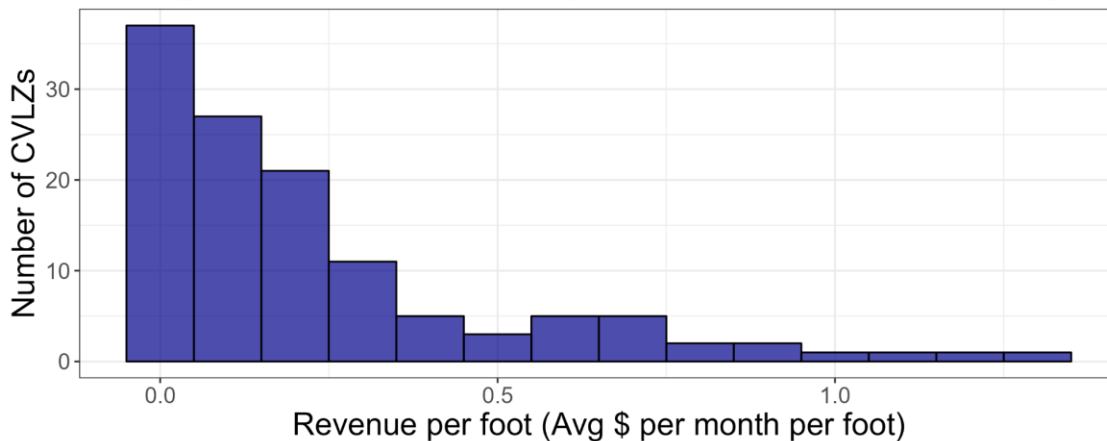
## Histogram of CVLZ Monthly Revenue



**Figure 14.** Empirical distribution of revenue generated per month by PaybyPhone for individual CVLZs in the study area

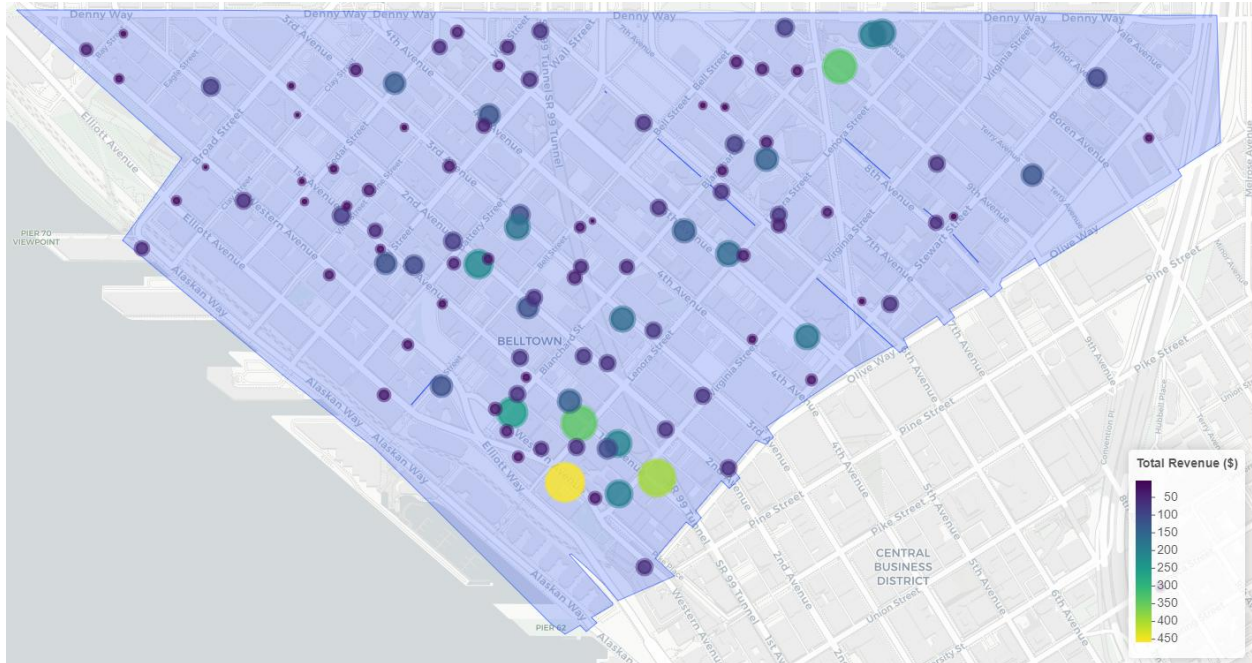
We also study the revenue generated by the length of each CVLZ. Figure 15 shows the distribution of average revenue generated by each CVLZ per its length in feet. The average monthly revenue per foot generated by a CVLZ is \$0.23, and the median value is \$0.14. 75% of monthly revenue per foot values were below \$0.31. The top three values for monthly revenue per foot were \$1.31, \$1.16, and \$1.09, which are associated with the three CVLZs that had the highest number of transactions.

## Histogram of CVLZ Monthly Revenue per CVLZ Length



**Figure 15.** Empirical distribution of revenue generated per month by PaybyPhone for individual CVLZs in the study area, divided by the length of each CVLZ

The maps below show the revenue generated by different CVLZs. Figure 16 shows the volume of revenue generated by each CVLZ using size and color to depict higher values (with yellow being the highest and purple being the lowest). Figure 17 shows the precise location of the corresponding CVLZs and uses the same colors to show values.



**Figure 16.** Map showing revenue generated by CVLZs (brighter colors/larger dots are higher values)



**Figure 17.** Map showing revenue generated by CVLZs with precise location (brighter colors are higher values)

## I-5.2 Citation analysis

SDOT provided citation data from 2017-2022. The violated laws fall into two categories: laws that directly relate to loading zone usage and laws that specify parking, stopping, or standing that may indicate possible demand for curb space when broken. The number of citations issued per year and approximate revenue generated from infractions are shown in Table 10.

**Table 10.** Number of CVLZ-related citations per year

| Year | No. Citations | \$\$ Fines Issued |
|------|---------------|-------------------|
| 2017 | 6,800         | \$319,600         |
| 2018 | 10,647        | \$500,409         |
| 2019 | 10,926        | \$513,522         |
| 2020 | 9,712         | \$456,464         |
| 2021 | 8,557         | \$402,179         |
| 2022 | 8,071         | \$379,337         |

The top 8 violations of the Seattle Municipal Code, as given by the number of CVLZ-related citations issued in 2022, are described in Table 11.

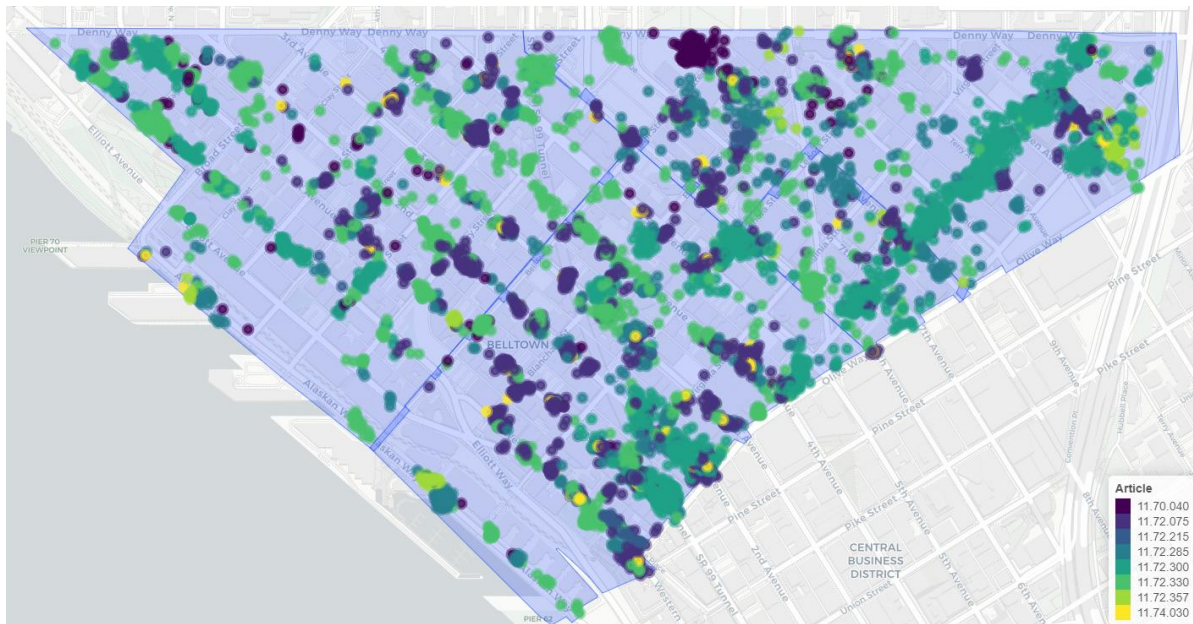
**Table 11.** Top 8 violation types by number of citations given in 2022 in study area

| Rank | Article   | No. obs. | Name                                 | Explanation                                                                                                                                                                                                                                                                                                                                                                                 | % of Infr. | Fine (\$) |
|------|-----------|----------|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------|
| 1    | 11.72.300 | 2625     | <a href="#">Peak traffic hours</a>   | No person shall stop, stand or park a vehicle during peak traffic hours on any day, except Sundays and parking holidays, on any portion of any street when signs are erected giving notice of the specified hours of such prohibition, and except as provided in Section 11.74.120.                                                                                                         | 31.6%      | 47        |
| 2    | 11.72.330 | 1749     | <a href="#">Posted signs</a>         | No person shall:<br>A. Stop, stand or park a vehicle at any place or time where official signs prohibit stopping;<br>B. Stand or park a vehicle at any place or time where official signs prohibit standing; or<br>C. Park a vehicle at any place or time where official signs prohibit parking.                                                                                            | 19.5%      | 47        |
| 3    | 11.72.075 | 1697     | <a href="#">Commercial load zone</a> | No person shall stop, stand or park a vehicle other than a commercial vehicle or a vehicle displaying a valid commercial loading permit in a commercial load zone during the hours the zone restriction is in effect; provided, that commercial load zone restrictions are not effective on Sundays or parking holidays, except where otherwise indicated by signposting for the load zone. | 21.2%      | 53        |

| Rank | Article   | No. obs. | Name                                             | Explanation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | % of Infr. | Fine (\$) |
|------|-----------|----------|--------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------|
| 4    | 11.72.285 | 852      | <a href="#">Passenger load zone</a>              | In a passenger load zone during the hours the zone restriction is in effect, no person shall stop, stand or park a vehicle for any purpose or period of time other than for the expeditious loading or unloading of passengers for a period not to exceed three (3) minutes.                                                                                                                                                                                                                                  | 13.5%      | 47        |
| 5    | 11.70.040 | 394      | <a href="#">Parallel parking—Right-hand side</a> | No person shall stop, stand, or park a vehicle in a roadway other than parallel with the edge of the roadway headed in the direction of lawful traffic movement and with the wheels on the right side of the vehicle within twelve inches (12") of the right constructed curb or with the wheels on the right side of the vehicle on a shoulder as provided in Section 11.70.080, except as otherwise provided in this chapter.                                                                               | 2.2%       | 47        |
| 6    | 11.72.357 | 125      | <a href="#">Shuttle Bus Load Zone</a>            | No person shall stop, stand, or park a vehicle other than a shuttle vehicle displaying a valid shuttle vehicle loading permit in a shuttle vehicle load zone during the hours the zone restriction is in effect; provided that shuttle vehicle load zone restrictions are not effective on Sundays or parking holidays, except where otherwise indicated by sign posting for the zone.                                                                                                                        | 1.42%      | 47        |
| 7    | 11.72.215 | 112      | <a href="#">Load and unload zone</a>             | No person shall stop, stand, or park a vehicle in a load and unload zone, for any purpose or length of time other than for the expeditious pickup and loading or unloading and delivery of persons or property, and then in no case shall the stop for such purposes exceed thirty (30) minutes.                                                                                                                                                                                                              | 1.95%      | 47        |
| 8    | 11.74.030 | 83       | <a href="#">Commercial load zone-usage</a>       | No person shall stop a commercial vehicle or a vehicle displaying a valid commercial loading permit in a commercial load zone for any purpose or length of time other than for the expeditious unloading and delivery or pickup and loading of property. In no case shall such stopping for loading and/or unloading of commercial products exceed thirty (30) minutes. Such time and loading limitations shall be in effect during the days and times displayed on the traffic signs or marking at the zone. | 1.7%       | 53        |

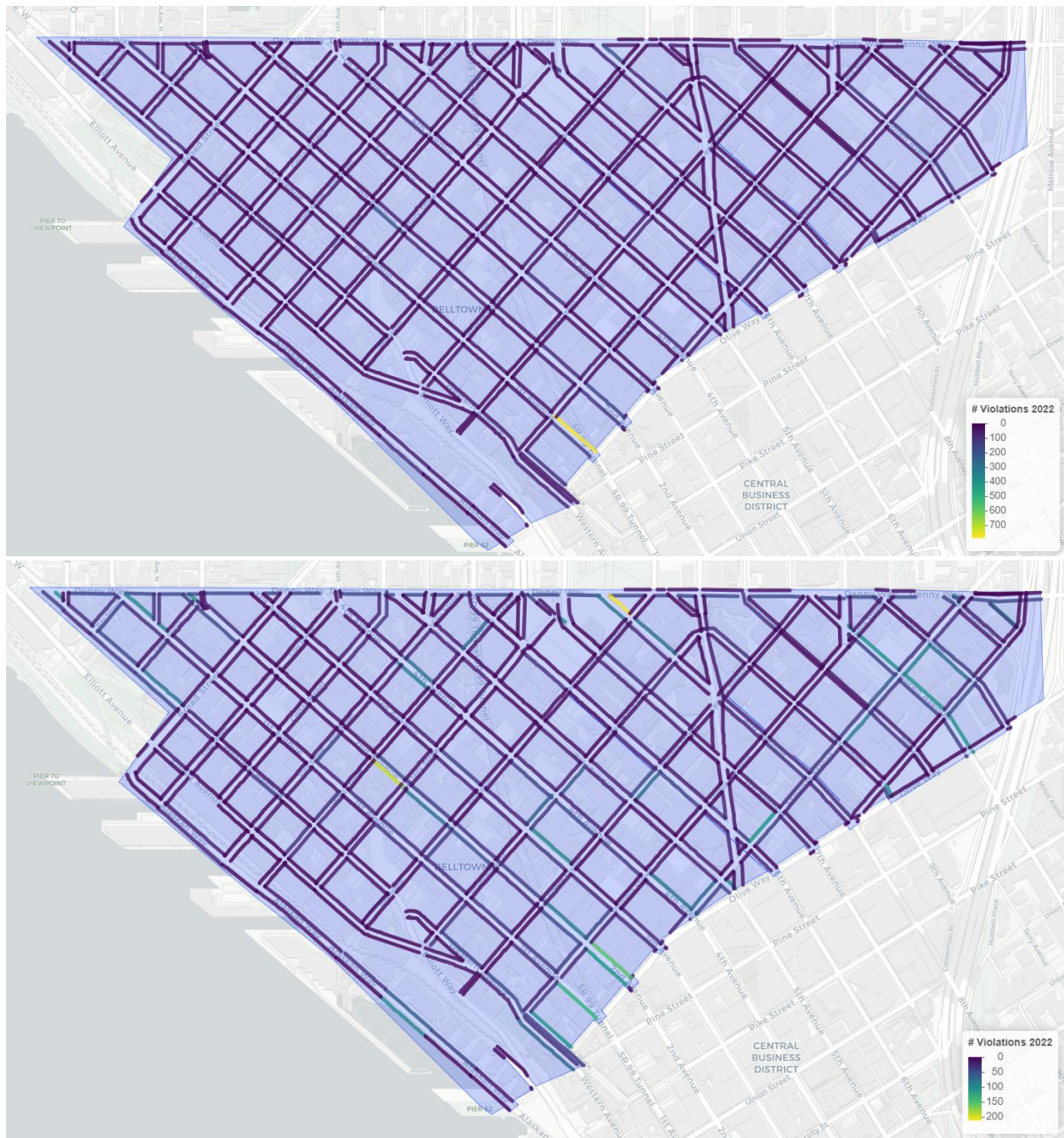
Notably, the number of citations for stopping in a CVLZ (1,697) is nearly as high as the number of citations for stopping anywhere that signs prohibit in article 11.72.330 (1,749), even though CVLZs take less than 2.5% of the curb allocation while general no parking policies apply to over 60% of the curb.

The locations of these citations in these 8 categories over 2022 are shown over a map of the study area in Figure 18.



**Figure 18.** Citations given in 2022 by type

Next we map the number of total violations in 2022 to the nearest blockface. The Northeastern side of 1st Avenue between Virginia Street and Stewart Street is the outlier and maximum in total violations with 783 (the next highest is 209 violations). Figure 19 below is color-coded to show the number of violations issued at each blockface in the study area in 2022.



**Figure 19.** Number of citations issued by blockface, with and without the max for visual clarity

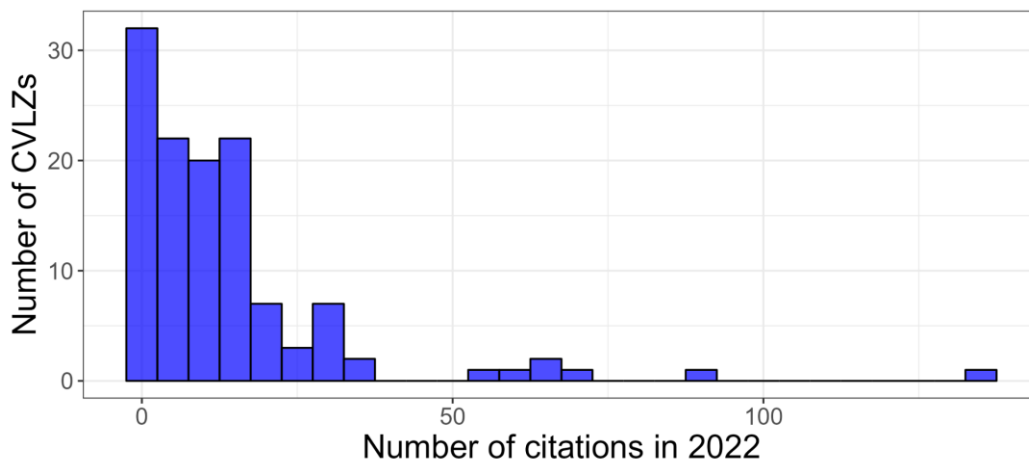
Focusing just on 11.72.075 relating to CVLZ occupancy, the color-coded map in Figure 20 shows the rates of these citations being issued at each CVLZ in the study area in 2022.



**Figure 20.** Number of CVLZ (11.72.075) citations issued by CVLZ location

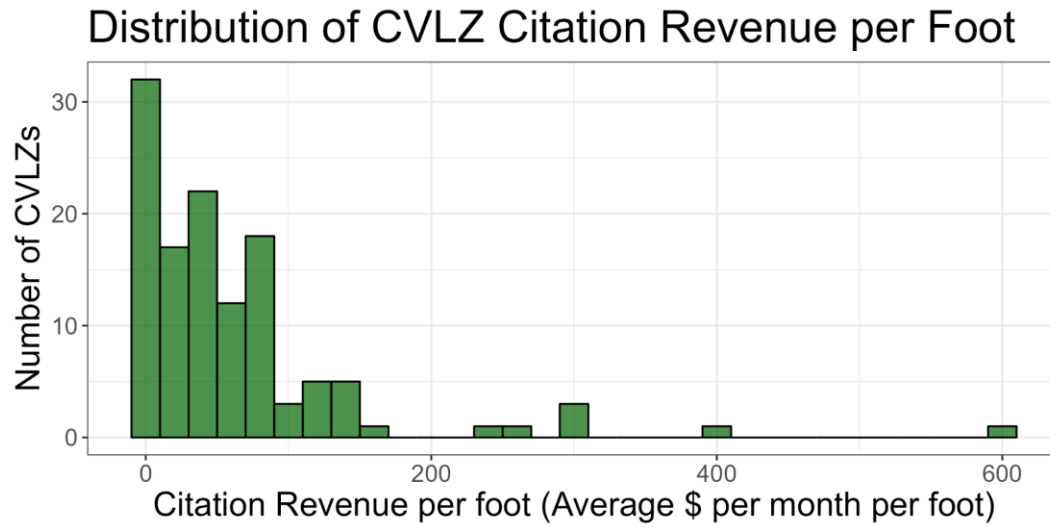
For violations that occurred in CVLZs we filter by article 11.72.075. The maximum number of citations received in a CVLZ in 2022 was 136 in the CVLZ located at the intersection of 1st Avenue and Virginia Street. The average number of citations received in 2022 was 14, and the distribution of the number of citations received in CVLZs is shown in Figure 21.

### Distribution of CVLZ Citations



**Figure 21.** Empirical distribution of the number of citations received by CVLZ

Figure 22 shows the revenue generated per the length of each CVLZ per month based on the number of citations in 2022. The fine issued for each violation was \$53. The average revenue for citations from violating Article 11.72.075 per month per foot of CVLZ length is \$61.43 and the median was \$39.75. The maximum revenue generated per foot is held by the same CVLZ at the intersection of 1st Ave and Virginia St at \$600.67.



**Figure 22.** Empirical distribution of the revenue for citations received by CVLZ, averaged over 12 months, per foot of CVLZ length

## **PART II**

### **TASK 4: ANALYSIS OF OBSERVED PARKING BEHAVIOR**

## PART II - TASK 4: ANALYSIS OF OBSERVED PARKING BEHAVIOR

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## II-1 Introduction

Task 4's objective is to document individual drivers' curb behaviors, with particular attention paid to commercial vehicles and vehicles with a valid commercial vehicle load zone (CVLZ) permit. Drivers' curb behaviors are generally defined as a sequence of choices related to curb use, including;

- Parking choice - type of parking location
- Parking payment - whether the drivers were equipped with a valid CVLZ permit, or paid for parking using pay-by-phone or paystation.
- Parking dwell time - the amount of time spent at the curb

To document these behaviors, the UFL research team drafted a data collection protocol for video data collection. Video cameras were strategically placed and manually processed by the video data collection company IDAX, recording each parking event taking place at a given blockface from 7 am to 7 pm. A total of 30 blockfaces were chosen to deploy video cameras, and each was observed for two days. One day, for each blockface data collection, the video data was augmented by human observers collecting information about whether a parked vehicle had a valid CVLZ permit. A total of 23 unique days of data collection were carried out (63 blockface-days), recording 8,182 parking events. The data show that CVLZs are used for their intended purpose only 25% of the time. The remaining time, CVLZs are occupied by passenger vehicles not involved in the delivery operations. The full list of key findings are summarized below.

### II-1.1 Key findings

#### Parking Behavior

- Commercial vehicles with permits are more likely to 1) use CVLZs and 2) exhibit authorized parking behavior than commercial vehicles without permits. That being said, CVLZs were still the most likely parking location for both permit holders (61% of parking events) and non-permit holders (47% of parking events).
- Commercial vehicles account for just 16.8% of CVLZ parking events; only 21.5% of CVLZ parking events were authorized by a permit or payment (this includes passenger vehicles with a CVLZ permit). This means 78.5% of the parking events in CVLZs during the study period were unauthorized.
- Considering all parking space types and parking events, commercial vehicles paid for or were permitted to park (were authorized) at a higher rate than passenger vehicles (35.4% vs. 28.6%).

#### Dwell time

- Authorized commercial vehicle parking events in CVLZs were three times as long as unauthorized events. For passenger vehicles, authorized parking events in CVLZs were four times as long as unauthorized events. Considering all parking space types, authorized parking events were twice as long as unauthorized events for commercial vehicles, and 5 times as long for passenger vehicles.

- Authorized use of CVLZs and paid parking were longer than unauthorized for all categories of commercial vehicles. However, it should be noted that authorized commercial vehicles dwelled longer in paid parking than in CVLZs.
- Passenger vehicles that paid for CVLZ use exhibited similar dwell times as authorized commercial vehicles, but dwelled for about half the time if they did not pay to use the space.

#### Parking occupancy

- Total CVLZ occupied time: 47,686 minutes (115,200 minutes possible; 41.4% occupancy).
- Of this total time, 22.3% was by commercial vehicles, 3.1% was by passenger vehicles that make deliveries, and 74.6% was by passenger vehicles not observed making deliveries.
- Of the total time 60.3% was unauthorized, 11.3% authorized by permit, and 28.3% authorized by payment
- Compared to paid parking (PP): 65.6% of dwell time was unpaid (unauthorized)

## II-1.2 Terminology

The following terminology is used throughout the report.

- *Commercial vehicle*. SDOT defines commercial vehicles as: “(1) a “motor truck” or “truck” except a passenger car; or (2) a station wagon or van that has been permanently modified to carry no more than three (3) seated passengers.” [1]
- *Passenger vehicle*: Passenger vehicles are here defined as any vehicle that is not a commercial vehicle, including transit and shuttle buses.
- *Parking event*: when a vehicle comes to a complete stop somewhere within the parking infrastructure. Typically this would occur in the curb lane or alley, but can also occur in the travel lane, which is considered double parking.
- *No parking*. Throughout this document, tables will refer to “No Parking” or “Other” designations. Included in this definition are: no parking zones (NP), hydrants (HYD), crosswalks (XW), driveways, tow-away zones (TAZ), curb ramps (CR), and curb bulbs (CRBBLB). For most vehicle types, bus zones (BUS) and shuttle bus only (SBO) zones were included as parking; the exception being buses and shuttles that use these spaces.
- *Authorized parking*: Vehicle displays a valid CVLZ permit when using a CVLZ or pays for parking in CVLZ or Paid Parking. All parking in passenger load zones (PLZs) is considered authorized. Buses and shuttles that park in bus only zones are considered authorized.
- *Unauthorized parking*: Parking without paying in PP, Parking without paying in CVLZ when a CVLZ permit is not observed, parking in “no parking” zones, double parking, or vehicles other than buses and shuttles parking in bus only zones.
- *Pay-by-phone (PBP) data*: Any payment transaction recorded, including through payment application (Pay-by-phone) or at the physical paystation via cash or credit card.

## II-2 Data Processing

**Table 12.** *Parking event data observations*

| Date         | Video        | Manual       | PBP          |
|--------------|--------------|--------------|--------------|
| 4/30/2024    | 130          | 80           | 13           |
| 5/1/2024     | 93           | 41           | 14           |
| 5/2/2024     | 166          | 0            | 24           |
| 5/3/2024     | 67           | 38           | 9            |
| 5/14/2024    | 155          | 78           | 4            |
| 5/15/2024    | 298          | 90           | 23           |
| 5/16/2024    | 410          | 140          | 95           |
| 5/17/2024    | 250          | 0            | 57           |
| 5/21/2024    | 390          | 133          | 77           |
| 5/22/2024    | 804          | 320          | 71           |
| 5/23/2024    | 513          | 0            | 18           |
| 5/24/2024    | 140          | 55           | 23           |
| 5/29/2024    | 62           | 0            | 23           |
| 5/30/2024    | 306          | 17           | 89           |
| 5/31/2024    | 291          | 130          | 114          |
| 6/4/2024     | 254          | 103          | 0            |
| 6/5/2024     | 424          | 62           | 18           |
| 6/6/2024     | 426          | 0            | 91           |
| 6/7/2024     | 288          | 170          | 78           |
| 6/10/2024    | 613          | 428          | 101          |
| 6/11/2024    | 1,201        | 298          | 131          |
| 6/12/2024    | 743          | 0            | 50           |
| 6/13/2024    | 158          | 72           | 5            |
| <b>TOTAL</b> | <b>8,182</b> | <b>2,255</b> | <b>1,128</b> |

the blockface and date combinations (blockface-day) captured in the video data, 1,160 transactions were kept, with 1,128 transactions ultimately matching with a parking event captured by video.

Table 12 (above) shows the number of parking events observations and PBP transactions recorded on each of the study dates. An additional table detailing the number of observation days per unique blockface has been included in [Appendix II](#).

### II-2.2 Sample data description

A complete description of the variables for each dataset can be found in [Appendix II](#).

### II-2.1 Data sources

To understand the behavior of drivers parking in the study area and understand how the infrastructure was used, three sets of data were analyzed:

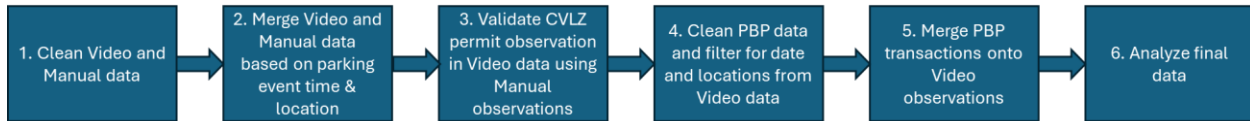
**Video data:** video cameras were deployed at strategic locations to observe all parking events on 30 blockfaces over 23 days (63 unique blockface-days). For each parking event, the following variables were recorded: the parking location, beginning and end times of the parking event and related dwell time, body type of vehicle, activity the vehicle or occupants were involved in, whether passenger(s) and/or driver exits the vehicles, and whether the vehicle displayed a valid CVLZ permit, among other variables.

**Manual data:** on-the-ground observers recorded 2,255 parking events on 30 blockfaces over the course of 17 days. These entries record the location, parking times, vehicle description, and the observance of a CVLZ permit, among other variables.

**Pay-by-phone (PBP) data:** payment transactions were recorded for the entire Denny Triangle and Belltown neighborhoods. This includes pay-by-phone and paystation transactions. After filtering for

## II-2.3 Processing method

Figure 23 describes the steps taken in processing the data sources.



**Figure 23.** Data processing method

1. Video and manual datasets were checked for errors and made machine readable. This includes checking values in categorical variables, changing column names for later merging, and identifying variables to validate (e.g., presence of CVLZ permit).
2. For each parking event captured by video, the respective manual observation was matched (whenever available) based on location, date, time the parking event began, and vehicle class.
3. Video data was updated to “correct” CVLZ permit observations based on the rate of false positives and false negatives recorded by the manual observers as well as vehicle category (e.g., some shuttle buses have shuttle permits that were mistaken for CVLZ permits).
4. Pay-by-phone and paystation dataset (henceforth “PBP”) was checked for errors and made machine-readable. Transactions were kept based on date, location, and the time payment was remitted.
5. For each parking event captured by video, the respective PBP transaction was matched (whenever available) based on location, date, vehicle class, and the transaction timestamp. Note: the transaction timestamp must occur after the video parking event begins and before the parking event ends to achieve a match.
6. Analysis of behavior and infrastructure use based on the final, merged dataset.

## II-2.4 Sample vehicle description and activity information

Video and manual data collection recorded the descriptions of vehicles (size, model, etc.) and activity (passenger pick-up/drop-off, goods delivery, service, etc.) in which they were involved. Throughout the rest of this report references will be made to “vehicle class” and “vehicle category.” There are two variables in vehicle class: “commercial” and “passenger.” Commercial vehicles are defined by SDOT as: “(1) a “motor truck” or “truck” except a passenger car; or (2) a station wagon or van that has been permanently modified to carry no more than three (3) seated passengers.” [1] All other vehicles are categorized as “passenger”.

“Vehicle category” describes the activity in which the parked vehicle was observed as being involved in. Commercial vehicles are designated as freight, service, other, or emergency services. Freight vehicles are commercial vehicles whose driver and/or passenger exit the vehicle to perform a load/unload operation, i.e., deliver parcels, food, construction materials, etc. Service vehicles typically have a company logo and the driver and/or passenger exit but do not have distinguishable goods they are delivering. Examples would include elevator, HVAC, or plumbing companies. “Other” includes those vehicles that have a company logo but from which the driver and/or passenger does not depart as well as certain activities like waste removal, towing companies, surveying crews, and parking enforcement. Emergency services include ambulances and firetrucks.

Passenger vehicles are designated as private use, food delivery, goods delivery, transportation network company (TNC), other (including emergency services), and transit.

Table 13 provides descriptions of each vehicle category and a breakdown of the fleet composition according to these categories. It is important to note that this sample is not representative of the City of Seattle at large. The table describes only those vehicles observed parking in the video and manual collection study area, which itself is a subset of the greater Belltown study area.

**Table 13.** Description of vehicles observed in this sample

| Vehicle Class / Category    | Description                                                                                                                                                          | Count        | Share of Category w/in Sample | CVLZ Permit Holders |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------------------------|---------------------|
| <b>Commercial</b>           |                                                                                                                                                                      |              |                               |                     |
| Commercial - Freight        | Commercial vehicles involved in the delivery of materials including, but not limited to, food, parcels, construction materials, waste, and other goods               | 376          | 56.5 %                        | 115                 |
| Commercial - Service        | Commercial vehicles whose driver and/or passenger leave the vehicle to perform some task without significant material. This includes private entities and utilities. | 158          | 23.7                          | 29                  |
| Commercial - Other          | Commercial vehicles whose purpose is unclear: e.g., driver and/or passenger remains in the vehicle and the vehicle is not involved in an load/unload activity        | 125          | 18.8                          | 23                  |
| Emergency Services          | Ambulances or fire trucks                                                                                                                                            | 7            | 1.0                           | 0                   |
| <b>Commercial Subtotals</b> |                                                                                                                                                                      | <b>666</b>   | <b>100.0 %</b>                | <b>167</b>          |
| <b>Passenger</b>            |                                                                                                                                                                      |              |                               |                     |
| Other                       | Police, fire (SUVs), parking enforcement, utilities                                                                                                                  | 17           | 0.2 %                         | 0                   |
| Food Delivery               | Driver and/or passenger exits the vehicle to deliver food (groceries or prepared)                                                                                    | 408          | 5.4                           | 15                  |
| Goods Delivery              | Driver and/or passenger exits the vehicle to deliver goods other than food                                                                                           | 6            | < 0.1                         | 3                   |
| Private Use                 | Passenger vehicles whose driver and passenger(s) exit the vehicle but does not perform loading or unloading activity                                                 | 4,738        | 63.0                          | 132                 |
| TNC                         | Passenger vehicles whose driver does not exit the vehicle but whose passenger(s) do exit the vehicle                                                                 | 2,171        | 28.9                          | 40                  |
| Transit                     | Buses, shuttles, and vans either involved in passenger pick-up/drop-off or that are clearly marked as transit                                                        | 176          | 2.3                           | 0                   |
| <b>Passenger Subtotals</b>  |                                                                                                                                                                      | <b>7,516</b> | <b>100.0 %</b>                | <b>190</b>          |
| <b>TOTAL</b>                |                                                                                                                                                                      | <b>8,182</b> | <b>-</b>                      | <b>357</b>          |

## II-3 Results

### II-3.1 Parking and payment behaviors

The behaviors of drivers at the curb are described below in Figure 24. Consider a vehicle  $i$ , arriving at blockface  $j$ , and attempting to park. Vehicle  $i$  can be one of two vehicle classes: commercial or passenger. Each vehicle or driver will consider how to behave in respect to 1) paying for parking (or not paying), and 2) which portion of the parking infrastructure to utilize.

Payment behavior can be represented by three options:

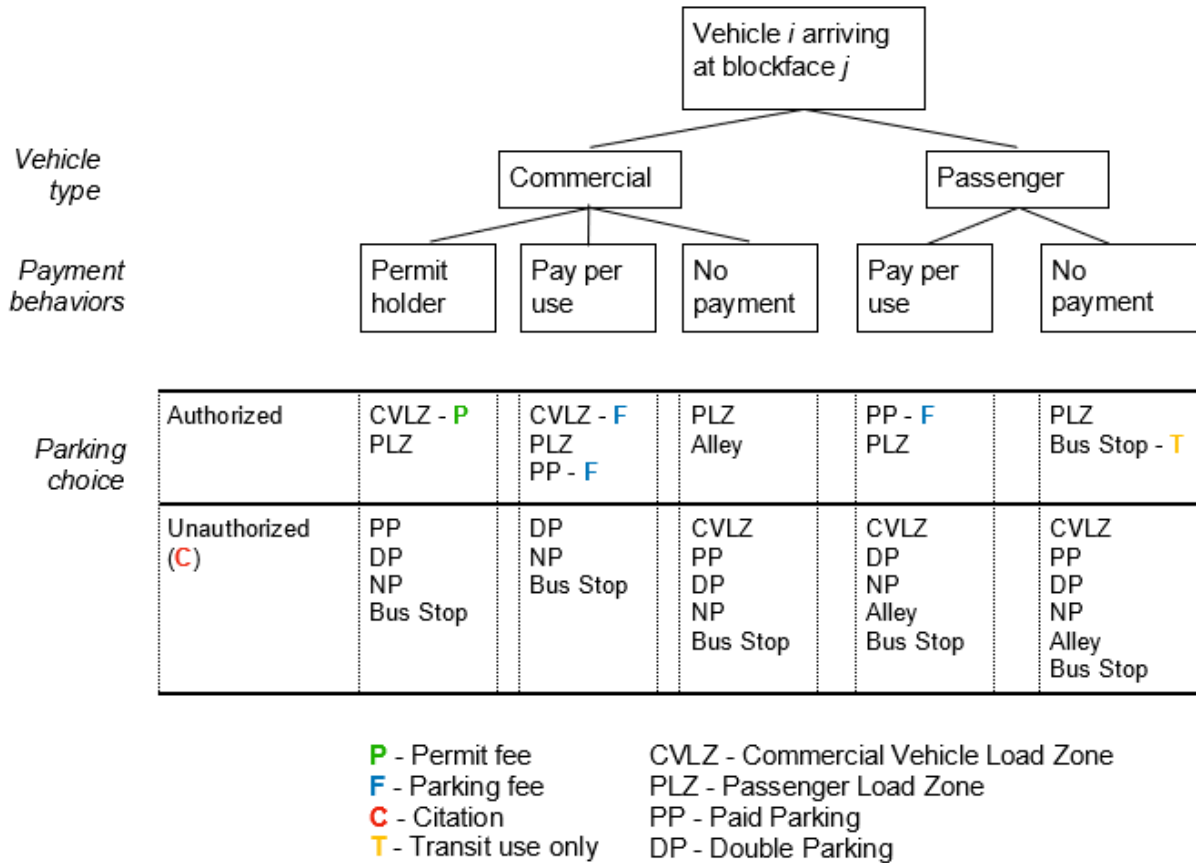
- Purchase a CVLZ permit (building service, shuttle, transit, and other permits were not considered in this study)
- Pay per one-time use
- No payment

The choice of parking infrastructure may take the following forms:

- CVLZ
- PLZ
- Paid parking
- Double parking
- Parking in an alley
- Parking in a no-parking zone (for most vehicles this includes bus zones, see [Terminology](#) for more detail)

According to the parking choice and payment behavior, the final outcome is either an authorized or unauthorized parking event. The possible transactions that can take place are:

- Permit fee (**P**)
- Parking fee (**F**)
- Citation (**C**) (Note: these have not been considered for this portion of the study)



**Figure 24. Overview of curb behaviors**

Table 14 describes the authorized and unauthorized parking activity in the study area according to commercial vehicle permit holders, commercial vehicle non-permit holders, and passenger vehicles. Commercial vehicles with permits are authorized users of CVLZs, but they are also authorized to use paid parking (PP) if they pay for use, and have authorized access to PLZs and alleys. Non-permit holding commercial vehicles are considered authorized if they pay for CVLZ and PP. Again, these vehicles have authorized access to PLZs and alleys. Personal vehicles are considered authorized in CVLZs if a) they have a valid CVLZ permit or b) they pay for parking. Passenger vehicles are authorized users of PP if parking fee is paid, and have authorized access to PLZs. Only transit vehicles are authorized users of bus stops and as such only those vehicles were counted in the passenger column. Any other vehicle parked in a bus stop - be it a commercial vehicle with a permit, commercial vehicle without a permit, or a category of passenger vehicle other than buses - are considered unauthorized and are counted in the "No Parking" row.

**Table 14. Parking event behavior frequency by vehicle type**

| Parking choice                           |                               | Vehicle Type<br>(No. observations) |                          |                                      |          |
|------------------------------------------|-------------------------------|------------------------------------|--------------------------|--------------------------------------|----------|
|                                          |                               | Commercial<br>666                  |                          | Passenger<br>7,516                   | All Veh. |
|                                          | Space type                    | Permit holder<br>167               | Non-permit holder<br>499 | Pay per use /<br>No payment<br>7,516 |          |
| Authorized Parking<br><i>n</i> = 2,373   | CVLZ                          | 103                                | 53                       | 278                                  | 434      |
|                                          | PP                            | 8                                  | 15                       | 637                                  | 660      |
|                                          | PLZ                           | 14                                 | 41                       | 1,094                                | 1,149    |
|                                          | Alley                         | -                                  | 2                        | -                                    | 2        |
|                                          | Bus Stop<br>(by transit only) | -                                  | -                        | 128                                  | 128      |
| Unauthorized Parking<br><i>n</i> = 5,809 | CVLZ                          | -                                  | 183                      | 1,406                                | 1,589    |
|                                          | PP                            | 15                                 | 76                       | 1,835                                | 1,926    |
|                                          | DP                            | 2                                  | 26                       | 526                                  | 554      |
|                                          | No Parking                    | 25                                 | 103                      | 1,612                                | 1,740    |
| Total                                    |                               | 167                                | 499                      | 7,516                                | 8,182    |

Approximately 8% of parking events in the study area were commercial vehicles. 25% of these commercial vehicles displayed a valid CVLZ permit. An additional 190 passenger vehicles displayed valid CVLZ permits. Together, CVLZ permit holders accounted for 4.4% of all parking events.

Commercial vehicles - with or without a permit - parked in CVLZs greater than 50% of the time (339 / 666 events). Another 19% of commercial vehicle parking events occurred in unauthorized “no parking” areas. These categories were followed by paid parking (17%), PLZs (8%), double parking (4%), and alleys (<1%).

Commercial vehicles with a valid CVLZ permit are more likely to 1) use a CVLZ and 2) park in an authorized manner than commercial vehicles without a permit. 61% of commercial vehicles with a permit use CVLZs versus 47% of commercial vehicles without a permit. 75% of permitted

commercial vehicles used some form of authorized space whereas 22% of non-permit holders did so. In part this is due to payment rates. Permit holders were more likely to pay for PP use (35% did so compared to 16% of non-permit holders). Non-permit holders were also more likely to double park, accounting for 93% of commercial vehicles that parked in the travel lane. This equates to a double parking rate 5 times higher than that of permit-holders. That being said, commercial vehicles represent a small portion of total double parking events (5% of 554 total dp events)

Overall, commercial vehicles were authorized to park in the observed area 35.4% of the time. Passenger vehicles were slightly less likely to be authorized to use their observed parking space type at a rate of 28.6%. The majority of these authorized events for passenger vehicles took place in PLZs (51% of authorized parking events, 15% of all passenger parking events). That being said, passenger vehicles were most likely to use paid parking (33%), CVLZs (22%), and no parking zones (21%). Passenger vehicles were also more likely than commercial vehicles to park in the travel lane (7%).

It is worth noting here that 78.5% of parking events in CVLZs were by unauthorized users. Unauthorized means the vehicles parking neither possessed a valid CVLZ permit nor paid for parking. Commercial vehicles accounted for just 16.8% of CVLZ parking events.

### II-3.2 Dwell times

In addition to authorized/unauthorized parking behavior, the parking events were analyzed based on dwell time and activity type. The vehicle activity categories are described in Table 13 (Section [II-2.4](#)). Tables 15 and 16 on the succeeding pages describe the dwell times of commercial vehicles and passenger vehicles, respectively. Commercial vehicle categories are broken down by permit holders and non-permit holders. As in the last section, authorized parking events by non-permit holders are reflective of payment being remitted. Authorized parking by passenger vehicles reflects either a valid CVLZ permit or payment in CVLZs and payment in paid parking (PP).

**Table 15. Commercial vehicle dwell times by vehicle category**

|                                                                    |            | Dwell time by commercial vehicle category                       |                                         |                                                                 |                                         |                                                              |                                        |                                                   |                                                             |                                         |
|--------------------------------------------------------------------|------------|-----------------------------------------------------------------|-----------------------------------------|-----------------------------------------------------------------|-----------------------------------------|--------------------------------------------------------------|----------------------------------------|---------------------------------------------------|-------------------------------------------------------------|-----------------------------------------|
|                                                                    |            | <i>n = sample size</i>                                          |                                         |                                                                 |                                         |                                                              |                                        |                                                   |                                                             |                                         |
|                                                                    |            | <i>(Median (minutes), STDEV (minutes))</i>                      |                                         |                                                                 |                                         |                                                              |                                        |                                                   |                                                             |                                         |
| Parking Behavior                                                   | Space Type | Commercial - Freight<br><i>n = 376</i><br><i>(12.23, 66.25)</i> |                                         | Commercial - Service<br><i>n = 158</i><br><i>(13.63, 80.78)</i> |                                         | Commercial - Other<br><i>n = 127</i><br><i>(1.95, 18.08)</i> |                                        | Emergency<br><i>n = 5</i><br><i>(6.10, 10.40)</i> | Commercial Total<br><i>n = 666</i><br><i>(10.73, 64.92)</i> |                                         |
|                                                                    |            | Permit holder<br><i>n = 115</i>                                 | No Permit<br><i>n = 261</i>             | Permit holder<br><i>n = 29</i>                                  | No Permit<br><i>n = 129</i>             | Permit holder<br><i>n = 23</i>                               | No Permit<br><i>n = 104</i>            | No Permit<br><i>n = 5</i>                         | Permit holder<br><i>n = 167</i>                             | No Permit<br><i>n = 499</i>             |
| Authorized Parking<br><br><i>n = 248</i><br><i>(17.60, 77.13)</i>  | CVLZ       | <i>n = 73</i><br><i>(14.65, 70.90)</i>                          | <i>n = 45</i><br><i>(26.22, 64.49)</i>  | <i>n = 20</i><br><i>(19.94, 96.35)</i>                          | <i>n = 16</i><br><i>(28.67, 21.25)</i>  | <i>n = 10</i><br><i>(11.78, 16.11)</i>                       | <i>n = 4</i><br><i>(27.33, 9.70)</i>   | n/a                                               | <i>n = 103</i><br><i>(16.20, 73.58)</i>                     | <i>n = 65</i><br><i>(26.22, 55.03)</i>  |
|                                                                    | PP         | <i>n = 7</i><br><i>(20.67, 10.31)</i>                           | <i>n = 6</i><br><i>(93.83, 147.05)</i>  | n/a                                                             | <i>n = 8</i><br><i>(69.91, 176.55)</i>  | <i>n = 1</i><br><i>(37.07, 0.00)</i>                         | <i>n = 1</i><br><i>(41.90, 0.00)</i>   | n/a                                               | <i>n = 8</i><br><i>(23.44, 10.69)</i>                       | <i>n = 15</i><br><i>(90.23, 155.34)</i> |
|                                                                    | PLZ        | <i>n = 9</i><br><i>(8.82, 38.62)</i>                            | <i>n = 20</i><br><i>(7.47, 83.40)</i>   | <i>n = 4</i><br><i>(2.98, 17.38)</i>                            | <i>n = 14</i><br><i>(8.82, 66.62)</i>   | <i>n = 1</i><br><i>(0.02, 0.00)</i>                          | <i>n = 7</i><br><i>(0.82, 12.01)</i>   | n/a                                               | <i>n = 14</i><br><i>(6.63, 32.96)</i>                       | <i>n = 41</i><br><i>(6.20, 70.75)</i>   |
|                                                                    | Alley      | n/a                                                             | <i>n = 1</i><br><i>(3.00, 0.00)</i>     | n/a                                                             | n/a                                     | n/a                                                          | <i>n = 1</i><br><i>(0.25, 0.00)</i>    | n/a                                               | n/a                                                         | <i>n = 2</i><br><i>(1.63, 1.94)</i>     |
| Unauthorized Parking<br><br><i>n = 418</i><br><i>(8.45, 55.39)</i> | CVLZ       | n/a                                                             | <i>n = 88</i><br><i>(12.04, 70.01)</i>  | n/a                                                             | <i>n = 42</i><br><i>(9.06, 41.72)</i>   | n/a                                                          | <i>n = 40</i><br><i>(2.18, 15.75)</i>  | <i>n = 1</i><br><i>(27.73, 0.00)</i>              | n/a                                                         | <i>n = 171</i><br><i>(9.40, 55.39)</i>  |
|                                                                    | PP         | <i>n = 7</i><br><i>(10.33, 11.28)</i>                           | <i>n = 38</i><br><i>(10.84, 77.64)</i>  | <i>n = 3</i><br><i>(13.97, 7.23)</i>                            | <i>n = 18</i><br><i>(60.08, 120.19)</i> | <i>n = 5</i><br><i>(1.95, 4.17)</i>                          | <i>n = 19</i><br><i>(6.17, 31.91)</i>  | <i>n = 1</i><br><i>(3.90, 0.00)</i>               | <i>n = 15</i><br><i>(4.88, 9.22)</i>                        | <i>n = 76</i><br><i>(13.19, 86.73)</i>  |
|                                                                    | DP         | <i>n = 1</i><br><i>(22.40, 0.00)</i>                            | <i>n = 12</i><br><i>(3.73, 4.17)</i>    | n/a                                                             | <i>n = 3</i><br><i>(2.17, 0.65)</i>     | <i>n = 1</i><br><i>(0.67, 0.00)</i>                          | <i>n = 9</i><br><i>(0.77, 1.28)</i>    | <i>n = 2</i><br><i>(7.76, 7.60)</i>               | <i>n = 2</i><br><i>(11.53, 15.37)</i>                       | <i>n = 26</i><br><i>(2.28, 4.03)</i>    |
|                                                                    | No Parking | <i>n = 18</i><br><i>(10.13, 16.07)</i>                          | <i>n = 51</i><br><i>(8.80, 34.68)</i>   | <i>n = 2</i><br><i>(69.49, 91.86)</i>                           | <i>n = 28</i><br><i>(4.21, 36.26)</i>   | <i>n = 5</i><br><i>(0.83, 2.99)</i>                          | <i>n = 23</i><br><i>(1.21, 12.71)</i>  | <i>n = 1</i><br><i>(6.1, 0.00)</i>                | <i>n = 25</i><br><i>(7.62, 28.51)</i>                       | <i>n = 103</i><br><i>(6.37, 31.72)</i>  |
| Totals                                                             |            | <i>n = 115</i><br><i>(12.93, 58.46)</i>                         | <i>n = 261</i><br><i>(11.88, 69.47)</i> | <i>n = 29</i><br><i>(16.83, 84.10)</i>                          | <i>n = 129</i><br><i>(13.03, 80.35)</i> | <i>n = 23</i><br><i>(3.43, 14.04)</i>                        | <i>n = 104</i><br><i>(1.83, 19.02)</i> | <i>n = 5</i><br><i>(6.1, 10.40)</i>               | <i>n = 167</i><br><i>(12.35, 60.56)</i>                     | <i>n = 499</i><br><i>(9.98, 66.37)</i>  |

### *II-3.2.1 Commercial vehicle dwell time behavior*

Overall, authorized parking events were longer than unauthorized parking events, independent of the commercial vehicle category. On average these authorized events were 208%, or 9.2 minutes longer than unauthorized events.

As a reminder, Commercial Vehicle Load Zones by statute have a maximum duration of 30 minutes. CVLZs were used by permit holders, non-permit holders that paid for their use, and non-permit holders that did not pay in each of the three major activity categories. In each case non-permit holders that paid for CVLZ parking had the longest median dwell time (26.2 minutes), followed by permit holders (16.2 minutes). Non-permit holders that did not pay for CVLZ access had the shortest median dwell times (9.4 minutes). Service vehicles tended to park in the CVLZs for the longest authorized periods, followed by freight and then commercial-other. With no detectable loading or unloading activity we would expect this result for the “other” category. Freight vehicles had the longest parking time among unauthorized CVLZ users.

Very similar patterns were observed in paid parking spaces. Freight vehicles that paid for parking dwelled anywhere from 10-80 minutes longer than freight vehicles that did not pay. Service vehicles that paid dwelled 10-50 minutes longer than non-payers. Commercial-other vehicles exhibited the shortest dwell time when not paying (2-6 minutes) for a difference of 30-35 minutes compared to similar vehicles that paid for parking. It should be noted that authorized use of paid parking dwell times were longer than authorized use of CVLZs, whereas unauthorized use of CVLZs dwell times were longer than unauthorized use of paid parking.

As expected, the shortest dwell times were by those vehicles that parked in the travel lane (double parked) at roughly 3.0 minutes. This was followed by users of PLZs (6.3 minutes) and no parking zones (6.6 minutes).

**Table 16. Passenger vehicle dwell times by vehicle category**

| Dwell time by passenger vehicle category<br>n = sample size<br>(Median (min), STDEV (min)) |            |                              |                           |                         |                             |                          |                           |                              |
|--------------------------------------------------------------------------------------------|------------|------------------------------|---------------------------|-------------------------|-----------------------------|--------------------------|---------------------------|------------------------------|
| Parking Behavior                                                                           | Space Type | Private Use<br>n = 4,738     | Food Delivery<br>n = 408  | Goods Delivery<br>n = 6 | TNC<br>n = 2,171            | Other<br>n = 17          | Transit<br>n = 176        | Passenger Total<br>n = 7,516 |
| Parking fee paid or use permitted by activity                                              |            |                              |                           |                         |                             |                          |                           |                              |
| Authorized Parking<br>n = 2,137<br>(9.54, 80.65)                                           | CVLZ       | n = 220<br>(15.76, 72.89)    | n = 22<br>(8.23, 52.08)   | n = 3<br>(17.12, 8.93)  | n = 33<br>(2.63, 13.41)     | n/a                      | n/a                       | n = 278<br>(13.53, 67.57)    |
|                                                                                            | PP         | n = 593<br>(62.38, 100.12)   | n = 33<br>(11.72, 51.91)  | n/a                     | n = 11<br>(26.77, 24.44)    | n/a                      | n/a                       | n = 637<br>(57.63, 98.59)    |
|                                                                                            | PLZ        | n = 703<br>(6.15, 69.45)     | n = 62<br>(5.34, 4.99)    | n = 2<br>(10.39, 7.62)  | n = 316<br>(1.18, 14.28)    | n = 2<br>(3.03, 3.13 )   | n = 9<br>( 2.07, 3.15)    | n = 1,094<br>(4.17, 56.91)   |
|                                                                                            | Bus Stop   | n/a                          | n/a                       | n/a                     | n/a                         | n/a                      | n = 128<br>(0.61 , 1.38 ) | n = 128<br>(0.61, 1.38)      |
| No payment or unauthorized use of space type                                               |            |                              |                           |                         |                             |                          |                           |                              |
| Unauthorized Parking<br>n = 5,379<br>(2.72, 79.22)                                         | CVLZ       | n = 945<br>(5.42, 73.46)     | n = 114<br>(4.68, 19.13)  | n/a                     | n = 332<br>(0.65, 7.45)     | n = 5<br>(14.93, 9.84 )  | n = 10<br>( 7.93, 23.11)  | n = 1,406<br>(3.60, 61.50)   |
|                                                                                            | PP         | n = 1,487<br>(21.53, 122.16) | n = 105<br>(6.38, 52.48)  | n = 1<br>(18.07, 0.00)  | n = 237<br>(1.32, 7.42)     | n/a                      | n = 5<br>(4.22 , 98.95 )  | n = 1,835<br>(11.50, 113.80) |
|                                                                                            | DP         | n = 159<br>(0.55, 20.81)     | n = 5<br>(1.37, 1.54)     | n/a                     | n = 353<br>(0.28, 31.98)    | n/a                      | n = 9<br>(0.50 , 0.80 )   | n = 526<br>(0.35, 28.57)     |
|                                                                                            | No Parking | n = 629<br>(3.02, 48.85)     | n = 67<br>(4.83, 6.20)    | n/a                     | n = 876<br>(0.40, 3.34)     | n = 9<br>(3.98, 12.16)   | n = 15<br>(3.10 , 2.99 )  | n = 1,596<br>(0.73, 30.59)   |
|                                                                                            | Alley      | n = 2<br>(30.43, 41.42)      | n/a                       | n/a                     | n = 13<br>(0.35, 0.36)      | n = 1<br>( 24.87, 0.00)  | n/a                       | n = 16<br>(0.38, 15.63)      |
| Totals                                                                                     | All spaces | n = 4,738<br>(9.44 , 95.73)  | n = 408<br>(5.68 , 35.16) | n = 6<br>(16.45 , 7.98) | n = 2,171<br>( 0.48, 15.07) | n = 17<br>(7.17, 10.99 ) | n = 176<br>(0.92 , 18.21) | n = 7,516<br>(4.11, 79.83 )  |

### II-3.2.2 Passenger vehicle dwell time behavior

Overall, authorized parking events were longer than unauthorized parking events, independent of the passenger vehicle category. On average these authorized events were 351%, or 6.8 minutes longer than unauthorized events.

Paid parking spaces have time limits of either two or four hours. Passenger vehicles that paid for use of paid parking exhibited the longest median dwell time at 57.6 minutes. This was followed by vehicles that paid for use of CVLZ (13.5 minutes), failed to pay for paid parking (11.5 minutes) and PLZs (4.2 minutes). The shortest dwell times (excluding buses) were double parking, no parking, and alleys, all of which were used for less than a minute.

The use of CVLZs by passenger vehicles varied by vehicle category. Vehicles involved in deliveries dwelled longer in CVLZs when they paid than TNCs, but were surpassed by private use vehicles that were not observed making any sort of delivery or dropping off passengers. We would expect TNC dwell time to be short, but TNCs that are authorized to use paid parking spaces by making payments had a median dwell time of 27 minutes.

### II-3.3 Parking occupancies

Analyzing the parking data from the perspective of the infrastructure is a useful way of understanding how the infrastructure is used in general. Table 17 summarizes the use of each space designation throughout the study period. Table 18 summarizes their use in terms of cumulative occupied time.

**Table 17. Use of Parking spaces by occurrence**

|                                  | Space Type |       |       |       |     |                    |               |
|----------------------------------|------------|-------|-------|-------|-----|--------------------|---------------|
|                                  | CVLZ       | PP    | PLZ   | Alley | DP  | Other / No Parking |               |
| <b>Vehicle Type</b>              |            |       |       |       |     |                    | <b>Totals</b> |
| Commercial Vehicles              | 339        | 114   | 55    | 2     | 28  | 128                | 666           |
| Passenger Vehicles               | 1,684      | 2,472 | 1,094 | 16    | 526 | 1,724              | 7,516         |
| <b>Authorized / Unauthorized</b> |            |       |       |       |     |                    | <b>Totals</b> |
| Has permit                       | 158        | 76    | 45    | 0     | 23  | 55                 | 357           |
| Paid for parking                 | 320        | 660   | 148   | 0     | 0   | 0                  | 1,128         |
| Unauthorized                     | 1,577      | 1,926 | 0*    | 0     | 554 | 1,724              | 5,781         |

The fleet of vehicles studied during the observation period was weighted heavily in favor of passenger vehicles (92%, see Section II-3.1) however the use of space by commercial and passenger vehicles was not uniformly distributed. Higher shares of commercial vehicles used CVLZs (16.8%) than any other space type. This was followed by alleys (11.1%) -- albeit with a small sample size -- and no parking zones (6.9%). Each of the other categories: paid parking, PLZs, and double parking were comparatively less by commercial vehicles at a rate of 4.4-5.0%.

**These figures suggest that targeted infrastructure, in this case CVLZs, is more likely to be used for the intended vehicle activity than neighboring spaces.**

Intended activity is not the same as authorized use. In the case of CVLZs, authorized is represented by users with a CVLZ permit or users that remit payment. 21.5% of CVLZ events were authorized by either means, meaning 78.5% of the parking events were unauthorized. By way of comparison, 65.6% of the paid parking events went unpaid and were therefore unauthorized. For a more complete story, however, dwell time must be introduced.

**Table 18.** *Use of Parking spaces by time (minutes)*

|                           | Space Type |         |        |       |       |                    |         |
|---------------------------|------------|---------|--------|-------|-------|--------------------|---------|
|                           | CVLZ       | PP      | PLZ    | Alley | DP    | Other / No Parking |         |
| Vehicle Type              |            |         |        |       |       |                    | Totals  |
| Commercial Vehicles       | 10,643     | 6,297   | 1,860  | 3     | 120   | 2,253              | 21,176  |
| Passenger Vehicles        | 37,043     | 171,917 | 18,741 | 92    | 1,316 | 12,759             | 241,868 |
| Total                     | 47,686     | 178,214 | 20,601 | 95    | 1,436 | 15,012             | 263,044 |
| Authorized / Unauthorized |            |         |        |       |       |                    | Totals  |
| Has permit                | 5,416      | 2,422   | 1,144  | 3     | 49    | 738                | 9,772   |
| Paid for parking          | 13,494     | 58,797  | 6,630  | 0     | 0     | 0                  | 78,921  |
| Unauthorized              | 28,776     | 116,995 | 0*     | 92    | 1,436 | 14,849             | 162,056 |

Considering cumulative time parked, commercial vehicles were responsible for 8.1% of the total time, in line with the share of parking events. The distribution of this time across space types, however, did not parallel parking events. Commercial vehicles spent 50.3% of their dwell time in

CVLZs, which accounted for 22.3% of total CVLZ dwell time. By contrast, passenger vehicles spent just 15.3% of total dwell time in CVLZs, with the majority of passenger vehicle time spent in paid parking spaces (71.1%).

Commercial vehicles also tended to dwell in PLZs longer than passenger vehicles. Commercial vehicles accounted for just 4.4% of PLZ parking events but 9.0% of total PLZ dwell time. Similarly, although dwell times when vehicles double parked (DP) were short for both vehicle classifications, commercial vehicles dwelled longer in the travel lane than passenger vehicles, resulting in 8.4% of total DP dwell time and only 5.0% of DP events.

**From a broader perspective, CVLZs are not utilized for their intended purpose most of the time.** 77.7% of occupied CVLZ time can be attributed to passenger vehicles (22.3% by commercial vehicles). Some passenger vehicles were involved in delivery activity as denoted by the vehicle categories. Even when the dwell time of passenger vehicles conducting delivery operations (the “Food Delivery” and “Goods Delivery” vehicle categories) is added to commercial vehicle class dwell time, the share of CVLZ time occupied by vehicles conducting commercial activities only increases to 25.4%.

The data also shows that CVLZ occupied time is 60.3% unauthorized, meaning vehicles neither had a CVLZ permit nor paid for parking. 11.3% of dwell time was authorized by permits and 28.3% was authorized by payment (note that there were some instances where permit holders paid for parking. These are included in the 11.3% and not double counted). Comparatively, the unauthorized (unpaid) dwell time of paid parking spaces was 65.6%.

## **PART III**

### **TASK 5: DOCUMENT CARRIER PRACTICES**

# PART III - TASK 5: DOCUMENT CARRIER PRACTICES

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### III-1 Interviews performed

Between January and May 2024, six face-to-face and online interviews were conducted with “champion” organizations. The names of these companies have been redacted to protect anonymity. The selected organizations were current CVLZ permit holders. They spanned different business sectors and company sizes, from large national parcel carriers to regional wholesale distributors to local restaurants and breweries. Table 19 provides an overview of the companies interviewed and their main business activities.

**Table 19.** *Description of interviewed businesses*

| ID | Company         | Business sector               | Business description                                                                                                                | Interview date |
|----|-----------------|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 1  | <i>ommitted</i> | Parcel carrier                | Large parcel delivery company                                                                                                       | Jan 23, 2024   |
| 2  | <i>ommitted</i> | Wholesaler - produce          | Local supplier of fresh produce                                                                                                     | Mar 27, 2024   |
| 3  | <i>ommitted</i> | Wholesaler - food ingredients | Local supplier of food ingredients serving local restaurants, food businesses, and chains in Western Washington                     | Apr 3, 2024    |
| 4  | <i>ommitted</i> | Wholesaler - beverages        | Multi-state beverage distributor, mostly supplying stores, bars, restaurants                                                        | Apr 18, 2024   |
| 5  | <i>ommitted</i> | Restaurant                    | Local restaurant using personal vehicles to pick up from distributors and restock the restaurant pantry                             | May 5, 2024    |
| 6  | <i>ommitted</i> | Brewery                       | Small local brewery company operating two breweries open to customers and performing deliveries to wholesalers and restaurants/bars | May 21, 2024   |

The goal of the interviews was to understand, within each context, the parking payment behaviors of individual companies. In particular, the interviewers focused on understanding the motivations behind the choice of purchasing CVLZ permits, the related parking and routing behaviors of their delivery drivers, and the challenges they face in performing deliveries in the study area. Each interview was 1 hour long and was guided on a questionnaire reported in [Appendix III](#). The questionnaire was developed into four sections:

- Organization - Describe their main business activities, logistics network and fleet composition.
- Permits - Number of permits purchased, who pays for the permits, and the main motivations behind the purchase.

- Routing, parking, and payment behaviors - Description of typical drivers' operations in Seattle downtown, including routing and parking behaviors, as well as use of paybyphone and citations.
- Future scenarios - Companies were asked on technology adoption, zero emission vehicles, and considerations regarding the CVLZ permit program

The following section provides the main results of the interviews, including a description of the logistics network infrastructure, delivery operations and curb use behaviors, and permit and payments behaviors. The following sections provide the key lessons learned.

## III-2 Interview results

### III-2.1 Infrastructure

Table 20 reports the main information on the logistic networks, typical customers, service area, and fleet composition of the interviewed organizations. The companies greatly differ in size, reflected in the type and extension of their logistic networks.

**Company description.** Company 1 is a national parcel carrier serving residents and businesses from a warehouse based in SODO. Companies 2-4 are medium-large produce, food ingredients, and beverage suppliers, respectively. They only provide B2B services, supplying their products to large chain stores (e.g., Costco), local restaurants, bars, coffee shops, and public organizations (e.g., schools and military bases). Organizations 5 and 6 consist of a local brewery and restaurant, respectively. Each has two locations across the Seattle metropolitan area, directly serving walk-in customers. The brewery also distributes its product to local restaurants and bars, while the restaurant operates two personal vehicles to pick up supplies to restock the restaurants.

**Fleet composition.** The interviewed organizations use large truck trailers, smaller vans, and personal vehicles to perform pick-ups and deliveries. All vehicles used are diesel-powered. Fleets with regular routes into the urban core are proactive about right-sizing vehicles based on delivery volumes and will use smaller vehicles like vans or smaller box trucks if possible. The companies prefer to use smaller vehicles (box trucks, vans, and pick-up trucks) to operate in Seattle's urban core.

**Table 20.** Infrastructure and fleet composition of interviewed organizations

| ID | Logistics network structure                                                                                                      | Typical customers                                                                                                                                                      | Service area                                                                                                                                                     | Fleet composition                                                                                                              |
|----|----------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| 1  | Several warehouses all over the US, one warehouse in SODO covering Seattle                                                       | Deliveries performed to residential, office, and small retail business areas                                                                                           | The whole US                                                                                                                                                     | NA                                                                                                                             |
| 2  | Seven warehouses across the west coast, two in WA, of which one in SODO covering western WA                                      | Large grocery chains, local restaurants, schools, military etc.                                                                                                        | US West Coast                                                                                                                                                    | 160 vehicles: all refrigerated; 59 box trucks and vans - food deliveries in urban areas, 101 truck trailers - more rural areas |
| 3  | One warehouse in SODO                                                                                                            | Wholesale food for local restaurants and bakeries. No fresh protein/produce                                                                                            | Western WA, with two trips per week to eastern WA                                                                                                                | 42 vehicles: All box trucks, refrigerated, 16 to 24 foot long                                                                  |
| 4  | Three warehouses located in Kent, WA, Everett, WA and Portland, OR                                                               | Large chains (full truckload or several pallets, e.g., large grocery stores, Costco, gas stations), as well as “On-premises accounts” (local bars, cafes, restaurants) | WA and OR states                                                                                                                                                 | 120 vehicles: 55 box trucks, 65 trailer or semi                                                                                |
| 5  | Two restaurant locations in Belltown and Bellevue would act as depots with storage                                               | Owner and manager resupply the restaurant picking up food and other products from distributors                                                                         | Travel for picking up and restocking the restaurants from suppliers in Sodo, Lynnwood, and Ballard, as well as travel to Bellevue to restock the second location | 2 vehicles: personal vehicles - one for the owner and one for the kitchen manager; SUV and one pickup truck                    |
| 6  | Two brewery locations (Belltown and Ballard, production facility in Belltown). Sell to customers and deliver to local businesses | Mostly directly to consumers through the 2 locations, but has 55-60 business customers, mostly local bars, restaurants, cafes                                          | Seattle metropolitan area (from Greenlake to White Center)                                                                                                       | 2 vehicles: one van and one pickup truck                                                                                       |

## III-2.2 Delivery operations and curb use behaviors

**Route characteristics.** On average, each organization has 20 delivery vehicles entering the Seattle metropolitan area daily, ranging from companies 5,6, having one vehicle per day operating, to companies 1-4, which have between 6 and 40 vehicles operating daily. A typical delivery route consists of 10 to 25 stops. Parking dwell times range between 15 to 45 minutes, with longer dwell times associated with large or full-truckload deliveries (e.g., to larger customers), areas characterized by large delivery density (several customers located near each other), and areas with high competition for curb parking. Some companies reported staying at a parking location for longer while walking several blocks to deliver to nearby customers as moving the vehicle would be too costly (e.g., in Capitol Hill). Company 5 reported not wanting to overstay and anger other vehicle drivers since their vehicle is branded.

**Challenging areas.** Some of the more difficult areas to operate in:

- Pike Place Market - Lack of CVLZs, drivers tends to stay longer whenever they find a safe location to park from which to deliver to multiple customers via walking;
- Capitol Hill, Old Ballard, California Ave in West Seattle, Queen Anne, and University District - Areas with lots of restaurants reported many vehicles using CVLZs for food pick-up, despite not having a permit, and being passenger vehicles;
- Downtown - Issues with new bike lanes and construction that moved/removed CVLZs.

**Delivery times.** Most companies are limited to performing deliveries and pick-ups within receivers' business hours. Only companies 2 and 4 reported being able to perform unattended deliveries to customers early in the morning (between 3 and 5 a.m.), and were provided access to these locations by the receiver.

**Parking choice and curb use.** All companies except the parcel carrier reported that their drivers prioritize parking at CVLZs. The parcel carrier mentioned that CVLZs are needed for about 30 percent of their stops, mostly due to their high delivery density and the fact that drivers are told not to back-up their vehicles or parallel park. All other organizations mentioned that their operations are dependent on finding available CVLZs. Parking in travel lanes and double parking are reported by almost all companies as the least preferred option, but they are still needed in many areas with high parking occupancies. Drivers are also willing to park at curb-paid parking areas and use alleys when available. Two companies also reported having to re-route the vehicle in high-traffic areas and return later on.

While companies 1-4 use CVLZs for en-route deliveries, companies 5,6, which have facilities within the study area, heavily depend on the nearest CVLZ to their retail location to park their vehicle while loading/unloading. Company 6 reported working with SDOT to convert the curb adjacent to their retail location to a CVLZ, whereas before it was a no-parking zone. The company also reported receiving repeated citations prior to the CVLZ conversion.

**Citations.** The companies received more citations in past years and currently do not receive many citations (about 1-3/ year). Companies generally do not penalize drivers for receiving citations, although drivers may get questioned or "re-trained" if they routinely get cited. One company also reported buying CVLZ permits such that enforcement is more lenient even when

they park outside of CVLZs. For company 1, the cost of tickets is considered the cost of doing business when compared to the loss of time by parking far away and walking for too long, considering one van carries 100-200 parcels a day.

**Table 21.** Typical delivery and parking operations of interviewed businesses in the study area

| ID | No. routes                                               | Dwell time                                                      | No. stops/<br>deliveries<br>per route      | Time                                                                                     | Parking choices                                                                                                              | Citations/year                                                                       |
|----|----------------------------------------------------------|-----------------------------------------------------------------|--------------------------------------------|------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 1  | NA                                                       | 15 minutes                                                      | 17 stops                                   | 8 am to 5 pm                                                                             | CVLZs are used 30% of the time, mostly in busy areas. In order of priority: 1) Curb, 2) CVLZ,/PLZ, 3) Alleys, 4) Double park | NA                                                                                   |
| 2  | 10-17 trucks a day enter Seattle                         | 20 minutes                                                      | 15-20 stops (8-12 for retail routes)       | 3 am to noon                                                                             | In order of priority: 1) CVLZ, 2) Curb, 3) Alley entry, 4) Double park, 5) Re-route                                          | Very few citations since COVID, they track citations and talk to drivers if repeated |
| 3  | 6-9 routes a day in Seattle - 37 routes per day in total | 20 minutes (30-45 min for larger deliveries)                    | 10 stops (typical market stop in Belltown) | 7:30 am to 3 pm                                                                          | In order of priority: 1)CVLZ, 2) Curb, 3) Left turn or middle lane, 4) Alley entry, 5) Re-route                              | Very few citations, 1-2/year                                                         |
| 4  | 40 routes in Seattle - 80 in total                       | 20 minutes minimum, longer if they find a good parking spots    | 10 to 22 customers per route               | Starts between 2:30 am and 4:30 am, until 3 pm                                           | In order of priority: 1) Loading dock, 2) CVLZ, 3) Alley entry, 4) Center lane, 5) Double park                               | If a driver gets too many citations, he/she is re-trained                            |
| 5  | 1 route per day                                          | 20-30 min. If longer will move truck to paid or other locations | Typically 5 trips per day                  | Starts shopping before 9 am; first drop off between 9-10 am; leaves restaurant by 6-7 pm | In order of priority: 1) CVLZ, 2) On-street paid parking, 3) Paid parking lot (if no enforcement visible)                    | About 1-3 citations/year on average.                                                 |
| 6  | 3 routes per week                                        | 15-20 minutes                                                   | 20-24 deliveries per route                 | Between 11 am and 5 pm (during business hours)                                           | In order of priority: 1) CVLZ, 2) Other load zones (e.g. PLZ), 3) Paid parking, 4) Center lane/shoulder                      | 1-2 citations/year (before getting the permit it was 4-5 citations/year)             |

### III-2.3 Permits & payments behaviors

Figure 25 shows the number of CVLZ permits each company interviewed has purchased since 1994. Overall, companies seem to have purchased a constant number of permits since the beginning of their operations, with a general increasing trend in permits purchased. The COVID-19 pandemic seems not to have affected the number of permits purchased.

The number of permits purchased in 2024 is proportional to the fleet size, although companies show different behaviors in choosing what portion of their fleet should be equipped with permits. Some companies are more preventive and purchase permits for most of their vehicles, while others only purchase permits only for vehicles typically entering downtown Seattle.

#### Main reasons companies reported purchasing permits

- **Be a good city partner.** Several companies reported purchasing permits to be “good” partners with the city and communities and to respect existing laws and regulations.
- **Efficiency.** All companies except Company 1 reported that their operations and efficiency rely on using CVLZs to park and load/unload. For many companies, the cost of cruising for parking is too high, and they would rather purchase permits and be able to use CVLZs. Permits also allow for efficiency for drivers in that they are pre-paid, recognizable, and typically sized for larger vehicles.
- **Cost of cruising for parking.** cost of additional driver’s time, able to deliver to fewer customers in a route, risk for perishable goods not getting delivered on time. While Company 1 reported using CVLZs only 30 percent of the time, it stated that CVLZs are an important asset in areas characterized by high parking occupancy, traffic congestion, and little curb parking, mostly downtown.
- **Lack of alternatives.** Some companies reported being able to use CVLZs but not other parking locations due to the need for parallel parking and the fact that the spaces are often not large enough.

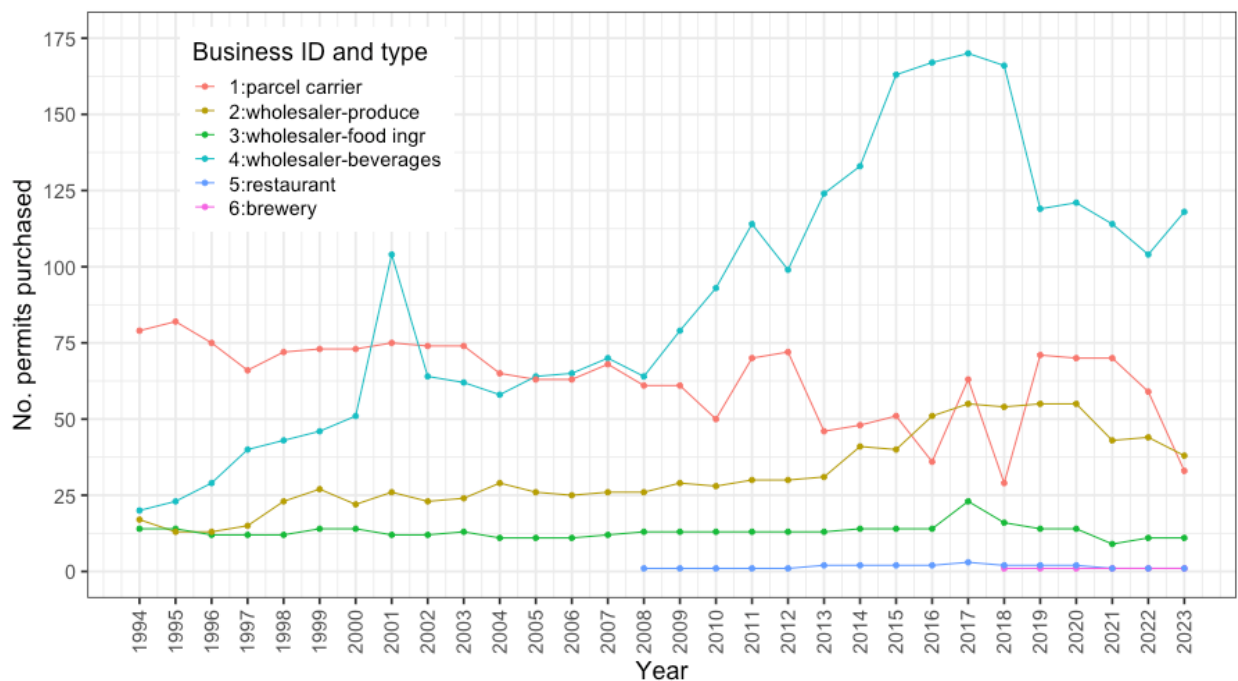
**CVLZ permit pricing.** Companies generally seem to be inelastic to price changes to date and willing to purchase permits even if the price increases. Interviewees had diverging opinions when asked whether commercial vehicles should pay for parking. Some companies stated that they believe CVLZs should be free of charge, and consider parking pricing as an additional cost/tax of doing business. Others understand that there is a cost behind the upkeep of the CVLZ program and are ok with paying into that system. Companies reported that very few drivers pay for parking through pay machines or Pay by Phone (even when offered to reimburse), except company 5, where the vehicle driver moves the vehicle to a paid parking area after finishing unloading the vehicle to restock the restaurant.

**Challenges.** The interviewed companies reported the following challenges when performing deliveries in the study area.

- There are not enough CVLZs, and they are not always in the right places. The network seems to be shrinking rather than expanding, with more CVLZs being removed than added.
- Not well enforced, with many passenger vehicles without a permit using the CVLZs (especially TNC and food delivery), as well as certain permit holders staying longer than the regulated 30 minutes.

- There is strong competition for the use of the curb, so they are not always able to use the zones when they need them.
- Fleets noticed a difference in unauthorized parking events during the summer/high tourism months (especially in the study area and adjacent to Pike Place Market) and linked these behaviors to lack of understanding or clarity of existing parking rules. For example- multiple interviewees referred to painted curbs that faded over time and became less effective in communicating rules (red vs. yellow vs. unpainted). Signage was referred to as “confusing” or “hard to understand”. A comment was made that different rules/signs for adjacent parking spots also led to confusion. While multiple permit purchasers mentioned the effectiveness and helpfulness of the permit office manager supporting them in the purchasing of the permits, they also reported that the online purchasing process is not user-friendly.

**Technology adoption.** Some companies report using routing software, but even those leave their drivers free to reroute and make changes, responding to a dynamic and complex urban environment. Several companies report using a “pencil and paper” method to plan routes, partially because their routes are static and do not change drastically over time and partially because route optimization software does not consider the complexities of their order cutoffs and Seattle downtown complexity. Generally, companies prefer the permit to remain visible on the windshield. Companies also report a strong preference for passive technology: if the digital permit system requires tapping or other actions from the drivers, that would increase the cost of managing drivers, as well as the time to perform deliveries. Some expressed concern about how enforcement would work if there was no physical decal. Many fleet owners have done some level of exploration into electric or zero/low emission vehicles with varying levels of detail.



**Figure 25.** Number of CVLZ permits purchased by interviewed companies since 1994

**Table 22. Permits and payment behaviors**

| ID | No. permits in 2024                                                                                                                                                                                                                                                                            | Percentage of fleet | First purchased | Avg. permits/year | Use PayByPhone                                                                                       |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-----------------|-------------------|------------------------------------------------------------------------------------------------------|
| 1  | N/A                                                                                                                                                                                                                                                                                            | N/A                 | 1994            | 67 permits        | No                                                                                                   |
| 2  | 59 permits <ul style="list-style-type: none"> <li>although only 10-15 trucks a day enter the Seattle metropolitan area, they made sure all smaller box trucks and vans have a permit in case any of those is deployed in Seattle (they were not aware of transferable CVLZ permits)</li> </ul> | 37%                 | 1994            | 29 permits        | No - drivers have the option to do it, but they would have to pay themselves and then get reimbursed |
| 3  | 11 permits                                                                                                                                                                                                                                                                                     | 26%                 | 1994            | 13 permits        |                                                                                                      |
| 4  | 97 permits <ul style="list-style-type: none"> <li>72 permits for delivery trucks</li> <li>Other 20-30 permits for sales vehicles</li> </ul>                                                                                                                                                    | 81%                 | 1994            | 86 permits        | No - at drivers' discretion                                                                          |
| 5  | 2 permits                                                                                                                                                                                                                                                                                      | 100%                | 2008            | 2 permits         | Have used for on-street parking when needed.                                                         |
| 6  | 1 permit                                                                                                                                                                                                                                                                                       | 50%                 | 2018            | 1 permit          | No - when using paid parking usually just risk it                                                    |

### III-3 Key lessons learned

- For most companies, CVLZs are perceived as necessary to efficiently perform operations in Seattle's downtown, especially for those using larger vehicles and with longer dwell times. Although they are not always available or well enforced, they often represent the only viable alternative for larger commercial vehicles to park in urban, congested areas. In other words, companies with larger vehicles, rely on CLVZs, in absence of alternative parking locations such as loading docks.
- Enforcement is a key factor in permit valuation and everyday decision-making, but not in the way it was expected. Companies report getting very few tickets in general. Consequently, the risk of getting a ticket is not listed as the primary reason for purchasing CVLZ permits. Instead, companies are asking for more enforcement of the CVLZs, as they are frustrated when other vehicles (especially smaller food delivery/passenger vehicles like TNCs) park at CVLZs even if they do not have a permit.

- Companies owning and operating facilities in the study area (the brewery and restaurant owners) have a sense of “ownership” of the CVLZs in front of their businesses. In one case, the company asked for a CVLZ to be placed in front of their downtown location.
- Urban deliveries drivers undergo a complex and manual decision-making process, where drivers are the final decision makers of where to park and for how long, with almost no use of technology. Few companies report using routing software, and all of those interviewed allow their drivers to re-route and change customer delivery order (within some bounds), in response to a complex, dynamic urban environment.
- Based on past data and current permit price, the interviewed companies seem to be inelastic to increases in permit prices, and the number of permits purchased have generally increased or remained unchanged over time.
- For the interviewed companies, parking at CVLZs is the preferred option, while double parking, parking in the middle lane, and re-routing the vehicle to return later on are the least preferred options.

## **PART IV**

### **TASKS 6 AND 7: CARRIER SURVEY AND BEHAVIORAL ANALYSIS**

## PART IV - TASKS 6 AND 7: CARRIER SURVEY AND BEHAVIORAL ANALYSIS

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## IV-1 Introduction

The purpose of Task 7 is to assess existing parking challenges commercial vehicle operators are experiencing in Seattle and investigate the impact of future parking policies.

To address this objective, the research team has drafted and distributed an online survey to commercial vehicle operators in Seattle. The survey questionnaire was developed and tested between November and December 2024, using the learnings obtained from Task 5 (“champions” interviews) and Task 6 (future policy scenarios). While the research team conducted six face-to-face interviews and site visits as part of Task 5, the purpose of the current task is to expand the reach to obtain information from a larger sample of potential commercial vehicle load zone (CVLZ) permit users. Furthermore, the survey questionnaire also aims to understand the impacts of future scenarios developed in Task 6 on commercial vehicle operators’ permit usage preferences. The online survey was distributed between December 10th, 2024, and February 5th, 2025, receiving 126 responses.

The rest of this report is structured as follows: first, the methodology is described, outlining the survey design, data collection process, and distribution approach. This is followed by the results section, which presents findings from the descriptive analysis and modeling. Finally, the conclusion section provides a summary of key insights and implications.

### IV-1.1 Key Findings

The purpose of Task 7 is to assess existing parking challenges commercial vehicle operators are experiencing in Seattle and investigate the impact of future parking policies.

To address this objective, the research team has drafted and distributed an online survey to commercial vehicle operators in Seattle. The survey questionnaire was developed, tested, and implemented between November 2024 and December February 20242025. The survey was structured into three sections: 1. Company and CVLZ information, 2. Driving, parking, and parking loading experiences in Seattle, and 3. Future CVLZ program scenarios. The survey was implemented in Qualtrics and distributed through various channels, including direct emails to CVLZ permit holders, UFL contacts, and UFL and SDOT social media channels. A total of 126 responses were obtained. After data processing, a total of 84 responses were retained, of which 70 (83.33%) were permit holders, and 14 (16.67%) were non-permit holders.

The following key insights were obtained from survey data analysis.

- Who are the permit holders vs. non-permit holders:** The largest portion of respondents report working in the service business sector (Accommodation and Food Services, Professional, Scientific, and Technical Services, Administrative and Support and Waste Management and Remediation Services) for both permit and non-permit holders. Permit holder companies more frequently report belonging to wholesale trade, construction and manufacturing, and Other (Information, Arts, Entertainment, and Recreation, Finance and Insurance, Health Care and Social Assistance, Real Estate and Rental and Leasing) sectors. In contrast, non-permit holders are primarily represented by retail trade and transport & logistics sectors. This aligns with the market segmentation of permit holders based on the number of permits issued from 2017 to 2023, as provided in Task 2 where

the data shows that permit holders are primarily from the wholesale trade, construction, and services sectors, while the proportion of companies in the transportation and warehousing sector was significantly lower.

- **Permit behaviors:** On average, permit-holder businesses hold 12.33 permits. The fleet-to-permit ratio, defined as the portion of the fleet owned covered by CVLZ permits in 2024, averages 71.32%, showing that most businesses hold permits for the majority of their fleet. Moreover, permit holders have an average of 11.58 years of purchasing history, showing that current permit holders have strong retention rates when purchasing CVLZ permits.
- **Route behaviors:** On average, permit holders make more stops per route than non-permit holders. Most activities occur during the day for both permit and non-permit holders. However, 50% of non-permit holders reported operating off-peak, compared to only 24.61% of permit holders.
- **Parking behaviors:** The average reported parking dwell time is 37.29 minutes, significantly longer than the average dwell time observed in Task 4's video data analysis. Non-permit holders reported, on average, 12 minutes longer than permit holders; however, their preferred parking locations are alleys and off-street parking, while permit holders prefer parking at CVLZs. A similar trend was observed in Task 4's video data analysis, where non-permit vehicles occupied parking CVLZs for significantly longer. Thus, the reported behavior aligns with actual observed behavior.
- **Stated preference for future CVLZ scenarios:** The data shows that as the annual permit price increases, the proportion of respondents selecting to buy the annual permit decreases, and more respondents indicate they will choose not to pay for parking. The share of respondents choosing the pay-per-use option remains mostly constant despite changes to the price of the annual permit. This suggests that demand for the annual permit is price elastic, with higher prices potentially leading to a shift to alternative options.

## IV-2 Methodology

### IV-2.1 Survey design

The survey was structured into three sections (see Table 23, the full survey questionnaire is reported in [Appendix IV](#)). The survey starts with an introduction paragraph that introduces respondents to the survey's purpose and provides the main instructions. The first section of the survey gathers detailed information about the respondents' company and its use of CVLZ permits. The second section focuses on driving and parking experiences in Seattle. The final section gathers input for future CVLZ scenarios. This section employs a discrete choice experiment design, presenting various scenarios featuring permit and pay-per-use options with different pricing and timing attributes for respondents to express their preferences.

The survey is designed to maintain respondent anonymity. However, participants have the option to provide their email address at the end of the survey for a chance of winning a \$200 prize, as a token of appreciation for their time and input.

**Table 23.** Survey questionnaire structure and main variables obtained

| Section                                      | Purpose                                                                                                          | Main variables                                                                                                                                                                                                                                                                                                                                                      |
|----------------------------------------------|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Company and CVLZ information              | Gathers information about the company and its CVLZ permits                                                       | Respondents' role, company's business sector, number of commercial vehicles, type of commercial vehicles, geographic scale, number of employees, main location, history of purchasing CVLZ permit, number of purchased permits in 2024, Responsible party for CVLZ permit payment                                                                                   |
| 2. Driving and parking experience in Seattle | Gathers information on the operational practices of these companies                                              | Number of routes per day, operation weekdays and time, average number of customers served per route, number of parking event per route, maximum parking distance from customer location, stop length per delivery, preferred parking location, parking payment method, number of parking tickets in 2024, responsible party for tickets, challenges while operating |
| 3. Future CVLZ program scenarios             | Gathers respondents' preferences for various parking options, each with different durations and associated costs | Respondents' preference between the following alternatives:<br>Pre-paid, per-pay-use, and not paying for parking                                                                                                                                                                                                                                                    |

#### *IV-2.1.1 Company and CVLZ information*

The first set of survey questions collects company and CVLZ-related information, including the business sector, geographic scale of operations, number of employees, fleet size, vehicle types, and the number of permits held. This section consists of twelve questions, two of which determine the survey flow.

The first filter question asks whether the company operates commercial vehicles in Seattle. If the response is "No," the survey will end and not collect further data. The second question asks whether the company purchased a CVLZ permit in 2024. If the response is "No," no additional CVLZ-related information is gathered. These conditional questions ensure that only relevant respondents provide detailed input on commercial vehicle operations and permit usage.

#### *IV-2.1.2 Driving and parking experience in Seattle*

The second set of questions gathers information about companies' parking experiences in Seattle, focusing on operational practices, routing strategies, delivery timing, and CVLZ and parking ticket payment practices. This data helps assess how businesses utilize CVLZs and navigate parking challenges.

This section consists of twelve questions and is only displayed if the company operates commercial vehicles in Seattle. The initial questions cover routing strategies and delivery timing, followed by questions on CVLZ payment practices. The section concludes with an open-ended question where respondents describe the challenges they face while operating commercial vehicles in Seattle. The questions in this section, along with those in the first section, were

developed based on insights from interviews with industry champions (Task 5) and a review of various CVLZ programs and freight parking policies (Task 6).

#### *IV-2.1.3 Future CVLZ program scenarios*

The Discrete Choice Experiment (DCE) methodology was used to collect stated preferences. A DCE is a survey-based method used to collect stated preferences by presenting respondents with multiple attributes and requiring them to choose their most preferred option. Unlike traditional methods that assess attributes independently, DCE requires respondents to evaluate multiple attributes simultaneously. This approach more accurately reflects real-world decision-making, where consumer preferences are shaped by a combination of factors.

The proposed DCE differentiates between two distinct parking payment alternatives: permit-based parking and pay-per-use parking. The opt-out choice was also incorporated as an alternative, an option provided for respondents to choose neither permit nor pay-per-use, reflecting a scenario where they would prefer not to pay for parking at all. These alternatives vary in key characteristics, such as pricing and timing structures, attracting different users.

The design of the DCE involved several critical steps:

1. Selection of attributes
2. Definition of attribute levels
3. Generation of choice sets

##### *IV-2.1.3.1 Selection of attributes*

The attributes were chosen based on expertise from the UFL research team, as well as insights from prior research and findings from *Task 5: Interviews with Industry Champions* provided a good starting point for selecting attributes. The final structure and choice of variables were refined through discussions with the SDOT team. The following attributes were selected:

- payment method;
- base payment cost;
- price per parking;
- maximum allowed parking time.

##### *IV-2.1.3.2 Defining Attribute Levels*

Attribute levels were developed to be both realistic and representative of potential scenarios in Seattle. For existing alternatives, at least one level was based on current practices in Seattle. For prospective alternatives, a range of plausible levels was established by examining similar cities across the United States and consulting with SDOT experts. The final selection included:

- **Base payment, price per parking, and total allowed parking time:** At least one level for each attribute matched Seattle's real-life scenarios, with additional levels informed by other cities' programs and local feedback.
- **Payment type:** The permit alternative used pre-paid cards, while the pay-per-use alternative included the mobile app and tap payment methods. These selections reflect viable options in actual practice.

The attributes and corresponding levels used in the DCE are summarized in Table 24.

**Table 24. Choice experiment attributes**

| Attributes                 | Alternatives  | Level 1    | Level 2 | Level 3 | Level 4 | Level 5 |
|----------------------------|---------------|------------|---------|---------|---------|---------|
| Payment method             | Annual permit | Pre-paid   |         |         |         |         |
|                            | Pay per use   | Mobile app | Tap     |         |         |         |
| Base payment               | Annual permit | \$250      | \$500   | \$750   | \$1000  | \$1500  |
|                            | Pay per use   | \$0        | \$25    | \$50    | \$75    | \$100   |
| Price per parking          | Annual permit | \$0        |         |         |         |         |
|                            | Pay per use   | \$2.5      | \$5     | \$10    | \$15    | \$20    |
| Total allowed parking time | Annual permit | 30 min     | 60 min  | 120 min | 180 min |         |
|                            | Pay per use   | 30 min     | 60 min  | 120 min | 180 min |         |

#### IV-2.1.3.3 Generation of choice sets

Each respondent was presented with four different choice sets, each containing a unique, randomized combination of attribute levels. For each choice set, respondents could select one of three alternatives: "Permit," "Pay-Per-Use," or an "Opt-Out" option. This randomization strategy ensured that each respondent's choice sets differed from one another and also varied across respondents, thus capturing a wide range of stated preferences. [Table A-IV-3](#) provides an example of one of the four choice sets presented to a respondent.

## IV-2.2 Survey implementation

The survey was implemented using Qualtrics, a cloud-based platform widely used for survey creation, data collection, and experience management. Qualtrics provides a user-friendly interface compatible with both desktop and mobile devices, supports multiple question types, and allows for logic branching, which was used in Sections 1 and 2 to tailor questions based on respondents' answers.

Moreover, the stated preference section was developed using custom JavaScript within Qualtrics' Code Task feature, enabling dynamic and adaptive question design. This customization allowed for the random assignment of unique choice sets to each respondent, which was crucial for the implementation of Section 3. These features made Qualtrics an ideal platform for this project. A survey link and QR code were generated for distribution to the target population.

### IV-2.3 Survey Target Population and Distribution Methods

The survey targeted fleet managers and commercial business representatives operating commercial vehicles in the Seattle area. The following approaches were used to access the target population and distribute the survey:

- **Permit Holder Data:** Permit holder datasets from multiple years were obtained from SDOT, including company names and email addresses of businesses that purchased CVLZ permits in recent years. Additionally, SDOT provided email contacts from their 2014 CVLZ permit survey respondents. These datasets were cleaned, merged, and de-duplicated, resulting in a final list of 1,297 unique email addresses.
- **Email blurb:** A survey invitation email (see [Appendix IV-3](#)) containing the survey link was distributed in multiple rounds: December 10, December 16, January 13, and January 19. At each stage, respondents who had already completed the survey were removed from follow-up emails.
- **UFL and SDOT Media Channels:** To reach a broader audience, the survey was promoted through Urban Freight Lab (UFL) and SDOT media channels. UFL shared the survey on its LinkedIn page, which has over 1,500 followers, providing direct outreach to industry professionals. SDOT featured the survey in a blog post titled “*Deliveries in Belltown Receive an Upgrade with Digital Sensors and Real-Time Curb Data*<sup>2</sup>” on January 22, 2025, further increasing visibility.
- **Flyer Distribution:** A flyer was designed and distributed in Seattle Downtown and the University District (see [Appendix IV-4](#)). Flyers were placed under the windshields of commercial vehicles or handed directly to drivers, with instructions to pass them along to company owners or fleet managers. Approximately 50 flyers were distributed.
- **Gift Card Incentive:** To encourage participation, three Amazon gift cards, each worth \$200, were offered as an incentive. At the end of the survey, respondents had the option to enter their email addresses for a chance to win in a randomized lottery draw.

### IV-2.4 Sample data description

A total of 126 responses were collected. After removing invalid responses with missing data on key questions, a final sample of 102 responses remained. From this, only complete responses from companies operating commercial vehicles in Seattle were retained, resulting in a final analysis sample of 84 responses. Table 25 presents the distribution of key characteristics within the sample.

<sup>2</sup> Seattle Department of Transportation (SDOT). *Deliveries in Belltown Receive an Upgrade with Digital Sensors and Real-Time Curb Data*. January 22, 2025. Available at: <https://sdotblog.seattle.gov/2025/01/22/deliveries-upgrade-digital-sensors-curb-data/>

**Table 25. Sample data distribution**

| Variable                                                                                                                                                                                | Count (%)  | Mean (SD)       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|-----------------|
| <b>Respondent's role: n = 102</b>                                                                                                                                                       |            |                 |
| Respondent's role: Owner                                                                                                                                                                | 45 (44.12) |                 |
| Respondent's role: Account manager                                                                                                                                                      | 19 (18.63) |                 |
| Respondent's role: Fleet manager                                                                                                                                                        | 17 (16.67) |                 |
| Respondent's role: Dispatcher                                                                                                                                                           | 11 (10.78) |                 |
| Respondent's role: Other                                                                                                                                                                | 10 (9.80)  |                 |
| <b>Business sector: n = 102</b>                                                                                                                                                         |            |                 |
| Business Sector: Wholesale tradeTrade                                                                                                                                                   | 16 (15.69) |                 |
| Business Sector: Retail tradeTrade                                                                                                                                                      | 10 (9.80)  |                 |
| Business Sector: Transportation and warehousingWarehousing                                                                                                                              | 15 (14.71) |                 |
| Business Sector: Construction & and ManufacturingManufacturing                                                                                                                          | 19 (18.63) |                 |
| Business Sector: Services (Accommodation and Food Services, Professional, Scientific, and Technical Services, Administrative and Support and Waste Management and Remediation Services) | 23 (22.55) |                 |
| Business Sector: Other (Information, Arts, Entertainment, and Recreation, Finance and Insurance, Health Care and Social Assistance, Real Estate and Rental and Leasing)                 | 19 (18.63) |                 |
| <b>Commercial vehicle ownership in Seattle: n = 102</b>                                                                                                                                 |            |                 |
| Commercial vehicle ownership in Seattle: Yes                                                                                                                                            | 88 (86.27) |                 |
| Commercial vehicle ownership in Seattle: No                                                                                                                                             | 14 (13.72) |                 |
| <b>CVLZ permit holder: n = 84</b>                                                                                                                                                       |            |                 |
| CVLZ permit holder: Yes                                                                                                                                                                 | 70 (83.33) |                 |
| CVLZ permit holder: No                                                                                                                                                                  | 14 (16.67) |                 |
| Number of employees per company: n = 84                                                                                                                                                 |            | 288.14 (837.96) |
| Number of commercial vehicles per company: n = 71                                                                                                                                       |            | 39.84 (125.88)  |

## IV-3 Results

### IV-3.1 Company characteristics

This section presents the descriptive analysis of company characteristics, with findings reported for the total sample and separately for CVLZ permit holders and non-permit holders.

Table 26 provides the distribution of permit holders and non-permit holders across various company characteristics. To ensure a valid comparison, responses with missing data for the permit ownership question (Q12) were excluded, resulting in a final sample of 84 responses.

The most common business sector in the collected sample falls under services, which includes Accommodation and Food Services, Professional, Scientific, and Technical Services, and Administrative and Support and Waste Management and Remediation Services, as classified by the North American Industry Classification System (NAICS). Conversely, the least represented sector is retail trade, accounting for approximately 10% of the sample.

The distribution of permit holders and non-permit holders across business sectors reveals notable differences in sectoral representation.

- Non-permit holders exhibit a significantly higher proportion in the retail trade sector (21.43% vs 8.57%), whereas permit holders are more prevalent in the wholesale trade sector.
- Additionally, the transportation and warehousing sector has a noticeably higher share of non-permit holders.
- Furthermore, the "Other" category, which includes sectors such as Information, Arts, Finance, Healthcare, and Real Estate, shows a contrasting trend. This category comprises a significant proportion of permit holders (20.00%) but has no representation among non-permit holders (0.00%).

For fleet size, small fleets (1-2 vehicles) companies dominate the sample, indicating that a significant portion of businesses operate with minimal vehicle resources, possibly reflecting a prevalence of small-scale operations or independent businesses.

The comparison between non-permit and permit holders for fleet size shows that:

- 53.85% of non-permit holders operate with 1-2 vehicles, compared to 37.93% of permit holders.
- 25.86% of permit holders have fleets of 3-9 vehicles, compared to only 15.38% of non-permit holders.
- Larger fleets (10+ vehicles) are evenly distributed between permit and non-permit holders, suggesting diverse business strategies regarding curbside loading access.

The fleet composition variable includes the following categories: light-duty vehicles (pick-up trucks or SUVs), work vans (mini-vans, vans, step-vans), single-unit trucks, trucks with trailers, and other vehicle types. As shown in Table 26, work vans (mini-vans, vans, step-vans) are the most common vehicle type and are present in more than half of the sample. Additionally, over 40% of businesses report using light-duty vehicles (pick-up trucks or SUVs). These are followed by single-unit trucks and trucks with trailers.

The comparison between non-permit-holders and permit-holders reveals:

- Work vans (mini-vans, vans, step-vans) are the most common vehicle type for both groups, suggesting their central role in commercial operations that require deliveries.
- Single-unit trucks are significantly more common among permit holders than non-permit holders, indicating that businesses relying on larger vehicles are more likely to obtain a CVLZ permit.
- Non-permit holders have a higher proportion of trucks with trailers (21.43%) compared to permit holders (14.29%). This suggests that these businesses may rely on alternative loading zones or private facilities rather than CVLZ spaces. Another possible explanation is that these vehicles, being too large for CVLZ spaces, may park in alleys or other less regulated areas.
- Light-duty vehicles make up a substantial portion of permit-holder fleets, with nearly half of permit-holder businesses using them—significantly higher than the 28.57% observed among non-permit holders.

The number of employees gives a sense of the scale of companies. Around one-third of the sample has less than 10 employees and can be considered small companies. This is followed by companies with 10-50 employees, which comprise 28.38% of the sample. Large companies with more than 100 employees comprise around a quarter of the sample, and the rest (13.51%) belong to companies with 50-99 employees.

Comparison between non-permit and permit holders shows the following key points:

- Small businesses (<10 employees) are evenly distributed between non-permit holders (35.71%) and permit holders (31.67%).
- Mid-size businesses with 10-49 employees have a significantly higher share among non-permit holders (50.00%) than permit holders (23.33%).
- Larger businesses (50-99 employees) are more likely to hold CVLZ permits.
- Only 14.28% of non-permit holders have 50+ employees, while 45.00% of permit holders have 50+ employees. This is the same for the largest businesses category (100+ employees), which represents 30.00% of permit holders but only 7.14% of non-permit holders. This suggests that larger businesses possibly with structured logistics operations might have a greater need for designated commercial loading zones, likely due to higher delivery volumes and operational complexity.

**Table 26. Descriptive analysis of company characteristics**

| Variable                 | Categories                                                                                                                                                             | No. of obs (%)    |               |            |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|---------------|------------|
|                          |                                                                                                                                                                        | Non-permit holder | Permit holder | All        |
| Business sector          | Wholesale trade                                                                                                                                                        | 1 (7.14)          | 12 (17.42)    | 13 (15.48) |
|                          | Retail trade                                                                                                                                                           | 3 (21.43)         | 6 (8.57)      | 9 (10.71)  |
|                          | Transportation and warehousing                                                                                                                                         | 4 (28.57)         | 9 (12.86)     | 13 (15.48) |
|                          | Construction & Manufacturing                                                                                                                                           | 2 (14.29)         | 14 (20.00)    | 16 (19.05) |
|                          | Services (Accommodation and Food Services, Professional, Scientific, and Technical Services, Administrative and Support and Waste Management and Remediation Services) | 4 (28.57)         | 15 (21.43)    | 19 (22.62) |
|                          | Other (Information, Arts, Entertainment, and Recreation, Finance and Insurance, Health Care and Social Assistance, Real Estate and Rental and Leasing)                 | 0 (0.00)          | 14 (20.00)    | 14 (16.66) |
| Fleet size               | 1-2                                                                                                                                                                    | 7 (53.85)         | 22 (37.93)    | 29 (40.84) |
|                          | 3-9                                                                                                                                                                    | 2 (15.38)         | 15 (25.86)    | 17 (23.94) |
|                          | 10-49                                                                                                                                                                  | 2 (15.38)         | 11 (18.96)    | 13 (18.31) |
|                          | 50+                                                                                                                                                                    | 2 (15.38)         | 10 (17.24)    | 12 (16.90) |
| Fleet composition (n=84) | Light duty (pick-up or SUV)                                                                                                                                            | 4 (28.57)         | 31 (44.29)    | 35 (41.66) |
|                          | Work van (mini-van, van, step-van)                                                                                                                                     | 9 (64.29)         | 38 (54.29)    | 47 (55.95) |
|                          | Single unit truck                                                                                                                                                      | 3 (21.43)         | 28 (40.00)    | 31 (36.90) |
|                          | Truck with trailer(s)                                                                                                                                                  | 3 (21.43)         | 10 (14.29)    | 13 (15.48) |
|                          | Others                                                                                                                                                                 | 1 (7.14)          | 2 (2.86)      | 3 (3.57)   |
| No. employees            | <10                                                                                                                                                                    | 5 (35.71)         | 19 (31.67)    | 24 (32.43) |
|                          | 10-49                                                                                                                                                                  | 7 (50.00)         | 14 (23.33)    | 21 (28.38) |
|                          | 50-99                                                                                                                                                                  | 1 (7.14)          | 9 (15.00)     | 10 (13.51) |
|                          | 100+                                                                                                                                                                   | 1 (7.14)          | 18 (30.00)    | 19 (25.68) |

### IV-3.2 Permit behaviors

This section analyzes permit behavior by examining the distribution of permit ownership and purchasing patterns. Additionally, the fleet-to-permit ratio was calculated to provide deeper insight into how businesses allocate permits relative to fleet size. This analysis includes only permit holder responses ( $n = 70$ ).

The distribution of permit ownership and purchasing history among businesses shows considerable variation. On average, businesses hold 12.33 permits, but with a high standard deviation (28.26), showing significant differences in permit allocation. The number of permits per company ranges from 1 to 150, suggesting that while some businesses operate with minimal permit usage, others require a large number of permits, likely due to fleet size or operational needs. The permit-to-fleet ratio, defined as the portion of the fleet owned and covered by CVLZ permit in 2024, averages 71.32%. Most businesses hold permits for a majority of their fleet. However, the high variability ( $SD = 36.27$ , range: 1.25% to 150%) indicates that some businesses obtain permits selectively, while others ensure that nearly all vehicles have a permit.

A notable outlier is a business with a 150% permit-to-fleet ratio, meaning it holds more permits than vehicles (e.g., 2 vehicles, 3 permits). Additionally, 27 out of 57 businesses (47%) reported a 1:1 permit-to-fleet ratio, indicating that maintaining an equal number of permits and vehicles is a common practice.

Permit holders have an average of 11.58 years of purchasing history, showing that current permit holders have a long reliance on buying CVLZ permits.

The majority of respondents, 91.43%, indicated that the company pays for the permit. 2.86% reported that the driver is responsible for the payment, while 5.71% mentioned other arrangements. One such respondent clarified that both the company and the driver contribute, with the company covering the permit for trucks and the driver paying if it's a personal vehicle.

### IV-3.3 Route characteristics

This section presents the analysis of route characteristics and compares CVLZ permit holders and non-permit holders (Table 27).

On average, businesses in the sample cover approximately 8 routes per day, with a median of 4, indicating that half of the businesses operate more than 4 routes per day, while the other half operate fewer. The minimum and maximum reported daily routes are 1 and 80, respectively.

The distribution of daily routes covering Seattle among CVLZ permit holders and non-permit holders reveals the following differences in operational scale:

- Permit holders cover significantly more routes per day on average (mean: 8.65) compared to non-permit holders (mean: 4.64).
- Despite this difference in averages, the median number of routes is relatively close: three for non-permit holders and four for permit holders.
- The higher average for permit holders suggests a skewed distribution, where a subset of permit holders operates significantly more routes per day.
- This is further supported by the fact that the maximum number of routes per day reported by permit holders is four times higher than that of non-permit holders, confirming the presence of a significantly higher number of routes for permit-holders.

These results indicate that businesses covering more daily routes are more likely to hold a CVLZ permit, while those with lower route counts may not require one.

The number of stops per route varies significantly across the sample, with an average of 8.45 stops and a median of 5 stops. The minimum and maximum number of stops per route are 1 and 45, respectively, indicating a high degree of variability.

A comparison between permit holders and non-permit holders reveals patterns similar to those observed in the analysis of routes per day:

- Permit holders make more stops per route on average (mean: 8.96) compared to non-permit holders (mean: 6.17).
- The median number of stops is slightly higher for permit holders (5.5) than for non-permit holders (4.5).
- The maximum number of stops per route is significantly higher among permit holders (45) compared to non-permit holders (20).

These differences in average, median, and maximum values suggest that permit holders tend to make more frequent stops per route and may require more parking opportunities throughout their trips compared to non-permit holders.

The distribution of businesses operating by day of the week shows consistent weekday activity among both CVLZ permit holders and non-permit holders, with lower operations on weekends.

The distribution of business operations by time of day shows that morning is the peak period, with 92.20% of businesses operating during this time. Afternoon operations remain high (70.13%) but lower than the morning peak. Night and off-peak operations are significantly less common with 28.57% and 25.97%, respectively. These trends highlight that most businesses rely on daytime operations, with limited activity extending into night or off-peak periods.

The comparison between non-permit and permit holders for business operation by time of day shows that:

- Most activities occur during morning and afternoon for both groups.
- Night operations show a notable difference between groups.
  - 50.00% of non-permit holders operate at night, compared to only 24.61% of permit holders.

The results for additional route characteristics, including customers per route, operating days per week, and start/end times, are provided in [Appendix IV, Table A-IV-5](#).

**Table 27. Descriptive analysis of route characteristics**

| Variable                      | Category  | Value              |                |            |
|-------------------------------|-----------|--------------------|----------------|------------|
|                               |           | Non-permit holders | Permit holders | All        |
| Routes covering Seattle / day | min       | 1                  | 1              | 1          |
|                               | mean      | 4.64               | 8.65           | 7.97       |
|                               | median    | 3                  | 4              | 4          |
|                               | max       | 20                 | 80             | 80         |
| Stops per route n=65          | min       | 1                  | 1              | 1          |
|                               | mean      | 6.17               | 8.96           | 8.45       |
|                               | median    | 4.50               | 5.50           | 5          |
|                               | max       | 20                 | 45             | 45         |
| Variable                      | Category  | No. obs (%)        |                |            |
| Day of the week               | Monday    | 10 (71.42)         | 47 (67.14)     | 57 (67.86) |
|                               | Tuesday   | 11 (78.57)         | 49 (70.70)     | 60 (71.43) |
|                               | Wednesday | 10 (71.42)         | 52 (74.29)     | 62 (73.81) |
|                               | Thursday  | 10 (71.42)         | 53 (75.71)     | 63 (75.00) |
|                               | Friday    | 9 (64.28)          | 51 (72.86)     | 60 (71.43) |
|                               | Weekend   | 5 (35.71)          | 27 (38.57)     | 32 (38.10) |
| Operation within: n = 77      | Off-peak  | 3 (25.00)          | 17 (26.15)     | 20 (25.97) |
|                               | Morning   | 11 (91.67)         | 60 (92.31)     | 71 (92.20) |
|                               | Afternoon | 8 (66.67)          | 46 (70.77)     | 54 (70.13) |
|                               | Night     | 6 (50.00)          | 16 (24.61)     | 22 (28.57) |

## IV-3.4 Parking behaviors

Table 28 presents the distribution of variables related to parking behavior for both permit holders and non-permit holders in the collected sample.

On average, each parking event lasted 37.29 minutes, with reported durations ranging from a minimum of 5 minutes to a maximum of 6 hours. The median parking duration is 30 minutes (std dev: ... minutes), indicating that half of the respondents reported parking durations above this threshold, while the other half reported shorter durations.

A comparison between permit holders and non-permit holders reveals that non-permit holders park, on average, 12 minutes longer per event than permit holders. A similar trend was observed in Task 4's video data analysis, where commercial vehicles without permits occupied various types of parking spaces for significantly longer durations compared to permit holders.

The shorter dwell times among permit holders may be influenced by loading zone regulations, operational requirements, and enforcement policies. In contrast, non-permit holders tend to park longer, potentially due to fewer restrictions, different business needs, limited parking options, or a lack of enforcement compliance. According to Table 28, parking closer to the customer is the preferred choice among respondents. A comparison between permit holders and non-permit holders reveals key differences in parking behavior:

- **Permit holders are more likely to park closer to customer locations.** This aligns with previous findings that permit holders make more stops per route and operate on tighter delivery schedules, making proximity to their destinations essential for efficiency.
- **Non-permit holders tend to park farther away more frequently.** Since non-permit holders also report longer stop durations, this suggests they may park at greater distances and remain in the same location longer, which is possibly due to limited curb access, fewer available parking options near their destinations, or different operational needs.

The most preferred parking locations, based on the number of times each location was ranked first, were analyzed for both permit holders and non-permit holders (Table 28). The results show that CVLZ (Yellow Curb) is the most preferred parking location for 74.29% of respondents. The Other category (including alley, off-street parking, double parking, and entrance of garages) was selected as the most preferred by 11.43% of respondents. Only 1.43% of respondents chose Paid parking as their most preferred option. These findings highlight that CVLZ (Yellow Curb) is the most favored parking location overall, followed by the Other category, with Paid parking being the least preferred option.

A comparison between permit holders and non-permit holders highlights key differences in parking preferences:

- Permit holders strongly prefer CVLZ spaces, reflecting their need for dedicated loading access and the incentive to use these spaces since they have paid for a permit.
- Non-permit holders rely more on "Other" parking options, such as alleys and double parking, possibly due to curbside access challenges.
- Passenger load zones serve as a secondary alternative for both groups, but more so for non-permit holders.
- Paid parking and travel lanes are the least preferred ones, indicating that businesses try to avoid them unless necessary.

**Table 28.** Descriptive analysis of parking behavior

| Variable                                 | Category                                                       | Value              |                |            |
|------------------------------------------|----------------------------------------------------------------|--------------------|----------------|------------|
|                                          |                                                                | Non-permit holders | Permit holders | All        |
| Stop time per parking (minute)           | min                                                            | 6                  | 5              | 5          |
|                                          | mean                                                           | 47.17              | 35.09          | 37.29      |
|                                          | median                                                         | 30                 | 30             | 30         |
|                                          | max                                                            | 180                | 360            | 360        |
| Variable                                 | Category                                                       | No obs (%)         |                |            |
| Farthest distance from customer location | Two or more blocks away                                        | 4 (33.33)          | 18 (27.69)     | 22 (28.57) |
|                                          | No more than a block away                                      | 3 (25.00)          | 25 (38.46)     | 28 (36.36) |
|                                          | Same block                                                     | 5 (41.67)          | 22 (33.85)     | 27 (35.06) |
| Most preferred location                  | CVLZ (yellow curb)                                             | 5 (41.67)          | 47 (81.03)     | 52 (74.29) |
|                                          | Passenger load zone (white curb)                               | 1 (8.33)           | 6 (10.34)      | 7 (10.00)  |
|                                          | Travel lane or center turn lane                                | 0 (0.00)           | 2 (3.45)       | 2 (2.86)   |
|                                          | Paid parking                                                   | 0 (0.00)           | 1 (1.72)       | 1 (1.43)   |
|                                          | Other (alley, off-street, double parking, entrance of garages) | 6 (50.00)          | 2 (3.45)       | 8 (11.43)  |

### IV-3.5 Challenges

A total of 50 respondents answered the open-ended question: “What challenges have you experienced while operating vehicles in Seattle?” Notably, all respondents were permit holders, indicating a higher willingness among permit holders to highlight operational challenges in this area. The responses contain various reported challenges faced by permit holders, most of which revolve around parking and enforcement issues. Common themes include **parking difficulties**, such as **commercial load zones (CLZ) being occupied by non-commercial vehicles**, and **construction-related obstructions** that block access to designated parking spaces. Additionally, there are challenges associated with **ride-sharing services** like Uber and Lyft, with drivers occupying **yellow load zones**, further exacerbating parking shortages. Some respondents also mentioned frustration about the **lack of available parking spots**, and others mentioned the issue of **commercial vehicles with permits** still facing difficulties due to **improper usage of designated zones** by others. Many respondents expressed concerns about **enforcement inconsistencies** and the **lack of adequate parking infrastructure** to meet the growing demand for commercial vehicle access, making it harder for businesses to efficiently conduct their operations. Additionally, some respondents noted that **dedicated bike lanes** have reduced the available space for commercial vehicles. Table 29 includes direct quotes from these responses.

**Table 29.** Direct quotes from respondents about challenges while operating commercial vehicles in Seattle

| Direct quotes from respondents                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| “People without a commercial load zone permit parked in our spots. Both unattended cars and people sitting in their cars. I find it harder and harder to find a parking spot.”                                                                                                                                                                                                                                                                                                                                      |
| “Parking is a major issue, we have glass trucks which do not fit in most garages. The guys have to load and unload glass and they need to be able to park close to the job. I have to spend extra in labor which costs our customers more money. They have to try and find a safe spot to unload or load glass and tools. Then drive around to find suitable parking. Then after the day of work go get the truck and return to job to load up glass and tools. The loading zones should be available for the day.” |
| “The biggest challenge is that the load zones are frequently occupied by a parked vehicle that doesn't have a load zone permit to begin with. it gets frustrating when we receive a parking ticket when forced to park on the street adjacent to a load zone and the vehicle parked in the zone without a permit doesn't receive a ticket for occupying the space. it also doesn't help that over the years the load spaces have been decreasing with the changing of vehicle accessibility to areas.”              |
| “Uber eats, postmates, etc parking in commercial load zones without a permit. Not enough commercial load zones for the density of businesses in certain areas.”                                                                                                                                                                                                                                                                                                                                                     |
| “1. The poor conditions of the roads themselves in spite of ever increasing taxes to pay to fix them; 2. Other drivers are the most unsavvy, uneducated, and untrained drivers we have ever experienced. There needs to be a requirement for continuing education in order to renew a license, it must be legitimately educational, and should be every time a license is up for renewal.”                                                                                                                          |

### IV-3.6 Behavioral analysis

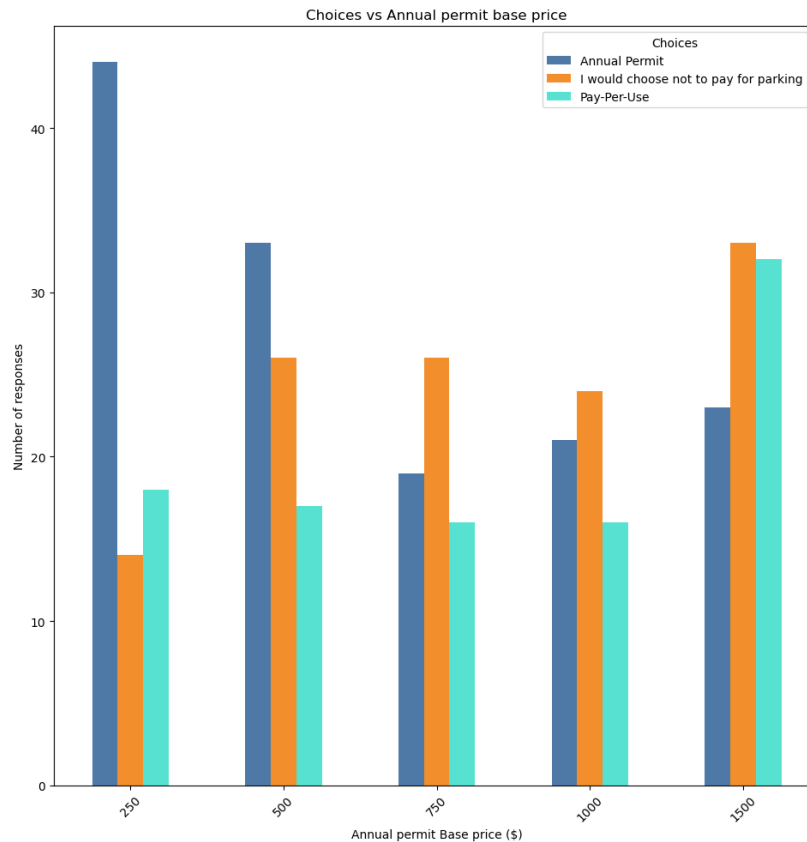
The responses from the Stated Preference section were analyzed, with 91 respondents each answering four choice scenarios, resulting in a total of 364 discrete choices for evaluation. A Multinomial Logistic Regression (MNL) model was conducted on 364 experimental choices to examine factors affecting respondents' selection of Permit, Pay-per-Use, or Neither alternatives. It is important to note that this analysis represents a preliminary base model, and only serves as an initial exploration of the stated preferences.

At this stage, the model only considers alternative-specific variables related to the Discrete Choice Experiment (DCE). These are variables whose values vary depending on the choice alternative being considered and, in this study, these include, annual permit base cost, pay-per-use base cost, pay-per-use parking cost, annual permit parking duration, pay-per-use parking duration, and pay-per-use payment method (tap or pay by phone). As outlined in Section 3.1.3, these variables have multiple levels randomly assigned to respondents. Variations in these levels can be associated with respondents' choice of alternatives.

In addition to alternative-specific variables, individual-specific variables represent respondent characteristics that remain constant across all choice alternatives. In this study, these variables were collected in the earlier sections of the survey and include company and CVLZ information, as well as operational and parking characteristics. However, at this stage, the analysis focuses exclusively on the relationship between alternative-specific variables and respondents' choices. In subsequent stages of the analysis, individual-specific variables will be incorporated to reach a better understanding of underlying factors affecting respondents' decisions.

The MNL model results indicate that as permit costs rise, respondents become less likely to choose the annual permit and prefer to either not pay for parking or use the pay-per-use option. Additionally, a decrease in the allowed parking time for Pay-per-Use permits increases the likelihood of selecting the annual permit option ([Table A-IV-5](#)).

To better visualize the results, Figure 25 presents respondents' preferences for each annual permit price. The data shows that as the base price of the annual permit increases, the proportion of respondents selecting the annual permit decreases, while the proportion choosing pay-per-use or none increases accordingly. This trend suggests that the demand for the annual permit is price elastic, meaning that as the price increases, the number of respondents choosing the annual permit decreases significantly. This price sensitivity among respondents suggests that the increase in prices might cause a potential shift toward alternative options, including pay-per-use or opting for no payment at all.



**Figure 26.** Number of responses for each Annual permit base price

## IV-4 Conclusion

In task 7, an online survey was designed and deployed to qualitatively assess existing parking challenges and estimate the behavioral impacts of future parking policy and pricing strategies. The analysis of the reported responses highlights significant differences between permit holders and non-permit holders, particularly in factors like fleet size, route frequency, parking preferences, and operational constraints.

Permit holders operate more routes, make more stops, and park closer to their destinations, which possibly can be due to their reliance on CVLZ spaces for efficient loading and deliveries. In contrast, non-permit holders indicated they may park farther away, have longer stop durations, and have a higher preference for informal parking solutions, which can possibly suggest greater curb space access challenges. The long history of permit purchasing and the high permit-to-fleet ratio further confirm the importance of CVLZ access for many businesses.

Despite the structured permit system, businesses express their concerns and challenges, including limited CVLZ availability, competition from non-commercial vehicles, parking enforcement restrictions, and construction-related disruptions. These findings emphasize the need for potential adjustments to CVLZ policies and law enforcement structures to better accommodate commercial vehicle operations.

**PART V**

**APPENDICES**

## PART V - APPENDICES

### Appendix I - Tasks 2 and 3: Establishing Baseline Conditions

#### A-I-1 Top 10 permit holders per year

**Table A-I-1.** Top 10 permit holders per year

| Year                      | Permit holder                              | No. permits |
|---------------------------|--------------------------------------------|-------------|
| 2017                      | columbia distributing of seattle           | 168         |
|                           | encompass-macdonald miller                 | 165         |
|                           | at&t broadband                             | 86          |
|                           | anheuser busch sales of wa                 | 74          |
|                           | mckinstry                                  | 65          |
|                           | united parcel service                      | 64          |
|                           | southern glazer wine/spirits west          | 59          |
|                           | king broadcasting company                  | 52          |
|                           | food services of america                   | 49          |
|                           | standard parking dba spplus transportation | 49          |
| 2018                      | macdonald-miller facility solutions        | 157         |
|                           | comcast                                    | 89          |
|                           | columbia distributing                      | 74          |
|                           | mckinstry co                               | 67          |
|                           | anheuser busch sales of wa                 | 64          |
|                           | southern glazer wine/spirits west          | 62          |
|                           | columbia distributing - beer               | 61          |
|                           | triple b corporation                       | 54          |
|                           | puget sound energy - gto                   | 50          |
|                           | king broadcasting company                  | 49          |
| Table continues next page |                                            |             |

| Year                      | Permit holder                       | No. permits |
|---------------------------|-------------------------------------|-------------|
| 2019                      | macdonald-miller facility solutions | 179         |
|                           | mckinstry co                        | 99          |
|                           | comcast                             | 73          |
|                           | united parcel service               | 71          |
|                           | columbia distributing               | 62          |
|                           | columbia distributing - beer        | 58          |
|                           | swire coca-cola                     | 56          |
|                           | triple b corporation                | 55          |
|                           | king broadcasting company           | 51          |
|                           | southern glazer wine/spirits west   | 51          |
| 2020                      | macdonald-miller facility solutions | 166         |
|                           | mckinstry co                        | 108         |
|                           | united parcel service               | 70          |
|                           | comcast                             | 66          |
|                           | columbia distributing - beer        | 64          |
|                           | columbia distributing               | 59          |
|                           | southern glazer wine/spirits west   | 56          |
|                           | triple b corporation                | 55          |
|                           | swire coca-cola                     | 52          |
|                           | king broadcasting company           | 48          |
| 2021                      | mckinstry co                        | 85          |
|                           | united parcel service               | 70          |
|                           | columbia distributing               | 60          |
|                           | macdonald-miller facility solutions | 57          |
|                           | columbia distributing - beer        | 54          |
|                           | puget sound energy                  | 50          |
|                           | king broadcasting company           | 46          |
|                           | swire coca-cola                     | 46          |
|                           | comcast                             | 44          |
|                           | triple b corporation                | 43          |
| Table continues next page |                                     |             |

| Year | Permit holder                       | No. permits |
|------|-------------------------------------|-------------|
| 2022 | macdonald-miller facility solutions | 156         |
|      | united parcel service               | 59          |
|      | columbia distributing               | 57          |
|      | puget sound energy                  | 51          |
|      | comcast                             | 49          |
|      | swire coca-cola                     | 49          |
|      | columbia distributing - beer        | 47          |
|      | king broadcasting company           | 46          |
|      | triple b corporation                | 44          |
|      | southern glazer wine/spirits west   | 41          |
| 2023 | macdonald-miller facility solutions | 123         |
|      | comcast                             | 62          |
|      | columbia distributing               | 61          |
|      | columbia distributing - beer        | 55          |
|      | swire coca-cola                     | 45          |
|      | king broadcasting company           | 43          |
|      | puget sound energy                  | 43          |
|      | southern glazer wine/spirits west   | 41          |
|      | astound broadband                   | 40          |
|      | triple b corporation                | 38          |

## A-I-2 Notes on permit holder data processing

### Terminology

- CVLZ permit: a permit uniquely tied to a given vehicle license plate, which allows the given vehicle to park at CVLZs
- CVLZ permit license: a CVLZ permit license is assigned to a company purchasing one or more CVLZ permits.
- Permit holder: an organization carrying a CVLZ permit license.

Two types of data were obtained from SDOT:

- Permit data: each row contains information for a given CVLZ permit. Main variables include:
  - Permit ID
  - License ID
  - Vehicle plate ID
  - First effective date = date when the permit ID was first valid
  - Effective date = date when the permit ID was last valid
  - Expiration date = date when the permit ID last expired
- Permit holder data: each row contains information for a given permit holder. Main variables include:
  - License ID
  - Organization name
  - Primary contact information (including email, representative, and address)

Each of the above data types was obtained for two time periods. Archive data corresponds to 1994-2017, while most recent data correspond to 2017-2024.

The database was updated in 2017 with some recording changes. The major change consisted in the way renewals were recorded. A permit holder can choose to renew a given CVLZ permit at the end of the year. In the old system, this action would generate a new row in the permit data. In the new system, no new row is generated upon renewal. Instead, the “effective\_date” variable is overwritten. Therefore, in the new system, it can happen that the “first\_effective\_date” is different from the “effective\_date.” For instance, in the new system, if a company purchased CVLZ permit 001 in 2018 and renewed it for the next two years, permit 001 is then shown as “first\_effective\_date”=1/1/2018 and “effective\_date”=1/1/2020 and “expiration date”=31/12/2020.

## A-I-3 Data layers

**Table A-I-2. data layers**

| Main Layer   | Sub-layers                                                  | Data Source                                                                                                                                                           | Description                                                                                                                                                                                                                                                                                                                                                                                      |
|--------------|-------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Base Map     | -                                                           | Study Area                                                                                                                                                            | Shows an outline of the study area                                                                                                                                                                                                                                                                                                                                                               |
| Buildings    | Shapes, Height,<br>No. floors,<br>No.<br>establishments     |                                                                                                                                                                       | Shows shapes and details on buildings in the study area                                                                                                                                                                                                                                                                                                                                          |
| Curb         | ALL, CVLZs,<br>PLZs, BUS,<br>PAID<br>PARKING, NO<br>PARKING | Created from<br><a href="https://data.seattle.gov/dataset/Curb-Space-Categories/88qf-2ydb">https://data.seattle.gov/dataset/Curb-Space-Categories/88qf-2ydb</a>       | Shows the allocation of curb space in 8 categories in the study area:<br>Bus, CVLZ, Disabled, Loading (excluding CVLZs),<br>No Parking Paid Parking, Passenger Load (PLZ),<br>Other<br><br>Sub-layers show individual allocations                                                                                                                                                                |
| Blockfaces   |                                                             | Created from<br><a href="https://data.seattle.gov/dataset/Curb-Space-Categories/88qf-2ydb">https://data.seattle.gov/dataset/Curb-Space-Categories/88qf-2ydb</a>       | Shows “blockfaces” aggregated from curb segments. Click a segment to show the “BLOCKID” reference number                                                                                                                                                                                                                                                                                         |
| Collisions   |                                                             | Created from<br><a href="https://data.seattle.gov/dataset/SDOT-Collisions-Vehicles/vg5f-ze5n">https://data.seattle.gov/dataset/SDOT-Collisions-Vehicles/vg5f-ze5n</a> | Shows the number of vehicle collision incidents in the past 10 years on streets and at intersections in the study area. Larger-sized markers indicate more collisions. Click a marker to see the number of collisions assigned to that location from 2013-2023                                                                                                                                   |
| Citations    | TOP 8<br><br>CVLZ<br>VIOLATIONS                             | Shared by SDOT                                                                                                                                                        | TOP 8 layer shows the locations of citations issued in 2022 for the following laws:<br>11.72.300, 11.72.330, 11.72.075, 11.72.285, 11.70.040, 11.72.357, 11.72.215, 11.74.030<br><br>CVLZ VIOLATIONS layer shows the CVLZs associated with law 11.72.075. Click a CVLZ to see the number of citations issued at that location in 2022                                                            |
| Transactions | REVENUES<br><br>BY CVLZ                                     | Shared by SDOT                                                                                                                                                        | REVENUES layer shows the revenue generated from Pay-per-use transactions at CVLZs from 1/23-10/23. Markers show the locations of the CVLZs, the size and color indicate the revenue value. Click a marker to see amount of revenue generated in 10 months<br><br>BY CVLZ layer shows the precise shapes of the associated CVLZs. Click a segment to see amount of revenue generated in 10 months |

## Appendix II - Task 4: Analysis of Observed Parking Behavior

### A-II-1 Data Sources

**Table A-II-1. Observations by blockface**

|    | Unique blockface (alphabetical)            | Side of Street | Video observation days (count) | No. video parking observations | Manual observation days (count) | No. manual parking observations | Number of payment transactions |
|----|--------------------------------------------|----------------|--------------------------------|--------------------------------|---------------------------------|---------------------------------|--------------------------------|
| 1  | 1ST AVE BETWEEN LENORA ST AND BLANCHARD ST | NE             | 3                              | 280                            | 1                               | 60                              | 137                            |
| 2  | 1ST AVE BETWEEN LENORA ST AND BLANCHARD ST | SW             | 2                              | 273                            | 1                               | 70                              | 234                            |
| 3  | 1ST AVE BETWEEN CEDAR AND VINE             | NE             | 2                              | 99                             | 1                               | 26                              | 2                              |
| 4  | 1ST AVE BETWEEN CEDAR AND VINE             | SW             | 2                              | 95                             | 1                               | 15                              | 27                             |
| 5  | 1ST AVE BETWEEN CLAY AND CEDAR             | SW             | 2                              | 132                            | 1                               | 38                              | 40                             |
| 6  | 1ST AVE BETWEEN WALL AND VINE              | NE             | 2                              | 137                            | 1                               | 33                              | 38                             |
| 7  | 1ST AVE BETWEEN WALL AND VINE              | SW             | 2                              | 139                            | 1                               | 47                              | 8                              |
| 8  | 2ND AVE BETWEEN BELL ST AND BATTERY ST     | NE             | 2                              | 177                            | 1                               | 46                              | 109                            |
| 9  | 2ND AVE BETWEEN BELL ST AND BATTERY ST     | SW             | 3                              | 334                            | 1                               | 94                              | 186                            |
| 10 | 2ND AVE BETWEEN VIRGINIA ST AND LENORA ST  | SW             | 2                              | 347                            | 1                               | 62                              | 120                            |
| 11 | 4TH AVE BETWEEN WALL ST AND VINE ST        | NE             | 2                              | 276                            | 1                               | 75                              | 124                            |
| 12 | 4TH AVE BETWEEN WALL ST AND VINE ST        | SW             | 2                              | 267                            | 1                               | 95                              | 158                            |
| 13 | 5TH AVE BETWEEN TAYLOR AVE AND DENNY WAY   | SW             | 2                              | 135                            | 1                               | 38                              | 4                              |
| 14 | 7TH AVE BETWEEN BLANCHARD ST AND BELL ST   | SW             | 2                              | 604                            | 1                               | 192                             | 60                             |
| 15 | 7TH AVE BETWEEN BLANCHARD ST AND BELL ST   | NE             | 2                              | 336                            | 1                               | 106                             | 127                            |

Table continues next page

|    | Unique blockface (alphabetical)                | Side of Street | Video observation days (count) | No. video parking observations | Manual observation days (count) | No. manual parking observations | Number of payment transactions |
|----|------------------------------------------------|----------------|--------------------------------|--------------------------------|---------------------------------|---------------------------------|--------------------------------|
| 15 | 7TH AVE BETWEEN BLANCHARD ST AND BELL ST       | NE             | 2                              | 336                            | 1                               | 106                             | 127                            |
| 16 | 7TH AVE BETWEEN LENORA ST AND BLANCHARD ST     | NE             | 2                              | 576                            | 1                               | 188                             | 141                            |
| 17 | 7TH AVE BETWEEN LENORA ST AND BLANCHARD ST     | SW             | 2                              | 739                            | 1                               | 240                             | 276                            |
| 18 | 8TH AVE BETWEEN STEWART ST AND VIRGINIA ST     | NE             | 2                              | 759                            | 1                               | 320                             | 0                              |
| 19 | BAY ST BTWN WESTERN AVE AND 1ST AVE            | SE             | 3                              | 171                            | 1                               | 56                              | 26                             |
| 20 | BAY ST BTWN WESTERN AVE AND 1ST AVE            | NW             | 2                              | 120                            | 1                               | 34                              | 16                             |
| 21 | BLANCHARD ST BETWEEN 6TH AVE AND 7TH AVE       | NW             | 2                              | 244                            | 1                               | 44                              | 0                              |
| 22 | BLANCHARD ST BETWEEN 6TH AVE AND 7TH AVE       | SE             | 2                              | 70                             | 1                               | 28                              | 10                             |
| 23 | CEDAR ST BETWEEN 4TH AVE AND DENNY WAY         | SE             | 2                              | 176                            | 1                               | 40                              | 34                             |
| 24 | MINOR AVE BETWEEN HOWELL ST AND STEWART ST     | NE             | 2                              | 431                            | 1                               | 49                              | 131                            |
| 25 | MINOR AVE BETWEEN HOWELL ST AND STEWART ST     | SW             | 2                              | 381                            | 1                               | 84                              | 98                             |
| 26 | STEWART ST BETWEEN 4TH AVE AND 5TH AVE         | NW             | 2                              | 106                            | 1                               | 17                              | 21                             |
| 27 | TERRY AVE BETWEEN LENORA ST AND DENNY WAY      | NE             | 2                              | 120                            | 1                               | 34                              | 15                             |
| 28 | TERRY AVE BETWEEN LENORA ST AND DENNY WAY      | SW             | 2                              | 156                            | 1                               | 21                              | 22                             |
| 29 | WESTERN AVE BETWEEN LENORA ST AND BLANCHARD ST | NE             | 2                              | 333                            | 1                               | 89                              | 0                              |
| 30 | WESTERN AVE BETWEEN LENORA ST AND BLANCHARD ST | SW             | 2                              | 169                            | 1                               | 14                              | 0                              |

## A-II-2 Variables recorded during data collection

**Table A-II-2.** List of variables captured in video observations of study area

| Variable              | Description                                                                       | Unit     |
|-----------------------|-----------------------------------------------------------------------------------|----------|
| Event_NB_Vid          | Event Number                                                                      |          |
| IDAX_Site_NB          | IDAX video observation location                                                   |          |
| UFL_Block_ID          | Block number according to UFL system                                              |          |
| UFL_Blockface_ID      | Block number + directional blockface (NW, SE, etc.)                               |          |
| Street_Names          | Street names including cross streets                                              |          |
| SDOT_Block_ID         | SDOT block identification number                                                  |          |
| Element_Key           |                                                                                   |          |
| Space_Type            |                                                                                   |          |
| Space_NB              | Space number                                                                      |          |
| Concatenated_Space_NB |                                                                                   |          |
| Date                  |                                                                                   |          |
| Park_Start_T          | Beginning time of parking event                                                   |          |
| Park_End_T            | Ending time of parking event                                                      |          |
| Park_T_Dur            | Time duration of parking event                                                    | minutes  |
| Body_Type             |                                                                                   |          |
| Pax_InOut_YN          | If passenger enters or exits vehicle                                              | Yes / No |
| Driver_Out_YN         | Driver exits vehicle                                                              | Yes / No |
| Driver_Out_Start_T    | Time driver exits vehicle                                                         |          |
| Driver_Out_End_T      | Time driver re-enters vehicle                                                     |          |
| Driver_Out_Dur        | Duration of time driver is outside vehicle                                        | minutes  |
| Activity_Type         |                                                                                   |          |
| Comm_Logo             | Records commercial logo language / company name                                   |          |
| Load_Unload_YN        | Records if driver loads or unloads goods/materials/food from vehicle while parked | Yes / No |

| Variable        | Description                                                               | Unit                 |
|-----------------|---------------------------------------------------------------------------|----------------------|
| Handcart_YN     | Records if driver used handcart to move materials                         | Yes / No             |
| CVLZ_Permit_Vid | Was vehicle observed with a CVLZ permit according to the video collection | Yes / No / Unclear   |
| Permit_Type     | Format of permit                                                          | Paper, sticker, etc. |
| TNC_Permit_Vid  | Was vehicle observed with a TNC permit according to the video collection  | Yes / No / Unclear   |
| Side_Of_Street  | Blockface (NW, SE, etc.)                                                  |                      |

**Table A-II-3.** List of variables captured in manual observations of study area

| Variable              | Description                           | Unit |
|-----------------------|---------------------------------------|------|
| Date                  | Date of transaction                   |      |
| Time_Start            | Timestamp of transaction              |      |
| PP_Area               | Neighborhood (Denny or Belltown)      |      |
| PP_Sub_Area           | Location within Area (North or South) |      |
| Pay_Station           | Numerical designation of pay station  |      |
| Transaction_Amount    | Price paid for total parking duration | \$   |
| Payment_Type          | By phone or credit card               |      |
| Parking_Time_Limit    | Maximum allowed time                  | min  |
| Side_Of_Street        | Blockface (NW, SE, etc.)              |      |
| Blockface             | Street names                          |      |
| Element Key           | Not used                              |      |
| Paid_Duration_Min     | Amount of time paid for               | min  |
| Space_NB              | Space number along block (1-24)       |      |
| Parking_Category      | Paid parking or no parking            |      |
| Total_Space_Count     | Total number of spaces on blockface   |      |
| Vendor_Transaction_ID | Individual transaction number         |      |

## Appendix III - Task 5: Document Carrier Practices

### A-III-1 Interview Questionnaire

Interviews were 1 hour long, performed mostly via Zoom, with only one in-person interview. Interviews were structured into four main topics, each containing multiple questions.

- Topic 1: general information about the organization being interviewed
- Topic 2: Parking permits and payments behaviors
- Topic 3: delivery operations and parking behaviors
- Topic 4: future scenarios for CVLZ permit program and tech adoption

The table on the following pages contains a list of questions categorized into the four above topics. However, the interviews were relatively informal, and the questionnaire was taken into consideration more as a starting point.

**Table A-III-1. Interview questions**

| #                                                 | Variable                 | Question/ Description                                                                                                                                                                  |
|---------------------------------------------------|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>0. Interviewee</i>                             |                          |                                                                                                                                                                                        |
| 0.1                                               | Contacts                 | Name and contact of the interviewee(s)                                                                                                                                                 |
| 0.2                                               | Role                     | Role in the organization, department, responsibilities, ...                                                                                                                            |
| <i>1. Organization</i>                            |                          |                                                                                                                                                                                        |
| 1.1                                               | Main business activity   | Describe the main business activities of your organization, including types of goods moved or services performed, who are their customers, and where are they located                  |
| 1.2                                               | Fleet composition        | How many vehicles do they have, and of what type                                                                                                                                       |
| <i>2. Permits</i>                                 |                          |                                                                                                                                                                                        |
| 2.1                                               | Past permit holder       | For how long has your company purchased CVLZ permits?                                                                                                                                  |
| 2.2                                               | No. valid permits (2024) | No. permits purchased in 2024                                                                                                                                                          |
| 2.3                                               | Main reasons             | Describe the main reasons why your organization decided to purchase CVLZ permits this year                                                                                             |
| 2.4                                               | Who purchased            | Who in the organization makes the choice to buy the permits, and who processes them?                                                                                                   |
| 2.5                                               | Who pays                 | How are the permits purchased paid for?                                                                                                                                                |
| <i>3. Routing, parking, and payment behaviors</i> |                          |                                                                                                                                                                                        |
| 3.1                                               | No. routes               | How many routes do you have during a typical day?                                                                                                                                      |
| 3.2                                               | Location of stops        | Where do you usually perform deliveries/pick-up/services? Are these routes urban or suburban? Which neighborhoods?                                                                     |
| 3.3                                               | Route time               | When do you usually perform the routes? Day of week, time of day (early morning, morning, ...)                                                                                         |
| 3.4                                               | No. stops per route      | How many times does the vehicle stop and park on a typical route?                                                                                                                      |
| 3.5                                               | No. deliveries per route | How many customers do you serve per route? How many deliveries do you make per route?                                                                                                  |
| 3.6                                               | Parking choice           | Where do drivers usually park? Do drivers use off-street parking, loading/unloading bays, alleys, and/or curb parking? Do your drivers use CVLZs? And how often/when do they use them? |
| 3.7                                               | Pay by use               | Do drivers ever pay for parking (at paid parking or CVLZs)? Do they use pay stations or PayByPhone?                                                                                    |

| #                          | Variable                            | Question/ Description                                                                                                                                                     |
|----------------------------|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3.8                        | Dwell time                          | What's the typical dwell time for a parking stop?                                                                                                                         |
| 3.9                        | Perceived pricing                   | Do drivers perceive parking pricing?                                                                                                                                      |
| 3.10                       | Citations                           | Do you often incur parking citations? How much do you spend on citations per year?                                                                                        |
| 3.11                       | Citations penalties                 | Do you penalize drivers who receive citations? Who pays for the citations?                                                                                                |
| 3.12                       | Challenges                          | What are the main challenges your drivers experience in driving and parking in Seattle? Which areas/neighborhoods are the most challenging to navigate and park, and why? |
| <i>4. Future scenarios</i> |                                     |                                                                                                                                                                           |
| 4.1                        | Zero-emission vehicles & incentives |                                                                                                                                                                           |
| 4.2                        | Payment level & structure           | Do you think commercial vehicles should pay for parking? And why?                                                                                                         |
| 4.3                        | Payment tech                        | What tech do you currently use. What type of technology would you be willing to adopt?                                                                                    |
| 4.4                        | Recommendations                     | Do you have any recommendations how a future CVLZ permitting system could work                                                                                            |

## Appendix IV - Tasks 6 and 7: Carrier Survey and Behavior Analysis

### A-IV-1 Survey questionnaire

#### *A-IV-1.1 Introduction to the survey*

## Commercial Vehicle Load Zone (CVLZ) survey

This survey is being conducted as part of a research project at the University of Washington-Urban Freight Lab in collaboration with the Seattle Department of Transportation (SDOT).

We seek input from carriers, fleet managers, and commercial establishments to better understand commercial vehicle operations in Seattle and gather information on **how we can improve the Commercial Vehicle Load Zone (CVLZ) program**.

The survey is structured into **three sections**:

1. Company and CVLZ permit information
2. Driving and parking experience in Seattle
3. Future CVLZ program scenarios

The survey takes about **10 minutes** to complete. Upon completion, you will be able to enter into a lottery to **win one of the three \$200 Amazon gift cards**.

Any information provided will be kept anonymous. Only aggregate summary statistics will be provided to SDOT. The content of the survey is entirely for research purposes and does not reflect any opinions or plans from SDOT.

**TO START THE SURVEY, CLICK THE ARROW BELOW**

## A-IV-1.2 Section 1 - Company and CVLZ permit information

**Table A-IV-1. Survey questionnaire section 1**

| #   | Question / instructions                                                                                                                                                                                                                                                                        | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Notes            |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| 1.1 | What is your role in the Company?                                                                                                                                                                                                                                                              | <ul style="list-style-type: none"> <li>• Owner;</li> <li>• Account manager</li> <li>• Fleet manager</li> <li>• Dispatcher</li> <li>• Other:</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Scrolling list   |
| 1.2 | Which of the following best describes your Company's primary business sector?<br><i>Choose all that applies</i>                                                                                                                                                                                | <ul style="list-style-type: none"> <li>• Utilities</li> <li>• Construction</li> <li>• Manufacturing</li> <li>• Wholesale Trade</li> <li>• Retail Trade</li> <li>• Transportation and Warehousing</li> <li>• Information</li> <li>• Finance and Insurance</li> <li>• Real Estate and Rental and Leasing</li> <li>• Professional, Scientific, and Technical Services</li> <li>• Administrative and Support and Waste Management and Remediation Services</li> <li>• Educational Services</li> <li>• Health Care and Social Assistance</li> <li>• Arts, Entertainment, and Recreation</li> <li>• Accommodation</li> <li>• Other</li> </ul> | Scrolling list   |
| 1.3 | Does your company operate one or more commercial vehicles in Seattle?<br><i>The term "commercial vehicle" means (i) a "motor truck" or "truck" except a passenger car or (ii) a station wagon or van that has been permanently modified to carry no more than three (3) seated passengers.</i> | <ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                  |
| 1.4 | At which geographical scale does your Company operate?<br><i>Please choose all that applies</i>                                                                                                                                                                                                | <ul style="list-style-type: none"> <li>• Local</li> <li>• County</li> <li>• State</li> <li>• Multi-state</li> <li>• National</li> <li>• Global</li> <li>• Other: _____</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                  |
| 1.5 | How many people does your company employ in Washington State?<br><i>Please insert a number</i>                                                                                                                                                                                                 | _____ employees                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | (integer number) |

| #    | Question / instructions                                                                                                                                                                                                                                                     | Answer                                                                                                                                                                                                        | Notes                                                                                    |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| 1.6  | How many commercial vehicles does your Company operate in Washington State?<br><i>Please insert a number</i>                                                                                                                                                                | _____ commercial vehicles                                                                                                                                                                                     | (integer number)<br>IF 1.3=="Yes"<br>"                                                   |
| 1.7  | What type of vehicles does your Company operate in Seattle?<br><i>Please choose all that apply.</i>                                                                                                                                                                         | <ul style="list-style-type: none"> <li>• Light duty (pick-up or SUV)</li> <li>• Work van (mini-van, van, step-van)</li> <li>• Single unit truck</li> <li>• Truck with trailer(s)</li> <li>• Others</li> </ul> | IF 1.3=="Yes"<br>"                                                                       |
| 1.8  | What is the main location of your Company in Washington State?<br><i>Please write an address or the nearest intersection (for example: Colorado ave S and S Alaska St)</i><br><i>If the company is multi-state, please only write the main location in Washington State</i> | _____                                                                                                                                                                                                         | IF 1.3=="Yes"<br>"<br><br>We assume this is the location where the vehicle routes depart |
| 1.9  | Has your Company purchased any Commercial Vehicle Load Zone (CVLZ) permits in 2024?                                                                                                                                                                                         | <ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>                                                                                                                                         | IF 1.3=="Yes"<br>"                                                                       |
| 1.10 | How many Commercial Vehicle Load Zone (CVLZ) permits have your Company purchased in 2024?                                                                                                                                                                                   | _____ permit(s)                                                                                                                                                                                               | IF 1.9=="Yes"<br>"                                                                       |
| 1.11 | For how many years has your company purchased Commercial Vehicle Load Zone permits?<br><i>Please insert a number</i>                                                                                                                                                        | _____ years                                                                                                                                                                                                   | IF 1.9=="Yes"<br>"                                                                       |
| 1.12 | Who pays for the Commercial Vehicle Load Zone permits?                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>• The company</li> <li>• The drivers</li> <li>• Others: _____</li> </ul>                                                                                               | IF 1.9=="Yes"<br>"                                                                       |

## A-IV-1.3 Section 2 - Driving and parking experience in Seattle

Table A-IV-2. Survey questionnaire section 2

| #    | Question / instructions                                                                                                                             | Answer                                                                                                                                                                                                                            | Notes            |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| 2.1  | On a typical day, how many routes does your Company operate in Seattle?<br><i>Please insert a number.</i>                                           | _____ routes                                                                                                                                                                                                                      | (integer number) |
| 2.2  | Which days of the week do these vehicle routes operate in Seattle?<br><i>Please choose all that apply.</i>                                          | Monday; Tuesday; Wednesday;<br>Thursday; Friday; Saturday; Sunday                                                                                                                                                                 |                  |
| 2.3  | What times does a typical route start/end?<br><i>Please enter hour in 24hour format (for instance enter 15 for 3 pm).</i>                           | Starts at: _____<br>Ends at: _____                                                                                                                                                                                                |                  |
| 2.4  | How many customers are usually served in a typical route?<br><i>Please insert a number</i>                                                          | _____ customers                                                                                                                                                                                                                   | (integer number) |
| 2.5  | How many times does the driver park the vehicle during a typical route?<br><i>Please insert a number</i>                                            | _____ parking stops                                                                                                                                                                                                               | (integer number) |
| 2.6  | What is the farthest distance a driver is willing to park from a customer location?                                                                 | The driver parks on the same block as the delivery customer<br>The driver parks no more than a block away from the customer's location<br>The driver might occasionally park two or more blocks away from the customer's location |                  |
| 2.7  | How long does the driver usually stop the vehicle while delivering to one or more customers?<br><i>Please insert a number.</i>                      | _____ minutes                                                                                                                                                                                                                     | (integer number) |
| 2.8  | Rank the Company drivers' preferred parking location:<br><i>Please drag and drop to rank from the most preferred (1) to the least preferred (5)</i> | Commercial Vehicle load zone or truck load zone (yellow curb)<br>Passenger load zone (white curb)<br>Travel lane or center turn lane<br>Paid parking<br>Other (alley, off-street, double parking, entrance of garages)            |                  |
| 2.9  | Does the driver ever pay to park using PayByPhone or a pay station?                                                                                 | Yes<br>No                                                                                                                                                                                                                         |                  |
| #    | Question / instructions                                                                                                                             | Answer                                                                                                                                                                                                                            | Notes            |
| 2.10 | How many parking tickets did the company receive in 2024?<br><i>Insert "0" if no parking tickets were given in 2024</i>                             | _____ parking tickets                                                                                                                                                                                                             | (integer number) |
| 2.11 | If a driver receives a parking ticket, who pays for it?                                                                                             | The company; Driver;<br>Other                                                                                                                                                                                                     |                  |
| 2.13 | What challenges have you experienced while operating vehicles in Seattle?                                                                           | _____                                                                                                                                                                                                                             | (paragraph)      |

#### A-IV-1.4 Section 3 - Future CVLZ program scenarios

Imagine the City is considering changing the parking permit program in 2026. For each of the following 4 questions, you will be asked to read the characteristics of the new permit program (payment method, base cost of parking, price per parking event, and maximum allowed parking time) and choose between:

1. **Permit:** Buying annual parking permits
2. **Pay-Per-Use:** The driver pays for each parking event
3. **Neither:** The driver chooses not to pay for parking

Please note:

The pay-per-use option will include the following payment methods:

**Mobile payment:** The driver will pay through a mobile phone app (similar to PayByPhone)

**Tap card:** The driver will be provided with a physical card to be tapped on the pay station (similar to the Orca card)

The permit option will only include a pre-paid payment method

**Pre-paid:** only available when purchasing the annual permit

Four questions similar to the following will be shown to gather the preferences of respondents considering different cost and timing alternatives.

**Table A-IV-3.** An example of a choice set

|                            | Annual Permit | Pay-per-Use    |
|----------------------------|---------------|----------------|
| Payment Method             | Pre-paid      | Mobile payment |
| Based Cost                 | \$500         | \$75           |
| Price per Park             | \$0           | \$10           |
| Total Allowed Parking Time | 30 min        | 2 hours        |

|              |                 |               |                                         |
|--------------|-----------------|---------------|-----------------------------------------|
| Your choice: | ● Annual permit | ● Pay-per-use | ● I would choose not to pay for parking |
|--------------|-----------------|---------------|-----------------------------------------|

## A-IV-2 Survey Appearance

### Computer view

Survey Completion 0% 100%



### Commercial Vehicle Load Zone (CVLZ) survey

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We seek inputs from carriers, fleet managers, and commercial establishments to better **understand commercial vehicle operations** in Seattle and gather information on **how we can improve the Commercial Vehicle Load Zone (CVLZ) program**.

The survey is structured into **three sections**:

I. Company and CVLZ permit information

### Mobile phone view

7:03 Survey Completion 0% 100%



### Commercial Vehicle Load Zone (CVLZ) survey

This survey is being conducted as part of a research project at the University of Washington-Urban Freight Lab in collaboration with the Seattle Department of Transportation (SDOT).

We seek inputs from carriers, fleet managers, and commercial establishments to better **understand commercial vehicle operations** in Seattle and gather information on **how we can improve the Commercial Vehicle Load Zone (CVLZ) program**.

The survey is structured into **three sections**:

I. Company and CVLZ permit information

uwashington.qualtrics.com

### Snapshot of stated preference choice set:



Question 4/4

Which parking method do you prefer?

|                                   | Annual Permit | Pay-Per-Use |
|-----------------------------------|---------------|-------------|
| <b>Payment Method</b>             | Pre-Paid      | Mobile app  |
| <b>Base Cost</b>                  | \$250         | \$50        |
| <b>Price per Park</b>             | \$0           | \$10        |
| <b>Total Allowed Parking Time</b> | 30 minutes    | 120 minutes |

Annual Permit      Pay-Per-Use      I would choose not to pay for parking

Your choice:      ☐      ☐      ☐

## A-IV-3 Email blurb

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Share your thoughts on commercial loading in Seattle - Chance to win a \$200 gift card!

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From Urban Freight Lab <uflab@uw.edu>

Date Tue 12/10/2024 7:22 PM

To Urban Freight Lab <uflab@uw.edu>

**Complete a brief survey about your experience as a delivery operator in Seattle and enter a chance to win \$200!**

The **University of Washington** is collaborating with the **Seattle Department of Transportation** to gather inputs from *fleet managers, transportation directors, and dispatchers* to improve the **Commercial Vehicle Load Zone (CVLZ) program**.

The survey will take **10 minutes** to complete. Upon completion, you will have the chance to win a **\$200 Amazon gift card!**

**CLICK THE LINK BELOW (OR SCAN THE QR CODE) TO GET STARTED:**

<https://bit.ly/4g0VX1p>



For any questions or feedback, please email [uflab@uw.edu](mailto:uflab@uw.edu)

Thank you for your valuable time!

Sincerely,

[The Urban Freight Lab](#)

University of Washington

A-IV-4 Flyer



Seattle  
Department of  
Transportation



GIFT CARD  
 \$200

# DELIVERY OPERATORS IN SEATTLE!

**WE WANT TO  
HEAR FROM YOU!**

WINTER 2025  
**COMMERCIAL  
VEHICLE LOAD  
ZONE SURVEY**

**DEADLINE IS JANUARY 22nd**

Scan below and take our 10-minute survey  
for a chance to win a \$200 Amazon gift card:



← **SCAN HERE**

This survey is intended only for **company owners, fleet managers, or dispatchers**. If you do not hold one of these roles, please forward the survey to the appropriate person!

Questions or feedback? Contact us at: [uflab@uw.edu](mailto:uflab@uw.edu)

## A-IV-5 Additional variables related to route characteristics

**Table A-IV-4.** Descriptive analysis of route characteristics (additional variables)

| Variable                | Category  | Value              |                |            |
|-------------------------|-----------|--------------------|----------------|------------|
|                         |           | Non-permit holders | Permit holders | All        |
| Customer per route n=65 | min       | 0                  | 1              | 0          |
|                         | mean      | 8.92               | 20.94          | 18.72      |
|                         | median    | 6                  | 8              | 7          |
|                         | max       | 30                 | 200            | 200        |
| Variable                | Category  | No. obs (%)        |                |            |
| Days per week           | 1-3       | 3 (21.43)          | 18 (25.71)     | 21 (25.00) |
|                         | 4-6       | 4 (28.57)          | 37 (52.86)     | 41 (48.81) |
|                         | Everyday  | 5 (35.71)          | 10 (14.28)     | 15 (17.86) |
|                         | mean      | 4.28               | 4.15           | 4.17       |
| Time of day: Start      | Off-peak  | 2 (16.67)          | 6 (9.23)       | 8 (10.39)  |
|                         | Morning   | 10 (83.33)         | 57 (87.69)     | 67 (87.01) |
|                         | Afternoon | 0 (0.00)           | 2 (3.08)       | 2 (2.60)   |
|                         | Night     | 0 (0.00)           | 0 (0.00)       | 0 (0.00)   |
| Time of day: End        | Off-peak  | 2 (16.67)          | 14 (21.54)     | 16 (20.78) |
|                         | Morning   | 3 (25.00)          | 16 (24.61)     | 19 (24.67) |
|                         | Afternoon | 2 (16.67)          | 30 (46.15)     | 32 (41.56) |
|                         | Night     | 5 (41.67)          | 5 (21.54)      | 10 (12.99) |

**Table A-IV-5. MNL base model results**

| Choice<br>(Reference:<br>Annual Permit) | Variables                                                    | Coefficient | Standard<br>Error | Significance<br>level |
|-----------------------------------------|--------------------------------------------------------------|-------------|-------------------|-----------------------|
| Pay-per-use                             | Intercept                                                    | -.576       | .518              | .266                  |
|                                         | Annual permit base cost                                      | .001        | .000              | <.001                 |
|                                         | Pay-per-use base cost                                        | -.004       | .004              | .260                  |
|                                         | Pay-per-use parking cost                                     | -.046       | .022              | .039                  |
|                                         | Annual permit parking duration                               | -.001       | .002              | .815                  |
|                                         | Pay-per-use parking duration                                 | .001        | .002              | .693                  |
|                                         | Pay-per-use payment method:<br>Tap (Reference: Pay by phone) | .129        | .274              | .638                  |
| Neither                                 | Intercept                                                    | -1.134      | .502              | .024                  |
|                                         | Annual permit base cost                                      | .001        | .000              | <.001                 |
|                                         | Pay-per-use base cost                                        | .000        | .004              | .983                  |
|                                         | Pay-per-use parking cost                                     | .035        | .020              | .088                  |
|                                         | Annual permit parking duration                               | -.003       | .002              | .119                  |
|                                         | Pay-per-use parking duration                                 | .001        | .002              | .704                  |
|                                         | Pay-per-use payment method:<br>Tap (Reference: Pay by phone) | .161        | .257              | .529                  |



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