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District Department of Transportation

On-Site Berths and Curbside Implications

Final Report

February 2021

Disclaimer

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On-Site Berths and Curbside Implications

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16. Abstract

This study looked at factors related to freight trip generation in Washington, DC and urban environments. The study presents a comprehensive review of literature and practices regarding loading zones at different US cities; collected commercial vehicle parking occupancy data through video-monitoring at 20 different buildings in the District of Columbia; conducted business surveys for evaluating loading demand at the curb and on-site berths; and analyzed video and survey data to derive dwell time data for commercial vehicle loading activity at curbs and onsite berths of the subject buildings. Video surveillance and post-surveillance analysis of the video footage offered a viable mechanism for obtaining data on loading and unloading activity at curbside and onsite berths. By deploying the video footage on a private YouTube channel, the study developed an innovative methodology to store, manage and encode loading-unloading activities. This less intrusive methodology saved a significant amount of time while providing accurate and verifiable data. The analysis of loading activity provided fairly consistent results for curbsides and on-site berths at all buildings for which video data were analyzed. Some of the generalized observations include the following:

- Most of the curbside activity at 13 buildings lasted for dwell times of 10 minutes or less
- The most frequent dwell time for loading activities was 2 minutes for all data collection sites
- On weekdays, loading peaks occur between 9AM-2 PM with most common peak-hour being 9-10 AM
- Wednesday through Friday are peak days of the week for loading; Sundays have the lowest loading

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Executive Summary

Residents, workers, and visitors in large metropolitan cities such as New York City, Washington DC, and San Francisco are net consumers of goods. This concentrated consumption and usually congested infrastructure lead to challenges in planning for the last-mile deliveries of such products as food, consumer staples, etc., into businesses where the consumption takes place. Recognizing the importance of freight trip generation for addressing a range of policy issues such as revising processes for issuing building permits and planning for urban freight needs in Washington DC (the District), the District Department of Transportation (DDOT) initiated this study with the following objectives:

1. to conduct a comprehensive review of popular literature and practices at different large cities in the United States,
2. to obtain parking occupancy data through video-monitoring at 20 different buildings in the District of Columbia (the District),
3. to survey up to 500 businesses that are operating out of the 20 subject buildings for evaluating the loading demand at the curbside and onsite berths, if available, and
4. to develop commercial vehicle trip generation rates by analyzing the video-monitored and survey data.

To achieve these objectives, DDOT selected the research team led by George Mason University with Virginia Teach as a key partner. At a very high level, the team's research plan recognizes the importance of planning for urban goods movement as a part of any long- and short-range multimodal transportation plan. The methodology adopted for meeting the study objectives was aligned within the framework of District's multimodal long-range transportation plan (moveDC, 2014). Specifically, moveDC was consulted for insights about curbside loading and other issues related to urban goods movement in the District. Consistent with the framework outlined in moveDC (2014), DDOT selected 20 buildings in the District as subject locations for studying curbside loading activity and assessing demand.

The study team conducted a comprehensive review of the state of the practice in loading zone ordinances, and surveys of establishments in freight trip generation and parking needs. The literature review[1] includes not only peer-reviewed journal articles, but also practice-oriented

[1] This comprehensive literature review was primarily conducted by Mr. Woojung Kim, a graduate student at Virginia Tech.

publications from National Cooperative Freight Research Program (NCFRP) and other sources. This section provides a review of published documents. The review is grouped into four sections:

1. Loading zones
2. Freight trip generation
3. Establishment survey
4. Service and courier vehicles

The literature review covered trip generation models for service and supply trips at office buildings, which has direct relevance to the objectives of this study, as well as truck loading provisions in building code and/or zoning regulations for New York City, Philadelphia, Chicago, Seattle, and San Francisco. These cities were considered especially relevant to the District of Columbia because of their dense urban environments, expensive real estate environments where building operations and construction costs dictate that non-revenue space be minimized (assuming that freight loading and unloading spaces are "overhead" in nature and are not directly revenue generating), and urban traffic congestion that impedes commuter and freight mobility and is exacerbated by on-street truck loading and unloading.

Parking Activity Data Collection via Video Surveillance

The first part of the second objective of the study is to obtain parking occupancy data through video-monitoring at 20 different buildings in the District. An ambitious and extensive plan was prepared to collect video surveillance data over several months beginning early spring through fall of 2017. The plan called for a thorough inspection of curbsides and loading berths at all 20 locations for identifying vantage points for installation and appropriate angles to obtain good coverage through video monitoring. The notes and pictures taken at each site were then consolidated into one or two illustrations per site to serve as field installation instructions. For example, Figure E-1 illustrates the consolidated version of detailed notes taken during the field inspection of the location at 1401 S St. NW. The figure identifies the location and other identifying information of the mounting location (such as light pole or signal mast) for camera hardware.

Figure E-1 | Consolidated Field Notes & Camera Installation Instructions for 1401 S St NW

DDOT staff installed the cameras based on these notes. Brinno –TLC 200 Pro with weather housing were used to monitor the curbsides and lading berths at all 20 subject buildings. Videos were recorded with a 30-second time-lapse for one full week so that data would include weekend and weekdays. The video data were first obtained during Spring 2017 (April – June 2017). A closer examination of that data revealed numerous issues, such as lack of adequate coverage due to missing data, improperly angled cameras, inconsistent time-lapse duration, or out-of-focus cameras. Due to these issues, a second batch of video recordings was obtained during April - August 2018. More than 20 cameras were commissioned to obtain the video data.

All video footages obtained for this study were uploaded to GMU.DDOT YouTube channel and was marked as “Unlisted”. Each camera produced three separate videos for the 7-day duration of recording. Several site-specific and camera-specific playlists were created to manage the encoding process and subsequent verification of encoded data.

Encoding Methods

Manuals on parking studies and past parking studies, which employed video logging for parking accumulation and turnover, were consulted for design of data logging instrument(s). The ultimate objective of the instrument was to facilitate tabulation and derive statistics of the recorded data. The video logs were analyzed, with necessary modifications, as if it were a parking demand study. In

typical parking demand studies, the available parking spaces are first recorded. Parking accumulation is the number of vehicles parked at any given time. The parking turnover analysis requires recording the number of times the same parking space is used by various users of the parking lot-during the day. Parking turnover analysis also depends on the type of land use and the duration of parking required by each vehicle.

A spreadsheet-based encoding instrument was developed for recording parking activity of commercial vehicles. Several undergraduate and graduate students at George Mason University were recruited and trained to encode the video data. The encoding process required several hours of viewing and reviewing videos played in real recorded time (i.e., recorded with 30 sec lapse) and at 25% speed. The time required to encode the 7-day, 35-minute footage for each camera was approximately 40 hours.

Parking Activity Analysis at Select Building

The second part of the second objective of the study is to analyze the video surveillance data to quantify the curbside and loading berth parking activity at select buildings. Encoded data from video footages were analyzed to draw insights into commercial vehicle parking and loading activity at curbside and loading berths. Due to resource constraints and unavoidable project delays, video data for 13 of the 20 original locations were analyzed.

The original intent of the project was to link video data to survey data to develop freight generation models. This proved impossible given the nature of survey responses, the inability to link vehicles in the videos to specific businesses within a building, the mixed-use nature of the buildings with 12 of the 13 having large residential populations, and limitations associated with the encoded video data. It was also difficult to determine whether delivery and package delivery vehicles were picking up or delivering or both to these locations. Instead, the video data and analysis are found to be best suited to supporting curbside management decision-making.

As a result, the parking activity analysis was limited to presenting and discussing number of vehicles by purpose, arrival time, and dwell time combined for all 13 buildings as well as for each building individually. Three purposes were considered in the assessment: delivery, package delivery, and service. Small pickup trucks, which make up approximately 15% of vehicles observed, were separated from the other three categories because coders could not always distinguish their purpose. Also, the general Delivery category includes special purpose vehicles such as garbage, construction, fire and rescue, etc.

A total of 4009 vehicles were considered in this assessment. Table E-1 provides a breakdown by purpose of vehicle type. Delivery and service vehicles make up approximately the same proportion of vehicles at 37% and 35%, respectively. Package delivery represents 14%, which is substantially higher than the twice-a-day delivery that was experienced before the Amazon effect.

Table E-1 | Vehicles by Purpose

Vehicle Purpose	Number	Percent
Small Vehicle - Pickup Truck	591	14.7%
Delivery*	1466	36.6%
Delivery Van	292	7.3%
Medium Truck (< 40 ft)	911	22.7%
Large Truck (40 to 50 ft)	228	5.7%
Tractor Trailer (>55 ft)	35	0.9%
Package Delivery	562	14.0%
Service	1390	34.7%
Service - Other	427	10.7%
Service - Truck	113	2.8%
Service - Van	326	8.1%
Utility Van	524	13.1%
Total	4009	100.0%

** No distinction was made between delivery trucks and special purpose trucks such as garbage, construction, fire, etc.*

The following observations provide a summary of analysis of video data at 13 buildings.

- Midweek sees the highest number of vehicles per day at about 18% of weekly total per day, while Monday and Friday are 3% to 4% lower followed by Saturday at 10% and Sunday at 4%.
- Delivery vehicles and service vehicles track together across the hours of the day beginning to increase between 3:00am and 4:00am with package delivery lagging and correlating more with normal working hours in the morning.
- The largest number of short-term stops are approximately 2 minutes long.
- The largest number of vehicles spend 10 minutes or less at a building. Without additional review, it is unclear why so many service vehicles are in this bin, particularly when compared to delivery and package delivery vehicles.
- With some exceptions, the temporal distributions of commercial vehicle parking are similar across the 13 different buildings.

Business Surveys

To meet the third objective of the study, three different types of business surveys were conducted to understand the demand for freight and truck trips in the District. Primary goal of the surveys was to develop freight trip generation models based on the business type and its attributes such as number of employees and square footage. For establishment survey purposes, businesses were categorized as Freight Intensive Sector (FIS) and Non-freight Intensive Section (Non-FIS). FIS businesses rely on foot-traffic from customers and display their brand on the building. Examples of FIS businesses include restaurants, specialty stores etc. On the other hand, Non-FIS businesses do not rely on the foot-traffic, but operate their businesses in such categories as legal services,

consultancies etc. FIS businesses normally operate out of the street-level floor(s) of the buildings, whereas Non-FIS businesses could be operating on any floor. These establishment surveys conducted for this study include:

1. Freight Intensive Sector (FIS)
2. Non-freight Intensive Sector (Non-FIS) businesses
3. Survey of building managers (also Non-FIS)

Lists of businesses operating from the subject buildings were obtained from Info USA, a sales and marketing solutions provider. Based on the InfoUSA lists, web searches and field visits to the locations, three separate lists for each survey category were prepared. The following is the summary sample sizes identified in this screening-process.

1. Businesses identified as FIS generators.
    - The compiled list of ground floor retail businesses from the InfoUSA data included 111 FIS businesses, whereas the updated list after site visits contained 120.
2. Building Managers of all 20-subject buildings.
    - Two buildings in the list (301 Tingey St SE and 1212 4th St SE) were managed by the same property management company.
3. Businesses that are not considered FIS generators contained approximately 400 businesses.

Questionnaires for these three surveys were finalized and approved by IRB (Appendix C). These forms were also deployed on the Qualtrics online survey platform, which is a popular portal for administering field surveys. The letters soliciting cooperation from building managers for successful execution of the survey are included in Appendix C.

Survey Summary

The original intent of the surveys was to use the information to develop freight trip generation models using video data in combination with survey data. Unfortunately, the number of survey responses – 9 building manager responses, 48 FIS business responses, and zero non-FIS business responses – were too few to use for model generation, particularly at a specific building level. The surveys asked questions specific to freight activities at each building. Although the building survey did ask about service and courier vehicles for businesses, the information provided by the building manager was limited to residential activity as the manager, in most cases, was only responsible for the residential aspects of the building.

Building Manager Survey

Of the 9 completed building surveys, one building was not included in the video data. Another five buildings with video data did not have survey information. A review of the responses made it clear that the person completing the survey had information about residences but not businesses when

considering leased and common space and did not understand that the question about where vehicles parked applied to vehicles operated from the building and not delivery vehicles to the building. Also, both from the video and survey, no distinction was made for refuse pickup. One survey did make that distinction, but others did not when completing trips by vehicle. For any follow-on work, the following recommendations are provided:

- Redesign the building survey for use specifically for curbside management and clarify the distinction between trip types.
- Provide a definition for service trips and delivery trips.
- Include more detailed questions about the building characteristics, including total square footage, number of residential units, number of businesses.
- Include a question about location of points of entry for service providers and couriers.
- Clearly distinguish regular service from other deliveries or service in the questions. The table format did not work.
- Include loading dock as an option for delivery location.
- For mixed-use buildings with residential, include a category for moving companies and rental trucks.

FIS Business Survey

Of the 48 business survey responses, 23 were categorized as Accommodation and Food Service, 20 as Retail Trade, one as wholesale trade, and 4 as other. None of the large box stores or supermarkets responded. From a review of the responses, the questions were appropriate to obtain the necessary information for a freight trip model but because the vehicles from the video could not be attributed to a specific business, no data could be obtained for validating such model. Additional consideration in the study design would be required to establish the necessary linkages.

Conclusions

All four objectives of the study were met with varying levels of success. Review of current literature and practices at different large cities in the United States provided insights for DDOT practices. Video surveillance and post-surveillance analysis of the video footage offered a viable mechanism for obtaining data on loading and unloading at curbside and loading berths. By deploying the video footage on a private YouTube channel, the study developed an innovative methodology to store, manage and encode loading-unloading activities. This less-intrusive methodology provided accurate and verifiable data while saving a significant amount of time. The analysis of loading activity provided consistent results for curbsides and loading berths at all buildings for which video data were analyzed.

This study is very labor intensive and required considerable amount of time for surveillance, data collection, encoding and analysis. Though the video data and the survey data could not be used for

developing freight trip generation models, the study provided high quality data on curbside parking and onsite parking. This data product could be used in studying on-street parking behavior by automobiles and developing on-street parking policies.

1. Background

Traditionally, the emphasis of transportation planning and operations has been on facilitating movement of people with movement of goods as a secondary consideration. In the Guidebook for Understanding Urban Goods Movement (NCFRP Report 14), Rhodes et al (2012) argue that, even though freight trips account for 65% of trips originating at, or destining to urban areas, urban freight trips do not receive adequate attention in the transportation planning process. Most intra-urban freight movements are for pick-up and delivery (PUD) of freight items almost always occur by truck (Chatterjee, 2004).

The NCFRP Report 14 also makes a compelling case for the importance of goods movement, strengthening its value in public planning and improving the perception of it among public decision makers. Populace, workers and visitors in large metropolitan cities such as New York City, Washington DC, San Francisco are net consumers of goods. This concentrated consumption and usually congested infrastructure lead to challenges in planning for the last-mile deliveries of such products as food, consumer staples, etc., into businesses where the consumption takes place. Recognizing the importance of freight trip generation for addressing a range of policy issues such as revising processes for issuing building permits and planning for urban freight needs in Washington DC (the District), the District Department of Transportation (DDOT) initiated this study with the following objectives:

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To achieve these objectives, DDOT selected the research team led by George Mason University with Virginia Teach as a key partner. At a very high level the team's research plan recognizes the importance of planning for urban goods movement as a part of any long- and short-range multimodal transportation plan.

The methodology adopted for meeting the study objectives was aligned with the framework of District's multimodal long-range transportation plan (moveDC, 2014). Specifically, moveDC was consulted for insights about curbside loading and other issues related to urban goods movement in

the District. The District Department of Transportation (DDOT) has established more than 500 commercial loading zones throughout the District, which are signed, on-street metered loading zones exclusively for commercial vehicles. About half of these loading zones are along commercial corridors to serve businesses that deal in small consumer goods and perishables.

Commercial vehicle loading zones are primarily operational between 9:30 a.m. and 4:00 p.m. (the period between rush hours on major corridors). Improving the availability and effectiveness of loading zones can reduce double-parking and improve multimodal travel and safety. Insufficient loading zone spaces, inconsistent enforcement of parking regulations—especially double parking—and low turnover of metered passenger-vehicle spaces are common parking problems faced by the trucking industry in the District.

Recommendations from earlier studies included longer commercial vehicle loading zones and the use of multi-space meters (Ellen, et. al., 2009). The District defines a loading berth as an off-street (also referred in this report as 'on-site') space provided for cargo vehicles to load and unload (Figure 1-1)[2]. A service area or delivery space is an off-street space provided for motor vehicles that are 20 ft. in length or less that are making deliveries and/or providing a maintenance service. A service/delivery space cannot be considered a parking space or a loading berth.

Figure 1-1 | Multiple On-site Loading Berths

Source: DC.GOV[2]

[2] Zoning Handbook. The District of Columbia. https://handbook.dcoz.dc.gov/definitionsglossary/i-l/

An analysis of curbside supply of loading space for delivery vehicles will not be complete without an examination of the supply of off-street loading space, which usually is provided inside buildings as loading docks. Zoning ordinances of many cities include requirements about the number of loading docks or berths to be provided for a specified amount of building floor space. The District's zoning requirements for office building loading berths are one berth for 20,000-50,000 square feet gross floor area; two berths for 50,000-200,000 square feet floor area; and three for floor areas greater than 200,000 square feet (Ellen, et. al., 2009).

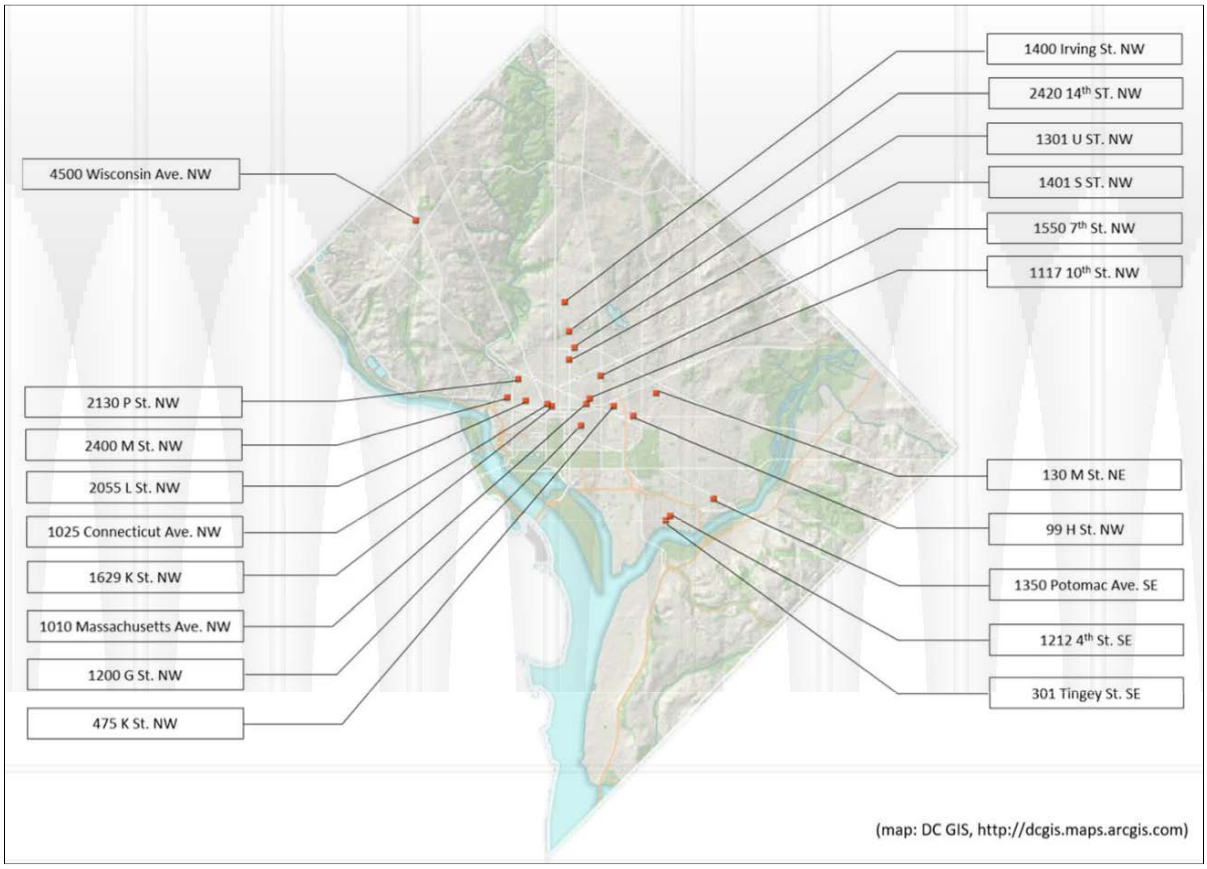
Consistent with the framework outlined in moveDC (2014), DDOT has selected 20 buildings in the District as subject locations (Table 1-1 and Figure 1.1) for studying curbside loading activity and assessing demand.

Table 1-1 | List of Buildings Included in the Study

#	Address	Land Use	Zoning
1	1010 Massachusetts Avenue NW	Commercial	D-4-R
2	1025 Connecticut Avenue NW	Commercial	D-6
3	1117 10th Street NW	Commercial	D-4-R
4	1200 G Street NW	Commercial	D-7
5	1212 4th Street SE	Federal Public	SEFC-1
6	130 M Street NE	Commercial	D-5
7	1301 U Street NW	Mixed-Use	ARTS-1/RA-2/ARTS-4
8	1350 Potomac Avenue SE	Mixed-Use	MU-5A
9	1400 Irving Street NW	Commercial	MU-7/RA-2
10	1401 S Street NW	Institutional	ARTS-3
11	1550 7th Street NW	Medium Density Residential	MU-4
12	1629 K Street NW	Commercial	D-6
13	2055 L Street NW	Commercial	D-5
14	2130 P Street NW	Medium Density Residential	MU-19
15	2400 M Street NW	Commercial	MU-6
16	2420 14th Street NW	Commercial	MU-5A
17	301 Tingey Street SE	Federal Public	SEFC-2
18	4500 Wisconsin Avenue NW	Mixed-Use	MU-7
19	475 K Street NW	Commercial	D-4-R
20	99 H Street NW	Mixed-use	MU-9

SEFC – Southeast; Federal Center D – Downtown; ARTS – Mixed Use Uptown Arts; RA – Residential Apartment; MU – Mixed Use

Figure 1-2 | Location of the Study Buildings



The study team included researchers from George Mason University and Virginia Tech and the study was conducted during January 2017-January 2019.

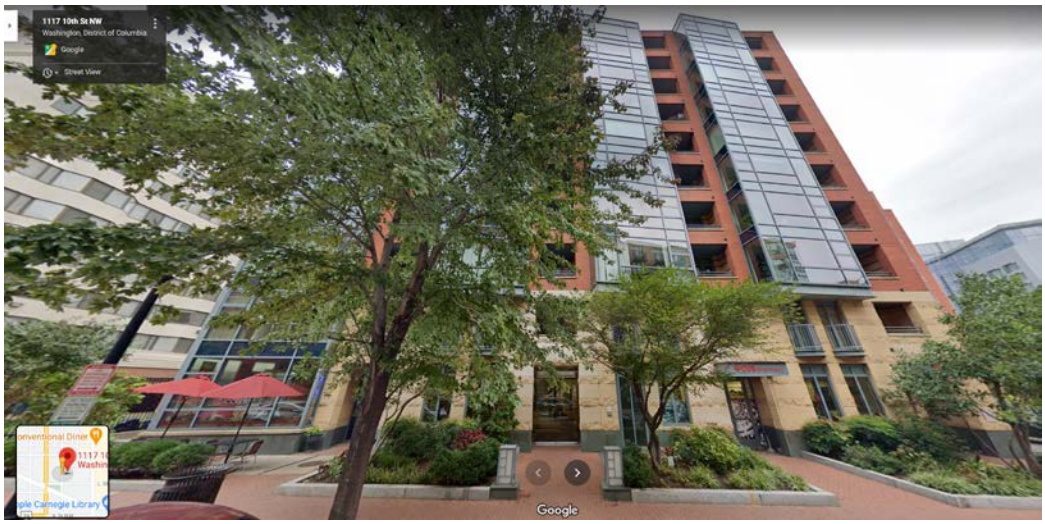
Figure 1-3 | 1010 Massachusetts Av. NW

(Source: Loopnet.com)

Figure 1-4 | 1025 Connecticut Ave. NW

(view from L St NW at Connecticut Ave. NW. Source: Google)

Figure 1-5 | 1117 10th Street NW



(Source: Google)

Figure 1-6 | 1200 G St. NW

(Source: Offices.net)

Figure 1-7 | 1212 4th Street SE

(Source: Google)

Figure 1-8 | 130 M Street NE

(Source: Realtor.com)

Figure 1-9 | 1301 U Street NW

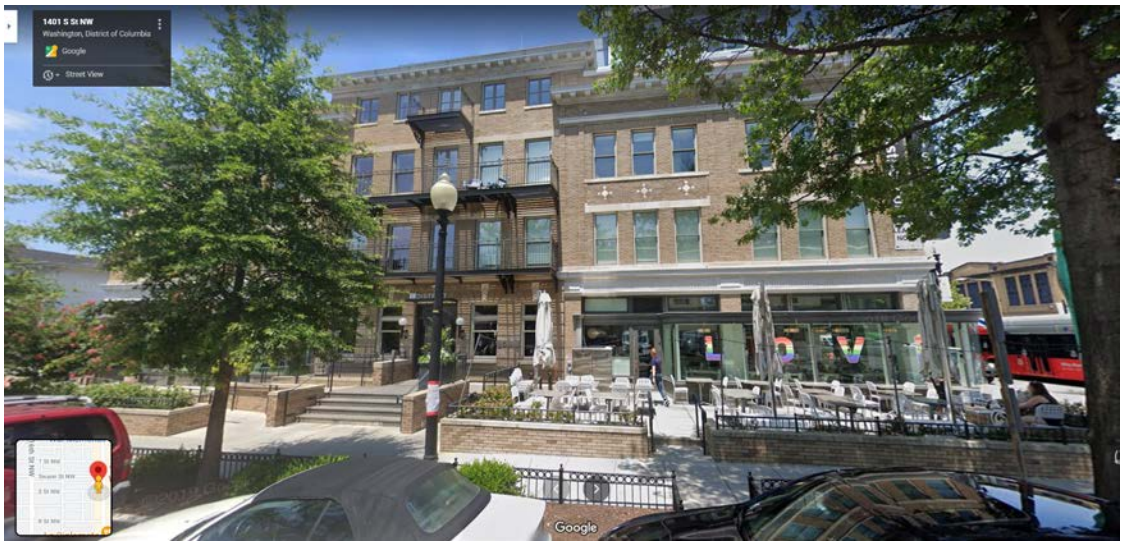
(Source: TheEllingtonDC.com)

Figure 1-10 | 1350 Potomac Ave. SE

(Source: Google)

Figure 1-11 | 1400 Irving St. NW

Figure 1-12 | 1401 S Street NW



(Source: Google)

Figure 1-13 | 1550 7th Street NW

(Source: Jefferson Apartment Group)

Figure 1-14 | 1629 K St. NW

(Source: Google)

Figure 1-15 | 2055 L St. NW

Figure 1-16 | 2130 P St. NW

(Source: Google)

Figure 1-17 | 2400 M St. NW

Figure 1-18 | 2420 14th Street NW

(Source: Zillow.com)

Figure 1-19 | 301 Tingey Street SE

(Source: The Yards)

Figure 1-20 | 4500 Wisconsin Ave. NW

(source: Google)

Figure 1-21 | 475 K St. NW

(Source: Zillow)

Figure 1-22 | 99 H Street NW

(Source: Google)

1.1.1 Report Outline

Section 2 provides an overview of zoning in the District of Columbia. Section 3 presents a comprehensive literature review. Section 4 details provisions for truck loading in building codes and zoning regulations for New York City, Philadelphia, Chicago, Seattle and San Francisco. Section 5 describes the methodology and tools used in data collection, managing and encoding of video footage. Section 6 presents the analysis of commercial vehicle parking activities observed at curbside and loading berths for subject buildings. Section 7 presents the business survey methodology and summary of survey responses with a discussion on the results. Section 8 presents conclusions from the study, discusses the lessons learned and outlines next steps.

2. Zoning in Washington DC

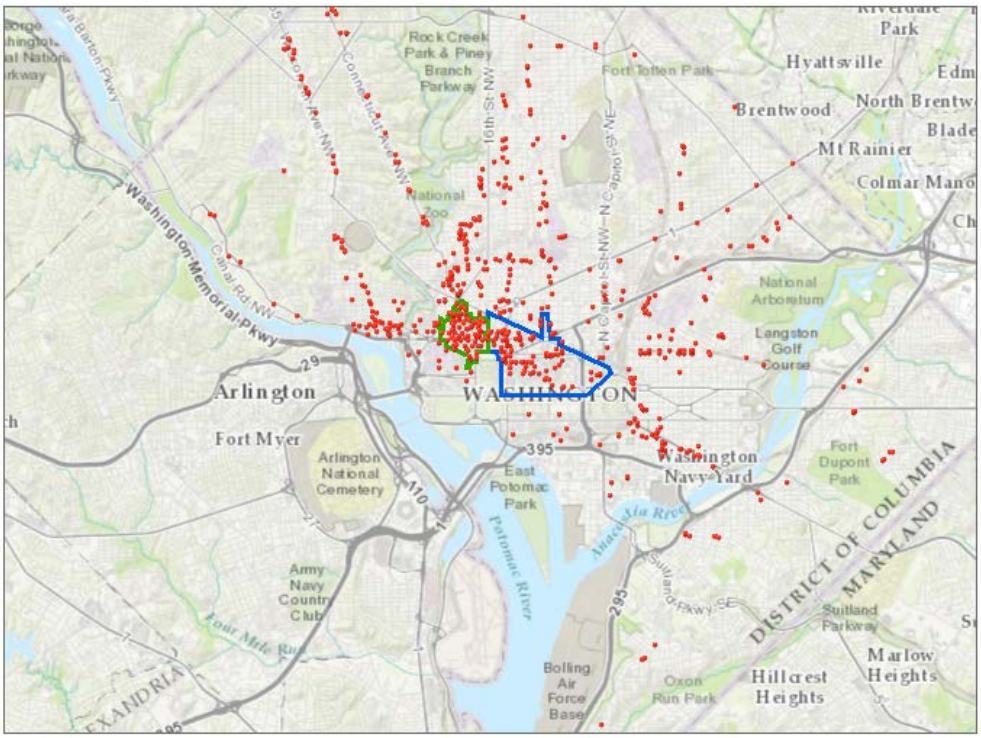
This section provides an overview of zoning policies and practices in Washington DC. The District's Zoning Commission (ZC) is responsible for establishing and enforcing the zoning policies for the city. ZC is an independent, quasi-judicial body. Created by the Zoning Act of 1920, as amended, the ZC is charged with preparing, adopting, and subsequently amending the Zoning Regulations and Zoning Map in a means not inconsistent with the Comprehensive Plan for the National Capital area. Three members of the ZC are residents of the District of Columbia appointed by the Mayor and confirmed by the Council. The fourth member of the ZC is the Architect of the Capitol (or his/her representative). The fifth ZC member is the Director of the National Park Service (or his/her representative)[3].

2.1.1 Existing Conditions

At the time of the study, a total of 602 loading zones are located throughout the District (DC Atlas Plus). As shown in Figure 2-2, approximately half of these loading zones are located within or near the two Business Improvement Districts (BID); the Golden Triangle BID highlighted in green and the Downtown BID highlighted in blue. Table 2-1 provides statistics associated with existing loading zones. Of the 38 loading zones with a length of 100 feet or longer, twelve are located within the two BIDs as shown in Figure 2-3.

[3] Zoning Handbook. The District of Columbia. https://handbook.dcoz.dc.gov/zoning-rules/general-procedures/

Figure 2-1 | Loading zones in Washington, DC



M-NCPPC, VITA, Esri, HERE, Garmin, Intermap, USGS, NGA, EPA, USDA, NPS

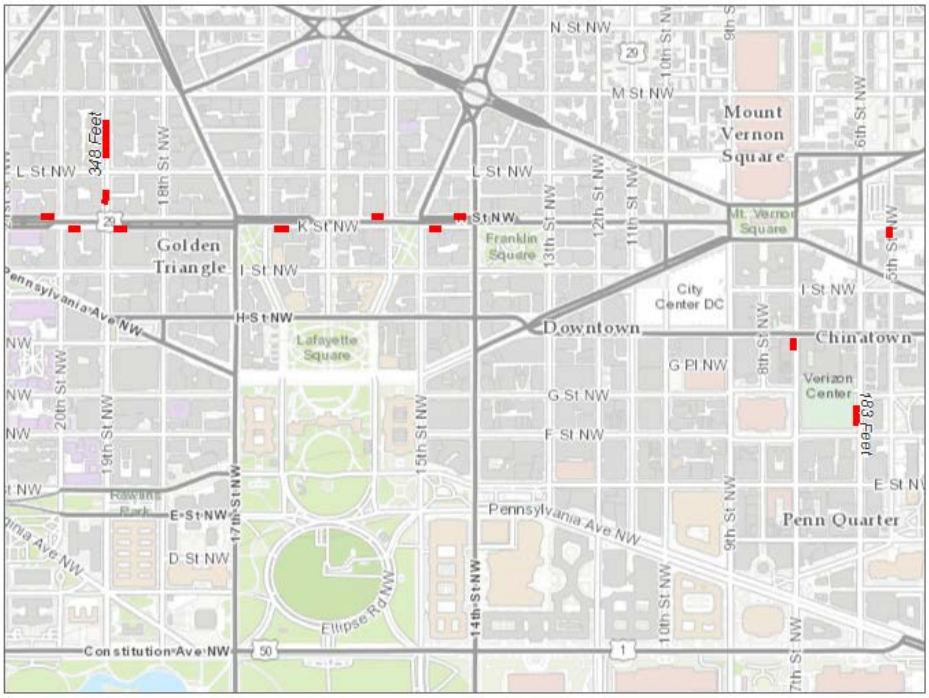
(source: DC Atlas Plus, http://atlasplus.dcgis.dc.gov/)

Table 2-1 | Loading zone length

Length (ft)	Frequency (N)	%
≤30	102	16.94
31-40	135	22.43
41-50	119	19.77
51-60	79	13.12
61-70	52	8.64
71-80	39	6.48
81-90	20	3.32
91-100	18	2.29
≥101	38	6.31
Total	602	100.00

(Data: DCGIS Open Data, http://dcgis.maps.arcgis.com)

Figure 2-2 | Loading zones (red bars) 100 ft. or longer in the two BIDs



(source: DC Atlas Plus, http://atlasplus.dcgis.dc.gov/)

2.1.2 Zoning Requirement

Per DC Municipal Regulation (DCMR), every building in the District should be provided with loading berths and spaces for service or goods delivery. Table 2-2 provides the DCMR recommended minimum number of loading berths or spaces required by land use. Table 2-3 shows the requirements for the physical dimensions of loading berths and service/delivery spaces.

Table 2-2 | Loading Berths and Service/Delivery Spaces

Use	Minimum Required Loading Berths	Minimum Required Service/Delivery Spaces
Basic utilities		
20,000 to 50,000 sq. ft. gross floor area	1	1
More than 50,000 to 200,000 sq. ft. gross floor area	2	1
More than 200,000 sq. ft. gross floor area	3	1
Food and alcohol services		
5,000 to 20,000 sq. ft. gross floor area	1	None
More than 20,000 to 100,000 sq. ft. gross floor area	2	1
More than 100,000 sq. ft. gross floor area	3	1
Retail		
5,000 to 20,000 sq. ft. gross floor area	1	None
More than 20,000 to 100,000 sq. ft. gross floor area	2	1
More than 100,000 sq. ft. gross floor area	3	1
Service		
5,000 to 20,000 sq. ft. gross floor area	1	None
More than 20,000 to 100,000 sq. ft. gross floor area	2	1
More than 100,000 sq. ft. gross floor area	3	1
Health care		
30,000 to 100,000 sq. ft. gross floor area	1	1
More than 100,000 sq. ft. gross floor area	2	1
Lodging		
10,000 to 50,000 sq. ft. gross floor area	1	None
More than 50,000 to 1000,000 sq. ft. gross floor area	2	None
More than 100,000 to 5000,000 sq. ft. gross floor area	3	None
More than 500,000 sq. ft. gross floor area	4	None
Office		
20,000 to 50,000 sq. ft. gross floor area	1	1
More than 50,000 to 200,000 sq. ft. gross floor area	2	1
More than 200,000 sq. ft. gross floor area	3	1

(Source: excerpted from Subtitle C, Title 11 of the DCMR)

Table 2-3 | Size and Layout Requirements

Minimum Requirements	Loading Berth	Service/Delivery Space
Width	12 ft	10 ft
Depth	30 ft	20 ft
Vertical Clearance	14 ft	10 ft

2.1.3 Recommendation from earlier studies

Challenges and recommendations related to commercial loading in DC were identified by several studies and are summarized in tables 2-4 and 2-5.

Table 2-4 | Identified Challenges from earlier studies for Washington, DC

Source	Challenge
DDOT Curbside Management Study (Nelson & Nygaard, 2014)	▪ Loading zones occupied by non-commercial vehicles ▪ Lack of loading zones ▪ Undersized loading zones ▪ Poor location ▪ Improperly timed loading zones
A Collaborative Plan for Curbside Freight Delivery in Washington, DC, USA (Jones et al., 2009)	▪ Double parking ▪ Demand for parking exceeding capacity of curbside on K Street, NW

Table 2-5 | Recommendations from earlier studies for Washington, DC

Source	Recommendations
Multimodal Long-Range Transportation Plan (MoveDC, 2014)	▪ Color-designated loading zones for strict enforcement ▪ Expand am parking restrictions to 10 am ▪ Eco-Loading zones for low emission vehicles ▪ Improve signs of curbside parking restrictions ▪ Dynamic pricing and reservations system to encourage off-peak deliveries
DDOT Freight Plan Final Report (CDM Smith, 2014)	▪ Expand morning parking restrictions to 10 am ▪ Create Eco-Loading Zones ▪ Improve signs of curbside parking restrictions ▪ Strict enforcement of parking regulations in a commercial vehicle zone ▪ Install parking meters for commercial vehicles
Urban Freight Case Studies: Washington, D.C. (FHWA, 2009)	▪ Longer loading zones in order to increase the supply of loading areas ▪ Metered loading zones in order to increase vehicle turnover
A Collaborative Plan for Curbside Freight Delivery in Washington, DC, USA (Jones et al., 2009)	▪ Longer loading zones ▪ New multi-space meters
District of Columbia Motor Carrier Management and Threat Assessment Study (DDOT, 2004)	▪ Improve enforcement of parking regulations in loading zone ▪ Install parking meters in loading zone ▪ Relocate loading zones ▪ Encourage off-peak deliveries in non-residential areas. ▪ Coordinate with the industries that generate significant truck activities to develop appropriate plans. ▪ Review curbside restrictions to ensure at least one available loading zone per block in the downtown ▪ Ensure all new construction has appropriate off-street loading spaces ▪ Create a program for courier vehicles to purchase parking rights to certain spaces

The objectives of this study (Section 1) take into consideration many of these recommendations. The results of the study expected primarily to help develop policy framework for on-street parking and loading berths by identifying the following issues at the study buildings:

- Occupancy of loading zones by non-commercial vehicles
- Adequacy of loading zones
- Location-related challenges
- Improperly timed loading zones
- Prevalence of double parking
- Demand-supply dynamics of parking

3. Literature Review

To meet the first objective of the study, the study team conducted a comprehensive review of the state of the practice in loading zone ordinances, surveys of establishments in freight trip generation and parking needs. The literature review[4] includes not only peer-reviewed journal articles, but also practice-oriented publications from National Cooperative Freight Research Program (NCFRP) and other sources. This section provides a review of published documents. The review is grouped into four sections as follows:

1. Loading zones
2. Freight trip generation
3. Establishment survey
4. Service and courier vehicles

General information related to loading zone policy such as the role of loading zones, their importance, and challenges is summarized in the first section. The second section summarizes general information, data requirements, estimation techniques, and the applications of freight trip generation models. Establishment surveys, one of the data collection methods for freight trip generation, were reviewed in the third section. Service trips and courier vehicles, which have traditionally been excluded from the freight planning process, were reviewed in the fourth section. The fifth section identifies current conditions and policies in Washington, DC. This review also identified several challenges and potential solutions for loading zones in Washington, DC.

[4] This comprehensive literature review was primarily conducted by Mr. Woojung Kim, a graduate student at Virginia Tech.

3.1 Loading Zones

3.1.1 Overview

Pick-up and delivery of goods are essential not only to economic activities but also have a safety implication in urban areas (Wegmann, 1996; Walter, 2001). Urban freight delivery requires spaces on-street or off-street for their loading/unloading activities. However, as many cities do not have enough off-street loading spaces, most trucks are forced to stop along the curbside for the loading/unloading of goods for nearby buildings (Wegmann, 1996). Lack of curbside space and competing curbside demands in urban areas lead to double parking problems, delivery slow-down, and ultimately a negative impact on other traffic flow and vulnerable users causing traffic congestion and an increase in opportunity for conflicts between users and trucks (Jones et al. 2009). Even when off-street loading spaces are available in a block, trucks have difficulty using them since other users (e.g., automobiles/personal vehicles, dumpsters) frequently occupy those spaces (Chatterjee et al. 2008). Therefore, allocating an appropriate amount of curbside space for loading/unloading activities is crucial (Holguín-Veras et al., 2015; Friebele, 2005).

Loading zone policy is one of the local policy tools available to manage the last-mile delivery operations in an urban area. The District of Columbia Department of Transportation (DDOT) defines a loading zone as "a space adjacent to a curb for exclusive use of commercial vehicles during the loading or unloading of materials" [5]. The number and the design of loading zones/spaces is typically determined by local authorities. Wegmann (1996) described that loading zones should be designed at least 40 ft in length and provided on every block of Central Business District. Adequate loading zones are important for freight activities to serve business and commercial establishments (Chatterjee, 2004; Chatterjee, 2006). For example, 27% of the Washington, DC's revenues are generated within 200 ft of loading zones and 15.8% of all jobs in the area are affected by truck freight activities (Cleckley, 2015). Inadequate supply of loading zones is costly to freight carriers, shippers, receivers, and consumers. For example, FedEx and Coca-Cola paid $8.2 million and $1.9 million respectively for parking tickets in New York City during 2005-2006 fiscal year (Chatterjee, 2006). Adequate loading zone policies are important not only for providing access to deliveries but also minimizing the impact of freight activities on traffic congestion and parking supply (Zalewski et

[5] Title 18 of the DC Regulation, http://regulations.dev.dcdecoded.org/18/18-99/18-9901/

al. 2012), and safety. Despite the importance of loading zones in the urban freight system, truck loading zone issues have yet to receive adequate attention from transportation engineers and planners.

Several documents addressed loading zone challenges in urban areas. The lack of loading zones for loading/unloading activities is one of major problems faced by truck drivers in their last-mile deliveries. Pivo et al. (2002) interviewed drivers in Seattle to identify challenges related to use of curbside loading zones. These drivers identified the lack of designated loading zones and a too short time limit of 30 minutes for parking in loading zones to make multiple deliveries. The lack of loading zones results in traffic congestion (e.g., double parking), increased time circling blocks waiting for proper spaces, dangerous situations for vulnerable street users (e.g., bicycles, pedestrian), additional costs (e.g., slow down delivery, parking tickets), and ultimately impacts on business/commercial vitality (Holguín-Veras et al. 2015, Giuliano et al. 2013, Rhodes et al. 2012). In addition to insufficient loading zones to meet the loading/unloading demand, other users (e.g., passenger cars) occupy existing truck loading zones compounding space issues (Rhodes et al. 2012). Since frequent non-truck parking in loading zones contributed to a decrease in loading zone availability, the most frequent parking violation for trucks in Washington, DC was double parking (Richards et al. 2016). The freight stakeholder survey results showed that lack of loading zones and occupied loading zones are the major problems in Washington, DC (Cleckley, 2015).

NCFRP Report 14 (Rhodes et al. 2012) presented potential solutions to improve loading zone management including providing more and larger loading zone spaces for trucks, strict enforcement, and longer times of day for commercial vehicles. Providing more loading zones can reduce delays caused by trucks and reduce environmental impacts in urban areas (Giuliano et al., 2013). New York City Department of Transportation (NYCDOT) established Commercial Vehicle Parking Plan to improve the management of loading zones in Midtown area. This plan included providing more loading zones and increasing enforcement. As a result, the number of double-parked vehicles significantly reduced (FHWA, 2009). However, provision of more and longer loading zones is not always possible due to the lack of spaces or high investment costs. A survey to identify challenges and potential solutions to loading zone issues was conducted by Walter (2001) and Pivo et al. (2002). Walter (2001) conducted a survey for four groups, namely, carriers, developers/businesses, consultants/architects, and cities/counties. The survey results indicated that:

1. the provision of adequate spaces for loading/unloading activities should be addressed more directly to improve safe and efficient freight mobility in urban area, and
2. widely accepted truck trip generation rates should be developed for the provision of off-street loading spaces.

In a study by Pivo et al. (2002), interviewees provided suggestions to improve loading zones including that loading zones should be 1) at least 30 feet long, 2) located at the ends of blocks, and 3) reserved exclusively for truck loading/unloading activities. NCFRP Report 33 (Holguín-Veras et al., 2015) provided general recommendations including updating existing outdated regulations and land use codes and rezoning since current practices cannot accommodate the growing demand for trucks. Wegmann (1996) and Chatterjee (2004) indicated that the service vehicles should not be allowed to park in loading zones since service vehicles tend to park and stay for a significantly longer time period than commercial vehicles loading and unloading.

3.1.2 Case Study: Loading Zone and Commercial Vehicle Parking Study (Conway et al, 2016)

University Transportation Research Center (UTRC)-Region 2 investigated existing available parking spaces and parking violation behavior for commercial vehicles in Manhattan, NY. This study used NYCDOT's STATUS parking database to examine parking supply by location and time of day. The distribution patterns of violations in each type of land use area were also analyzed using census tract data. The results indicated that there is a lack of available parking spaces for commercial vehicles due to high violation rates.

The study developed a commercial vehicle parking duration model using an existing observation dataset. The results showed that service and other deliveries make parking duration longer, and illegally parked vehicles park for a shorter period. It is not clear from the report if shorter duration for illegal parking is because the driver had to make parking time as short as possible or due to the nature of the types and size of goods delivered. See Table 3-1 for the estimated regression model.

Table 3-1 | Estimated regression model (source: Conway et al, 2016)

Variable/Parameter	Coefficient	t-statistic	Hazard Ratio	Hazard Ratio t-statistic
Constant	3.025	20.93	---	---
V_Van	-0.471	-2.83	1.61	2.28
D_Servic	0.729	3.34	0.48	4.71
D_Other	0.767	4.42	0.46	6.72
D_Unknow	-0.975	-2.91	2.67	1.79
I_DP	-1.003	-5.85	2.75	3.25
I_NP	-0.659	-1.59	1.94	1.16
OfficerP	0.647	2.53	0.52	3.43
Log Likelihood	-268.37			
Number of observations	177			
Weibull parameter P	1.00839			
Note - V_Van: Van, D_Servic: Service delivery, D_Other: known delivery that is not parcel, food/drink, or service, D_Unknown: unknown delivery type, I_DP: vehicle was double parked, I_NP: vehicle parked in other no parking/standing zone, OfficerP: parked vehicle passed by police officer				

The study presented the following recommendations to improve curbside management:

1. updating zoning requirements for commercial vehicles to provide additional loading zones in residential areas,
2. updating parking regulations in residential areas to prevent parking violations (e.g., provision of dedicated parking spaces),
3. evaluating time-variable regulations due to rapidly changing demands,
4. evaluating dedicated commercial parking regulations since different types of commercial uses have different parking durations (parcel delivery/service vehicle), and
5. considering the trade-offs between the cost of designated curbside space and parking violation costs in street design.

3.2 Freight Trip Generation

3.2.1 Overview

Freight Trip Generation (FTG) modeling is a process that estimates the number of vehicle trips produced at and/or attracted to a given establishment (Holguín-Veras et al., 2017). FTG models provide useful information to transportation-related decision-making process. According to Fischer

and Han (2001) and Kawamura et al. (2005), freight trip generation data can be used for a variety of needs including:

1. estimating impact of new development on traffic patterns, air pollution,
2. designing of off-street loading spaces,
3. estimating the needs for access improvements and parking facilities, and
4. development of truck routes.

Despite its importance to the freight system, FTG models are yet to receive comparable attention from transportation engineers and planners when compared with trip generation for passenger vehicles (Fischer and Han, 2001). Also, the public sector has difficulty in collecting freight transportation data because most private organizations are not willing to provide their sensitive business information (Pendyala et al. 2000).

Major industries that usually generate freight trips are retail trade, wholesale trade, and accommodations and food services (Holguín-Veras et al., 2017). There are many different factors that affect freight trip generation. NCFRP Report 19 summarized the findings regarding factors affecting freight trip generation including employment, building area, establishment, land use, and commodity type (Holguín-Veras et al. 2012).

In addition to freight trip generation, Holguín-Veras et al. (2017) indicated that service trips are an important component of the truck trips generated by commercial establishments, but they have been overlooked in truck trip generation modeling process. Service Trip Generation (STG) is the number of service trips generated at a commercial establishment by technicians or service providers. The major industry sectors that usually generate service trips include professional, scientific, and technical services, health care and social assistance, and administrative, and waste management (Holguín-Veras et al., 2017).

Holguín-Veras et al. (2012) presented widely used modeling techniques to estimate freight trip generation. FTG rate is the simplest and most widely used technique. FTG rate can be calculated as total freight vehicle trips generated divided by an independent variable (e.g., employment, building area). Regression modeling technique was used to find statistical relationships between vehicle trips and these independent variables using ordinary-least-square method (Holguín-Veras et al., 2012).

Table 3-2 lists the research reports on freight trip generation and provides a summary of the data used for FTG models. From this research, the following insights are provided. There are limited FTG data and models available in the literature and existing establishment-level FTG data for the DC are quite old. Most of the literature classifies commercial vehicles by weight (light, medium, and heavy) or number of tires (4-tire vehicles and 6+ tire vehicle), not by trip purpose. Service trips typically require longer parking times at the curbside (Holguín-Veras et al. 2015). Therefore, collecting separate data for freight trips and service trips is important for evaluating loading zone use.

Table 3-2 | Truck Trip Generation Data Sources

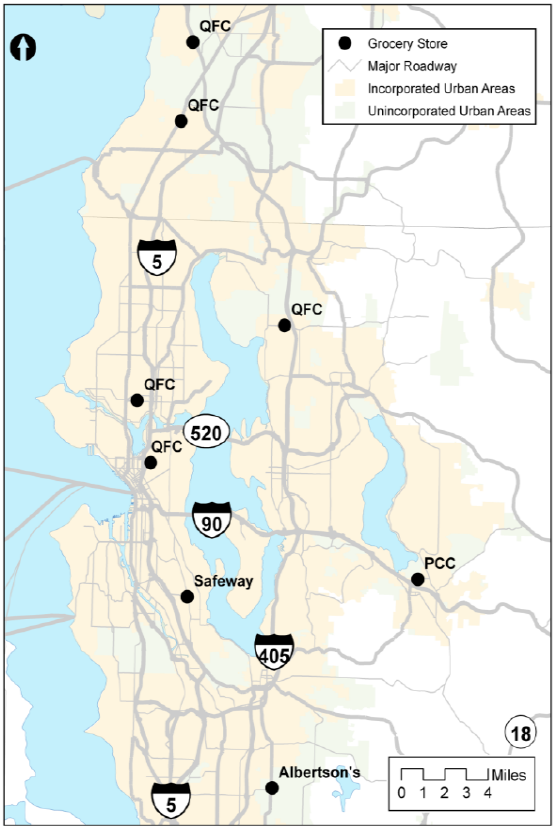
Source	Data Description
QRFM (FHWA, 1996)	· Truck trip generation rates for different locations, land uses, and vehicle classifications - per employee - per 1,000 square feet - per acre · Regression models by location, land use, and vehicle classification
ITE Trip Generation Manual (ITE, 2012)	· Summary of truck trip generation data from several studies including: - Truck trip generation rates by land use in Australia - Truck stops by land use in suburban Baltimore - Truck trip rates per employee in Tampa - Truck trip generation rates in Fontana, CA
NCHRP Synthesis 298 (Fischer and Han, 2001)	· Literature review on: - Compendia of trip generation data including ITE Trip Generation Handbook and QFRM - Engineering studies - Special generator studies - Ports and intermodal terminal data - Vehicle- and commodity-based travel demand models
NCFRP Report 19 (Holguín-Veras et al. 2012)	· Literature review on freight generation and freight trip generation modeling practices · An electronic database for comprehensive freight trip generation models
NCFRP Report 37 (Holguín-Veras et al. 2017)	· Establishment-level regression models to estimate - Freight trip generation including freight trip production and attraction - Freight production - Service trip attraction

3.2.2 Case Study: Truck Trip Modeling (FTG)

Grocery Stores in Seattle (McCormack et al, 2010)

Eight grocery stores were selected in the Puget Sound metropolitan area for this study as shown in Figure 3-1. These stores include five Quality Food Centers (QFC), one Safeway, one Albertsons, and one Puget Consumers Co-op (PCC) Natural Market. Data were collected by telephone interview and manual on-site truck counts/observations. The phone interview for individual grocery stores includes questions about a) typical hours of deliveries, b) the location for accepting delivery, c) average number of truck deliveries per day, and d) variation between weekdays or season, and e) whether there were specific days for specific products. Experienced vehicle counters conducted manual truck counts. The proper counting locations were determined from Google Earth and Google Street Views. Two to four counters observed the following information for each site; a) total trucks observed, b) delivery location (front door or loading dock), c) type of truck, and d) arrival/departure time. The results from the manual count showed that an average of 18 trucks arrives at each store per day and an average delivery time for each truck was approximately 27 minutes.

Figure 3-1 | Geographic extent of grocery stores



(Source: McCormack et al. 2010)

This study also developed a multiple regression model with the data related to store characteristics and land use for estimating truck trips. The result is shown in Table 3-3. Square footage was the only statistically significant factor.

Table 3-3 | Regression Analysis Results

Variable	β	t	
(Intercept)	**12.2600**	**2.925**	
Employment	0.1852	2.334	
Square Footage	**-0.0002**	**-3.634**	
Median household income	0.0000	0.707	
Residential Density	-0.1328	-1.319	
Jobs-Housing balance	-0.6936	-0.573	
	N = 8		
	R2 = 0.8798		
Bold indicates p < 0.1			

(Source: McCormack et al.2010)

New York City Receivers and Carriers Study (Holguin-Veras et al, 2012)

This study analyzed the existing dataset of receivers and carriers in the New York City. The existing disaggregated data was collected from receivers and carriers in Manhattan and Brooklyn as part of a project with New York State Department of Transportation. They estimated freight trip production and freight trip attraction based on two different industrial classification systems (SIC and NAICS). Three different estimation techniques were used: constant rates per establishment (type S), linear models with an intercept and slope (type C), and multiple classification analysis (type E). The authors made a comparison between two industrial classification systems in terms of Root Mean Square Error (RMSE). As a result, for estimating freight trip attraction, SIC-based models have lower RMSE than NAICS-based models have. For estimating freight trip generation, NAICS-based models estimate better than SIC-based models. Final models are presented in tables 3.4 and 3.5.

Table 3-4 | Final NAICS-based models for FTP (trips/day) (source: Holguín-Veras et al. 2012)

Gr.	NAICS	Description	Obs.	Const. / Empl.		Best Model	RMSE
				c	b		
1	23	Construction*	9		0.068	E	1.586
2	31,32,33	Manufacturing*	28	2.214		S	3.599
	31	Food, beverage, tobacco, textile, apparel, leather & allied product manufacturing	13	2.846		S	4.990
	32	Wood, paper, printing, petroleum & coal products, chemical, plastics, nonmetallic & mineral manufacturing	7		0.023	E	0.648
	33	Metal, machinery, computer, electronic, electrical, transportation, furniture & misc. manufacturing	8	1.750		S	1.639
3	42	Wholesale Trade*	124	1.755	0.036	C	5.094
4	44,45	Retail Trade*	9		0.161	E	6.485
	44	Motor vehicle, furniture, electronics, building material, food & beverage, health, gasoline, & clothing stores	5	0.993	0.021	C	0.237
5	48,49	Transportation and Warehousing*	157	2.718	0.038	C	4.811
	48	Air, rail, water, truck, transit, pipeline, scenic & sightseeing, & support activities	153	2.725	0.038	C	4.005

** Group models; Gr – group model number, Obs – Number of observations*

Table 3-5 | Final SIC-based models for FTA (deliveries/day) (source: Holguín-Veras et al. 2012)

Gr.	NAICS	Description	Obs.	Const. / Empl.		Best Model	RMSE
				c	b		
3	15,16,17	Construction*	25	2.160		S	0.869
	15	General contractors & operative builders	7		0.129	E	0.938
	17	Special trade contractors	17	2.106		S	1.365
4	21-39	Manufacturing*	45	3.156		S	3.420
	23	Apparel & other finished products	7	3.571		S	1.178
	24	Lumber & wood products, except furniture	5		0.067	E	0.764
	25	Furniture & fixtures	6	2.167		S	1.067
	34	Fabricated metal products	4	1.500		S	0.500
	39	Miscellaneous manufacturing industries	5	2.280		S	0.280
6	50, 51	Wholesale Trade*	117	2.272	0.069	C	3.655
	50	Wholesale trade - durable goods	58	3.986		S	4.740
	51	Wholesale trade - nondurable goods	59	1.713	0.071	C	2.147
7	52, 53, 55, 56, 57, 59	Retail Trade*	84	3.371		S	5.384
	52	Building materials … & mobile home dealers	9		0.369	E	1.672
	56	Apparel & accessory stores	13		0.187	E	4.598
	57	Home furniture, furnishings, equipment stores	13	3.769		S	2.189
	59	Miscellaneous retail	47	3.349		S	4.067
8	20, 54, 58	Food*	83	1.826	0.090	C	4.813
	20	Food and kindred products	3	2.000		S	0.032
	54	Food stores	23		0.288	E	4.851
	58	Eating and drinking places	56	1.307	0.081	C	3.091

[*Gr. – group model number, Obs – Number of observations*]

On-Site Berths and Curbside Implications

New York City Whole Food Market Study (Holguin-Veras et al, 2012)

Whole Food Market is one of the largest grocery store chain providing high quality natural and organic foods. Five Whole Food Markets located in Manhattan, NY (Union Square, Columbus, Bowery, Tribeca, and Chelsea) were selected for this study. Available information from the same receiver's dataset discussed in the New York Receivers and Carriers above included number of daily deliveries per Whole Food Market store per time of day. The resulting information shown in Table 3-6, provides the number of deliveries per day for each store, week deliveries per employment, weekday deliveries per employment, and week deliveries per day.

Table 3-6 | FTG information for Whole Foods Market in Manhattan

Store name	Emp	Deliveries							Sub-Total	Week del/emp	Week del/emp	Week del/day	Vendors
		M	T	W	R	F	S	S					
W. F. Union Square (USQ)	173	26	28	27	26	30	15	7	189	0.92	0.16	22	46
W. F. Columbus (CIR)	193	35	48	40	34	36	9	9	211	1.09	0.20	30	87
W. F. Bowery (HOU)	167	25	25	23	13	13	13	3	115	0.69	0.12	16	58
W. F. Tribeca (TRB)	173	28	32	31	26	37	14	1	169	0.98	0.18	24	52
W. F. Chelsea (CHE)	140	32	27	36	33	30	11	4	173	1.24	0.23	24	68
Total	846	146	160	157	132	146	62	24	827	0.98	0.18	116	311

(Source: Holguín-Veras et al. 2012)

The authors also developed freight trip attraction model for grocery stores in Manhattan to compare patterns across the region in another study. Additional sample from grocery stores were supplemented with the Whole Foods Market study. The estimated regression model for Manhattan grocery stores is shown in Table 3-7.

Table 3-7 | Manhattan Grocery Stores Freight Trip Attraction Model

Variable	Name	Coefficient	t-value
Regression model			
Intercept	CONSTANT	5.731	2.133
Total employment	USEDEMPL	0.087	2.726
n (establishments)	31		
RMSE	4.92		
R^2	0.204		
Adjusted R^2	0.177		

(Source: Holguín-Veras et al. 2012)

Area-Based Freight Trip Generation Models (Jaller et al, 2014)

This study analyzed the performance of area-based FTG modeling compared with the employment-based FTG modeling for New York and New Jersey. Two FTG data sets from receiver/carrier surveys in 2006 and 2012 were used for this study. Since no significant relationship was identified between 2006 FTG data and area for this study, the authors developed employment based FTG models for 2006 based on the employment as a function of area. Three estimation technique were used: constant rates per establishment (type S), linear models with an intercept and slope (type C), and multiple classification analysis (type E).

Table 3-8 compares disaggregate and industry group employment and area-based (1,000s square feet) FTA models in terms of Root Mean Square Error (RMSE). The results showed that both area-based and employment-based modeling resulted in good estimations, but employment-based FTG modeling performed slightly better than area-based FTG modeling in terms of RMSE.

Table 3-8 | Comparison of RMSE (source: Jaller et al. 2014)

Industry sector	NAICS	Obs.	Employment-based				Area*-based		Area-based	
			2006 Diss.	2012 Diss.	2006 Grp.	2012 Grp	2006 Diss.	2006 Grp.	2012 Diss.	2012 Grp.
Construct.	23	25	1.364	n.a	1.364	n.a	1.364	1.364	n.a	n.a
Manufacturing	31	21	1.295	1.307	1.365	1.303	1.295	1.365	1.307	6.830
	32	10	5.483	6.141	5.709	5.849	5.483	5.709	6.141	6.094
	33	20	2.483	2.559	2.506	2.564	2.483	2.506	2.672	2.677
Wholesale	42	117	4.415	4.729	4.415	4.729	6.370	6.370	6.415	6.415
Retail	44	70	5.071	5.885	5.297	5.504	8.126	6.111	5.799	5.827
	45	29	4.352	4.352	4.803	4.968	4.352	4.919	4.563	4.562
A and F***	72	55	2.142	3.474	2.142	3.474	2.369	2.369	2.539	2.539

a) 2012 FTG data

Industry sector	NAICS	Obs.	Employment-based				Area*-based		Area-based	
			2006 Diss.	2012 Diss.	2006 Grp.	2012 Grp	2006 Diss.	2006 Grp.	2012 Diss.	2012 Grp.
Manufacturing	31	12	1.192	1.115	1.257	n.a	1.192	1.257	1.115	n.a
	32	12	3.150	1.208	1.801	n.a	3.150	1.801	1.275	n.a
	33	20	2.298	2.300	2.283	n.a	2.298	2.283	2.220	n.a
Wholesale	42	28	5.297	4.370	5.297	4.370	6.082	6.082	4.928	4.928
Retail	44	67	5.118	3.058	3.635	n.a	3.094	3.061	3.058	n.a
	45	33	3.580	3.420	3.674	n.a	3.580	3.674	3.663	n.a
A, E, R***	71	13	n.a	4.414	n.a	4.414	n.a	n.a	4.607	4.607
A and F***	72	9	6.050	5.457	6.050	5.457	0.53****	0.53****	0.50****	0.50****
Services	81	47	n.a	8.246	n.a	8.246	n.a	n.a	9.598	9.598

Notes: (*) Estimated using the relationship between employment and commercial area and 2006 Models; (**) Arts, entertainment, and recreation; (***) Accommodation and food services; (****) Only 4 observations; Highlighted cells show lowest RMSE value
Obs – number of observations, Diss – disaggregate model, Grp – group model

Freight Trip Generation Based on Land Use (Lawson et al, 2012)

This study developed freight trip attraction models based on three different land use classification codes: The City of New York Zoning Resolution (NYCZR), the Land-Based Classification Standards (LBCS), and the Institute of Transportation Engineers (ITE) manual. The LBCS system classifies land use according to the following dimensions: 1) *activity* as observable characteristics of actual land use such as farming, shopping, manufacturing, 2) *function* or the economic function such as agricultural, commercial, industrial, 3) *structure type* or type of building such as office building and warehouse, 4) *site development characteristic* or overall physical development such as parks and open spaces, and 5) *ownership* reflecting the relationship between land use and rights such as public and private. In

this study, commercial/manufacturing/residential districts were considered for NYCZR and the two dimensions (activity and function) of LBCS were included. Three modeling approaches (trip generation rates, ordinary least squares, and multiple classification analysis) were used for developing models. The data were collected from the survey for receivers of goods including questions about company attributes and FTG patterns. The data were complemented with the Dun and Bradstreet database which was used to categorize the size of the companies (small, medium, and large) based on the number of employees. The best suitable modeling approaches for each category were selected in terms of t-statistics and Root Mean Square Error (RMSE). The authors then compared the three land use classification systems. The results indicated that NYCZR and LBCS based freight trip attractions have 30% lower RMSE than ITE's model.

3.3 Service and Courier Trips

3.3.1 Overview

Service trips and parcel deliveries play an important role in the transportation system and are an important component of truck trips generated by commercial establishments, but they have been overlooked in the transportation planning process as well as in truck trip generation modeling process (Holguín-Veras et al. 2017). Parcel deliveries are another significant component of the transportation system in terms of value of goods, and they are growing fast due to its importance in modern commerce industry (Morlok et al. 2000).

According to the commercial vehicle survey in Denver (Denver Regional Council of Governments, 2001), trips for service calls were 13% of total commercial vehicle trips. Corpus Christi commercial vehicle survey (Texas A&M Transportation Institute, 2012) made a comparison between cargo vehicles and service vehicles in terms of total number of trips, trips per vehicle, trip length, and vehicle miles traveled (VMT). Chatterjee and Cohen (2004) conducted a study for commercial vehicles in the urban transportation planning models. For the study, commercial vehicles were divided into three groups by purpose: 1) Commercial passenger vehicles (e.g., school bus, taxi, paratransit, rental cars), 2) Freight vehicles (e.g., package & mail delivery, freight delivery, construction transport), and 3) Service vehicles (e.g., utility vehicle, public service, business & personal service, safety vehicle). They estimated trip rates, Vehicle Miles Traveled (VMT), time of day and other travel characteristics based on the data from commercial vehicle surveys, vehicle

registration, vehicle count data, and travel surveys in several urban areas. As a result, they found that commercial vehicles make up 6 to 18 percent of total VMT in the urban areas and concluded that the commercial vehicles should be included directly in urban transportation planning models. Travel characteristics found in their study for package and mail delivery and utility service vehicles are summarized as below.

- Package & mail delivery vehicles:
  - 72% of all trips are made during the day (9am to 3pm) by light vehicles.
  - Delivery tips are concentrated in high employment area. The number of delivery trips can be estimated by the number of household or employment in the study area (0.005 per number of area employees, 0.01 daily trips per employee, and 0.02 trips per household).

- Utility service vehicles:
  - 55% of all trips are made during the pm peak, 41% in the midday, and 4% at night.
  - Utility service trips can be estimated by population, acreage, and employment (0.001 per population)
  - 0.3% of total VMT
  - Vehicle composition: Trucks (43%), passenger autos (30%), and garbage trucks (27%) where trucks consisted of delivery vans and heavy-duty pickup trucks and passenger autos included general pickup trucks, light-weight vans and SUVs.

3.3.2 Service Trip Generation

Service Trip Generation (STG) is defined as the number of service trips generated at a commercial establishment by technicians or service providers. The major industry sectors that usually generate service trips include professional, scientific, and technical services (NAICS code 54), health care and social assistance (NAICS code 62), and administrative, waste management (NAICS code 56) (Holguín-Veras et al., 2017).

Case Study: Service and Supply Trips at the Office Buildings

Spielberg and Smith (1981) surveyed service and supply trips to eleven Federal office buildings in the Washington D.C. metropolitan area. The authors defined service and supply trips as “trips in which a service was performed or in which some type of commodity was either picked up or delivered”. The

field observers identified vehicle type, arrival and departure time, trip purpose, and type of commodities or services. Table 3-9 shows the service and supply trip generation rates.

Table 3-9 | Service and Supply Trip Generation Rates

Site	Daily trips	Trips per employee	Trips per 1,000 square ft	Trips per loading dock
Cameron Station	128	0.038	0.153	N/A
Department of Commerce	91	0.019	0.089	11
Government Printing Office, North Capitol	265	0.050	0.278	15
Government Printing Office, Franconia	21	1.235	0.142	7
Government Printing Office, Eisenhower	19	0.107	0.186	5
Hoffman Building	34	0.007	0.044	9
National Bureau of Standards	65	0.021	0.049	7
National Park Service	104	0.889	N/A	N/A
National Research Laboratory	63	0.014	0.041	N/A
Pentagon	219	0.009	0.058	15
Veterans Administration Hospital	26	0.015	0.067	7

(source: Spielberg and Smith, 1981)

Case Study: Service Trip Attraction in NYC (Holguin-Veras et al, 2017)

Holguín-Veras et al. (2017) developed the first Service Trip Attraction (STA) models in the published literature. The data were collected using establishment surveys from 280 respondents in the New York City (NYC) metropolitan area and 170 from the New York State Capital Region (CR). The survey questions include the number of service trips received, type of vehicle, most common types of planned and emergency service trips, and percentage of planned and emergency service trips that occur during business hours and non-business hours. The linear regression models for NYC are shown in Table 3-10.

Table 3-10 | STA Linear Model (STA=α+β*Emp)

NYC - STA (trips /day)							
NAICS	Description	α	β	Obs.	Employment		
					Min.	Mean	Max.
23	Construction	-	3.92E-03	6	12	72	201
31-33	**Manufacturing**	**0.251**	**-**	**29**	**3**	**89**	**309**
31	Food, Beverage, Tobacco, Textile, Apparel	0.167	-	3	100	142	184
32	Wood, paper, chemical, plastics, nonmetals	0.233	-	15	3	61	223
33	Metal, machinery, electronic, furniture & misc.	0.298	-	11	12	115	309
42	Wholesale	0.266	-	13	10	92	355
44-45	**Retail Trade**	**0.248**	**-**	**13**	**11**	**52**	**125**
44	Motor vehicle, furniture, electronics, clothing	0.295	-	10	11	48	125
45	Sporting goods, hobby, book & music stores	0.091	-	3	45	68	91
48	Modal Transportation & Support Activities	-	9.25E-03	6	8	42	100
51	Information	0.804	-	13	15	209	900
52	Finance and Insurance	0.428	3.22E-04	10	15	844	4000
53	Real Estate	-	9.15E-04	7	17	137	405
54	Professional, Sci and Tech Services	-	1.10E-03	7	65	514	2000
56	Administrative and Waste Services	0.393	-	11	40	159	523
61	Education Services	-	2.77E-03	11	10	84	177
62	Health Care and Social Assitance	1.126	-	9	40	152	500
71	Entertainment	0.879	-	12	13	75	300
72	Accomodation and Food Services	-	0.017	12	6	32	79
81	Other Services (except Public Admin	0.571	-	7	31	114	305
All	**All Sectors - Weighted**	**0.420**	**4.10E-04**	**156**	**3**	**167**	**4000**

(source: Holguín-Veras et al. 2017)

3.3.3 Service Vehicle and Courier Vehicles in Loading Zone

Wegmann et al. (1996) made a distinction between trucks, courier vehicles, and service vehicles for loading zones: 1) trucks are pick-up and delivery trucks carrying freight, 2) courier vehicles are small vans carrying small packages, and 3) service vehicles are small vans or automobiles for service activities (e.g., electricians, plumbers, or machine service) and they tend to park for a significantly longer time period than other vehicles. Wegmann et al. (1996) and Chatterjee (2004) indicated that the service vehicles should not be allowed to park in loading zones due to their length of stay that they do not actively load and unload goods. In Washington DC study, vehicles for goods movement

on the curbside made up for 31.6% and service vehicle made up for 5.8% (as cited in Wegmann et al. 1996).

To balance conflicting demands for curb space between package delivery vehicles, freight vehicles, courier vehicles, and other vehicles, Philadelphia Parking Authority established 36 package delivery zones in central business district (Dickson, 2015). Package delivery zones are explicitly for registered parcel delivery companies to remove package delivery vehicles from truck loading zones.

3.4 Establishment Survey

Various survey techniques can be used for collecting urban freight data to develop FTG models. FHWA (2007) provides several survey techniques used for FTG modeling.

3.4.1 Vehicle Classification Counts.

Collecting vehicle classification counts is a common local freight data collection method. It is typically conducted by manual observation/videography/loop detectors/pneumatic tubes. Counts by truck classification provide input data for developing FTG regression model and FTG rates model.

Establishment Surveys. Establishment surveys provide inputs for FTG modeling such as economic, land-use, and freight activity characteristics. This survey can be conducted by telephone interviews or a mail-out/mail-back method. Inputs collected from establishment surveys include number of employees, facility area, and commodities handled. For vehicle delivery/collection trips at establishments, the following topics need to be collected through the survey: 1) type of establishment, 2) employees at establishment, 3) number of deliveries/collections, 4) frequency, 5) time of day, 6) variation by day of week or during year, 7) type of vehicle, and 8) deliveries made by vehicles at the establishment (Allen and Browne, 2008).

The establishment survey is the main method to collect data for freight trip generation modeling and an essential part of understanding freight activities (Allen and Browne, 2008; Beagan et al. 2007), because the establishment-level data provides useful information such as the relationship between freight activity and employment (Holguín-Veras et al. 2017). According to Beagan et al. (2007), establishment survey result can provide information related to economic, land use, and characteristics of freight activities and can be key inputs for the freight modeling process. The

following data can be collected through the establishment survey for developing FTG models including trip rates and regression models (Beagan et al. 2007; Allen and Browne, 2008):

- The number of employees,
- Site area,
- The number of deliveries,
- Frequency,
- Time of day,
- Variation by day of week or season,
- Whether vehicles based at establishment, and
- Type of vehicle.

Holguín-Veras et al. (2012) presented prototype of establishment survey for FTG modeling as part of the NCFRP project 25. They developed a survey to collect data on 1) basic establishment information, 2) type of business, 3) number of employees, 4) total site area, 5) number of vehicles operated from the establishment, 6) type of cargo produced/received by the establishment, and 7) number of trips related to goods/services coming in and out of the establishment.

McCormack et al. (2010) conducted establishment phone interviews to collect data for developing FTG models for the grocery stores in the Puget Sound metropolitan area. The questions included a) typical hours of deliveries, b) the location for accepting delivery, c) average number of truck deliveries per day, and d) variation between weekdays or seasons, and e) whether there were specific days for specific products.

To examine variables affecting FTG, Iding et al. (2002) designed a large-scale survey for collecting establishment data in the Netherlands. The survey included questions about 1) type of business, 2) site and floor area, 3) number of employees, and 4) number of trucks per day per type of vehicle coming in and out of the establishment. The survey was conducted through the postal and on-line methods, and the response rate was 15% (1,529 respondents).

To find participants in an off-peak delivery pilot project in Chicago, the receivers and carriers survey was conducted by LaBelle and Frève (2016). The survey questions included questions about 1) number of deliveries, 2) the time of deliveries, 3) the location of deliveries (e.g., loading dock or on

the street), 4) delivery frequency, time of delivery, and type of truck, and 5) other questions related to shifting receipt of deliveries to off-peak hours.

4. Truck Loading Provisions in Building Code and Zoning Regulations for Selected Major U.S. Cities

The review activity discussed in this section was conducted to meet the first objective of the study. This section provides a review of current building codes/zoning regulations related to required accommodations for truck loading/unloading at and near commercial buildings for selected major United States cities. The information gathered in this exercise is expected to provide a basis and framework for assessing best practices in building code provisions and regulations that accommodate the need for commercial establishments to be able to receive/ship freight, parcel, and package deliveries balanced with reducing traffic flow impediments in dense urban environments. This project element does not evaluate the success of any given city in achieving a balance between truck loading/unloading/freight mobility and overall traffic flows, nor does it seek to quantify the degree to which the identified codes and regulations are enforced, or requirements waived in the permitting process.

4.1 Overview and Summary

The cities selected by District of Columbia Department of Transportation (DDOT) staff and the research team at George Mason University and Virginia Tech (research team) include: New York City, Philadelphia, Chicago, Seattle, and San Francisco. These cities were selected to be especially relevant to the District of Columbia because of high density urban environments, exceptionally high real estate values where building operations and construction costs dictate that non-revenue space be minimized (assuming that freight loading and unloading spaces are “overhead” in nature and are not directly revenue generating), with high degrees of urban traffic congestion that impedes commuter and freight mobility and is exacerbated by on-street truck loading and unloading.

While the cities included in this review often have design specifications for parking features related to establishments in traditional residential areas, such as schools, libraries, places of worship, and community centers, we focus our review on regulations related to commercial buildings and multifamily residential mixed-used buildings in downtown settings.

In general, we found common ground among the regulations among the selected cities in the treatment of mixed-use developments. For mixed-use buildings, off-street loading requirements are based on the cumulative gross floor area by use as listed in designated code tables.

4.2 New York City

In New York City, these rules are specified in the *Zoning Resolution* and are defined for the three types of zones – residential, commercial, and manufacturing. The requirements for size and dimensions for commercial and manufacturing districts are similar, but the residential area regulations include specific community-related buildings, such as community centers, houses of worship, schools, libraries, etc. The residential regulations are more for parking spaces than truck loading/unloading. Truck loading and unloading on the street in commercial areas is permitted with a time limit, but commercial buildings require special "accessory" off-street parking/ loading areas depending on type of establishment/ activity, and size of the building "floor area." Table 4-1 shows the off-street (loading dock) berth requirements for New York City for land uses most relevant to this study. Requirements for other land uses can be found in Appendix A. Detailed definitions of the New York City Zoning Code designations can be found at:
https://www1.nyc.gov/site/planning/zoning/districts-tools/use-groups.page

Table 4-1 | City of New York Truck Berthing Requirements (most relevant for downtown settings)

Building Type	Zoning Code Designation	Requirement
Hospitals and related facilities, prisons	C1, C2, C3, C4, C5, C6, C8	10,000-300,000 sf: 1 berth Each additional 300,000 sf or fraction: 1 berth
Hotels, offices, court houses	C12, C22, C3, C4-1, C4-2, C4-3, C8-1, C8-2	25,000 – 100,000 sf: 1 berth Next 200,000 sf: 1 berth Each additional 300,000 sf or fraction: 1 berth
Hotels, offices, court houses	C13, C1-6, C1-7, C1-8, C1-9, C23, C2-6, C2-7, C2-8, C4-4, C4-5, C4-6, C4-7, C5, C6, C8-3, C8-4	100,000-300,000 sf: 1 berth Each additional 300,000 sf or fraction: 1 berth
Commercial Retail, Amusement, Services (not hotels)	C12, C22, C3, C4-1, C4-2, C4-3, C8-1, C8-2	8001-25,000 sf: 1 berth Next 15,000 sf: 1 berth Next 20,000 sf: 1 berth Next 40,000 sf: 1 berth Each additional 150,000 sf or fraction: 1 berth
Commercial Retail, Amusement, Services (not hotels)	C13, C1-6, C1-7, C1-8, C1-9, C23, C2-6, C2-7, C2-8, C4-4, C4-5, C4-6, C4-7, C5, C6, C8-3, C8-4	25,001- 40,000 sf: 1 berth Next 60,000 sf: 1 berth Each additional 150,000 sf or fraction: 1 berth

Waivers to any of these requirements can be made when the Commissioner of Buildings determines there is no way to arrange the required berths for street access in compliance with other city codes. The size requirements for berths are shown in Table 4-2.

Table 4-2 | New York City Truck Berth Minimum Dimension Requirements (linear feet)

Use	Length	Width	Vertical Clearance
Hospitals and related facilities or prisons	33	12	12
Funeral establishments	25	10	8
Hotels, offices or courthouses	33	12	12
Commercial uses*	33	12	14
Wholesale, manufacturing or storage uses:			
- with less than 10,000 square feet of floor area'	33	12	14
- with 10,000 square feet of 'floor area' or more	50	12	14

4.3 Philadelphia

The requirements for off-street loading areas are determined by type of establishment and according to type of zoned district (Commercial, Industrial, Residential). These are defined in Title 14 (Zoning and Planning), Chapter 14 (Parking and Loading), Section 8 (General Requirements for all Districts) of the *Philadelphia Code*. There are also special Commercial Mixed Use and Industrial Mixed Use Districts with different requirements. Table 4-3 below reproduces the Commercial District portion of Table 14-801-1 in the Philadelphia Code. Truck berth requirements in other Land Use Districts are described in Appendix B.

Table 4-3 | Truck Berthing Space Requirements for Commercial Districts in Philadelphia.

Description	Square Feet	Number of Truck Berths
Office, Hospital, Public, Civic, Institutional, Hotel, Residential	100,000-150,000	1
	150,001-400,000	2
	400,001 – 660,000	3
	660,001-970,000	4
	970,001-1,300,000	5
	Over 1,300,000	1 additional space per each additional 350,000 sf
All Other Permitted Uses	20,000-40,000	1
	40,001-100,000	2
	100,001-160,000	3
	160,001-240,000	4
	240,001-320,000	5
	Over 320,000	1 additional space per each additional 90,000 sf

There are special districts that have substantially fewer berth requirements for residential buildings, which are generally capped at 3 spaces for buildings that are greater than or equal to 500,000 square feet. Table 4-4 shows the requirements for the physical dimensions of truck berths in the Philadelphia Code.

Table 4-4 | Off-Street Truck Berth Minimum Dimensions

Required Loading Space	Dimensions
1	10 ft. wide, 40 ft. long, 14 ft. high
2*	11 ft. wide, 60 ft. long, 14 ft. high
3	10 ft. wide, 30 ft. long, 14 ft. high
4	10 ft. wide, 40 ft. long, 14 ft. high
5*	11 ft. wide, 60 ft. long, 14 ft. high
Each Additional	10 ft. wide, 30 ft. long, 14 ft. high

* Except where access

4.4 Chicago

The City of Chicago provides basic guideline for loading facilities that include:

- When City Council allows alley access, all loading facilities must be located behind the building or otherwise screened from visibility from the public right-or-way and should be accessed from the alley.
- No loading spaces may be located within 25 feet of the nearest point of intersection of any two streets.

- No loading spaces may be located in a required front setback or side setback.
- Any loading spaces located in a required rear setback must be open to the sky.

Table 4-5 shows the minimum requirements of loading spaces by land use and gross floor area of buildings in the City of Chicago.

Table 4-5 | City of Chicago Minimum Truck Berth Requirements

Use	Gross floor area (sq. ft.)
Multi-Unit Residential, Lodging, Group Living and all uses in Public and Civic Use Group	25,000-199,999 sf: 1 berth 1 additional berth for each 200,000 sf or fraction
Retail	10,000 to 24,999 sf: 1 berth 25,000 to 49,999 sf: 2 berths 50,000 to 99,999 sf: 3 berths 100,000 to 249,999 sf: 4 berths 1 additional berth for each 200,000 sf or fraction
Commercial (uses in Commercial Use Group for which loading standard is not otherwise specified in this schedule)	25,0000-499,999 sf: 1 per each 100,000 sf or fraction 500,000+ sf: 1 per each additional 500,000 sf or fractions

Off-street loading requirements

- Each required off-street loading space must be designed with appropriate means of vehicular access to a street or alley in a manner which will least interfere with traffic movements, subject to approval by the Commissioner of Transportation.
- Every building which faces or abuts upon a public alley where freight, goods, and other commodities are loaded or unloaded through rear doors onto and from any vehicle, shall be equipped with a movable, rolling, folding or collapsible platform, so that such vehicle may stand parallel with the building from which said loading or unloading is done; provided, however, that whenever it may not be practical to load or unload any vehicle when thus placed in a parallel position to any building by reason of large, bulky, unwieldy or cumbersome freight, goods, or other commodities required to be loaded or unloaded, such vehicle may then be placed in a crosswise or cross-alley position.

Table 4-6 shows the minimum berth sizes required by land use and building size. There are no listed height restrictions found in our initial review, but these may be listed elsewhere in applicable regulations.

Table 4-6 | Truck Berth Size Minimums for the City of Chicago

Use	Truck berth minimum (ft)
Multi-Unit Residential	10 X 25
Lodging, Group Living and all uses in Public and Civic Use Group	10 X 25 10 X 50 for buildings over 50,000 sf
Retail	1 berth: 10 X 25 2+ berths: 10 X 50
Commercial	10 X 25

4.5 Seattle

The City of Seattle takes a somewhat different approach in designated off-street truck loading berth requirements. Seattle categorizes land uses by intensity of demand with low, medium, and high levels. Table 4-7 provides a listing of uses by intensity of demand in Seattle's regulations. These regulations can be found in Seattle Municipal Code Title 23 Land Use accessible at: (https://www.municode.com/library/WA/seattle/codes/municipal_code?nodeId=TIT23LAUSCO_SUBTITLE_IIILAUSRE_CH23.54QUDESTACOREPASOWAST_23.54.035LOBERESPST)

Table 4-7 | City of Seattle Land Use Intensity Categories

Low Demand	Medium Demand	High Demand
Animal Services	Agricultural Uses	Airport, land-based
Business incubator	Airport, water-based	Cargo terminals
Business support services	Assisted living facilities	Commercial laundries
Car wash	Automotive parts or accessory sales	Construction services
Custom and craft work	Eating and drinking establishments	Food processing for human consumption
Entertainment uses	Heavy commercial services except commercial laundries and construction services	High-impact uses
Gas station	Institute for advanced study	Hospitals
Helistop and heliport	Mini-warehouse	Manufacturing
Institutions, except hospitals and institutes for advanced study	Monetary services	Outdoor storage
Lodging	Passenger terminal	Recycling center (separate facilities)
Marine retail sales, services	Personal and household retail sales and services	Sale of heating fuel
Offices	Recycling collection stations	Sales, service, and rental of commercial equipment and construction materials
Personal transportation services	Research and development laboratory	Salvage yard
Sales and rental of motorized vehicles	Sales, service, and rental of equipment	Warehouse
Towing services	Transit vehicle base	Wholesale showroom
	Utilities	
	Vehicular repair, major and minor	

Within the Downtown and South Lake Union Urban Centers and within the MPC-YT zone, loading berth requirements may be waived or modified if the Director finds, after consultation with and approval by the Director of Transportation, that the number of loading berths specified in code is not required and that the modified number will be sufficient. All loading is proposed to occur on-site; or loading that is proposed to occur in a public right-of-way can take place without disrupting pedestrian circulation or vehicular traffic; additional evidence relating to the size, character and operation of the building and likely tenancy; and where loading occurs at a central loading facility,

On-Site Berths and Curbside Implications

goods can be distributed to other buildings on-site without disrupting pedestrian circulation or vehicular traffic. Table 4-8 shows the truck berth requirements by land use.

Table 4-8 | City of Seattle Truck Berth Requirements by Land Use/Demand Intensity

Type of Use	Sq Ft of Aggregate Gross Floor Area	Required number of Loading Berths
Low Demand	40,000 – 60,000	1
	60,001 – 160,000	2
	160,001 – 264,000	3
	264,001 – 388,000	4
	388,001 – 520,000	5
	520,001 – 652,000	6
	652,001 – 784,000	7
	784,001 – 920,000	8
	Each additional 140,000	1 additional berth
Medium Demand	10,000 – 60,000	1
	60,001 – 160,000	2
	160,001 – 264,000	3
	264,001 – 388,000	4
	388,001 – 520,000	5
	520,001 – 652,000	6
	652,001 – 784,000	7
	784,001 – 920,000	8
	Each additional 140,000	1 additional berth
High Demand	5,000 – 16,000	1
	16,001 – 40,000	2
	40,001 – 64,000	3
	64,001 – 96,000	4
	96,001 – 128,000	5
	128,001 – 160,000	6
	160,001 – 196,000	7
	Each additional 36,000	1 additional berth

City of Seattle standards for loading berths require that each loading berth shall be not less than 10 feet in width and shall provide not less than 14 feet vertical clearance. Berth lengths are determined by use intensity:

- High-demand Uses: Each loading berth for a high-demand use shall be a minimum of 55 feet in length unless reduced by determination of the Director.

- Low- and Medium-demand Uses: Each loading berth for low- and medium-demand uses, with some exceptions, shall be a minimum of 35 feet in length.

Multipurpose convenience stores, sales, service and rental of major durables, and specialty food stores may be required to increase the length of required loading berths; however, these uses shall not be required to provide loading berths in excess of 55 feet. The review of loading berth length requirements for these uses shall focus on the size of vehicles that frequently serve the business and the frequency of loading activity that will extend beyond the lot line during daytime hours (6 a.m. to 6 p.m.). Large-truck loading occurring on a daily basis shall generally require longer loading berths; when such activity occurs on at least a weekly basis, it will be evaluated regarding the amount of traffic disruption and safety problems potentially created; such activity occurring on less than a weekly basis shall generally not require longer loading berths.

4.6 San Francisco

San Francisco's Off-street freight loading requirements vary depending on districts in San Francisco. In general, off-street parking and loading facilities shall be arranged, designed, and operated so as to prevent encroachments upon sidewalk areas, bicycle lanes, transit-only lanes, and adjacent properties. To best match relevant city requirements with those of the District of Columbia, our review focuses on mixed-use districts located in the Eastern Neighborhoods and South of Market areas of this city. Table 4-9 shows truck berth requirements by land use and building size.

Table 4-9 | City of San Francisco Truck Berth Requirements

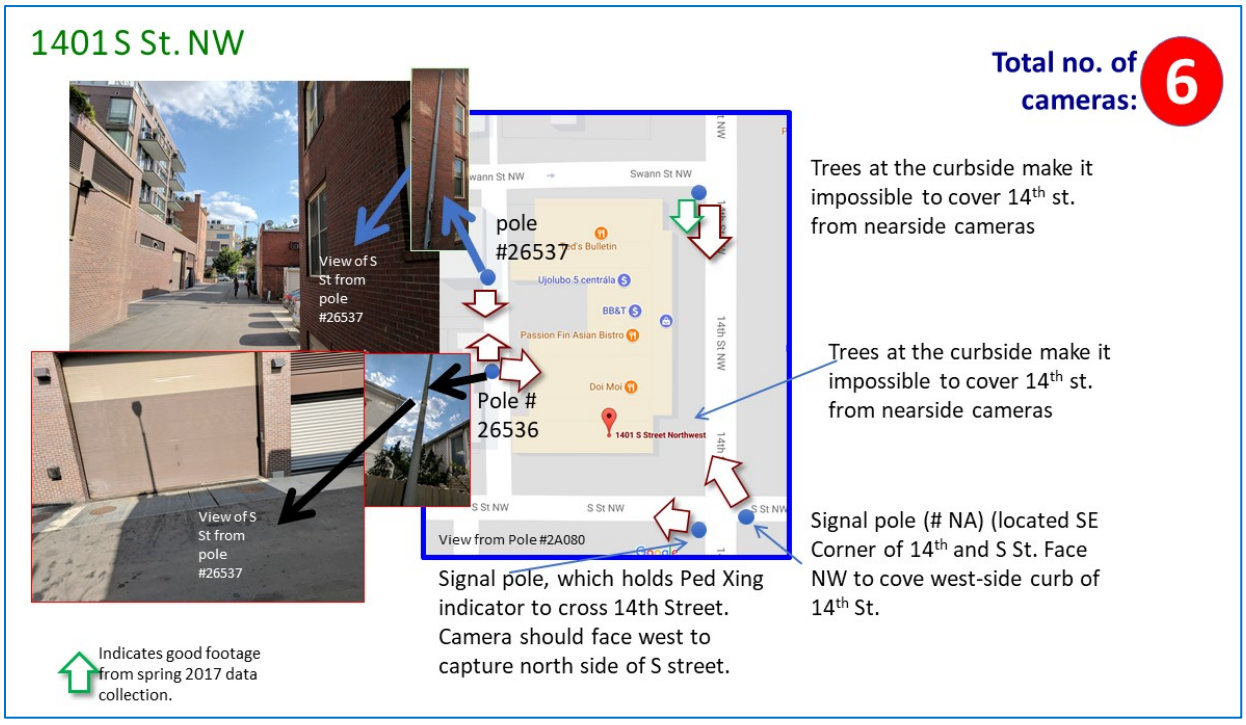
USE OR ACTIVITY	NUMBER OF OFF-STREET FREIGHTLOADING SPACES REQUIRED
Offices and Banks	0.1 space per 10,000 sq. ft. of gross floor area (to closest whole number)
Retail stores, restaurants, bars, nighttime entertainment and drugstores	10,001-30,000 sf: 1 berth 30,001- 50,000 sf: 2 berths >50,000 SF0: 1 space per 25,000 sf or fraction
Wholesaling, manufacturing, and all other uses primarily engaged in handling goods, and live/work units within existing buildings, within Eastern Neighborhoods Mixed Use Districts, and South of Market Mixed Use Districts	10,001-50,000 sf: 1 berth >50,000 sf: 0.21 berths per 10,000 sf or fraction
Hotels, apartments, live/work units not included above, and all other uses not included above	100,001 – 200,000 sf: 1 berth 200,001-500,00 sf: 2 berths >500,000 sf: 3 berths plus 1 additional berth for each 400,000 sf
Non-Residential Uses	0-50,000 sf: 1 berth >50,000 sf: 1 additional berth per 50,000 sf
All Residential Uses, including dwelling units, group housing, and SRO units	0-100 units: 1 berth 101+ units: 1 additional berth for every additional 200 units
Total Number of Loading Spaces Allowed for Any Single Project (all uses)	4

The City of San Francisco allows off-street freight loading spaces in Downtown Residential (DTR) Districts. There are additional design requirements that in specified zones all off-street freight loading and service vehicle spaces are to be completely enclosed and access from a public street or alley shall be provided by means of a private service driveway, which is totally contained within the structure.

5. Time-lapse Video Data: Collection, Managing and Encoding

The first part of the second objective of the study is to obtain parking occupancy data through video-monitoring at 20 different buildings in the District. An ambitious and extensive plan was prepared to collect video surveillance data over several months beginning early spring through fall of 2017. The plan called for, prior to installing the video cameras, a thorough inspection of curbsides and loading berths at all 20 locations for identifying vantage points for installation and appropriate angles to obtain good coverage. The notes and pictures taken at each site were then consolidated in to one or two illustrations per site to serve as field installation instructions. For example, Figure 5-1 illustrates the consolidated version of the detailed notes taken during the field inspection of the location at 1401 S St. NW. The figure identifies the location and other identifying information of the mounting location (such as light pole or signal mast) for camera hardware.

Figure 5-1 | Consolidated Field Notes & Camera Installation Instructions for 1401 S St NW



The study team prepared notes that are similar to the illustration in Figure 5-1 for all 20 locations. DDOT staff installed the cameras based on these notes. Brinno –TLC 200 Pro with weather housing (Figure 5-2) were used to monitor the curbsides and lading berths at all 20 subject buildings. Videos were recorded with a 30-second time-lapse for one full week so that data would include weekend and weekdays. The video data were first obtained during Spring 2017 (April – June 2017). A closer examination of the data collected in Spring 2017 revealed numerous issues, such as lack of adequate coverage due to missing data, improperly angled cameras, inconsistent time-lapse duration, or out-of-focus cameras. Due to these issues, a second batch of video recordings was obtained during April - August 2018. More than 20 cameras were commissioned to obtain the video data.

Figure 5-2 | Equipment and Mounting Mechanism Used in Obtaining Time-lapse Video data

(Photo courtesy: Brinno USA Inc.)

The original video surveillance plan was appropriately modified as new data arrived and the team faced new challenges. A drastic revision to the video surveillance plan became necessary because of numerous problems with the quality of data collected during the first deployment of cameras. Consequently, video data was collected for the second time in the winter-spring period of 2018. The discussion in this section mainly focusses on the second successful deployment of camera installations and the subsequent encoding.

5.1 Video Footage Management

After the first batch of video logs was and examined, the need for efficient management of video footage was recognized. The properties of the video footage data are as follows.

- Bit rate: 125 kbps
- Resolution: 720p
- Frame rate: 10 fps
- Approximate footage length for 7-day data at 30-sec time lapse: 35 min
- Number of videos in the footage per camera (as limited by file size): 3
- Size on disk (per camera): 400 MB

These specifications require approximately 40 GB of storage for the 20 locations (at an average of 5 cameras per building). Though storage is inexpensive, distributing the videos in disk drives or via a server to a team of nearly 10 encoding staff proved to be challenging. To circumvent the problems associated with storage and distribution of the videos, a private YouTube channel (GMU.DDOT) was established. All video footages obtained for this study were uploaded to GMU.DDOT YouTube channel and was marked as "Unlisted"[6]. As mentioned above, each camera produced three separate videos for the 7-day duration of recording. Several site-specific and camera-specific playlists were created to manage the encoding process and subsequent verification of encoded data. Figure 5-3 illustrates the access management to the GMU.DDOT channel and the footage. Table 5-1 provides the list and direct web-links to camera-specific playlists at each location.

[6] An unlisted video on YouTube could be accessed only by channel owner or those with access to the link of a specific video or a playlist in which the video is included.

Figure 5-3 | Management of Video Footages and Playlists using GMU.DDOT YouTube Channel

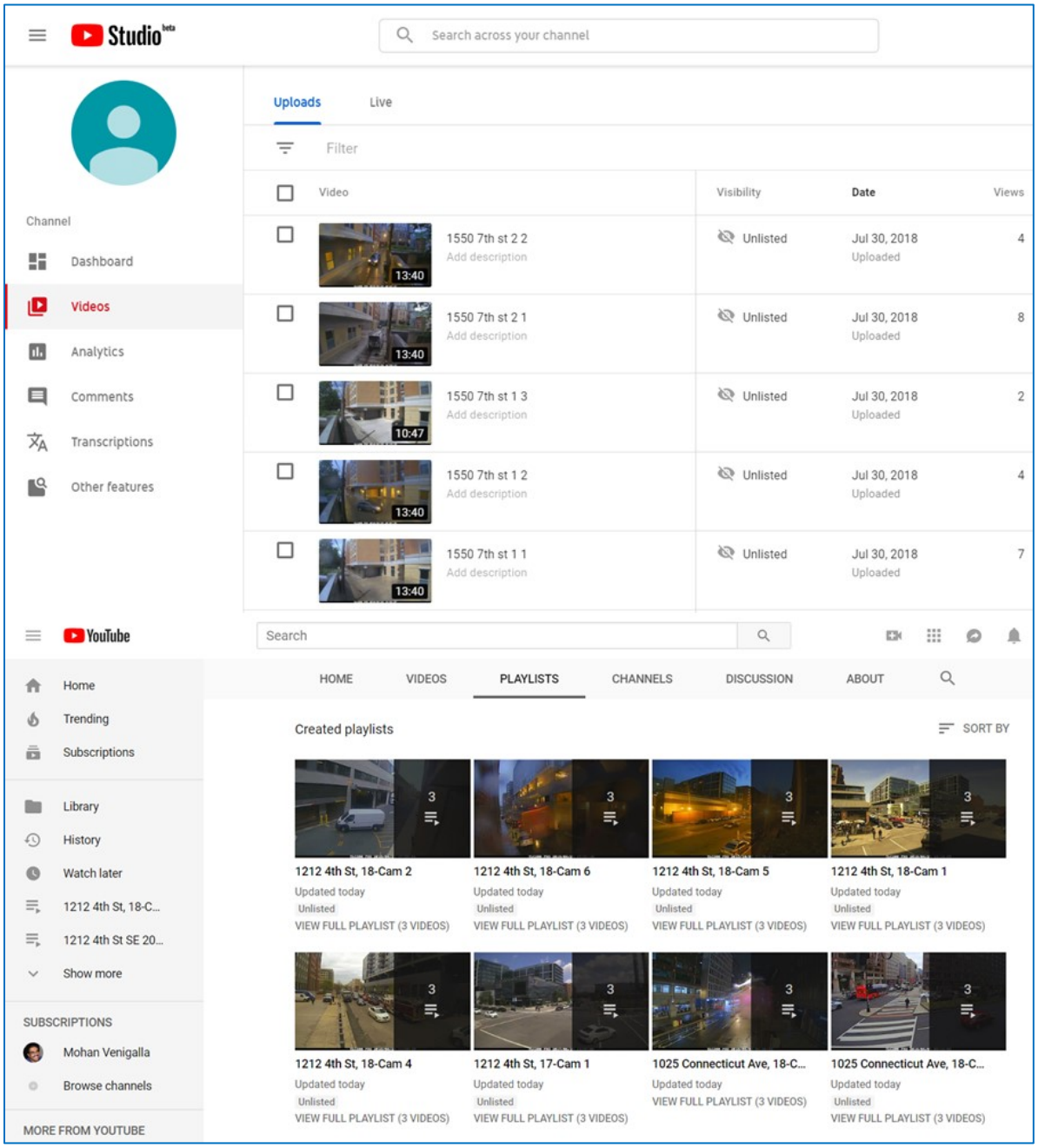


Table 5-1 | Camera-specific Playlists

Location	Year-Cam #	Playlist link	Notes
1025 Connecticut Ave NW	18-Cam 1	https://www.youtube.com/playlist?list=PL50zkcUl8gZ78p8KNglPA6Mt9TQKTRMWE	Cam was set with wrong date
	18-Cam 2	https://www.youtube.com/playlist?list=PL50zkcUl8gZ4MWtRJ62baZ0aAoA2KcHHm	
	18-Cam 3	https://www.youtube.com/playlist?list=PL50zkcUl8gZ6LVSnRlLu3cPP1lgZ9bCU-	
	18-Cam 4	https://www.youtube.com/playlist?list=PL50zkcUl8gZ4RAVTvISr_AFHu3kRPpUuJ	Cam 4 was set with wrong date.
1212 4th St SE	17-Cam 1	https://www.youtube.com/playlist?list=PL50zkcUl8gZ45TOFkmyFgRa21PLNvwzLi	
	18-Cam 1	https://www.youtube.com/playlist?list=PL50zkcUl8gZ7xt3Sdm4MwfsQDCZDFQh9M	
	18-Cam 2	https://www.youtube.com/playlist?list=PL50zkcUl8gZ5Zh4FVnvUR60V5BYCB85rw	
	18-Cam 4	https://www.youtube.com/playlist?list=PL50zkcUl8gZ4kxENq1z9JFPmFgEPX8Q8g	
	18-Cam 5	https://www.youtube.com/playlist?list=PL50zkcUl8gZ7OY5iS221NvBpZuKYImVjY	
	18-Cam 6	https://www.youtube.com/playlist?list=PL50zkcUl8gZ61Gz0m5VFqWab-a9AnT5o1	
130 M St NE	17-Cam 2	https://www.youtube.com/playlist?list=PL50zkcUl8gZ7scQGx5reFXyYomrVkn030	
1301 U St NW	18-Cam 1	https://www.youtube.com/playlist?list=PL50zkcUl8gZ4BWk9kUu0gZqg7zAJNjhH7	
	18-Cam 2	https://www.youtube.com/playlist?list=PL50zkcUl8gZ71vJUmlp0K9B0KVF7aNoqO	
	18-Cam 4	https://www.youtube.com/playlist?list=PL50zkcUl8gZ70Ur0mgsLeZR9lO77KZIjB	
	18-Cam 5	https://www.youtube.com/playlist?list=PL50zkcUl8gZ7Qlyssa9TqL8a4RzyvCK-J	
1400 Irving St NW	17-Cam 1	https://www.youtube.com/playlist?list=PL50zkcUl8gZ6i3Eoi0N-L3Wnv8_odE8yB	
	18-Cam 2	https://www.youtube.com/playlist?list=PL50zkcUl8gZ6DBoppEVZPeRFT-kLsd3ZY	
1550 7th St NW	18-Cam 1	https://www.youtube.com/playlist?list=PL50zkcUl8gZ5vrCCItOS81deH9M2ilifc	
	18-Cam 2	https://www.youtube.com/playlist?list=PL50zkcUl8gZ4lDJeodzDbaTP6wxMQ1LKT	
	18-Cam 3	https://www.youtube.com/playlist?list=PL50zkcUl8gZ4FoJzM43lMpyh5M-umJwry	
	18-Cam 4	https://www.youtube.com/playlist?list=PL50zkcUl8gZ4jvTYrEIa8CC70l728VTMg	
	18-Cam 5	https://www.youtube.com/playlist?list=PL50zkcUl8gZ5bdRo8IQ4-fud9LElbEgzo	
	18-Cam 6	https://www.youtube.com/playlist?list=PL50zkcUl8gZ5BWAZF1i0aYhBLI2AI4UZ9	
	18-Cam 7	https://www.youtube.com/playlist?list=PL50zkcUl8gZ4cw2MsxvPtCsNDAVo5eQNV	
	18-Cam 8	https://www.youtube.com/playlist?list=PL50zkcUl8gZ62Aogvb3dns1BkOkPerSez	
1629 K St NW	18-Cam 1	https://www.youtube.com/playlist?list=PL50zkcUl8gZ5uNUy6hHkfa8dz_uzbv-OL	

Table 5-1 | Camera-specific Playlists

Location	Year-Cam #	Playlist link	Notes
	18-Cam 2	https://www.youtube.com/playlist?list=PL50zkcUl8gZ4smrAQSMi2I6NQM4RX_f3u	
	18-Cam 3	https://www.youtube.com/playlist?list=PL50zkcUl8gZ58pMYoAjVFi1wzGMsJQZ17	
2130 P St NW	17-Cam 1	https://www.youtube.com/playlist?list=PL50zkcUl8gZ5Kg4K8qZfGhc3KusTz7Nfj	Several setup errors occurred while redoing video recording in 2018. A decision as made to use the 2017 data.
	17-Cam 2	https://www.youtube.com/playlist?list=PL50zkcUl8gZ4Zs0ZznrxfU867N0FiZ3-L	
	17-Cam 3	https://www.youtube.com/playlist?list=PL50zkcUl8gZ4PLCEgfNBLK-6tmnHfyiMO	
	18-Cam 4	https://www.youtube.com/playlist?list=PL50zkcUl8gZ6A_08D6cJJHFQD6Z9TK_X4	
2400 M St NW	18-Cam 2	https://www.youtube.com/playlist?list=PL50zkcUl8gZ62prByImpvY8Xc0rtec7sJ	
	17-Cam 1	https://www.youtube.com/playlist?list=PL50zkcUl8gZ62prByImpvY8Xc0rtec7sJ	
2420 14th St NW	18-Cam 1	https://www.youtube.com/playlist?list=PL50zkcUl8gZ7kWzgERKPn-PfXgD4lAdgq	
	18-Cam 2	https://www.youtube.com/playlist?list=PL50zkcUl8gZ6F6rtlKDUm1SrGK_QvXc1a	
	18-Cam 3	https://www.youtube.com/playlist?list=PL50zkcUl8gZ4udiiRWCfZPJuljU2_nQoU	
	18-Cam 4	https://www.youtube.com/playlist?list=PL50zkcUl8gZ5HleDXpm6BvtQYJ3Rj9Yv0	
	18-Cam 5	https://www.youtube.com/playlist?list=PL50zkcUl8gZ6HpjxUqeUiEVuiyAJAI6Jj	
	18-Cam 6	https://www.youtube.com/playlist?list=PL50zkcUl8gZ7G__yDy22PcBzqnG4u2riF	
	17-Cam 2	https://www.youtube.com/playlist?list=PL50zkcUl8gZ7QWd_26Jkz_lOnRoP9msqM	
301 Tingey, SE	17-Cam 1	https://www.youtube.com/playlist?list=PL50zkcUl8gZ5SmKK9SK5v9IPlZHhPF1y3	
	18-Cam 2	https://www.youtube.com/playlist?list=PL50zkcUl8gZ5A_791J-rBzLsjthXYQSbu	
	18-Cam 3	https://www.youtube.com/playlist?list=PL50zkcUl8gZ7df1kJ5OQKhFU9xTJnWu-Q Note the wrong date & time on Cam (2013/10/01 @ 4:15 PM = 2018/4/20 @ 1:07 PM	Cam was set with wrong date.
	18-Cam 4	https://www.youtube.com/playlist?list=PL50zkcUl8gZ6RW5HFYx_w-QlTQpkvhIl2	
4500 Wisconsin Ave NW	17-Cam 1	https://youtu.be/yezbY2QINJk	
	17-Cam 2	https://www.youtube.com/playlist?list=PL50zkcUl8gZ53lAo65__ZayK_GKJI-9p2	
	18-Cam 1	https://www.youtube.com/playlist?list=PL50zkcUl8gZ45pvdpUre_7-VmdZb8D6j8	
	18-Cam 3	https://www.youtube.com/playlist?list=PL50zkcUl8gZ5sgnOMmXHfRtaRrk0R3G8W	
	18-Cam 4	https://www.youtube.com/playlist?list=PL50zkcUl8gZ7l8JO54DNaTLS-HVrtoK1X	
475 K St NW	18-Cam 1	https://www.youtube.com/playlist?list=PL50zkcUl8gZ4ndbPQxq8NH_EJG_fEFFKi	

Table 5-1 | Camera-specific Playlists

Location	Year-Cam #	Playlist link	Notes
	18-Cam 2	https://www.youtube.com/playlist?list=PL50zkcUl8gZ5sG-fB_qlNrGvrTOqkXbJm	
	18-Cam 4	https://www.youtube.com/playlist?list=PL50zkcUl8gZ5M7vdeWcyxtJqJD2Vwn3OF	
	18-Cam 5	https://www.youtube.com/playlist?list=PL50zkcUl8gZ6MRZOV1vtaMpeMdBYkBgEh	
	18-Cam 6	https://www.youtube.com/playlist?list=PL50zkcUl8gZ73vE0q5a0k0QgmnywucX_z	
	18-Cam 7	https://www.youtube.com/playlist?list=PL50zkcUl8gZ5xcAdqMAwKQeyG_4nI0nwI	
	18-Cam 8	https://www.youtube.com/playlist?list=PL50zkcUl8gZ6eNY2ZloESsARK4Etw5O6x	
1401 S St NW	18-All Cams	https://www.youtube.com/playlist?list=PL50zkcUl8gZ6Y_gmBNhv04CC6mSqmK0E1	Not encoded for this report
1200 G St NW	18-All Cams	https://www.youtube.com/playlist?list=PL50zkcUl8gZ7-d9lyJ5wBqHKyl1mkdJYF	Not encoded for this report
1117 10th St NW	18-All Cams	https://www.youtube.com/playlist?list=PL50zkcUl8gZ7fMhgTNDpR4wqRbcZxlQrX	Not encoded for this report
1010 Mass. Ave., NW	18-All Cams	https://www.youtube.com/playlist?list=PL50zkcUl8gZ6KxkI8K_BdavEl2ZTmqaws	Not encoded for this report

- Footage for 99 H St NW, 1350 Potomac Ave NW, and 2055 L St NW was either incomplete or cameras were erroneously setup. Due to budget constraints, it was decided to exclude these buildings in the analysis.
- As shown in the 'notes' column, some cameras were set to wrong date and time. Corrected date and time were entered in the video description

5.2 Encoding Methods

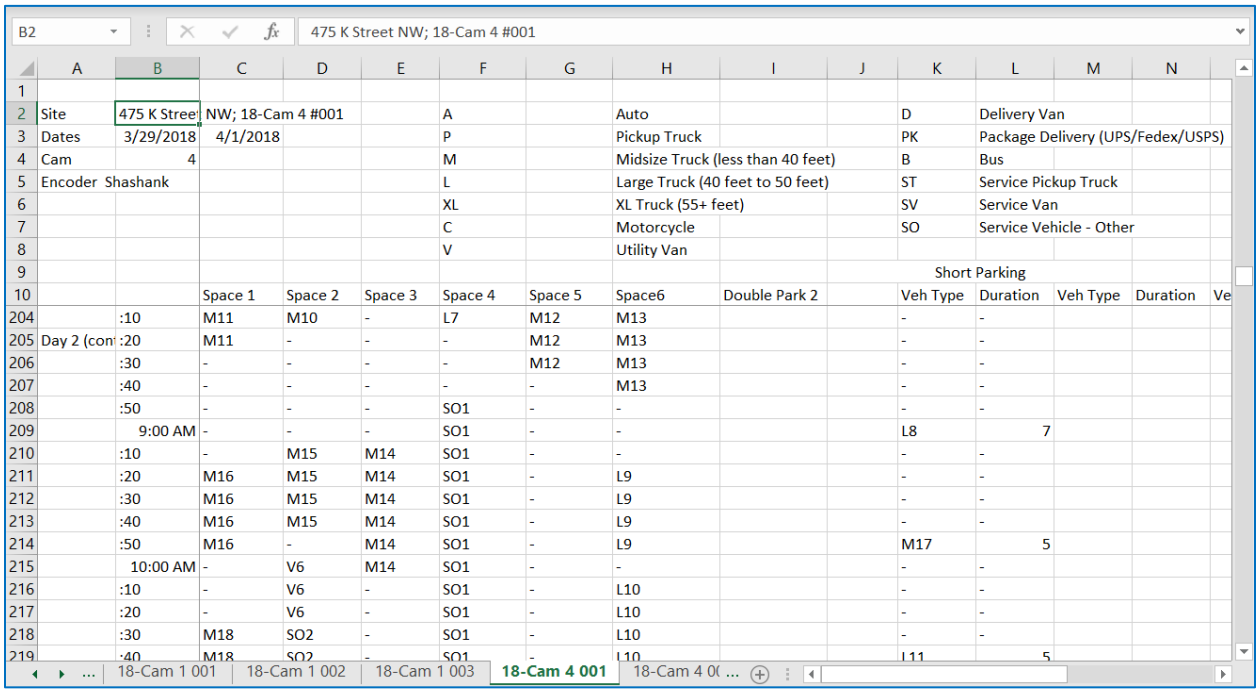
Manuals on parking studies and past parking studies, which employed video logging for parking accumulation and turnover, were consulted for design of data logging instrument(s). The ultimate objective of the instrument was to facilitate tabulation and derive statistics of the recorded data. The video logs were analyzed, with necessary modifications, as if it were a parking demand study. In typical parking demand studies, the available parking spaces are first recorded. Parking accumulation is the number of vehicles parked at any given time. The parking turnover analysis requires recording the number of times the same parking space is used by various users of the parking lot-during the day (Murthy and Grover, 1993). Parking turnover analysis depends on the type of land use and the duration of parking required by each vehicle.

A spreadsheet-based encoding instrument (Table 5-2 and Figure 5-4) was developed for recording parking activity of commercial vehicles. Several undergraduate and graduate students at George Mason University were recruited for encoding the video data. The student encoders were trained in using the instrument for encoding the parking data. The encoding process required several hours of carefully and repeatedly looking at the videos being played in real time and at 25% speed. Time required for encoding a 7-day, 35-minute footage for each camera was approximately 40 hours.

Table 5-2 | Vehicle Descriptions and Codes Used in Video Footage Encoding

Code	Vehicle Description	Code	Vehicle Description
A	Auto	D	Delivery Van
P	Pickup Truck	PK	Package Delivery (UPS/Fedex/USPS)
M	Midsize Truck (less than 40 feet)	B	Bus
L	Large Truck (40 feet to 50 feet)	ST	Service Pickup Truck
XL	XL Truck (55+ feet)	SV	Service Van
C	Motorcycle	SO	Service Vehicle - Other
V	Utility Van		

Figure 5-4 | Encoding Instrument with an Illustrative Example



B2: 475 K Street NW; 18-Cam 4 #001

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1														
2	Site	475 K Stree	NW; 18-Cam 4 #001			A		Auto			D	Delivery Van		
3	Dates	3/29/2018	4/1/2018			P		Pickup Truck			PK	Package Delivery (UPS/Fedex/USPS)		
4	Cam	4				M		Midsize Truck (less than 40 feet)			B	Bus		
5	Encoder	Shashank				L		Large Truck (40 feet to 50 feet)			ST	Service Pickup Truck		
6						XL		XL Truck (55+ feet)			SV	Service Van		
7						C		Motorcycle			SO	Service Vehicle - Other		
8						V		Utility Van						
9											Short Parking			
10			Space 1	Space 2	Space 3	Space 4	Space 5	Space6	Double Park 2		Veh Type	Duration	Veh Type	Duration
204		:10	M11	M10	-	L7	M12	M13			-	-		
205	Day 2 (con	:20	M11	-	-	-	M12	M13			-	-		
206		:30	-	-	-	-	M12	M13			-	-		
207		:40	-	-	-	-	-	M13			-	-		
208		:50	-	-	-	SO1	-	-			-	-		
209		9:00 AM	-	-	-	SO1	-	-			L8	7		
210		:10	-	M15	M14	SO1	-	-			-	-		
211		:20	M16	M15	M14	SO1	-	L9			-	-		
212		:30	M16	M15	M14	SO1	-	L9			-	-		
213		:40	M16	M15	M14	SO1	-	L9			-	-		
214		:50	M16	-	M14	SO1	-	L9			M17	5		
215		10:00 AM	-	V6	M14	SO1	-	-			-	-		
216		:10	-	V6	-	SO1	-	L10			-	-		
217		:20	-	V6	-	SO1	-	L10			-	-		
218		:30	M18	SO2	-	SO1	-	L10			-	-		
219		:40	M18	SO2	-	SO1	-	L10			L11	5		

Sheet tabs: ... | 18-Cam 1 001 | 18-Cam 1 002 | 18-Cam 1 003 | 18-Cam 4 001 | 18-Cam 4 0(...

Footnotes to Figure 4-4:

- The highlighted worksheet name (in green) indicates that the data in the sheet pertains to year 2018, Camera 4, footage 001 (of 3), that was collected 3/29/2018 through 4/1/2018 (cells B3-C3), encoded by Shashank (cell B5)
- Day 2 (cell A 205) indicates that this data is for 3/30/2018
- Spaces 1 through 6 (cells C10 through H10 in row 10) are six spaces identified along the curbside of the subject building 475 K St NW, that are visible in the view of 18-Cam 4
- M14 (E201 through E215) indicates that this is the 14th midsize truck observed in this footage that was parked along the curbside. M14 was first spotted after 9:10 AM and was seen through 10:00 AM, or six 10-min slots, which indicates that the dwell time of 60 minutes for this vehicle.
- After taking snapshots of parking at every 10-min mark in the video, encoders reviewed the videos in slow motion (at 25% of the original speed) to spot and record parking that lasted for less than 10 minutes. For example, a large truck (L8 in K209) was parked for 7 minutes (7 in L209) during the 10-min period that stated at 9:00 AM

5.2.1 Data collection summary

Table 4-4 summarizes the data collection effort for each of the 20 subject buildings.

Table 4-4 | Video Data Collection Summary

#	Building Address	Video Footage	
		Collected?	Analyzed?
1	1010 Massachusetts Avenue NW	Yes	No[2]
2	1025 Connecticut Avenue NW	Yes	Yes
3	1117 10th Street NW	Yes	No[2]
4	1200 G Street NW	Yes	No[2]
5	1212 4th Street SE	Yes	No[2]
6	130 M Street NE	Yes	Yes
7	1301 U Street NW	Yes	Yes
8	1350 Potomac Avenue SE	No[1]	No
9	1400 Irving Street NW	Yes	Yes
10	1401 S Street NW	Yes	No[2]
11	1550 7th Street NW	Yes	Yes
12	1629 K Street NW	Yes	Yes
13	2055 L Street NW	No[1]	No
14	2130 P Street NW	Yes	Yes
15	2400 M Street NW	Yes	Yes
16	2420 14th Street NW	Yes	Yes
17	301 Tingey Street SE	Yes	Yes
18	4500 Wisconsin Avenue NW	Yes	Yes
19	475 K Street NW	Yes	Yes
20	99 H Street NW	No[1]	No

[1] Video footage obtained was unusable for these sites
[2] Though video footage is good, it was not processed due to budget constraints

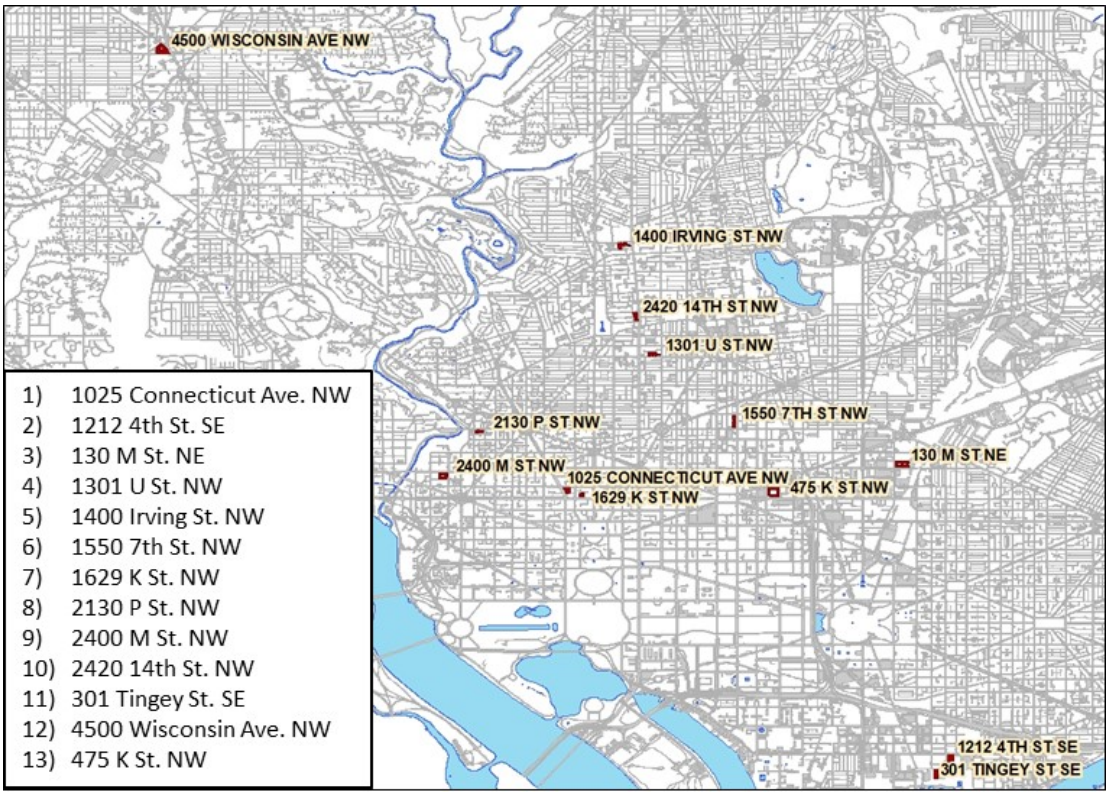
6. Curbside and Loading Berth Parking Activity at Select Buildings

The second part of the second objective of the study is to analyze the video surveillance data to quantify the curbside and loading berth parking activity at select buildings. This section describes the team's encoding activities and the analysis of encoded data to meeting this objective.

6.1 Introduction

Encoded data from video footages were analyzed to draw insights into commercial vehicle parking and loading activity at curbside and loading berths. Due to resource constraints and unavoidable project delays, video data were for 13 of the 20 original locations shown in Figure 6-1 were analyzed. A summary of the data obtained from the videos is provided in table 6-1. The data file for 13 building sites are available for download from https://1drv.ms/u/s!An1eFLP7jej_tO8g-d6qThlYTd5wHQ?e=yclv8v (if clicking on the link does not work, copy the link on to clipboard and paste the URL in the browser).

Figure 6-1 | Analysis Locations for Curbside Freight Vehicle Loading Activity



The intent for the video collection was to obtain a minimum of one week of activity for each building. Because a limited inventory of video cameras was available, data collection occurred at different times both across buildings and, in some cases, for cameras at a specific building. For on-street data, coders only captured vehicles on the building side of the street and for some buildings, the decision was made to only install cameras at locations that were expected to have higher volumes of vehicles of interest. Similarly, some installations did not capture a full 7 days of information. As a result, the number of vehicles may be under-represented at these locations. Table 6-2 summarizes the times of each video collection for each building along with any anomalies or issues identified during the concatenation of the encoded data.

Table 6-1 | Video Data Contents

Field	Description
Address	Building address
Street	Street of Video view
Date	Date of vehicle presence
Date / time	Combined date and time of vehicle presence
Weekday	Weekday of vehicle presence
Vehicle Type	Vehicle Type: A – Auto* P – Pickup Truck *(only those with markings indicating commercial purpose)* M – Midsize Truck (less than 40 ft) L – Large Truck (40 ft to 50 ft) XL – XL Truck (55+ ft) C – Motorcycle* V – Utility Van D – Deliver Van PK – Package Delivery (UPS/Fedex/USPS) B – Bus* ST – Service Pickup Truck SV – Service Van SO – Service Vehicle – Other * These vehicle types were removed from the analysis because of small numbers and possible ambiguity of use for commercial purposes.
Arrival Time	Timestamp when vehicle arrived in video (adjusted for videos with incorrect time stamp)
Duration (min)	Vehicle dwell time
Location	Alley Loading Dock On-street Frontage
Note	Any notes associated with encoding: B/E video – vehicle observed in the frame at the beginning or end of video. Could not determine dwell time. Double – vehicle was double parked Illegal – vehicle was illegally parked In-time only – time vehicle arrived was recorded with no dwell time Out-time only – time vehicle left was recorded with no dwell time Resident? – vehicle remained stationary for more than 6 hours
Camera	Camera ID as identified on Camera layout figures
Worksheet	Worksheet ID as identified on worksheet within encoding spreadsheet

Table 6-2 | Beginning and Ending Times of Video Data Collection

Building	Camera	Time (hr)	Date Start	Time Start	Date End	Time End
1025 Connecticut Ave NW	1	7.5	3/31/2018	12:00 AM	4/7/2018	11:30 AM
	2	7.0	3/31/2018	10:10 AM	4/7/2018	11:00 AM
	3	7.2	3/31/2018	10:00 AM	4/7/2018	2:20 PM
	4 (LD)	7.0	3/31/2018	10:50 AM	4/7/2018	10:40 AM
1212 4th St SE	1 (17)	7.0	6/17/2017	9:10 AM	6/24/2017	8:20 AM
	1 (18)	7.2	4/20/2018	10:40 AM	4/27/2018	2:30 PM
	2	7.2	4/20/2018	12:00 PM	4/27/2018	3:40 PM
	4	7.1	4/20/2018	1:10 PM	4/27/2018	4:40 PM
	5	7.2	4/20/2018	12:20 PM	4/27/2018	4:00 PM
	6	6.3	4/20/2018	12:20 PM	4/26/2018	7:00 PM
	Note: Camera 2 missing 6 hrs of data. Camera 6 data collected separately for 4th St and Loading Dock					
130 M St NE	2 & 2 (LD)	6.0	4/29/2017	8:40 AM	5/5/2017	9:50 AM
	Note: Camera 2 data collected separately for mid-block and Loading Dock Camera 2 data not collected for entire street Data encoded in 2017 and much higher than other buildings. May be an anomaly or not representative					
1301 U St NW	1	7.0	7/14/2018	11:00 AM	7/21/2018	10:10 AM
	2	7.0	7/14/2018	11:00 AM	7/21/2018	10:30 AM
	5	7.0	7/14/2018	10:30 AM	7/21/2018	10:30 AM
	Note: Camera 2 data collected separately for U and 13th St					
1400 Irving St NW	1	6.0	5/6/2017	10:10 AM	5/12/2017	10:30 AM
	2	7.0	7/14/2018	9:50 AM	7/21/2018	9:30 AM
	Note: Camera 2 – cones placed in curb bump-in area during daylight					
1550 7th St NW	1	7.0	7/21/2018	11:00 AM	7/28/2018	11:50 AM
	2	7.0	7/21/2018	11:10 AM	7/28/2018	11:50 AM
	4	7.0	7/21/2018	11:50 AM	7/28/2018	12:00 PM
	5	7.0	7/21/2018	11:40 AM	7/28/2018	12:00 PM
	7	7.0	7/21/2018	11:20 AM	7/28/2018	12:00 PM
	8	7.0	7/21/2018	11:30 AM	7/28/2018	12:00 PM
1629 K St NW	1	7.2	3/31/2018	11:10 AM	4/7/2018	4:50 PM
	2	7.2	3/31/2018	10:00 AM	4/7/2018	3:50 PM
	3	7.2	3/31/2018	11:00 AM	4/7/2018	2:50 PM
	Note: Camera 1 – tape put up across alley at 4/3/18 2:44 AM					
2130 P St NW	1	7.0	7/15/2017	10:30 AM	7/22/2017	10:00 AM
	2	7.0	7/15/2017	10:40 AM	7/22/2017	10:20 AM
	3 (17)	8.0	7/15/2017	10:40 AM	7/23/2017	10:30 AM
	3 (18)	9.0	3/31/2018	9:40 AM	4/9/2018	10:10 AM
	Note: Camera 3(18) – View shifted at 4/4/18 11:24 AM limiting street view					

Table 6-2 | Beginning and Ending Times of Video Data Collection

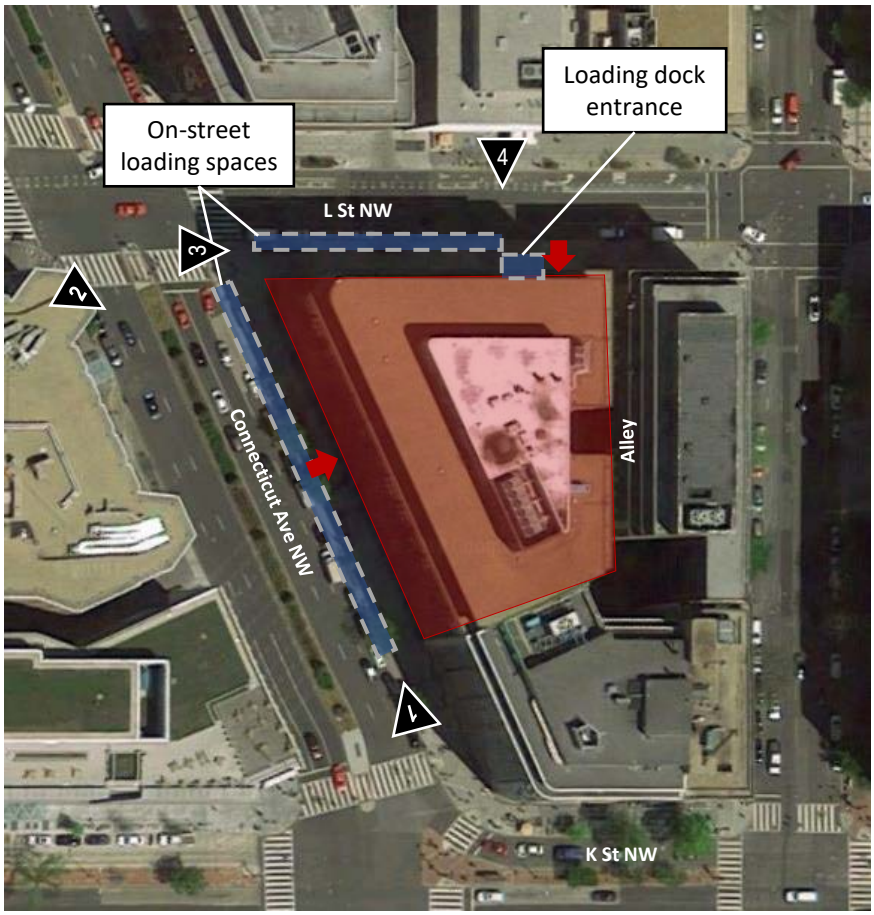
Building	Camera	Time (hr)	Date Start	Time Start	Date End	Time End
2400 M St NW	1	7.0	7/15/2017	9:00 AM	7/22/2017	8:40 AM
	2	8.0	3/31/2018	9:50 AM	4/8/2018	10:30 AM
2420 14th St NW	2 (17)	6.0	5/6/2017	11:00 AM	5/12/2017	11:00 AM
	1	7.0	7/14/2018	9:20 AM	7/21/2018	9:40 AM
	2 (18)	7.0	7/14/2018	9:20 AM	7/21/2018	9:40 AM
	3	7.0	7/14/2018	9:20 AM	7/21/2018	9:40 AM
	4	7.0	7/14/2018	9:10 AM	7/21/2018	10:00 AM
301 Tingey St SE	1	5.7	6/17/2017	8:10 AM	6/23/2017	12:50 AM
	2	7.2	4/20/2018	12:40 PM	4/27/2018	4:20 PM
	3	7.2	4/20/2018	12:40 PM	4/27/2018	4:20 PM
	4	7.2	4/20/2018	12:40 PM	4/27/2018	4:30 PM
	Note: Camera 1 – right lane blocked due to construction *Camera 4 – Water St blocked from beginning to 4/21 4:50 PM*					
4500 Wisconsin Ave NW	1 (17)	2.8	6/6/2017	10:00 AM	6/9/2017	6:20 AM
	2	7.2	6/6/2017	11:30 AM	6/13/2017	3:50 PM
	1 (18)	7.2	3/29/2018	10:00 AM	4/5/2018	2:50 PM
	3	7.1	3/29/2018	10:30 AM	4/5/2018	2:00 PM
	4	7.2	3/29/2018	10:30 AM	4/5/2018	2:50 PM
475 K St NW	1	7.2	3/29/2018	11:50 AM	4/5/2018	4:20 PM
	4	7.2	3/29/2018	11:40 AM	4/5/2018	3:50 PM
	5	7.2	3/29/2018	12:20 PM	4/5/2018	4:00 PM
	6	7.2	3/29/2018	12:10 PM	4/5/2018	3:50 PM
	8	7.1	3/29/2018	10:50 AM	4/5/2018	1:40 PM
	Note: Camera 8 – View shifted at 4/4 2:30 PM limiting street view					

6.2 Video Placement and Building Information

Figures 6-2 through 6-27 provide details on the curbsides and onsite berths at the 13 locations. (In some pdf versions of this document, video playlists for each camera may be accessed by clicking on the camera number shown in the figure).

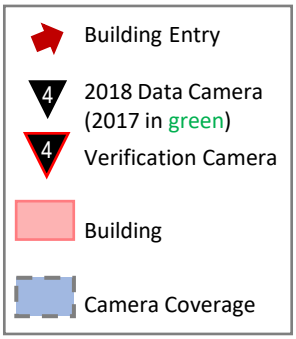
Figure 6-2 | Layout of Cameras, Curbside and Onsite Berths: 1025 Connecticut Ave NW

1025 Connecticut Ave NW



Map data © 2018 Google

DC Trucks and Bus Map
https://godcgo.com/freight/



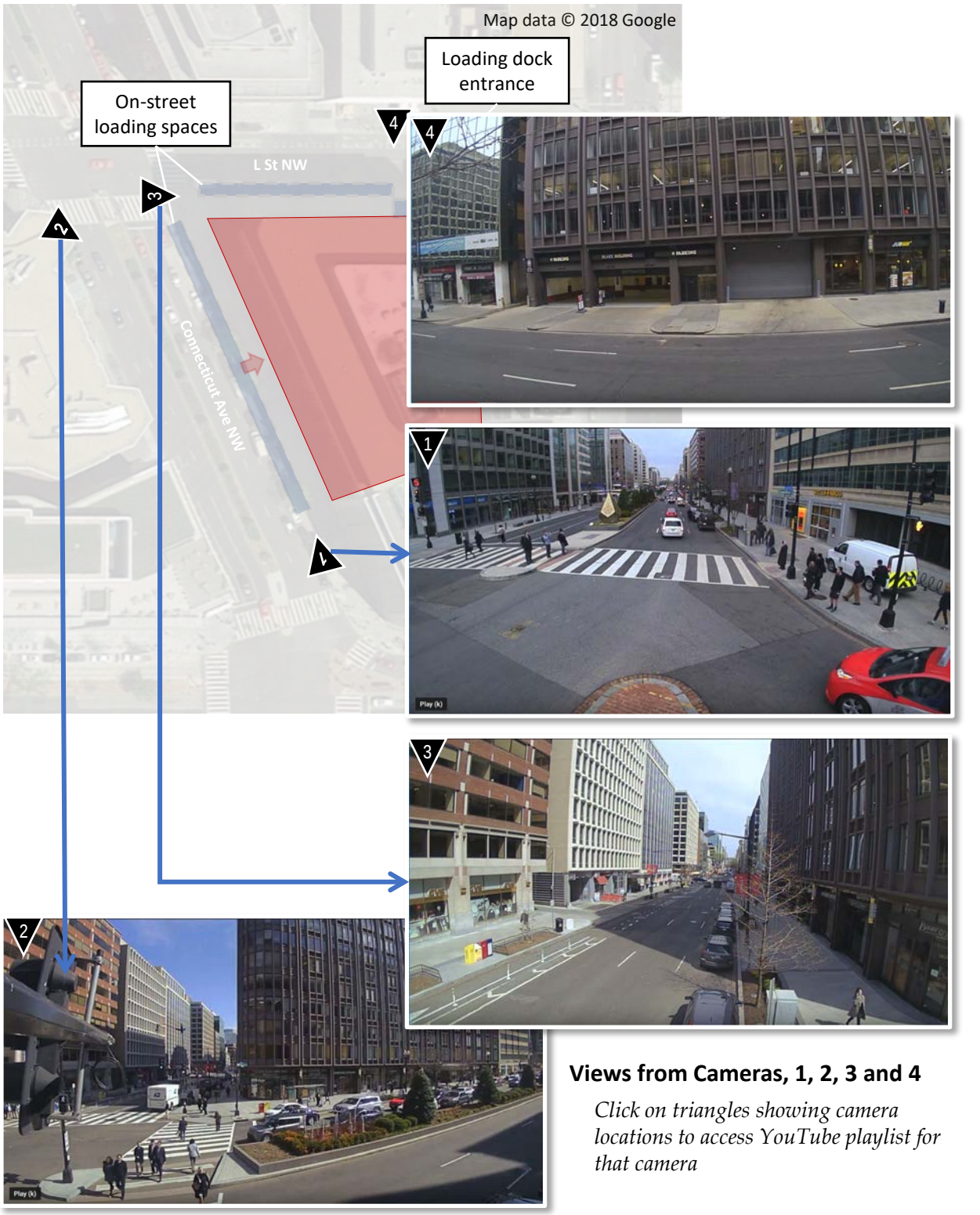
Street Parking:
Connecticut Ave: 200 ft
5 meters – 8 cars + Loading
L St: 120 ft
3 meters – 5 cars

Street View © 2018 Google

Click on triangles showing camera locations to access YouTube playlist for that camera

Figure 6-3 | Camera Views: 1025 Connecticut Ave NW

1025 Connecticut Ave NW

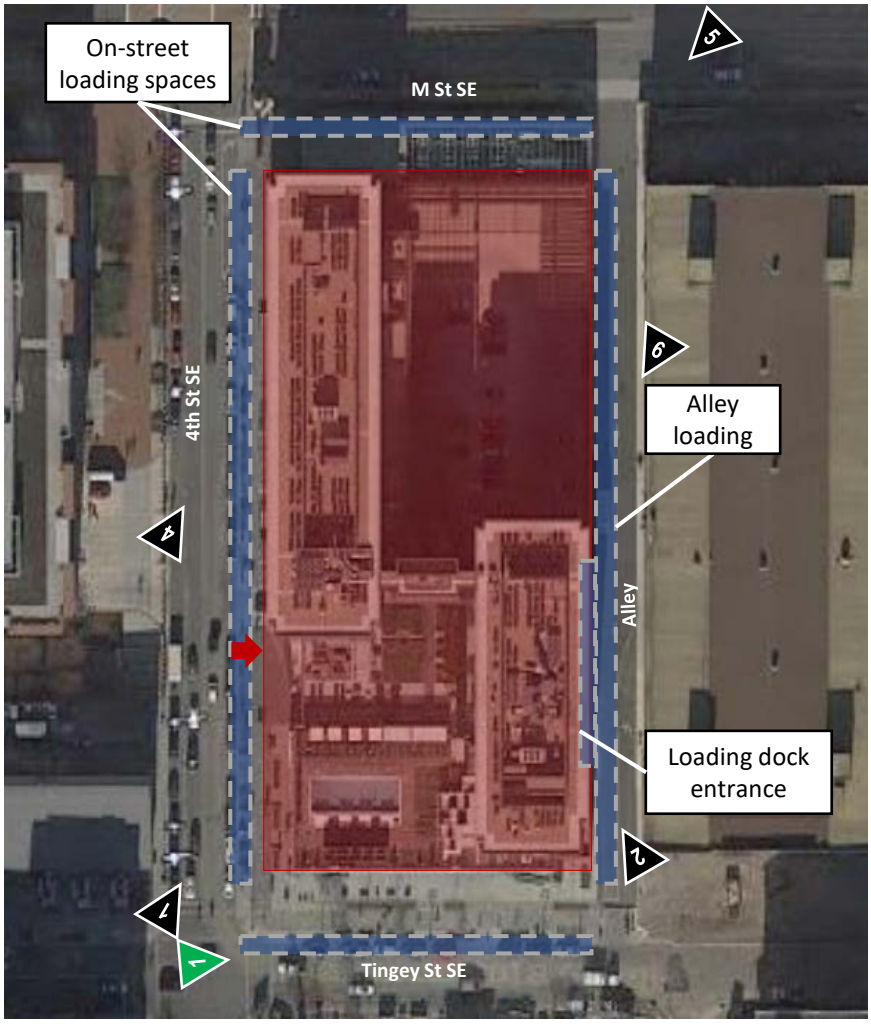


Views from Cameras, 1, 2, 3 and 4

Click on triangles showing camera locations to access YouTube playlist for that camera

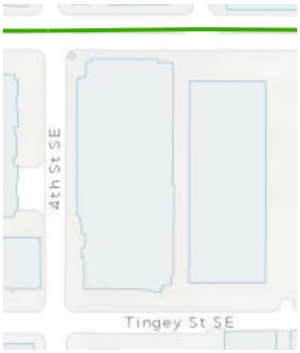
Figure 6-4 | Layout of Cameras, Curbside and Onsite Berths: 1212 4th St SE

1212 4th St SE



Map data © 2018 Google

DC Trucks and Bus Map
https://godcgo.com/freight/



Building Entry
2018 Data Camera (2017 in green)
Verification Camera
Building
Camera Coverage

Street Parking:
M St: 190 ft
10 metered spaces
4th St: 180 ft
6+7 metered spaces
Tingey St: 170 ft
8 metered spaces
Alley: ~400ft

Click on triangles showing camera locations to access YouTube playlist for that camera

Street View © 2018 Google

Figure 6-5 | Camera Views: 1212 4th St SE

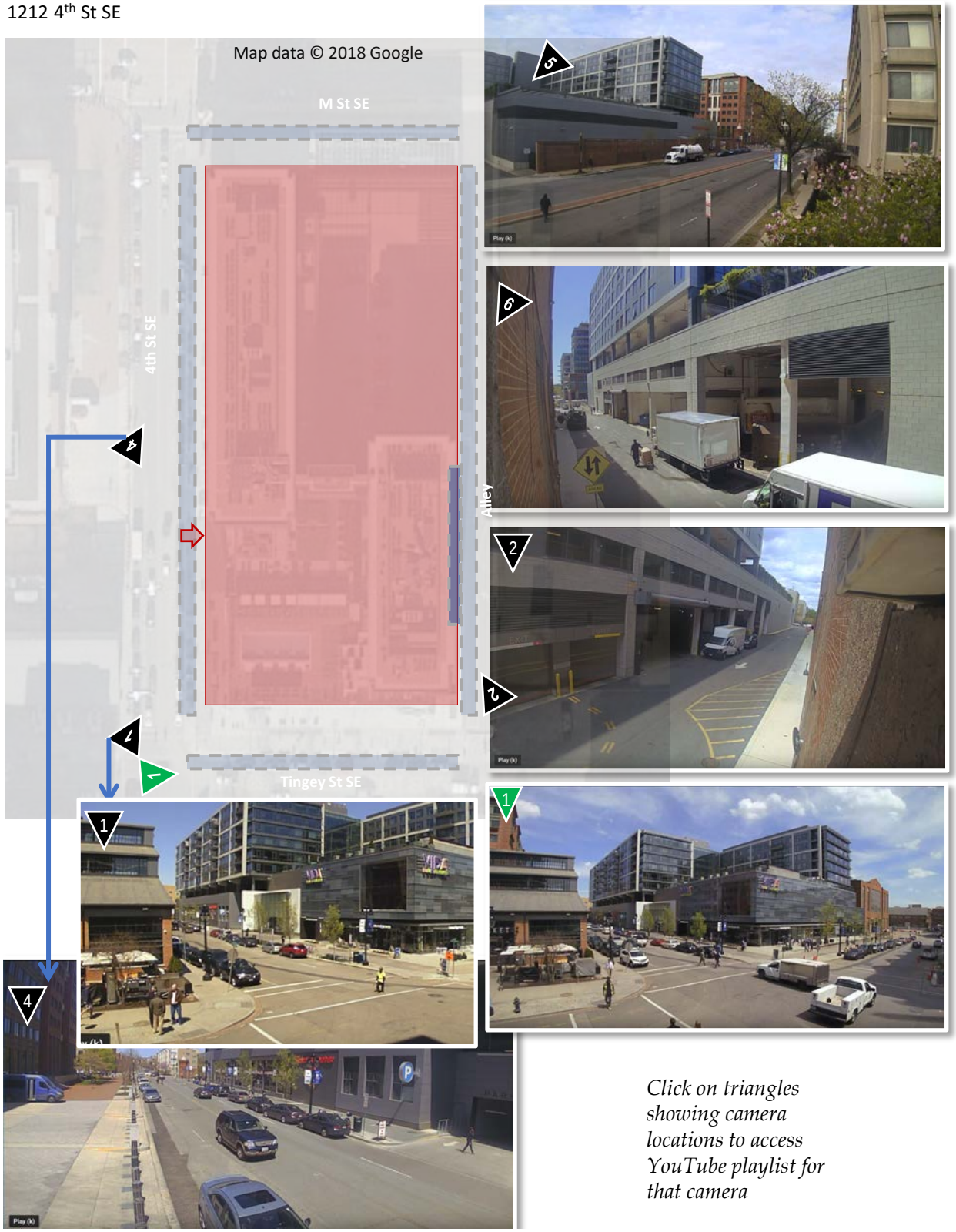
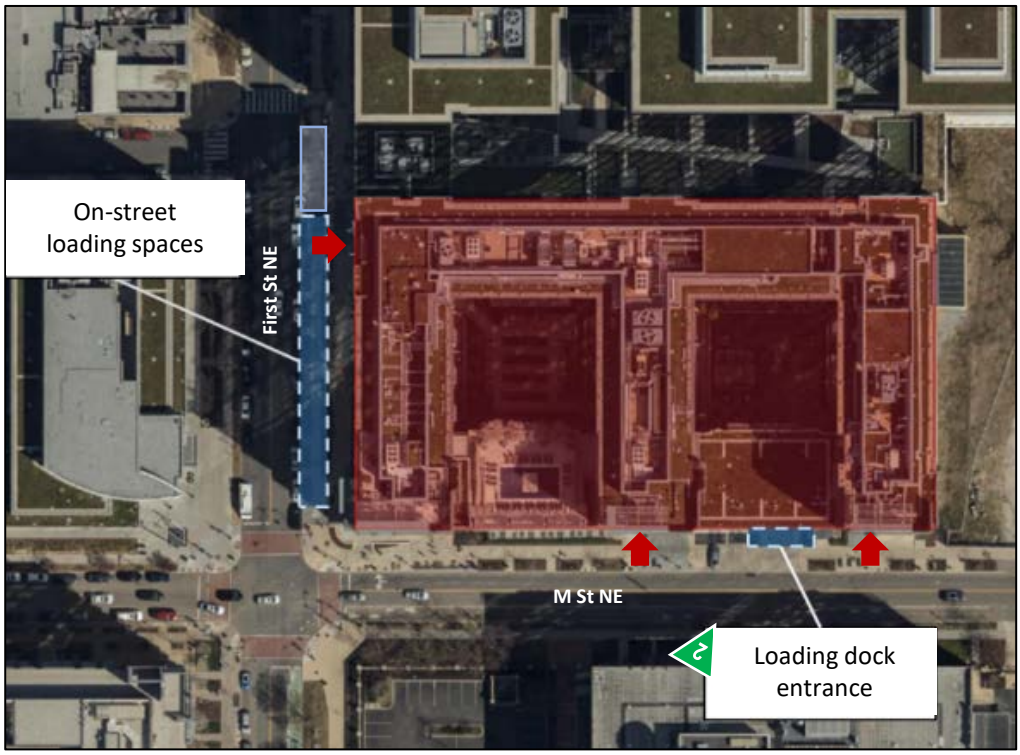


Figure 6-6 | Layout of Cameras, Curbside and Onsite Berths: 130 M St NE

130 M St NE

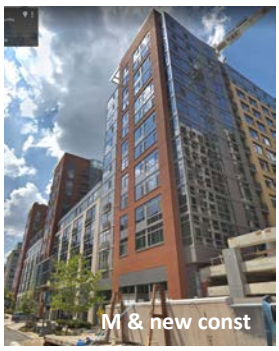


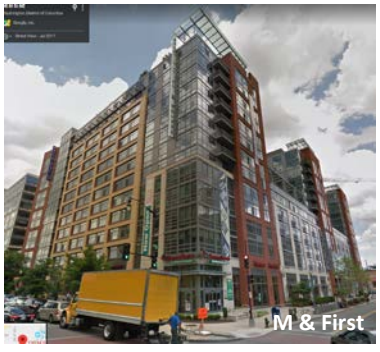
Map data © 2018 Google

Street Parking:
1st St NE: 120 ft
6 metered spaces
+60 ft
3 Taxi Stand

DC Trucks and Bus Map
https://godcgo.com/freight/

Building Entry
4 2018 Data Camera (2017 in green)
4 Verification Camera
Building
Camera Coverage



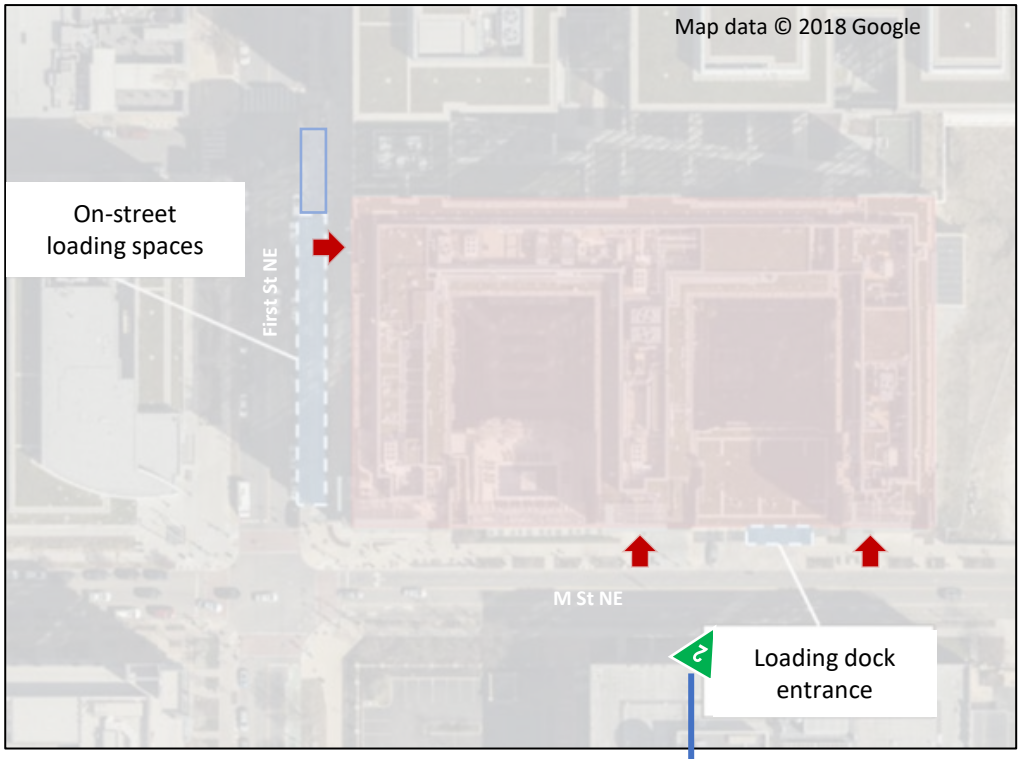


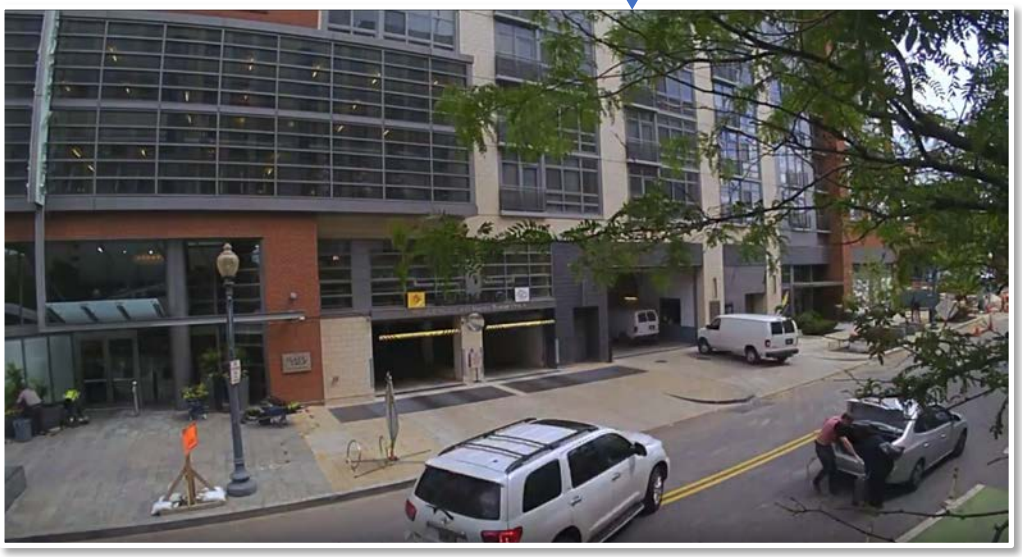
Street View © 2018 Google

Click on triangles showing camera locations to access YouTube playlist for that camera

Figure 6-7 | Camera Views: 130 M St NE

130 M St NE

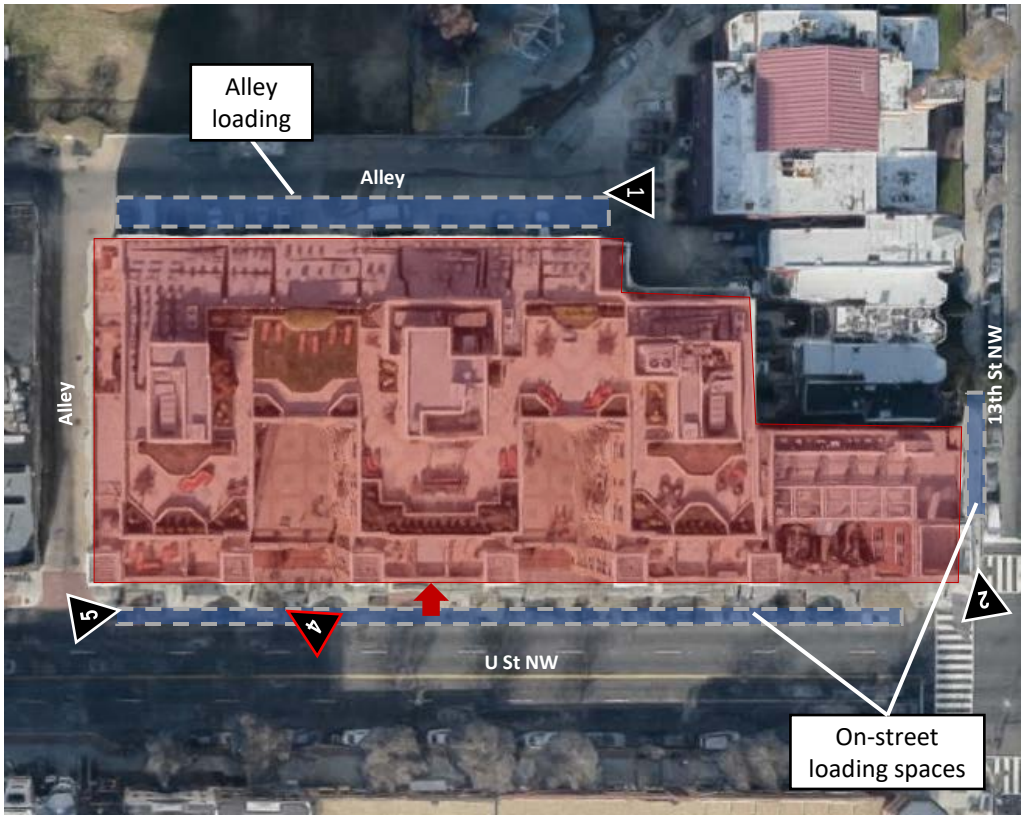




Click on triangles showing camera locations to access YouTube playlist for that camera

Figure 6-8 | Layout of Cameras, Curbside and Onsite Berths: 1301 U St NW

1301 U St. NW

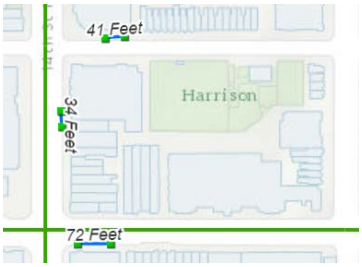


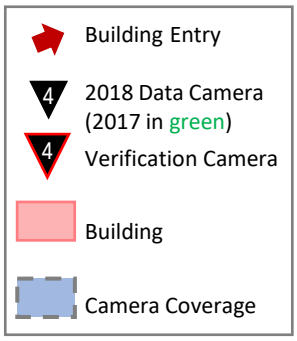
Map data © 2018 Google

Street Parking:
U St NW: 270 ft
14 metered spaces
(+50 ft no parking for Ellington)
13th St NW:
Zone parking
40 ft no parking area

Alley: ~ 200 ft (face-in parking)

DC Trucks and Bus Map
https://godcgo.com/freight/

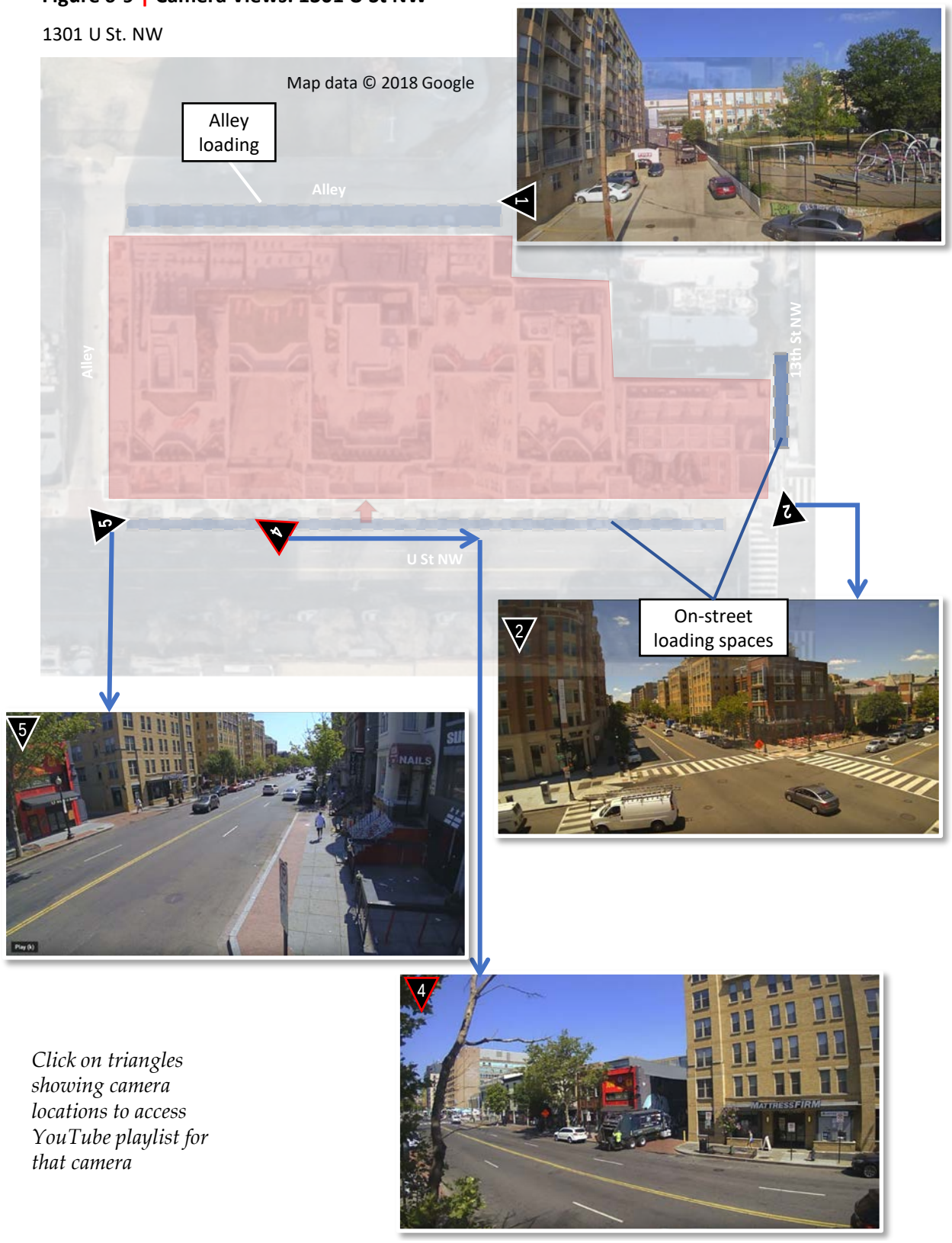




Click on triangles showing camera locations to access YouTube playlist for that camera

Street View © 2018 Google

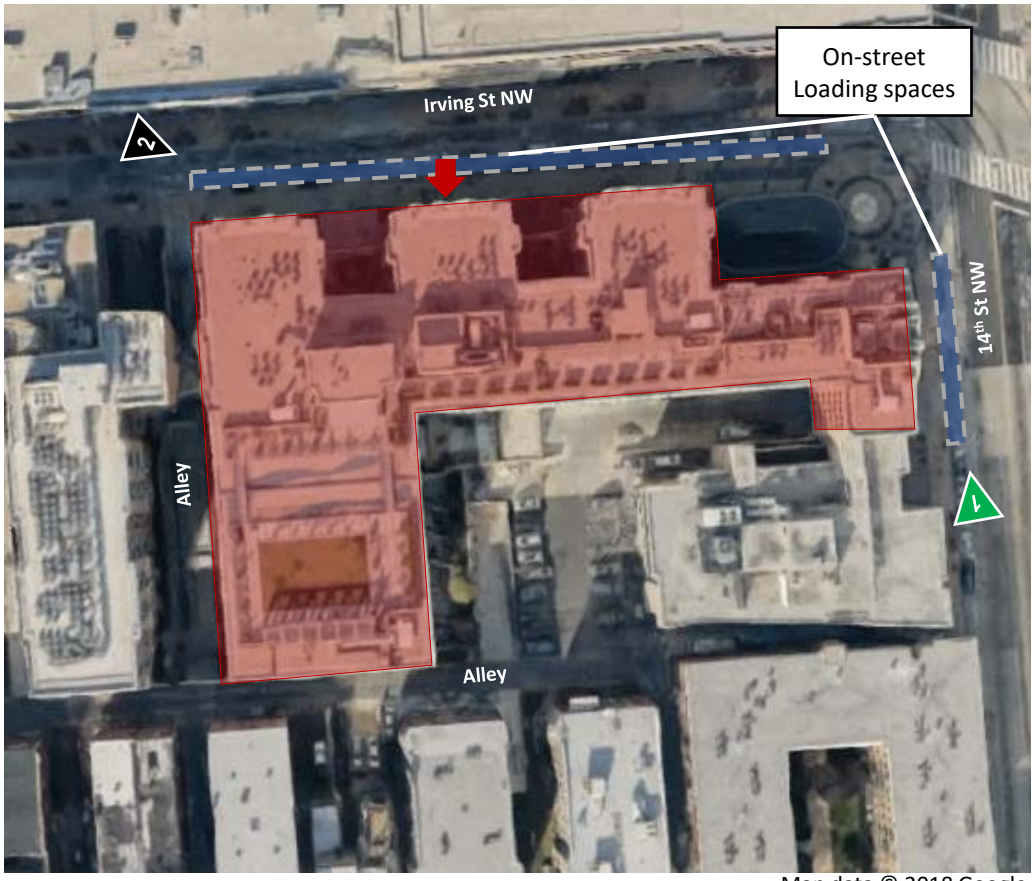
Figure 6-9 | Camera Views: 1301 U St NW



Click on triangles showing camera locations to access YouTube playlist for that camera

Figure 6-10 | Layout of Cameras, Curbside and Onsite Berths: 1400 Irving St NW

1400 Irving St. NW



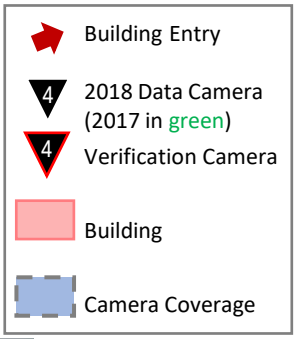
Map data © 2018 Google

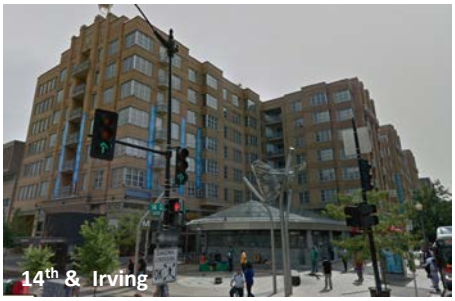
<u>Street Parking:</u>
14th St NW: 100 ft

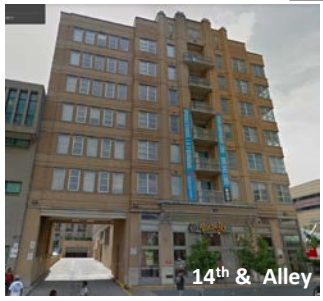
Irving St NW: 360 ft
No parking?
60 ft cutout (no parking)

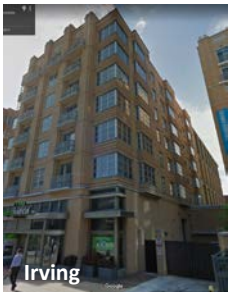
Deliveries to back parking/alley?
Deliveries to west gate on Irving?

DC Trucks and Bus Map
https://godcgo.com/freight/







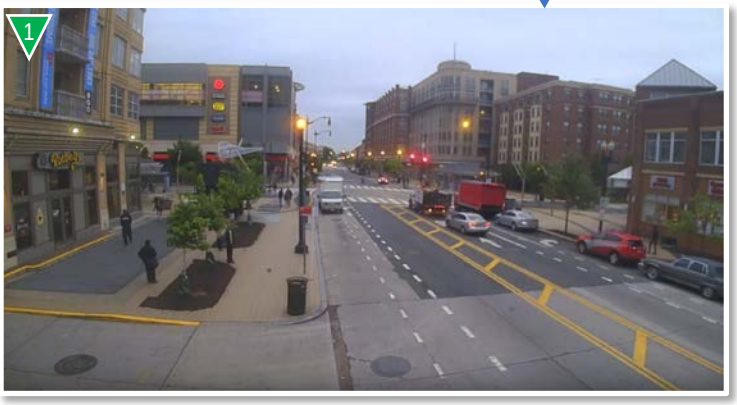


Street View © 2018 Google

Click on triangles showing camera locations to access YouTube playlist for that camera

Figure 6-11 | Camera Views: 1400 Irving St NW

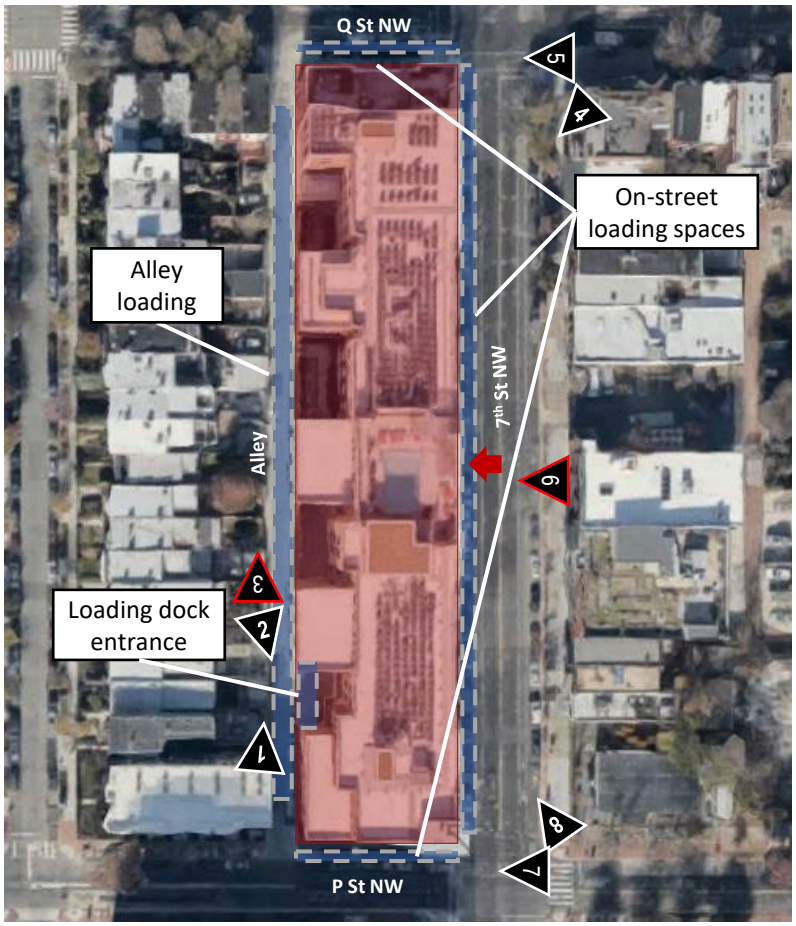
1400 Irving St. NW



Click on triangles showing camera locations to access YouTube playlist for that camera

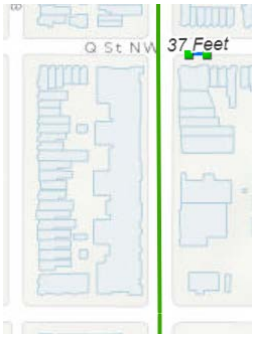
Figure 6-12 | Layout of Cameras, Curbside and Onsite Berths: 1550 7th ST NW

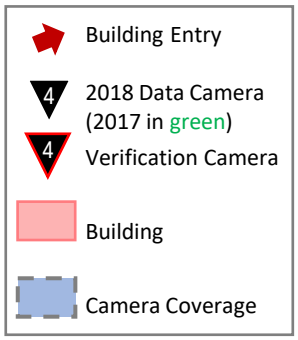
1550 7th St. NW



Map data © 2018 Google

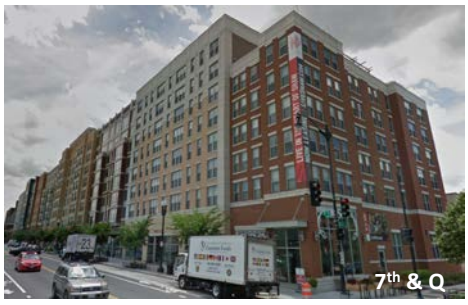
DC Trucks and Bus Map
https://godcgo.com/freight/





Street Parking:
7th St NW: 300 ft
14 metered parking
80 ft bus zone
P St NW: 50 ft
3 metered parking
Q St NW: 70 ft
4 metered parking
Deliveries to alley?

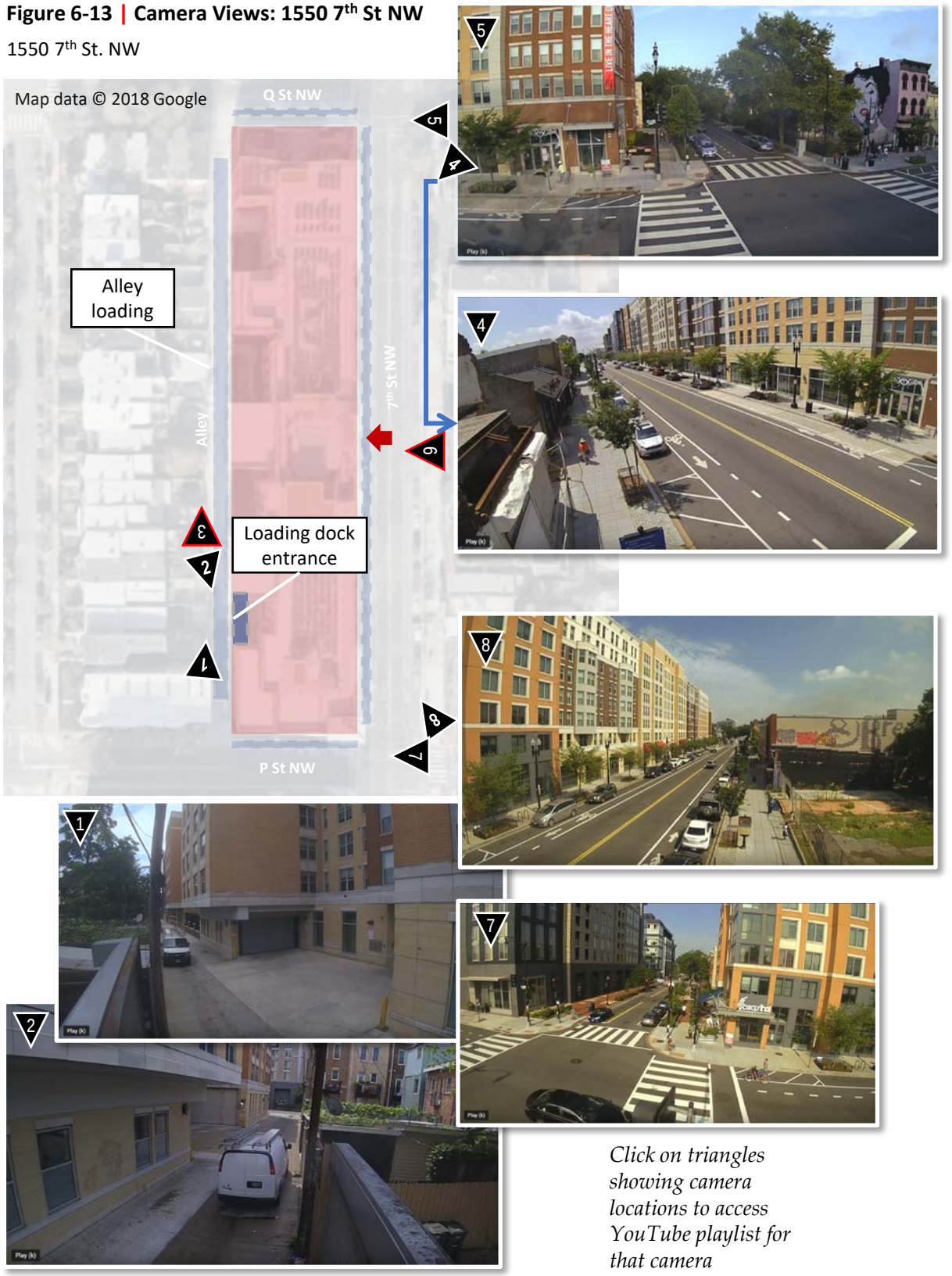
Click on triangles showing camera locations to access YouTube playlist for that camera



Street View © 2018 Google

Figure 6-13 | Camera Views: 1550 7th St NW

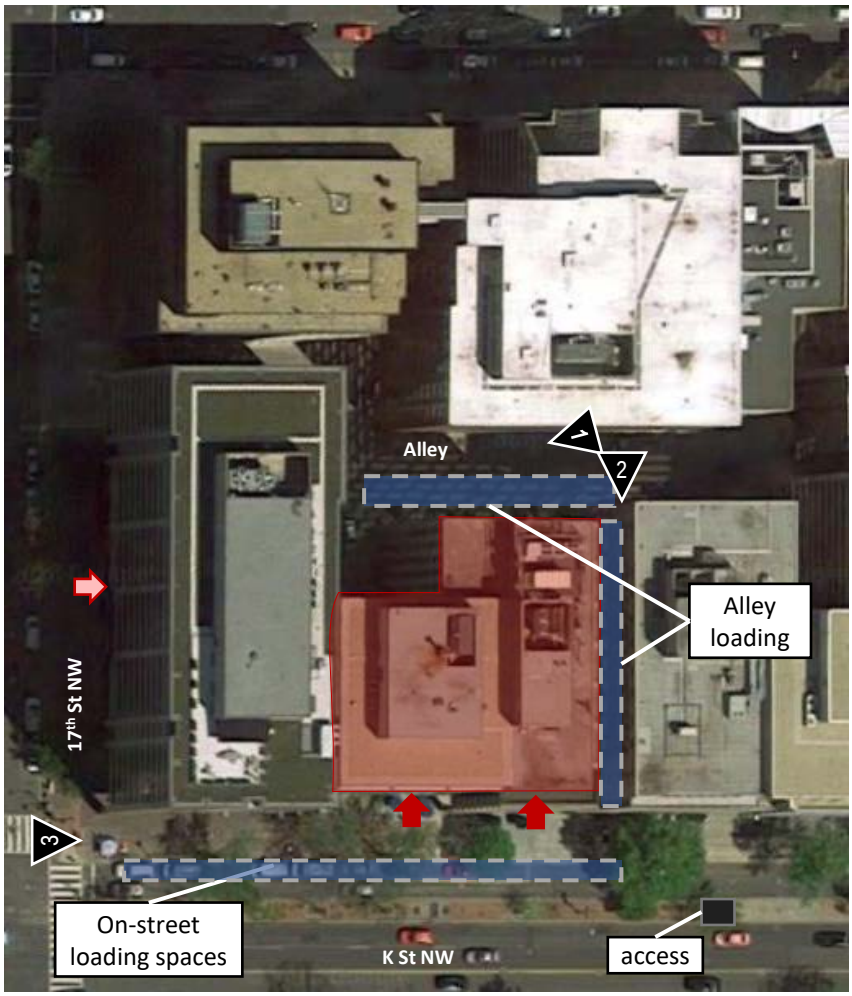
1550 7th St. NW



Click on triangles showing camera locations to access YouTube playlist for that camera

Figure 6-14 | Layout of Cameras, Curbside and Onsite Berths: 1629 K St NW

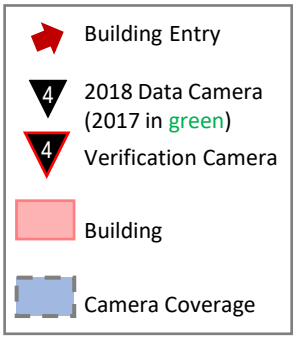
1629 K St. NW



Map data © 2018 Google

Click on triangles showing camera locations to access YouTube playlist for that camera

DC Trucks and Bus Map
https://godcgo.com/freight/

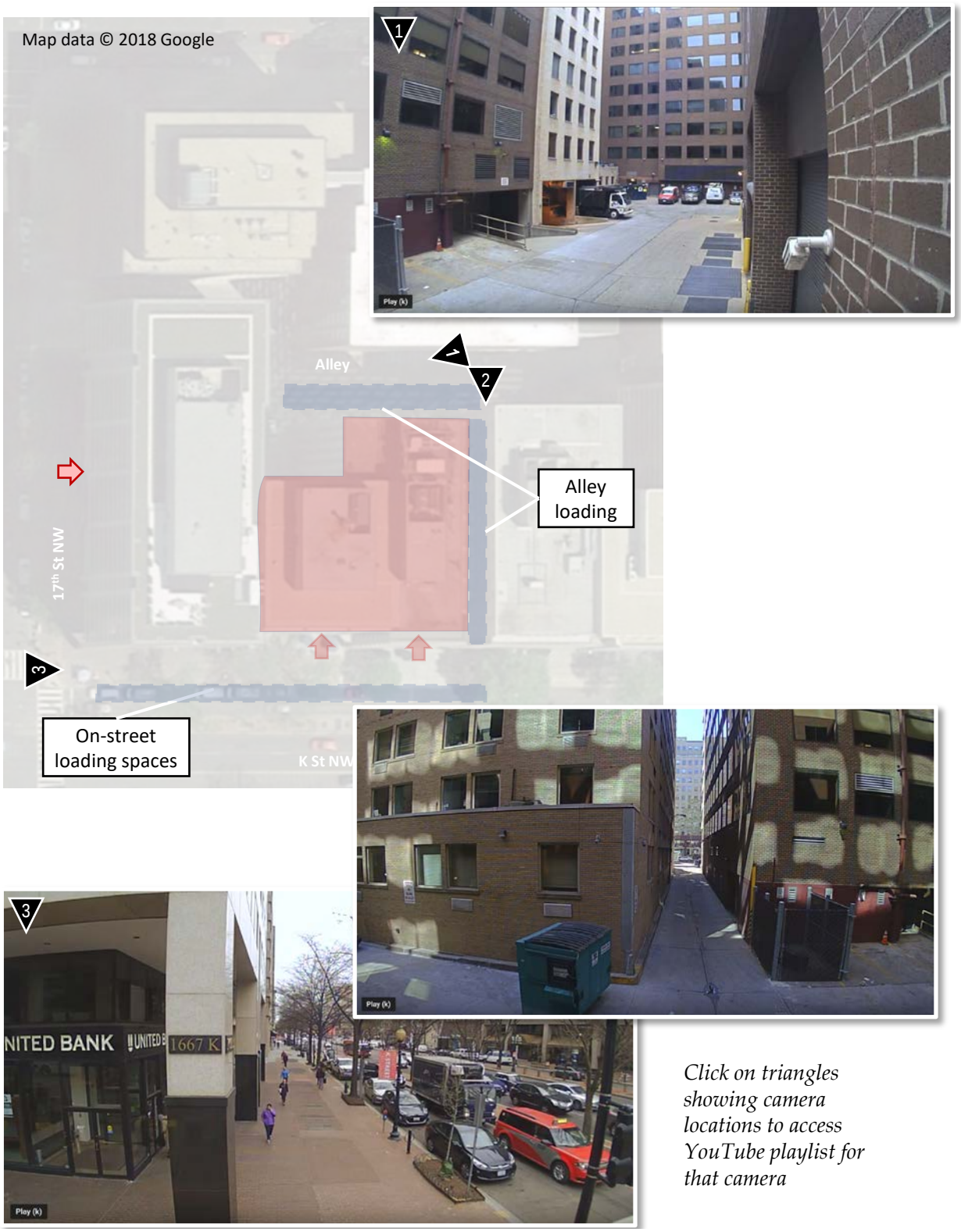


Street Parking:
K St NW: 190 ft
9 metered parking
K St NW - mainline: 160 ft?
17th St NW: 50 ft
7 metered parking
Alley off K
Very narrow
Back alley
Unknown
17th St not captured
Alley off 17th St not captured

Street View © 2018 Google

Figure 6-15 | Camera Views: 1629 K St NW

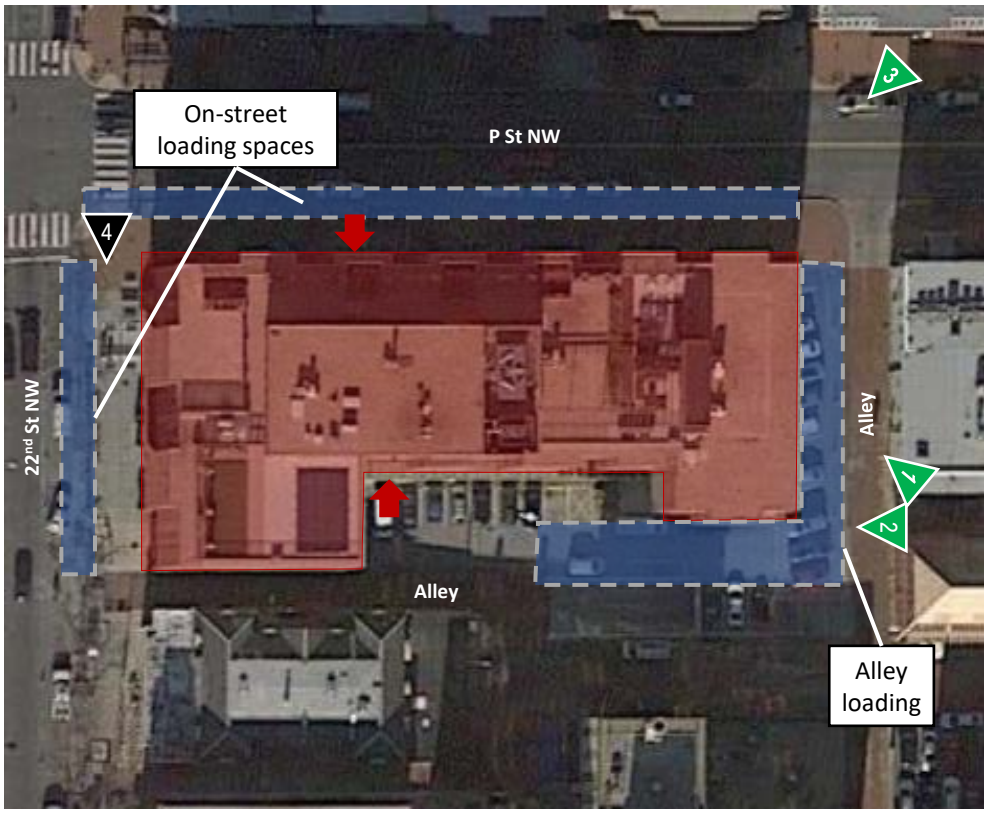
1629 K St. NW



Click on triangles showing camera locations to access YouTube playlist for that camera

Figure 6-16 | Layout of Cameras, Curbside and Onsite Berths: 2130 P St NW

2130 P St NW

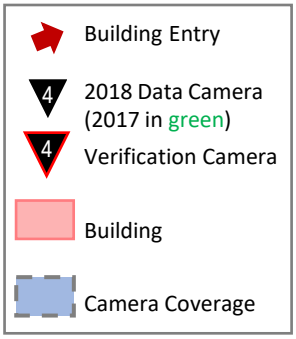


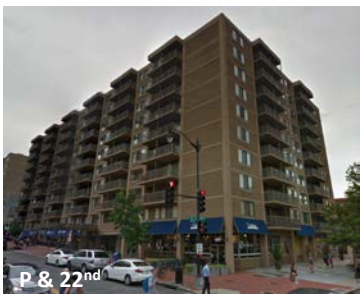
Click on triangles showing camera locations to access YouTube playlist for that camera

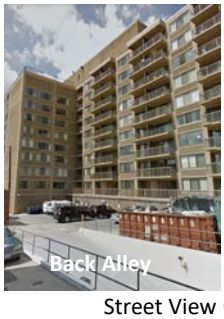
Map data © 2018 Google

<u>Street Parking:</u>
22nd St NW: 100 ft
  4 metered parking
P St NW: 230 ft
  7 metered parking
  loading zone: 67 ft
  no parking entrance: 60 ft
Twining Ct (alley): 70 ft
  15 Reserved Parking
Alley:
  5 parallel parking
  11 parking

DC Trucks and Bus Map
https://godcgo.com/freight/



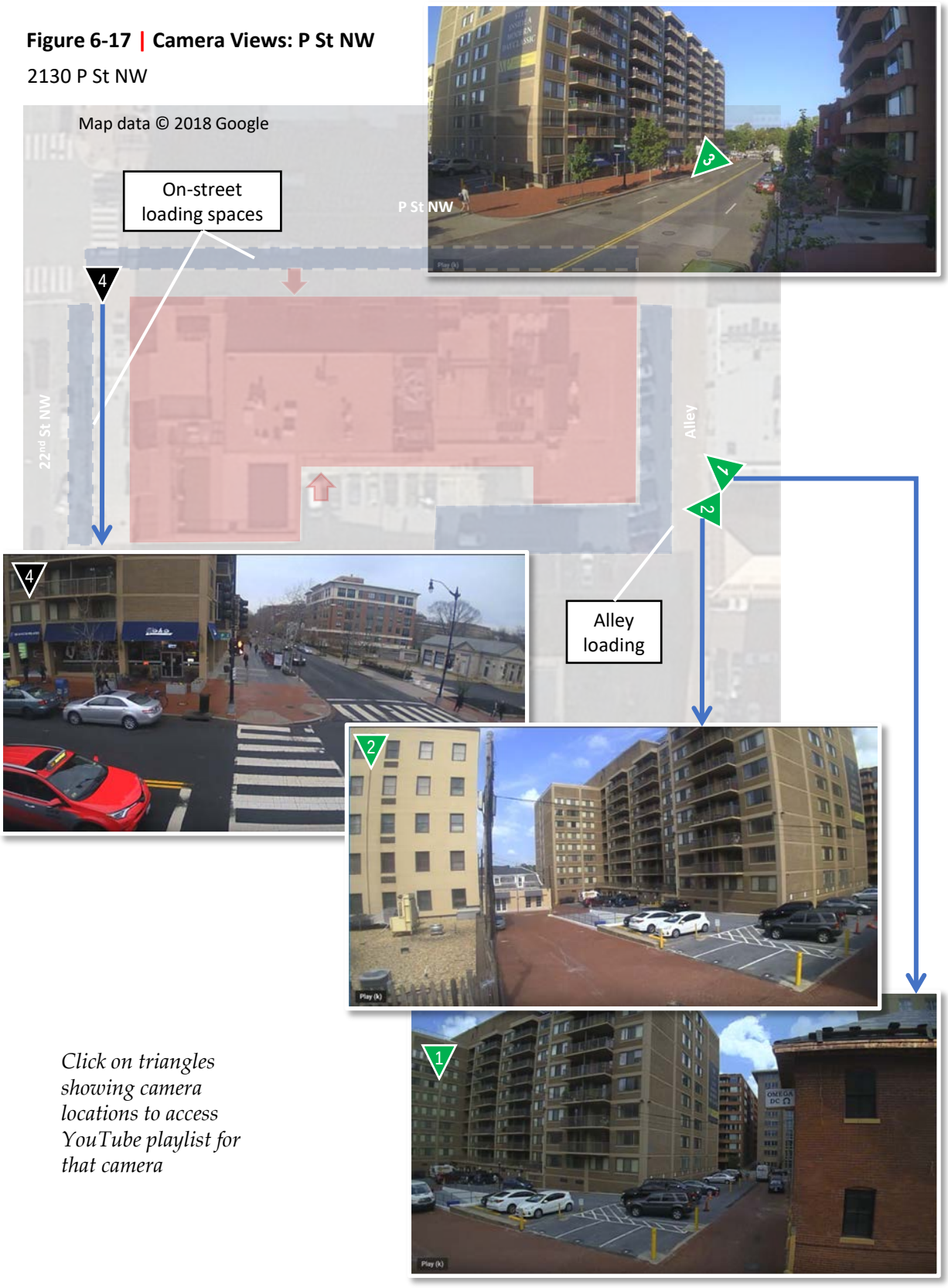




Street View © 2018 Google

Figure 6-17 | Camera Views: P St NW

2130 P St NW



Click on triangles showing camera locations to access YouTube playlist for that camera

Figure 6-18 | Layout of Cameras, Curbside and Onsite Berths: 2400 M St NW

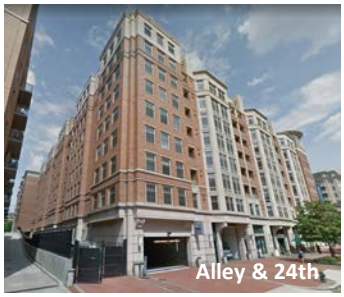
2400 M St NW

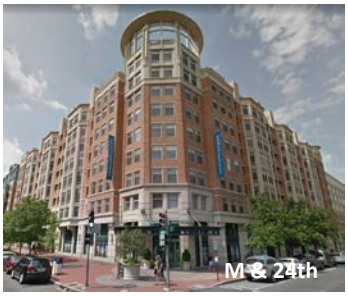
Map data © 2018 Google

Street Parking:
M St NW: 220 ft
11 parking meters
24th St NW: 150 ft
8 parking meters

DC Trucks and Bus Map
https://godcgo.com/freight/

- Building Entry
- 2018 Data Camera (2017 in green)
- Verification Camera
- Building
- Camera Coverage



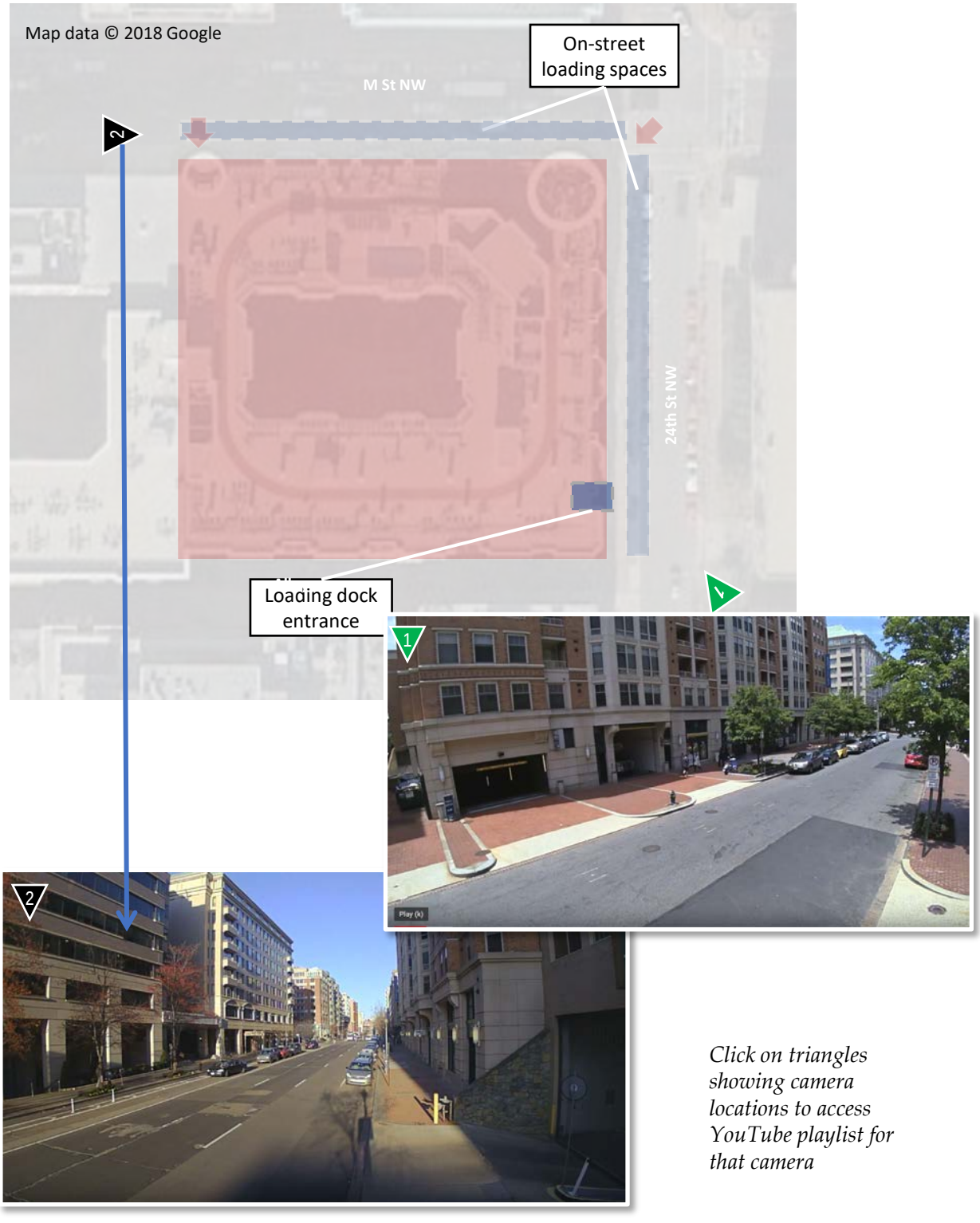


Street View © 2018 Google

Click on triangles showing camera locations to access YouTube playlist for that camera

Figure 6-19 | Camera Views: 2400 M St NW

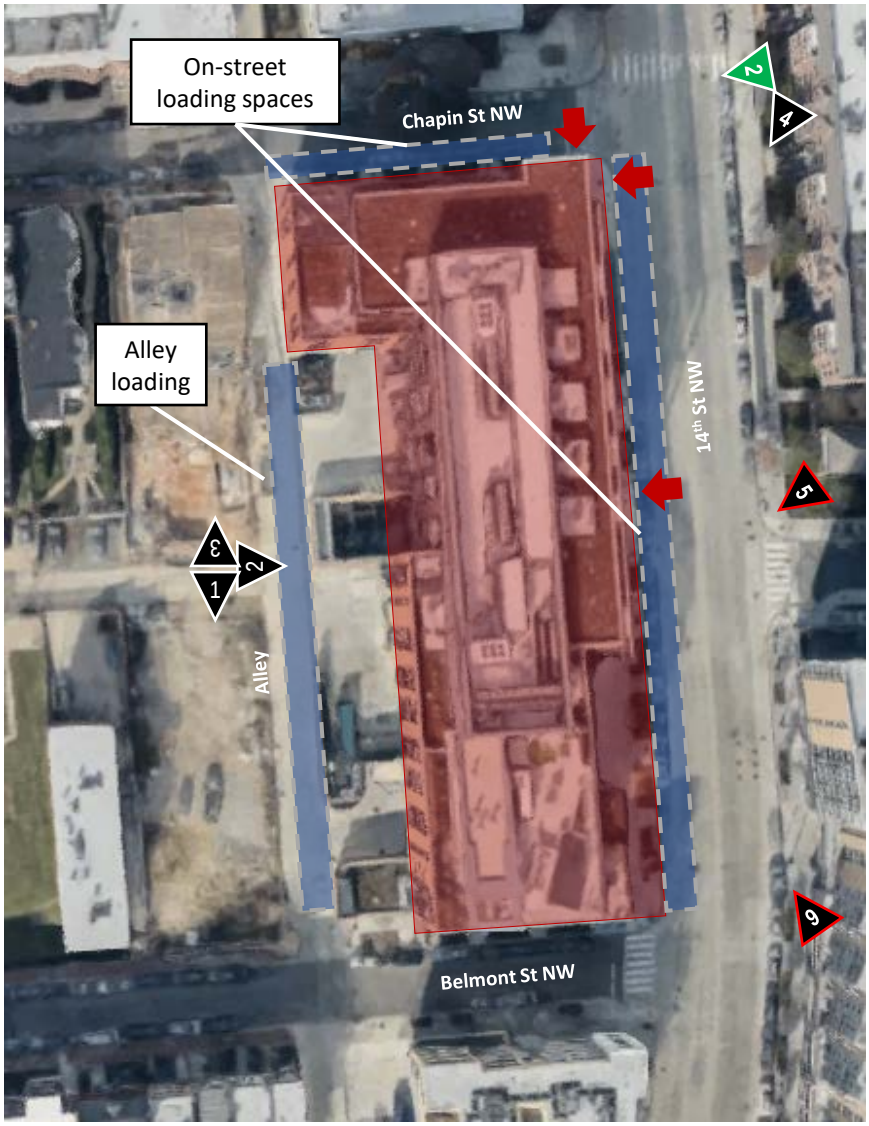
2400 M St NW



Click on triangles showing camera locations to access YouTube playlist for that camera

Figure 6-20 | Layout of Cameras, Curbside and Onsite Berths: 2420 14th St NW

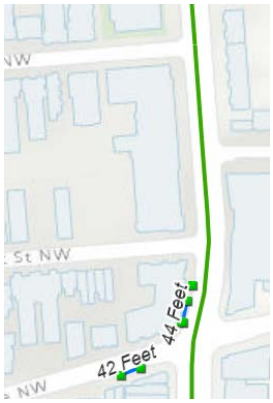
2420 14th St. NW

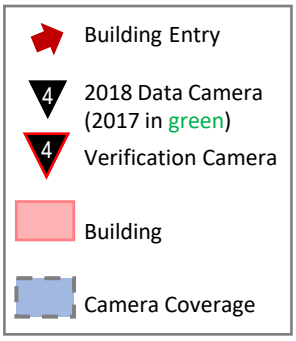


Map data © 2018 Google

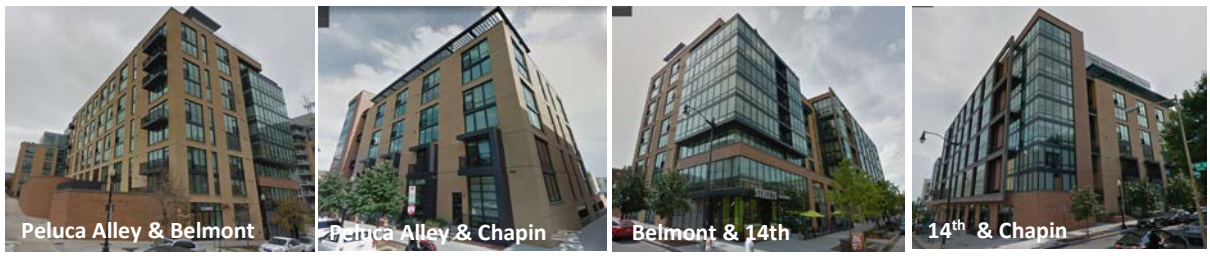
Click on triangles showing camera locations to access YouTube playlist for that camera

DC Trucks and Bus Map
https://godcgo.com/freight/





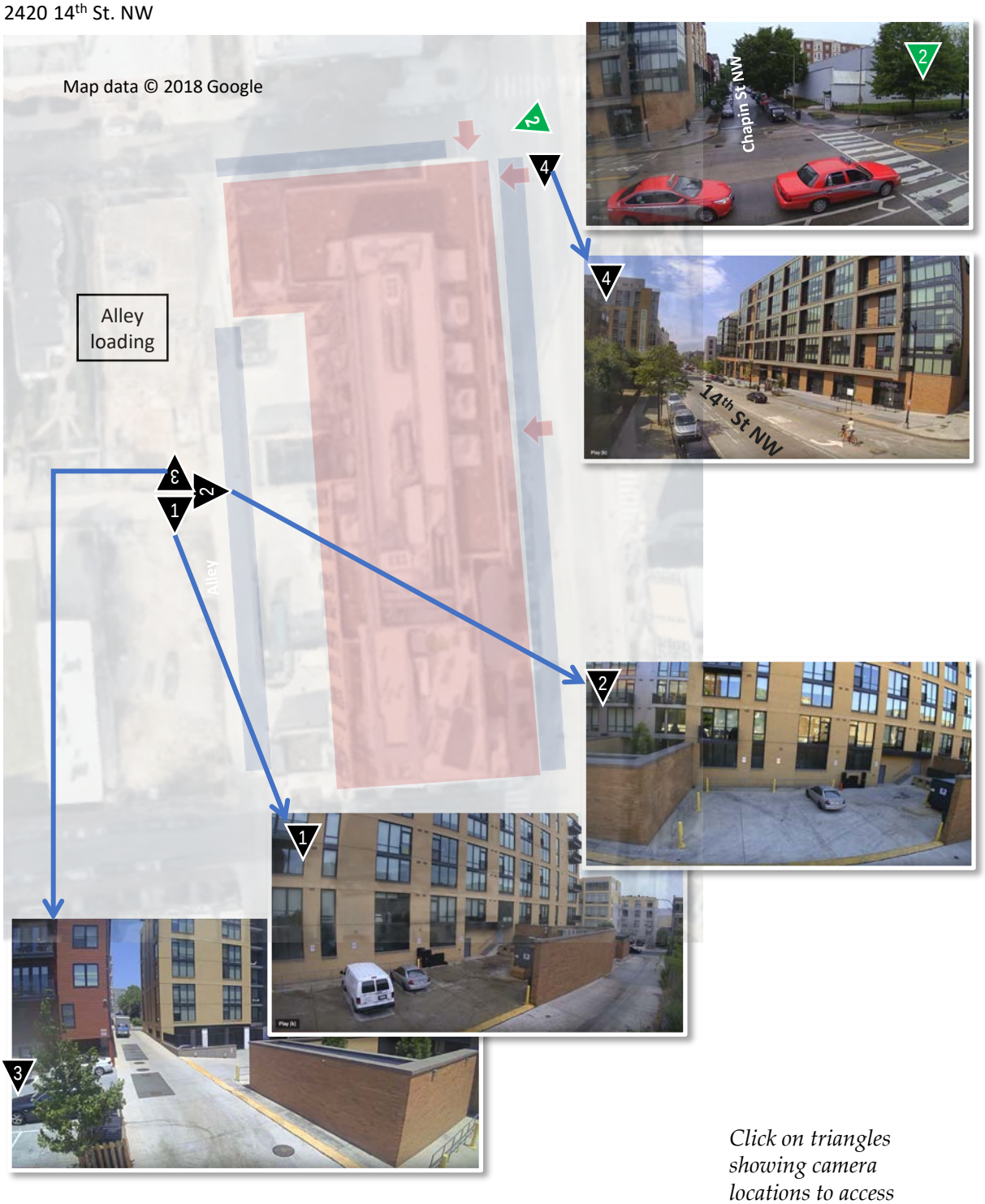
Street Parking:
14th St NW: 200 ft
11 metered parking
Chapin St NW: 100 ft
5 metered parking
Belmont St: 120 ft
6 metered parking
Peluca Alley: 90 ft access
Lower Garage?
Res Parking
Garbage



Street View © 2018 Google

Figure 6-21 | Camera Views: 2420 14th St NW

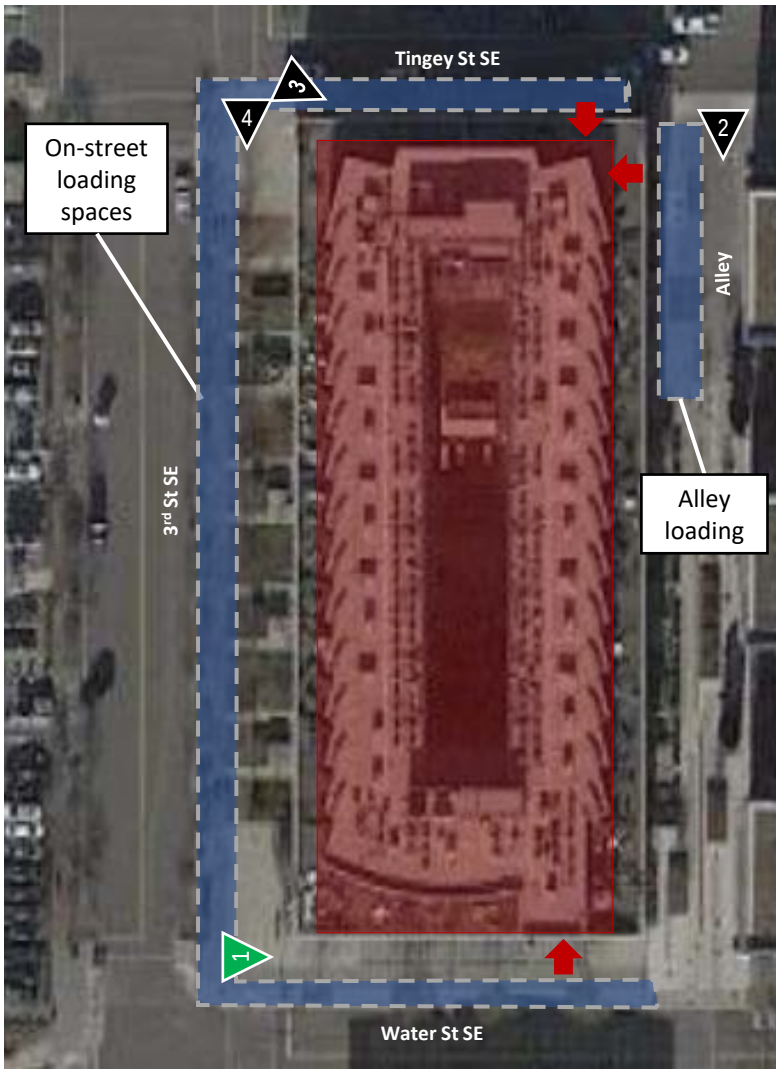
2420 14th St. NW



Click on triangles showing camera locations to access YouTube playlist for that camera

Figure 6-22 | Layout of Cameras, Curbside and Onsite Berths: 301 Tingey St SE

301 Tingey St SE



Map data © 2018 Google

Click on triangles showing camera locations to access YouTube playlist for that camera

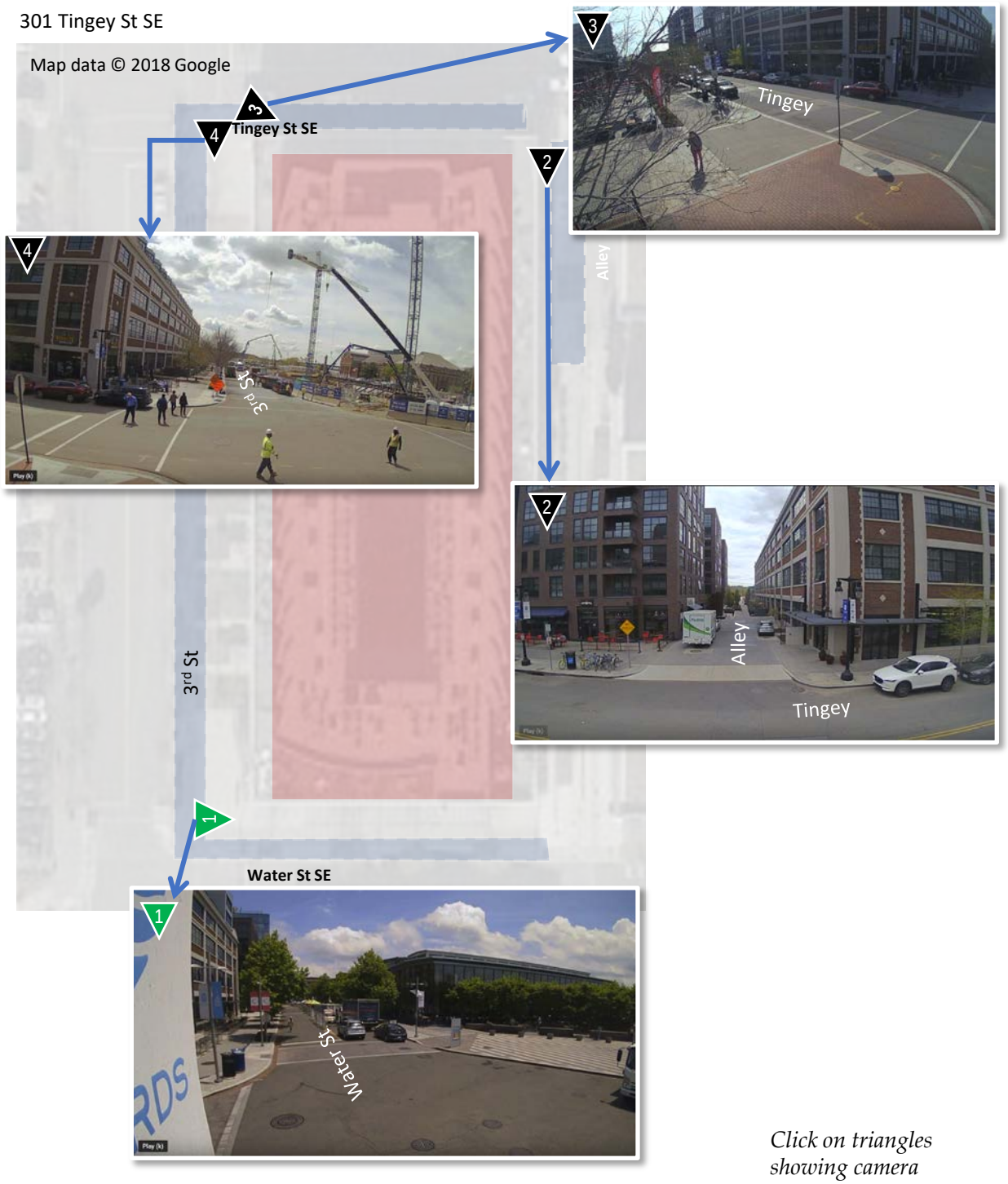
DC Trucks and Bus Map
https://godcgo.com/freight/

Building Entry
2018 Data Camera (2017 in green)
Verification Camera
Building
Camera Coverage

Street Parking:
Tingey St SE: 160 ft
8 metered parking
3rd St SE: 290 ft
Marked no parking
Water St SE: 140 ft
Marked no parking
Alley: 110 ft
Garage?

Street View © 2018 Google

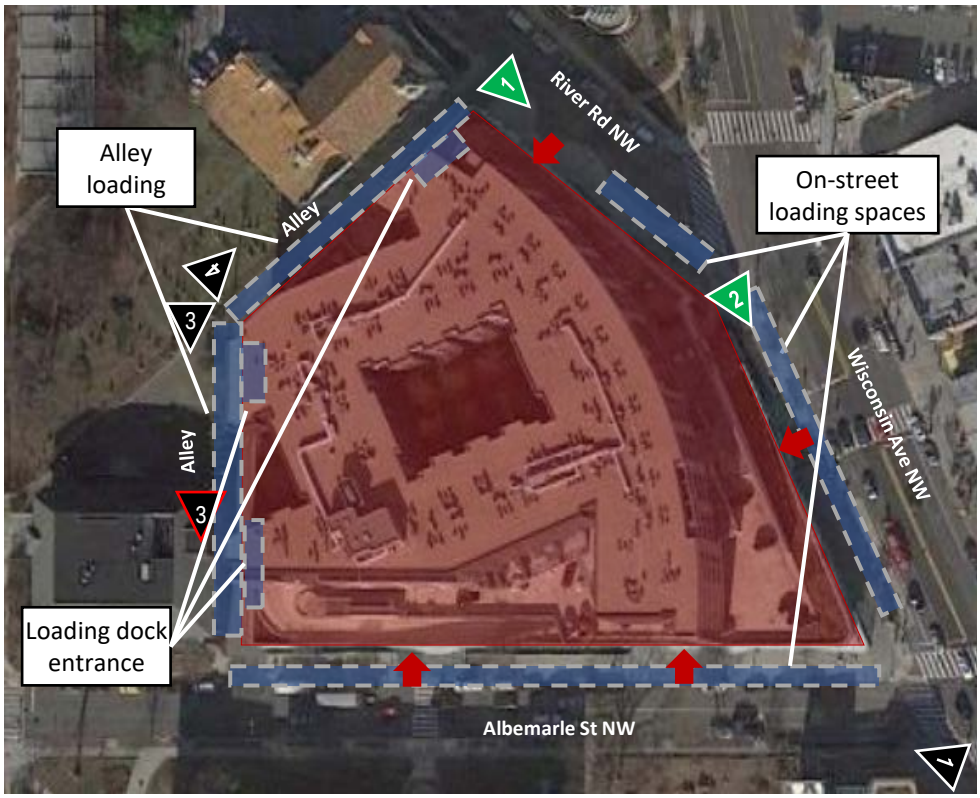
Figure 6-23 | Camera Views: 301 Tingey St SE



Click on triangles showing camera locations to access YouTube playlist for that camera

Figure 6-24 | Layout of Cameras, Curbside and Onsite Berths: 4500 Wisconsin Ave NW

4500 Wisconsin Ave NW



Click on triangles showing camera locations to access YouTube playlist for that camera

Map data © 2018 Google

<u>Street Parking:</u>
Wisconsin Ave: 200 ft
Marked no parking
Bus Stop/traffic signal
River Rd NW: 50 ft
Marked no parking
Abemarle St NW: 380 ft
14 parking meters
North Alley: 250 ft
Garage?
West Alley: 230 ft

DC Trucks and Bus Map
https://godcgo.com/freight/

Building Entry
2018 Data Camera (2017 in green)
Verification Camera
Building
Camera Coverage

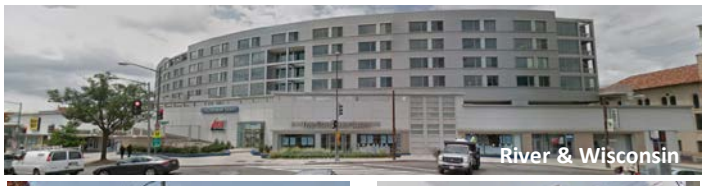


Figure 6-25 | Camera Views: 4500 Wisconsin Ave NW

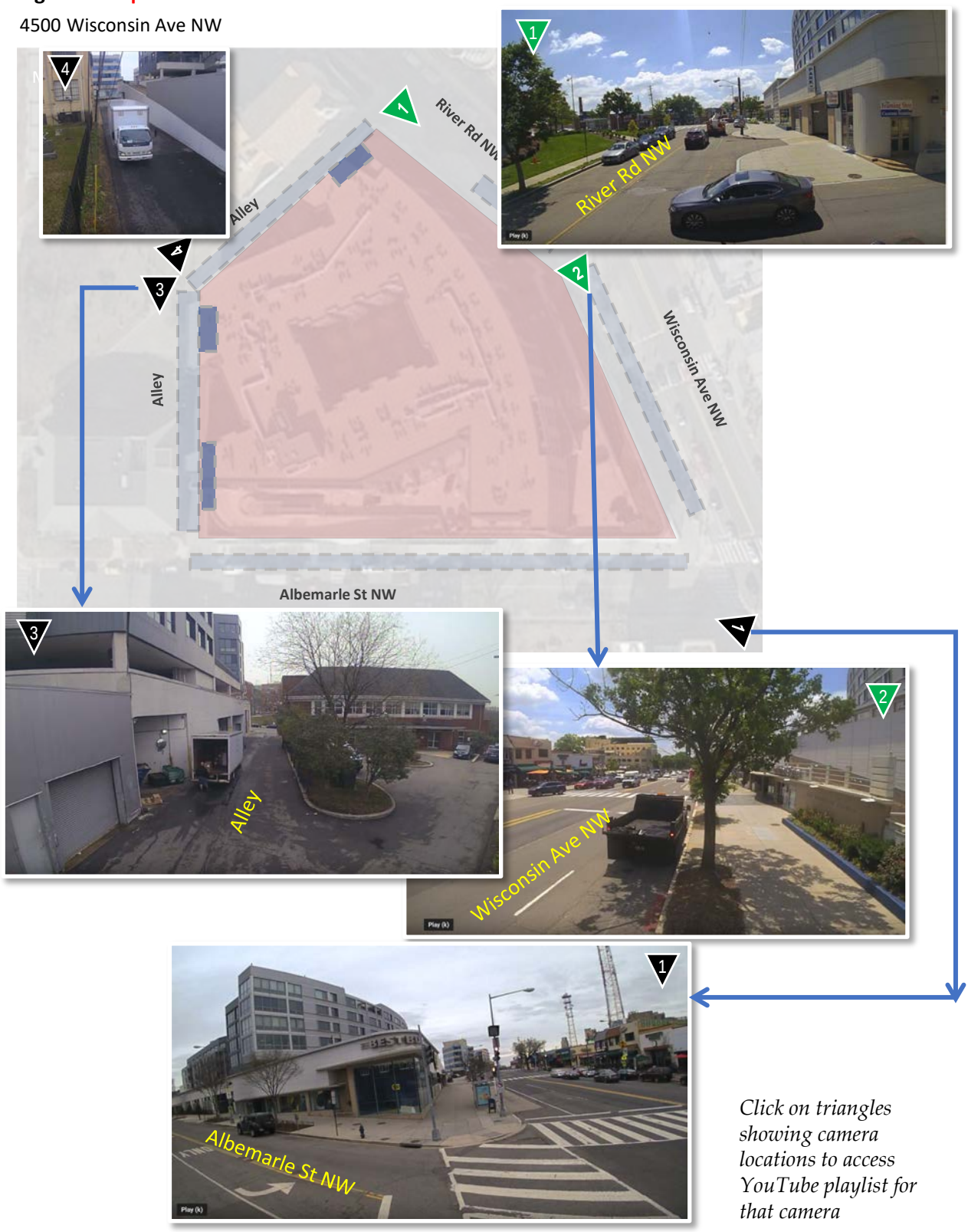
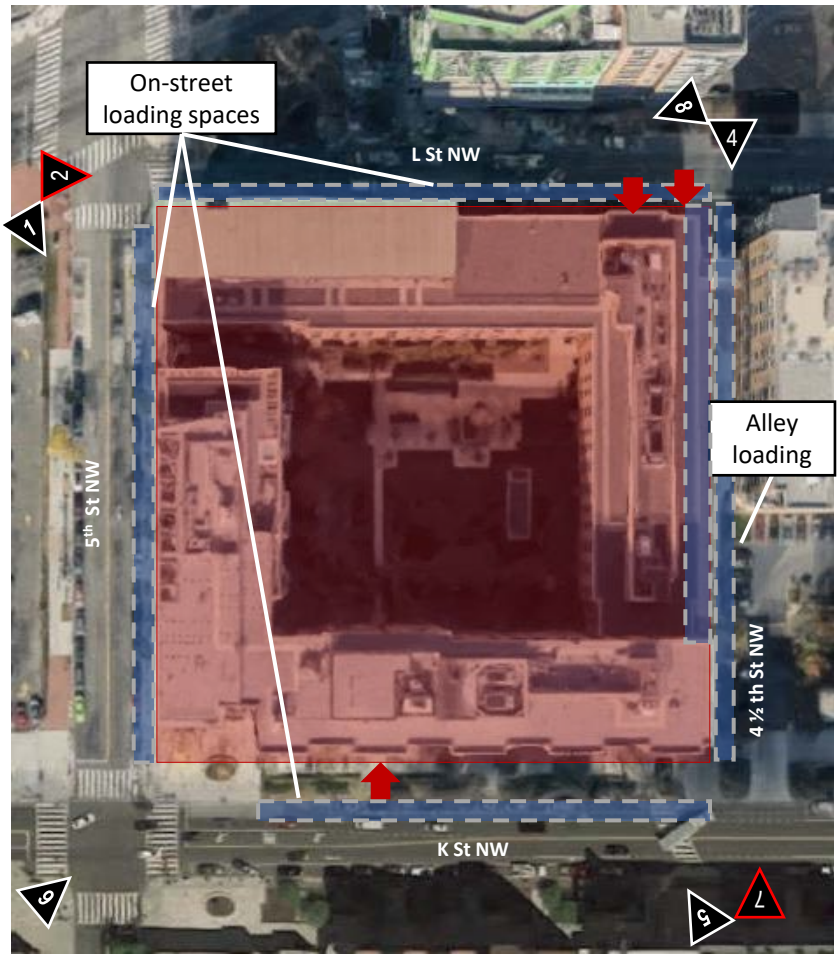


Figure 6-26 | Layout of Cameras, Curbside and Onsite Berths: 475 K St NW

475 K St. NW

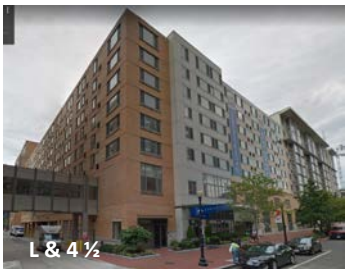


Map data © 2018 Google

DC Trucks and Bus Map
https://godcgo.com/freight/

Building Entry
2018 Data Camera (2017 in green)
Verification Camera
Building
Camera Coverage

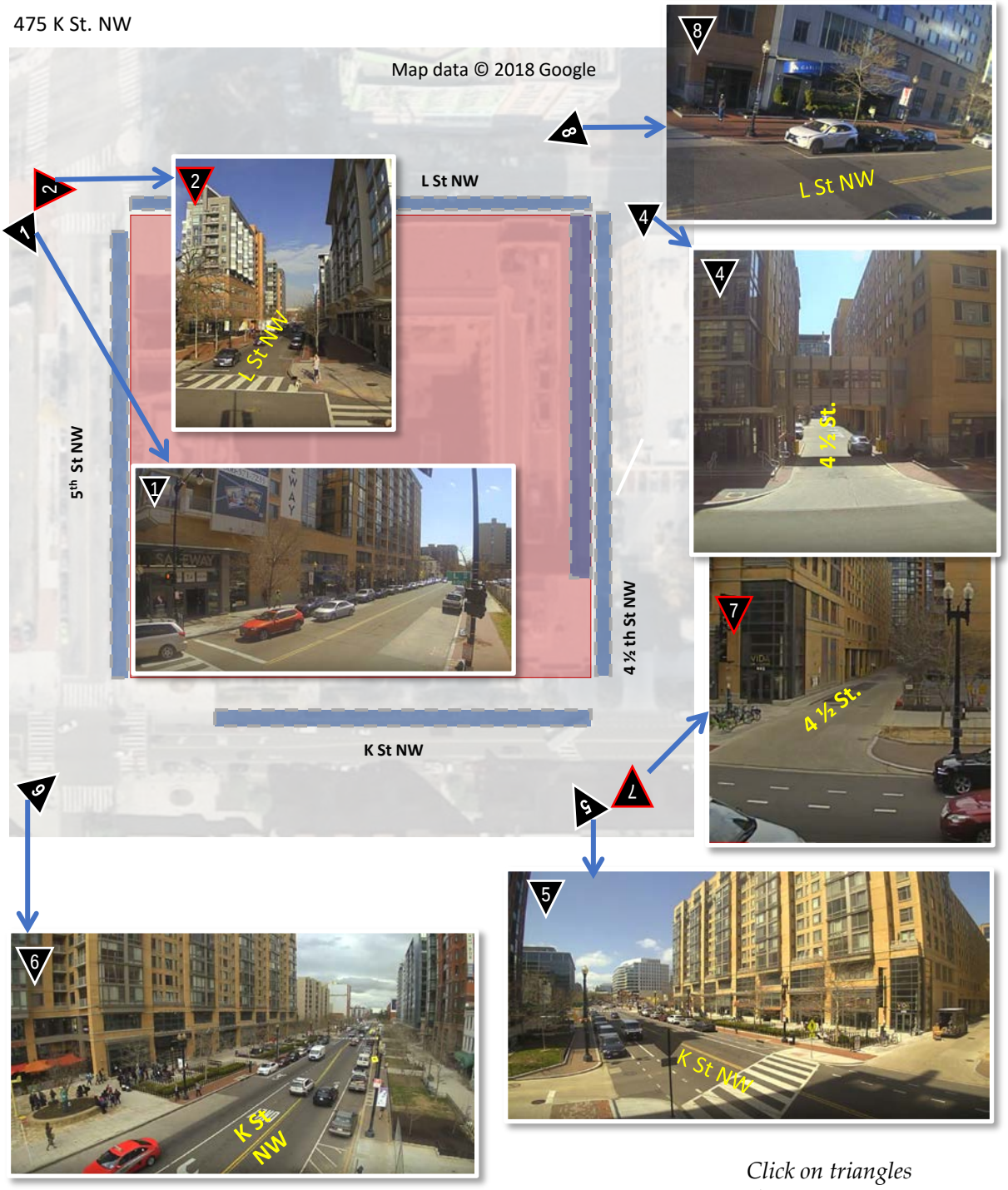
Street Parking:
K St NW: 230 ft
11 metered parking
Bus Stop
L St NW: 260 ft
12 metered parking
5th St NW: 330 ft
15 metered parking
Alley: 340 ft
Garage?



Street View © 2018 Google

Click on triangles showing camera locations to access YouTube playlist for that camera

Figure 6-27 | Camera Views: 475 K St NW



Click on triangles showing camera locations to access YouTube playlist for that camera

6.3 Video Data Analysis

The original intent of the project was to link video data to survey data to develop freight generation models. This proved impossible given the nature of survey responses as discussed in Chapter 6, the inability to link vehicles in the videos to specific businesses within a building, the mixed-use nature of the buildings with 12 of the 13 having large residential populations, and limitations associated with the encoded video data. It was also difficult to determine whether delivery and package delivery vehicles were picking up or delivering or both to these locations. Instead, the video data and analysis are best suited to supporting curbside management decision-making.

As a result, the analysis is limited to presenting and discussing number of vehicles by purpose, arrival time, and dwell time combined for all 13 buildings as well as for each building individually. Three purposes were considered in the assessment: delivery, package delivery, and service. Small pickup trucks, which make up approximately 15% of vehicles observed, were separated from the other three categories because coders could not always distinguish their purpose. Also, the general Delivery category includes special purpose vehicles such as garbage, construction, fire and rescue, etc.

6.3.1 Overall Assessment

A total of 4009 vehicles were considered in this assessment. Because of the issues identified in Table 6-2, numbers of vehicles in the following tables and figures should be considered in the context of trends and orders of magnitude and not as absolute numbers. Table 6-3 provides a breakdown by purpose of vehicle type. Delivery and service vehicles make up approximately the same proportion of vehicles at 37% and 35%, respectively. Package delivery represents 14%, which is substantially higher than the twice-a-day delivery that was experienced before the Amazon effect.

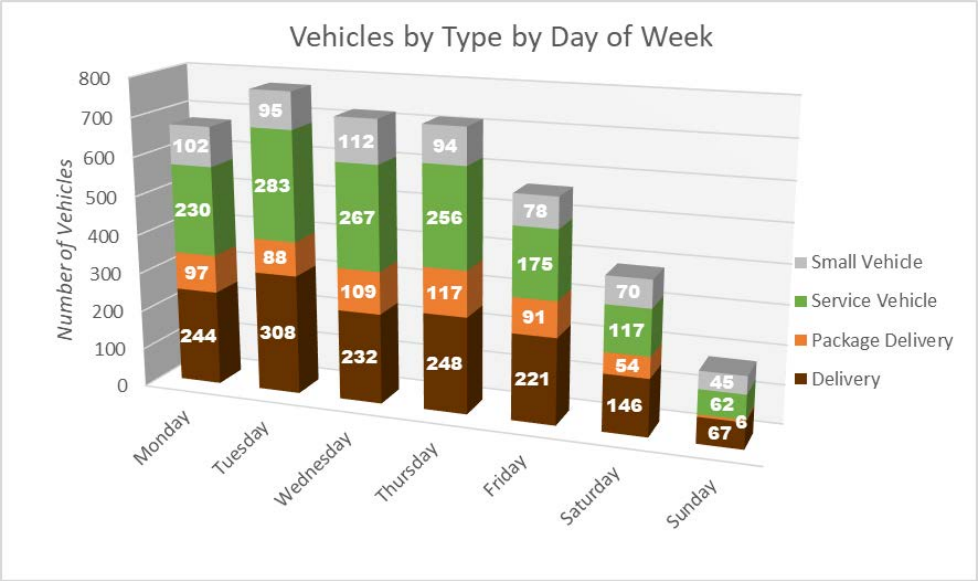
Table 6-3 | Vehicles by Purpose

Vehicle Purpose	Number	Percent
Small Vehicle - Pickup Truck	591	14.7%
Delivery*	1466	36.6%
Delivery Van	292	7.3%
Medium Truck (< 40 ft)	911	22.7%
Large Truck (40 to 50 ft)	228	5.7%
Tractor Trailer (>55 ft)	35	0.9%
Package Delivery	562	14.0%
Service	1390	34.7%
Service - Other	427	10.7%
Service - Truck	113	2.8%
Service - Van	326	8.1%
Utility Van	524	13.1%
Total	4009	100.0%

** No distinction was made between delivery trucks and special purpose trucks such as garbage, construction, fire, etc.*

Figure 6-28 shows purpose by day of week. As expected, midweek sees the highest number of vehicles per day at about 18% of the weekly total per day, while Monday and Friday are 3% to 4% lower followed by Saturday at 10% and Sunday at 4%.

Figure 6-28 | Vehicle Purpose by Day of Week



Purpose by arrival time is shown in Figure 6-29. The first image shows the overall week while the second image shows only weekdays. Delivery vehicles and service vehicles track together across the hours of the day beginning to increase between 3:00am and 4:00am with package delivery lagging and correlating more with normal working hours in the morning. All three drop off dramatically in the late afternoon before the PM rush hour. Peak time for all three occurs mid-morning to just after 1:00pm with package delivery extending into the late afternoon. When considering the difference between the overall week and weekday, two trends stand out. Service trips on the weekend have a smoothing effect being more evenly distributed during the weekend days and weekend deliveries have an observable peak in the evening. Figure 6-30 shows the cumulative effect of all vehicles by time of day for the entire week and then for weekday and weekend. Seeing the cumulative view emphasizes arrival time pattern for four types of vehicles, highlighting three peaks at 6:00am, 10:00am and 12:00pm and a smaller peak at 7:00pm.

Figure 6-29 | Vehicle Purpose by Arrival Time – Total Week (top) and Weekday (bottom)

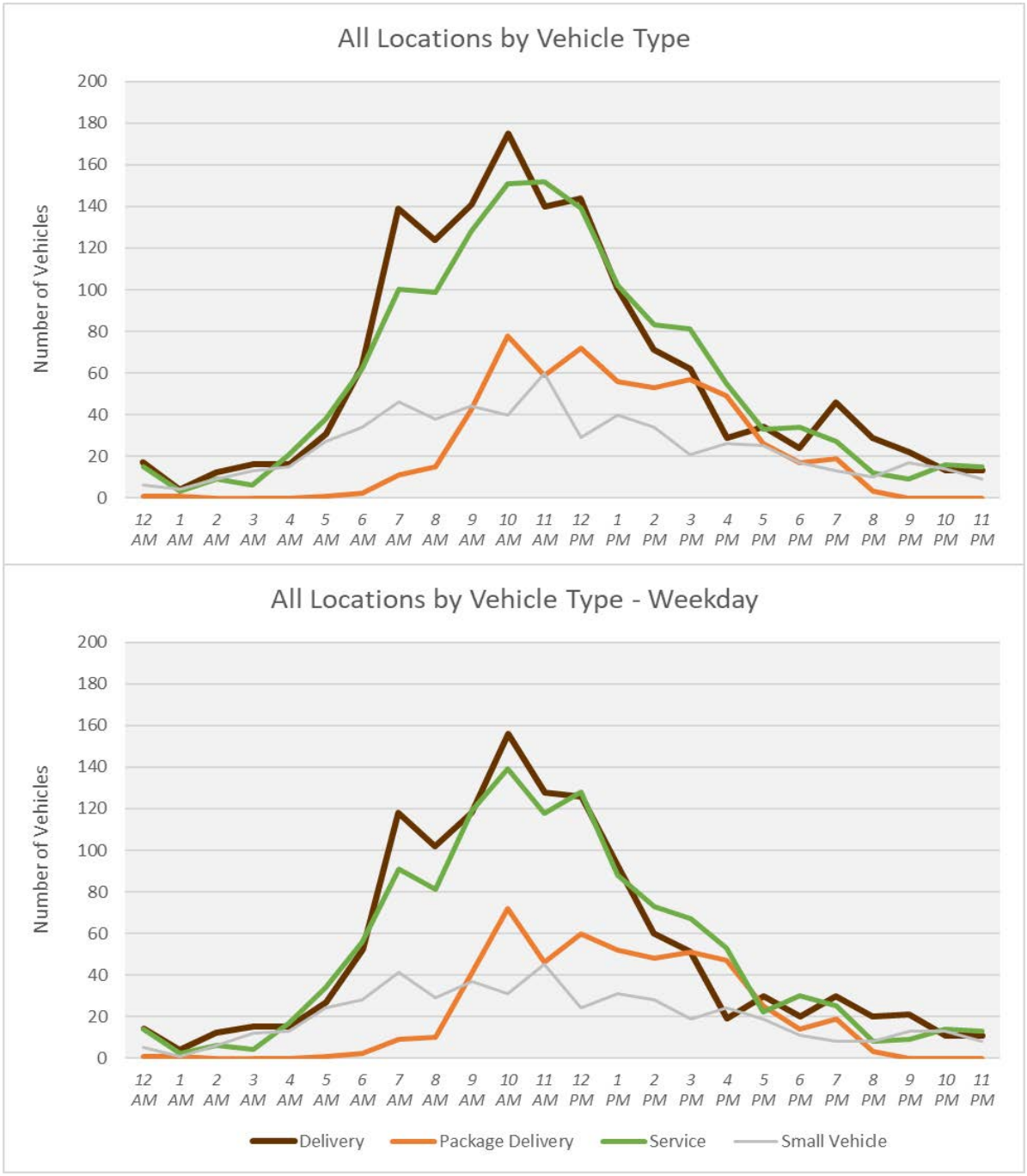
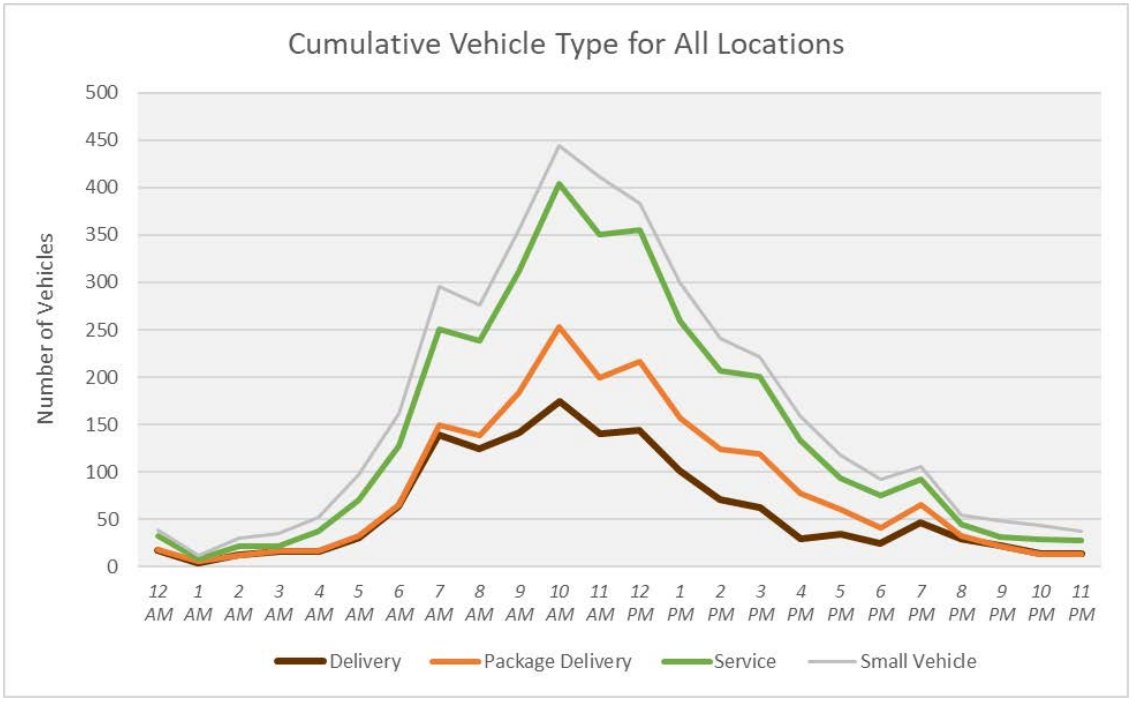
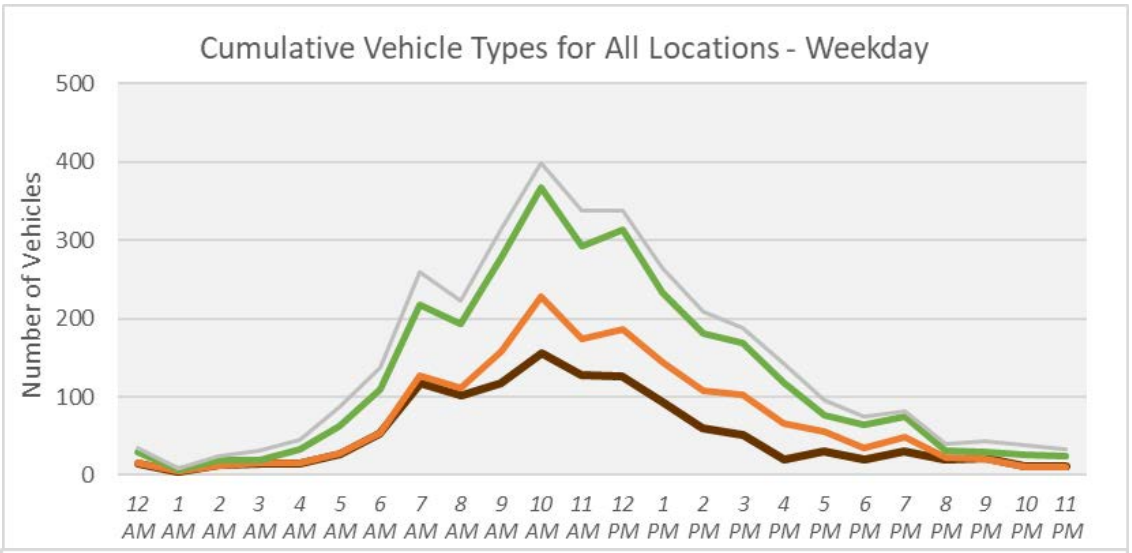
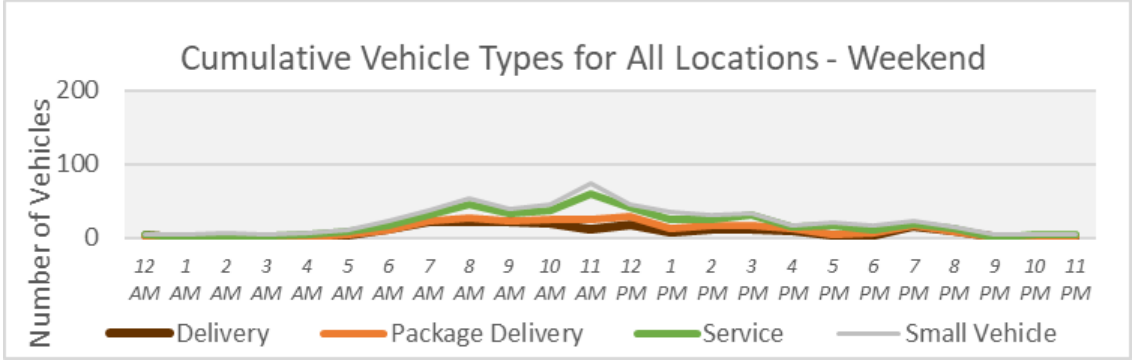


Figure 6-30 | Cumulative Vehicles by Arrival Time







On-Site Berths and Curbside Implications

Figures 6-31, 6-32, and 6-33 provide three different aggregations of vehicle dwell time. The first shows every dwell time length. The second aggregates the larger dwell times to 30- and 60-minute bins after the first hour and the third aggregates dwell times 10 minutes or less. Note that the Unknown columns on the right side of the three figures consist of vehicles that were in a video at the beginning or end of the recording. The first two figures are cumulative to show the impacts of each vehicle purpose on the overall dwell time while the last one provides individual bars for each purpose to provide a comparison of purposes.

Figure 6-31 shows that vehicle dwell times vary dramatically and drop off rapidly after the first hour, continuing to gradually decrease for the next two hours. When seen in Figure 6-32, the majority of vehicles that stay beyond 3 hours are service vehicles which makes it difficult to determine when a vehicle is parked because the driver lives in the area or whether the service required the indicated time to complete.

Figure 6-31 | Dwell Time by Un-aggregated Times

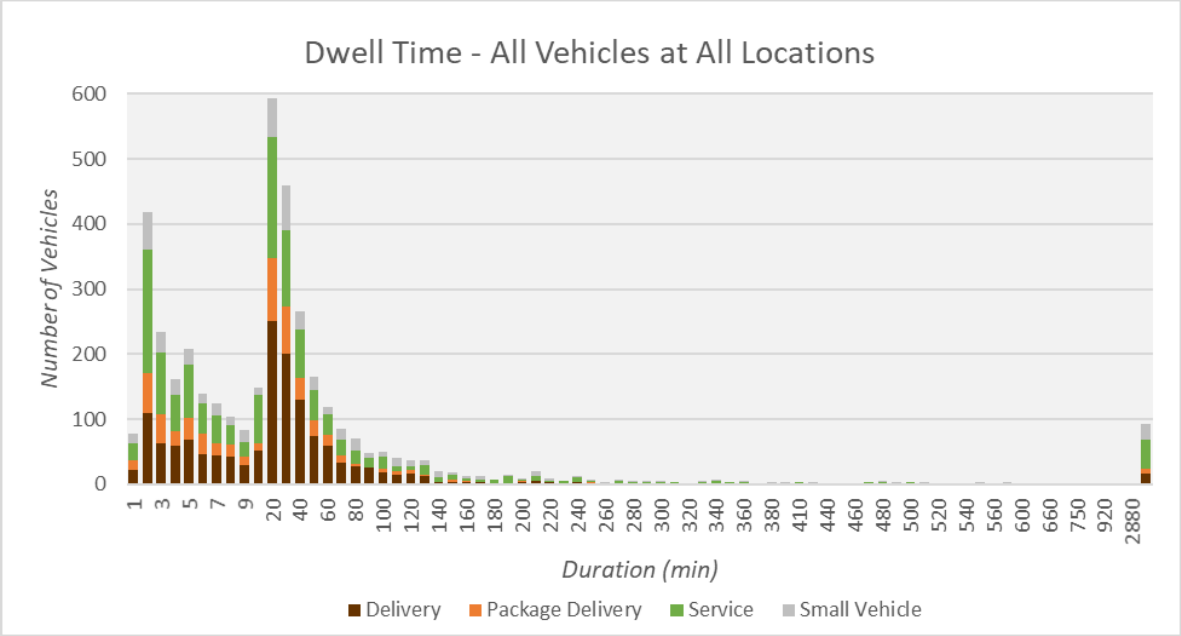


Figure 6-32 also shows that the largest number of short-term stops are approximately 2 minutes long. From Figure 6-33, the largest number of vehicles spend 10 minutes or less at a building. Without additional review, it is unclear why the large number of service vehicles in this bin particularly when compared to delivery and package delivery vehicles.

Figure 6-32 | Aggregated Dwell Time

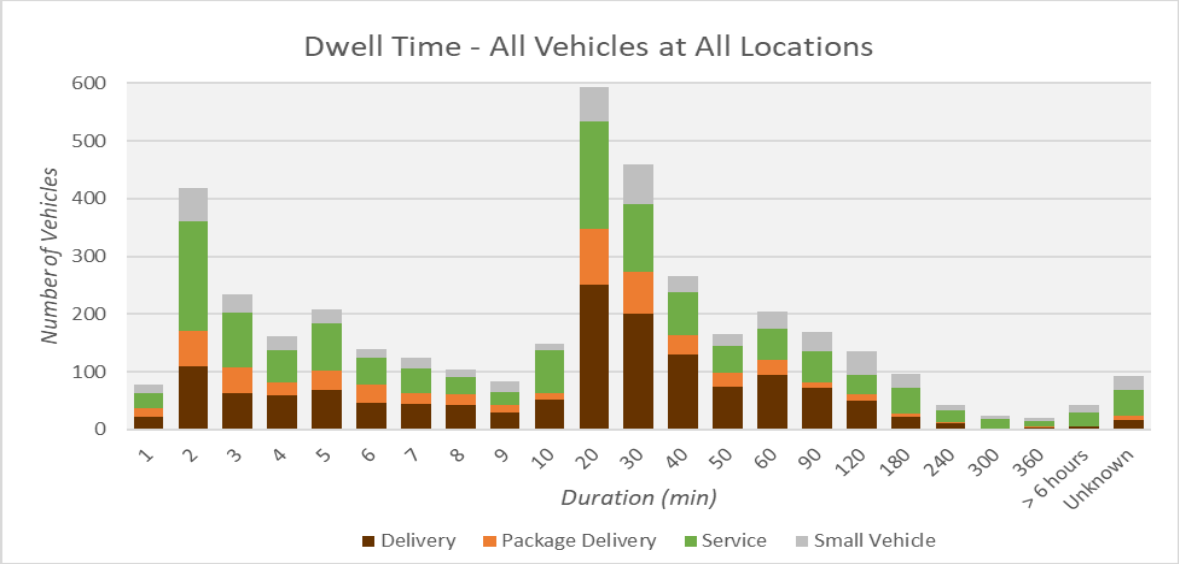
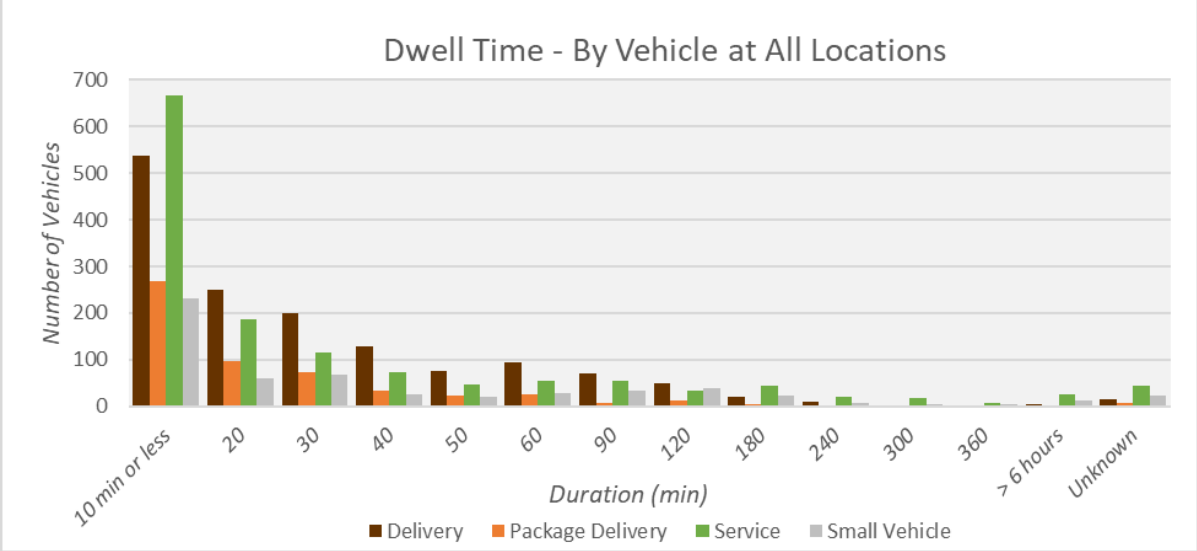


Figure 6-33 | Aggregated Dwell Time by Vehicle Purpose



6.3.2 Individual Building Assessments

Although the buildings in this study are all mixed use, they are all very different, both in their combination of retail, businesses, and residential use and in the road network and loading space options available to vehicles. For each building, its characteristics are summarized followed by a set of figures showing number of vehicles by camera/street by day of week and cumulative vehicle purpose by time of day. These are followed by two comparisons across all buildings, one for buildings by day of the week

and one for dwell times by vehicle purpose. The pivot tables and graphs that were used to create these figures are included in the video_data.xlsx file allowing for additional analyses and comparisons.

1025 Connecticut Ave NW

Characteristics. The Blake Building at 1025 Connecticut Ave NW has nine retail and service businesses on the ground floor, multiple offices in the ten upper floors, no residents, parking below the building, and 11 street parking spaces. It faces two major streets with a narrow alley off L St. There is a loading dock off L St and a 91-ft loading zone on Connecticut Ave. Three additional buildings share the block and three other loading zones are located on the opposite sides of the block. There is limited video coverage of the alley beyond the entry with all videos having at least 7 days of coverage. All data were collected in 2018 over the same week in April.

Assessment. Figure 6-34 provides the number of vehicles recorded by each video by day. Data from the two Connecticut Ave cameras should be added when considering street usage. The largest number of vehicles uses Connecticut Ave. Figure 6-35 provides the cumulative distribution of vehicles by type by time of day. Relatively narrow peaks occur at 10:00am and 9:00pm.

Figure 6-34 | Total Number of Vehicles by Day by Camera – 1025 Connecticut Ave NW

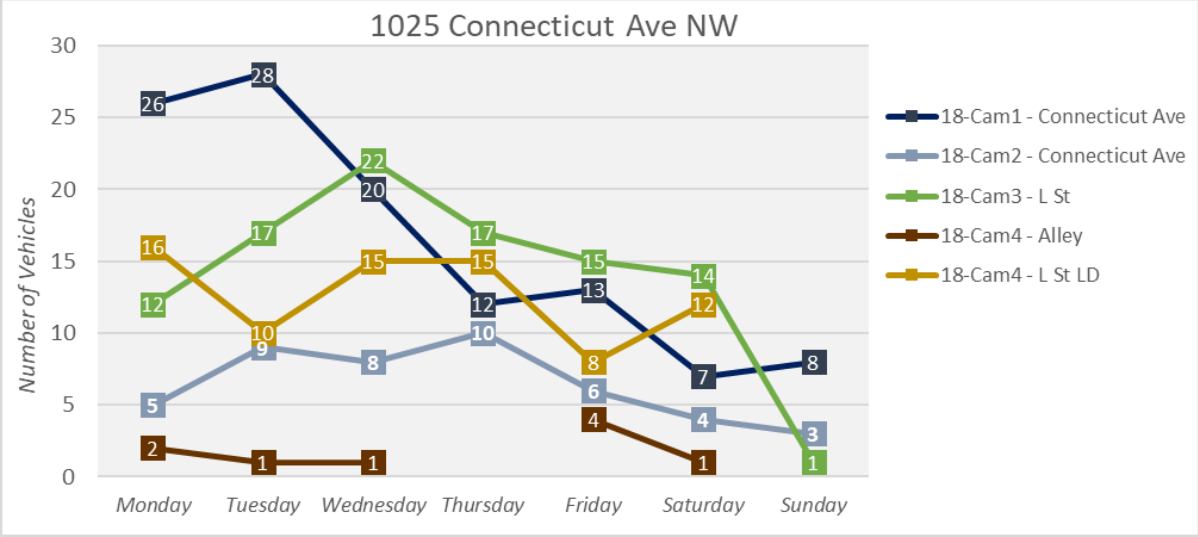
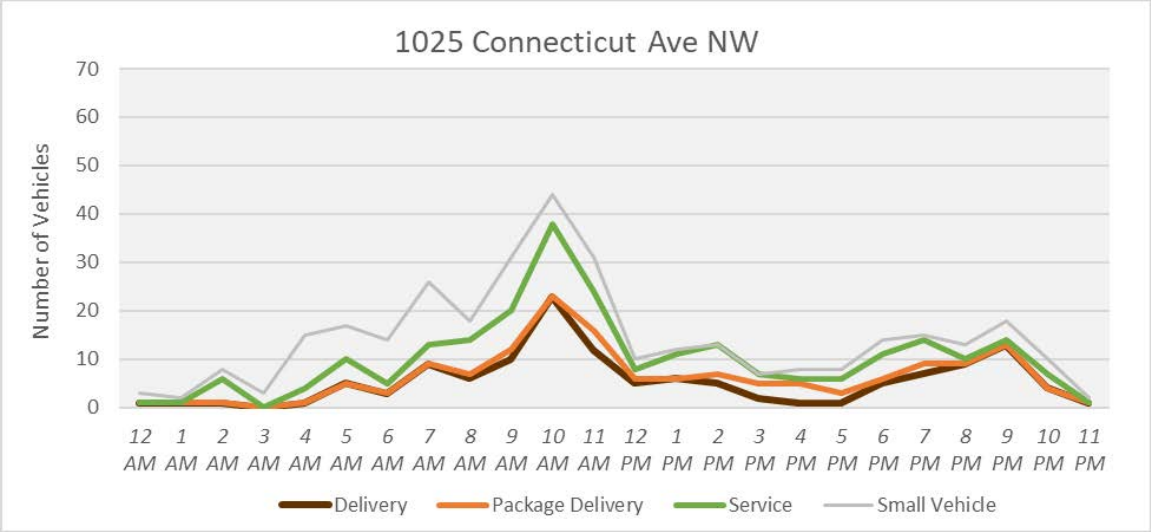


Figure 6-35 | Vehicles by Type by Time of Day – 1025 Connecticut Ave NW



1212 4th St SE

Characteristics. The Yards at 1212 4th St SE has eight retail and service businesses, including a supermarket, located on the ground floor, 217 residences, parking below the building, and 24 street parking spaces. It faces two major streets and a local street with an alley between M and Tingey St. There are loading docks off the alley but no loading zones in the immediate area. It shares the block with one other building. This building has good video coverage with all videos except the alley having a minimum of 7 days of data. The alley video has 6.3 days of data. Data for Tingey St was collected in June 2017 while all other data were collected during the same week in April 2018.

Assessment. Figure 6-36 provides the number of vehicles recorded by each video by day. The data for the two 4th St cameras and the two alley cameras should be added when considering street usage. The largest number of vehicles use 4th St. Figure 6-37 provides the cumulative distribution of vehicles by type by time of day. The morning peak for this building extends from 10:00am to 12pm as defined primarily by service vehicles. Delivery vehicles are spread more broadly from 6:00am to 12pm without a reduction for the morning peak traffic. A more limited evening peak occurs for all vehicles at 7:00pm.

Figure 6-36 | Total Number of Vehicles by Day by Camera – 1212 4th St SE

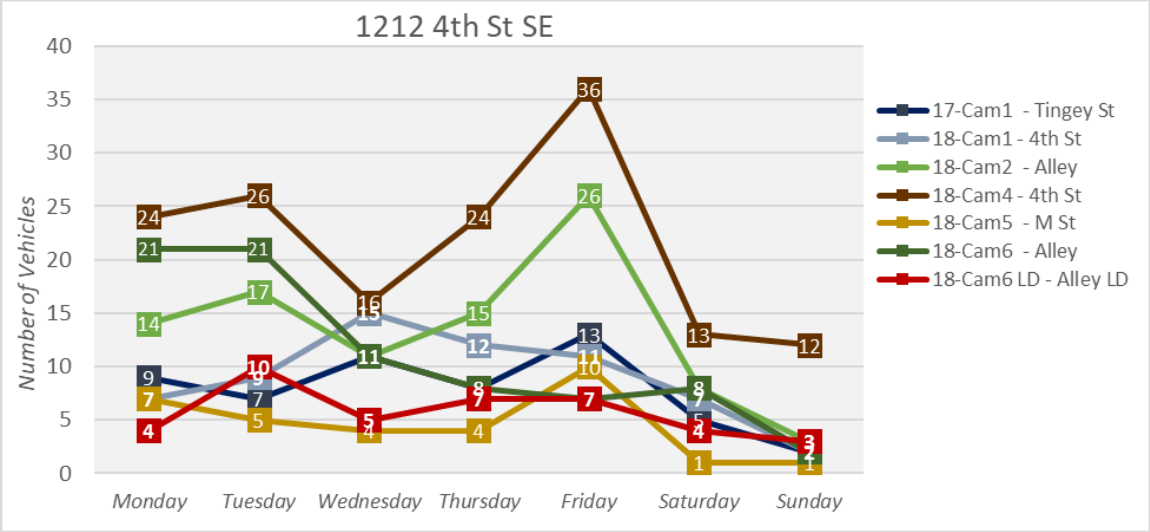
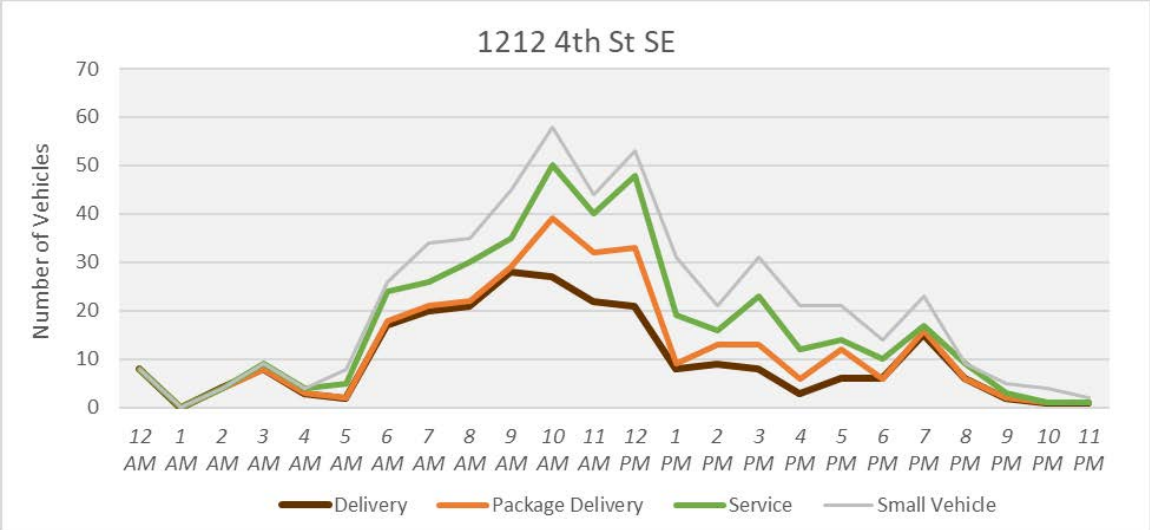


Figure 6-37 | Vehicles by Type by Time of Day – 1212 4th St SE



130 M St NE

Characteristics. Flats 130 at 130 M St NE has a supermarket on the ground floor, 643 residences, parking below the building, 6 street parking spaces and 3 taxi stops. It faces two major streets with a loading dock off M St, a small loading zone across First St and no access from the other two sides. It abuts a hotel, has three additional buildings and, during data collection, a construction site for a fourth building that share the block. There is limited video coverage of M St and no data available for First St. This was the first building with video coverage collected in May 2017 and data were only collected for 6 days. As a result, no data are available for Friday. Even given the single camera with only six days of data, this site has a very large number of vehicles compared to other sites. The majority are service

vehicles, which may be reflective of the large number of residential units, but care should be used when using this data.

Assessment. Figure 6-38 provides the number of vehicles recorded by the video for the street and for the loading dock by day. Figure 6-39 provides the cumulative distribution of vehicles by type by time of day. Because of the limitations of this data, it is unclear whether this distribution is representative of vehicle arrival times.

Figure 6-38 | Total Number of Vehicles by Day by Camera – 130 M St NE

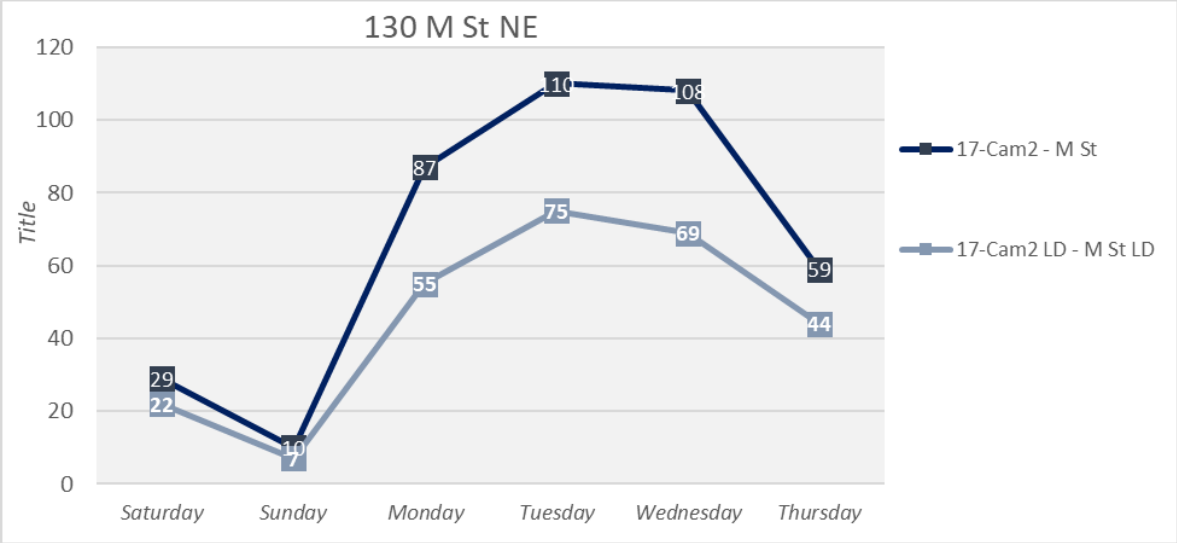
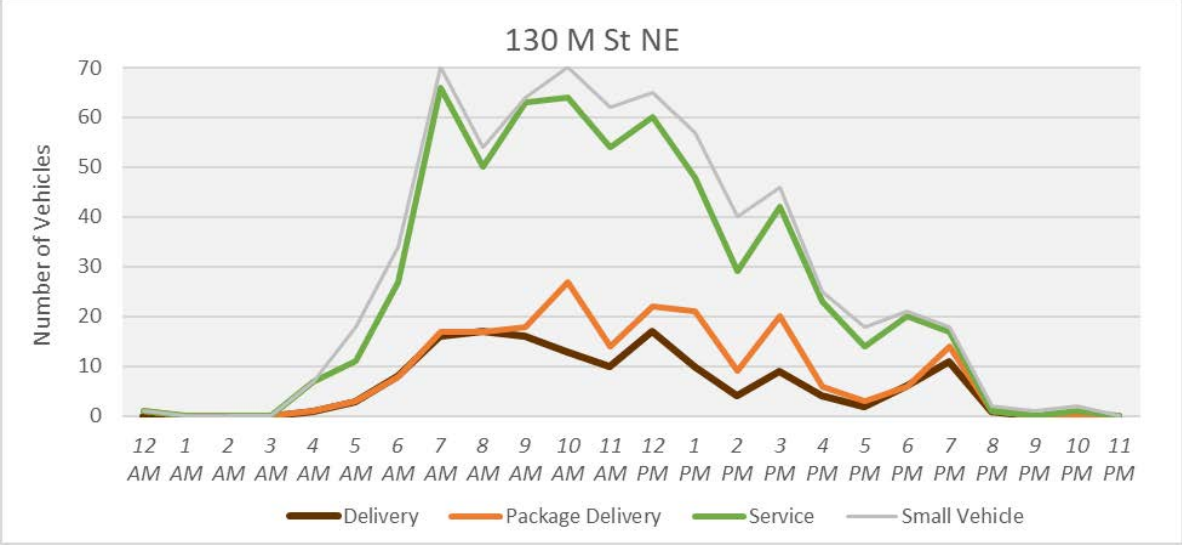


Figure 6-39 | Vehicles by Type by Time of Day – 130 M St NE



1301 U St NW

Characteristics. The Ellington at 1301 U St NW has six retail and service businesses located on the ground floor, an unknown number of residences, parking below the building, and 14 street parking spaces on U St and zoned parking on 13th St. It faces one major street and a local street with an alley off U St that extends to the back of the building. Loading is mostly from the back alley and there are three loading zones around the block but none directly in front of the building. It shares the block with a church, community park, multiple small businesses and town houses and one other multiuse building. This building has good video coverage with all videos having 7 days of data although no data was collected for the side alley, which provides access to the back. All data were collected during the same week in July 2018.

Assessment. Figure 6-40 provides the number of vehicles recorded by each video for the two streets and back alley. The largest number of vehicles uses U St. Figure 6-41 provides the cumulative distribution of vehicles by type by time of day. This location sees a peak at 8:00am followed by one at 10:00am. No peak occurs in the afternoon or evening.

Figure 6-40 | Total Number of Vehicles by Day by Camera – 1301 U St NW

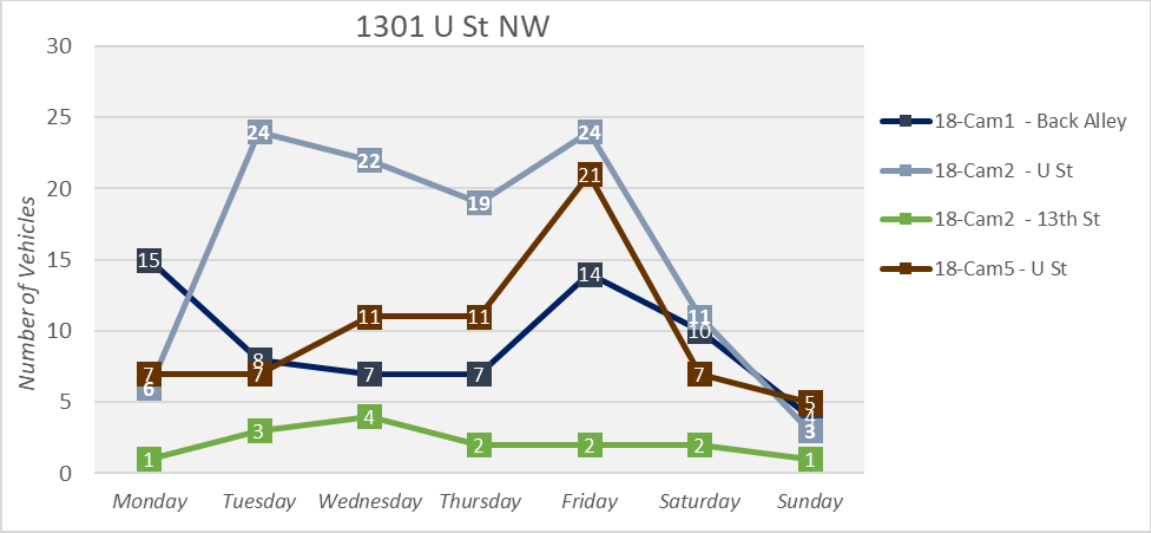
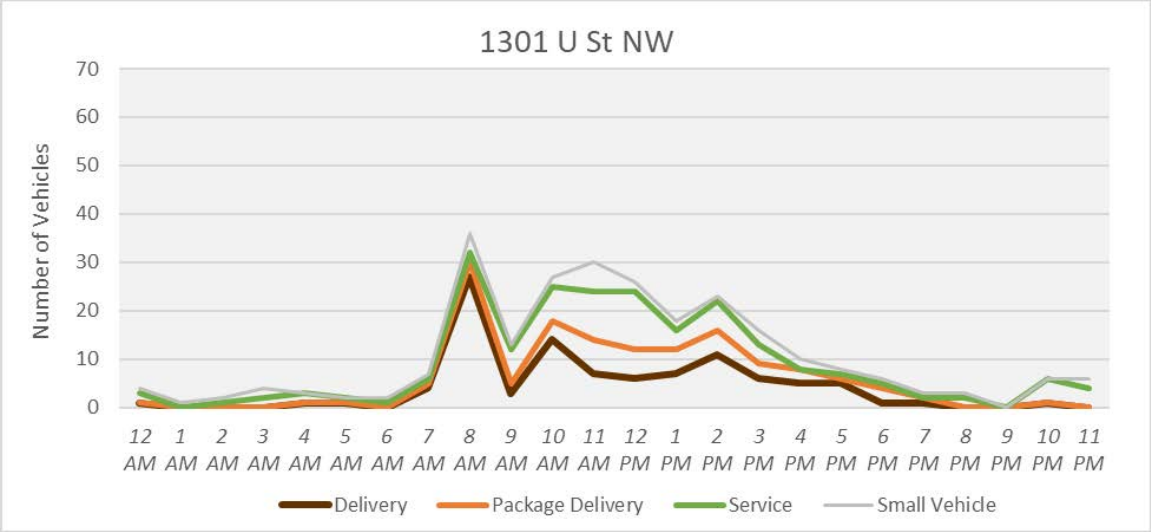


Figure 6-41 | Vehicles by Type by Time of Day – 1301 U St NW



1400 Irving St NW

Characteristics. Highland Park at 1301 U St NW has seven retail and service businesses located on the ground floor, 373 residences, parking below the building, and no identified street parking. It faces a one-way street that crosses a major street on one side. The other side has a gated alley/garage entrance. There is a mid-block alley behind the building opening to parking and loading area. No loading zones exist in the immediate area. The building is on an oversize block that includes more than 20 other buildings including a church, a school, apartments and public surface parking. This building has video coverage of the two streets but no coverage of the back. Irving St has 7 days of data collected in July 2018 while 14th St only has 6 days collected in May 2017 with data for Friday ending at 10:30am.

Assessment. Figure 6-42 provides the number of vehicles recorded by each video for the two streets. The largest number of vehicles uses Irving St. Figure 6-43 provides the cumulative distribution of vehicles by type by time of day. Very few delivery vehicles were observed at this location, so service vehicles defined the peak at 11:00am and 7:00pm. A late-night peak occurred at midnight.

Figure 6-42 | Total Number of Vehicles by Day by Camera – 1400 Irving St NW

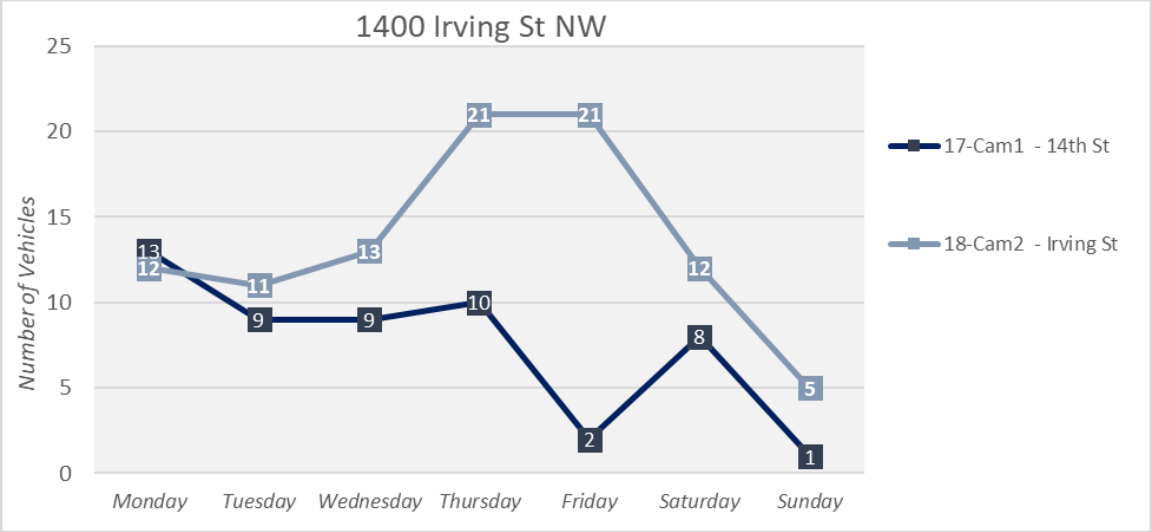
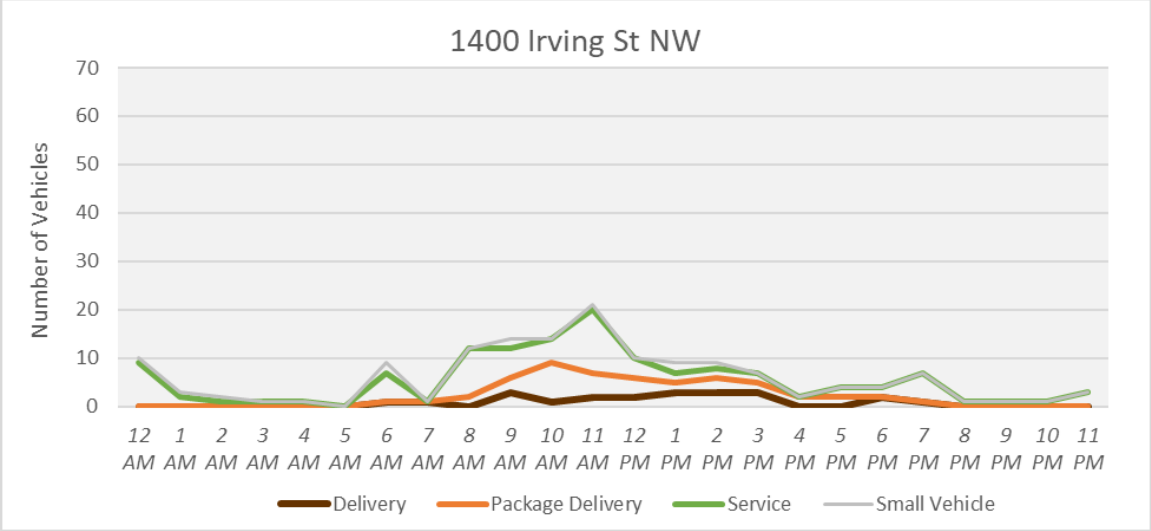


Figure 6-43 | Total Number of Vehicles by Day by Camera – 1400 Irving St NW



1550 7th St NW

Characteristics. Jefferson Marketplace at 1550 7th St NW has five retail and service businesses located on the ground floor, 281 residences, parking below the building, and 21 street parking spaces. It faces one major street with local streets on both side and a mid-block alley at the back of the building. The back alley includes a loading dock. There are no loading zones around the block, but one is located opposite the northeast corner. The building shares the block with multiple townhouses. This building has good video coverage of the three streets and the south end of the alley, and all videos have 7 days of data for the same week in July 2018.

Assessment. Figure 6-44 provides the number of vehicles recorded by each video for the three streets and south end of the alley and loading dock. The data from the two alley cameras and the two 7th St cameras should be added when considering vehicle usage. The largest number of vehicles use 7th St. Figure 6-45 provides the cumulative distribution of vehicles by type by time of day. A narrow peak occurs at 7:00am with a more extended peak from 9:00am to noon. This location does not demonstrate an evening peak.

Figure 6-44 | Total Number of Vehicles by Day by Camera – 1550 7th St NW

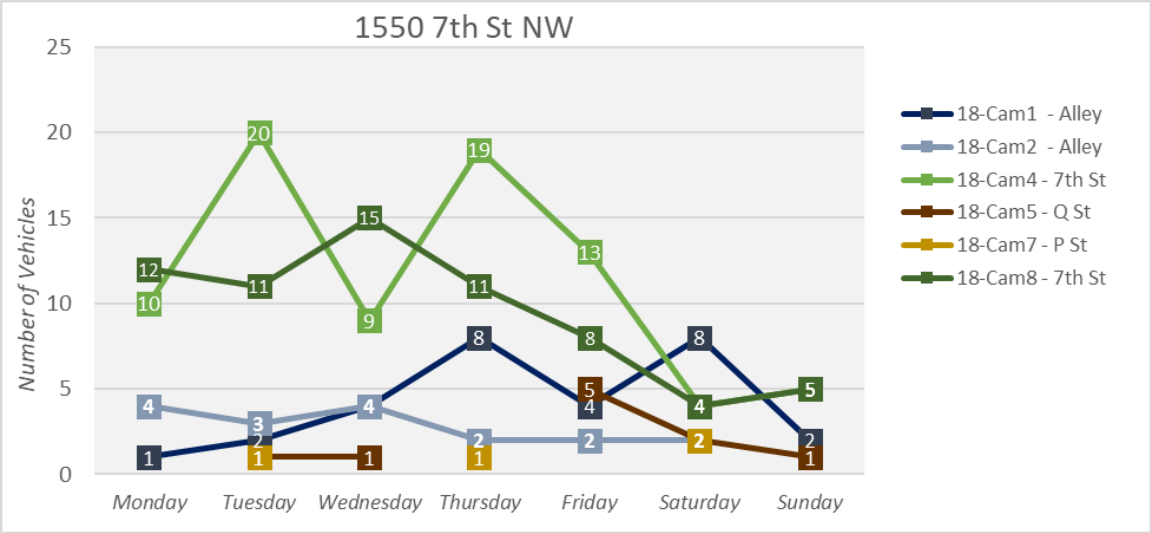
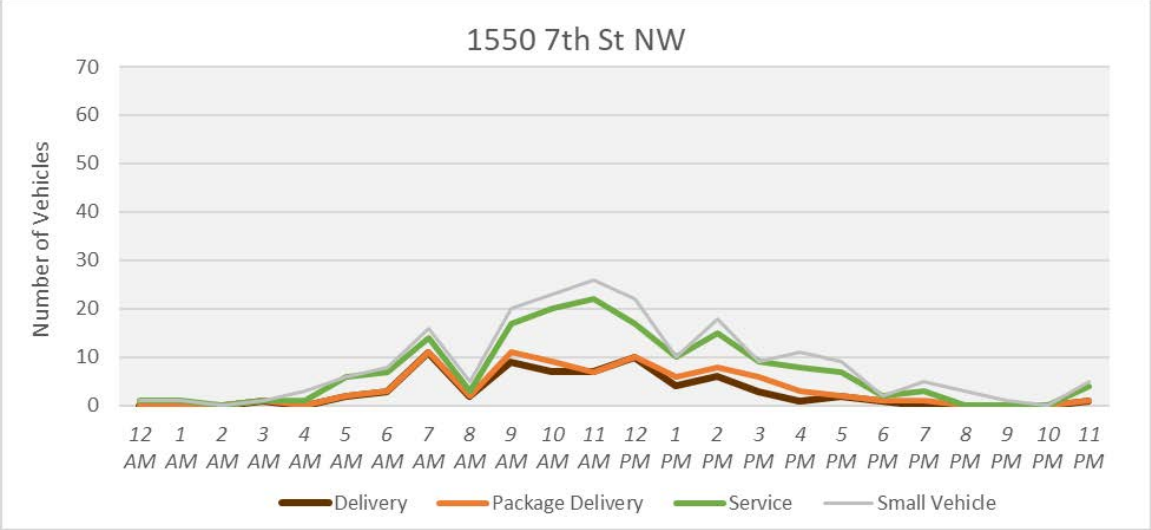


Figure 6-45 | Vehicles by Type by Time of Day – 1550 7th St NW



1629 K St NW

Characteristics. The Davis Building at 1629 K St NW has four retail and service businesses on the ground floor, multiple offices in the eight upper floors, no residents, parking below the building, and 11 street parking spaces. It abuts a large multiuse building on 17th St NW and a frontage road for a major arterial,

a back alley, and a narrow alley between the frontage road and the back alley. Although there are no loading zones in front of the building, eight loading zones are located nearby, two of which are on the block itself. Eight other buildings share the block. There is good video coverage of the frontage road and the two alleys although the northwest corner of the back alley is not covered. All data were collected in April 2018 over the same week.

Assessment. Figure 6-46 provides the number of vehicles recorded by each video for the frontage road and the two alleys. The largest number of vehicles uses the back alley. Figure 6-47 provides the cumulative distribution of vehicles by type by time of day. Peaks occur at 5:00am, 10:00am, and 12:00pm with no peak in the afternoon or evening.

Figure 6-46 | Total Number of Vehicles by Day by Camera – 1629 K St NW

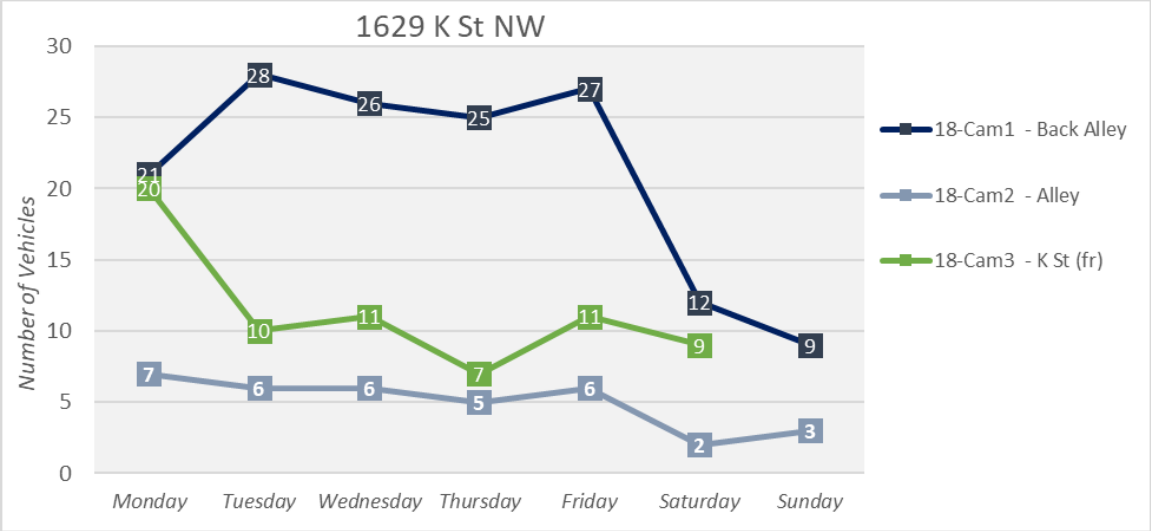
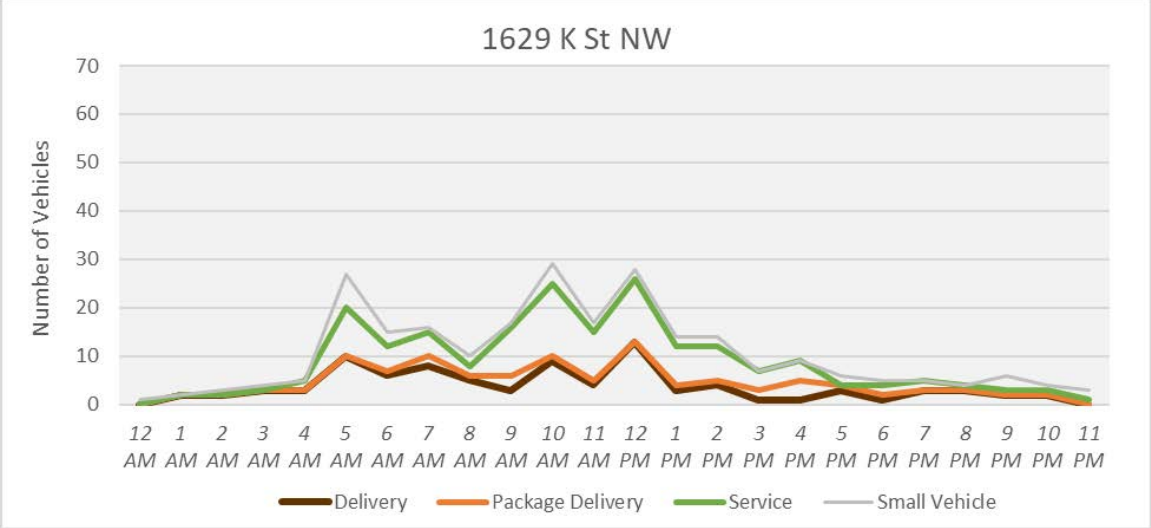


Figure 6-47 | Vehicles by Type by Time of Day – 1629 K St NW



2130 P St NW

Characteristics. The Westpark Apartments at 2130 P St NW has nine retail and service businesses including a supermarket located on the ground floor, 360 residences, parking below the building, 11 street parking spaces, and reserved parking off the alleys. It faces one major street and a one-way local street, an alley off of P St and a mid-block alley at the back of the building that opens to parking and a freestanding entry to garage. There are two loading zones in front of the building with two additional loading zones on the block and three more in the vicinity. The building shares the block with a hotel, two apartment buildings, multiple townhouses, and a small commercial building. This building has good video coverage of 22nd St and both alleys for the same week in July 2018 and for P St which had data from April 2017. All videos have 7 or more days of data.

Assessment. Figure 6-48 provides the number of vehicles recorded by each video for the two streets and the two alleys. The largest number of vehicles uses the side alley. Figure 6-49 provides the cumulative distribution of vehicles by type by time of day. Peaks occur at 7:00am and 10:00am. Delivery vehicles gradually reduce over the morning dropping off between 1:00pm and 2:00pm while package delivery has a third peak at noon and again at 3:00pm. This location does not demonstrate an evening peak.

Figure 6-48 | Total Number of Vehicles by Day by Camera – 2130 P St NW

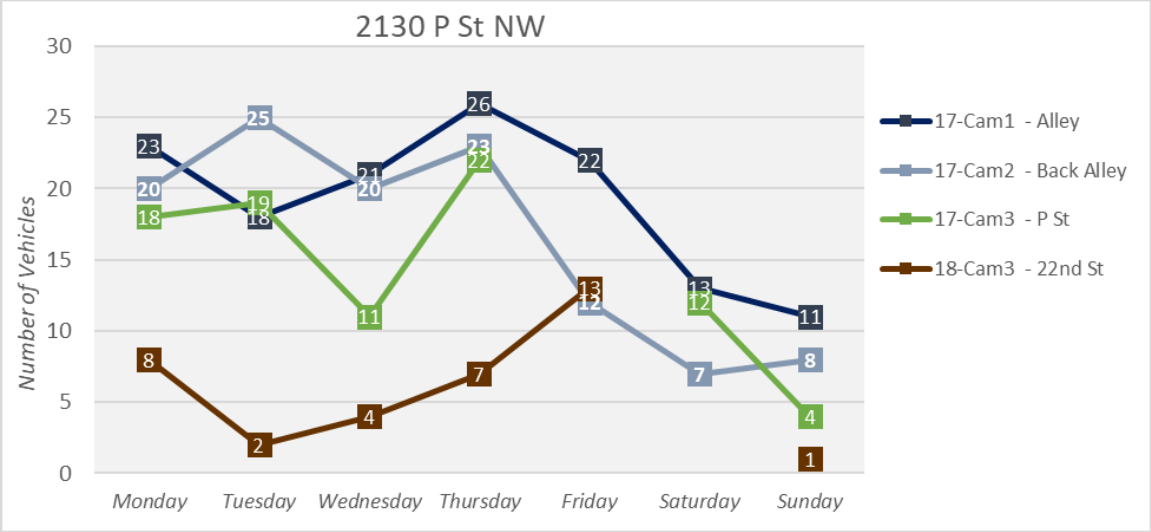
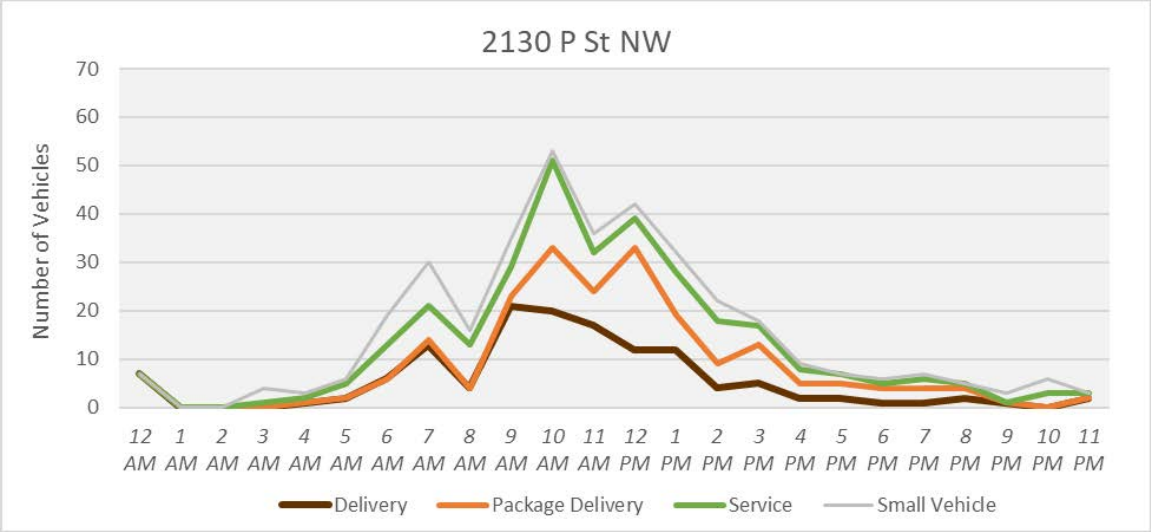


Figure 6-49 | Vehicles by Type by Time of Day – 2130 P St NW



2400 M St NW

Characteristics. 2400 M St has five retail and service businesses located on the ground floor, an unknown number of residences on the upper eight floors, parking below the building and 19 street parking spaces. It faces one major street and one local street with a mid-block alley at the back of the building. There is a loading dock off of 24th St but no additional loading zones in the vicinity. The building abuts to a medical office building and shares the block with a large multi-use and residential complex that includes a supermarket. This building has good video coverage of both streets with data for 24th St collected in July 2017 and for M St in April 2018. Both videos have 7 or more days of data.

Assessment. Figure 6-50 provides the number of vehicles recorded by each video for the two streets. The largest number of vehicles uses M St. Figure 6-51 provides the cumulative distribution of vehicles by type by time of day. This location has few delivery vehicles the peaks are low and broad at 7:00am, 9:00am, noon, and 3: 00pm. Package deliveries peak 9:00am and 4:00pm. The peaks for all vehicles occur at 9:00am and 11:00am with an afternoon peak at 4:00pm and an evening peak at 7:00pm.

Figure 6-50 | Total Number of Vehicles by Day by Camera – 2400 M St NW

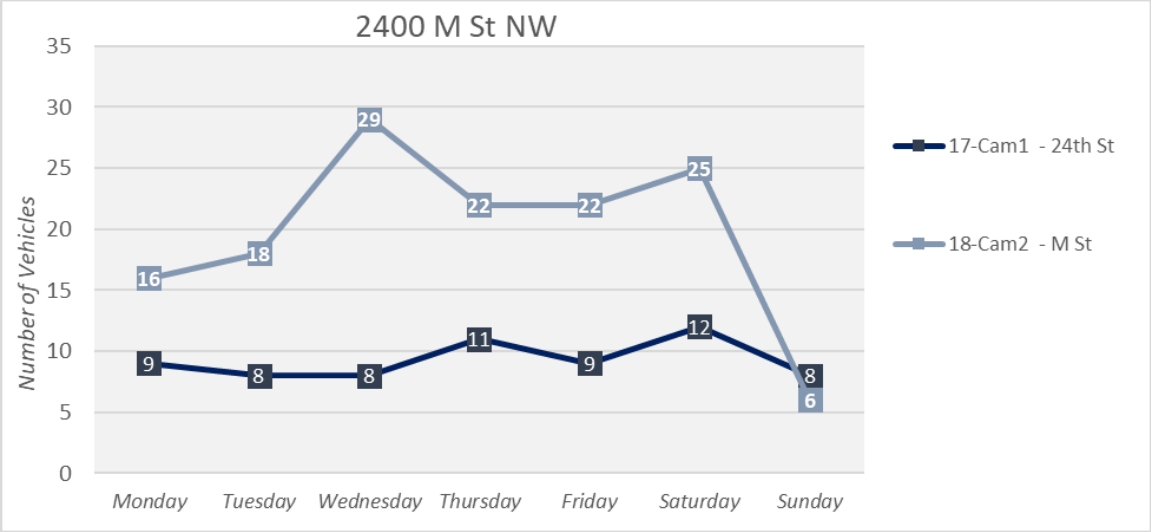
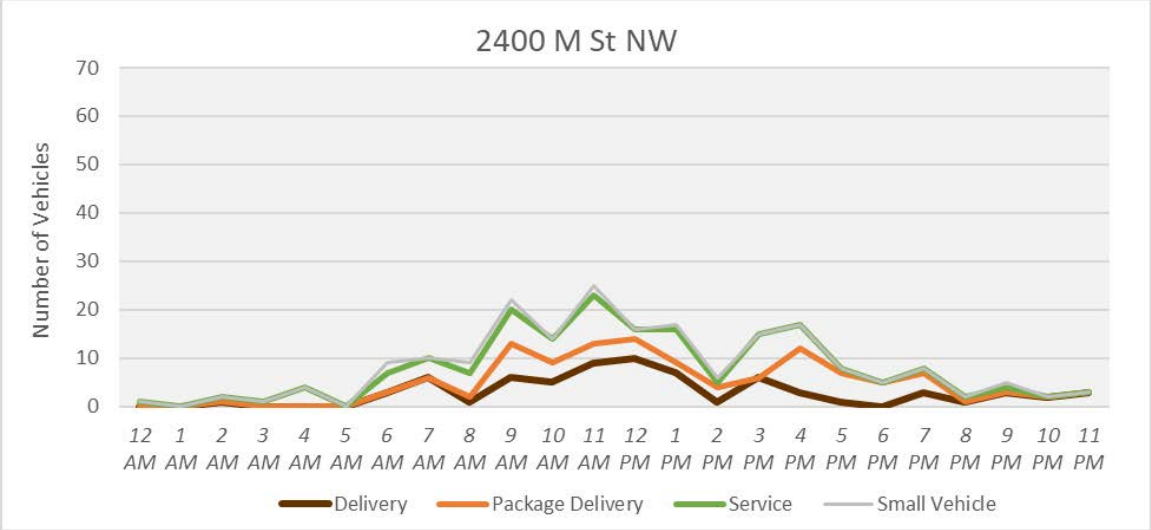


Figure 6-51 | Vehicles by Type by Time of Day – 2400 M St NW



2420 14th St NW

Characteristics. Capital View at 2420 14th St NW has five retail and service businesses located on the ground floor, an unknown number of residences on the upper eight floors, parking below the building, and 22 street parking spaces. It faces one major street, two local streets and amid-block alley behind the building that opens to a loading area. No loading zones exist on the block but there are two in the vicinity. This building is somewhat self-contained on a half-block area that is separated from the oversize block opposite Peluca Alley. This building has good video coverage of 14th St and Peluca Alley for the same seven days in July 2018 and for Chapin St, which had data for 6 days in May 2017.

Assessment. Figure 6-52 provides the number of vehicles recorded by each video for the two streets and the alley. Three cameras were used to collect data for Peluca Alley so these should be added when

considering street usage. The largest number of vehicles use the Peluca Alley. Figure 6-53 provides the cumulative distribution of vehicles by type by time of day. This location demonstrates a broad peak from 9:00am to noon. Delivery vehicles peak again at 3:00pm. Otherwise, little activity occurs from 6:00pm to 6:00am with the exception of service vehicles.

Figure 6-52 | Total Number of Vehicles by Day by Camera – 2420 14th St NW

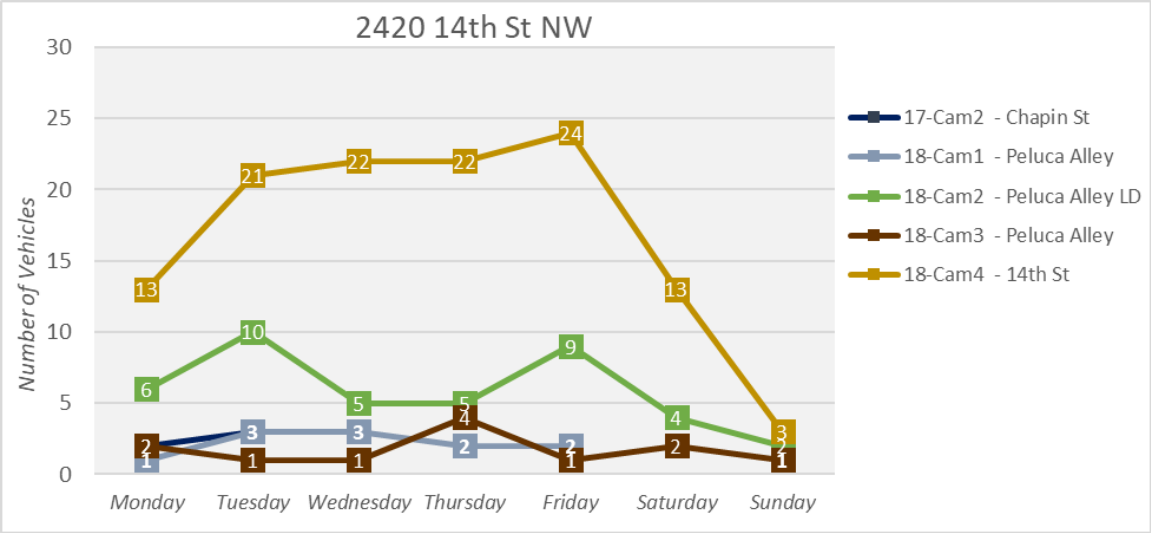
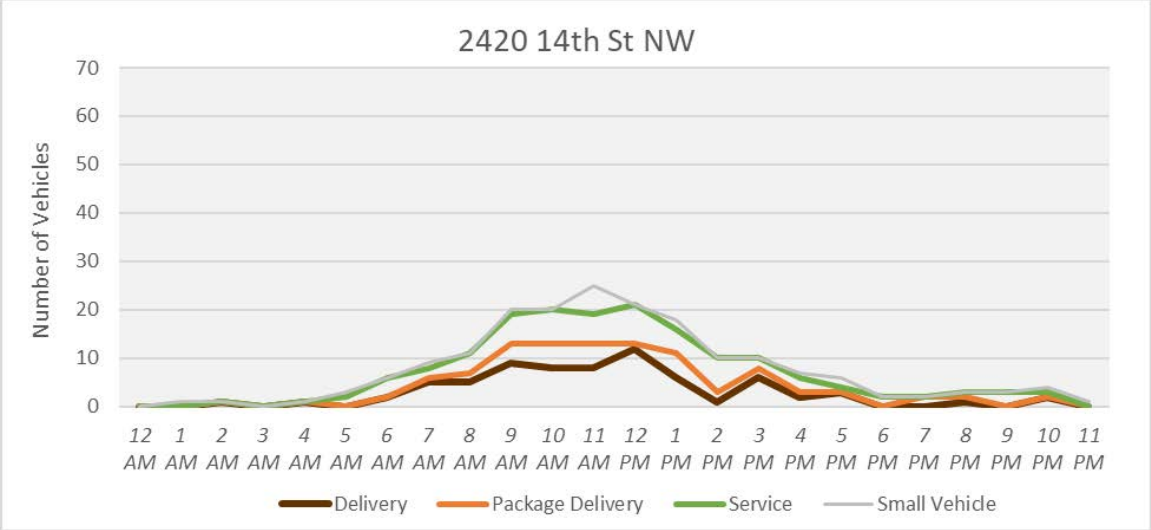


Figure 6-53 | Vehicles by Type by Time of Day – 2420 14th St NW



301 Tingey St SE

Characteristics. Foundry Lofts at 301 Tingey St SE has four retail and service businesses on the ground floor, 177 residences, no on-site parking and 8 street parking spaces. It faces three local streets, and a short alley off Tingey St used as a loading area. There are no loading zones in the vicinity. The building shares the block with a large multi-use building, which includes a parking garage. This building has good

video coverage of Tingey, 3rd St and the alley for the same seven days in April 2018 and for Water St, which had data for under 6 days in June 2017.

Assessment. Figure 6-54 provides the number of vehicles recorded by each video for the three streets and the alley. Although the largest number of vehicles uses the alley, this information is suspect given the limitations of the data collection and the patterns displayed in Figure 6-54. Figure 6-55 provides the cumulative distribution of vehicles by type by time of day. The peaks at 10:00am, noon, 8:00am and 5:00pm are governed by delivery vehicles.

Figure 6-54 | Total Number of Vehicles by Day by Camera – 301 Tingey St SE

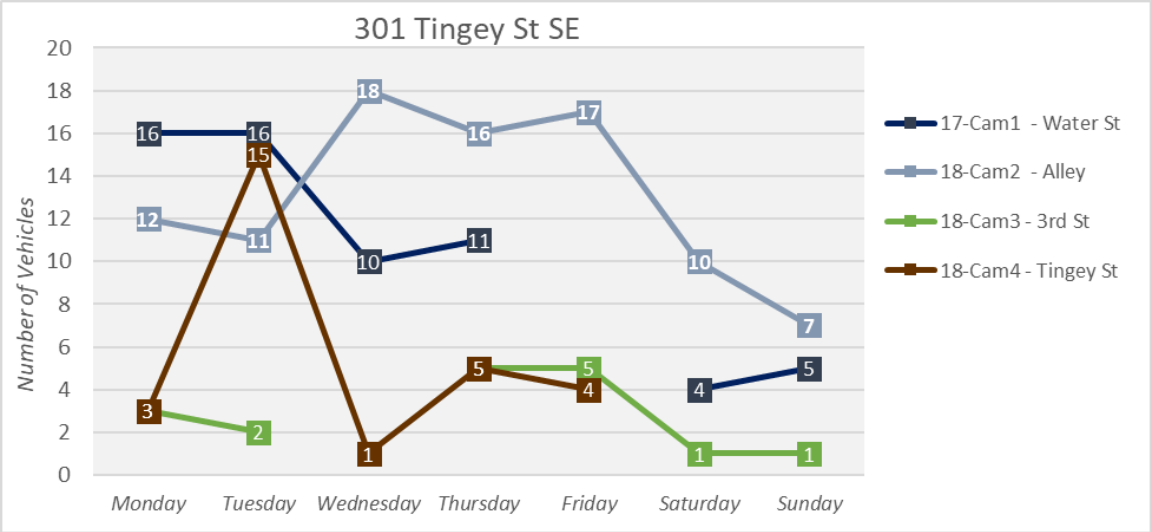
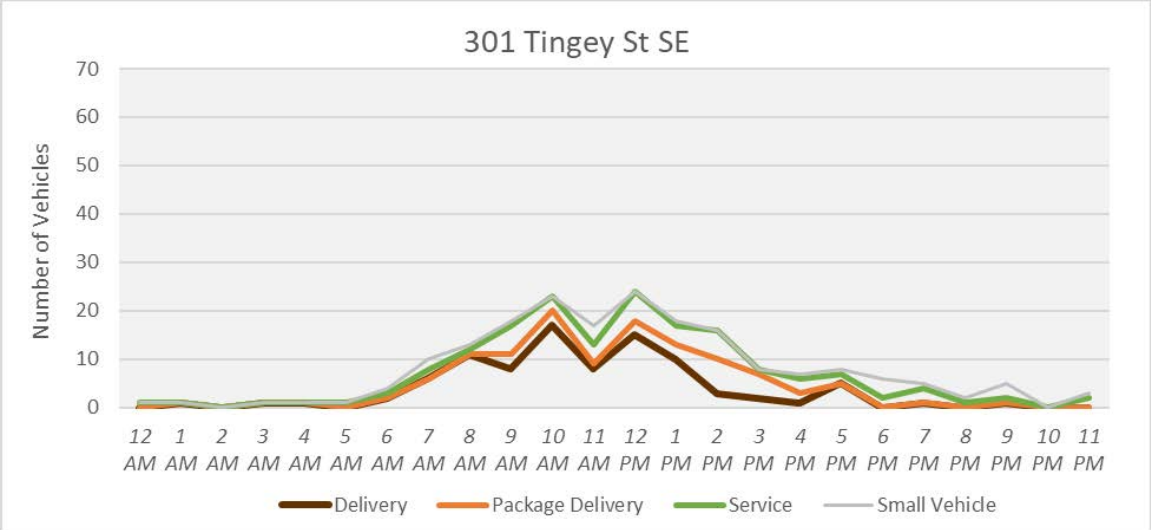


Figure 6-55 | Vehicles by Type by Time of Day – 301 Tingey St SE



4500 Wisconsin Ave NW

Characteristics. 4500 Wisconsin Ave NW has three large and one small retail store on the ground floor, 204 residences, parking below the building and 14 street parking spaces. It faces one major street, two local streets and an alley off River Rd that wraps around two sides of the building with three loading docks. There are two loading zones across Wisconsin Ave. The building is on a large irregularly shaped block that it shares with a church, series of townhouse offices and a medium size office building. This building has good video coverage of Albemarle St and the alleys for the same seven days in April 2018. River Rd is covered for seven days during June of 2017 while Wisconsin Ave only has data for 2.8 days during that time.

Assessment. Figure 6-56 provides the number of vehicles recorded by each video for the three streets and the two alleys. The largest number of vehicles uses the back alley. Figure 6-57 provides the cumulative distribution of vehicles by type by time of day. All vehicles have a broad peak that occurs from 11:00am to 1:00pm with another peak at 8:00am and then at 8:00pm.

Figure 6-56 | Total Number of Vehicles by Day by Camera – 4500 Wisconsin Ave NW

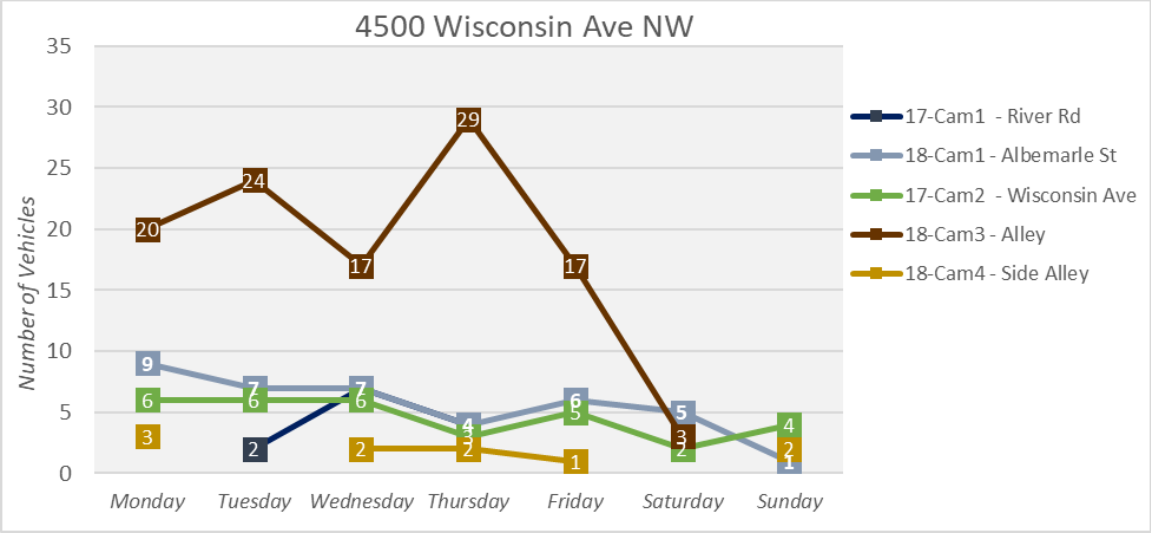
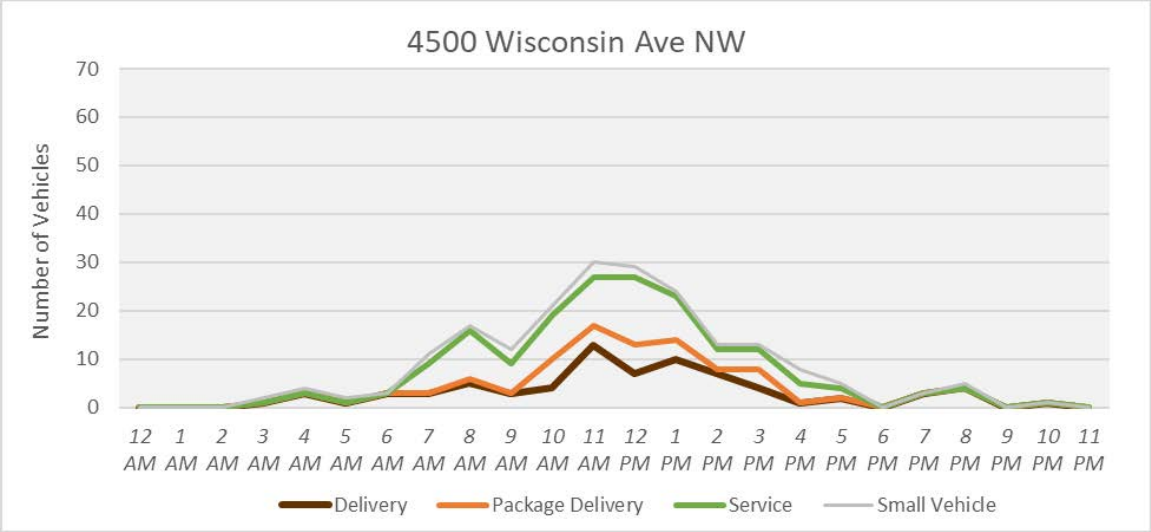


Figure 6-57 | Vehicles by Type by Time of Day – 4500 Wisconsin Ave NW



475 K St NW

Characteristics. City Vista at 475 K St NW has 19 retail and service businesses on the ground floor including a supermarket, 736 residences, parking below the building, and 38 street parking spaces. It faces two major streets, a local street and a mid-block alley. There is one loading zone across from the southwest corner of the building on 5th St. The building shares the block with two large residential buildings. This building has good video coverage of all three streets and the alley for the same seven days in April 2018.

Assessment. Figure 6-58 provides the number of vehicles recorded by each video for the three streets and the alley. The largest number of vehicles use the alley, 4 ½ St. Figure 6-59 provides the cumulative distribution of vehicles by type by time of day. This location has a large narrow peak at 7:00am followed by a broader peak at 10:00am. A nighttime peak occurs at 11:00pm for delivery vehicles.

Figure 6-58 | Total Number of Vehicles by Day by Camera – 407 K St NW

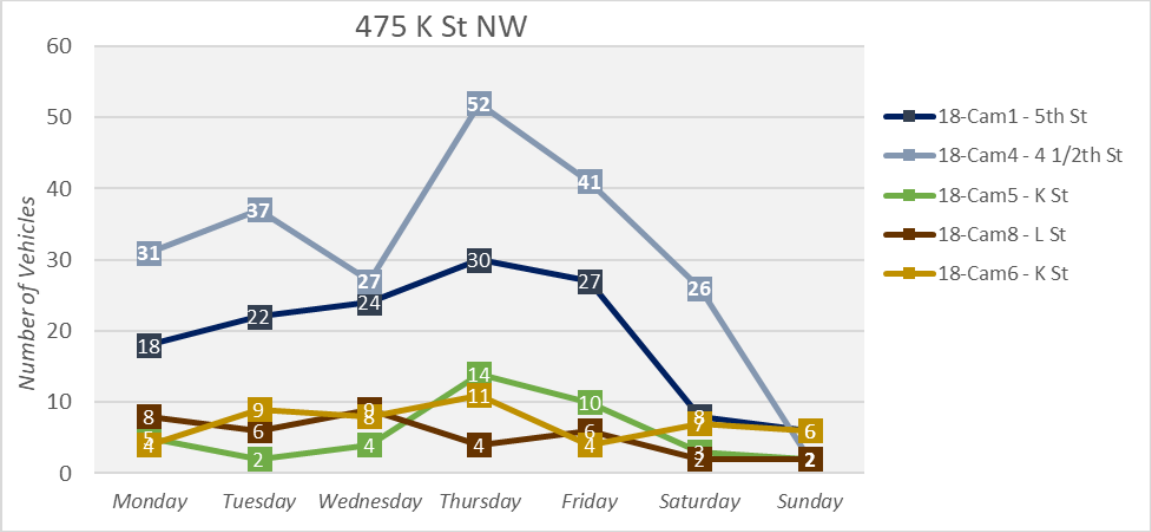
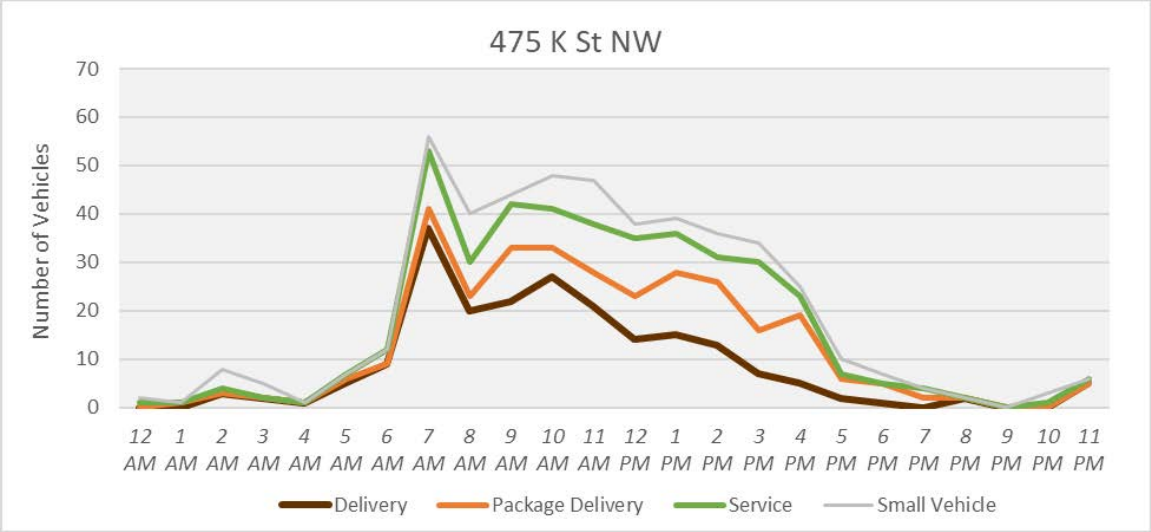


Figure 6-59 | Vehicles by Type by Time of Day – 4500 Wisconsin Ave NW



6.3.3 Building Comparisons

This section provides some comparisons across all buildings. Figure 6-60 compares total vehicles by day of the week across buildings while figure 6-61 considers each building across days of the week. From Figure 6-60, the high values shown for 130 M St should be reviewed in more detail before using this information. Excluding this location, 2130 P St and 475 K St have the highest number of vehicles. Figure 6-61 provides an indication of the variation by day across locations. 1212 4th St sees the highest number of vehicles on Friday while 475 K St sees them on Thursday. 1629 K St sees its highest number of vehicles on Monday while 1025 Connecticut St is on Wednesday. 475 K St, 2130 P St, 4500 Wisconsin Ave, and 1400 Irving St see their highest numbers on Thursday and 1212 4th St, 1301 U St, and 2420 14th St see their highest numbers on Friday.

Figure 6-60 | All Vehicles by Day of Week by Building

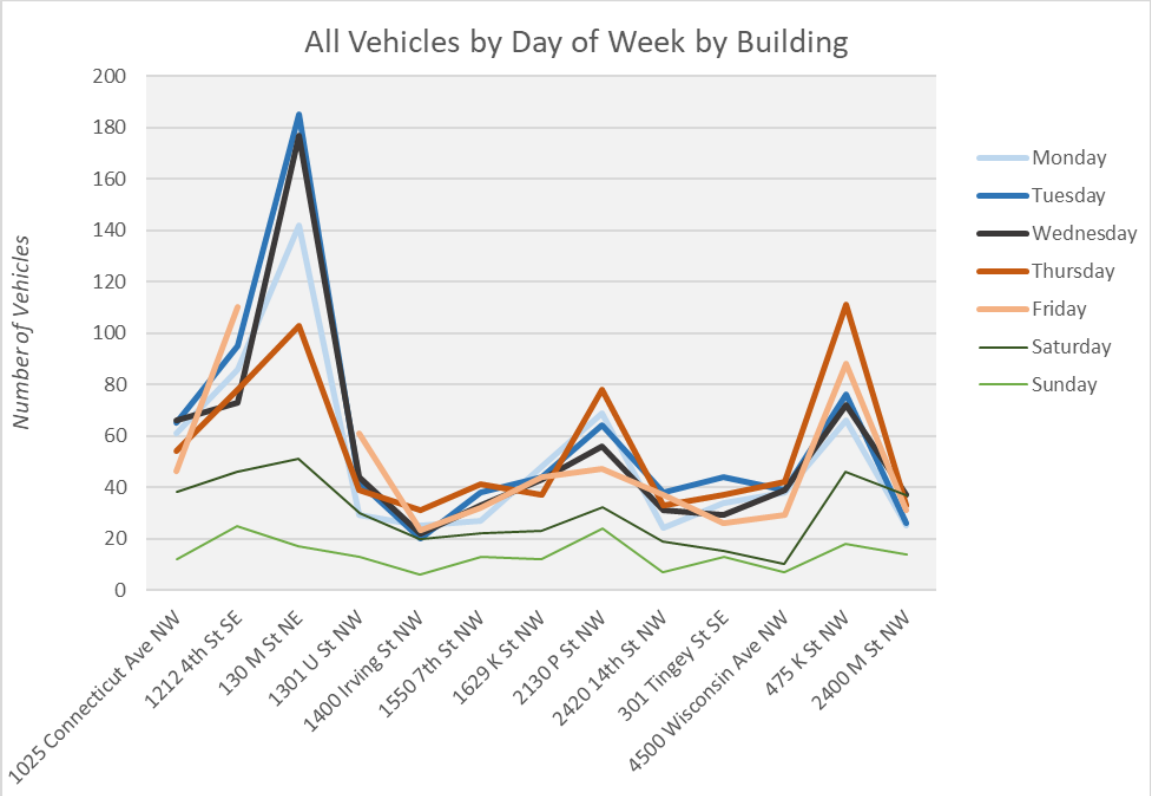


Figure 6-61 | All Vehicles by Building by Day of Week

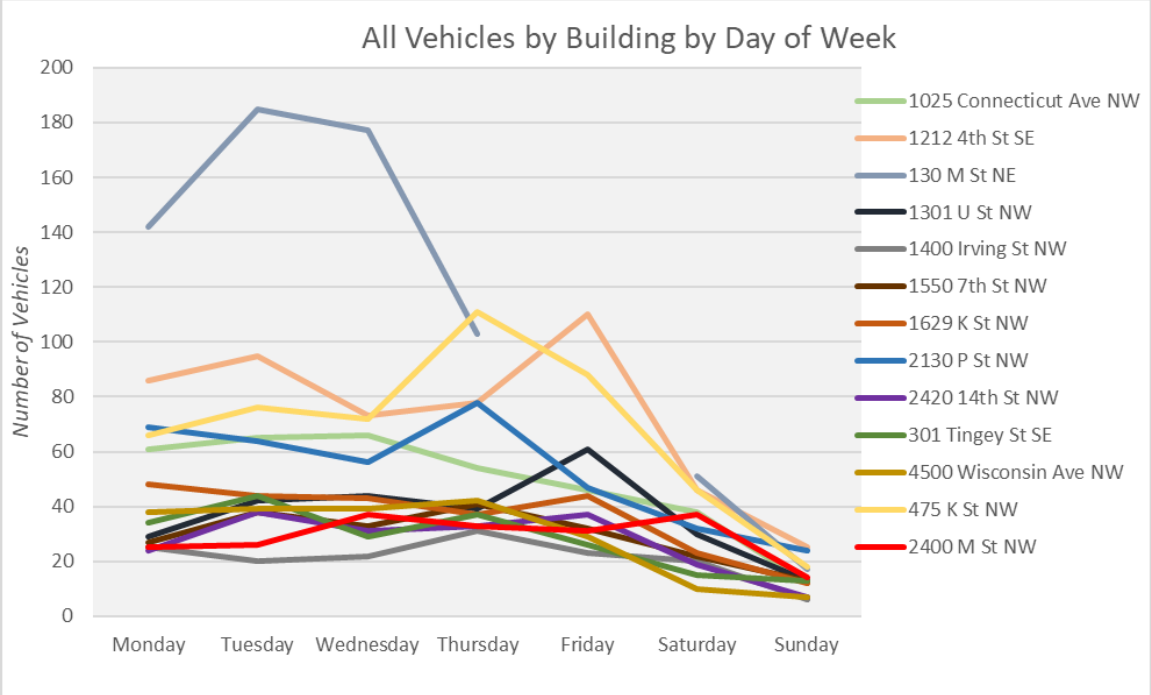


Figure 6-62 looks at dwell time across buildings by vehicle type giving an indication of the variability that exists for buildings with different characteristics and mixes of uses.

These are a few examples of the comparisons that can be performed. With additional information about the buildings and their surroundings, this information could be used to perform parametric modeling of vehicle behavior at mixed use facilities in Washington DC.

Figure 6-62 | Dwell Time by Vehicle Type across Locations

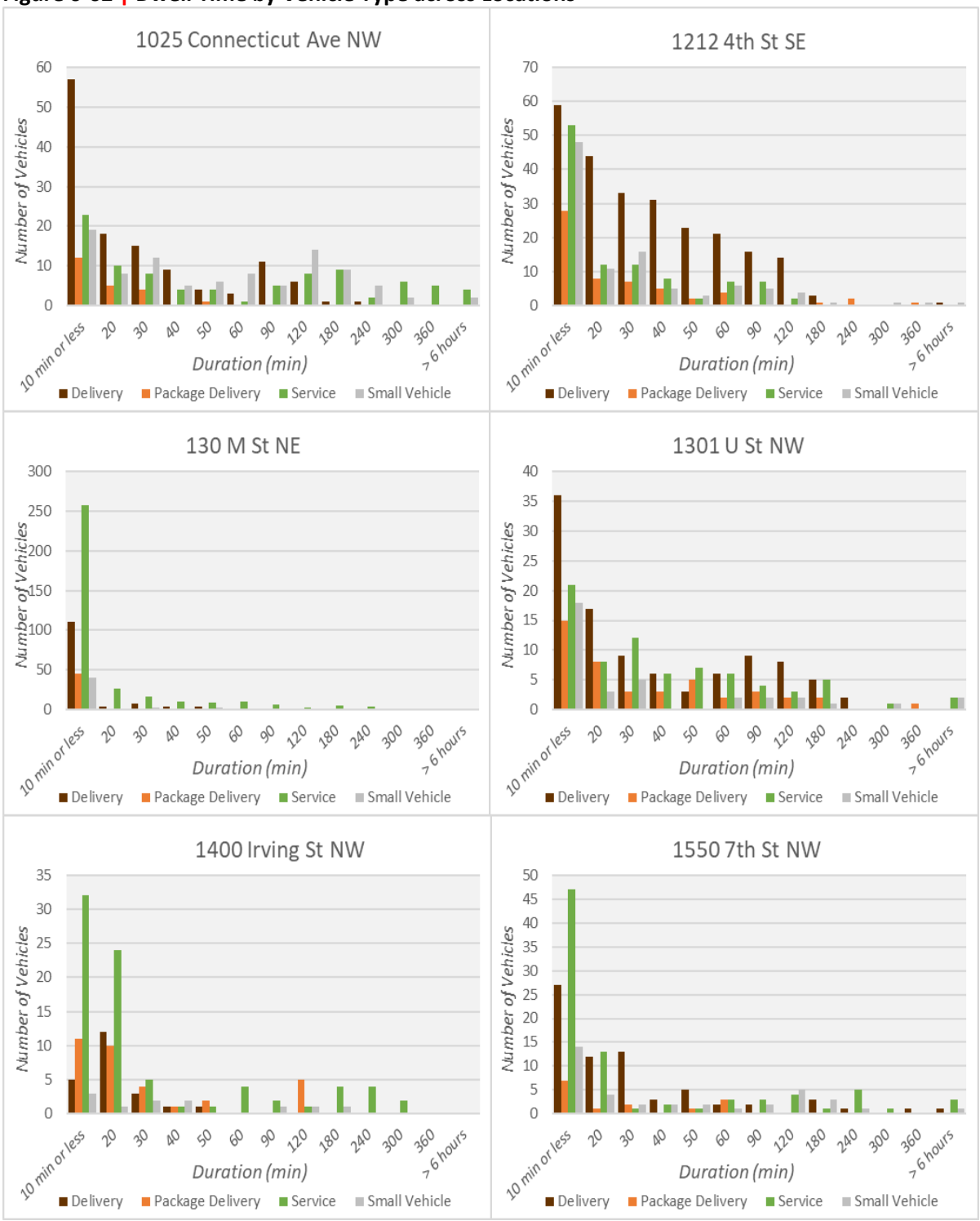


Figure 6-60 | Dwell Time by Vehicle Type across Locations (continued)

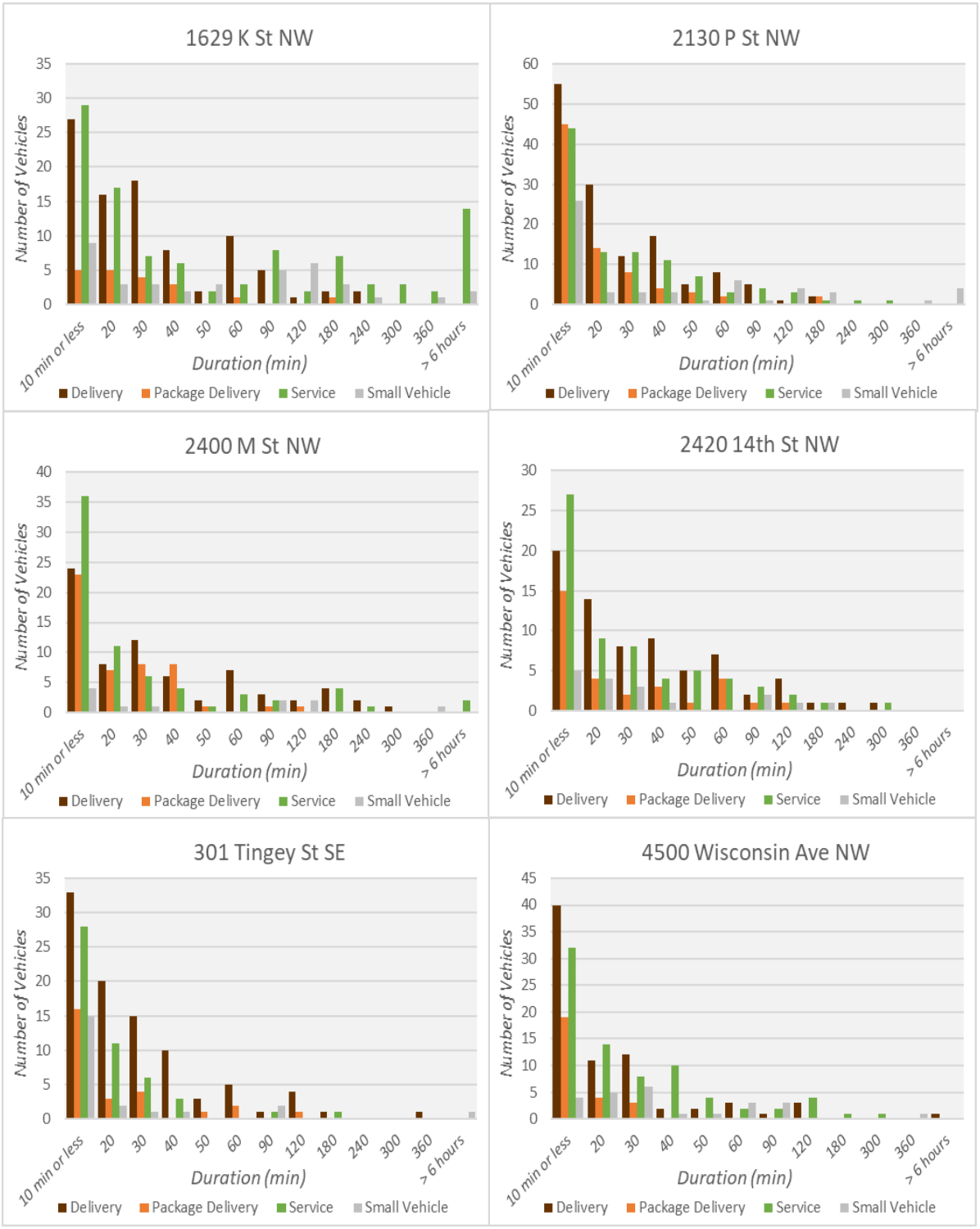
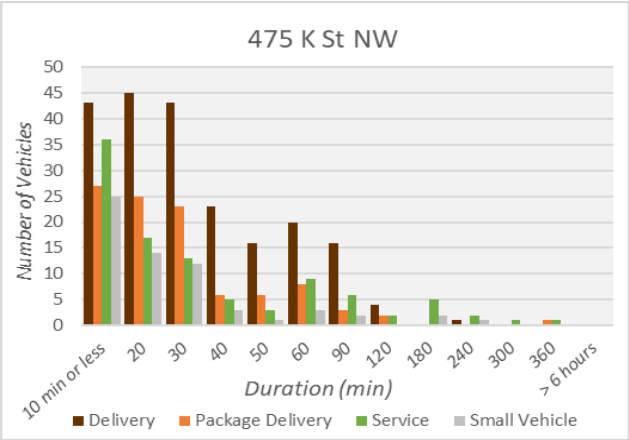


Figure 6-60 | Dwell Time by Vehicle Type across Locations (continued)



7. Business Surveys

To meet the third objective of the study, three different types of business surveys were conducted to understand the demand for freight and truck trips in the District. For establishment survey purposes, businesses were categorized as Freight Intensive Sector (FIS) and Non-freight Intensive Section (Non-FIS). FIS businesses rely on foot-traffic from customers and display their brand on the building. Examples of FIS businesses include restaurants, specialty stores etc. On the other hand, Non-FIS businesses do not rely on the foot-traffic, but operate their businesses in such categories as legal services, consultancies etc. FIS businesses normally operate out of the street-level floor(s) of the buildings, whereas Non-FIS businesses could be operating on any floor. These establishment surveys conducted for this study include:

4. Freight Intensive Sector (FIS)
5. Non-freight Intensive Sector (Non-FIS) businesses
6. Survey of building managers (also Non-FIS)

Primary goal of the surveys was to develop freight trip generation models based on the business type and its attributes such as number of employees, square footage.

7.1 Business Data

Lists of businesses operating from the subject buildings were obtained from Info USA, a sales and marketing solutions provider. The lists were acquired in August 2017 and the specifics on how current the lists were not available. Therefore, to verify the data, the GMU Team collected information on g businesses operating from the subject buildings using web resources and on-site visits. Because FIS business signs are visible from the street, the FIS list verification was relatively straight forward. On the other hand, signs for Non-FIS businesses are not visible from the street. Thus, verifying and updating the information on the Non-FIS businesses operating out of the subject building posed significant challenges.

Additionally, while businesses occupying the upper floors operate with the subject buildings' street address and a unit number (such as a suite or apartment number), retail businesses occupying the ground floor could be operating with its own unique street address. For example, Dunkin Donuts operates at 1210 G St NW, but is located within the building addressed as 1200 G Street NW. Unless the unique street addresses for these businesses are specifically requested, Info USA data includes them in the list of businesses belonging to 20 buildings.

The Info USA database provided a list of 498 businesses operating in the 20 subject buildings with 112 unique addresses (Example, 1200 G St NW included 23 different addresses with different suite numbers).

These two business lists were reviewed with help from DDOT and BIDs. Based on the InfoUSA lists, web searches and field visits to the locations, three separate lists for each survey category were prepared. The following is the summary sample sizes identified in this screening-process.

4. Businesses identified as FIS generators.
    - The compiled list of ground floor retail businesses from the InfoUSA data included 111 FIS businesses, whereas the updated list after site visits contained 120.
5. Building Managers of all 20-subject buildings.
    - Two buildings in the list (301 Tingey St SE and 1212 4th St SE) were managed by the same property management company.
6. Businesses that are not considered FIS generators contained approximately 400 businesses.

Questionnaires for these three surveys have been finalized and approved by IRB (Appendix C). These forms were also deployed on the Qualtrics online survey platform, which is a popular portal for administering field surveys. The letters soliciting cooperation from building managers for successful execution of the survey are included in Appendix C.

7.2 Survey Administration

7.2.1 Freight Intensive Sector (FIS)

The FIS businesses in the subject buildings primarily includes such industry categories as restaurants, specialty retail store, box stores, convenience stores, and coffee shops. In mixed-use buildings, those businesses located on the ground floor with separate entrances can be generally treated as FIS. The process of securing these interviews will start soon after the on-line FIS survey is tested. All these businesses were approached in person for survey participation during Spring and Summer of 2018. The list of the FIS businesses targeted in the survey and the result of their participation is summarized in Table 7-1.

Table 7-1 | List of Freight Intensive Sector Businesses Operating from the Subject Buildings (Aug 2017)

Building / Mailing Address	Business Name	Type of Business	FIS survey status
99 H St NW	WalMart	Supermarket	Declined
	District Rico	Café, restaurant	Declined
	Starbucks Coffee	Café, restaurant	Declined
	CH Brite Cleaners	Drycleaners	Declined
	Capital One Bank	Banking/financial	Declined
	Quickway Japanese Hibachi	Café, restaurant	Declined
130 M St NE	Harris Teeter	Supermarket	Declined
301 Tingey St SE	Eighteen Eight Fine Men's Salons	Beauty salon	Declined
	Potbelly Sandwich Shop	Café, restaurant	Completed
	Kruba Thai/Sushi	Café, restaurant	Completed
475 K St NW	Cupcakesrperfect.Com	Café, restaurant	N/A
	Net Zero Lighting Inc	Specialty retail	N/A
	Outdoor Lighting Perspective	Landscape Lighting designer	
	Ra'Lei Photography	Photography	N/A
	Busboys and Poets		N/A
	Harris Teeter	Supermarket	Declined
	Sweetgreen	Café, restaurant	Completed
445 K St NW	ATM	Banking/Financial	Declined
	Vida Fitness	Exercise/fitness	Completed
449 K St NW	Ray's Hell burger	Café, restaurant	Completed
453 K St. NW	Mandu	Café, restaurant	Completed
465 K St NW	Alta Strada	Café, restaurant	Completed
	Caviar French Fries	Café, restaurant	Declined
	Conosci	Café, restaurant	Declined
485 K St NW	Taylor Gourmet	Café, restaurant	Declined
1010 Mass Ave NW	Subway	Café, restaurant	Declined
	Z Lights & Furniture	Specialty retail	N/A
	Concuest Pest Control Inc	Pest Controllers	N/A
	Hai Gloss Nail & Beauty Spa	Beauty salon	Completed
	Passion Food Hospitality	Café, restaurant	N/A
	Bolt Burgers	Café, restaurant	Completed
	Scout Photo Expeditions	Photography	N/A
1025 CT Ave NW	CVS Pharmacy	Pharmacy	Declined
	Washington First Bank	Banking/financial	Declined
	Allen-Edmonds	Specialty retail	Completed
	Ecco	Specialty retail	Completed
	Weight Watchers	Exercise/fitness	Declined
	Voorthius Optical	Specialty retail	Completed

Table 7-1 | List of Freight Intensive Sector Businesses Operating from the Subject Buildings (Aug 2017)

Building / Mailing Address	Business Name	Type of Business	FIS survey status
	Boone & Sons	Specialty retail	Completed
	Subway	Café, restaurant	Completed
	Imperial Wine + Spirits	Specialty retail	Completed
1117 10th St NW	CVS Pharmacy	Pharmacy	Completed
	Café Cozy Corner	Café, restaurant	Completed
1200 G St NW			
1202 G	Robert Laurence Jewelers	Specialty retail	Completed
1204 G	ZAGG	Phone repair	Completed
1208 G	Jimmy John's	Café, restaurant	Completed
1210 G	Dunkin Donuts	Café, restaurant	Declined
618 12th St NW	Chop't	Café, restaurant	Completed
620 12th St NW	Imperial wine and spirits	Specialty retail	Completed
1212 4th St SE	Vida Fitness	Exercise/fitness	Declined
	Takorean	Café, restaurant	Completed
	Sweetgreen	Café, restaurant	Completed
	Bang Salon	Beauty salon	Declined
	Penthouse Pool and Lounge	Bar/lounge	Declined
	Banfield Pet Hospital	Veterinarian	Declined
	Aura Spa	Beauty salon	Declined
	Harris Teeter		Declined
1301 U St NW	Takorean	Café, restaurant	Completed
	U Sushi	Café, restaurant	Completed
	Bin 1301 Wine Bar	Bar/lounge	Declined
	United Bank	Banking/financial	Declined
	Mattress Firm	Specialty retail	Completed
	Alero Mexican Restaurant	Café, restaurant	Completed
1350 Potomac St SE	AT&T	Specialty retail	Declined
	Harris Teeter	Supermarket	Declined
	Subway	Café, restaurant	Declined
	Signal Financial	Banking/financial	Completed
	Game Stop		Declined
1400 Irving St NW	Lou's City Bar	Bar/lounge	Declined
	Signal Financial	Banking/financial	Declined
	Bar Ropubaix	Coffee shop	Completed
	Lou's City Bar	Bar / Restaurant	Completed
	Acre 121	Café, restaurant	Declined
	Tynan Coffee & Tea	Café, restaurant	Completed
	Five Guys	Café, restaurant	Completed

Table 7-1 | List of Freight Intensive Sector Businesses Operating from the Subject Buildings (Aug 2017)

Building / Mailing Address	Business Name	Type of Business	FIS survey status
	Potbelly Sandwich Shop	Café, restaurant	Completed
	Pete's New Haven Style Pizza	Café, restaurant	Completed
1401 S St NW	Little Leaf	Specialty retail	Declined
1800 14th St NW	Doi Moi	Café, restaurant	Declined
1800 14th St NW	Passion Fin	Café, restaurant	Declined
1818 14th St NW	Ted's Bulletin	Café, restaurant	Declined
	Two Birds One Stone		Declined
	BB&T		Declined
	Lou Lou		Declined
1550 7th St NW	Grand Cata	Liquor store	Completed
	Unleashed by Petco	Specialty retail	Completed
	Beau Thai	Café, restaurant	Declined
	La Jambe	Café, restaurant	Declined
	Grand Cata	Winecshop	Declined
	Yoga Shala		Declined
1629 K St NW	Roti	Café, restaurant	Completed
1627 K St NW	Eatsa	Café, restaurant	Declined
	Chop't	Café, restaurant	Completed
2055 L St NW	My Face, My Smile	na	Declined
1117 10th St NW	Café Cozy Corner	Café, restaurant	Completed
2140 L St NW	Venus Nails & Spa	Beauty salon	Declined
2142 L St. NW	Char Bar	Restaurant	Declined
2130 P St NW	Pure Barre DC	Fitness Studio	Completed
	B/O	Salon	Completed
	Anatolia	Tailor, tuxedo rental	Completed
	Metro Market	Grocery store	Completed
2400 M St NW	Starbucks Coffee	Café, restaurant	Declined
	West Wing Café	Café, restaurant	Declined
	Fed Ex Office	Shipping	Declined
	Uptowner Café	Café, restaurant	Declined
	Hope Cleaners	Drycleaners	Declined
2130 P St NW	Metro Super Market	Groceries	Declined
2130 P St NW	Pure Barre	Fitness	Declined
2128 P St NW	Linea Pitti	Tuxedo rental	Declined
2126 P St NW	Blo	Hair Salon	Declined
2130 P St. NW	Liberty Cleaners and Shoe Repair	Drycleaner	Declined
1419 22nd St NW	Tigani Hair Botique	Hair Salon	Declined

Table 7-1 | List of Freight Intensive Sector Businesses Operating from the Subject Buildings (Aug 2017)

Building / Mailing Address	Business Name	Type of Business	FIS survey status
2130 P St NW	Quantum Pilates	Exercise/fitness	Declined
2150 P St NW	Soho Tea and Coffee	Café, restaurant	Declined
	Solar Planet	Tanning	Declined
	Pure Barre	Exercise/fitness	Declined
2420 14th St NE	Love 'n Faith Café	Café, restaurant	Completed
	Elevate Interval Fitness	Exercise/fitness	Declined
	Crème Restaurant & Bar	Café, restaurant	Completed
	Streets Market & Café	Café, restaurant	Completed
	Capital View Cleaners		Declined
4500 Wisconsin Ave	Ace Hardware	Specialty retail	Completed
	The Container Store	Specialty retail	Declined
	Best Buy	Specialty retail	Declined

Only 48 (about 40%) of the 120 establishments in the FIS list responded to the survey. As seen in Table 7-1, the most predominant type of business in the FIS businesses in the subject buildings is 'café / restaurant.' The FIS surveyed sample contained 23 responses from café / restaurants. The second most popular category is 'specialty retail' (9 completed surveys).

Several box stores also operate out of the subject buildings. However, major chain box stores such as Best Buy, CVS, Walmart, the Container Store and Safeway have declined to participate in the survey. Some of the store managers at these sores indicated that they would participate if they have approval from their corporate offices. Repeated attempts were made to seek permissions from their respective corporate offices and the requests were declined. Though two box stores participated in the survey (CVS at 1117 10th St. NW and Ace Hardware at 4500 Wisconsin Ave NW), the data are not enough to develop any trip generation models.

7.2.2 Establishment Survey for Non-FIS: Building Managers and Businesses

A Pivot-Table analysis was conducted to learn the breakdown of the non-FIS businesses in each building and a comparison of business types. There are nearly 190 different categories of businesses listed in the study buildings. The top 25 categories are shown in Table 7-2. As can be seen in the summary table, law practices are the predominant non-FIS business type, followed by non-classified establishments. The majority of the top 3 non-FIS business types operate from three study buildings: 1200 G St, 1629 K ST, and 2055 L St. The study team sought cooperation from managers of these three buildings in reaching out to tenants. However, the results were discouraging. Numerous field trips and web searches were to verify and update the list with most current list of Non-FIS businesses also produced disappointing results. Ultimately, survey forms were mailed to about 400 non-FIS businesses operating from the subject buildings. A self-addressed stamped envelope was included in every form mailed. Nearly 50% of

the forms were returned because the mail could not be delivered. A follow up phone call was placed to the other 50% businesses requesting survey participation. Only a fraction of them could be reached. Some businesses promised to participate in the survey. However, only five surveys were returned (response rate of 1%). Thus, the surveys did not result in any useful data for developing trip generation models for any Non-FIS business category.

Senior members of the team approached each of the 19 building managers in person seeking participation in the survey. Only 9 of the 20 building mangers participated in the building manager surveys.

Details and summary tables of the FIS and building manager surveys are presented in Appendix D.

Table 7-2 | Mix of top 25 business categories at study buildings

Row Labels	1010 Mass Ave	1050 17th St NW	1117 10th St NW	1200 G St NW	1212 4th St SE	130 M St NE	1301 U St NW	1350 Potomac Ave SE	1400 Irving St NW	1401 S St NW	1550 7th St NW	1629 K St NW	2055 L St NW	2130 P St NW	2400 M St NW	2420 14th St NW	301 Tingey St SE	4500 Wisconsin Ave NW	475 K St NW	99 H St NW	Grand Total
Attorneys				17								51	19								87
Non-classified Establishments				10								14	3								27
Associations				7								2	5								14
Full-Service Restaurants			1		2				5	1							1		2		12
Counselors												11									11
Lessors of Residential Buildings & Dwellings			1						1	2	1				2	1	2				11
Psychologists				1								9		1							11
Unclassified Establishments	3								2						2				3		10
Business Management Consultants				5								2	2								9
Social Workers				2								7									9
Federal Government Contractors				1								5									6
Physicians & Surgeons												4	1	1							6
Real Estate Management				2		2						1									5
Restaurants				1			2					2									5
Accountants				2								2									4
Apartments						1	1							2							4
Dentists												3	1								4
Employment Agencies & Opportunities				1								3									4
Insurance				2		1						1									4
Limited-Service Restaurants	1								1						1		1				4
Non-Profit Organizations				2								2									4
Offices of Physicians (Excl. Mental Health Specs)											1				2						4
Automated Teller Machines								1					1					1			3

7.3 Survey Summary

The original intent of the surveys was to use the information to develop freight trip generation models using video data in combination with survey data. Unfortunately, the number of survey responses – 9 building responses, 48 FIS business responses, and no non-FIS business responses – were too few to use for model generation, particularly at a specific building level. The surveys asked questions specific to freight activities at each building. Although the building survey did ask about service and courier vehicles for businesses, the information provided by the building manager was limited to residential activity as the managed, in most cases, was only responsible for the residential aspects of the building.

Building Survey

Of the 9 completed building surveys, one building was not included in the video data. Another five buildings with video data did not have survey information. After reviewing the responses, it was clear that the person completing the survey had information about residences but not businesses when considering leased and common space and did not understand that the question about where vehicles parked applied to vehicles operated from the building and not delivery vehicles to the building. Also, both from the video and survey, no distinction was made for refuse pickup. One survey did make that distinction, but others did not when completing trips by vehicle. For any follow-on work, the following recommendations are provided:

- Redesign the building survey for use specifically for curbside management and clarify the distinction between trip types.
- Provide a definition for service trips and delivery trips.
- Include more detailed questions about the building characteristics, including total square footage, number of residential units, number of businesses.
- Include a question about location of points of entry for service providers and couriers.
- Clearly distinguish regular service from other deliveries or service in the questions. The table format did not work.
- Include loading dock as an option for delivery location.
- For mixed-use buildings with residential, include a category for moving companies. and rental trucks.

FIS Business Survey

Of the 48 business surveys, 23 were categorized as Accommodation and Food Service, 20 as Retail Trade, one as wholesale trade, and 4 as other. None of the large box stores or supermarkets responded. From a review of the responses, the questions were appropriate to obtain the necessary information for a freight trip model but because the vehicles from the video could not be attributed to a specific business, no data could be obtained for validating such model. More

resources. Additional consideration in the study design would be required to establish the necessary linkages. Tables 7-3 provides a summary of collected survey data. Tables 7-4 and 7-5 provides statistics of deliveries made at FIS businesses in the survey data.

Table 7-3 | Survey Data Collection Summary

#	Building Address	Business Surveys[1]	
		FIS	Building Manager[2]
1	1010 Massachusetts Avenue NW	Yes	No
2	1025 Connecticut Avenue NW	Yes	No
3	1117 10th Street NW	Yes	Yes
4	1200 G Street NW	Yes	No
5	1212 4th Street SE	Yes	Yes
6	130 M Street NE	Yes	No
7	1301 U Street NW	Yes	No
8	1350 Potomac Avenue SE	Yes	No
9	1400 Irving Street NW	Yes	No
10	1401 S Street NW	Yes	No
11	1550 7th Street NW	Yes	Yes
12	1629 K Street NW	Yes	Yes
13	2055 L Street NW	Yes	No
14	2130 P Street NW	Yes	No
15	2400 M Street NW	Yes	No
16	2420 14th Street NW	Yes	No
17	301 Tingey Street SE	Yes	Yes
18	4500 Wisconsin Avenue NW	Yes	No
19	475 K Street NW	Yes	Yes
20	99 H Street NW	No	No

[1] Non-FIS business surveys were emailed to nearly 400 businesses, followed up with phone calls and further mails. Less than 7 surveys were returned.
[2] All building managers were approached multiple times. Several of them refused to participate

Table 7-4 | Summary of Businesses in FIS Survey by Business Characteristics

Business Category	Total respondents	Number of Employees				Floor space (Sq. ft)				Deliveries Days (# of businesses)			Deliever-ries made
		Resp.	Avg.	Max	Min	Resp.	Resp.	Avg.	Max	Resp.	Week day	Both	# resp
Food Service	23	22	17	55	2	14	1703	5000	500	20	9	11	11
Retail Trade	20	19	7	35	1	8	2293	10000	400	19	16	3	13
Wholesale Trade	1	1	30	30	30	0	-	-	-	1	1	0	1
Other	4	4	19	37	4	0	-	-	-	3	2	1	1
Total	48	46	18	55	1	22	1998	10000	400	43	28	15	26

Table 7-5 | Summary of Businesses in FIS Survey by Time of Day

Business Category	Deliveries received (# of businesses)							Delivery Vehicles per week (Origin and Destination (# of businesses)					
	Resp.	6-9 am	9-12 am	12-3 pm	3-6 pm	6-9 pm	6-Sep	Resp.	Car	PU/ van	2-axle truck	Large Truck	Other
Food Service	16	9	11	8	6	5	6	20	6	4	11	7	1
Retail Trade	19	3	12	12	8	4	1	20	4	5	9	6	1
Wholesale Trade	1	0	0	1	0	0	0	1	0	1	0	0	0
Other	3	1	2	2	2	1	1	4	1	1	2	0	0
Total	39	13	25	23	16	10	8	45	11	11	22	13	2

8. Conclusions

All four objectives of the study were met with varying levels of success. Review of current literature and practices at different large cities in the United States provided insights into the practices at DDOT. Video surveillance and post-surveillance analysis of the video footage offered a viable mechanism for obtaining data on loading and unloading activity at curbside and loading-berths. By deploying the video footage on a private YouTube channel, the study developed an innovative methodology to store, manage and encode loading-unloading activities. This less intrusive methodology also saved significant amount of time while also providing accurate and verifiable data. The analysis of loading activity provided consistent results for curbsides and loading-berths at all buildings for which video data were analyzed. Some of the generalized observations include the following:

- Most of the curbside activity at 13 buildings lasted for dwell times of 10 minutes or less. However, at a few buildings (e.g., 1400 Irving St NW and 475 K St NW) activity lasted for over 20 minutes;
- The most frequent dwell time for loading activities was 2 minutes for all data collection sites
- On weekdays, loading peaks occur between 9AM-2 PM with most common peak-hour being 9-10 AM; and
- Wednesday through Friday are peak days of the week for loading activity and Sundays experience the lowest loading activity.

It should be cautioned that loading activity is not necessarily attributable to the business activity at the data collection buildings.

8.1.1 Next Steps

With adequate caution, video footage could be used to normalize characteristics associated with curbside management based on the following variables:

- Number of residential units in the subject buildings
- Business area square footage
- Available number of loading berths

The research effort provided an important data set for further analysis of activity at curbside and loading docks. This data can be used for answering several research questions. For example, a statistical experiment to study the variation in loading activity by vehicle type at different buildings would characterize similarities and differences among selected locations.

Video footage can be encoded to study parking of personal autos for dwell time analyses.

8.1.2 Lessons Learned

We are wary of developing any recommendations pertaining to facilitation of loading/unloading in central business districts based on the evidence we gathered and very little statistical significance we can attach to the findings. This study should be viewed as a successful endeavor in massive data collection effort with a mixed success in meeting all the objectives of the study. Specifically, the effort was not successful in developing in freight trip generation models due to the limitations on the scope of data collected.

The survey methodology assumed that curbside commercial vehicle-loading activity could be correlated with business activities in the building. However, this is not necessarily the case. For example, while conducting surveys, the team noted that several commercial vehicles parked at the subject buildings to make deliveries or receive packages at nearby buildings, some as far away as 4 city blocks. Similarly, some vehicles may have belonged to residents of the building.

With respect to the objective related to business surveys, the study produced mixed results. The primary goal of business surveys was to attribute the loading activity to business-specific variables for the subject buildings. Only 48 of the establishments spread across 7 industry categories completed the survey, which was not adequate to develop a reasonable trip generation model in any of the categories. If a reasonable truck trip generation model were to be developed for commercial establishments, the survey should be expanded to numerous businesses at several additional buildings. Also, mail-in surveys (even with follow up phone calls and visits) are clearly the least effective way to engage with businesses. The format for obtaining number and type of vehicles associated with businesses should also be reconsidered. The survey used in this study was a modification of one that was developed for a more macro-level generalized truck trip generation study. No surveys were returned from non-retail businesses that did not have ground-level access.

For curbside management, the scheme used to classify vehicle types from the video was adequate. However, for truck trip generation, it should be revised, primarily for medium and large trucks, to include specific truck purpose such as waste management, city vehicles (fire trucks, bucket trucks, etc.), and both commercial and rental moving vehicles.

References

Allen, J., & Browne, M. (2008). Review of survey techniques used in urban freight studies. Project Report of the Green Logistics: Work Module, 9.

Beagan, D. F., Fischer, M. J., & Kuppam, A. R. (2007). Quick response freight manual II (No. FHWA-HOP-08-010).

Bomar, M. A., Becker, E. P., & Stollof, E. R. (2009). Urban Freight Case Studies: New York. Publication FHWA-HOP-10-019. Federal Highway Administration, US Department of Transportation, Washington, DC.

Bomar, M., Becker, E., & Stollof, E. (2009). Urban freight case studies: Washington DC Publication FHWA-HOP-10-018. Federal Highway Administration, US Department of Transportation, Washington, DC.

Cambridge Systematics, Comsis Corporation, University of Wisconsin at Milwaukee, (1996). Quick response freight manual. Report DTFH61-93-C-00075, Prepared for the USFHWA, Washington, DC.

CDM Smith. (2014). DDOT Freight Plan Final Report.

Chatterjee, A. (2004). Freight Transportation Planning for Urban Areas. ITE Journal, 74(12), 20-25.

Chatterjee, A., & Cohen, H. (2004). Accounting for Commercial Vehicles in Urban Transportation Models.

Chatterjee, A. (2006). Curbside Truck Loading in Downtown Areas. Talking Freight. Retrieved from https://www.fhwa.dot.gov/planning/freight_planning/talking_freight/06talking.cfm

Chatterjee, A., & Venigalla, M. M. (2004). Travel demand forecasting for urban transportation planning. Handbook of transportation engineering, 1.

Chatterjee, A., Varma, A., Fischer, A., & Swenson, J. (2008). Curbside Delivery of Freight by Trucks in Downtowns of Small- and Medium-Sized Urban Areas. Institute of Transportation Engineers. ITE Journal; Washington, 78(1), 32,37-42.

Cleckley, (2015). “Downtown Delivery-Philadelphia.” Downtown Delivery Symposium, Delaware Valley Regional Planning Commission, Philadelphia, PA, July 15, 2015.

Conway, A., Wang, X., Chen, Q., & Schmid, J. (2016). Freight Costs at the Curbside.

DDOT. (2004). District of Columbia Motor Carrier Management and Threat Assessment Study.

Denver Regional Council of Governments (2001) Denver Regional Travel Behavior Inventory—Commercial Vehicle Survey Report.

Dickson, R., (2015). "Downtown Delivery-Philadelphia." Downtown Delivery Symposium, Delaware Valley Regional Planning Commission, Philadelphia, PA, July 15, 2015.

Fischer, M. J., & Han, M. (2001). NCHRP Synthesis of Highway Practice 298: Truck Trip Generation Data. Transportation Research Board of the National Academies, Washington, DC.

Friebele, J. (2005). Issues and Challenges of Curbside Loading and Parking in Urban Areas. Talking Freight. Retrieved from https://www.fhwa.dot.gov/planning/freight_planning/talking_freight/05talking.cfm

Giuliano, G., O'Brien, T., Dablanc, L., Holliday, K. (2013). NCFRP report 23: Synthesis of Freight Research in Urban Transportation Planning. Washington, D.C.: Transportation Research Board.

Holguín-Veras, J., Jaller, M., Sánchez-Díaz, I., Wojtowicz, J., Campbell, S., Levinson, H., ... & Tavasszy, L. (2012). NCHRP Report 739/NCFRP Report 19: freight trip generation and land use. Washington DC: Transportation Research Board of the National Academies.

Holguín-Veras, J., Amaya-Leal, J., Wojtowicz, J., Jaller, M., González-Calderón, C., Sánchez-Díaz, I., ... & Frazier, R. J. (2015). NCFRP report 33: Improving freight system performance in metropolitan areas: A planning guide. *Transportation Research Board of the National Academies: Washington, DC*.

Holguín-Veras, J., Lawson, C., Wang, C., Jaller, M., González-Calderón, C., Campbell, S., … National Academies of Sciences, Engineering, and Medicine. (2017). NCFRP report 37: Using Commodity Flow Survey Microdata and Other Establishment Data to Estimate the Generation of Freight, Freight Trips, and Service Trips: Guidebook. Transportation Research Board of the National Academies, Washington, DC.

Iding, M. H., Meester, W. J., & Tavasszy, L. (2002). Freight trip generation by firms.

Institute of Transportation Engineers (Ed.). (2012). Trip generation manual (9th ed). Washington, DC: Institute of Transportation Engineers.

Jaller, M., Sanchez, I., Holguín-Veras, J., & Lawson, C. (2013). Area Based Freight Trip Generation Models.

Jones, E., Chatterjee, A., & Marsili, R. L. (2009). A Collaborative Plan for Curbside Freight Delivery in Washington, DC, USA. Institute of Transportation Engineers. ITE Journal, 79(5), 22–25.

Kawamura, K., Shin, H. S., McNeil, S., & Ogard, L. (2005). Business and Site-Specific Trip Generation Methodology for Truck Trips (No. MRUTC 05-03). Midwest Regional University Transportation Center, College of Engineering, Department of Civil and Environmental Engineering, University of Wisconsin, Madison.

Lawson, C., Holguín-Veras, J., Sánchez-Díaz, I., Jaller, M., Campbell, S., & Powers, E. (2012). Estimated generation of freight trips based on land use. Transportation Research Record: Journal of the Transportation Research Board, (2269), 65-72.

LaBelle, J. C., & Frève, S. F. (2016). Exploring the Potential for Off Peak Delivery in Metropolitan Chicago: Research Findings and Conclusions.

McCormack, E., Ta, C., Bassok, A., & Fishkin, E. (2010). Truck trip generation by grocery stores (No. TNW2010-04).

Morlok, E. K., Nitzberg, B. F., Balasubramaniam, K., & Sand, M. L. (2000). The parcel service industry in the US: Its size and role in commerce. Systems Engineering Department. School of Engineering and Applied Science, University of Pennsylvania, Philadelphia.

MoveDC (2014). District of Columbia's Multimodal Long-Range Transportation Plan.

Nelson\Nygaard Consulting Associates. (2014). DDOT Curbside Management Study.

Pendyala, R., Shankar, V., & McCullough, R. (2000). Freight travel demand modeling: synthesis of approaches and development of a framework. Transportation Research Record: Journal of the Transportation Research Board, (1725), 9-16.

Pivo, Gary, Daniel Carlson, Matthew Kitchen,et al. (2002). Learning from truckers: Truck drivers' views on the planning and design of urban and suburban centers. Journal of Planning Literature, 17(1), 85-168.

Rhodes, S. S., Berndt, M., Bingham, P., Bryan, J., Cherrett, T. J., Plumeau, P., & Weisbrod, R. (2012). NCFRP report 14: Guidebook for understanding urban goods movement. Transportation Research Board of the National Academies, Washington, DC.

Richards, L., Pérez, B.,& Dey, S. (2016). An analytical approach for improving freight deliveries in an urban area. ITS America 2016.

Spielberg, F., & Smith, S. A. (1981). Service and Supply Trips at Federal Institutions in Washington, DC, Area. Transportation Research Record, (834).

Texas A&M Transportation Institute (2012). Corpus Christi Commercial Vehicle Survey

Venigalla, M. M., & Baik, B. H. (2007). GIS-based engineering management service functions: taking GIS beyond mapping for municipal governments. Journal of Computing in Civil Engineering, 21(5), 331-342.

Walters, C. H. (2001). COMMERCIAL DEVELOPMENTS NEED LOADING SPACES--BUT HOW MANY? WHAT SIZE? ITE Journal, 71(5).

Wegmann, F. J., Technology Sharing Program (U.S.), United States, & University of Tennessee, K. (1996). Characteristics of urban freight systems. Washington, DC: U.S. Department of Transportation : Distributed in cooperation with the Technology Sharing Program.

Zalewski, A. J., Buckley, S. M., & Weinberger, R. R. (2012). Regulating Curb Space: Developing a Framework to Understand and Improve Curbside Management. Presented at the Transportation Research Board 91st Annual Meeting Transportation Research Board.

Appendix – A
New York City Zoning Code

NYC Zoning Resolution (see: https://www1.nyc.gov/site/planning/zoning/access-text.page)

(NYC loading Berth zoning regulations. For original documents, see Article III and IV of the NYC *Zoning Resolution. Article IV shown below*)

44-50 GENERAL PURPOSES

The following regulations on permitted and required accessory off-street loading berths are adopted in order to provide needed space off public streets for loading and unloading activities, to restrict the use of the streets for such activities, to help relieve traffic congestion in manufacturing and industrial areas within the City, and thus to promote and protect public health, safety, and general welfare. (12/15/61)

44-51 Permitted Accessory Off-Street Loading Berths

M1 M2 M3

In all districts, as indicated, 'accessory' off-street loading berths, open or enclosed, may be provided for all permitted 'uses', under rules and regulations promulgated by the Commissioner of Buildings, and subject to the provisions of Sections 44-582 (Location of access to the street), 44-583

(Restrictions on location of berths near Residence Districts), 44-584 Surfacing) and 44-585 (Screening). (2/2/11)

44-52 Required Accessory Off-Street Loading Berths

M1 M2 M3

In all districts, as indicated, 'accessory' off-street loading berths, open or enclosed, shall be provided in conformity with the requirements set forth in the table in this Section and under rules and regulations promulgated by the Commissioner of Buildings, for all 'development' after December 15, 1961, for the 'community facility', 'commercial' or 'manufacturing uses' listed in the table, except as otherwise provided in Sections 44-53 (Special Provisions for a Single Zoning Lot with Uses Subject to Different Loading Requirements) or 44-54 (Wholesale, Manufacturing or Storage Uses Combined with Other Uses), as a condition precedent to the 'use' of such 'development'.

After December 15, 1961, if the 'use' of any 'building or other structure' or 'zoning lot' is changed or 'enlarged', the requirements set forth in the table shall apply to the 'floor area' of the changed or 'enlarged' portion of such 'building' or of the 'lot area' used for such 'use'. For the purposes of this

Section, a tract of land on which a group of such 'uses' is 'developed' under single ownership or control shall be considered a single 'zoning lot'. Whenever any 'use' specified in the table is located on an open lot, the requirements set forth in the table for 'floor area' shall apply to the 'lot area' used for such 'use'.

Required Off-Street Loading Berths for Developments, Enlargements or Changes Of Use

C1 C2 C3 C4 C5 C6 C8

- Hospitals and related facilities1 or prisons
- First 10,000 sq. ft. of floor area – None
- Next 290,000 sq. ft. of floor area – 1 required berth
- Each additional 300,000 sq. ft. of floor area or fraction thereof
    - 1 required berth

C1 C2 C4 C6 C8

- Funeral establishments
- First 10,000 sq. ft. of floor area – 1 required berth
- Next 20,000 sq. ft. of floor area – 1 required berth
- Any additional amount – 1 required berth

C12 C22 C3 C4-1 C4-2 C4-3 C8-1 C8-2

- Hotels, offices or court houses
- First 25,000 sq. ft. of floor area – None
- Next 75,000 sq. ft. of floor area – 1 required berth
- Next 200,000 sq. ft. of floor area – 1 required berth
- Each additional 300,000 sq. ft. of floor area or fraction thereof
    - 1 required berth

C13 C1-6 C1-7 C1-8 C1-9 C23 C2-6 C2-7 C2-8 C4-4 C4-5 C4-6 C4-7 C5 C6 C8-3 C8-4

- Hotels, offices or court houses
- First 100,000 sq. ft. of floor area – None
- Next 200,000 sq. ft. of floor area – 1 required berth
- Each additional 300,000 sq. ft. of floor area or fraction thereof
    - 1 required berth
- Commercial uses
- All retail or service uses listed in Use Group 6A, 6C, 7B, 8B,
- 9A, 9B, 10A, 12B, 14A or 16A
- All amusement uses listed in Use Group 8A or 12A

- All automotive service uses listed in Use Group 7D

C12 C22 C3 C4-1 C4-2 C4-3 C7 C8-1 C8-2

- First 8,000 sq. ft. of floor area – None
- Next 17,000 sq. ft. of floor area – 1 required berth
- Next 15,000 sq. ft. of floor area – 1 required berth
- Next 20,000 sq. ft. of floor area – 1 required berth
- Next 40,000 sq. ft. of floor area – 1 required berth
- Each additional 150,000 sq. ft. of floor area or fraction thereof
    - 1 required berth

C13 C1-6 C1-7 C1-8 C1-9 C23 C2-6 C2-7 C2-8 C4-4 C4-5 C4-6 C4-7 C5 C6 C8-3 C8-4

- First 25,000 sq. ft. of floor area – None
- Next 15,000 sq. ft. of floor area – 1 required berth
- Next 60,000 sq. ft. of floor area – 1 required berth
- Each additional 150,000 sq. ft. of floor area or fraction thereof
    - 1 required berth
- Service, wholesale, manufacturing, or storage uses
- All service, wholesale or storage uses listed in Use Group 7C,
- 10B, 11B, or 16D
- All manufacturing uses listed in Use Group 11A

C22 C4-1 C4-2 C4-3 C8-1 C8-2

- First 8,000 sq. ft. of floor area – None
- Next 17,000 sq. ft. of floor area – 1 required berth
- Next 15,000 sq. ft. of floor area – 1 required berth
- Next 20,000 sq. ft. of floor area – 1 required berth
- Next 20,000 sq. ft. of floor area – 1 required berth
- Each additional 80,000 sq. ft. of floor area or fraction thereof
    - 1 required berth

C23 C2-6 C2-7 C2-8 C4-4 C4-5 C4-6 C4-7 C5 C6 C8-3 C8-4

- First 15,000 sq. ft. of floor area – None
- Next 25,000 sq. ft. of floor area – 1 required berth
- Next 40,000 sq. ft. of floor area – 1 required berth
- Each additional 80,000 sq. ft. of floor area or fraction thereof

  - 1 required berth
- 1 Requirements in this table are in addition to area utilized
- for ambulance parking
- Mapped within R1, R2, R3, R4, R5, R6
- Mapped within R7, R8, R9, R10
- Districts
- Type of Use Floor Area - Required Berths

M1 M2 M3

- *Hospitals and related facilities* or prisons*
- First 10,000 square feet of floor area - 1 required berth
- Next 290,000 square feet of floor area - None
- Each additional 300,000 square feet of floor area or fraction thereof - 1 required berth

M1 M2 M3 - *Funeral establishments*

- First 10,000 square feet of floor area - 1 required berth
- Next 20,000 square feet of floor area - 1 required berth
- Any additional amount - 1 required berth

M1-1 M1-2 M1-4 M2-1 M2-3 M3-1 M3-2 - *Hotels, offices, or court houses*

- First 25,000 square feet of floor area - None
- Next 75,000 square feet of floor area - 1 required berth
- Next 200,000 square feet of floor area - 1 required berth
- Each additional 300,000 square feet of floor area or fraction thereof - 1 required berth

M1-3 M1-5 M1-6 M2-2 M2-4 - *Hotels, offices, or court houses*

- First 100,000 square feet of floor area - None
- Next 200,000 square feet of floor area - 1 required berth
- Each additional 300,000 square feet of floor area or fraction thereof - 1 required berth

M1-1 M1-2 M1-4 M2-1 M2-3 M3-1 M3-2 - *Commercial uses*.

- All retail or service uses listed in Use Group 6A, 6C, 7B, 8B, 9A, 9B, 10A, 14A or 16A. All amusement
- uses listed in Use Group 8A or 12A. All automotive service
- uses listed in Use Group 7D.
- First 8,000 square feet of floor area - None
- Next 17,000 square feet of floor area - 1 required berth
- Next 15,000 square feet of floor area - 1 required berth

- Next 20,000 square feet of floor area - 1 required berth
- Next 40,000 square feet of floor area - 1 required berth
- Each additional 150,000 square feet of floor area or fraction thereof - 1 required berth

M1-3 M1-5 M1-6 M2-2 M2-4

- *Commercial uses*. All retail or service uses listed in Use Group 6A, 6C, 7B, 8B, 9A, 9B, 10A, 14A or 16A. All amusement uses listed in Use Group 8A or 12A. All automotive service uses listed in Use Group 7D. First 25,000 square feet of floor area – None Next 15,000 square feet of floor area - 1 required berth Next 60,000 square feet of floor area - 1 required berth
- Each additional 150,000 square feet of floor area or fraction thereof - 1 required berth

M1-1 M1-2 M1-4 M2-1 M2-3 M3-1 M3-2

- *Services, wholesale, manufacturing or storage uses.* All service, wholesale or storage uses listed in Use Group 7C, 10B, 11B, 16D, 17A or 18B. All manufacturing uses listed in Use Group 11A, 17B or 18A.
- First 8,000 square feet of floor area - None
- Next 17,000 square feet of floor area - 1 required berth
- Next 15,000 square feet of floor area - 1 required berth
- Next 20,000 square feet of floor area - 1 required berth
- Each additional 80,000 square feet of floor area or fraction thereof - 1 required berth

M1-3 M1-5 M1-6 M2-2 M2-4

- *Services, wholesale, manufacturing or storage uses.* All service, wholesale or storage uses listed in Use Group 7C, 10B, 11B, 16D, 17A or 18B. All manufacturing uses listed in Use Group 11A, 17B or 18A.
- First 15,000 square feet of floor area - None
- Next 25,000 square feet of floor area - 1 required berth
- Next 40,000 square feet of floor area - 1 required berth
- Each additional 80,000 square feet of floor area or fraction thereof - 1 required berth

(12/15/61)

44-53 Special Provisions for a Single Zoning Lot with Uses Subject to Different Loading Requirements

M1 M2 M3

In all districts, as indicated, if any building or zoning lot contains two or more uses having different requirements for loading berths as set forth in Section 44-52 (Required Accessory Off-Street Loading Berths), and if:

a. the floor area of each separate use is less than the minimum floor area for which berths are required; and
b. the total floor area of all the uses for which berths are required is greater than the smallest amount of floor area for which berths are required for any of the uses individually; then off-street loading berths shall be provided as if the total floor area of the uses for which berths are required were used for that use for which the most berths are required.

Wholesale, Manufacturing or Storage Uses Combined with Other Uses

M1 M2 M3

In all districts, as indicated, except as provided in Section 44-53 (Special Provisions for a Single Zoning Lot with Uses Subject to Different Loading Requirements), if any building or zoning lot is used partly for wholesale, manufacturing or storage uses or any combination of such uses, and partly for any other uses set forth in the table in Section 44-52 (Required Accessory Off-Street Loading Berths), at least 50 percent of the floor area in the building shall be subject to the requirements set forth for wholesale, manufacturing or storage uses, and the remainder shall be subject to the other applicable requirements.

(12/15/61)

44-55 Waiver of Requirements for All Zoning Lots Where Access Would Be Forbidden

M1 M2 M3

In all districts, as indicated, the requirements set forth in the following Sections shall not apply to any building or zoning lot as to which the Commissioner of Buildings has certified that there is no way to arrange the required berths with access to the street to conform to the provisions of Section 44-582 (Location of access to the street):

Section 44-52 (Required Accessory Off-Street Loading Berths)

Section 44-53 (Special Provisions for a Single Zoning Lot with Uses Subject to Different Loading Requirements)

Section 44-54 (Wholesale, Manufacturing or Storage Uses Combined with Other Uses). The Commissioner of Buildings may refer such matter to the Department of Transportation for a report and may base a determination on such report.

44-56 Special Provisions for Zoning Lots Divided by District Boundaries

M1 M2 M3

In all districts, as indicated, whenever a zoning lot is divided by a boundary between districts having different requirements for accessory off-street loading berths, the provisions set forth in Article VII, Chapter 7, shall apply.(12/15/61)

44-57 Joint Loading Berths Serving Two or More Buildings

M1 M2 M3

In all districts, as indicated, required loading berths may be provided in facilities designed to serve jointly two or more adjoining buildings or zoning lots within a single block, provided that:

a. the number of berths in such joint facilities shall be not less than that required for the total combined floor area of such buildings or zoning lots as set forth in Sections 44-52 (Required Accessory Off-Street Loading Berths), 44-53 (Special Provisions for a Single Zoning Lot with Uses Subject to Different Loading Requirements) and 44-54 (Wholesale, Manufacturing or Storage Uses Combined with Other Uses);
b. direct access is provided from such joint facilities to all such buildings or zoning lots; and(c) the design and layout of such joint facilities meet standards of adequacy set forth in regulations promulgated by the Commissioner of Buildings. (12/15/61)

44-58 Additional Regulations for Permitted or Required Berths

M1 M2 M3

In all districts, as indicated, all permitted or required accessory off-street loading berths shall conform to the provisions set forth in this Section.(12/15/61)

44-581 Size of required loading berths

M1 M2 M3

In all districts, as indicated, all required off-street loading berths, open or enclosed, shall conform to the regulations on minimum dimensions set forth in the following table. The dimensions of off-street berths shall not include driveways, or entrances to or exits from such off-street berths.

Minimum Dimensions For Required Accessory Off-Street Loading Berths (in feet)

	Length	Width	Vertical Clearance
Hospitals and related facilities or prisons	33	12	12
Funeral establishments	25	10	8
Hotels, offices or courthouses	33	12	12
Commercial uses*	33	12	14

Wholesale, manufacturing or storage uses:			
with less than 10,000 square feet of floor area	33	12	14
with 10,000 square feet of floor area or more	50	12	14

---

* As set forth in the table in Section 44-52 (Required Accessory Off-Street Loading Berths) (12/15/61)

44-582 Location of access to the street

M1 M2 M3

In all districts, as indicated, no permitted or required accessory off-street loading berth, and no entrance or exit thereto, shall be located less than 50 feet from the intersection of any two street lines. However, a location closer to such intersection may be permitted if the Commissioner of Buildings certifies that such a location is not hazardous to traffic safety and not likely to create traffic congestion. The Commissioner of Buildings may refer such matter to the Department of Transportation for report and may base a determination on such report. The waiver provisions of Section 44-55 (Waiver of Requirements for All Zoning Lots Where Access Would Be Forbidden) shall apply when the Commissioner of Buildings has certified that there is no way to arrange the berths with access to the street to conform to the provisions of this Section. (12/15/61)

44-583 Restrictions on location of berths near Residence Districts

M1 M2 M3

In all districts, as indicated, where accessory off-street loading berths are located within 60 feet of a Residence District boundary, such berths shall be enclosed within a building, and no entrance to or exit from the berths on to the street shall be less than 30 feet from the district boundary. (12/15/61)

44-584 Surfacing

M1 M2 M3

In all districts, as indicated, all permitted or required open off-street loading berths shall be surfaced with asphaltic or Portland cement concrete, or other hard-surfaced dustless material, at least six inches thick. (4/8/98)

44-585 Screening

M1 M2 M3

In all districts, as indicated, all permitted or required open off-street loading berths which are located on zoning lots adjacent to the boundary of a Residence District shall be screened from all adjoining zoning lots in Residence Districts, including zoning lots situated across a street, by either:

a. a strip at least four feet wide, densely planted with shrubs or trees which are at least four feet high at the time of planting and which are of a type which may be expected to form a year-round dense screen at least six feet high within three years; or
b. a wall or barrier or uniformly painted fence of fire resistant material, at least six feet but not more than eight feet above finished grade. Such wall, barrier, or fence may be opaque or perforated, provided that not more than 50 percent of the face is open. In addition, such screening:
    i. shall be maintained in good condition at all times;
    ii. may be interrupted by normal entrances or exits; and
    iii. shall have no signs hung or attached thereto other than those permitted in Section 42-52 (Permitted Signs). (4/22/09)

Appendix – B
Philadelphia Zoning Code

(For original document, see Title 14, Chapter 14, Section 8 of the Philadelphia Code available at: http://library.amlegal.com/nxt/gateway.dll/Pennsylvania/philadelphia_pa/thephiladelphiacode?f=templates$fn=default.htm$3.0$vid=amlegal:philadelphia_pa)

§ 14-806. Off-Street Loading.

All development shall comply with the off-street loading standards in this section. Uses that are not permitted in a particular zoning district shall provide off-street loading in accordance with the zoning district in Table 14-806-1 that has the strictest requirements for that use at the gross floor area occupied by that use. In the case of mixed-use buildings or developments, off-street loading requirements shall be calculated by determining the required loading spaces for the cumulative gross floor area occupied by each group of uses listed in each row of Table 14-806-1 or Table 14-806-2, as applicable, and then taking the highest result of these calculations. [470]

(1) General Requirement for All Districts Except RMX-3, CMX-4, and CMX-5.

Every building on a property that is abutting two or more streets shall provide off-street loading spaces in accordance with Table 14-806-1.

Table 14-806-1: Off-Street Loading[471]

Use	Gross Floor Area (Sq. Ft.)	Required Loading Spaces
Residential Districts except RMX-3		
Office, Hospital, Public, Civic, and Institutional, Visitor Accommodation, or Residential	100,000 - 150,000	1
	150,001 - 400,000	2
	400,001 - 660,000	3
	660,001 - 970,000	4
	970,001 - 1,300,000	5
	Over 1,300,000	1 additional space per each additional 350,000 sq. ft.
Commercial Districts except CMX-4 and CMX-5		
Office, Hospital, Public, Civic, and Institutional, Visitor Accommodation, or Residential	100,000 - 150,000	1
	150,001 - 400,000	2
	400,001 - 660,000	3
	660,001 - 970,000	4
	970,001 - 1,300,000	5
	Over 1,300,000	1 additional space per each additional 350,000 sq. ft.
All other permitted uses	20,000 - 40,000	1
	40,001 - 100,000	2
	100,001 - 160,000	3
	160,001 - 240,000	4
	240,001 - 320,000	5
	Over 320,000	1 additional space per each additional 90,000 sq. ft.
Industrial Districts except IRMX		
All permitted uses	10,000 - 20,000	1
	20,001 - 40,000	2
	40,001 - 60,000	3
	60,001 - 80,000	4
	80,001 - 100,000	5
	Over 100,000	1 additional space per each additional 50,000 sq. ft.

Use	Gross Floor Area (Sq. Ft.)	Required Loading Spaces
IRMX		
Office, Hospital, Public, Civic, and Institutional, Visitor Accommodation, or Residential	100,000 - 150,000	1
	150,001 - 400,000	2
	400,001 - 660,000	3
	660,001 - 970,000	4
	970,001 - 1,300,000	5
	Over 1,300,000	1 additional space per each additional 350,000 sq. ft.
All other permitted uses	20,000 - 40,000	1
	40,001 - 60,000	2
	60,001 - 80,000	3
	80,001 - 100,000	4
	100,001 - 120,000	5
	Over 120,000	1 additional space per each additional 50,000 sq. ft.

(2) **RMX-3, CMX-4, and CMX-5 Districts.**

(a) **Required Spaces.** 472

Off-street loading in RMX-3, CMX-4, and CMX-5 districts shall be provided in accordance with Table 14-806-2, except for:

(b) Properties in an area bounded by Chancellor Street, 16th Street, St James Street, and 17th Street, where no loading shall be required, provided that the provisions of this § 14-806(2)(a)(.1) shall expire on December 31, 2017.

Table 14-806-2: Off-Street Loading in RMX-3, CMX-4, and CMX-5[473]

Use	Gross Floor Area (Sq. Ft.)	Required Loading Spaces
Office and Visitor Accommodation	100,000-150,000	1
	150,001- 400,000	2
	400,001 - 660,000	3
	660,001 - 970,000	4
	970,001 - 1,300,000	5
	Over 1,300,000	1 additional space per each additional 400,000 sq. ft.
Residential	100,000-200,000	1
	200,001-500,000	2
	Over 500,000	3
All other permitted uses	40,000-100,000	1
	100,001-160,000	2
	160,001-240,000	3
	240,001-320,000	4
	Over 320,000	1 additional space per each additional 90,000 sq. ft.

(c) **Enclosed Structure Required.**

Every off-street loading space shall be located either (1) within the building it serves, or (2) in an enclosed structure with direct access to each building the loading spaces serve.

(d) **Ingress and Egress.** [476]

Each individual loading space or group of loading spaces shall be limited to one two-way curb cut with a maximum width of 24 ft. on the street frontage or two one-way curb cuts with a maximum width of 16 ft. on each street frontage; provided that, for curb cuts on the south side of Fairmount Avenue, between Broad Street and Thirteenth Street, on lots designated "CMX-4," the 24 ft. maximum width shall not apply to a two-way curb cut and a maximum of two two-way curb cuts shall be allowed if the curb cuts are intended to be used for a mixed use development with at least 50,000 gross square feet of space for retail use. As an exception to this standard, when the loading spaces or their access drives have direct access to a street of less than 40 ft. wide, there shall not be a limit imposed on the size of the curb cut(s) to that street. Driveways that cross the public sidewalk must be at the same level as the sidewalk. The driveway material must change at the building line to demarcate the transition to the sidewalk. Sidewalks should be visually continuous across driveways to indicate pedestrians have the right-of-way.

(e) **Common Loading.**

Two or more buildings may share a common loading area provided that the loading area is located within a commonly accessible structure and that the total number of loading spaces provided is calculated on the basis of the sum of the loading spaces required for each building that the common spaces are intended to serve.

Table 14-806-3: Required Loading Space Dimensions[475]

Required Loading Space	Dimensions
1	10 ft. wide, 40 ft. long, 14 ft. high
2 [1]	11 ft. wide, 60 ft. long, 14 ft. high
3	10 ft. wide, 30 ft. long, 14 ft. high
4	10 ft. wide, 40 ft. long, 14 ft. high
5 [1]	11 ft. wide, 60 ft. long, 14 ft. high
Each additional	10 ft. wide, 30 ft. long, 14 ft. high
Table Notes: [1] Except where access to the loading space is by a street which is less than 35 ft. wide in which case, such space may be at least 10 ft. wide, 40 ft. long, 14 ft. high.	

(3) **General Design and Access Standards.**

Except as provided in § 14-806(2) (RMX-3, CMX-4, and CMX-5 Districts), the following standards apply to all required off-street loading spaces.

a. Where off-street loading spaces do not adjoin the street, convenient access at least 12 ft. wide to each space shall be provided.
b. Access driveways across sidewalks shall be subject to the approval of the Streets Department.
c. Each required off-street loading space shall be at least 11 ft. wide, 60 ft. long, and have at least 14 ft. of unobstructed height unless otherwise stated in another provision of this Zoning Code for a specific location.
d. No required off-street loading space may be located in a required front setback or rear or side yard area.

Appendix – C
Survey Forms

C.1. Truck Trip Generation Establishment Survey for Freight Intensive Sector, FIS

All information you provide in this survey will be kept confidential. This information will be used only for planning purposes.

■ Contact information for the person completing the survey

· Name:_____ · Position:_____

· Phone Number:_____ · Email:_____

■ Establishment information

· Company Name:_____ · Address:_____

· City:_____ · State:_____

· Zip Code:_____

· Is this the headquarters of the firm? ☐ YES ☐ NO

· Type of Business: ☐ Retail trade ☐ Wholesale trade ☐ Accommodation and food service

☐ Other:_____

· Number of people employed at this address currently

- Total employees at this establishment Full-time:_____ Part-time:_____

- Total employees in a typical day Full-time:_____ Part-time:_____

· Is the work done at the premises performed in shifts? ☐ YES ☐ NO

If yes, Total number of employees per shift:_____

· Is your establishment the only one at this site? ☐ YES ☐ NO

If yes, Establishment Floor Area: _____

If no, Total site area:_____ and Establishment floor area:_____

(Specify units, e.g., sq yds, sq ft, acres)

· Number of floors of the main building occupied by the firm:_____

■ Number of vehicles owned/leased and operated from this address

Vehicle Type	Example	Number of vehicles	Vehicle Type	Example	Number of vehicles
Cars			2 axle single unit trucks		
Small pickup/ vans			Large trucks		
Other					

■ Number of delivery trips with this address as origin or destination by vehicle type

(Please provide average number of deliveries per day or per week)

Vehicle Type	Example	MADE FROM this address (deliveries to customers)	RECEIVED AT this address (deliveries to your establishment)	Time Unit
Cars				☐ per day ☐ per week
Small pickup/ vans				☐ per day ☐ per week
2 axle single unit trucks				☐ per day ☐ per week
Large trucks				☐ per day ☐ per week
Other				☐ per day ☐ per week
Courier (USPS/FedEx/UPS)	 Utility van			☐ per day ☐ per week
	 Walk-in van			☐ per day ☐ per week
				☐ per day ☐ per week

	2 axle single unit trucks			

■ Delivery Pattern

· When are your typical day of deliveries? ☐ Weekday ☐ Weekend ☐ Both

· When do you typically make deliveries? : (Please check all that apply)

☐ 6am-9am ☐ 9am-12pm ☐ 12pm-3pm ☐ 3pm-6pm ☐ 6pm-9pm ☐ 9pm-6am

· When do you typically receive deliveries? : (Please check all that apply)

☐ 6am-9am ☐ 9am-12pm ☐ 12pm-3pm ☐ 3pm-6pm ☐ 6pm-9pm ☐ 9pm-6am

· Do deliveries vary by season? ☐ Yes ☐ No

If yes, there are (☐ increases / ☐ decreases) in deliveries on _____

■ Delivery location

· Where do you make/receive deliveries? ☐ Loading dock ☐ On street in a loading zone

☐ On street, but not in a loading zone ☐ In the alley

☐ Other:_____

■ Off-Hours delivery program (receiving deliveries/goods between 7 pm to 6 am)

· Is your establishment participating in the DDOT's off-hours delivery program? ☐ Yes ☐ No

If not, please explain primary concerns in participating in off-hours delivery program:

■ Number of service trips (e.g., technicians, service providers, cleaning windows) with this address as origin or destination by vehicle type. (Please provide average number of service per day or per week.)

Vehicle Type	Example	LEAVING this address	RECEIVED AT this address	Time Unit
Cars				☐ per day ☐ per week
Small pickup/ vans				☐ per day ☐ per week
2 axle single unit trucks				☐ per day ☐ per week
Other				☐ per day ☐ per week

Thank you for taking time to complete this survey.

C.2. Truck Trip Generation Establishment Survey for Building Managers

All information you provide in this survey will be kept confidential. This information will be used by DDOT for planning purposes.

■ Contact information for the person completing the survey

· Name:_____ · Position:_____

· Phone Number:_____ · Email:_____

■ Establishment information

· Company Name:_____ · Address:_____

· Suite:_____ · Zip Code:_____

· Does this building have a centralized location for package pick-up/delivery:

- For businesses? ☐ YES ☐ NO
- For residences? ☐ YES ☐ NO

· Number of businesses currently located in this building _____

. Number of residences currently located in this building _____

. Number of floors _____

· Area of non-leased space _____ sq. ft.

. Area of common space (elevators, lobby, etc.) _____sq. ft.

■ Number of management company vehicles operated FROM this address

Vehicle Type	Example	Number of vehicles	Vehicle Type	Example	Number of vehicles
Cars			2 axle single unit trucks		
Small			Other		

pickup/ vans					

Where do these vehicles park? ☐ Off street ☐ On street in a loading zone ☐ On street, but not in a loading zone

☐ In the alley ☐ Other:_____

■ Information related to the service trips **arriving at this address**

· Do you schedule service for this building? ☐ YES ☐ NO

· What is the purpose of service trips arriving at this building? (check all that apply)

☐ Waste management ☐ Building maintenance ☐ Electricians ☐ Cleaning ☐ Plumbers

☐ Other: _____

· When does regularly scheduled service typically occur at this building? (Please check all that apply)

☐ 6am-9am ☐ 9am-12pm ☐ 12pm-3pm ☐ 3pm-6pm ☐ 6pm-9pm ☐ 9pm-6am

· Where do service vehicles park? ☐ Off street ☐ On street in a loading zone

☐ On street, but not in a loading zone ☐ In the alley

☐ Other:_____

■ Number of service trips (e.g., technicians, service providers, cleaning windows) with this address as origin or destination by vehicle type. (Please provide average number of service per day or per week.)

Vehicle Type	Example	Regularly Scheduled Service	All other Service	Time Unit
Cars				☐ per day ☐ per week
Small pickup/ vans				☐ per day ☐ per week
2 axle single unit trucks				☐ per day ☐ per week
Other				☐ per day ☐ per week

■ Number of delivery trips with this address as origin or destination by vehicle type (Please provide average number of deliveries per day or per week)

Vehicle Type	Example	MADE FROM this address (deliveries to customers)	RECEIVED AT this address (deliveries to your building)	Time Unit
Cars				☐ per day ☐ per week
Small pickup/ vans				☐ per day ☐ per week
2 axle single unit trucks				☐ per day ☐ per week
Large trucks				☐ per day ☐ per week
Other				☐ per day ☐ per week
Courier (USPS/FedEx/UPS)	 Utility van			☐ per day ☐ per week
	 Walk-in van			☐ per day ☐ per week
	 2 axle single unit trucks			☐ per day ☐ per week

Thank you for taking time to complete this survey.

C.3. Truck Trip Generation Establishment Survey for Non-Freight Intensive Sector

All information you provide in this survey will be kept confidential. This information will be used by DDOT for planning purposes.

■ Contact information for the person completing the survey

· Name:_____ · Position:_____

· Phone Number:_____ · Email:_____

■ Establishment information

· Company Name:_____ · Address:_____

· Suite:_____ · Zip Code:_____

· Is this the headquarters of the firm? ☐ YES ☐ NO

. Is this office part of an executive suite? ☐ YES ☐ NO

· Type of Business: ☐ Real Estate ☐ Legal Services ☐ Finance & Insurance

☐ Professional, Scientific, and Technical Service ☐ Other:_____

· Number of people currently employed at this address

- Total employees at this location Full-time:____ Part-time:_____

- Total employees in a typical day Full-time:____ Part-time:_____

· Office lease space: _____sq. ft.

■ Number of package delivery trips with this address as origin or destination

Package Delivery	Average number of deliveries SHIPPED FROM this address	Average number of deliveries RECEIVED AT this address	Time Unit
USPS/FedEx/UPS			☐ per day ☐ per week
Local courier (florist/food/etc)			☐ per day ☐ per week
2 axle single unit trucks 			☐ per day ☐ per week
Large trucks 			☐ per day ☐ per week
Other			☐ per day ☐ per week

■ Information related to service trips (maintenance/electricians/cleaning etc.) **arriving at this address**

. Do you use services beyond those provided by the building management company? ☐ YES ☐ NO

. What is the purpose of service trips that you request for this location? (please check all that apply)

☐ Office equipment maintenance ☐ Electricians ☐ Cleaning ☐ Plumbers

☐ Other: _____

. Typical number of service trips at this address _____☐ per day ☐ per week

· When does service typically occur at this address? (Please check all that apply)

☐ 6am-9am ☐ 9am-12pm ☐ 12pm-3pm ☐ 3pm-6pm ☐ 6pm-9pm ☐ 9pm-6am

Thank you for taking time to complete this survey.

Appendix – D
Establishment Survey Results

Table D-1 | Establishment Survey Summary: FIS Businesses

Sur No.	Establishment Information				
	Company Name	**Address**	**Zip Code**	**HQ?**	**Type of Business**
1	POTBELLY	301 TINGEY ST SE	20006	no	Accommodation & food service
2	KRUBA	301 TINGEY ST SE	20003	no	Accommodation & food service
3	HAI GLOSS NAIL & BEAUTY SPA	1010 MASS AVE NW	20001	yes	Other - Beauty and Spa
4	BOLT BURGERS	1010 MASS AVE NW	20001	yes	Accommodation & food service
5	CVS	1117 10TH ST NW		yes	Retail trade
6	IMPERIAL WINE AND SPIRIT	620 12TH ST NW	20005	no	Retail trade
7	ROGERT LAWRENCE JEWELERS	1202 G ST NW	20005	yes	Retail trade
8	ZAGG	1204 G ST NW	20002	no	Retail trade
9	JIMMY JOHNS	1208 G ST NW	20005	no	Accommodation & food service
10	TAKOREAN	1212 4TH ST SE	20003	no	Accommodation & food service
11	SWEET GREEN	1212 4TH ST SE	20003	no	Accommodation & food service
12	ALERO RESTURANT	1301 U ST NW	20009		Accommodation & food service
13	TOKU JAPAN & ASIAN CUIS	1301 U ST NW	20009	no	Accommodation & food service
14	MATTRESS FIRM	1301 U ST NW	20009	no	Retail trade
15	TAKOREAN	1301 U ST NW	20009	no	Accommodation & food service
16	POTBELLY	1400 IRVING ST NW	20009	no	Accommodation & food service
17	TYNAN COFFEE AND TEA	1400 IRVING ST NW	20010	yes	Accommodation & food service
18	PETES PIZZA	1400 IRVING ST NW	20010	no	Accommodation & food service
19	FIVE GUYS	1400 IRVING ST NW	20009	no	Accommodation & food service
20	BAR ROUBAIX	1400 IRVING ST NW	20010	yes	Accommodation & food service
21	LOU'S CITY BAR	1400 IRVING ST NW	20010	yes	Accommodation & food service
22	CAFÉ COZY CORNER	2055 L ST NW		yes	Accommodation & food service

Table D-1 | Establishment Survey Summary: FIS Businesses

Sur No.	Establishment Information				
	Company Name	Address	Zip Code	HQ?	Type of Business
23	PURE BARRE DC	2130 P ST NW	20037	no	Other - Fitness Studio
24	BLO	2126 P ST NW		no	Retail trade
25	ANATOLIA INC	2129 P ST NW	20037	yes	Retail trade
26	METRO MARKET	2130 P ST NW	20037	yes	Retail trade
27	STREETS MARKET	2400 TH ST NW	20003	no	Wholesale trade
28	EZ GROUP LLC	2436 14TH ST NW	20005	yes	Retail trade
29	LOVE N FAITH CAFÉ	2424 14TH ST NW	20009	yes	Accommodation & food service
30	FEDEX OFFICE	2400 M STREET NW	20037	yes	Retail trade
31	HOPE CLEANER WASH DC	2400 M STREET NW		no	Retail trade
32	ACE HARDWARE	4500 WISCONSIN AVE	20016	no	Retail trade
33	SWEET GREEN	475 K ST NW	20001	no	Accommodation & food service
34	ALTA STRADA	475 K ST NW	20001	no	Accommodation & food service
35	MANDU LLC	475 K ST NW	20001	yes	Accommodation & food service
36	VIDA FITNESS	475 K ST NW	20001	no	Other - Gym
37	RAY'S HELL BURGER	475 K ST NW	20001	no	Accommodation & food service
38	ALLEN EDMONDS	1025 CONNECTICUT AVE NW	20036	no	Retail trade
39	IMPERIAL WINE AND SPIRIT	1025 CONNECTICUT AVE NW			Retail trade
40	VOORTHUIS OPTICIANS	1025 CONNECTICUT AVE NW	20006	no	Retail trade
41	BOOKE AND SONS	1025 CONNECTICUT AVE NW	20036	no	Retail trade
42	ECCO	1025 CONNECTICUT AVE NW	20036	no	Retail trade
43	SUBWAY	1025 CONNECTICUT AVE NW	200036	no	Accommodation & food service
44	UNLEASHED BY PETCO	1550 7TH ST NW	20011	yes	Retail trade
45	GRAND CATS	1550 7TH ST NW	20001	yes	Retail trade
46	CHOPT SALAD	1629 K ST NW	20006	no	Accommodation & food service
47	ROTI MEDITERRENEAN	1629 K ST NW	20006	no	Retail trade
48	SIGNAL FINANCIAL FCU	1350 POTOMAC AVE	20003	no	Other - Financial

Table D-2 | Establishment Survey Results: FIS Businesses (1 of 7)

	Establishment Information									
Sur No. (from D-2)	Number of people employed in this establishment in a typical day				Work performed in shift (yes/no)	Number of employees per shift	Only estab at the site (yes/no)	Estab floor area (sqft)	Total Site Area (sqft)	Number of floors occupied
	Full-time	*Part-time*	*Full-time*	*Part-time*						
1	10			3	yes	9	no			
2	15		12		yes	7	no	2500	120	1
3		4			yes	4	yes			1
4	12		8		yes	4	yes	1000		
5	6	10	9		yes	2	yes	1500		1
6					yes	3	yes	500		1
7	4		4		no		yes	450		1
8	1			1	yes	1	no	400		1
9	12	2	9		no		yes	500		1
10	13		10		yes	5	no	1000		
11	25		11		yes	8	no			
12	40	15			yes	25	yes	2500		1
13	10	2	8		yes	8	no	1000		
14	3		2		no		yes			1
15	11		8		yes	5	yes	1100		1
16		8		5	yes		no			
17	6	6	2	2	yes	3	yes	1800		1
18	15	5	7	1	yes	4	yes			1
19					yes		no	5000		1
20	12	8	4	4	yes	6	yes	1000		1
21	8	7	3	3	yes	5	yes	800		1
22	5		4		yes	4	yes			1
23	2	30	1	5	yes	2	yes			1
24	8				yes	5				
25	2	1	2	1	no		yes	10000		
26	4	2	4	2	yes	3	yes			1
27	15	15	10	15	yes		no			1
28	3	3	3	3	yes	6	no			
29	3	4	1	1	yes	2	yes	900		1
30	4		4		yes	2	no			1
31	1				no			500		1
32	30	5	20		yes	20	no			1
33		25		16	yes	17	no		87	
34	30	15	12	5	yes	10	no	2400	3900	1
35	15	10	8	3	yes	10	yes	2349		2

Table D-2 | Establishment Survey Results: FIS Businesses (1 of 7)

	Establishment Information									
Sur No. (from D-2)	Number of people employed in this establishment in a typical day				Work performed in shift (yes/no)	Number of employees per shift	Only estab at the site (yes/no)	Estab floor area (sqft)	Total Site Area (sqft)	Number of floors occupied
36	7	30	7	15	no		no			1
37	2	1	1	1	no		no			1
38	2			2	yes					
39	2				yes					
40	5		3		no		no			1
41	9		9		no		no			1
42	1			4	yes	2	yes	500		1
43	2				yes		no			
44	2	4	1	2	yes	3	yes	4500		1
45		9		4	yes	2	yes			1
46		20		20	yes	20	no			
47	6	3	10	2	no		yes			
48	4	1	4	1	no		no			1

Table D-3 | Establishment Survey Results: FIS Businesses (2 of 7)

	Number of Vehicles owned/leased and operated from this address				
Sur No	Cars	Small pickup /vans	2 axle SU trucks	Large trucks	Other
1					
2					
3					
4					
5					
6	1				
7					
8	1				
9					1
10					
11					
12					
13	3				
14					
15					
16				2	
17					
18	8				
19					
20					
21					
22					
23					
24	15	5	5	2	
25					
26					
27		1			
28					
29	1				
30					
31					
32		2	2		
33					
34					
35					
36					

Table D-3 | Establishment Survey Results: FIS Businesses (2 of 7)

	Number of Vehicles owned/leased and operated from this address				
Sur No	Cars	Small pickup /vans	2 axle SU trucks	Large trucks	Other
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					

Table D-4 | Establishment Survey Results: FIS Businesses (3 of 7)

Number of delivery trips with this address as origin or destination (per week)																
Sur No	Cars		Small pickup/ vans		2 axle SU trucks		Large trucks		Other		Utility van (Courier)		Walk-in van (Courier)		2 axle SU trucks (Courier)	
	Origin	*Destination*	*Origin*	*Destination*	*Origin*	*Destination*	*Origin*	*Destination*	*Origin*	*Destination*	*Origin*	*Destination*	*Origin*	*Destination*	*Origin*	*Destination*
1								4								
2																
3				1								1		1		
4								3								
5						4		1								
6	1							3								1
7														5		
8													5	10	10	5
9									70	35						
10	10							5								
11						5								0.25		
12				1		1										
13	1			2		4										
14						1						2				
15	24					6										
16								2								
17		7		21		7						7		7		7
18	210															
19								2								
20						8										
21						8										
22																
23						0.5								0.5		
24	12		8		5		6				5		5		7	
25														2		
26				1		3		2								
27			5													
28																
29	2	2					2	2								
30												6		24		
31			7	7												

Table D-4 | Establishment Survey Results: FIS Businesses (3 of 7)

Number of delivery trips with this address as origin or destination (per week)																
Sur No	Cars		Small pickup/ vans		2 axle SU trucks		Large trucks		Other		Utility van (Courier)		Walk-in van (Courier)		2 axle SU trucks (Courier)	
	Origin	*Destination*	*Origin*	*Destination*	*Origin*	*Destination*	*Origin*	*Destination*	*Origin*	*Destination*	*Origin*	*Destination*	*Origin*	*Destination*	*Origin*	*Destination*
32								10								
33						14								2		
34						6								2		
35						13										
36						1										3
37						2										
38																5
39						1										
40		5										5				
41		1												15		
42				3												
43														0.25		
44						1		1					7			
45				4								9				
46				10				4						1		
47														1		
48		2														

Table D-5 | Establishment Survey Results: FIS Businesses (4 of 7)

	Delivery Pattern															
	Typical Day of Deliveries	Time of day typically deliveries are MADE						Time of day typically deliveries are RECEIVED						Deliveries vary by season		
		6am - 9am	*9am - 12pm*	*12pm - 3pm*	*3pm - 6pm*	*6pm - 9pm*	*9pm - 6am*	*6am - 9am*	*9am - 12pm*	*12pm - 3pm*	*3pm - 6pm*	*6pm - 9pm*	*9pm - 6am*	*yes/no*	*inc/dec*	*Season*
1			1				1									
2	Both		1	1										yes	increase	
3	Both			1	1					1	1			no		
4	Weekday	1						1						no		
5	Both							1	1	1	1	1				
6	Weekday		1	1					1	1	1			no		
7	Weekday				1					1				no		
8	Weekday	1	1	1	1	1	1	1	1	1	1			no		
9	Both							1	1	1	1	1		yes	decrease	FALL/WIN
10	Both							1						no		
11	Weekday						1						1	no		
12	Weekday			1						1				yes	increase	SUMMER
13	Both		1	1	1	1			1	1	1	1		no		
14	Weekday								1					no		
15	Weekday		1	1	1	1			1	1	1			no		
16	Weekday						1						1	no		
17	Both							1	1	1	1			no		
18	Both					1			1					no		
19	Weekday												1	no		
20	Both								1					no		
21	Both								1					no		
22	Weekday		1					1	1					no		
23																
24	Weekend			1						1				no		
25	Weekend				1						1			no		
26	Weekend		1						1					no		
27	Weekend			1						1				no		
28	Weekend		1	1					1	1				no		
29	Both			1				1		1				yes	increase	SUMMER
30	Both		1	1	1	1			1	1	1			no		
31	Weekday					1						1				
32									1	1	1	1	1			
33																
34																

Table D-5 | Establishment Survey Results: FIS Businesses (4 of 7)

	Delivery Pattern														
	Typical Day of Deliveries	Time of day typically deliveries are MADE						Time of day typically deliveries are RECEIVED						Deliveries vary by season		
		6am - 9am	*9am - 12pm*	*12pm - 3pm*	*3pm - 6pm*	*6pm - 9pm*	*9pm - 6am*	*6am - 9am*	*9am - 12pm*	*12pm - 3pm*	*3pm - 6pm*	*6pm - 9pm*	*9pm - 6am*	*yes/no*	*inc/dec*	*Season*
35	Both							1	1	1	1	1	1	no		
36	Weekday							1	1	1	1	1	1			
37	Weekday								1					no		
38	Weekday		1	1	1	1										
39	Weekday			1						1						
40	Weekday								1	1	1			no		
41	Weekday								1		1			no		
42	Weekday									1		1		no		
43	Both							1	1	1	1	1	1	no		
44	Both	1	1					1	1					yes	decrease	WEATHER CHANGE
45	Weekday								1					yes	increase	HOLIDAYS
46	Weekday							1				1	1			
47	Weekday				1					1				no		
48	Weekday								1					no		

Table D-6 | Establishment Survey Results: FIS Businesses (5 of 7)

Sur No	Delivery Location					
	Loading dock	On street in loading zone	On street, not in loading zone	In the alley	Other	Other location
1		1				
2			1			
3		1		1		
4	1					
5		1		1		
6		1	1			
7			1			
8				1		
9			1			
10	1					
11			1			
12				1		
13	1					
14				1		
15					1	BEHIND ESTABLISHMENT
16				1		
17				1		
18				1		
19			1			
20			1			
21			1			
22			1	1		
23						
24			1			
25			1			
26	1		1			
27		1				
28	1					
29			1	1		
30			1			
31		1				
32	1					
33						
34						

Table D-6 | Establishment Survey Results: FIS Businesses (5 of 7)

Sur No	Delivery Location					
	Loading dock	On street in loading zone	On street, not in loading zone	In the alley	Other	Other location
35	1					
36	1	1				
37	1					
38		1				
39		1				
40					1	IN STORE
41			1			
42		1				
43	1	1				
44	1					
45					1	FRONT DOOR
46	1	1				
47		1				
48		1	1			

Table D-7 | Establishment Survey Results: FIS Businesses (6 of 7)

Sur No	DDOT's Off-Hour Delivery Program perticipation		Number of service trip with this address as origin or destination (trips per week)							
			Cars		Small pickup/ vans		2 axle single unit trucks		Other	
	yes/ no?	Reason	*Origin*	*Destination*	*Origin*	*Destination*	*Origin*	*Destination*	*Origin*	*Destination*
1										
2										
3	no					1				
4	no									
5	no									
6										
7										
8	no	NO ONE DOES AT THE ESTABLISHMENT								
9	yes							7		
10	yes									
11	yes									
12										
13	no									
14										
15	no	NONN-NIGHT TIME BUSINESS HOURS				0.5				
16	yes									
17	no	NO CONCERNS				1				
18	no									
19	yes									
20	no					1				
21	no					1				
22	no	I WOULD HAVE TO PAY WAGES DURING OFF-HOURS								
23										
24	no			2						
25										
26	no									
27	no				1	6				
28				1		1				
29	no							1		

Table D-7 | Establishment Survey Results: FIS Businesses (6 of 7)

DDOT's Off-Hour Delivery Program perticipation			Number of service trip with this address as origin or destination (trips per week)							
			Cars		Small pickup/ vans		2 axle single unit trucks		Other	
Sur No	yes/ no?	Reason	*Origin*	*Destination*	*Origin*	*Destination*	*Origin*	*Destination*	*Origin*	*Destination*
30	no									
31										
32	no									
33										
34										
35	no									
36	no					3				
37	no									
38										
39										
40	no									
41	no									
42	no					3				
43	no									
44	no	THEF				1				
45	no	WE DO NOT KNOW THAT PROGRAM								
46	no									
47	yes									
48	no									

Table D-8 | Establishment Survey Results: FIS Businesses (7 of 7)

Sur No	COMMENTS
22	THE ADDRESS GIVEN BY THE PARTICIPANT: 1117 10TH ST NW
23	MISSING PAGES 4, 5
32	NUMBER OF DELIVERY TRIPS ARE NO CLEARLY MENTIONED
33	ADDRESS GIVEN BY PARTICIPANT: 1065 5TH ST; DELIVERY TRIPS ARE NOT CLEARLY MENTIONED
34	ADDRESS GIVEN BY PARTICIPANT: 465 K ST NW
35	ADDRESS GIVEN BY PARTICIPANT: 475 K ST NW
36	ADDRESS GIVEN BY PSRTICIPANT: 445 K ST
37	ADDRESS GIVEN BY PSRTICIPANT: 449 K ST NW
38	ADDRESS GIVEN BY PSRTICIPANT: 1027 CONNECTICUT AVE NW
39	ADDRESS GIVEN BY PSRTICIPANT: 1033 CONNECTICUT AVE NW
40	ADDRESS GIVEN BY PSRTICIPANT: 1035 CONNECTICUT AVE NW
42	ADDRESS GIVEN BY PSRTICIPANT: 1029 CONNECTICUT AVE NW
43	ADDRESS GIVEN BY PSRTICIPANT: 1712 L STREET NW
47	DELIVERY TRIPS ARE NOT CLEARLY MENTIONED
48	ADDRESS GIVEN BY PSRTICIPANT: 1391 PENN AVE SE
No comments or notes on surveys 1-21, 24-31, 41, 44-46	

Table D-9 | Survey Results: Building Manger

Building	1117 10TH ST NW (no video)	1212 4TH ST SE	130 M ST NE	1350 POTOMAC AVE SE (no video)	1550 7TH ST	1629 K ST NW	2130 P ST NW	301 TINGEY ST SE	475 K ST NW
Completed by	On-site manager	Property Manager	Director Resident Services	General Manager	Concierge	Security Officer	Property Manager	Property Manager	Lead Concierge
Company Name	Quincy Court Condos	The Yards /Forest City	Bozzuto	CMC Mgmt	Market Place Leasing	ne	Westpark Apts	First City / The Yards	K at City Vista
Residences	Quincy Court Condos	The Yards	Flats 130	Jerkins Row HOA	Hefferson Market Place Apts	Davis Building	Westpark Apts	Foundry Lofts	K at City Vista /Gables at City Vista
Suite	ne	ne	ne	Mgmt office	Front Desk	ne	QDC MGT	ne	ne
central loc for packages: business	no	yes	yes	yes	yes	yes	yes	yes	yes
central loc for packages: residence	yes	yes	yes	yes	yes	no	no	yes	yes
Number of floors	11	9	14	5	8	10	10	5	12
Num businesses	2	5	0	ne	5	184	7	4	0
Comments	listed in tenants.xlsx	7 businesses listed in tenants.xlsx	Retail for lease (excludes Harris Teeter or Hilton)	5? Businesses	listed in tenants.xlsx	floors from streetview; businesses from infoUSA	9? Businesses	Listed in tenants.xlsx	12? Businesses
Num apartments	128	217	643	247	281	0	360	177	295

Table D-9 | Survey Results: Building Manger

Building	1117 10TH ST NW (no video)	1212 4TH ST SE	130 M ST NE	1350 POTOMAC AVE SE (no video)	1550 7TH ST	1629 K ST NW	2130 P ST NW	301 TINGEY ST SE	475 K ST NW
Num residents	ne	ne	1000	ne	ne	0	ne	ne	ne
Non-lease space (sqft)	ne	ne	0	0	2500	ne	6000	ne	ne
Common space (sqft)	ne	ne	3000	NA	1000	ne	3000	ne	ne
Comments		retail sp: 70,984 sf	Excludes Harris Teeter				240 residences occupied?	retail sp: 9978 sf	295 units are Gables. 441 units in K
Mgmt_Cars	ne	NA	0	0	0	ne	0	NA	ne
Mgmt_Small pickup/vans	ne	ne	0	0	0	ne	0	ne	ne
Mgmt_2 axle single unit trucks	ne	ne	ne	0	0	ne	0	ne	ne
Mgmt_Other	0	ne	ne	0	ne	ne	0	ne	ne
Mgmt_Off street parking	ne	ne	ne	ne	ne	ne	ne	ne	No
Mgmt_On street loading zone	ne	ne	ne	ne	ne	ne	ne	ne	yes
Mgmt_On street parking	ne	ne	ne	ne	ne	ne	ne	ne	yes
Mgmt_In alley	ne	ne	ne	ne	ne	ne	ne	ne	yes
Mgmt_Other	ne	ne	ne	ne	ne	ne	ne	ne	No
Sched serv?	yes	yes	yes	no	yes	no	yes		yes
Waste management	yes	yes	Yes	yes	yes	yes	yes		yes
Building maintenance	yes	yes	Yes	yes	no	yes	yes		yes
Electricians	yes	yes	Yes	no	yes	yes	yes		yes

Table D-9 | Survey Results: Building Manger

Building	1117 10TH ST NW (no video)	1212 4TH ST SE	130 M ST NE	1350 POTOMAC AVE SE (no video)	1550 7TH ST	1629 K ST NW	2130 P ST NW	301 TINGEY ST SE	475 K ST NW
Cleaning	yes	yes	Yes	yes	no	yes	yes		yes
Plumbers	yes	yes	Yes	no	yes	yes	yes		yes
Other	yes	ne	Yes	ne	ne	ne	ne		ne
Comments	moving		packages, vendors						
6am - 9am	no	no	Yes	yes	no	ne	no		No
9am - 12pm	yes	yes	Yes	yes	yes	ne	yes		yes
12pm - 3pm	yes	yes	Yes	yes	yes	ne	yes		yes
3pm - 6pm	yes	yes	Yes	yes	yes	ne	yes		yes
6pm - 9pm	no	no	No	no	no	ne	no		No
9pm - 6am	no	no	No	no	no	ne	no		No
SerVeh_offstreet	no	no	Yes	ne	no	ne	no		yes
SerVeh_loadingzone	no	no	No	ne	yes	ne	no		yes
SerVeh_onstreetparking	no	no	Yes	yes	no	ne	yes		yes
SerVeh_alley	no	no	No	yes	yes	ne	no		yes
SerVeh_other	yes	yes	No	ne	ne	ne	yes		ne
Comments	Loading dock	Loading dock					Employee spaces		
Ser_cars_regsched	1	NA	ne	3	5	ne	0		ne
Ser_cars_other	ne	10	60	ne	ne	ne	ne		2
S_un_car	per day	per week	per day	per week	per week	ne	per week		per week
Ser_PUVan_regsched	ne	NA	ne	3	2	ne	5		ne
Ser_PUVan_other	1	2	10	ne	ne	ne	ne		3
S_un_PUV	per day	per week	per day	per day	per week	ne	per week		per week
Ser_SUTruck_regsched	3	NA	ne	4	0	ne	ne		NA

Table D-9 | Survey Results: Building Manger

Building	1117 10TH ST NW (no video)	1212 4TH ST SE	130 M ST NE	1350 POTOMAC AVE SE (no video)	1550 7TH ST	1629 K ST NW	2130 P ST NW	301 TINGEY ST SE	475 K ST NW
Ser_SUTruck_other	ne	9	10	ne	ne	ne	ne		NA
S-un_SUT	per week	per week	per day	per day	per week	ne	ne		NA
Ser_Other_regsched	ne	NA	ne	ne	ne	ne	ne		3
Other	moving	ne	ne	ne	ne	ne	ne		trash
Ser_Other_other	1	ne	ne	ne	ne	ne	ne		ne
S_un_oth	per month	ne	ne	ne	ne	ne	ne		per week
FIS_Car_O	ne		ne	ne	0	ne	ne		ne
FIS_Car_D	1		ne	1	2	ne	ne		ne
F_un_car	per day		ne	per week	per week	ne	ne		ne
FIS_PUVan_O	ne		ne	ne	1	ne	ne		ne
FIS_PUVan_D	ne		ne	5	ne	ne	ne		3
F_un_PUV	ne		ne	per week	per day	ne	ne		per week
FIS_SUTruck_O	ne		ne	ne	0	ne	ne		NA
FIS_SUTruck_D	ne		ne	4	ne	ne	ne		NA
F_un_SUT	ne		ne	per week	ne	ne	ne		NA
FIS_LargeTruck_O	ne		ne	ne	0	ne	ne		NA
FIS_LargeTruck_D	ne		ne	3	ne	ne	ne		NA
F_un_LT	ne		ne	per week	ne	ne	ne		NA
FIS_Other_O	ne		ne	ne	ne	ne	ne		ne
FIS_Other_D	ne		ne	ne	ne	ne	ne		ne
F_un_oth	ne		ne	ne	ne	ne	ne		ne
Cour_UtVan_O	ne		ne	ne	2	ne	ne		ne
Cour_UtVan_D	1.5		ne	2	ne	ne	9		1
C_un_UV	per day		ne	per day	per day	ne	per day		per week
Cour_WIVan_O	ne		ne	ne	2	ne	ne		ne

Table D-9 | Survey Results: Building Manger

Building	1117 10TH ST NW (no video)	1212 4TH ST SE	130 M ST NE	1350 POTOMAC AVE SE (no video)	1550 7TH ST	1629 K ST NW	2130 P ST NW	301 TINGEY ST SE	475 K ST NW
Cour_WIVan_D	1.5		ne	1	ne	5	ne		2
C_un_WIV	per day		ne	per day	per day	per day	ne		per week
Cour_SUTruck_O	ne		ne	ne	ne	ne	ne		ne
Cour_SUTruck_D	1.5		ne	3	ne	ne	ne		ne
C_un_SUT	per day		ne	per day	ne	ne	ne		ne
Comments	FOR SERVICE TRIPS: SMALL PICKUP/ VANS - ALL OTHER SERVICE - 1 ~ 2 IN CASE OF EMERGENCY , 2 AXLE SINGLE UNIT TRUCKS - ALL OTHER SERVICE - 1/MONTH (MOVING)	PAGE 3 MISSING	no comment	DELIVERY TRIPS: ALL THE DELIVERY TRIPS ARE MARKED AS "MADE FROM" IN THE SURVEY FORM, THEY COULD ME RECEIVED AT ACTUALLY	no comment	2 fedex, 1 ups, 2 usps	2 UPS - DAILY, 2 USPS - DAILY, 2 FEDEX. 1 DHL, 1 LAZERSHIP (PER DAY) VEHICLE TYPE NOT KNOWN	PAGE 2, 3 MISSING	

NA Not applicable

ne No entry