



TRAFFIC IMPACT STUDY

The Dover Transit Center Water and Queen Streets

City of Dover, Kent County, Delaware

Prepared for
Kling Stubbins

Prepared by
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ORA Job No. 2007 052

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EXECUTIVE SUMMARY

Orth-Rodgers & Associates, Inc. (ORA) has conducted a traffic impact study for Kling Stubbins in association with DelDOT's proposed Transit Center project. The site is located south of Water Street between West and Queen Streets in Dover, DE. As proposed the transit center will include transit service for DART and Greyhound. There will be a 40-space park n ride lot located on site and consideration has been given to the possibility of a future commuter rail station being located in the vicinity. The project is expected to be completed in 2009.

At the time this report was prepared there were two conceptual site plans being considered. The plans are referred to as Scheme D and Scheme E. A copy of each plan is included in the appendix of this report. From a traffic operation standpoint, the conceptual plans are described as follows:

Scheme D: This conceptual plan has the front of the transit center directed towards the west, with access to a pickup/drop off area and the park n ride lot located along West Street. The West Street pickup/ drop off area would be used by the general public as well as DART's para transit vehicles. Busses would enter the site from the rear via Queen Street where there would be separate access points for entering and exiting busses.

Scheme E: This conceptual plan also has the front of the transit center directed towards the west with a pickup/drop off area located on West Street. The park n ride located adjacent to the Transit center building would be accessed via Water Street. Busses would operate along a one-way service road where they would enter on Queen Street and exit on West Street.

In addition to reviewing the proposed site plan and the proposed site access points, we have also analyzed two existing intersection locations. They are:

- Queen Street and Water Street and
- West Street and Water Street.

At these intersections traffic volumes were collected for a typical Tuesday during the morning (7:00-9:00 AM) and evening (4:00-6:00 PM) peak periods. The traffic data collection efforts were conducted on a Tuesday to account for the additional traffic that Spence's Bazaar generates. The bazaar only operates on Tuesdays and Fridays. All of the study intersection traffic data collection was completed by ORA in December 2006.

Capacity and level of service analysis were performed for each intersection and all site access points. The analysis was done for three separate scenarios; they are 2006 existing, 2009 no build, and 2009 full build. The latest version of the HCS+ software (Version 5.2) was used in the analysis. The results show that all individual turning movements operate at a level of service or "C" or better under existing conditions. Without any significant upgrades, those acceptable levels can still be achieved in the future even if the proposed site is developed. However, it was determined that Scheme D's busses only exit on Queen Street would result in a level of service "D", and would be very close to operating at a level typically deemed unacceptable. Under Scheme E all site driveway locations would operate a level of service "B" or better.

The results of our capacity analysis shows that the proposed transit center will not generate a need for any significant off-site improvements and that traffic conditions at the adjacent intersections will remain the same with or without the proposed project.

In addition to the off-site traffic impact, it should also be noted that certain design practices can be applied to the site that will further enhance all modes of transportation. Because of the proposed use of this facility, it is essential that the chosen site design promote all modes of transportation in a safe, convenient and attractive manor. As such this report identifies various site design practices and raises items of concern that should be considered as the project moves through the land development process.

A summary of the recommendations identified are as follows.

On-site Vehicular Circulation

1. Bus Access

- Based on the existing bus routes serving central Dover, it would seem that the majority of busses using the proposed facility would arrive and depart through the intersection of Water and Queen. Therefore Scheme E with a single bus exit on Queen Street will result in a large portion of busses making a left-turn out of the site onto Queen Street. It should be noted that of the three roads that bound the site, Queen Street has the highest amount of traffic and would be the most difficult access point for busses.
- The single bus exit on West Street under Scheme E would result in busses mainly turning right out of the site and then turning right onto Water Street. From a traffic operations perspective this concept would be more desirable when compared to Queen Street access shown in Scheme D.
- The existing curb radius would need to be widened for busses to make a right turn from northbound Queen Street to eastbound Water Street.
- To accommodate busses turning left from westbound Water Street to southbound Queen Street, the existing pavement markings would need to be modified at the intersection.
- While bus lanes and travels ways should be wide enough to allow for busses to easily maneuver, it is recommended that those widths be minimized within the acceptable design standard. Using the minimum design standards will promote lower travel speeds without jeopardizing functionality.
- Entrances intended for busses only should be clearly signed as such.

2. Public Access

- Both Scheme D and E successfully reduce conflict points by effectively separating bus traffic from other activity.
- To further reduce conflict points among pedestrians, cyclist and motor vehicles, consideration should be given to consolidating or minimizing the number a site access points.
- Currently both Scheme D and E show two curb cuts each for the park n ride and the pickup/drop off areas. It should be noted that with the projected traffic volumes, single access points would also be effective.
- Consideration should be given to provide clear separation among pedestrians, cyclists, and vehicles.
- Consider implementing traffic calming devices such as raised crosswalks or curb extensions to better define conflict points and to reduce vehicular travel speeds on site.

Parking Recommendations

- The parking lot area should be designed with designated walkways through the lot. Those walkways should be situated so that pedestrian access is separate from the vehicular access points.
- Consideration should be given to providing preferential or reserved parking for those who participate in the State's ride share program.
- Parking should be for the use of transit and carpool riders only. It is recommended that signing be placed in several highly visible areas that clearly designates who should be using the lot. Overnight parking should be discouraged.
- The pickup/drop off area should be clearly marked as short term parking only. It is recommended that a 15-minute limit be posted in this area.
- At the site entrance points signs should be posted or other architectural treatments to clearly identify the intended use of each access point.
- Consideration should be given towards the effects of darkness. It is typical that a commuter will travel in darkness for at least one leg of their commute.

Bicycle Recommendations

- Bicycle parking should be incorporated into the site plan. The bicycle parking facilities should be situated in an area that will minimize the risk of theft or vandalism.
- The bicycle rack design should comply with the Association for Pedestrian and Bicycle Professionals' *Bicycle Parking Guidelines (APBP, 2003)* or a similar current standard.
- Because usage of bicycle racks will vary and there usage is difficult to predict, the usage should be monitored and if necessary the amount of parking should be modified as needed.

Pedestrian Recommendations

- The site should provide for frequent pedestrian crossing opportunities with the site. Typically these locations should be located perpendicular to the roadway to minimize crossing length and should be located at intersection locations when possible.
- All pedestrian crosswalks within the site should be consistently and clearly marked and should comply with current ADA guidelines.
- Provide stop bars and stop signs at conflict points to guide motorists to stop in locations that do not encroach into pedestrian walkways.

Off-site Recommendations

- The traffic signal at the intersection of Queen Street and Water Street is scheduled to be upgraded by DelDOT in the near future. If not already planned, this traffic signal upgrade should include the installation of pedestrian signal heads and push buttons on all legs of the intersection.
- DelDOT should install signage within the general area of the Transit Center that directs motorists to the site, giving additional time to position themselves to the correct access point. The exact method for signing will vary depending on the final site plan's access scheme. However signing to the transit center would likely be installed along sections of North Street, Queen Street, West Street and New Burton Road at a minimum.
- Because of the location of the site, busses will frequently be required to conducted turning movements at the intersections of Water & West and Water &

Queen. ORA checked the existing conditions at both intersections and identified four potential conflicts. Using a 40' vehicle as the design standard, the following upgrades would be needed to accommodate turning busses:

- A. Right-turn from northbound Queen Street to eastbound Water Street – The existing corner curb line would need to be increased from a 25' to a 40' radius.
- B. Left-turn from westbound Water Street to southbound Queen Street – The existing stop bar on Queen Street would need to be relocated 15' further back.
- C. Right-turn from eastbound Water Street to southbound Queen Street – The existing corner curb line would need to be increased from a 25' to a 40' radius. Additionally the stop bar on Queen Street would need to be moved back 15" to avoid conflicts with opposing vehicles.
- D. Right-turn from northbound West Street to eastbound Water Street – The existing corner curb line would need to be increased from a 25' to a 40' radius.

- At the intersection of Water Street and West Street, it should be noted that there are preliminary plans that show a fourth leg being added to this intersection. As currently proposed this fourth leg will approach from the west and will serve the proposed Eden Hill development. If constructed, it should be anticipated that a traffic signal would likely need to be installed at this location. It should also be noted that the proposed access would be required to cross an active rail line, which is within close proximity to the intersection. Because of the presence of the rail line and in order to ensure safe operation, an entrance and traffic signal at this location would have several operational issues in which to overcome. Additionally in our research, we have found that there was no traffic impact study done for the Eden Hill project, and to date DeIDOT has not reviewed any entrance plans for this proposed site access. It appears as if no engineering studies have been done for this proposed access point and in our opinion there are some very serious concerns about allowing such an access at this location. Although it does not necessarily effect the operation of the proposed transit facility, we question the concept of providing a fourth leg at this intersection. It is recommended that DeIDOT's traffic section further study the Eden Hill plans at this location to determine its feasibility.

PROJECT DESCRIPTION

This project is for the development of a 4.35-acre assemblage of parcels located on the south side of Water Street, between West Street and Queen Street in Dover, Kent County, Delaware. As currently proposed, the site will be developed as a Bus Park-N-Ride facility as the current bus transfer location on Water Street east of this site does not fully serve these needs. This new facility will include the following:

- DeIDOT ticketing building including waiting/community meeting area,
- Greyhound and DART bus loading area, and
- Vehicular drop off area and surface parking (40 spaces) for passengers.

The layout of this proposed site is currently being represented in two different schematics, Scheme D and E. In general Scheme D has all buses entering/exiting via Queen Street with drop-off/Para transit vehicles and patrons using the parking lot entrance via West Street. Scheme E has all buses entering via Queen Street and exiting via West Street with drop-off/Para transit vehicles entering/exiting West Street and people utilizing the parking lot entering/exiting via Water Street.

The land is currently zoned C-3 (Service Commercial), RG-O (General Residence and Office), and C-PO (Commercial/Professional office) but will be developed under the proposed zoning of C-4 (Highway Commercial).

The proposed land use and the corresponding Institute of Transportation Engineer's (ITE) land use codes are described in Table I below. The location of the proposed development is illustrated in Figure 1.

Table I. Proposed Land Use

Land Use	ITE-Code	Quantity
Park-N-Ride Lot w/Bus Service	090	40 parking spaces
Bus Transfer Facility	N/A	+13 Dart bus routes/ Greyhound bus service/ Para transit service

The proposed site is expected to be developed over a three-year period with full build out scheduled for the year 2009. Therefore, this traffic impact study will evaluate the following scenarios:

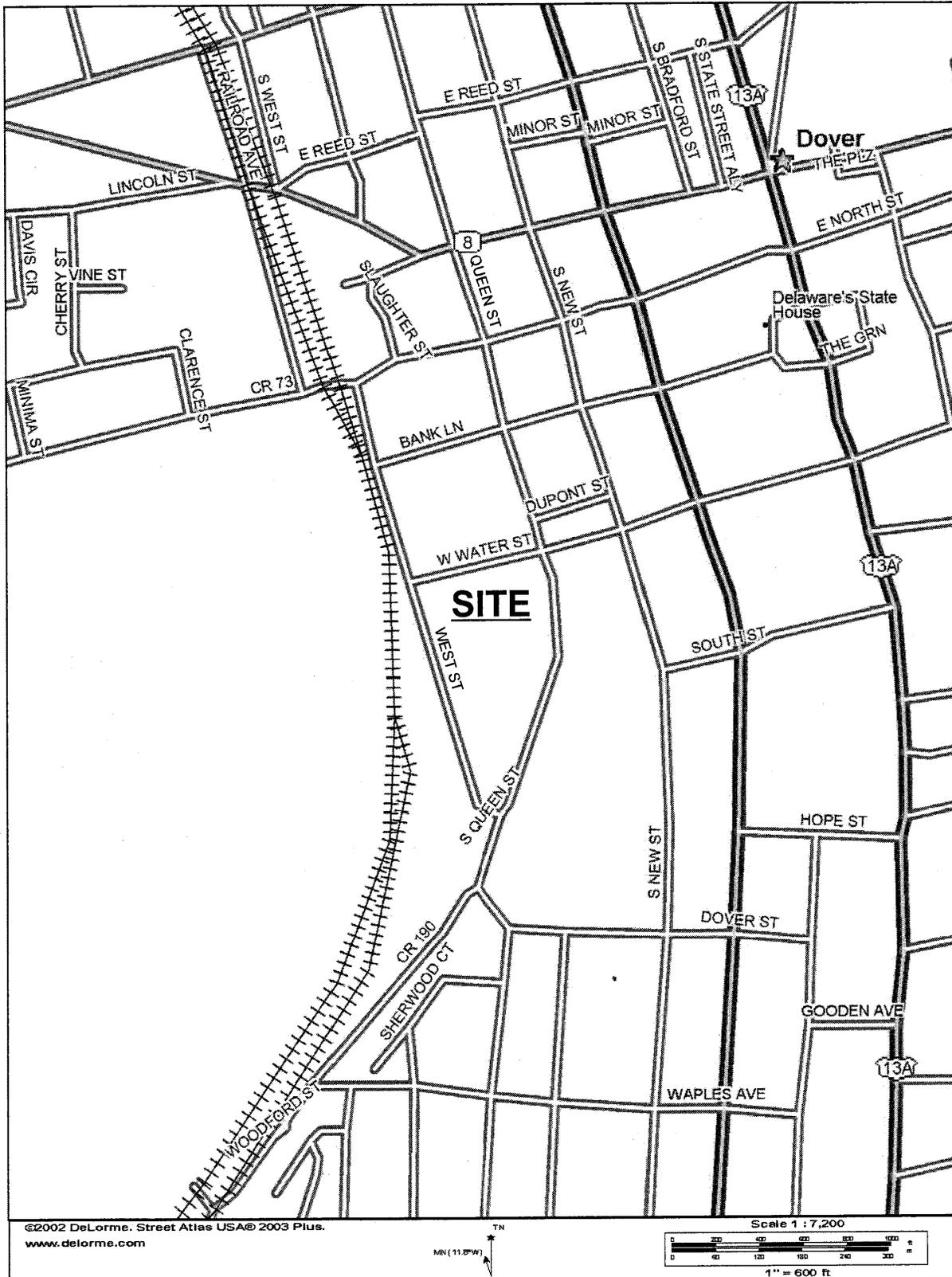
- 2006 existing a.m. and p.m. peaks,
- 2009 a.m. and p.m. peaks without the development, and
- 2009 a.m. and p.m. peaks with the development.



Site Location Map

Dover Transit Center

DOVER, DELAWARE



STUDY AREA

The study area will focus on two intersections. These include:

1. West Street and Water Street
2. Queen Street and Water Street

The 2009 scenarios will include both intersections as well as the various proposed site driveway locations for both Schemes D and E. Figure 2 illustrates the location of the study area intersections.

EXISTING TRAFFIC

Manual traffic counts were performed at the study intersections during the month of December 2006. Because Spence's Bazaar, which is located on Queen Street just south of Water Street, is open for business on just Tuesdays and Fridays, all counts were conducted on a Tuesday. Spence's Bazaar is a farmers market and auction which generates a significant amount of traffic within the study area.

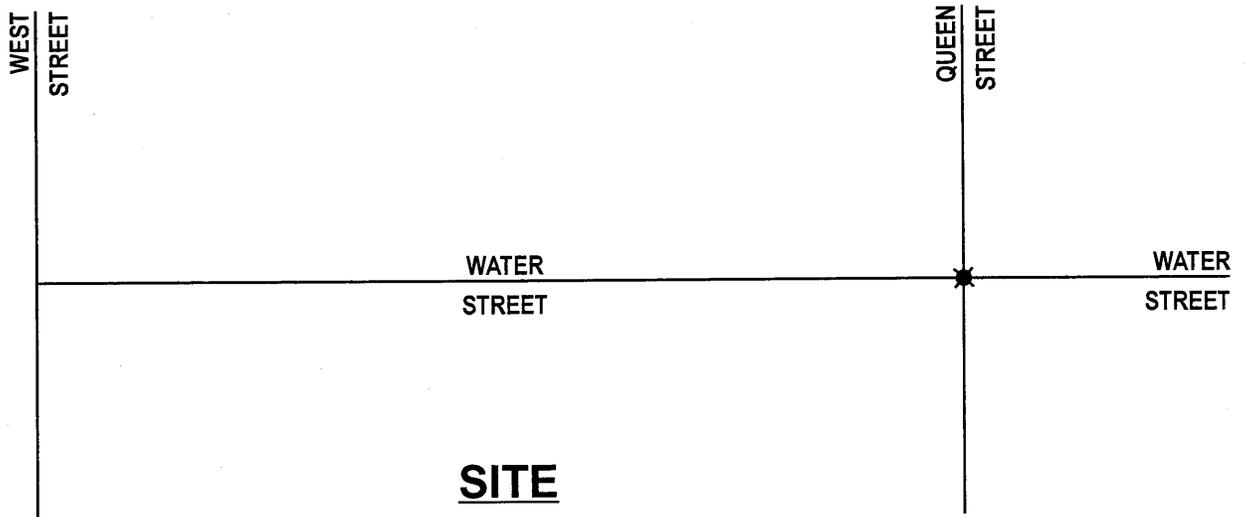
The a.m. traffic counts were conducted on December 12, 2006 while the p.m. counts were conducted on December 19, 2006. The counts were conducted between the hours of 7:00 a.m. to 9:00 a.m. for the morning peak period and from 3:00 p.m. to 6:00 p.m. for the evening peak period. The existing a.m. and p.m. peak hour traffic volumes can be found in Figures 3. The raw traffic count data is included in Appendix A of this report.



Map of Study Intersections

Dover Transit Center

DOVER, DELAWARE



LEGEND

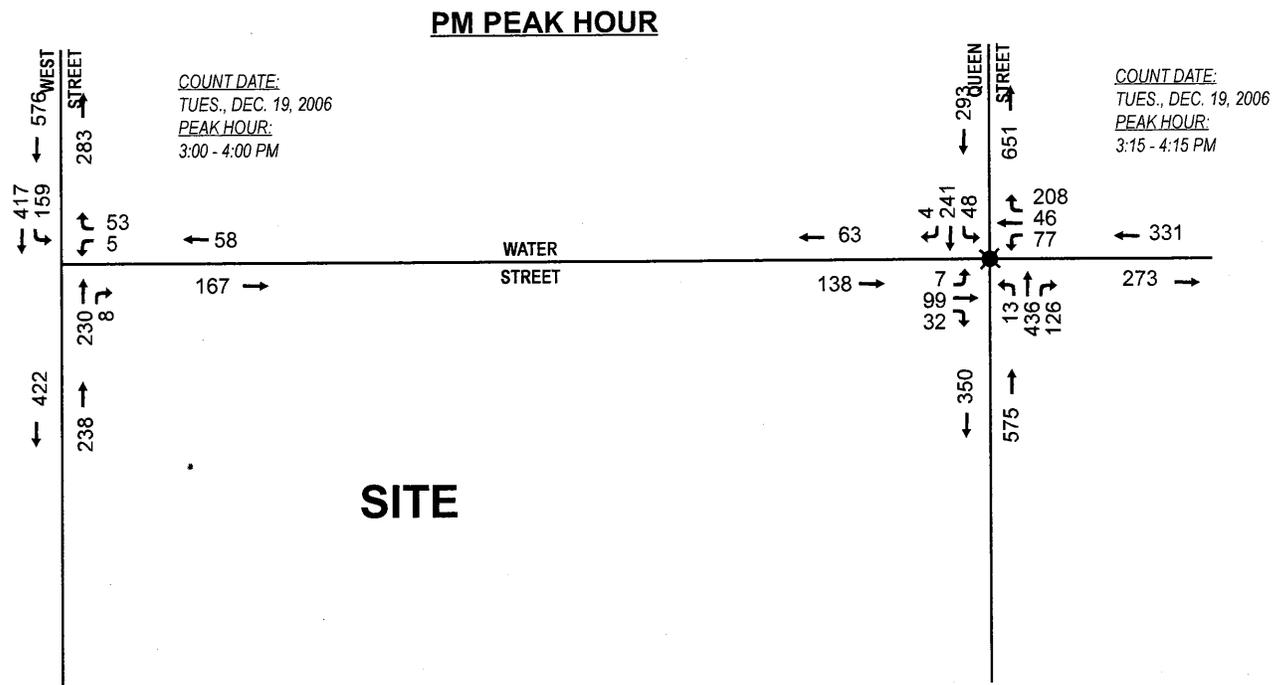
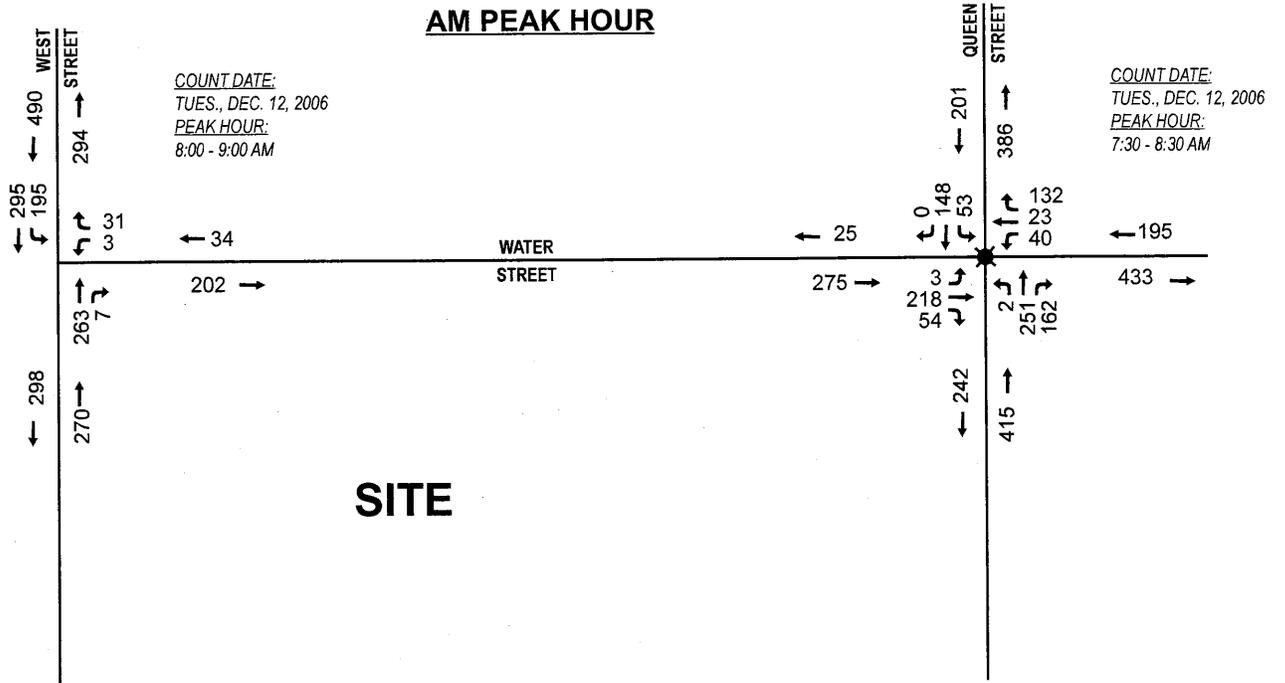
- EXISTING SIGNALIZED INTERSECTION



2006 Existing Peak Hour Traffic Volumes

Dover Transit Center

DOVER, DELAWARE



LEGEND

- EXISTING SIGNALIZED INTERSECTION

FUTURE TRAFFIC WITHOUT DEVELOPMENT

In order to review the development's traffic impact, future traffic volumes for the year 2009 were developed. These volumes are based on the existing volumes being projected to the future design year using the following annual growth rates from the 2005 DeIDOT Traffic Summary:

- A 1.02 annual growth rate for West Street,
- A 1.02 annual growth rate for Water Street, and
- A 1.02 annual growth rate for Queen Street.

By applying these factors to the existing traffic volumes, we get future background traffic. The projected 2009 a.m. and p.m. peak hour background traffic volumes are shown in Figure 4.

There are also two other committed developments included as part of the no build future traffic volumes. For each of these developments, a.m. and p.m. peak hour trips were calculated for the un-built portion of the sites. Information regarding the proposed land use and percent occupied was researched for each development and only the un-built portions were added to the base traffic volumes. These developments and their remaining portions include:

- Eden Hill Farm – Phase 1 (Figure 5) – Located south of North Street and west of West Street, Phase 1 of this site will consist of 398,250 SF of office space. Mr. Richard Woodhall, Subdivision Manager for DeIDOT was contacted regarding this development. He suggested including Phase 1 of this development for our design year. There was mention of a driveway access opposite of Water Street at West Street, which would make this a four-way intersection in the future. Unfortunately Mr. Woodhall did not have any concept plans available. This proposed site access point would have safety and operational concerns as vehicles would have to contend with a railroad crossing. For this report, since no definite plans have been forwarded, the West Street and Water Street intersection remains a t-intersection. At the time of this study, no office space has been built.
- State Street Commons (Figure 6) – Located near the State Street and Water Street intersection, this site will consist of 27,222 SF of office space. At the time of this study, no office space has been built.

In order to account for the increased traffic volumes associated with the above-mentioned developments, the trip generation volumes were calculated by using the data found in the Institute of Transportation Engineers (ITE) *7th edition of the Trip Generation Manual*. As a result, the following a.m. and p.m. peak hour trips are anticipated from the remaining portions of those developments:

Table II. Other Committed Development Trip Generation – Weekday AM peak hour

Land use	ITE Code	AM peak hour			External trips			Pass-by %	Internal Trip %
		Enter	Exit	Total	Enter	Exit	Total		
Eden Hill Farm									
- General office (398,250 SF)	710	499	68	567	499	68	567	0%	0%
State Street Commons									
- General office (27,222 SF)	710	58	8	66	58	8	66	0%	0%
TOTAL AM Peak Hour Trips	-	557	76	633	557	76	633	-	-

**NOTE: Trips generated for the unbuilt/unoccupied portions of the proposed developments*

Table III. Other Committed Development Trip Generation – Weekday PM peak hour

Land use	ITE Code	PM peak hour			External trips			Pass-by %	Internal Trip %
		Enter	Exit	Total	Enter	Exit	Total		
Eden Hill Farm									
- General office (398,250 SF)	710	89	436	525	89	436	525	0%	0%
State Street Commons									
- General office (27,222 SF)	710	19	90	109	19	90	109	0%	0%
TOTAL PM Peak Hour Trips	-	108	526	634	108	526	634	-	-

**NOTE: Trips generated for the unbuilt/unoccupied portions of the proposed developments.*

The total amount of traffic added by these other committed developments during the a.m. and p.m. peak hours are illustrated in Figure 7. Information on the status of each site along with the estimated traffic distribution for each of these other committed developments is included in Appendix C.

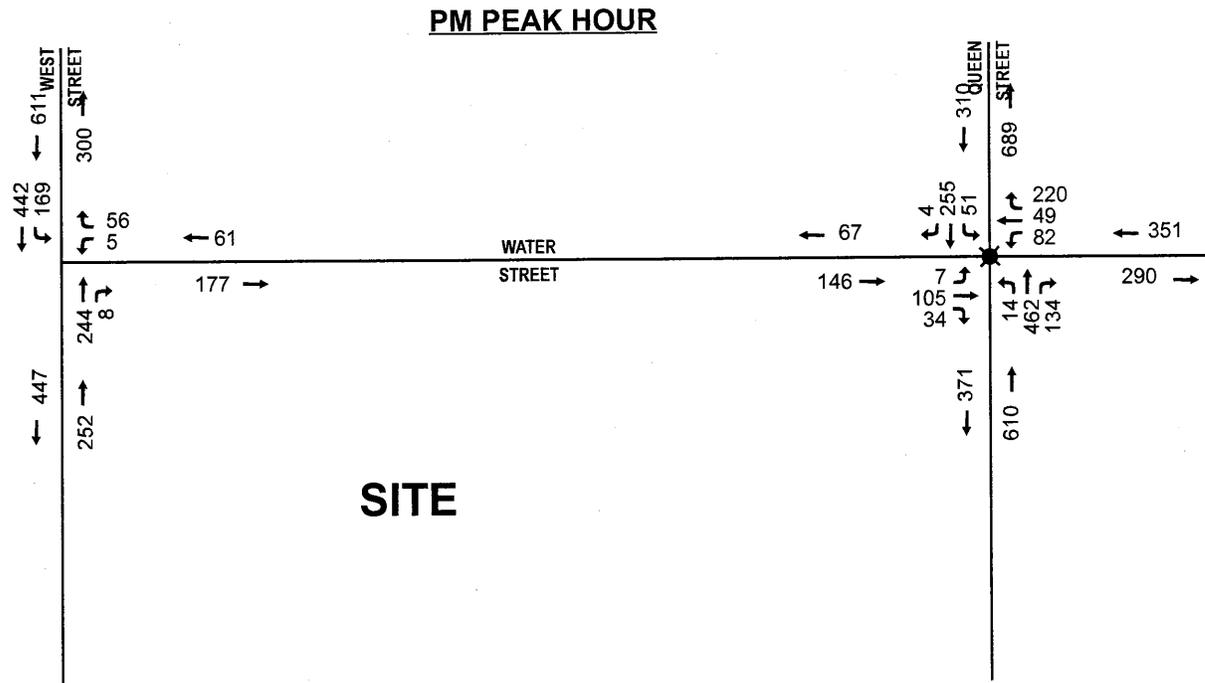
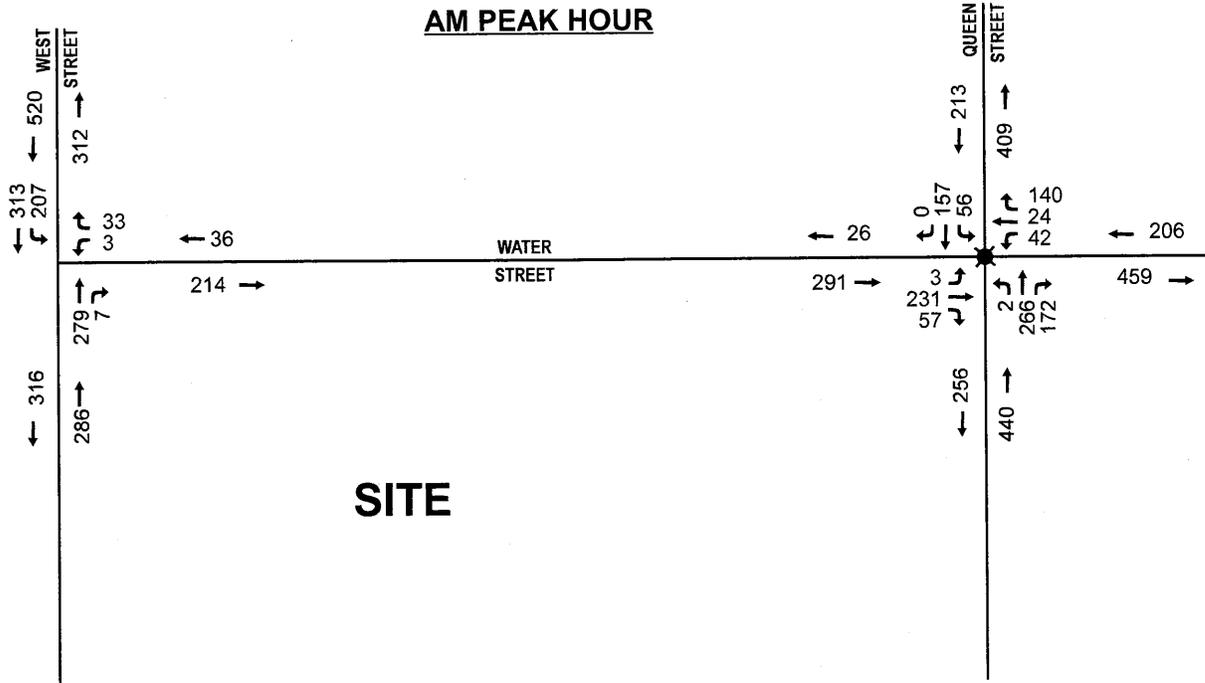
By adding the traffic from these other committed developments to the future volumes with background growth, we get 2009 future no build traffic volumes. The a.m. and p.m. 2009 no build peak hour traffic volumes are shown in Figure 8.



2009 Peak Hour Traffic Volumes with Background Growth

Dover Transit Center

DOVER, DELAWARE



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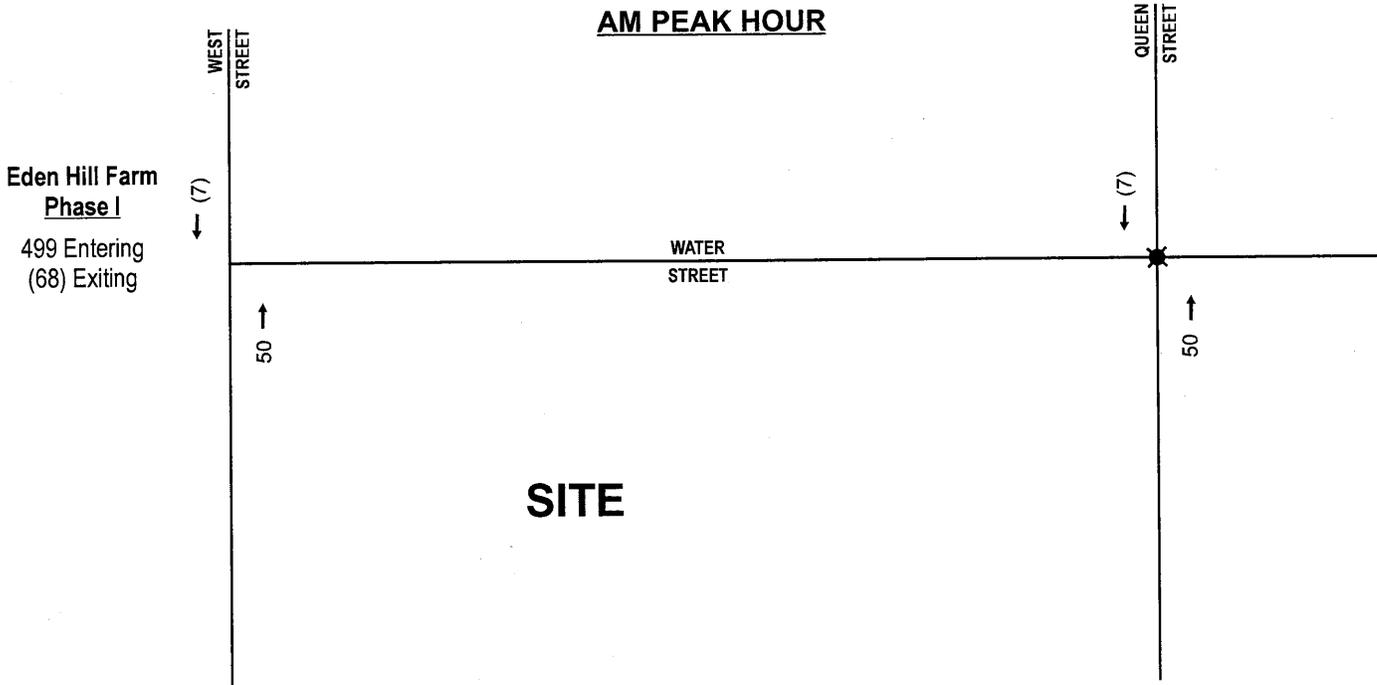
⊗ - EXISTING SIGNALIZED INTERSECTION



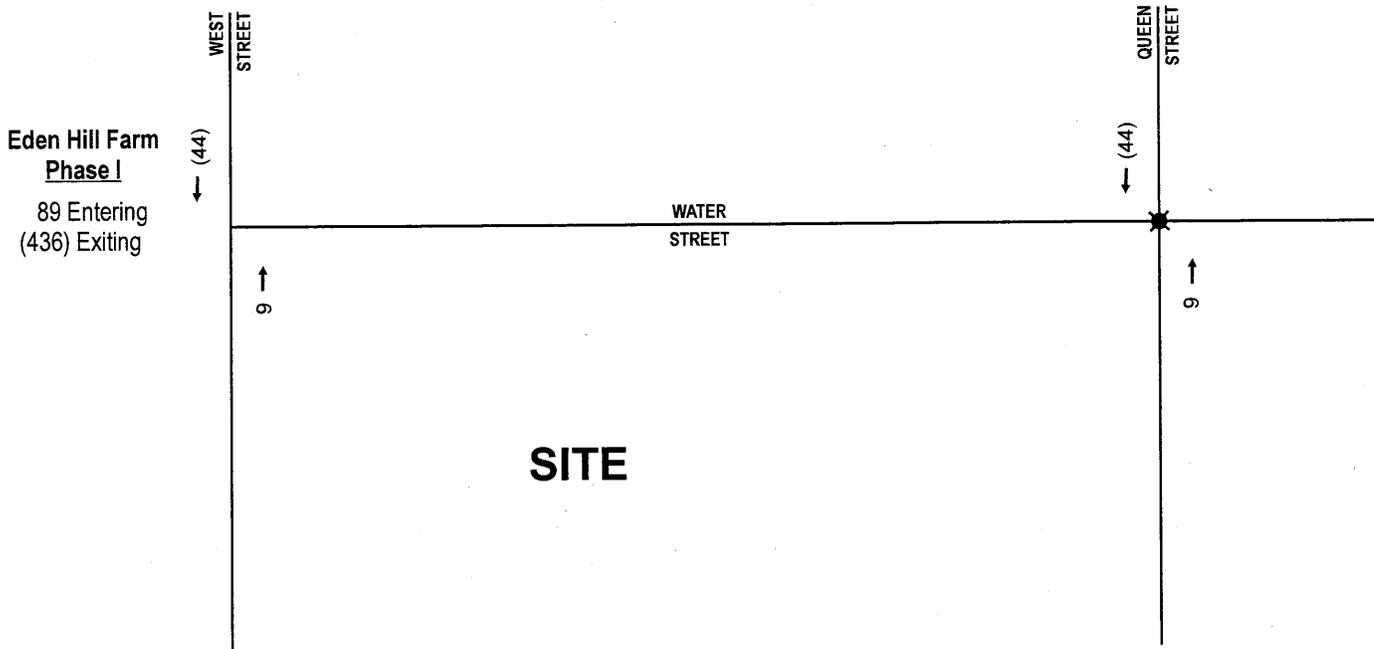
Future Peak Hour Traffic Volumes from Eden Hill Farm Phase I Dover Transit Center DOVER, DELAWARE



AM PEAK HOUR



PM PEAK HOUR

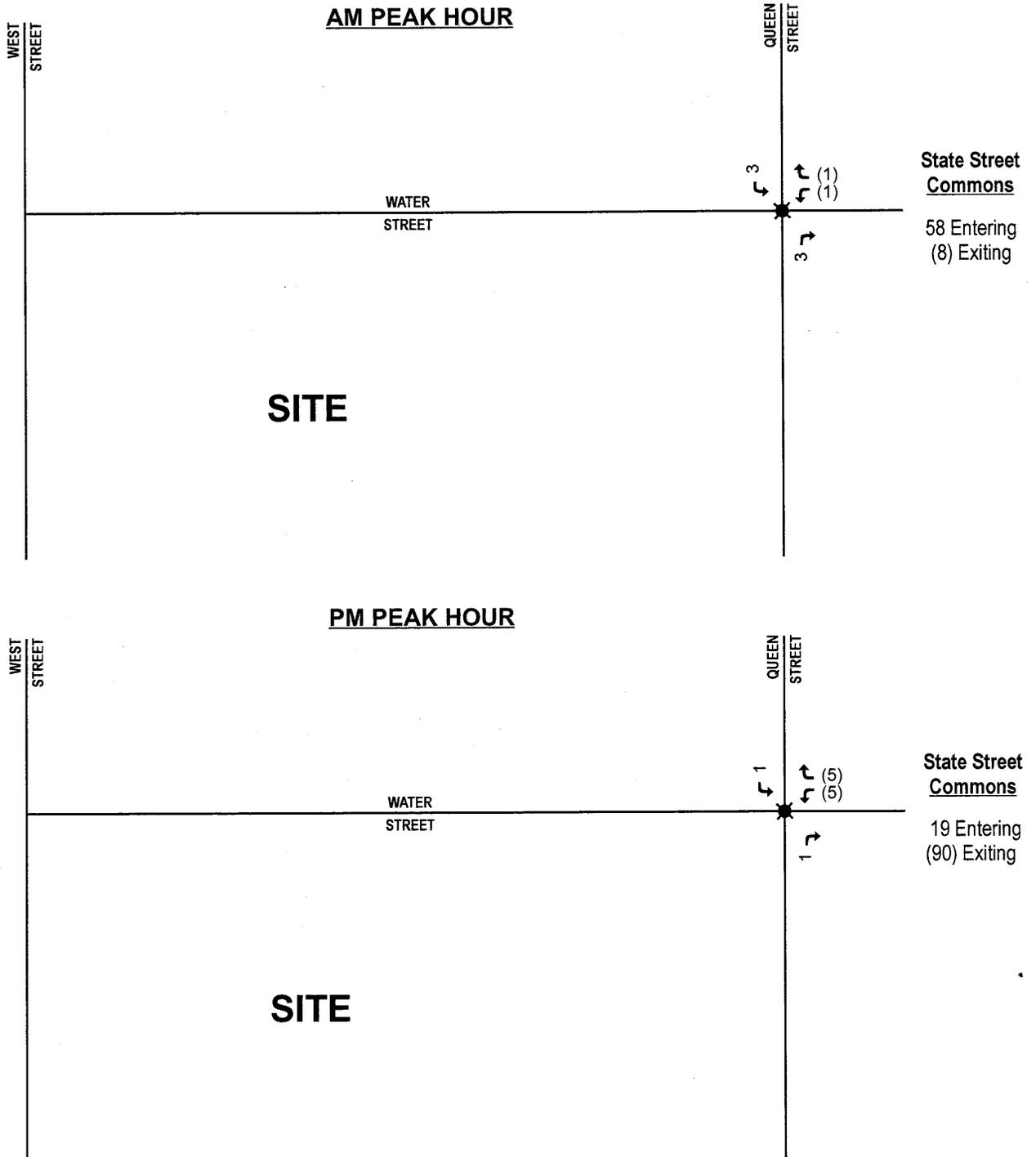


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⊗ - EXISTING SIGNALIZED INTERSECTION



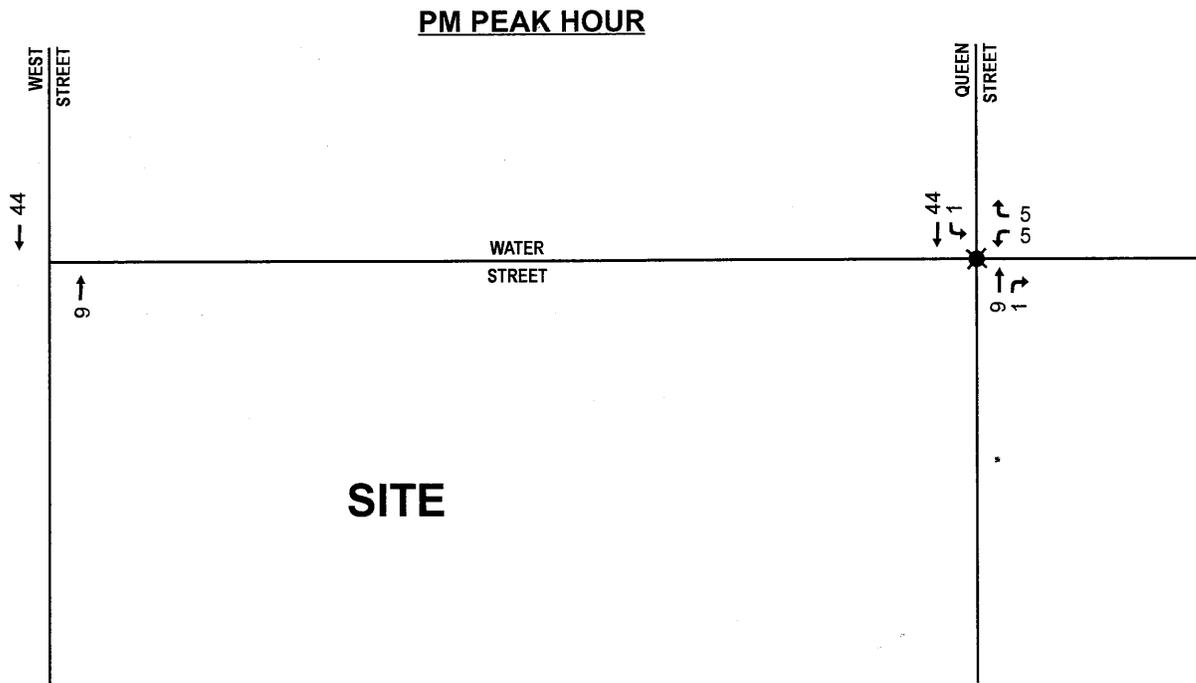
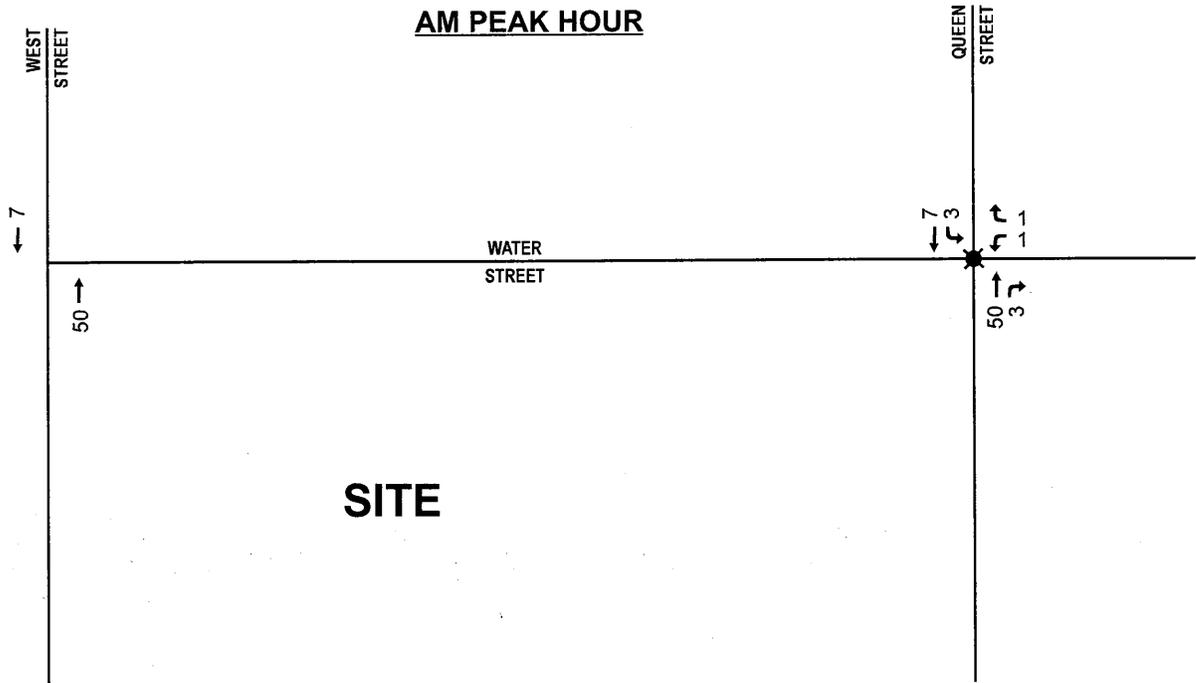
Future Peak Hour Traffic Volumes from State Street Commons Dover Transit Center DOVER, DELAWARE



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☘ - EXISTING SIGNALIZED INTERSECTION

**Total Peak Hour Traffic Volumes
From Other Committed Developments
Dover Transit Center
DOVER, DELAWARE**



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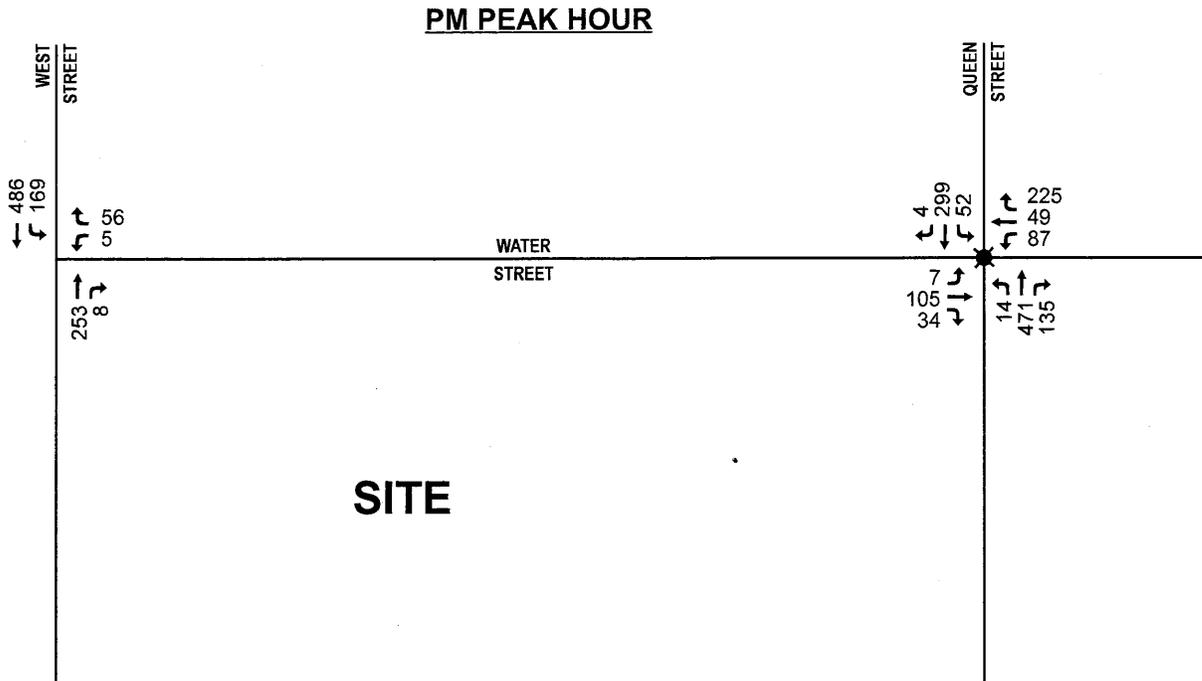
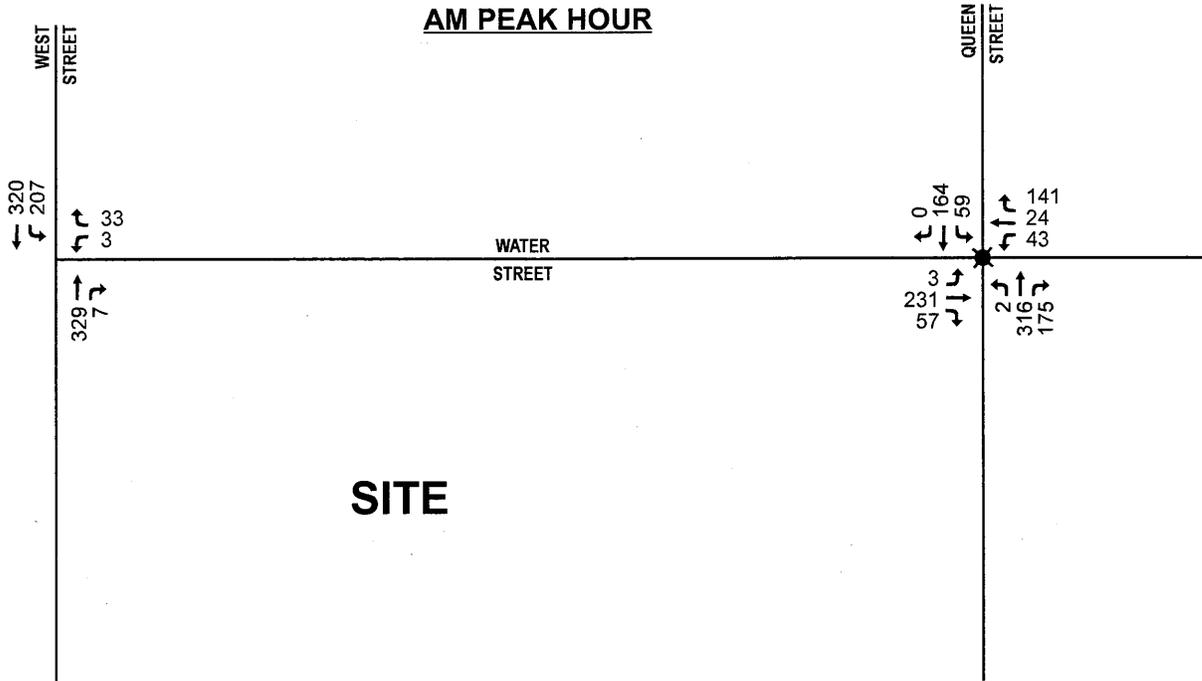
■ - EXISTING SIGNALIZED INTERSECTION



2009 No-Build Peak Hour Traffic Volumes

Dover Transit Center

DOVER, DELAWARE



LEGEND

- EXISTING SIGNALIZED INTERSECTION

TRIP GENERATION, DISTRIBUTION OF SITE TRAFFIC

Trip Generation

Trip generation rates for the site were obtained from various sources. For the park n ride lot the data was obtained from the Institute of Transportation Engineers' Trip Generation, 7th Edition. For estimating DART bus traffic volumes, data on the existing DART bus routes in the central Dover area were used to estimate bus traffic and data provided by Greyhound was used to determine the Greyhound bus volumes.

The traffic volumes projected to be generated are outlined in Table IV for the a.m. and p.m. peaks. Due to the nature of the site, pass-by trips are not included as part of this study. The trip calculations and additional supporting data can be found in Appendix D.

Table IV

Dover Transit Center – Peak Hour Trip Generation

Land use	ITE Code	AM peak hour			PM peak hour		
		Enter	Exit	Total	Exit	Total	Total
Park & Ride Lot w/bus service							
- 40 parking spaces	090	24	6	30	6	19	25
- DART bus routes per hour*	-	19	18	37	18	18	36
- Para Transit service	-	2	2	4	2	2	4
-Greyhound service**	-	0	0	0	1	1	2
TOTAL peak hour trips	-	45	26	71	27	40	67

*As per DART schedule at the Water Street transfer center.

**As per Greyhound's provided schedule

Trip Distribution

The distribution of the site-generated traffic was based on the type of land use and the existing traffic patterns in the study area in relation to the proposed site access points. For the purposes of this study we have assumed that bus traffic and vehicular traffic generated by the site will have separate trip distribution patterns. Furthermore, it should be noted that the arrival and departure patterns of site traffic would vary between the different conceptual plans.

Scheme D Site Traffic

Under Scheme D, non bus traffic to and from the site is estimated to have the following distribution patterns:

- 20 percent of the site traffic enter/exit via West Street to the north,
- 35 percent of the site traffic enter/exit via West Street to the south,
- 25 percent will enter/exit via Queen Street to the north,
- 5 percent will enter/exit via Queen Street to the south, and
- 15 percent will enter/exit via Water Street to the east.

Under Scheme D, bus traffic to and from the site was projected to have the following distribution patterns:

- 0 percent of the site traffic enter/exit via West Street to the north,
- 5 percent of the site traffic enter/exit via West Street to the south,
- 10 percent will enter/exit via Queen Street to the north,
- 25 percent will enter/exit via Queen Street to the south, and
- 60 percent will enter/exit via Water Street to the east.

These distribution patterns were used to assign the site-generated traffic to the roadway network for the a.m. and p.m. peaks. The proposed trip distribution percentages for Scheme D are illustrated in Figure 9 for the a.m. and p.m. peaks. By applying the proposed trip distribution percentages to the trip generation data, we developed the estimated peak hour traffic volumes for the site. The projected total site traffic for passenger vehicles is shown in Figure 10. The projected total site traffic for busses is shown in Figure 11. The combined total peak hour traffic volumes for Scheme D is shown in Figure 12.

By combining these site traffic volumes with the projected 2009 no build volumes, we get the 2009 full build traffic volume projections for Scheme D. The full build peak hour volumes for Scheme D are shown in Figure 13.

Scheme E Site Traffic

Under Scheme E, non bus traffic to and from the site is estimated to have the following distribution patterns:

- 20 percent of the site traffic enter/exit via West Street to the north,
- 20 percent of the site traffic enter/exit via West Street to the south,
- 25 percent will enter/exit via Queen Street to the north,
- 20 percent will enter/exit via Queen Street to the south, and
- 15 percent will enter/exit via Water Street to the east.

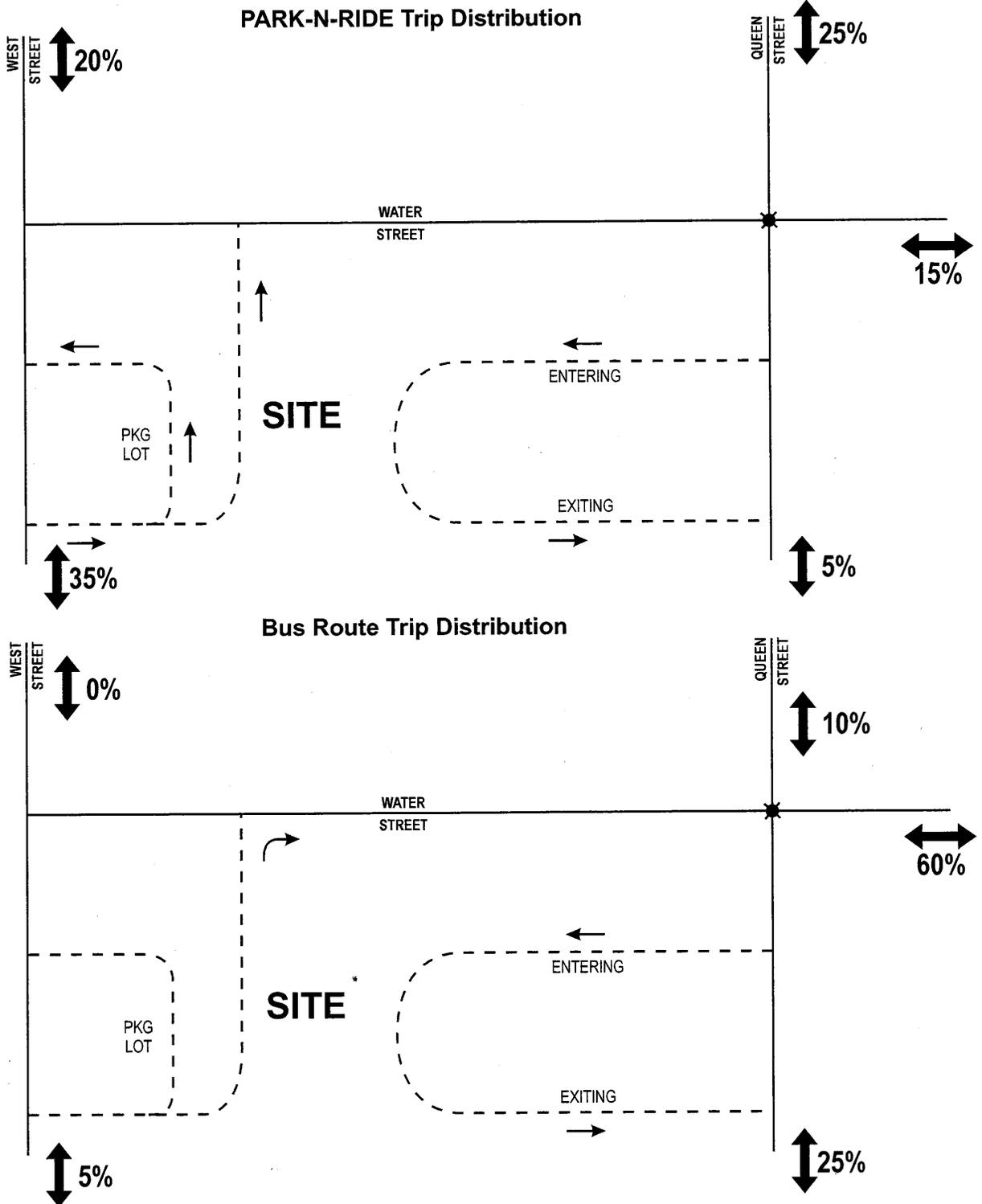
Under Scheme E, bus traffic to and from the site was projected to have the following distribution patterns:

- 0 percent of the site traffic enter/exit via West Street to the north,
- 15 percent of the site traffic enter/exit via West Street to the south,
- 10 percent will enter/exit via Queen Street to the north,
- 15 percent will enter/exit via Queen Street to the south, and
- 60 percent will enter/exit via Water Street to the east.

These distribution patterns were used to assign the site-generated traffic to the roadway network for the a.m. and p.m. peaks. The proposed trip distribution percentages for Scheme E are illustrated in Figure 14 for the a.m. and p.m. peaks. By applying the proposed trip distribution percentages to the trip generation data, we developed the estimated peak hour traffic volumes for the site. The projected total site traffic for passenger vehicles is shown in Figure 15. The projected total site traffic for busses is shown in Figure 16. The combined total peak hour traffic volumes for Scheme E is shown in Figure 17.

By combining these site traffic volumes with the projected 2009 no build volumes, we get the 2009 full build traffic volume projections for Scheme E. The full build peak hour volumes for Scheme E are shown in Figure 18.

Proposed Trip Distribution (Scheme D)
Dover Transit Center
DOVER, DELAWARE

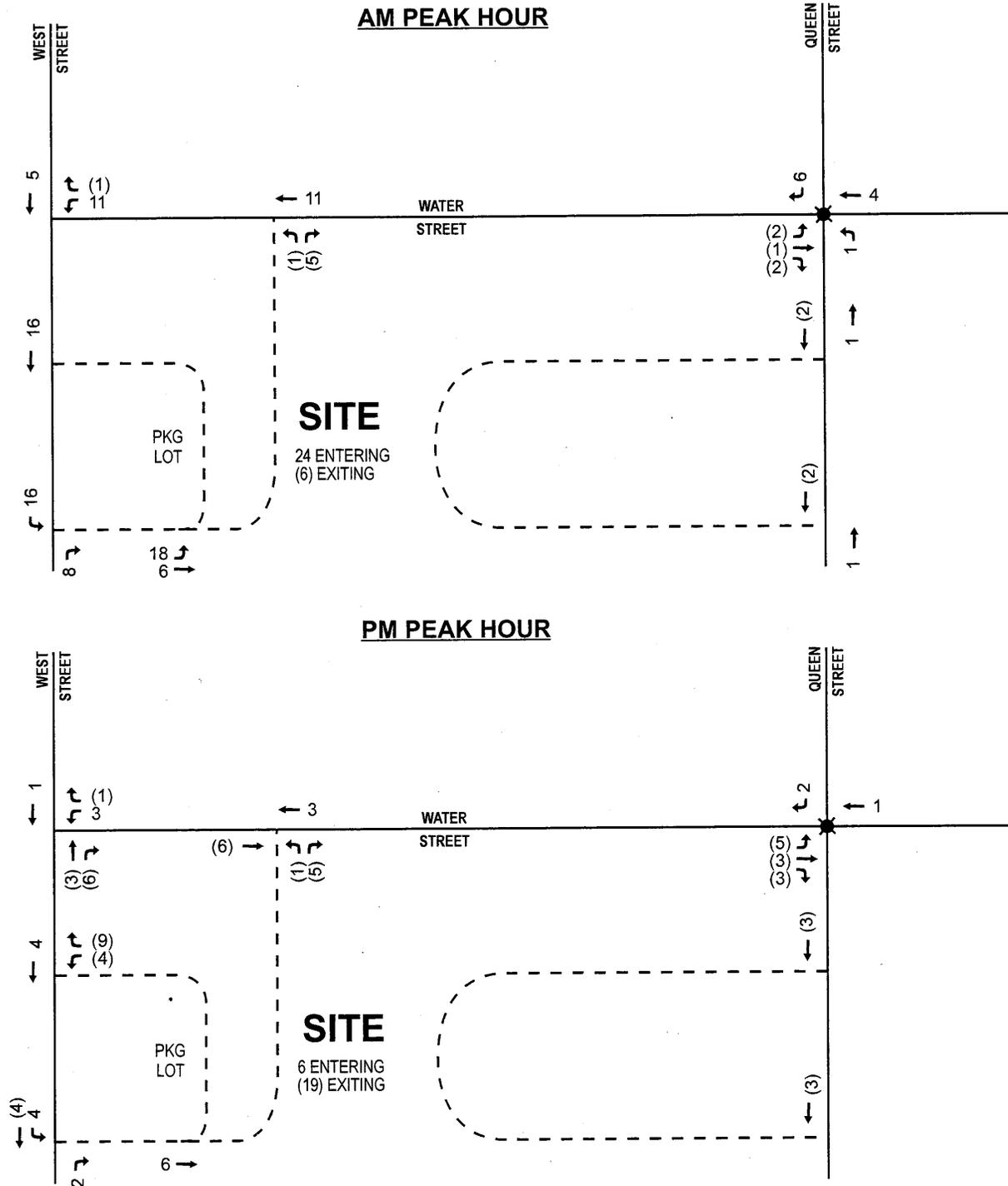


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✘ - EXISTING SIGNALIZED INTERSECTION



Peak Hour Site Traffic Volumes For Passenger Vehicles (Scheme D) Dover Transit Center DOVER, DELAWARE

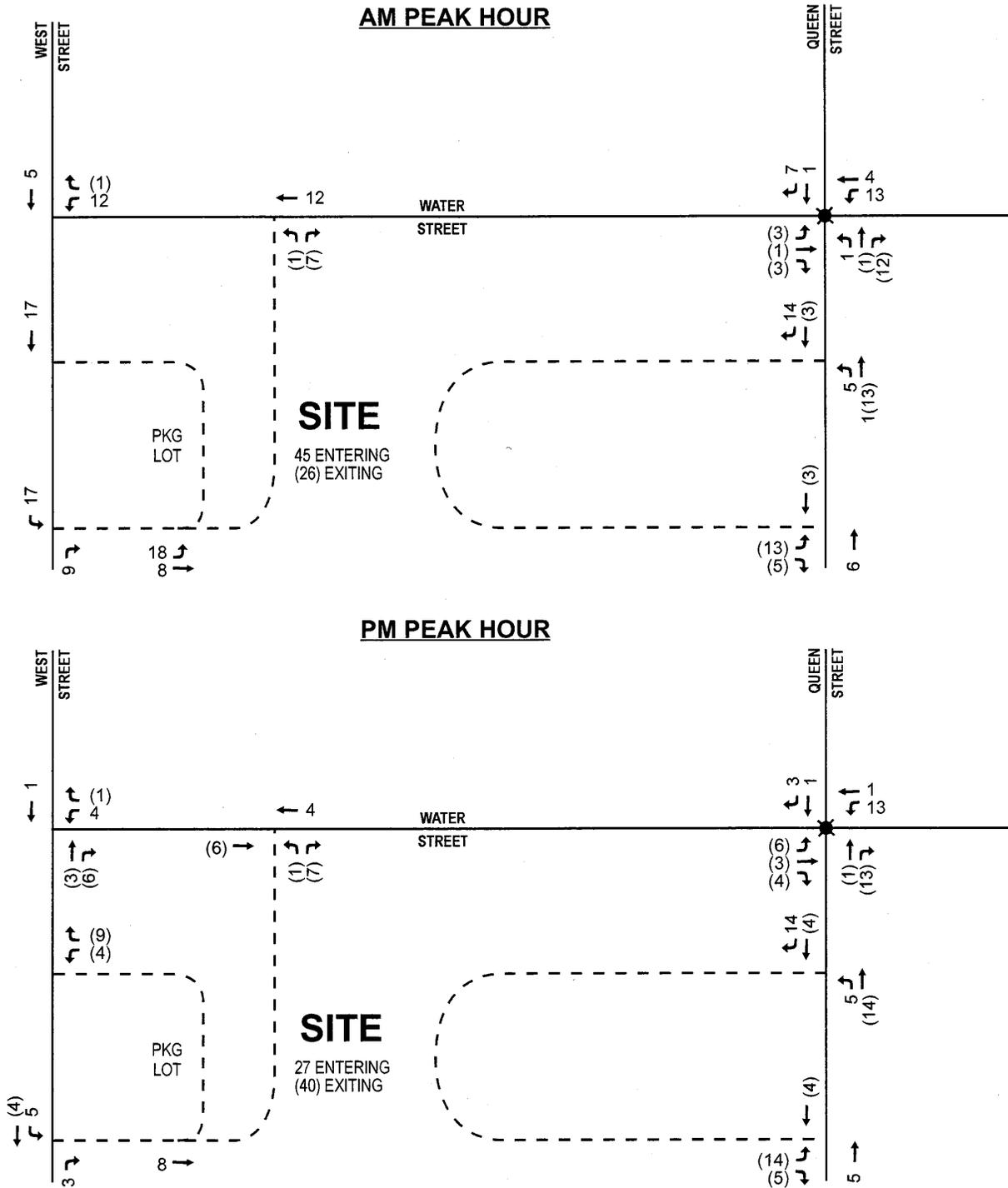


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■ - EXISTING SIGNALIZED INTERSECTION

Total Peak Hour Site Traffic Volumes (Scheme D)

Dover Transit Center
DOVER, DELAWARE



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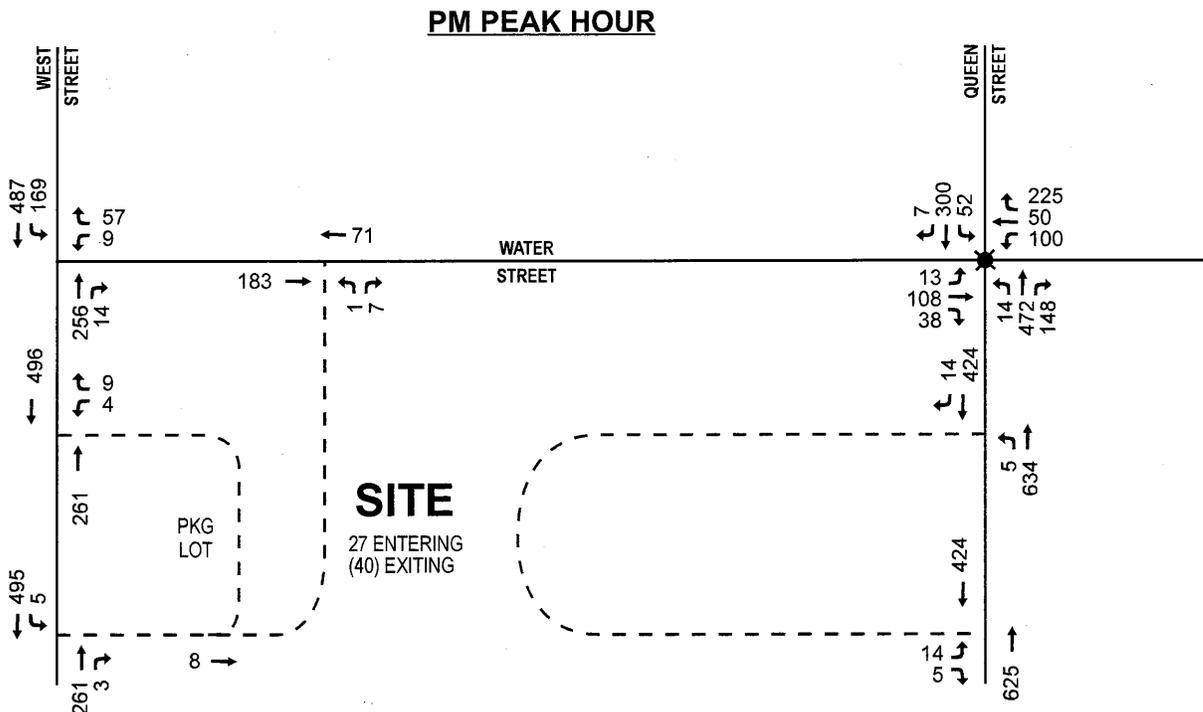
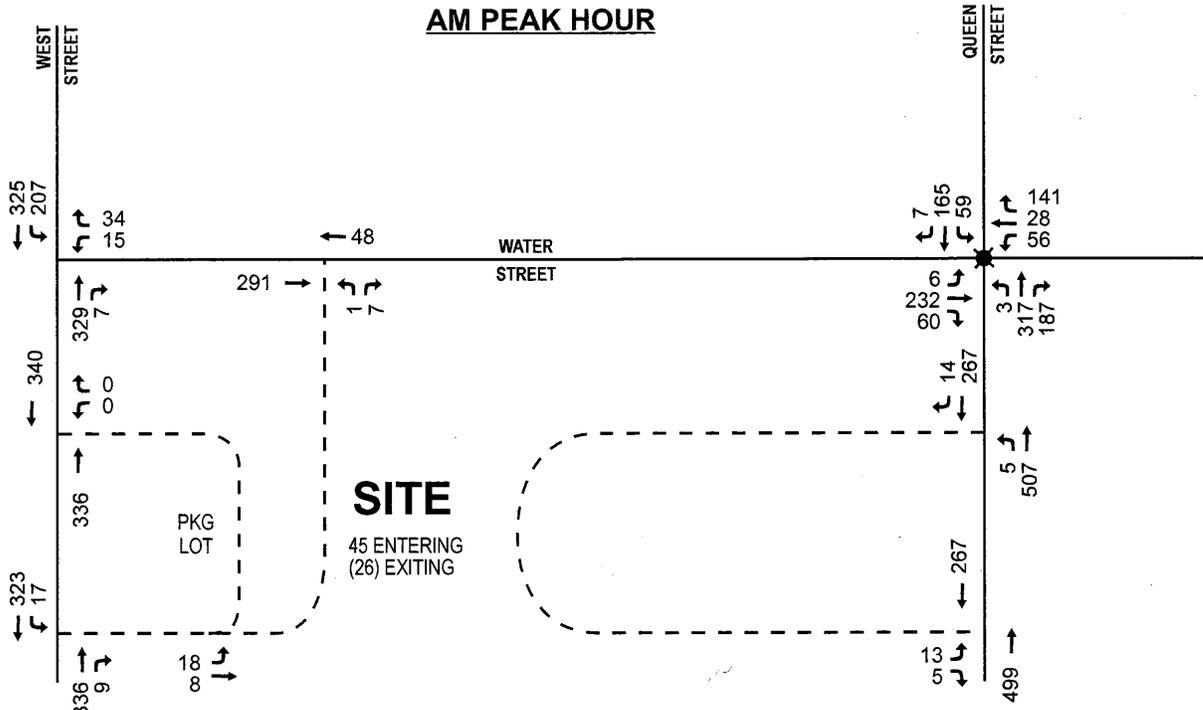
■ - EXISTING SIGNALIZED INTERSECTION



2009 Full-Build Peak Hour Traffic Volumes (Scheme D)

Dover Transit Center

DOVER, DELAWARE



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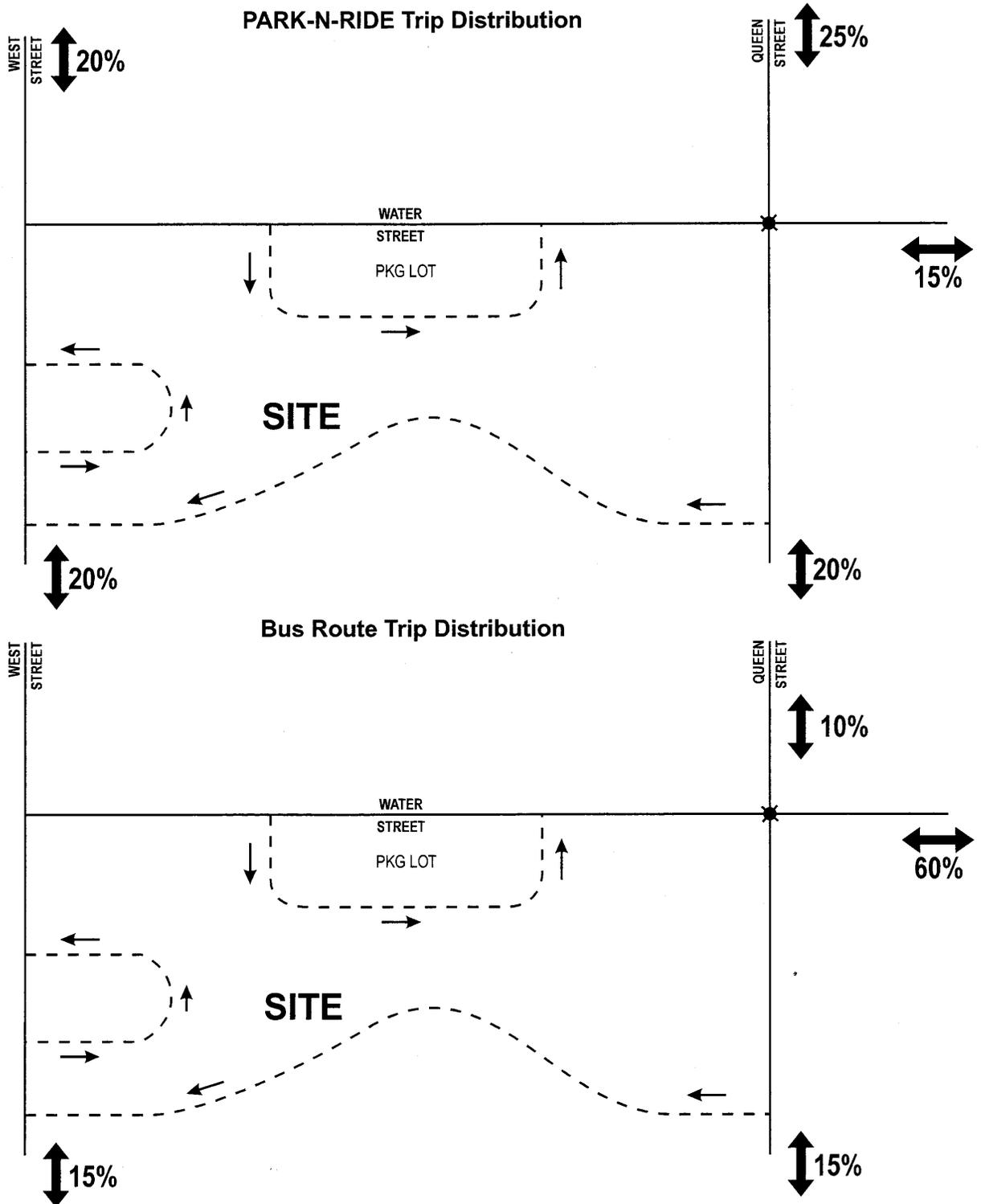
■ - EXISTING SIGNALIZED INTERSECTION



Proposed Trip Distribution (Scheme E)

Dover Transit Center

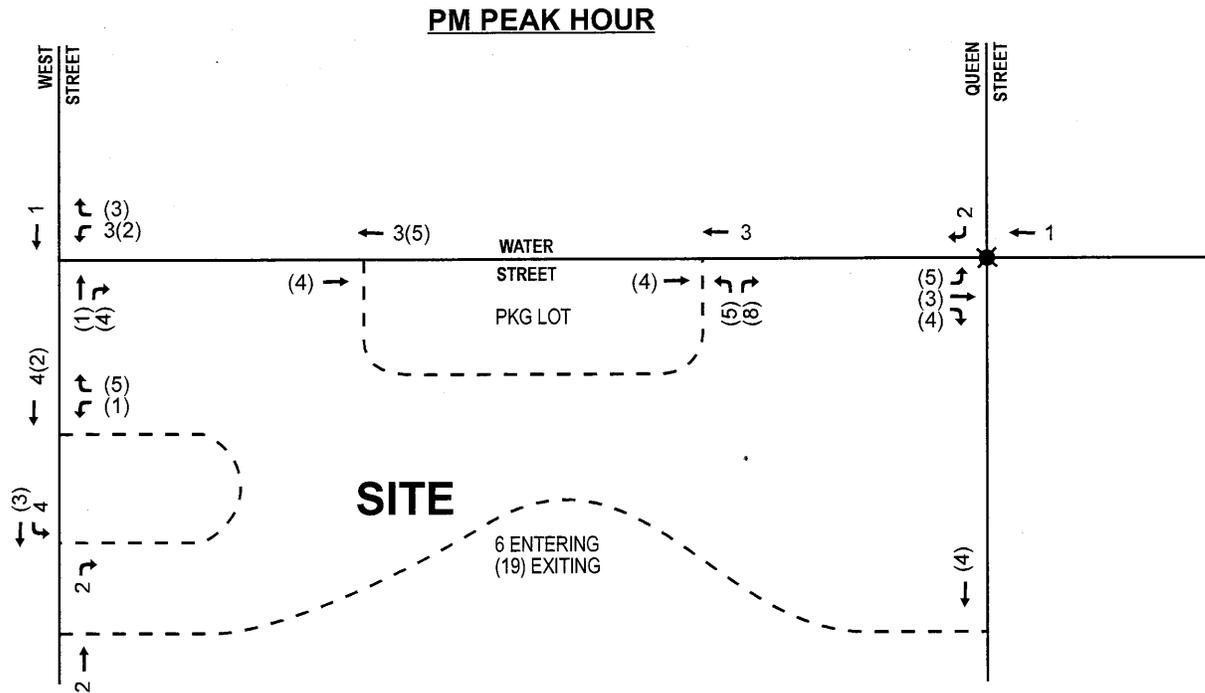
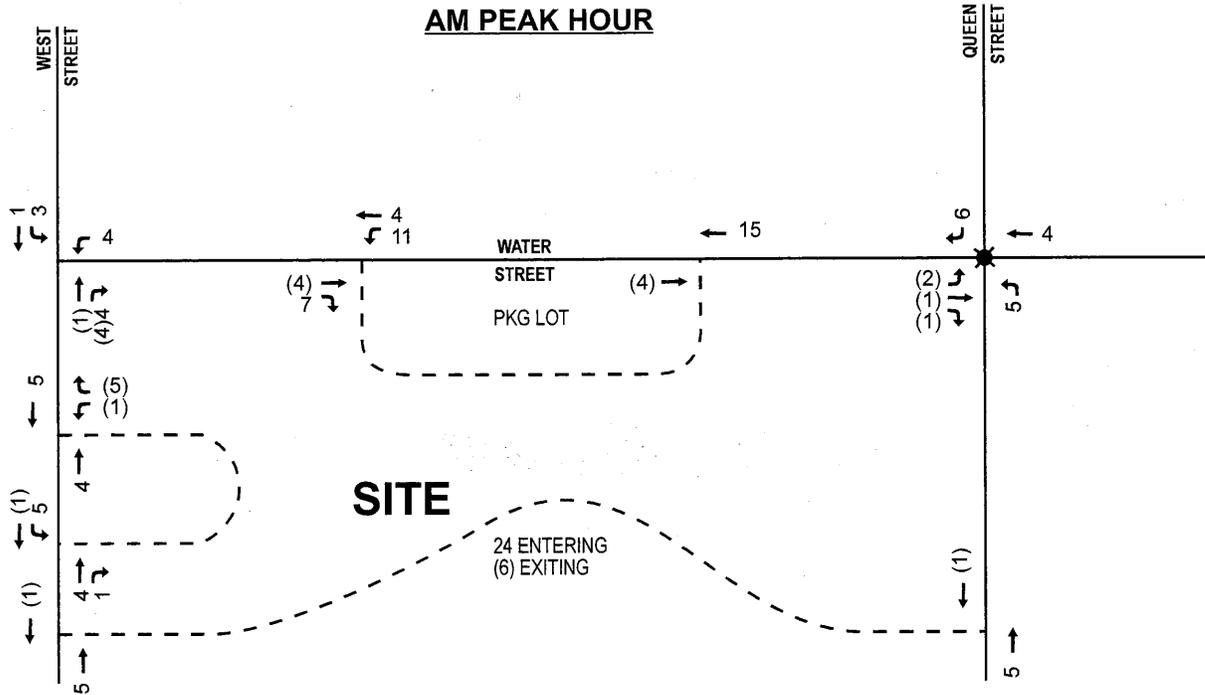
DOVER, DELAWARE



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✘ - EXISTING SIGNALIZED INTERSECTION

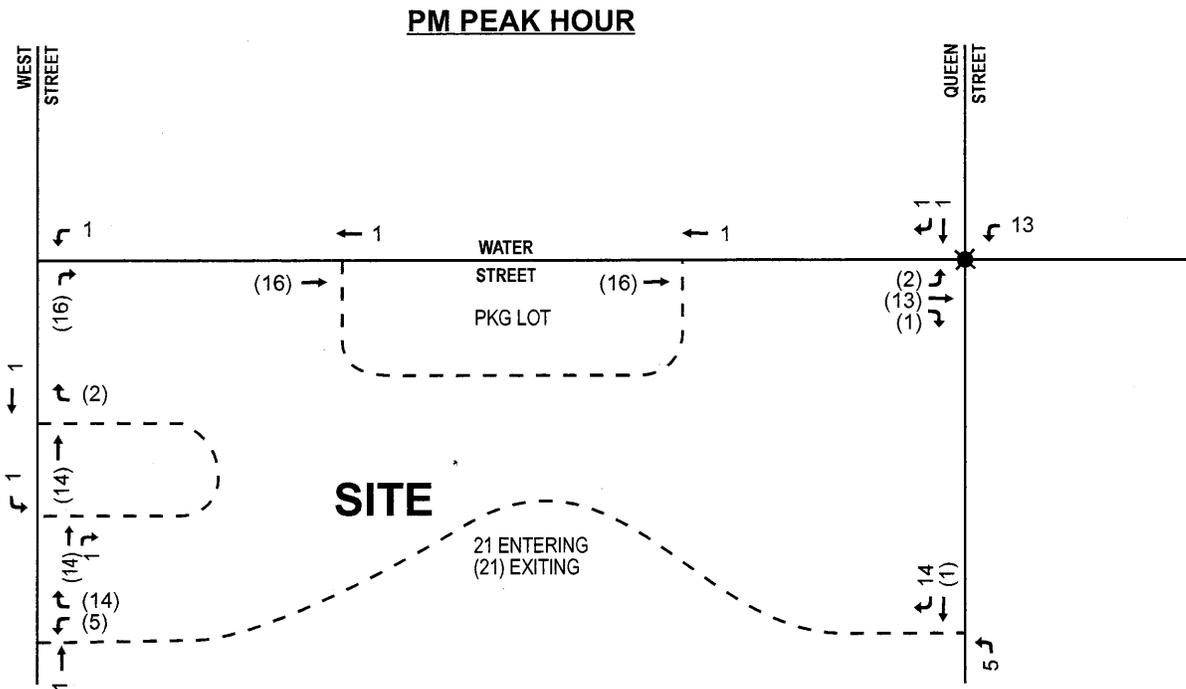
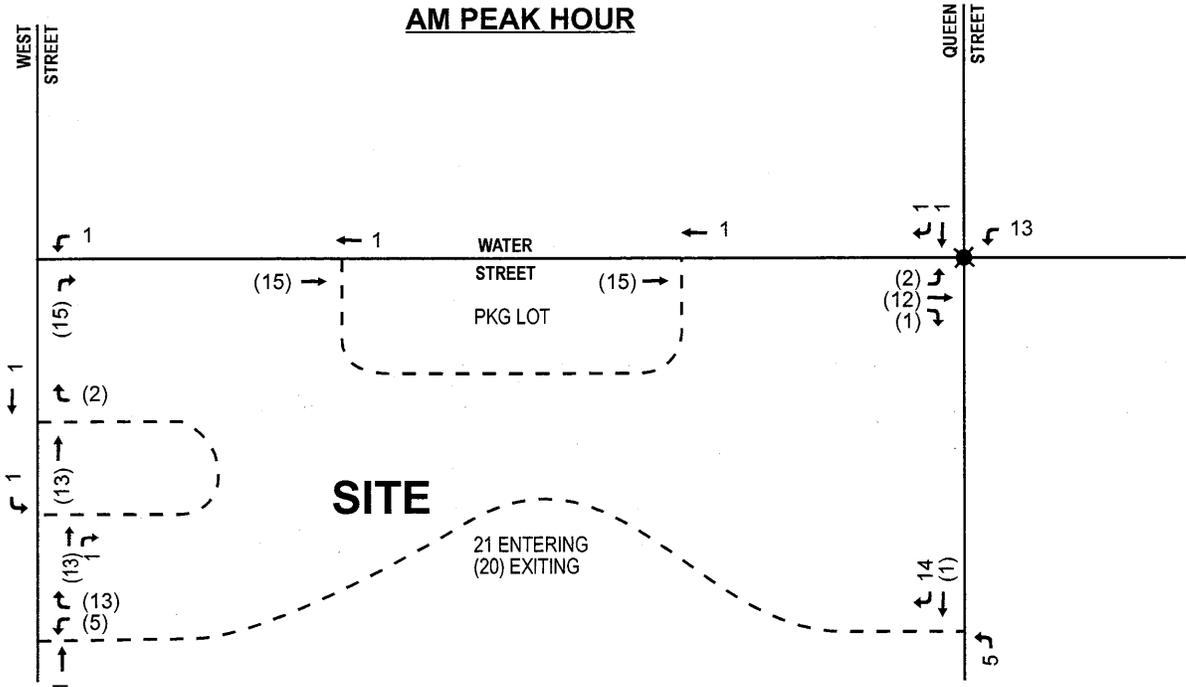
Peak Hour Site Traffic Volumes For Passenger Vehicles (Scheme E) Dover Transit Center DOVER, DELAWARE



LEGEND

■ - EXISTING SIGNALIZED INTERSECTION

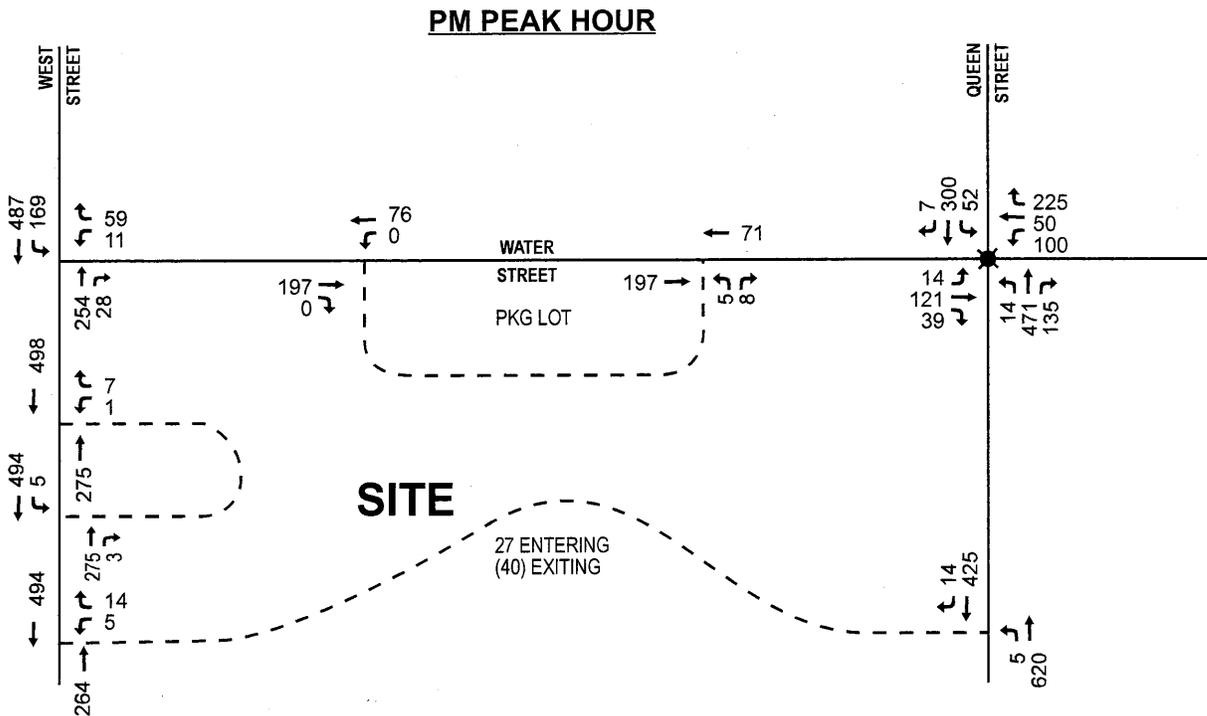
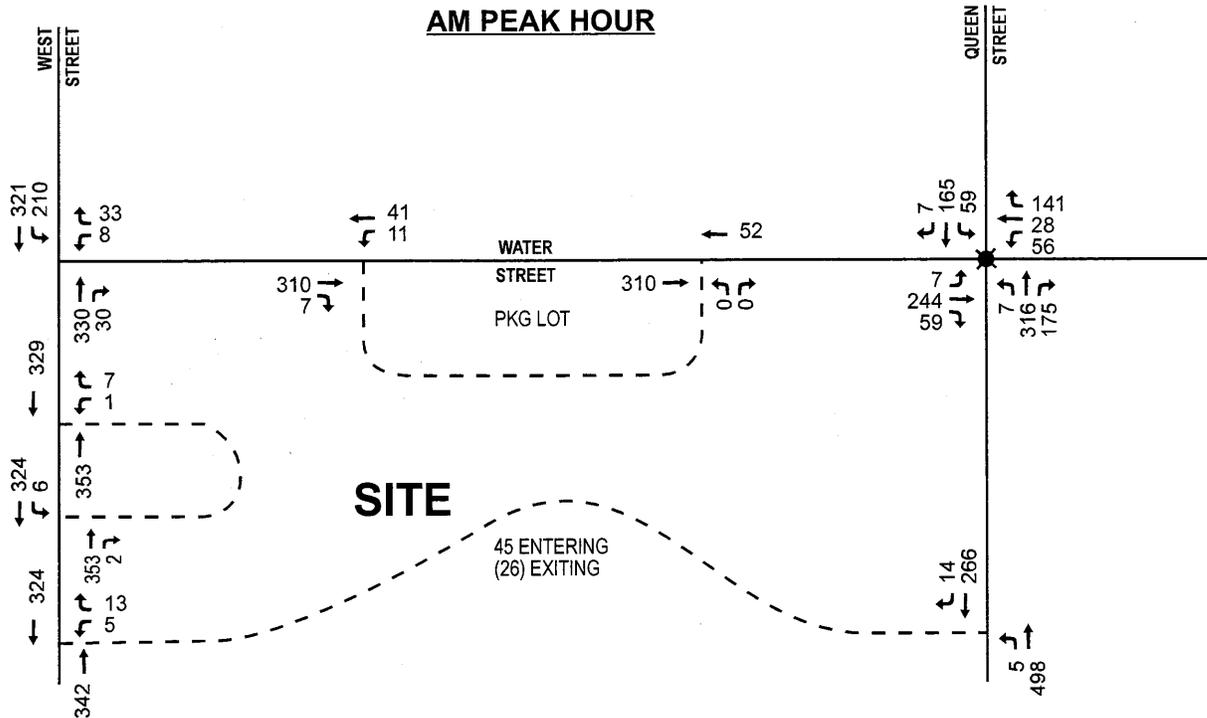
Peak Hour Site Traffic Volumes For Busses (Scheme E)
Dover Transit Center
DOVER, DELAWARE



LEGEND

■ - EXISTING SIGNALIZED INTERSECTION

2009 Full Build Peak Hour Traffic Volumes (Scheme E)
Dover Transit Center
DOVER, DELAWARE



LEGEND

⊗ - EXISTING SIGNALIZED INTERSECTION

CAPACITY ANALYSIS / BUS TURNING MOVEMENTS

Capacity Analysis

A volume/capacity analysis has been done for each of the study intersections and for each of the proposed driveway locations. The analysis was conducted using Highway Capacity Software Plus, Release 5.2. As part of that analysis the following scenarios were reviewed:

- Existing – 2006 (weekday a.m. and p.m.)
- Future - 2009 no build conditions (weekday a.m. and p.m.)
- Future - 2009 full build conditions (weekday a.m. and p.m.)

It should be noted that the traffic count data for this analysis was conducted on a Tuesday, while the nearby Spence’s Bazaar was open for business.

The results of this analysis are defined in terms of average delay. This delay is used as a measure of a driver’s expectation for given conditions. Because operating below or near capacity is usually tolerable to most drivers, a descriptive concept has been developed for intersections called level of service. Levels of service range from ‘A’ to ‘F’ and are based on delay in seconds for each movement. A more detailed level of service description is summarized in Table V for unsignalized intersections and Table VI for signalized locations.

Existing Conditions

The results of the capacity analysis for existing conditions show that for the weekday a.m. and p.m. peak periods; both study intersections operate at an overall level of service ‘B’ or better, while some individual movements were found to be operating at the “C” level. In urban areas such as Dover, Delaware an overall level of ‘D’ or better is typically deemed acceptable. The existing levels of service for the weekday a.m. and p.m. peaks are shown in Figure 19.

2009 No Build Analysis

Under the 2009 No Build (pre-development) scenario, the weekday a.m. peak hour shows both intersections will continue to operate with acceptable levels of service during the peak hours. The results of the 2009 No Build levels of service analysis are shown in Figure 20.

2009 Full Build Analysis

Due to anticipated growth, it is expected that traffic will increase over time and in general vehicular delays will slightly increase from what they are today. However it is expected that both study intersections will continue to operate with acceptable levels of service with or without the proposed site being developed.

Under the 2009 full build scenario, both Scheme D and E were reviewed. The results show that there is very little difference at the existing intersection when comparing the results of each conceptual scheme. However there were significant differences in the results of the site access points.

Under Scheme D, which shows bus access via Queen Street, the results show that busses exiting the site during the PM peak period would operate under a level of service “D” with an average delay of 30 seconds per vehicle. Level D is considered the maximum level of acceptable delay.

The reason for this delay is due to the difficulty busses will experience while attempting to turn left out of the site. All other access points proposed under Scheme D would be “B” or better.

For Scheme E, all site access points including the bus exit on West Street would operate at a level of service “B” or better. This is mainly because a bus exit on West Street would result in most busses turning right out of the site and generally right turn movements are more easily accommodated.

The results of the 2009 Full Build levels of service analysis for Scheme D and Scheme E are shown in Figures 21 and 22, respectively.

Turning Movement Conflicts

Because of the location of the site, busses will frequently be required to conduct turning movements at the intersections of Water & West and Water & Queen. ORA checked the existing conditions at both intersections and identified several potential conflicts. Using a 40’ vehicle as the design standard, the following upgrades would be needed to accommodate turning busses:

- A. Right-turn from northbound Queen Street to eastbound Water Street – The existing corner curb line would need to be increased from a 25’ to a 40’ radius.
- B. Left-turn from westbound Water Street to southbound Queen Street – The existing stop bar on Queen Street would need to be relocated 15’ further back.
- C. Right-turn from eastbound Water Street to southbound Queen Street – The existing corner curb line would need to be increased from a 25’ to a 40’ radius and the existing stop bar on Queen Street would need to be relocated 15’ further back. .
- D. Right-turn from northbound West Street to eastbound Water Street – The existing corner curb line would need to be increased from a 25’ to a 40’ radius.

The potential turning movement conflicts for the intersections of Water & Queen and Water & West are illustrated in Figures 23 and 24 respectively.

Table V

LEVEL OF SERVICE AND EXPECTED DELAY
FOR UNSIGNALIZED INTERSECTIONS (TWO-WAY STOP CONTROLLED)

LEVEL OF SERVICE	EXPECTED TRAFFIC DELAY	AVERAGE TOTAL DELAY PER VEHICLE (sec)
a	Little or no delay	0 to 10.0
b	Short traffic delays	10.1 to 15.0
c	Average traffic delays	15.1 to 25.0
d	Long traffic delays	25.1 to 35.0
e	Very long traffic delays	35.1 to 50.0
f	Volumes exceed capacity	Over 50.0

Source: Transportation Research Board, 2000 Highway Capacity Manual, published by the Transportation Research Board, Washington, D.C.

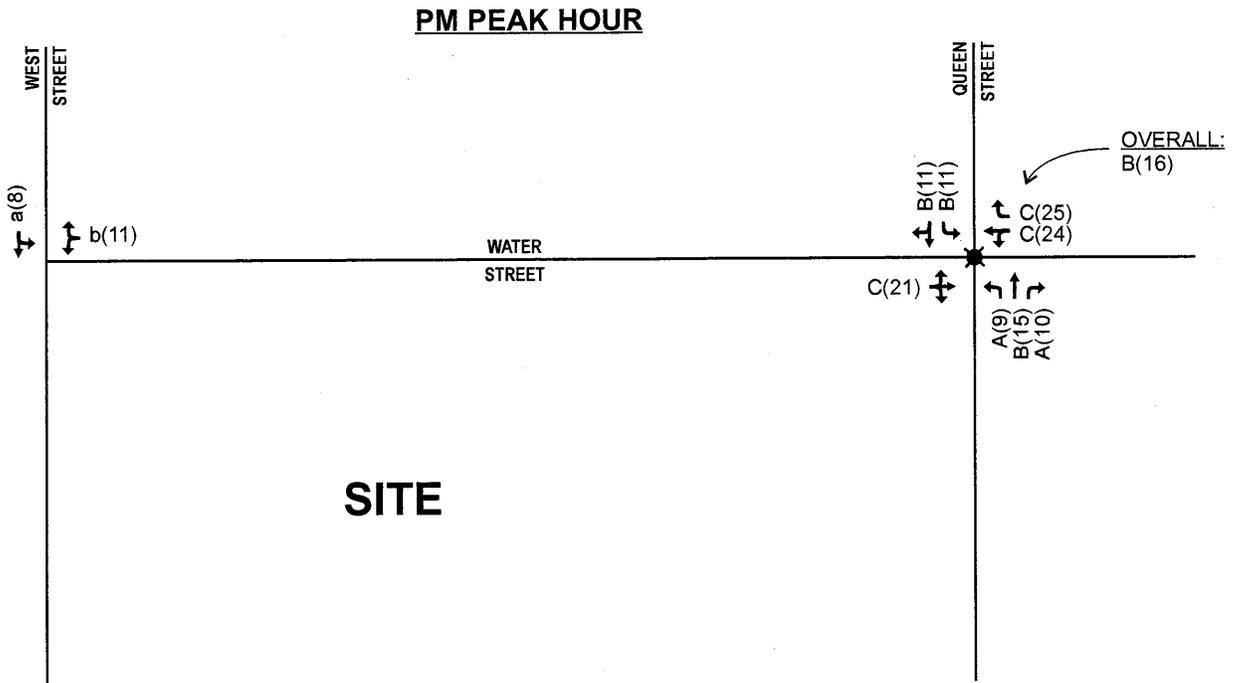
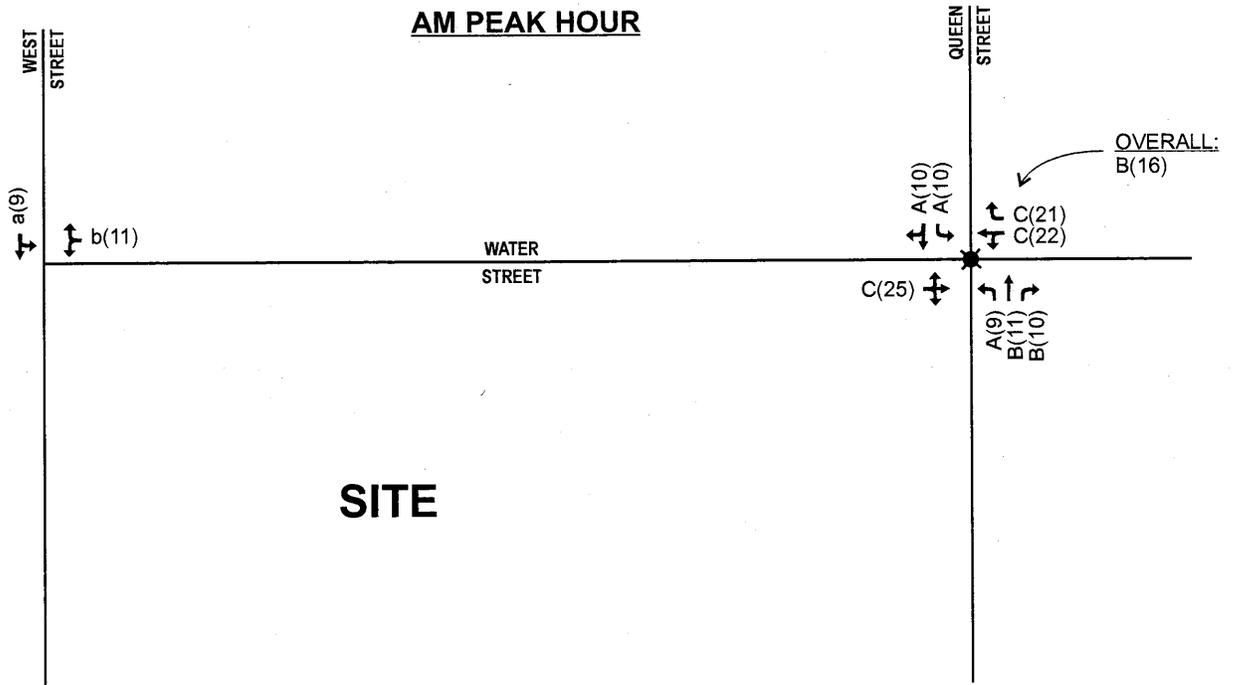
TABLE VI
LEVEL OF SERVICE
FOR SIGNALIZED INTERSECTIONS

LEVEL OF SERVICE	DESCRIPTION	AVERAGE CONTROL DELAY PER VEHICLE (sec/veh)
A	Very short delay, good progression, most vehicles do not stop at intersection.	0 to 10.0
B	Generally good signal progression and/or short cycle length, more vehicles stop at intersection than Level of Service A.	10.1 to 20.0
C	Fair progression and/or longer cycle length, significant number of vehicles stop at intersection.	20.1 to 35.0
D	Congestion becomes noticeable, individual cycle failures, longer delays from unfavorable progression, long cycle length, or high volume/capacity ratio, most vehicles stop at intersection.	35.1 to 55.0
E	Usually considered <u>limit of acceptable delay</u> indication of poor progression, long cycle length, or high volume/capacity ratio, frequent individual cycle failures.	55.1 to 80.0
F	Could be considered excessive delay in some areas, frequently and indication of saturation, or very long cycle lengths with minimal side street green time. Capacity is not necessarily exceeded under this level of service.	Over 80.0

Source: Transportation Research Board, 2000 Highway Capacity Manual, published by the Transportation Research Board, Washington, D.C.



2006 Existing Peak Levels of Service Dover Transit Center DOVER, DELAWARE



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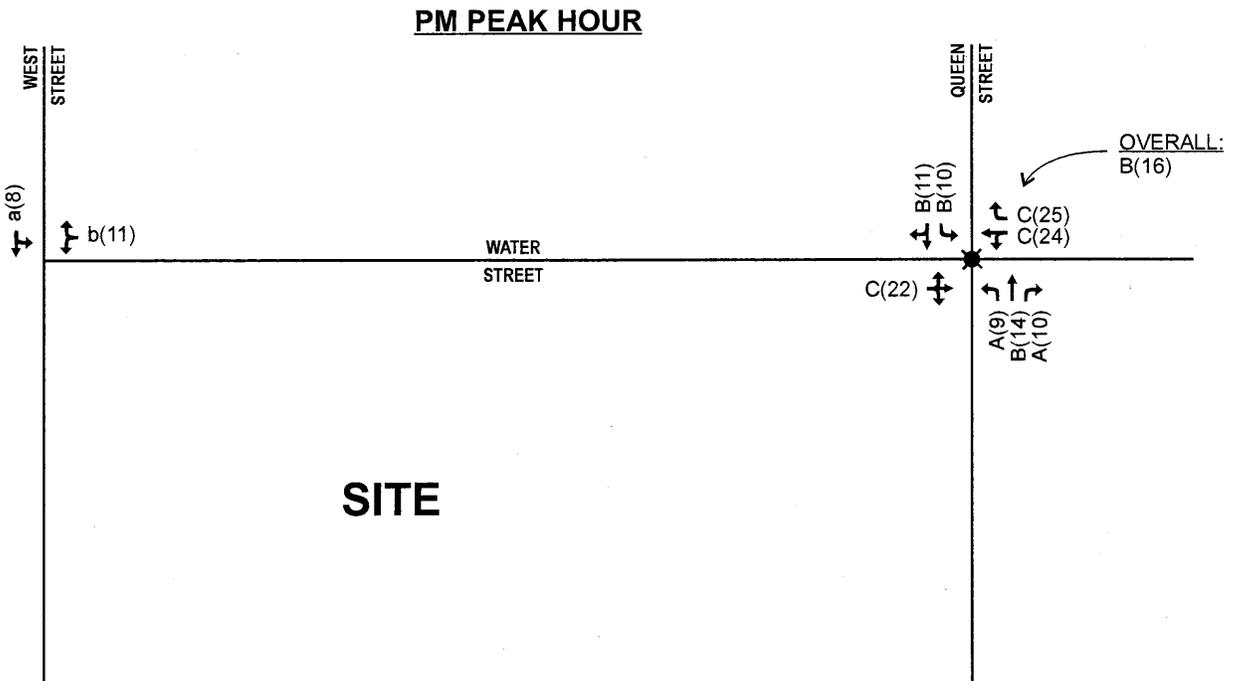
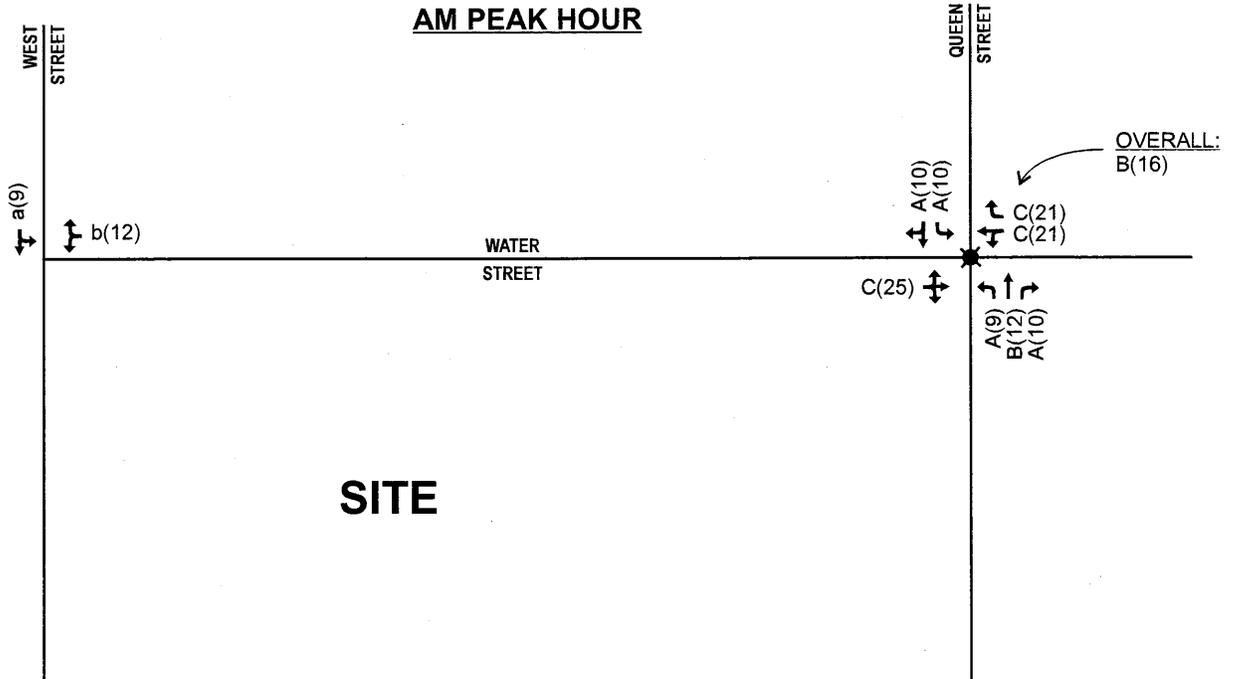
☘ - EXISTING SIGNALIZED INTERSECTION

a(#) - UNSIGNALIZED LEVEL OF SERVICE (DELAY IN SECONDS)

A(#) - SIGNALIZED LEVEL OF SERVICE (DELAY IN SECONDS)



2009 No Build Peak Levels of Service Dover Transit Center DOVER, DELAWARE



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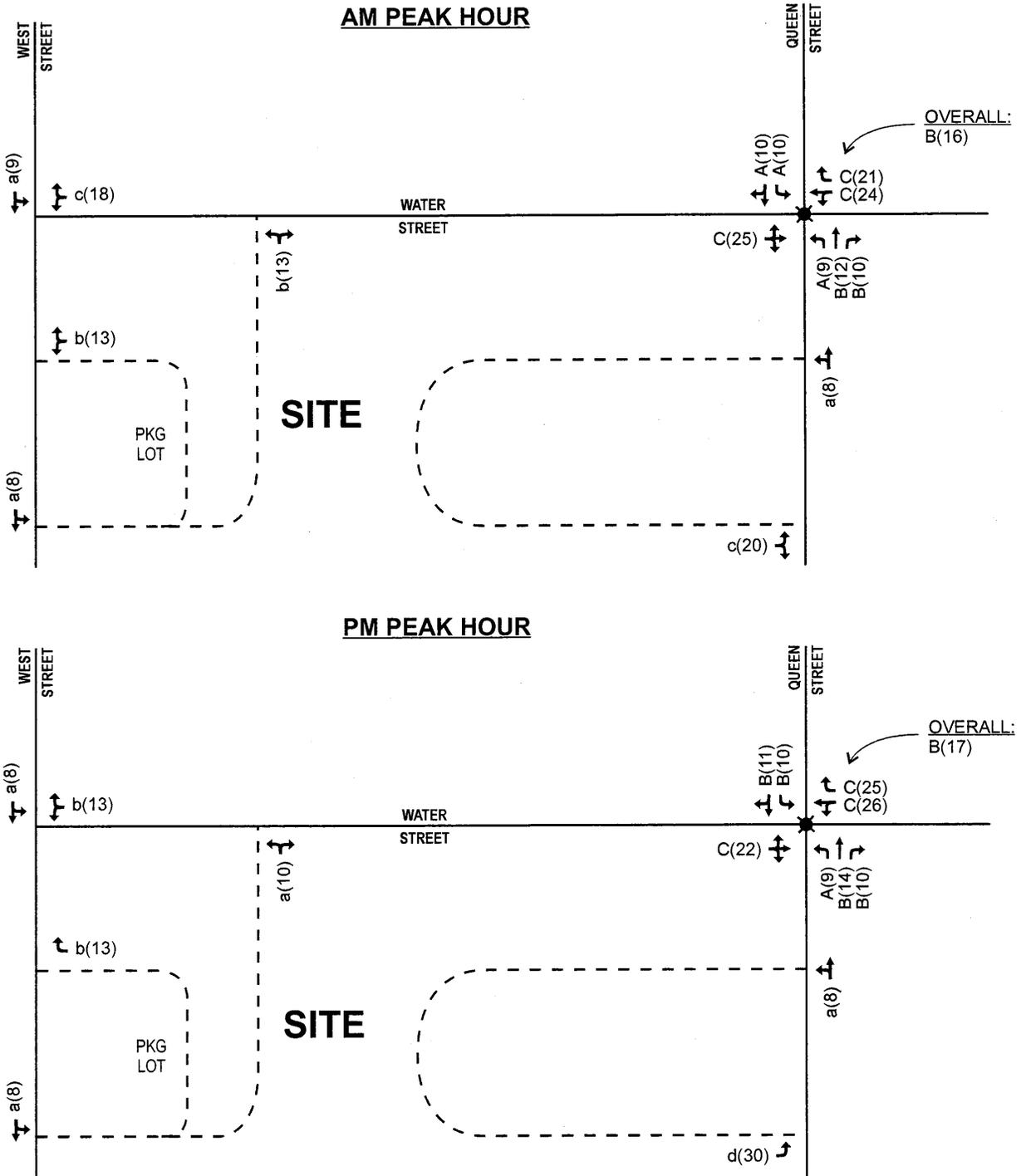
- EXISTING SIGNALIZED INTERSECTION
- a(#) - UNSIGNALIZED LEVEL OF SERVICE (DELAY IN SECONDS)
- A(#) - SIGNALIZED LEVEL OF SERVICE (DELAY IN SECONDS)



2009 No Build Peak Levels of Service (Scheme D)

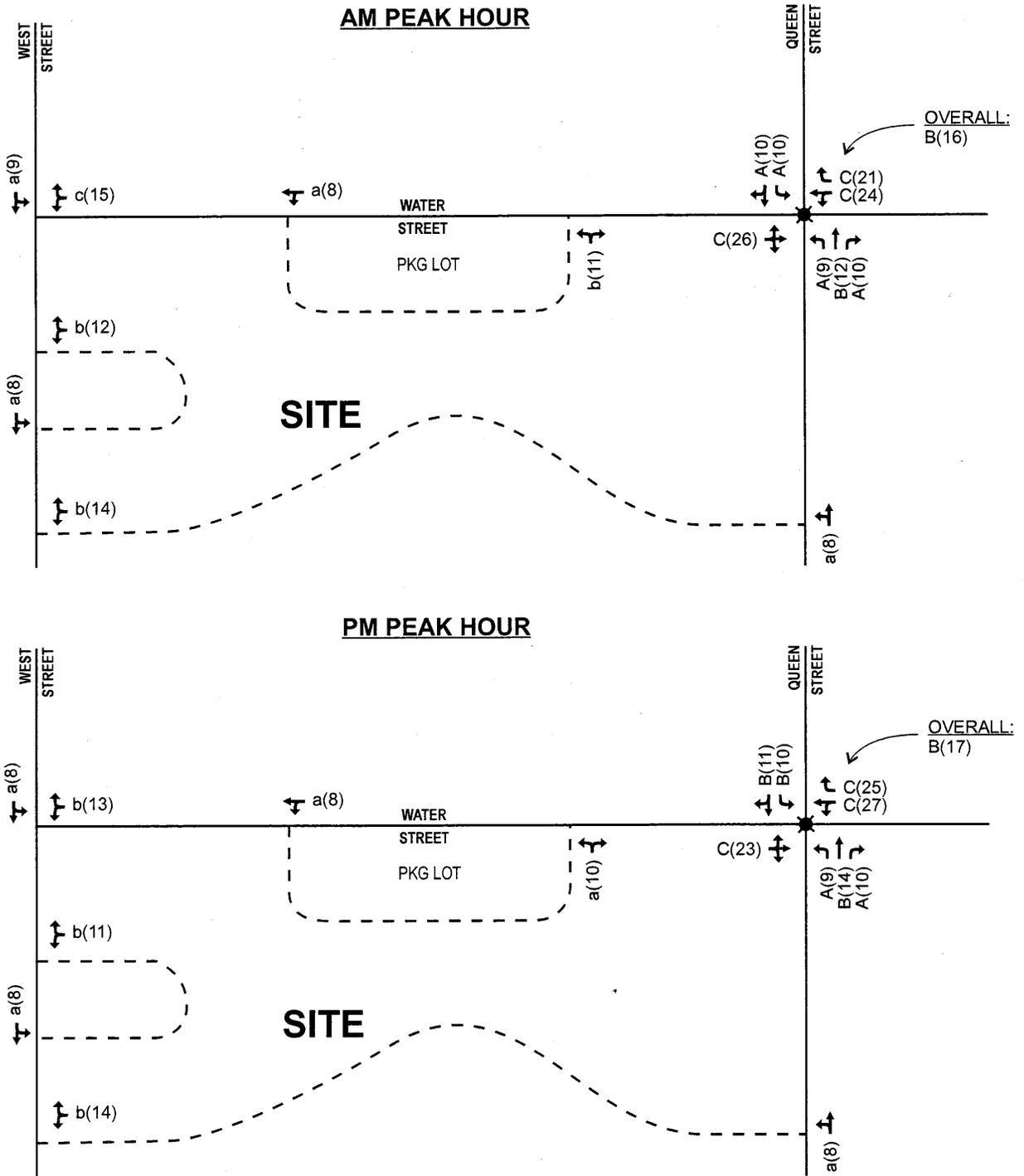
Dover Transit Center

DOVER, DELAWARE

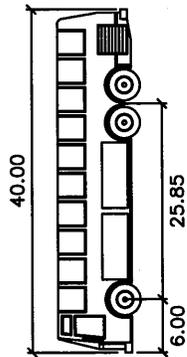




2009 Full Build Peak Levels of Service (Scheme E) Dover Transit Center DOVER, DELAWARE



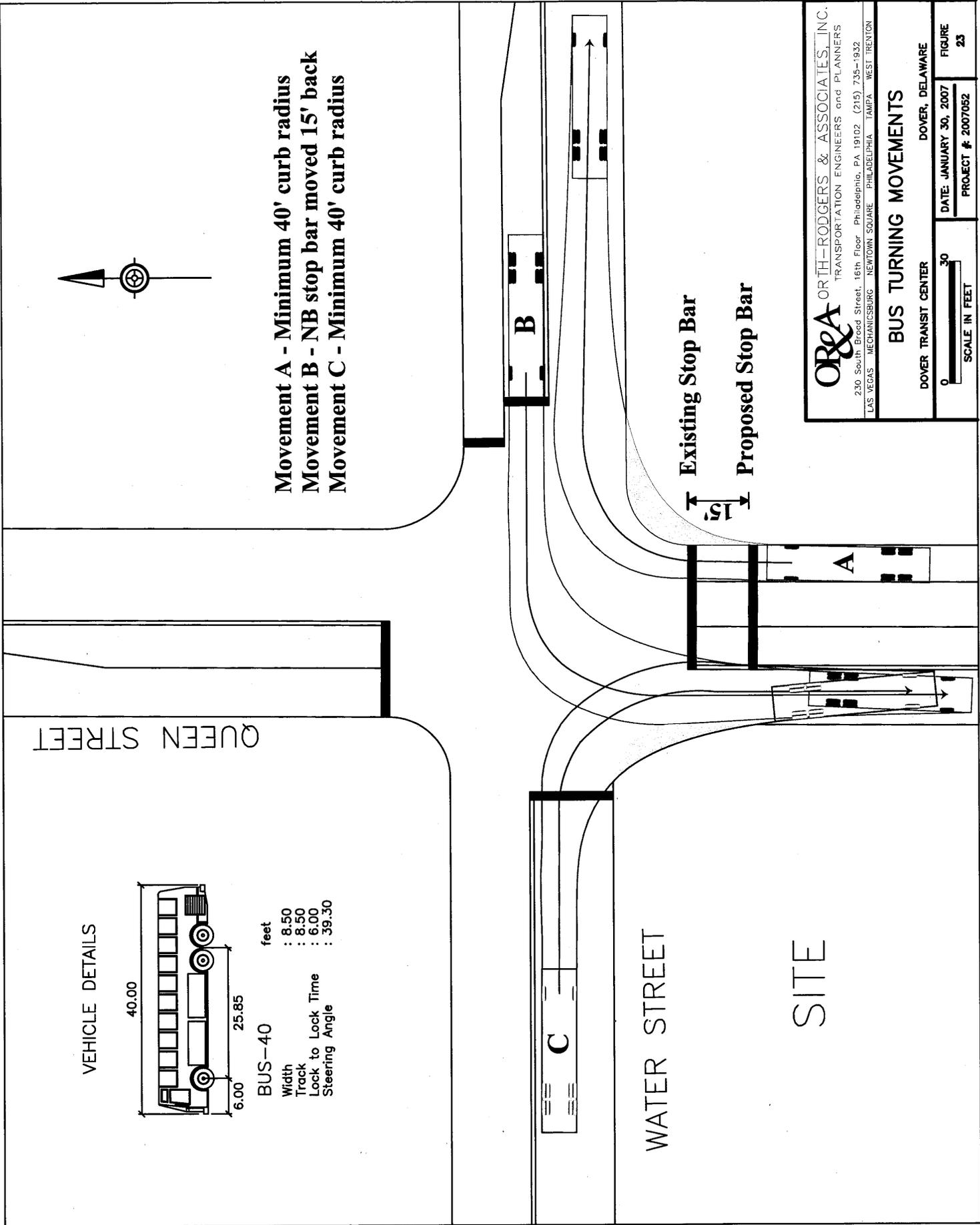
VEHICLE DETAILS



BUS-40	feet
Width	: 8.50
Track	: 8.50
Lock to Lock Time	: 6.00
Steering Angle	: 39.30

QUEEN STREET

- Movement A - Minimum 40' curb radius**
- Movement B - NB stop bar moved 15' back**
- Movement C - Minimum 40' curb radius**



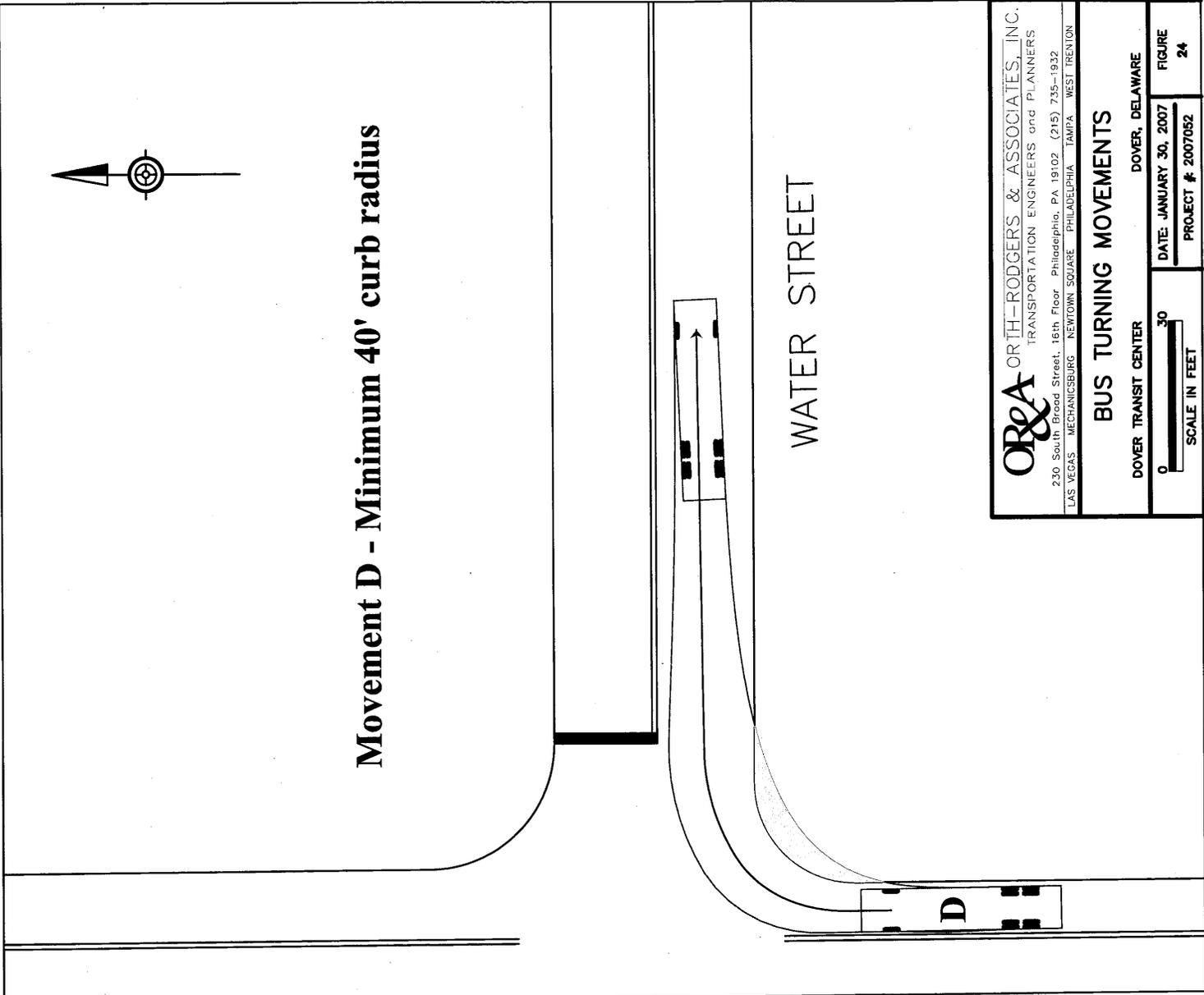
WATER STREET

SITE

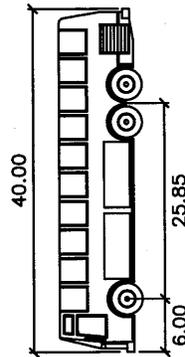
<p>ORTH-RODGERS & ASSOCIATES, INC. TRANSPORTATION ENGINEERS and PLANNERS 230 South Broad Street, 16th Floor Philadelphia, PA 19102 (215) 735-1932 LAS VEGAS MECHANICSBURG NEWTOWN SQUARE PHILADELPHIA TAMPA WEST TRENTON</p>	BUS TURNING MOVEMENTS	
	DOVER TRANSIT CENTER	DOVER, DELAWARE
<p>SCALE IN FEET</p>		DATE: JANUARY 30, 2007 PROJECT #: 2007052
		FIGURE 23

WEST STREET

Movement D - Minimum 40' curb radius



VEHICLE DETAILS



- BUS-40
- Width : 8.50 feet
- Track : 8.50
- Lock to Lock Time : 6.00
- Steering Angle : 39.30

OR&A ORTH-RODGERS & ASSOCIATES, INC.
 TRANSPORTATION ENGINEERS and PLANNERS
 230 South Broad Street, 16th Floor Philadelphia, PA 19102 (215) 735-1932
 LAS VEGAS MECHANICSBURG NEWTOWN SQUARE PHILADELPHIA TAMPA WEST TRENTON

BUS TURNING MOVEMENTS
 DOVER TRANSIT CENTER DOVER, DELAWARE

DATE: JANUARY 30, 2007
 PROJECT #: 2007052

SCALE IN FEET: 0 30

FIGURE 24

RESULTS and RECOMMENDATIONS

Based on the analysis previously presented in this report, observations of existing conditions and review of the proposed concept plans, the following section lists improvements recommended to accommodate the proposed development of the Dover Transit Center. In general the findings of this report offer proven design practices that should be considered early in the planning process and incorporated into the site plan where possible.

It should be noted that the 2009 No Build scenario includes the projected traffic volumes from 2 other committed developments within the project study area. They are Eden Hill and State Street Commons. Additionally an annual background growth rate of 2% was applied to the 2006 base traffic volumes. Based on the data currently available we feel this report generates an accurate prediction of what traffic conditions will be like when the site is fully operational in 2009.

The Proposed recommendations are as follows:

On-site Vehicular Circulation

2. Bus Access

- Based on the existing bus routes serving central Dover, it would seem that the majority of busses using the proposed facility would arrive and depart through the intersection of Water and Queen. Therefore Scheme E with a single bus exit on Queen Street will result in a large portion of busses making a left-turn out of the site onto Queen Street. It should be noted that of the three roads that bound the site, Queen Street has the highest amount of traffic and would be the most difficult access point for busses.
- The single bus exit on West Street under Scheme E would result in busses mainly turning right out of the site and then turning right onto Water Street. From a traffic operations perspective this concept would be more desirable when compared to Queen Street access shown in Scheme D.
- The existing curb radius would need to be widened for busses to make a right turn from northbound Queen Street to eastbound Water Street.
- To accommodate busses turning left from westbound Water Street to southbound Queen Street, the existing pavement markings would need to be modified at the intersection.
- While bus lanes and travel ways should be wide enough to allow for busses to easily maneuver, it is recommended that those widths be minimized within the acceptable design standard. Using the minimum design standards will promote lower travel speeds without jeopardizing functionality.
- Entrances intended for busses only should be clearly signed as such.

2. Public Access

- Both Scheme D and E successfully reduce conflict points by effectively separating bus traffic from other activity.
- To further reduce conflict points among pedestrians, cyclist and motor vehicles, consideration should be given to consolidating or minimizing the number of site access points.
- Currently both Scheme D and E show two curb cuts each for the park n ride and the pickup/drop off areas. It should be noted that with the projected traffic volumes, single access points would also be effective.

- Consideration should be given to provide clear separation among pedestrians, cyclists, and vehicles.
- Consider implementing traffic calming devices such as raised crosswalks or curb extensions to better define conflict points and to reduce vehicular travel speeds on site.

Parking Recommendations

- The parking lot area should be designed with designated walkways through the lot. Those walkways should be situated so that pedestrian access is separate from the vehicular access points.
- Consideration should be given to providing preferential or reserved parking for those who participate in the State's ride share program.
- Parking should be for the use of transit and carpool riders only. It is recommended that signing be placed in several highly visible areas that clearly designates who should be using the lot. Overnight parking should be discouraged.
- The pickup/drop off area should be clearly marked as short term parking only. It is recommended that a 15-minute limit be posted in this area.
- At the site entrance points signs should be posted or other architectural treatments to clearly identify the intended use of each access point.
- Consideration should be given towards the effects of darkness. It is typical that a commuter will travel in darkness for at least one leg of their commute.

Bicycle Recommendations

- Bicycle parking should be incorporated into the site plan. The bicycle parking facilities should be situated in an area that will minimize the risk of theft or vandalism.
- The bicycle rack design should comply with the Association for Pedestrian and Bicycle Professionals' *Bicycle Parking Guidelines (APBP, 2003)* or a similar current standard.
- Because usage of bicycle racks will vary and there usage is difficult to predict, the usage should be monitored and if necessary the amount of parking should be modified as needed.

Pedestrian Recommendations

- The site should provide for frequent pedestrian crossing opportunities with the site. Typically these locations should be located perpendicular to the roadway to minimize crossing length and should be located at intersection locations when possible.
- All pedestrian crosswalks within the site should be consistently and clearly marked and should comply with current ADA guidelines.
- Provide stop bars and stop signs at conflict points to guide motorists to stop in locations that do not encroach into pedestrian walkways.

Off-site Recommendations

- The traffic signal at the intersection of Queen Street and Water Street is scheduled to be upgraded by DeIDOT in the near future. If not already planned, this traffic signal upgrade should include the installation of pedestrian signal heads and push buttons on all legs of the intersection.
- DeIDOT should install signage with the general area of the Transit Center that directs motorists to the site giving additional time to position themselves to the

correct access point. The exact method for signing will vary depending on the final site plan's access scheme. However signing to the transit center would like be installed along sections of North Street, Queen Street, West Street and New Burton Road at a minimum.

- At the intersection of Water Street and West Street, it should be noted that there are preliminary plans that show a fourth leg being added to this intersection. As currently proposed this fourth leg will approach from the west and will serve the proposed Eden Hill development. If constructed it should be anticipated that a traffic signal would likely need to be installed at this location. It should also be noted that the proposed access would be required to cross an active rail line, which is within close proximity to the intersection. Because of the presence of the rail line and in order to ensure safe operation, an entrance and traffic signal at this location would have several operational issues in which to overcome. Additionally in our research, we have found that there was no traffic impact study done for the Eden Hill project, and to date DelDOT has not reviewed any entrance plans for this proposed site access. It appears as if no engineering studies have been done for this proposed access point and in our opinion there are some very serious concerns about allowing such an access at this location. Although it does not necessarily effect the operation of the proposed transit facility, we question the concept of providing a fourth leg at this intersection. It is recommended that DelDOT's traffic section further study the Eden Hill plans at this location to determine if it is feasible.

- Because of the location of the site, busses will frequently be required to conducted turning movements at the intersections of Water & West and Water & Queen. ORA checked the existing conditions at both intersections and identified four potential conflicts. Using a 40' vehicle as the design standard, the following upgrades would be needed to accommodate turning busses:
 - A. Right-turn from northbound Queen Street to eastbound Water Street – The existing corner curb line would need to be increased from a 25' to a 40' radius.
 - B. Left-turn from westbound Water Street to southbound Queen Street – The existing stop bar on Queen Street would need to be relocated 15' further back.
 - C. Right-turn from eastbound Water Street to southbound Queen Street – The existing corner curb line would need to be increased from a 25' to a 40' and The existing stop bar on Queen Street would need to be relocated 15' further back.
 - D. Right-turn from northbound West Street to eastbound Water Street – The existing corner curb line would need to be increased from a 25' to a 40' radius.