Trip Generation Study
Big Box Retail
(Home Improvement Superstores In New York City)

Traffic Planning
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City of New York
Michael R. Bloomberg, Mayor

SERVING THE COUNTIES OF
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NEW YORK CITY
DOT
New York City
Department of Transportation
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Trip Generation Study

Big Box Retail (Home Improvement Super Stores)

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Table of Contents

List of Figures

List of Tables

Executive Summary

S1. Introduction

This Trip Generation Study is an attempt to determine the trip generating characteristics of new large-scale retail "super stores" and in this case specifically home improvement superstores (HISS). From a pool of 22 HISS's within the NYC area, seven facilities were chosen as well as one from Nassau County for detailed analysis. These eight facilities include one from Manhattan, Brooklyn, the Bronx and Nassau County and two from Staten Island and Queens. This analysis focuses on the trips generated by the facilities, trip characteristics such as mode, occupancy, trip type and customer charactertistics, as well as the socio-economic characteristics, physical site characteristics (number of parking spaces and facility size), and the transportation accessibility of the immediate catchment area.

S.2 Trip Generation Field Surveys

Traffic counts were conducted in 2007 at facility driveways which recorded vehicle ins and outs, vehicle classification, occupancy, and parking accumulation and utilization. Additionally, questionnaire surveys were performed at four facilities to gather additional information about the trip type, mode and purpose.

S.2.1 Vehicle Trips

Individual peak period and 24 hour vehicle trip rates are shown in Table 1. In every case the Manhattan facility had lower vehicle trip rates than the other facilities. This is largely due to the high transit/low vehicle mode share in the area. The Northern Blvd. and Rockaway Blvd. facilities in Queens had the highest weekday 24 hour vehicle trip rates as well as high weekend peak hour rates.

Table 1: HISS facility vehicle trips/1,000 square feet

	WD 24 hour	AM	MD	PM	Sat Peak
23rd Street	10.62	0.49	0.97	0.95	1.60
Cropsey Ave	44.09	3.17	3.29	3.17	5.51
Jericho Turnpike	52.91	3.99	5.15	3.20	3.08
Northern Boulevard	59.26	4.04	4.20	3.83	5.75
Rockaway Blvd	56.61	4.67	3.87	3.92	6.59
Targee Street	43.39	3.38	3.16	3.32	6.06
Veterans Road	28.01	1.92	2.37	1.91	5.00
Zerega Avenue	40.71	2.97	3.28	3.04	4.98

S.2.2 Mode of Travel

Transportation mode information was collected by both the trip generation survey as well as the questionnaire survey. The questionnaire survey includes transit modes not covered by the trip generation survey and was performed at the 23rd street Manhattan site where the trip generation survey was unable to record mode share due to the absence of dedicated on-site parking.

The private automobile was the predominant mode of travel to all Home Depots except the 23rd Street Manhattan facility where walking and public transit were more heavily used. The two Queens facilities generated more walk/bike trips and commercial van trips and less private vehicle trips than the other five facilities (excluding 23rd Street).

S.2.3 Vehicle Occupancy

The weekday vehicle occupancy peaked at 1.55 persons per vehicle while the Saturday vehicle occupancy rate peaked at 1.60 persons per vehicle. Both peaks occurred in the PM hours. Saturday and Sunday vehicle occupancy rates were very similar.

S.3 Significant Factors in Trip Generation

The study identified a 1 mile radius catchment area as the primary study area for each of the facilities and focused on the following contributing factors to trip generation:
- Demographic/Socio-Economic
- Land Use/Zoning
- Transportation/Accessibility

S.3.1 Demographics/Socio-Economic Variables

The demographic analysis shows the average population within the 1 mile radius catchment area is 115,481 persons with a range from 13,625 at the Jericho Turnpike, Nassau County catchment area, which is located in a more suburban environment, to 281,228 at the Manhattan site, which has the highest development density. The economic analysis shows that the average median household income is $51,780, ranging from $26,646 at the Cropsey Avenue catchment area in Brooklyn to $98,385 at the Jericho Turnpike catchment area. The average household size is 2.7 persons per household and ranges from 1.59 at the 23rd Street Manhattan catchment area to 3.32 persons per household at the Rockaway Boulevard catchment area in Queens.

S.3.2 Land Use

The zoning analysis grouped zoning districts based upon predominant use and development densities. Residential districts were grouped into three classes (R1-R4, R5-R7, R8-R10), Commercial districts into two classes (C1-C4, C5-C7) and manufacturing districts were all grouped together. The analysis shows that the catchment areas of the two Staten Island

facilities, the Nassau County facility and the Rockaway Boulevard facility in Queens are surrounded by primarily low density residential uses. The Northern Boulevard site in Queens, the Cropsey Avenue site in Brooklyn, and the Zerega Avenue site in the Bronx have primarily medium density residential catchment areas. The 23rd Street Manhattan site catchment area is a mixture of high density residential, commercial and manufacturing uses.

S.3.3 Transportation Accessibility

Accessibility to the sites was evaluated based upon direct travel routes and transit provision (arterials, bus lines and subway stops) in the surrounding catchment areas, taking into account the proximity of the various transportation facilities to the sites.

S.4 NYC Trip Generation Rates

A statistical test of variance was conducted on the trip rates of the eight facilities resulting in the exclusion of three Home Depot sites. The three facilities that were not included in the NYC trip rate computation are the 23rd Street facility in Manhattan, the Jericho Turnpike facility in Nassau County and the Veterans Road facility in Staten Island. An average NYC trip rate was created using the remaining 5 facilities of which the summary results are shown in table 2 below.

Table 2: Summary Results

NYC Home Depot Average Area (sq ft): 136,171		WD AM	WD MD	WD PM	Sat Pk
Vehicle Trip Rate/1,000 sq ft		3.65	3.56	3.46	5.78
Modal Split	Walk	10.4%	12.3%	10.6%	11.1%
	Bike	0.4%	0.4%	0.3%	0.3%
	Auto	73.9%	76.8%	81.2%	82.8%
	Taxi	0.9%	1.8%	1.9%	1.7%
	Commercial Van	14.4%	8.7%	6.0%	4.1%
Vehicle Trip Temporal Distribution		7.2%	7.1%	7.0%	9.8%
Vehicle Directional Split (ins/outs)		52% / 48%	50% / 50%	51% / 49%	50% / 50%
Vehicular Occupancy	Auto	1.24	1.33	1.40	1.52
	Taxi	1.50	1.44	1.57	1.58
	Commercial Van	1.29	1.36	1.29	1.29
# Truck Trips		15	13	5	6
Truck Trip Rate/1,000 sq ft		0.110	0.095	0.036	0.043

Table 3 below shows the vehicle trip generation rates for NYC derived from the survey as well as the ITE trip generation rates and the rates used in NYC specific Home Improvement Superstore EIS's conducted in 1999.

Table 3: Vehicle Trips /1,000 sq ft

	NYC	ITE	EIS
Weekday AM	3.65	2.85	N/A
Weekday MD	3.56	N/A	4.70
Weekday PM	3.46	3.05	4.28
Sat Peak	5.78	5.40	6.83

Introduction

Study Goals/Objectives

The New York City Department of Transportation is responsible for managing traffic on the street network and addressing traffic impacts that result from significant urban development. The ability to reasonably predict potential impacts from proposed developments through the use of proper tools is central to the effective management of traffic.

New York City (NYC), though established and built up over time, finds ways of rejuvenating itself through imaginative zoning and other incentives that encourage urban revitalization and growth. Such changes in land-use and urban development form have direct implications for traffic and congestion on the street network. Recently, the city has seen an explosion in the increase of big box retail stores such as Home Improvement Superstores (HISS). In order to generate reasonable predictions and an effective traffic planning response to this phenomenon, the tools and data used must take into account the unique conditions of New York City.

The current research effort is aimed at determining what traffic will be generated by new large-scale retail "super stores", in this case specifically Home Improvement Superstores, instances of which have been increasing rapidly in the five boroughs. It should be noted that the hours of operation of these facilities are also changing, with many operating 24 hours a day, thus affecting the temporal distribution of traffic and the vehicle mix in the traffic stream.

Big box retail stores that have gone into operation recently provide empirical evidence to examine the assumptions and projections that were made and reflected in Environmental Impact Statements (EIS). They also provide an opportunity to develop more appropriate and accurate trip generation rates for the future, if needed.

This study therefore aims to develop appropriate trip generation rates for big box retail facilities in NYC, taking into consideration that the character of NYC itself varies considerably between boroughs. Currently the ITE "Trip Generation Handbook" trip rates tend to reflect an average national condition and therefore can lead to less than reasonable predications when applied to a dense urban environment. ITE trip rates are often modified based on limited site surveys to more clearly reflect NYC's characteristics. The current effort seeks to investigate the operations of existing facilities in various locations to determine their trip generation rates as well as to identify some of the significant variables that account for any differences in trip generation rates.

The current research process involves the following basic steps:

1. Identify and select appropriate Home Improvement Superstore sites and associated catchment areas
2. Conduct traffic count and questionnaire surveys
3. Examine significant factors that can affect trip generation
4. Conduct statistical analysis and develop trip generation rates
5. Compare new trip generation rates with ITE and other rates used in the past

Site Selection

Initially, a specific group of HISS sites in the city were identified, and then evaluated to determine which facilities would be subjected to detailed survey and analysis. The following set of objectives was established to select the facilities to be studied:

a. At least one site should be selected from each of the five boroughs
b. At least one site should be selected from outside of NYC
c. Sites should be selected where EIS's have been completed in order to examine the validity and accuracy of the assumptions and trip estimates.
d. Sites should be selected with similar physical characteristics in different neighborhoods or market area settings.

The process resulted in selecting seven facilities within the five boroughs (one each from Manhattan, Brooklyn and the Bronx; and two each from Queens and Staten Island). One facility was selected from Nassau County outside of New York City, thereby providing the opportunity to determine if NYC conditions are indeed different from the average national condition represented by the ITE trip generation handbook. Figure 1 maps the locations of all the considered and selected sites, while Table 1 lists all of these facilities with supporting information.

Figure 1: Home Improvement Superstore Sites (HISS)

N

BX

Zerega Ave

Jericho Turnpike

Northern Blvd

West 23rd Street

MN

QN

Rockaway Blvd

Targee Street

BK

Cropsey Ave

SI

Veterans Road West

Legend

★ HISS Selected for Analysis

● Other HISS Sites

Scale

0 2 4 8 Miles

Division of Traffic Planning
Office of Project Analysis
6/17/09
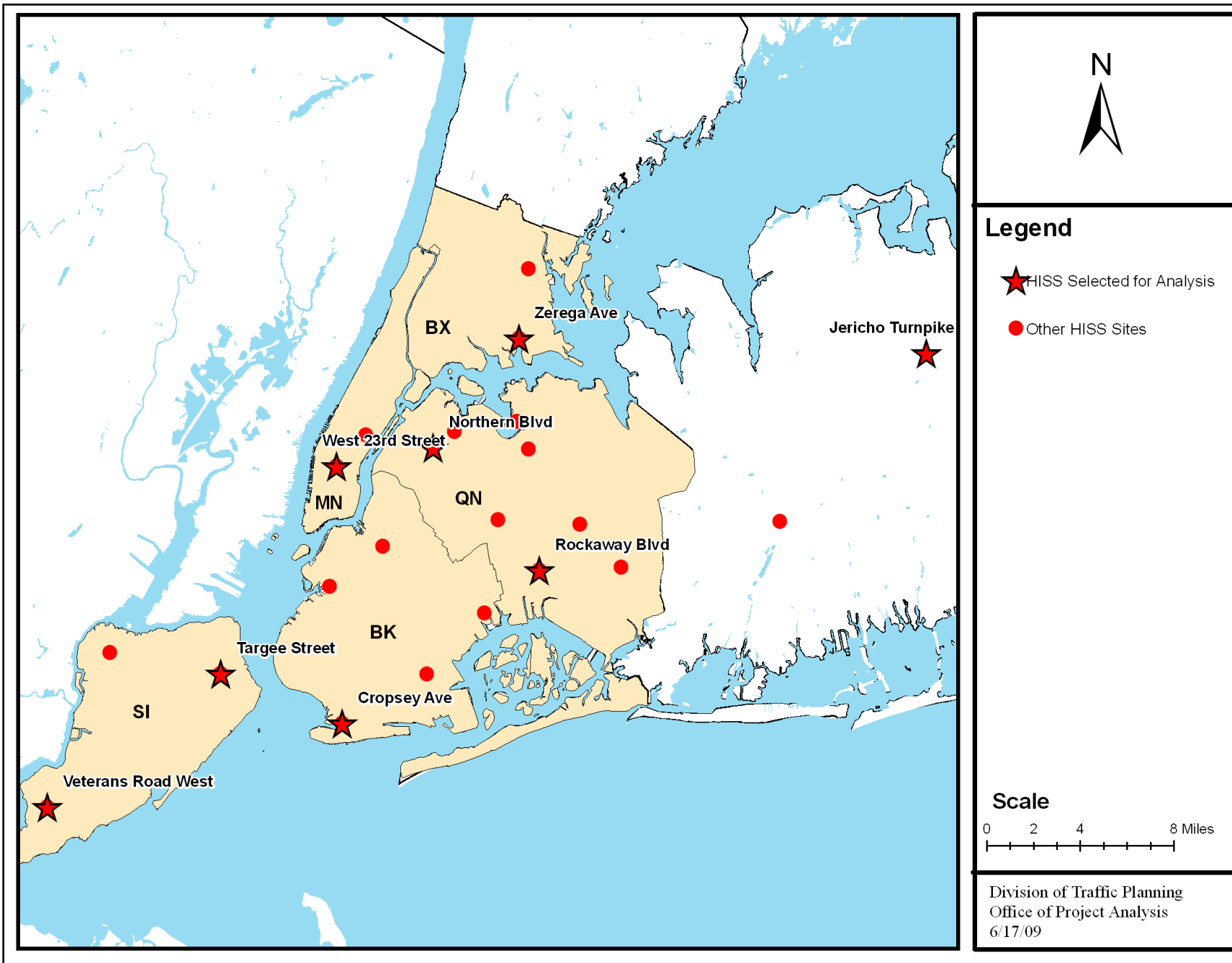
Table 4: HISS sites in New York

	Location (Area)	Facility Address	Telephone	Date Opened	Operating Hours	Size (Sq Ft)	Parking Spaces
Queens (8 locations)	1. East Elmhurst	73-01 25th Avenue, East Elmhurst, NY 11370	(718) 507-9004	12/2001	6AM-10PM M-Sat; 8AM-8PM Sun	101,000	171
	2. Jamaica	92-30 168th Street, Jamaica, NY 11433	(718) 558-8640	4/2007	6AM-10PM M-Sat; 8AM-8PM Sun	113,000	225
	3. Springfield Gardens	132-30 Merrick Blvd Jamaica, NY 11434	(718) 977-2081	8/16/2001	6AM-10PM M-Sat; 8AM - 7PM Sun	160,000	477
	4. College Point	124-04 31st Avenue Flushing, NY 11354	(718) 661-4608	5/3/2001	6AM-9PM M-Thurs; 6AM-10PM Fri-Sat; 8AM-9PM Sun	128,000	488
	5. Flushing	131-35 Avery Avenue Flushing, NY 11354	(718) 358-9600	6/15/2005	6AM-11PM M-Sat; 8AM-9PM Sun	144,000	483
	6. Long Island City*	50-10 Northern Blvd Long Island City, NY 11101	(718) 278-9031	1/7/1999	5AM-11PM M-Sat; 8AM - 9PM Sun	155,000	439
	7. Glendale	75-09 Woodhaven Blvd Glendale, NY 11385	(718) 830-3323	2/17/2000	6AM-9PM M-Sat; 8AM-9PM Sun	132,000	496
	8. Ozone Park*	112-20 Rockaway Blvd Ozone Park, NY 11420	(718) 641-5500	1/1994	6AM-11PM M-Sat; 8AM-8PM Sun	150,384	339
Brooklyn (5 locations)	1. Bedford Stuyvesant	585 Dekalb Avenue, Brooklyn, NY 11205	(718) 230-0833	5/2005	6AM-10PM M-Sat; 8AM-8PM Sun	155,000	225
	2. Red Hook	550 Hamilton Ave Brooklyn, NY 11232	(718) 832-8553	3/5/1998	6AM-12AM M-Sat; 8AM-9PM Sun	86,200	450
	3. Mill Basin	5700 Avenue U Brooklyn, NY 11234	(718) 692-7296	4/4/2002	6AM-10PM M-Sat; 8AM-8PM Sun	90,000	210
	4. Starrett City	579 Gateway Drive Brooklyn, NY 11239	(718) 827-9568	9/26/2002	6AM-10PM M-Sat; 8AM-8PM Sun	67,500	400
	5. Coney Island*	2970 Cropsey Avenue Brooklyn, NY 11214	(718) 333-9850	12/20/2001	5AM-12AM M-Sat; 8AM-12AM Sun	148,861	572
Staten Island (3 locations)	1. Staten Island East*	545 Targee Street Staten Island, NY 10304	(718) 818-9334	10/3/2002	6AM- 8PM M-Sun	88,914	363
	2. Staten Island	2501 Forest Ave Staten Island, NY 10303	(718) 273-5069	8/14/1997	6AM-10PM M-Sat; 8AM-8PM Sun	125,000	501
	3. Staten Island*	2750 Veterans Road Staten Island, NY 10309	(718) 984-4690	1/1/2006	6AM-9PM M-Sat; 8AM-8PM Sun	160,000	480
Bronx (2 locations)	1. Bronx	1806 E Gunhill Rd Bronx, NY 10469	(718) 862-9800	6/26/1997	6AM-10PM M-Sat; 8AM-8PM Sun	123,000	491
	2. Castle Hill*	635 Zerega Avenue Bronx, NY 10473	(718) 518-8811	10/10/2002	5AM-12AM M-Sat; 8AM-12AM Sun	137,698	557
Manhattan (2 locations)	1. Midtown 23rd St*	40 West 23rd Street New York, NY 10010	(212) 929-9571	Summer 04	7AM-9PM M-Sat; 8AM-7PM Sun	108,000	0
	2. Midtown 59th Street	980 Third Avenue New York, NY 10022	(212) 888-1512	Summer 04	6AM-10PM M-Sat; 8AM-8PM Sun	83,000	0
Long Island (2 Locations)	1. Nassau County	111 Jericho Turnpike, Syosset, NY 11791	(516) 364-4677	1/2001	6AM-10PM M-Sat; 8AM-8PM Sun	93,750	481
	2. Nassau County	150 Fulton Avenue, Hempstead, NY 11550	(516) 565-3700	2/2002	6AM-10PM M-Sat; 8AM-8PM Sun	145,000	423

The eight selected facilities are described below.

40 West 23rd Street, Manhattan

The 23rd Street facility in Manhattan is approximately 108,000 square feet in size and has no on-site parking facilities directly associated with the site. The facility is located on 23rd Street, which is a principal arterial. It is also near three other principal arterials: 5th Avenue, 6th Avenue, and Broadway. The facility is located in a high density commercial and residential area. An aerial view of the facility is shown below in Figure 2.

Figure 2: Aerial View of 23rd Street Facility

2970 Cropsey Avenue, Brooklyn

The Cropsey Avenue facility is approximately 150,000 square feet in size and has 572 parking spaces. An Environmental Impact Statement was prepared for the facility in 1999. It is located directly off an expressway, the Belt Parkway, and is situated on Cropsey Avenue, a principal arterial. The parking lot is shared with a small storage facility which uses approximately 20 parking spaces. An aerial view of the facility is shown below in Figure 3.

Figure 3: Aerial View of Cropsey Avenue Facility
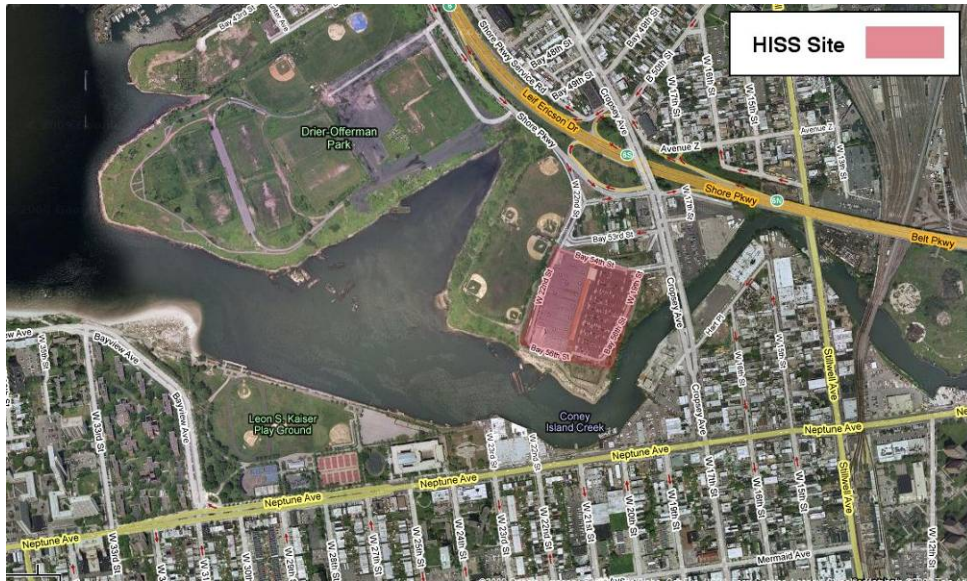
111 Jericho Turnpike, Syosset NY

The Jericho Turnpike facility in Nassau County is approximately 93,750 square feet in size and has 480 parking spaces. It is located on a major arterial, Jericho Turnpike, just north of the Long Island Expressway. While the facility is located near other major commercial establishments, the parking lot is exclusive for its customers. An aerial view of the facility is shown below in Figure 4.

Figure 4: Aerial View of Jericho Turnpike Facility
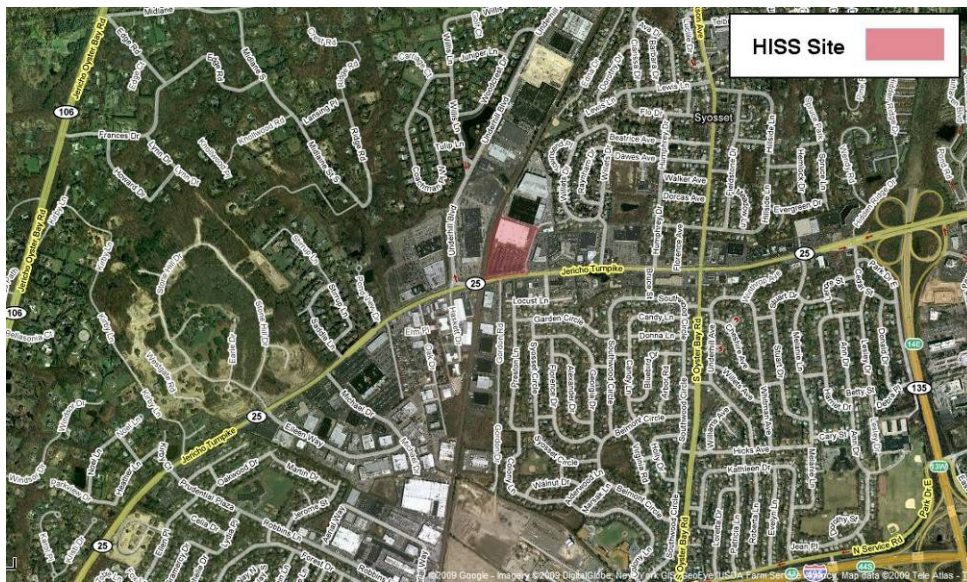
50 – 10 Northern Boulevard, Queens

The Northern Boulevard facility is approximately 155,000 square feet in size and has 440 parking spaces. It is located on a principal arterial, Northern Boulevard, and near two others; Broadway and Steinway Street. The facility is located in a medium density residential area that includes commercial uses such as the Sunnyside mall and some manufacturing uses. An aerial view of the facility is shown below in Figure 5.

Figure 5: Aerial View of Northern Boulevard Facility

112-20 Rockaway Boulevard, Queens

The Rockaway Boulevard facility is approximately 150,000 square feet in size and has 340 on-site parking spaces. It is located on a principal arterial, Rockaway Boulevard, and near two others; Linden Boulevard and Lefferts Boulevard. The facility is situated adjacent to the Aqueduct racetrack in a low density residential area with some land zoned and used for commercial uses along the arterials. An aerial view of the facility is shown below in Figure 6.

Figure 6: Aerial View of Rockaway Boulevard Facility

545 Targee Street, Staten Island

The Targee Street facility is approximately 89,000 square feet in size and has 360 on-site parking spaces. It is located on a principal arterial, Targee Street, and near a major expressway, the Staten Island Expressway. The facility is located in a low density residential area that includes some commercial uses. An aerial view of the facility is shown below in Figure 7.

Figure 7: Aerial View of Targee Street Facility

2750 Veterans Road, Staten Island

The Veterans Road facility is approximately 160,000 square feet in size and has 480 on-site parking spaces. It is located on a principal arterial, Veterans Road near the Richmond Parkway and West Shore Expressway interchange. The facility is located in a commercial area that contains other retail facilities, but does not share parking area. An aerial view of the facility is shown below in Figure 8.

Figure 8: Aerial View of Veterans Road Facility

625 Zerega Avenue, Bronx

The Zerega Avenue facility is approximately 137,700 square feet in size and has 550 on-site parking spaces. It is located near three expressways; The Cross Bronx Expressway, Bruckner Expressway, and the Hutchinson River Parkway. It is situated in a low density residential area that has some manufacturing uses. An aerial view of the facility is shown below in Figure 9.

Figure 9: Aerial View of Zerega Avenue Facility

Trip Generation

Vehicle Counts

To obtain the trip generation information for each facility, detailed surveys were conducted to collect data on the number of trips to and from the facilities by time of day, vehicle type, and vehicle occupancy, as well as parking accumulation. The surveys were conducted on two weekdays and one Saturday for each of the eight facilities. The Cropsey Avenue, Jericho Turnpike, and Zerega Avenue facilities were also surveyed on a Sunday. The trip generation survey recorded the following in 15 minute intervals:

a.) Vehicle ins and outs and vehicle classification counts at the site driveways.

b.) Vehicle occupancy

c.) Parking utilization/accumulation (2 hour intervals)

Table 5 below shows the store hours of operation and periods when the surveys were conducted.

Table 5: HISS Store Hours and Survey Periods

HISS	Weekday		Saturday		Sunday	
	Store Hours	Survey Period	Store Hours	Survey Period	Store Hours	Survey Period
23rd Street , Mn	7AM - 9PM	7AM - 9PM	7AM – 9PM	Noon - 6PM	8AM – 7PM	-
Cropsey Ave, Bk	6AM - 10PM	6AM – 10PM	6AM - 10PM	6AM - 10PM	8AM - 7PM	8AM - 8PM
Jericho Turnpike, Nassau County	6AM - 10PM	6AM – 10PM	6AM - 10PM	6AM - 10PM	8AM - 7PM	7AM - 7PM
Northern Blvd, Qn	5AM - 11PM	6AM – 10PM	5AM - 11PM	Noon - 6PM	8AM – 9PM	-
Rockaway Blvd, Qn	6AM - 11PM	6AM – Midnight	6AM - 11PM	Noon - 6PM	8AM – 8PM	-
Targee Street, SI	6AM - 8PM	6AM - 8PM	6AM – 8PM	Noon - 6PM	6AM – 8PM	-
Veterans Road, SI	6AM - 9PM	6AM – 10PM	8AM – 8PM	Noon - 6PM	8AM – 8PM	-
Zerega Ave , Bx	6AM - 10PM	6AM – 10PM	6AM - 10PM	6AM - 10PM	8AM - 7PM	8AM - 8PM

The parking accumulation surveys recorded the number of cars in the parking lot before and after the survey as well as the total vehicles parked every two hours during the survey period. The surveys recorded travel mode for walk, bike, and auto as well as vehicle classification (car, taxi, commercial van or truck). The 23rd street facility does not provide on-site parking, so the questionnaire survey focused on person trips to and from the facility at the building entrances.

Peak Hours

The weekday peak hour was determined for each facility from the traffic survey and is shown in Table 6 below. The earliest weekday peak hour occurred from 10:30 to 11:30 AM at both

facilities in Queens and the Cropsey Avenue facility in Brooklyn. The latest weekday peak hour was 3:00 PM to 4:00 PM, observed at the 23rd Street facility in Manhattan.

Table 6: Weekday Peak Hour

23rd Street, New York	3:00 - 4:00 PM
Cropsey Ave, Kings	10:30 - 11:30 AM
Jericho Turnpike, Nassau	12:45 - 1:45 PM
Northern Blvd, Queens	10:30 - 11:30 AM
Rockaway Blvd, Queens	10:30 - 11:30 AM
Targee Street, Staten Island	2:30 - 3:30 PM
Veterans Rd West, Staten Island	12:45 - 1:45 PM
Zerega Ave, Bronx	1:15 - 2:15 PM

Equally important as the peak hour of the generator is the peak of the background traffic which was determined from automated traffic recorders (ATR's). The peak period of the street network background traffic was derived from ATR's located near the facilities at Cropsey Avenue and Zerega Avenue as well as from New York City Bridge counts. The weekday background traffic peak periods concur essentially with those in the ITE.

Upon reviewing both the background and generator peak hours, it was decided that two hour peak periods would be used for the analysis. The peak periods for both the trip generator and the background traffic are shown below in Table 7 along with the ITE peak periods for comparison. These were derived from a comparative analysis of the peak periods of all facilities, and selecting the most common peak periods. Figure 10 below displays the weekday AM, MD and PM peak periods (indicated in pink overlays) in relation to the facilities trip distribution.

Table 7: Peak Periods of the Trip Generator and Background Traffic

Generator	NYC	ITE
Weekday AM	9:00 - 11:00 AM	10:00-12:00
Weekday MD	12:00 - 2:00 PM	
Weekday PM	5:00 - 7:00 PM	12:00-5:00
Weekday Peak	10:00 - 12:00 PM	
Saturday Peak	12:45 - 2:45 PM	12:00-3:00

Background Traffic		
Weekday AM	7:00 - 9:00 AM	7:00-9:00AM
Weekday PM	4:00 - 6:00 PM	4:00-6:00PM

Figure 10: Facility Trip Distribution and Peak Hours
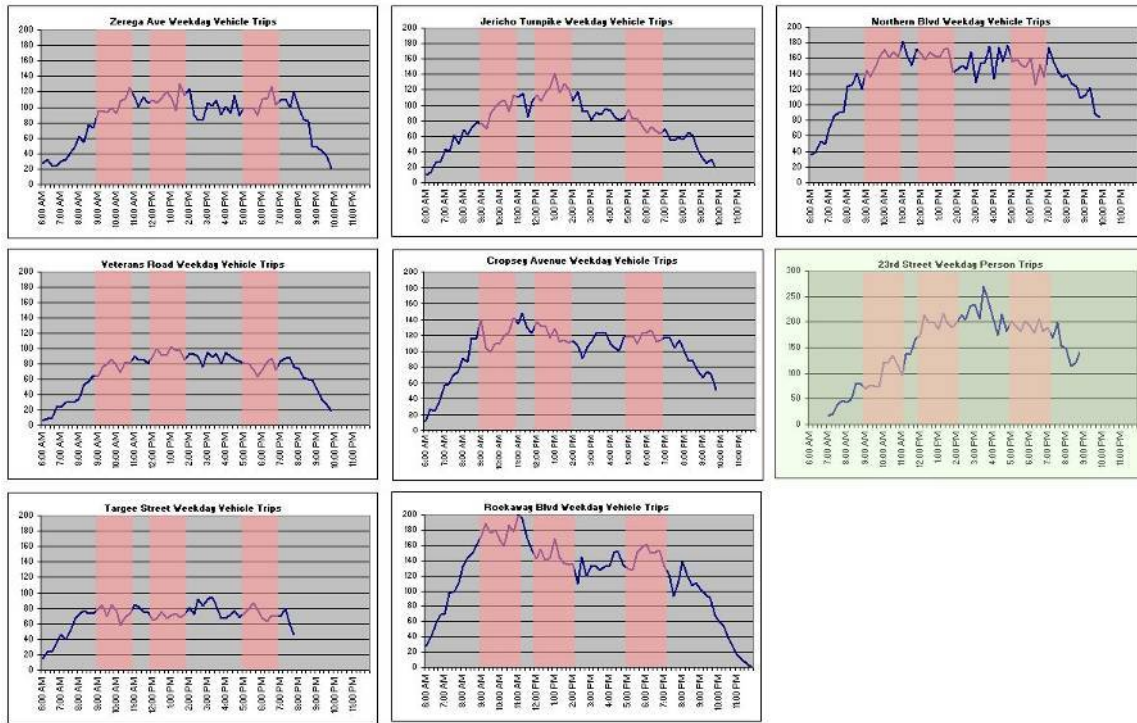
* 23rd Street Facility (yellow shading) recorded person trips

Vehicle Occupancy

The traffic count and questionnaire surveys both recorded vehicle occupancy: Figure 11 below shows graphs of the 8 site average Weekday, Saturday, and Sunday vehicle occupancy. Table 8 below displays the vehicle occupancy for each site. For the purpose of this survey, vehicles included trucks, commercial vans, taxis, and private automobiles. Note: taxi operators were not counted as occupants.

Table 8: Daily Vehicle Occupancy

	Vehicle Occupancy		
	Weekday	Saturday	Sunday
23rd Street	N/A	N/A	N/A
Cropsey Ave	1.282	1.360	1.528
Jericho Street	1.101	1.146	1.344
Northern Blvd	1.343	1.610	N/A
Rockaway Blvd	1.326	1.574	N/A
Targee Street	1.148	1.331	N/A
Veterans Road	1.552	1.255	N/A
Zerega Avenue	1.440	1.609	1.645

Figure 11: Average Vehicle Occupancy
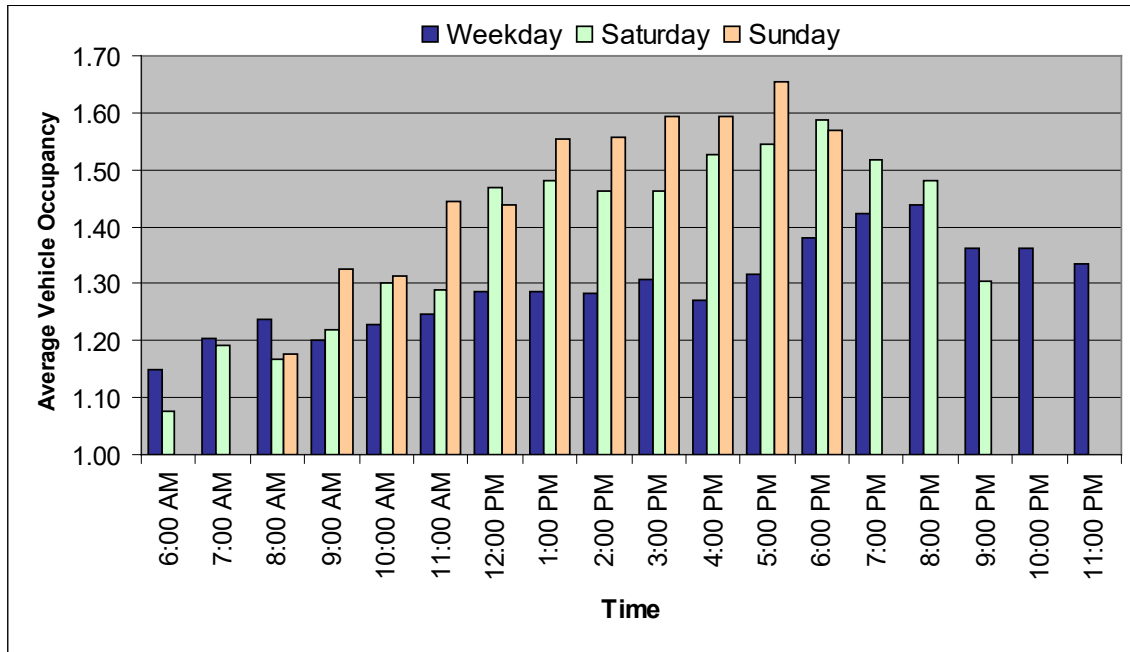
As shown in Figure 11, vehicle occupancy varied by weekday and weekend as well as by time of day. Vehicle occupancy ranged from 1.15 to 1.45 on Weekdays, and from 1.05 to 1.58 on weekends. Individual facility daily vehicle occupancy rates ranged from 1.10 to 1.55 on the weekday and from 1.15 to 1.61 on Saturdays.

Mode of Travel

Travel mode and vehicle classification from the traffic survey at seven of the facilities is shown in table 9. No vehicle counts were taken at the 23rd Street facility as there is no on-site parking. Private automobile use accounts for at least 69% of the mode share for 7 sites. Bike/Walk modes accounted for 12% and 15% of the trips at the Rockaway Boulevard and Northern Boulevard facilities respectively. None of the 7 facilities recorded more than 2.4% of taxi trips while the Northern Boulevard and Rockaway Boulevard facilities had just over 10% of the trips via commercial van.

Table 9: Mode and Vehicle Classification

HISS Site	Bike/Walk	Taxi	Commercial Vans	Trucks	Private Vehicles
Cropsey Ave	6.6%	0.9%	6.7%	1.3%	84.4%
Jericho Turnpike	0.4%	0.0%	7.4%	1.5%	91.0%
Northern Boulevard	15.1%	2.4%	12.4%	1.3%	69.6%
Rockaway Boulevard	11.7%	0.5%	10.7%	1.4%	75.8%
Targee Street	7.3%	0.6%	4.5%	0.6%	87.0%
Veterans Road	1.8%	0.1%	2.4%	0.2%	95.5%
Zerega Ave	5.4%	2.4%	7.0%	0.7%	84.4%

Parking Accumulation

Parking accumulation counts were recorded at 2 hour intervals at 7 facilities as the 23rd Street facility has no on-site parking. Figure 12 below shows the average parking utilization by time of day. The average weekday accumulation varies from approximately 8% at the time the store opens, peaks midday at approximately 42% and is approximately 9% when the store closes. The weekend accumulation peaks at approximately 57% at 2:00pm.

Figure 12: Average Parking Accumulation

	6:00AM	8:00 AM	10:00 AM	12:00 PM	2:00 PM	4:00 PM	6:00 PM	8:00 PM	10:00PM
Weekday	8%	22%	34%	42%	42%	36%	29%	19%	9%
Saturday	5%	17%	37%	54%	57%	50%	39%	23%	11%
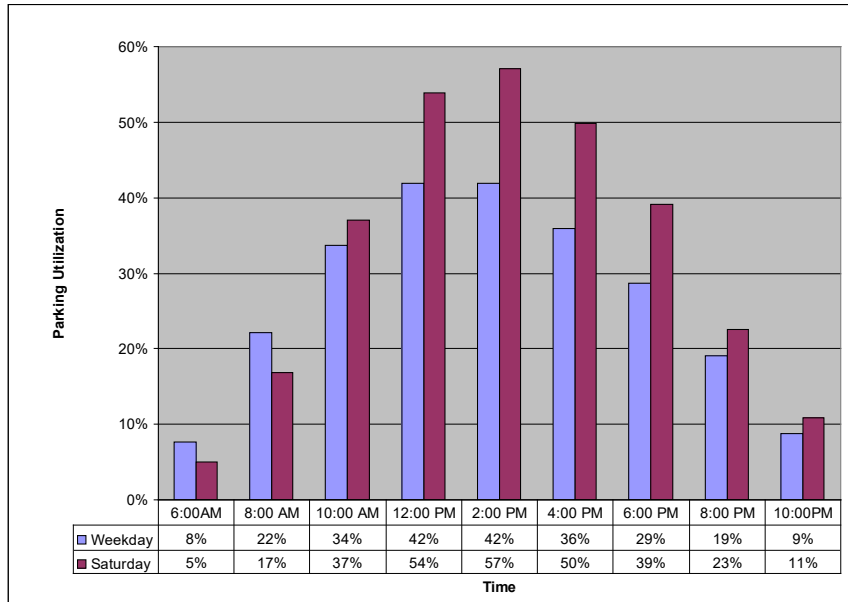
Vehicle Trip Rates

Vehicle trip rates are usually expressed as the number of trips per 1000 square feet and derived by dividing the peak hour vehicle trips by the facility size in square feet multiplied by 1000. Since the study uses 2 hour peaks, the eight 15-minute interval vehicle trips are averaged and multiplied by 4 to arrive at a peak hour. Table 10 below displays the peak hour and 24 hour vehicle trip rates per 1000 square feet for the eight HISS facilities.

Table 10: HISS Facility Peak Hour Vehicle Trips per 1000 Square Feet

	WD 24 hour	AM	MD	PM	Sat Peak
23rd Street	10.62	0.49	0.97	0.95	1.60
Cropsey Ave	44.09	3.17	3.29	3.17	5.51
Jericho Turnpike	52.91	3.99	5.15	3.20	3.08
Northern Boulevard	59.26	4.04	4.20	3.83	5.75
Rockaway Blvd	56.61	4.67	3.87	3.92	6.59
Targee Street	43.39	3.38	3.16	3.32	6.06
Veterans Road	28.01	1.92	2.37	1.91	5.00
Zerega Avenue	40.71	2.97	3.28	3.04	4.98

The Northern Boulevard, Rockaway Boulevard and Jericho Turnpike facilities have the highest weekday vehicle trip rates. The 23rd Street and Veterans Road facilities have the lowest weekday vehicle trip rates. The Cropsey Avenue, Northern Boulevard and Rockaway Boulevard facility have the highest Saturday peak hour vehicle trip rates while the 23rd Street and Jericho Turnpike facilities have the lowest peak hour Saturday vehicle trip rates. The 23rd Street facility's low vehicle trip rates can be largely attributed to the lack of on-site parking and the extensive transit network in the general area.

Questionnaire Survey

In addition to traffic counts, questionnaire surveys (interviews) were conducted to obtain additional information such as travel time, trip length, trip purpose, trip mode, whether the trip was a primary or linked trip, and whether the customer was a contractor, homeowner or a tenant. Questionnaire surveys were conducted at the 23rd Street, Cropsey Avenue, Northern Boulevard, and Zerega Avenue sites. The survey was conducted for two weekdays and one Saturday. A Sunday survey was also conducted at the Cropsey Avenue and Zerega Avenue facilities. Table 11 below shows the number of response collected at each facility. The Northern Boulevard facility had a low response rate. See Appendix D for a sample Questionnaire Survey.

Table 11: Survey Responses

Time Period	23rd Street	Cropsey Ave	Northern Blvd	Zerega Ave
Weekday	160	221	51	244
Weekend	59	171	14	247

Table 12 provides a summary of the questionnaire survey identifying trip origin, type of customer and whether the trip is a primary trip. Most trips originated at home as primary trips. Approximately 15% of the customers were building contractors, 50% home owners and 30% tenants. The results didn't vary significantly between weekday and weekend except for a decrease in work originated trips.

Table 12: Trip and User Type

		Trip Origin			Primary Trip		User Type		
		Home	Work	Other	Y	N	Home Owner	Tenant	Contractor
4 Site Avg	Weekday	70%	26%	4%	85%	15%	54%	28%	18%
	Weekend	83%	15%	2%	91%	9%	53%	32%	15%

Table 13 below shows the vehicle type/mode share derived from the questionnaire survey. The Cropsey Avenue and Zerega Avenue questionnaire surveys yielded similar results to the traffic survey results displayed in Table 6. While the Northern Boulevard results vary from the other surveyed sites, it can be attributed to the low response rate at this facility. This mode share information was used to estimate the 23rd Street facility vehicle trips, which is approximately 13.3% of the total person trips generated by the facility. This percentage was used to convert the person trips to vehicle trips for the 23rd Street facility.

Table 13: Questionnaire Survey - Mode Share

HISS Site	Car	Bus	Subway	Taxi	Walk	Bike	Truck/Van
23rd Street	2.9%	11.0%	36.4%	5.8%	38.7%	0.6%	4.6%
Cropsey Ave	84.6%	1.4%	0.0%	0.0%	10.9%	0.5%	2.7%
Northern Boulevard	23.5%	7.8%	5.9%	5.9%	19.6%	3.9%	33.3%
Zerega Ave	86.9%	1.2%	0.0%	0.4%	5.7%	0.4%	4.1%
Average	61%	4%	10%	2%	17%	1%	6%

Table 14 displays the average travel time and distance derived from the questionnaire survey for the four sites. According to these results, the travel time for more than 80% of the trips were 15 minutes or less while the distance travelled for 55% of the trips were more than 2 miles. Travel time and distance did not vary significantly between the weekday and weekend activities.

Table 14: Trip Time and Distance

		Time						Distance				
		5min	10 min	15 min	30 min	45 min	1 hour	1/2 mile	1 mile	2 mile	Other
4 Site Avg	Weekday	18%	19%	45%	12%	3%	3%	11%	18%	17%	55%
	Weekend	12%	17%	51%	17%	1%	1%	11%	13%	23%	54%

Significant Factors in Trip Generation

Having selected the eight sites, an analysis of significant variables in trip generation was undertaken consistent with the scope of the study. The major factors identified that could influence trip generation rates are:

- Socio-Economic – Demographics; income and car ownership
- Physical characteristics - Land use/spatial distribution and development densities
- Transportation - Highway access, transit service provision and mode convenience

To facilitate the analysis of the possible contributing factors, a market catchment area for each of the stores was identified. The market area is the area from which the majority of the store's customers are drawn. Assuming that customers will travel the shortest distance to shop, concentric circles were drawn at radii of 1, 1.5 and 2 miles from each facility to help delimit an appropriate catchment area. The 1 mile radius minimizes overlap of catchment areas, so it was determined that this would be the size of the primary study area. Figure 13 illustrates the various radii and catchment areas of multiple HISS sites.

Figure 13: Delimiting the Catchment Area

Legend

● Other HISS Sites

- - - 1 Mile Radius

- - - 1.5 Mile Radius

- - - 2 Mile Radius

N

MN

QN

BK

Scale

0   0.5   1   2 Miles

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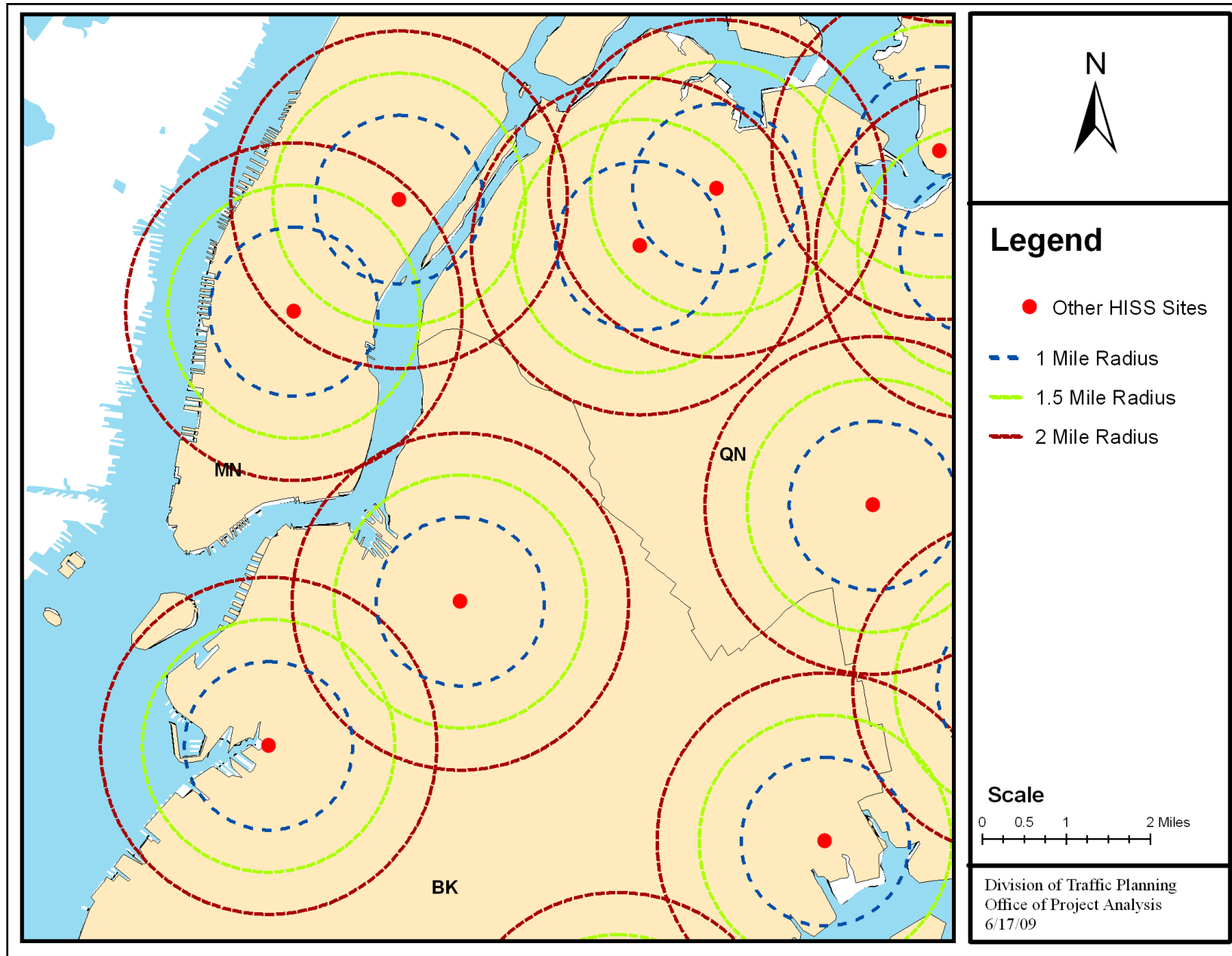
Demographics and Socio-Economic Characteristics

The demographic and socio-economic characteristics of an area's population can help to explain some of the travel characteristics of store patrons. Therefore, characteristics such as income, household size, and vehicle ownership were examined for each catchment area. Data from the 2000 census were used by focusing on census tracts that fall within the established catchment areas. Figure 14 shows the Cropsey Avenue facility catchment area and corresponding census tracts. A similar analysis was done for all the sites, see appendix A.

A summary of the demographic/socio-economic analysis for each of the facilities is shown in Table 15. It includes population, average household (HH) size, median household income, and the average number of vehicles per household. The analysis shows that the 23rd Street and Northern Boulevard facilities' catchment areas have significantly larger populations than the other facilities. The 23rd Street facility catchment area has the smallest average household size of 1.59 persons, with a vehicle ownership rate of 0.23 vehicles per household. It also has the second highest median household income ($61,260) in NYC. In contrast, the Jericho Turnpike facility catchment area in Nassau County, NY has the smallest population, the second largest average household size of 2.99 persons, the highest vehicles ownership rate of 2.05 vehicles per household, and the highest median household income ($98,385). The characteristics of the population of the Jericho Turnpike facility catchment area are more typical of suburban communities than the urban characteristics found within New York City.

Table 15: Demographic/Socio-Economic Summary

HISS Sites	Demographic		Socio – Economic		
	Population	Population/ Square Mile	HH Size	Median HH Income	Vehicles/ HH
23rd Street, Mn	281,228	89,563	1.59	$61,260	0.23
Cropsey Ave, Bk	107,169	34,119	2.52	$26,646	0.61
Jericho Turnpike, Nassau	13,625	4,311	2.99	$98,385	2.05
Northern Boulevard, Qn	215,452	68,615	2.60	$37,860	0.53
Rockaway Boulevard, Qn	132,148	42,085	3.32	$45,466	1.09
Targee Street, SI	69,658	22,184	2.68	$47,433	1.15
Veterans Road, SI	37,011	11,787	2.92	$64,062	1.67
Zerega Ave, Bx	67,559	21,516	2.82	$33,134	0.75

HH - Household

Figure 14: Catchment Area and Corresponding Census Tracts – Cropsey Ave
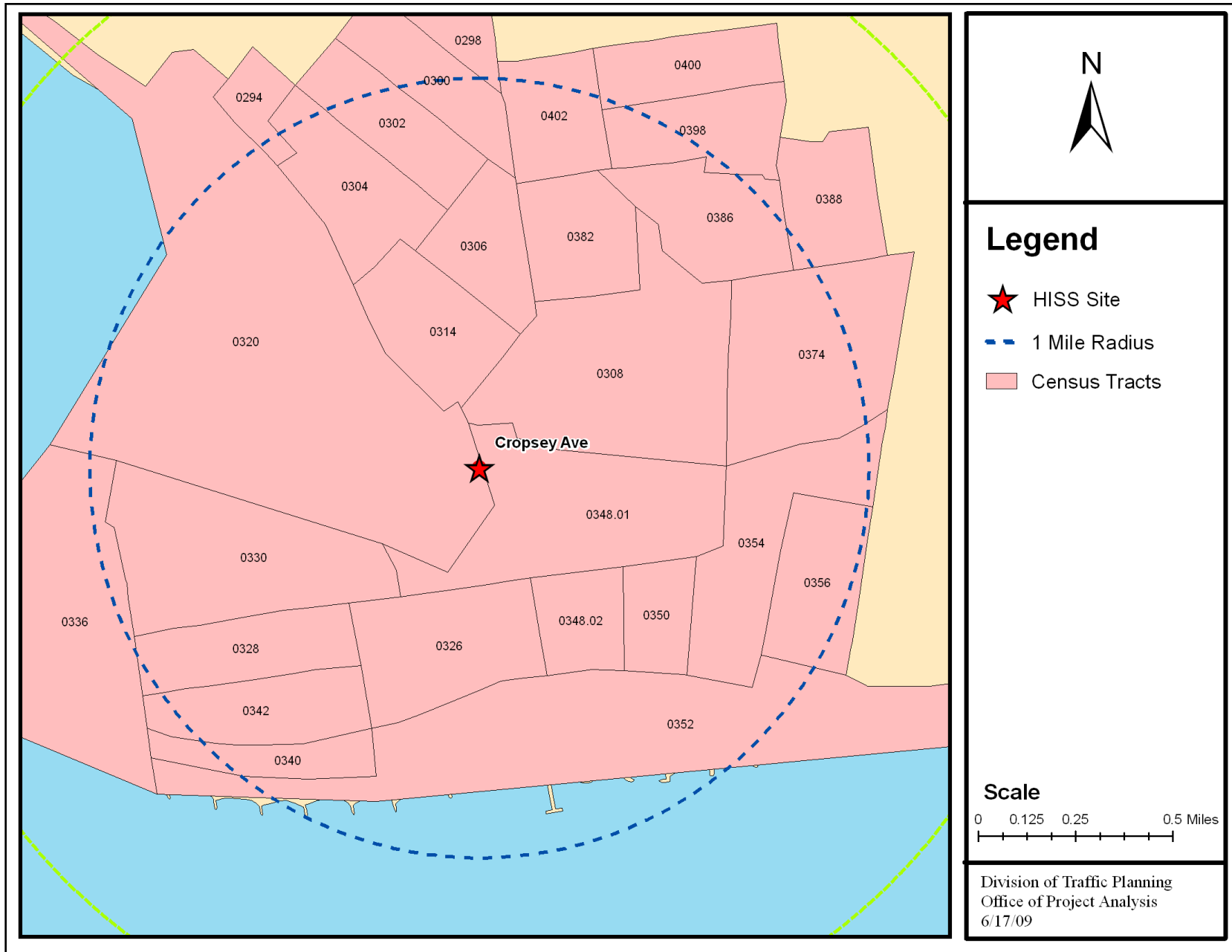
Figures 15, 16, 17 and 18 below display the population density, household size, median household income and vehicles per household respectively at the 8 HISS facilities and the corresponding counties in which they reside. The yellow shaded region represents one standard deviation above and below the 8 facility average. Figure 15 show that the 23rd Street and Northern Boulevard facilities have a population density above the standard deviation while the Jericho Turnpike facility has a population density below the one standard deviation area.

Figure 15: Population Density
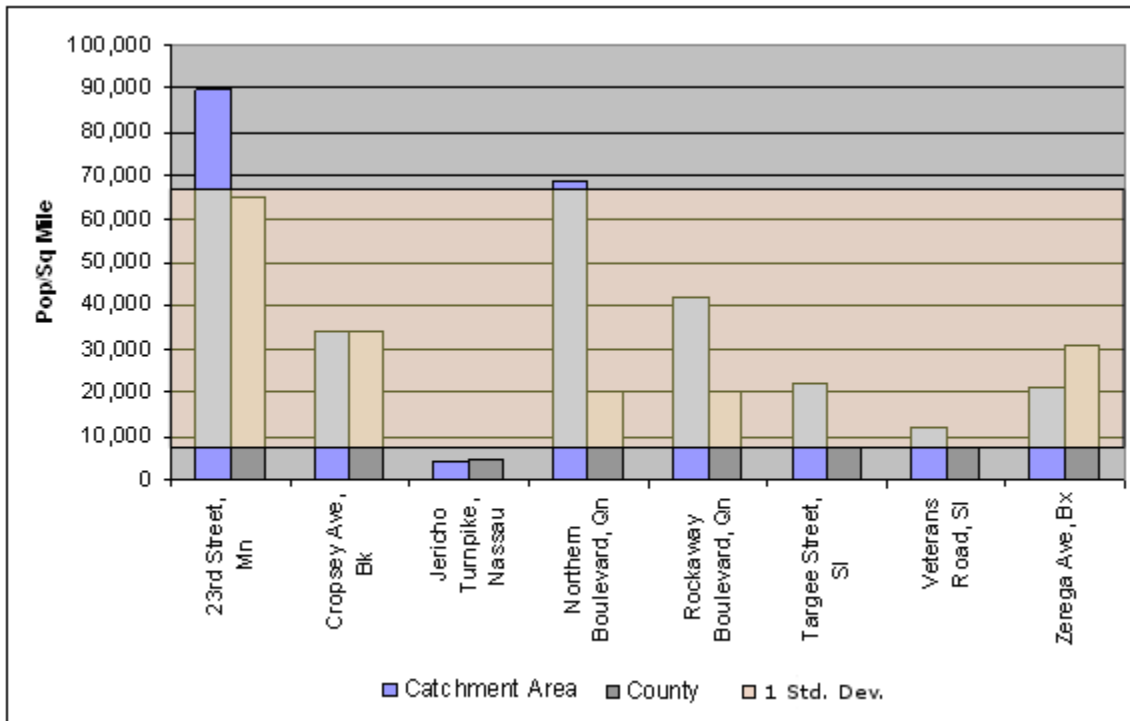
Figure 16: Household Size
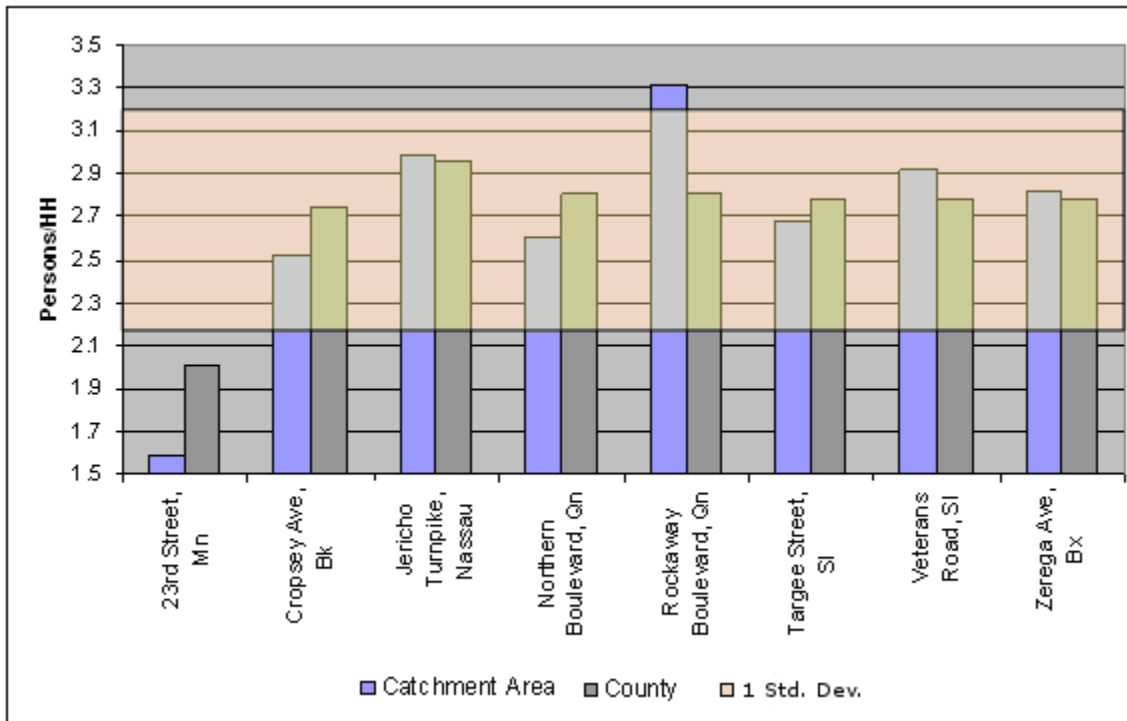
Figure 16 above shows that the 23rd Street facility's catchment area population has a household size lower than the standard deviation while the northern Boulevard facility catchment area has a household size higher than one standard deviation from the average. Figure 17 below show that the Jericho Turnpike catchment area population has a median household income well above while the Cropsey Avenue catchment area population median household income is just below one standard deviation from the 8 site average. Figure 18 shows that the Jericho Turnpike catchment area and Veterans Road facility catchment area population have a vehicle ownership rate higher than 1 standard deviation from the 8 site average while the 23rd Street catchment area population has a car ownership rate lower than one standard deviation from the 8 site average.

Figure 17: Median Household Income
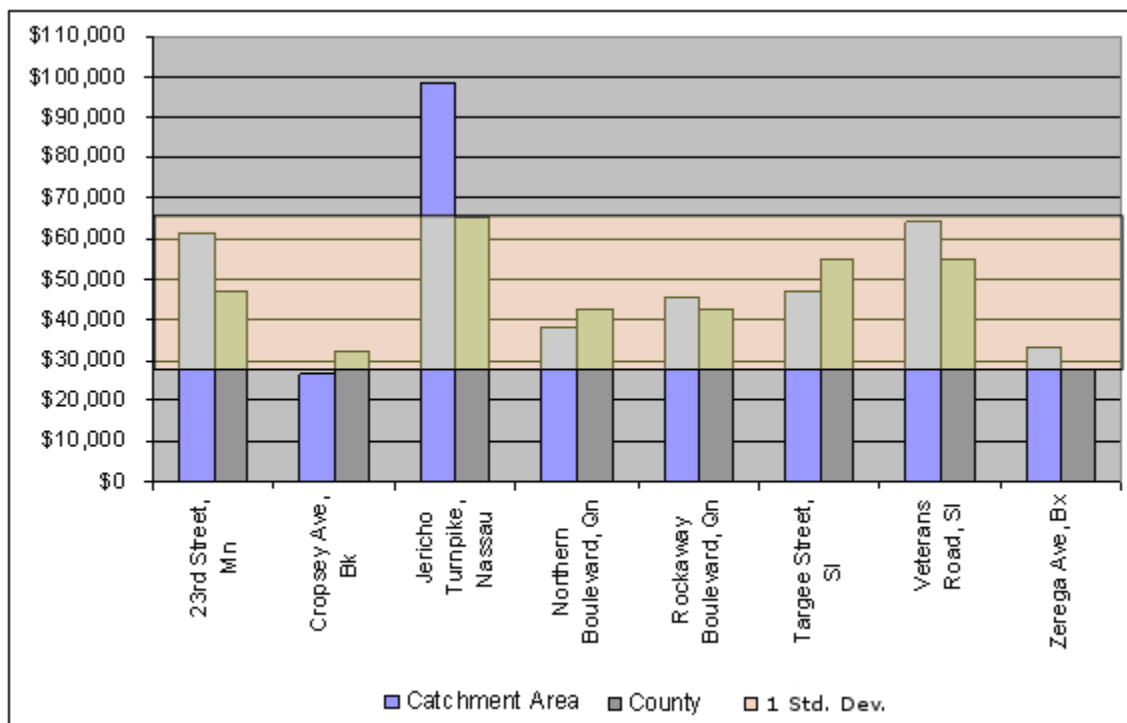
Figure 18: Vehicles per Household
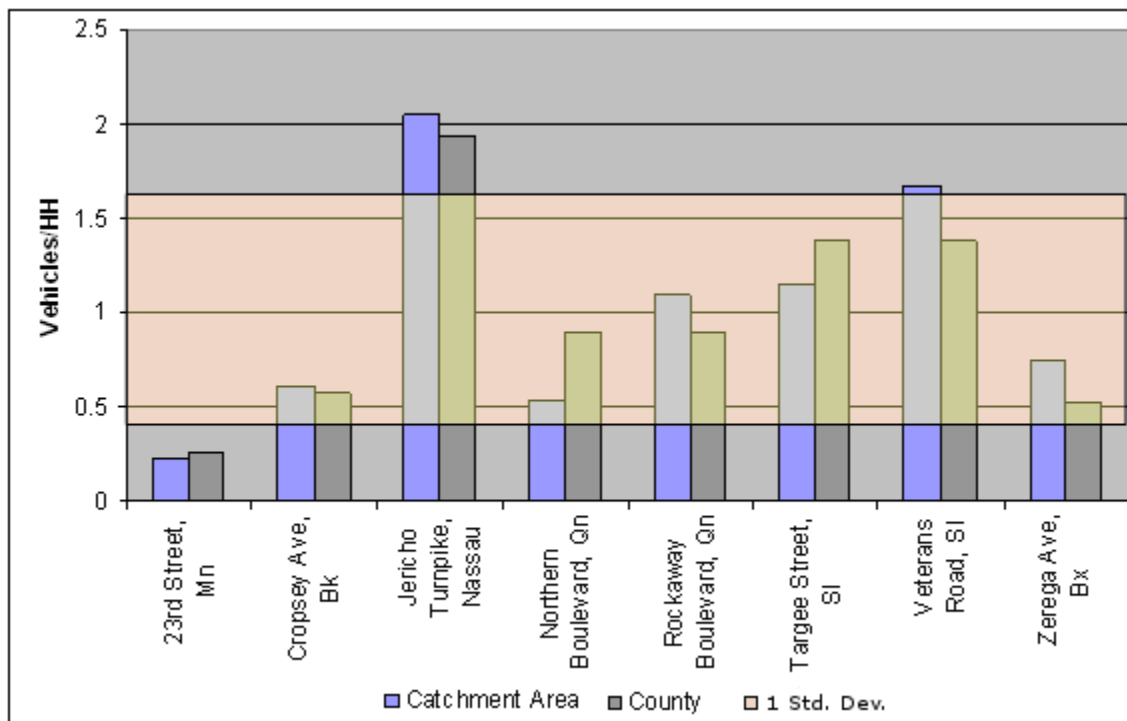
Land Use

There is a direct relationship between transportation/traffic and land use. Also different land uses and development densities produce different travel and trip characteristics. Therefore, an analysis of the existing zoning and land use in the catchment areas was conducted in order to better understand local travel behaviors. Land uses were identified using city zoning maps and MAPPluto GIS files that identify the particular land use of individual lots as well as general zoning classifications. Due to the presence of many commercial and residential sub-districts spread throughout the catchment areas, some form of grouping was needed for ease of analysis. The following zoning categories and groups were developed and used in this analysis based upon the distribution of zoning districts/land use and development densities within the catchment areas: R1-R4, R5-R7, R8-R10, C1-C4, C5-C8 and M1-M3.

The R1-R4 districts are low density residential areas that allow 1-2 family detached and attached housing. The R5-R7 districts allow multi-family medium density walkup residential buildings, and R8-R10 districts allow high density elevator residential buildings. C1-C4 districts allow low to medium density commercial uses. C5 and C6 districts allow for high density commercial uses, R7 districts allow amusement parks, and R8 districts allow for automotive uses such as showrooms and repair shops. Figure 19 below shows the Cropsey Avenue catchment area zoning analysis using the groups described above.

Table 16 below shows the percentages of land by zoning district within the catchment areas. The Jericho Turnpike catchment area, which includes the Jericho Turnpike commercial corridor and 1-2 family detached housing, was estimated from data compiled from longislandindex.com because the information was not available in the MapPluto GIS files.

Figure 19: Cropsey Avenue Zoning Analysis

Legend

★ HISS Site

┅┅ 1 mile radius

Zoning Districts/Groupings

R1-R4

R5-R7

C1-C4

C5-C8

Manufacturing

Scale

0   0.1   0.2   0.4 Miles

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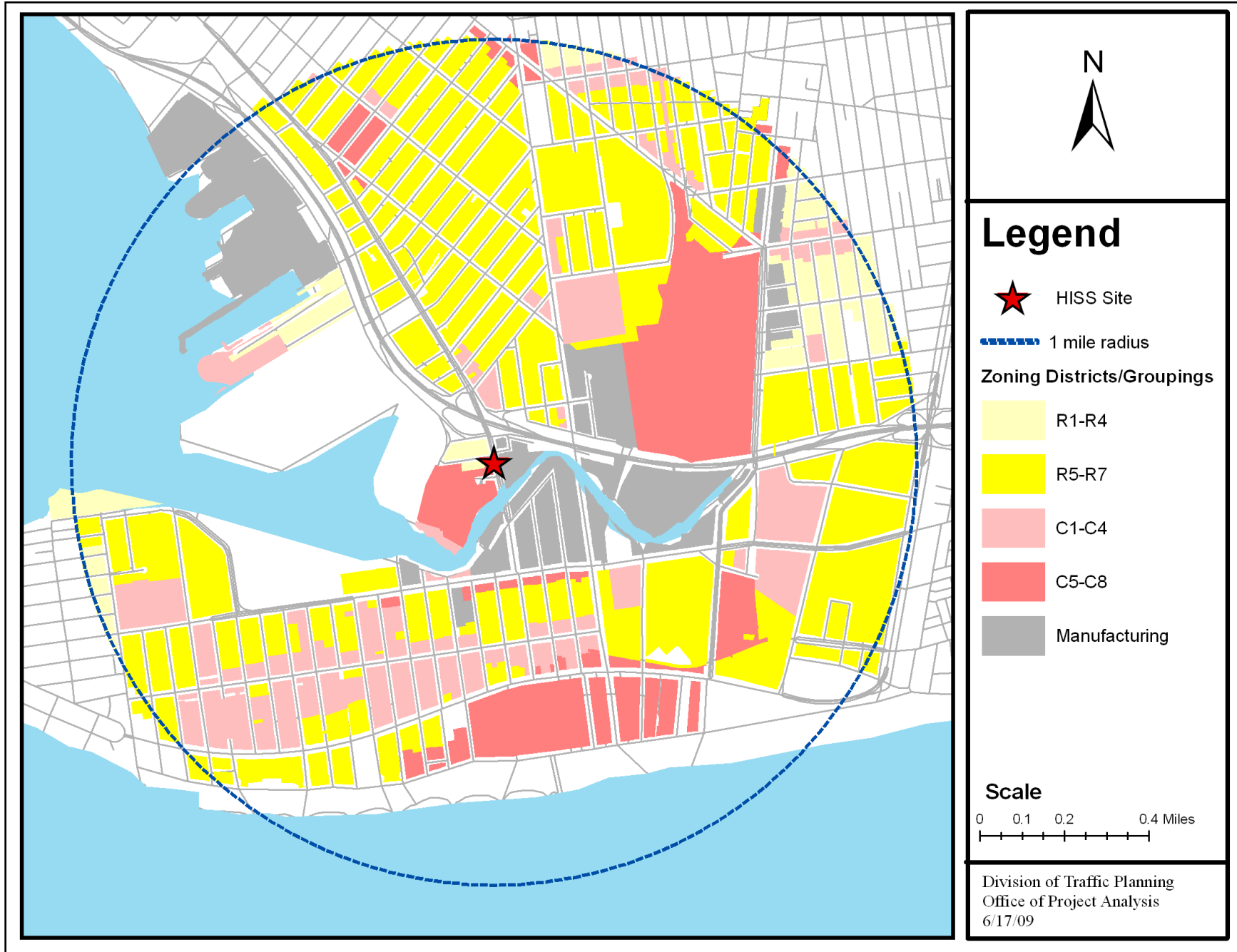
Table 16: Percentage Zoning Distribution

HISS Sites	Zoning Categories/Groups						Designation
	R1-R4	R5-R7	R8-R10	C1-C4	C5-C7	M1-M3	
23rd Street, Mn	0%	20%	15%	10%	35%	20%	High Density
Cropsey Ave Bk	5%	50%	0%	15%	15%	15%	Medium Density
Jericho TPK, Nassau	80%	0%	0%	10%	0%	10%	Low Density
Northern Blvd, Qn	10%	50%	0%	5%	2%	33%	Medium Density
Rockaway Blvd, Qn	60%	15%	0%	10%	15%	0%	Medium Density
Targee Street, SI	82%	3%	0%	7%	3%	5%	Low Density
Veterans Road, SI	60%	0%	0%	0%	0%	40%	Low Density
Zerega Ave, Bx	30%	40%	0%	7%	3%	20%	Medium Density

The analysis shows that the Targee Street, Jericho Turnpike and Veterans Road catchment areas are zoned predominately for low density residential development, with 60% or more of the land designated to that use. The Veterans Road and Northern Boulevard catchment areas have the highest percentage of land zoned for manufacturing of the studied catchment areas: 40% and 33% respectively. The Cropsey Avenue, Zerega Avenue and Northern Boulevard catchment areas each designate more than 40% of land to medium density residential uses. The Cropsey Avenue, 23rd Street, and Rockaway Boulevard catchment areas have more than 25% of the land area zoned for commercial uses. The 23rd street catchment area is zoned for med-high density residential, commercial, and manufacturing uses, and accommodates the largest population, with 281,220 residents. The Northern Boulevard catchment area, with 50% of land devoted to medium density residential development has the second largest population, with 215,652 residents. If development density and population concentration are the key determinants in trip making, then the Cropsey Avenue HD, Northern Boulevard HD and Zerega Avenue facility should generate more trips than the other studied catchment areas. However, accessibility, car ownership, and vehicle occupancy are also significant factors to consider.

Transportation /Accessibility

Location and accessibility have always been essential to the success of any commercial retail activity. The extent to which each studied facility has direct access by various transportation modes was identified and quantified in the following manner:

Roadway Access

    a.) Proximity of expressway to the site, i.e., within 1 mile of the facility

    b.) Presence of principal arterials within 1 mile of the facility

    c.) Number of Collectors within 1 mile of the facility.

    d.) Distance and number of signalized intersections of shortest route from facility to nearest expressway.

    e.) Average travel time from catchment area midpoint (1/2 mile radius) to facility.

    f.) Number of on-site parking spaces

Transit Access

    a.) Number of surface transit (bus routes) lines running adjacent and within 1 mile of the facility.

    b.) Number of subway lines and stations within 1 mile of the facility

    c.) Distance of closest subway station

The quantification of the roadway and transit access factors helped to identify which sites are either not very accessible, are accessible or are very accessible. Figure 20 below shows the Cropsey Avenue roadway accessibility map. Similar maps for each facility can be found in Appendix B. As seen in figure 20, the Cropsey Avenue facility has direct access from an expressway and a principal arterial that runs through the center of the catchment area. Also there are two principal arterials within ½ mile of the facility, thus making the site very accessible by automobiles. It also has a bus route within 1000 feet of the site.

Figure 20: Cropsey Avenue Roadway Access

Legend

★ HISS Site

- - - 1 Mile Radius

━━ Expressway

━━ Principal Arterial

━━ Collector

Scale
0   0.125   0.25   0.5 Miles

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6/17/09

Stillwell Ave

Belt Parkway

Cropsey Ave

Cropsey Ave

Ocean Ave

Neptune Ave

Surf Ave

N

25
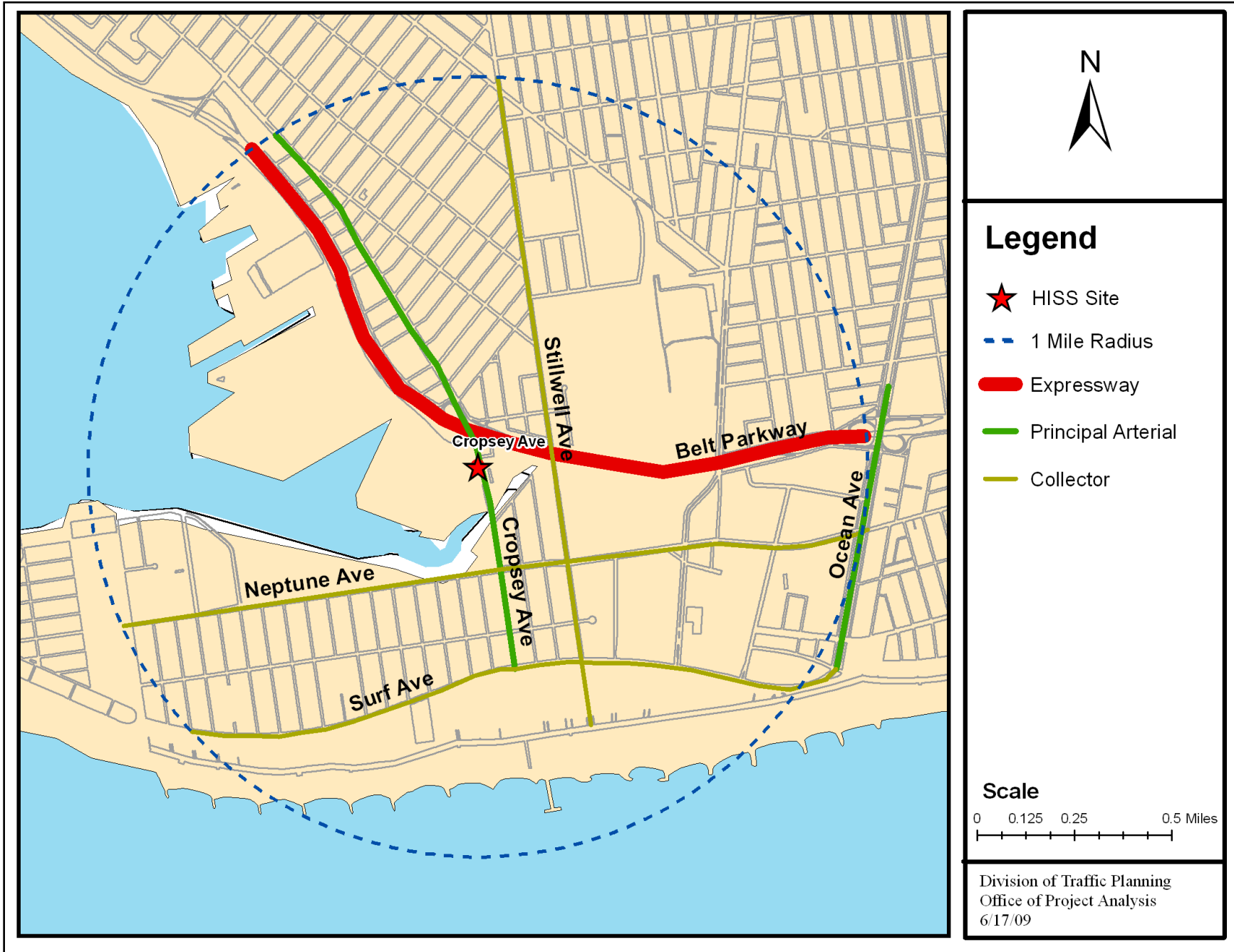
The eight facilities and their corresponding roadway and transit access factors, which assess the degree of accessibility of the facility, are quantified in tables 17 and 18. Cropsey Avenue, Veterans Road and Zerega Avenue were deemed highly accessible by automobile due to the number and proximity of major expressways in the area. The 23rd Street site was rated not very accessible by automobile due to the proximity of expressways and the lack of on-site parking. The 23rd Street facility and the Northern Boulevard facility are very accessible via transit with multiple subway lines and bus routes near or adjacent to the site. Conversely, the Jericho Turnpike, Veterans Road and Zerega Avenue facilities are not very accessible by transit with no or few subways and limited bus service in the area.

Table 17: Roadway Accessibility

Facilities	# Expressways (1 mile)	# Arterials (1 mile)	# Collectors (1 mile)	Shortest Route to Nearest Expressway	# Signalized Intersections Along Route	Average Time Traveled (within catchment area)	# Parking Spaces	Roadway Accessibility
23rd Street	2	14	2	5,400'	7	1:42	0	not very accessible
Cropsey Street	1	1	3	800'	2	2:05	572	very accessible
Jericho Turnpike	2	1	5	5,000'	6	2:08	480	accessible
Northern Blvd	1	4	6	4,000'	8	2:07	440	accessible
Rockaway Blvd	3	3	4	6,500'	12	1:54	340	accessible
Targee Street	1	4	2	2,500'	5	2:58	360	accessible
Veterans Rd	2	3	3	900'	0	3:00	480	very accessible
Zerega Ave	3	3	2	2,800'	3	2:59	550	very accessible

Table 18: Transit Accessibility

Facilities	# Subway Lines (1 mile)	# Subway Stops (1 mile)	Distance to Nearest Subway Stop	# Bus Lines (1 mile)	# Adj. Bus Lines	Adj. Bus Headway (Peak Period)	Transit Accessibility
23rd Street	15	25	500'	89	7	53	Very Accessible
Cropsey Street	4	7	2,000'	12	3	26	Accessible
Jericho Turnpike	0	0	N/A	1	0	0	Not Accessible
Northern Blvd	8	12	1,000'	26	5	48	Very accessible
Rockaway Blvd	1	4	3,000'	9	2	28	Accessible
Targee Street	1	2	4,000'	36	3	26	Accessible
Veterans Rd	1	2	4,000'	3	0	0	Not Accessible
Zerega Ave	0	0	5,000'	13	0	0	Not accessible

Evaluation of Significant Factors in Trip Generation

The proceeding evaluation of the significant factors: demographic/socio-economic, land use and accessibility helped to identify those facilities that are similar or dissimilar among the 8 facilities. In comparing the significant factors of each facility a statistical analysis was applied and those values that fell within one standard deviation were considered average while those falling above or below the standard deviation were considered as outliers. One standard deviation was also used among the AM, MD, PM and Saturday trip rates of the eight facilities to identify unusually high and low rates within the set. Having grouped the factors, trip generation rates, demographic factors, land use and accessibility into high (h), medium (m) and low (l) categories, a matrix was used to evaluate the sites. For example, in the land use and accessibility analysis, medium density and medium accessibility was used to represent the norm while high and low density and accessibility were seen as different from the norm. Table 19 shows the various sites with the trip rates and other factors expressed as high, medium or low. The medium ratings were then tallied and the facilities were ordered by the number of medium ratings. Evaluating the facilities in this manner reveals 23rd Street and Jericho Turnpike have many characteristics that differ significantly from the other 6 facilities.

Table 19: Secondary Survey Outliers

Locations	Vehicle Trip Rates				Demographics				Land Use	Access		
	AM	MD	PM	Sat	Pop Density	HH Income	Vehicles / HH	HH Size		Vehicle	Transit	# Medium
Targee Street	M	M	M	M	M	M	M	M	L	M	M	10
Zerega Ave	M	M	M	M	M	M	M	M	M	H	L	9
High	M	M	M	M	H	M	M	M	M	M	H	9
Cropsey Ave	M	M	M	M	M	L	M	M	M	H	M	9
Rockaway Blvd	H	M	H	H	M	M	M	H	M	M	M	7
Veterans Road	M	M	L	M	M	M	H	M	L	H	L	6
Jericho Tpk	M	H	M	L	L	H	H	H	L	M	L	3
23rd Street	L	L	L	L	H	M	L	L	H	L	H	1

Trip Generation Rate Calculation

The analysis of trip generation, demographics, land use, and transportation accessibility for each facility revealed that two of the eight facilities differed significantly from the others. The statistical analysis concluded that the difference of the two sites, 23rd Street and Jericho Turnpike, are statistically significant. The Veterans Road site was on the border line but it was not a mature site having been built less than two years before the survey. Thus the 23rd Street site in Manhattan, the Jericho Turnpike site in Nassau County and Veterans Road in Staten Island were not used in the computation of NYC trip generation rates.

The Jericho Turnpike facility, located outside of New York City, was selected as a control to test the hypothesis that trip generation rates in New York City are different from other areas and the ITE. The results of this study prove the hypothesis to be true.

The 23rd Street facility, located in Manhattan with the highest development density, significant transit provisions and the lowest vehicle ownership rates, yielded exceedingly low trip rates. At this facility, the vehicle trip rates are therefore far below those of the other facilities, and the person trip rates per 1,000 square feet are very high compared to the other facilities.

The Veterans Road facility opened in 2006. The site was not mature at the time of the study, being in operation for less than two years, so the trip characteristics had not settled and may not reflect average conditions. Additionally, the facility is located in a very low density area which accounts for trips and peak periods that varied significantly from the average of the other facilities.

Computing the trip generation rates from the remaining five facilities yielded the following; The average size of the five facilities is 136,171 square feet with an average of 6,745 vehicle trips during the weekday and 7,817 vehicle trips on Saturday. On a weekday a NYC Home Improvement Superstore can be expected to generate 49.53 vehicle trips per 1,000 square feet with average vehicle occupancy of 1.32 persons. The weekday peak hour rates are 3.65, 3.56, and 3.46 trips per 1,000 square feet during the AM peak, Midday peak, and PM peaks, respectively. The average vehicle occupancy rate is 1.24, 1.33, and 1.40 persons (auto only) during the AM, Midday, and PM peaks, respectively. The Saturday peak trip rate is 5.67 trips per 1,000 square feet with vehicle occupancy of 1.52. The summary results are in table 20 below

Table 20: Summary Trip Generation

NYC HISS Average Size: 136,171 sq ft		WD AM	WD MD	WD PM	Sat Pk
Vehicle Trips/1,000 sq ft		3.65	3.56	3.46	5.78
Mode Split	Walk	10.4%	12.3%	10.6%	11.1%
	Bike	0.4%	0.4%	0.3%	0.3%
	Auto	73.9%	76.8%	81.2%	82.8%
	Taxi	0.9%	1.8%	1.9%	1.7%
	Commercial Van	14.4%	8.7%	6.0%	4.1%
Temporal Distribution		7.2%	7.1%	7.0%	9.8%
Directional Distribution (ins/outs)		52% / 48%	50% / 50%	51% / 49%	50% / 50%
Vehicular Occupancy	Auto	1.24	1.33	1.40	1.52
	Taxi	1.50	1.44	1.57	1.58
	Commercial Van	1.29	1.36	1.29	1.29
# Truck Trips		15	13	5	6
Truck Trips/1,000 sq ft		0.110	0.095	0.036	0.043

* WD - Weekday

Comparison of Trip Rates

Table 21 below shows the peak period trip generation rates for NYC (study results), the ITE and the rates used in two EIS's. The EIS's were conducted for the Cropsey Avenue facility development in Brooklyn (1999) and the Zerega Avenue facility in the Bronx (2000).

Table 21: NYC, ITE and EIS Vehicle Trips per 1,000 Square Feet

Peak Period	NYC	ITE	EIS
Weekday AM	3.65	2.85	N/A
Weekday MD	3.56	N/A	4.70
Weekday PM	3.46	3.05	4.28
Sat Peak	5.78	5.40	6.83

The study concludes that the trip generation rates for Home Improvement Superstores in NYC are higher than the ITE rates for each peak period. However, the rates used in the Environmental Impact Statements (EIS) are higher for each peak period. Figure 21 below shows the estimated trips resulting from trip rates used in this study (NYC), the ITE and the EIS that was done at the Cropsey Avenue facility in comparison to the trips that were observed at Cropsey Avenue during this study's vehicle survey. Figure 22 shows the same information at the Zerage Avenue facility.

Figure 21: Cropsey Avenue Observed and Estimated Vehicle Trips

	Weekday AM	Weekday MD	Weekday PM	Sat Peak
NYC	624	609	592	988
ITE	487		522	923
EIS (1998)		804	732	1168
Cropsey Ave.	472	490	472	750
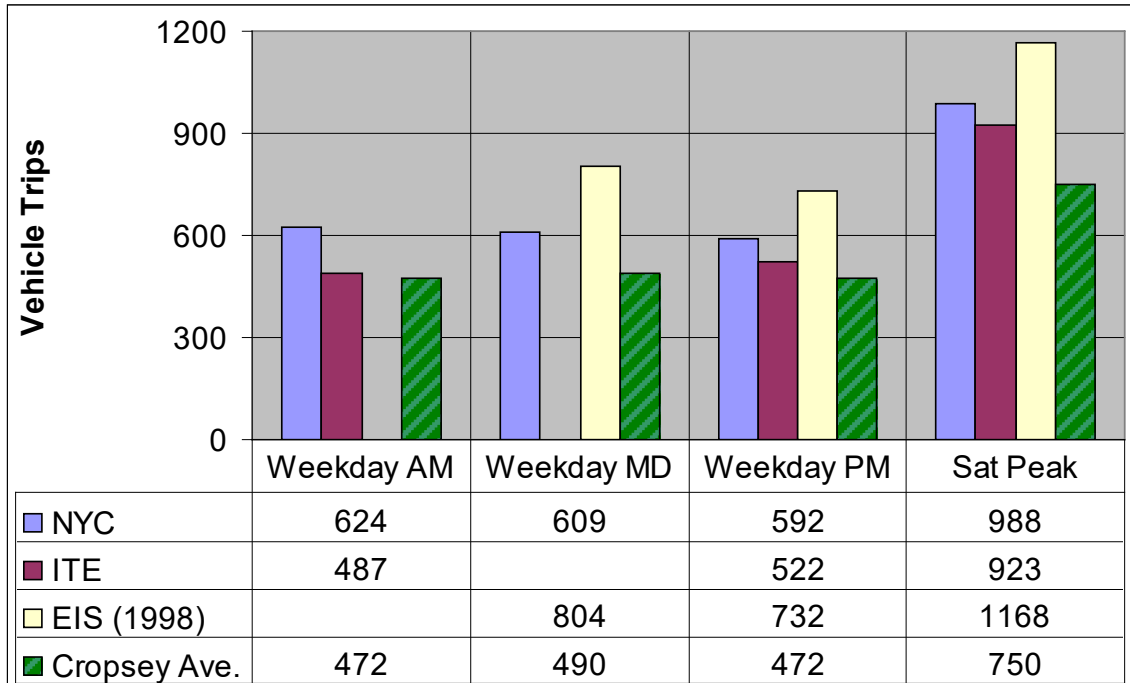
Figure 22: Zerega Avenue Observed and Estimated Vehicle Trips

	Weekday AM	Weekday MD	Weekday PM	Sat Peak
NYC	503	490	476	796
ITE	392		420	744
EIS (1998)		647	589	940
Zerega Ave.	409	452	419	686
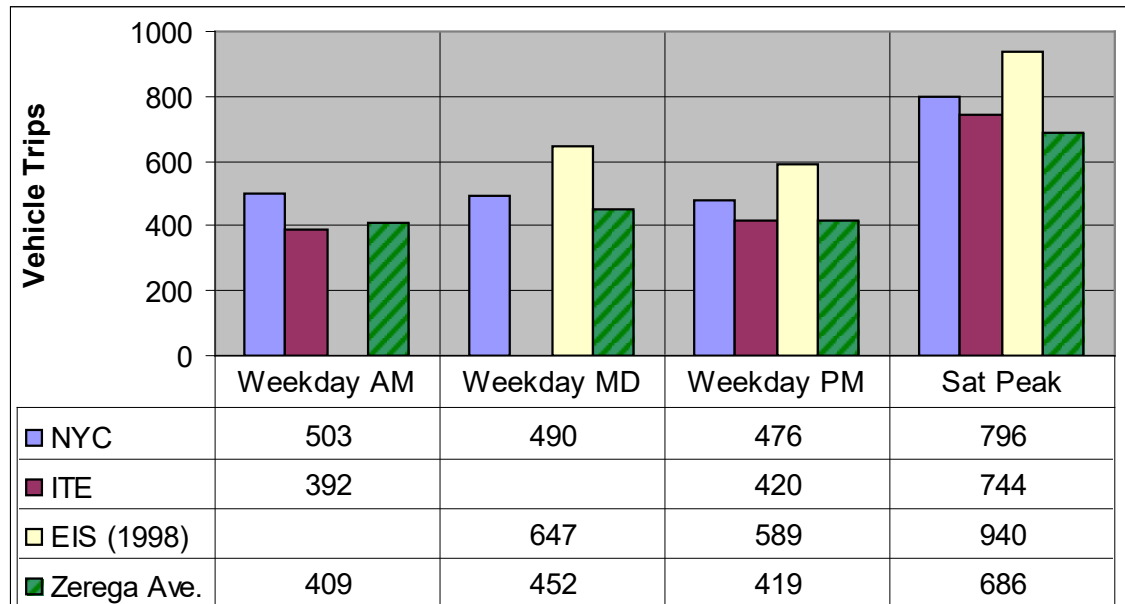
The following explains the statistical analysis employed in developing the trip generation rates.

Statistical Test:

A one way Analysis of Variance (ANOVA) was performed to test the equality of the Average trip rates derived from the field survey data for each of the eight buildings studied. A one way Analysis of Variance is a way to test the equality of three or more means at one time using their respective variances. The tests were conducted for AM, Midday, and PM peak periods of vehicular trip generation.

Assumptions:

The trip rates were calculated using the vehicular trips generated by each building surveyed as a function of their respective gross square feet. The population from which the samples (trip rates) were obtained was assumed to be approximately normally distributed.

Hypothesis:

The *null hypothesis (H0)* is that all average trip rates calculated for each building are equal. The *alternative hypothesis (Ha)* is that at least one Average trip rate (mean) is different.

Of all the information presented in the ANOVA table, our major interest is focused on the value located in the "Significance (Sig)" column. If the number (or numbers) found in this column is (are) less than the critical alpha value (α) set for this study which is usually set at 0.05, then the effect is said to be significant. Any value greater than this value, will result in a non significant effects. If the effects are found to be non significant, then the differences between the means are not significant enough to say that the mean trip rates are different.

When the effects are significant, or the decision from the ANOVA is to reject the null hypothesis, the mean trip rates that are identified to be significantly different must be examined in order to figure out where the differences lie, and what accounts for the difference and not just that there is difference. These procedures to be applied are called "post-hoc tests". If the sample sizes are

the same for each building, the Tukey Test can be used to analyze pairs of means to see if there is a difference or similarities in the average trip rates. After performing *multiple comparison,* a set of groups that have means which are not significantly different from one another are isolated. Those that are significantly different can further be examined to determine possible factors that account for the variations.

Results of ANOVA:

The results of the ANOVA for the AM, Midday, and PM peak periods are presented in the Appendix C. The tables contain columns labeled the Sum of Squares, DF – for degrees of freedom, mean square, F – or F-ratio, and sig., or sig. of F. The only columns that are critical for interpretation are the first and the last. The others are used mainly for intermediate computational purposes. For all peak periods, the significance levels show a value of 0.000. This value is lower than the critical alpha value (α) set for this study which is 0.05. This indicates that for each peak period the means are significantly different and we decide that the effects are real. They did not occur due to chance alone. Therefore, we reject the null hypothesis that all average trip rates calculated for each building are equal.

Levene's test of homogeneity of variance is computed by SPSS to test the ANOVA assumption that each group (category) of the independent) (s) has the same variance. If the Levene statistic is significant at the .05 level or better, then we reject the null hypothesis that the groups have equal variances.

Result of the Levene's Test: Because the Levene statistic is significant at the .05 level for the trip rates derived for each building, we conclude that the eight buildings trip rates are not homogenous in variances, negating an assumption of ANOVA that each building trip rates has the same variance.

Note, however, that failure to satisfy the assumption of homogeneity of variances is not fatal to ANOVA, because it is relatively robust, particularly when groups are of equal sample size. For the eight building we analyzed, the trip rate sample size was the same.

Results of post-hoc tests: The Tukey Test was performed to compare pairs of average trip rates (means) to see if there is a difference or similarities in the average trip rates. If we look in the "Mean Difference" column, in the Post Hoc Tests (Appendix) we will note that some of the differences have asterisks, to indicate which are significant at the .05 level or better. For instance, the first such coefficient is in the am peak period, -0.2038, indicating that mean trip rates is significantly different between the "Cropsey" and the "Jericho" buildings. Table 22below show the buildings that do not have significant difference in their mean trip rates.

Table 22: Trip Rate Comparisons

AM Peak Period	Buildings	Significance alpha = .05
Buildings	**Buildings**	**Significance alpha = .05**
1 Cropsey	Targee	0.991
2 Jericho	Northern Boulevard	0.255
3 23 Street	-	
4 Northern Boulevard	Jericho	0.255
5 Rockaway	Northern Boulevard	0.483
6 Targee	Cropsey, Zerega	0.991; 0.592
7 Veterans	-	
8 Zerega	Cropsey; Targee	0.972; 0.592
Midday Peak Period		
Buildings	**Buildings**	**Significance alpha = .05**
1 Cropsey	Targee; Zerega	0.984, 1.0
2 Jericho	Northern Boulevard	0.064
3 23 Street	Veterans	0.240
4 Northern Boulevard	Jericho	0.064
5 Rockaway	-	0.483
6 Targee	Cropsey, Zerega	0.991; 0.0.991
7 Veterans	23 Street	0.240
8 Zerega	Cropsey; Targee	1.0; 0.991
PM Peak Period		
Buildings	**Buildings**	**Significance alpha = .05**
1 Cropsey	Jericho, Targee, Zerega	1.0; 0.996; .997
2 Jericho	Cropsey, Targee; Zerega	1.0; 0; 0.999;0.991
3 23 Street	Veterans	1.0
4 Northern Boulevard	Rockaway	0..998
5 Rockaway	Northern Boulevard	0.998
6 Targee	Cropsey, Jericho; Zerega	0.996; 0.999; 0.843
7 Veterans	23 street	1.0
8 Zerega	Cropsey; Jericho; Targee	0.997; 0.991; 0.843

Figure 23: Data Plot and Equation - AM Peak

Average Trip Ends vs: 1000 Sq.Ft GFA on AM PK. HR Generator

Average Rate = 3.76 Range of Rates: 2.97 - 4.68

Number of Studies = 5

X= 1000 SQ Ft GFA ln T= X ln 0.0111+ ln 108.636 R^2=0.699
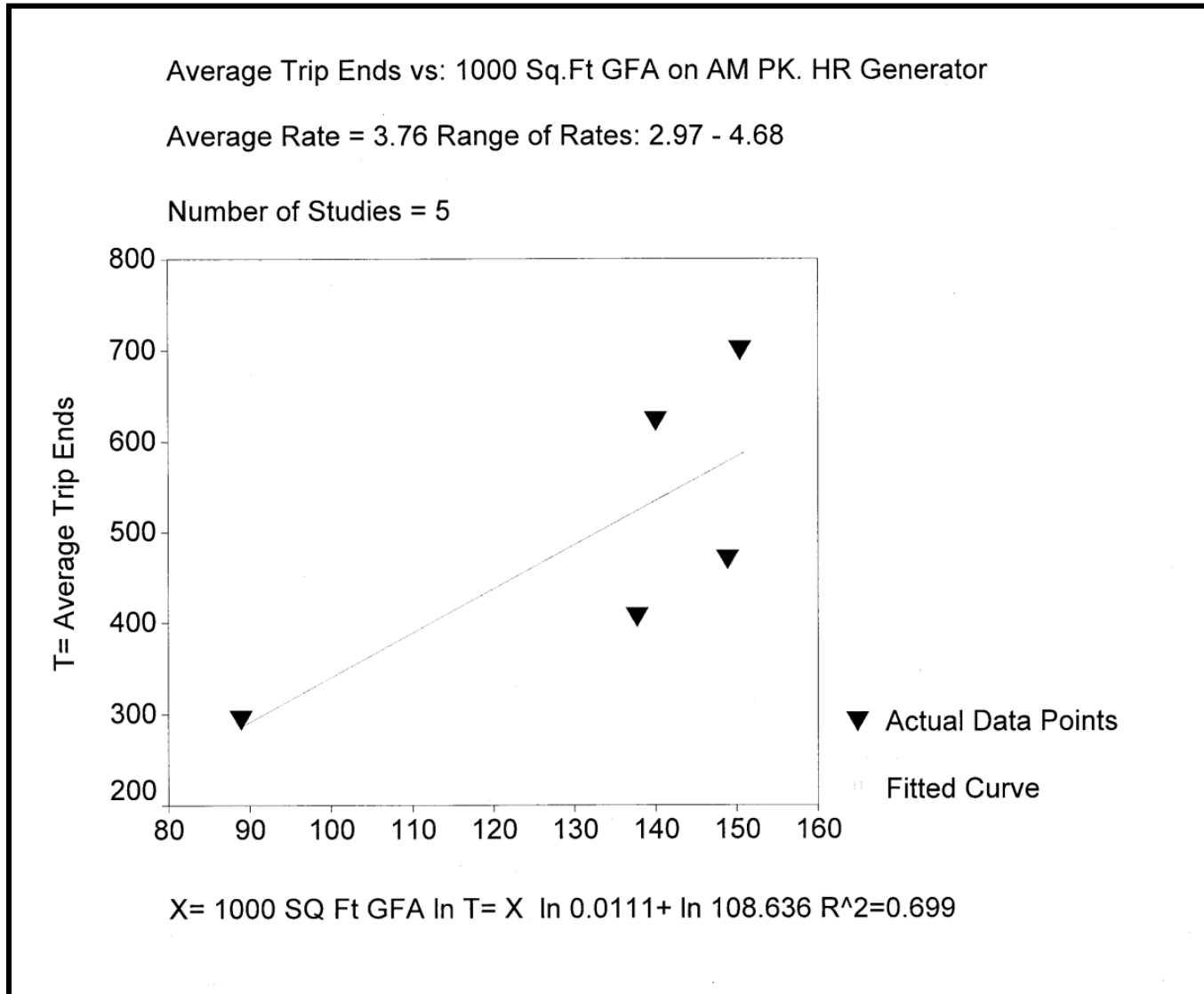
Figure 24: Data Plot and Equation - MD Peak

Average Trip Ends vs: 1000 Sq.Ft GFA on MD PK. HR Generator

Average Rate = 3.69 Range of Rates: 3.14 - 4.65

Number of Studies = 5

X=1000 SQ. Ft GFA ln T = X ln 0.0114+ ln 102.915 R^2=0.760
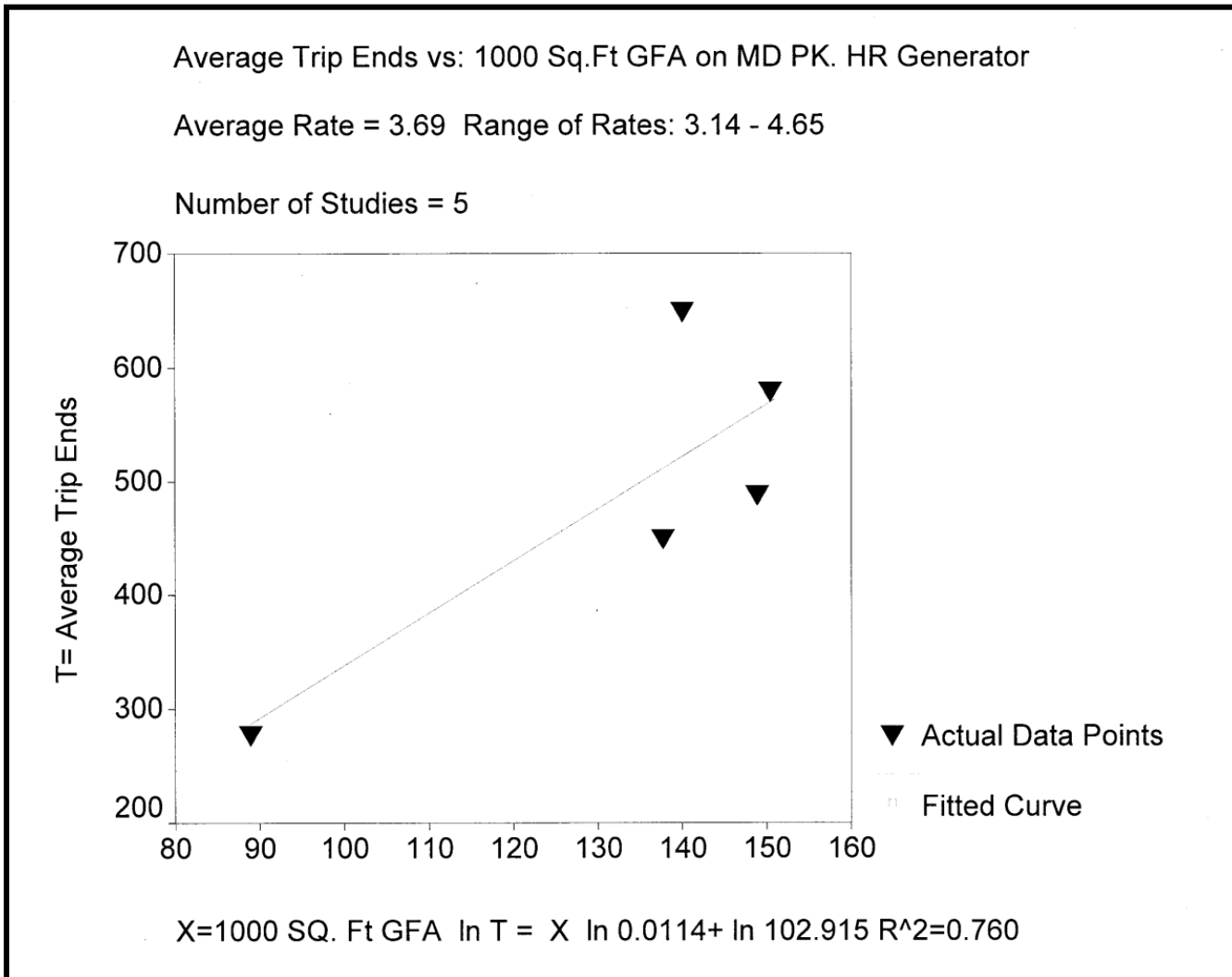
Figure 25: Data Plot and Equation - PM Peak

Avg. Trip Ends vs: 1000 Sq. Ft GFA on PM PK. HR Generator

Average Rate = 3.56 Range of Rates: 3.04 - 4.24

Number of Studies=5

X=1000 SQ.Ft Gross Floor Area lnT= X ln 0.100 + ln 120.893 R^2=0.769
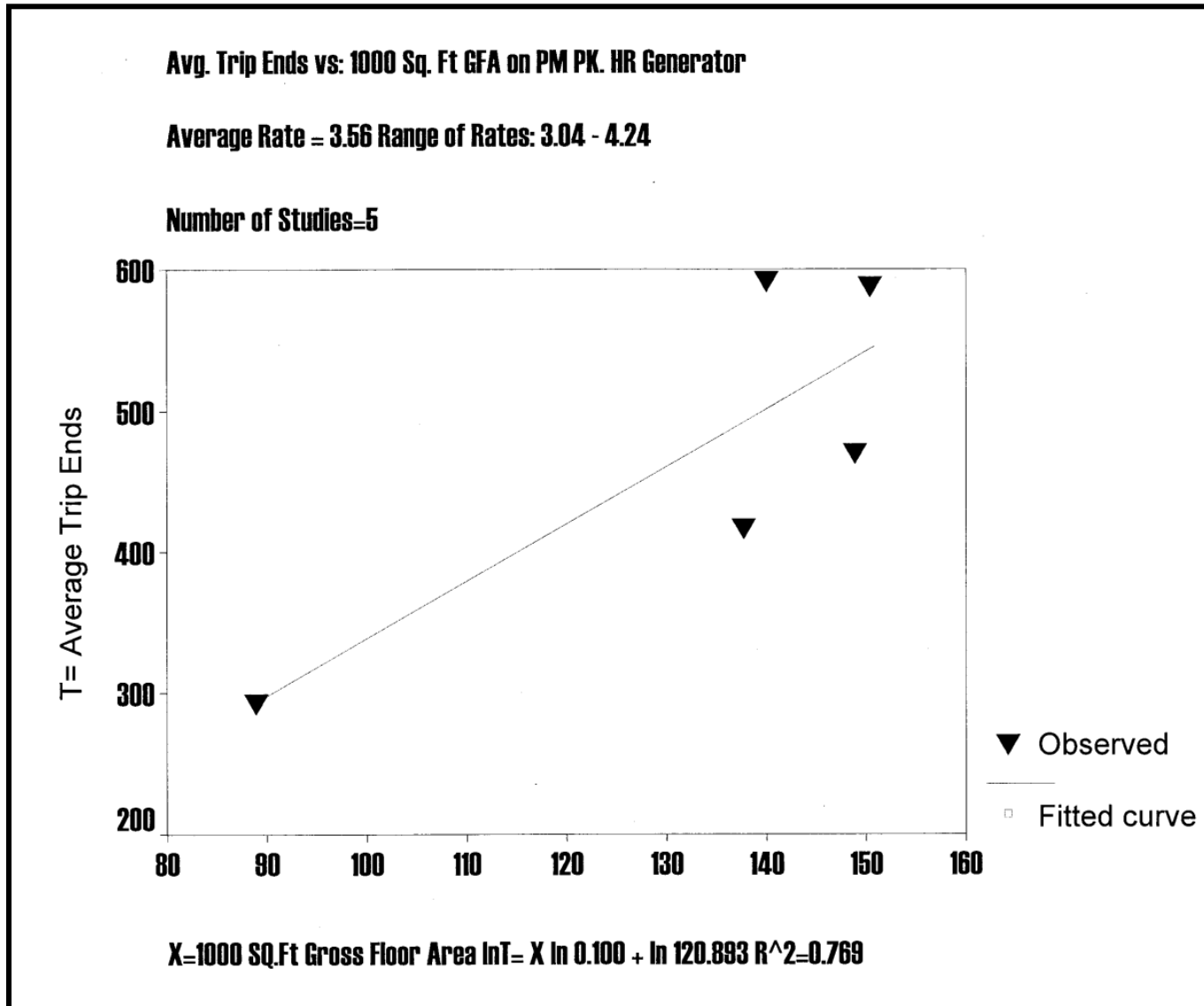
Figure 26: Data Plot and Equation - WD Peak

Avg.Trip Ends vs:1000 Sq.Ft GFA on Wk Day PK.HR Generator

Average Rate = 3.90 Range of Rates: 3.15 - 4.74

Number of Studies = 5

▼ Actual Data Points

Fitted Curve

X=1000 SQ.Ft Gross Floor Area lnT = X ln 0.0121 + ln 99.3017 R^2 =0.766
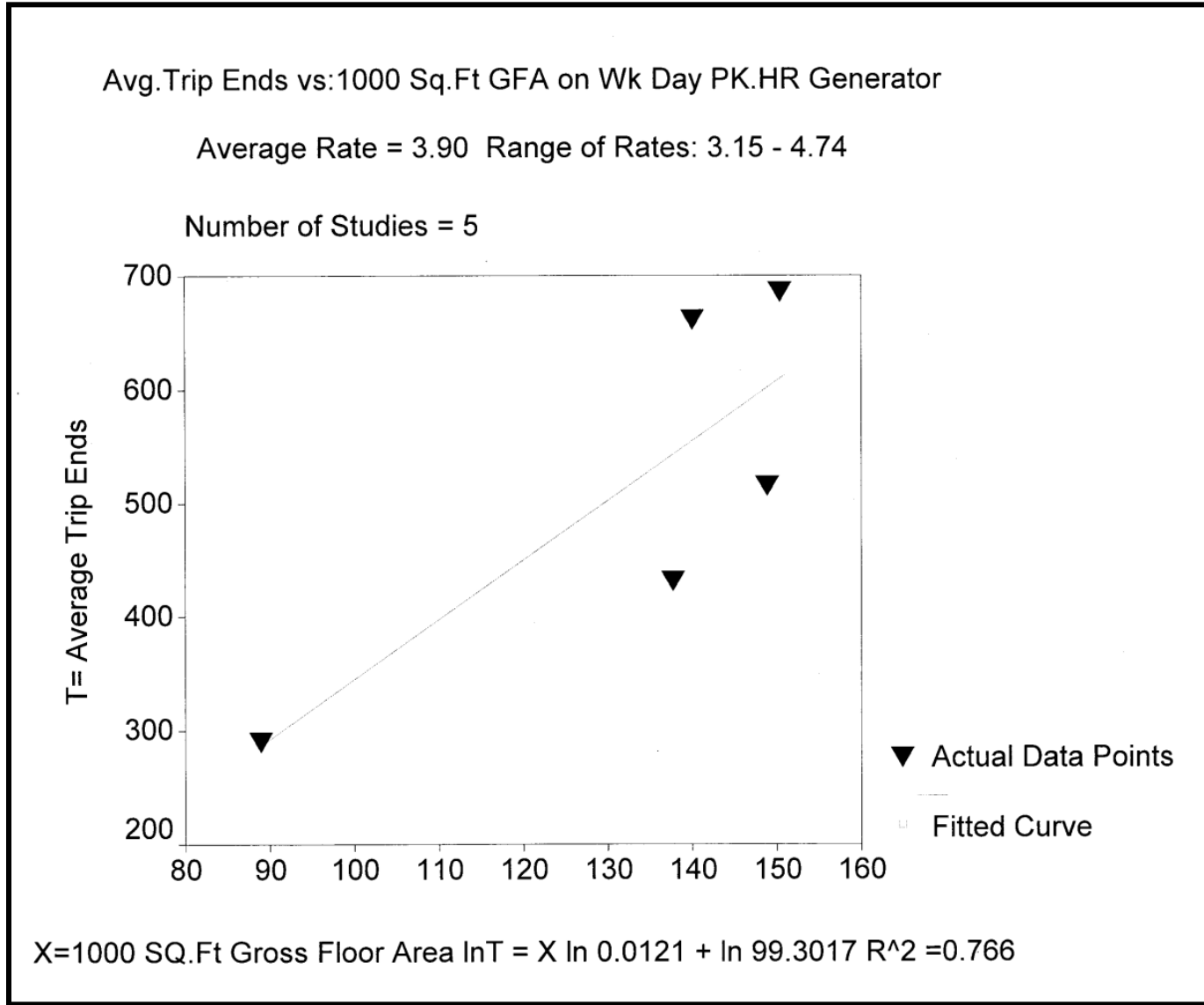
Figure 27: Data Plot and Equation - AM Adj.

Average Trip Ends vs: 1000 Sq. Ft GFA on AM Adj.

Average Rate: 2.55 Range of Rates: 1.53 - 3.20

Number of Studies = 5

▼ Actual Data Points

Fitted Curve

X=1000 SQ Ft GFA T= 0.1620 X^2-35.804X+2151.89   R^2=0.470
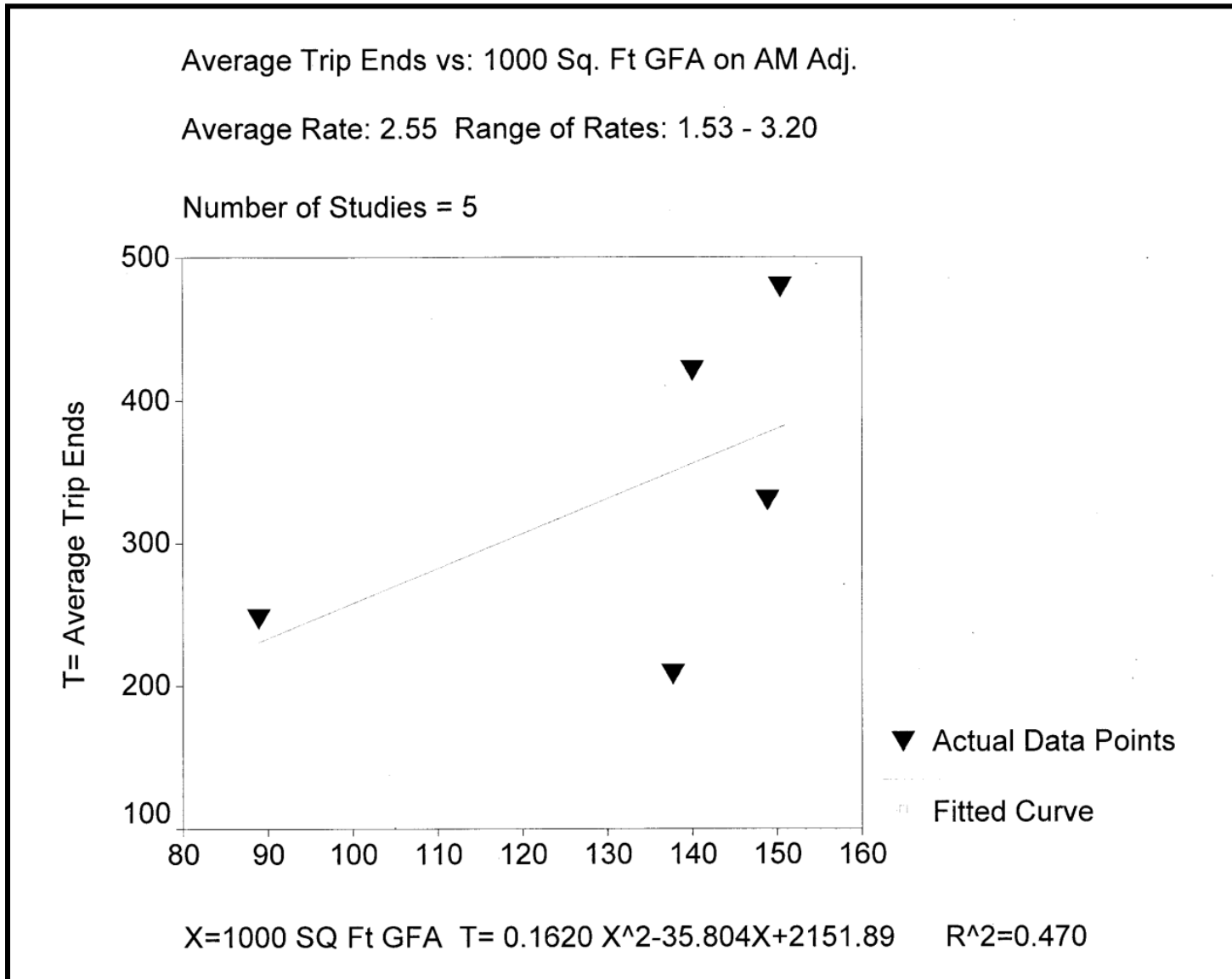
Figure 28: Data Plot and Equation - PM Adj.

Average Trip Ends vs:1000 Sq. Ft GFA on PM Adj

Average Rate = 3.50   Range of Rates: 2.84 - 4.46

Number of Studies = 5

▼ Actual Data Points

▫ Curve Fitted

X=1000 SQ Ft GFA In T= X In 0.0091 + In 134.525   R^2 = 0.622
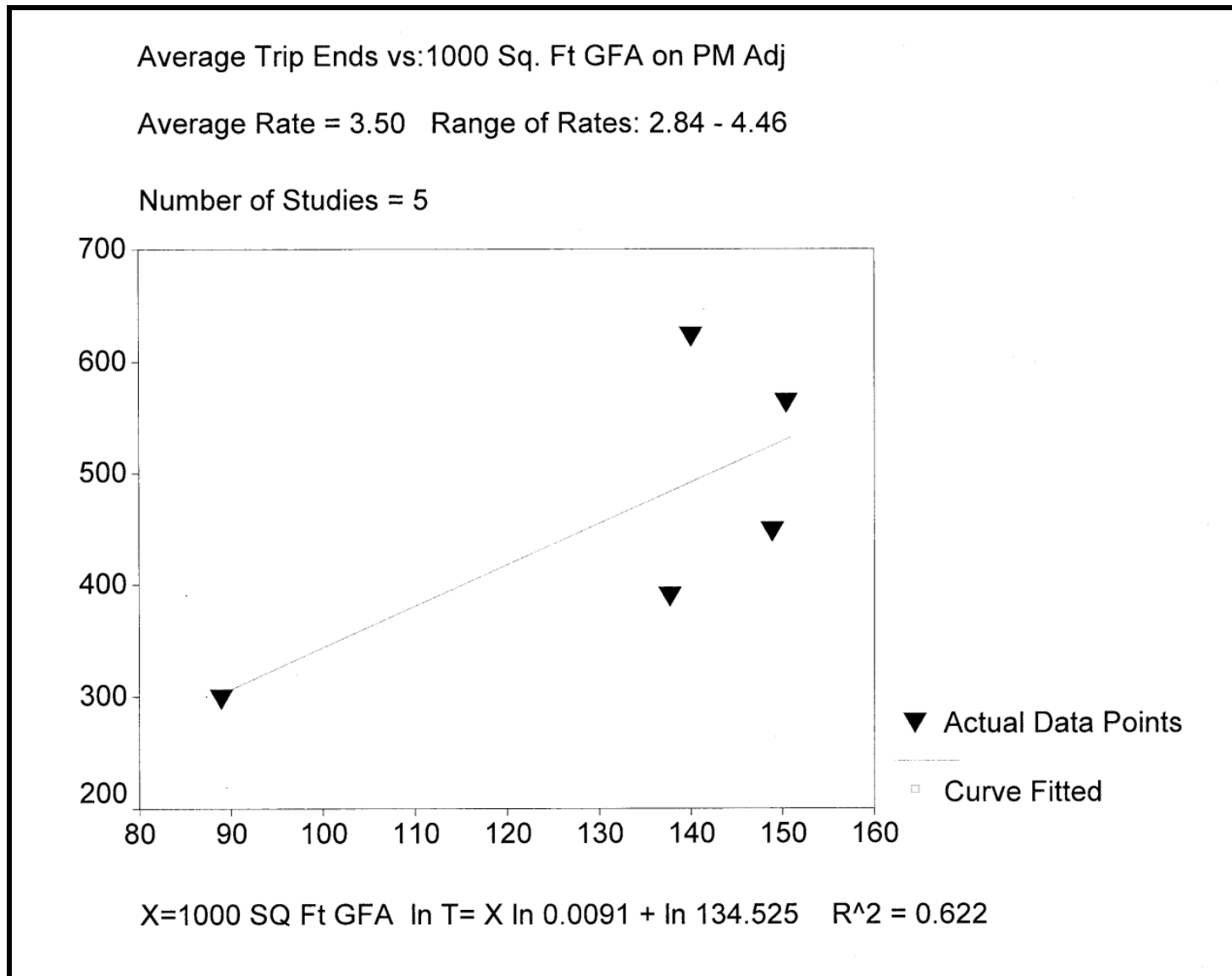
Appendices

A. Demographic/Socio-Economic Data

The following tables provide census tract based demographic information, including population, households, number of vehicles available and the median household income in 1999, for the census tracts that make up the each of the 8 HISS's catchment areas.

Manhattan, 23rd Street Catchment Area Census Tracts

	Population	Households	Vehicles Available	Median HH Income 1999
Manhattan	1,537,195	738644	195401	$ 47,030
Census Tract 34 New York County	6,561	3,772	549	$ 37,371
Census Tract 38 New York County	9,162	5,351	674	$ 40,886
Census Tract 40 New York County	8,690	4,560	557	$ 51,413
Census Tract 42 New York County	3,898	1,697	362	$ 63,258
Census Tract 44.01 New York County	15,112	8,564	2880	$ 66,154
Census Tract 48 New York County	6,402	3,869	949	$ 62,229
Census Tract 50 New York County	5,695	3,625	1150	$ 71,734
Census Tract 52 New York County	3,741	1,706	429	$ 82,882
Census Tract 54 New York County	3,955	2,440	582	$ 81,696
Census Tract 55.01 New York County	4,907	2,480	801	$ 77,877
Census Tract 55.02 New York County	2,174	1,238	302	$ 83,497
Census Tract 56 New York County	2,590	1,522	421	$ 85,399
Census Tract 57 New York County	2,595	1,519	489	$ 97,765
Census Tract 58 New York County	634	381	74	$ 68,523
Census Tract 59 New York County	5,581	3,123	1071	$ 72,480
Census Tract 60 New York County	3,989	2,379	1170	$ 76,573
Census Tract 61 New York County	5,101	2,445	619	$ 86,597
Census Tract 62 New York County	2,068	288	84	$ 52,656
Census Tract 63 New York County	6,265	4,069	1046	$ 77,355
Census Tract 64 New York County	7,334	4,687	1346	$ 63,678
Census Tract 65 New York County	6,690	3,553	611	$ 56,625
Census Tract 66 New York County	11,841	6,696	1373	$ 44,914
Census Tract 68 New York County	6,753	4,367	759	$ 52,442
Census Tract 70 New York County	7,763	4,866	1199	$ 67,850
Census Tract 71 New York County	5,620	3,631	874	$ 75,502
Census Tract 72 New York County	8,111	4,922	966	$ 75,097
Census Tract 73 New York County	6,699	4,548	861	$ 58,202
Census Tract 74 New York County	3,712	2,138	377	$ 76,804
Census Tract 76 New York County	2,445	1,558	217	$ 41,276
Census Tract 77 New York County	6,146	4,124	1065	$ 68,133
Census Tract 78 New York County	7,471	4,795	1012	$ 70,174
Census Tract 80 New York County	5,392	3,482	702	$ 68,868
Census Tract 81 New York County	7,359	4,711	1130	$ 61,525

Census Tract 82 New York County	2,647	1,931	469	$ 62,136
Census Tract 83 New York County	3,490	1,738	217	$ 28,700
Census Tract 84 New York County	1,145	626	132	$ 70,694
Census Tract 87 New York County	4,626	3,076	593	$ 56,939
Census Tract 89 New York County	5,320	3,085	751	$ 55,198
Census Tract 91 New York County	4,553	2,927	511	$ 58,381
Census Tract 93 New York County	8,714	5,262	1418	$ 51,710
Census Tract 95 New York County	2,723	828	117	$ 60,993
Census Tract 96 New York County	168	n/a	n/a	$ 60,083
Census Tract 97 New York County	4,852	2,656	495	$ 32,350
Census Tract 99 New York County	1,151	370	161	$ 60,476
Census Tract 101 New York County	247	n/a	n/a	$ 66,786
Census Tract 103 New York County	1,501	969	163	$ 61,007
Census Tract 109 New York County	159	n/a	n/a	$ 71,641
Census Tract 111 New York County	2,987	1,519	385	$ 41,940
Census Tract 113 New York County	288	n/a	n/a	$ 47,813
Census Tract 115 New York County	1,403	534	80	$ 44,519
Census Tract 119 New York County	1,424	1,070	21	$ 12,173

Brooklyn, Cropsey Avenue catchment Area Census Tracts

	Population	Households	Vehicles Available	Median HH Income 1999
Kings County	2,465,326	880,727	498,736	32,135
Census Tract 294, Kings County	2,351	606	438	40,227
Census Tract 298, Kings County	3,355	1,276	1,025	32,385
Census Tract 300, Kings County	3,576	1,304	968	37,750
Census Tract 302, Kings County	3,711	1,431	1,212	39,881
Census Tract 304, Kings County	3,966	1,591	1,105	35,724
Census Tract 306, Kings County	1,918	690	693	35,515
Census Tract 308, Kings County	1,691	697	552	32,670
Census Tract 314, Kings County	4,501	1,948	1,755	32,083
Census Tract 320, Kings County	70	24	n/a	55,781
Census Tract 326, Kings County	7,247	2,325	702	12,041
Census Tract 328, Kings County	3,304	1,006	597	24,750
Census Tract 330, Kings County	5,288	1,752	984	20,276
Census Tract 336, Kings County	5,159	1,902	1,644	33,359
Census Tract 340, Kings County	2,511	654	114	16,028
Census Tract 342, Kings County	7,462	2,825	554	10,069
Census Tract 348.01, Kings County	1,064	385	223	27,448
Census Tract 348.02, Kings County	907	268	69	16,250
Census Tract 350, Kings County	3,579	1,567	896	25,938
Census Tract 352, Kings County	1,267	460	144	7,863
Census Tract 354, Kings County	5,622	2,875	1,789	28,678
Census Tract 356, Kings County	8,164	4,308	2,377	30,493
Census Tract 374, Kings County	9,211	4,112	2,707	37,924
Census Tract 382, Kings County	6,161	1,968	863	15,601
Census Tract 386, Kings County	3,377	1,203	929	26,129

Census Tract 388, Kings County	3,804	1,505	1,231	37,571
Census Tract 398, Kings County	2,391	830	648	31,078
Census Tract 400, Kings County	2,948	1,112	724	30,559
Census Tract 402, Kings County	2,564	910	575	39,960

Nassau County, Jericho Turnpike Catchment Area Census Tracts

	Population	Households	Vehicles Available	Median HH Income in 1999
Block Group 3, Census Tract 5177.01, Nassau County, New York	3,691	1,120	2,678	192,840
Block Group 3, Census Tract 5183, Nassau County, New York	644	239	381	81,030
Block Group 4, Census Tract 5183, Nassau County, New York	1,607	549	1,077	85,308
Block Group 3, Census Tract 5184, Nassau County, New York	2,271	743	1,510	102,009
Block Group 1, Census Tract 5187, Nassau County, New York	1,100	362	783	97,375
Block Group 2, Census Tract 5187, Nassau County, New York	748	272	537	82,435
Block Group 3, Census Tract 5187, Nassau County, New York	802	280	547	90,380
Block Group 4, Census Tract 5187, Nassau County, New York	547	189	351	103,621
Block Group 5, Census Tract 5187, Nassau County, New York	802	301	495	78,285
Block Group 6, Census Tract 5187, Nassau County, New York	698	258	480	62,100
Block Group 7, Census Tract 5187, Nassau County, New York	715	247	510	72,625

Queens, Northern Boulevard Catchment Area Census Tracts

Geography	Population	Households	Aggregate Vehicles	Median HH Income 1999
Census Tract 31, Queens County	1736	578	277	33819
Census Tract 51, Queens County	2526	815	416	36020
Census Tract 53, Queens County	5966	2502	1238	38240
Census Tract 55, Queens County	1216	396	206	33611
Census Tract 57, Queens County	4904	1884	746	35290
Census Tract 59, Queens County	4779	1966	1174	41520
Census Tract 61, Queens County	6749	2955	1099	31010
Census Tract 63, Queens County	7029	2786	1171	32730
Census Tract 65, Queens County	8790	3694	1994	37169
Census Tract 71, Queens County	4572	1794	814	35909
Census Tract 73, Queens County	4881	2200	958	42019
Census Tract 75, Queens County	4518	2212	1109	30983
Census Tract 141, Queens County	1970	772	490	30542
Census Tract 143, Queens County	4509	1781	764	34515
Census Tract 145, Queens County	2282	945	675	37813
Census Tract 147, Queens County	3268	1401	887	44125
Census Tract 149, Queens County	3133	1113	609	44630
Census Tract 151, Queens County	3148	1258	750	39788
Census Tract 153, Queens County	2622	1057	495	40665
Census Tract 155, Queens County	2675	1000	530	39864
Census Tract 157, Queens County	1635	643	244	30903
Census Tract 159, Queens County	4754	1998	946	33936
Census Tract 161, Queens County	2908	903	505	45383
Census Tract 163, Queens County	4546	1678	701	25102

Census Tract 169, Queens County	5579	2411	1366	43205
Census Tract 171, Queens County	21			0
Census Tract 179, Queens County	1135	435	194	29250
Census Tract 181, Queens County	8915	3745	1432	34932
Census Tract 183, Queens County	6766	2837	1650	42299
Census Tract 185, Queens County	7729	3224	1480	38482
Census Tract 229, Queens County	0			0
Census Tract 235, Queens County	8426	2556	1201	33280
Census Tract 245, Queens County	4675	2057	1389	41395
Census Tract 247, Queens County	1502	521	338	44000
Census Tract 249, Queens County	5095	1999	1074	36526
Census Tract 251, Queens County	5501	2150	1153	38143
Census Tract 253, Queens County	7835	3074	1208	33682
Census Tract 255, Queens County	1849	725	556	47143
Census Tract 257, Queens County	1504	533	523	34375
Census Tract 259, Queens County	3365	1109	762	36091
Census Tract 261, Queens County	7233	2286	897	36104
Census Tract 263, Queens County	6003	2022	1155	33838
Census Tract 265, Queens County	4534	1456	767	34127
Census Tract 291, Queens County	7120	2469	1124	36892
Census Tract 293, Queens County	1368	397	371	38438
Census Tract 295, Queens County	3790	1658	1028	44231
Census Tract 297, Queens County	1961	669	671	44643
Census Tract 299, Queens County	18			0
Census Tract 309.01, Queens County	10553	3303	3132	48398
Census Tract 309.02, Queens County	7949	2679	2528	41018

Queens, Rockaway Boulevard Catchment Area Census Tracts

	Population	Households	Vehicles Available	Median HH Income 1999
Queens County	2,229,379	782,664	705,429	$ 42,439
Census Tract 38, Queens County	2,213	722	660	$ 42,908
Census Tract 40.01, Queens County	1,786	623	511	$ 41,436
Census Tract 40.02, Queens County	1,248	397	305	$ 31,705.00
Census Tract 54, Queens County	5,247	1677	1584	$ 44,954.00
Census Tract 58, Queens County	5,569	2055	2450	$ 46,563.00
Census Tract 86, Queens County	2,699	925	1152	$ 45,431.00
Census Tract 88, Queens County	2,967	1114	1455	$ 46,691.00
Census Tract 94, Queens County	3,079	910	731	$ 36,341.00
Census Tract 96, Queens County	3,378	955	832	$ 40,406.00
Census Tract 98, Queens County	2,918	855	672	$ 39,943.00
Census Tract 100, Queens County	3,475	956	1046	$ 55,601.00
Census Tract 102, Queens County	2,745	780	817	$ 43,589.00
Census Tract 104, Queens County	3,481	970	964	$ 41,750.00
Census Tract 106, Queens County	3,482	950	780	$ 45,396.00
Census Tract 108, Queens County	2,996	837	681	$ 54,073.00
Census Tract 110, Queens County	3,101	865	826	$ 39,122.00
Census Tract 112, Queens County	2,233	706	701	$ 43,015.00
Census Tract 114, Queens County	1,120	388	358	$ 28,571.00
Census Tract 116, Queens County	2,066	579	528	$ 41,772.00
Census Tract 118, Queens County	2,370	676	698	$ 37,179.00
Census Tract 120, Queens County	2,599	683	621	$ 45,750.00

Census Tract 148, Queens County	2,276	617	534	$ 32,475.00
Census Tract 150, Queens County	2,633	667	794	$ 37,684.00
Census Tract 154, Queens County	2,423	686	622	$ 41,848.00
Census Tract 156, Queens County	3,578	918	896	$ 42,583.00
Census Tract 158, Queens County	8,761	2363	2091	$ 42,329.00
Census Tract 164, Queens County	3,607	930	1083	$ 55,625.00
Census Tract 166, Queens County	3,723	1059	1059	$ 42,791.00
Census Tract 168, Queens County	2,827	836	947	$ 45,296.00
Census Tract 170, Queens County	2,512	703	759	$ 47,202.00
Census Tract 172, Queens County	2,055	627	559	$ 38,438.00
Census Tract 174, Queens County	2,571	673	896	$ 57,500.00
Census Tract 176, Queens County	2,037	606	610	$ 41,321.00
Census Tract 178, Queens County	1,885	561	625	$ 45,313.00
Census Tract 180, Queens County	1,099	320	389	$ 50,278.00
Census Tract 716, Queens County	30	n/a	22	$ 47,750.00
Census Tract 818, Queens County	3,531	1021	1320	$ 49,631.00
Census Tract 838, Queens County	4,764	1508	1989	$ 52,179.00
Census Tract 840, Queens County	6,903	1976	2706	$ 47,908.00
Census Tract 846.01, Queens County	2,809	937	1252	$ 43,167.00
Census Tract 846.02, Queens County	1,117	242	325	$ 53,646.00
Census Tract 864, Queens County	2,498	802	852	$ 60,505.00
Census Tract 884, Queens County	7,932	2915	4701	$ 60,056.00

Staten Island, Targee Street catchment Area Census Tracts

	Population	Households	Vehicles	Median HH Income 1999
Richmond County	443728	156341	216422	55039
Census Tract 6, Richmond County	2530	1165	1211	41000
Census Tract 8, Richmond County	4,730	1740	2189	$ 51,404.00
Census Tract 15, Richmond County	668	352	265	$ 49,531.00
Census Tract 20.01, Richmond County	2,261	950	1125	$ 50,859.00
Census Tract 20.02, Richmond County	3,260	1187	1634	$ 51,741.00
Census Tract 21, Richmond County	3,375	1098	1026	$ 39,967.00
Census Tract 27, Richmond County	1,911	354	308	$ 30,227.00
Census Tract 29, Richmond County	5,197	1591	901	$ 17,019.00
Census Tract 33, Richmond County	3,180	1255	1466	$ 55,568.00
Census Tract 36, Richmond County	1,937	746	1020	$ 50,671.00
Census Tract 39, Richmond County	2,432	1018	1207	$ 48,271.00
Census Tract 40, Richmond County	11,105	3700	2701	$ 30,616.00
Census Tract 47, Richmond County	3,353	1026	1330	$ 57,500.00
Census Tract 50, Richmond County	3,649	1403	1822	$ 48,600.00
Census Tract 59, Richmond County	2,584	1146	1510	$ 59,811.00
Census Tract 64, Richmond County	3,659	1302	1329	$ 40,069.00
Census Tract 96.01, Richmond County	3,885	1486	1881	$ 44,599.00
Census Tract 169.01, Richmond County	2,973	1090	1607	$ 68,403.00
Census Tract 169.02, Richmond County	1,051	354	651	$ 110,375.00
Census Tract 177, Richmond County	5,862	2034	3754	$ 83,031.00

Staten Island, Veterans Road Catchment Area Census Tracts

	Population	Households	Vehicles	Median HH Income 1999
Richmond County	443728	156341	216422	55039
Census Tract 196, Richmond County	4,977	1696	2967	$66,345.00
Census Tract 208.01, Richmond County	8,261	2768	4371	$ 60,528.00
Census Tract 208.03, Richmond County	5,318	1715	3074	$ 70,885.00
Census Tract 226, Richmond County	6,103	1806	2925	$ 61,278.00
Census Tract 236, Richmond County	82	16	40	N/A
Census Tract 244, Richmond County	8,401	2890	5158	$ 68,073.00
Census Tract 248, Richmond County	3,868	1364	2027	$ 57,209.00

Bronx, Zerega Avenue Catchment Area Census Tracts

	Population	Households	Vehicles Available	Median HH Income 1999
Bronx County	1,332,650	463,212	239,128	27,611
Census Tract 4, Bronx County	3,257	1,051	858	39,013
Census Tract 16, Bronx County	5,208	1,810	1,031	24,552
Census Tract 36, Bronx County	7,529	2,655	1,255	29,375
Census Tract 40.01, Bronx County	1,365	547	530	29,545
Census Tract 40.02, Bronx County	1	1	n/a	n/a
Census Tract 74, Bronx County	3,263	1,326	1,013	40,654
Census Tract 78, Bronx County	6,171	2,079	1,444	34,353
Census Tract 84, Bronx County	2,167	616	593	39,911
Census Tract 86, Bronx County	4,381	1,440	527	14,409
Census Tract 88, Bronx County	3,397	1,080	462	16,136
Census Tract 92, Bronx County	4,989	1,778	1,271	36,589
Census Tract 94, Bronx County	1,511	463	436	40,833
Census Tract 98, Bronx County	5,538	1,906	1,741	38,642
Census Tract 102, Bronx County	45	13	n/a	20,417
Census Tract 110, Bronx County	371	264	100	9,461
Census Tract 132, Bronx County	5,655	2,187	3,034	54,509
Census Tract 144, Bronx County	5,518	1,956	838	22,656
Census Tract 154, Bronx County	875	353	275	52,339
Census Tract 156, Bronx County	1,433	580	852	56,343
Census Tract 166, Bronx County	2,193	821	887	41,776
Census Tract 194, Bronx County	1,586	630	669	51,705
Census Tract 196, Bronx County	577	152	92	34,297

B. Street and Transit Accessibility Maps

The following maps detail the transit and street network that exists within the 8 HISS catchment areas.
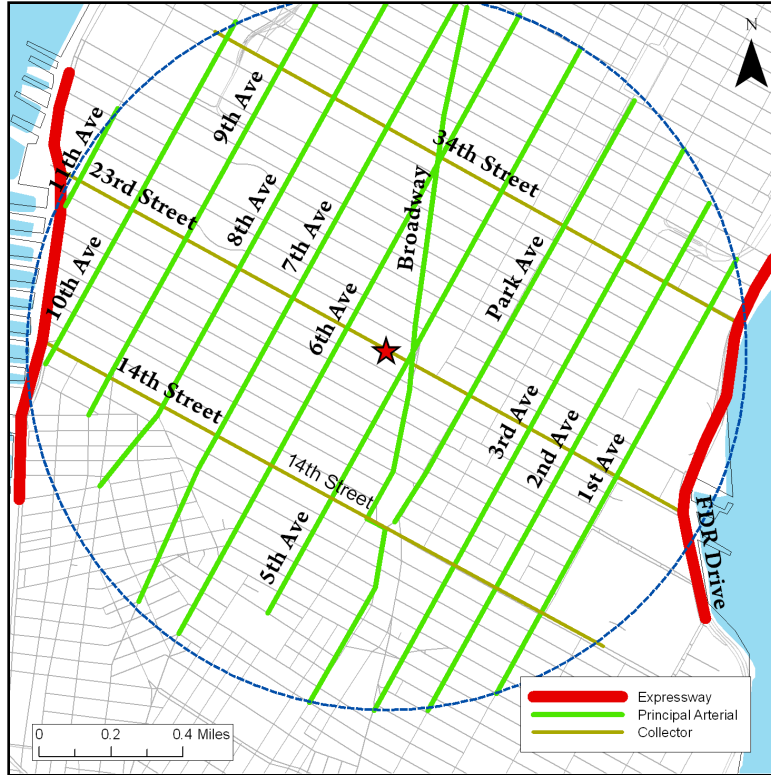
Figure 29: 23rd St. Street System

Figure 30: 23rd St. Transit System

Figure 31: Cropsey Ave Street System

Figure 32: Cropsey Ave Transit System
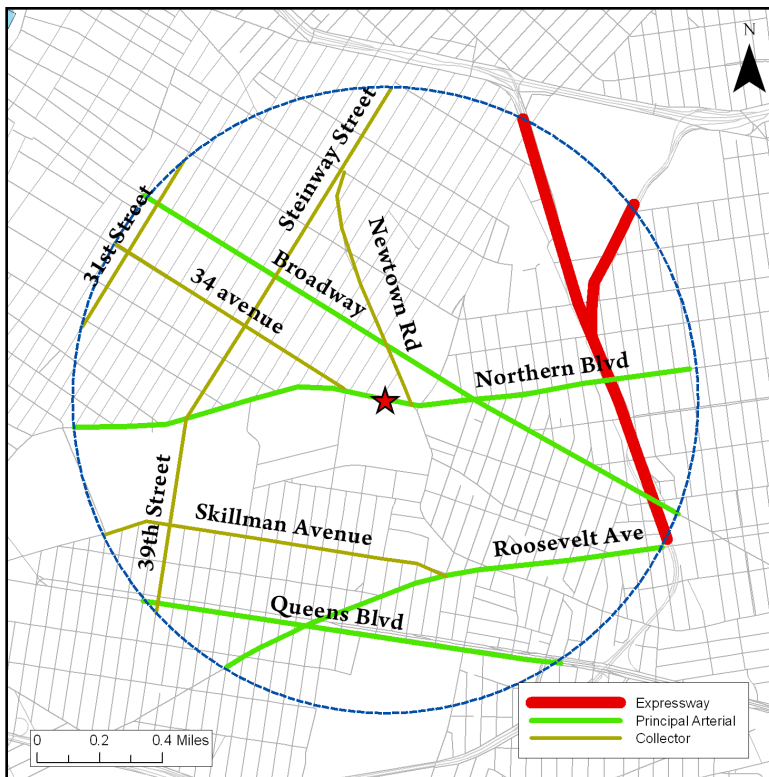
Figure 33: Northern Blvd Street System
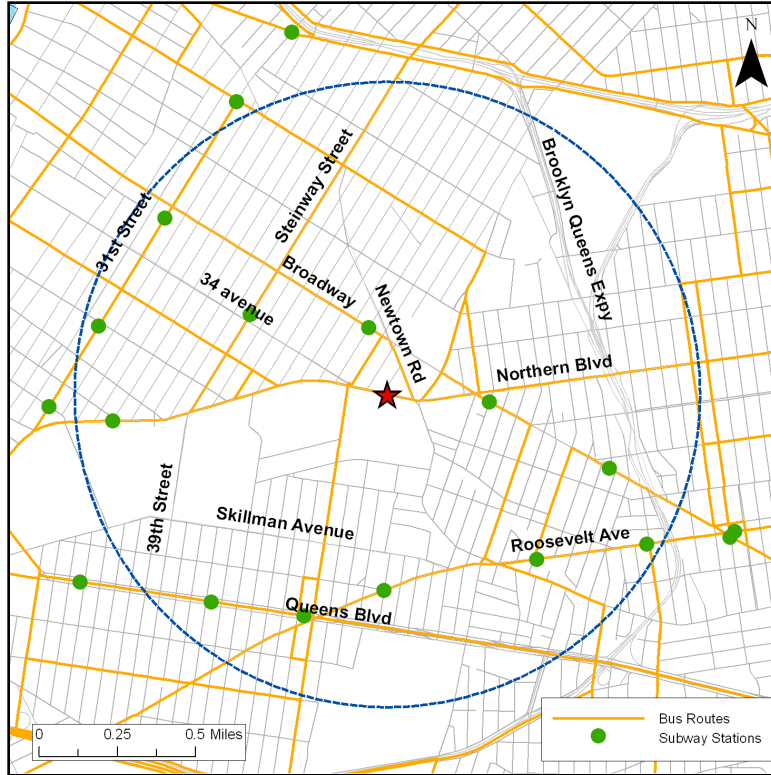
Figure 34: Northern Blvd Transit System
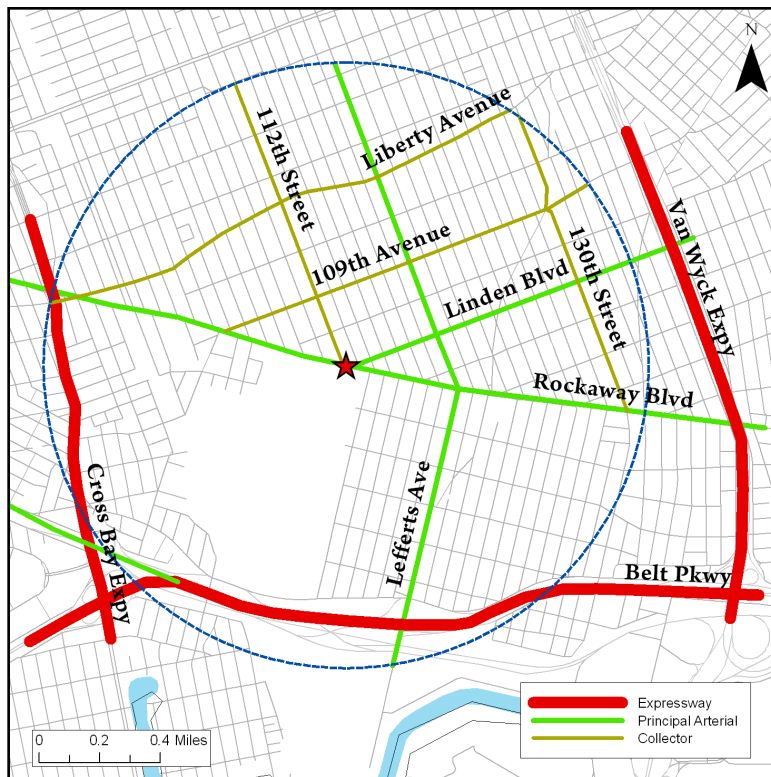
Figure 35: Rockaway Blvd Street System
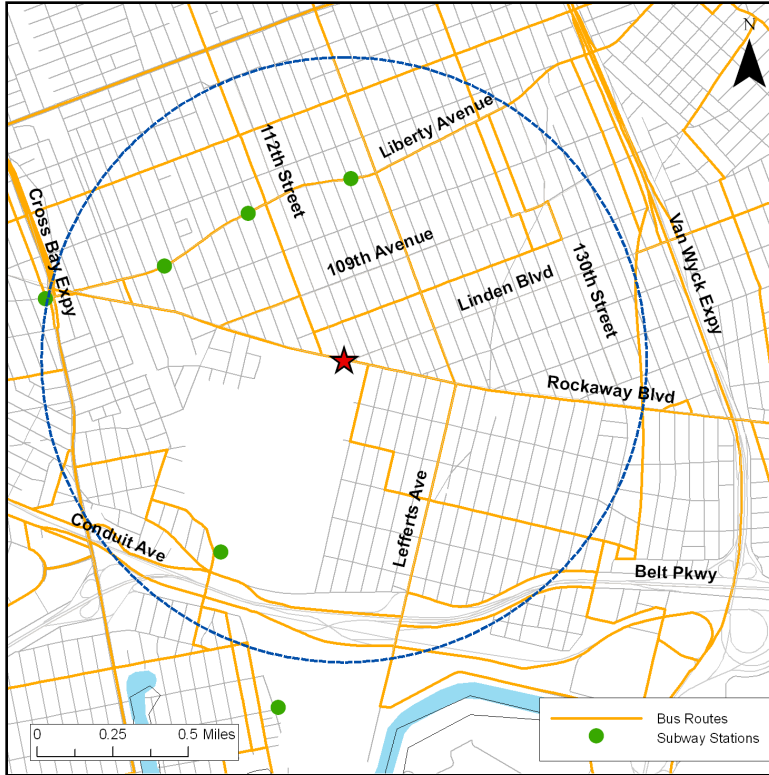
Figure 36: Rockaway Blvd Transit System
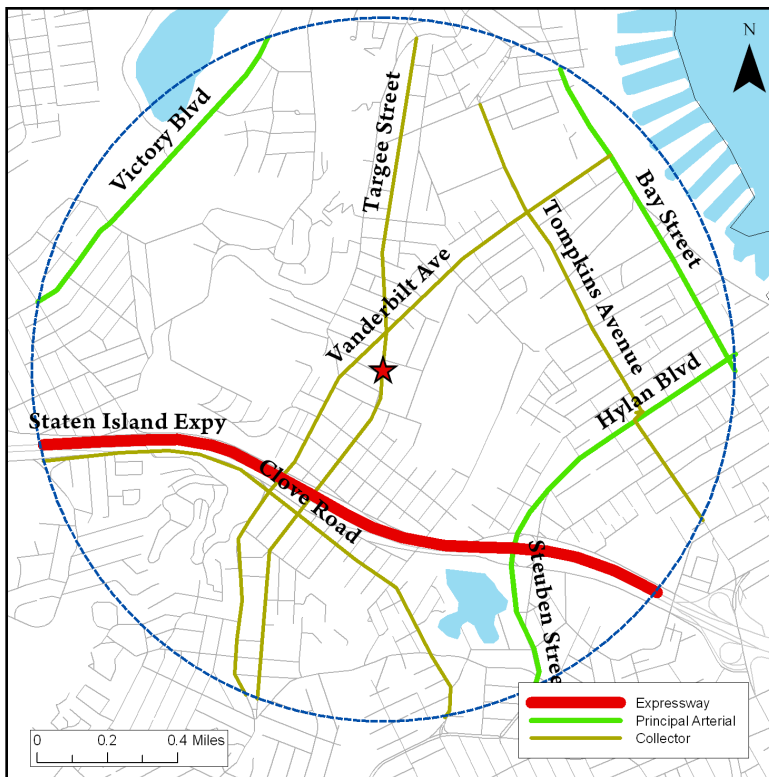
Figure 37: Targee St Street System
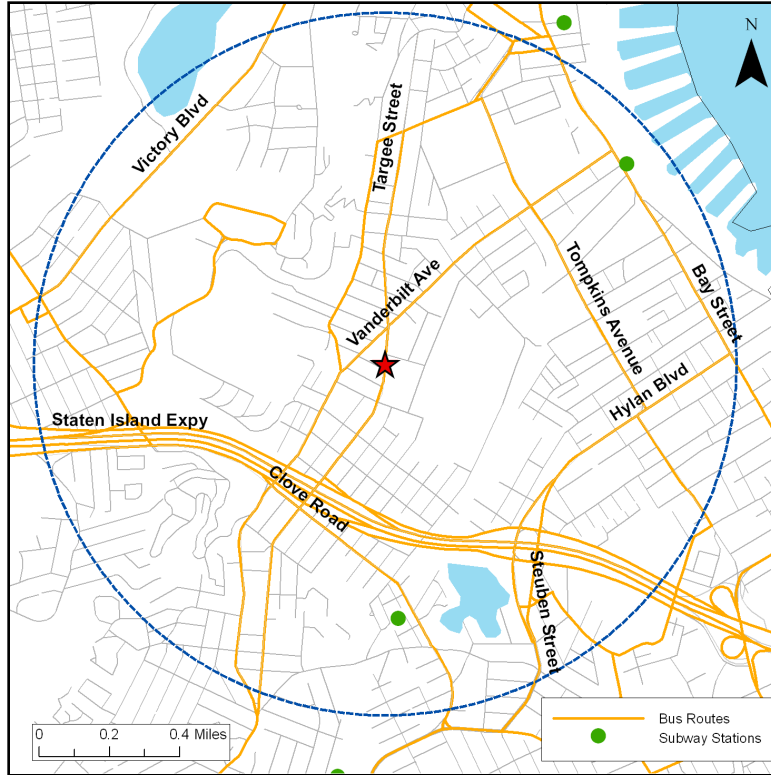
Figure 38: Targee St. Transit System
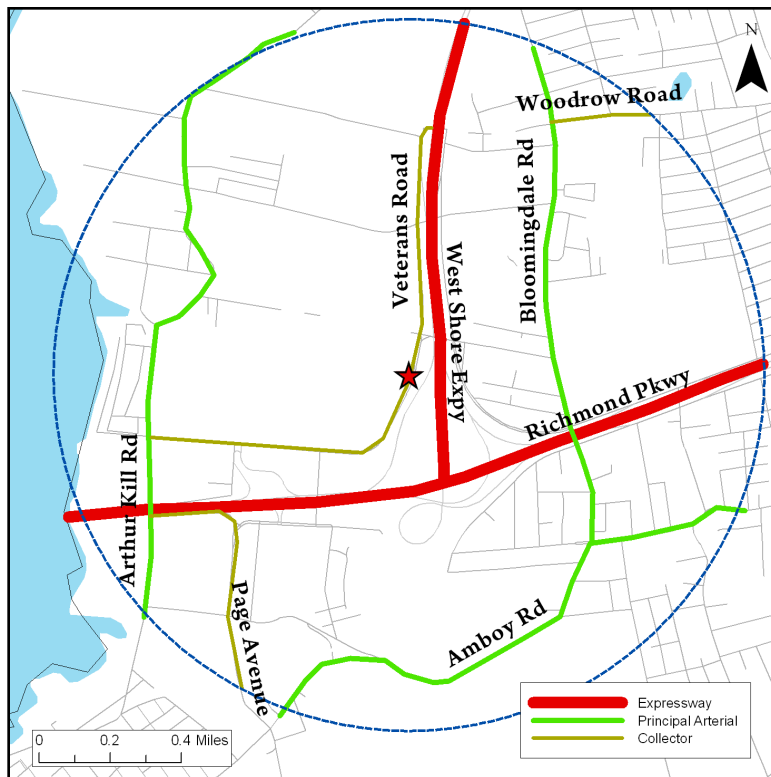
Figure 39: Veterans Rd Street System
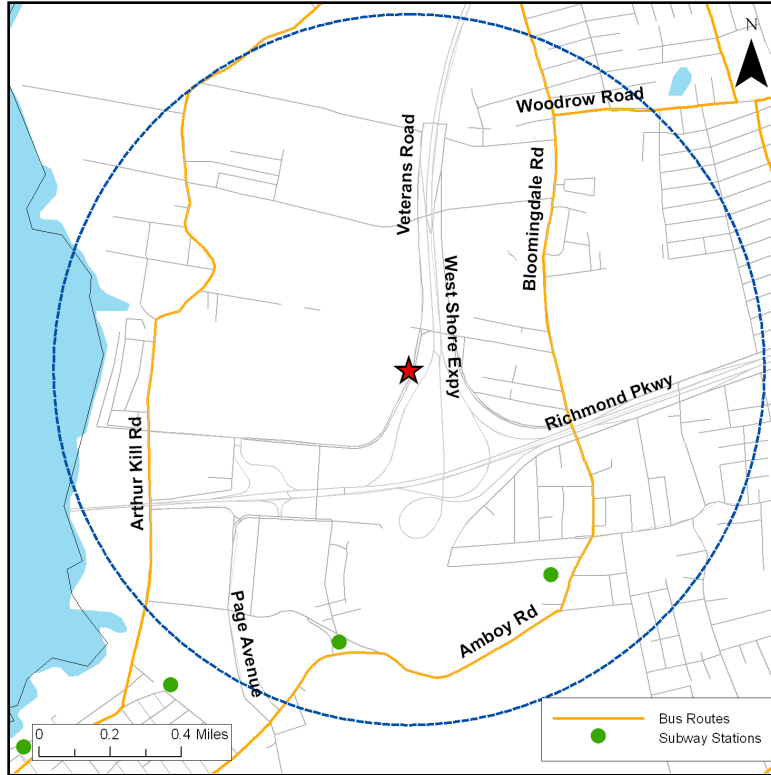
Figure 40: Veterans Road Transit System
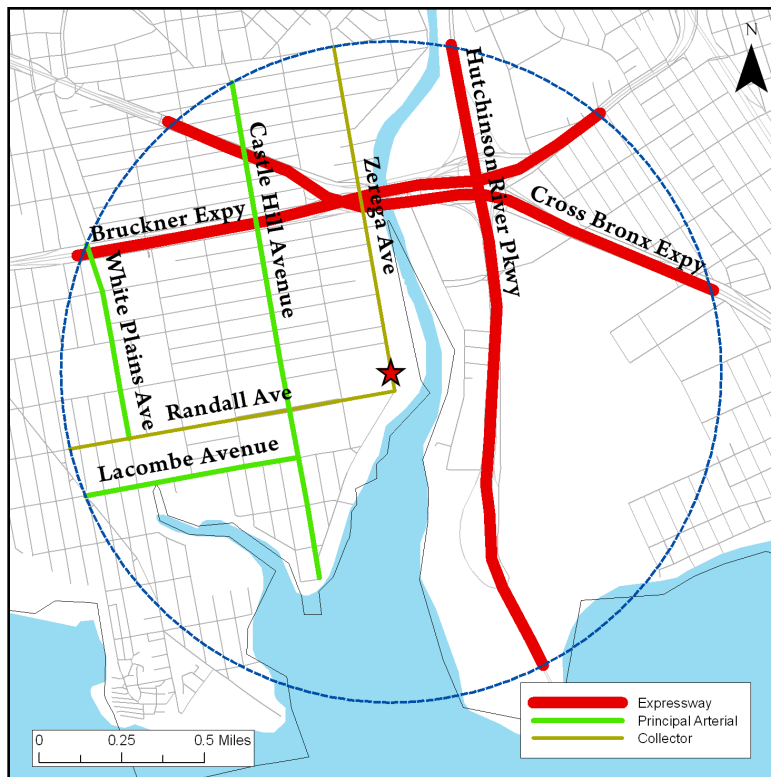
Figure 41: Zerega Ave Street System

Figure 42: Zerega Ave Transit System

C. Land Use Maps

The following maps detail the zoning groups and land use that exists within the 8 HISS catchment areas.
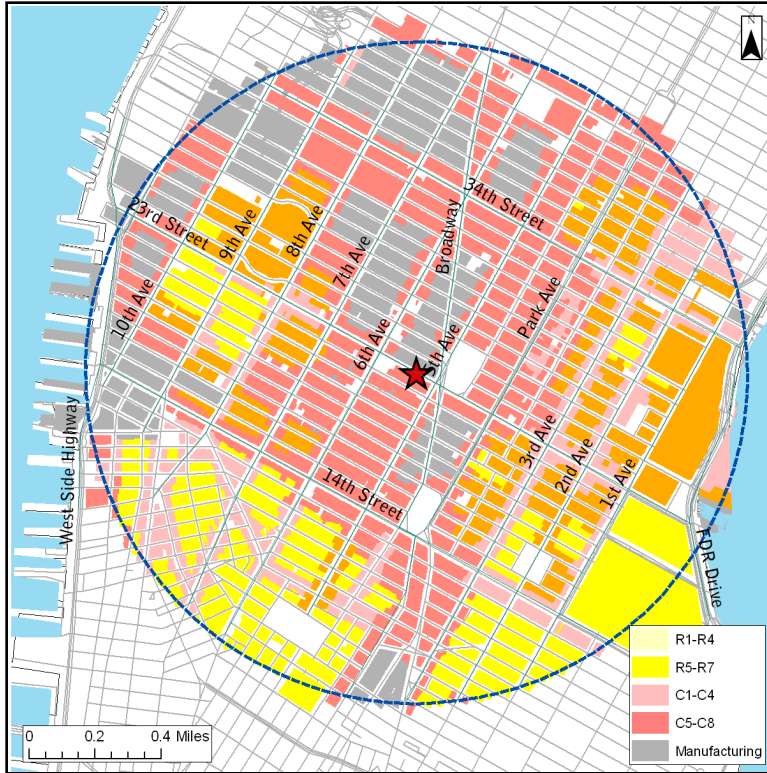
Figure 43: 23rd Street Land Use
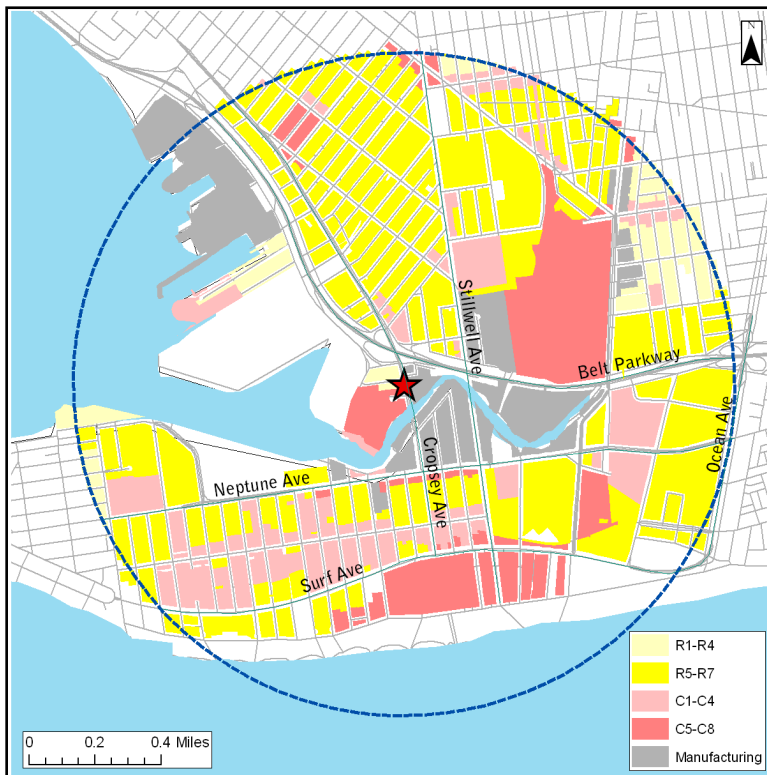
Figure 44: Cropsey Avenue Land Use
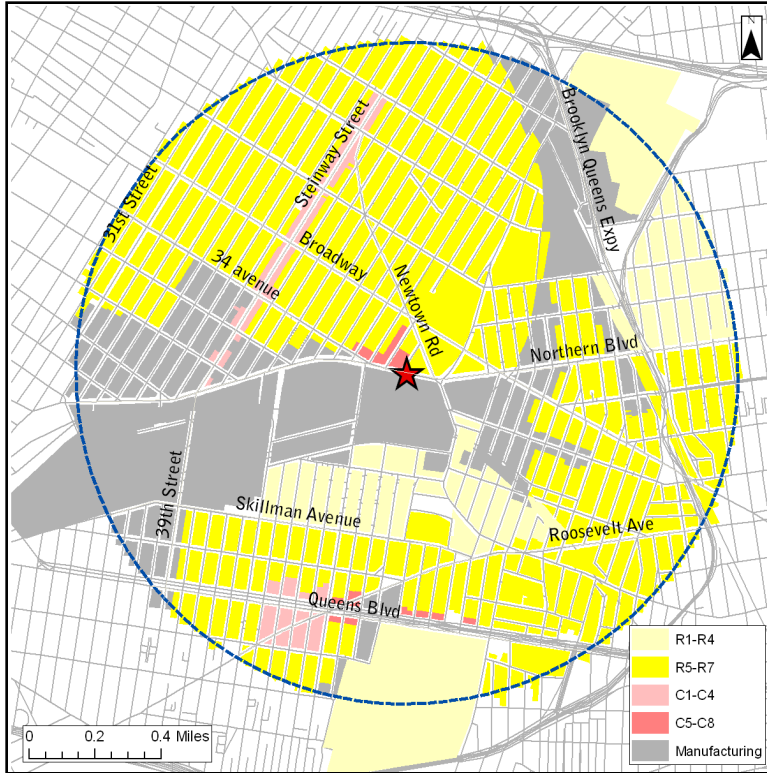
Figure 45: Northern Blvd Land Use
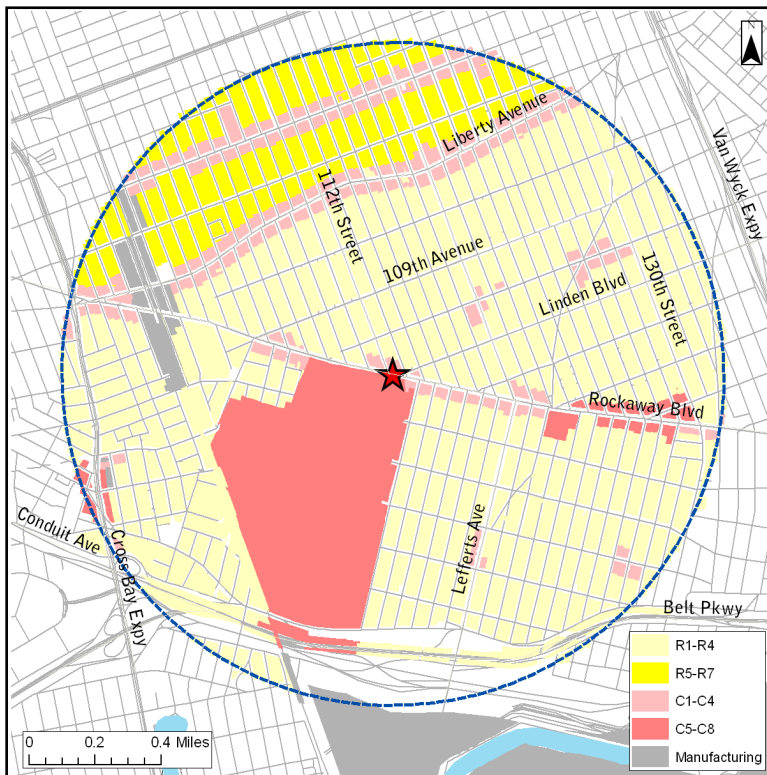
Figure 46: Rockaway Blvd Land Use
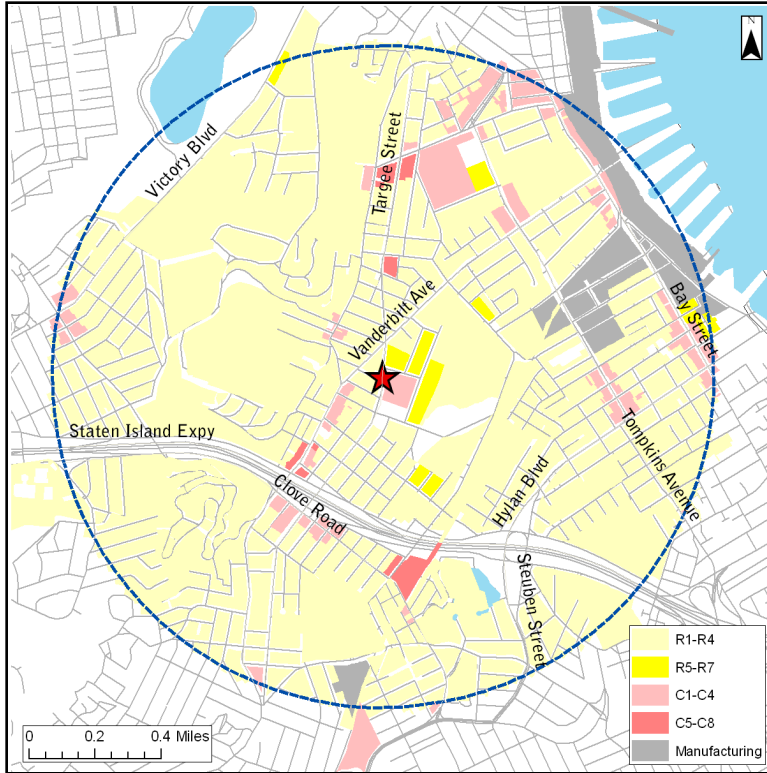
Figure 47: Targee Street Land Use
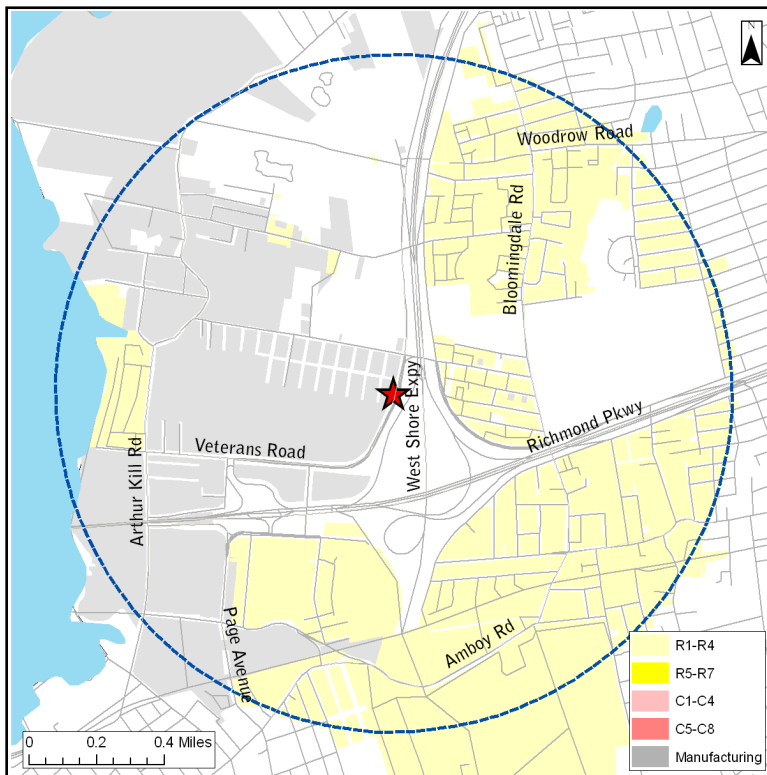
Figure 48: Veterans Road Land Use
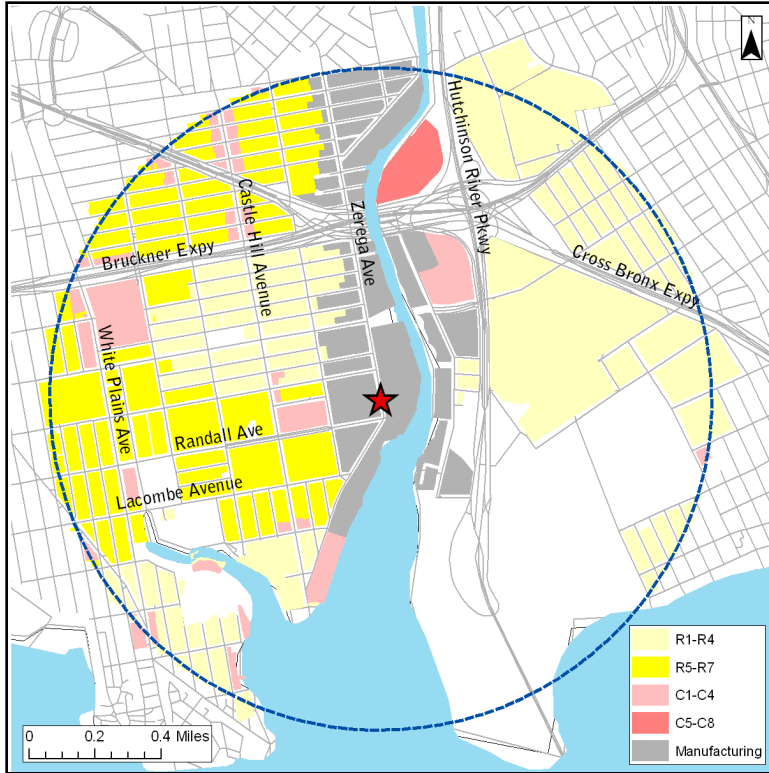
Figure 49: Zerega Avenue Land Use

D. Questionnaire Survey

Big Box Retail Trip Generation Rates: HISS in New York City

Site: _____

DOW: _____ Date: _____

Start Time: _____ End Time: _____

1 Where did your trip originate?
2 Is Store the main reason for your trip?
3 What made of transportation did you use?
4 How far did you travel and time you travel?
5 Please check one that apply to you. **DOT July 31, 2007**

Trip Origin (1)				Primary Trip Store (2)		Mode of Travel (3)								Travel Distance or Time (4)								Customer Category (5)		
Home	Work	Other	Specify	Y	N	Car	Bus	Subway	Taxi	Walk	Bike	Other	Specify	15 min	30 min	1 hour	1/2 mile	1 mile	2 mile	Other	Specify	Home owner	Tenant	Contractor

E. Results of the ANOVA for the AM, Midday, and PM peak

Oneway Analysis of Variance (ANOVA)

AM Peak Period

Descriptives

TRIPRATE

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound
1	16	.7937	.13681	.03420	.7208	.8667
2	16	.9975	.19570	.04893	.8932	1.1018
3	16	.2531	.07709	.01927	.2120	.2942
4	16	1.1175	.10116	.02529	1.0636	1.1714
5	16	1.2181	.23421	.05855	1.0933	1.3429
6	16	.8356	.14066	.03517	.7607	.9106
7	16	.4963	.07238	.01809	.4577	.5348
8	16	.7431	.08965	.02241	.6954	.7909
Total	128	.8069	.32939	.02911	.7493	.8645
Model Fixed Effects			.14191	.01254	.7820	.8317
Random Effects				.11261	.5406	1.0732

Descriptives

TRIPRATE

	Minimum	Maximum	Between-Component Variance
1	.60	1.03	
2	.59	1.30	
3	.13	.36	
4	.89	1.26	
5	1.05	1.98	
6	.58	1.07	
7	.35	.64	
8	.64	.94	
Total	.13	1.98	
Model Fixed Effects			
Random Effects			.10019

Test of Homogeneity of Variances

TRIPRATE

Levene Statistic	df1	df2	Sig.
2.945	7	120	.007

ANOVA

TRIPRATE

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	11.362	7	1.623	80.599	.000
Within Groups	2.417	120	.020		
Total	13.779	127			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: TRIPRATE
Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-.2038*	.05017	.002	-.3585	-.0490
	3	.5406*	.05017	.000	.3858	.6954
	4	-.3238*	.05017	.000	-.4785	-.1690
	5	-.4244*	.05017	.000	-.5792	-.2696
	6	-.0419	.05017	.991	-.1967	.1129
	7	.2975*	.05017	.000	.1427	.4523
	8	.0506	.05017	.972	-.1042	.2054
2	1	.2038*	.05017	.002	.0490	.3585
	3	.7444*	.05017	.000	.5896	.8992
	4	-.1200	.05017	.255	-.2748	.0348
	5	-.2206*	.05017	.001	-.3754	-.0658
	6	.1619*	.05017	.034	.0071	.3167
	7	.5013*	.05017	.000	.3465	.6560
	8	.2544*	.05017	.000	.0996	.4092
3	1	-.5406*	.05017	.000	-.6954	-.3858
	2	-.7444*	.05017	.000	-.8992	-.5896
	4	-.8644*	.05017	.000	-1.0192	-.7096
	5	-.9650*	.05017	.000	-1.1198	-.8102
	6	-.5825*	.05017	.000	-.7373	-.4277
	7	-.2431*	.05017	.000	-.3979	-.0883
	8	-.4900*	.05017	.000	-.6448	-.3352
4	1	.3238*	.05017	.000	.1690	.4785
	2	.1200	.05017	.255	-.0348	.2748
	3	.8644*	.05017	.000	.7096	1.0192
	5	-.1006	.05017	.483	-.2554	.0542
	6	.2819*	.05017	.000	.1271	.4367
	7	.6212*	.05017	.000	.4665	.7760
	8	.3744*	.05017	.000	.2196	.5292
5	1	.4244*	.05017	.000	.2696	.5792
	2	.2206*	.05017	.001	.0658	.3754
	3	.9650*	.05017	.000	.8102	1.1198
	4	.1006	.05017	.483	-.0542	.2554
	6	.3825*	.05017	.000	.2277	.5373
	7	.7219*	.05017	.000	.5671	.8767
	8	.4750*	.05017	.000	.3202	.6298

Multiple Comparisons

Dependent Variable: TRIPRATE
Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
6	1	.0419	.05017	.991	-.1129	.1967
	2	-.1619*	.05017	.034	-.3167	-.0071
	3	.5825*	.05017	.000	.4277	.7373
	4	-.2819*	.05017	.000	-.4367	-.1271
	5	-.3825*	.05017	.000	-.5373	-.2277
	7	.3394*	.05017	.000	.1846	.4942
	8	.0925	.05017	.592	-.0623	.2473
7	1	-.2975*	.05017	.000	-.4523	-.1427
	2	-.5013*	.05017	.000	-.6560	-.3465
	3	.2431*	.05017	.000	.0883	.3979
	4	-.6212*	.05017	.000	-.7760	-.4665
	5	-.7219*	.05017	.000	-.8767	-.5671
	6	-.3394*	.05017	.000	-.4942	-.1846
	8	-.2469*	.05017	.000	-.4017	-.0921
8	1	-.0506	.05017	.972	-.2054	.1042
	2	-.2544*	.05017	.000	-.4092	-.0996
	3	.4900*	.05017	.000	.3352	.6448
	4	-.3744*	.05017	.000	-.5292	-.2196
	5	-.4750*	.05017	.000	-.6298	-.3202
	6	-.0925	.05017	.592	-.2473	.0623
	7	.2469*	.05017	.000	.0921	.4017

*. The mean difference is significant at the .05 level.

Homogeneous Subsets

TRIPRATE

Tukey HSD[a]

GROUP	N	Subset for alpha = .05				
		1	2	3	4	5
3	16	.2531				
7	16		.4963			
8	16			.7431		
1	16			.7937		
6	16			.8356		
2	16				.9975	
4	16				1.1175	1.1175
5	16					1.2181
Sig.		1.000	1.000	.592	.255	.483

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 16.000.

Oneway Analysis of
Variance (ANOVA)

Midday Peak Period

Descriptives

TRIPRATE

| | N | Mean | Std. Deviation | Std. Error | 95% Confidence Interval for Mean | |
					Lower Bound	Upper Bound
1	16	.8238	.07375	.01844	.7845	.8630
2	16	1.2881	.17410	.04352	1.1954	1.3809
3	16	.5094	.06137	.01534	.4767	.5421
4	16	1.1631	.09991	.02498	1.1099	1.2164
5	16	.9656	.17405	.04351	.8729	1.0584
6	16	.7856	.11639	.02910	.7236	.8476
7	16	.6106	.09712	.02428	.5589	.6624
8	16	.8206	.09483	.02371	.7701	.8712
Total	128	.8709	.27117	.02397	.8234	.9183
Model Fixed Effects			.11820	.01045	.8502	.8915
Random Effects				.09248	.6522	1.0895

Descriptives

TRIPRATE

	Minimum	Maximum	Between-Component Variance
1	.70	.94	
2	1.02	1.80	
3	.38	.61	
4	.86	1.29	
5	.74	1.28	
6	.57	.98	
7	.43	.78	
8	.69	.98	
Total	.38	1.80	
Model Fixed Effects			
Random Effects			.06754

Test of Homogeneity of Variances

TRIPRATE

Levene Statistic	df1	df2	Sig.
3.310	7	120	.003

66

ANOVA

TRIPRATE

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	7.663	7	1.095	78.356	.000
Within Groups	1.676	120	.014		
Total	9.339	127			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: TRIPRATE
Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-.4644*	.04179	.000	-.5933	-.3355
	3	.3144*	.04179	.000	.1855	.4433
	4	-.3394*	.04179	.000	-.4683	-.2105
	5	-.1419*	.04179	.020	-.2708	-.0130
	6	.0381	.04179	.984	-.0908	.1670
	7	.2131*	.04179	.000	.0842	.3420
	8	.0031	.04179	1.000	-.1258	.1320
2	1	.4644*	.04179	.000	.3355	.5933
	3	.7787*	.04179	.000	.6498	.9077
	4	.1250	.04179	.064	-.0039	.2539
	5	.3225*	.04179	.000	.1936	.4514
	6	.5025*	.04179	.000	.3736	.6314
	7	.6775*	.04179	.000	.5486	.8064
	8	.4675*	.04179	.000	.3386	.5964
3	1	-.3144*	.04179	.000	-.4433	-.1855
	2	-.7787*	.04179	.000	-.9077	-.6498
	4	-.6537*	.04179	.000	-.7827	-.5248
	5	-.4563*	.04179	.000	-.5852	-.3273
	6	-.2763*	.04179	.000	-.4052	-.1473
	7	-.1012	.04179	.240	-.2302	.0277
	8	-.3112*	.04179	.000	-.4402	-.1823
4	1	.3394*	.04179	.000	.2105	.4683
	2	-.1250	.04179	.064	-.2539	.0039
	3	.6537*	.04179	.000	.5248	.7827
	5	.1975*	.04179	.000	.0686	.3264
	6	.3775*	.04179	.000	.2486	.5064
	7	.5525*	.04179	.000	.4236	.6814
	8	.3425*	.04179	.000	.2136	.4714
5	1	.1419*	.04179	.020	.0130	.2708
	2	-.3225*	.04179	.000	-.4514	-.1936
	3	.4563*	.04179	.000	.3273	.5852
	4	-.1975*	.04179	.000	-.3264	-.0686
	6	.1800*	.04179	.001	.0511	.3089
	7	.3550*	.04179	.000	.2261	.4839
	8	.1450*	.04179	.016	.0161	.2739

Multiple Comparisons

Dependent Variable: TRIPRATE
Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
6	1	-.0381	.04179	.984	-.1670	.0908
	2	-.5025*	.04179	.000	-.6314	-.3736
	3	.2763*	.04179	.000	.1473	.4052
	4	-.3775*	.04179	.000	-.5064	-.2486
	5	-.1800*	.04179	.001	-.3089	-.0511
	7	.1750*	.04179	.001	.0461	.3039
	8	-.0350	.04179	.991	-.1639	.0939
7	1	-.2131*	.04179	.000	-.3420	-.0842
	2	-.6775*	.04179	.000	-.8064	-.5486
	3	.1012	.04179	.240	-.0277	.2302
	4	-.5525*	.04179	.000	-.6814	-.4236
	5	-.3550*	.04179	.000	-.4839	-.2261
	6	-.1750*	.04179	.001	-.3039	-.0461
	8	-.2100*	.04179	.000	-.3389	-.0811
8	1	-.0031	.04179	1.000	-.1320	.1258
	2	-.4675*	.04179	.000	-.5964	-.3386
	3	.3112*	.04179	.000	.1823	.4402
	4	-.3425*	.04179	.000	-.4714	-.2136
	5	-.1450*	.04179	.016	-.2739	-.0161
	6	.0350	.04179	.991	-.0939	.1639
	7	.2100*	.04179	.000	.0811	.3389

*. The mean difference is significant at the .05 level.

Homogeneous Subsets

TRIPRATE

Tukey HSD[a]

GROUP	N	Subset for alpha = .05 1	2	3	4
3	16	.5094			
7	16	.6106			
6	16		.7856		
8	16		.8206		
1	16		.8238		
5	16			.9656	
4	16				1.1631
2	16				1.2881
Sig.		.240	.984	1.000	.064

Means for groups in homogeneous subsets are displayed.
a. Uses Harmonic Mean Sample Size = 16.000.

Oneway Analysis of
Variance (ANOVA)   PM Peak Period

Descriptives

TRIPRATE

| | N | Mean | Std. Deviation | Std. Error | 95% Confidence Interval for Mean | |
					Lower Bound	Upper Bound
1	16	.7931	.05400	.01350	.7643	.8219
2	16	.7994	.13208	.03302	.7290	.8698
3	16	.5044	.08477	.02119	.4592	.5495
4	16	1.0606	.09234	.02308	1.0114	1.1098
5	16	1.0294	.26496	.06624	.8882	1.1706
6	16	.8275	.13955	.03489	.7531	.9019
7	16	.4913	.08277	.02069	.4471	.5354
8	16	.7594	.11550	.02887	.6978	.8209
Total	128	.7831	.23551	.02082	.7419	.8243
Model Fixed Effects			.13507	.01194	.7595	.8068
Random Effects				.07361	.6091	.9572

Descriptives

TRIPRATE

	Minimum	Maximum	Between-Component Variance
1	.67	.87	
2	.54	1.02	
3	.30	.61	
4	.87	1.20	
5	.77	1.95	
6	.58	1.05	
7	.34	.62	
8	.64	1.13	
Total	.30	1.95	
Model Fixed Effects			
Random Effects			.04221

Test of Homogeneity of Variances

TRIPRATE

Levene Statistic	df1	df2	Sig.
1.955	7	120	.067

ANOVA

TRIPRATE

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.855	7	.694	38.018	.000
Within Groups	2.189	120	.018		
Total	7.044	127			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: TRIPRATE
Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	-.0063	.04775	1.000	-.1536	.1411
	3	.2887*	.04775	.000	.1414	.4361
	4	-.2675*	.04775	.000	-.4148	-.1202
	5	-.2363*	.04775	.000	-.3836	-.0889
	6	-.0344	.04775	.996	-.1817	.1130
	7	.3019*	.04775	.000	.1545	.4492
	8	.0337	.04775	.997	-.1136	.1811
2	1	.0063	.04775	1.000	-.1411	.1536
	3	.2950*	.04775	.000	.1477	.4423
	4	-.2612*	.04775	.000	-.4086	-.1139
	5	-.2300*	.04775	.000	-.3773	-.0827
	6	-.0281	.04775	.999	-.1755	.1192
	7	.3081*	.04775	.000	.1608	.4555
	8	.0400	.04775	.991	-.1073	.1873
3	1	-.2887*	.04775	.000	-.4361	-.1414
	2	-.2950*	.04775	.000	-.4423	-.1477
	4	-.5562*	.04775	.000	-.7036	-.4089
	5	-.5250*	.04775	.000	-.6723	-.3777
	6	-.3231*	.04775	.000	-.4705	-.1758
	7	.0131	.04775	1.000	-.1342	.1605
	8	-.2550*	.04775	.000	-.4023	-.1077
4	1	.2675*	.04775	.000	.1202	.4148
	2	.2612*	.04775	.000	.1139	.4086
	3	.5562*	.04775	.000	.4089	.7036
	5	.0312	.04775	.998	-.1161	.1786
	6	.2331*	.04775	.000	.0858	.3805
	7	.5694*	.04775	.000	.4220	.7167
	8	.3012*	.04775	.000	.1539	.4486
5	1	.2363*	.04775	.000	.0889	.3836
	2	.2300*	.04775	.000	.0827	.3773
	3	.5250*	.04775	.000	.3777	.6723
	4	-.0312	.04775	.998	-.1786	.1161
	6	.2019*	.04775	.001	.0545	.3492
	7	.5381*	.04775	.000	.3908	.6855
	8	.2700*	.04775	.000	.1227	.4173

Multiple Comparisons

Dependent Variable: TRIPRATE
Tukey HSD

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
6	1	.0344	.04775	.996	-.1130	.1817
	2	.0281	.04775	.999	-.1192	.1755
	3	.3231*	.04775	.000	.1758	.4705
	4	-.2331*	.04775	.000	-.3805	-.0858
	5	-.2019*	.04775	.001	-.3492	-.0545
	7	.3363*	.04775	.000	.1889	.4836
	8	.0681	.04775	.843	-.0792	.2155
7	1	-.3019*	.04775	.000	-.4492	-.1545
	2	-.3081*	.04775	.000	-.4555	-.1608
	3	-.0131	.04775	1.000	-.1605	.1342
	4	-.5694*	.04775	.000	-.7167	-.4220
	5	-.5381*	.04775	.000	-.6855	-.3908
	6	-.3363*	.04775	.000	-.4836	-.1889
	8	-.2681*	.04775	.000	-.4155	-.1208
8	1	-.0337	.04775	.997	-.1811	.1136
	2	-.0400	.04775	.991	-.1873	.1073
	3	.2550*	.04775	.000	.1077	.4023
	4	-.3012*	.04775	.000	-.4486	-.1539
	5	-.2700*	.04775	.000	-.4173	-.1227
	6	-.0681	.04775	.843	-.2155	.0792
	7	.2681*	.04775	.000	.1208	.4155

*. The mean difference is significant at the .05 level.

Homogeneous Subsets

TRIPRATE

Tukey HSD[a]

GROUP	N	Subset for alpha = .05 — 1	Subset for alpha = .05 — 2	Subset for alpha = .05 — 3
7	16	.4913		
3	16	.5044		
8	16		.7594	
1	16		.7931	
2	16		.7994	
6	16		.8275	
5	16			1.0294
4	16			1.0606
Sig.		1.000	.843	.998

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 16.000.

F. Exponential Smoothing Estimations For Daily Vehicle Trips

Trip Forecast for Northern Boulevard Facility - Saturday								
time	trips	Rounded Forecast	ALPHA α	MAD	MSE	MAPE	AVG ERROR.	CFE
1200	165.00	165.00	0.90	0.00	0.00	0.00	0.00	
1215	196.00	165.00		31.00	961.00	0.16	31.00	31.00
1230	242.00	192.90		49.10	2410.81	0.20	49.10	49.10
1245	243.00	237.09		5.91	34.93	0.02	5.91	5.91
1300	221.00	242.41		21.41	458.35	0.10	-21.41	-21.41
1315	217.00	223.14		6.14	37.71	0.03	-6.14	-6.14
1330	241.00	217.61		23.39	546.90	0.10	23.39	23.39
1345	237.00	238.66		1.66	2.76	0.01	-1.66	-1.66
1400	212.00	237.17		25.17	633.33	0.12	-25.17	-25.17
1415	218.00	214.52		3.48	12.13	0.02	3.48	3.48
1430	195.00	217.65		22.65	513.10	0.12	-22.65	-22.65
1445	216.00	197.27		18.73	350.99	0.09	18.73	18.73
1500	217.00	214.13		2.87	8.26	0.01	2.87	2.87
1515	224.00	216.71		7.29	53.11	0.03	7.29	7.29
1530	216.00	223.27		7.27	52.87	0.03	-7.27	-7.27
1545	222.00	216.73		5.27	27.80	0.02	5.27	5.27
1600	221.00	221.47		0.47	0.22	0.00	-0.47	-0.47
1615	217.00	221.05		4.05	16.38	0.02	-4.05	-4.05
1630	195.00	217.40		22.40	501.97	0.11	-22.40	-22.40
1645	220.00	197.24		22.76	518.00	0.10	22.76	22.76
1700	170.00	217.72		47.72	2277.58	0.28	-47.72	-47.72
1715	189.00	174.77		14.23	202.42	0.08	14.23	14.23
1730	147.00	187.58		40.58	1646.51	0.28	-40.58	-40.58
1745	148.00	151.06		3.06	9.35	0.02	-3.06	-3.06
Summation				386.62	11276.50	1.95	-18.55	-18.55
AVG				16.81	490.28	0.08	-0.81	

			For α= 0.9	MAD	16.81				
				MSE	490				
				MAPE	8.0%				
				AVG. ER.	-0.81				
				CFE	-18.55				

			Trip Forecast for 23rd Street Facility - Saturday					
Exponential Smoothing								
		Rounded						
time	trips	Forecast	ALPHA				AVG.	
		UF	α	MAD	MSE	MAPE	ERROR	CFE
1200	114.00	114.00	0.90	0.00	0.00	0.00	0.00	
1215	142.00	114.00		28.00	784.00	0.20	28.00	28.00
1230	223.00	139.20		83.80	7022.44	0.38	83.80	83.80
1245	316.00	214.62		101.38	10277.90	0.32	101.38	101.38
1300	308.00	305.86		2.14	4.57	0.01	2.14	2.14
1315	281.00	307.79		26.79	717.50	0.10	-26.79	-26.79
1330	298.00	283.68		14.32	205.10	0.05	14.32	14.32
1345	326.00	296.57		29.43	866.25	0.09	29.43	29.43
1400	344.00	323.06		20.94	438.62	0.06	20.94	20.94
1415	373.00	341.91		31.09	966.86	0.08	31.09	31.09
1430	347.00	369.89		22.89	523.98	0.07	-22.89	-22.89
1445	353.00	349.29		3.71	13.77	0.01	3.71	3.71
1500	376.00	352.63		23.37	546.21	0.06	23.37	23.37
1515	353.00	373.66		20.66	426.96	0.06	-20.66	-20.66
1530	367.00	355.07		11.93	142.41	0.03	11.93	11.93
1545	334.00	365.81		31.81	1011.66	0.10	-31.81	-31.81
1600	321.00	337.18		16.18	261.81	0.05	-16.18	-16.18
1615	331.00	322.62		8.38	70.26	0.03	8.38	8.38

1630	278.00	330.16		52.16	2720.85	0.19	-52.16	-52.16
1645	289.00	283.22		5.78	33.45	0.02	5.78	5.78
1700	316.00	288.42		27.58	760.57	0.09	27.58	27.58
1715	301.00	313.24		12.24	149.87	0.04	-12.24	-12.24
1730	284.00	302.22		18.22	332.12	0.06	-18.22	-18.22
1745	276.00	285.82		9.82	96.48	0.04	-9.82	-9.82
1800		276.98		602.65	28373.65	2.11	181.09	181.09
				26.20	1233.64	0.09	7.87	
		For α= 0.9	MAD	26.2				
			MSE	1,234				
			MAPE	9.0%				
			AVG. ER.	7.87				
			CFE	181.09				

Trip Forecast for Targee Street Facility- Saturday								
Exponential Smoothing								
		Rounded						
time	trips	Forecast	ALPHA				AVG.	
		UF	α	MAD	MSE	MAPE	ERROR	CFE
1200	150.00	150.00	0.90	0.00	0.00	0.00	0.00	
1215	223.00	150.00		73.00	5329.00	0.33	73.00	73.00
1230	213.00	215.70		2.70	7.29	0.01	-2.70	-2.70
1245	187.00	213.27		26.27	690.11	0.14	-26.27	-26.27
1300	208.00	189.63		18.37	337.57	0.09	18.37	18.37
1315	208.00	206.16		1.84	3.38	0.01	1.84	1.84
1330	190.00	207.82		17.82	317.42	0.09	-17.82	-17.82
1345	186.00	191.78		5.78	33.43	0.03	-5.78	-5.78
1400	197.00	186.58		10.42	108.61	0.05	10.42	10.42

time	trips	Rounded Forecast		error				
1415	214.00	195.96		18.04	325.52	0.08	18.04	18.04
1430	182.00	212.20		30.20	911.79	0.17	-30.20	-30.20
1445	156.00	185.02		29.02	842.14	0.19	-29.02	-29.02
1500	179.00	158.90		20.10	403.93	0.11	20.10	20.10
1515	150.00	176.99		26.99	728.47	0.18	-26.99	-26.99
1530	146.00	152.70		6.70	44.88	0.05	-6.70	-6.70
1545	140.00	146.67		6.67	44.49	0.05	-6.67	-6.67
1600	135.00	140.67		5.67	32.11	0.04	-5.67	-5.67
1615	138.00	135.57		2.43	5.92	0.02	2.43	2.43
1630	160.00	137.76		22.24	494.77	0.14	22.24	22.24
1645	183.00	157.78		25.22	636.27	0.14	25.22	25.22
1700	106.00	180.48		74.48	5546.91	0.70	-74.48	-74.48
1715	113.00	113.45		0.45	0.20	0.00	-0.45	-0.45
1730	116.00	113.04		2.96	8.73	0.03	2.96	2.96
1745	123.00	115.70		7.30	53.22	0.06	7.30	7.30
1800		122.27		434.66	16906.15	2.71	-30.81	-30.81
				18.90	735.05	0.12	-1.34	
		For α= 0.9	MAD	18.9				
			MSE	735				
			MAPE	12.0%				
			AVG. ER.	-1.34				
			CFE	-30.81				

Trip forecast for Warehouses - Rockaway BI - Saturday

Exponential Smoothing

time	trips	Rounded Forecast	ALPHA				AVG.	
		UF	α	MAD	MSE	MAPE	ERROR	CFE
1200	256	268	0.9	12	0	0.046875	-12	
1215	238	257.2		19.2	368.64	0.0806723	-19.2	-19.2

1230	264	239.92		24.08	579.8464	0.0912121	24.08	24.08
1245	254	261.592		7.592	57.638464	0.0298898	-7.592	-7.592
1300	253	254.7592		1.7592	3.0947846	0.0069534	-1.7592	-1.7592
1315	257	253.17592		3.82408	14.623588	0.0148797	3.82408	3.82408
1330	247	256.61759		9.617592	92.498076	0.0389376	-9.617592	-9.617592
1345	250	247.96176		2.0382408	4.1544256	0.008153	2.0382408	2.0382408
1400	251	249.79618		1.2038241	1.4491924	0.0047961	1.2038241	1.2038241
1415	222	250.87962		28.879618	834.03231	0.1300884	-28.879618	-28.879618
1430	248	224.88796		23.112038	534.16631	0.0931937	23.112038	23.112038
1445	222	245.6888		23.688796	561.15906	0.1067063	-23.688796	-23.688796
1500	210	224.36888		14.36888	206.4647	0.0684232	-14.36888	-14.36888
1515	217	211.43689		5.563112	30.948216	0.0256365	5.563112	5.563112
1530	215	216.44369		1.4436888	2.0842373	0.0067148	-1.4436888	-1.4436888
1545	199	215.14437		16.144369	260.64065	0.0811275	-16.144369	-16.144369
1600	211	200.61444		10.385563	107.85992	0.0492207	10.385563	10.385563
1615	247	209.96144		37.038556	1371.8547	0.1499537	37.038556	37.038556
1630	228	243.29614		15.296144	233.97203	0.0670884	-15.296144	-15.296144
1645	228	229.52961		1.5296144	2.3397203	0.0067088	-1.5296144	-1.5296144
1700	186	228.15296		42.152961	1776.8722	0.2266288	-42.152961	-42.152961
1715	210	190.2153		19.784704	391.43451	0.0942129	19.784704	19.784704
1730	190	208.02153		18.02153	324.77553	0.0948502	-18.02153	-18.02153
1745	184	191.80215		7.802153	60.873591	0.042403	-7.802153	-7.802153
1800		184.78022		346.52666	7821.4225	1.5653257	-80.466427	-80.466427
				15.066377	340.06185	0.0680576	-3.4985403	

For α= 0.9	MAD	15.07
	MSE	340.06
	MAPE	0.07
	AVG. ER.	-3.5
	CFE	-80.47

Trip Forecast for Veterans Rd facility - Saturday

Exponential Smoothing

time	trips	Rounded Forecast UF	ALPHA α	MAD	MSE	MAPE	AVG. ERROR	CFE
1200	268.00	268.00	0.90	0.00	0.00	0.00	0.00	
1215	270.00	268.00		2.00	4.00	0.01	2.00	2.00
1230	273.00	269.80		3.20	10.24	0.01	3.20	3.20
1245	283.00	272.68		10.32	106.50	0.04	10.32	10.32
1300	352.00	281.97		70.03	4904.48	0.20	70.03	70.03
1315	295.00	345.00		50.00	2499.68	0.17	-50.00	-50.00
1330	300.00	300.00		0.00	0.00	0.00	0.00	0.00
1345	290.00	300.00		10.00	100.00	0.03	-10.00	-10.00
1400	283.00	291.00		8.00	64.00	0.03	-8.00	-8.00
1415	330.00	283.80		46.20	2134.44	0.14	46.20	46.20
1430	333.00	325.38		7.62	58.06	0.02	7.62	7.62
1445	323.00	332.24		9.24	85.34	0.03	-9.24	-9.24
1500	368.00	323.92		44.08	1942.71	0.12	44.08	44.08
1515	386.00	363.59		22.41	502.10	0.06	22.41	22.41
1530	288.00	383.76		95.76	9169.83	0.33	-95.76	-95.76
1545	296.00	297.58		1.58	2.48	0.01	-1.58	-1.58
1600	284.00	296.16		12.16	147.81	0.04	-12.16	-12.16
1615	258.00	285.22		27.22	740.70	0.11	-27.22	-27.22
1630	243.00	260.72		17.72	314.05	0.07	-17.72	-17.72
1645	255.00	244.77		10.23	104.61	0.04	10.23	10.23
1700	285.00	253.98		31.02	962.41	0.11	31.02	31.02
1715	241.00	281.90		40.90	1672.62	0.17	-40.90	-40.90
1730	245.00	245.09		0.09	0.01	0.00	-0.09	-0.09
1745	234.00	245.01		11.01	121.20	0.05	-11.01	-11.01
1800		235.10		530.77	25647.29	1.78	-36.55	-36.55
				23.08	1115.10	0.08	-1.59	

For α= 0.9   **MAD**   **23.08**

MSE	**1,115**
MAPE	**8.0%**
AVG. ER.	**-1.59**
CFE	**-36.55**

Facility Trip Estimations

	Northern Blvd		23rd Street	Targee Street	Veterans Rd	Rockaway Blvd
	WD Veh	Sat Veh	Sat Per	Sat Veh	Sat Veh	Sat Veh
5:00 AM	24.7	16				
5:15 AM	27.1	17.4				
5:30 AM	29.8	18.9				
5:45 AM	32.8	20.5				
6:00 AM	36	22.3		7		44.9
6:15 AM	39.5	24.2		7.9		48.2
6:30 AM	52.5	26.4		9		51.9
6:45 AM	50	28.6		10.2		55.8
7:00 AM	69.5	31.1	17.3	11.6		60.0
7:15 AM	85.5	33.8	19	13.2		64.5
7:30 AM	90.5	36.8	20.9	15		69.3
7:45 AM	90	40	22.9	17.1		74.6
8:00 AM	124	43.5	25.2	19.4	70.6	80.2
8:15 AM	126.5	47.2	27.7	22	76.7	86.2
8:30 AM	140.5	51.3	30.4	25.1	83.4	92.7
8:45 AM	120	55.8	33.5	28.5	90.7	99.7
9:00 AM	144	60.7	36.8	32.4	98.5	107.2
9:15 AM	135.5	65.9	40.4	36.8	107.1	115.2
9:30 AM	148.5	71.7	44.4	41.8	116.4	123.9
9:45 AM	163	77.9	48.8	47.5	126.5	133.2
10:00 AM	171	84.7	53.6	53.9	137.5	143.3
10:15 AM	160.5	92	58.9	61.3	149.5	154.0
10:30 AM	167.5	100	64.7	69.7	162.5	165.6
10:45 AM	161.5	108.7	71.1	79.2	176.6	178.1
11:00 AM	181.5	118.2	78.2	90	192	191.5
11:15 AM	164.5	128.5	85.9	102.2	208.7	205.9
11:30 AM	150.5	139.7	94.4	116.2	226.8	221.4
11:45 AM	171.5	151.8	103.7	132	246.6	238.1
12:00 PM	166	165	114	150	268	256.0
12:15 PM	157.5	196	142	223	270	238.0
12:30 PM	168.5	242	223	213	273	264.0
12:45 PM	162.5	243	316	187	283	254.0
1:00 PM	162	221	308	208	352	253.0
1:15 PM	171.5	217	281	208	295	257.0
1:30 PM	172	241	298	190	300	247.0
1:45 PM	142.5	237	326	186	290	250.0
2:00 PM	146	212	344	197	283	251.0
2:15 PM	150	218	373	214	330	222.0
2:30 PM	145.5	195	347	182	333	248.0
2:45 PM	167.5	216	353	156	323	222.0
3:00 PM	128	217	376	179	368	210.0

Time						
3:15 PM	154	224	353	150	386	217.0
3:30 PM	153	216	367	146	288	215.0
3:45 PM	175	222	334	140	296	199.0
4:00 PM	133	221	321	135	284	211.0
4:15 PM	173.5	217	331	138	258	247.0
4:30 PM	155	195	278	160	243	228.0
4:45 PM	176	220	289	183	255	228.0
5:00 PM	155.5	170	316	106	285	186.0
5:15 PM	157.5	189	301	113	241	210.0
5:30 PM	151	147	284	116	245	190.0
5:45 PM	148.5	148	276	123	234	184.0
6:00 PM	161	*136.16*	*251.2*	*108.2*	*215.3*	171.1
6:15 PM	126.5	*125.3*	*228.6*	*95.3*	*198.1*	159.1
6:30 PM	151.5	*115.2*	*208*	*83.8*	*182.2*	148.0
6:45 PM	135.5	*106*	*189.3*	*73.8*	*167.6*	137.6
7:00 PM	174.5	*97.5*	*172.2*	*64.9*	*154.2*	128.0
7:15 PM	155	*89.7*	*156.7*	*57.1*	*141.9*	119.0
7:30 PM	142.5	*82.6*	*142.6*	*50.3*	*130.5*	110.7
7:45 PM	136	*76*	*129.8*	*44.2*	*120.1*	103.0
8:00 PM	140	*69.9*	*118.1*			95.8
8:15 PM	127.5	*64.3*	*107.5*			89.1
8:30 PM	124	*59.1*	*97.8*			82.8
8:45 PM	108.5	*54.4*	*89*			77.0
9:00 PM	112	*50.1*				71.6
9:15 PM	122	*46.1*				66.6
9:30 PM	88.5	*42.4*				62.0
9:45 PM	84	*39*				57.6
10:00 PM	*76.44*	*35.9*				53.6
10:15 PM	*69.56*	*33*				49.8
10:30 PM	*63.3*	*30.4*				46.3
10:45 PM	*57.6*	*27.9*				43.1
11:00 PM						
11:15 PM						
11:30 PM						
11:45 PM						
Total	**9,186**	**8,084**	**10,120**	**5,629**	**10,563**	**10,164**

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