



TRIP AND PARKING GENERATION STUDY OF A MINI-WAREHOUSE

Introduction

The Brigham Young University (BYU) Institute of Transportation Engineers (ITE) student chapter recently completed the 2011 Data Collection Project as proposed to the ITE Western District. The data for this project were collected at a local mini-warehouse facility, which corresponds to Land Use Code 151. This project was a great learning experience for our student chapter; the funds we receive will help student chapter members attend the Western District ITE meeting in Anchorage, Alaska.

Ryan Hales, P.E., PTOE, AICP, of Hales Engineering, provided mentoring support and project review for this data collection effort. Craig Wagner, from Econolite, provided our student members with training on the use of our traffic data collection trailer on January 19 and February 23, 2011 (see Figure 1). Dr. Mitsuru Saito Ph.D., P.E. and Dr. Grant Schultz Ph.D., P.E., PTOE, both of BYU, have provided invaluable help and support and data collection equipment for the project.

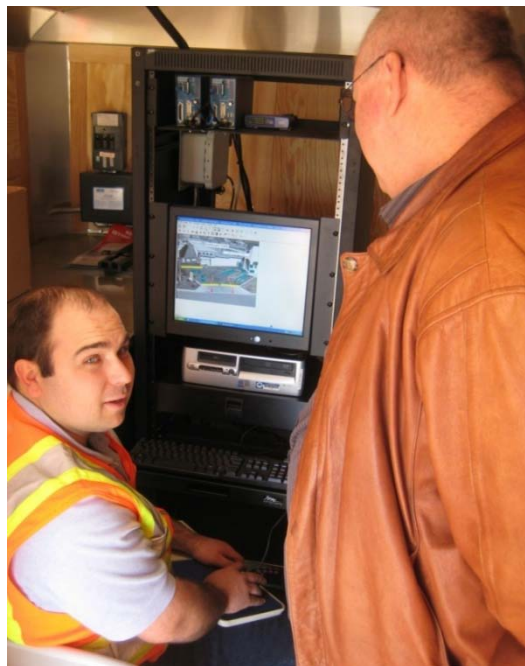


Figure 1: Data Collection training with Craig Wagner.

Site Information

Data were collected on three different days at the mini-warehouse facility, shown in Figure 2. The facility is Hillside Storage, located at 2067 Ironton Blvd. in Provo, UT. The approximate square footage of the office building, number of employees, number of parking stalls, number of units, percent of units occupied, net rentable area, gross floor area, and total property area can be seen in Table 1. There are two parking areas at the site, one of which includes the entrance to the area that contains the storage units.

Table 1: Site Characteristics

Characteristic	Value
Number of Employees	4 (2 FT, 2 PT)
Number of Units	420
Occupied Units	60%
Net Rentable Area	56,476 ft ²
Office Floor Space	1,700 ft ²
Gross Floor Area	58,098 ft ²
Property Area	3.44 acres
Number of Parking Stalls	6 (1 handicap)

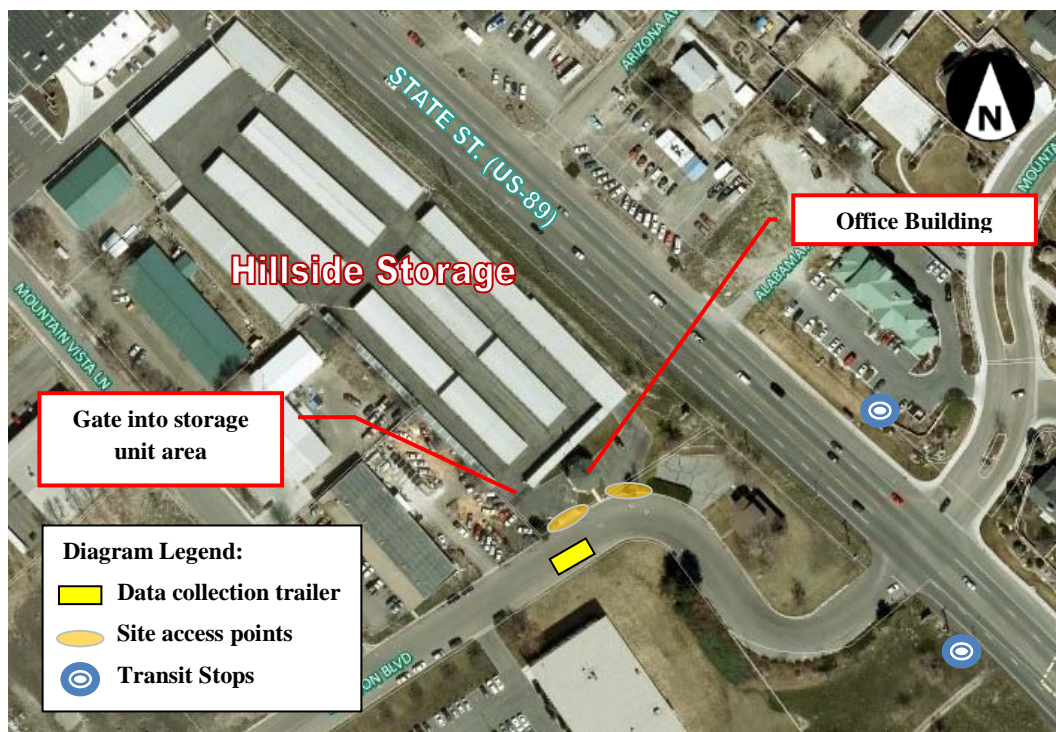


Figure 2: Site layout.

Methodology

Data were collected on Saturday, February 26, 2011; Sunday, February 27, 2011; and Tuesday, March 1, 2011. As stated in the proposal, trip generation was counted between the hours of 7am and 7pm on each day. The BYU Traffic Data Collection Trailer, shown in Figure 3, was used to collect data at the site.

The trailer is equipped with two video cameras that recorded each entrance to the site during the specified hours. These videos were then used to manually count vehicles entering and exiting the site through each access. The counts for the two driveways were totaled for each hour. The results of the trip generation are summarized in the attached Trip Generation Data Forms. Parking demand data were also collected every hour, on the hour, from 7am to 7pm. The parking data are attached in the Parking Demand Survey Forms.



Figure 3: BYU traffic data collection trailer at the site.

Results

The trip data for the morning peak period, the afternoon peak period, and the peak hour of generator are shown in Table 2, Table 3, and Table 4, respectively. Data about vehicle occupancy was not collected during this study. Furthermore, no pedestrian, bicycle, or transit trips were observed during the study. The trip rates shown are rates per occupied unit and per 1000 square feet of gross floor area (GFA). Table 5 shows a summary of trips counted for each day of the study.

Table 2: Morning Peak Period Trip Data for the Mini-Warehouse

Variable	Saturday 2/26/11	Sunday 2/27/11	Tuesday 3/1/11
Peak Hour	8:00-9:00 AM	8:00-9:00 AM	8:00-9:00 AM
All Vehicles	1	1	0
Trucks	0	0	0
Total Trips	1	1	0
Trip Rate (Occ. Units)	0.004	0.004	0.00
Trip Rate (GFA)	0.017	0.017	0.00
% Entering	100.0%	0.0%	0.0%
% Exiting	0.0%	100.0%	0.0%

Table 3: Afternoon Peak Period Trip Data for the Mini-Warehouse

Variable	Saturday 2/26/11	Sunday 2/27/11	Tuesday 3/1/11
Peak Hour	5:00-6:00 PM	5:00-6:00 PM	5:00-6:00 PM
All Vehicles	3	0	4
Trucks	0	0	2
Total Trips	3	0	4
Trip Rate (Occ. Units)	0.012	0.00	0.016
Trip Rate (GFA)	0.052	0.00	0.069
% Entering	66.7%	0.0%	50.0%
% Exiting	33.3%	0.0%	50.0%

Table 4: Peak Hour of Generator Trip Data for the Mini-Warehouse

Variable	Saturday 2/26/11	Sunday 2/27/11	Tuesday 3/1/11
Peak Hour	11:00-12:00 PM	9:00-10:00 AM	5:00-6:00 PM
All Vehicles	4	2	4
Trucks	0	0	2
Total Trips	4	2	4
Trip Rate (Occ. Units)	0.016	0.008	0.016
Trip Rate (GFA)	0.069	0.034	0.069
% Entering	50.0%	100.0%	50.0%
% Exiting	50.0%	0.0%	50.0%

Table 5. Summary of Daily Trip Data

Saturday (2/26/11)			Sunday (2/27/11)			Tuesday (3/1/11)		
Entering	Exiting	Total	Entering	Exiting	Total	Entering	Exiting	Total
13	12	25	4	4	8	11	8	19

Trip rates generated from this study have been calculated and are shown in Table 6 alongside average trip rates from *ITE Trip Generation, 7th Edition*. The actual number of trips for each analysis period is shown alongside the number of trips predicted from ITE trip rates in Table 7.

Table 6. Comparison of Calculated and ITE Trip Generation Rates

Independent Variable	Analysis Period	Saturday 2/26/11		Sunday 2/27/11		Tuesday 3/1/11	
		Calculated	ITE	Calculated	ITE	Calculated	ITE
Occupied Units	Full Day	0.099	0.250	0.032	0.180	0.075	0.280
	Peak Hour of Generator	0.016	0.040	0.008	0.030	0.016	0.030
Gross Floor Area	Full Day	0.430	2.330	0.138	1.780	0.327	2.500
	Peak Hour of Generator	0.069	0.400	0.034	0.300	0.069	0.290

Table 7. Comparison of Actual and Predicted Trips

Independent Variable	Analysis Period	Saturday 2/26/11		Sunday 2/27/11		Tuesday 3/1/11	
		Actual	Predicted	Actual	Predicted	Actual	Predicted
Occupied Units	Full Day	25	63	8	45	19	71
	Peak Hour of Generator	4	10	2	8	4	8
Gross Floor Area	Full Day	25	135	8	103	19	145
	Peak Hour of Generator	4	23	2	17	4	17

The trip rates calculated from this data collection study are substantially lower than the average trip rates provided by ITE. The difference between the trip rates is much larger when using gross floor area as the independent variable. This is due to gross floor area including both the space of the occupied units and unoccupied units. At the time of collection about 40% of the units were unoccupied. One reason the calculated rates are lower than the average rates provided by ITE may be that the storage units are usually used for long term storage rather than short term storage. Some of the storage units are being occupied by Brigham Young University for long term storage, which results in a lower number of trips being made for these units. Sunday trip rates may further be impacted by the demographics of the area as a large proportion of the nearby population believes that work and business activities should be avoided on Sunday. Finally, some of the difference in trip rates could be due to the timing of the study. Temperatures in Utah during February and March are often cool and accompanied by precipitation in the form of rain and snow. Cooler weather affects the behavior of mini-warehouse clients, resulting in less trips being made.

Figure 4, Figure 5, and Figure 6 show the hourly counts of vehicles entering and exiting the site, as well as the parking demand for the specified hour, for the Saturday, Sunday, and Tuesday dates, respectively.

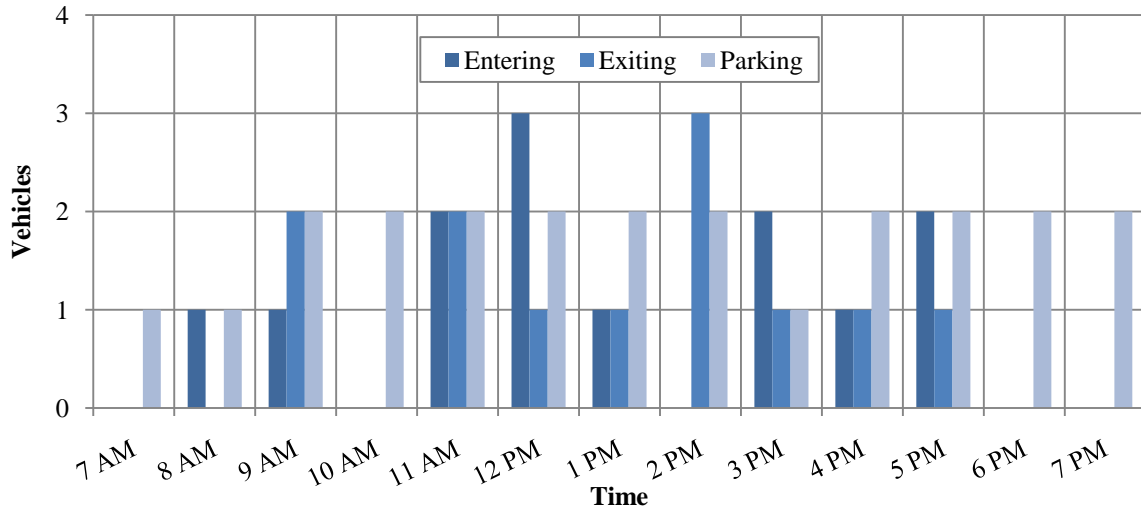


Figure 4: Counts for Saturday, February 26, 2011.

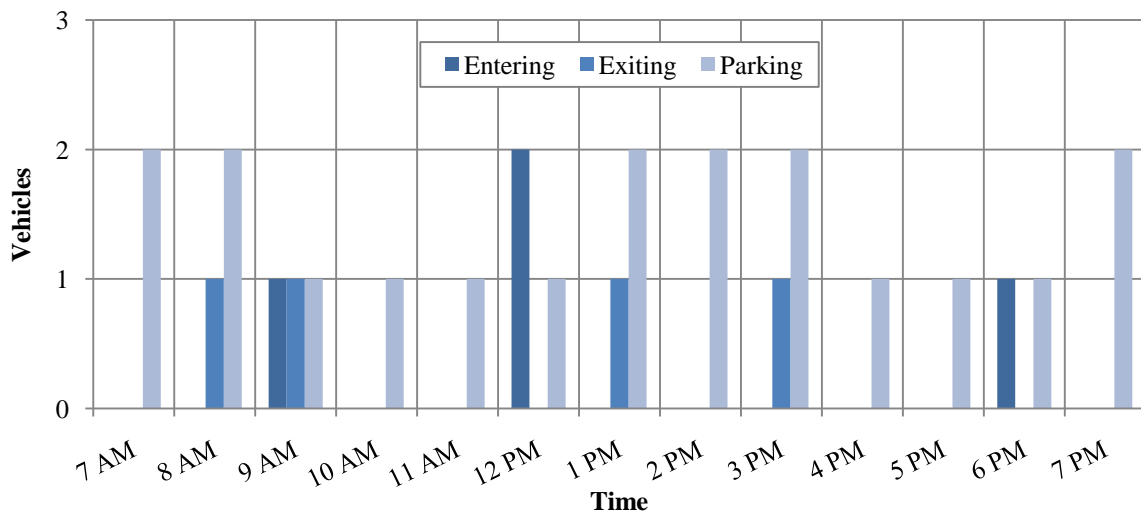


Figure 5: Counts for Sunday, February 27, 2011.

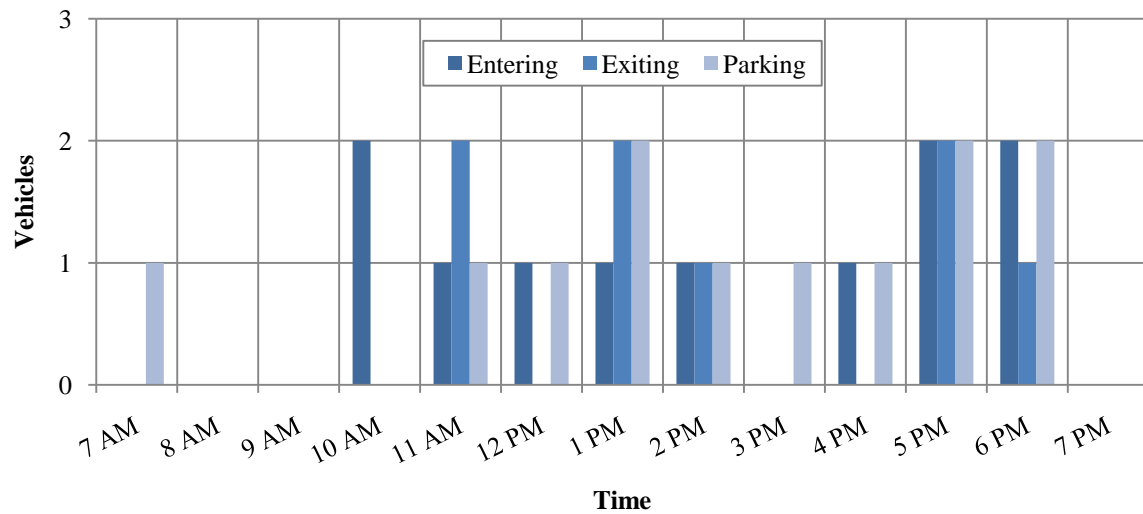


Figure 6: Counts for Tuesday, March 1, 2011.

Level of Effort

Many different BYU ITE student members were involved in this project. BYU ITE student chapter officers especially spent a lot of time organizing and carrying out the data collection efforts. A summary of hours spent on the project by student members is shown in Table 8.

Table 8: Level of Effort

Task	Number of Students	Hours per Student	Total Hours
Training	6	5	30
Data Collection	4	4	16
Data Reduction and Analysis	6	5	30
Writing and Revision	4	3	12
Total:			88

Trip Generation Data Form (Part 1)

Land Use/Building Type: ¹ <u>Mini Warehouse (Storage facility)</u>		ITE Land Use Code: <u>151</u>	
Source:		Source No. (ITE use only):	
Name of Development: <u>Hillside Storage</u>		Day of the Week: <u>Saturday, Sunday, Tuesday</u>	
City: <u>Provo</u>	State/Province: <u>Utah</u>	Zip/Postal Code: <u>84606</u>	Day: _____ Month: <u>February</u> Year: <u>2011</u>
Country: <u>U.S.A.</u>		Metropolitan Area: <u>Provo, UT</u>	

1. For fast-food land use, please specify if hamburger- or nonhamburger-based.

Location Within Area: <input type="checkbox"/> (1) CBD <input checked="" type="checkbox"/> (3) Suburban (Non-CBD) <input type="checkbox"/> (5) Rural <input type="checkbox"/> (2) Urban (Non-CBD) <input type="checkbox"/> (4) Suburban CBD <input type="checkbox"/> (6) Freeway Interchange Area (Rural) <input type="checkbox"/> (7) Not Given				Detailed Description of Development:³ <u>Hillside Storage is a self storage business located in Provo, Utah. There are a variety of units available for rent and are open 365 days each year. The primary employees live on site.</u>	
Independent Variable: (include data for as many as possible) ²		Actual	Estimated	Actual	Estimated
<u>4</u> (1) Employees (#)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<u>6</u> (9) Parking Spaces (% occupied: _____)	<input checked="" type="checkbox"/>	<input type="checkbox"/>
(2) Persons (#)	<input type="checkbox"/>	<input type="checkbox"/>	(10) Beds (% occupied: _____)	<input type="checkbox"/>	<input type="checkbox"/>
<u>420</u> (3) Total Units (#) (indicate unit: <u>rentable units</u>)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	(11) Seats (#)	<input type="checkbox"/>	<input type="checkbox"/>
<u>252</u> (4) Occupied Units (#) (indicate unit: <u>rentable units</u>)	<input type="checkbox"/>	<input type="checkbox"/>	(12) Servicing Positions/Vehicle Fueling Positions	<input type="checkbox"/>	<input type="checkbox"/>
(5) Gross Floor Area (gross sq. ft.)	<input type="checkbox"/>	<input type="checkbox"/>	(13) Shopping Center % Out-parcels/pads	<input type="checkbox"/>	<input type="checkbox"/>
(% of development occupied _____)			(14) A.M. Peak Hour Volume of Adjacent Street Traffic	<input type="checkbox"/>	<input type="checkbox"/>
<u>56,476</u> (6) Net Rentable Area (sq. ft.)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	(15) P.M. Peak Hour Volume of Adjacent Street Traffic	<input type="checkbox"/>	<input type="checkbox"/>
(7) Gross Leasable Area (sq. ft.)	<input type="checkbox"/>	<input type="checkbox"/>	(16) Other <u>sq. ft. Total office Space</u>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
(% of development occupied _____)			(17) Other _____	<input type="checkbox"/>	<input type="checkbox"/>
<u>3.44</u> (8) Total Acres (% developed: _____)	<input type="checkbox"/>	<input checked="" type="checkbox"/>			

2. Definitions for several independent variables can be found in the *Trip Generation, Second Edition, User's Guide Glossary*.

3. Please provide all pertinent information to describe the subject project, including the presence of bicycle/pedestrian facilities. To report bicycle/pedestrian volumes, please refer to Part 4 of this data form.

Other Data: Vehicle Occupancy (#): _____ A.M. _____ P.M. _____ 24-hour % Percent by Transit: _____ A.M. % _____ P.M. % _____ 24-hour % Percent by Carpool/Vanpool: _____ A.M. % _____ P.M. % _____ 24-hour % Employees by Shift: First Shift: Start Time _____ End Time _____ Employees (#) _____ Second Shift: Start Time _____ End Time _____ Employees (#) _____ Third Shift: Start Time _____ End Time _____ Employees (#) _____ Parking Cost on Site: Hourly _____ Daily _____		Transportation Demand Management (TDM) Information: At the time of this study, was there a TDM program (that may have impacted the trip generation characteristics of this site) underway? <input checked="" type="checkbox"/> No <input type="checkbox"/> Yes (If yes, please check appropriate box/boxes, describe the nature of the TDM program(s) and provide a source for any studies that may help quantify this impact. Attach additional sheets if necessary) <div style="display: flex; justify-content: space-between;"> <div> <input type="checkbox"/> (1) Transit Service <input type="checkbox"/> (2) Carpool Programs <input type="checkbox"/> (3) Vanpool Programs <input type="checkbox"/> (4) Bicycle/Pedestrian Facilities and Site Improvements </div> <div> <input type="checkbox"/> (5) Employer Support Measures <input type="checkbox"/> (6) Preferential HOV Treatments <input type="checkbox"/> (7) Transit and Ridesharing Incentives <input type="checkbox"/> (8) Parking Supply and Pricing Management </div> <div> <input type="checkbox"/> (9) Tolls and Congestion Pricing <input type="checkbox"/> (10) Variable Work Hours/Compressed Work Weeks <input type="checkbox"/> (11) Telecommuting <input type="checkbox"/> (12) Other _____ </div> </div>	
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Please Complete Form on Other Side

ite Institute of Transportation Engineers
Trip Generation Data Form (Part 2)

Summary of Driveway Volumes

(All = All Vehicles Counted, Including Trucks; Trucks = Heavy Duty Trucks and Buses)

	Average Weekday (M-F)						Saturday						Sunday					
	Enter		Exit		Total		Enter		Exit		Total		Enter		Exit		Total	
	All	Trucks	All	Trucks	All	Trucks	All	Trucks	All	Trucks	All	Trucks	All	Trucks	All	Trucks	All	Trucks
24-Hour Volume	11		8		19		13		12		25		4		4		8	
A.M. Peak Hour of Adjacent ¹ Street Traffic (7 – 9) Time (ex.: 7:15 – 8:15):																		
P.M. Peak Hour of Adjacent ¹ Street Traffic (4 – 6) Time:																		
A.M. Peak Hour Generator ² Time: 11:00 am – 12:00 pm	1		2		3													
P.M. Peak Hour Generator ² Time: 5:00 – 6:00 pm	2		2		4													
Peak Hour Generator ³ Time (Weekend): 12:00 – 1:00 pm							3		1		4		2		0		2	

¹ Highest hourly volume between 7 a.m. and 9 a.m. (4 p.m. and 6 p.m.). Please specify the peak hour.

² Highest hourly volume during the a.m. or p.m. period. Please specify the peak hour.

³ Highest hourly volume during the entire day. Please specify the peak hour.

Please refer to the *Trip Generation User's Guide* for full definition of terms.

Hourly Driveway Volumes- Average Weekday (M-F)

A.M. Period	Enter		Exit		Total		Mid-Day Period	Enter		Exit		Total		P.M. Period	Enter		Exit		Total	
	All	Trucks	All	Trucks	All	Trucks		All	Trucks	All	Trucks	All	Trucks		All	Trucks	All	Trucks	All	Trucks
6:00-7:00	0	0	0	0	0	0	11:00-12:00	1	0	2	0	3	0	3:00-4:00	0	0	0	0	0	0
6:15-7:15							11:15-12:15							3:15-4:15						
6:30-7:30							11:30-12:30							3:30-4:30						
6:45-7:45							11:45-12:45							3:45-4:45						
7:00-8:00	0	0	0	0	0	0	12:00-1:00	1	0	0	0	1	0	4:00-5:00	1	0	0	0	1	0
7:15-8:15							12:15-1:15							4:15-5:15						
7:30-8:30							12:30-1:30							4:30-5:30						
7:45-8:45							12:45-1:45							4:45-5:45						
8:00-9:00	0	0	0	0	0	0	1:00-2:00	1	0	2	0	3	0	5:00-6:00	2	1	2	1	4	2

☐ Check if Part 3, 4 and/or additional information is attached.

Survey conducted by: Name: Steven Dudley
 Organization: Brigham Young University ITE Student Chapter
 Address: 368 Clyde Building
 City/State/Zip: Provo, UT 84602
 Telephone #: 801-422-2811 Fax #: 801-422-0159 E-mail: byuite@gmail.com

Please return to: Institute of Transportation Engineers
 Technical Projects Division
 1627 Eye Street, NW, Suite 600
 Washington, DC 20006 USA
 Telephone: +1 202-785-0060
 Fax: +1 202-785-0609
 ITE on the Web: www.ite.org



Parking Demand Survey Form

Institute of Transportation Engineers

(fill in all highlighted cells - * are required data)

Land Use Code* 151

Name of Site Hillside Storage

Brief Description of Site

Mini-warehouse site in south part of Provo UT

Transit* Yes

Area* SUB

TMP* NO

City Provo

State UT

Country USA

Parking Price* \$ -

Daily Rate

\$

Hourly Rate

Site Size* 420

Units* Storage units

Occupancy* 60%

Land Use

Site Size 4

Units Employees

Occupancy

Site Size 56,476

Units Net rentable area

Occupancy

Site Size 10,700

Units Office floor area

Occupancy

Site Size 58,098

Units Gross floor area

Occupancy

Site Size 3

Units Acres

Occupancy

Number of Parking Spaces Provided at Site

6

Highest Observed Parking Demand for the following hours of the day (hour beginning)*

Date	2/26/2011	2/27/2011	3/1/2011				
Day	Saturday	Sunday	Tuesday				
12 Mid							
1:00 AM							
2:00 AM							
3:00 AM							
4:00 AM							
5:00 AM							
6:00 AM							
7:00 AM	1	2	1				
8:00 AM	1	2	0				
9:00 AM	2	1	0				
10:00 AM	2	1	0				
11:00 AM	2	1	1				
12 Noon	2	1	1				
1:00 PM	2	2	2				
2:00 PM	2	2	1				
3:00 PM	1	2	1				
4:00 PM	2	1	1				
5:00 PM	2	1	2				
6:00 PM	2	1	2				
7:00 PM	2	2	0				
8:00 PM							
9:00 PM							
10:00 PM							
11:00 PM							

Person Steven Dudley

Organization BYU ITE

Phone 801-636-8821

Fax

Email

Notes Includes only vehicles parked at the office parking lot, not those parked at the storage units.

Enter data on the web at www.ite.org

Comments to: ite_staff@ite.org

IF not entered on web site, please mail to:

Institute of Transportation Engineers, 1627 Eye Street, NW Suite 600; Washington, DC 20006