



**CLOUGH, HARBOUR  
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June 26, 2000

Mr. Robert Mitchell  
Planning Director  
Town of Amherst Planning Board  
4 Boltwood Avenue  
Amherst, MA 01002

**Re: Amherst Parking Garage Traffic Engineering Services, Amherst, Massachusetts;  
CHA Project No. 9462-3101**

Dear Mr. Mitchell:

Clough, Harbour, and Associates (CHA) has completed the traffic engineering analysis for the above referenced project. The following report details our findings and recommendations.

## I. INTRODUCTION

The Town of Amherst, Massachusetts is proposing to construct a parking garage in the Sweetser Park area, which will replace the existing 96 space surface parking lot at Boltwood Walk and Lessey Street. The proposed garage will supply at most 188 space, and could be limited to either 176 spaces or 164 spaces. An earlier study for the Sweetser Park intersections of Main Street at Boltwood Walk, Main Street at Churchill Street, and Churchill Street at Lessey Street was conducted, which included traffic from the construction of a 199 space garage. This earlier study evaluated three alternative Sweetser Park modifications including intersection improvements. The chosen alternative was referenced as option three. It includes the elimination of an intersection at Boltwood Walk and Lessey Street; the formation of a T-intersection at Boltwood Walk and Main Street with a pedestrian crossing of Main Street, and a dedicated left turn lane on Main Street for traffic destined to Boltwood Walk and the proposed parking garage; as well as, the formation of a T-intersection at Lessey Street and Churchill Street. Also, an earlier study was conducted for the Main Street/Amity Street at North Pleasant Street intersection as part of the intersection improvement project.

The purpose of this study is to evaluate the impacts of the additional traffic generated by the construction of the proposed Parking Garage on the operations of the adjacent street system. The study will detail the future roadway conditions at the Boltwood Walk at Main Street access intersection including traffic volumes, roadway geometrics, traffic queues and traffic operations. Additionally, the study will discuss the traffic impacts of Boltwood Walk project traffic on the operations of the following intersections:

- Main Street/Amity Street at North Pleasant Street
- Main Street at Churchill Street
- Lessey Street at Churchill Street

Recommendations regarding geometric and/or traffic control improvements, if necessary, that could be implemented to accommodate the additional traffic and improve safety are included.



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## **II. EXISTING TRAFFIC CONDITIONS**

### **II.1. Roadway Description**

Main Street is a two-way roadway running in generally an east-west direction, with metered parking allowed on both sides. In option three, discussed in the earlier traffic study, a left turn lane will added to the eastbound direction allowing for storage of two turning vehicles into the Boltwood Walk access to the proposed Parking Garage. (See drawing 3 of 3 in the earlier study.) The construction of this lane will result in the elimination of three parking spaces on the south side of Main Street. Churchill Street is also a two-way roadway with permit parking allowed on the eastside. Lessey Street connects to Boltwood Walk under existing conditions. In option three, it is to be closed at Boltwood Walk and reconstructed to provide a pedestrian plaza and provisions for vehicles to turn around at a point west of Clark House.

### **II.2 Existing Traffic Volumes**

Traffic volume data for the study area intersections was obtained from the earlier study completed for Sweetser Park and from the Design Report completed for the intersection improvement project at Main Street/Amity Street and North Pleasant Street. The Main Street/Amity Street and North Pleasant Street information has been factored to reflect the 1999 conditions described in the Sweetser Park Study. The 1999 AM and PM weekday peak hour traffic volumes for the study area intersections are illustrated on Figure 1. It is noted the Design Report only included peak hour data for the PM Peak hour.

## **III. PROJECTED TRAFFIC CONDITIONS**

To address the impacts of a development on the surrounding roadway system using existing MHD Standards, it is necessary to predict the traffic that will be present on the roadway system at least 5-years after the time of completion of the proposed development. This is considered the future background scenario, which is studied to establish the baseline condition.

### **III.1. Background Growth**

To estimate design year background traffic conditions resulting from area wide traffic growth, which is not associated with the proposed development, a growth factor is applied to the existing traffic volumes. Information provided by MHD from the Main Street/Amity Street and North Pleasant Street intersection improvement project Design Report, indicates the Amherst area traffic will experience an average annual growth of approximately 1.5 percent. Therefore, this analysis assumes that the traffic in the study area will increase at a rate of 1.5 percent per year. The projected 2005 background peak hour traffic conditions are illustrated on Figure 2 for the weekday AM and PM peak periods.

### **III.2. Site Generated Traffic**

The number of vehicle trips generated by the proposed development were estimated for the peak hour conditions based on the existing rate of parking space turnover for the Lessey Street/Boltwood Walk parking lot (as discussed in the Sweetser Park Study). The new trips attributed to the proposed garage are equivalent to the garage size, minus the number of existing parking spaces in the lot. The estimated trip generation for the proposed parking garage, for 188 spaces, 176 spaces, and 164 spaces is summarized in Table 1.

**Table 1**  
**Estimated Trip Generation**  
**For Amherst Parking Garage**

	<i>Weekday AM Peak Hour</i>			<i>Weekday PM Peak Hour</i>		
	<i>Enter</i>	<i>Exit</i>	<i>Total</i>	<i>Enter</i>	<i>Exit</i>	<i>Total</i>
Calculated Rate: Trips per space	0.29	0.12	0.41	0.91	0.80	1.71
Proposed 188 Space Garage	27	12	39	84	74	158
Proposed 176 Space Garage	23	10	33	73	64	137
Proposed 164 Space Garage	20	9	29	62	55	117

**III.3. Trip Distribution**

The estimated traffic generated by the proposed development has been assigned to the adjacent street system based on the existing peak hour turning movement percentages present at the study area intersections. Figures 3, 4, and 5 depict the distribution of the new site generated traffic for the AM and PM Peak hours for the 188-space garage, 176-space garage, and the 164-space garage, respectively.

**III.4. Future Traffic Volumes**

The estimated peak hour site generated traffic for the 188, 176, and 164 space garage scenarios have been combined with the 2005 background traffic volumes resulting in the 2005 build traffic volumes shown on Figures 6, 7, and 8.

**IV. OPERATING CONDITIONS**

**IV.1. Capacity Analysis Description**

The operating conditions of transportation facilities are evaluated based on the relationship of existing or projected traffic volumes to the theoretical capacity of the highway facility. Various factors affect capacity including traffic volume, travel speed, roadway geometry, grade, number and width of travel lanes, and intersection control. The current standards for evaluating capacity and operating conditions are contained in the 1997 *Highway Capacity Manual*, published by the Transportation Research Board. The procedures describe operating conditions in terms of level of service (LOS). These operations are given letter designations with "A" representing the best operating condition and "F" representing the worst. Generally, LOS "E" represents the condition under which the roadway or intersection is functioning at capacity.

**IV.2. Results of Analysis**

This section contains the results of the intersection capacity analyses and recommendations, as necessary, to mitigate the impacts of the proposed Parking Garage facility development on these operations. Tables 2 follows and summarizes the results of the capacity analyses. The capacity analysis worksheets are included in the Appendix.

**1. Main Street/Amity Street at North Pleasant Street**

The completion of the proposed project will result in no change to the overall operations of the intersection. Analyses of the PM peak hour operating conditions at the intersection indicate that the intersection operates at LOS E. However, the eastbound left turning movement operates at LOS F for 2005 background, and the three alternative 2005 build conditions. Changing the traffic signal timing plan to provide additional seconds of green time for the east-west left turn phase will improve operations to at least LOS E for all movements and all of the 2005 scenarios. Capacity improvements are not recommended since there is no change in the Main Street levels of service between the background and build conditions.

**2. Main Street at Boltwood Walk**

Analysis of the operating conditions at this intersection, indicates that the left turn maneuver from Main Street to Boltwood Walk will operate at LOS A for the weekday AM and PM peak hour for the 2005 background, and build conditions. The analysis also indicates that the Boltwood Walk approach will operate at LOS C for the 2005 background, and 164 space garage Build conditions, but will operate at LOS D with a 188 space garage or a 176 space garage. Capacity improvements are not recommended since this is a minor movement. It is noted that this analysis is very conservative since it was assumed that the traffic using the existing 21 space parking lot near Kellogg would all exit to Main Street, through the proposed parking garage. In addition, the proximity to the traffic signal at Main Street/Amity Street and North Pleasant Street may generate gaps in traffic for vehicles exiting the garage.

**3. Main Street at Churchill Street**

Analyses of the operating conditions at this intersection, indicate that all approaches will operate at LOS D or better during the 2005 design year AM and PM peak hours, with or without the proposed parking garage. Capacity improvements are not recommended.

**4. Churchill Street at Lessey Street**

Analyses of the operating conditions at this intersection, indicate that all approaches will operate at LOS A during the 2005 design year, with or without the proposed parking garage. Capacity improvements are not recommended.

**5. Boltwood Walk at Lessey Street**

The Boltwood Walk at Lessey Street intersection will operate at LOS A during the 2005 design year for the Background conditions. It will be removed under the three 2005 build scenarios.

**Table 2  
 Level of Service Summary**

Intersection	2005 Background		2005 Build-188 Spaces		2005 Build-176 Spaces		2005 Build-164 Spaces	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Main/Amity & N. Pleasant								
Northbound	---	E (61.4) <sup>1</sup>	---	E (79.0)	---	E (78.1)	---	E (77.2)
Southbound	---	D (44.5)	---	E (67.2)	---	E (63.4)	---	E (60.3)
Eastbound Left-Turn	---	F (106.8)	---	F (118.1)	---	F (118.1)	---	F (118.1)
Eastbound Through/Right	---	D (50.3)	---	E (63.2)	---	E (61.0)	---	E (59.0)
Westbound Left-Turn	---	E (56.7)	---	E (66.0)	---	E (64.2)	---	E (63.0)
Westbound Through/Right	---	D (48.6)	---	E (68.5)	---	E (58.0)	---	E (56.6)
Overall	---	E (56.2)	---	E (73.7)	---	E (70.4)	---	E (68.7)
Main/Amity & N. Pleasant <sup>2</sup>								
Northbound	---	D (53.3)	---	E (55.4)	---	D (54.9)	---	D (54.6)
Southbound	---	D (42.4)	---	D (51.4)	---	D (49.4)	---	D (48.5)
Eastbound Left-Turn	---	E (67.1)	---	E (67.1)	---	E (67.1)	---	E (67.1)
Eastbound Through/Right	---	E (56.3)	---	E (68.1)	---	E (66.6)	---	E (64.0)
Westbound Left-Turn	---	D (53.3)	---	E (56.2)	---	E (55.8)	---	E (55.2)
Westbound Through/Right	---	D (54.3)	---	E (75.3)	---	E (63.6)	---	E (62.1)
Overall	---	D (51.4)	---	E (59.8)	---	E (57.0)	---	E (56.0)
Main St. & Boltwood Walk								
Southbound Shared	B (11.8)	C (20.4)	B (12.2)	D (30.0)	B (12.0)	D (26.8)	B (12.1)	C (24.5)
Eastbound Left-turn	A (8.0)	A (8.2)	A (8.2)	A (8.5)	A (8.1)	A (8.6)	A (8.1)	A (8.6)
Main St. and Churchill St.								
Northbound Shared	C (16.0)	C (22.2)	C (17.2)	D (29.0)	C (17.0)	D (27.7)	C (17.1)	D (27.4)
Southbound Shared	B (14.9)	D (25.8)	B (14.2)	C (21.2)	B (14.1)	C (20.4)	B (14.1)	C (20.7)
Eastbound Left-turn	A (8.2)	A (8.5)	A (8.3)	A (8.6)	A (8.3)	A (8.6)	A (8.3)	A (8.5)
Westbound Left-turn	A (7.7)	A (8.4)	A (7.8)	A (8.5)	A (7.7)	A (8.4)	A (7.8)	A (8.5)
Churchill St. and Lessey St.								
Northbound Left-turn	A (7.4)	A (7.4)	---	---	---	---	---	---
Boltwood Walk and Lessey St.								
Westbound Shared	A (8.8) <sup>1</sup>	A (9.8)	---	---	---	---	---	---

1- Level of service (delay in vehicles per second)

2- w/ Signal Timing Mitigation

**IV. 3. Queue Analysis**

The vehicle queues on the westbound Main Street approach to the intersection of Main Street/Amity Street at North Pleasant Street have been observed to back up and block vehicular access at Boltwood Walk. A queue analysis has been conducted to supplement the capacity analysis for this intersection. The queue analysis was conducted using the MHD methods and the results for the 2005 design year background and build conditions are summarized as follows (the full analyses are contained in the appendices):

- 2005 Background, Main Street 95% queue – 413 feet
- 2005 Build 188-space Garage, Main Street 95% queue – 525 feet
- 2005 Build 176-space Garage, Main Street 95% queue – 476 feet
- 2005 Build 164-space Garage, Main Street 95% queue – 467 feet

The distance between the Boltwood Walk intersection and the North Pleasant Street intersection is only 420 feet, thus the traffic queuing at the light will occasionally block the Boltwood Walk access. To

mitigate the situation it is recommended that a traffic sign (R10-7 in the MUTCD) be installed on the north side of Main Street directing vehicles not to block the intersection. This sign should be located ahead of the proposed crosswalk east of Boltwood Walk. In addition, it is recommended that the left turn pocket for the eastbound traffic be lengthened to accommodate an additional two vehicles. This can be accomplished by change the taper section for the turn lane to the minimum allowable, from 12:1 to 4:1 per the AASHTO design standards. Other mitigation strategies to consider include the installation of a variable message sign (VMS) on North Pleasant Street to inform the drivers as to the availability of parking in the garage; and/or restricting the traffic exiting Boltwood Avenue to the north to right maneuvers only.

## V. CONCLUSIONS AND SUGGESTIONS

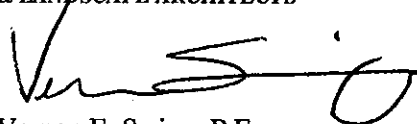
The preceding analysis has evaluated the potential traffic impacts at the study area intersections due to the completion of the proposed Parking Garage. The analysis included three different garage sizes, 188 spaces, 176 spaces and 164 space. The study emphasized the impacts to the traffic operations at the key intersections including Main Street/Amity Street at North Pleasant Street, Main Street at Boltwood Walk, Main Street at Churchill Street, and Churchill Street at Lessey Street and resulted in the following conclusions:

- The intersection of Main Street/Amity Street at North Pleasant Street will experience LOS F operations for the eastbound left turning movement. With signal timing modification LOS E or better can be attained for all approaches.
- The westbound vehicles at the Main Street/Amity Street at Pleasant Street intersection are expected to queue past the Boltwood Walk intersection during the design year. It is recommended that a Do Not Block Intersection traffic control sign be installed for the westbound approach. In addition, the left turn storage area for the eastbound approach may be extended by modifying the approach taper. Installation of a VMS on North Pleasant Street, as well as turning movement restrictions at Boltwood Avenue should also be considered.

It is has been a pleasure working with the Town of Amherst on this project, and CHA looks forward to continuing to strengthen our relationship on future projects. If you have any questions or require any additional information please call me at (413) 796-0746.

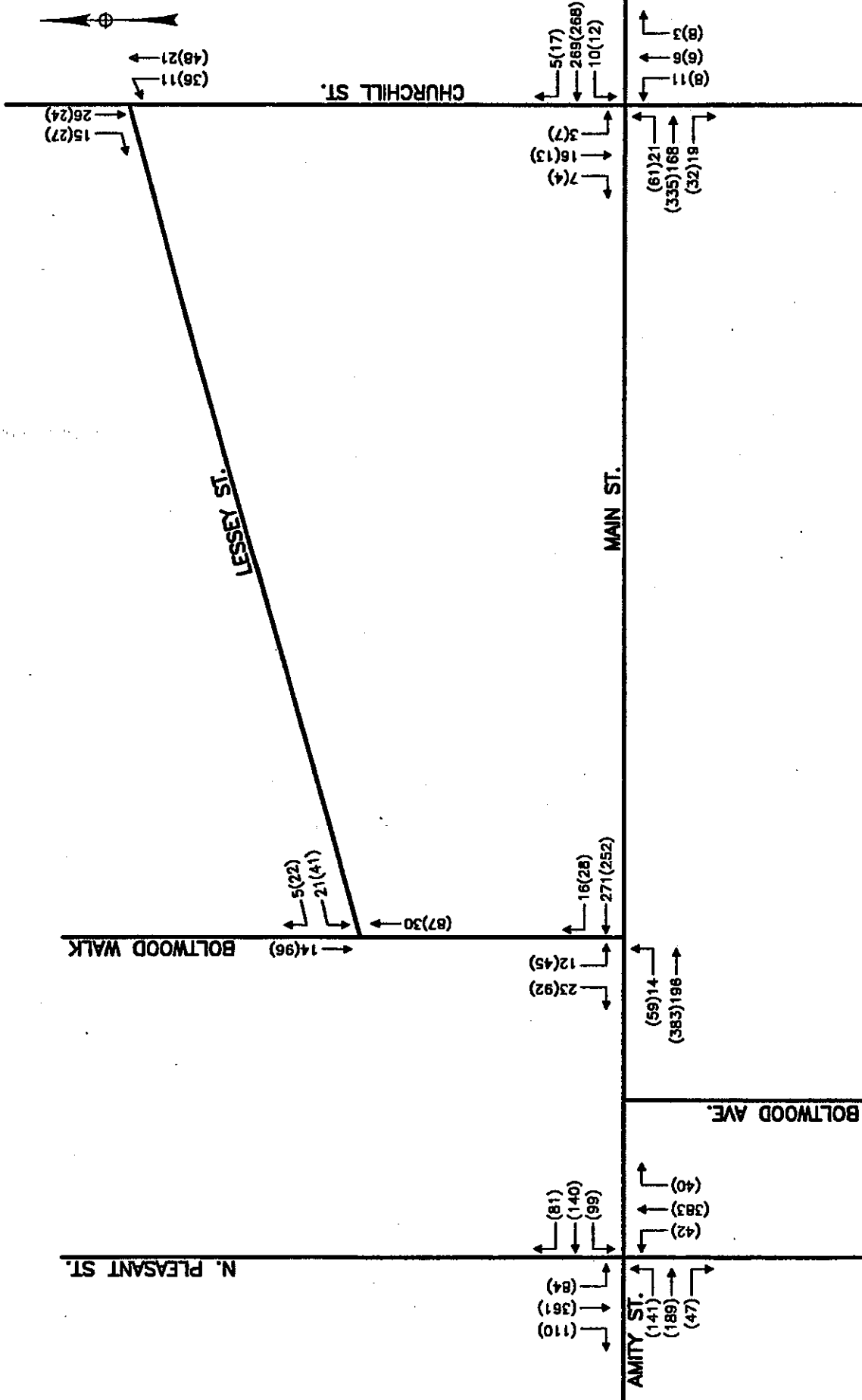
Sincerely,

**CLOUGH, HARBOUR & ASSOCIATES LLP**  
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Vernon E. Swing, P.E.  
Senior Traffic Engineer

VES/dcc  
Enclosure  
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**1999 BASELINE CONDITIONS  
 PROPOSED PARKING GARAGE**

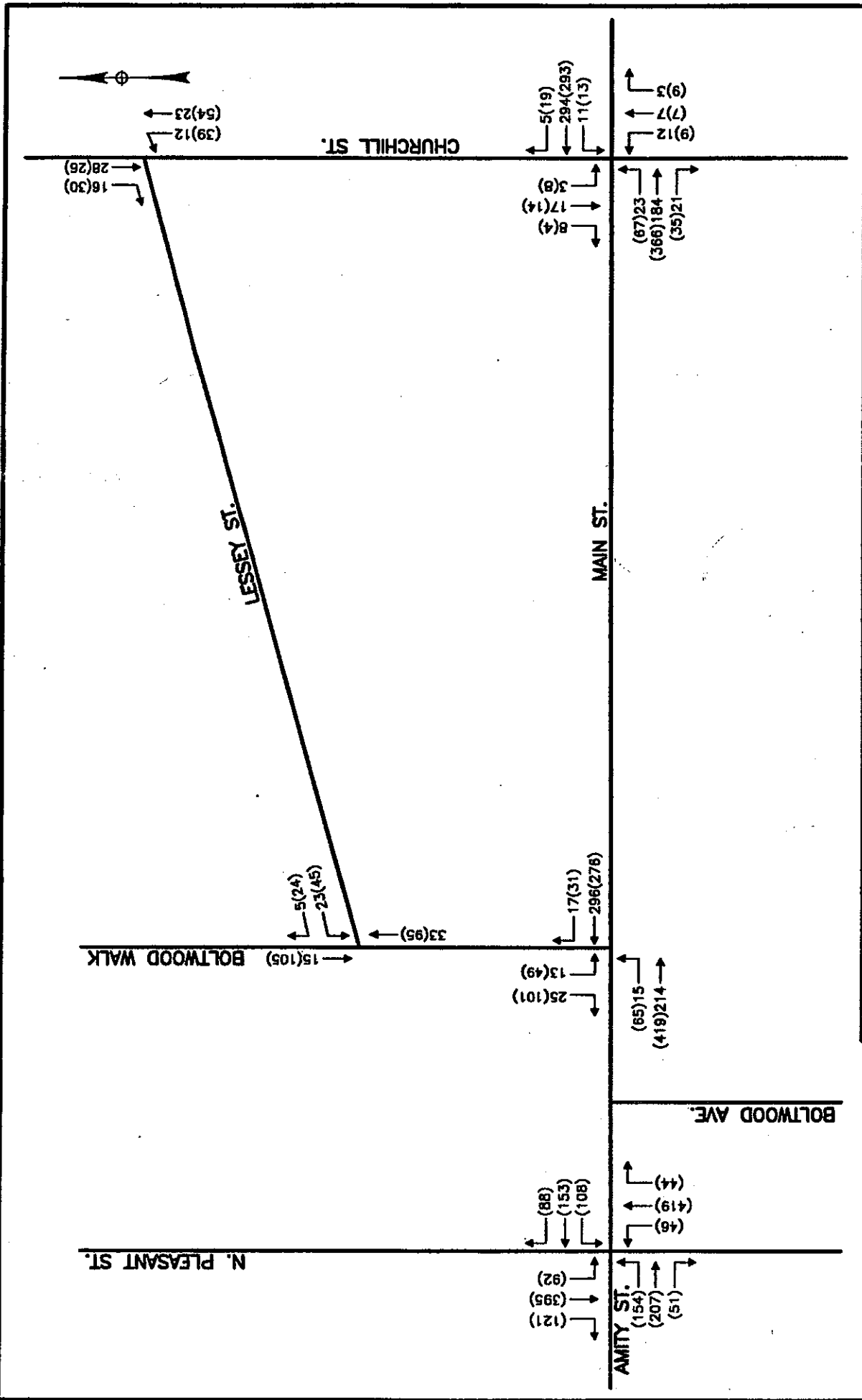
AMHERST PARKING GARAGE  
 AMHERST, MASSACHUSETTS

FIGURE 1

NOT TO SCALE

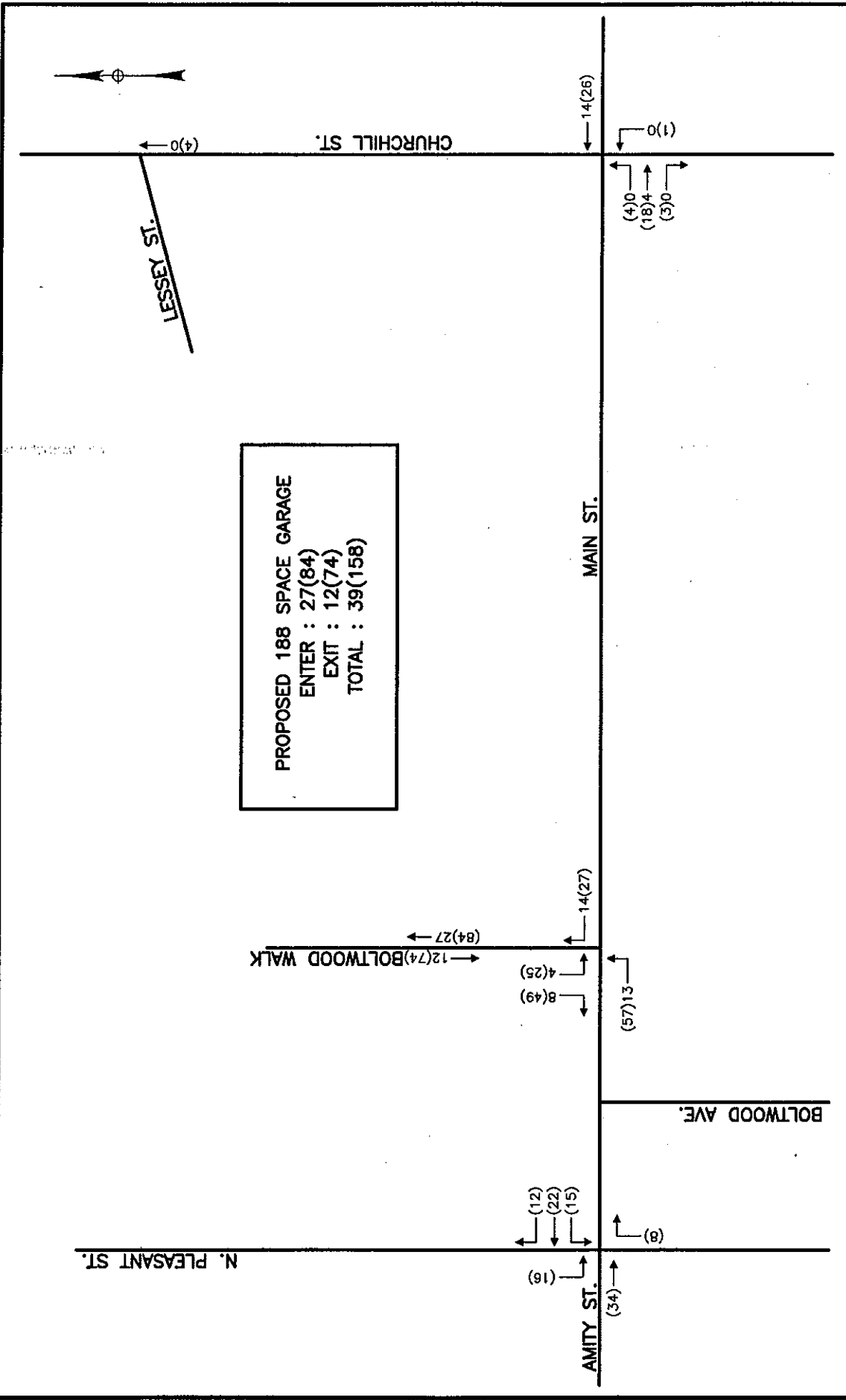
**LEGEND**

AM PEAK HOUR (PM PEAK HOUR)  
 8:00 - 9:00 AM (5:00 - 6:00 PM)

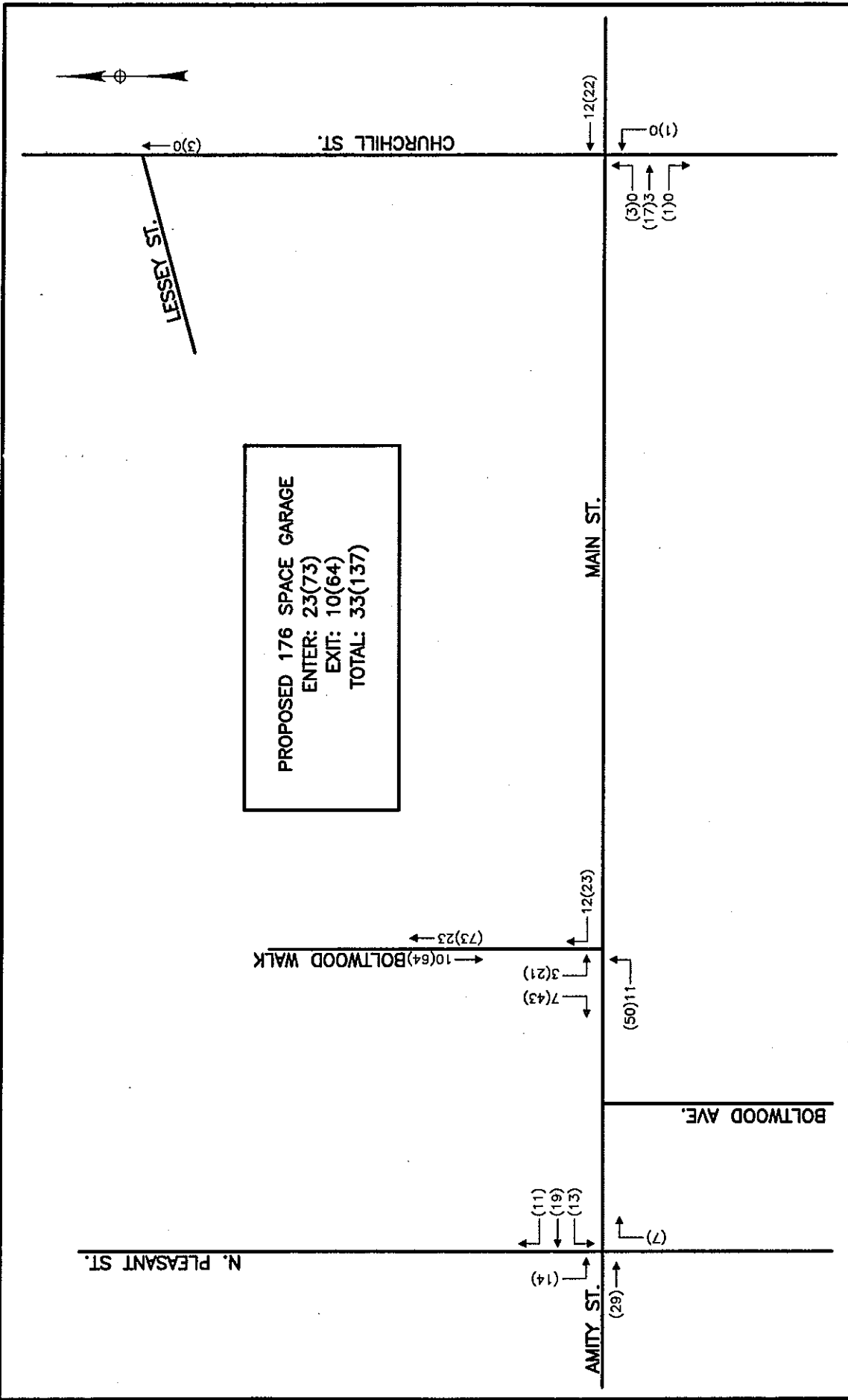


<p><b>CHA</b>                  drawing copyright © 2005  <b>CLOUGH, HARBOUR &amp; ASSOCIATES LLP</b>                  ENGINEERS, SURVEYORS, PLANNERS &amp; LANDSCAPE ARCHITECTS                  450 COTTAGE STREET SPRINGFIELD, MA 01104</p>	<p>2005 BACKGROUND CONDITIONS                  PROPOSED PARKING GARAGE</p>
	<p>AMHERST PARKING GARAGE                  AMHERST, MASSACHUSETTS</p>
<p>NOT TO SCALE</p>	<p>FIGURE 2</p>

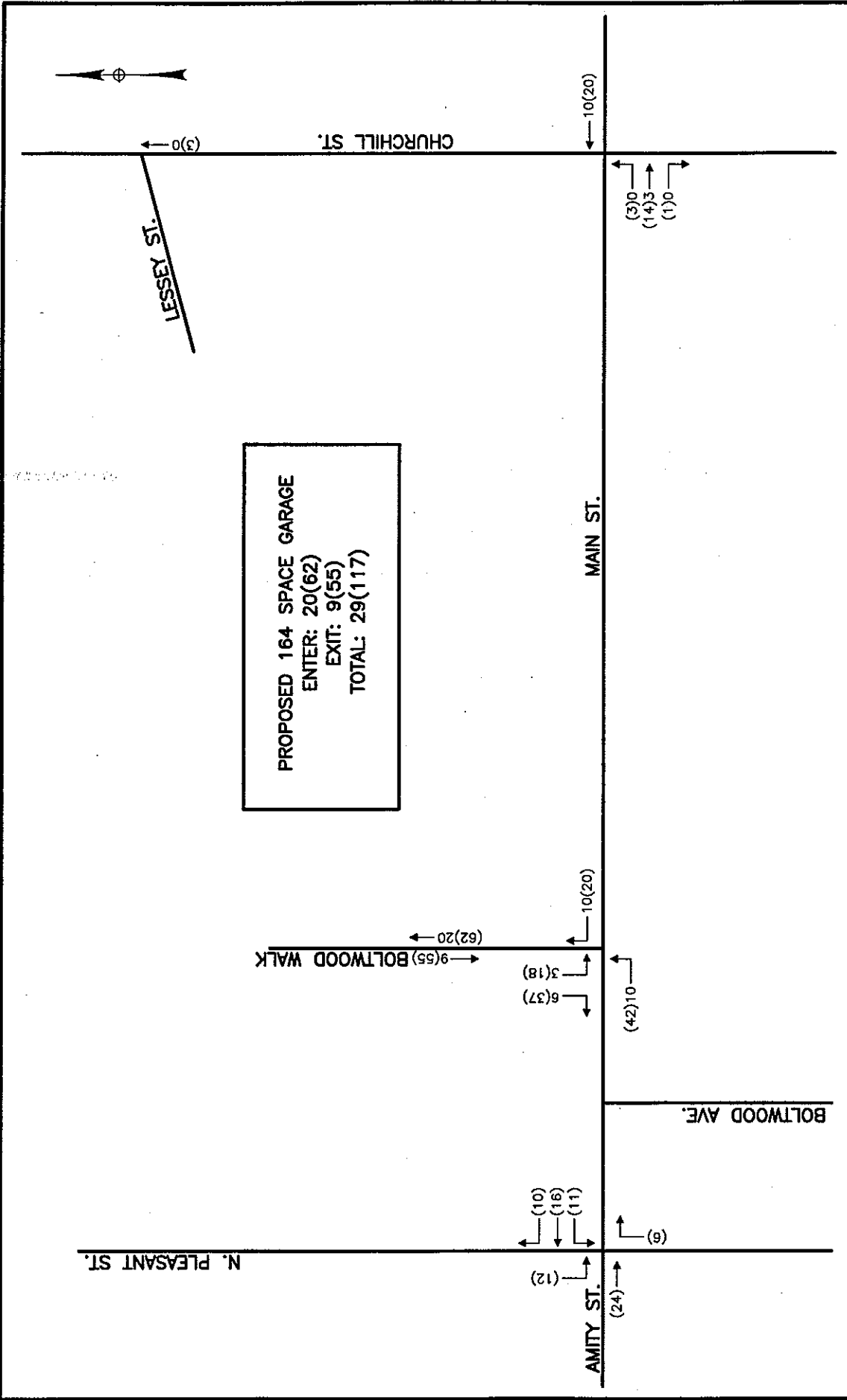




	<p><b>2005 TRIP GENERATION</b>  <b>PROPOSED 188 SPACE PARKING GARAGE</b></p>
	<p>AMHERST PARKING GARAGE          AMHERST, MASSACHUSETTS</p>
<p><b>NOT TO SCALE</b></p>	<p><b>FIGURE 3</b></p>



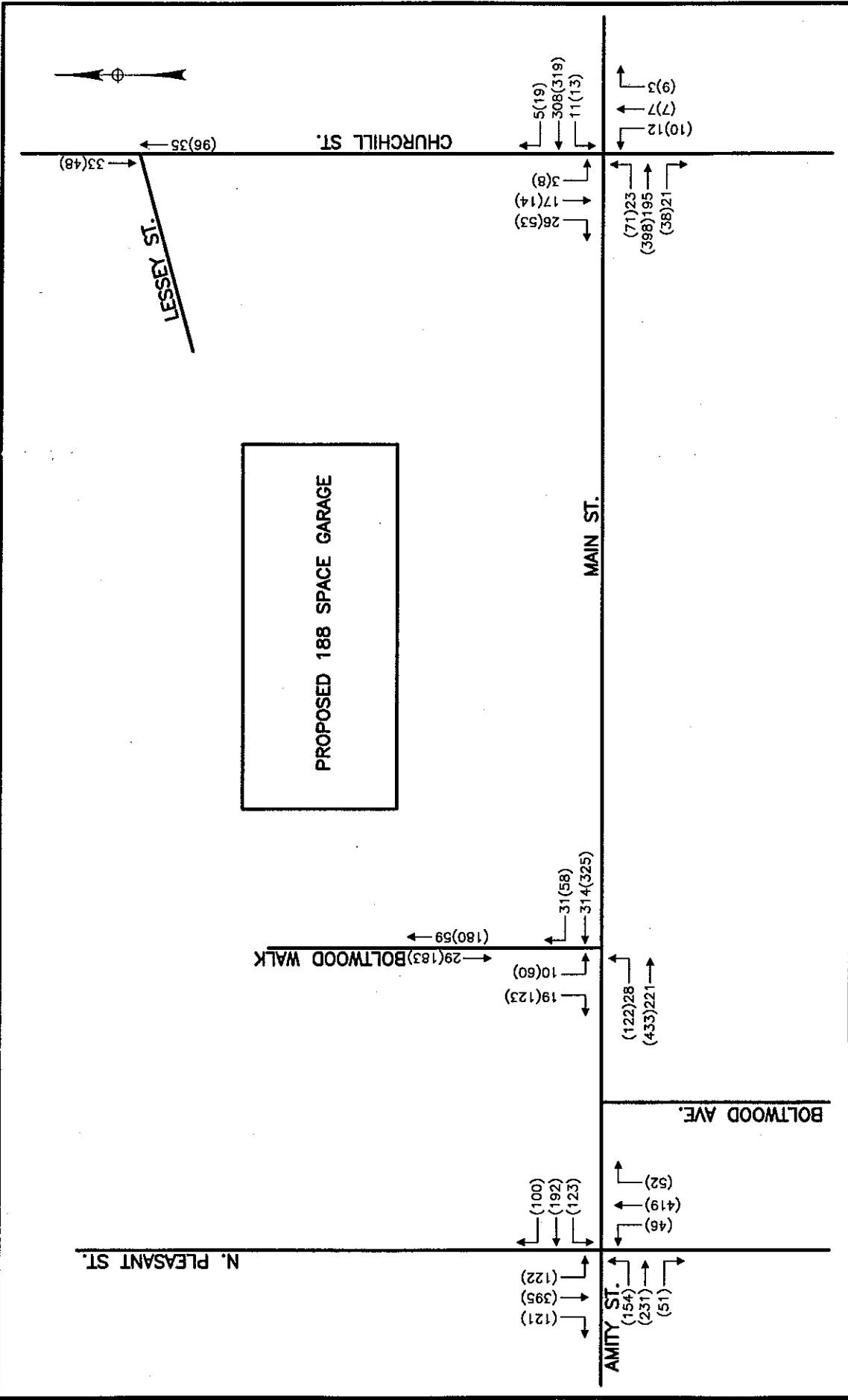
<p><b>CHA</b>          DRAWING COPYRIGHT © 2000  <b>CLOUGH, HARBOUR &amp; ASSOCIATES LLP</b>          ENGINEERS, SURVEYORS, PLANNERS &amp; LANDSCAPE ARCHITECTS          450 COTTAGE STREET SPRINGFIELD, MA 01104</p>	<p><b>2005 TRIP GENERATION</b>  <b>PROPOSED 176 SPACE PARKING GARAGE</b></p>
	<p>AMHERST PARKING GARAGE          AMHERST, MASSACHUSETTS</p>
<p>LEGEND          AM PEAK HOUR (PM PEAK HOUR)          8:00 - 9:00 AM (5:00 - 6:00 PM)</p>	<p>NOT TO SCALE</p>
<p>FIGURE 4</p>	



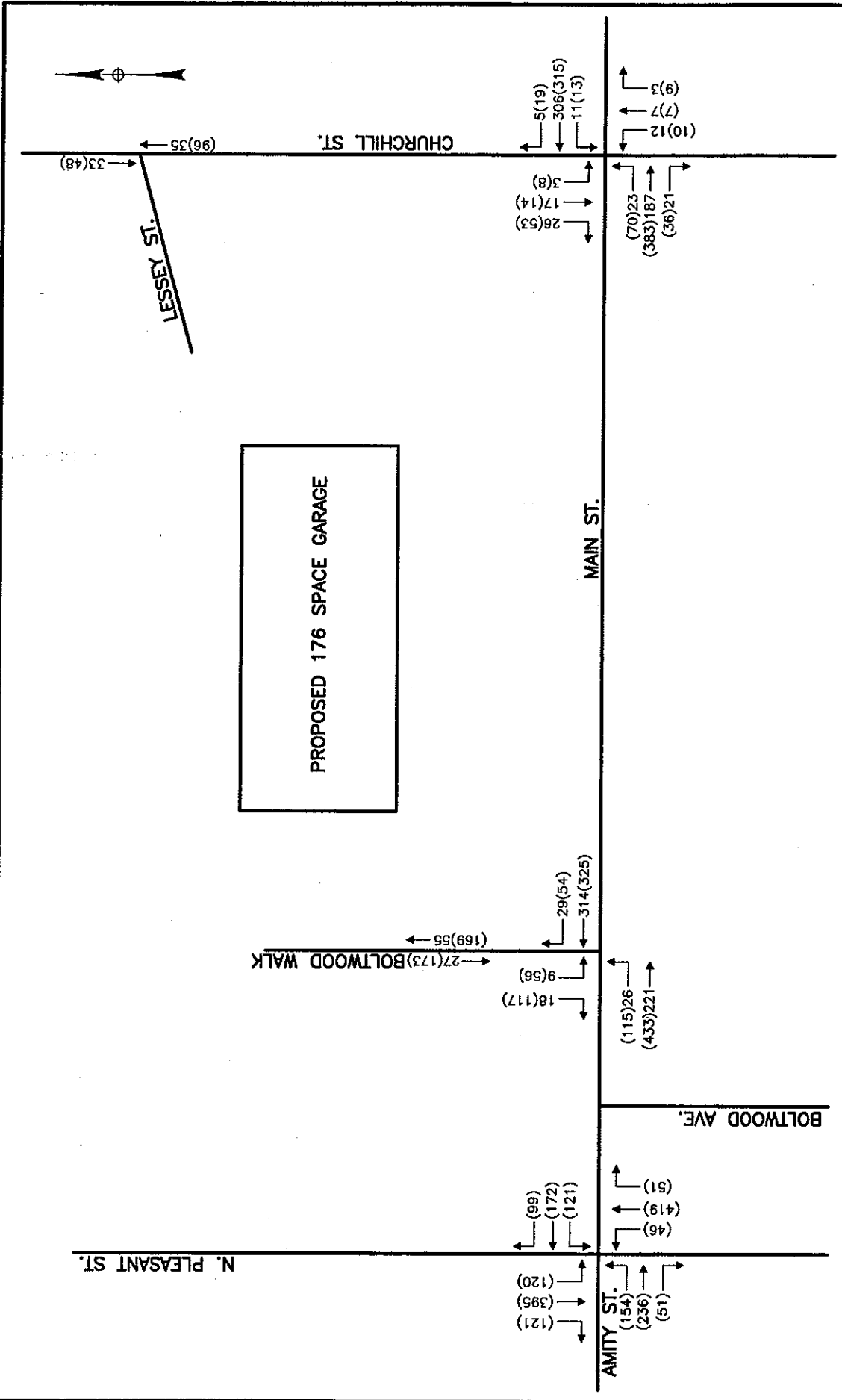
PROPOSED 164 SPACE GARAGE  
 ENTER: 20(62)  
 EXIT: 9(55)  
 TOTAL: 29(117)

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	<p>AMHERST PARKING GARAGE          AMHERST, MASSACHUSETTS</p>
<p>NOT TO SCALE</p>	<p>FIGURE 5</p>

**LEGEND**  
 AM PEAK HOUR (PM PEAK HOUR)  
 8:00 - 9:00 AM (5:00 - 6:00 PM)



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<p><b>NOT TO SCALE</b></p>		
<p><b>LEGEND</b></p> <p>AM PEAK HOUR (PM PEAK HOUR) 8:00 - 9:00 AM (5:00 - 6:00 PM)</p>		
<p><b>2005 BUILD CONDITIONS</b> <b>PROPOSED 188 SPACE PARKING GARAGE</b> AMHERST PARKING GARAGE AMHERST, MASSACHUSETTS</p>		



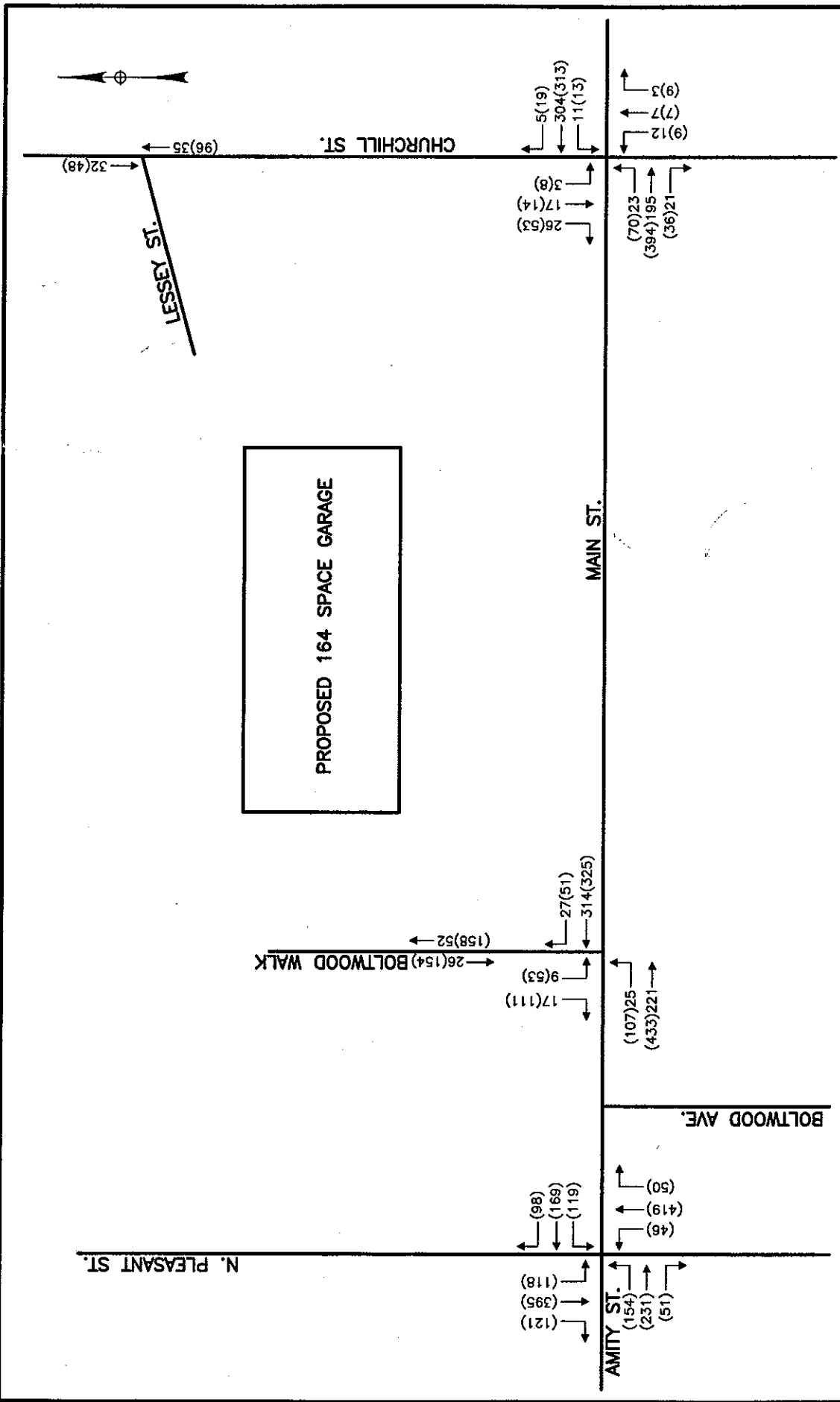
**2005 BUILD CONDITIONS**  
**PROPOSED 176 SPACE PARKING GARAGE**  
 AMHERST PARKING GARAGE  
 AMHERST, MASSACHUSETTS

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NOT TO SCALE

FIGURE 7

**LEGEND**  
 AM PEAK HOUR (PM PEAK HOUR)  
 8:00 - 9:00 AM (5:00 - 6:00 PM)



PROPOSED 164 SPACE GARAGE

**CHA**  
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NOT TO SCALE

FIGURE 8

2005 BUILD CONDITIONS  
 PROPOSED 164 SPACE PARKING GARAGE  
 AMHERST PARKING GARAGE  
 AMHERST, MASSACHUSETTS

**LEGEND**

AM PEAK HOUR (PM PEAK HOUR)  
 8:00 - 9:00 AM (5:00 - 6:00 PM)