6. PILOT PROGRAM

6.1 Introduction – Why a pilot program?

An important part of the Downtown Brooklyn Traffic Calming Project was the implementation and evaluation of a pilot program of traffic calming treatments in Downtown Brooklyn. The purpose of this pilot program was to explore practical issues surrounding implementation of typical traffic calming measures, and to gauge the impacts each had on safety, traffic operations, and public perception and it has indeed proved a rich source of insights into such practical issues. The pilot program was not intended to implement a scaled-down version of the overall strategy; such an objective would be impossible to achieve in advance of the strategy's development and within the budget earmarked for the pilot program. In this context, the pilot program was an experiment that helped inform the overall strategy – the lessons learned on the practical issues of traffic calming were coupled with intense study of Downtown Brooklyn's conditions to develop the specific recommendations in the strategy.

At an agency level, the pilot program:

- provided the project team with an understanding of the NYCDOT's design approach and allowed the team to expand on that approach and foster acceptance that traffic management can be approached in various ways;
- explored issues with emergency service agencies (NYPD and FDNY) and built confidence that traffic calming treatments are workable and that operational and design issues unique to New York City can be addressed;
- built confidence among other agencies that such measures are workable;
- provided an understanding of construction and permitting issues; and
- provided an understanding of inter-agency issues.

At a community level, the pilot program:

- yielded safety and traffic operations data from these measures in the field in Brooklyn; and
- allowed the project team to gauge public acceptance of actual traffic calming measures.

Implementing the pilot program demonstrated to the community what traffic calming treatments look like, allowed the project team to investigate how New Yorkers react to traffic calming, and built confidence in these methods. An illustration of the benefits of the pilot program was the changing position of Community Board 6. The Board initially rejected several pilot program treatments based on perceived safety and parking loss concerns, yet eighteen months later, after pilot program implementation, the Board was willing to approve a much more comprehensive set of measures for inclusion in the broad strategy.

6.2 Pilot program overview

6.2.1 Pilot program development process

Early in the project a list of traffic calming measures appropriate for Downtown Brooklyn was compiled. This is reproduced in *Appendix E* and summarized in *Table 4.2*.

This list was the starting point for development of the pilot program. However, although a treatment's appropriateness for Downtown Brooklyn was necessary for inclusion in the pilot program, it was not sufficient justification. For the pilot program, a further assessment was made of the suitability of these calming measures for installation as test cases in specific locations. Nine criteria were used for this purpose. These are summarized below:

- *The measure addresses issues raised by community*: Initial public outreach identified such issues as vehicle speeds, pedestrian crossing safety, etc. These issues are summarized in *Appendix A3*.
- *The measure is likely to be utilized in final area-wide strategy*: Initial investigation by the project team identified those measures likely to be most practical and suitable for Downtown Brooklyn, as described in *Table 4.2*.
- *The measure's applicability at other locations*: The types of measure should, as much as possible, be able to be utilized elsewhere so their evaluation can provide useful guidance in development of an area-wide program
- *The measure has limited physical scope (and hence construction cost)*: Funds for traffic calming implementation were allocated for the finalized program; the cost of pilot test cases was minimized in order to allow the limited pilot program budget to be spread over as many measures as possible.
- *The measure minimizes impact on existing street infrastructure, such as drainage and other services and street lighting*: Pilot program measures should as far as possible avoid the need to modify existing street infrastructure and utility plant.
- *The impacts of the measure can be evaluated*: The impacts of pilot program measures should be measurable, in terms of safety, traffic impact, and public acceptance.
- *The measure has more than one traffic calming effect*: Measures are most useful for the pilot program where they address a number of local issues – for instance, they reduce speeds *and* improve pedestrians' ability to cross *and* enhance the local environment.
- *The measure is compatible with the draft Street Management Framework*: Measures should fit with the management approach appropriate for the Street Management Framework as it stood at the time the pilot program was designed.
- *The measure provides guidance on detailed construction issues*: Measures can be useful in assessing construction methods and layouts – for instance, pedestrian ramp layouts, the height of raised crosswalks, and drainage details.

For the pilot program, the focus was on physical and management measures that could have an impact in the short term, rather than on educational measures that focus on improved driver behavior in the long-term. The preferred measures for consideration for the pilot program can be categorized broadly as either:

- **Localized physical measures** with particular traffic calming effects such as neckdowns to improve pedestrian crosswalk facilities; or
- **Traffic management measures** involving changes to the way a street handles traffic, such as restricting traffic flow along a street, or modifying signal timings to achieve changes in flows or speeds.

In light of the above criteria and given that various types of measure have already been implemented in New York City, an initial screen of the suitability of types of measure for inclusion in the pilot program was undertaken. This is summarized in *Table 6.1*.

Table 6.1: Pilot Program Suitability		
Measure	**Pilot Program suitability**	**Comments**
Speed Humps	No	In use already; therefore not appropriate for testing in pilot program
Surface Texture	Yes	Could be used in combination with other measure
Raised Crosswalks	Yes	Could be used in combination with other measure
Raised Intersection	Yes	Could be used in combination with surface texture
Street Narrowing	No	Only if no major traffic capacity implications
Curb Extensions (Neckdowns)	Yes	Only if no major traffic capacity implications
Gateway Treatments	Yes	Could be used in combination with other measure
Roadway Medians	No	Would result in major traffic re-routing, therefore not suitable in pilot program
Pedestrian Refuges	Yes	Could be used where excess road space exists
Bicycle Lanes	Yes	Could test effect of on-street bicycle lanes on traffic behavior
Signing and Striping	No	Limited impact without physical changes, therefore not appropriate in pilot program
Traffic Signal Timing	Yes	Relatively straightforward to introduce
Leading Pedestrian Interval	Yes	Relatively straightforward to introduce
Speed Enforcement	No	Requires enforcement regime and therefore not suitable in pilot program
Safety Zones	No	Limited short-term impact and therefore not suitable in pilot program
Truck Restrictions	No	Difficult to enforce in pilot program
Angled Parking	Yes	Need to satisfy existing DOT roadway width standards for angled parking
Street Direction / Restriction	Yes	Could be tested if current road works involve street traffic restrictions

6.2.2 Pilot program scope

An initial set of potential pilot program treatments was developed in consultation with the community and shared with the Brooklyn Borough President's Task Force. While the scope of this initial set of treatments was consistent with the funds available in the project contract, members of the task force indicated a strong desire to implement a broader set of measures for the pilot program. Accordingly, NYCDOT reviewed the funding arrangements for its broader traffic calming program (of which this study is part) and allocated an additional amount for development and implementation of the pilot program utilizing funding supplied by Assembly Member Joan Millman.

An expanded set of pilot program measures was presented to the Brooklyn Borough President's Task Force and thereafter to Community Boards 2 and 6. The expanded set of measures is shown in *Figure 6.1* (see next page), summarized in *Table 6.2*, and described below. The project Task Force and Community Boards 2 and 6 endorsed the pilot program, with the exception of proposed neckdowns on Court Street at President and Carroll Streets. These latter measures, although endorsed by Community Board 6's Transportation Committee, were rejected by the full board of Community Board 6, based on perceived accident risk, loss of parking (each scheme would have resulted in the loss of two spaces) and FDNY maneuverability concerns. Accordingly, these measures were dropped from the pilot program and an additional pair of neckdowns on Lafayette Avenue at Carlton and Adelphi Streets was substituted. The proposed pilot program, with the exception of the two measures rejected by Community Board 6 and with the additional measures on Lafayette Avenue, were taken through the design process and constructed by April 2002.

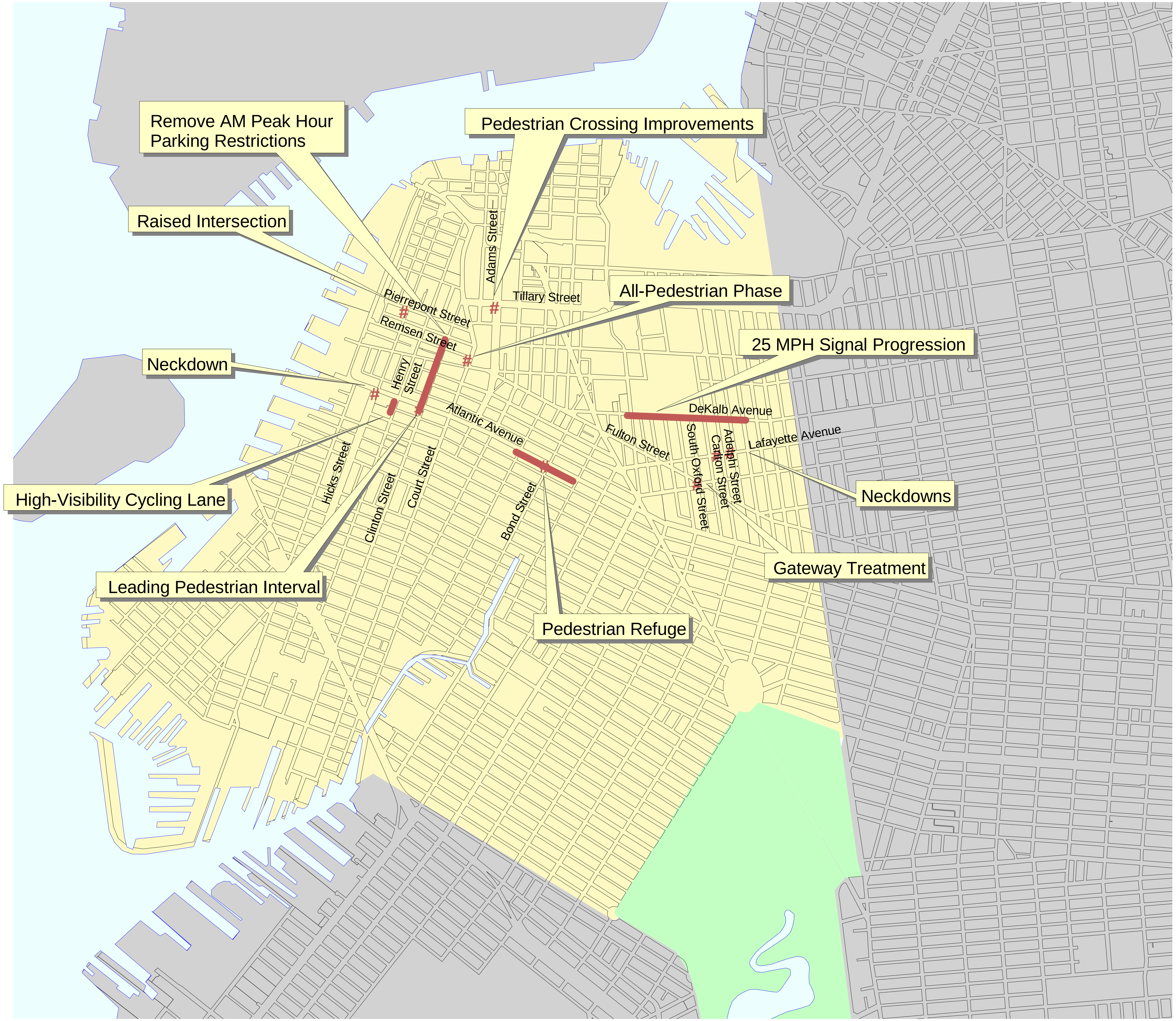
Table 6.2 Candidate pilot program measures

Measure	Location	Status
Widen pedestrian island	Tillary Street/Adams Street	Implemented August 2001
All pedestrian phase ("Barnes Dance")	Court Street/Remsen Street	Implemented December 2000
Raised intersection	Hicks Street/Pierrepont Street	Implemented October 2001
Neckdown	Atlantic Avenue/Hicks Street	Implemented September 2001
High-visibility on-street cycling lane	Henry Street between Atlantic Avenue and Amity Street	Implemented August 2001 Expanded March 2002 [2]
Leading Pedestrian Interval	Atlantic Avenue/Clinton Street	Implemented 2001
Remove morning peak parking restrictions	Clinton Street north of Atlantic Avenue	Implemented 2001
Road closure (part of reconstruction of water main)	Clinton Street south of Atlantic Avenue	Implemented 2000
Pedestrian island, lane realignment, neckdown	Atlantic Avenue/Bond Street	Implemented April 2002
Neckdown	Fulton Street/South Oxford Street	Implemented October 2001
Neckdown	Lafayette Avenue/Adelphi Street	Implemented October 2001
Neckdown	Lafayette Avenue/Carlton Avenue	Implemented October 2001
Neckdown	Court Street/President Street	Not implemented [3]
Neckdown	Court Street/Carroll Street	Not implemented [4]
Slower signal progression	DeKalb Avenue	Implemented 2001

[2] After the cycling community reacted positively to the October 2001 installation of the high-visibility lane between Atlantic and Pacific, the lane was extended in March 2002 to the block of Henry Street between Pacific and Amity Streets.

[3] Neckdowns at Court/President were part of the original pilot proposal, but were rejected by Community Board #6.

[4] Neckdowns at Court/Carroll were part of the original pilot proposal, but were rejected by Community Board #6.



Downtown Brooklyn Traffic Calming Project

Final Report

LEGEND

Pilot Program Measures

- # Intersections
- Corridors

Figure 6.1

Pilot Program Measures

N

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NEW YORK CITY DOT

ARUP

6.2.3 Design of pilot program treatments

The process of turning concept designs into construction drawings provided rich insights into the issues surrounding implementation of physical measures designed to support a traffic calming program. The team undertook extensive discussions with representatives of various units of NYCDOT. During the process, various design ideas were explored and underlying design philosophies tested. Some compromises were made in the interests of reaching agreement on the pilot program designs; these are discussed below in relation to each of the treatments.

In addition, the emergency service agencies – FDNY and NYPD – had to be reassured that their vehicles could negotiate physical treatments designed to slow and control traffic. By their nature, such treatments cannot differentiate between the movements of general road users and the needs of emergency and other service users. This is an issue inherent to traffic calming and one whose resolution depends partly on appropriate design and partly on building confidence on the part of those affected that their interests have been protected.

The process of designing the neckdown at Hicks Street and Atlantic Avenue illustrates how the team worked with emergency services users. As part of the design development process, meetings were held with FDNY representatives and a field trial was set up designed to determine the physical requirements of FDNY vehicles. The field trial demonstrated that the design for seven-foot-wide neckdowns was generally appropriate for the types of FDNY vehicles used in the area, but in the interest of building confidence within FDNY that they could negotiate these devices, the width of the neckdown at Hicks Street and Atlantic Avenue was reduced to six feet. Although some of the effectiveness of the devices in relation to controlling general traffic was sacrificed, the likelihood that emergency services and Sanitation Department users would find them acceptable increased.

Figure 6.2 Example of pilot information sign, Hicks Street and Pierrepont Street

Another key factor in the design process was the requirement that traffic calming devices must follow a set of guidelines called the Manual of Uniform Traffic Control Devices (MUTCD). The Federal Highway Administration (FHWA) publishes the MUTCD, which contains all national design, application, and placement standards for traffic control devices. The purpose of these devices, which includes signs, signals, and pavement markings, is to promote safety, efficiency, and uniformity so that traffic can move efficiently on the Nation's streets and highways. The manual gives certain criteria that should be met before NYCDOT can use a particular device. The MUTCD is a dynamic document because standards change to address travel patterns and road conditions, and to incorporate technology and materials advancements. The job of totally rewriting the manual is undertaken about every 10 to 20 years. The FHWA has previously relied on periodic updates, usually every 2 to 3 years, to revise existing manuals. For example, the 1988 edition has been updated 7 times. It is recommended that the MUTCD be updated to reflect the increased use of traffic calming devices and to provide statutory support for their implementation.

6.2.4 Signage

To make the public aware of traffic calming treatments, signs were installed at each pilot location. These signs are 11"x17", with white text on a blue background, and were mounted either on existing lampposts and driverails or on new driverails adjacent to each pilot treatment. *Figure 6.2* shows the sign installed at Hicks Street and Pierrepont Street as an example. *Appendix G1* contains images of each sign installed as part of the pilot program[5].

6.2.5 Monitoring program

In order to evaluate the effectiveness of the pilot program, a before-and-after survey program was established. It was important that the survey program be as focused and effective as possible. In addition, since the World Trade Center disaster occurred before "after" surveys could be conducted, the resulting change in traffic patterns and levels required the amendment to some of elements of the survey program. It was concluded that while traffic volumes at individual locations would have changed as a result of the Trade Center disaster, local speed and other behavioral factors would not. Accordingly, the survey program focused on these speed and behavioral issues. In any event, it is clear that a small number of isolated treatments would not have a substantial impact on traffic volumes and so collecting traffic volume data would have been an inefficient use of resources.

Table 6.3 summarizes the data collected to monitor the performance of the pilot program.

[5] In January 2002, pilot information signs were updated to read *Mayor Michael R. Bloomberg*.

Table 6.3 Monitoring of Final Pilot Program

Measure	Location	User Survey	Video Monitoring	Speed Survey
Widen pedestrian island	Tillary Street/Adams Street	X	X	
All pedestrian phase ("Barnes Dance")	Court Street/Remsen Street	X	X	X
Raised Intersection	Hicks Street/Pierrepont Street	X	X	X
Neckdown	Atlantic Avenue/Hicks Street	X	X	X
High-visibility on-street cycling lane	Henry Street		X	
Leading Pedestrian Interval	Atlantic Avenue/Clinton Street	X	X	
Remove morning peak parking restrictions	Clinton Street north of Atlantic Avenue			[6]
Road closure (part of reconstruction of water main)	Clinton Street south of Atlantic Avenue			X[7]
Pedestrian island, lane realignment, neckdown	Atlantic Avenue/Bond Street	X	X	X
Neckdown	Fulton Street/South Oxford Street	X	X	X
Neckdown	Lafayette Avenue/Carlton Street	X	X	X
Neckdown	Lafayette Avenue/Adelphi Street	X	X	X
Slower signal progression	DeKalb Avenue		X	X

6.2.6 Construction issues

Construction of the pilot program measures was part of the scope of the consultant's service on this study. Arup satisfied this component of the scope by procuring a contractor, Westmoreland Construction, to install the treatments designed in concert with NYCDOT.

A number of implementation issues arose because of the peculiarities of this procurement process. Since some of these have general relevance to implementing traffic calming devices, they are briefly reviewed below.

6.2.6.1 Limited scope of traffic calming implementation/construction

It proved difficult to find contractors willing to bid for a construction program with the limited scope of the pilot program. While this did not prove insuperable, it was somewhat difficult to obtain adequate competitive bids for this project. This may be a problem for future small-scale, neighborhood-based applications in New York City. It may be prudent to develop a "where and when" contract for these types of installations.

6.2.6.2 Permitting and coordination requirements

The permitting requirements proved particularly onerous for a construction project of this size. Once NYCDOT was satisfied with the design of the pilots, a variety of construction permits were required from the DOT, New York City Department of Environmental Protection (NYCDEP), and New York City Transit (NYCT). In the end, this process was so time-consuming that Westmoreland Construction chose to use an expediter to obtain permits even though it knew the expediter's fee could not be paid by this project.

[6] Data on traffic volume throughout the northbound corridor between the BQE and Fourth Avenue was collected to monitor the extent to which traffic unable to use Clinton Street either changed to parallel routes, or stopped driving through Downtown Brooklyn altogether. These data are presented in *Appendix C*.
[7] Results of these speed surveys are discussed in *Section 7.2.3.5*.

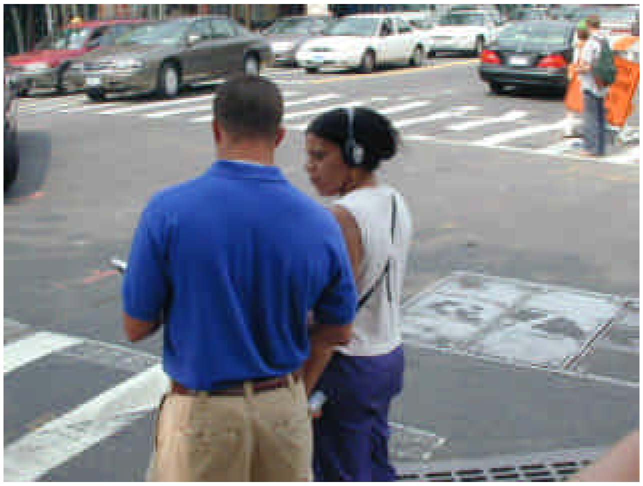
Coordination within and between authorities also proved difficult for a project of this size. The contractor needed to coordinate its construction with utilities, NYCDEP, and NYCT, all of whom own utilities in Brooklyn's roadways; and the New York City Department of Design and Construction (DDC), which was reconstructing the water main on Atlantic Avenue.

6.3 Evaluation

This section describes each traffic calming device and its implementation in detail, and evaluates its impact. The following surveys were undertaken to evaluate the impacts of each pilot measure:

- **Speed surveys** – Taken before and after implementation, these surveys measure the median and 85^{th} percentile travel speeds of vehicles traveling past each measure. As with all traffic speed data, the median reading represents a typical driver, while the 85^{th} percentile helps define safe travel speeds and represents the upper end of the speed profile – the drivers most likely to cause accidents. Note that speed data were only collected at intersections and blocks where speed reduction was a goal or an expected outcome of the traffic calming measure.
- **Video surveys** – Taken before and after implementation, these videos provided an opportunity to observe any significant changes in driver and pedestrian behavior that resulted from the pilot measures.
- **User surveys** – At all but two pilot locations, a mix of mailbox-dropped and face-to-face surveys were conducted, asking residents, merchants, and pedestrians their opinions on the pilot traffic calming treatment. At least 50 people at each location were asked whether each measure was a good idea, whether it influenced driver and pedestrian behavior, whether it made pedestrians safer, and whether it was effective at meeting its overall goal. The responses provided an important gauge of the public's understanding and acceptance of various treatments. User surveys were not conducted at the Henry Street blue cycling lane and the DeKalb Avenue 25 m.p.h. speed progression because of the difficulty of distributing questionnaires to the primary targets of these measures - cyclists and motorists, respectively.

Figure 6.3 User surveys underway at Atlantic Avenue and Bond Street, July 2002



6.3.1 Tillary St/Adams St: Pedestrian Refuge

6.3.1.1 Design

The pedestrian refuges at this location are actually widenings of the existing raised medians in the east and west (Tillary Street) legs of the intersection. The existing medians were 11'3" medians and terminated at the east and westbound stop bars, respectively. The pilot project doubled the width of these medians at the crosswalk to 22'6", and extended them 10' into the intersection. An at-grade channel was provided for pedestrians, and three steel bollards were installed at the end of the median extension to further protect pedestrians from turning vehicles.

6.3.1.2 Evaluation

Video Surveys

Evaluation of the impacts of this measure on pedestrian behavior has been difficult because the crosswalk on the west leg of the intersection has been closed since mid-2001 due to the construction of the Federal Courthouse. Only the east leg of the intersection can be compared to its pre-pilot condition. Video surveys showed pedestrians waiting on the refuge, rather than standing off the curb in the path of left-turning vehicles, as they had prior to the median installation. However, these surveys also showed that southbound pedestrians still attempt to cross Tillary Street against "Don't Walk" signals – a maneuver that puts them in the path of vehicles turning left off the Brooklyn Bridge.

Figure 6.4 Pedestrian refuge on west leg of Tillary Street – Adams Street intersection

User Surveys

While the long-term strategy for the Tillary Street-Adams Street intersection remains unresolved (see *Section 7*), the user surveys revealed strongly positive attitudes about the particular pilot measure. The surveys showed that:

- 66% of respondents said drivers turn more slowly
- 84% said drivers are more aware of pedestrians
- 98% said pedestrians are safer
- 96% said pedestrians have better opportunities to cross
- 88% said the sidewalk environment had been improved

These surveys encourage the notion that reclaiming unused road space can begin to restore pedestrian safety and confidence at major Travel Street intersections, with no loss of traffic capacity.

6.3.1.3 General Application

Enlarging medians and installing bollards clearly increases pedestrians' visibility, confidence, and feeling of safety. However, the ongoing jaywalking problem is a concern. This is due to a unique timing pattern that protects left turns from each leg of the intersection, and contains short Walk phases that often mean slow moving pedestrians use the median refuge. At Tillary Street and Adams Street, because of the heavy turning movements leading to and from the Brooklyn Bridge, retiming signals to give extra time to these slow-moving pedestrians is impossible, however, without reducing the intersection's vehicular capacity.

6.3.2 Court Street/Remsen Street: All-Pedestrian Phase

6.3.2.1 Design

The all-pedestrian phase was designed to regularize pedestrian crossing at an extremely busy crosswalk with a chronic jaywalking problem. Instead of displaying Walk signs only when parallel traffic signals are green, the pilot timing plan provides three distinct signal phases:

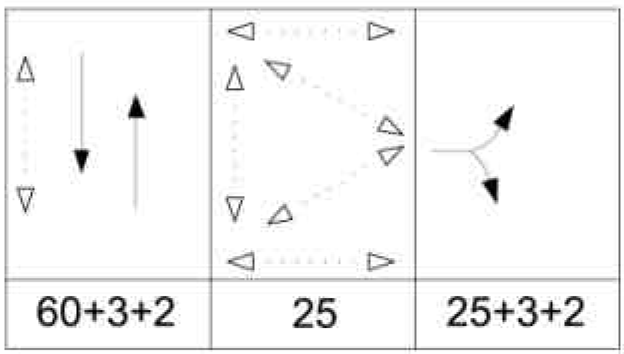
i. Green indication to north-south traffic on Court Street, Walk indication to north-south pedestrians crossing Remsen Street (65 seconds)

ii. All-pedestrian phase: Red indication to all traffic, Walk indication to all pedestrians. (25 seconds)

iii. Green indication to eastbound traffic turning off Remsen Street, Don't Walk indication to all pedestrians (30 seconds)

This phasing plan is illustrated in *Figure 6.5*.

Figure 6.5 Pilot signal timing at Court Street and Remsen Street, showing the time (in seconds) given to green, yellow, and all-red indications in each phase



No construction or capital costs were incurred in relation to with this treatment.

6.3.2.2 Evaluation

Video Surveys

The Court Street /Remsen Street pilot measure aims to separate pedestrian movement from conflicts with vehicles turning off Remsen Street. It succeeds in that there is now a conflict-free pedestrian move across Court Street, and a greater sense of pedestrian priority at the intersection. This has not impacted vehicle throughput, since turning volumes from Remsen Street have always been minimal, but it removes the conflict between pedestrians and turning vehicles. However, this has come at a cost – pedestrians on Remsen Street, however, are observed to disobey the "Don't Walk" sign in practice, and to begin crossing Court Street during Phase 3 of the cycle, when vehicles are meant to be turning off Remsen Street, rather than waiting for the all-pedestrian phase. . Finally, when the pilot was first implemented in December 2000, it was observed that stopped drivers on Court Street would begin to lurch forward through the intersection at the end of Phase 2, only to stop when they realized they did not get a green light immediately. By the time the video surveys were conducted in May 2002, this was no longer occurring; it was concluded this was because regular drivers (Court Street is used heavily by buses, delivery vehicles, and commuters) became accustomed to the timing change.

Figure 6.6 Court Street and Remsen Street

User Surveys

The most telling statistic revealed by the user surveys at this intersection is only 2% of those surveyed were even aware that an all-pedestrian phase had been introduced. This is evident in video surveys that show rampant jaywalking against "Don't Walk" indications, causing conflicts with traffic on both Court Street and Remsen Street. Once it was described to them, 74% of users thought the all-pedestrian phase significantly improved pedestrian safety. On the other hand, users perceived the fact that the measure was not well-observed – only 28% said it significantly changed driver behavior, and only 30% said it significantly changed pedestrian behavior.

6.3.2.3 General Application

In New York City, where pedestrians tend to cross whenever parallel traffic streams have green indications (rather than waiting for their "Walk" indications), simple signage may be necessary to describe a unique signal plan like the one introduced at Court Street and Remsen Street to pedestrians and drivers. Also, the initial problem of vehicles lurching forward as soon as opposing traffic movements received red indications could be solved by simply adding a standard MUTCD "Delayed Green" sign above the signal head.

6.3.3 Hicks Street/Pierrepont Street: Raised Intersection

6.3.3.1 Design

The intersection of Hicks and Pierrepont Streets was raised two inches to reinforce the low-speed, Living Street nature of Hicks Street and Pierrepont Street. The height of the raised intersection was a focus of much discussion. Community and advocacy groups, such as Transportation Alternatives, believed the intersection should be raised four inches in order for the treatment to control travel speeds and driver behavior.. This height is commonly adopted in this situation around the world. However, NYCDOT was concerned that adoption of this height would raise the pavement to sidewalk level, thereby blurring the distinction between road and sidewalk, and that such a grade change would impact on traffic operations. For test purposes, DOT determined that two inches was appropriate. In order to maintain safe conditions for pedestrians crossing the roadway, curb lines were rebuilt with ramps at an 8.33% grade. Road striping, "Stop," and "Bump" signs were installed to indicate the raised intersection to oncoming motorists. In 2002, the raised intersection was removed and a traffic signal was installed. This is discussed in *Section 6.3.3.3.*

Figure 6.7 Raised intersection at Hicks Street and Pierrepont Street

6.3.3.2 Evaluation

Speed Surveys

Both before and after surveys were taken in off-peak periods when traffic was flowing freely. Speed data showed a substantial reduction in median speed on Hicks Street, but not in 85th percentile speed. . Therefore, the raised intersection slowed most drivers down, but had no effect on the fastest 15% of drivers.

Table 6.4 Vehicle Speeds on Hicks Street north of Pierrepont Street

Data Collected	Median Speed (mph)	85th Percentile Speed (mph)
10/5/99 (before)	25	30
7/3/02 (after)	21	30
Percent Change	- 16%	0%

Video Surveys

Video observation of the raised intersection showed some positive impacts on traffic behavior, but also revealed a negative impact on the neighborhood environment. The positive impact was that the raised intersection, along with the "Stop" sign, caused most northbound drivers on Hicks Street to at least slow down, if not stop, at the stop bar. In particular, turning movements seemed to be slowed particularly by this measure, especially when pedestrians were present. On the negative side, the installation of a pure asphalt raised intersection did not perform well from a noise point of view – a lip developed at the north (upstream) end of the intersection, where the roadway sloped back down to grade. This lip caused heavy vehicles to drop back to grade loudly, just when they were accelerating away from the intersection. The sound was clearly a nuisance to residents and unacceptable on a Living Street.

User Surveys

The user surveys showed that pedestrians perceived a real change in the behavior and travel speed of drivers in the Hicks Street corridor. When asked whether cars turned more slowly on Hicks Street, 46% said “Significantly,” and 31% said “Slightly.” Asked if the raised intersection slows traffic, 54% said “Significantly,” and another 37% said “Slightly.” When traffic data shows a reduction in speed, and that reduction is perceived by over 75% of pedestrians, the sense of a Living Street environment can be seen to emerge. At the same time, the noise caused by the lip at the upstream end of the intersection detracted from this environment; indeed, even respondents who praised the pilot measure’s effect on travel speeds criticized the noise it created in a dense residential area. Such concerns need to be addressed (see *Section 6.3.3.3* below) if traffic calming is to be generally accepted.

6.3.3.3 General Application

Provided noise and other impacts can be managed, coupling a raised intersection with a legal speed control like a “Stop” sign or a traffic signal can reinforce the message to drivers that they are traveling through a slow-speed zone and should behave accordingly. Wherever warrants for a “Stop” or signal are met at proposed speed table locations, they should be installed to strengthen the sense of the Living Street. As for the noise problem, it is clear that raised intersections need to be constructed with a concrete base, not simply with asphalt. Ramps should be graded to return drivers to the base road elevation gently; in terms of slowing through traffic, the vertical deflection at the upstream end is more important than that at the downstream end. Finally, DOT should consider allowing a higher raised intersection. The international standard of 4” would bring traffic closer to curb level – a condition that would actually signal to drivers that they should slow down.

Since the pilot installation, a traffic signal has been installed at the Hicks Street/Pierrepont Street intersection. In general, there is no conflict between traffic signals and the various forms of physical traffic calming treatment that might be implemented at this intersection, in particular:

- Neckdowns
- Raised crosswalk
- Raised intersection
- Textured or colored pavement

However, due to community concerns about noise at the raised intersection, it was removed once the signal was installed.

6.3.4 Hicks Street/Atlantic Avenue: Neckdown

6.3.4.1 Design

The Hicks Street /Atlantic Avenue treatment was originally planned as a full gateway treatment on the north leg of the intersection, combining a color-textured raised crosswalk and a 7 foot wide neckdown to signal to drivers that they were entering a Living Street environment. Because there is a firehouse on Hicks Street two blocks north of Atlantic Avenue, FDNY expressed concern that their trucks would not be able to negotiate the neckdown. Though a field trial with cones placed 7 feet from the west curb of Hicks Street showed that the largest truck housed at the Hicks Street firehouse could negotiate the neckdown, the measure was reduced to 6 feet to provide FDNY with an added level of comfort. After the neckdown was installed in September 2001, DOT chose not to proceed with the raised crosswalk. Instead, the final installation of the brick red color-textured marking in the crosswalk was completed in October 2001. In April 2002, this marking was removed in the east half of the crosswalk when DDC temporarily resurfaced Atlantic Avenue as part of its water main replacement project.

6.3.4.2 Evaluation

Speed Surveys

Speed data showed a surprising, and counterintuitive, result of the Hicks Street neckdown – that vehicles actually travel faster once they are past the measure. This is likely due to the fact that the neckdown introduces an additional choke point at an intersection that is already a traffic bottleneck. While the neckdown may discourage opportunistic drivers from cutting through Living Streets to make regional trips, those drivers who choose to go north may be so frustrated by the measure and the jockeying for position it causes (see *Section 6.3.4.3*) that they speed up once they are past it.

Table 6.5 Vehicle Speeds on Hicks Street north of Atlantic Avenue

Data Collected	*Median Speed (mph)*	*85th Percentile Speed (mph)*
4/19/01 (before)	20	26
7/3/02 (after)	23	34
Percent Change	+ 13%	+ 31%

Video Surveys

Video surveys showed little improvement in driver behavior through the necked-down north leg of the intersection. Before the pilot installation, two lanes of traffic proceeded northbound through the intersection in peak periods, only to merge down to one lane one block north on Hicks Street, between Atlantic Avenue and State Streets. Narrowing the intersection seems to have displaced this problem southward – instead of merging north of Atlantic Avenue, drivers jockey for position in the intersection itself, swinging close to the crosswalk (see *Figure 6.8).* While this maneuver is illegal (the three lanes of the Hicks Street approach from the south are striped as left, through, and right), and traffic does not move at high speeds in the peak due to downstream congestion, the pilot has not regularized the through movement.

Although the crossing distance is already short across Hicks Street, the neckdown allows pedestrians to wait safely off the main line of the sidewalk, allowing a quicker crossing. This helps them navigate the traffic conditions described above.

Figure 6.8 Looking south on Hicks Street at Atlantic Avenue: Vehicles jockey for position

Figure 6.9 Color-textured crosswalk at Hicks Street and Atlantic Avenue before its removal

User Surveys

The goal of the Hicks Street/Atlantic Avenue neckdown was to differentiate between two types of road – Atlantic Avenue, a Travel Street with direct access to the BQE, and Hicks Street, a Living Street with primarily residential character. This differentiation would manifest itself most in the perception that vehicle speeds were decreasing as motorists entered the Living Street area. As noted above, this speed reduction did not occur. However, it is interesting that despite an objective increase in travel speeds north of Atlantic Avenue, some 20% of pedestrians perceived a significant speed *decrease* due to the neckdown – probably a simple, positive response to the idea that something was being done about speeding traffic. At the same time, users do perceive some benefits for pedestrians – 49% said the neckdown significantly improved crossing opportunities, and 53% said it significantly improves the visibility of pedestrians at the intersection.

6.3.4.3 General Application

In general, traffic calming devices work best when they are self-enforcing. So, while the neckdown forces traffic to form a single lane on northbound Hicks Street, it cannot prevent drivers from ignoring striped lanes as they approach from the south, nor can it prevent them from speeding once they pass the choke point. However, as at the Court Street/Remsen Street intersection, signage may help reinforce the fact that the neckdown signals entry into a Living Street environment. Further downstream, additional measures such as mid-block narrowing, speed tables, or chicanes) may be necessary to slow drivers down on Living Streets.

The partial removal of the red color-textured crosswalk on Hicks Street points to a need for NYCDOT to raise the profile of traffic calming measures and educate its own and other agencies' contractors on how to install and maintain them.

6.3.5 Henry Street/Atlantic Avenue: High-Visibility Bicycle Lane

6.3.5.1 Design

This measure involved resurfacing one 170 foot long block of the existing Henry Street bike lane from Atlantic Avenue to Pacific Street using a color-textured pavement treatment. The new lane is five feet wide, including a four-inch wide white stripe separating the bike lane from the travel lane, and runs from Atlantic Avenue to Pacific Street. The color-textured material used on this block is the epoxy-and-aggregate compound "TyreGrip," marketed by Traffic Safety Systems. The surface is now bright blue and has a granular texture. After the August 2001 installation of this treatment, DOT received positive feedback from the cycling community and requested that the next block of the Henry Street bike lane (between Pacific and Amity Streets) be converted to a high-visibilty surface. However, because the TyreGrip surface had already begun to fail – it did not adhere properly to the asphalt due to oily residues and bituminous materials on the surface – and because of its rough texture a different product was chosen. The new product, "ColorSet," marketed by Statewide Paving and Striping, is also an epoxy-and-aggregate compound with a slightly brighter blue hue, granular texture, and better skid resistance. This second installation, completed in March 2002, has been successful: it has retained its bright color and smooth texture and there is no evidence of breakdown of the surface.

Figure 6.10 Blue bike lane on Henry Street, between Pacific Street and Amity Street

6.3.5.2 Evaluation

Video Surveys

The increased visibility of the bike lane has reduced drivers' tendency to encroach on cyclists' space on Henry Street. The "before" video showed cars and trucks frequently straddling the nearly-invisible white stripe of the bike lane, especially when ambulances serving Long Island College Hospital were laying over on the east curb of the street. The introduction of the blue lane has resulted in increased compliance with regulations. Today, the only violators seem to be the occasional trucks that need to swerve into the lane to avoid parked ambulances.

6.3.5.3 General Application

Due to their low cost, positive effect on lane discipline, and popularity among cyclists, color-textured lanes should be explored elsewhere in New York City, especially where lane discipline problems exist. The experience with TyreGrip at this location, however, indicates that any product deployed on a busy, multiuse street needs to be simple to install and durable. TyreGrip's specifications required a nearly perfectly-clean, dry road surface, something the contractor could not achieve even by powerwashing the road. Products like ColorSet, which are able to adhere to suboptimal pavement surfaces, are always preferred when working in urban areas, where streets are used too intensely and vary too much in surface condition to expect ideal installation conditions.

6.3.6 Clinton Street/Atlantic Avenue: Leading Pedestrian Interval

6.3.6.1 Design

The Leading Pedestrian Interval (LPI) at Clinton Street and Atlantic Avenue was installed to give pedestrians crossing Atlantic Avenue a head start before vehicles making the heavy left and right turn movements onto Atlantic Avenue begin turning. Walk indications for north- and southbound pedestrian movements across Atlantic Avenue are now displayed five seconds sooner than the

Green indication for northbound traffic (there is no southbound traffic because Clinton Street is one-way northbound). The new signal cycle consists of the following phases:

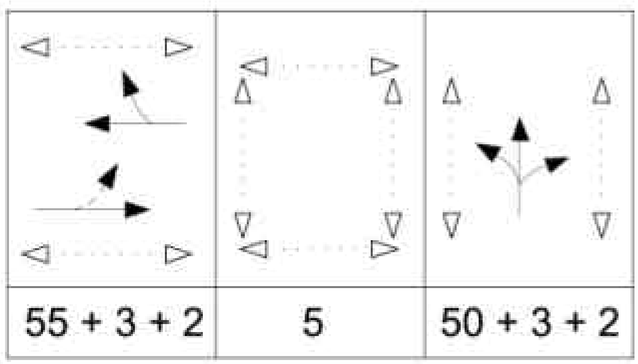
i. Green indication for east-west traffic on Atlantic Avenue, "Walk" indication for east-west pedestrians (60 seconds)

ii. Leading pedestrian interval: Red indication for all vehicular traffic, "Walk" indication for north-south pedestrians crossing Atlantic Avenue (5 seconds)

iii. Green indication for northbound traffic on Clinton Street, "Walk" indication for north-south pedestrians (55 seconds)

This phasing plan is illustrated in *Figure 6.11*.

Figure 6.11 Pilot signal timing at Clinton Street and Atlantic Avenue, showing the time (in seconds) given to green, yellow, and all-red indications in each phase



No construction or capital costs were incurred in implementing this treatment.

Figure 6.12 Using the leading pedestrian interval to cross Atlantic Avenue at Clinton Street

6.3.6.2 Evaluation

Video Surveys

Public response to the LPI has been almost universally positive. Video surveys at this location bear out the frequently heard comment that the new signal timing gives pedestrians more confidence when crossing Atlantic Avenue. The before video showed that many pedestrians had to wait to cross, either on the curb or on the centerline, for turning vehicles to clear the intersection. After the LPI was installed, virtually all pedestrians are able to cross before turning vehicles proceed. The exceptions were slow-moving pedestrians trying to cross the west leg of the intersection in the path of left-turning vehicles, who are not able to reach the centerline before drivers start turning left. It should also be noted that the after videos were shot while construction was taking place elsewhere on Atlantic Avenue, meaning that drivers who would normally turn onto Atlantic Avenue may have continued north on Clinton Street instead to avoid construction downstream.

User Surveys

User surveys confirmed the anecdotal evidence that the LPI was popular with pedestrians: 89% said the measure increased pedestrian safety at the intersection and 96% said it increased pedestrian crossing possibilities. However, only 35% said the measure improved driver behavior even slightly. And many respondents said the LPI actually decreased traffic throughput on Clinton Street, causing a honking problem during the morning peak hour – current signal timings already give cars much shorter phases (30 seconds) at Atlantic Avenue than at upstream intersections (60 seconds at Pacific Street, for example).

6.3.6.3 General Application

LPIs are an inexpensive way to improve pedestrian safety and crossing conditions at busy intersections, particularly at intersections where a wide street with heavy traffic and the majority of the signal cycle split intersects a narrow street with less traffic. Indeed, the areawide strategy recommends them for all intersections along Atlantic Avenue from Hicks to Hoyt Streets. However, since LPIs are typically timed to take green time away from the low-traffic street, the impacts on upstream intersections should be considered. In the case of Clinton Street, simply "feathering" northbound traffic (giving drivers slightly less green time at successive intersections in a corridor in order to store vehicles evenly across intersections – a strategy the DOT uses with great success in peak hours at the north end of 4th Avenue) would decrease the driver frustration and honking at the Atlantic Avenue intersection.

Finally, the pilot LPI gave pedestrians a 5-second head start to cross Atlantic Avenue. While this is enough time for most pedestrians to make enough progress across the intersection so that drivers do not try to cut them off, at times the first car in the queue on Clinton Street turns left in front of pedestrians. Ideally, the phase would be lengthened at intersections where the pedestrians cannot reach the centerline of the major roadway in 5 seconds (when left-turning traffic begins to move), such as Atlantic Avenue and Clinton Street. However, this would further reduce vehicle throughput on the minor street.

6.3.7 Bond Street/Atlantic Avenue: Pedestrian Refuge

6.3.7.1 Design

The Bond Street /Atlantic Avenue pilot measure was originally planned to consist of a 12-foot wide raised concrete median refuge in the east leg of Atlantic Avenue and a 7-foot wide neckdown on the west side of the north leg of Bond Street, which is one-way northbound. To allow traffic to pass the refuge safely, eastbound lanes on Atlantic Avenue had to be restriped so they tapered away from the centerline as they approach Bond Street from the west, and tapered back toward the centerline as they continue to the east. This required the removal of a total of ten metered parking spaces from the south curb of Atlantic Avenue on each side of Bond Street. In keeping with DOT policy, the taper was designed to comply with the 85^{th} percentile observed speed on Atlantic Avenue, which in 2000 was 38 mph. This raised some objections among Atlantic Avenue merchants, who believe that the road should be designed physically for a lower travel speed.

Figure 6.13 Using the pedestrian refuge to cross Atlantic Avenue at Bond Street

Because of the scheduled reconstruction of Atlantic Avenue, NYCDOT elected to proceed with the refuge, but not with the neckdown on Bond Street. DOT also decided to introduce eight full-time parking spaces on the west curb of Bond Street between Atlantic Avenue and Schermerhorn Street – parking spaces that were previously marked "No Standing 7-10 a.m." The refuge, whose western limit is flush with the east curb of Bond Street, contained a pedestrian channel and three steel bollards to protect pedestrians from oncoming traffic. It broke the 60-foot crossing distance on Atlantic Avenue into two legs – 26 feet wide north of the refuge, and 20 feet wide south of the refuge. DDC installed this measure as part of the temporary road surface during water main construction. When the road was rebuilt permanently in August 2002, DDC and NYCDOT agreed that the pedestrian refuge should be removed, but the proposed neckdown on Bond Street – which was not installed in the pilot program – would be installed.

6.3.7.2 Evaluation

Speed Surveys

Speed surveys show that the horizontal deflection created by the pedestrian refuge has had an effect on travel speeds. Under free-flowing midday traffic conditions, both median and 85^{th} percentile speeds fell as a result of this measure.

Table 6.6 Vehicle Speeds on eastbound Atlantic Avenue east of Bond Street

Data Collected	Median Speed (mph)	85th Percentile Speed (mph)
3/20/01 (before)	30	36
6/27/02 (after)	28	33
Percent Change	- 7%	- 8%

Video Surveys

The installation of a pedestrian refuge introduced a driver discipline problem on Atlantic Avenue and Bond Street. When the refuge was designed, existing travel lanes were realigned to allow traffic to flow around it. This means that drivers who formerly traveled parallel to the Atlantic Avenue curb should have now traveled a path that tapered toward the curb as they approached Bond Street and back toward the centerline as they drove away from it.

However, the video surveys showed that eastbound drivers were not following the tapered lane striping but rather taking a straight-line course through the intersection. This may be because the refuge exists nowhere elseon Atlantic Avenue, and because drivers have clear sightlines for several blocks beyond the intersection, with no parking maneuvers to block their view.

Due to the shorter crossing distance between sidewalk and refuge, pedestrians were observed to cross against the "Don't Walk" sign when traffic gaps occurred on either side of Atlantic Avenue.

User Surveys

Surveys showed that user perceptions of the pedestrian refuge were mainly negative in changing the use of the street space at Atlantic Avenue and Bond Street. Only 4% said the measure improved crossing time or distance significantly, only 13% said it improved crossing opportunities significantly, and 57% said the measure had no impact on driver behavior. On the other hand, 71% said the measure improved pedestrian visibility at least slightly.

In addition to the formal surveys of pedestrians, merchants along Atlantic Avenue also complained that the loss of parking along the south curb of Atlantic Avenue and the loss of the bus stop on the southeast corner made their businesses less accessible and degraded the quality of the street's pedestrian environment by bringing high-speed traffic right up to the curb. Many of these businesses are furniture and antique stores that depend on high turnover parking and loading in front of their doors.

6.3.7.3 General Application

As noted in *Section 6.3.1* (regarding the Tillary Street-Adams Street measure), pedestrian refuges may be an effective way of reclaiming unused streetspace on Travel Streets for pedestrians. Such reclamation may be a "win-win" situation, in which pedestrians' visibility and safety is improved with no loss in traffic capacity. However, the application on Atlantic Avenue involved a trade-off – not between safety and capacity, but between safety in the crosswalk and safety on and accessibility to the fronting land uses. While the refuge may have improved crossing conditions slightly, the lane shift forced parking to be removed from the curb, making pedestrians on the sidewalk feel exposed and less safe. Moreover, the loss of parking and the bus stop made the blocks adjacent to Atlantic Avenue and Bond Street less accessible, creating concern among the local merchants. In general, street reclamation measures should be focused on win-win locations like Tillary Street before locations like Atlantic Avenue, which require tradeoffs.

6.3.8 Fulton Street/South Oxford Street: Gateway Treatment

6.3.8.1 Design

The gateway treatment at Fulton and South Oxford Streets was originally planned to include two 7-foot neckdowns, one on either side of South Oxford Street, steel bollards to protect pedestrians, and a raised crosswalk with a blue color-textured surface. The goal was to manage the behavior of turning drivers (in terms of speed and turning path) by signaling the transition from a busy Community Street, Fulton Street, onto a quiet Living Street, South Oxford Street. This measure was constructed to plan in October 2001. However, a week after it was installed, the raised crosswalk was inadvertently paved over by an NYCDOT road maintenance crew resurfacing South Oxford Street. The neckdowns, and bollards remain intact. The neckdowns narrow what used to be a 32-foot wide crosswalk that allowed sweeping turns into a tight, 18-foot wide entrance into a Living Street. Located directly above the Lafayette Avenue subway station, this measure presented an additional civil engineering challenge, as an existing catch basin on New York City Transit property had to be relocated.

Figure 6.14 Gateway treatment at Fulton Street and South Oxford Street

6.3.8.2 Evaluation

Speed Surveys

While the community perceived a travel speed problem at this intersection, the actual safety problem was not the speed, but rather the wide sweeping movement of turning traffic. Travel speeds on South Oxford Street, never dangerously high before the pilot program, were virtually unchanged after the gateway was installed. A one mile per hour (mph) increase in median speed was offset by a two mph decrease in 85^{th} percentile speed. Possibly, more aggressive drivers are slowed slightly by this measure, but the data collection indicated that speed was a perceived problem, not an actual problem on South Oxford Street, before or after the pilot measure.

Table 6.7 Vehicle Speeds on South Oxford Street north of Fulton Street

Data Collected	Median Speed (mph)	85th Percentile Speed (mph)
3/29/01 (before)	25	30
7/10/02 (after)	26	28
Percent Change	+ 4%	- 7%

Video Surveys

As expected, by narrowing the entrance to South Oxford Street, the gateway treatment has improved the discipline of turning drivers. Before the gateway treatment, drivers turning right off westbound Fulton Street were able to make a sweeping turn along the curb, running nearly parallel to pedestrians crossing South Oxford Street. Westbound pedestrians could not see these cars coming. With the gateway treatment in place, drivers do not start turning until they are perpendicular with South Oxford Street. The smaller turning radius slows drivers slightly, and also forces them to drive through the crosswalk perpendicular to pedestrians, giving both users of the road space (drivers and pedestrians) better views of one another. In this sense, the measure succeeds in managing turning traffic.

User Surveys

User surveys revealed a new perception of the relationship between pedestrians and vehicles at the intersection – 96% said it increased pedestrian opportunities to cross South Oxford Street, 88% said the gateway increased pedestrian visibility, and 83% said it gave priority to pedestrians crossing South Oxford Street. The measure also succeeds at demonstrating how traffic calming measures can differentiate between types of street space – in this case, a Community Street (Fulton Street) from a Living Street (South Oxford Street) – 90% said the measure made them feel that South Oxford Street had a "different character or nature" than Fulton Street.

6.3.8.3 General Application

Fulton Street presents a special challenge because it runs diagonally across the Fort Greene street grid, creating awkward intersections, many of which have more than four approaches. The existing curb lines leave a great deal of road space that could be reclaimed for pedestrians. Rectilinear intersections elsewhere in Brooklyn may be simpler places to install gateway treatments, since less pavement needs to be reclaimed to make turning vehicles slow down when entering Living Streets. This may, however cause problems where gateways are designed to protect Living Streets from Travel Streets. Because westbound Fulton Street had a "No Standing" zone along the curb east of South Oxford Street, turning vehicles could store along the curb while westbound traffic flowed around them. Generally, thought should be given as to how to store at least one turning vehicle at such an intersection, even if the goal is to discourage any but local destination traffic from turning onto the Living Street.

6.3.9 Lafayette Avenue/Adelphi Street and Carlton Ave: Neckdowns

6.3.9.1 Design

Neckdowns on Lafayette Avenue were constructed at two intersections, Adelphi Street and Carlton Avenue. At both intersections, the neckdowns consist of seven foot curb extensions into both sides of Lafayette Avenue and an additional seven foot curb extension into the west curb of the upstream side of the cross street. This design provides the maximum benefit for pedestrians while ensuring that left-turning vehicles off Lafayette Avenue have, at most, one neckdown to negotiate. As at Hicks Street and Atlantic Avenue, the extent of the neckdowns was a concern for DOT and FDNY, but because the streets in this section of Fort Greene are wider and less congested, and because Lafayette Avenue is a two-lane, one-way street that allows large vehicles to make sweeping turns if necessary, the seven-foot width was deemed acceptable. Ramps from the curb to the crosswalk were constructed at a maximum incline of 8.33%.

Figure 6.15 Neckdowns at Lafayette Avenue and Adelphi Street

6.3.9.2 Evaluation

Video Surveys

The primary effect of the Lafayette Avenue neckdowns has been to regularize a practice common among pedestrians at this location – standing in the parking lane while waiting for lights to change. Midday traffic volumes on Lafayette Avenue and its side streets are light, and before the neckdowns, pedestrians felt comfortable standing in the roadway, behind parked cars, while waiting to cross the street – a potentially dangerous situation if cars turn quickly off Lafayette Avenue. The neckdowns provide these pedestrians a safe, legal space to stand, and shorten the crossing distance, with no impact on traffic flow.

User Surveys

The neckdowns at Carlton Avenue and Adelphi Street have increased pedestrians' confidence and sense of safety – 94% said pedestrians felt safer and had better crossing opportunities, and 100% said pedestrians were more visible. Pedestrians, however, had varying perceptions of changes in travel speeds – only 12% said traffic was slowed significantly, but 90% said that, at least sometimes, cars turned more slowly onto Carlton Avenue or Adelphi Street.

6.3.9.3 General Application

While the neckdowns along Lafayette Avenue have succeeded in regularizing a potentially unsafe pedestrian practice, they have not slowed traffic either mid-block or in the crosswalk. While this was not the primary goal of the measure, it does point to the need for further devices downstream to control speeds on Living Streets, especially wide streets like those in Fort Greene. Such measures might include mid-block neckdowns, speed tables, or chicanes.

One design issue that must be addressed in future neckdown construction is the radius of the new curbline at the beginning of the taper back to the original curbline (the far end of the neckdown, away from the intersection). The pilot neckdowns were designed with a 4' radius at both the beginning and end of this taper. This radius proved too tight for the Sanitation Department's normal street sweepers to negotiate, meaning they had to leave a section of the gutter unswept (see *Figure 6.21*). Contrast this with Hicks Street and Atlantic Avenue, where a demonstration was set up using cones that simulated the actual neckdown layout to ensure that FDNY's fire trucks could negotiate the device (see *Section 6.3.4.1)*. The same demonstration should be given to Sanitation Department vehicles; had this been done, the turning radii of the Lafayette Avenue neckdowns would have been larger.

6.3.10 DeKalb Avenue: 25 mph Signal Progression

6.3.10.1 Design

To address a community identified speeding problem on DeKalb Avenue (at one location, initial speed surveys found an 85th percentile speed of 40 mph in a 25 mph zone), the traffic signals along DeKalb Avenue were retimed between Clermont and Flatbush Avenues to ensure safe travel speed. Formerly, there was no standard progression speed on this stretch of DeKalb Avenue. The new signals were set to allow traffic to proceed through a green wave no faster than the speed limit of 25 mph. There was no capital cost associated with implementing this measure.

6.3.10.2 Evaluation

Speed Surveys

The slow speed progression on DeKalb Avenue has not only failed to control speeds, but actually increased them. This may be because drivers are not warned at the upstream end of the new progression that their driving conditions are about to change. Thus, they not only drive at the same speed as they did upstream, but also become frustrated when they fall out of sync with the green band. This is discussed in detail in *Section 6.3.10.3*.

Table 6.8 Vehicle Speeds on DeKalb Avenue west of Washington Park

Data Collected	*Median Speed (mph)*	*85th Percentile Speed (mph)*
10/7/01 (before)	28	34
7/10/02 (after)	31	35
Percent Change	+ 11%	+ 3%

Video Surveys

Apart from changing travel speeds, this measure was also aimed at changing driver behavior. It was expected that once the signal offsets were standardized, drivers would not race from one intersection to the next and await a green light. Rather, it was thought drivers would proceed at the progression speed (25 mph) and remain in the green band. But just as speed surveys showed little difference in travel speed, video surveys showed little difference in driver behavior on DeKalb Avenue. During peak hours, queued vehicles accelerated beyond 25 mph as soon as they saw a green light, only to brake when they came to a red light downstream. After a few seconds, they accelerated again, only to repeat the process at the next signal. This pattern was especially evident along Fort Greene Park, where there are no signals on DeKalb Avenue for three blocks. Drivers would accelerate in this downhill section, only to lose any time they hoped to gain by driving above the speed limit when they came to a red signal at the west end of the park.

User Surveys

The project team attempted to distribute survey forms to drivers traveling west on DeKalb Avenue in the AM peak period. However, few drivers accepted the forms and the team felt it was unsafe to continue to walk in the heavily-traveled roadway handing out the forms. Accordingly, user survey distribution at this location was suspended and there are no results to report.

6.3.10.3 General Application

In order for slower signal progressions to be effective, drivers must be aware of them. DeKalb Avenue east of Clermont Avenue is still timed to allow 38 mph travel, and drivers are given no indication that conditions change west of Clermont Avenue. Without clear signage, signal timing changes may not only be ineffective but actually counterproductive – in this case, the change seems to have promoted slightly faster driving. The New York State MUTCD provides for signage reading "Signals Set For 25 M.P.H[8].," warning drivers of upcoming progression speeds. While the effectiveness of such signage is uncertain, it could be tested at other signal progression changes in the future, to see whether drivers react to timing changes less aggressively.

6.3.11 User Surveys: Summary of common questions

Certain questions were included on all pilot survey forms. The common questions were:

- Are you familiar with the Downtown Brooklyn Traffic Calming Project? (Yes or no)
- Do you think the Downtown Brooklyn Traffic Calming Project is a good idea? (Yes or no)
- Does the recent change in traffic volumes and patterns in Downtown Brooklyn make this particular pilot treatment more or less effective? (More effective, less effective, or the same)
- Were you aware that a pilot program/installation of traffic calming measures was being implemented in general and specifically in this location? (Yes or no)
- Does this measure succeed in its goal (the goal of each measure was described to respondents before the survey began)? (Significantly, slightly, or not at all)

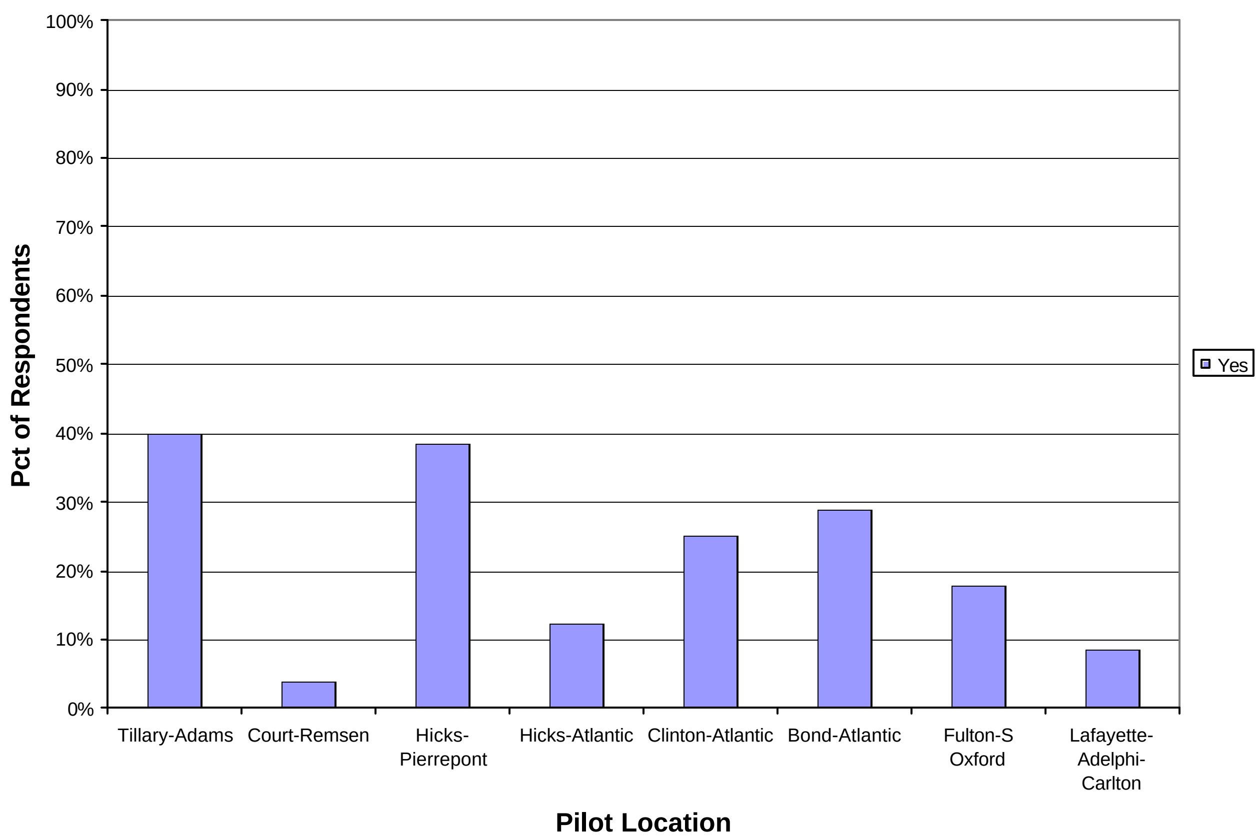
Comparing the responses to these questions leads to the conclusion that users were generally unfamiliar with the traffic calming project, but felt positively about it. Most importantly, the measures of which users were aware tended to be physical measures; this points to the need to maintain a role for physical measures not only to calm traffic but also to maintain awareness and enthusiasm for traffic calming in Brooklyn over the long term. Another distinction is that measures located on community and Living Streets (Court-Remsen, Hicks-Pierrepont, Hicks-

[8] Section 253.4 of the *New York State Manual of Uniform Traffic Control Devices* provides for this "traffic signal speed sign," which is to be placed "near the first signal and at subsequent intersections in the signal system as circumstances require." The sign should contain white lettering on green background and should display the speed limit for which the signals are set, rounded to the nearest multiple of 5 mph.

Atlantic, Fulton-South Oxford, and Lafayette-Carlton-Adelphi) tended to be slightly better received than those on Travel Streets (Tillary-Adams, Clinton-Atlantic, and Bond-Atlantic).

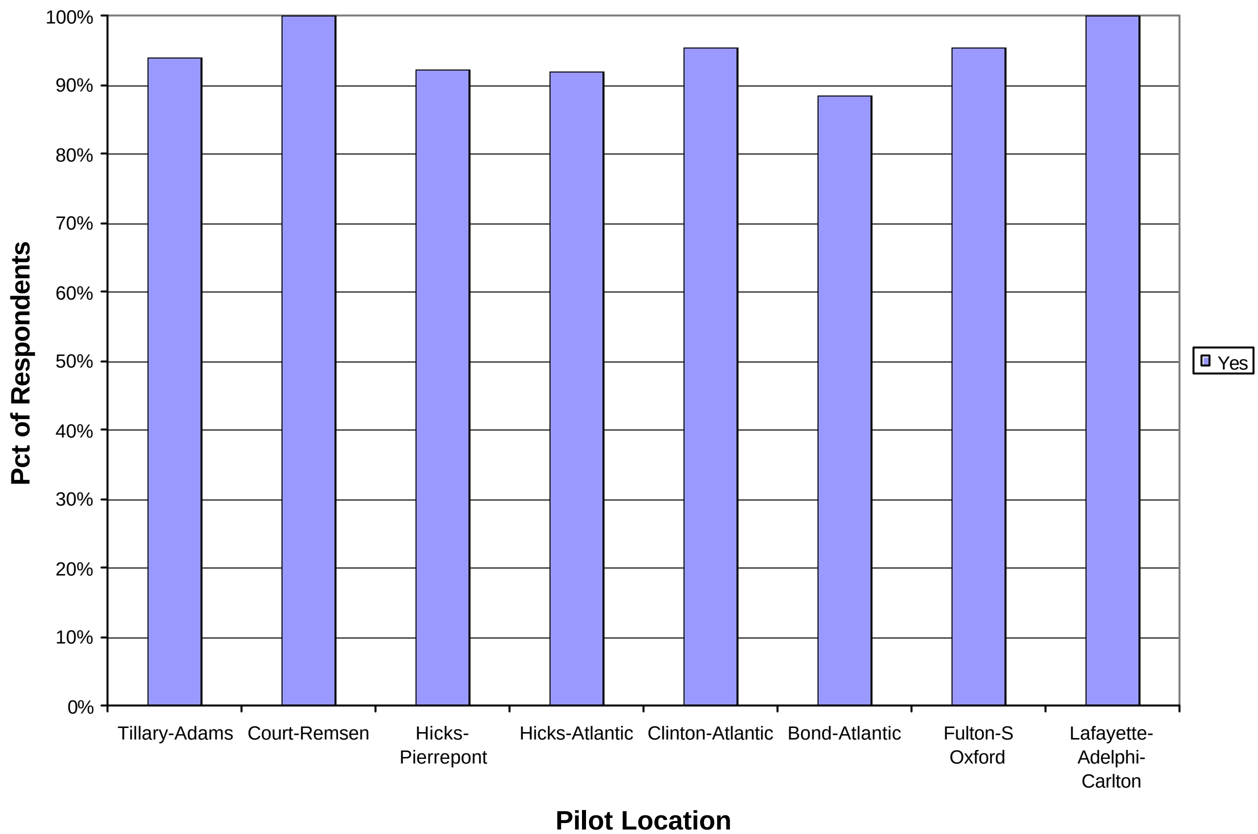
The following graphs show how the answers to these questions varied among the pilot locations.

Figure 6.16 Are you familiar with the Downtown Brooklyn Traffic Calming Project?



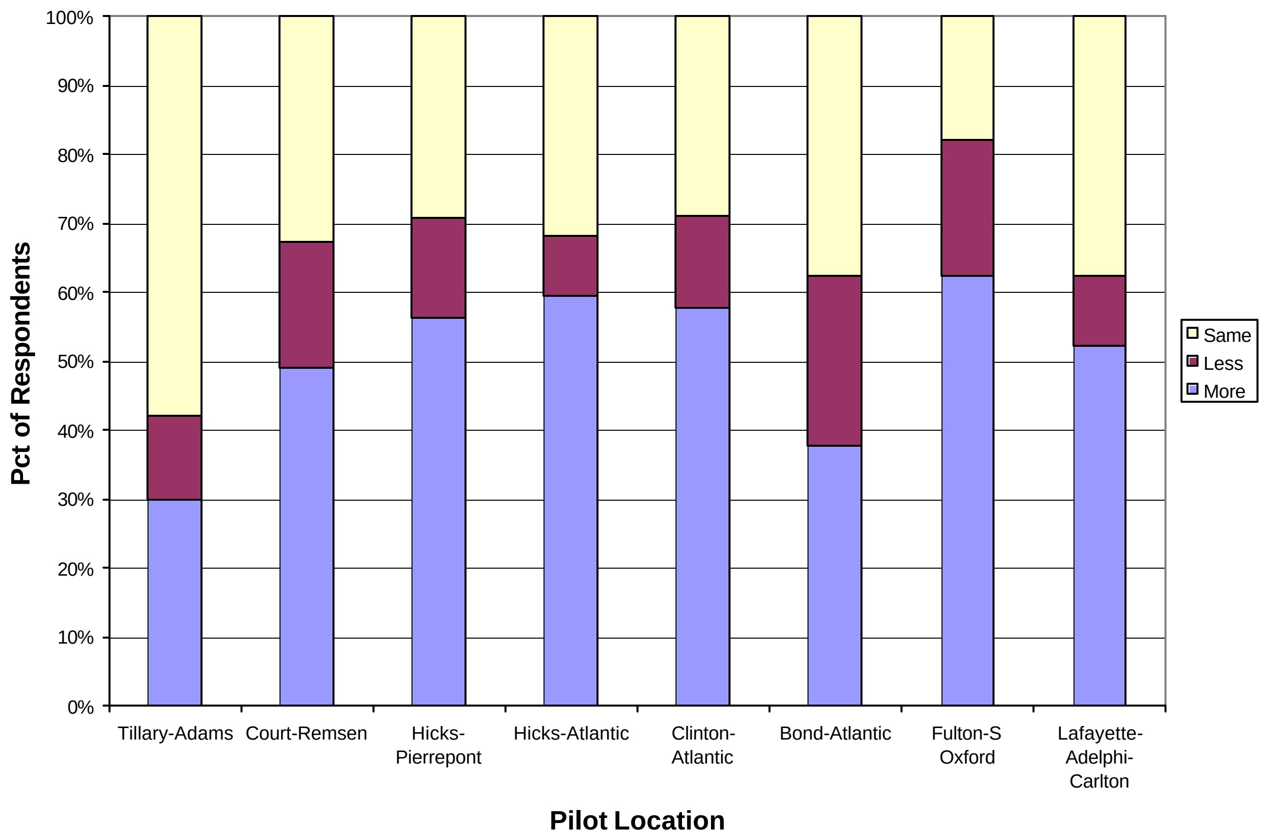
This question indicated the general profile of the Downtown Brooklyn Traffic Calming Project. Generally, respondents were most familiar with the project in the areas of the most "physical" treatments, like Tillary-Adams, Hicks-Pierrepont, and Bond-Atlantic.

Figure 6.17 Do you think the Downtown Brooklyn Traffic Calming Project is a good idea?



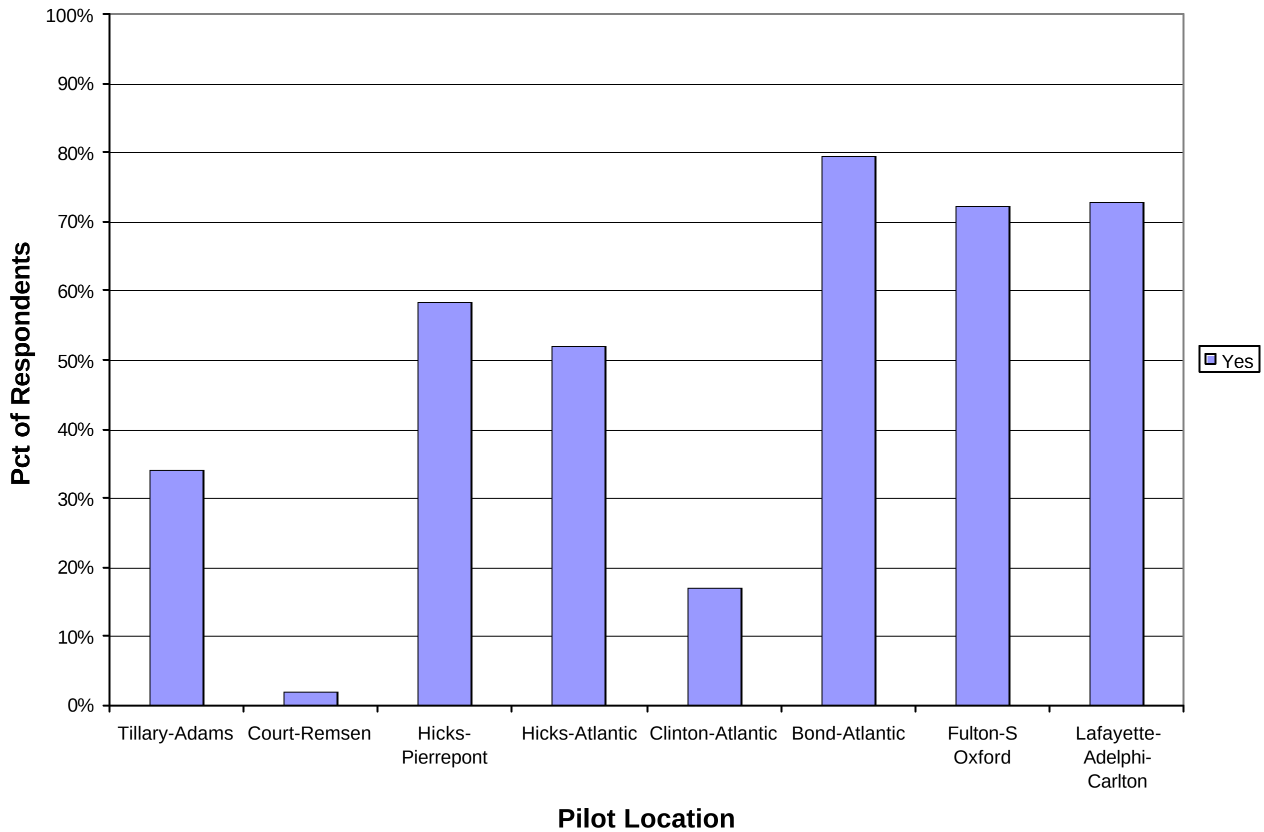
The overwhelmingly positive responses to this question indicate general support for the idea of traffic calming in Downtown Brooklyn. The response rates are fairly uniform across all locations, meaning no connections can be drawn between types of treatments and respondents' acceptance of traffic calming.

Figure 6.18 Does the recent change in traffic volumes and patterns in Downtown Brooklyn make this particular pilot more or less effective?



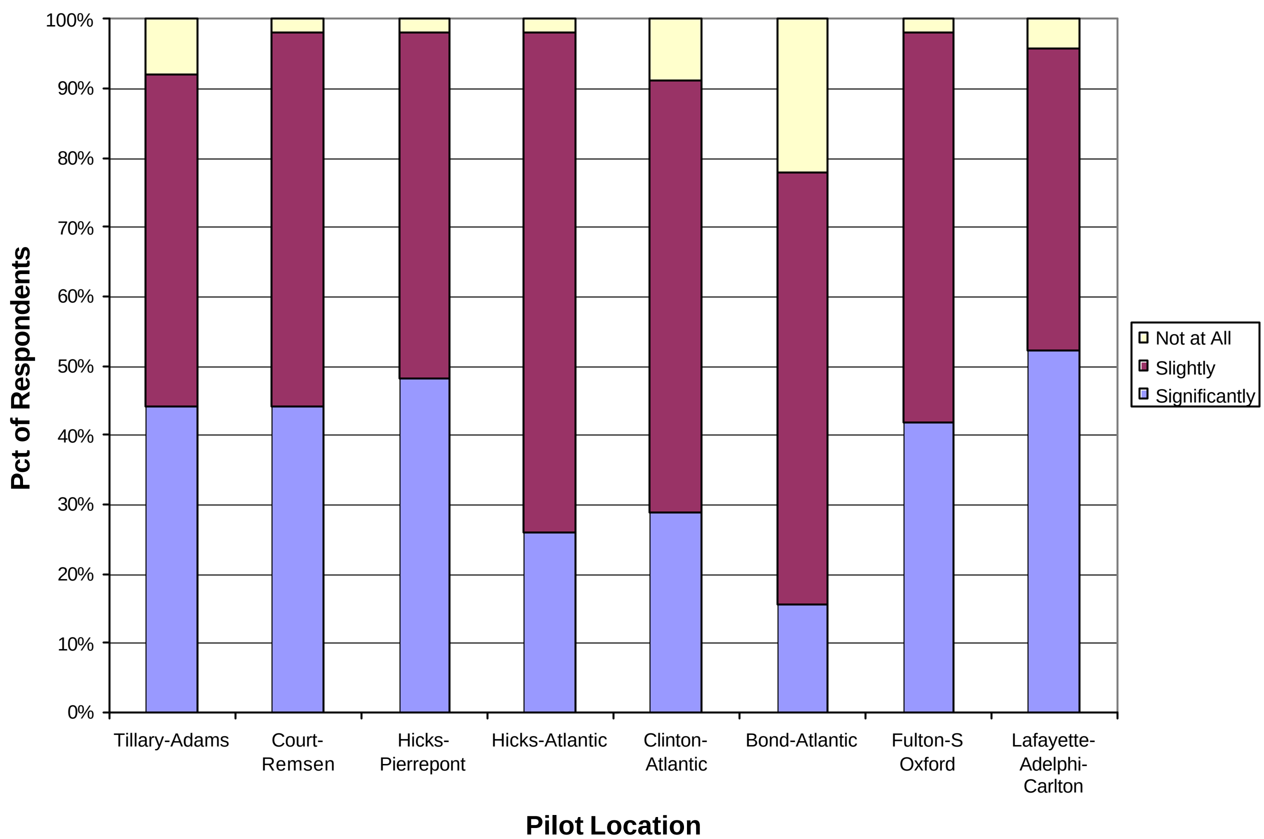
This question was intended to make respondents think about the relationship of traffic calming to managing roads and public spaces in the post-September 11th urban context. Even though some measures were located on residential blocks and some near major public buildings and landmarks (Tillary-Adams and Court-Remsen), there was no specific pattern in the responses.

Figure 6.19 Were you aware that a pilot program/installation of traffic calming measures was being implemented in general and specifically at this location?



Responses to this question again highlight the connection between the physicality of traffic calming devices and user perceptions. Measures involving neckdowns, pedestrian refuges, and raised intersections scored high on this question. The only two measures at which fewer than 20% of respondents were aware of the pilot program were signal timing changes (Court-Remsen and Clinton-Atlantic).

Figure 6.20 Does this measure succeed in its goal?



Before the surveys began, each respondent was told the stated goal of each pilot measure (the same goal as printed on the measure's pilot information sign). Responses to this question showed the Bond-Atlantic treatment was viewed as the least successful with the fewest respondents indicating that the measure had "significantly succeeded" in achieving its goal. The negative community feedback that NYCDOT received regarding this measure supported the survey results.

6.4 Lessons learned

This section summarizes lessons learned from pilot program design, construction, and operations.

6.4.1 Design

6.4.1.1 Improving traffic operations

Opportunities exist to address the issues of importance to traffic calming without adverse impact on motorized traffic, even on busy Travel Streets. Various simple measures could be used to improve intersection operations to provide benefits for all street users. Improving traffic channelization, for instance, by better defining lanes and the boundary of the section of road used for moving cars is consistent with a desire to minimize pedestrian crossing distances with neckdowns and center medians. In concert with the agency's goal, NYCDOT staff were enthusiastic about the opportunity to improve conditions for pedestrians, for instance by increasing the available pedestrian walk times at busy intersections.

6.4.1.2 Roadway design guidelines

As discussed in *Section 6.2.3*, the MUTCD has evolved to provide some guidance for the design of traffic calming treatments. Design for traffic calming should both conform to the MUTCD and reflect the traffic calming project's implicit street management framework. It is important that the manual reflects the increased use of traffic calming devices and provides statutory support for their implementation.

6.4.1.3 Catch basins and other utilities

An important virtue of traffic calming treatments is that they can in many cases be implemented inexpensively. However, their cost can increase significantly if catch basins and other utilities need to be relocated to accommodate the treatments. In designing the pilot program treatments, the project team investigated various design options with NYCDOT staff that minimized the need for relocation of utilities. However, the realities of maintenance and cleaning practice in New York City mean that it is generally not possible to avoid relocating catch basins or raising service pits.

For instance, while it would be possible to design a traffic island at an intersection that fulfilled the same traffic management purpose as a neckdown without interrupting storm water drainage paths, the additional manual effort required to clean the device is currently regarded as too onerous by Department of Sanitation, which currently relies almost exclusively on street cleaning vehicles. Quite legitimately, the Department of Sanitation is concerned about any design solution that places an additional burden on its cleaning staff, particularly after the experience with the Lafayette Avenue neckdowns. These are important issues to investigate as acceptance of traffic calming devices matures in New York City.

6.4.1.4 Standards of design

Because many pilot treatments had not been tried before in New York City, various design compromises were reached in the interests of implementing the designs as part of this study. These compromises gave NYCDOT and other agencies more confidence in the treatments' safety. As traffic calming becomes more familiar to city agencies responsible for street design, these compromises warrant further consideration.

For instance, NYCDOT required that all raised pavement treatments retain a two inch height differential between road pavement and sidewalk. On roads where successive road resurfacing efforts over the years has diminished the nominal six inch level difference between road surface and sidewalk to three or four inches, traffic calming devices involving a two-inch vertical displacement become almost indistinguishable from general surface roughness. This issue may have contributed to the ineffectiveness of the raised intersection treatment at Hicks and Pierrepont Streets – the minimal height of the raised table demanded by the required level difference between road and sidewalk meant that the treatment was almost invisible, and that the intended ramp up to and down from the table could only be formed as a lip. This led to the problem of noise as vehicles (especially trucks) passed over it. NYCDOT required maintenance of the height differential in order to retain the firm delineation between road and sidewalk and so protect pedestrians. Such delineation has been achieved elsewhere without the requirement of a level difference – through such means as surface texture, bollards, and signage. With this in mind, NYCDOT should review its standard to allow raised pavement all the way to curb level, provided some combination of the aforementioned delineation measure are installed.

6.4.1.5 Slow speed zones

While communities in Downtown Brooklyn were eager to take advantage of the New York State law that permits local jurisdictions to establish slow speed zones in residential neighborhoods, NYCDOT is reviewing the law to determine the spacing of traffic calming treatments that are needed to qualify as a low speed zone. The pilot measures show that speed control can be effected by strategically placed traffic calming measures and that perhaps an alternative interpretation of the slow speed zone law is in order. That said, slow speed zones are more effective when a series of traffic calming measures are implemented. Ultimately, a site-by-site examination is recommended to determine what is reasonable and how "physical" traffic calming treatments need to be, and DOT needs to finalize its policy for implementing slow speed zones.

6.4.1.6 Driver behavior

Notwithstanding the previous lesson about strategic speed reductions, it is also clear that certain traffic calming devices like gateway treatments are not enough to slow vehicles downstream of the treatment. While aggressive driving is not by any means unique to New York City, it seems clear that treatments located at transition points between Travel Streets and Living Streets require further downstream reinforcement.

6.4.2 Construction

6.4.2.1 Quality Materials

A lesson learned around the world in implementating traffic calming treatments is that use of temporary materials can be entirely counterproductive. Physical treatments implemented temporarily can create opposition to their more permanent implementation, more than outweighing the construction cost savings. This does not mean the most appropriate construction materials and design solutions are necessarily the most expensive. When doubts arise about construction materials, the default solution should be to use familiar materials whose installation, reliability and maintenance schedules will be predictable. This is particularly important when testing new treatments, which may need to be removed if they prove unsuccessful.

6.4.2.2 Color-textured concrete treatments

Some color-texture surface treatments are effective. However, they demand ongoing maintenance due to inevitable utility and resurfacing projects and the time and skill required to maintain a non-standard road surface. The trials of colored surface treatments yielded mixed results. The trial of TyreGrip on the Henry Street bike lane was disappointing; this material began to flake after only one winter season. The ColorSet trial proved more successful, although it has not yet been subjected to the rigors of a winter. As noted in *Section 6.3.5*, the traffic volumes, surface conditions, and weather in New York all require extremely durable surface treatments. In any case, when quality color-textured surfacing materials are identified, they should be installed at multiple locations; this will allow NYCDOT to justify procuring a large enough supply to support ongoing maintenance required by inevitable utility and resurfacing projects. The issue of time and skill required to maintain non-standard road surface remains.

6.4.2.3 Construction permitting

NYCDOT's construction permitting and approval of unique treatments at disparate single locations was a lengthy process. This is a process issue that should be addressed when the construction program for the broad strategy begins (see *Section 6.2.5)* – all agency staff reviewing traffic calming proposals should be brought on board at the outset of the project.

6.4.3 Operations

6.4.3.1 Emergency services

Emergency service concerns about the impact of traffic calming treatments on their operations were generally not borne out by experience. This is consistent with experience elsewhere in the world, where appropriately designed physical treatments do not hinder emergency service access or movement. In any event, emergency service workers reported that they are used to taking actions necessary to access their destinations (witness the common practice of emergency vehicles traveling the wrong way down one-way streets) and so during discussions they indicated their pragmatic acceptance of allowing their vehicles to mount curbs if absolutely necessary to enter a street. However, these services must be consulted and worked with in a collaborative manner so that implementation does not impede their operation.

6.4.3.2 Sanitation services

The design of traffic calming treatments must recognize the Department of Sanitation's vehicle operations and cleaning practices. Unlike emergency vehicles, street sweepers do not have the ability to mount curbs and still be effective, and any difficult-to-sweep locations will impact their operations.

Figure 6.21 Lafayette Avenue neckdown: Small curb radius created areas difficult to reach with streetsweepers

6.4.3.3 Road surface maintenance

Maintenance of the road surface is a major issue in New York City. Coordinating maintenance, installation and construction activities is extremely problematic, with the result that road surfaces are routinely opened by any of a number of agencies authorized to do so. In many cases, the quality of road reinstatement is poor, with the result that road surfaces very quickly become uneven and inconsistent. In this environment, any unusual road surface treatments are extremely difficult to maintain. Throughout the city, examples can be found of well-meaning attempts to improve the street environment through use of unique surface treatments that have been rendered ineffective through maintenance practices that do not restore the roadway treatment.

All special treatments are subject to the problems caused by utility maintenance and construction – in very short order some of the pilot treatments (at the Hicks Street/Atlantic Avenue and Fulton Street/South Oxford Street intersections) were affected by roadway construction. This is a problem that cannot be solved through specification; it can only be solved by implementing much more stringent maintenance practices. Whether and how this is achievable lies beyond the scope of this study. However, ease of maintenance and installation of treatment is a factor that should be considered in selecting materials.