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MEMORANDUM

To: Kirkland City Council

From: Kirkland Transportation Commission, Dan Fisher, Chair

Date: September, 2006

Subject: **Permanent Radar Sign Policies**

Kirkland has installed 6 permanent radar signs on streets with different speed, volume, and land use characteristics. The Transportation Division of Public Works has written a report on the effectiveness of these signs (attached). Public Works noted that while 6 signs is a small sample, they found the following:

- The radar signs worked best on a 35 mph, heavily-traveled principal arterial and in the 20 mph time period in school zones. Note that crossing guards were present during these periods and it is assumed that the crossing guards and radar signs helped reinforce good driver behavior.
- The radar signs lowered speeds on lower-volume streets with 25 mph speed limits when motorists were in close proximity to the signs.
- The radar signs didn't work as well on streets with lower volumes and 25 mph speed limits when the motorists were farther from the signs. The exception was when motorists were entering (as opposed to leaving) their own neighborhood.
- The success of a radar sign should be measured in the reduced number of high speed motorists, not just a reduction in the 85th percentile speed.

The Transportation Commission reviewed this report and has recommended the following polices to the Public Works Department:

1. Consider radar signs as one of the several traffic calming tools available for solving speeding problems in Kirkland.
2. Use on 2 or 3 lane arterials and collector streets, especially where other traffic calming devices may not be appropriate, such as streets with traffic volumes greater than 5,000 vehicles per day and on Primary Emergency Response Routes.
3. Do not use on use on local streets where other traffic calming measures are applicable.
4. Each application of radar signs needs a "before and after" study with community feedback to build upon our experience of where the signs are most effective.

The Transportation Commission hereby forwards the report and our recommendations to the City Council for their reading file.

attachment

Evaluation of Permanent Radar Signs
In
Kirkland, Washington

August 25, 2006

Kirkland Department of Public Works
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by
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Neighborhood Traffic Control Coordinators

Evaluation of Permanent Radar Signs
In
Kirkland, Washington
August 25, 2006

EXECUTIVE SUMMARY

Purpose
The City of Kirkland has installed 6 permanent radar signs on streets with different speed, volume, and land use characteristics. The purpose of this analysis is to determine the effectiveness of these signs and help City Officials develop policies on the future application of permanent radar signs.

Operational Mode
The radar signs are not regulatory signs – they serve as reminders for motorists and they supplement existing regulatory speed limit signing. Each sign is set to show the speed limit; to display, "your speed is __) for speeds up to 10 mph over the speed limit; and to flash a "slow down" message to motorists traveling greater than 10 mph over the speed limit. For school zones, the "slow down" message flashes when motorists are 4 mph over the "20 mph" speed limit.

Current Applications
- School Zones. Two signs are in elementary school zones. One on NE 68th St east of Lakeview Elementary School and one on 6th Street south of Peter Kirk Elementary School. These signs are programmed for 25 mph except during the half hour before school starts and for the half hour after school lets out, when the signs switch to the 20 mph messaging.
- Neighborhood Traffic Calming. Two signs are placed 1000 feet apart on 112th Ave NE, a neighborhood collector street. This street carries 2300 vehicles per day and the legal speed is 25 mph.
- Principal Arterial. Two signs are placed 1550 feet apart on Lake Washington Boulevard. This street carries 24,000 vehicles per day and the legal speed limit is 35 mph.

Measures of Results
<u>85th Percentile Speed</u> This is the traditional measure for determining whether or not a speeding problem exists. This is the speed at, or below which, 85% of the motorists are traveling. Ideally, this speed should match the posted speed limit. Kirkland considers a speed of 5 mph over the 85th percentile speed as the threshold of a speeding problem and is one criterion for considering the use of neighborhood traffic calming strategies.
<u>Accumulative Frequency Speed Curves</u> These graphs plot the percentage of motorists driving at various speeds. They can show the speed ranges most influenced by the traffic control measure – radar signs in this study.
<u>Number of Vehicles at Higher Speeds</u> This is a variation of the Accumulative Frequency Speed Curve, but the focus is on the higher end of the speed curve.

The number of vehicles traveling 10 mph or more over the speed limit is compared. These high-speed vehicles are often the greatest concern for pedestrians, bicyclists, other motorists, police, and traffic operations staff.

Findings and Conclusions

- The radar signs worked best on a 35 mph, heavily-traveled principal arterial and in the 20 mph time period in school zones. Note that crossing guards were present during these periods and it is assumed that the crossing guards and radar signs helped reinforce good driver behavior.
- The radar signs lowered speeds on lower-volume streets with 25 mph speed limits when motorists were in close proximity to the signs.
- The radar signs didn't work as well on streets with lower volumes and 25 mph speed limits when the motorists were farther from the signs. The exception was when motorists were entering (as opposed to leaving) their own neighborhood.
- The success of a radar sign should be measured in the reduced number of high speed motorists, not just a reduction in the 85th percentile speed.

General Discussion of Implications

A test sample of 6 signs is pretty small to draw explicit conclusions, but the information in this analysis can be used for general guidelines for future radar sign installations. Also, if the objective is to slow traffic in school zones only during 20 mph time periods, other less expensive controls such as beacons that flash during the 20 mph time periods may be more cost-effective. If the need for speed control is on a Primary Emergency Response Route, radar signs may be one of the few options available.

Recommended Policies

1. Consider radar signs as one of the several traffic calming tools available for solving speeding problems in Kirkland.
2. Use on 2 or 3 lane arterials and collector streets, especially where other traffic calming devices may not be appropriate, such as streets with traffic volumes greater than 5,000 vehicles per day and on Primary Emergency Response Routes.
3. Do not use on use on local streets where other traffic calming measures are applicable.
4. Each application of radar signs needs a "before and after" study with community feedback to build upon our experience of where the signs are most effective.

Evaluation of Permanent Radar Signs
In
Kirkland, Washington
August 25, 2006

Purpose

The City of Kirkland has installed 6 permanent radar signs **Figure 1 (appendix)** on streets with different speed, volume, and land use characteristics. The purpose of this analysis is to determine the effectiveness of these signs and help City Officials develop policies on the future application of permanent radar signs.

Current Applications

The locations of the 6 permanent radar signs are shown in **Figure 2** and their applications are described below. These radar signs are not regulatory signs – they serve as reminders for motorists and, as such, they supplement the existing, standard regulatory speed limit signing. Each of the signs is set to show a maximum speed of 10 mph over the speed limit – above that limit, the signs flash the message, "slow down". The exception is in school zones where the "slow down" message flashes at 4 mph over the 20 mph speed limit. The strobe light capability of these signs is turned off. If it were activated, the strobe light would flash when a motorist exceed a specified speed. All 6 signs are VCalm from Fortel Traffic, Inc (www.forteltraffic.com).

School Zone Protection

1. NE 68th Street at Lakeview Elementary School. This sign became operational in October 2004). The sign reminds motorists in the westbound direction of their speed as they approach the school zone. NE 68th Street is a minor arterial that steps down from 30 mph to 25 mph on the approach to the school. This street connects to I-405 and it carries 11,700 vehicles per day, 5,500 in the westbound direction. The sign reads, "speed limit 20 mph" and "your speed is" for the ½ hour in the morning when children are coming to school and for the ½ hour after school lets out. Otherwise, the sign reads, "speed limit 25 mph" and "your speed is". Crossing guards were present during the 20 mph periods before the sign was installed and they continue their service with the sign in place. The land use is commercial and residential. Police enforcement of speeds is a priority for elementary school zones.
2. 6th Street in the 1100 block south of Peter Kirk Elementary School. This sign became operational in October 2004 and it reminds motorists in the northbound direction of their speed as they approach the school zone. 6th Street is a collector street carrying 4,500 vehicles per day, 2,570 in the northbound direction. This street connects with Central Way, a Principal Arterial that serves Kirkland's central business district. The sign reads, "speed limit 20 mph" and "your speed is" for the ½ hour in the morning when children are coming to school and for the ½ hour after school lets

out. Otherwise, the sign reads, “speed limit 25 mph” and “your speed is”. Crossing guards were present during the 20 mph periods before the sign was installed and they continue their service with the sign in place. The land use is single family residential. Police enforcement of speeds is a priority for elementary schools. Various traffic-calming measures on 6th Street also help moderate traffic speeds. These calming devices were in place before the radar sign was installed and they remain in place with the radar signs. The calming devices are curb bulbs to narrow the street in the 1100 block (the radar sign is placed in the south end of one of these bulbs), a traffic circle at 9th Avenue, and a median island and curb bulbs at 7th Avenue.

Neighborhood Traffic Calming

3. 9001 - 112th Ave NE. This sign became operational in October 2005. It is on a collector street in the Highlands neighborhood that carries 2,300 vehicles per day, 1100 northbound and 1200 southbound. This sign reminds motorists in the southbound direction as they depart the neighborhood. This sign is paired with another radar sign 3 blocks farther north that reminds northbound motorists of their speed. The sign reads, “speed limit 25 mph” and “your speed is”. Two of the three speed cushions on this street are within the influence area of the radar signs. These cushions were in place before the radar signs were installed. The land use is single family residential.
4. 9222 – 112th Ave NE. This sign became operational in October 2005. It is on a collector street in the Highlands neighborhood. This sign reminds motorists in the northbound direction as they enter the neighborhood. This sign is paired with another radar sign 3 blocks farther south that reminds southbound motorists of their speed. The sign reads, “speed limit 25 mph” and “your speed is”. Three speed cushions help calm traffic on this street. These cushions were in place before the radar signs were installed. The land use is single family residential.

Principal Arterial

5. 5300 block of Lake Washington Boulevard. This sign became operational in November 2005. It is on a Principal Arterial that has a 35 mph speed limit and carries 24,000 vehicles per day. This sign reminds southbound motorists of their speed and is paired with a sign in the 4500 block that reminds northbound motorists of their speed. The sign reads, “speed limit 35 mph” and “your speed is”. This stretch of Lake Washington Boulevard is a major pedestrian corridor. The dominant land use is multi family residential.

6. 4500 block of Lake Washington Boulevard. This sign became operational in November 2005. It is on a Principal Arterial that has a 35 mph speed limit and carries 24,000 vehicles per day. This sign reminds northbound motorists of their speed and it is paired with a sign in the 5300 block that

reminds southbound motorists of their speed. The sign reads, “speed limit 35 mph and “your speed is”.

Analysis Methodology/Overview

85th Percentile Speed The traditional method of determining whether or not a speeding problem exists is to examine the 85th percentile speed. This is the speed at, or below which, 85% of the motorists are traveling. Ideally, this speed should match the posted speed limit. While this ideal is rarely the case, Kirkland considers a speed of 5 mph over the 85th percentile speed as the threshold of a speeding problem. This “at least 5 mph over” threshold is one criterion for considering the use of neighborhood traffic calming strategies like speed cushions or traffic circles on non-arterial streets. For this analysis of permanent radar signs, the 85th percentile is used to compare before and after traffic speeds.

Accumulative Frequency Speed Curves These are graphs that plot the percentage of motorists driving at various speeds. Graphs showing before and after distributions can show the speed ranges most influenced by the traffic control measure – radar signs in this study.

Number of Vehicles at Higher Speeds This is a variation of the Accumulative Frequency Speed Curve, but the focus is on the higher end of the speed curve. The number of vehicles traveling 10 mph or more over the speed limit is compared. It is these high-speed vehicles that are the greatest concern for pedestrians, bicyclists, other motorists, police, and traffic operations staff.

Analysis

1. **NE 68th Street at Lakeview Elementary School**
    - **a.** The 85th percentile speed for a 24-hour weekday showed a reduction of 0.6 mph in the westbound direction after the radar sign was installed. The shift to a lower speed is good, but the magnitude of the shift does not show such a significant shift that a concerned person would intuitively agree that the problem had been solved.
        - 85th percentile all day
            - Before : 34.0 mph
            - After : 33.4 mph
            - Change: -0.6 mph (-2%)
    - **b.** However, by isolating the time period when the 20 mph School Zone Speed Limit was in effect, the 85th percentile shows a more dramatic shift to slower speeds:
        - 85th percentile during the 20 mph school zone period
            - Before : 33.1 mph
            - After : 27.9 mph
            - Change: - 5.2 mph (- 16%)
    - **c.** Cumulative Speed Frequency during the 20 mph time periods (**Figure 3**) This graph shows a dramatic shift to slower speeds during the 20 mph period. For example, follow the 25 mph column up on the graph and find that before the radar sign became operational, about 12% of the motorists were driving at or below 25 mph. After the sign was turned on, about 68% of the motorists were driving at or below 25 mph.
    - **d.** # Vehicles 10 mph or more over the 20 mph speed limit. This measure of the higher-speed vehicles also shows a significant improvement.
        - Before: 141 vehicles per hour (vph)
        - After: 15 vph
        - Change - 126 vph (-89%)
    - **e.** During the Normal 25 mph speed limit. A Wednesday before and after the radar sign became operational was used as a 'typical day'.
        - 85th percentile
            - Before: 32.9 mph
            - After: 32.5 mph
            - Change: - 0.4 mph (-1%)
        - Cumulative Speed Frequency **(Figure 4)** This graph shows a very slight shift to slower speeds at the mid to upper speed ranges. For example, at 30 mph, about 56% of the motorists were traveling at or below that speed before the radar sign became operational. Afterward, about 61% were traveling at or below 30 mph.

- # Vehicles 10 mph or more over the 25 mph speed limit. Using the raw data, 6.7% (314 vpd) of the "before" motorists were driving 10 mph or more over the 25 mph speed limit. 4.9% were doing so after the radar was installed. To convert this to actual numbers of vehicles, the after count of 257 vpd needed to be adjusted downward to account for the higher daily volume.
    - Before: 314 vpd
    - After : 229 vpd (adjusted down for vol diff)
    - Change: - 85 vpd (-27%)

2. 6th Street at Peter Kirk Elementary School

a. Overall, the northbound 85th percentile speed dropped by 1.3 mph. This is a "fair" decrease, but would not likely be interpreted as dramatic.

- 85th percentile
    - Before: 29.5 mph
    - After: 28.2 mph
    - Change: -1.3 mph (-4%)
- 85th percentile with the 20 mph speed period isolated.
    - Before: 28.6 mph
    - After: 22.1 mph
    - Change: - 6.5 mph (-23%)
- Cumulative Speed Frequency for the 20 mph periods (**Figure 5**) This graph shows a dramatic improvement in compliance to the 20 mph speed limit. For example, 47% of the motorists were driving at or below 25mph before the radar was turned on and 97% were doing so after the radar sign.
- # Vehicles 10 mph or more over the 20 mph speed limit
    - Before: 11.4%
    - After: 0.5 %
    - Change: -10.9% (96% improvement)

b. During the Normal 25 mph speed limit (20 mph speeds removed)

- The 85th percentile (note: Thursday used as a typical day)
    - Before: 28.7 mph
    - After: 27.1
    - Change: - 1.6 mph
- Cumulative Speed Frequency for the 25 mph periods **(Figure 6)** This graph shows a definite shift to greater compliance to the speed limit. For example, at the 30 mph range, 87% were driving at or below that speed before the radar sign was operational. Then, afterward, 95% were. A good condition got even better.

- # Vehicles 10 mph or more over the 25 mph speed limit
    - Before: 0 – 1%. The graph shows virtually no motorists were driving more than 10 mph over the speed limit. Calculations showed 1% .
    - After 0%
    - Change 0 to -1%

3. **112th Ave NE: Highlands Neighborhood Traffic Calming**
    - **a.** Traffic speeds at various distances from the radar signs **(Figure 7)**. These tables show:
        - A decrease in speeds within 200 feet on the approach to the radar signs;
        - A general decrease in speeds on the northbound entry to the neighborhood; and
        - No success in reducing speeds in the southbound exit from the neighborhood except when close to the radar sign.
    - **b.** Combined northbound and southbound approach to the two signs within 200 feet of the signs. Northbound at 140 feet on the approach to the sign and southbound 190 feet on the approach to the sign.
        - 85th percentile
            - Before: 31.8 mph
            - After: 30.8 mph
            - Change: - 1.0 mph (-3%)
        - Cumulative Speed Frequency **(Figure 8)**. This graph shows a general reduction in speeds over the range of speeds. For example, at 30 mph, 76% of the motorists were traveling at or below that speed before the radar sign was operational. Afterwards, 82% were driving at or below that speed.
        - # Vehicles 10 mph or more over the 25 mph speed limit. 3% of the motorists were driving 35 mph or more before the radar signs were activated and 1% were doing so afterward.
        - Locations more remote from the Radar Signs.

4. **Lake Washington Boulevard: Principal Arterial, Major Pedestrian Route.** (Before data: Nov 2005; Radar turn-on: Nov 2005; After data Jan 2006). The three different ways of comparing the 'before and after' speeds at varying distances from the radar signs on this major arterial all showed slower speeds. The 85th percentile speed showed a zero to 2 mph drop in speeds. While these were not impressive numbers, the 'cumulative frequency' chart showed a general shift to lower speeds throughout the speed profile. A look at the number of vehicles being driven at 45 mph or more (10 mph or more over the speed limit) showed a range of 77 to 178 fewer high speed vehicles per day driving the route. Of course on a route carrying 24,000 vehicles per day, this amounts to less than 1%. However, it is the higher speed traffic that causes the most concern.

a. 320 feet in advance of the radar signs

	Northbound	Southbound
85th percentile		
Before:	39 mph	38 mph
After:	38	36
Change:	- 1 mph	- 2 mph

- Cumulative Speed Frequency (northbound and southbound combined) **Figure 9** shows a general shift to lower speeds throughout the speed range. For example, looking at 35 mph (the speed limit), before the radar signs were installed, about 55% of the motorists were driving at or below the speed limit. Then, after the signs were turned on, 70% of the motorists were driving at or below 35 mph. The graph is hard to read at the very high and very low speeds. That is where the next measure, the number of vehicles being driven 10 mph or more over the speed limit, helps with the interpretation.
- # Vehicles 10 mph or more over the 35 mph speed limit. (also see **Figure13**)
  - Before (7day total) : 1943 vehicles > 45 mph
  - After (7 day total) : 699
  - Change (7 day total) : -1244 (-64%)
  - Change (ave. per day): - 178 vehicles per day > 45

b. 250 feet after the radar signs

	Northbound	Southbound
85th percentile		
Before:	38 mph	37 mph
After:	38	36
Change	0 mph	- 1 mph

- Cumulative Speed Frequency (northbound and southbound combined) **Figure 10** shows a general shift to lower speeds throughout the speed range. Again, looking at the 35 mph example (the speed limit), before the radar signs were installed, about 60% of the motorists were driving at or below the speed limit. Then, after the signs were turned on, 70% of the motorists were driving at or below 35 mph. The graph is hard to read at the very high and very low speeds. Again, refer to **Figure 13**, which shows the number of vehicles being driven 10 mph or more over the speed limit.
- # Vehicles 10 mph or more over the 35 mph speed limit.
  - Before (7 day total) : 1787 vehicles > 45 mph
  - After (7 day total) : 686
  - Change (7 day total) :-1101 (-62%)
  - Change (ave. per day): -157 vehicles per day > 45 mph

c. 1300 feet after the radar signs

	Northbound	Southbound
85th percentile		
Before:	38 mph	38 mph
After:	37	38
Change	- 1 mph	0 mph

- Cumulative Speed Frequency (northbound and southbound combined) **Figure 11** again shows a general shift to lower speeds throughout the speed range. However, the shift at 1300 feet (1/4 mile) following the radar sign, the shift is noticeably less than it was closer to the sign. Again, looking at the 35-mph example, before the radar signs were installed, about 55% of the motorists were driving at or below the speed limit. Then, after the signs were turned on, 62% of the motorists were driving at or below 35 mph. This was a gain of about 7%. The graph is hard to read at the very high and very low speeds. Again, refer to **Figure 13** for the 'high end' details.
- # Vehicles 10 mph or more over the 35 mph speed limit.
  - Before (7 day total) : 1184 vehicles > 45 mph
  - After (7 day total) : 646
  - Change (7 day total) : - 538 (- 45%)
  - Change (ave. per day): - 77 vehicles per day >45 mph

d. 1865 feet after the radar signs

	Northbound	Southbound
85th percentile		
Before:	38 mph	38 mph
After:	37	38
Change	- 1 mph	0 mph

- Cumulative Speed Frequency (northbound and southbound combined) **Figure 12** once again shows a general shift to lower speeds throughout the speed range. However, the shift at 1865 feet (0.35 mile) following the radar sign, the shift is noticeably less than it was closer to the sign. Again, using the 35-mph example, about 54% of the motorists were driving at or below the speed limit before the signs were installed. Then, after the signs were turned on, about 60% of the motorists were driving at or below 35 mph – an improvement of 6%.
- # Vehicles 10 mph or more over the 35 mph speed limit .**Figure 13** shows the change in behavior of the motorists driving at the higher speeds.
  - Before (7 day total) : 1205 vehicles > 45 mph
  - After (7 day total) : 630
  - Change (7 day total) : - 575 (- 48%)
  - Change (ave. per day): - 82 vehicles per day >45 mph

Findings and Conclusions

- The radar signs worked best on a 35 mph, heavily-traveled principal arterial and in the 20 mph time period in school zones. Note that crossing guards were present during these periods and it is assumed that the crossing guards and radar signs helped reinforce good driver behavior.
- The radar signs lowered speeds on lower-volume streets with 25 mph speed limits when motorists were in close proximity to the signs.
- The radar signs didn't work as well on streets with lower volumes and 25 mph speed limits when the motorists were farther from the signs. The exception was when motorists were entering (as opposed to leaving) their own neighborhood. Note that the Highlands neighborhood is an "access peninsula" with one major route in and out: it has no cut-through traffic.

General Discussion of Implications

A test sample of 6 signs is pretty small to draw explicit conclusions, but the information in this analysis can be used for general guidelines for future radar sign installations. Also, if the objective is to slow traffic in school zones only during 20 mph time periods, other less expensive controls such as beacons that flash during the 20 mph time periods may be more cost-effective. It should also be considered that if the need for speed control is on Primary Emergency Response Routes, radar signs may be one of the few options available.

Appendix

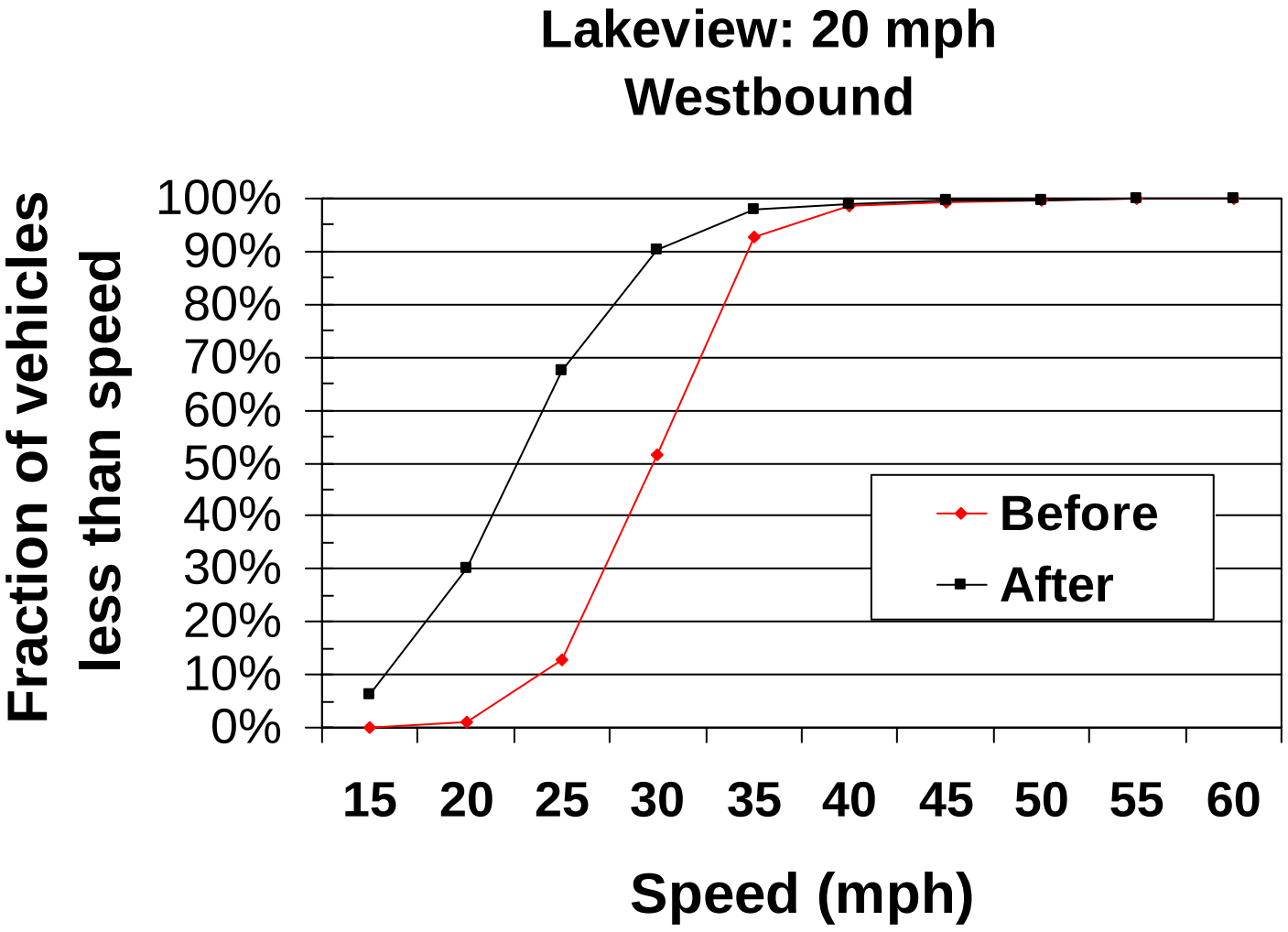
Graphics: Figures 1 –13

Permanent Radar Signs

FIGURE 1

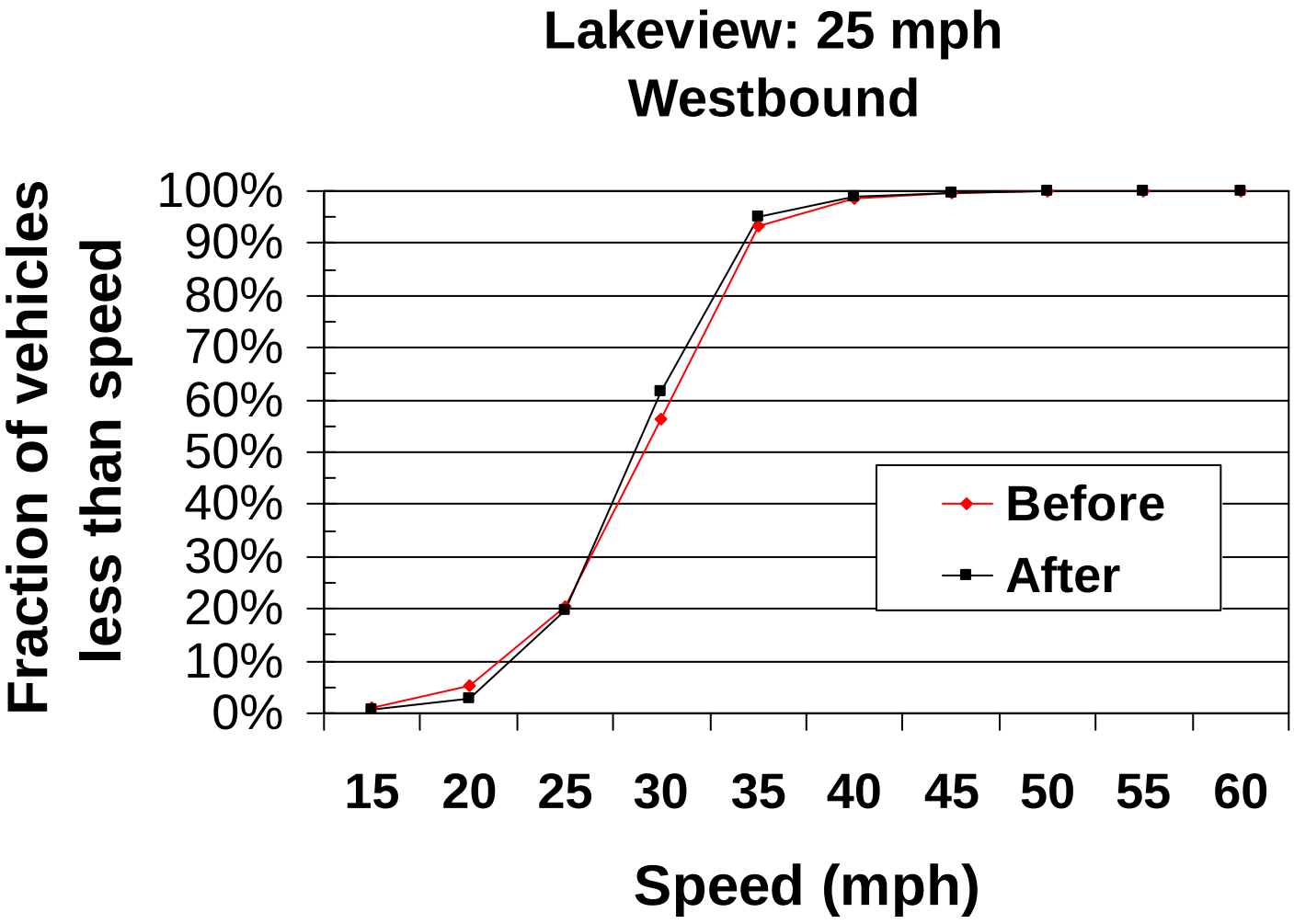
Locations of Permanent Radar Signs in Kirkland
June 2006

FIGURE 2



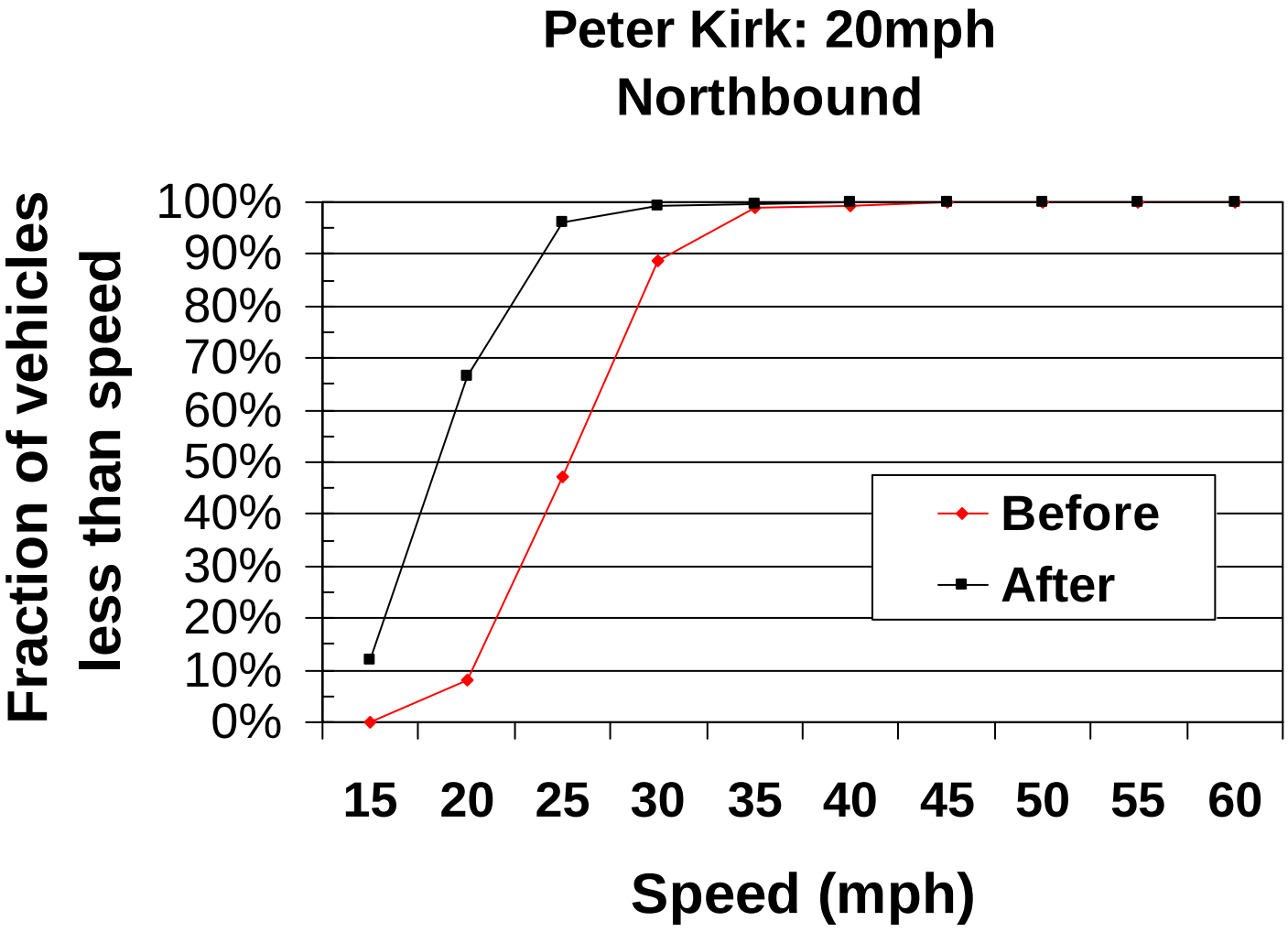
Cumulative Speed Frequency
20 mph Time Periods
NE 68th Street at Lakeview Elementary School

FIGURE 3



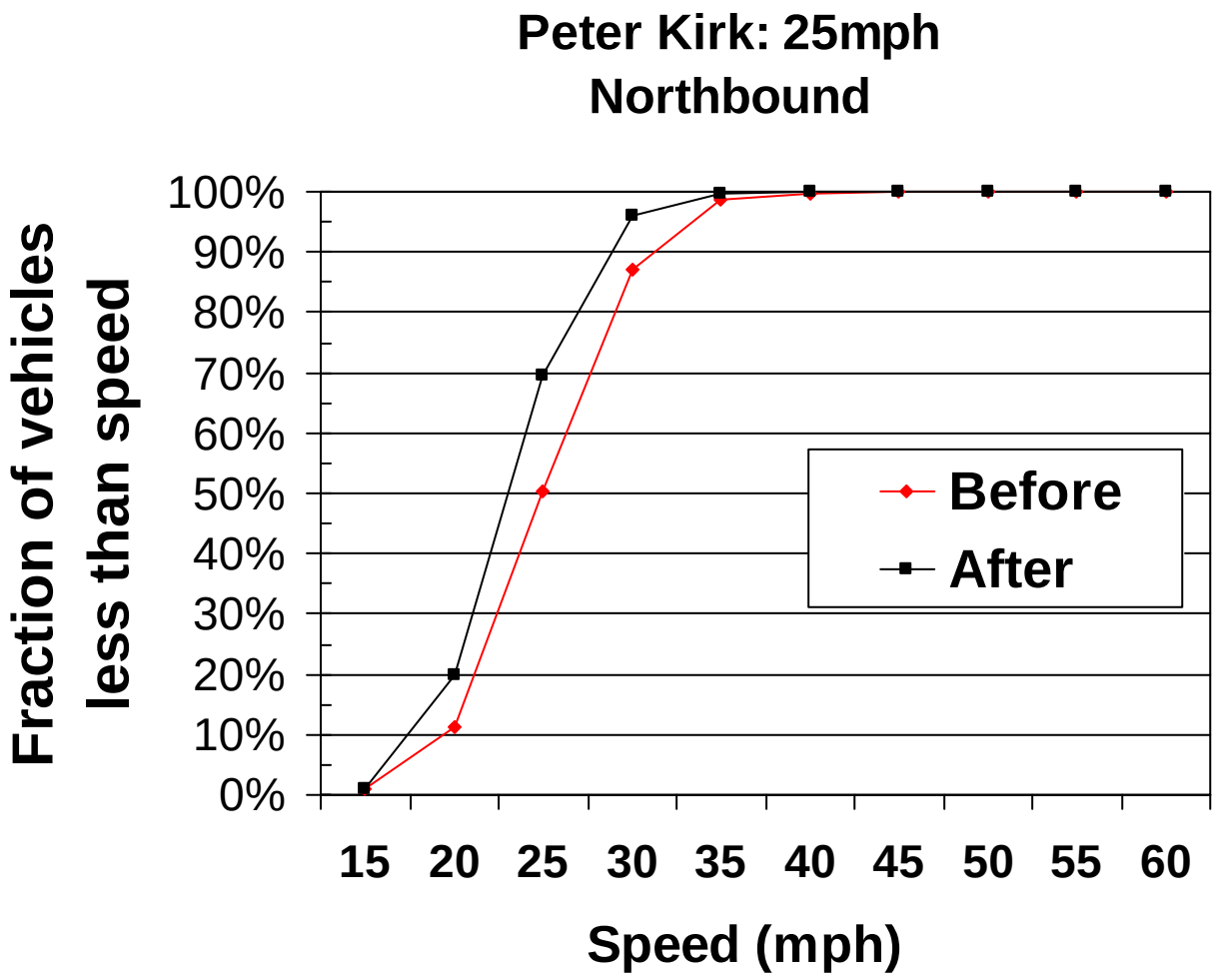
Cumulative Speed Frequency
25 mph Time Periods
NE 68thStreet at Lakeview Elementary School

FIGURE 4



Cumulative Speed Frequency
20 mph Time Periods
6th Street at Peter Kirk Elementary School

FIGURE 5



Cumulative Speed Frequency
25 mph Time Periods
6th Street at Peter Kirk Elementary School

FIGURE 6

Radar Signs on 112th Ave NE: NE 87th – NE 95th Street
Highlands Neighborhood

Radar Operational October 19, 2005
Before Data Collected September 2005
After Data Collected November 2005

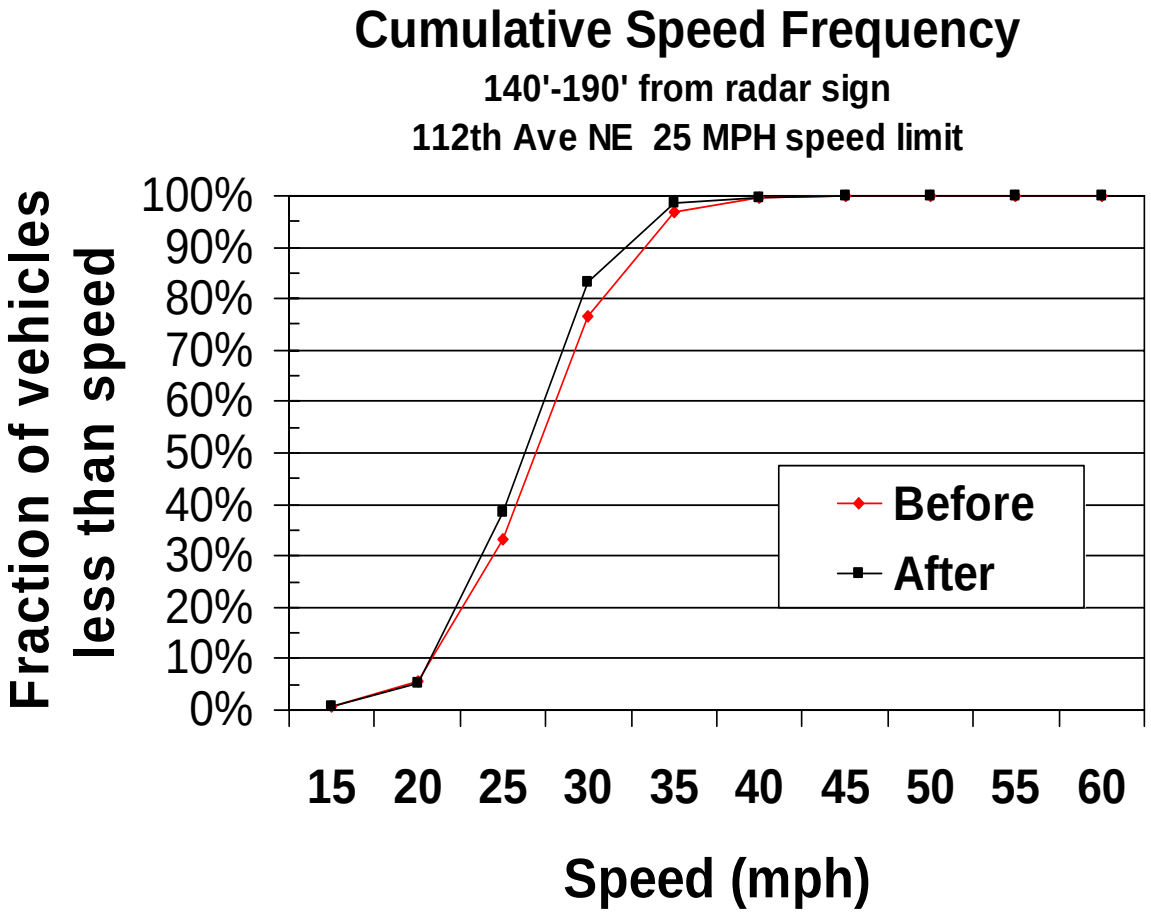
Southbound on 112th Ave NE Departing the Highlands Neighborhood												
	85th Percentile Speed			# Veh > 35 mph			Daily Volume			Adjusted # Veh>35 mph		
Distance	Before	After	Change	Before	After	Change	Before	After	Change	Before	After	Change
1230' *	32.7	33.0	+ 0.3	124	171	+ 47	730	677	- 7%	115	171	+ 56
860' *	32.1	32.2	+ 0.1	147	161	+ 14	822	764	- 7%	137	161	+ 24
190'	33.0	31.8	- 1.2	260	118	- 42	968	925	- 4%	250	118	- 132
300' beyond	29.9	30.8	+ 0.9	66	100	+ 34	1092	1046	- 4%	63	100	+ 37
Notes: * Radar sign not readable at this distance; "beyond" is data recorded after motorists have passed the sign												

Northbound on 112th Ave NE Entering the Highlands Neighborhood												
	85th Percentile Speed			# Veh > 35 mph			Daily Volume			Adjusted # Veh>35 mph		
Distance	Before	After	Change	Before	After	Change	Before	After	Change	Before	After	Change
1300' *	28.9	28.3	- 0.6	24	17	- 7 veh	1012	968	- 4%	23	17	- 6 veh
810'	30.0	29.8	- 0.2	86	81	- 5	944	890	- 6%	81	81	0
140'	30.4	29.3	- 1.1	129	57	- 72	817	742	- 9%	117	57	- 60
230' beyond	32.7	32.1	- 0.6	184	117	- 67	734	662	-10%	166	117	- 49
Notes: * Radar sign not readable at this distance; "beyond" is data recorded after motorists have passed the sign												

Sorted by Distance from Radar Signs			85th Percentile Speed			# Vehicles > 35 mph		
Distance from Radar Sign	Travel Direction	Sign Readable?	Before	After	Change	Before	After	Change
1300'	NB	No	28.9	28.3	-0.6	23	17	-6
1230'	SB	No	32.7	33.0	+0.3	115	171	+56
860'	SB	No	32.1	32.2	+0.1	137	161	+24
810'	NB	Yes	30.0	29.8	-0.2	81	81	0
190'	SB	Yes	33.0	31.8	-1/2	250	118	-132
140'	NB	Yes	30.4	29.3	-1.1	117	57	-60
230' beyond	NB	N/A	32.7	32.1	-0.6	166	117	-49
300' beyond	SB	N/A	29.9	30.8	+0.9	63	100	+37

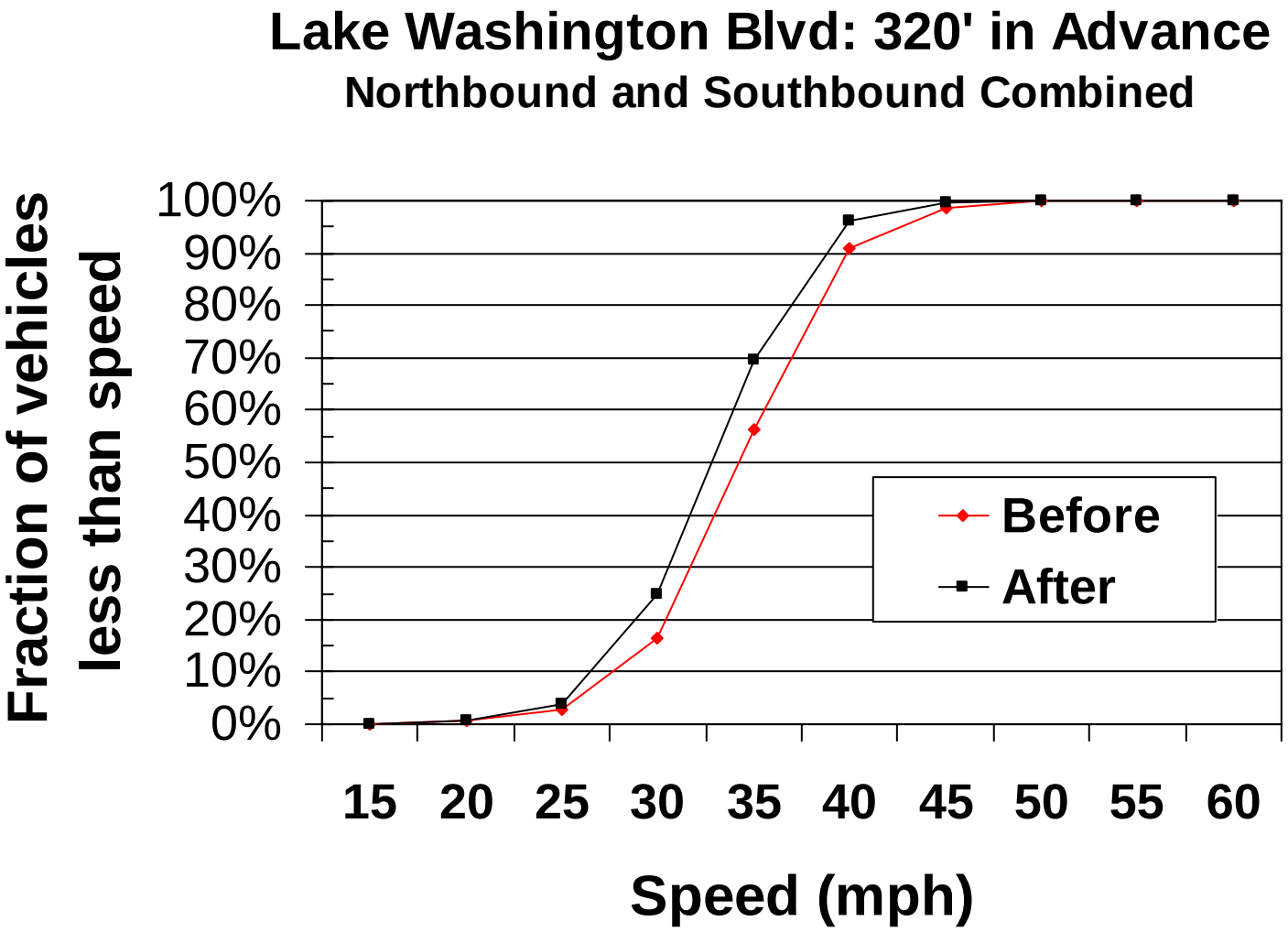
112th Ave NE – Highlands Neighborhood
Speed Changes by Distance from the Radar Signs

Figure 7



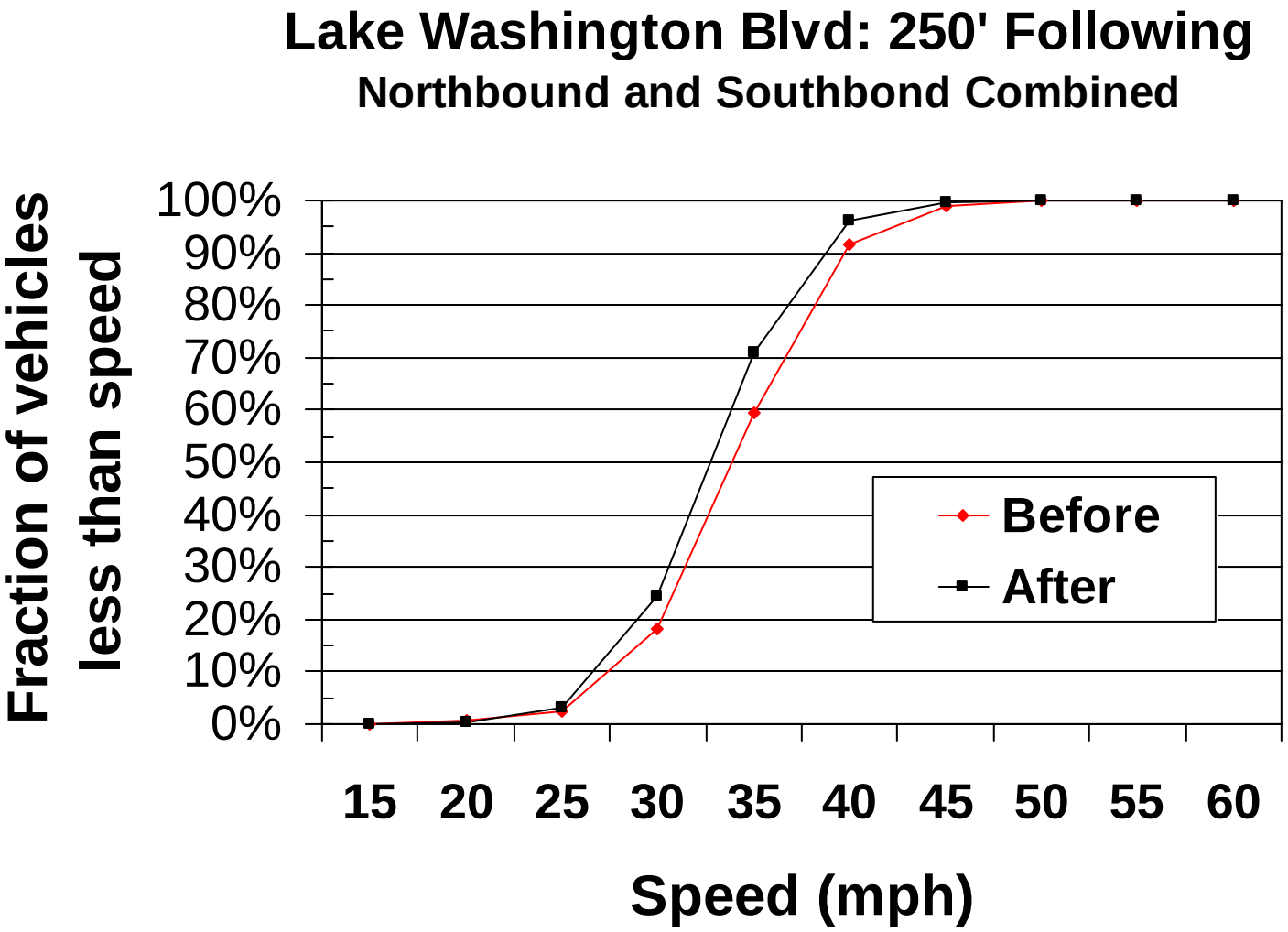
Cumulative Speed Frequency
140 – 190 feet Approaching the Radar Signs
112th Ave NE – Highlands Neighborhood
25 mph Speed Limit

FIGURE 8



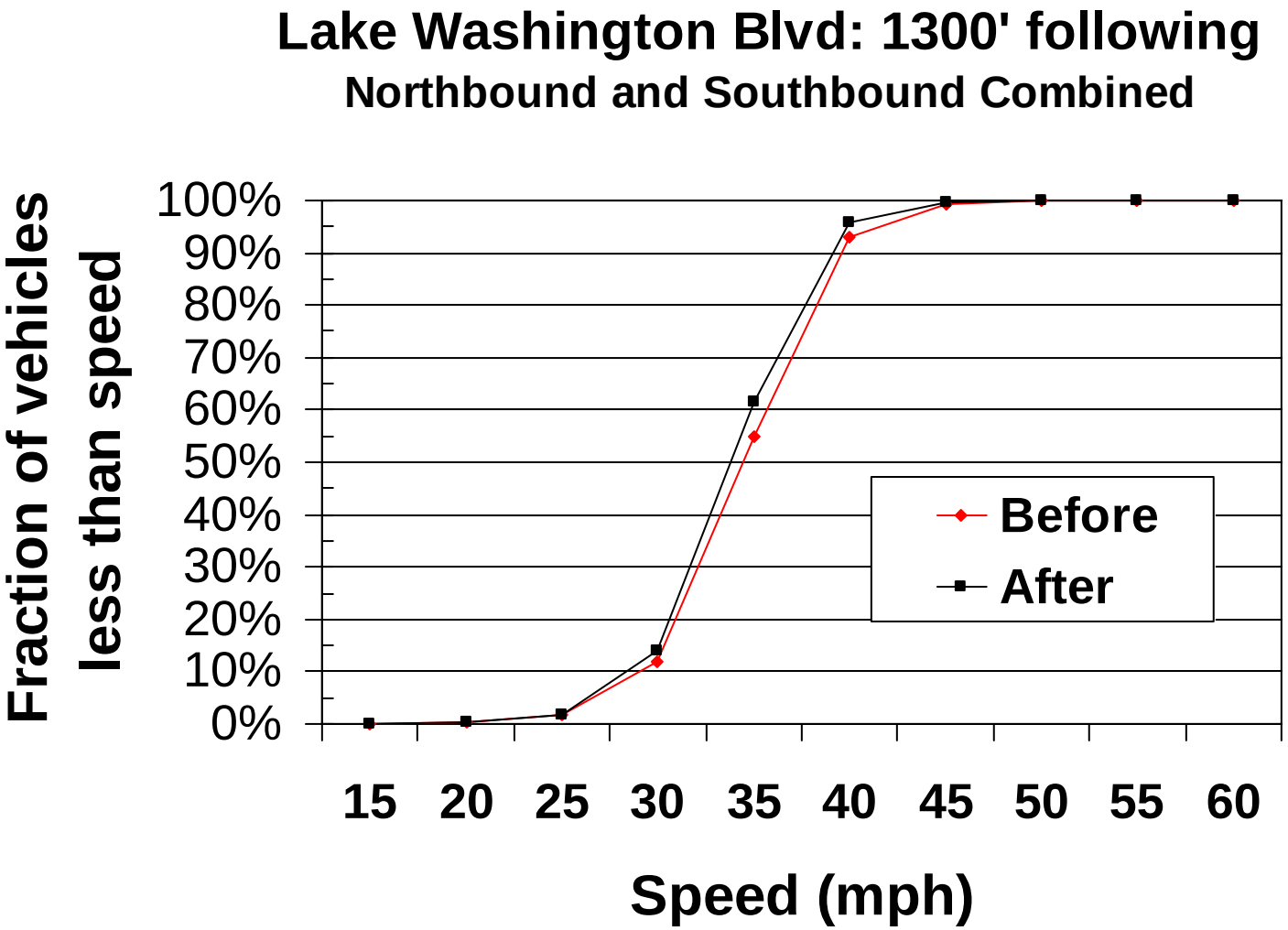
Cumulative Speed Frequency
35 mph Speed Limit
320 Feet in Advance of the Radar Signs on Lake Washington Boulevard

FIGURE 9



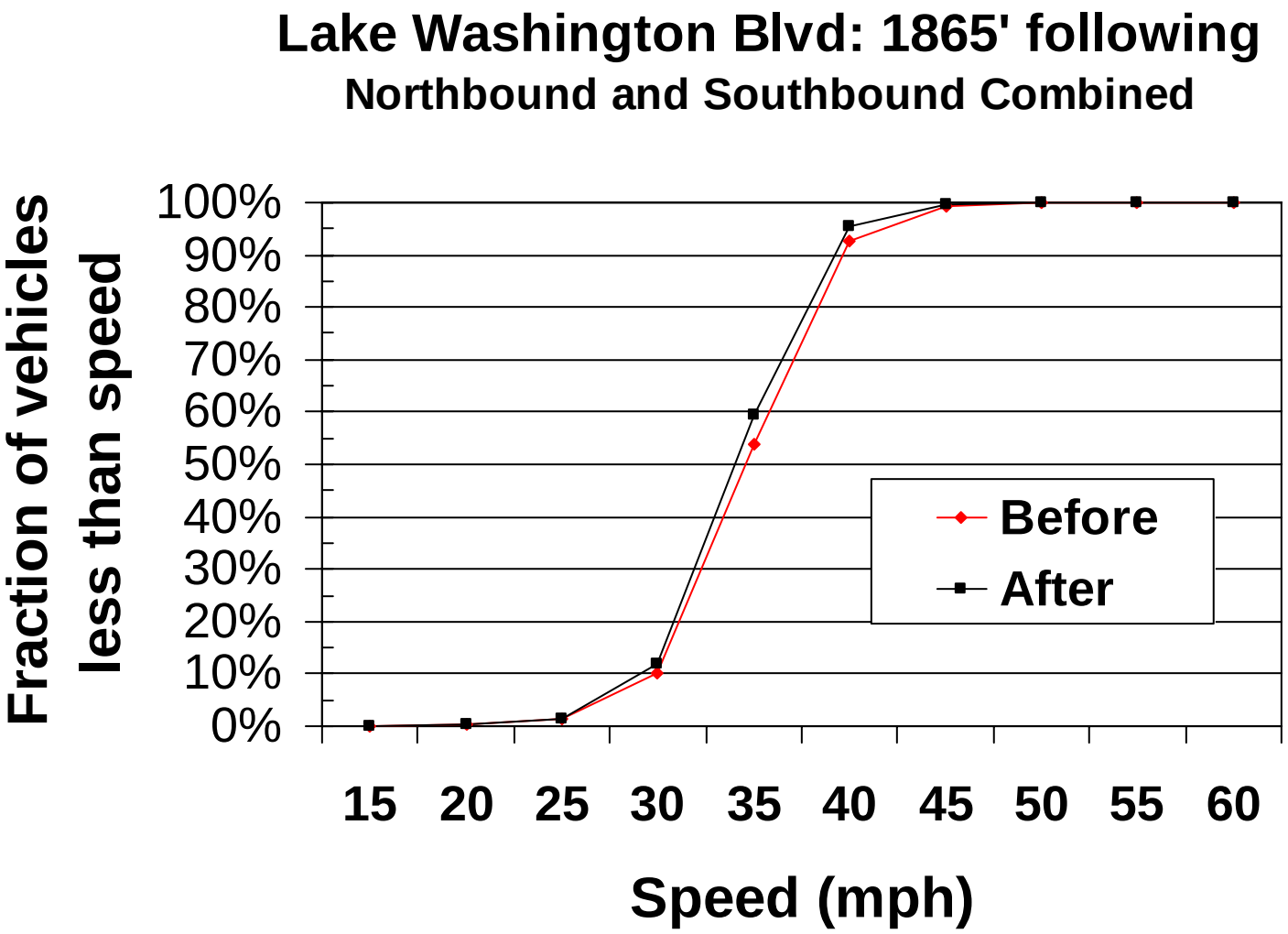
Cumulative Speed Frequency
35 mph Speed Limit
250 Feet After the Radar Signs on Lake Washington Boulevard

FIGURE 10



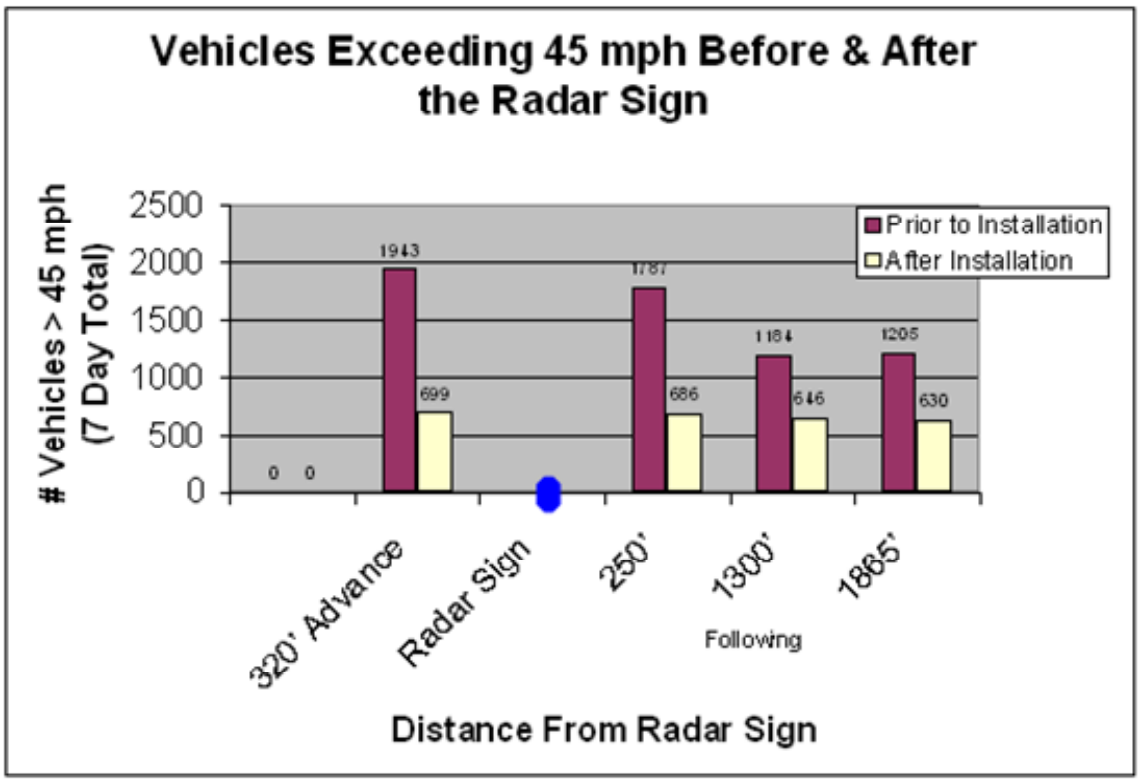
Cumulative Speed Frequency
35 mph Speed Limit
1300 Feet After the Radar Signs on Lake Washington Boulevard

FIGURE 11



Cumulative Speed Frequency
35 mph Speed Limit
1865 Feet After the Radar Signs on Lake Washington Boulevard

FIGURE 12



Number of Vehicles 10 mph or More Over the Speed Limit
35 mph Speed Limit
Various Distances Before and After the Radar Signs
Lake Washington Boulevard

FIGURE 13