Standard Drawing Report

Date: May 1, 2026

Technical Owner: Traffic – Jennifer Ruth Tower, P.E.

Standard Drawing No. P-441 **Calculation Book No.** n/a

Drawing Title: 22’ Asphalt Collector Speed Bump

REGISTERED PROFESSIONAL ENGINEER
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OREGON
JUNE 20, 2010
JENNIFER RUTH TOWER
Expires 6/30/24

Original Report Date: November 8, 2017 (Brett I. Kesterson)

Background Information, Including Reference Material:

Appendix A: Split Speed Bump, Kathy Mulder, PE, 1998

Appendix B: The Influence of Traffic Calming Devices on Fire Vehicle Travel Times, Portland Bureau of Transportation, 1996

Appendix C: A Brief History of the Traffic Calming Program in Portland.

Assumption Made:

The 22’ speed bump with 10’ table is designed to reduce traffic speeds on city streets and assumes that street is designated as a minor emergency response route and as a transit access or lower classification in the City of Portland’s Transportation System Plan.

Design Narrative:

In 1991 the City of Portland embarked on a program to reduce vehicle speeds on certain streets due to vehicle diversion from congested streets. The 22’ bump was developed for traffic on busy streets. Various shapes and lengths were paved on streets. Vehicles were then observed traveling over the bumps.

This bump was based on a Florida speed table that was 22’ long with a 10’ table portion. The 3-inch height was chosen based on a survey of what other jurisdictions were doing at the time. Since then, it is now the recommended height by the Institute of Transportation Engineers. In testing, this bump produced an 85th percentile speed for passenger cars and light vans of between 29 and 34 mph. Collector and arterial streets typically had posted speed limits of 30-35 mph at that time. The City of Portland Attorney advised that any

reduction of speed not be below the posted speed or otherwise the effect of the speed bump would likely not be defensible in court. In recent years the posted speed limits have been lowered on collector streets with many as low as 20-25 mph. A closer recommended speed bump spacing was developed to reduce the 85th percentile speeds accordingly.

City of Portland Fire & Rescue tested the 22' bump and said the maximum comfortable speed for their vehicles over the bump was 25 mph. Subsequent testing found the 22' speed bump could cause up to 9 seconds of delay to a fire truck for each bump constructed. This eventually resulted in the prohibition of speed bumps on designated major or secondary emergency response routes.

While this report deals with the development of the bump itself, it is critical that the engineer takes care in the placement of the bumps along the roadway to avoid creating other problems and to achieve the target speed reduction. Reference the Portland Bureau of Transportation's Traffic Design Manual, Volume 1 (TDM) for general guidelines on the design and placement of speed bumps.

For the September 2022 update, the following revisions were made:

1) Notes 1 and 2 were revised to allow permanent pavement markings to be installed separately after bump installation.
2) Notes 1 and 2 were revised to require testing for markings that are installed concurrently with bump installation.

For the February 2026 update, the following revisions were made:

1) Changed title to "22' ASPHALT COLLECTOR SPEED BUMP" to conform with current TDM guidance that they not be used on higher TSP classifications than Collectors.
2) Note 1 was revised to allow permanent pavement markings to be installed on either fresh or cured asphalt in accordance with manufacturer's recommendations.
3) Note 2 was revised to remove the testing requirement.
4) Note 2 was revised to include only information on required pavement markings and signing associated with the bumps.
5) Added clarifier that SB pavement marking should be centered in the travel lane.
6) Updated drafting of standard drawing to current PBOT CAD standards.

Appendix A

Split Speed Bump

Kathy Mulder, PE, City of Portland, Oregon, Traffic Calming Program*

January, 1998

Introduction
History/Problem
Test and Test Plan
Conclusions and Recommendations

Introduction

Speed bumps have been found to be very effective at slowing traffic on residential streets throughout the City of Portland. City residents have embraced these devices as a means to slow traffic and enhance their livability.

The speed bump programs began in 1992 after several months of test and evaluation with two bump designs. The 14 foot speed bumps, only used on Local Service Streets (the lowest classification of streets in the City), slow passenger cars and light vans so that the 85th percentile speed along the street is between 24 and 28 mph. The 22 foot speed bumps allow an 85th percentile speed of 29 to 34 mph.

The Fire Bureau expressed concern that the 22' speed bumps are slowing their trucks and engines causing a negative impact on the Fire Bureau's 4 minute "fire response time"goal. In a series of several speed bumps on primary fire response routes, valuable time is lost, endangering public safety. We needed to develop a solution that would address both aspects of public safety, rapid response by Emergency Services and traffic calming for residential streets.

History/Problem

In 1991 the City of Portland Bureau of Traffic Management undertook a study of speed bumps (humps) in response to public demands for some respite from the excessive and continual increase of traffic speeds. As the result of two years of testing, speed bumps became a standard 'tool' for addressing the problem of speeding on Portland's residential streets. In Phase III of the original 1992 speed bump tests, the " Fire Bureau indicated a maximum comfortable speed of 20 mph for the 14'...speed bump and 25 mph for the 22'...speed bump"**.**

The 14' speed bump was adopted for local service streets that do not have transit or are not a primary fire response route. The 22' speed bump is designed for streets with high volumes of traffic, and those that are transit or primary fire response routes.
The Traffic Calming Program has been installing speed bumps since 1992, and in the fiscal year 1995-96, installed more than 100 new speed bumps. With so many bumps installed, and hundred's of streets on waiting lists, the Fire Bureau and the Bureau of Traffic Management became concerned about a "cumulative effect", or how several speed bump streets along any emergency route may impact the response time.

The goal of the Portland Bureau of Fire and Emergency Services is a response time of 4 minutes or less on 90% of emergency calls. A study was undertaken to quantify the effects of speed bumps on emergency vehicles. Measurements found that the amount of the time increase was dependent upon the type of vehicle and the type of traffic calming. Rescue vehicles were not slowed at all over the 22' bumps, while trucks and engines were slowed as much as 9 seconds per bump.

It was decided that an "emergency response route" street classifications would need to be developed, similar to the City's existing traffic street classifications[2], before any more traffic slowing devices could be placed on emergency response routes. This process of developing an emergency response route street classification and policies is a long and detailed task that can take several years to complete. All projects planned for streets currently used as primary routes by the Fire Bureau were put on hold until the classification process was completed.

In the meantime, excessive vehicle speeds continue to threaten public safety and neighborhood livability, and a great number of speeding problems are found on streets that also serve as primary response routes. The Traffic Calming Program needed a device that would both accommodate the Fire Bureau vehicles, and still slow speeding motorists.

Test and Test Plan

Since fire and emergency vehicles are allowed, by law, to use any portion of the street they need when on an emergency response run, we began with the concept of a chicane using two halves of a 22' speed bump separated by enough distance so that the emergency vehicle with the least amount of maneuverability could go through the chicane at approximately 20 mph.

Phase I

A Traffic Calming engineer and a Fire Bureau battalion chief used cones to build a simulation of the test device at the Fire Bureau Training Center. The vehicle selected by the Fire Bureau for testing was the vehicle with the least amount of maneuverability. The truck was 39 feet long, 8 feet, 4 inches wide, with a wheelbase of 18 feet, 6 inches. The street width used was 40'.

RESULTS OF PHASE I

In August of 1996, trial runs were conducted in the Fire Bureau Training Center lot, in a wide area of asphalt. A street segment and speed bump halves were outlined with cones, and runs were made through the split bump halves. After several runs, it was decided that the distance between the two lane bump halves needed to be at least 28 feet for the vehicle to maneuver through at or near 20 mph. Preliminary drawings of the new device were made and a field test was planned.

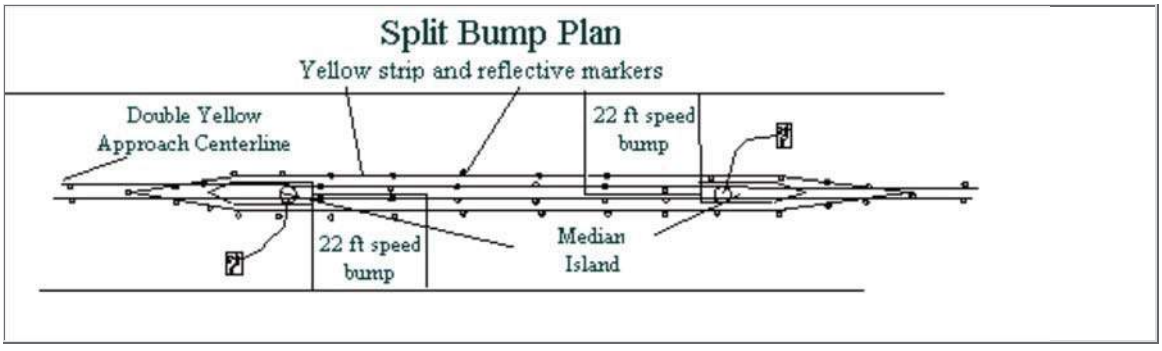
Phase II

Part 1 An actual street test location was selected that was part of an existing traffic calming project: SE Market Street between SE 117th and SE 112th Avenues. This street is 42 feet wide, has no horizontal curves, and the visibility along the street is excellent. This segment of SE Market is defined by a signal at SE 112th and an all-way stop at SE 117th.

Photos

The nearby fire station was notified and asked to make a few practice runs through the off-set speed bump and offer any suggestions they felt were appropriate.

The device was placed approximately 200 feet west of the all-way stop. The first part of the testing was for safety. Concerns of whether automobile drivers would violate the device and chicane between the bumps were raised. Twenty-four hour time lapse video equipment was placed to record driving patterns over the bump.



Part 2 This part of the initial testing was to determine if, and how fast fire vehicles were able to drive around the two bump halves. The largest Fire Bureau vehicles from from the nearby station was used for the short test.

Part 3 The final part of Phase II was to place another split speed bump device approximately 600 feet west of the original device to determine the effect on speeds the two devices have in combination.

Total slowing effect on fire vehicles was tested. This was a controlled test that matched the original test that determined the time lost by speed bumps on fire vehicle response times.

RESULTS OF PHASE II

The 24 hour time-lapse video showed that drivers did not swerve into the oncoming lane to avoid the speed bump half in their lane. The temporary concrete medians and signs placed in advance of each bump half seemed to keep drivers in their own lane and over the speed bump. Dense centerline striping and raised reflective pavement markings gave an illusion that a median continued the entire distance between the bump halves. Subsequent 24 hour time-lapse video showed no indication of confusion on the part of the drivers, nor any violations of drivers trying to avoid the device at any time.

The results of the Fire Bureau vehicle testing were favorable. The vehicles were able to travel through the "chicane" at 17 to 21 mph. They indicated that the speed was quite satisfactory, and that this maneuver is no different than weaving around cars.

Concern was raised that a car may stop in the middle of the gap between bumps while the emergency vehicle approaches. There was fear that this device might prevent drivers from pulling off to the right when the emergency vehicles are running. Parking removal would alleviate this problem by providing an available refuge for cars pulling off to the right. If a car does stop in the middle of the device and blocks the fire vehicle pathway, the Fire Bureau decided that they would just go over the 22' bump. An occasional 22' speed bump does not create serious delay problems for them.

It was determined that parking removal would be necessary for the Fire Bureau to perform the chicane maneuver. Parking was removed on both sides of Market Street opposite each bump half.

Since it was found that the general public is willing to stay to the right of the centerline, two adjustments were considered to the companion device to be installed approximately 600' from the first device.

- The first adjustment was to make the approach islands shorter. It appeared that the "Keep Right" sign was enough to win driver compliance, and that the 20' island could be made smaller, just enough to place the sign.
- The second adjustment was to widen the gap between the two bump halves. This was done to explore how far apart the two bump halves can be and still maintain driver compliance on a straight stretch of street.

With the second device in place (installed 4/11/97) the street was measured for overall slowing effect. The effect on the 85th percentile speed was impressive. While control locations along Market Street (106th, 110th, 122nd) had no change in their 85th percentile speeds, the 85th percentile speed at the location between the two off-set bumps (114th) dropped from 37 mph to 26 mph.

85th Percentile Speed Changes on SE Market Street

Market St. Location	**85th %ile Before Test (mph)**	**85th %ile with One Split Bump in Place**	**85th %ile with Two Split Bumps in Place**
East of 106th Ave	40	36	37
West of 114th Ave*	37	35	26
West of 122nd Ave	34	33	34

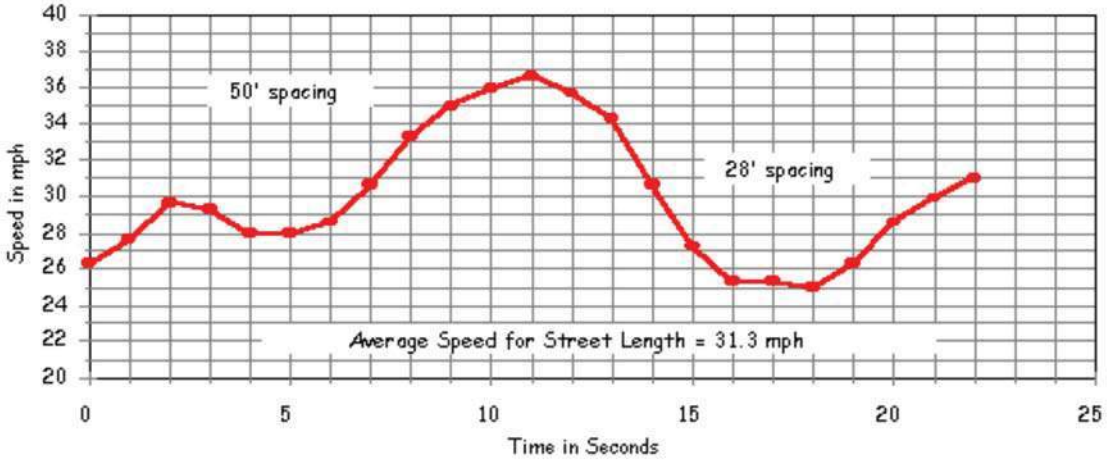
Table 1 * Between the two bump locations

Emergency vehicles ran timed tests through both of the new split bumps to determine the time lost by each vehicle. A truck and an engine were supplied for the test. These are the vehicles that had the greatest delay per device during the original testing of the other traffic calming devices.

Both vehicles were able to travel the length of the street at speeds between 29 and 31 mph. The vehicle speeds through the 50 foot off-set spacing were 26 mph to 30 mph. Between the 28 foot off-set spacing, speeds were 20 mph to 26 mph. It was found that the actual time lost was no more than 1 to 2 seconds for the largest of the vehicles.

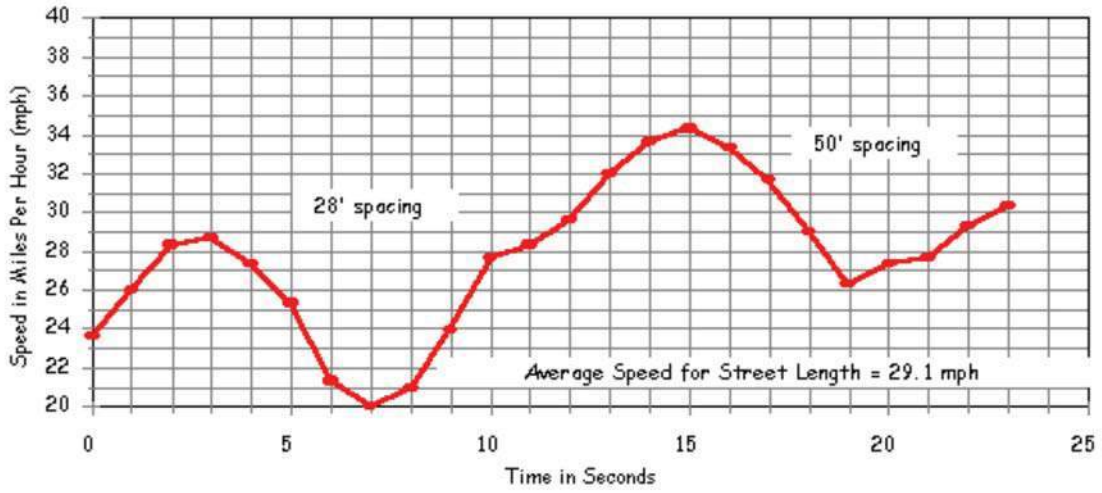
SE Market Speed Bump Test

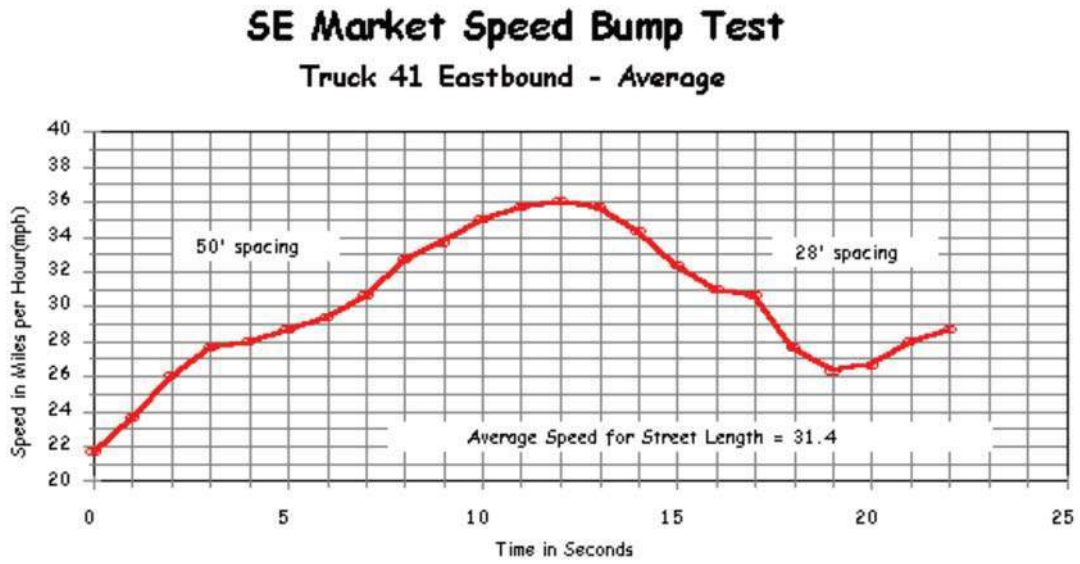
Engine 41 Eastbound - Average

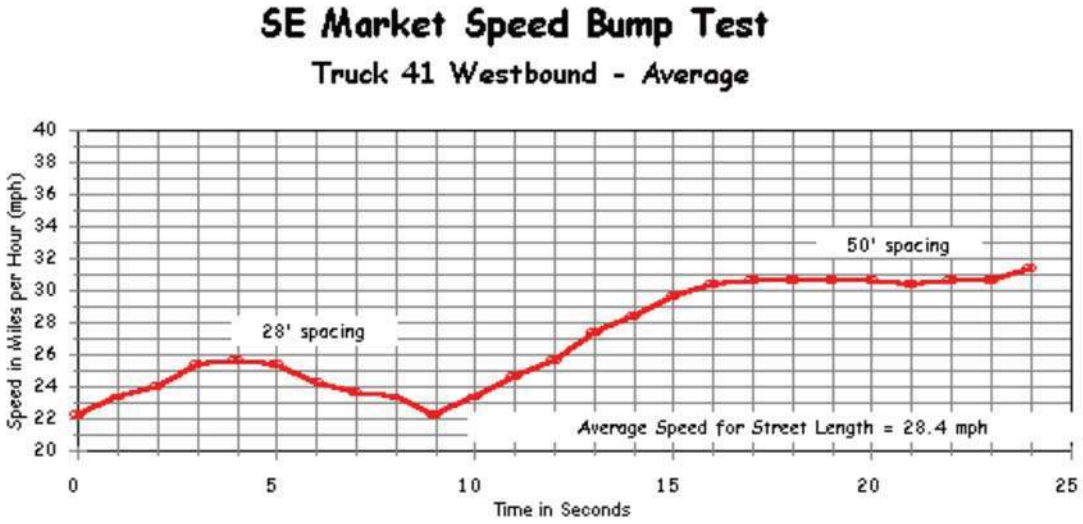


SE Market Speed BumpTest

Engine 41 Westbound - Average







The Fire Bureau is satisfied with the results and have no objections to limited use of this device. They asked that the distance between bump halves be greater than the original 28 feet. 50 feet was set as the standard minimum distance between the bumps. The distance may be extended, however, driver compliance must be maintained. It is hoped that the bump halves will be able to function as individual devices.

In reviewing the data for the test, it was noted that the slowest speeds, and therefore the most time lost, were at the off-set speed bump with the 28' spacing The speed for the off-set speed bump with the 50' spacing never went below 25 mph.

Since the Fire Bureau believes that 25 mph is a reasonable speed for their vehicles on a Local Service street, it was concluded that the split bump, as it was designed with the 50' spacing, would meet their needs.

Based on the results of Phase I and II of the Off-Set Speed Bump Test, a third phase was initiated to determine some of the limitations of this new device.

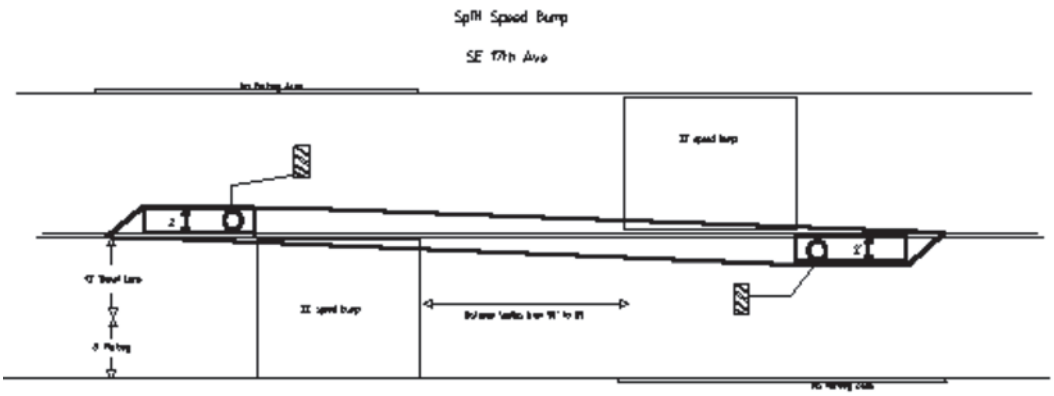
Phase III

The third phase of the testing included the split speed bump in combination with other traffic calming devices, and to test this combination on a street narrower than 42'. The most common street width in the City is 36'. SE 17th

Avenue between SE McLoughlin Blvd and SE Tacoma St. was chosen for this test. It is 36 feet wide, with parking allowed on both sides of the street. 85th percentile speeds along this 11/2 mile section measured from 37 mph to 39 mph. The speed limit is 25 mph.

A Traffic Committee consisting of area residents interested in solving the traffic problems on SE 17th established speed reduction as one of its primary goals. They circulated a petition for a test, and a majority of residents on SE 17th signed the petition.

The design on the split bumps for this narrower street required some lane adjustments to maintain a minimum 10' lane through the device. Because of the width restriction on SE 17th, parking was removed for 30' opposite each of the split bumps. This incorporated both the 22' length of the bump half, and 7 feet for the approach island. These islands were only 2 feet wide, and set in such a way as to maintain the 10' travel lane. The distances between the bumps ranged from 50' to 85'.



Two issues arose. The parking removal, necessary for the Fire Bureau vehicle moves and lane widths for the buses. While the bus system in Portland, Tri-Met, felt that their buses could operate satisfactorily on the 10' lane, the day following the device installations Tri-Met re-routed the bus line on SE 17th west 1 block to SE Milwaukie (a Neighborhood Collector). Tri-Met contended that the parking removal was insufficient for their needs. 10 to 30 feet of additional parking was removed to allow the buses the additional lane width they required.

Tri-Met had additional concerns about the street designs. Their concern was that if a larger vehicle were to park at the edge of the "no parking" areas, that they might not be able to get through the device. This "tight area" was at the concrete median in advance of the bumps.

Tri-Met concluded that a 10' travel lane is not enough for them to maneuver their buses down the City Streets. They require the option of crossing over the yellow centerline in cases where large vehicles were parked along the street. It was decided that the split speed bumps would be removed, and other methods of traffic slowing would be investigated.

Speed and volume data were collected on SE 17th as well as parallel streets (including SE Milwaukie). The results indicated that the 85th percentile speed had dropped 5 to 6 mph on SE 17 with the speed bumps. In addition, speeds were also reduced on SE Milwaukie, most likely due to the increase in volume.

85th Percentile Changes with Split Speed Bump in Place

Street	**Location**	**85th %ile Before**	**85th %ile After**	**Change**
Milwaukie	north end	37 mph	36 mph	-1 mph
	south end	34 mph	28 mph	-6 mph
SE 17th	north end	38 mph	32 mph	-6 mph
	south end	37 mph	32 mph	-5 mph
SE 18th	north end	20 mph	21 mph	1 mph

	south end	26 mph	27 mph	1 mph
SE 19th	north end	27 mph	25 mph	-2 mph
	south end	28 mph	27 mph	-1 mph
SE 20th	north end	22 mph	25 mph	3 mph
	south end	24 mph	24 mph	0
SE 21st	north end	25 mph	25 mph	0
	south end	25 mph	27 mph	2 mph
SE 22nd	north end	28 mph	27 mph	-1 mph
	south end	32 mph	31 mph	-1 mph

Table 2

No violations of the devices were observed. Drivers either slowed, or chose another route for their trips.

A comparison between the total area volumes before and after the split speed bumps were installed revealed an overall net loss of traffic volume at both the north end of the area and a greater volume reduction at the south end of the area. They also reduced the amount of large truck traffic that had used SE 17th as a cut-through to avoid the business areas of NE Milwaukie St.

Volume Change with Split Speed Bumps in Place

x-str	**Milwaukie**	**SE 17th**	**SE 18th**	**SE 19th**	**SE 20th**	**SE 21st**	**SE 22nd**	**Total**
Ellis	1184	-2094	0	18	52	26	62	-752
Rex	1568	-3136	18	-26	-36	-101	-55	-1768

Table 3 all numbers are in vehicles per day (vpd)

Since the split bumps have been removed, residents of SE 17th report that the speeds have increased and large trucks are again using their streets.

Conclusions and Recommendations

The split speed bump was found to effectively slow traffic speeds without delay to emergency vehicles. In both of the tests, speeds were reduced and Fire Bureau quick response time was maintained. The larger distances between each of the bump halves does not seem to influence driver behavior. Especially on high volume streets, drivers showed no tendency to cross over the center line to avoid the bump.

The test on SE 17th showed that the additional parking removal needed for bus operation conflicted with the neighborhoods need for on-street parking. Tri-met tells us that if more parking could have been removed for the bumps, transit buses would have had no difficulty negotiating them on this 36' wide street.

Since parking removal is necessary for these devices to operate well on the street widths tested, they should not be considered for streets where on street parking is important. The advantages of slower vehicle speeds needs to be weighed against the residents needs for on street parking with the final decision to be made by the residents.

*Kathy Mulder, PE, is a senior engineering associate with the City of Portland, OR, Bureau of Transportation System Management, Traffic Calming Program and an Associate Member of ITE.

End Notes:

1. Speed Bump Evaluation Status Report, City of Portland, OR, Bureau of Traffic Management; June 1992.

2. Transportation Element of the Comprehensive Plan, City of Portland, OR Department of Transportation; June 1996.

Appendix B

The Influence of Traffic Calming Devices on Fire Vehicle Travel Times
January 1996

Portland Bureau of Fire, Rescue and Emergency Service	Traffic Calming Section Bureau of Traffic Management
55 SW Ash Street Portland, OR 97204	**Portland Office of Transportation** 1120 SW Fifth Avenue, Room 730 Portland, OR 97204

INTRODUCTION

Traffic calming devices are used on Portland's neighborhood streets when traffic conditions are out of character with their adjacent residential, institutional, and recreational land uses. Calming devices are used to slow vehicle speeds; to encourage the use of more appropriate streets for through trips; and to enhance pedestrian, bicycle, and transit safety. The devices have proven to be effective without significantly impacting convenience, mobility, and travel time for drivers. At the same time certain devices affect the speed of various fire vehicles and may increase overall response times.

During the Fall of 1995 the City's Fire Bureau and Bureau of Traffic Management conducted a thorough data collection effort to help quantify the relationship between three types of traffic calming devices and fire vehicle travel times. Different types of fire vehicles were driven on streets calmed with traffic circles, 22-foot speed bumps, and 14-foot speed bumps. Figures 1, 2, and 3 illustrate the three devices. Table 1 lists basic information about the types of fire vehicles used in this study.

PURPOSE

The purpose of this paper is to present how speed bumps and traffic circles affect fire vehicle travel times. This paper describes how the data was collected and analyzed, presents the findings, and goes on to recommend additional areas in need of research.

RESEARCH METHOD

The testing considered four variables that influence the speed at which a fire vehicle can be negotiated around traffic circles or across speed bumps. The variables tested are: the driver, the type of fire vehicle, the desirable vehicle speed, and the types of calming devices.

The data collection effort involved six fire vehicles of varying characteristics. Test runs were conducted on a total of six streets. Two streets had 22-foot speed bumps. Two streets had 14-foot speed bumps, and two had traffic circles. A total of 36 different drivers participated in the testing. The total number of test runs on each street was four per vehicle, or 24 runs per street. Each test run was video taped. The camera recorded the vehicle speeds that were detected and displayed by a radar gun. The time of day, to the nearest second, was superimposed on the recording.

Table 1. Fire Vehicle Specifications

Vehicle	Overall Length	Wheelbase	Weight (lbs)	Horse-power (HP)	Wt./HP Ratio (lbs/HP)	0-40 mph Accel. Time (sec)
Engine 18	29' 10"	15' 5"	34,860	185	188	19
Rescue 41	21'	11' 6"	na	185	na	12
Squad 1	27'	14' 6"	23,170	275	84	17

Truck 1	48'	21' 0"	53,000	450	118	20
Truck 4	57'	13' 0"	53,960	450	120	22
Truck 41	37' 6"	16' 9"	42,100	350	120	27

The speed and time information for each test run was transcribed from the video tapes to a spreadsheet. The information for each run was used to calculate the distance traveled after each second as well as the vehicle's distance from the starting line after each second of the run.
For various combinations of the four variables, the time needed to travel a length of street that had no calming device was compared to the time needed to travel the same length with a calming device. The time and impact distance required to decelerate from a desirable response speed, negotiate the calming device, and accelerate back to the original speed was determined from the data. The time required to travel the same impact distance without a calming device to influence the desirable response speed was calculated. The difference between the two travel times equals the delay associated with the calming device. This delay-per-device was calculated for all six vehicles as they negotiated every calming device on the six test streets. Delays-per-device were calculated for desirable response speeds of 25, 30, 35, and 40 mph.

FINDINGS

The results of the City's research are presented in Table 2, Table 3, and Table 4. Depending on the type of fire vehicle and the desirable response speed, the three devices were found to create a range of delays for each device as follows:

- 14-foot bumps: 1.0 to 9.4 seconds of delay per bump
- 22-foot bumps: 0.0 to 9.2 seconds of delay per bump
- Traffic circles: 1.3 to 10.7 seconds of delay per circle

The drivers' performances did not appear to significantly influence the results. Their choices of deceleration and acceleration rates as well as their choices of minimum speeds near the devices were very consistent.

CONCLUSIONS

The purpose of this paper was to show how speed bumps and traffic circles used in Portland affect fire vehicle travel times. The results provide quantitative data that can be used in the determination of the impacts of one or more traffic calming devices on fire response times along a given emergency response route. Additional information is necessary in order to make a complete assessment of these impacts. This includes: 1) the types of fire vehicles responding to emergencies; 2) the desirable and appropriate speed of fire vehicles at each of the calming devices located along the response route; 3) the geographical area that will be affected by any increase in delay to response times; and 4) the use of this route by fire vehicles given the likely demand for emergency services and the availability of good alternative routes.
A full assessment of the impacts on response times for a given set of traffic calming devices needs to be balanced with the benefits of traffic calming on reducing speeding problems and enhancing public safety and livability along neighborhood streets. This paper provides the initial quantitative data that is necessary to begin to weigh the pros and cons of traffic calming.

RECOMMENDATIONS

The City needs to pursue full assessments of the impacts of specific traffic calming projects, either planned or existing projects, on emergency vehicle responses. This assessment needs to consider all the necessary information as summarized above. The results of this assessment then needs to be compared to the benefits of the traffic calming project, especially the benefits to public safety.

Due to the City's desire to provide both fast response for emergency services and slower overall traffic speeds on neighborhood streets, a public process should be undertaken to address the trade-offs between these two community values and to provide policy direction for implementing traffic calming on a city-wide basis. This should be done by revising the Transportation Element to include a classification for emergency response routes.

Factors that may need to be considered in addressing any trade-offs are options to mitigate impacts on fire vehicle response times. These options include the use of traffic signal preemption devices, the locating of new fire stations, fire vehicle modifications to minimize weight-to-horsepower ratios, securing and cushioning certain pieces of equipment, and improving vehicle suspensions.

Table 2: Typical Impacts of 14-foot Speed Bumps on Emergency Vehicles

Bureau of Traffic Management
Portland Office of Transportation
City of Portland, Oregon
January 1996

Vehicle	Lowest Speed (mph)	Desirable Speed (mph)e	Travel Time Delay (seconds)	Impact Distance (feet)
Engine 18	13	25	2.3	236
	13	30	3.7	399
	13	35	5.2	581
	13	40	7.7	814
Rescue 41	17	25	1.0	147
	17	30	1.7	269
	17	35	2.9	483
	17	40	4.9	628
Squad 1	12	25	2.7	244
	12	30	4.1	436
	12	35	5.9	611
	12	40	8.3	852
Truck 1	11	25	3.4	269
	11	30	4.9	455
	11	35	6.6	646
	11	40	9.4	931
Truck 4	12	25	3.4	315
	12	30	4.9	485
	12	35	6.8	732
	12	40	9.1	1053
Truck 41	12	25	3.5	327
	12	30	4.7	472
	12	35	6.6	762
	12	40	8.6	1152

Lowest Speed: This is the lowest speed a vehicle travels when crossing a 14-foot speed bump.

Desirable Speed: This is the speed a driver might wish to travel if there were no speed bumps.

Travel Time Delay: This is the additional time required to travel to a destination due to a 14-foot speed bump's influence.

Impact Distance: This is the length of street where a given vehicle cannot be driven at the desired speed because of the speed bump's influence.

Table 3: Typical Impacts of 22-foot Speed Bumps on Emergency Vehicles

Bureau of Traffic Management
Portland Office of Transportation
City of Portland, Oregon
January 1996

Vehicle	Lowest Speed (mph)	Desirable Speed (mph)	Travel Time Delay (seconds)	Impact Distance (feet)
Engine 18	21	25	0.8	136
	21	30	1.7	323
	21	35	3.0	505
	21	40	5.0	752
Rescue 41	34	25	0.0	0
	34	30	0.0	0
	34	35	0.3	118
	34	40	1.5	263
Squad 1	24	25	0.4	80
	24	30	1.0	214
	24	35	2.1	433
	24	40	3.4	708
Truck 1	22	25	0.6	137
	22	30	1.4	320
	22	35	3.0	600
	22	40	4.9	885
Truck 4	16	25	1.8	254
	16	30	3.4	449
	16	35	5.9	674
	16	40	7.7	1039
Truck 41	14	25	3.0	316
	14	30	4.8	622
	14	35	7.2	912
	14	40	9.2	1322

Lowest Speed: This is the lowest speed a vehicle travels when crossing a 22-foot speed bump.
Desirable Speed: This is the speed a driver might wish to travel if there were no speed bumps.
Travel Time Delay: This is the additional time required to travel to a destination due to a 22-foot speed bump's influence.
Impact Distance: This is the length of street where a given vehicle cannot be driven at a given desirable speed because of the speed bump's influence.

Table 4: Typical Impacts of Traffic Circles on Emergency Vehicles

Bureau of Traffic Management
Portland Office of Transportation
City of Portland, Oregon
January 1996

Vehicle	Lowest Speed (mph)	Desirable Speed (mph)	Travel Time Delay (seconds)	Impact Distance (feet)
Engine 18	14	25	2.8	261
	14	30	4.3	489
	14	35	6.1	671
	14	40	8.5	814
Rescue 41	16	25	1.3	170
	16	30	2.3	301
	16	35	3.1	467
	16	40	5.1	612
Squad 1	17	25	1.2	172
	17	30	2.3	326
	17	35	3.7	501
	17	40	5.3	776
Truck 1	10	25	4.8	319
	10	30	6.4	524
	10	35	8.4	749
	10	40	10.7	1034
Truck 4	11	25	4.3	322
	11	30	6.2	549
	11	35	8.1	799
	11	40	10.3	1139
Truck 41	11	25	3.9	338
	11	30	5.2	555
	11	35	7.3	845
	11	40	9.2	1255

Lowest Speed: This is the lowest speed a vehicle travels when navigating around a traffic circle.
Desirable Speed: This is the speed a driver might wish to travel if there were no traffic circles.
Travel Time Delay: This is the additional time required to travel to a destination due to a traffic circle's influence.
Impact Distance: This is the length of street where a given vehicle cannot be driven at the desired speed because of the traffic circle's influence.

Appendix C

A Brief History of the Traffic Calming Program in Portland

- Arterial Streets Classification Policy, adopted in 1977 as the Transportation Element of the City's Comprehensive Plan, classifies streets by their intended type and function.

- A citizen survey reveals excessive traffic speeds and volumes as threats to feeling comfortable and safe as a non-motorized user of residential streets (early 80's).

- Origins of Comprehensive Plan Policies that directed improvements to Local Service and Neighborhood Collector Streets to reduce the negative impacts of excess traffic on residential livability and safety.

- The adopted update of the Arterial Streets Classification Policy contained the directive to create a "Neighborhood Traffic Program."

- Established the Neighborhood Traffic Management Program (NTMP) through Council Resolution No. 33706 on July 12, 1984, with one of the nation's first systematic approaches to the mitigation of residential traffic problems.

- Citizen Advisory Committee (CAC) appointed to undertake Neighborhood Traffic Management Plan (NTMP) evaluation and examine how well the NTMP objectives were being met.

- Technical Advisory Committee (TAC) also appointed to examine the effectiveness of traffic circles, impacts of traffic management devices on emergency vehicles, new devices and other issues of a technical nature.

- Initial tests on 12' speed bump design conducted in Willamette Park. Fire Bureau and other agencies participate in the test.

- Citizen concern regarding excessive traffic speeds and volumes on residential streets is reaffirmed in a 1992 Bureau of Transportation Management (BTM) survey of licensed drivers.

- Transportation Element (formerly ASCP) adopted by City Council in October 1992 included major policy change to expand the use of residential traffic management techniques to Neighborhood Collector Streets.

- Speed Bump Evaluation report published in June 1992 containing results of field studies on three bump designs: 12', 14', and 22'. Fire Bureau participated in field studies.

- Results of CAC and TAC evaluation of NTMP adopted by City Council

Resolution No. 35001, June 10, 1992.

- Significant changes resulted from the two reports: implementation of an Impact Threshold Curve for traffic diversion, modification of the ballot area, improvements to the visibility around traffic circles and the authority to use of speed bumps as traffic management devices.

- Peer Review Report on Portland's Traffic Circle Program found that reported accident rate had decreased by 28 to 84% at intersections where circles had been installed.

- CAC and TAC committees established to develop the Arterial Traffic Calming Program, the first program of its kind in the United States to address traffic management problems on Neighborhood Collector Streets with at least 75% residential zoning.

- City Council adopts Arterial Traffic Calming Program (ATCP) in September 1993 (Resolution #35183; September 22, 1993) Representative from Fire Bureau testified in support of this new program and indicated that the agency was satisfied that their concern about "cumulative impact" had been adequately addressed.

- Proposed changes to both the NTMP and ATCP were presented to and adopted by Council Resolution No. 35317, October, 19, 1994. ATCP and NTMP were consolidated and renamed the Traffic Calming Program (TCP); project planning process reduced; Streamlined Speed Bump Projects were proposed to address speeding problems on Local Service Streets with low traffic volumes and high speeds to reduce the backlog of requests; Residential Speed Bumps Purchase Projects were proposed to enable residents on some Local Service Streets to pay for speed bumps.

- 1995/1996: BTM and Fire Bureau conducted field studies of five representative fire response vehicles with traffic circles and speed bumps, determining typical slowing caused by each device.

- 1996: As a compromise with the Fire Bureau, Streamlined Speed Bumps and Residential Purchase projects were restricted to Local Services Streets that do not appear on the Fire Response Routes map, cutting the pool of eligible streets almost in half, until an official Major Emergency Response route classification and map is added to the TSP (Completed in 1998).

- Review of eight TCP projects found reported accidents reduced by 45% at intersections treated with traffic circles. Review of 17 projects involving both traffic circles and speed bumps indicated that the overall accident frequency was reduced by 32% for the length of the street treated. On streets where speed bumps have been installed, an overall average speed reduction of 8 mph

has been produced.

- In 1997 PBOT and Portland Fire and Rescue (PFR, former Fire Bureau) began testing 'fire friendly' offset speed tables (with approach islands) to determine the parameters for construction and to reduce delay for the largest of the fire vehicles. While tests were conducted on City streets, and the estimated delay was reduced from 10 seconds per speed table to 2 seconds per offset speed table, no officially approved device was adopted.

- 1999: Low volume Neighborhood Collector streets were approved to purchase simple speed bump projects under the Residential Speed Bump Purchase Program by City Council.

- Portland Safe Routes to School (SR2S) began to develop programming in 2000, when the national conversation began with the funding of the Marin County program and the Oregon Walk + Bike to School committee was formed. The City of Portland took a step toward formalization when the State of Oregon passed House Bill 3712 (known as the 'Safe Routes to School Bill') in 2001. To date, over eighty elementary schools have been served and over forty have ongoing education programs.

- In 2001, PBOT and PFR again tested speed cushions and the offset speed table design, this time without the leading island. With an island, fire vehicles were required to drive in the opposing lane to go around the devices. Without the islands, fire vehicles only had to straddle the centerline. 22-foot speed cushions did not appear to have any effect on standard vehicle speeds. No device was approved or tested on City streets upon completion of these tests, though devices constructed in Beaverton were evaluated.

- 2003: Community and School Traffic Safety Partnership (CSTSP) created.

- 2004: Subsidized Residential Speed Bump Purchase projects authorized where the City funds 60% of the project costs for low volume Local Service streets with approved petitions, or low-volume Neighborhood Collector streets with approved petitions that also have Neighborhood Association endorsement.

- 2005: Safe Routes to School (SR2S) Program engineering evaluations begin. Thirty-two schools have had engineering evaluations.

- 2006/2007: Traffic Calming Program mothballed. City funding for traffic calming is reduced to only those projects that are part of a larger programmatic goal, such as Safe Routes to School, Neighborhood Greenways.

- 2009: Initiation of new bike classification – Neighborhood Greenways (NGs) – and goals that includes traffic calming to achieve 20 mph along the project street and diversion to achieve traffic volumes below 1,000 vehicles per day.

- 2010: Adopted MUTCD Option A pavement marking for speed bumps.

- 2011: PBOT and PFR were directed to evaluate and test a 'fire friendly' traffic calming device. PBOT agreed to evaluate 14-foot speed cushions (a speed bump with channels for fire vehicle tires), and after an initial test at the PFR training facility, speed cushions were installed on NW Cornell, between Lovejoy and the first tunnel, replacing the existing speed tables. PBOT also changed the design on SW 51st, Maplewood to Multnomah, from speed bumps to speed cushions at the request of PFR. Tests show that it is likely that speed reductions to near 30 mph are probable, but reductions to near 25 mph will be difficult. Also, the sizing of the cushions has not been finalized.

- 2011: Legislative authority (HB 3150) to reduce neighborhood greenway streets to 20 mph under certain conditions.

- 2012(?): The Community and School Traffic Safety Partnership (CSTSP, formerly Traffic Calming Program) is merged with Transportation Options to become the Active Transportation and Safety Division.

- 2013: Funding for approved neighborhood greenway projects ceases as of July first. Current approved projects and pending work is placed on hold. Traffic calming for Safe Routes to School and Bike Lanes is dependent on Federal funding.

- 2015: Completion of the Neighborhood Greenways (formerly Bike Boulevards) Assessment Report that establishes standards for auto speed and volume (daily and peak hour) and auto speed on designated greenway streets. Opens up such streets for internal diversion; identifies five legacy boulevards for upgrading to current standard.

- 2015: City Council adopts Vision Zero (June).

- 2016: On May 17th, Portland voters passed Measure 26-173, Portland's first local funding source dedicated to fixing our streets. Measure 26-173 will raise an estimated $64 million over four years. In the same month, the Portland City Council also passed the Heavy Vehicle Use Tax, a measure that will generate an estimated additional $10 million over four years. Funding is identified for paving and maintenance, Safe Routes to School, Neighborhood Greenways, crossing improvements, and protected bike lanes.

- 2016: Vision Zero action plan adopted (December).

- 2017: Portland gains authority to lower speed limit to 20 mph on non-Arterial (FFCS) streets. 25 mph limit reserved as lowest posted limit on MER routes.

- 2018: Secondary Emergency Response (SER) routes added with the update of the Transportation System Plan. Speed cushions permitted on SER without Portland Fire and Rescue permission. Speed cushions permitted on MER with permission.

Estimate of Traffic Calming Built – 9/26/18

Device	**Number**	**Note**
12-foot Bump	13	
14-foot Bump	1535	
22-foot Table	294	
22-foot Raised Crosswalk	45	Same profile as Speed Table
14-foot Cushion	42	Same profile as Speed Bump
Cul-de-sac/Dead End	16	
Diagonal Diverter	4	
Median Barrier	6	
Mini-Roundabouts	1	Test object, circular Speed Table
Pedestrian Refuge Island	119	
Roundabout	3	
Semi-diverter	28	
Traffic Circles	71	
Truck Trap	1	Access management