Item V. c.

O'Fallon
ILLINOIS

Public Works Committee Agenda Item

Date: **September 23, 2013**

Subject: **East Jefferson Stop Sign Request**

Background:

Speeding is a concern in all of the O'Fallon neighborhoods. The residents of East Jefferson are concerned about this issue as well, and have asked through their Aldermen for a 4-way stop intersection to be created at E. Jefferson and Penn to mediate speeding and improve overall safety in the neighborhood for pedestrians and children at play.

While multi-stop intersections can be useful as a safety measure at intersections, they should only be considered if certain traffic conditions exist as laid out in the Manual on Uniform Traffic Control Devices (MUTCD). The MUTCD is approved by the Federal Highway Administrator as the National Standard in accordance with Title 23 U.S. Code, Sections 109(d), 114(a), 217, 315, and 402(a), 23 CFR 655, and 49 CFR 1.48(b)(8), 1.48(b)(33), and 1.48(c)(2). The MUTCD's safety concerns associated with multi-way stops include pedestrians, bicyclists, and all road users expecting other road users to stop. Generally, multi-way stop control is used where the volume of traffic on the intersecting roads is approximately equal.

The current MUTCD calls for an "Engineering Study" of any intersection where traffic control is being considered for modification to a 4-way stop. As such, the City Engineer was asked to provide that study (see attached).

Budget Impact: Erection of additional stop signs and placarding for a 4-way stop would cost approximately $400.

Staff recommendation: Staff recommendation based on the Engineering Study attached is not to convert the existing 2-way stop to a 4-way stop.

NOTE: The attached contains only 8.5 x 11 inch reproductions of drawings. Therefore, scales cited are compressed from original format and not valid.

Engineering Study

Proposed Multi-Way (4-Way) Stop

for the

Intersection of E. Jefferson and N. Penn

City of O'Fallon, IL

Department of Public Works

August 2013

Engineering Study – Proposed Multi-Way (4-Way) Stop for the Intersection of E. Jefferson and N. Penn

Setting -

The intersection of Jefferson and Penn Streets is in a neighborhood where some of the homes date prior to 1940. As such the setback for some of the homes there is as little as 15-feet from the right-of-way/front property line. The right-of-ways for Jefferson and Penn are both 60-feet wide.

The lots on which the homes set along Jefferson near Penn are approximately 150-feet deep, and the rear property line is defined by an alley right-of-way line. As an alley provides access to the lots, many homes have their garages and parking areas in the rear.

Parking along Jefferson Street over the years has led to encroachment into what has been described by local historians of the area as "the old tree lawn." Cars are parked in several locations today as near as 6 to 8-feet from the edge of right-of-way as the tree lawn has disappeared in many places along the ROW. This practice gives the allusion to an operator of a vehicle traveling along Jefferson that as much as 30-feet of roadway is available for traversing the area. With that comes the sense of security that vehicles can be operated safely at speeds in excess of the speed limit, in affect encouraging high vehicle speeds. Drivers will operate at speeds they are comfortable with, and while that varies widely from driver to driver, often the local speed limit of 25mph is not adhered to.

Roadway –

Jefferson Street received an asphaltic concrete overlay in 2008, making the previous irregular or bumpy, oil & chip surface smooth. The overlaid area of the old oil & chip surface runs from 22 to 26-feet wide along the stretch one block either east or west of Penn.

As for classification, the speed data that the City of O'Fallon's Department of Public Safety collected near the intersection of Jefferson and Penn reflects that Jefferson's traffic count is between 200 and 600 vehicles. So, an average daily traffic (ADT) of 500 will be assumed for Jefferson. The threshold for a "residential collector" roadway is 1,500. Therefore for further analysis Jefferson Street acts as a "local road," predominately serving the surrounding neighborhood.

Roadway Geometry –

Jefferson Street lies along terrain affected by local drainage patterns. A reach of Engle Creek bisects Jefferson west of Penn, causing the road to fall from its intersection with Penn to the west. (See road centerline elevation data).

Existing Intersection Control –

Currently, stop signs exist to control traffic approaching Jefferson from both the north and south on N. Penn Street.

Requested Intersection Control -

Residents in the area have requested the intersection of E. Jefferson and N. Penn be made a 4-way (multi-way) stop controlled intersection. Their request is based on excessive speed of vehicles traveling along Jefferson and line of sight issues due to the abrupt change in the slope of the E. Jefferson roadway to the west side of its intersection with N. Penn.

Manual on Uniform Traffic Control Devices (MUTCD) -

While multi-stop intersections can be useful as a safety measure at intersections, they should only be considered if certain traffic conditions exist as laid out in the Manual on Uniform Traffic Control Devices (MUTCD). The MUTCD is approved by the Federal Highway Administrator as the National Standard in accordance with Title 23 U.S. Code, Sections 109(d), 114(a), 217, 315, and 402(a), 23 CFR 655, and 49 CFR 1.48(b)(8), 1.48(b)(33), and 1.48(c)(2). The MUTCD's safety concerns associated with multi-way stops include pedestrians, bicyclists, and all road users expecting other road users to stop. Generally, multi-way stop control is used where the volume of traffic on the intersecting roads is approximately equal.

The following guidance is re-printed directly from the 2009 MUTCD (the most current document) on multi-way stop sign installations:

> *"The decision to install multi-way stop control should be based on an engineering study. The following criteria should be considered in the engineering study for a multi-way STOP sign installation:*
>
> *A. Where traffic control signals are justified, the multi-way stop is an interim measure that can be installed quickly to control traffic while arrangements are being made for the installation of the traffic control signal.*
>
> *B. Five or more reported crashes in a 12-month period that are susceptible to correction by a multi-way stop installation. Such crashes include right-turn and left-turn collisions as well as right-angle collisions.*
>
> *C. Minimum volumes:*
>
> *1. The vehicular volume entering the intersection from the major street approaches (total of both approaches) averages at least 300 vehicles per hour for any 8 hours of an average day; and*

2. The combined vehicular, pedestrian, and bicycle volume entering the intersection from the minor street approaches (total of both approaches) averages at least 200 units per hour for the same 8 hours, with an average delay to minor-street vehicular traffic of at least 30 seconds per vehicle during the highest hour; but

3. If the 85th-percentile approach speed of the major-street traffic exceeds 40 mph, the minimum vehicular volume warrants are 70 percent of the values provided in Items 1 and 2.

D. Where no single criterion is satisfied, but where Criteria B, C.1, and C.2 are all satisfied to 80 percent of the minimum values. Criterion C.3 is excluded from this condition.

Other criteria that may be considered in an engineering study include:

A. The need to control left-turn conflicts;

B. The need to control vehicle/pedestrian conflicts near locations that generate high pedestrian volumes;

C. Locations where a road user, after stopping, cannot see conflicting traffic and is not able to negotiate the intersection unless conflicting cross traffic is also required to stop; and

D. An intersection of two residential neighborhood collector (through) streets of similar design and operating characteristics where multi-way stop control would improve traffic operational characteristics of the intersection."

Additionally, the MUTCD states the restrictions on the use of STOP signs which apply to 2-way yield or stop controlled intersections, also apply to multi-way stop applications. That guidance follows:

"Engineering judgment should be used to establish intersection control. The following factors should be considered:

A. Vehicular, bicycle, and pedestrian traffic volumes on all approaches;

B. Number and angle of approaches;

C. Approach speeds;

D. Sight distance available on each approach; and

E. Reported crash experience.

YIELD or STOP signs should be used at an intersection if one or more of the following conditions exist:

A. An intersection of a less important road with a main road where application of the normal right-of-way rule would not be expected to provide reasonable compliance with the law;

B. A street entering a designated through highway or street; and/or

C. An unsignalized intersection in a signalized area.

In addition, the use of YIELD or STOP signs should be considered at the intersection of two minor streets or local roads where the intersection has more than three approaches and where one or more of the following conditions exist:

A. The combined vehicular, bicycle, and pedestrian volume entering the intersection from all approaches averages more than 2,000 units per day;

B. The ability to see conflicting traffic on an approach is not sufficient to allow a road user to stop or yield in compliance with the normal right-of-way rule if such stopping or yielding is necessary; and/or

C. Crash records indicate that five or more crashes that involve the failure to yield the right-of-way at the intersection under the normal right-of-way rule have been reported within a 3-year period, or that three or more such crashes have been reported within a 2-year period.

YIELD or STOP signs should not be used for speed control."

Data -

Accident investigations were requested from the O'Fallon Police Department for the vicinity of the E. Jefferson and N. Penn intersection. Eleven reports were received by the O'Fallon Department of Public Works. Only one report, a 2005 incident, was near the intersection of E. Jefferson and N. Penn. That report was for property damage to a vehicle parked along E. Jefferson near the intersection of N. Penn. Therefore, it was deemed not to be related to the functioning of the intersection at E. Jefferson and N. Penn. (See Attachment #1)

A copy of speed data collected by the Police from 5/22/13 to 6/3/13 was also received by Public Works. The speed data used in this Engineering Study is for bi-directional traffic from approximately 2:25 PM on 5/22/13 to 8:58 AM on 6/3/13 (approximately 282 hours of surveillance). During that period, 7,119 vehicles traveled past the data collection device. The collection device was located in the 300 block of E. Jefferson. In analyzing the speed data, 3 vehicle counts were discarded as the speed registered was in excess of 100 mph and 25 were discarded for registering 0 mph. The total vehicle count used in this study is 7,091. (See Attachment #2)

The speed data provides traffic count information, and from a visual scan of the data, three periods were further analyzed to provide information on traffic passing through the intersection of E. Jefferson and N. Penn along Jefferson. Counts for the periods of 6:00 AM to 8:00 AM, 10:00 AM to 12:00 PM, and 3:00 PM to 7:00 PM were made for the days that data existed to determine traffic loading of the intersection. Additionally, total day counts were made. (See Attachment #3)

The hourly averages for the three periods show that the maximum number of vehicles passing through the intersection on Jefferson is likely less than 100 on any given day. The average number of vehicles per day passing through the intersection on Jefferson is likely less than 1,000 on any given day.

To provide data on the roadway at the intersection and its approaches, LIDAR (LIght Detection And Ranging) information was used. The ½-foot contours for the roadway right of way were used in determining the profile of Jefferson's roadway centerline. (See Attachment #4)

Scaling the map of Attachment #4 to determine where contour lines crossed the roadway in relation to the intersection, elevations of the Jefferson roadway centerline were plotted to provide a profile of E. Jefferson in the vicinity of its intersection with N. Penn. (See Attachment #5)

To determine the stopping distances for vehicles traveling E. Jefferson, computations using a formula for those distances was used with varying speeds, gradients of the roadway and reaction times. All computations assumed the pavement was wet, the most critical condition

for skidding tire friction coefficients. Values received were compared to an AASHTO (American Association of State Highway and Transportation Officials) table for minimum sight distances to ensure validity. (See Attachment #6)

Analysis –

Referring to the MUTCD guidance above for multi-way stop sign installations:

1. Control signals are not justified for the intersection: therefore, a multi-way stop configuration for the E. Jefferson and N. Penn intersection cannot be justified as an interim measure for future signaling.

2. There have been no reported crashes at the intersection in the past the past ten years. So, crash data cannot be used to support a multi-way stop installation at the intersection.

3. The vehicular volume entering the intersection from the major street approaches (total of both approaches) does not average 300 vehicles per hour for any 8 hours of an average day. Although, no data was collected for N. Penn, it would have to have 200+ vehicles per hour for 8 hours to support a multi-stop configuration, nearly twice what the data for E. Jefferson shows. Additionally, the combined vehicular, pedestrian, and bicycle volume entering the intersection from the minor street approaches (total of both approaches) does not average 200 units per hour for the same 8 hours, and the delay to minor-street (N. Penn) vehicular traffic is less than the 30 seconds per vehicle during the highest hour, called for. Finally, the 85th-percentile approach speed of the major-street (E. Jefferson) traffic does not exceed 40 mph.

4. There is no need to control left-turn conflicts, or control vehicle/pedestrian conflicts as the location is not near a generator of high pedestrian volumes.

5. The location of the intersection is not one where a road user, after stopping, cannot see conflicting traffic and is not able to negotiate the intersection unless conflicting cross traffic is also required to stop; nor is the intersection of two residential neighborhood collector (through) streets of similar design and operating characteristics where multi-way stop control would improve traffic operational characteristics of the intersection.

6. STOP signs should not be used for speed control.

Line of Sight and Stopping Distant Issues –

Attachment #5 attempts to address these issues. The standard for determining line of sight calls for the analysis to assume the height of the driver's eyes is 42 or 45-inches dependent

upon the literature researched. 42-inches is used in this study's analysis. The object to be sighted is 6-inches or 0.5-feet in height on the horizon.

From the graphical presentations on the Sheets #1 thru #3 of Attachment #5 and the calculations in Attachment #6, the following table is built. The breaking reaction – perception times (reaction times) used are 2.5 seconds, a very slow time, as compared with 0.9 seconds the "median" for the population. Median means that half those tested had times less than 0.9 seconds and half exceeded 0.9. Additionally, stopping distances are for wet conditions, and the steepest grade that would be encountered during breaking was used. All breaking data was for a locked wheel condition. Anti-lock braking systems (ABS) have not been considered in the analysis.

		Reaction Time (tp) = 2.5 secs			tp = 0.9 secs
	Line of Sight Distance*	Stopping Distance (30 mph)	Stopping Distance (35 mph)	Stopping Distance (40 mph)	Stopping Distance (40 mph)
Attachment #5, Sheet #1 Scenario	340'	214'	280'	352'	207'
Attachment #5, Sheet #2 Scenario	270'	214'	280'	352'	207'
Attachment #5, Sheet #3 Scenario	360+'	Not Computed	Not Computed	302'	Not Computed

* Horizontal Distance

Recommendations –

1. A four way stop configuration for the intersection of E. Jefferson and N. Penn should not be installed, based on MUTCD guidance.

2. Installation of stop signs to control speed violates MUTCD guidance, and therefore, is not recommended.

3. Stopping distance issues are present based on the speed of some vehicles using the intersection; however, less than 7% of the vehicles using the intersection are traveling at 35 mph or more. Less than 2% of the vehicles using the intersection are traveling at 40 mph or more. The average speed is 25 mph, the median speed is 26 mph, and the 85th

percentile speed is 32 mph. The speed approaching the intersection reflects similar situations all over the City. The relatively minor stopping distance issues do not compel the use of stop signs to alleviate the potential problem.

Accident Data from E. Jefferson -

Summary -

03/21/2002 05:14:00	E JEFFERSON ST / N HILGARD	2002-00005111	IL0821600
10/03/2003 12:53:00	E JEFFERSON ST / N ORANGE ST	2003-00021161	IL0821600
03/04/2005 03:24:00	E JEFFERSON ST / N VINE ST	2005-00003900	IL0821600
03/06/2005 05:40:00	E JEFFERSON ST / N PENN ST	2005-00004552	IL0821600
07/08/2007 12:50:00	E JEFFERSON ST / N VINE ST	2007-00013192	IL0821600
01/03/2008 03:18:00	E JEFFERSON ST / N SMILEY ST	2008-00000175	IL0821600
06/19/2008 05:25:00	E JEFFERSON ST / N VINE ST	2008-00013055	IL0821600
04/08/2012 08:02:00	E JEFFERSON ST / N SMILEY ST	2012-00006306	IL0821600
05/19/2012 01:43:00	E JEFFERSON ST / N SMILEY ST	2012-00009136	IL0821600
09/04/2012 03:39:00	E JEFFERSON ST / N HILGARD ST	2012-00016292	IL0821600
05/20/2013 08:15:00	E JEFFERSON ST / N HILGARD ST	2013-00014646	IL0821600

Individual accident reports withheld due to personal information contained in them and the number of pages involved in reproduction.

Attachment #1

Speed Data -

7091 records omitted to preclude printing of the 304 page report.

	A	B	C	D	E	F	G	H	I
1	Veh. No.	Corrected Date	Corrected Time	Lane	Speed (In MPH)				
7092	7091	5/29/2013	5:49:11 PM	1	62				
7093	vehicles				177,596	vehicle-mph			
7094									
7095					Average Speed	25.05	MPH		
7096					Median Speed	26	MPH		
7097			Vehicle 5249 is last one in 30 MPH or less Speed Group			74.0%			
7098			Vehicle 5632 is last one in 31 MPH or less Speed Group			79.4%			
7099			Vehicle 5939 is last one in 32 MPH or less Speed Group			83.8%	← 85th Percentile		
7100			Vehicle 6227 is last one in 33 MPH or less Speed Group			87.8%			
7101									
7102			Vehicle 6607 is last one in 35 MPH or less Speed Group			93.2%			
7103									
7104			Vehicle 6947 is last one in 39 MPH or less Speed Group			98.0%			
7105									
7106			So, only 2% of the vehicles are driven 40 MPH or greater						
7107									
7108		Deleted all "254" MPH Vehicles			3 Total				
7109		Deleted all "0" MPH Vehicles			25 Total				
7110									

Attachment #2

Traffic Data, 2-Way, E. Jefferson (300 Block)

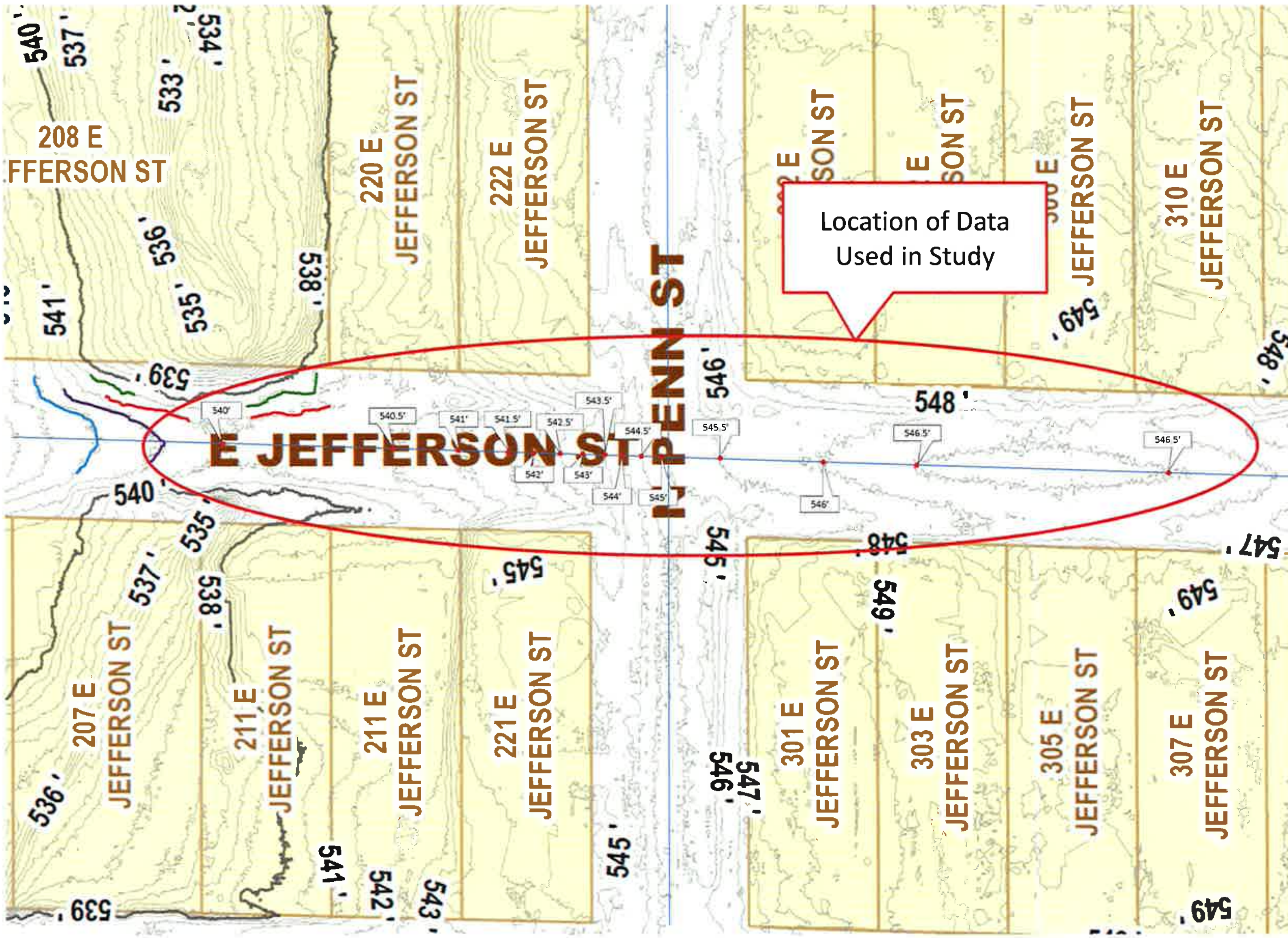
				Wednesday	Thursday	Friday	Saturday
Hourly Average				**5/22/13**	**5/23/13**	**5/24/13**	**5/25/13**
6:00 AM to 8:00 AM				na	35	34	13
10:00 AM to 12:00 PM				na	30	50	39
3:00 PM to 7:00 PM				46	42	45	30
Total Daily Count				na	531	687	467

	Sunday	Monday*	Tuesday	Wednesday	Thursday	Friday	Saturday
Hourly Average	**5/26/13**	**5/27/13**	**5/28/13**	**5/29/13**	**5/30/13**	**5/31/13**	**6/1/13**
6:00 AM to 8:00 AM	9	7	17	19	24	18	26
10:00 AM to 12:00 PM	32	31	94	32	34	33	36
3:00 PM to 7:00 PM	28	75	43	45	76	39	39
Total Daily Count	428	623	675	612	829	800	639

	Sunday	Monday					
Hourly Average	**6/2/13**	**6/3/13**					
6:00 AM to 8:00 AM	6	21					
10:00 AM to 12:00 PM	40	na					
3:00 PM to 7:00 PM	28	na					
Total Daily Count	448	na					

* Holiday

Attachment #3



N

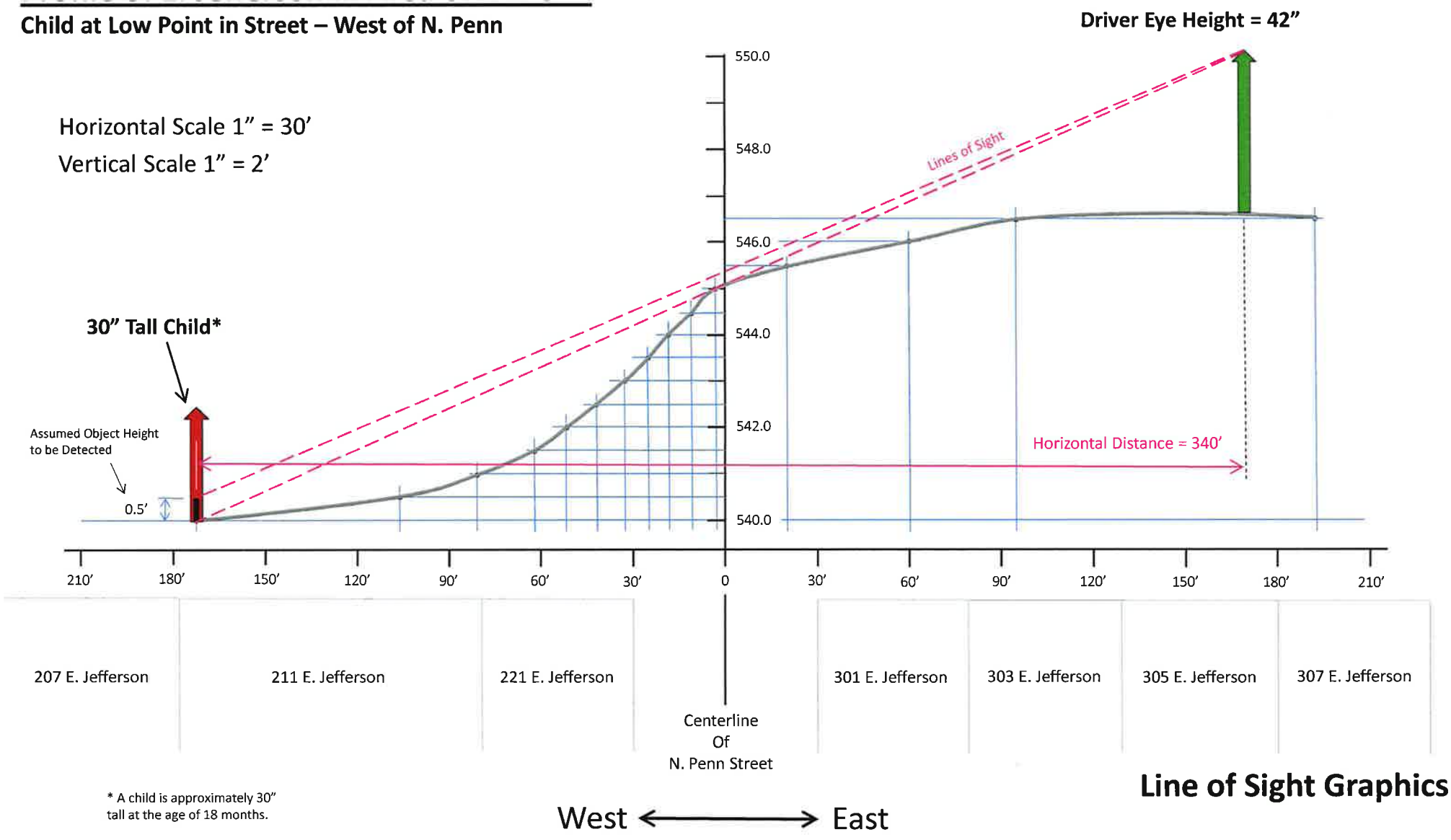
Scale: 1" = 40'

LIDAR Elevation Contour Data

Attachment #4

Profile of E. Jefferson in Area of N. Penn

Child at Low Point in Street – West of N. Penn



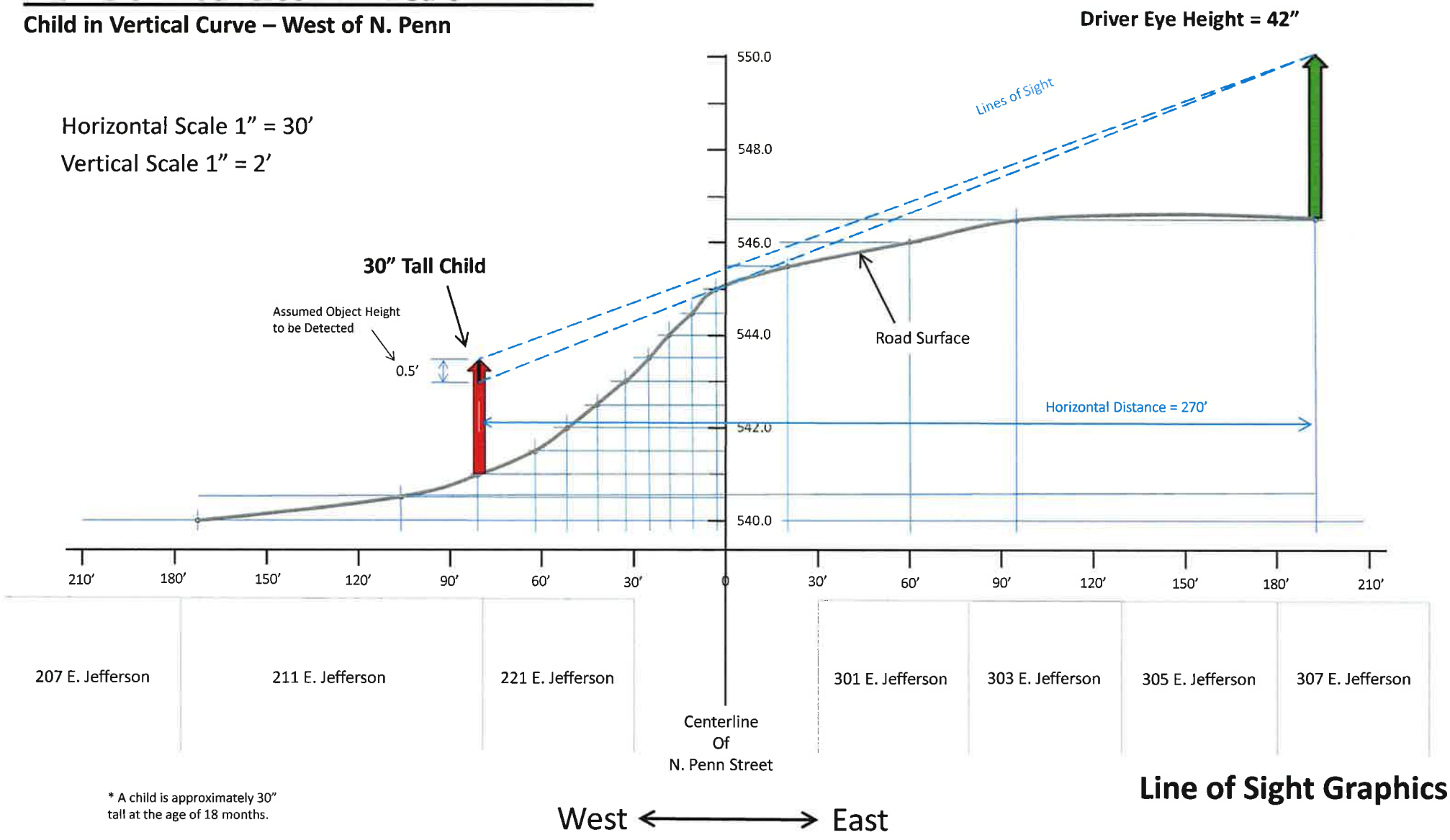
* A child is approximately 30" tall at the age of 18 months.

Line of Sight Graphics

Attachment #5, Sheet #1

Profile of E. Jefferson in Area of N. Penn

Child in Vertical Curve – West of N. Penn



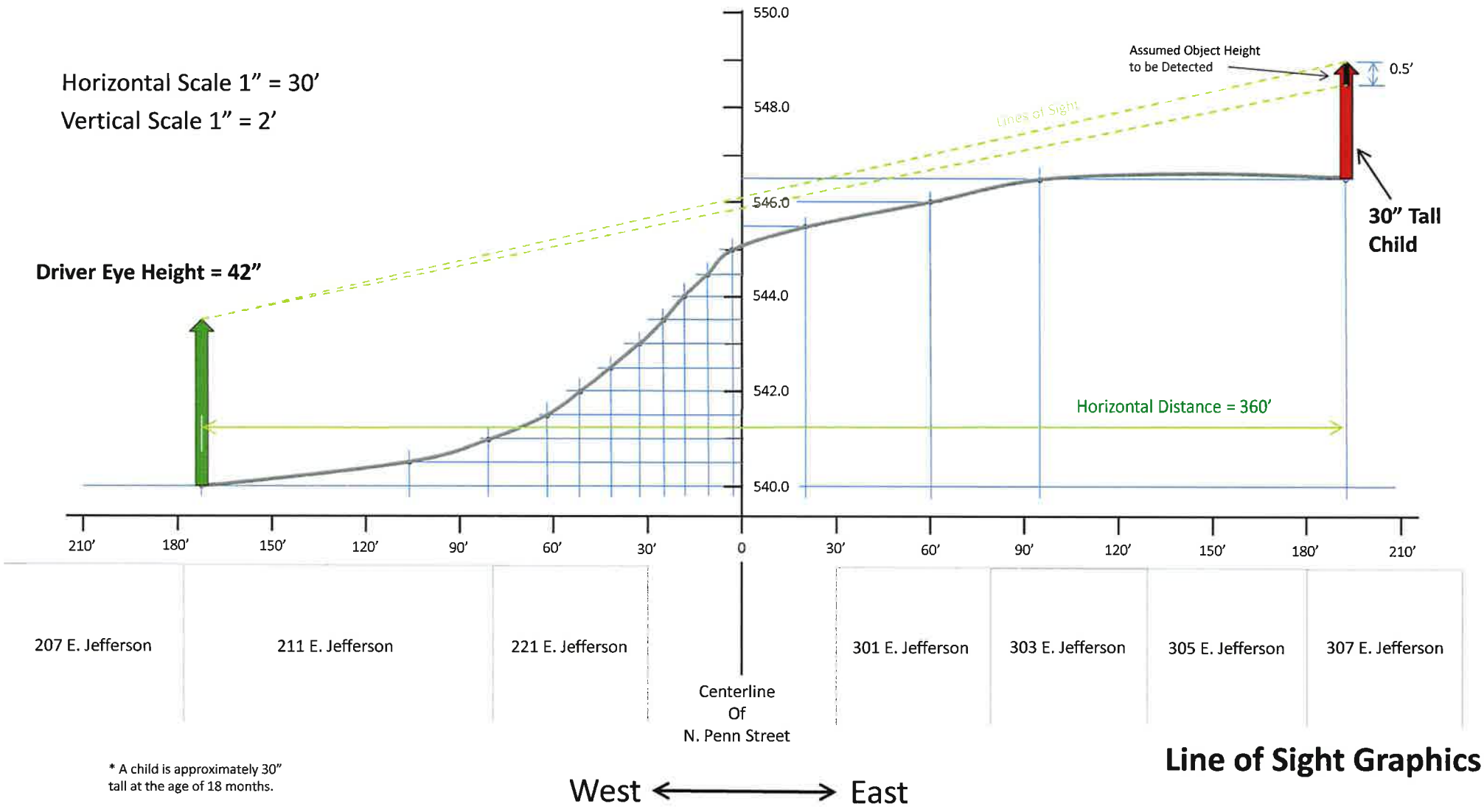
* A child is approximately 30" tall at the age of 18 months.

Line of Sight Graphics

Attachment #5, Sheet #2

Profile of E. Jefferson in Area of N. Penn

Vehicle at Low Point in Street – West of N. Penn



* A child is approximately 30" tall at the age of 18 months.

Line of Sight Graphics

Attachment #5, Sheet #3

Stopping Sight Distance (S):

$$S = (1.47)\,(t_p)\,(MPH) + \frac{(MPH)^2}{(30)\,(f + G)}$$

Where: t_p is "breaking reaction – perception time" in seconds

(median value ~ 0.90 seconds, slow value ~ 2.5 seconds)

MPH is vehicle speed in miles per hour (mph)

f is coefficient of skidding friction

at 30 mph = 0.36 (wet conditions)

at 35 mph ~ 0.34 (wet conditions)

at 40 mph = 0.33 (wet conditions)

G is % grade of roadway expressed as decimal

For vehicle traveling from East to West:

Slow reaction time

At 30 mph:

$$S = (1.47)\,(2.5)\,(30) + \frac{(30)^2}{(30)\,(0.36 + (-0.07))}$$

$$S = 110.25 + 103.44 = 214\text{-feet}$$

7% slope is steepest grade, negative due to down slope

At 35 mph:

$$S = (1.47)\,(2.5)\,(35) + \frac{(35)^2}{(30)\,(0.34 + (-0.07))}$$

$$S = 128.6 + 151.2 = 280\text{-feet}$$

Attachment #6

At 40 mph:

$$S = (1.47)\,(2.5)\,(40) + \frac{(40)^2}{(30)\,(0.33 + (-0.07))}$$

$$S = 147.0 + 205.1 = 352\text{-feet}$$

Median reaction time

At 40 mph:

$$S = (1.47)\,(0.9)\,(40) + \frac{(40)^2}{(30)\,(0.33 + (-0.07))}$$

$$S = 52.9 + 153.8 = 207\text{-feet}$$

For vehicle traveling from West to East:

At 40 mph:

$$S = (1.47)\,(2.5)\,(40) + \frac{(40)^2}{(30)\,(0.33 + 0.015)}$$

$$S = 147.0 + 154.6 = 302\text{-feet}$$

1.5% slope approximately, positive due to up slope