

MEMORANDUM

TO: Mayor Jones and Members of the Board
FROM: Cheryl Kuechenmeister, Town Administrator
DATE: August 4, 2016
RE: **Study Session – Traffic Mitigation**

Attached are memos from the Town's traffic engineer, Jon Larson, which address traffic mitigation measures as requested by the Board.

The first memo contains information about the temporary or permanent closure of South Richfield at the southern entrance to the Town.

The second memo addresses the placement and use of speed humps throughout Town in order to address speed issues.

Mr. Larson will be in attendance at the meeting in order to speak to the Board about these issues.



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MEMORANDUM

TO: Cheryl Kuechenmeister - Town of Foxfield
FROM: Jon E. Larson, PE, PTOE – Senior Traffic Engineer
DATE: July 14, 2016
RE: Town of Foxfield - Richfield Road Closure Information
SEH No. FOXFD - 136007

Based on our discussions, the Town is requesting information regarding the ramifications of a road closure at the southern entrance to the Town on Richfield Street. Specifically, the Town is seeking information to the following questions:

1. If a gate is placed at the southern entrance to the Town, what will be the impact on traffic using the Fremont entrance to the Town off of Parker Road?
2. What are the various types of both temporary and permanent gates or barriers that can be placed in this location and what are the costs of each?
3. What other implications are there to placing gates or barriers at this location?

The purpose of this memorandum is to provide information that addresses the above questions in a mostly qualitative approach. It is intended to begin the conversation between the Town Board as to whether pursuit of a road closure is still desirable. If the Town would like to explore further analysis and impacts of a road closure on Richfield, then more traffic data would need to be collected to be able to quantify those impacts more precisely.

The following sections address each question above:

1. If a gate is placed at the southern entrance to the Town, what will be the impact on traffic using the Fremont entrance to the Town off of Parker Road?

Data from the speed radar signs provided by the Town was used to develop potential daily traffic that uses the Town entrance at Richfield. The data points may include traffic from Hinsdale and does not isolate vehicles using Richfield. Estimations were made in order to apply numbers to traffic diversions. However, further data collection would be necessary to determine the magnitude of traffic using just the Richfield entrance. The existing traffic using South Richfield Street in the vicinity of the proposed gate location is approximately 442 vehicles per day (vpd) southbound and 610 vpd northbound. Of that traffic, it is estimated that the daily routes of 200-300 vpd will be affected in the southbound direction and 300-500 vpd in the northbound direction. Figure 2 displays traffic diversions that could potentially occur as a result of closing Richfield Street. The existing traffic patterns on South Richfield Street are shown in solid blue and orange lines for southbound and northbound respectively. Re-routed traffic patterns are displayed in dotted lines.

Diverted Vehicles from Northbound Richfield

Vehicles traveling from west of Parker Road and wanting to use northbound Richfield to access the Town or cut-through to the east could potentially be re-routed along the surrounding roadways: Long Avenue and Fremont Avenue. There is potential for approximately 300 to 500 vehicles per day that would divert to the alternative routes. Vehicles traveling east on Broncos Parkway would be required to turn left at the signal on

Parker Road and then turn right onto Fremont Avenue, which could be time consuming and drivers may choose to take Long Avenue instead. However, vehicles traveling east on Chambers Way could make a right turn onto Parker Road and then turn left to access Fremont Avenue.

Diverted Vehicles from Southbound Richfield

Vehicles traveling from the north of Hinsdale Avenue and wanting to use southbound Richfield Street to cut-through the Town or access Parker Road to the west could potentially be re-routed along the surrounding roadways: Easter Avenue and Fremont Avenue. Additionally, vehicles traveling east and west on Hinsdale Ave and wanting to use southbound Richfield could potentially be re-routed along surrounding roadways: Chapparral Circle West and Richfield Avenue to access Arapahoe Road avoiding Fremont Avenue as a result. There is potential for approximately 200 to 300 vehicles per day that would divert to these alternative routes. Traffic diverting to Fremont Avenue from Southbound Richfield would be minimized. The presence of Chambers Way provides the only roadway that may provide a faster route to the west of Parker Road without having to travel through the Arapahoe Road interchange. Additionally, vehicles would likely avoid turning left onto Parker Road to access Broncos Parkway.

The following summarizes several impacts to the traffic currently using the Fremont Avenue entrance to Foxfield off of Parker Road:

- Approximately 200-300 vehicles per day would divert onto nearby streets from southbound Richfield Street;
- Approximately 300-500 vehicles per day would divert onto nearby streets from northbound Richfield Street;
- It appears that a net increase in vehicles using the Fremont Entrance would result from the closure to Foxfield at Richfield Street;
 - However, the net increase in traffic volume on Fremont Avenue is not likely to be equivalent the amount of traffic diverted traffic from the Richfield closure as vehicles are likely to spread out across other surrounding roadways both within and outside the Town limits.
 - The question is whether the increase on Fremont Avenue is an acceptable trade-off to preventing cut-through traffic on Richfield Street.
- Consequently, it appears that traffic volumes would decrease on South Richfield Street between East Easter Avenue and East Hinsdale Avenue; and
- Overall, it appears that diverted traffic would spread out to surrounding roadways resulting in a likely increase in traffic on East Easter Avenue, East Fremont Avenue, South Chapparral Circle West, and East Long Avenue.

2. What are the various types of both temporary and permanent gates or barriers that can be placed in this location and what are the costs of each?

Temporary Closure Treatments

Bollard and Chain



A bollard or fence would be placed on either side of the road and a chain would be strung across the road. The system could have break away capabilities so that, in the event of a collision, the chain would break to minimize the damage to the impacting vehicle.

- Temporary Treatment
- Cost: \$3000
- Implications
 - This treatment could hinder snow removal around the barricade, blocking clear sight to the closure.
 - Residents may be able to pass if a lock was added to the chain and all Foxfield residents were given the code/key.
 - Use dependent on approval of local emergency services. However, access could still be maintained.
 - Maintenance costs are low.

Type III Barricade



A Type III Barrier is a common traffic control device used to close roads. Type III Barriers are not attached to the road and typically weighed down by sand bags.

- Temporary Treatment
- Cost: \$1750
- Implications
 - Type III Barriers could be easily moved/vandalized, and must be kept up to MUTCD standards for reflectiveness.
 - Maintenance costs are low.
 - Snow removal around the barrier could be affected.
 - Access by residents would be restricted.
 - Use dependent on approval of local emergency services.

Concrete Jersey Barrier



Jersey Barriers (also called Class 7 Barriers) are typically found dividing highways and surrounding long term construction sites.

- Temporary Treatment
- Cost: \$750-\$2500
- Implications
 - Jersey Barriers are typically used for vehicle deflection, not in situations with the potential for head on collisions. Use of barriers could open the Town to liability issues.
 - Maintenance cost are low.
 - Barriers are a typical target for graffiti/vandalism.
 - Snow removal around the barrier would be affected.
 - Use depends on the approval of local emergency services due to closure of street access.
 - Access by residents would be restricted.

Water Barrier



Water Barriers are similar to Concrete Jersey Barriers. Unlike Concrete jersey Barriers, however, Water Barriers have more give which makes them more suitable for direct collisions.

- Temporary Treatment
- Cost: \$500-\$1000
- Implications
 - Water Barriers can be vandalized and would need to be replaced.
 - Snow removal around the barriers would be affected.
 - Use depends on the approval of local emergency services due to closure of street access.
 - Access by residents would be restricted.
 - Maintenance cost are low.

Flower/Landscape Planters

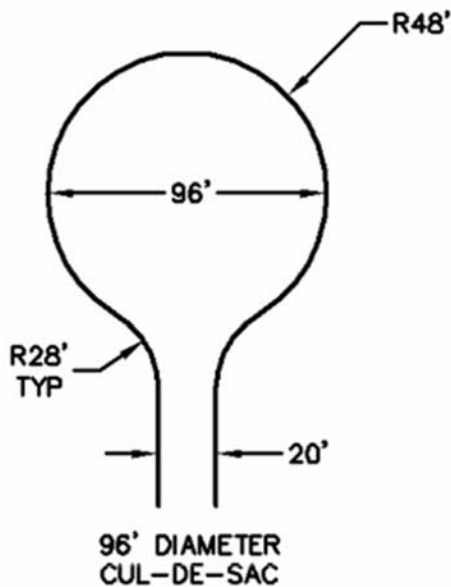


Flower/Landscape Planters are decorative barriers which are not attached to the ground. Because the planters are not connected to the ground, they have additional give like the Water Barriers.

- Temporary Treatment
- Cost: \$500-\$5000
- Implications
 - Cost of treatment is highly dependent on the choice of planter and plant.
 - Planters, depending on what is planted, require additional maintenance cost.
 - Access by residents would be restricted.
 - Snow removal around the planters would be affected.
 - Use dependent on approval of local emergency services.

Permanent Closure Treatments

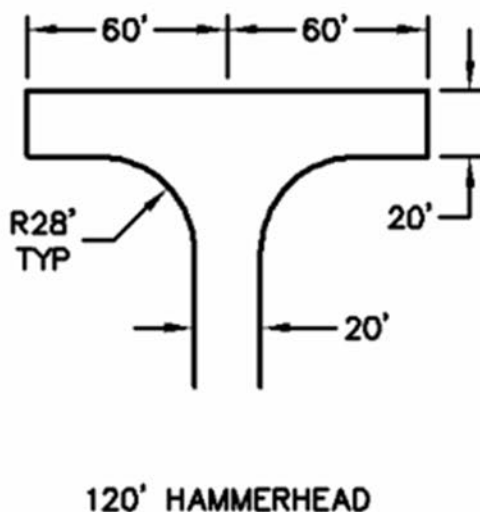
Cul de sac



A cul de sac consists of a paved road with one end open to traffic and one permanently closed by a vehicle turn around. Per Arapahoe County standards, a minimum diameter of 96 feet is required.

- Permanent Treatment
- Cost: \$40,000 - \$70,000
- Implications
 - Town would be required to purchase additional right of way (cost not included).
 - Typical roadway maintenance is required.
 - Drainage may be affected by construction.
 - Use may depend on the approval of local emergency services due to closure of street access.

Hammerhead



Paved road with one end open to traffic and one permanently closed by a vehicle turn around. Per Arapahoe County standards, a minimum length, perpendicular to the traveled path, of 120 feet is required.

- Permanent Treatment
- Cost: \$20,000 - \$30,000
- Implications
 - Town would be required to purchase additional right of way (cost not included).
 - Typical roadway maintenance is required.
 - Drainage may be affected by construction.
 - Use may depend on the approval of local emergency services due to closure of street access.

Decorative Gate (manual or automatic)



A gate serves as a barrier to traffic and could be opened either manually or electrically.

- Permanent Treatment
- Cost: \$3,200 to \$7,200
 - Does not include turnaround
 - Remote control: \$25 - \$75 ea
- Implications
 - Treatment requires turnaround.
 - **If manual**, snow storms may interfere with operating the gate
 - **If electric**, residents would need a device to open the gate.
 - **If electric**, power would need to be supplied to operate the gate.
 - Use depends on the approval of local emergency services. However, access could still be maintained
 - Maintenance costs are required.
 - Installation and contractor costs are required.
 - Gates and any accessories could be vandalized.

Barrier Gate Arm



A barrier gate arm can serve as a barrier to traffic and can be opened by a card scanner or equivalent device.

- Permanent Treatment
- Cost: \$1500 - \$3500
- Implications
 - Treatment requires turnaround.
 - Maintenance cost required.
 - Installing and powering the gate provide additional cost.
 - Gate arm and any accessories could be vandalized.
 - Use depends on the approval of local emergency services. However, access could still be maintained.

Line of Bollards



Bollards are short, thick posts which can be used to divert or exclude vehicles. A line of bollards can serve as a barrier to traffic.

- Permanent Treatment
- Cost: \$10,000 - \$11,000
- Implications
 - Treatment requires turnaround.
 - Hammerhead or cul de sac required for vehicles to turn around.
 - Maintenance costs are lower than other options.
 - Bollard faces may be vandalized
 - Use depends on the approval of local emergency services due to closure of street access.

3. What other implications are there to placing gates or barriers at this location?

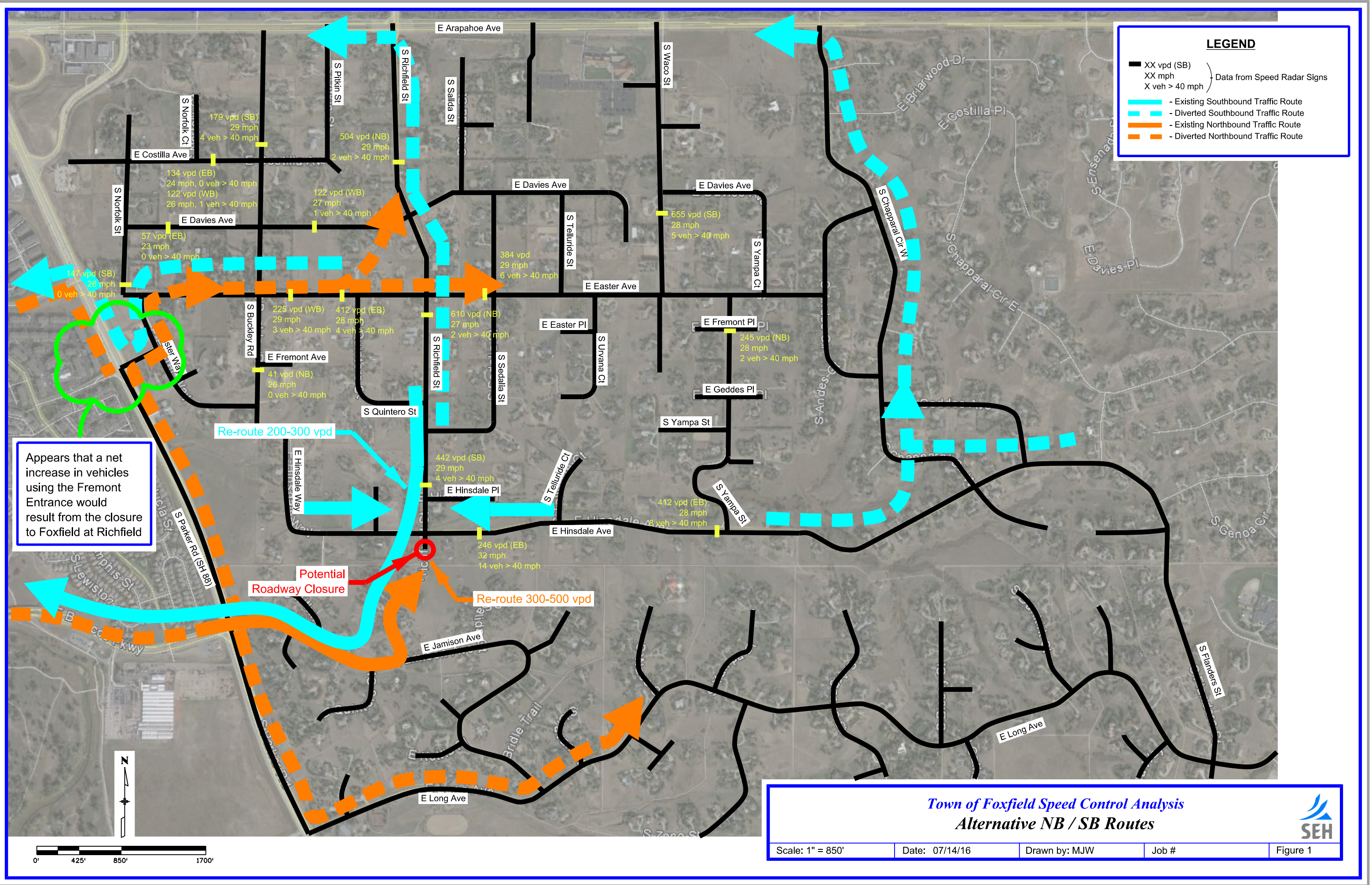
Aside from the potential for traffic diversion impacts at Fremont Avenue associated with the closing of Richfield Street, there are additional implications associated with the closing treatments as listed in each treatment above. The following is a summary of those implications:

- Local emergency services and Town resident access could be impacted depending on the treatment selected.
 - If a barrier-type treatment is used, then emergency vehicles and residents would not have access to Foxfield from Richfield Street.
 - If a gate or moveable barrier is used, then emergency vehicles and residents would still have access, but would be hindered by having to stop and wait for a gate to be opened or barrier moved.
- A closed road would necessitate the construction of a turnaround, such as a cul-de-sac or hammerhead, at a minimum on the south side of the closure.
 - If emergency vehicles have the ability to access through the closure, then a smaller turnaround could be used for residents and may fit within the existing Town right-of-way.
 - However, if a barrier blocks emergency vehicle access through the closure, then a larger turnaround meeting Arapahoe County Standards is recommended, and right-of-way acquisition would be required.
- Maintenance costs would be incurred for the new roadway pavement as well as for the road closure treatment.
- Snow removal activities could be impacted depending on the type of treatment used.
- A power source for the gated treatments would need to be identified and installed.
- Drainage would need to be considered and accommodated as part of the turnaround installations.

Please feel free to contact Jon at 303.441.5417 with any questions or comments.

jel

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MEMORANDUM

TO: Cheryl Kuechenmeister, Town of Foxfield

FROM: Jon E. Larson, PE, PTOE – Senior Traffic Engineer

DATE: July 14, 2016

RE: Town of Foxfield Speed Hump Program
SEH No. FOXFD - 136007

Based on our discussions, there is a perceived issue with drivers consistently exceeding the posted speed limit on residential roadways within the Town limits. With the present traffic volumes on the roadway, there may be significant cut-through traffic as well that contributes to the perceived speed issues. The Town is interested in determining locations throughout that could potentially benefit from speed hump installation for the purpose of reducing speeds. It is recommended that emergency services be informed prior to the installation of any traffic calming measure. We have evaluated the Town's roadways against a set of criteria to develop a list of eligible roadways where speed humps could be installed. The following table lists the roadways within the Town of Foxfield that are considered candidates for speed humps and indicates the degree to which the roadway segments might benefit from speed hump installation. The methodology and evaluation criteria are summarizing in the subsequent pages of this memorandum.

Summary of Results:

Candidate Roadway Segment	Scoring Summary				Total
	Speed Difference	# of cars > 40 mph	Traffic Volume	Cut-Through Potential	
Hinsdale Avenue e/o Richfield	5	5	1	5	16
Richfield Street s/o Arapahoe	3	1	5	5	14
Richfield Street n/o Hinsdale	3	1	5	5	14
Easter Avenue e/o Richfield	3	3	3	5	14
Hinsdale Avenue w/o Yampa	1	3	5	5	14
Richfield Street s/o Easter	1	1	5	5	12
Easter Avenue w/o Richfield	1	1	5	5	12
Buckley Road s/o Arapahoe	3	1	1	5	10
Waco Street s/o Davies	1	1	5	3	10
Easter Avenue e/o Buckley	3	1	1	5	10
Buckley Road s/o Easter	1	1	1	5	8
Yampa Street s/o Easter	1	1	1	3	6
Norfolk Street n/o Easter	1	1	1	1	4
Davies Avenue e/o Buckley	1	1	1	1	4
Costilla Avenue w/o Buckley	0	1	1	1	3
Davies Avenue w/o Buckley	0	1	1	1	3

Engineers | Architects | Planners | Scientists

Short Elliott Hendrickson Inc., 2000 South Colorado Boulevard, Suite 6000, Colorado Center Tower One, Denver, CO 80222-7938

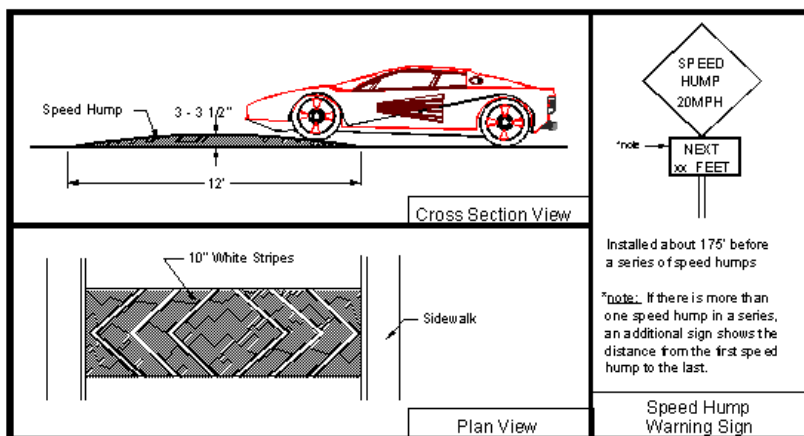
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Speed Humps vs. Speed Bumps

A speed hump is a raised area in the roadway pavement surface extending transversely across the travel way. Agencies typically implement speed humps with a height of 3 to 3.5 inches and a travel length of 12 to 14 feet. Speed humps are generally used on residential local streets. A speed bump is also a raised pavement area across a roadway. Speed bumps are typically found on private roadways and parking lots and do not tend to exhibit consistent design parameters from one installation to another. Speed bumps generally have a height of 3 to 6 inches with a travel length of 1 to 3 feet.

Speed humps and bumps have significantly different impacts on vehicles. Within typical residential operational speed ranges, vehicles slow to about 20 mph on streets with properly spaced speed humps. A speed bump, on the other hand, causes significant driver discomfort at typical residential operational speed ranges and generally results in vehicles slowing to 5 mph or less at each bump.

The focus of this evaluation will be with an eye toward the appropriate installation of speed humps to slow vehicles at or below the Town's posted speed limits of 25 mph. The following exhibit illustrates a detail for a speed hump.



Evaluation Criteria

To evaluate the potential speed hump projects within the Town, first, each roadway was screened against a preliminary set of roadway characteristics typically used in determining whether a roadway should be considered a candidate for speed hump installation. Then, after the initial screening, each roadway was ranked according to a separate set of criteria established in this section. Roadway sections were assigned points on the basis of existing speeds, volumes, and cut-through potential. The roadway segments accumulating the greatest number of points were considered to have the highest benefit derived from speed hump installation.

Candidate Criteria (Initial Screening)

The following criteria were developed using various speed hump program guidelines used by other agencies throughout the country, as well as from the *“Updated Guidelines for the Design and Application of Speed Humps”* (Institute of Transportation Engineers, 2007) research paper. All candidate criteria below must be met to pass the initial screening phase of this evaluation. A summary of the initial screening is illustrated on Figure 1.

- Functional Classification = local residential or minor collector;
- Posted Speed Limit = 30 miles per hour or less;
- Two-lane roadway;
- Traffic Volumes less than 4,000 ADT;
- Continuous roadways (Not a cul-de-sac);
- Roadway segment length of ½-mile or more; and
- Roadway curvature = 300-foot radius or more.

Prioritization Criteria

Speed and volume data were collected by the Town through the use of Foxfield's radar signs posted on various roadways throughout the Town. The speed and volume data was used in the evaluation where information was available.

- **Speed Criteria.** The speed criteria consists of two separate scoring elements. The first considers the magnitude number of vehicles driving above 40 mph and the second considers the difference between the average 85th-percentile speed collected by Foxfield's radar signs during 2015 and 2016. (85th-percentile speed is the speed at or below which 85 percent of the drivers are traveling). The speed difference between the 85th-percentile speed and the posted speed limit was used in the criteria scoring.

Speed Difference Between 85th %-ile Speed and Posted Speed Limit (mph)	Points Assigned
Below Zero	0
0 - 3	1
4 - 5	3
Above 5	5

# of Vehicles > 40 mph	Points Assigned
0 - 5	1
6 - 10	3
> 10	5

- **Traffic Volume Criteria.** One way daily traffic volumes are considered.

Daily Volume (One Way)	Points Assigned
< 250 vpd	1
251 - 400 vpd	3
> 400 vpd	5

- **Cut-Through Potential.** Cut-through was evaluated based on the connectivity of the residential roadways through the Town of Foxfield. Low connectivity roadways would have the lowest potential for cut-through traffic and would not provide a continuous route through the entire Town. High connectivity roadways would have a route continuous across the Town limits. Medium connectivity roadways provide a route continuous across approximately half of the Town limits (ex. Davies Avenue).

Cut-Through Potential	Points Assigned
Low	1
Medium	3
High	5

Results

The following table summarizes the scoring results for the roadways segments and indicates the degree of the potential for speed humps to be beneficial in reducing speeds.

Candidate Roadway Segment	Scoring Summary				Total
	Speed Difference	# of cars > 40 mph	Traffic Volume	Cut-Through Potential	
Hinsdale Avenue e/o Richfield	5	5	1	5	16
Richfield Street s/o Arapahoe	3	1	5	5	14
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Norfolk Street n/o Easter	1	1	1	1	4
Davies Avenue e/o Buckley	1	1	1	1	4
Costilla Avenue w/o Buckley	0	1	1	1	3
Davies Avenue w/o Buckley	0	1	1	1	3

Other Considerations

Spacing and Location

Speed humps will usually be placed between 200 feet to 600 feet apart. Other spacing may be used based upon engineering judgment. The following may provide guidance when determining speed hump spacing.

1. On single short blocks (300 ft. to 500 ft.) a single hump positioned near mid-point is usually sufficient.
2. On single blocks of moderate length (500 ft. to 1000 ft.) a two hump configuration is usually adequate.
3. On very long blocks (1000 ft. to 1600 ft.) three or more humps may be necessary.
4. On lengthy continuous street segments or for humps provided over a series of blocks, interior bumps may be placed 400 ft. to 600 ft. apart

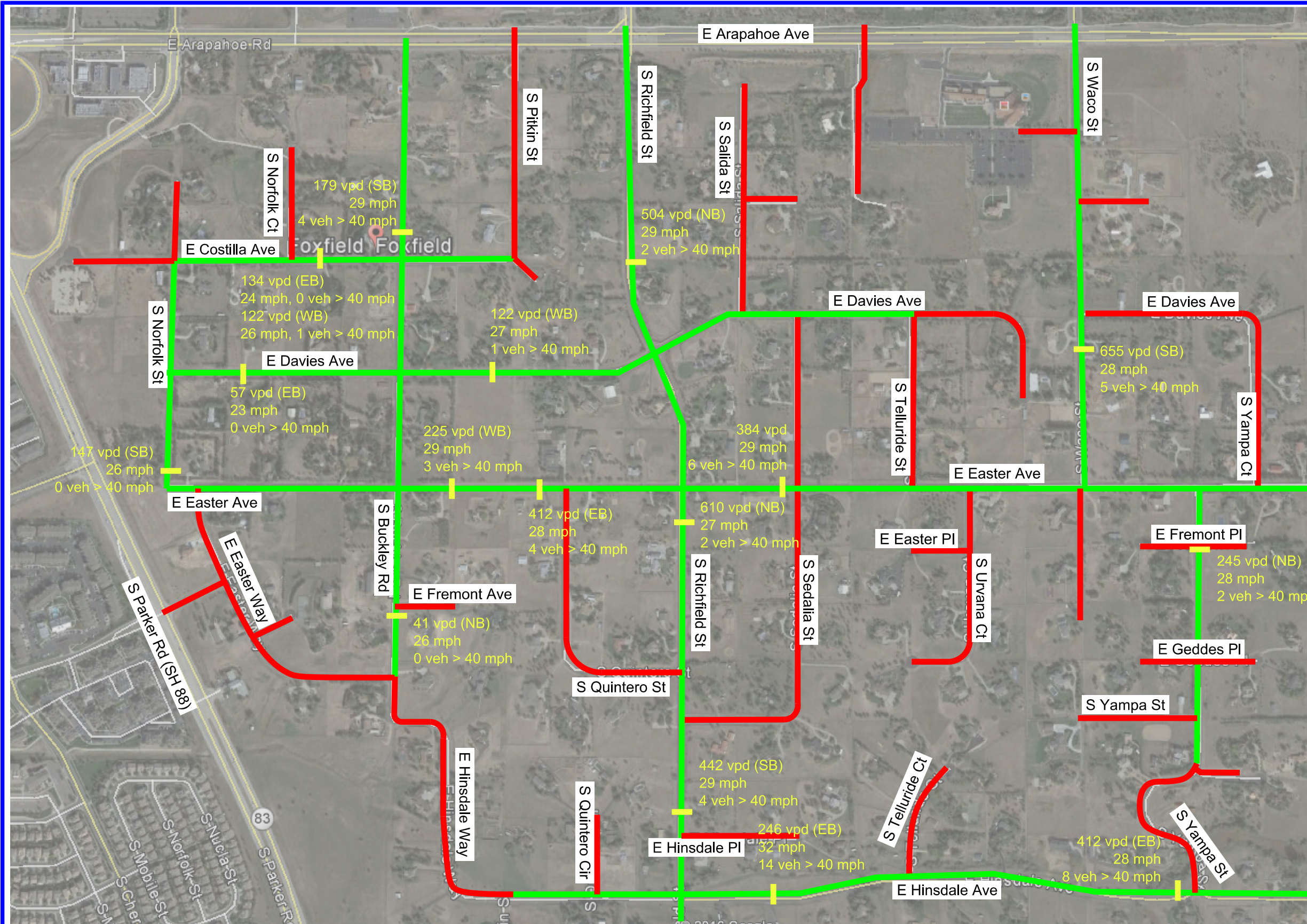
Cost

Speed humps cost vary significantly and are a function of site conditions and the geometry of the speed hump. Costs range from \$2,500 to \$7,500 to install.

Please feel free to contact Jon at 303.441.5417 with any questions or comments.

jel

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LEGEND

Vehicles / Day (vpd) - ~ADT (one way)

mph - 85th %ile Speed

Red = Not considered beyond initial screening

Green = Carried forward as candidate for speed hump

