

# **TRAFFIC OPERATIONS POLICIES AND PROGRAMS**

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## INTRODUCTION AND BACKGROUND

The goal of Arapahoe County Traffic Operations is to enhance the safety and efficiency of the County's transportation network. This is accomplished through the practice of traffic engineering while following applicable guidelines, laws, and best management practices combined with engineering judgement. The County follows the federal Manual on Uniform Traffic Control Devices (MUTCD) through the Colorado Model Traffic Code as adopted by Colorado Revised Statutes (CRS) 42-4-104 and is empowered to place and maintain traffic control devices within its jurisdiction by the authority granted in CRS 42-4-105.

The purpose of the Traffic Operations Policies and Programs Manual is to provide guidance to County Staff for execution of their duties during their decision making process in order to have standard, consistent, appropriate, and warranted traffic engineering measures in place throughout the County. This document is made publicly accessible to provide information and transparency to County residents and patrons regarding Staff actions.

The efforts of Traffic Operations support the County's goals as defined in the Strategic Plan, including to be fiscally sustainable, provide essential and mandated services, and to be community focused. Traffic Operations has its own Goals which are based on the County's overall goals:

- Manage the existing transportation system to ensure safe and efficient operation through participation in the Traffic Signal Control System as part of the National Intelligent Transportation System architecture.
- Respond in a timely manner to the public and other jurisdictional entities in matters of traffic safety, traffic trends, transportation plans and planning efforts.
- Maintain and enhance where possible the basic accessibility and efficient mobility for present and future residents of the county and surrounding jurisdictions, by continually evaluating strategies for upgrading the existing traffic signal capabilities to match real-time traffic patterns / volumes.
- Guide improvement programs to ensure a continuing review and update of transportation facility needs and classification.
- Provide appropriate direction to land developers such that all new developments have proper signal, sign and striping components in their traffic control plans.
- Continue to implement the programs within the neighborhoods to more effectively address localized traffic related concerns.
- Make timely amendments to the transportation plan as needed to maximize multi-department, multi-jurisdictional and region-wide transportation opportunities.

The first section of this document reflects information around regular day to day operations and the criteria that support the decision-making process for placement of traffic control devices. Specific relevant programs provided by Traffic Operations or others are described in the second section of this document.

Traffic Operations is responsible for the design, implementation, operation, and coordinating maintenance of publicly owned traffic control devices, accepted for public maintenance, in the

unincorporated areas of Arapahoe County right of way. These devices include, but are not limited to:

- Traffic signs
- Pavement markings
- Warning beacons and flashing signs
- Crosswalks and other pedestrian enhancements
- Radar speed limit feedback signs
- Traffic signals
- Multimodal facilities (bicycles, mobility devices, etc.)
- All other traffic control devices

Additionally, Traffic Operations is responsible for the design, implementation, operation, and maintenance of Intelligent Transportation Systems (ITS). ITS efforts provide a foundation for Smart County/Smart Community efforts, support the County and Traffic Operations goals, and include, but are not limited to:

- Traffic cameras, multiple types
- Travel time reporting for arterial roadways
- Data collection and analysis
- Fiber optic and network communications infrastructure for transportation related items
- School Zone Flashing Beacons

Traffic Operations also frequently coordinates efforts between other County and non-County agencies to resolve specific issues as needed. These important stakeholders can include Police and Fire, school districts, other City and County governments, the Denver Regional Council of Governments (DRCOG), the Colorado Department of Transportation (CDOT), utility companies, homeowner's associations (HOAs), business parks, private contractors, private consultants, developers, and other private businesses.

## **POLICIES**

## 1. DAY TO DAY PUBLIC RESPONSE

### 1. Background, Definitions, and References

- a. The Traffic Operations Section receives a very large number of citizen/public requests for various traffic related issues. These requests are handled in various ways ranging from simple telephone conversations to traffic engineering investigations involving site analysis. In most cases, if an actual traffic engineering investigation is required, the request is initiated by the applicant contacting the County Staff, who then input a service request. The request is assigned a case number for tracking and then forwarded to the Traffic Operations Staff for evaluation/response.

### 2. Policy Statement

- a. Initial acknowledgement of the public request for information or action to the requesting party shall occur within no more than three (3) business days from contact with the County.
- b. Timeframes for final responses to public requests for installation of traffic control devices may vary widely depending on the nature of the request and what level of traffic engineering investigation or study may be required. Budget and funding availability can also impact the potential timeframe for design and installation of traffic engineering measures even if a request is approved. Future approved infrastructure items not able to be funded and constructed immediately shall be input into a prioritized project list for planning and programming efforts.
- c. The information in the previous section shall be communicated to the requesting party early in the request process, and the final disposition of the request shall be communicated to the requesting party in as timely a fashion as possible given the above. Decisions and communication of decisions will be documented in Traffic's tracking system.

### 3. Examples of Applications

- a. See the County's Traffic Operations Frequently Asked Questions (FAQ) and educational information located here: <https://www.arapahoegov.com/650/Traffic-Operations-Educational-Information> for more information regarding typical topics and some sample answers.
- b. Memorial Erected by a Private Party: These types of installations are not permitted within the public right of way. The County has adopted the Model Traffic Code for Colorado. Part 6 Signals, Signs and Markings of the Model Traffic Code, Section 606 states display of unauthorized signs or devices provides for local authority to remove such signs and devices without providing notice. Because of the emotional significance represented by memorials placed in memory of a deceased person, County Staff encountering such memorials will make every effort to identify the owner and try to work with them on finding an alternate location within private property for this memorial. If an alternate location is not available, County Traffic Operations Staff shall require the owner to remove the unauthorized sign or memorial and as an alternative, pursue the County's Memorial Sign Program to remember and honor the life of a loved one. If

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the owner cannot be located, County Traffic Operations Staff shall have the Road and Bridge Division remove the signs or roadside memorials if they create a visibility concern or hazard in the public right-of- way. The items removed shall be kept and stored for two weeks from the date of removal to allow the owner the opportunity to claim and pick up the items.

4. Associated Program List
  - a. Neighborhood Traffic Management Program
  - b. Memorial Sign Program
  - c. Neighborhood Block Party Program

## **2. TRAFFIC ENGINEERING INVESTIGATIONS AND STUDIES**

### **1. Background, Definitions, and References**

- a. As part of responding to citizen/public requests, Traffic Operations Staff determine the level of traffic engineering investigation necessary for the circumstances. In some case, it is necessary to conduct a more comprehensive traffic engineering investigation. Often this results in Staff conducting an engineering study. Engineering studies are also typically part of project designs and analysis as needed for development activities and/or infrastructure improvement projects, among others.
- b. The Manual on Uniform Traffic Control Devices (MUTCD), issued by the Federal Highway Administration, adopted by the State of Colorado, and by Arapahoe County through the State “Model Traffic Code”, defines an Engineering Study as “the comprehensive analysis and evaluation of available pertinent information, and the application of appropriate principles, provisions, and practices as contained in this Manual and other sources, for the purpose of deciding upon the applicability, design, operation, or installation of a traffic control device. An engineering study shall be performed by an engineer, or by an individual working under the supervision of an engineer, through the application of procedures and criteria established by the engineer. An engineering study shall be documented.”
- c. The MUTCD also provides guidance that decisions around the selection and location of traffic control devices should be made on the basis of either an engineering study or the application of engineering judgment.
- d. The MUTCD defines Engineering Judgment as “the evaluation of available pertinent information, and the application of appropriate principles, provisions, and practices as contained in this Manual and other sources, for the purpose of deciding upon the applicability, design, operation, or installation of a traffic control device. Engineering judgment shall be exercised by an engineer, or by an individual working under the supervision of an engineer, through the application of procedures and criteria established by the engineer. Documentation of engineering judgment is not required.”

### **2. Policy Statement**

- a. Arapahoe County Traffic Operations will conduct engineering studies and/or review of others’ engineering study applications to the County and apply engineering judgment, as defined in the MUTCD, consistent with the guidance contained within the MUTCD and other relevant engineering standards and practices.

### **3. Examples of Applications**

- a. Information regarding traffic volumes, crash history, and other relevant data may be included in consideration for application of this policy item. Output from this policy item may be applied to other policy items such as the Day to Day Public Response and to associated programs such as the Neighborhood Traffic Management Program. Traffic engineering investigations have widespread applicability.

### **4. Associated Program List**

- a. Neighborhood Traffic Management Program

- b. Traffic Volume Count Program
- c. Crash Analysis Program



### 3. TRAFFIC SIGNS

#### 1. Background, Definitions, and References

- a. To ensure uniformity, the federal Manual on Uniform Traffic Control Devices (MUTCD) defines which signs are approved for use on the roadway network. This includes the type, color, shape, legend/symbols, lettering, size, retroreflectivity, and illumination requirements for each sign as well as placement guidelines.
- b. The purpose of a sign is to convey clear, reliable information and guidance so there will be an orderly and predictable movement of traffic. The three basic types of signs are regulatory, warning, and guide and the intended use for each type is summarized below.
- c. Regulatory: is used to inform users of traffic laws and regulations which apply at definite locations and at specific times. Typical uses are:
  - i. Intersection control
  - ii. Definition of right-of-way
  - iii. Speed limits
  - iv. Turning movement control
  - v. Pedestrian control
  - vi. Exclusions and prohibitions
  - vii. Parking control and limits
  - viii. Regulations for maintenance and construction
- d. Warning: is used to warn traffic of unusual or potentially hazardous condition(s) on or adjacent to a street or highway. Typical uses are:
  - i. Horizontal and vertical alignment (curves, turns, hills, etc.)
  - ii. School areas
  - iii. Crossings and entrances to streets, highways and freeways
  - iv. Intersection areas
  - v. Road construction and maintenance
- e. Guide: is used to provide simple and specific information to aid roadway users in reaching their destination. Typical uses are:
  - i. Route markings
  - ii. Destination signing
  - iii. Information Signing
  - iv. General services
  - v. Parks and recreation signing

#### 2. Policy Statement

- a. Arapahoe County Operations Staff will review existing and/or authorize the installation of new signs as specified in the federal Manual on Uniform Traffic Control (MUTCD). Federally approved traveler information signs and other ITS related devices used to heighten awareness of a condition will be considered on a case by case basis. The warrants and placement guidelines for all standardized signs are contained in the MUTCD. These guidelines are straightforward and apply to most situations.
- b. Maintenance of traffic control devices should be to high standards to assure that legibility is retained, that the device is visible, and that it is removed if no longer needed. A sample section of the traffic signs is inspected annually by Arapahoe

County Staff, in day and night time conditions. This is to assure that these standards are being met, and manage a large sign inventory prioritized for replacement. County signs that are graded as poor will be scheduled for replacement as soon as possible, whereas grades of fair, good or new/excellent will be prioritized on availability in future.

- c. Before each County sign is installed in the field, a trained Staff member takes 3 retro readings on the sign to be installed with a County owned Retro Sign GR3 Retroreflectometer.
  - d. Background and Legend readings are recorded and written on the back of the sign at the time of County Staff sign installation. The reading is also stored in the County asset management software.
  - e. Additional details regarding Traffic Sign requirements may be found in the County's Specifications for Traffic Materials and Testing in the Signs subsection and in the County's Sign Details within ROW, located here: <https://www.arapahoegov.com/DocumentCenter/View/10348/Arapahoe-County-Sign-Details-within-ROW>.
3. Examples of Applications
- a. Street Name Sign Placement
    - i. Stop Controlled Intersections: Street name signs shall be placed above the stop signs at a two-way stop controlled intersections. When the main street is a north/south street the street name signs will be placed on the northeast and southwest corners. When the main street is an east/west street the street name signs will be placed on the northwest and southeast corners. When the intersection is controlled by an all-way stop the signs will only be placed on the northeast and southwest corners.
    - ii. T-intersections, Right Angle Intersections and Curved Alignment: Only one location will require a street name sign in these locations. The street name signs shall be located above the stop sign at T-intersections. Right angle intersections will have the sign located on the inside corner of the curve, and likewise for the curved alignment.
    - iii. Signalized Intersections: Street Name signs shall be placed overhead on the traffic signal mast arm at signalized intersections.
  - b. Multi-way Stops
    - i. The decision to install multi-way stop control should be based on an engineering study as defined in the federal Manual on Uniform Traffic Control Devices (MUTCD).
    - ii. Stop signs should not be used for speed control, per MUTCD guidance.
    - iii. Additional information and criteria regarding the installation of multiway stops can be found in Section 2B.07 of the MUTCD.
    - iv. Further information can also be found in the County's Traffic Operations Frequently Asked Questions (FAQ) and educational information located here: <https://www.arapahoegov.com/650/Traffic-Operations-Educational-Information>.
  - c. Private Roadways
    - i. Consistent with the guidance and definitions provided within the federal Manual on Uniform Traffic Control Devices (MUTCD), private roadways

within the County's jurisdiction shall be subject to the same sign placement and specification requirements as public roadways. The owner/operator of a private roadway shall be responsible for permitting, installing, owning, and maintaining any such signage or other traffic control devices.

- d. Specialty Warning Signage
  - i. Specialty warning signage such as Deaf Child, Blind Child, Special Needs Child, etc., will not be installed. This type of signage is not included in the federal Manual on Uniform Traffic Control Devices (MUTCD) as available standard signage, and the County does not install non-MUTCD-compliant signage. Additionally, these signs may provide a false sense of security for the parents and child. They are not typically effective at capturing motorist attention, changing any driver behavior, nor are they clearly understood what action should be taken by an informed driver. These signs are not regulatory and there is no enforcement condition possible. The County expects that drivers should remain aware of all pedestrians, including children, in residential neighborhoods at all times regardless of warning signage. Children should also be discouraged by their guardians from playing in or near the roadway for their own safety.
  - ii. Further information can also be found in the County's Traffic Operations Frequently Asked Questions (FAQ) and educational information located here: <https://www.arapahogov.com/650/Traffic-Operations-Educational-Information>.
- e. Non-standard Signage
  - i. Non-standard signs, such as "CAUTION – CHILDREN AT PLAY", "SLOW – CHILDREN", etc., will not be installed. This type of signage is not included in the federal Manual on Uniform Traffic Control Devices (MUTCD) as available standard signage, and the County does not install non-MUTCD-compliant signage. Additionally, the referenced examples infer that children are permitted to play in the street. On the contrary, every means should be used to discourage children from playing in a roadway.
  - ii. Further information can also be found in the County's Traffic Operations Frequently Asked Questions (FAQ) and educational information located here: <https://www.arapahogov.com/650/Traffic-Operations-Educational-Information>.
- 4. Associated Program List
  - a. Memorial Sign Program
  - b. Neighborhood Traffic Management Program

## 4. PAVEMENT MARKINGS

### 1. Background, Definitions, and References

- a. To ensure uniformity, all pavement markings shall be installed in accordance with the standards and latest revisions of the MUTCD and all other applicable state and local standards.
- b. The purpose of pavement markings is to provide guidance and information for the road user.
- c. Pavement markings shall include but not be limited to lane lines, crosswalks, arrows, bicycle symbols, worded messages, etc.

### 2. Policy Statement

- a. All pavement marking materials including methods of installations and removals shall meet the requirements included in the County's Specifications for Traffic Materials and Testing, Pavement Markings subsection.
- b. Arapahoe County Traffic Operations Staff shall make the final determination with regards to the type and location of pavement markings and striping within the right-of-way during reviews of project signing and striping plans.
- c. The party responsible for installation of pavement markings shall obtain County "Sign Stripe and Signalization Permit" or "Street Cut and Right of Way Use", or other permit for documentation as deemed appropriate (by Arapahoe County Staff for project) which includes an appropriate temporary traffic control plan. Typical temporary traffic control plans and devices shall be MUTCD compliant. The responsible party shall provide all permitted temporary traffic control devices consistent with the plan, which may include flaggers, signs, barricades, cones, or other work zone traffic control devices needed to ensure sufficient safety for all relevant modes of traffic including but not limited to vehicles, bicycles, and/or pedestrians.
- d. When parked vehicles interfere with the installation of any pavement markings, the party responsible for installation of the pavement markings shall provide a minimum of three (3) day advance notification to an affected homeowner, tenant, or business in order to allow for vehicle removal. The County has adopted Ordinance No. 2020-03 which establishes temporary no parking zones for Arapahoe County initiated projects under these conditions and which can be found here: [https://www.arapahoegov.com/DocumentCenter/View/11284/Temporary-No-Parking-Zones\\_2020-03?bidId=](https://www.arapahoegov.com/DocumentCenter/View/11284/Temporary-No-Parking-Zones_2020-03?bidId=)
- e. The cleanup of any tire tracking of paint shall fall to the party responsible for installation of the pavement markings.

### 3. Examples of Applications

- a. Symbols and Legends: The use of preformed pavement markings shall be used with the installation of all symbols and legends such as: all arrows; "ONLY"s; "SCHOOL X-ING"s; bicycle symbols; "RR X-ING"s; etc., on new and overlay streets.
- b. Crosswalks

- i. Standard Crosswalk: White 8' long x 1' wide "Continental" or standard style bars. The placement of these bars shall be 6' center to center spacing and avoid vehicle wheel tracks as much as possible.
    - ii. Transverse Crosswalk: Where applicable, shall be a white 1' Crosswalk bar on both sides of the designated walkway area, and shall be installed across the full asphalt or concrete width of the roadway with the exception of the gutter pans.
  - c. Stop Bars
    - i. Stop bars are required at all signalized intersections. Other locations could require stop bars as directed by the County Traffic Operations Staff.
    - ii. All stop bars shall be white and 2' wide, extending the full width of the appropriate travel lane including the designated bike lane, but not closer than 4' from the closest edge of the pedestrian crossing whether marked or unmarked.
  - d. Bicycle Markings shall be consistent with the MUTCD, the Arapahoe County Bicycle and Pedestrian Master Plan, and as reviewed by County Traffic Operation Staff. The Bike Master Plan can be found here: <https://www.arapahoegov.com/1594/Bicycle-and-Pedestrian-Master-Plan>
  - e. Stencil Painting: All stencils used shall conform to MUTCD standards for shapes and sizes.
- 4. Associated Program List
  - a. Neighborhood Traffic Management Program
  - b. Arapahoe County Bicycle and Pedestrian Master Plan
  - c. Arapahoe County Bicycle and Pedestrian Design Guide

## **5. WARNING BEACONS AND FLASHING SIGNS**

1. Background, Definitions, and References
  - a. Beacons and flashing signs are used to supplement an appropriate warning or regulatory sign/marker when it is necessary to attract more driver attention and to ensure a high probability of driver compliance.
  - b. The various design and placement requirements for these items are contained in the MUTCD.
2. Policy Statement
  - a. Arapahoe County will install a flashing beacon if it is deemed appropriate based on an engineering study.
3. Examples of Applications
  - a. Obstructions in or immediately adjacent to the roadway
  - b. Supplemental or integral to advance warning signs
  - c. At intersections where warning is required (e.g. limited sight distance)
  - d. Intersection Control Beacons, as defined in the MUTCD
  - e. Supplemental or integral to regulatory signs, except the YIELD and DO NOT ENTER signs
  - f. School zones:
    - i. Arapahoe County will only fund for and install/maintain flashing beacons for school zones when 2 or more of the following criteria are met OR will allow for the installation of flashing beacons in school zone areas if the devices are funded with other than County funds (i.e., local school district, etc):
      1. Pedestrian Volume: at least 60 school age pedestrians crossing during a 2-hour period of a typical school day; or
      2. Vehicle Volume: at least 600 vehicles per hour during a period that students cross the street; or
      3. Vehicle Speed: where the prevailing speed of vehicles approaching the potential beacon location is in excess of 35 mph; or
      4. Crossing Opportunity: There is no other crossing controlled by a signal, stop sign, or crossing guard within 800 feet of the proposed location; or
      5. Geometry: Where appropriate required sight distance is not available.
    - ii. The school flashers will be used in combination with an advance warning sign and/or school speed zone signing. The operation of the beacons will be based on procedures contained in the MUTCD.
4. Associated Program List
  - a. Neighborhood Traffic Management Program
  - b. Crash Analysis Program

## 6. CROSSWALKS AND ENHANCEMENTS

### 1. Background, Definitions, and References

- a. The primary purpose of marked crosswalks is to guide pedestrians in a proper path when crossing the street. Crosswalks can be designated at controlled intersections, uncontrolled intersections, or mid-block locations. When no control is provided, the crosswalks also serve as a warning to motorists that a pedestrian crossing point exists. With uncontrolled crossings, advance warning signs are required.
- b. Crosswalks should be considered whenever there is a clear need for increased visibility and designation of a crossing area. Marked crosswalks are found at:
  - i. Signalized intersections equipped with pedestrian signals
  - ii. Designated school crossings
  - iii. Crossings at two-way and multi-way stop intersections
  - iv. Intersection crossings with unusual geometric design where the pedestrian path is confusing and could lead to potential conflict
- c. CRS 42-1-102 (21) specifies that a crosswalk is defined by the area in the roadway that is either the prolongation of sidewalks at intersections, or any area defined by lines or other markings.
- d. Like other traffic control devices, crosswalk markings and their associated enhancements should be installed consistent with the principles of the federal Manual on Uniform Traffic Control Devices (MUTCD). Specifically, to be effective, a traffic control device should meet five basic requirements:
  - i. Fulfill a need;
  - ii. Command attention;
  - iii. Convey a clear, simple meaning;
  - iv. Command respect from road users; and
  - v. Give adequate time for proper response.
- e. Too many marked crosswalks too close together can violate these requirements and result in a less safe environment for both crosswalk users and roadway users than when these requirements are appropriately applied.

### 2. Policy Statement

- a. Arapahoe County will use the following guidelines for marked crosswalks:

<u>Functional Classification</u>	<u>General Requirement</u>	<u>Specific Locations</u>
Arterial Streets	Controlled Intersections	Signalized intersections which are equipped with pedestrian signals.  Multi-way stop intersections which are designated as approved school crossings.  Roundabouts

Collector Streets	Controlled and Uncontrolled Intersections	<p>Signalized intersections which are equipped with pedestrian signals.</p> <p>Any intersection which is designated as an approved school crossing.</p> <p>Any intersection which meets the County's warrants.</p> <p>Roundabouts</p>
Local Streets	Controlled and Uncontrolled Intersections and Mid-block Locations	<p>Any location which is designated as an approved school crossing.</p> <p>Any location which meets the County's warrants.</p> <p>Roundabouts</p>

- b. Both Advance and Crossing signs should be used in conjunction with designated crosswalks and in accordance with the MUTCD. Crossing signs will not be used at crosswalks that have stop sign control.
3. Examples of Applications
    - a. Approved School Crossings: In order for Arapahoe County Traffic Operations Staff to designate a location as an approved school crossing, the school district MUST submit to the County a school-age pedestrian probable route map(s). The designated route(s) should be designed to assure that the children:
      - i. Form into a group as soon as possible to be more readily visible to motorists.
      - ii. Cross the fewest number of streets to reduce vehicle/pedestrian exposures. When determining which streets to cross, factors such as vehicle approach speeds, traffic volumes, and road geometry should be considered.
      - iii. Walk on sidewalks or paths where available.
      - iv. Walk the shortest possible distance on streets without sidewalks or shoulders.
      - v. Avoid high speed, high volume roadways.
      - vi. Make maximum use of protective techniques (crossing guards, traffic control devices).
      - vii. Use easements with walkways through parks or other available areas where student safety is maximized.
      - viii. County Traffic Operation Staff will then review the plans and work with School District personnel in determining which crossings should be marked and signed. Engineering judgment which considers factors such as the number of children crossing, the location of crossing with respect to the school, and the physical characteristics of the area will be used in making the final decision.
    - b. Non-School Related Marked Crosswalks:



- i. The Arapahoe County warrants for non-school related marked crosswalks are listed below:

Functional Classification	Street Volume <sup>(1)</sup>	Pedestrian Crossing Volume <sup>(2)</sup>	Posted Speed Limit
Arterial	600	50	35+ MPH
Collector	300	25	25-35 MPH
Local <sup>(3)</sup>	100	15	20-30 MPH

<sup>1</sup>Minimum traffic volume for a 1-hour period.

<sup>2</sup>Minimum pedestrian volume for the same 1 hour period

<sup>3</sup>The warrants for a local street only apply to a crossing which serves a recreational area or provides continuity in a trail system.

- ii. Note: Not all conditions/areas may relate to the above criteria for non-school related crosswalks. Engineering judgement should be used where the above conditions cannot be met but may justify marked crosswalks (i.e., parks, seasonal recreation areas, etc.). The MUTCD, however, should be used as a guideline to any crosswalk considerations. MUTCD design sign standards and specifications shall always apply.
- c. Rectangular Rapid Flashing Beacons (RRFBs):
  - i. Marked crosswalks can be further enhanced with additional devices of several types. Pedestrian pushbutton-activated RRFBs, which use static warning signage in combination with rectangular yellow LED arrays that flash in an alternating pattern for a specific amount of time when activated, can provide for additional driver awareness of the presence of a crosswalk user.
  - ii. The MUTCD provides guidance and specific conditions regarding the configuration and operations of RRFB systems. The County shall comply with the MUTCD guidance and conditions.
  - iii. The installation of RRFBs at a marked crosswalk location or as part of the installation of a marked crosswalk shall only be considered as the result of a traffic engineering study as defined in Section 2 of this document. Existing and future conditions such as roadway type and geometry, types and volumes of pedestrians, nearby destinations, etc., may be considered as part of the traffic engineering study.
  - iv. Design and installation of RRFBs shall be subject to approval by County Traffic Operations Staff, funding availability, and overall prioritization.
- d. Pedestrian Hybrid Beacons:
  - i. Pedestrian hybrid beacon systems can also be utilized to provide increased awareness and control at a marked crosswalk location without the need to install a traditional midblock traffic signal.
  - ii. The MUTCD provides guidelines for the installation and requirements for the configuration and operations of a pedestrian hybrid beacon system. The County shall comply with the MUTCD guidance and requirements.

- iii. The installation of a pedestrian hybrid beacon system at a marked crosswalk location or as part of the installation of a marked crosswalk shall only be considered as the result of a traffic engineering study as defined in Section 2 of this document. Existing and future conditions such as roadway type and geometry, types and volumes of pedestrians, nearby destinations, etc., may be considered as part of the traffic engineering study.
- iv. Design and installation of a pedestrian hybrid beacon shall be subject to approval by County Traffic Operations Staff, funding availability, and overall prioritization.

4. Associated Program List

- a. Neighborhood Traffic Management Program
- b. Traffic Volume Count Program
- c. Crash Analysis Program
- d. Arapahoe County Bicycle and Pedestrian Master Plan
- e. Arapahoe County Bicycle and Pedestrian Design Guide

## 7. SPEED LIMITS

### 1. Background, Definitions, and References

- a. In the state of Colorado, the following speed limits are mandated by Colorado Revised Statutes if no special hazards exist and there are no otherwise posted limits:
  - i. 25 MPH in any business district
  - ii. 30 MPH in any residential district
  - iii. 55 MPH on paved highways
- b. The maximum safe speed, however, is defined as follows: “No person shall drive a vehicle at a speed greater than is reasonable and prudent under the conditions and having regard to the actual and potential hazards then existing. Consistent with the foregoing, every person shall drive at a safe and appropriate speed when approaching and crossing an intersection or railroad grade crossing, when approaching and going around a curve, when approaching a hill crest with respect to pedestrians or other traffic or by reason of weather or highway conditions.”
- c. As specified in the State Statutes, a local jurisdiction has the authority to change the above speed limits if the adjustment is warranted based on an engineering study. During the study at a minimum the following factors should be considered.
  - i. Road surface characteristics, shoulder condition, cross section, grade alignment, and available sight distance.
  - ii. The 85-percentile speed and pace speed.
  - iii. Roadside development and culture, and roadside friction.
  - iv. Number and placement of accesses
  - v. Safe speed for curves or hazardous locations within the zone.
  - vi. Parking practices and pedestrian/cyclist activity.
  - vii. The most recent reported crash experience for a recent 12-month period.
- d. In all cases, the maximum posted speed limit cannot exceed 55 MPH. In a school area, special speed limits can be set for certain hours or periods of the day. These speed limits cannot be less than 25 MPH on a State Highway or arterial nor less than 20 MPH on any other road or street. These special speed limits only apply at times when the special condition exists.

### 2. Policy Statement

- a. The appropriate State Statutory speed limits will apply on all County roads unless otherwise posted. The posted speed limit, if different from the statutory limit, will be based on the findings of a detailed engineering study.
- b. In all school zones (i.e. Elementary, Middle School and High School) within the County, the minimum posted speed limit will be 20 MPH. This limit will only apply during hours of activity defined by the School District and evaluated by County Traffic Operation Staff. Specific hours of applicability will be shown with the speed limit sign instead of “When Children are Present”. Experience has shown that the listing of specific hours is easier to enforce and is more readily understood by the motorists. The extent of the posted school speed zone will be determined during the detailed engineering study.
- c. For any speed limit evaluation, the results of an engineering study as defined above, coupled with engineering judgment and input from interested parties, will be used

in determining the appropriate speed limit. This may result in an increase to the posted speed, a decrease in the posted speed, or no change to the posted speed.

### 3. Examples of Applications

#### a. Spacing of Regulatory Speed Limit Signs

- i. Two considerations are predominant: speed limits need to be repeated more frequently in urban settings than in rural; and repetition of speed limit signs is important when the speed limit is less than the norm for the class of road that is being signed.
- ii. Per Section 2B.13 of the 2009 MUTCD, speed limit signs shall be placed beyond major intersections; at the end of a section to which speed limit applies; and at statutory speed limits at entrances to the State and, where appropriate, at jurisdictional boundaries in urban areas.
- iii. In addition to Section 2B.13 of the MUTCD, the following spacing of reminder signs to provide for proper education and enforcement is recommended by the National Committee on Uniform Traffic Control Devices (NCUTCD):
  1. Freeways – beyond the entrance ramps associated with each interchange, at the beginning and ending of a freeway section, and at the approximate midway point between the interchanges where interchange spacing exceeds 25 miles.
  2. Expressways – beyond the entrance ramps associated with each interchange, at the beginning and ending of an expressway section, after major intersections, and the approximate midway point between the interchange or intersection where the spacing exceeds 25 miles.
  3. Rural roadways – High Speed (55 MPH and higher) – reminder signs approximately every 10 miles.
  4. Rural roadways – Intermediate High Speed (45 MPH and 50 MPH) —reminder signs approximately every 2 miles.
  5. Rural roadways – Low Speed (40 MPH and lower) - reminder signs approximately every 1 mile.
  6. Urban Arterials
    - a. 35 MPH and lower – Maximum spacing approximately ¼ mile
    - b. 40 and 45 MPH - Maximum spacing approximately ½ mile
    - c. 50 MPH, 55 MPH and higher – Maximum spacing approximately 1 mile
  7. Urban Collector Streets
    - a. 40 MPH and lower – Maximum spacing of approximately ¼ mile
    - b. 45 MPH – Maximum spacing of ½ mile where average intersection spacing exceeds ¼ mile
    - c. 50 MPH and over – not typical for urban collectors. See Urban Arterials for spacing for 50 MPH and over.

### 4. Associated Program List

#### a. Neighborhood Traffic Management Program

- b. Traffic Volume Count Program
- c. Crash Analysis Program

## 8. TRAFFIC SIGNALS

### 1. Background, Definitions, and References

- a. Before a traffic signal can be considered for installation, it must first meet at least one of the warrants found in the Manual on Uniform Traffic Control Devices (MUTCD). The MUTCD is a federal document that is adopted by the Colorado Department of Transportation for the State of Colorado that lists guidelines and/or sets of criteria that justify the placement of traffic control devices, including traffic signals.
- b. The MUTCD provides that “An engineering study of traffic conditions, pedestrian characteristics, and physical characteristics of the location shall be performed to determine whether installation of a traffic control signal is justified at a particular location.” See section 2 of this document for more information on engineering studies.
- c. Engineering is required to be applied as defined in the MUTCD. See section 2 of this document, Traffic Engineering Investigations and Studies, for more information.
- d. The MUTCD further provides that “The satisfaction of a traffic signal warrant or warrants shall not in itself require the installation of a traffic control signal.”

### 2. Policy Statement

- a. For an intersection to be considered for signalization in Arapahoe County, the intersection must meet at least one, and preferably more than one, of the warrants found in the MUTCD. The MUTCD warrants are primarily based on traffic volume requirements and/or accident history as well as other elements associated with signal operations.
- b. It should be noted, however, that even if a location meets one or more of the warrants, a traffic signal should not be installed unless an engineering study indicates that installing a traffic signal will improve the overall safety and/or operation of the intersection.
- c. Design and installation of a warranted new traffic signal shall be subject to approval by County Traffic Operations Staff, funding availability, and overall prioritization.

### 3. Examples of Applications

- a. Traffic Signing, Striping, and Signalization Permits
  - i. The County’s Engineering Services Division has the primary responsibility for these permits but regular ongoing coordination with Traffic Operations Staff is anticipated for this item.
  - ii. Ongoing coordination with Road and Bridge Staff is also anticipated for this item.
- b. See also Section 11 of this document for more information regarding traffic signals and Development Review.

### 4. Associated Program List

- a. Traffic Signal Health Index Program
- b. Traffic Volume Count Program

## **9. TRANSPORTATION/TRAFFIC FIBER OPTICS AND NETWORK COMMUNICATIONS**

### **1. Background, Definitions, and References**

- a. The County possesses existing traffic fiber optic and other types of communication infrastructure that supports communications for traffic signal operations and intelligent transportation systems (ITS) devices.

### **2. Policy Statement**

- a. The County shall continue to maintain the existing traffic fiber optic infrastructure and actively seek out opportunities for continued expansion of the existing network as appropriate.
- b. Future network expansions may consist of additional fiber optics and/or other communications means where deemed appropriate by County Staff. This could include, but not be limited to, public/private partnerships; wireless or cloud-based communications particularly in rural areas; and future technologies to be determined.
- c. Additional ITS or Smart devices may be integrated into the existing transportation network at the discretion of County Staff.
- d. The County shall work towards development of a Fiber Optics and Network Communication Master Plan, with subsequent review and update on a regular recurring basis.
- e. The County may also choose to work towards development of a Traffic Management Center (TMC) or Traffic Operations Center (TOC), in order to provide a facility where Staff may more efficiently monitor transportation/traffic network conditions and ITS functions.
- f. The goal of Arapahoe County Traffic Operation is to provide inter-connectivity with adjacent jurisdictions, as to allow for the joint viewing of County and city transportation system operations with the goal of improving operations of the transportation system within Arapahoe County.
- g. As the County's traffic fiber network is considered a utility, annexations of roadways will not include the transfer of the network to the annexing city.

### **3. Examples of Applications**

- a. Internal Designs – Traffic Operations Staff will review and approve relevant items under this section as needed.
- b. Referrals – Engineering Services should request review and feedback from Traffic Operations Staff regarding these elements as needed.
- c. External Coordination – Traffic Operations Staff will provide feedback and may coordinate improvements of these types with other jurisdictions and stakeholders as needed.

### **4. Associated Program List**

- a. Fiber Optics and Network Communication Master Plan

## 10. UTILITY LOCATES AND MAINTENANCE

### 1. Background, Definitions, and References

- a. The County owns and operates underground utilities such as traffic signal wiring, fiber optics communications, etc. As a facility owner, the County has a vested interest in protecting the condition and operations of its underground utilities.
- b. Colorado 811 (the Utility Notification Center of Colorado) provides a communications link between utility/facility owners and excavators/homeowners and can be found at <https://www.colorado811.org/>
- c. Colorado Revised Statutes (CRS) Title 9, Article 1.5, specifies Excavation Requirements including duties of facility owners to mark their underground utilities when notified of potential excavation work that could impact their facilities.

### 2. Policy Statement

- a. Arapahoe County shall comply with all requirements of CRS for locating services and marking of County owned underground utilities.
- b. County infrastructure projects shall also comply with all subsurface utility engineering requirements of CRS for design levels of quality and other items as appropriate.
- c. County maintenance activities shall also comply with CRS requirements.
- d. Any consultant, vendor, or contractor performing work on behalf of or within the jurisdiction of the County shall comply with CRS requirements.

### 3. Examples of Applications

- a. Traffic Signal/ITS/Fiber Optic Locates: Traffic Operations Staff will prescreen all Colorado 811 requests on the County's infrastructure map in order to determine if there are any County facilities of these types within a buffered distance from the planned work. If it is determined that any of these types of County facilities have the potential to be impacted by the planned work, Traffic Operations Staff will contact the company contracted by the County to provide utility locates and they will conduct the actual field locating and marking of the County facilities, consistent with the terms of their contract.
- b. Additional information regarding the County's Utility policies can be found here: <https://www.arapahoegov.com/574/Utility-Installations>

### 4. Associated Program List

- a. n/a



## 11. DEVELOPMENT REVIEW SUPPORT

### 1. Background, Definitions, and References

- a. Arapahoe County's Public Works and Development Department handles all applications for land use approvals through its Current Planning Staff. These Staff work in close coordination with the Engineering Services Division.
- b. Arapahoe County's Public Works and Development Department maintains a County-wide Comprehensive Plan through its Long Range Planning Staff. The County also has several Sub-Area Plans which provide more guidance for specific areas of the County.

### 2. Policy Statement

- a. Traffic Operations Staff shall provide support as subject matter experts to the County's land development process by means of assisting with the review of plans and other submittal or application documents with respect to traffic and transportation related items.
- b. Traffic Operations Staff shall also participate in a subject matter expert role as appropriate in the County's long range planning processes by means of reviewing and providing input on updates to the Comprehensive and/or Sub-Area Plans with respect to traffic operations related items.
- c. Additional information and detail regarding the role of Traffic Operations in this area can be found in the following:
  - i. Traffic Impact Study Guidelines  
<https://www.arapahoegov.com/556/Guidelines-for-Traffic-Impact-Studies>
  - ii. Land Development Code  
<https://www.arapahoegov.com/620/Land-Development-Code>
  - iii. Infrastructure Design and Construction Standards  
<https://www.arapahoegov.com/557/Infrastructure-Design-and-Construction-S>

### 3. Examples of Applications

- a. Traffic Signal Plans – Traffic Operations Staff provides support as subject matter experts for review and comment on these types of plans.
- b. Signing & Striping Plans – Traffic Operations Staff provides support as subject matter experts for review and comment on these types of plans.
- c. Traffic Impact Studies – Traffic Operations Staff provides support as subject matter experts for review and comment on these types of studies.
- d. Site Access and Sight Distance Considerations – Traffic Operations Staff provides support as subject matter experts for review and comment on these types of considerations.
- e. Mobile-communications facilities – Traffic Operations Staff provides support as subject matter experts for review and comment regarding traffic and transportation items on these types of plans.
- f. Pavement Maintenance Plan review - Traffic Operations Staff provides support as subject matter experts for review and comment regarding traffic and transportation items on these types of plans.

### 4. Associated Program List

- a. n/a

## **12. TEMPORARY TRAFFIC CONTROL (WORK ZONE) REVIEW**

1. Background, Definitions, and References
  - a. The federal Manual on Uniform Traffic Control Devices (MUTCD) and the Colorado Revised Statutes require that highway construction, utility work, maintenance operations, incident management, and any other applicable situations involving impacts to the public right of way provide appropriately for continuity of movement of all modes of traffic as well as transit operations and property/utility access. This also provides for increased worker and public safety.
  - b. Arapahoe County requires advance preparation and submittal of Traffic Control Plans (TCPs), also known as Methods of Handling Traffic (MHTs) or Maintenance of Traffic (MOTs), for anything meeting the previous criteria.
  - c. Large scale development and infrastructure projects may have these types of documents included in their project plans.
2. Policy Statement
  - a. Traffic Operations Staff shall provide support in the role of subject matter experts to other County Staff as needed for technical review of TCPs whether through the County's permitting process, through the County's plans review process, or in any other capacity as appropriate.
  - b. Level of necessary involvement by Traffic Operations Staff is anticipated to vary depending on the type and content of a particular TCP.
3. Examples of Applications
  - a. Development Plans - Traffic Operations Staff provides support as subject matter experts for review and comment of temporary traffic control content on these types of plans.
  - b. Capital Project Plans - Traffic Operations Staff provides support as subject matter experts for review and comment of temporary traffic control content on these types of plans.
  - c. Special Events – see Section 13 Special Event and Other Permits for more information.
  - d. Street Cut and Right-of-Way Use Permits
    - i. The County's Engineering Services Division has the primary responsibility for these permits but may request support from Traffic Operations Staff for technical review of a specific case.
4. Associated Program List
  - a. Neighborhood Block Party Program

### 13. SPECIAL EVENT AND OTHER PERMITS

1. Background, Definitions, and References
  - a. Arapahoe County reviews applications and issues permits for multiple types of activities which have the potential to impact the traveling public as well as County infrastructure.
  - b. The Public Works and Development Department is responsible for a wide variety of these permits within the unincorporated areas of Arapahoe County.
2. Policy Statement
  - a. Traffic Operations Staff shall have primary responsibility for or shall provide support to County Staff in the role of subject matter experts as needed for technical review of permit applications and supporting documents with respect to any traffic related items. This may include, but not be limited to: sight distance considerations; access placements; road closure requests; safety considerations; infrastructure impacts; etc.
  - b. Level of necessary involvement by Traffic Operations Staff is anticipated to vary depending on the particular permit type and content.
3. Examples of Applications
  - a. Special Event Permits
    - i. Special events requiring a permit include, but are not limited to: parades; fairs; exhibitions; motion picture filming; bicycle events, foot races, or walks; or similar events taking place on or near public roadways or rights-of-way within unincorporated Arapahoe County.
    - ii. Special events may also include events taking place away from a road which, due to the number of persons in attendance, could create traffic congestion on a County roadway before, during, or after the event.
    - iii. Neighborhood block parties do not fall under this item. For more information regarding the County's Neighborhood Block Party Program, please see Section 6 of the Programs portion of this document.
    - iv. Applications for special event permits may be made online at **INSERT URL HERE**. All applications with complete supporting documentation and fee paid shall be submitted a **minimum of 60 days in advance** of the proposed event date(s).
    - v. Review of applications for special event permits by Traffic Operations Staff shall not begin until the **AMOUNT** application fee has been paid and all required supporting documentation has been provided along with a completed application form.
    - vi. Required supporting documentation includes at a minimum:
      1. An Operations Plan that includes: a start and end location for the event with documentation allowing use of the location; parking information and agreement; emergency medical services with documentation; sanitary facilities with documentation; public safety issues with documentation from Arapahoe County Sheriff; communications plan.
      2. Course map(s) that include: documentation detailing the route(s) of the event with road names, path names, directions of travel, turn

locations, law enforcement presence, aid stations, any lane closures, etc.; an aerial overview map showing the start of the event, the route with directional notations and road names, and the finish of the event; and a map (can be the same as the aerial overview map) including locations of aid stations, law enforcement, and volunteers (marshals).

3. Traffic Control Plan (TCP) for any proposed lane or road closures that includes: detailed TCP(s) prepared by a traffic control barricade company in conformance with the federal Manual on Uniform Traffic Control Devices (MUTCD) and a signed contract with said barricade company to provide the traffic control shown in the TCP(s).
  4. Jurisdictional Approval: documentation in the form of permits or emails for any and all locations that are not part of unincorporated Arapahoe County rights of way, including but not limited to private property, trails, other jurisdictional facilities, etc.
  5. Public Notification of the Event: information regarding any fliers being published, social media/website information, newspaper articles, and any other communications providing information or advertising to the public regarding the event.
  6. Certificate of Insurance (COI) dated within the past 90 days meeting the following criteria: \$1,000,000 minimum coverage with both general liability and auto liability coverage; extended to spectators and participants; naming "Arapahoe County and its officers, employees, and agents" as additional insured; listing as certificate holder Arapahoe County, 5334 S Prince St, Littleton, CO 80120; including date(s) and times from setup to takedown of event and event name on the certificate. NOTE: The COI does not have to be turned in prior to the 60 day limit for the permit application as some insurance companies do not provide them that far in advance. It must, however, be submitted and approved prior to the permit being issued.
- vii. The application is responsible for all costs in relation to the event, including but not limited to: traffic control; law enforcement; advertising; etc.
  - viii. The applicant may only use Arapahoe County law enforcement for traffic control on County roads. The applicant must contract separately with other law enforcement jurisdictions in which traffic control is required (incorporated cities and towns within the County, adjoining counties, Colorado State Patrol, etc.). All law enforcement jurisdictions will coordinate their efforts for a safe, legal event. **The applicant shall clarify with all involved personnel that only law enforcement officers can interact with vehicular traffic in accordance with Colorado Revised Statute 18-9-107.**
  - ix. No use of road markings of any kind (paint, chalk, etc.) may be used in the roadway for the event, even if said markings are advertised as not being

permanent. The applicant will be held liable for any costs of removing markings placed by the applicant or their agent in the County roadway.

- x. The use of and placement of any traffic control devices (cones, barricades, message boards, signage, etc.) in the roadway shall be contracted only through companies certified by the Colorado Contractors Association, American Traffic Safety Services Association (ATSSA) or the equivalent. No other individuals or companies shall place, relocate or remove any traffic control device for the event other than those approved through the special event process or authorized by Arapahoe County personnel.
  - xi. Arapahoe County reserves the right to cancel or reroute any permitted Special Event due to situations beyond the County's control. Examples to include, but not be limited to: fires; flooding and other acts of nature; crashes; emergency road or street closures; etc.
  - xii. All decisions made by Arapahoe County regarding a special event permit are final.
  - xiii. If all requirements of an approved special event permit are not met, the special event permit may be revoked. If the applicant or their agent fails to comply with any required conditions during the event, the special event permit may be revoked by the appropriate law enforcement personnel and the event shall terminate.
  - xiv. A copy of the signed permit shall be available with the applicant's designated representative on site throughout the event.
  - xv. Approval of the event shall be contingent upon the County's determination that allowing the event will result in no adverse effect to normal traffic and safety; no hazard to participants or any other highway users; and will not be an unreasonable inconvenience to motorists or property owners in the area.
  - xvi. The information furnished by the applicant shall be complete and accurate.
  - xvii. Special Event Permits may also require a corresponding Temporary Use Permit or other permits depending on the location and/or nature of the event.
- b. Temporary Use Permits
    - i. The County's Zoning Division has the primary responsibility for these permits but may request support from Traffic Operations Staff for technical review of a specific case.
    - ii. These types of permit applications may include, but not be limited to: Christmas tree lots; fireworks stands; bus benches; etc.
    - iii. Special Event Permits may also require a corresponding Temporary Use Permit depending on the location and/or nature of the event.
  - c. Street Cut and Right-of-Way Use Permits (includes Access/Curb Cuts)
    - i. The County's Engineering Services Division has the primary responsibility for these permits but may request support from Traffic Operations Staff for technical review of a specific case.
  - d. Fence Permits
    - i. The County's Zoning Division has the primary responsibility for these permits but may request support from Traffic Operations Staff for technical review of a specific case.
  - e. Sign Permits

- i. The County's Zoning Division has the primary responsibility for these permits but may request support from Traffic Operations Staff for technical review of a specific case.
  - f. Oversized/Overweight Vehicle Permits
    - i. The County's Engineering Services Division has the primary responsibility for these permits but may request support from Traffic Operations Staff for technical review of a specific case.
    - ii. Traffic Operations Staff will typically also pass on referrals of a specific permit to Engineering Inspections Staff.
    - iii. Coordination with Road and Bridge Staff may also be required to identify potential impacts to existing County pavement condition resulting from the movement of an oversize/overweight vehicle on unincorporated County roadways.
- 4. Associated Program List
  - a. Neighborhood Block Party Program
  - b. Should we reference Arapahoe County Land Use Code since you are discussing TUPs?

# **PROGRAMS**

## **1. NEIGHBORHOOD TRAFFIC MANAGEMENT PROGRAM**

### **1. Background**

- a. The County Transportation Division receives a very large number of neighborhood related requests for the installation of various traffic control devices in order to address resident concerns around speeding and other traffic-related issues. These requests are typically handled on a case by case basis and investigated/evaluated based on guidelines/criteria that either warrants or does not warrant their placement. When a neighborhood concern is more complex or sensitive in nature, residents may be referred to the Arapahoe County Neighborhood Traffic Management Program (NTMP) for further investigation and resolution of their concern.

### **2. Program Criteria**

- a. See NTMP document for more information.

### **3. Application and Contact Information Reference**

- a. See NTMP document for more information.



## **2. MEMORIAL SIGN PROGRAM**

### **1. Background**

- a. The Department will review and consider for approval all requests for roadside Memorial Signage in unincorporated Arapahoe County Right of Way according to the following documents which are hereby adopted by the Department. All memorials must meet County criteria described below and be approved by County Traffic Operations Staff.
- b. The signage program offers families of roadway fatality victims an additional opportunity to honor and remember their loved ones. The signs also serve as education and reminders to other roadway users to be mindful of our shared community responsibility to travel safely and respectfully of ourselves and others.

### **2. Program Criteria**

- a. An approved roadside memorial will consist of signs made by the County to standard specifications to be installed and maintained by the County for the duration of the memorial period (maximum 6 years). Standard sign size will be 24" x 30" and consist of a blue background with white lettering. The wording on the sign will be approved by County Traffic Operations Staff. Preapproved messages include: PLEASE DRIVE SAFELY, DON'T DRINK AND DRIVE, PLEASE RIDE SAFELY, PLEASE BUCKLE UP. The main sign will be accompanied by an In Memory Of Victim's Name(s) sign if desired.
- b. A Memorial Sign Application with a letter of consent (if applicable) shall be submitted prior to approval.
- c. Applications will only be accepted from the family of the victim or other sponsors that have an approved family letter of consent indicating support for the application.
- d. Applications should be made within one year of the crash date.
- e. The fee for manufacturing, erecting and maintaining the sign is \$100.00. Applicant will be required to remit payment to Arapahoe County in the amount of \$100.00 once the sign application is approved.
- f. When the maximum 6 year memorial sign posting period has concluded the sign will be removed and provided to the victim's family. If the victim's family cannot be located at that time the sign shall remain the property of Arapahoe County.
- g. Arapahoe County will make every effort to install the signs at the approximate location of the crash site. However, signs will not be placed directly in front of a residence or business and cannot create a distraction from other traffic control devices.
- h. Signs will be installed on the right-hand side of the road. No signs will be erected in the median or on the left-hand side of the road.
- i. Final decision of location and orientation will remain with the County Traffic Operations Staff.
- j. Multiple signs will not be permitted at the same location.

- k. Multiple names associated with the same event will be permitted on the same sign only with approved written consent letter from all families. A maximum of three names may be placed on a sign.
  - l. The County reserves the right to reject any application.
  - m. Any request for memorial signs on Colorado State Highways within Unincorporated Arapahoe County must be made to the Colorado Department of Transportation (CDOT). To contact CDOT concerning a memorial sign, the application can be obtained from the Safety and Traffic Engineering Branch: <https://www.codot.gov/programs/signs/memorial-sign.html> or PHONE (303) 757-9654 or EMAIL: Roadside.Memorial@DOT.State.CO.US
3. Application and Contact Information Reference
- a. For more information or to obtain an application form, contact Arapahoe County Traffic Operations Program, Lima Plaza, 6924 S Lima St, Centennial, CO 80112; phone 720-874-6500.

### 3. TRAFFIC SIGNAL HEALTH INDEX PROGRAM

#### 1. Background

- a. Arapahoe County's Traffic Signal Health Index Program was developed to improve upon the evaluation process of the County's traffic signals as a whole along with individual components and sub-systems of the traffic signal outside of the normal realm of routine maintenance services. For Arapahoe County, it is meant to serve as a complement to the County's preventive maintenance program. Under the Traffic Signal Health Index process, various components of the traffic signal are inspected and, unlike the normal PM routine, then rated and weighted to provide an overall condition or "health" rating for each traffic signal.
- b. The components are categorized as **Structural** which includes poles/foundations; **Overhead** including detection/signal heads/supports; **Underground** including communication infrastructure, conduits/wiring; and **Auxiliary** components such as cabinets/controllers, etc.
- c. These individual component ratings are then rolled up into an overall condition rating for the traffic signal based on weighting of each component area. This rating provides the County with a better overall understanding of the traffic signal's current condition or "health" in part and in whole as related to operations/maintenance and public safety thereby assisting the County in defining responsible longer-term budget requirements. This system of rating shows better defined trends in deterioration of signals and signal components which helps County Traffic Operations Staff make reliable prediction of immediate and more importantly, future needs which the County can then better forecast long term budget needs. Ultimately, this program is far more extensive in nature when compared to typical preventive maintenance (PM) efforts that when used in coordination with PM programs, provide a much more comprehensive look into a traffic signal's overall actual condition or "health". This program provides a systematic way of managing traffic signal infrastructure and truly making it part of a strategic planning effort of anticipating future needs rather than solely reactive maintenance.

#### 2. Program Criteria

- a. To start the process, a yearly review of all Annual Preventive Maintenance (APM) reports, and trouble call reports will be completed and will include all reports from the previous 12 months. Information gathered through this review will be consolidated into a single report for quick reference and shall include, but not be limited to, failed equipment yet to be repaired, and components which, in the opinion of the technician, face imminent failure.
- b. The report will also identify locations which required the greatest amount of service over the past 12 months, along with the most common failures at each of these locations. The number of locations identified will be limited to 10% of the total locations owned by the agency. Areas of concern which require further

investigation shall be noted as part of this report and may include, but not be limited to, dented poles, pole/mast arms with rust, and poles/mast arms with fading paint.

- c. A report is generated and reviewed by County Traffic Operations Staff by assigned date to assist in better defining budget requirements for the following year.
  - d. Along with a yearly review as outlined above, a Traffic Signal Health Index study which includes non-destructive testing (NDT) will be completed a minimum of every 3-5 years or as recommended.
  - e. Only existing components will be considered during the Traffic Signal Health Index study. Suggested and proposed upgrades for expansion will not be considered.
3. Application and Contact Information Reference
- a. Additional detailed information regarding program parameters and requirements is available in the County's Specifications for Traffic Materials and Testing, Traffic Signal Health Index Testing subsection.
  - b. For more information, contact Arapahoe County Traffic Operations Program, Lima Plaza, 6924 S Lima St, Centennial, CO 80112; phone 720-874-6500.

## 4. TRAFFIC VOLUME COUNT PROGRAM

### 1. Background

- a. Traffic Operations Staff conducts 24 hour traffic volume counts annually at various locations. Every year the list of count locations is reviewed and counts are either added or deleted based on this Staff review. Data is saved and available online as referenced below in 3.a.
- b. This program was originated at the County in 2014 through funding originally obtained from the Denver Regional Council of Governments (DRCOG). The original purpose of the data collection efforts was to provide a good baseline for traffic volume information to support the DRCOG regional travel model.

### 2. Program Criteria

- a. Count locations are distributed between unincorporated Arapahoe County roadways located in both the urban and rural portions of the County, and include a mixture of roadway types.
- b. Data collected from the annual program is also provided to DRCOG for inclusion in their data warehousing and regional planning efforts.
- c. Collecting data annually in the same locations can provide County Traffic Operations Staff and other stakeholders with both background information and context for transportation trends and changes over time. Growth rates can also be calculated to augment DRCOG and Colorado Department of Transportation (CDOT) system information.
- d. Data may be provided to developers upon request to support growth rate calculation and forecasting efforts for Traffic Impact Study (TIS) and other planning studies.
- e. Collected data may be reviewed with reference to the County's guidelines for typical roadway sections and volumes to identify triggers for potential improvements and project identifications.
- f. Collected data may be used to support updates to the County Transportation Master Plan (TMP) as well as corridor studies, area plans, and other short and long term planning efforts.
- g. Collected data may be reviewed to determine if County Traffic Operations Staff can support consideration of development activity in a particular area or at a particular location as referenced in the County's Guidelines for Traffic Impact Studies.
- h. Collected data may identify locations where pavement conditions may be impacted by increased traffic activity and maintenance activities may need to become more or less frequent.
- i. Collected data may be incorporated into the County's Crash Analysis Program as described in Section 5 of the Programs.

### 3. Application and Contact Information Reference

- a. Additional detailed information regarding the count locations and data obtained is available at <https://www.arapahoe.gov/649/Traffic-Counts>

- b. For more information regarding the County's traffic counts, contact Arapahoe County Traffic Operations Program, Lima Plaza, 6924 S Lima St, Centennial, CO 80112; phone 720-874-6500.
- c. Information regarding other traffic count information available for the metro Denver area can also be obtained through the Denver Regional Council of Governments (DRCOG) website here: <https://drcog.org/planning-great-region/transportation-planning/regional-traffic-count-program>

## 5. CRASH ANALYSIS PROGRAM

### 1. Background

- a. Nationally, many people are involved in traffic crashes every year. These collisions can result in public and private property damage, injury, and even death. There are ongoing efforts by many parties, including automobile manufacturers, engineers, planners, and others, to reduce or eliminate these collisions.
- b. The State of Colorado has established a Strategic Transportation Safety Plan which includes a shared vision to achieve zero fatalities and serious injuries so people using any transportation mode in the state of Colorado arrive at their destination safely.
- c. The Denver Regional Council of Governments (DRCOG), of which Arapahoe County is a member jurisdiction, has established Taking Action on Regional Vision Zero, which identifies a target of zero fatalities and serious injuries on the Denver region's transportation system.
- d. Information on the types and locations of crashes that are most frequently contributing to serious injury and fatal crash incidence can support local governments in taking action to reduce these key crash profiles.

### 2. Program Criteria

- a. Traffic Operations Staff utilizes crash analysis software that allows definition of Levels of Service of Safety (LOSS) for roadway segments and intersections of various types. This software also allows for pattern recognition and benefit-cost calculations in order to assist Staff in identifying and programming potential mitigations for crash rates or patterns of concern to provide enhanced safety for the traveling public.
- b. Annually, Traffic Operations Staff compiles a list of the highest recorded accident locations (usually the top 20) along with severity and rate. This information is considered public record and can be requested from operations Staff if desired.
- c. In addition to this, when questions or concerns are received regarding a particular intersection or stretch of roadway, Traffic Operations Staff can check crash history for the location and proceed as appropriate if a concern is identified.
- d. Traffic Operations Staff provides information upon request regarding crash history for a location or area to support preparation of Traffic Impact Studies (TIS) or other analysis or plans as needed.
- e. The results of crash analysis are utilized by Traffic Operations Staff to support Federal Highway Safety Improvement Program (HSIP) and other grant applications as needed in order to acquire funding for potential crash mitigation efforts to augment or replace County budget funding needs.
- f. Crash data and analysis are included in the County's inaugural Local Road Safety Plan (LRSP), and will be key elements for future updates of the LRSP.

### 3. Application and Contact Information Reference

- a. For more information contact Arapahoe County Traffic Operations Program, Lima Plaza, 6924 S Lima St, Centennial, CO 80112; phone 720-874-6500.

- b. Copies of specific crash reports can be requested from the Arapahoe County Sheriff's Office at <https://recordsrequest.arapahogov.com/> Traffic Operations does not provide this information.



## 6. NEIGHBORHOOD BLOCK PARTY PROGRAM

### 1. Background

- a. The County provides for a Neighborhood Block Party/Street Closure permit in order to safely support residents' enjoyment of their community and local neighborhood and also provide for the opportunity for larger events such as parades or races to be held on County roadways.

### 2. Program Criteria

- a. Closure requests must be received no less than two weeks prior to the event.
- b. Applicant shall be required to submit a traffic control plan for review. This plan shall be created by a traffic control company or licensed engineer.
- c. Applicant shall be required to utilize traffic control devices in compliance with the MUTCD.
- d. No vehicular traffic will be allowed in the closure area.
- e. As part of the request, the following information must be included:
  - i. Date of the event
  - ii. Time of closure and time the event will start and finish
  - iii. Submittal of a Method of Handling Traffic (MHT) created by a qualified person
  - iv. Submittal of resident notification and concurrence that no driveway access is allowed during closure
  - v. Exact location of event with a detailed map of the area to be closed/blocked off, with streets named and addresses identified
  - vi. Purpose of the event or closure
  - vii. Fire Protection District must be contacted by the applicant and a contact phone number listed (County Traffic Operations Staff can assist in providing this information if necessary)
  - viii. Contact information for the applicant: mailing address, email address, fax number and phone number.
- f. A fee is not required, but the applicant is ultimately responsible for contacting and contracting with a certified barricade/traffic control company to properly block off the street(s) and adhere to other conditions as required by the County. **Proof of this must be submitted.** No vehicles, traffic cones, sawhorses, trash cans, or similar items will be allowed as traffic control or for barricades to block off any roadway.
- g. Neighborhood block party and street closures take a minimum of 10 working days to process. The applicant as well as the Sheriff's Office, Fire Protection District, and any other affected entities will be notified by mail, fax or email of the approval and any applicable conditions for the closure.
- h. Cherry Creek Dam Road Closure requests follow a special process due to additional coordination and insurance requirements. Please contact County Staff for more information in this case.

### 3. Application and Contact Information Reference

- a. For more information including the current email address for submittal, call 720-874-6500. Requests may also be sent by mail to Arapahoe County Public Works and Development, 6924 South Lima Street, Centennial, CO 80112; or by fax to 720-874-6611. Program information can also be found online here: <https://www.arapahoe.gov/646/Block-Party-Street-Closure-Permit>

## **APPENDIX A**



**ARAPAHOE COUNTY**

**Neighborhood  
Traffic  
Management  
Program  
Manual**

Draft: June 10, 1998

Revised: 2021

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# INTRODUCTION

There is a growing concern that some residential streets do not function as Complete Streets in the true sense of the term. A Complete Street is one that is not dominated by vehicles, but shared by the pedestrians, bicyclists and vehicles. The Complete Street concept for residential streets recognizes that there are corridors devoted to the efficient, rapid movement of vehicles, but requires that residential areas be serviced by roads designed to accommodate vehicular circulation in a non-threatening, non-intrusive manner. When severe speeding or volume problems exist on residential streets, quality of life is negatively affected. Methods to address these issues must be defined so that complaints registered regarding neighborhood traffic problems can be effectively and efficiently handled. This Policies and Procedures Manual has been developed as a guide to understanding how Arapahoe County will receive, evaluate and address neighborhood traffic issues.

## TYPES OF NEIGHBORHOOD TRAFFIC PROBLEMS

### Speed

Speeding generally occurs on roadways, which by design allows the driver to feel safe while exceeding the posted speed limit. Factors which contribute to this perception, include long, unbroken street grade sight distances, steep roadway grades, overly wide roadways, low-density development, low pedestrian activity, and deep building setbacks. While young drivers and "outsiders" are popularly accused of speeding, the blame does not entirely lie with those two groups. Often those drivers who consistently violate posted speed limits are local residents.

The 85<sup>th</sup> percentile rule is generally used to measure speed on any given street. The 85<sup>th</sup> percentile speed is the speed at which 85% of the vehicles are travelling at or below. If the 85<sup>th</sup> percentile speed is below the speed limit, a speeding problem is judged not to exist. However, if the 85<sup>th</sup> percentile speed is above the posted speed limit, either the speed limit is not appropriate or a speeding problem may exist. Obviously, the more above the speed limit, the greater the potential for a problem.

There are two schools of thought regarding the responsibility to control neighborhood speed limits:

1. First and foremost, roadways are designed to safely accommodate vehicular traffic and it is up to drivers to obey the law regardless of how fast they feel the roadway will safely accommodate traffic. Failing driver compliance, it is up to the local law enforcement agency to enforce safe speeds. This theory places the responsibility on the enforcement agency to maintain safe speeds.
2. The second school of thought submits that drivers will regularly and habitually violate the posted speed limit if they feel safe and comfortable doing so. It is therefore up to the planner and engineer to propose solutions that will make drivers feel uncomfortable exceeding the posted speed limit. In this scenario, it is up to the planner and engineer to control speed through educational programs and/or the physical design or alteration of the roadway.

## Intrusion

Intrusion is the result of increased volume or excessive non-local traffic on a neighborhood street. Often this intrusion is caused by drivers using a local street to cut through a neighborhood and save time in their commute. Local streets that are less impeded than others within the same neighborhood, invite cut-through traffic. Drivers are naturally drawn to those routes, which they perceive will save them time, even if that route does not provide the most direct path from point A to B. This increased cut-through traffic can cause a local street to function as a collector street. The current maximum volume allocated for a local street in Arapahoe County is 1,500 vehicles per day (VPD).

Much like speeding, intrusion can be promoted or discouraged by street network design. If there is not a logical hierarchy of streets, traffic volume will not be suitably distributed. Likewise, land uses adjacent to roadways must be appropriately matched based on expected traffic volumes. The local neighborhood street should serve as the final destination roadway for the immediate residents of that neighborhood.

## Accidents/Safety

Safety is an implied concern on streets experiencing speeding vehicles and/or intrusive traffic. There are however, cases where a particular intersection or pedestrian crossing is considered dangerous because of its location, the design of the street, and/or the behavior of the average driver. Of particular concern are locations near neighborhood schools and parks, which often generate high volumes of pedestrian activity. These areas require special consideration for the mobility and safety of the pedestrian.

In addition to high volume pedestrian areas, accident-prone intersections are a major concern. The accident rate at an intersection may not be particularly high, but its design and driver behavior might lead people to perceive that a higher than normal accident probability exists.

## STRATEGIES

### Range of Strategies

Traffic calming strategies can be grouped into three categories:

1. education
2. enforcement
3. engineering

In general, only comprehensive and continued education and enforcement programs have met with long term success. The public will usually forget the lessons learned from short-term education and enforcement programs unless they are continually and creatively reinforced. However, a well planned and executed education program, if continually reinforced, can preclude the need for enforcement or re-engineering. Education should be the first step in any traffic-calming effort. Engineering refers to the physical alteration of the roadway. Typical engineering alternatives are more expensive to implement and may require additional maintenance, but they are also permanent in their effectiveness. Arapahoe County strives to have

a well-balanced neighborhood traffic program that includes emphasis on education and enforcement, but also allows the opportunity for physical engineering solutions when warranted.

## EMERGENCY VEHICLE RESPONSE CONSIDERATIONS

Emergency vehicle response is a basic requirement whenever physical street modifications are considered as part of a proposed neighborhood traffic management program. Changes in roadway physical characteristics that may be considered appropriate from a neighborhood traffic management viewpoint must be considered in the context of meeting adopted emergency vehicle response standards.

**Figure 1** shows the primary emergency response routes for the urbanized area of Arapahoe County. These are considered of such importance that physical street modifications that would reduce or lower the level of service for emergency response activities will not be considered.

For those neighborhood streets not shown on this emergency vehicle priority route map, consideration of emergency vehicle access must be made on a case-by-case basis.

In the final analysis, it is recognized that there must be a balance as can only be determined on a case-by-case basis. The total involvement of the particular study process determines the relative importance of emergency vehicle response level of service versus the change in level of service for neighborhood residents with implementation of the physical changes. It is clear that the affected emergency response agencies should be involved early in the consideration of possible street physical changes and, should not be notified after the neighborhood has "bought in" to a particular scheme of changes to improve speed levels and/or volume conditions.

## THE PROPOSED PROGRAM

### INTRODUCTION

The proposed neighborhood traffic-management program consists of two stages:

Stage 1 - Normal activities by the Traffic engineering Staff.

Stage 2 - Consideration of physical street modification necessitated by the inadequacy of Stage 1 actions in order to achieve the adopted acceptable speed and traffic volume standards.

### STAGE 1

Stage 1 activities are focused on excessive or perceived excessive speeds utilizing the following countermeasures:

- Education of the neighbors about excessive speeds by the neighborhood residents. This would also include continuing speed awareness activities within the neighborhood.
- Traditional enforcement by the Sheriff's Department.
- Deployment of the radar speed trailer.



- Installation of signs and markings that are considered by the Traffic Engineer to be appropriate after a review of the particular situation.

The Stage 1 activities listed above can be expected to satisfy about 90-95% of the complaints.

## STAGE2

### Introduction

Stage 2 activities would be considered only after the following criteria have been satisfied:

1. Stage 1 activities have failed to solve the actual or perceived problem(s), and
2. The speed and/or traffic volumes exceed the following limits on a local residential street:
  - 85<sup>th</sup> percentile speed exceeds the posted speed limit by 5 mph or more and/or
  - Volume exceeds 800 vehicles per day, and
3. At least 51% of the residents (one signature per address) in an area designated by the Traffic Engineer have signed a petition (wording approved by the Traffic Engineer) in favor of conducting a study that may show that one or more streets in the area may be impacted by the installation of the defined Stage 2 techniques or tools.
4. Staff deems safety issues may warrant intervention.

The Stage 2 traffic management program discussed here is to be considered only after the Traffic Engineer has determined that techniques such as personal contact, education, radar speed trailer use, and other traditional techniques have been tried and have been determined unsuccessful in satisfying the particular problem. Also, this program applies to local streets with more than 800 ADT and/or 85<sup>th</sup> percentile speeds greater than 5mph over the posted speed limit.

The goals of the Stage 2 program is to provide a methodology of solving problems that could not be solved under Stage 1.

### A Detailed GuideObjectives

1. Improve neighborhood livability by mitigating the impact of increasing traffic volumes and speed of vehicular traffic on residential neighborhoods.
  2. Restrict vehicular speed to levels compatible with the residential environment.
  3. Promote safe and pleasant conditions for residents, motorists, bicyclists, pedestrians, and transit riders on residential streets.
  4. Encourage citizen participation in all phases of Stage 2 TMP.
- Make efficient use of County resources.

## Policies

1. Through traffic should be encouraged to use higher classification streets.
2. A combination of education, enforcement, and engineering methods should be employed. Traffic Management devices should be planned and designed in keeping with sound engineering and planning practices. The County Traffic Engineer shall direct the installation of traffic control devices (signs, signals, and markings) as needed to accomplish the project, in compliance with MUTCD Standards.
3. Emergency vehicle access should be accommodated in keeping with existing Public Safety response standards. If current emergency vehicle access does not meet the existing response standard, traffic management efforts should not further degrade the response time. The Emergency Vehicle Access Routes shown on Figure 1 - shall not be considered for Stage 2 street modifications.
4. Transit service access, safety, and scheduling should not be significantly impacted.
5. Reasonable vehicle access should be maintained. Pedestrian, bicycle, and transit access should be encouraged and enhanced wherever possible.
6. Parking removal should be considered on a project-by-project basis. Parking needs of residents should be balanced with the equally important function of traffic, emergency vehicle access, transit, bicycle, and pedestrian movement.
7. Application of Stage 2 TMP shall be limited to local and residential collector streets in neighborhoods with direct driveway access. The exception may be considered on collectors with no direct driveway access located near parks, schools, or in high pedestrian use areas with documented accident history.
8. To implement the Stage 2 TMP, the Traffic Engineer should process traffic management requests in accordance with applicable codes and related policies and within the limits of available resources. At a minimum, the procedure shall provide for submittal of project proposals, evaluation and selection, appropriate County Commissioners review, citizen participation, and communication of test results and specific findings to project area residents and affected neighborhood organizations before installation of permanent traffic calming devices.
9. The affected neighborhood association will be required to fund a minimum of 50% the cost of the improvement.
10. Stage 2 improvements must be supported by greater than 75% of the residents within the affected area as determined by Arapahoe County Traffic Engineer. The Arapahoe County Traffic Engineer must approve wording of the petition.

## Types of Projects

The Stage 2 TMP encompasses two types of projects:

1. Internal Neighborhood Residential Collector Streets
2. Local Residential Streets

These projects are intended to decrease the negative impact of speeding on primarily residential internal neighborhood collector streets that have direct residential access, and to improve safety for all. Collector streets function to distribute traffic from a higher classification street to a local street. Because of this function, there should not be physical diversion on these streets. Projects are however intended to make the streets safer by reducing speeds.

#### Major project steps:

##### A. Ranking and Selection

At least 75% of properties fronting on the street must be zoned residential in order for the street to be considered. Those street segments that meet this qualification will be ranked using the criteria shown in Appendix A. This criteria gives the highest importance to speed, as high speeds can be the chief detractor of safety and livability on residential collectors. It is also the element that can best be mitigated by the traffic management devices available.

Project selection reviews will begin with those streets ranking highest. The Traffic Engineer will review potential projects by looking at their size/complexity, compatibility with other Department projects, budget availability, and other factors. In addition to the identified high-ranking segments, projects may also include additional segments or portions thereof to ensure that street system continuity is maintained.

#### Procedure

The procedure for implementation of residential collector projects is outlined in Appendix C. The procedure will enable Traffic Engineering Staff to measure project area residents' support for the project, and to allow for public participation. A project area meeting will be held, followed by additional meetings to work with residents to develop the traffic management plan. A petition will be required to show area support and a public hearing may be held. A close dialogue with project area residents will be provided for and encouraged throughout the process, with the end result being a project developed and supported by both Staff and residents.

#### Local Residential Streets

The major steps that a project will go through are outlined as follows:

##### A. Initiation

These projects are citizen initiated. Residents and/or a neighborhood association fill out the online application to express concerns about the traffic conditions on their streets. A Traffic

Engineering Services (TES) Attachment Z application must be completed at this time. These concerns are reviewed by the Traffic Engineering Staff, who collect preliminary data about the traffic conditions on the streets, including volume, speed, and accident information. If there is no immediate solution and the Traffic Engineer deems it appropriate, the request is evaluated for a traffic management program. Remember that Stage 1 activities must be tried and those efforts exhausted before Stage 2 program methods will be considered.

B. Ranking and Selection

The street will be ranked using the criteria shown in Appendix B. This criteria gives equal importance to speed and volume, as neither high speeds nor volume are appropriate on local streets.

C. Procedure

A procedure for the implementation of local street projects has been developed to enable the Traffic Engineering Staff to work with project area residents and to measure their support for the project. A project area meeting will be held, followed by additional meetings (if required) to work with residents to develop the traffic management plan. A petition will be required within the area, and a public hearing may be held. A close dialogue with project area residents is provided for and encouraged throughout the process, with the end result being a project developed and supported by both the Traffic Engineering Staff and by residents. The detailed steps and requirements of this procedure are outlined in Appendix C.

## APPENDIX A

### RANKING CRITERIA FOR RESIDENTIAL COLLECTOR STREETS

**Speed** - Speed will be based on average daily speed during non-peak hours. Up to 30 points may be assigned (2 points for every mile over the posted speed limit up to a maximum of 30 points)

**Volume**- Volume counts will be based on average daily traffic (ADT). Up to 25 points may be assigned (1.667 points per 1,000 ADT, up to a maximum of 25 points for 15,000 ADT).

**Residential Density** - Residential density will be determined based on zoning. Both single and multi-family residential buildings, which front on the street segment, will be included. Up to 20 points may be assigned at 4 points per 100 dwelling units per mile up to a total of 500.

**Lack of Sidewalks** - Street segments lacking sidewalks will be given 9 points. The lack of sidewalks is defined as the absence of a continuous sidewalk on both sides of the street segment. Selections of these streets do not necessarily mean that sidewalks will be built as part of the project.

**Elementary School Crossing** - Street segments will be assigned 7 points if children need to cross the street to get to an elementary school. This includes marked crosswalks.

**Other Pedestrian Generators** - Street segments will be assigned 5 points if any of the following pedestrian generators occur within the street segment (i.e., from arterial to arterial) within 1,000 feet of the street:

- Retail Commercial uses
- Institutional uses
- Parks
- Schools not included in the elementary school crossing criterion (e.g. high schools)

**Street Width** - Street segments over 40 feet wide will be given 4 points.

## APPENDIX B

### RANKING CRITERIA FOR LOCAL STREETS

#### Traffic Volume

Average daily volume of over 1,000 vehicles on the segment of the project street having the highest volume divided by 100.

30 points are the maximum score allowed for traffic volume.

#### Speed

Percent of vehicle 85<sup>th</sup> percentile speeds 5mph over the posted speed limit on the segment of the project street having the highest percentage over the limit divided by 3.

30 points are the maximum score allowed for speed.

#### Accident Rates

Most recent three years of available accident data, counting only correctable accidents.

Accidents to be included are:

- Over the entire length of the street and/or,
- In the intersections of minor streets associated with movement in or out of the street and/or,
- In the intersections of collectors associated with movement in or out of the street.

The number of accidents times 1,000,000 vehicle miles times 0.30 divided by 365 days per year, the average daily traffic (ADT), the time period of the study, the length of the street section in miles, and an ADT adjustment factor of 0.86

30 points are the maximum score allowed for accidents.

#### Elementary Schools

5 points if any public or private schools (kindergarten through 8<sup>th</sup> grade only) are located on the project street. Schools across collectors or through streets, or in the neighborhood, are addressed in the next section.

Score 5 points if any schools are present.

#### Pedestrian Generators

Up to 5 points may be given for each pedestrian area, except an elementary school on the street per the Traffic Engineer's discretion. Pedestrian areas may include parks, special housing facilities, high schools, elementary schools not on the street, or other facilities that

generate a significant number of pedestrians. If a group of pedestrian areas is located in the same area of the street, a maximum of 5 points should be given to the group.

5 points are the maximum allowed for each individual or group of pedestrian areas on the street. A maximum of 10 points will be given.

#### Pedestrian Routes

A street classified as “missing sidewalk gap” in the Bicycle and Pedestrian Plan will be given 5 points.

Bicycle Routes - A street classified as a bikeway in the Bicycle and Pedestrian Plan will be given 5 points:.

## APPENDIX C

### PROCEDURE FOR RESIDENTIAL COLLECTOR AND LOCAL STREET PROJECTS

#### STEPS:

1. Staff receives application for consideration of Stage 2 improvements and makes initial determinations.

After receiving application to be considered for Stage 2 improvements the County Traffic Engineer will make a determination if all Stage 1 activities have been exhausted. If the Traffic Engineer does not feel all methods have been tried or enough time has been allowed for Stage 1 activities he/she will indicate that in a response to the request along with what is planned to further address the issues. If the Traffic Engineer feels that all Stage 1 activities available have been tried for sufficient period of time the Traffic Engineer will conduct additional research and data collection to see if the area meets the minimum criteria for Stage 2 improvement consideration.

2. Project ranking is completed.

If the project meets minimum criteria to be considered for Stage 2 improvements the project will then be ranked against other projects. Available funding will also be considered.

3. Request of Area Petition.

If the project meets the criteria for Stage 2 improvements and ranks high enough that County funding may be provided the County will request that a petition be developed and circulated for signature. The County Traffic Engineer must approve the petition area and wording. A minimum of 50% of the property owners in the study area must sign in support of the study providing conceptual plans and cost estimates for Stage 2 improvements. At this time the County will get a bid to develop conceptual designs and cost estimates and present them at a community meeting. The neighborhood must agree to fund one-half the cost of this engineering work before it shall be authorized by the County.



- 4• Present traffic-calming alternatives to residents at a Meeting. Determine the preferred traffic-calming alternative.

Notification for this meeting will be sent to all those residents within the project area as approved by the Arapahoe County Traffic Engineer. At this meeting, the Traffic Engineering Staff and the Consultant will present the traffic-calming plan(s) developed. Residents will be asked to prioritize their preferences in determining the plan they prefer. If necessary, a second meeting may be held to determine the final traffic-calming plan.

Petition to Install.

Once the project proponents have agreed upon an alternative a final petition must be circulated to the residents within the project area. The Arapahoe County Traffic Engineer must approve the wording on the petition and the project area. The petition must detail the proposed project include maps or drawings if necessary. The petition must also indicate the estimated cost of the project, maintenance responsibilities and the financial participation by the County and the neighborhood. A super majority (75% or above) of the residents in the project area must support the plan for installation to proceed.

- 5• Design and Construction.

If a super majority of the project area residents support the project plan, the neighborhood has entered into an agreement to fund a minimum of 50% of the design and construction and County funding is available the project may proceed. County Staff will contract with the engineer to provide final engineering and any other related services such as bid documents, surveying, or construction management services. The project will then proceed to public bid and a construction contract will be awarded to the lowest responsible bidder.

The County shall reserve the right to remove Stage 2 improvements at any time. If at any time the neighborhood wishes to remove Stage 2 improvements they must be removed at the neighborhoods expense and supported by a petition signed by at least 51% percent of the residents in the area as approved by the Arapahoe County Traffic Engineer.

The County also reserves the right to construct Stage 2 improvements at any time.

**Table 2-1**  
**Strategy Characteristics**

<b>Traffic Calming Strategy</b>	<b>Street Type</b>	<b>Appropriate Use</b>	<b>Inappropriate Use</b>	<b>Benefits/ Effectiveness</b>	<b>Drawbacks</b>
<b>Education and Awareness</b> <ul style="list-style-type: none"> <li>• brochures</li> <li>• neighborhood meetings and workshops</li> </ul>	All	<ul style="list-style-type: none"> <li>• Initial tool to be used for an area that is primarily affected by "repeat offenders"</li> </ul>	<ul style="list-style-type: none"> <li>• Previously tried with no significant results</li> <li>• As a solitary solution in areas that visually encourage excessive speeds</li> </ul>	<ul style="list-style-type: none"> <li>• Empowers citizens</li> <li>• Can be effective with strong neighborhood participation</li> <li>• Can promote neighborhood cohesion.</li> </ul>	<ul style="list-style-type: none"> <li>• May be difficult to measure effectiveness</li> <li>• May need to be frequently updated/enforced</li> <li>• Public already inundated with information</li> <li>• Effectiveness may decrease over time</li> </ul>
<b>Radar Trailer</b> <ul style="list-style-type: none"> <li>• mobile radar trailer that monitors and displays motorists' speeds as they drive by</li> </ul>	Local Collector and Some Arterial Streets	<ul style="list-style-type: none"> <li>• To reduce speeds, esp. in school and construction zones where spot speed "education" is needed</li> </ul>	<ul style="list-style-type: none"> <li>• Remote locations</li> <li>• Four-lane roadways</li> </ul>	<ul style="list-style-type: none"> <li>• Public relations tool</li> <li>• Inexpensive</li> </ul>	<ul style="list-style-type: none"> <li>• Effective for limited time</li> <li>• Requires labor to move</li> </ul>
<b>Enforcement</b> <ul style="list-style-type: none"> <li>• use of Sheriff to monitor and enforce speed limits</li> </ul>	All	<ul style="list-style-type: none"> <li>• To reduce speeds, esp. in school and construction zones where spot speed "control" is needed</li> </ul>	<ul style="list-style-type: none"> <li>• Where pulling over a vehicle creates a hazard</li> <li>• Where problem can shift to alternate routes</li> </ul>	<ul style="list-style-type: none"> <li>• Immediately slows vehicle speeds</li> <li>• Public education</li> </ul>	<ul style="list-style-type: none"> <li>• Temporary solution</li> <li>• May divert problem to alternate route</li> <li>• May prompt complaints about inappropriate duty of sheriff officers</li> <li>• Expensive</li> <li>• Effectiveness may decrease over time if enforcement is not constant</li> </ul>
<b>Pavement Markings and Signage</b> <ul style="list-style-type: none"> <li>• edgelines and parking delineation</li> <li>• crosswalks</li> <li>• pedestrian or bicycle symbols</li> <li>• bike lane designations</li> <li>• yield signs</li> </ul>	Primarily Collector and Arterial Streets, Some Local Streets	<ul style="list-style-type: none"> <li>• To provide direction and reduce confusion</li> </ul>	<ul style="list-style-type: none"> <li>• Too many signs in area already</li> </ul>	<ul style="list-style-type: none"> <li>• Clearly defines travel paths</li> <li>• Enforceable</li> <li>• Inexpensive</li> <li>• Can cause "narrowing" effect</li> </ul>	<ul style="list-style-type: none"> <li>• Continuing maintenance</li> <li>• Too many signs reduce effectiveness</li> <li>• Drivers may ignore inappropriately placed signs</li> </ul>
<b>Speed Limit Signs</b>	All	<ul style="list-style-type: none"> <li>• Inform drivers of speed limit</li> <li>• Inform drivers of change in speed limit</li> </ul>	<ul style="list-style-type: none"> <li>• None</li> </ul>	<ul style="list-style-type: none"> <li>• Enforceable</li> </ul>	<ul style="list-style-type: none"> <li>• Drivers may ignore if the road is comfortable to drive at higher speeds.</li> </ul>

<b>Traffic Calming Strategy</b>	<b>Street Type</b>	<b>Appropriate Use</b>	<b>Inappropriate Use</b>	<b>Benefits/ Effectiveness</b>	<b>Drawbacks</b>
Stop Signs	Local and Collector Streets	<ul style="list-style-type: none"> <li>To reduce accidents due to undefined right-of-way</li> <li>At low volume street intersections with higher volume streets</li> </ul>	<ul style="list-style-type: none"> <li>To reduce speeds</li> <li>Steep grades</li> <li>Insignificant traffic volumes</li> <li>On higher volume street intersecting lower volume street</li> </ul>	<ul style="list-style-type: none"> <li>Prioritize traffic movements</li> <li>May reduce cut-through traffic</li> <li>Inexpensive</li> </ul>	<ul style="list-style-type: none"> <li>Does not decrease average speeds - drivers tend to rapidly accelerate after sign</li> <li>Drivers ignore if there is insignificant cross traffic or if stop signs are excessively used</li> <li>Noise and air pollution increase</li> </ul>
Curb Extensions	Local and Collector Streets	<ul style="list-style-type: none"> <li>To reduce accidents at intersections with high pedestrian usage</li> </ul>	<ul style="list-style-type: none"> <li>On designated bike route</li> </ul>	<ul style="list-style-type: none"> <li>Reduce accidents by reducing pedestrian crossing distance</li> <li>Reduce speeds through intersection if lane width is significantly reduced</li> <li>Does not encroach upon adjacent properties</li> <li>Will accommodate emergency vehicles</li> </ul>	<ul style="list-style-type: none"> <li>Speeds may increase between intersections</li> <li>Reduces width of travelway for bicyclists</li> <li>May cause drainage problems</li> </ul>
Raised Crosswalks	Local Street Entry, Collector Streets	<ul style="list-style-type: none"> <li>To reduce accidents and speeds at locations with high pedestrian usage</li> </ul>	<ul style="list-style-type: none"> <li>On primary emergency vehicle route</li> </ul>	<ul style="list-style-type: none"> <li>Improve safety for pedestrians</li> <li>Reduce speeds at crosswalk</li> </ul>	<ul style="list-style-type: none"> <li>Speeds may increase away from crosswalk</li> <li>May damage vehicles if improperly designed</li> <li>Installation cost is moderate to high</li> </ul>
Raised Median Islands	Local Street Entry, Collector and Arterial Streets	<ul style="list-style-type: none"> <li>To reduce excessive speeds due to street width</li> </ul>	<ul style="list-style-type: none"> <li>On streets with residential driveways</li> <li>Where median displaces bikeway or premium on-street parking</li> </ul>	<ul style="list-style-type: none"> <li>Reduce speeds if lane width is significantly reduced</li> <li>Provide pedestrian refuge area</li> <li>Provide landscaping area</li> </ul>	<ul style="list-style-type: none"> <li>Reduce width of travelway for bicyclists</li> <li>Installation cost is moderate to high</li> </ul>

Traffic Calming Strategy	Street Type	Appropriate Use	Inappropriate Use	Benefits/ Effectiveness	Drawbacks
Roadway Deviations or Chicanes	Local and Collector Streets	<ul style="list-style-type: none"> <li>To reduce excessive speeds due to street width and unimpeded sight distance</li> </ul>	<ul style="list-style-type: none"> <li>To reduce accidents and cut-through traffic</li> <li>On streets with residential driveways</li> <li>On streets where on-street parking is at a premium</li> <li>Roadways with inadequate ROW to implement safe, effective treatment</li> </ul>	<ul style="list-style-type: none"> <li>Reduce speeds without impeding emergency vehicle access</li> <li>May reduce cut-through traffic</li> </ul>	<ul style="list-style-type: none"> <li>If designed improperly, some drivers accelerate around chicanes in order to avoid oncoming traffic</li> </ul>
Traffic Circles	Local and Collector Streets	<ul style="list-style-type: none"> <li>To reduce accidents and speeds at intersections</li> <li>As aesthetic enhancement</li> </ul>	<ul style="list-style-type: none"> <li>To reduce cut-through traffic</li> <li>At locations where modifications to the street width or corner radii are not required to accommodate circle</li> </ul>	<ul style="list-style-type: none"> <li>Reduce intersection accidents and speeds</li> <li>Cost savings from accident reduction exceeds construction cost</li> <li>Do not divert traffic to other residential streets</li> <li>Aesthetic enhancement if landscaped</li> <li>Can be designed to allow access for emergency vehicles</li> </ul>	<ul style="list-style-type: none"> <li>Some drivers may go wrong way to turn left</li> <li>Cause emergency vehicles to slow down</li> <li>Relative cost is moderate to high</li> </ul>
Lane Narrowing or Neckdowns	Most	<ul style="list-style-type: none"> <li>To reduce excessive speeds due primarily to street width</li> </ul>	<ul style="list-style-type: none"> <li>To reduce accidents and cut-through traffic</li> <li>On streets with residential driveways</li> <li>On roadways with inadequate ROW to implement safe, effective treatment</li> </ul>	<ul style="list-style-type: none"> <li>Reduce speeds if lane width is significantly reduced</li> <li>May provide opportunity for landscaping</li> </ul>	<ul style="list-style-type: none"> <li>May present hazard to bicyclists</li> <li>Relative cost is moderate to high</li> </ul>

Traffic Calming Strategy	Street Type	Appropriate Use	Inappropriate Use	Benefits/ Effectiveness	Drawbacks
<b>Chokers</b>	Local and Collector Streets	<ul style="list-style-type: none"> <li>• To reduce excessive speeds due primarily to street width</li> <li>• To improve pedestrian crossing conditions</li> </ul>	<ul style="list-style-type: none"> <li>• On roadways with inadequate ROW to implement safe, effective treatment</li> <li>• To reduce cut-through traffic</li> </ul>	<ul style="list-style-type: none"> <li>• Reduce speeds and may reduce accidents</li> <li>• Require less linear distance than chicanes, neckdowns or roadway narrowing measures</li> <li>• Do not impede access for emergency vehicles</li> </ul>	<ul style="list-style-type: none"> <li>• May present hazard to bicyclists</li> <li>• Relative cost is moderate</li> </ul>

**Table 2-2**  
**Traffic Calming Strategy Average Costs\***

Strategy	Average Cost
Education and Awareness	Variable - Dependent upon extent of program
Pavement Marking and Signage	\$ _____ per foot of striping \$100 per sign
Curb Extensions	Average - Between \$7,000 and \$10,000 (per extension)
Raised Crosswalks	Low to Average - Between \$1,000 and \$10,000
Raised Median Island	Average - Between \$8,000 and \$15,000
Chicane	Average - Between \$10,000 and \$40,000
Traffic Circle	Average to Expensive - Up to \$25,000
Neckdown	Average to Expensive - Between \$10,000 and \$40,000
Choker	Expensive - Greater than \$40,000 ( <b>4-way</b> intersection)

"Note: Costs vary considerably based on landscaping and other improvements.

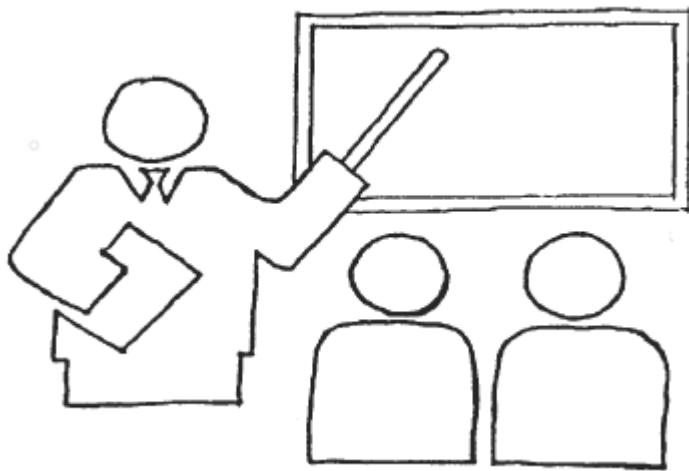
Table 3  
Applicability Summary

	Intent			
	Reduction of Traffic Speeds	Reduction of Traffic Intrusion	Reduction of Accident	Provisions for Pedestrians and Bicyclists
<b>Traffic Calming Strategy</b>				
Education	E	S	S	E
Enforcement	E	NA	S	NA
Radar Trailer	E	Na	S	S
Pavement Markings and Signage	S	S	S	E
Speed Limit Signs	S	NA	NA	S
Stop Signs	NA	S	E	S
Curb Extensions	E	S	E	S
Raised Crosswalks	E	NA	E	E
Raised Median Islands	E	S	NA	S
Roadway Deviations or Chicanes	E	S	NA	NA
Traffic Circles	E	S	E	NA
Lane Narrowing or Neckdowns	E	S	NA	S
Chokers	E	S	NA	E
X = Effective S = Secondary Benefits NA = Not Applicable				

## ATTACHMENT I

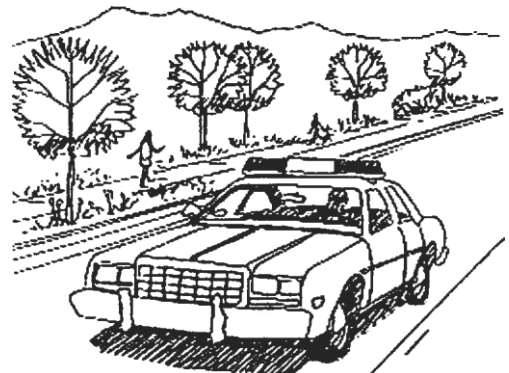
### **NEIGHBORHOOD TRAFFIC MANAGEMENT PROGRAM (Education) A Stage 1 Tool**

Activities that inform and seek to modify driver behavior. Techniques include printed information, meetings, and workshops with Staff, interaction with neighbors, enforcement activities, school programs, parent outreach, etc.



### **ENFORCEMENT (Visible and Active Sheriff Presence) A Stage 1 Tool**

Sporadic monitoring of speeding and other violations by sheriff. Sheriff deputies can come out to a neighborhood for short periods of time to issue tickets. Additionally, sheriff deputies can "take a neighborhood under their wing," and monitor traffic on a regular basis. Neighborhood can also contract with off duty sheriff deputies to provide enforcement.





## **SPEED WATCH (Speed Wagon/Trailer) A Stage 1 Tool**

The use of a portable radar speed meter capable of measuring vehicle speed graphically and then displaying the speed to passing drivers.



## **SPEED LIMIT SIGNS A Stage 1 Tool**

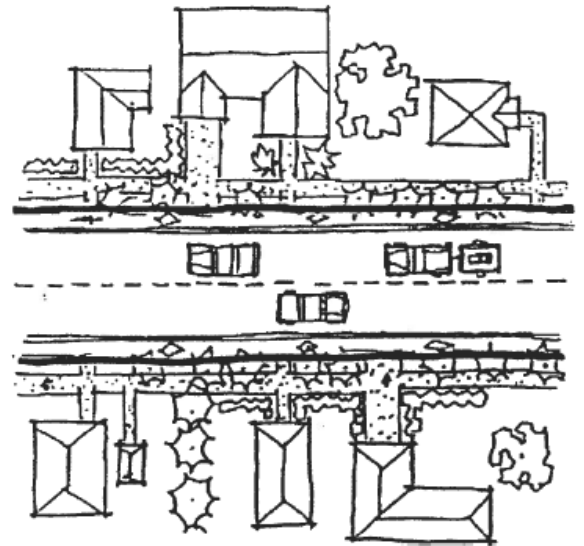
Signs that inform drivers of the maximum safe driving speed under normal conditions.



## **STREET STRIPING**

### **A Stage 1 Tool**

Highlighting various areas of the street to increase the driver's awareness of speed or other conditions (e.g., edge of travel way to create a narrowing/slowing effect while defining space for cyclists).



## **SPEED TABLES (3-4" X 22')**

### **A Stage 2 Tool**

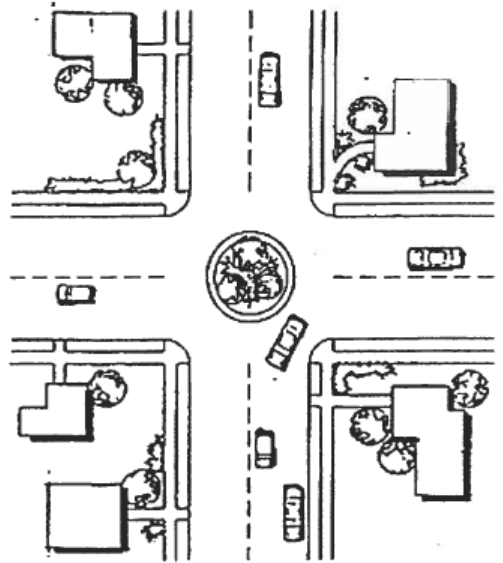
Speed humps with a long flat section, often used as crosswalks.



## TRAFFIC CIRCLES

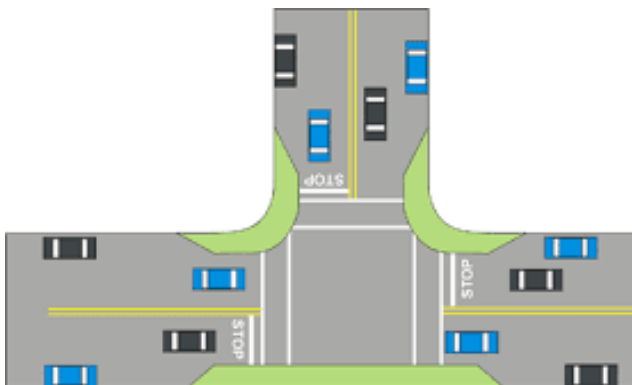
### A Stage 2 Tool

This device is a circle in the middle of two intersecting routes. Direct straight-through movements are obstructed by the central island, causing traffic to move around the circle in a one-way pattern. Approaches to the intersection area are normally controlled by "YIELD" signs. Their primary purpose is to slow high-speed traffic. They also reduce the number of reported accidents. Traffic circles are most effective when constructed in a series.



## CURB EXTENSIONS (Entry, Exit, Mid-Block) A Stage 2 Tool

Curb extensions narrow the street by widening the sidewalk and/or the landscaped parking strip. They are used to make pedestrian crossings easier and to provide a visual narrowing along the roadway that helps increase driver awareness. They can be installed either at intersections or mid-block.



## **MEDIAN ENTRY/ EXIT ISLANDS**

### **A Stage 2 Tool**

**Traffic islands used to create narrower**  
Roadway at entry/exit point.



## **MEDIAN BARRIERS**

### **A Stage 2 Tool**

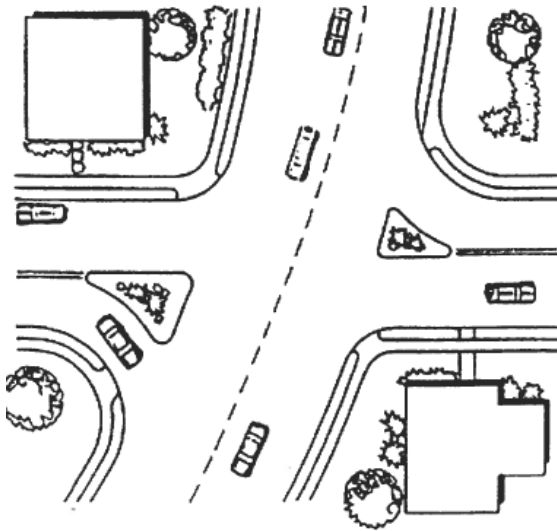
A median barrier (raised median) is used at the intersection of a major and a minor street to prevent left turns to and from the minor street, in addition to through movements across the major street.



## FORCED-TURN ISLANDS, BARRIERS, CHANNELIZATION

### A Stage 2 Tool

This technique primarily involves the utilization of traffic islands to restrict specific traffic movements at an intersection. The basic purpose of forced-turn channelization is to discourage the use of a particular route or street segment by through traffic

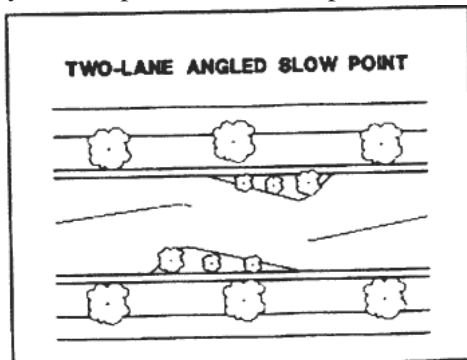


## MID-BLOCK SLOW POINTS, CHICANES

### A Stage 2 Tool

Serpentine curb protrusions offset from each other in mid-block locations that narrow the width of the roadway and help reduce traffic speeds and improve

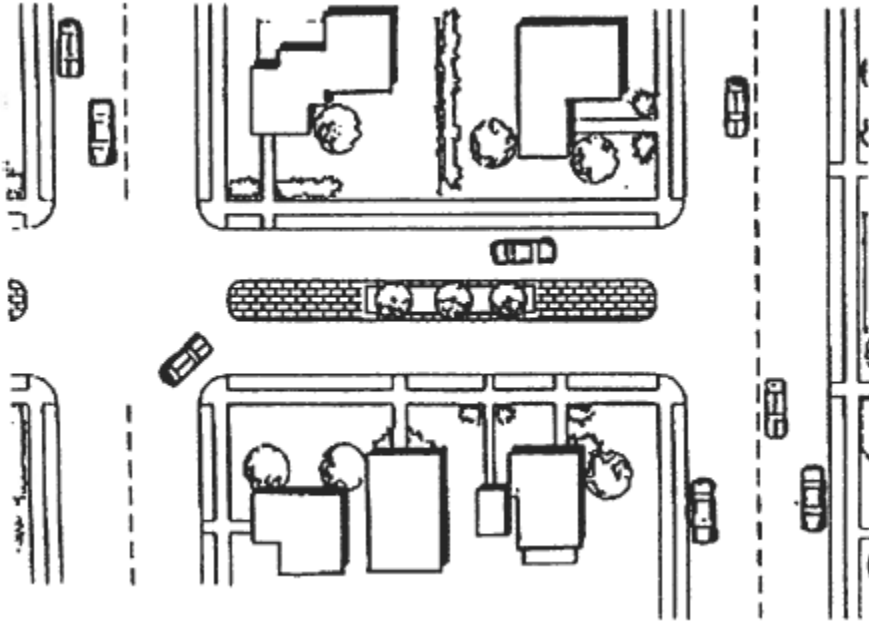
safety.



## MEDIAN MID-BLOCK ISLANDS

### A Stage 2 Tool

Traffic islands between intersections to create a narrower roadway or provide refuge for crossing pedestrians.



## Attachment 2

### TRAFFIC ENGINEERING SERVICES APPLICATION Arapahoe County PWD

Applicant Name: _____	Date: _____
Address: _____ _____	Telephone Numbers: Home: _____ Work: _____
Describe Problem and Location (attach sketch if appropriate)	
Applicants Suggested Solution (show on sketch if appropriate)	
Supporting Documents Drawing Attached Petition Attached (list number of signatures) (Attach drawing that shows location of signators) Homeowners Association letter attached (show Association area on map) Other (describe)	
<p>The Arapahoe County Department of Development Services/Infrastructure Management received this application on _____.</p> <p>It has been assigned case number _____. In general, we evaluate applications on a first-submitted first-evaluated basis. At present, we have a backlog of approximately _____ applications. It is my estimate that we should be able to process your application in approximately _____ months.</p> <div style="display: flex; justify-content: space-between;"><div style="width: 45%;">Comments: _____ _____</div><div style="width: 45%;">Signature: _____ Traffic/ Transportation Engineer</div></div>	
Evaluation completed Response dated _____	Signature :Traffic/Transportation Engineer _____ sent.

## **APPENDIX B**



# **SPECIFICATIONS FOR TRAFFIC MATERIALS AND TESTING**

## **TABLE OF CONTENTS**

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## 1. SIGNS

### Urban Type Street Name Sign



### Rural Type Street Name Sign



1. At signalized intersections street name signs shall be sized in accordance with Specifications for Oversize Street Signs or approved equal in the Highway Standards. Use Word Font D – Initial uppercase letters at least 12 inches and lowercase letters at least 9 inches in height.
2. Street and Avenue signs for post mounting shall be aluminum, from 9" x 36" (minimum) to 9" x 42" (maximum) in length.
3. All signs shall be mounted with County approved bolts, nuts, and washers. Street name signs shall be bolted at the ends.
4. Sign material shall be as follows:
  - a. 36" x 36" or less shall be .080 gauge aluminum – pre-punched holes.
  - b. 48" x 48" or larger shall be .100 gauge aluminum – pre-punched holes.
  - c. 36" x 9" shall be .080 gauge aluminum – pre-punched holes.
  - d. 42" x 9" shall be .080 gauge aluminum – pre-punched holes.
5. All signs shall be High Intensity Prismatic (HIP) or Diamond Grade Reflective (DG) Type 11 Sheeting with at least ten year guarantee, or approved equal. Legends and symbols shall be made with Electro Cut (EC) Film. Fabricator may also use traffic grade inks with approved laminate. The County reserves the right to request material changes to signs.
6. Telespar type post and anchors shall meet or exceed the following:
  - a. (All Telespar post shall be attached to anchors with 3/8" corner bolt with nut. Rivets will not be allowed)
  - b. Post – 1 3/4" x 1 3/4" x 10' – 11' – 12' = 14 gauge, ASTM Specification No. A446, Grade A, Drilled on 1" centers.

- c. Anchors – 2" x 2" x 3', 12 gauge, ASTM Specification No. A446, drilled on 1" centers.
  - d. Post – 2" x 2" x 10' – 11' – 12' = 14 gauge, ASTM Specification No. A446, Grade A, Drilled on 1" centers.
  - e. Anchors – 2 1/4" x 2 1/4" x 3', 12 gauge, ASTM Specification No. A446, drilled on 1" centers.
  - f. All post and anchors shall be galvanized to ASTM Specification A525 coating designation G90
7. Wood/Metal/Fiberglass/post mounting: Band-It Type #201 3/4" stainless steel band, Band-It Type #201 3/4" Ear-Lokt-Buckle, Band-It Type #D022 3/4" Bracket, 5/16" x 3/4" Bolt w/six- sided head, 5/16" washer.
  8. A single sign shall have a seven foot (7') clearance (minimum) from the bottom of sign to the ground at installation, or as approved by Manual on Uniform Traffic Control Devices (MUTCD) standards.
  9. For all multiple mounted signs on a single post, the lowest sign shall be no lower than six (6') feet on urban roadways, with a one (1") gap between signs. The lowest sign shall be seven (7') feet if near pedestrian or parking traffic. All signs placed in rural settings shall be installed to current MUTCD standards.
  10. All signs installed, with the exception of STOP and YIELD signs, shall be near property lines; they are not to intrude on driveways, doorways or any type of entrance.
  11. Signs shall be placed behind curb to minimum specifications according to MUTCD standards.
  12. Signs shall be placed a minimum of five (5') feet from fire hydrants.
  13. Placement of "STOP" signs shall be in accordance with County Policies and behind curb, ramp or crosswalk with a minimum of 36" inches behind sidewalk at the radius point or as approved by the County Transportation Division.
  14. Signs placed in concrete shall be either core drilled with a 4" inch hole, or alternatively a piece of 4" inch PVC pipe may be placed into the full depth of the concrete and end flush with the top of concrete.
  15. All sign placements shall request current utility locates from <https://www.colorado811.org/> Locate markings shall additionally be requested and must be clearly visible before final inspection and acceptance of sign installation.
  16. Please contact Signs and Markings Supervisor at (720) 874-6777 for sign layouts and font sizes.

## 2. PAVEMENT MARKINGS

The Arapahoe County Road & Bridge Division maintains the pavement markings on all public rights-of-way after completion of the two (2) year warranty period and resolution of any outstanding warranty items. All pavement markings shall be installed in accordance with the standards and latest revisions of the federal Manual on Uniform Traffic Control Devices (MUTCD), Federal Highway Administration (FHWA) Standard Specifications for Road and Bridge Construction, Colorado Department of Transportation (CDOT) standards, and Arapahoe County standards and policies.

At intersections all markings shall be of a permanent type marking, to include but not be limited to: Crosswalks, Stop Bars, Arrows, and Onlys.

All new roadways shall be painted using epoxy paint unless otherwise approved by the County Traffic Engineer and shall be painted with a full striping width of 15 mils when applied. Drop on glass beads shall be applied at the rate of no less than seventeen (17) pounds, and no more than twenty-five (25) pounds, per gallon of paint using Potters P-20+ 80% round.

### **PART I – GENERAL**

All pavement markings shall be placed in accordance with the following requirements:

When the term “full compliance” is used, it means pavement markings shall meet the requirements of these specifications.

A. *Pavement Marking Plan:* When pavement marking location details are not provided in approved plans the Contractor shall submit a layout of existing conditions to the County for approval or modification. This layout is to be used as the final pavement marking plan. The layout of pavement marking shall be the responsibility of the contractor. The County Project Representative will review each project site for final marking placement.

B. *Longline Striping:* Striping over existing markings shall not vary more than ¼" along the edge of existing marking. The party responsible for installation may be required to apply markings by means of hand-operated equipment in order to accurately match existing striping at tight radius curves.

C. *Roadways Closed to Traffic During Construction:* Full compliance pavement markings shall be in place on all roadways prior to opening traffic. The County Project Representative will determine the location and need for full compliance prior to roadways being open to traffic.

D. *Roadways Constructed Under Traffic:* Full compliance final pavement markings shall be placed within two (2) weeks after final surfacing is completed. Full compliance pavement markings shall also be placed on any roadways open to traffic when the project pavement work is discontinued for more than two (2) weeks. The County Project Representative will be responsible for coordinating the schedule for the installation of the markings within this two (2) week period.

E. Temporary pavement markings and control points for the installation of those pavement markings for roadways that are being constructed under traffic are as follows:

1. When one roadway of a normally physically divided highway is closed, and a crossover is constructed, full compliance pavement marking shall be placed along the tapers and through the median crossovers to the two-way traffic section. Pavement marking through the two-way traffic section shall be as shown on the plans.
2. When a two-lane highway is closed, and a bypass detour is provided, full compliance pavement markings shall be placed the full length of the detour prior to operation of the detour.
3. In either case, the type of marking materials applied to a final surface, when removed, shall not leave a scar that will conflict with permanent markings.
4. The following criteria apply to all construction and maintenance on roadways open to traffic other than D.1. above:
  - a. Control points, four-inch by two-foot marks at 40-foot intervals, are guide markers for the installation of temporary and/or full compliance markings.
  - b. All temporary broken-line pavement markings shall be installed daily and shall be at least 18 inches long with a maximum gap of 38 feet. An 18-inch stripe with a maximum gap of 18 feet shall be used on curves for roadways with severe curvature. A severe curve is defined as a curve whose safe speed is 10 mph or more below the approach posted speed limit.
  - c. Temporary pavement markings for “no passing zones” shall be full compliance.
  - d. For a short-term situation (3 calendar days or less) where temporary broken center lines are installed, “no passing” restrictions may be identified by appropriate signs including R4-1 and R4-2 until final markings are installed.
  - e. For roadways with a volume of 750 ADT or less, “no passing” restrictions can be identified for up to two (2) weeks with appropriate signs.
  - f. Temporary pavement stencils (school, railroad, etc.) are not required unless detailed on the plans.
  - g. Temporary pavement markings shall be installed per manufacturer’s recommendations in such a way that the markings adequately delineate the desired alignment.

F. Control points, temporary pavement markings, and Contractor pavement marking plans will not be paid separately but shall be included in the work.

## **PART II – MATERIALS AND EXECUTION**

A. Pavement Markings with Paint (Waterborne)

*Description.* Low VOC, ready mixed, one component, 100% acrylic waterborne traffic paints.

All paints shall be suitable for application to Asphaltic or Portland cement concrete pavements when applied with or without glass beads.

Striping shall be done when the air and pavement temperatures are at least 50° F and rising. The pavement surface and weather conditions shall be conducive to satisfactory results.

Equipment shall be capable of painting a reasonably clean-edged stripe of the designated width ( $\pm \frac{1}{4}$  in.) and shall have a bead dispenser directly behind synchronized with the paint applicator. For centerlines and lane lines, an automatic skip control shall be used that will paint a stripe with a gap, as shown on the plans. Machines having multiple applicators shall be used for centerlines with “no passing zones.” In areas where machines are not practical, suitable hand-operated equipment shall be used. All stripes shall be protected until dry. Paint and beads shall be applied within the following limits using Potters P20+, 20% DM 80% round:

Application Rate or Coverage per Gallon of Paint

	MINIMUM	MAXIMUM
Paint:	100 sq. ft.	110 sq. ft. (Approximately 15 miles when wet)
Beads:	5 lbs. 13 oz.	6 lbs. 3 oz.

Pavement marking paint shall conform to the requirements listed in the table below. All proportions are by weight.

Pigment composition and vehicle composition shall not vary by more than 1.0 percent of each amount specified.

Characteristics:	YELLOW	WHITE
Viscosity at 77 degrees F, KU	80-90	80-90
Dry to no pick up time, ASTM D-711 without beads, minutes	3 max.	3 max.
No-Track time, Actual @ 77 degrees F/50% RH, seconds	90 max.	90 max.
Directional Reflectance %	87 min.	50 min.
Contrast Ratio @ 15 mils wet	0.98 min.	0.95 min.
Scrub test, Cycles	1000 min.	1000 min.
Volatile Organic Compound, grams/liter	Below 150	Below 150
Total Pigment, % By Weight	62 min.	62 min.
Total Solids, % By Weight	76 min.	76 min.
Total Solids, % By Volume	58 min.	58 min.
PH	9.6 min.	9.6 min.

Reportable Components:

YELLOW	Vapor Pressure mm Hg @ Temp °F		Weight Percent
METHYL ALCOHOL	97.68	68	5
QUARTZ SILICA	N/A	N/A	0.32
OSHA PEL = 200 PPM (skin) (260 MG/M3), STEL 250 PPM			
ACGIH TLV = 200 PPM (skin) (260 MG/M3) STEL 250 PPM			
NIOSH = TWA 200 PPM, 800 PPM (CEILING)			
2,2,4 TRIMETHYL - 1,3 - PENTANEDIOL MONOISOBUTYRATE			1
NIOSH REL = TWA 0.05 MG/M3, 3,000,000 FIBERS/M3			
OSHA PEL = TWA RESPIRABLE: 0.1 MG/M3 TOTAL DUST: 30 MG/M3			
ACGIH TLV = TWA RESPIRABLE: 0.1 MG/M3			

WHITE	Vapor Pressure mm Hg @ Temp °F		Weight Percent
METHYL ALCOHOL	98.68	68	5
QUARTZ SILICA	N/A	N/A	1.24
OSHA PEL= 200 PPM (SKIN), STEL 250 PPM			
ACGIH = 200 PPM (SKIN), STEL 250 PPM			
NIOSH = TWA 200 PPM, 800 PPM (CEILING)			
2,2,4 TRIMETHYL - 1,3 - PENTANEDIOL MONOISOBUTYRATE			1
NIOSH REL = TWA 0.05 MG/M3, 3,000,000 FIBERS M/3			
OSHA PEL = TWA RESPIRABLE: 0.1 MG/M3, TOTAL DUST: 30 MG/M3			
ACGIH = TWA RESPIRABLE: 0.1 MG/M3			

B. Epoxy Pavement Markings

The epoxy pavement-marking compound shall be applied with equipment that will precisely meter the two components.

The equipment shall produce the required amount of heat at the mixing head and gun tip to provide and maintain the temperatures specified.

Before mixing, the individual components A and B shall each be heated to a temperature of 80° F to 140° F. After mixing the application temperature for the combined material at the gun tip shall be 80° F to 140° F. The 140° F upper limit is the maximum temperature under any circumstances.

Both pavement and air temperatures shall be at least 50° F at the time of epoxy pavement application.

The surface areas of new Portland cement concrete pavement and decks that are to receive markings shall be sandblasted prior to placement of the epoxy pavement marking. The amount of sandblasting shall be sufficient to remove all dirt and curing compound residue.

The surface areas of new asphalt pavement, existing asphalt pavement, and existing concrete pavement that are to receive markings shall be cleaned with a high-pressure air blast to remove loose material prior to placement of the epoxy pavement marking. Any pavement which has become dirty from tracked mud, etc., as determined by the Project Representative and shall be cleaned prior to the placement of the epoxy pavement marking.

When recommended by the epoxy manufacturer, a high-pressure water blast integrated into the gun carriage shall be used to clean the pavement surface prior to epoxy pavement marking application. The water blast shall be followed by a high-pressure air blast to remove all residual water leaving only a damp surface.

Epoxy pavement marking shall be applied to the road surface according to the epoxy manufactures recommended methods at 15 mils minimum thickness. Glass beads shall be applied into the epoxy pavement marking by means of a pressurized bead applicator at a rate of no less than (17), and no more than (25) pounds per gallon.

Epoxy pavement marking and beads shall be applied within the following limits:

	MINIMUM	MAXIMUM
15 mil Marking:	100 sq. ft.	110 sq. ft.
Beads:	17 lbs.	25 lbs.

Epoxy Pavement Marking Material:

1. *Formulation.* Epoxy pavement marking material shall be a two component, 100% solids, material formulated to provide simple volumetric mixing ratio of two volumes of component A and one volume of component B, unless otherwise recommended by the material manufacturer.

2. *Composition.* The component A of both white and yellow shall be within the following limits:

Pigments:	White	Yellow
Min% by weight	18% Titanium Chrome Dioxide, (ASTM D 476 Type II)	23% Yellow, (ASTM D 211, Type III)
Epoxy Resin	75-82%	70-77%

3. *Epoxy Number.* The epoxy number of the epoxy resin shall be  $0.38 \pm 0.05$  as determined by ASTM D1652 for white and yellow Component A on pigment free basis.

4. *Amine Number.* The Amine number on the curing agent (Component B) shall be  $410 \pm 50$  per ASTM D2071.



5. *Toxicity.* Upon heating to application temperature, the material shall not produce fumes which are toxic or injurious to persons or property.
6. *Color and Weather Resistance.* The mixed epoxy compound, both white and yellow, when applied to 3-inch by 6-inch aluminum panels at  $15 \pm \frac{1}{2}$  mils of thickness with no glass beads and exposed in the Q.U.V. Environmental Testing Chamber as described in ASTM G 53 shall conform to the following minimum requirements: (The test shall be conducted for 75 hours at 50° C, 4 hours humidity, and 4 hours U.V., in alternating cycles. The prepared panels shall be cured at 77° F for 72 hours prior to exposure.) The color of the white epoxy system shall not be darker than Federal Standard No. 595A17778. The color of the yellow epoxy system shall conform to Federal Standard No. 595A13538. The gloss values of both samples shall not be less than 70° after the test.
7. *Drying Time.* The epoxy pavement marking material shall have a setting time to a no-tracking condition of not more than 25 minutes at a temperature of 73° F and above.
8. *Curing.* The epoxy material shall be capable of fully curing under the constant surface temperature condition of 25° F and above.
9. *Adhesion to concrete.* The catalyzed epoxy pavement marking material, when tested according to ACI Method 503, shall have such a high degree of adhesion to the specified (4,000 psi minimum) concrete surface that there shall be a 100% concrete failure in the performance of this test.
10. *Hardness.* The epoxy pavement marking materials, when tested according to ASTM D 2240, shall have a Shore D Hardness between 75 and 100. Samples shall be allowed to cure at room temperature ( $75^{\circ} \text{F} \pm 2^{\circ} \text{F}$ ) for a minimum of 12 hours and a maximum of 48 hours prior to performing the indicated test.
11. *Abrasion Resistance.* The abrasion resistance shall be evaluated on Taber Abrader with a 1000-gram load and CS-17 wheels. The wear index shall be calculated based on ASTM test Method C-501 and the wear index for the catalyzed material shall not be more than 70. The test shall be run on cured samples of material, which have been applied at film thickness of  $15 \pm \frac{1}{2}$  mils to code S-16 stainless steel plates. The samples shall be allowed to cure at  $75^{\circ} \pm 2^{\circ} \text{F}$  for a minimum of 48 hours prior to performing the indicated tests.
12. *Tensile Strength.* When tested according to ASTM D 638, the epoxy pavement marking materials shall have a tensile strength of not less than 6,000 pounds per square inch. The Type IV Specimens shall be cast in a suitable dynamic testing machine. The samples shall be allowed to cure at room temperature ( $75^{\circ} \text{F} \pm 2^{\circ} \text{F}$ ) for a minimum of 12 hours and a maximum of 48 hours prior to performing the indicated tests.
13. *Compressive Strength.* When tested according to ASTM D 695, the catalyzed epoxy pavement marking materials shall have a compressive strength of not less than 12,000 pounds per square inch. The cast sample shall be conditioned at room temperature ( $75^{\circ} \text{F} \pm 2^{\circ} \text{F}$ ) for a minimum of 12 hours and a maximum of 48 hours prior to performing the tests. The rate of compression of these samples shall be no more than 1/4-inch per minute.

C. Types of Equipment

1. *Portable applicator.* The portable applicator shall be a device typically used for painting crosswalk lines, stop bars, short lane lines, and short lane center lines. The applicator shall be easily maneuverable and capable of being propelled by the operator.
2. *Mobile applicator.* The mobile applicator shall contain equipment to provide for automatic installation of skip lines in any combination of line and skip up to 40 feet. The mobile applicator shall be moved in conjunction with the melting and heating kettles in such a manner as to provide continuous highway operation of the kettles and the mobile applicator as an integral unit.
3. *Epoxy Primer Equipment.* The epoxy primer application shall be accomplished using equipment having the following features:
  - a. The main storage tank shall be equipped with a visible gauge which will allow the Engineer to readily ascertain the rate of application.
  - b. The main storage tank shall be equipped with a heating device which will maintain the epoxy at a constant efficient temperature.
  - c. The spray nozzle and epoxy spray shall be protected from the action of wind to insure placement where needed.
4. *Cleaning Equipment.* Equipment must be provided to ensure removal of dust, debris, paint, and other foreign matter from the road surface immediately prior to the installation of the composition, or immediately prior to the application of primer.

D. Pavement Primers

The type and application rate of epoxy resin primer shall be as recommended by the thermoplastic or preformed plastic pavement marking manufacturer.

A primer application rate of zero will not be accepted, except for thermoplastic marking and inlaid preformed plastic pavement marking placed on new asphalt surfaces as recommended by the manufacturer and approved in writing by the Engineer. However, if the Engineer determines that a new asphalt surface has become soiled, prior to placement of the pavement markings, pavement primer will be required and shall be applied as approved.

The epoxy resin primer material may be accepted at the job site on the basis of a manufacturer's certification, or a sample may be sent to the Laboratory for testing, in which case three weeks shall be allowed between sampling and intended use.

E. Preformed Thermoplastic / Existing Overlay or Older Top Surface Application:

1. All symbols and legends shall comply with the MUTCD including metric requirements.

2. After the marking has cooled down, a chisel test shall be performed to ensure that a proper bond has been achieved.
3. Road and ambient temperature should have no effect on the performance of the marking material.
4. Dry asphalt of existing moisture. Do not install marking if it is raining or snowing. Wait to install marking 24 hours after it has stopped raining.
5. Do not apply marking on top of salt or other deicers. Wait for 2 or 3 heavy rainfalls prior to installing the marking material or use a pressure washer.
6. The road must be free of dirt, dust, chemicals, and significant oily substances.
7. The material can be placed over existing preformed thermoplastic, if existing material has been heated with a torch, and the majority has been lifted with a shovel.
8. On Portland cement concrete roads, a sealant may be needed to ensure a proper bond. (Check manufacturer's recommended instructions for installations.)
9. Curing compounds must be sandblasted or ground on new Portland cement concrete to ensure adequate bonding.
10. All leading edges of the pavement markings shall be feathered to minimize snowplow damage.
11. Glass beads shall be sprinkled onto the pavement marking material surface. This will enhance initial retro-reflectivity and aid in cooling the markings. It is important to keep all traffic off the pavement marking material to prevent damage.
12. Crosswalks, stop bars, sidewalks, and access ramps that have any loose glass beads shall be cleaned thoroughly with a leaf blower immediately after pavement marking is installed.
13. Pavement marking tape (removable) shall be installed in accordance with the manufacturer's recommendations and maintained throughout the required construction phase at no additional cost to the County. Pavement marking tape designated in the pay item as removable shall conform to ASTM D 4592, Type I, and shall be  $4 \pm 0.1$  inches wide.
  - a. *Description.* The marking tape shall consist of weather and traffic resistant yellow or white colored reflective material. The material shall consist of conformable (metal foil) backing with a pressure-sensitive adhesive design for adhesion to asphalt or concrete surfaces.
  - b. *Requirements:*
    - i. *Color.* The color of the visible or outer surface shall closely match the white or yellow traffic marking paint specified for highway delineation. Glass beads shall be strongly adhered to the tape.

- ii. *Reflectance.* The white and yellow tapes shall have the following initial minimum reflectance values at 0.2° and 0.5° observation angles and 86.0° entrance angles as measured in accordance with the testing procedures of Federal Test Method Standard 370. The photometric quantity measured is specific luminance (SL) and is expressed as millicandelas per square foot per foot-candle.

Color	White		Yellow	
Observation Angle	0.2°	0.5°	0.2°	0.5°
Specific Luminance	1360	760	820	510

- iii. *Adhesive.* The striping tape shall be supplied in rolls ready for application and have a protected pressure sensitive adhesive, which shall not have a protective liner nor require a solvent activator.
- iv. *Adhesion.* The material shall adhere to asphalt and concrete surfaces when applied at surface temperatures of 35° F and above. Once applied, the tape shall adhere to the pavement at sub-freezing temperatures.
- v. *Conformability.* The material shall be thin, flexible, conformable, and show no cracking, flaking, or bead loss. Following application, the tape shall remain conformed to the texture of the pavement surface. The thickness shall not be less than 17 mils.
- vi. *Removability.* The tape shall be removable by following manufacturer's recommendations, so long as the material is substantially intact. Removal shall not require sandblast, solvents, or grinding methods.
- vii. *Durability.* The striping material applied in accordance with manufacturer's recommended procedures shall be weather resistant and show no appreciable fading, lifting, or shrinkage during the useful life of the line.
- viii. *Packaging and Delivery.* The striping material as supplied shall be of good appearance and free of cracks. The edges shall be true, straight, and unbroken.
- ix. The Contractor shall specify the material used for temporary pavement markings. Materials shall be durable enough to maintain a minimum reflectivity of 100 millicandelas throughout the life of the detour or their intended use. This may require many applications of temporary pavement markings as determined by the County.
- x. Where temporary pavement marking materials are used on new or existing pavement surfaces, temporary pavement markings or other material shall be used so it can be removed from surface without scarring.
- xi. The striping material shall be packaged in accordance with accepted commercial standards to prevent damage during shipment and storage. The tape as supplied shall be suitable for use for a period of at least one year following delivery when stored at temperatures of 100° F or below.

#### F. Temporary Marking Tabs

Raised pavement markers (temporary) shall be installed on centerlines, edge lines, and lane lines where specified in the contract. Single markers shall be installed at 20' intervals for solid lines. A group of three markers at three-foot spacing and at 40-foot intervals shall be installed for skip lines.

When chip seals, slurry seals, or tack coats are used, temporary marking tabs with covers shall be used, or protect the markers with an approved protective cover, which is removed after the asphalt material is sprayed.

#### G. Grooved Concrete for Inlay Applications

Prior to installation operation, the Contractor shall submit to the Traffic Engineer instructions from the preformed plastic pavement manufacturer detailing surface preparation, grooving requirements, and material application. The instructions shall include the following:

1. Equipment Requirements
2. Approved Work Methods and Procedures
3. Material Application Temperature Requirements
4. Weather Limitations
5. Special Limitations
6. Special Precautions
7. Any other requirements necessary for successful installation and satisfactory performance of the material.

All materials for use by the County shall have manufacturer's installation specifications for installation and shall be supplied to the project representative.

The bottom of the groove shall have a smooth, flat finished surface. This shall be accomplished by utilizing gang-stacking cutting heads having diamond tipped cutting blades. The spacers between each blade shall be such that there will be less than a 10-mil rise in the finished groove between the blades.

The edges of the preformed plastic pavement marking shall be straight and uniform, and uniformly adhere to the pavement.

Grooves shall be clean, dry and free of oil, dirt, grease, paint or other foreign contaminants. Contractor shall protect the grooves from traffic and re-clean grooves as necessary prior to application of the preformed plastic pavement markings.

Grooved width shall be the tape width plus or minus  $\frac{1}{4}$ ". Grooved depth shall be 100% of the tape and adhesive thickness plus 15%. For Series A380-I or A381-I tape, the grooved depth shall be 80 mils plus or minus 10 mils.

Groove position shall be a minimum of 2" from the edge of the tape to the longitudinal pavement joint.

## H. Removal

The following are the required procedures / practices for removal:

- a. Pavement markings shall be removed by using a rotary type grinder (a drum type grinder manufactured for this purpose), sandblasting, or by hydro- blasting.
- b. Preformed plastic material may require using a weed-burning torch.
- c. The roadway shall have no more than  $\frac{1}{4}$ " depth of damage after removal of pavement markings.
- d. Disposal of materials resulting from removal are the responsibility of the party conducting the removal. That party shall legally dispose of the material.

### 3. TRAFFIC SIGNAL HEALTH INDEX TESTING

#### Pre-requisites:

1. **Ultrasonic testing of poles and mast-arms:** Ultrasonic testing of every traffic signal pole and mast arm is recommended every five years, unless the most current test results deem that testing be completed at shorter intervals.

#### Inclusions:

Inclusions as part of this health index study are grouped and defined below. Groups and individual components have been given a Health Index Weight (HIW) to assist in health index calculations.

#### **Major Component Rating:**

Major components include all components which commonly fail over time and which present the greatest liability to the public. Major components present a major impact on the agency's budget. Categories for major components include structural, overhead underground, and auxiliary.

#### *1. Structural (HIW: 30%)*

The County's traffic signal poles and mast arm specifications adhere to AASHTO specifications and have a 50 year design life rating given proper installation, wind loading within specifications, and without physical damage including that caused when subjected to a magnesium chloride solution. Older poles have a reduced design life rating.

#### *2. Poles (HIW: 40%)*

##### *a. Street Light Pole*

- Ultrasonic test results will be used to define health and will be conducted at regular intervals of five years or less, depending upon the recommendations of the testing firm.
- Additional testing is recommended whenever damage occurs as a result of an accident.
- Field replaceable hardware is not being considered as part of the HIW. Hardware requiring replacement will be defined during the inspection. Hardware requiring replacement will be replaced by the maintenance contractor as required.

##### *b. Traffic Signal Pole*

- Ultrasonic test results will be used to define health and will be conducted at regular intervals of five years or less, depending upon the recommendations of the testing firm.
- Additional testing is recommended whenever damage occurs as a result of an accident.

- Field replaceable hardware is not being considered as part of the HIW. Hardware requiring replacement will be defined during the inspection. Hardware requiring replacement will be replaced by the maintenance contractor as required.

*c. Span Pole*

- The following criteria will be used:
  - No damage or indication of rust;
  - Minor dents, surface rust, failing/fading paint;
  - Major rust with coverage exceeding 10 % of pole;
  - Malformation of the pole with curvature and/or bending of pole.

*3. Mounting Structure (HIW: 40%)*

*a. Mast arms*

- Ultrasonic test results will be used to define health and will be conducted at regular intervals of five years or less, depending upon the recommendations of the testing firm.
- Additional testing is recommended whenever damage occurs as a result of an accident.
- Field replaceable hardware is not being considered as part of the HIW. Hardware requiring replacement will be defined during the inspection. Hardware requiring replacement will be replaced by the maintenance contractor as required.

*b. Span/Tether*

- The following criteria will be used:
  - No splices;
  - One splice;
  - More than one splice.

*4. Foundations (HIW: 20%)*

*a. Street Light Pole/Traffic Signal Pole*

(Determine testing options for the foundations in conjunction with pole and mast/arm ultrasonic testing)

*b. Span Pole*

- The following criteria will be used:
  - Span pole standing properly;
  - Span pole leaning **without** guy wires or additional anchoring;
  - Span pole leaning **with** guy wires or additional anchoring.

*5. Overhead (HIW: 30%)*



The life expectancy of polymer signal heads may be 20 years or more. Damage due to external influences including, but not limited to, hail and UV exposure may however significantly reduce the life expectancy.

*a. Signal Heads (HIW: 34%)*

*i. Traffic Signal*

- New/Like New;
- Color fading;
- Cracked/Chipped/Warping without water penetration;
- Cracked/Chipped/Warping with water penetration;
- Burned out LED percentage;

*ii. Pedestrian Signal*

- Review number of indication failures throughout the year

*b. Backplates (HIW: 33%)*

*c. Indications, LED (HIW: 33%)*

*6. Underground (HIW: 20%)*

*a. Wiring (HIW: 40%)*

*b. Conduit (HIW: 30%)*

*c. Pull Boxes (HIW: 30%)*

*(As part of pull boxes, consider drainage)*

*7. Auxiliary (HIW: 20% )*

*a. Cabinet (HIW: 75%)*

*b. Local Controller (HIW: 25%)*

**Minor Component Rating:**

Minor components include all components which commonly fail quickly, require immediate replacement, and minimally impact the agency's budget. Additionally, during signal rebuilds, these components are not normally salvageable but are replaced as part of the rebuild. Minor components' impact on the overall health index study is considered low.

1. Controller
2. Communications Hardware  
(Consider copper, wireless, and fiber)
3. Detection
  - a.* Vehicle
  - b.* Pedestrian
  - c.* Emergency
4. Uninterruptible Power Supply
5. Signs and Markings
  - a.* Signs

- b. Markings
  - i. Crosswalk
  - ii. Stop Bar
  - iii. Instructional

**Summary of Condition Findings and Recommendations:**

After all associated health index inspections/calculations are completed, a final report is generated outlining all condition findings and recommended action.

*Overall Rating:*

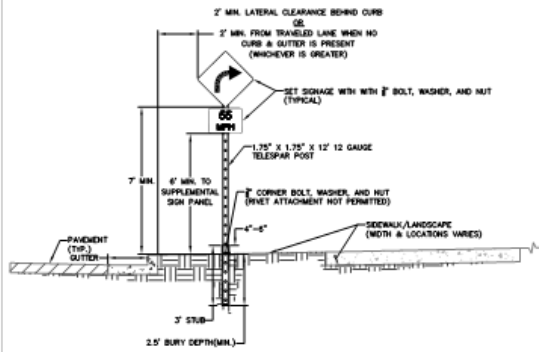
To complete the health index process, an overall rating is provided for each signal based on the above major component calculation procedure and determined by an agency specific formula.

The final rating range is defined below:

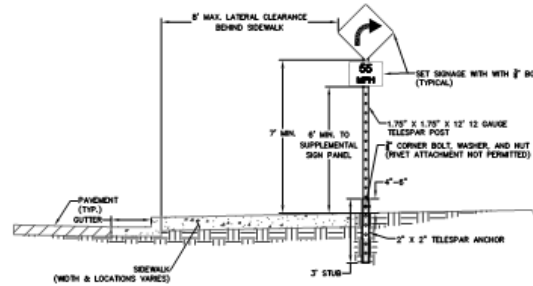
- 6.0 = Imminent failure, requires immediate attention.
- 5.0 = Poor condition, repairs recommended within 6 months.
- 4.0 = Below average condition, requires monitoring.
- 3.0 = Average condition.
- 2.0 = Above average condition.
- 1.0 = New/Like new condition.

Arapahoe County's overall rating formula is based on a rating system of various traffic signal component and traffic signal engineering criteria that determines the final rating indicated above. This "health" rating along with the final conditions report enables the County to responsibly and accurately chart recent and historic information of its traffic signals/equipment, prioritize/determine minor and major repair schedules and plan for both short- and long-range funding.

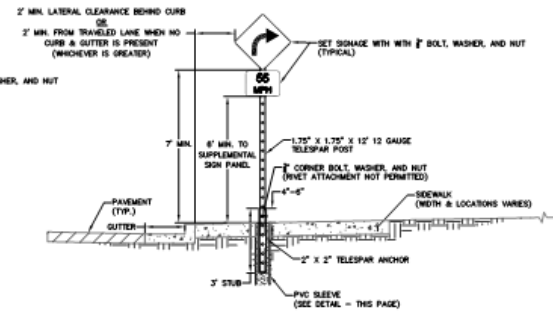
## **APPENDIX C**



ROAD SIDE SIGN INSTALLATION  
(NO SIDEWALK OR DETACHED SIDEWALK)



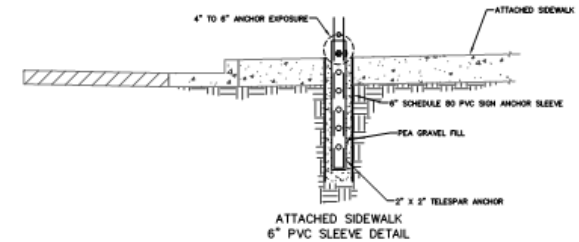
ROAD SIDE SIGN INSTALLATION  
(ATTACHED & BEHIND SIDEWALK)



ROAD SIDE SIGN INSTALLATION  
(ATTACHED AND WITHIN SIDEWALK)

#### ROAD SIDE SIGN INSTALLATION NOTES:

1. SIGNAGE SHALL BE SET PERPENDICULAR TO ROADWAY AND VISIBLE TO ONCOMING TRAFFIC.
2. ALL SIGNAGE SHALL MEET THE CURRENT MUTCD STANDARDS.
3. TELESPAR ANCHOR SHALL BE SET IN PEA GRAVEL WITHIN A 6\"/>



<b>DRAWN:</b> JB	<b>SCALE:</b>	<b>DETAIL #:</b>
<b>CHECKED:</b> KP	NTS	8-1
<b>APPROVED:</b> DS		

#### REVISIONS

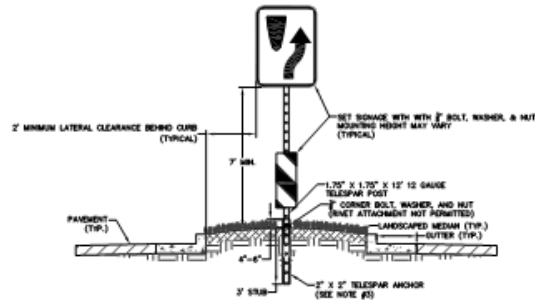
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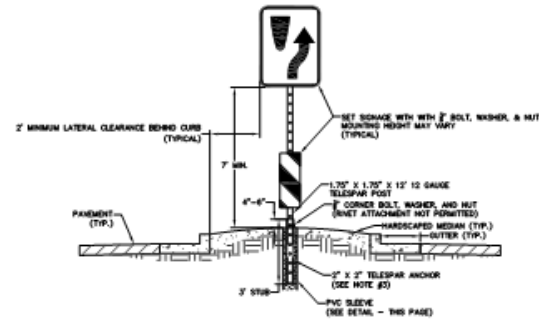
ARAPAHOE COUNTY, COLORADO  
DEPARTMENT OF  
PUBLIC WORKS AND  
DEVELOPMENT

DESIGNED BY THE ARAPAHOE COUNTY ENGINEERING & TRANSPORTATION DIVISION  
8004 SOUTH MAIN STREET - CENTENNIAL, CO 80112 - PH: 703.874.8800 - FAX: 303.874.8811

#### ROAD SIDE SIGN STANDARD DETAIL



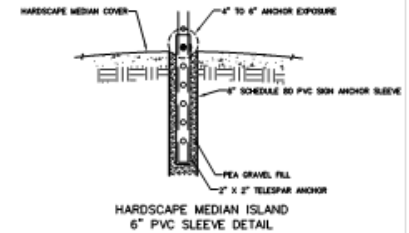
MEDIAN ISLAND SIGN INSTALLATION  
(LANDSCAPE COVER)



MEDIAN ISLAND SIGN INSTALLATION  
(HARDSCAPE MEDIAN COVER)

**MEDIAN ISLAND SIGN INSTALLATION NOTES:**

1. SIGNAGE SHALL BE SET PERPENDICULAR TO ROADWAY AND VISIBLE TO ONCOMING TRAFFIC.
2. ALL SIGNAGE SHALL MEET THE CURRENT MUTCD STANDARDS.
3. TELESCOPIC ANCHOR SHALL BE SET IN PICA GRAVEL WITHIN A 6" SCHEDULE 80 PVC PIPE WHEN SIGN IS LOCATED IN CONCRETE OR AS DIRECTED BY THE ENGINEER.
4. COMPACT EXISTING SOIL MATERIAL PRIOR TO SETTING TELESCOPIC ANCHOR.
5. SIGNS LARGER THAN 30" USE A 2"x2" 12 GAUGE WITH 2.25" X 2.25" X 3' ANCHOR.
6. ALL SIGNAGE SHALL COMPLY WITH CHAPTER 3 OF THE ARAPAHOE COUNTY



**REVISIONS**

#	DATE	DESCRIPTION	BY
1			
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5			



ARAPAHOE COUNTY, COLORADO  
DEPARTMENT OF  
PUBLIC WORKS AND  
DEVELOPMENT

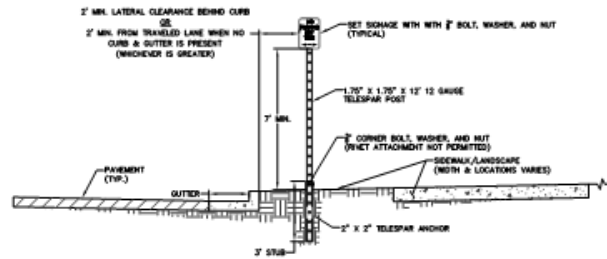
DESIGNED BY THE ARAPAHOE COUNTY ENGINEERING & TRANSPORTATION DIVISION  
8004 SOUTH LUNA STREET - DENVER, COLORADO 80212 - PH: 720-874-8333 - FAX: 303-874-0811

**MEDIAN SIGN STANDARD DETAIL**

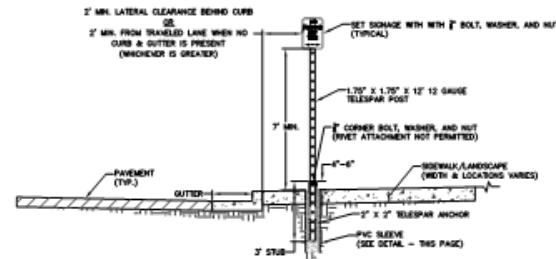
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APPROVED: DS

SCALE:  
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DETAIL #:  
9-2



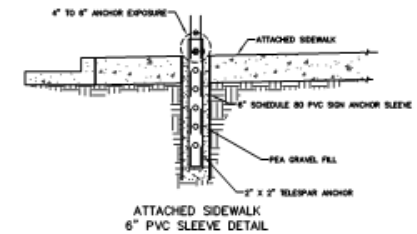
NO PARKING SIGN INSTALLATION  
(NO SIDEWALK OR DETACHED SIDEWALK)



NO PARKING SIGN INSTALLATION  
(WITHIN ATTACHED SIDEWALK)

**NO PARKING SIGN INSTALLATION NOTES**

1. SIGNAGE SHALL BE SET PARALLEL TO ROADWAY AND VISIBLE TO TRAFFIC.
2. ALL SIGNAGE SHALL MEET THE CURRENT MUTCD STANDARDS.
3. TELESPAR ANCHOR SHALL BE SET IN PEA GRAVEL WITHIN A 6" SCHEDULE 80 PVC PIPE WHEN SIGN IS LOCATED IN CONCRETE OR OTHER HARDSCAPE.
4. COMPACT EXISTING SOIL MATERIAL PRIOR TO SETTING TELESPAR ANCHOR.
5. SIGNS LARGER THAN 30" USE A 2"x2" 1/2 GAUGE WITH 2.25" X 2.25" X 3" ANCHOR.
7. SIGNAGE SHALL COMPLY WITH ALL APPLICABLE ARAPAHOE COUNTY STANDARDS & DETAILS.



ATTACHED SIDEWALK  
6" PVC SLEEVE DETAIL

REVISIONS		
NO.	DATE	DESCRIPTION

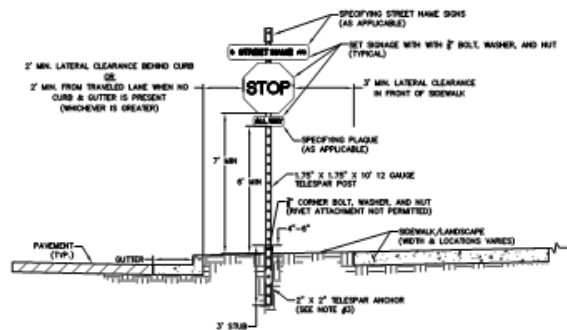


ARAPAHOE COUNTY, COLORADO  
DEPARTMENT OF  
PUBLIC WORKS AND  
DEVELOPMENT

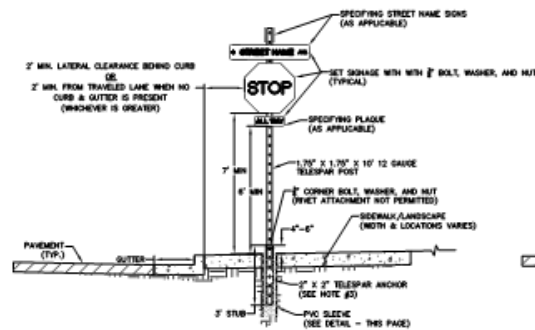
DESIGNED BY: THE ARAPAHOE COUNTY ENGINEERING & TRANSPORTATION DIVISION  
6004 SOUTH LUNA STREET - DENVER, COLORADO 80212 - TEL: 720-874-8200 - FAX: 303-874-0811

**NO PARKING SIGN STANDARD DETAIL**

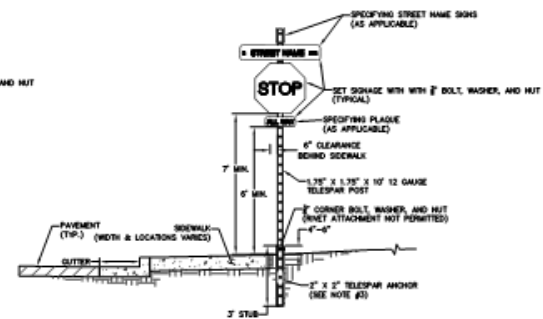
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APPROVED: DS		



STOP SIGN INSTALLATION  
(NO SIDEWALK OR DETACHED SIDEWALK)



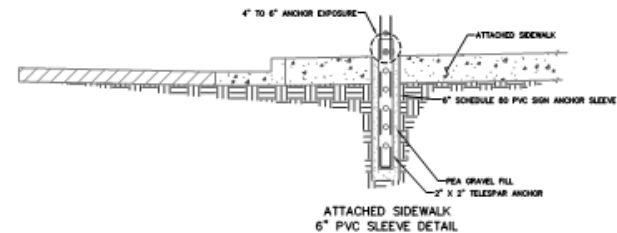
STOP SIGN INSTALLATION  
(WITHIN ATTACHED SIDEWALK)



STOP SIGN INSTALLATION  
(BEHIND ATTACHED SIDEWALK)

**STOP SIGN INSTALLATION NOTES:**

1. SIGNAGE SHALL BE SET PERPENDICULAR TO ROADWAY AND VISIBLE TO ONCOMING TRAFFIC.
2. ALL SIGNAGE SHALL MEET THE CURRENT MUTCD STANDARDS.
3. TELESPAR ANCHOR SHALL BE SET IN PEA GRAVEL WITHIN A 6\"/>



ATTACHED SIDEWALK  
6\"/>

REVISIONS		
#	DATE	DESCRIPTION
1	08/01/2018	ISSUED FOR BIDDING



ARAPAHOE COUNTY, COLORADO  
DEPARTMENT OF  
PUBLIC WORKS AND  
DEVELOPMENT

DESIGNED BY THE ARAPAHOE COUNTY ENGINEERING & TRANSPORTATION DIVISION  
1000 SOUTH JAVINA STREET - DENVER, COLORADO 80212 - PH: 720.894.8333 - FAX: 720.894.8311

**STOP SIGN STANDARD DETAIL**

**DRAWN:** JB  
**CHECKED:** KP  
**APPROVED:** DG

**SCALE:**  
NTS

**DETAIL #:**  
6-4

