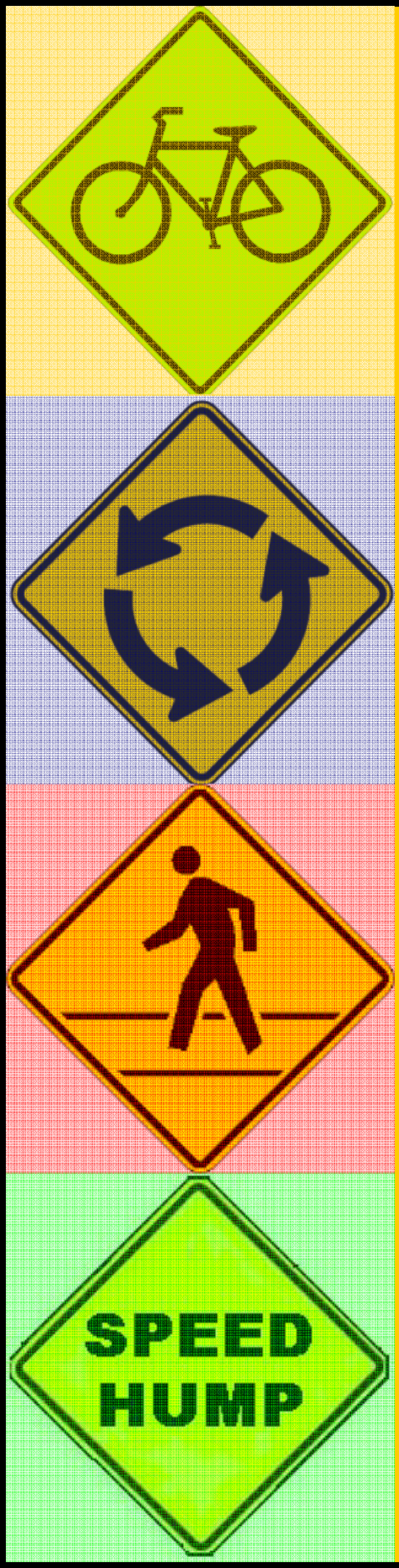


Guidelines for Traffic Calming

January 2007

City of Sparks
Public Works
Traffic Division

Acknowledgements

Mayor
Geno Martini

City Council
John Mayer
Phil Salerno
Ron Smith
Mike Carrigan
Ron Schmitt

City Manager

Shaun Carey

Public Works

Wayne Seidel, P.E. – Public Works Director
Pete Etchart, P.E. – Engineering Manager
Jon Ericson, P.E. – Transportation Manager

Consultant

Sirous Alavi, Ph.D., P.E.
President

Sierra Transportation Engineers, Inc.
1005 Terminal Way, Suite #125
Reno, NV 89502
Tel: 775-827-4400 Fax: 775-324-4407

TABLE OF CONTENTS

PAGE

LIST OF FIGURES

LIST OF TABLES

PAGE

LIST OF ACRONYMS

AADT	Average Annual Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
ADT	Average Daily Traffic
AWDT	Average Weekday Traffic
AWSC	All-Way Stop-Controlled
DOT	Department of Transportation
FHWA	Federal Highway Administration
HCM	Highway Capacity Manual
ITE	Institute of Transportation Engineers
MUTCD	Manual on Uniform Traffic Control Devices
RPM	Raised Pavement Markers
TMWA	Truckee Meadows Water Authority
TWSC	Two-Way Stop-Controlled
VPD	Vehicle Per Day

1.0 INTRODUCTION

Many agencies are developing guidelines and policies for traffic calming. The topic has become increasingly important to the public, agencies and other interested parties in order to develop effective neighborhood environments that adequately accommodate motor vehicles, pedestrians and bicyclists. The City of Sparks is interested in applying appropriate traffic calming with the goals of improving neighborhood ***safety*** and ***livability***.

The Institute of Transportation Engineers (ITE) and the Federal Highway Administration (FHWA) produced a report in August 1999 called *Traffic Calming: State of Practice*. The report defines traffic calming as:

> *"… the combination of mainly physical measures that reduce the negative effects of motor vehicle use, alter driver behavior and improve conditions for non-motorized street users."*

In other words, traffic calming is a methodology to influence motorist behavior and prevent undesirable driving practices. Traffic calming is generally achieved with physical measures that reduce vehicle speeds, reduce traffic volumes, discourage cut-through traffic on local streets, minimize conflicts between street users, and enhance the environment.

This document presents recommended traffic calming guidelines for use within the City of Sparks. The guidelines are applicable to new developments and existing neighborhoods. The guidelines contain descriptions of traffic calming measures, recommendations for use of specific traffic calming measures and recommendations for design of traffic calming measures.

An extensive literature search was conducted of the state-of-the-practice by other agencies and organizations to gather information on the best practices for designing neighborhood traffic circles. This information was utilized to develop guidelines for the City of Sparks.

1.1 PRINCIPLES OF TRAFFIC CALMING

There are several principles of traffic calming that should be considered when implementing traffic calming measures. The following principles are intended to provide guidance and direction for users of this document:

Problem Identification

Identifying the real traffic problem for a neighborhood roadway is not always easy. Sometimes the perceived nature of a traffic problem is very different from the real problem. For example, residents often mention both "traffic volume" and "speeding" as problems on their streets, but in many cases the traffic problem is one or the other. It is important to identify the real traffic problem in order to select the appropriate measure.

Problem Characterization

In order to ensure that appropriate traffic calming measures are implemented, it is essential that the extent of problems be characterized and quantified. Roadway information such as width of roadway and intersection dimensions should be collected. Diagrams can also be made to show such items as traffic volumes, speeds, peak hours of travel, turning movement counts, historical accident information, transit routes, bicycle routes, and pedestrian volumes.

First Consider Major Road Network Improvements

Before implementing any traffic calming measures for unwanted through movements on neighborhood roadways, the reason for these movements need to be determined. Sometimes congestion on adjacent arterials "forces" motorists to shortcut through the neighborhood. There are a wide range of low-cost options available to improve operations on

the major road network, including fine-tuning signal timings, adding turn bays, and implementing turn prohibitions and parking restrictions.

Minimize Access Restrictions
Residents, businesses, and others who live and work in the community will be more supportive of traffic calming measures that do not restrict their access into and out of a neighborhood. Problems should be addressed with other less restrictive traffic calming measures when possible.

Target Passenger Vehicles
The purpose in implementing traffic calming measures is to affect passenger vehicles and not other modes of traffic. Designs for traffic calming measures should take into account transit buses, bicyclists, and pedestrians.

Temporary Implementation
When possible inexpensive temporary measures should be installed to ensure that traffic calming measures will achieve the intended results prior to constructing permanent measures. A temporary installation also provides an opportunity to alter the geometrics of a measure or make other changes prior to permanent installation. Temporary measures should resemble permanent measures as much as possible.

Neighborhood Involvement
Residents, businesses and others who live and work in the community should be involved in developing traffic calming. Their input is essential in identifying problems and in selecting traffic calming solutions. Involving the neighborhood builds support for a traffic calming plan, and enhances the credibility of a plan.

Monitor Conditions
Traffic patterns change and consequently it is important that traffic volumes, vehicle speeds, accidents and other indicators of potential traffic problems are recorded and analyzed on an on-going basis. Much of this information is already collected. City personnel should monitor conditions on an on-going basis.

1.2 TRAFFIC CALMING PROCESS

This section describes the steps in the process of implementing traffic calming in new developments and existing neighborhoods. **Figure 1** presents the typical traffic calming process. **Appendix I** includes the documents needed for the traffic calming request process.

The general steps in the process are discussed in the following paragraphs.

1.2.1 TRAFFIC CALMING REQUESTS

The initial step of the process is to formulate a request for traffic calming. This step can be from a concerned Sparks resident or from proactive personnel within the City of Sparks.

For new developments, the City of Sparks will review development plans to identify potential traffic problems such as speeding or cut-through traffic. Often traffic problems can be predicted and prevented by properly reviewing roadway and lot plans for new developments.

For existing neighborhoods, the citizen can submit a request to the City of Sparks regarding a perceived traffic problem. The citizen should discuss their primary concern such as vehicle safety, pedestrian safety, congestion, noise, speeding or cut-through traffic. The ***Request for Traffic Calming Form*** can be found in **Appendix I** of this document.

1.2.2 Petition

Once a request has been filed, the citizen must distribute a petition to the neighborhood for support of the traffic calming request. At least **ten residents directly residing along the roadway** in question must sign the petition in order for the City of Sparks to proceed with the traffic calming process.

1.2.3 Review

After the petition has been verified, the City will determine whether or not the roadway is eligible for traffic calming. Data such as traffic volume, travel speeds, roadway description, description of petition area, description of impacted areas, etc. will be collected.

1.2.4 Selecting Measures

Based on the character of the traffic problem and the data that has been collected, the City will develop possible traffic calming solutions. The solutions shall be evaluated to determine if they meet the required goals and objectives.

Once solutions have been developed, it is important to involve the community. A public meeting should be held to discuss the solutions. Attendees shall include the original petitioners, residents from the impacted area, homeowner association, ward council member, police, fire, rescue, etc.

1.2.5 Approval & Implementation

Once a final solution has been developed, the traffic calming measures will be presented to the Public Works Director and City Council. **The approval of traffic calming measures is ultimately up to the Public Works Director and City Council.** As part of the solution, a plan should also be included for implementation of the traffic calming measure. The plan should detail the design and construction costs.

Additionally, due to budget planning, a priority ranking of the particular project may be performed. Based on a point system, the solution will receive points based on various data. Based on this priority ranking, the project may or may not be implemented.

Costs can also be shared with the neighborhood. For instance, if a community requests a speed hump yet it is of low priority, the community can share the burden of cost in order for the construction to go forward. Costs not only include construction but also maintenance of landscaping. Costs shall be discussed as part of the public meeting. See page 38 for estimated approval and implementation timeframe.

1.2.6 Construction

Using the guidelines discussed in this document, the traffic calming measures will be designed. The final design will be in accordance to the guidelines (e.g., geometric, safety, landscaping, etc.) presented in this document.

Additionally, trial installations may be used to evaluate the traffic calming measure's impact to the area prior to a final design. This will be left to the discretion of the City of Sparks.

1.2.7 Evaluation

If **trial** traffic calming measures have been constructed, the City of Sparks may evaluate the effectiveness of the installed traffic calming measures. The evaluation is performed to ensure that the traffic calming measures are effective. If the traffic calming measure has been ineffective, the City of Sparks may remove the traffic calming measures.

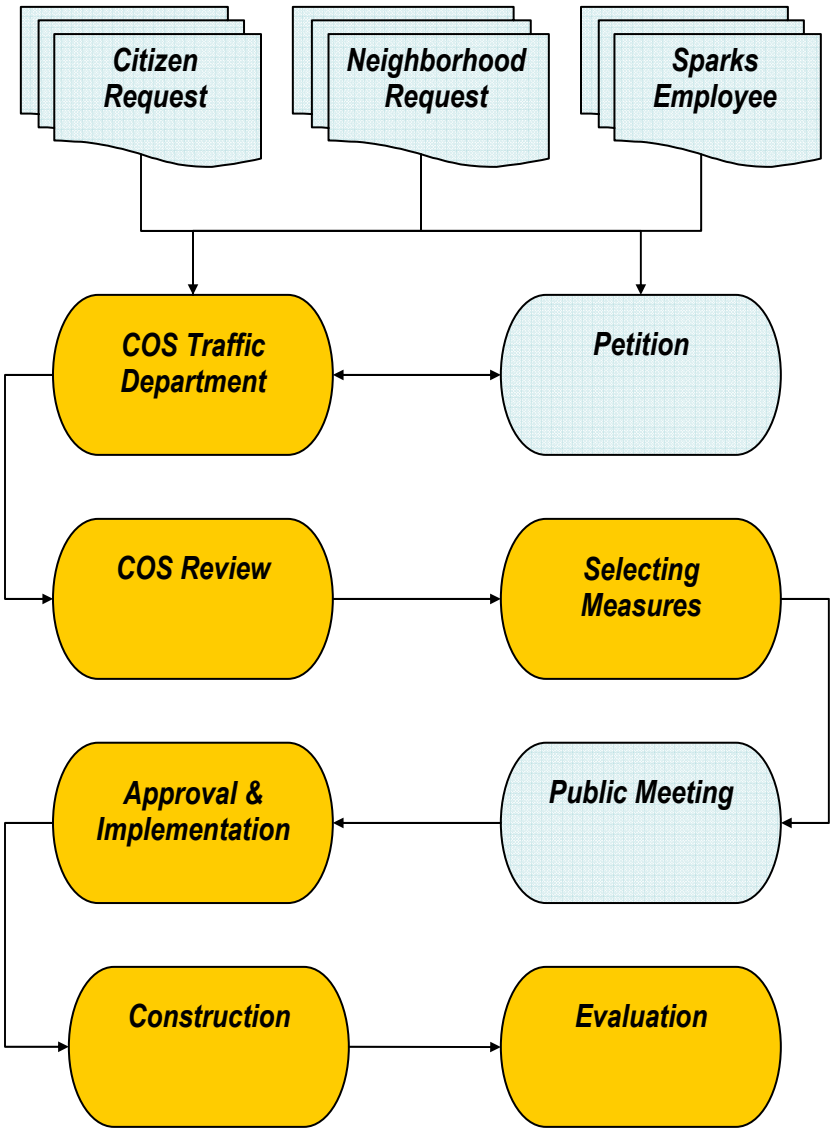


Figure 1: Traffic Calming Process.

2.0 TRAFFIC CALMING MEASURES

The traffic calming measures have been organized into six types: *Non-Physical Measures*, *Volume Control Measures, Vertical Speed Control Measures, Horizontal Speed Control Measures, Narrowing Measures, and Combined Measures*. Each measure is discussed in detail on the following pages.

2.1 NON-PHYSICAL MEASURES

Non-Physical Measures are measures such as signage or speed enforcement that do not require any construction or physical modifications to the roadway. These items can be attempted first since these can be economical and can be easier to remove if they do not improve the problem.

Effectiveness of Non-Physical Measures: Some measures such as speed enforcement signs or trailers have temporary effectiveness. Other measures have inconclusive effectiveness and may not significantly reduce travel speeds.

2.1.1 SPEED ENFORCEMENT

For areas where vehicle speed has been deemed excessive, speed enforcement can be a temporary traffic calming measure.

Targeted speed enforcement can be attempted on areas where speeding is observed by neighborhood residents and/or agency representatives. Limited personnel can be cost-effectively deployed on major roadways. For low volume streets, periodic daytime speed enforcement is the best option. Because of the expense to maintain increased levels of police enforcement, targeted speed enforcement should only be used temporarily and/or in conjunction with other new traffic calming measures to help drivers become aware of new restrictions.

Figure 2: Police Radar Trailer

Another option available for speed enforcement is a **radar trailer** device, which measures and displays a vehicle's speed as it approaches. The legal speed limit is shown in clear view next to the vehicle's speed. This reminds drivers to slow to the appropriate speed. These devices are easily transported and utilized rapidly at different locations.

Approximate Cost (2005 U.S. Dollars): Varies.

Advantages	Disadvantages
Inexpensive if used temporarily	Expensive to maintain for a long period
Does not require time for design	Trailer subject to vandalism
Does not slow trucks and emergency vehicles	

2.1.2 Radar Speed Sign

Another option that is very similar to a radar trailer device is called **radar speed sign**. The difference between this device and other radar devices is that this is permanent or semi-permanent. The device can also have the capability of storing data overtime and providing historical speed information to the City. This device measures and displays a vehicle's speed as it approaches. The legal speed limit is shown in clear view next to the vehicle's speed. This reminds drivers to slow to the appropriate speed.

Approximate Cost (2005 U.S. Dollars): $8,000 to $20,000.

Figure 3: Radar Speed Sign - Springland Dr.

Advantages	Disadvantages
Does not slow trucks and emergency vehicles	Has not been shown to significantly reduce travel speeds
Does not require much time for design	High cost of long-term maintenance
Can mount to existing poles	

2.1.3 Lane Striping

Lane striping can be used to create formal bicycle lanes, parking lanes and/or edge lines. The striping "narrows" the travel lane for vehicles and may encourage drivers to lower their speeds.

Approximate Cost (2005 U.S. Dollars):
$0.20-$0.30 per lineal foot.

Figure 4: Edge Striping - Wingfield Springs Rd.

Advantages	Disadvantages
Inexpensive	Increases regular maintenance
Can be used to create bicycle lanes or delineate on-street parking	Has not been shown to significantly reduce travel speeds
Does not require much time for design	
Does not slow trucks and emergency vehicles	

2.1.4 SIGNAGE

Signage such as speed limit and various restriction type signs can be used as a traffic calming measure. Speed limit signs should only be placed after engineering study is performed. Restriction type signs include: NO TRUCKS, CROSS TRAFFIC DOES NOT STOP, NO RIGHT TURN, NO LEFT TURN, NO THRU TRAFFIC.

Figure 5: Typical Signage

Approximate Cost (2005 U.S. Dollars): $250 per sign.

Advantages	Disadvantages
Inexpensive	Ineffective if not accompanied by speed enforcement
Turn restrictions can reduce cut through traffic	Speed must be set at a reasonable value for drivers to follow
Does not slow trucks and emergency vehicles	Has not been shown to significantly reduce travel volume or speeds

2.1.5 SPEED LEGEND

Speed legends are numbers painted on the roadway indicating current speed limit. These are usually painted near the speed limit signposts. Speed legends may be useful for reinforcing speed reduction between different roadway segments (e.g., from one functional class to another or at major residential entry points).

Approximate Cost (2005 U.S. Dollars): $100 per legend.

Figure 6: Speed Legend - Baring Blvd.

Advantages	Disadvantages
Inexpensive	Has not been shown to significantly reduce travel speeds
May help reinforce a change in speed limit	
Does not require much time for design	
Does not slow trucks and emergency vehicles	

2.1.6 Raised Pavement Marker

Raised pavement markers (RPM) are little "buttons" that can be placed on roadways to distinguish centerlines, edgelines or lanes of a roadway. These RPM's alert drivers when they drift outside of their lane. These are often used on curves, where vehicles have the tendency to drift into oncoming traffic. RPM's can also incorporate reflective qualities that improve nighttime visibility.

RPMs can be arranged perpendicular to roadway travel to create a "rumble strip". These RPMs produce a vibration in the vehicle and can make an audible noise. RPM's have been shown to improve opposite lane encroachments.

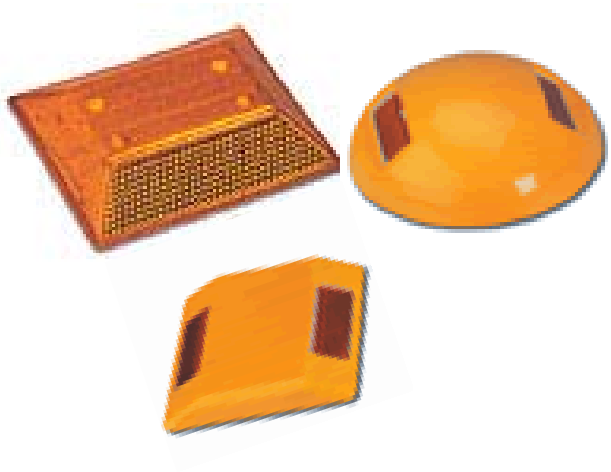


Figure 7: Raised Pavement Marker Samples

Approximate Cost (2005 U.S. Dollars): $5 to $15 per RPM.

Advantages	Disadvantages
Inexpensive	Noise caused by RPMs
Does not slow trucks and emergency vehicles	Snow plows often remove
May help drivers stay in lane on curves and during poor visibility	Constant maintenance/replacement

2.1.7 ANGLED PARKING

Angled parking can be used to reduce the width of the travel lane, which will likely reduce vehicle speeds. Angled parking may also increase the number of parking spaces available on a roadway. Angled parking changes parking from the parallel position to a 30°-60° angle.

Another option available is called Reverse Angled Parking. Like parallel parking, the driver enters the stall by stopping and backing up. In contrast to standard angled parking, the visibility while exiting reverse angle stalls is much improved. When exiting, the driver does not blindly back the rear half of the vehicle out into an active travel lane.

Figure 8: Diagonal Parking - Victorian Ave.

Approximate Cost (2005 U.S. Dollars): Varies by length.

Advantages	Disadvantages
Reduces speeds by narrowing travel lanes	Does not allow for bike lanes
Increases the number of parking spaces	Ineffective on roadways with frequent driveways
Makes parking maneuvers easier than parallel parking	Potential safety concerns when backing out
Favored by business and multi-family residences	

2.2 VOLUME CONTROL MEASURES

Volume Control Measures reduce the quantity of vehicles that use a roadway. Typical volume control measures are full street closures, half street closures, diagonal diverters, median barriers, and forced turn islands.

2.2.1 FULL CLOSURE

Full closure is a physical barrier placed across a roadway to block all vehicle traffic. Pedestrian and bicycle traffic are usually unrestricted. Typical barriers include: landscaped islands, walls, gates, side-by-side bollards, posts, etc. The barrier should be designed to eliminate vehicles (e.g., passenger car) from entering.

Effectiveness: Vehicles per day (vpd) were examined before and after the traffic calming measures were installed. Overall, there was an observed reduction of 671 vpd or 44% reduction in traffic volume.

Sample Measure	Sample Size	Traffic Volume (vpd)	
		Average Change After Calming	Average % Change After Calming
Full Closure	19	-671	-44%

Approximate Cost (2005 U.S. Dollars): $30,000 to $150,000.

Figure 9: Full Closure - 13th St. & D St.

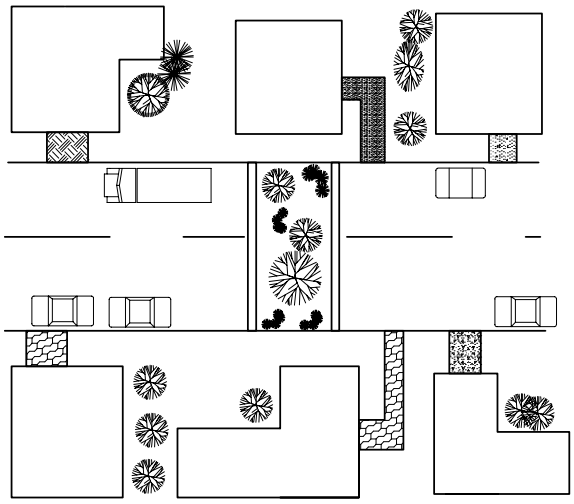


Figure 10: Diagram of Full Closure

Advantages	Disadvantages
Able to maintain pedestrian and bicycle access	Cause indirect routes for local residents and emergency vehicles
Does not adversely affect access by children	May limit access to businesses
Very effective in reducing traffic volumes	May be expensive

2.2.2 HALF CLOSURE

Half closure is a physical barrier that blocks travel in one direction. Pedestrian and bicycle traffic are usually maintained. Typical barriers include: landscaped islands, walls, gates, side-by-side bollards, posts, etc. The barrier should be designed to eliminate vehicles (e.g., passenger car) from entering.

Effectiveness: Vehicles per day (vpd) were examined before and after the traffic calming measures were installed. Overall, there was an observed reduction of 1,611 vpd or 42% reduction in traffic volume.

Sample Measure	Sample Size	Traffic Volume (vpd)	
		Average Change After Calming	Average % Change After Calming
Half Closure	53	-1,611	-42%

Approximate Cost (2005 U.S. Dollars): $3,000 to $10,000.

Figure 11: Half Closure - Mae Anne (Reno)

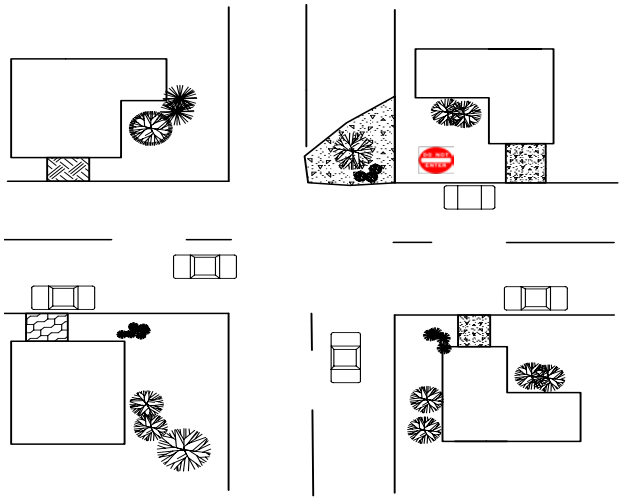


Figure 12: Diagram of Half Closure

Advantages	Disadvantages
Able to maintain pedestrian and bicycle access	Cause indirect routes for local residents
Does not affect emergency vehicles	May limit access to businesses
Effective in reducing traffic volumes	May be expensive
	Drivers can circumnavigation barrier

2.2.3 DIAGONAL DIVERTER

Diagonal diverters are barriers built across an intersection that prevents through and/or turning movements. Pedestrian and bicycle traffic are usually maintained. Typical barriers include: landscaped islands, walls, gates, side-by-side bollards, posts, etc. The barrier should be designed to eliminate vehicles (e.g., passenger car) from entering.

Effectiveness: Vehicles per day (vpd) were examined before and after the traffic calming measures were installed. Overall, there was an observed reduction of 501 vpd or 35% reduction in traffic volume.

Sample Measure	Sample Size	Traffic Volume (vpd)	
		Average Change After Calming	Average % Change After Calming
Diagonal Diverter	27	-501	-35

Approximate Cost (2005 U.S. Dollars): $15,000 to $45,000.

Figure 13: Diagonal Diverter - 11th St. & D St.

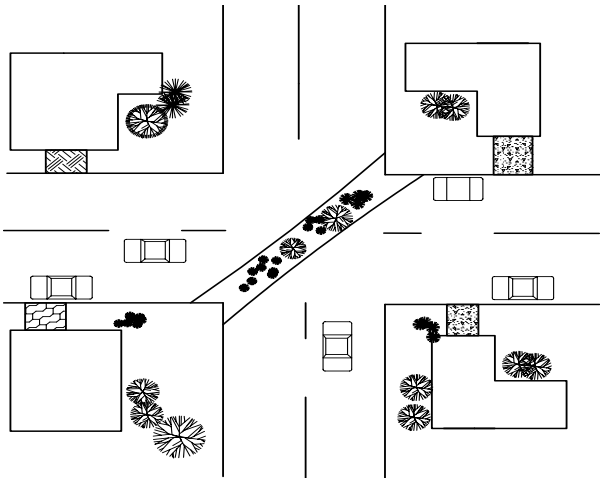


Figure 14: Diagram of Diagonal Diverter

Advantages	Disadvantages
Able to maintain pedestrian and bicycle access	Cause indirect routes for local residents and emergency vehicles
Effective in reducing traffic volumes	May be expensive
	May require reconstruction of corner curbs

2.2.4 MEDIAN BARRIER

Median barriers are raised islands placed in the center of the roadway and across an intersection. Median barriers prevent left turns from the through street and left turns and through movement from the cross street.

Approximate Cost (2005 U.S. Dollars): $15,000 to $40,000 per 100 feet.

Figure 15: Median Barrier - Santa Barbara Ave.

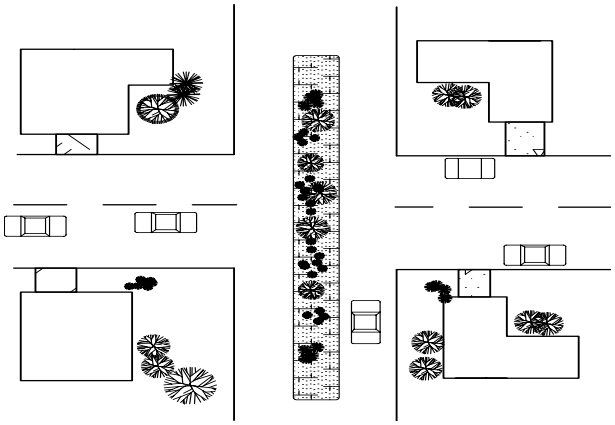


Figure 16: Diagram of Median Barrier

Advantages	Disadvantages
Can improve safety at intersection by prohibiting dangerous turning movements	May require right-of-way acquisition
Can reduce traffic volumes on a cut-through route that crosses major street	Limit turns to and from side street for local residents
	May limit access for emergency vehicles
	Keep plants and irrigation to a minimum due to pavement deterioration from water runoff

2.2.5 Forced Turn Island

Forced turn islands are barrier islands that block certain movements on approaches to an intersection. Designs can vary significantly depending on the installation location. Forced turn islands are best when used on residential streets at intersections with larger streets. The larger street can accommodate the diverted traffic and will cut down on the number of vehicles that might attempt to circumnavigate the measure. Occasionally additional center line barriers or channelization required to keep drivers from circumventing islands.

Approximate Cost (2005 U.S. Dollars): $3,000 to $5,000.

Figure 17: Forced Turn Island - Domaine Dr. at Vista Blvd.

Figure 18: Forced Turn Island - Vista Blvd.

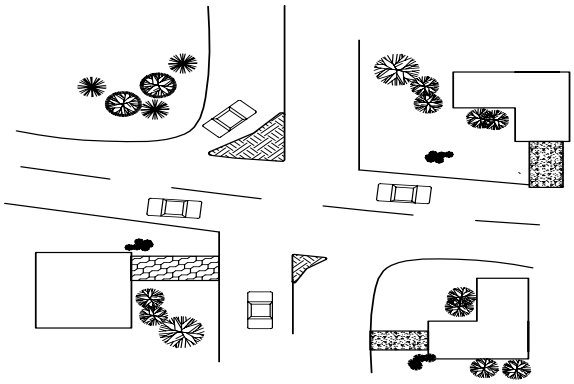


Figure 19: Diagram of Forced Turn Islands

Advantages	Disadvantages
Can improve safety at intersection by prohibiting dangerous turning movements	May simply divert traffic problem to different street
	May limit access for local residents.

2.3 VERTICAL SPEED CONTROL MEASURES

Vertical Speed Control Measures are vertical elevated segments of roadway that require a vehicle to slow. Typical vertical speed control measures include speed humps, speed tables, raised sidewalks and raised intersections.

2.3.1 SPEED HUMP

A speed hump is a raised rounded device usually constructed from asphalt that is placed across a roadway. Speed humps are usually 3 to 4 inches in height and are parabolic or sinusoidal (e.g., gradual) in shape. They extend fully across the roadway but are tapered on each side to allow unimpeded water flow in curb and gutter system. The design speed for a speed hump is approximately 15-25 mph.

2.3.2 MODIFIED SPEED HUMP: SPEED LUMP

Speed lumps are similar to speed humps, except they are divided into three lumps with one foot of space between each lump. The space between the lumps is specifically designed to accommodate the axle width of fire vehicles. All other vehicles with smaller axle widths have to go over the humps from at least one side of the vehicle. Speed lumps are typically 12-14 feet long. Extreme care must be taken to ensure the height of the speed lump can accommodate the ground clearance of fire vehicles.

Effectiveness: The 85th percentile speed was examined from before and after the traffic calming measures were installed. The 85th percentile speed is normally assumed to be the highest safe speed for the roadway section. Speed humps were observed to reduce speed approximately 7 mph or approximately 22%.

Sample Measure	Sample Size	85th Percentile Speed (mph)		Average % Change
		Average After Calming	Average Change After Calming	
12 foot Humps	179	27.4	-7.6	-22%
14 foot Humps	15	25.6	-7.7	-23%

Approximate Cost (2005 U.S. Dollars): $1,500 to $4,000.

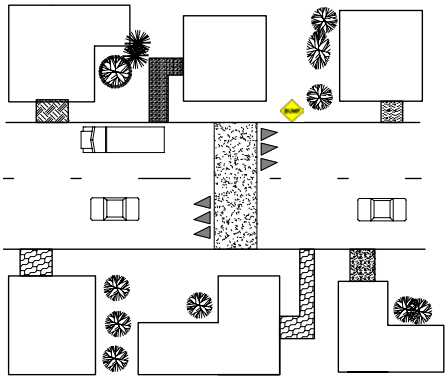


Figure 20: Diagram of a Speed Hump

Figure 21: Speed Hump - Locomotive Way

Advantages	Disadvantages
Relatively inexpensive	Causes a rough ride for drivers
Relatively easy for bicyclists to cross at taper if designed properly	Slows and may damage emergency vehicles
Very effective at slowing travel speed	Increase noise and air pollution
	Poor aesthetics

2.3.3 SPEED TABLE

A speed table is a raised flat-topped device, which is placed across the roadway. Speed tables are usually 3 to 4 inches in height. The flat-top is approximately 10 feet in the direction of travel and each ramp is 6 feet. The flat-top is usually constructed of asphalt, concrete, brick, or other textured materials. The ramps are parabolic in shape and are usually made of asphalt. Speed tables extend fully across the roadway but are tapered on each side to allow unimpeded water flow in curb and gutter system. The design speed for a speed table is approximately 30 mph, which is a safe and comfortable speed for passenger vehicles.

Effectiveness: The 85th percentile speed was examined from before and after the traffic calming measures were installed. The 85th percentile speed is normally assumed to be the highest safe speed for the roadway section. Speed tables were observed to reduce speed at least 3 mph or approximately 9%.

Sample Measure	Sample Size	85th Percentile Speed (mph)		Average % Change
		Average After Calming	Average Change After Calming	
22 foot Tables	58	30.1	-6.6	-18%
Longer Tables	10	31.6	-3.2	-9%

Approximate Cost (2005 U.S. Dollars): $4,000 to $15,000 depending on materials used.

Figure 22: Speed Table – Santa Barbara Ave.

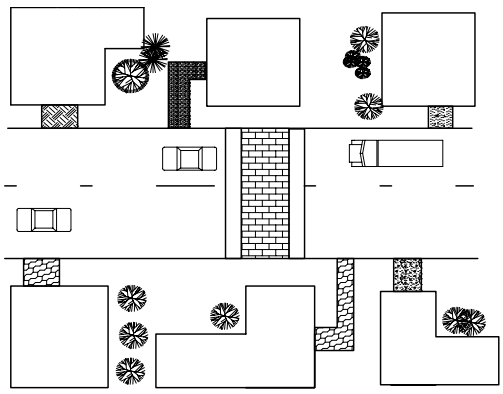


Figure 23: Diagram of Speed Table

Advantages	Disadvantages
Relatively inexpensive	Poor aesthetics if no textured material are used
Smoother on large vehicles than speed humps	Some textured materials can be expensive
Effective at slowing travel speed	Increased noise
	Slows and may damage emergency vehicles

2.3.4 RAISED CROSSWALK

Raised crosswalks are speed tables with crosswalk markings and signage. The only geometric difference between them is the raised crosswalk extends from curb to curb and the raised crosswalk may be longer and higher than a typical speed table.

Effectiveness: The 85th percentile speed was examined from before and after the traffic calming measures were installed. The 85th percentile speed is normally assumed to be the highest safe speed for the roadway section. The most similar device for which data was available is a 22 foot speed table, which can reduce speed at least 6 mph or approximately 18%.

Sample Measure	Sample Size	85th Percentile Speed (mph)		Average % Change
		Average After Calming	Average Change After Calming	
22 foot Tables	58	30.1	-6.6	-18%

Approximate Cost (2005 U.S. Dollars): $4,000 to $15,000 depending on materials used.

Figure 24: Raised Crosswalk - Victorian Ave.

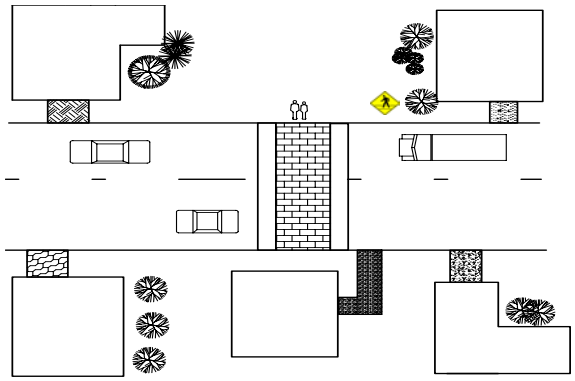


Figure 25: Diagram of Raised Crosswalk

Advantages	Disadvantages
Relatively inexpensive	Poor aesthetics if no textured material are used
Smoother on large vehicles than speed humps	Some textured materials can be expensive
Improve safety for pedestrians	Increased noise
Effective at slowing travel speed	Slows and may damage emergency vehicles
	May change or restrict drainage

2.3.5 RAISED INTERSECTION

Raised intersections are like speed tables that cover an entire intersection. Ramps are present on all approaches. The flat-top area is usually a textured material. Raised intersections usually rise to sidewalk level or slightly below to provide an edge for the visually impaired. If there is a concern about loss of on-street parking, raised intersections are a more acceptable traffic calming measure.

Effectiveness: The 85th percentile speed was examined from before and after the traffic calming measures were installed. The 85th percentile speed is normally assumed to be the highest safe speed for the roadway section. Raised intersection did not lower speed significantly.

Sample Measure	Sample Size	85th Percentile Speed (mph)		Average % Change
		Average After Calming	Average Change After Calming	
Raised Intersections	3	34.3	-0.3	-1%

Approximate Cost (2005 U.S. Dollars): $25,000 to $70,000 depending on materials used.

Figure 26: Raised Intersection (pedestrian) - Whitewood Dr.

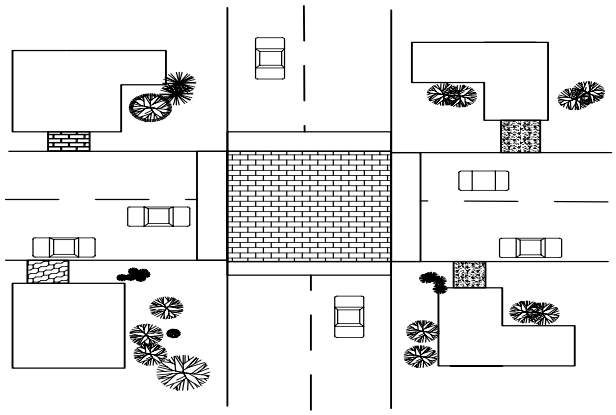


Figure 27: Diagram of Raised Intersection

Advantages	Disadvantages
Improve safety for pedestrians and vehicles	Some textured materials can be expensive
Can calm two streets at same time	Increased noise
	Less effective in slowing travel speed
	May change or restrict drainage

2.4 HORIZONTAL SPEED CONTROL MEASURES

Horizontal Speed Control Measures are altered segments of roadway, where the straight line of travel has been altered in order to require a vehicle to slow. Typical horizontal speed control measures are chicanes, traffic circles, roundabouts, and lateral shifts.

2.4.1 TRAFFIC CIRCLE

A traffic circle is a raised island placed in an intersection which traffic circulates. Generally, traffic circles are circular in shape and have some type of landscaping in its center. Also, traffic circles have outer rings (i.e., truck apron or lip) that are mountable so large vehicles can circumnavigate the small radius traffic circle. Further detailed information is available from the City in a document called Traffic Circles prepared in June, 2005.

Effectiveness: The 85th percentile speed was examined from before and after the traffic calming measures were installed. The 85th percentile speed is normally assumed to be the highest safe speed for the roadway section. Traffic circles were observed to reduce speed at least 3 mph or approximately 11%.

Sample Measure	Sample Size	85th Percentile Speed (mph)		Average % Change
		Average After Calming	Average Change After Calming	
Traffic Circles	45	30.3	-3.9	-11%

Approximate Cost (2005 U.S. Dollars): $20,000 to $40,000 for asphalt streets and $30,000 to $60,000 for concrete streets.

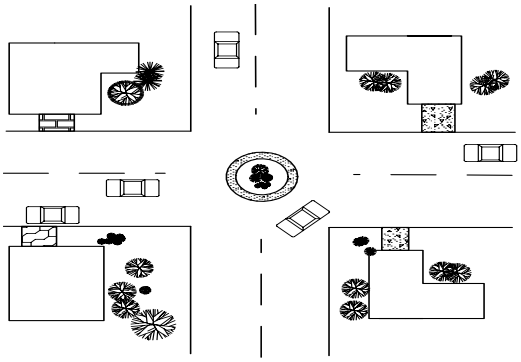


Figure 28: Diagram of Traffic Circle

Figure 29: Residential Traffic Circle – Washington Ave. (Reno)

Advantages	Disadvantages
Provides increased access to street from side street	Landscaping must be maintained
Breaks up sight-lines on straight street	Difficult for large vehicles (e.g., fire truck) to circumnavigate
Effective at slowing travel speed	Potential loss of on-street parking
	May require modifications to curb, gutter and sidewalks

2.4.2 ROUNDABOUT

A roundabout is similar to a traffic circle. It also has a raised island placed in an intersection with circulating traffic. However, there are differences. Roundabouts generally are much larger than traffic circles (i.e., control measure placed in an existing intersection) and thus need more land for construction. Roundabouts are used at intersections with higher traffic volumes and are designed for higher speeds. Roundabouts generally have raised splitter islands that deflect traffic to the right, which help form gaps in traffic. Roundabouts may also have flared entry lanes, which increase the capacity of the intersection. Roundabouts may also have bypass lanes to allow drivers to travel through the area without entering the intersection at all.

Effectiveness: Effectiveness is inconclusive. Speed entering roundabouts is affected by geometric curvature design features. However, roundabouts have been shown reduce crash frequencies. From a sample of 11 sites, there was a 37% reduction in accidents, which corresponds to a reduction from 9.3 to 5.9 accidents per year.

Approximate Cost (2005 U.S. Dollars): $100,000 to $250,000 depending on materials and dimensions.

Figure 30: Roundabout at Los Altos Parkway

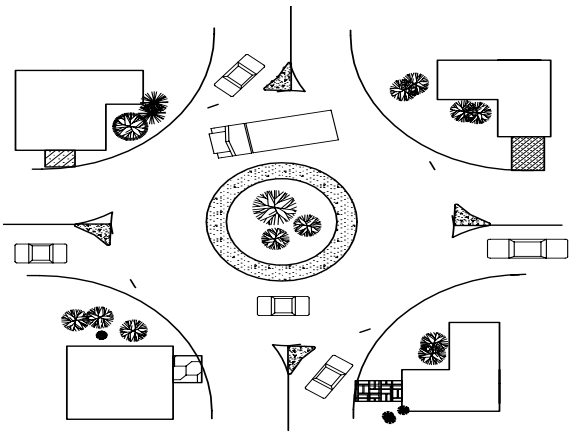


Figure 31: Diagram of Roundabout

Advantages	Disadvantages
Enhanced safety compared to traffic signal	Landscaping must be maintained
Minimizes queuing at approaches	May require major reconstruction and extensive right-of-way
May be effective at slowing travel speed	Potential loss of on-street parking
	Increases pedestrian distance and travel time on crosswalks

2.4.3 CHICANE

Chicanes are curb extensions or edge islands that alternate from one side of roadway to the other. These curb extensions or edge islands give the roadway more "winding" attribute. Curb extensions or edge islands can be semi-circular, triangular or squared off. Trapezoidal islands have been found to be more effective at reducing speeds than semi-circular shapes. Curb extensions or edge islands should have a vertical element to draw attention to them. Trees and other landscape materials are an option. For low speed roadways or roadways that lack right-of-way, mountable curbs are also an option to allow larger vehicles to maneuver through the chicanes.

Chicanes can also be formed by alternative on-street parking from one side of the roadway to the other. Parking bays can be created using striping or by installing landscaped islands at each end.

Effectiveness: Effectiveness is inconclusive. However, in several communities such as Montgomery County, Maryland, Charlotte, North Carolina and Seattle, Washington, chicanes have reduced speeds by at least 5 mph or approximately 15%.

Sample Measure	Sample Size	85th Percentile Speed (mph)		Average % Change
		Average After Calming	Average Change After Calming	
Chicanes*	4	28.0	-5.0	-15.2%

**Chicanes may have been combined with other measures.*

Approximate Cost (2005 U.S. Dollars): $40,000 per chicanes (i.e., curb extensions or edge islands).

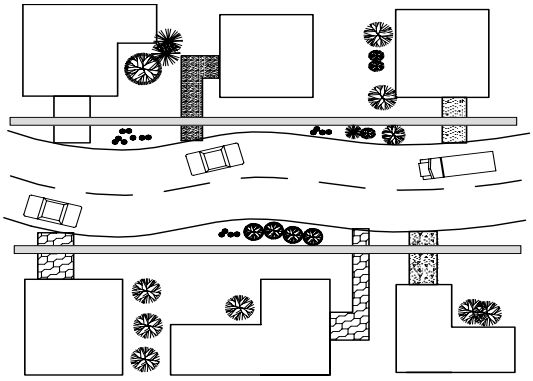


Figure 32: Diagram of Chicane

Figure 33: Chicane Example

Advantages	Disadvantages
Discourages high speeds by forcing horizontal deflection	Landscaping must be maintained
Negotiable by large vehicles (e.g., fire truck)	Require major reconstruction and extensive right-of-way
	Potential loss of on-street parking

2.4.4 LATERAL SHIFT

A lateral shift is like a chicane however the roadway alignment only shifts once. It is only one curb extension or edge islands rather than a series of alternating curb extension or edge islands. Because the road alignment shifts only once, the crossing speed is approximately 5 mph higher than a series of chicanes. A higher speed means that lateral shifts can be placed on higher functional classification roadways (i.e., collectors or arterials).

Typical lateral shifts incorporate a landscaped center island to separate opposing traffic. This prohibits drivers from veering into the opposing lane.

Effectiveness: Effectiveness is inconclusive. Lateral shifts have not been shown to significantly reduce travel speeds.

Approximate Cost (2005 U.S. Dollars): Varies depending on size of offset and length of transition.

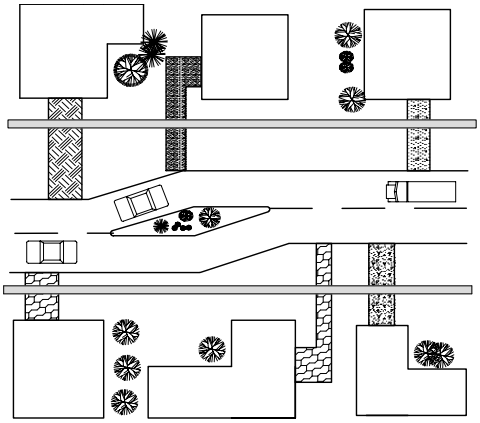


Figure 34: Diagram of Lateral Shift

Figure 35: Lateral Shift – Keystone Ave. (Reno)

Advantages	Disadvantages
Can accommodate higher traffic volumes	Potential loss of on-street parking
Negotiable by large vehicles (e.g., fire truck)	May require additional effort to properly design
	Landscaping must be maintained

2.5 NARROWING MEASURES

Narrowing Measures are short roadway segments that are narrower than the typical roadway section. Typical narrowing measures are neckdowns, chokers, and island narrowing.

2.5.1 NECKDOWN

Neckdowns are curb extensions at an intersection. These neckdowns reduce the roadway width from curb to curb and provide shorter pedestrian crossing distances and times. The short curb return radius also reduces the speeds of turning vehicles.

Effectiveness: The 85th percentile speed was examined from before and after the traffic calming measures were installed. The 85th percentile speed is normally assumed to be the highest safe speed for the roadway section. The most similar device for which data was available is called narrowing, which can reduce speed at least 2 mph or approximately 4%.

Vehicles per day (vpd) were examined before and after the traffic calming measures were installed. Overall, there was an observed reduction of 263 vpd or 10% reduction in traffic volume.

Sample Measure	Sample Size	85th Percentile Speed (mph)		Average % Change
		Average After Calming	Average Change After Calming	
Narrowings	7	32.3	-2.6	-4%
	Traffic Volume (vpd)			
	Sample Size	Average Change After Calming	Average % Change After Calming	
	11	-263	-10%	

Approximate Cost (2005 U.S. Dollars): $10,000 to $40,000 per corner.

Figure 36: Narrowing Measure - C St. & Victorian Square

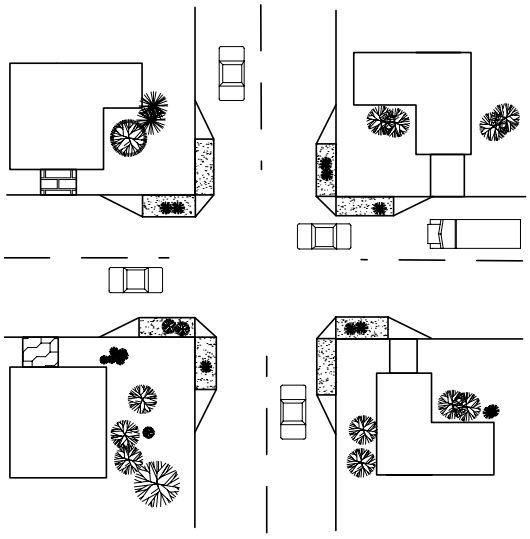


Figure 37: Diagram of Narrowing

Advantages	Disadvantages
Improves pedestrian comfort and safety	Effectiveness may be limited because there is no vertical or horizontal deflection
Through and left turn movements are negotiable by large vehicles (e.g., fire trucks)	Right turn not easily negotiable by large vehicles (e.g., fire trucks)
Can create protected on-street parking	Potential loss of on-street parking
May reduce speeds and traffic volumes	May bring bicycle lanes in closer proximity with travel lanes
	May change or restrict drainage

2.5.2 CHOKER

Chokers are curb extensions at mid-block that narrow the roadway by widening the sidewalk, planting strip, or centerline. A typical two-lane choker is 20 feet from curb to curb. One-lane chokers narrow the roadway to just one travel lane. This is similar to a one-lane bridge condition. The constricted length in the direction of travel varies but should be kept short enough not to block driveways or accesses.

Effectiveness: The 85th percentile speed was examined from before and after the traffic calming measures were installed. The 85th percentile speed is normally assumed to be the highest safe speed for the roadway section. One lane chokers were observed to reduce speed at least 4 mph or approximately 14%.

Vehicles per day (vpd) were examined before and after the traffic calming measures were installed. Overall, there was an observed reduction of 392 vpd or 20% reduction in traffic volume.

Sample Measure	Sample Size	85th Percentile Speed (mph)		Average % Change
		Average After Calming	Average Change After Calming	
One Lane Choker	5	28.6	-4.8	-14%
	Traffic Volume (vpd)			
	Sample Size	Average Change After Calming	Average % Change After Calming	
	5	-392	-20%	

Approximate Cost (2005 U.S. Dollars): $10,000 to $40,000 depending on site conditions and landscaping.

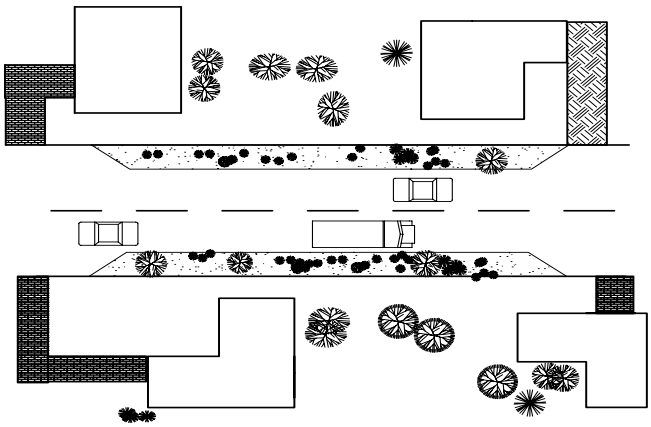


Figure 38: Diagram of Two-Lane Chokers

Figure 39: Centerline Choker – Washington St. (Reno)

Advantages	Disadvantages
Negotiable by large vehicles (e.g., fire truck)	Effectiveness may be limited because there is no vertical or horizontal deflection
May reduce travel speed and volume	May bring bicycle lanes in closer proximity with travel lanes
Can have positive aesthetic value	Potential loss of on-street parking
	One-lane choker can only be used on extremely low volume roadways without causing safety concerns or traffic congestion
	May limit driveway access

2.5.3 CENTER ISLAND

Center islands are raised barriers in the center of the roadway that narrow the travel lanes. The center island should be large enough to draw attention (e.g., 6 feet wide by 20 feet long). The center island can also be offset to the left from the perspective of approaching traffic. They are often landscaped and can be used as refuge for pedestrians crossing the roadway. Center islands create intermittent left turn areas rather than a continuous median. Center islands placed at intersections or entrances to neighborhoods are often called gateways.

Effectiveness: The 85th percentile speed was examined from before and after the traffic calming measures were installed. The 85th percentile speed is normally assumed to be the highest safe speed for the roadway section. The most similar device for which data was available is called narrowing, which can reduce speed at least 2 mph or approximately 4%.

Vehicles per day (vpd) were examined before and after the traffic calming measures were installed. Overall, there was an observed reduction of 263 vpd or 10% reduction in traffic volume.

Sample Measure	Sample Size	85th Percentile Speed (mph)		Average % Change
		Average After Calming	Average Change After Calming	
Narrowings	7	32.3	-2.6	-4%
	Traffic Volume (vpd)			
	Sample Size	Average Change After Calming	Average % Change After Calming	
	11	-263	-10%	

Approximate Cost (2005 U.S. Dollars): $10,000 to $20,000 per 100 feet depending on site conditions and landscaping.

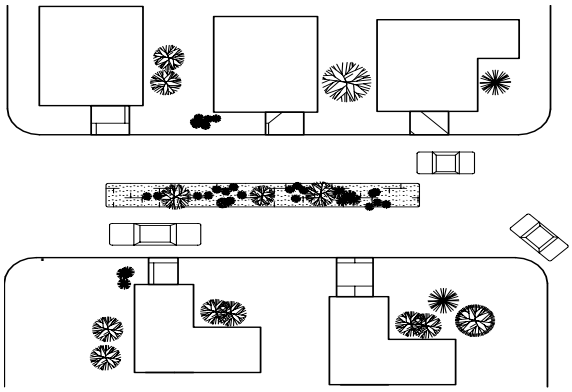


Figure 40: Diagram of Center Island

Figure 41: Center Island - Disc Dr.

Advantages	Disadvantages
Increases pedestrian safety	Effectiveness may be limited because there is no vertical or horizontal deflection
May reduce travel speed and volume	Potential loss of on-street parking
Can have positive aesthetic value	If center island is too long, channelized traffic may increase travel speed
	Keep plants and irrigation to a minimum due to pavement deterioration from water runoff

2.6 COMBINED MEASURES

Sometimes one traffic calming measure may not sufficiently address specific traffic problems like excess speeding. Combined Measures are a combination of the previously mentioned traffic calming measures that are installed to accomplish the design goals.

Effectiveness: Varies.
Approximate Cost (2005 U.S. Dollars): Varies.

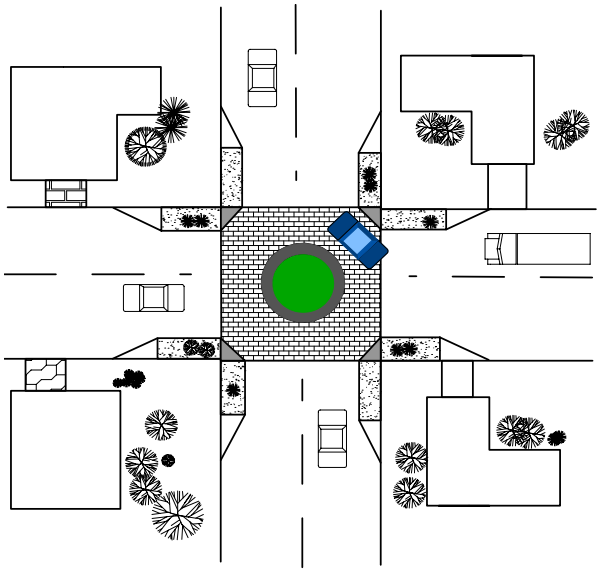


Figure 42: Diagram of Combined Measures

Figure 43: Combined Measure - Vista Blvd. / Mt. McKinley

Advantages	Disadvantages
Can create a more successful traffic calming	Vary based on the combination of measures used.

2.7 APPROPRIATENESS

After identifying and characterizing the traffic problem, one can select the appropriate traffic calming measure to be implemented. The major types of traffic problems are:

- **Speed** – vehicles speeds are too high.
- **Traffic Volume** – vehicle usage levels are too high and are affecting level of service.
- **Safety** – vehicles have excessive level of risk (e.g., accident history). Pedestrians and bicyclists are at unnecessary risk due to vehicles.
- **Pollution** – vehicles cause excessive levels of noise, vibration, and air pollutions.

Besides the traffic problem types, there are other issues such as location and traffic constraints that can be investigated. The following tables present each traffic calming measure and its appropriateness versus problem type, location type and traffic constraints. The appropriateness is an assessment derived from the literature search of the state of the industry and results from other agencies.

Table 1. Traffic Calming Measure versus Traffic Problem Type

Traffic Calming Measure	Traffic Problem Type			
	Speed	Traffic Volume	Safety	Pollution
Non-Physical				
Speed Enforcement	●	○	◒	◒
Lane Striping	●	○	○	○
Signage	●	○	○	○
Speed Legend	●	○	○	○
Raised Pavement Marker	○	○	●	○
Angled Parking	●	◒	○	○
Volume Control				
Full Closure	●	●	○	○
Half Closure	●	●	○	○
Diagonal Diverter	●	●	○	○
Median Barrier	○	●	◒	○
Forced Turn Island	○	●	◒	○
Vertical Speed Control				
Speed Hump	●	●	◒	✖
Speed Table	●	◒	◒	✖
Raised Crosswalk	●	◒	◒	✖
Raised Intersection	●	◒	◒	✖
Horizontal Speed Control				
Traffic Circle	●	◒	●	○
Roundabout	◒	◒	●	●
Chicane	●	◒	○	○
Lateral Shift	◒	◒	○	○
Narrowing				
Neckdown	●	◒	●	○
Choker	●	◒	◒	○
Center Island	●	◒	●	○

Legend:
● Strongly Appropriate, ◒ Moderately Appropriate, Possible, ○ Indifferent, Unlikely, ✖ Inappropriate, Not Applicable

Table 2. Traffic Calming Measure versus Location Type

Traffic Calming Measure	Location Type			
	Residential		Non-Residential	
	Mid-Block	Intersection	Mid-Block	Intersection
Non-Physical				
Speed Enforcement	●	●	●	●
Lane Striping	●	✖	●	✖
Signage	●	●	●	●
Speed Legend	●	●	●	●
Raised Pavement Marker	●	✖	●	✖
Angled Parking	●	✖	●	✖
Volume Control				
Full Closure	✖	●	✖	✖
Half Closure	✖	●	✖	✖
Diagonal Diverter	✖	●	✖	✖
Median Barrier	✖	◒	✖	✖
Forced Turn Island	✖	◒	✖	●
Vertical Speed Control				
Speed Hump	●	✖	✖	✖
Speed Table	●	✖	◒	✖
Raised Crosswalk	●	◒	◒	✖
Raised Intersection	✖	●	✖	●
Horizontal Speed Control				
Traffic Circle	✖	●	✖	◒
Roundabout	✖	◒	✖	●
Chicane	●	✖	●	✖
Lateral Shift	●	✖	●	✖
Narrowing				
Neckdown	✖	●	✖	●
Choker	●	✖	●	✖
Center Island	●	●	●	●

Legend:
● Applicable, ◒ Applicable in Some Cases, ✖ Not Applicable

3.0 GENERAL DESIGN PRINCIPLES

The following are general design principles that should be considered before and after traffic calming measure implementation.

3.1 DATA COLLECTION

One of the initial steps that should be considered prior to traffic calming measure implementation is data collection. The following data items can be collected:

1. Is the roadway on an Emergency Response Route
2. Twenty-four (24) hour directional approach volumes for each leg of the intersection should be obtained to identify the heaviest eight hours.
3. Twenty-four (24) hour directional volumes for the roadway should be obtained to identify the heaviest eight hours.
4. Percentage of large trucks that would be using the roadway or intersection.
5. Posted speeds for roadways should be obtained.
6. 85th percentile speed for all approaches should be obtained.
7. Miscellaneous data, such as existing roadway geometry, drainage information, area population, land uses and distances to other intersections and adjacent intersection control treatments, will also be useful for analysis.
8. Bicycle and pedestrian counts for the intersection should be gathered, where their numbers are significant. Special consideration should be paid to future pedestrian and bicycle traffic generators, such as plans to build a school near the intersection.
9. Detailed accident records should be compiled to analyze the frequency and types of collisions occurring at the existing intersection.
10. Community considerations should be investigated, including the need for parking, the landscaping character of the area and existence of other traffic management strategies.
11. Transit routes (and frequencies) through the intersection along with any stops which are located within area.

3.2 APPLICATION GUIDELINES

Criteria that should be considered are listed for the different physical traffic calming measures.

3.2.1 VOLUME CONTROL CRITERIA

The following are criteria that should be considered when installing volume control measures:

1. Volume control measures should be considered if the daily traffic volume is less than 5,000 vpd.
2. Volume control measures should be considered on intersections where there is one lane per approach entering the intersection.
3. Volume control measures should be considered where greater than 25% of traffic is non-local traffic.

3.2.2 Vertical Speed Control Criteria

The following are criteria that should be considered when installing vertical speed control measures:

1. Vertical speed control measures should be considered if the daily traffic volume is less than 7,500 vpd.
2. Speed humps should only be considered if the daily traffic volume is less than 4,000 vpd.
3. Vertical speed control measures will be considered on roadways where the posted speed is 25 mph or less.
4. Vertical speed control measures should be considered on roadways or intersections where the grade is less than 5% on the approach streets.

3.2.3 Horizontal Speed Control Criteria

The following are criteria that should be considered when installing horizontal speed control measures:

1. Horizontal speed control measures can be considered for all roadway functional classes.
2. Traffic circles and chicanes should only be considered if the daily entering traffic volume is less than 5,000 vpd.
3. Traffic circles should be considered on intersections where there is one lane per approach entering the intersection.
4. Horizontal speed control measures should be considered with a low volume (less than 2%) of buses and large trucks.
5. Horizontal speed control measures will be considered where the posted speed is 25 mph or less.
6. Roundabouts should only be considered on intersections where the grade is less than 6% on the approach streets with other measures where grade is less than 5%.

3.2.4 Narrowing Control Criteria

The following are criteria that should be considered when installing narrowing control measures:

1. Narrowing control measures can be considered for all roadway functional classes.
2. One lane chokers should only be considered if the daily entering traffic volumes is less than 3,000 vpd.
3. Narrowing control measures will be considered where the posted speed is 25 mph or less on the approach roadways.
4. Narrowing control measures should accommodate bicycle and pedestrian traffic in design.

3.2.5 Other Considerations

The following are other considerations that are application to all traffic calming measures:

1. Community sentiment
2. Number and types of accidents
3. Presence of pedestrian crosswalks
4. Presence of curb and gutter
5. Drainage
6. Presence of parking
7. Location within roadway network (e.g., minimum distance from other intersections)
8. Whether or not it is an emergency route, a bus route or a snow route
9. Snow removal issues
10. Whether or not traffic calming has been tried before (e.g., targeted speed enforcement, painted speed legends)

3.3 GEOMETRY

The following are general criteria that should be considered when installing traffic calming measures.

1. Examine as-is geometry of roadway or intersection.
2. Check physical feasibility of installing traffic calming measure.
3. Determine desired crossing speed (i.e., design speed) at slow points of traffic calming measure.
    - For vertical speed control measure (e.g., speed humps), the typical design speed is 25 to 30 mph. Speed versus vertical curvature relationships can be found in *ITE's Traffic Calming State of Practice.*
    - For horizontal speed control measures (e.g., traffic circles and roundabouts), the center islands and circular perimeters need to be determined. Speed versus horizontal curvature relationships can be found in *AASHTO's A Policy on Geometric Design of Highways and Streets*.

Specific geometric details are provided in the ***Appendix III: Standard Drawings***.

3.4 DESIGN VEHICLE

The minimum design vehicle for the City of Sparks shall be a fire truck with ladder (i.e., BUS) and/or a single-unit truck (i.e., SU) depending on public transit stops and routes, school bus stops and routes, and emergency vehicle routes. Fire trucks require a minimum design turning radius of 45 feet. Other design vehicle information can be obtained from the latest edition of *A Policy on Geometric Design of Highways and Streets* (see **Figure 44**).

AASHTO DESIGN VEHICLE
BUS – SINGLE UNIT BUS

AASHTO DESIGN VEHICLE
SU – SINGLE UNIT TRUCK

Figure 44: Typical Bus and Single Unit Trucks

3.5 UTILITIES

The City of Sparks shall review the site for utility conflicts and alter design as needed. The following areas should be considered: water, sewer, gas, power, telephone, storm drainage, fire hydrants, traffic signal wire interconnect.

3.6 SAFETY

As part of installing any traffic calming measure, signing and pavement markings should be incorporated as well. Agencies use the *Manual on Uniform Traffic Control Devices* (MUTCD) as general guidance; however, the MUTCD is not specific on any traffic calming measure.

1. The City of Sparks shall design signage and pavement markings using to the latest *Manual on Uniform Traffic Control Devices* (MUTCD) as guidance. The following items should be considered:
    - Warning signs need not be used where hazards are self-evident.
    - Signs must be legible, which requires high visibility, lettering or symbols of adequate size and short legends for quick comprehension.
    - Sign lettering must be in upper-case letters of the type approved by the City and FHWA.
    - Signs must be reflectorized or illuminated to show the same shape and color by day and night.
    - Signs are ordinarily placed on the right-hand side of the road, where the driver is looking for them.
    - Signs are ordinarily mounted separately, except where one sign supplements another, as advisory speed plates supplement warning signs.
    - Before any street is opened to traffic, all hazardous conditions must be signed and marked.
    - Symbol signs are preferred to word signs when an appropriate symbol exists.
    - New symbols not readily recognizable should be accompanied by educational plaques.
    - Analogous signs shall be used for new situations similar to those for which standard signs already exist.

2. Signs should be limited to minimize confusion.
3. Signs should be placed in advance to warn drivers. Placement of advance warning signs should conform to guidance provided in the latest MUTCD.
4. Check sight distances by visiting sight before and after traffic calming measure installation.
5. Depending on the characteristics of the intersection, pedestrian crosswalk signs and pavement markings may be needed and should follow guidance provided in the latest MUTCD (*Section 3B.17* & *Section 2C.37).*
6. Depending on the characteristics of the intersection, bicycle lane signs and pavement markings may be needed and should follow guidance provided in the latest MUTCD.
7. If sidewalk ramps are needed, they should be constructed according to City standards and be ADA compliant using the latest Department of Justice release at the time of construction.
8. Depending on the characteristics of the intersection, "no parking" signs may be needed as well as red painted curbs to properly mark the intersection.
9. Lighting should be installed to provide safe illumination. The following items should be considered:
    - Good illumination should be provided on the approach nose of the splitters islands, the conflict area where traffic enters the circulating stream and places where traffic streams separate at points of exits.
    - If applicable, pedestrian crossing areas should be illuminated.

3.7 LANDSCAPING

Although landscaping is not required, some agencies believe that landscaping plays an important role. Acceptance of traffic calming measures by the neighborhood is essential for successful implementation. In some cities, local residents view attractive "green space" more favorably than plain concrete or asphalt with brightly colored signs and pavement markings.

Landscaping must be maintained not only for aesthetics but also for safety (i.e., line of sight concerns). The maintenance of landscaping can be a burden on an agency. The use of landscaping and its cost should be evaluated. The type of plants used in the landscaping are carefully selected to select the "right" type of plant, one that will not grow too large and block visibility and one that is drought tolerant.

The following items are guidelines for landscaping:

1. Landscaping is not required for newly installed traffic circles in the City of Sparks.
2. Landscaping may be considered with the following conditions:
    - Maintenance costs are low for the City.
    - Initial plant costs are paid for or donated by community.
    - Community wishes to participate in landscape design, planting, and maintenance.
    - Turf areas should be small
3. Landscaping must be maintained.
    - Must allow adequate sight distances for motorists, pedestrians and bicyclists.
4. Landscaping uses low maintenance, drought resistant, native plants.
    - Types of plants can be selected with help of local agencies such as Truckee Meadows Water Authority (TMWA).
    - Acceptable flowers:
        - Sulfur flowered buckwheat (Eriogonum umbellatum)
        - Beard tongue (Penstemon species)
    - Acceptable shrubs:

  - Big sagebrush (Artemisia tridentate var. tridentata)
  - Four wing saltbush (Atriplex canescens)
  - Rubber rabbitbrush (Chrysothamnus nauseosus)
  - Sumac (Rhus species)
  - Golden currant (Ribes aureum)
  - Silver buffaloberry (Shepherdia argentea)
- Acceptable trees:
  - Pine (Pinus species)

5. The City of Sparks has a list of trees that **cannot** be planted, which includes:
   - All species of elm (Ulmus)
   - All Species of willow (Salix)
   - Following species of cottonwood (Populus): lanceleaf (Acuminata) narrowleaf (Angustifolia), western (Fremontii) and black (Trichocarpa)
6. Check sight distances by visiting sight before and after landscaping installation.
   - Bushes and shrubs should be kept less than 30 inches in height.
   - Trees should have limbs trimmed to 7 feet above street level.

Sulfur Flowered Buckwheat (Eriogonum Umbellatum)

Golden Currant (Ribes Aureum)

Silver Buffaloberry (Shepherdia Argentea)

Figure 45: Typical Acceptable Plants

REFERENCES

1. *Streets: A Users' Manual*, City of Las Vegas, Neighborhood Traffic Management Program, September 2001.
2. http://www.trans.ci.portland.or.us/trafficcalming/default.htm
3. http://www.cityofreno.com/res/engineering/traffic/
4. *City of Sacramento Traffic Calming Guidelines*, Department of Public Works, Sacramento, CA.
5. Mundell, J. *Constructing and Maintaining Traffic Calming Devices*, Seattle Department of Transportation.
6. Mundell, J. and Grisby, D., *Neighborhood Traffic Calming: Seattle's Traffic Circle Program,* ITE District 6 Annual Meeting, July 20-23, 1997, Salt Lake City, Utah.
7. Ewing, R. (2000). *Delaware Traffic Calming Design Manual*, Wilmington, DE., Delaware Department of Transportation.
8. Ewing, R. *Traffic Calming: State of the Practice*, U.S. Department of Transportation, Federal Highway Administration, Office of Safety Research and Development and Office of Human Environment; prepared by Institute of Transportation Engineers, August, 1999, FHWA-RD-99-135.
9. Robinson, B.W., et al (2000). *Roundabouts: An Informational Guide*. U.S. Department of Transportation, Federal Highway Administration, FHWA –RD-00-067, Washington, D.C.
10. *Florida Roundabout Guide*, Florida Department of Transportation, May 1998.
11. *Traffic Calming Protocol Manual*, Municipality of Anchorage Traffic Department, 4700 S. Bragaw Street, Anchorage, Alaska 99507, Prepared by: DOWL Engineers, 4040 B Street, Anchorage, Alaska 99503, W. O. D56869, March 2001.
12. Litman, T. *Evaluating Traffic Calming Benefits, Costs and Equity Impacts*. Victoria Transport Policy Institute (VTPI), October 21, 1999.
13. *The City of Calgary Traffic Calming Policy*, Planning and Transportation Policy, Land Use and Mobility of The City of Calgary, Alberta, Canada. Prepared by: Urban Systems Limited, January 2003.
14. *Traffic Calming Policy*, City of Waterloo, Ontario, Canada, http://www.city.waterloo.on.ca.
15. *A Policy on Geometric Design of Highways and Streets,* American Association of State Highway and Transportation Officials (ASSHTO), Washington D.C., 4th Edition, 2001.
16. *Manual on Uniform Traffic Control Devices (MUTCD)*, Federal Highway Administration (FHWA), Washington, DC, 2000, 2003, 2004.
17. *Landscaping in the Truckee Meadows,* Truckee Meadows Water Authority.
18. *Traffic Calming Guide for Local Residential Streets,* Virginia Department of Transportation, Richmond, Virginia, October 2002.
19. *The 2003 Annual Traffic Report,* Nevada Department of Transportation, Carson City, Nevada, 2003.
20. *Policy on Speed Humps,* City of Sparks.
21. *Neighborhood Traffic Calming Manual,* City of Jacksonville, Florida, Traffic Engineering Division, Revision 1, February 8, 2002.
22. *NCHRP Report 518 – Safety Evaluation of Permanent Raised Pavement Markers,* Transportation Research Board, Washington D.C., 2004.
23. *City of Roswell Transportation Calming Program,* Roswell Transportation Department, Roswell, New Mexico, Revised November 5, 2001.
24. *Traffic Circles*, City of Sparks, Nevada, Prepared by: Sierra Transportation Engineers, Inc., June 1, 2005.

APPENDIX I: PROCESS DOCUMENTATION

Traffic Calming Program Instructions

I. Introduction

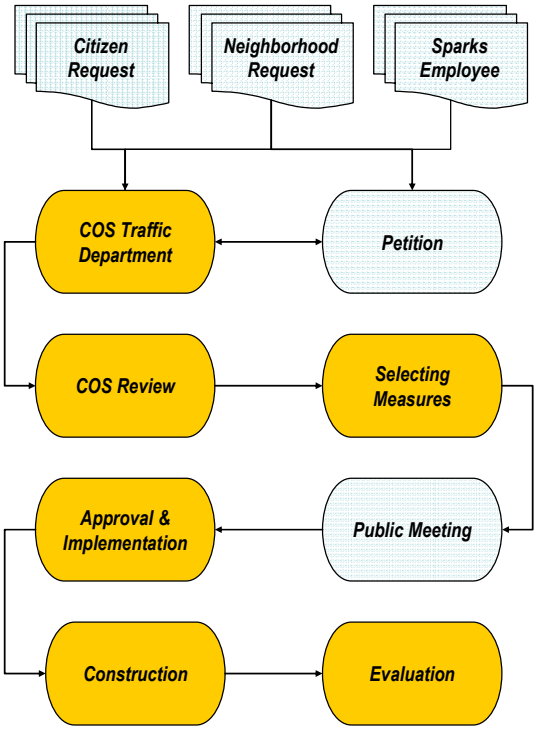
Welcome to the City of Sparks (COS) traffic calming program! These instructions outline the steps in the traffic calming request process. Please read and understand these instructions before filling out the Traffic Calming Request for Review form or Petition.

II. Implementation Process/Time Frame

The implementation process and time frame depends on the number of traffic calming requests running concurrently and the complexity of the traffic analyses. The time frames shown here represent the estimated maximum time taken from neighborhood request to installation.

Request submitted

COS to accept and review request:	1 month
Petitioner completes petition.	2 months
COS reviews petition and confirm signatures.	2 months
COS accepts petition and performs traffic study.	4 months
COS presents calming options to neighborhood and presents recommendations to City Council.	4 months
Temporary measures installed.	*2-6 months
Permanent installation if temporary measures are satisfactory.	*2-6 months
Possible total timeframe	**17-25 months**



**Some traffic calming measures may be beyond the budget of the traffic calming program and require the project be added to the Capital Improvement Program (CIP). This could extend the project timeline by 12 months in order to be considered in the next fiscal years CIP funding.*

III. Traffic Calming Request

Establishing a Neighborhood Representative

Communication with the COS will be through a "neighborhood representative" and neighborhood meetings.

The neighborhood representative **must be a home owner, 18 years of age or older, and lives on the street where traffic calming is being requested.** Endorsement from other neighborhood residents is NOT required for someone to initiate a traffic calming request and become the neighborhood representative. The neighborhood representative fills out the ***Request for Traffic Calming*** form and will work with his/her neighbors to sign the COS Traffic Calming petition.

Request for Traffic Calming

The Request for Traffic Calming form (request form) establishes communication between the City and the neighborhood representative. The request form is to be completed by the neighborhood representative and needs to be filled in completely in order for the COS to process. Please attach any other supporting pictures or drawings as needed to explain your traffic calming request. Return the form to the City of Sparks Traffic Division.

City of Sparks-Traffic Division
431 Prater Way
Sparks, NV 89431
Fax: 775-353-1638

Minimum Qualifying Criteria

Once the request form is completed and submitted to the COS, the City will confirm that the request meets the following minimum criteria:

a. The study street is classified as a neighborhood street by the COS.
b. The roadway must front residential, park, and/or schools (66% of its length).
c. The posted speed limit is 25 mph or less.
d. The street is **NOT** a major emergency response route for emergency vehicles (see map in **Appendix II**).
e. The longitudinal grade does not exceed 5%.

For assistance, please contact the COS Traffic Division at Sparks City Hall (353-2310)

Once the COS determines that the above minimum criteria are met, the neighborhood representative will be informed to proceed with the petition process.

IV. Neighborhood Petition

The purpose of the traffic calming petition is to establish minimum neighborhood support to proceed with the COS traffic calming program. One petitioner per household may sign the petition and petitioners must reside on the street where calming is requested. A minimum of ten (10) signatures are required for the COS to perform a traffic study and start reviewing traffic issues on the study street. A completed petition doesn't necessarily ensure that calming measures will be installed on the study street, but it does allow the COS to continue with a traffic study and scoring process. The COS traffic department accepts traffic calming petitions at anytime during the year and petitions are processed on a first-come first-serve basis.

The neighborhood representative should be the first to sign the petition and is the liaison between the City and the neighborhood and is responsible for obtaining the required minimum number of signatures (ten) for the traffic calming request to be accepted by the COS.

V. Review and Ranking

Traffic Study

The COS will verify petition signatures and perform a traffic analysis to evaluate neighborhood concerns. Depending on the traffic issues in the neighborhood various traffic study components may include: traffic volumes, travel speeds, signing and striping, circulation, vehicle queuing, intersection operations, driver sight distance, accidents, proximity to sensitive facilities, pedestrian safety, etc.

Scoring

The purpose of the scoring process is to determine which neighborhood traffic calming project has the most need. If there are multiple traffic calming requests being processed by the COS concurrently a scoring and ranking system will be used to prioritize projects. Scoring will be performed by COS staff after the traffic analysis is complete.

Ranking

Once the traffic study is complete and the request has been scored, projects are ranked. The highest ranked projects will be accommodated first depending on the availability of funding resources.

VI. Selecting Measures

Based on the character of the traffic problem and the collected data, the City will develop possible calming measures. Public neighborhood meetings will be held to discuss the appropriate measure. The Neighborhood Representative, original Petitioners, other impacted residents, homeowner association representatives, police, fire, etc., shall be in attendance. Certain measures may affect more residents than the original petitioners. If this is the case, the City will notify the affected residents and an additional public meeting may be required.

The affected neighborhood residents (as determined by the COS) will then vote on whether the chosen measure and location is acceptable. Seventy-five percent (**75%)** or more of the residents need to approve the recommended measure in order to proceed with submittal to the City Council. In instances where there is temporary installation, **50%** of the affected residents need to approve the installation of a temporary measure and **75%** for permanent installation.

VII. Approval and Implementation

The selected traffic calming measure will then be presented to the City Council for approval. Large traffic calming projects may be required to be included in the next years Capital Improvement Plan (CIP).

VIII. Construction

Some measures may require temporary installation in order to evaluate the effectiveness and impact to an area prior to final design. Other measures may be able to be installed permanently without a trial period.

IX. Evaluation

After the traffic calming measure has been constructed, the COS may evaluate the effectiveness of the installed traffic calming device. This is to ensure the effectiveness of the measure. If ineffective, the COS may decide to remove the traffic calming measure.

Request for Traffic Calming

Read the "Traffic Calming Program Instructions" before starting the traffic calming request process!!

Date: _____Neighborhood Representative: _____

The Neighborhood Representative will serve as the liaison between the neighborhood and the City of Sparks and is responsible for obtaining the appropriate petition signatures.

Daytime Phone Number: _____Other Phone Number_____

Address: _____

_____

Name and Phone Number of Neighborhood Association Contact Person (if applicable): _____

NeighborhoodName:_____

Council District and/or
CouncilRepresentative:_____

Please indicate traffic issues that concern the residents in your neighborhood.

	Speeding		Traffic Volumes
	Pedestrian/Bicycle Safety		Accidents
	Blocked Line of Site		Access/Traffic Operations
	Other (explain):		
Description/Location of Problem			

Return to: City of Sparks-Traffic Division, 431 Prater Way, Sparks, NV 89431, Fax: 775-353-1638

Petition

Read the "Traffic Calming Program Instructions" before starting the traffic calming request process!!

Come Now, the residents on _____(street) located between_____(cross street) and_____(cross street), hereinafter referred to as the "Petitioners", hereby petition the City of Sparks to consider the installation of traffic calming measures to mitigate traffic issues on our above referenced street and detailed on the attached "Request Form."

Petitioners must be at least 18 years of age and reside in separate households. By signing this petition you agree to allow traffic calming measures to be installed on your street that may permanently restrict access or parking along your street. There must be a minimum number of ten petitioners to process this request.

Signature	Printed Name	House #	Phone #
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10			
11.			
12.			
13.			
14.			
15.			

Return to:
City of Sparks-Traffic Division
431 Prater Way
Sparks, NV 89431
Fax: 115-353-1638

Scoring

85th Percentile Speed (40 points maximum) _____**pts**

The 85th percentile speed represents the speed, at or below, 85 percent of the free flowing vehicles are traveling. Points will be assigned based on the difference between the posted speed and the 85th percentile speed as follows:

0 points, less than or equal to 5 mph difference	or	(30 mph)
10 points, greater than 5 mph and less than or equal to 7 mph	or	(32 mph)
20 points, greater than 7 mph and less than or equal to 9 mph	or	(34 mph)
30 points, greater than 9 mph and less than or equal to 11 mph	or	(36 mph)
40 points, greater than 13 mph	or	(38 mph+)

Traffic Volume (25 points maximum) _____**pts**

Average Daily Traffic (20 points maximum) _____pts

Points for Average Daily Traffic (ADT) will be assigned as follows:

0 points, less than 800 ADT
5 points, 801 ADT to 1,500 ADT
10 points, 1,501 ADT to 2,500 ADT
15 points, 2,501 ADT to 3,500 ADT
20 points, 3,501 ADT +

Peak Hour Volume (5 points maximum) _____pts

The percent of the daily traffic occurring during the peak hour will be assigned points as follows:

5 points, peak hour of traffic is equal to or greater than 10% of ADT volume

3-Year Accident Data (20 points maximum) _____**pts**

0 points, 0 to 6 accidents over last 3 years
10 points, 7 to 12 accidents over last 3 years
20 points, 13 or more accidents over last 3 years

Pedestrian Facilities (5 points maximum) _____**pts**

0 points, if sidewalks are present and continuous on BOTH sides of the street throughout the project limits
2 points, if sidewalks are discontinuous or do not exist on ONE side of the street throughout the project limits
5 points, if sidewalks are discontinuous or do not exist on BOTH sides of the street throughout the project limits

Within Safe Route to School Boundaries (10 points maximum) _____**pts**

Other Generators: senior centers, libraries, parks, community centers, schools, and sites with significant pedestrian activity.

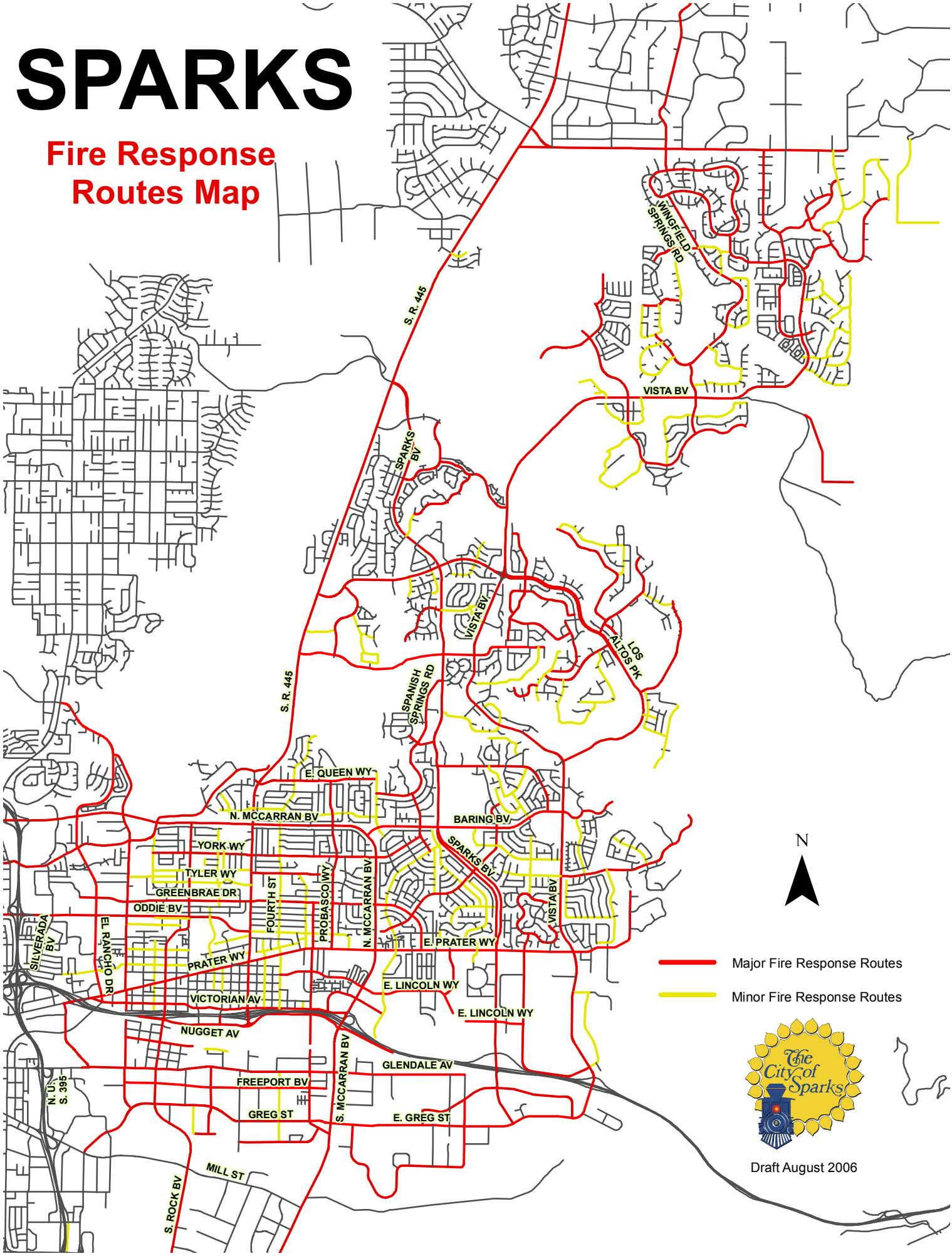
0 points, no sensitive facilities or pedestrian crossings
3 points, if roadway is within a High School Safe Route to School Boundary
5 points, if roadway is within both a High School **AND** Middle School Safe Route to School Boundary
10 points, if roadway is within a High School, Middle School, **AND** Elementary School Safe Route to School Boundary

Total Points Maximum (100) **Total Score** _____**pts**

APPENDIX II: EMERGENCY RESPONSE ROUTE MAP

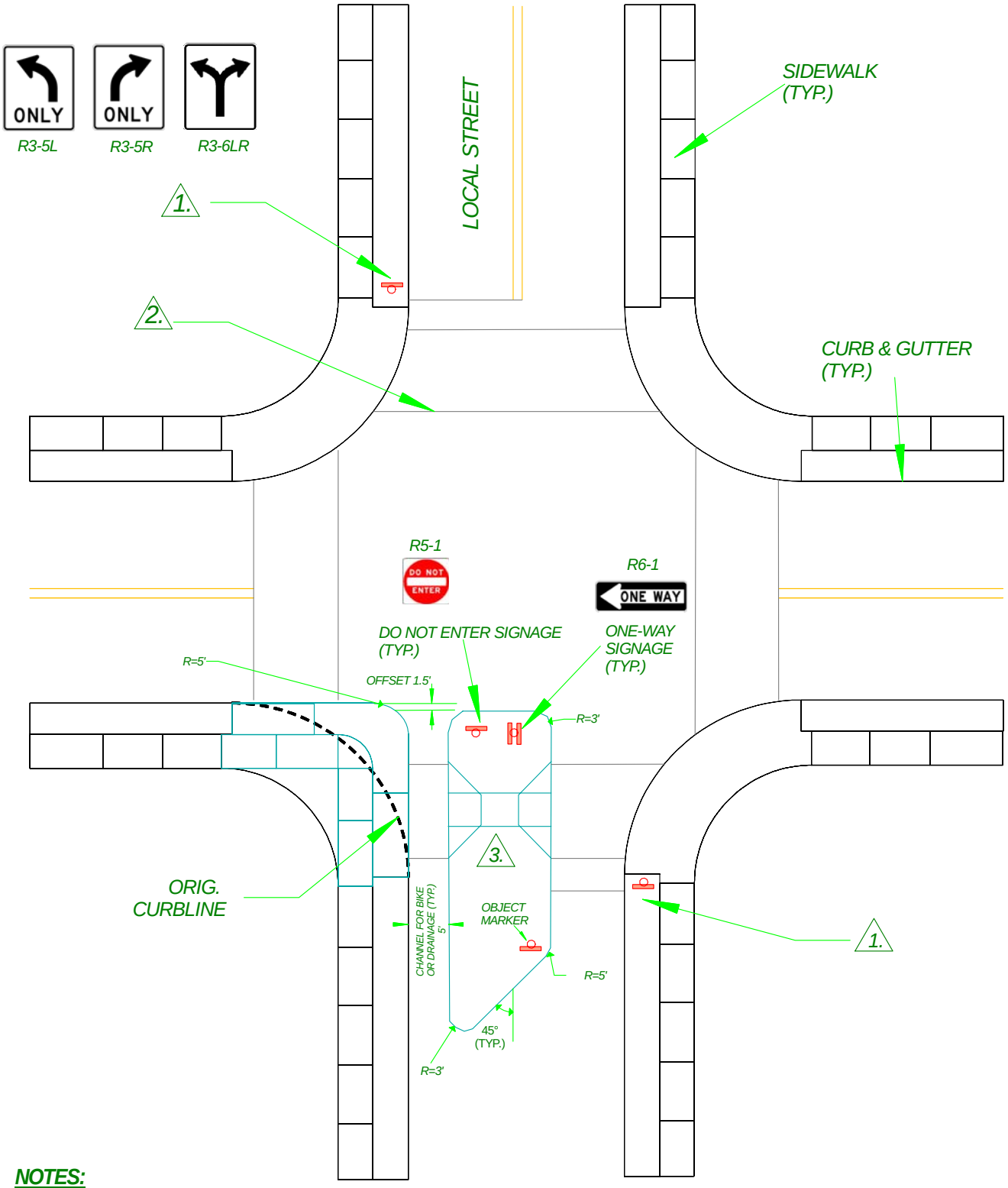
SPARKS

Fire Response Routes Map



Draft August 2006

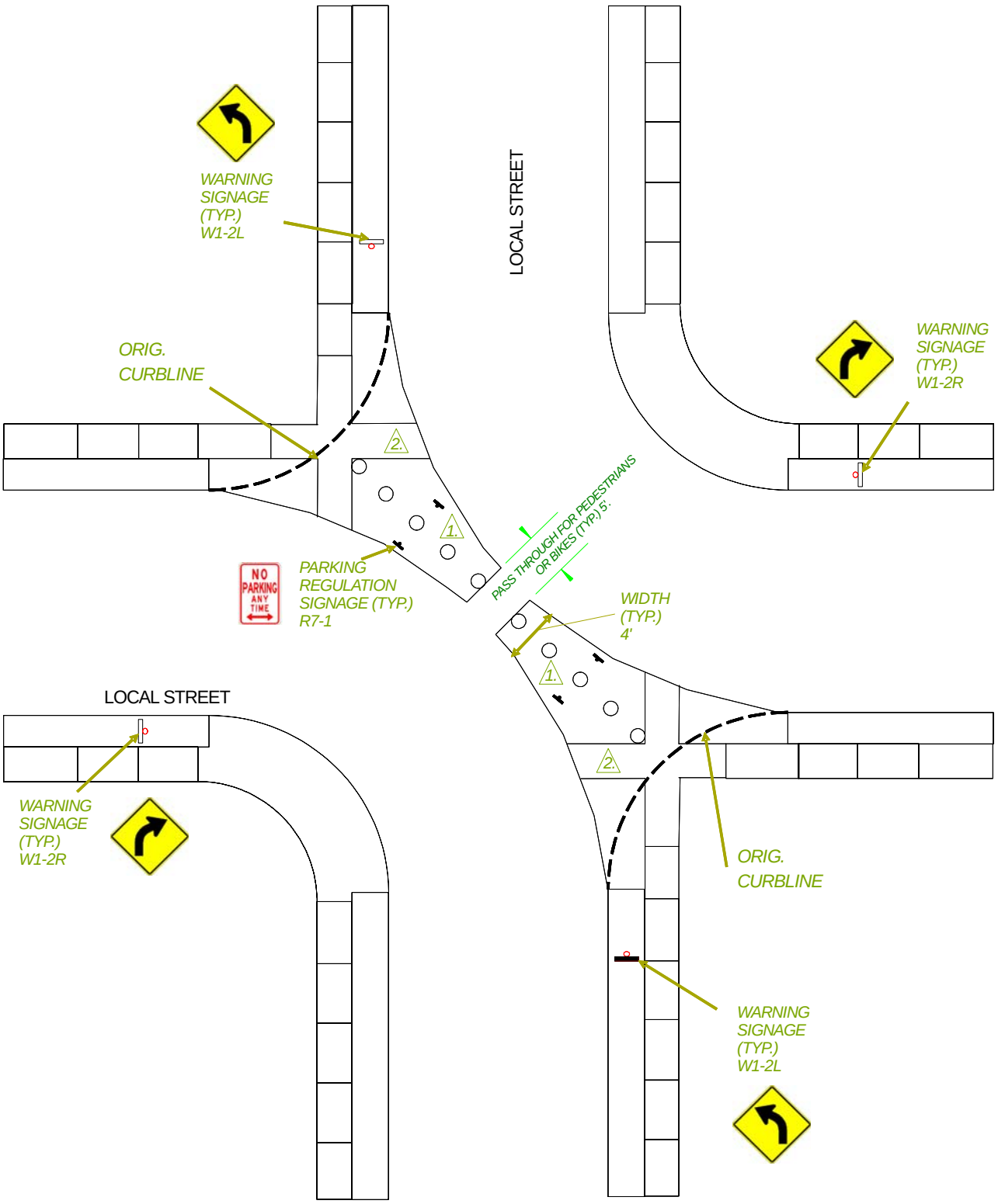
APPENDIX III: STANDARD DRAWINGS



NOTES:

1. SIGNING ON EACH APPROACH IS OPTIONAL AND SHOULD BE IN ACCORDANCE WITH LATEST VERSION OF MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (MUTCD). TYPICAL SIGNS ARE R3-5L, R3-5R, R3-6LR.
2. SPECIAL CONSIDERATIONS MUST BE MADE IF PEDESTRIAN CROSSING AND BIKE LANES ARE PRESENT. CROSSWALK IS OPTIONAL AND SHOULD FOLLOW CITY OF SPARKS STANDARDS.
3. CLOSURE CAN BE CURB EXTENSIONS, ISLANDS, WALLS, GATES, BOLLARDS, ETC. CLOSURE MATERIAL AND DESIGN SHOULD BE APPROVED BY CITY ENGINEER.

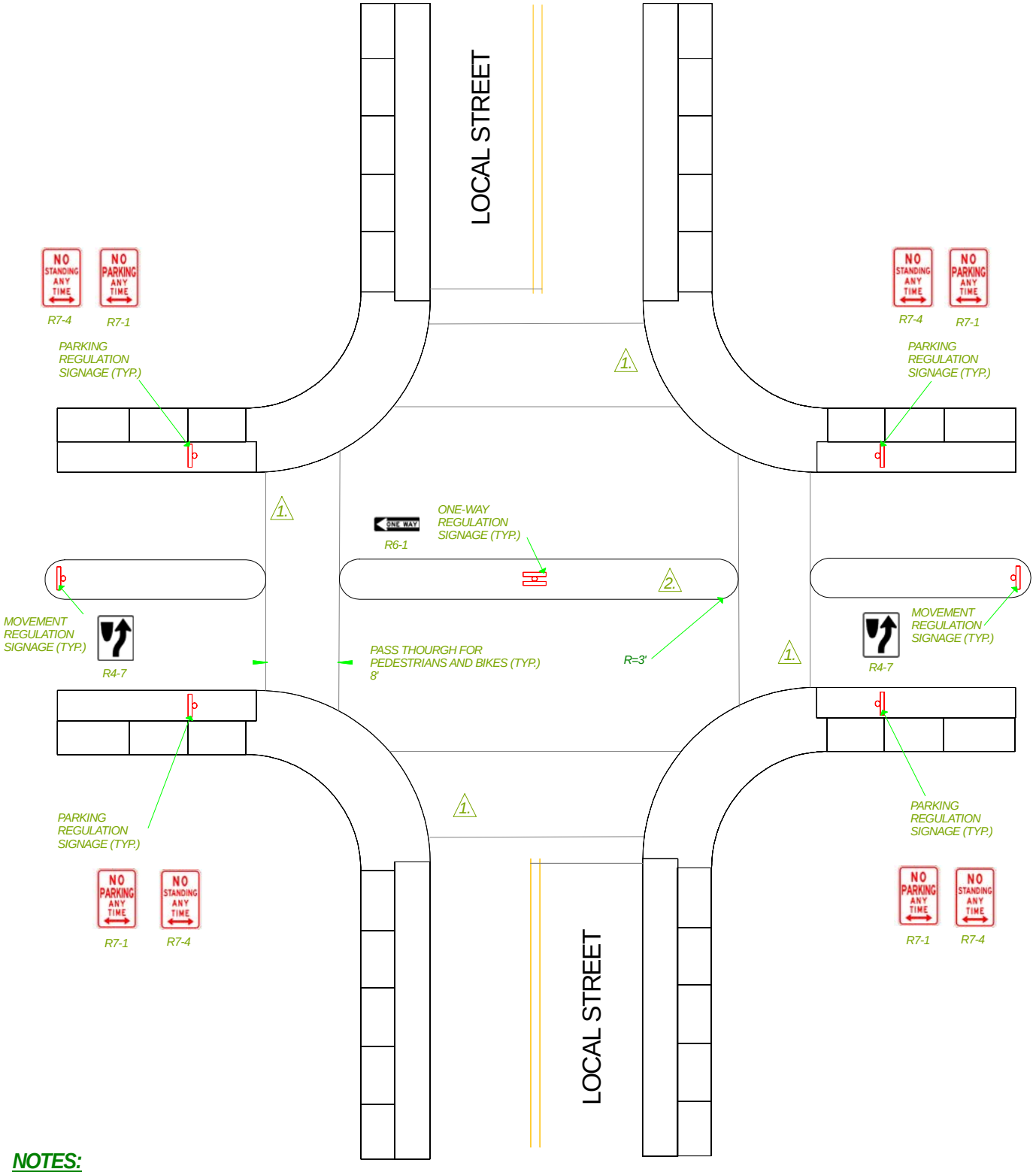
NO	REVISION	DATE	STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION	SECTION SPARKS
			HALF CLOSURE (PLAN)	DRAWING NO. S-TC1
				DATE 9/06 / PAGE 5
APPROVED BY:				



NOTES:

1. *INTERIOR OF DIVERTER CAN BE LANDSCAPED AND/OR BOLLARDS CAN BE PLACED (TYP. SPACING IS 5'). BOLLARDS CAN BE ELIMINATED AND MOUNTABLE CURB INSTALLED TO ALLOW EMERGENCY ACCESS.*
2. *SPECIAL CONSIDERATIONS MUST BE MADE IF PEDESTRIAN CROSSING AND BIKE LANES PRESENT.*

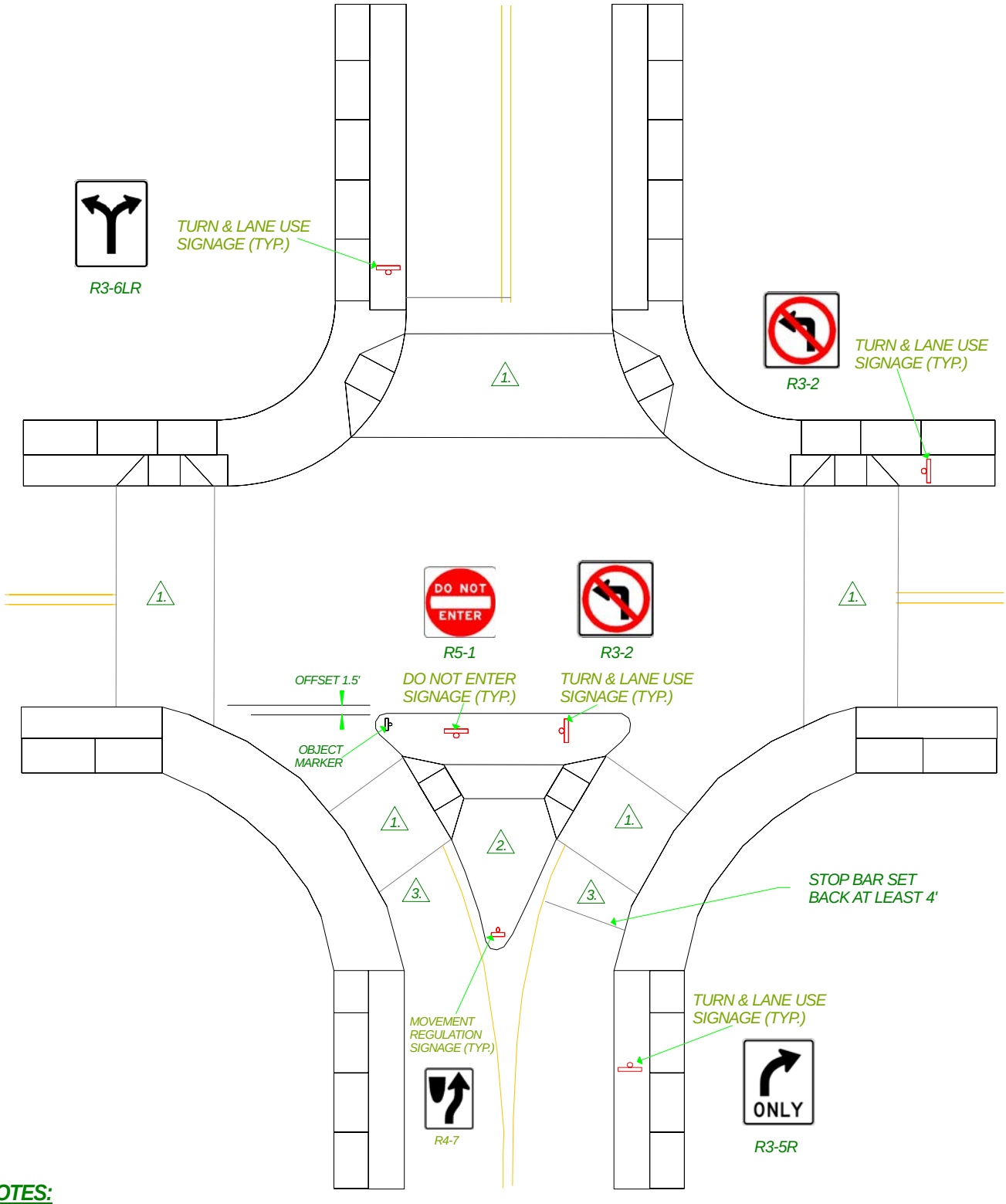
NO	REVISION	DATE	STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION	SECTION SPARKS
			# DIAGONAL DIVERTER (PLAN)	DRAWING NO. S-TC2
				DATE 9/06 / PAGE 6
APPROVED BY:				



NOTES:

1. SPECIAL CONSIDERATIONS MUST BE MADE IF PEDESTRIAN CROSSING AND BIKE LANES ARE PRESENT. CROSSWALK IS OPTIONAL AND SHOULD FOLLOW CITY OF SPARKS STANDARDS.
2. INTERIOR OF BARRIER CAN BE LANDSCAPED AND/OR BOLLARDS CAN BE PLACED (TYP. SPACING IS 5'). BOLLARDS CAN BE ELIMINATED AND MOUNTABLE CURB INSTALLED TO ALLOW EMERGENCY ACCESS.

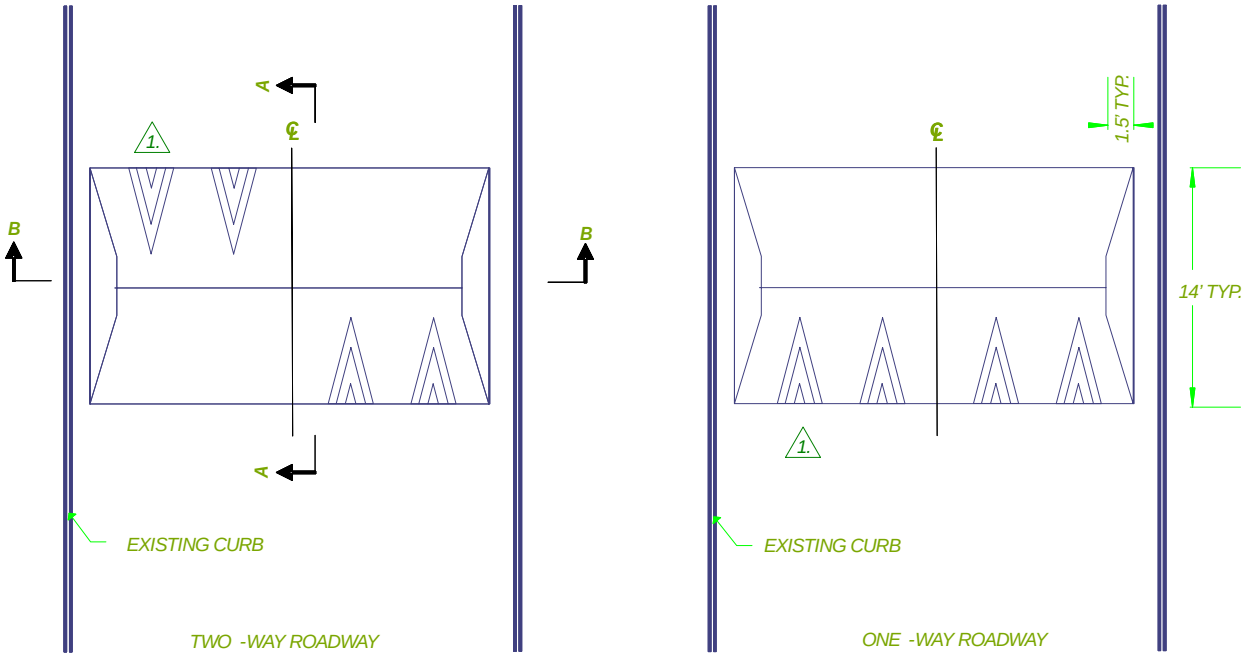
NO	REVISION	DATE	STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION	SECTION SPARKS
			# MEDIAN BARRIER (PLAN)	DRAWING NO. S-TC3
				DATE 9/06 / PAGE 7
APPROVED BY:				

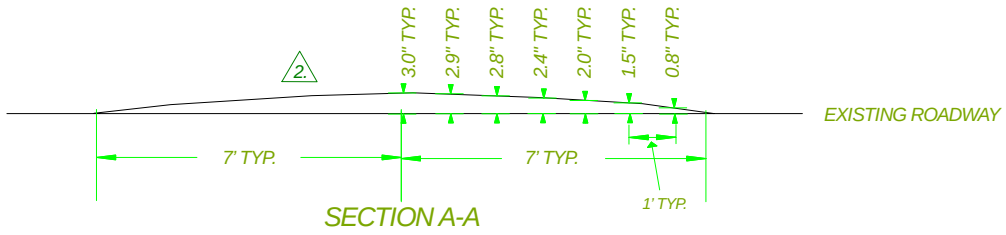


NOTES:

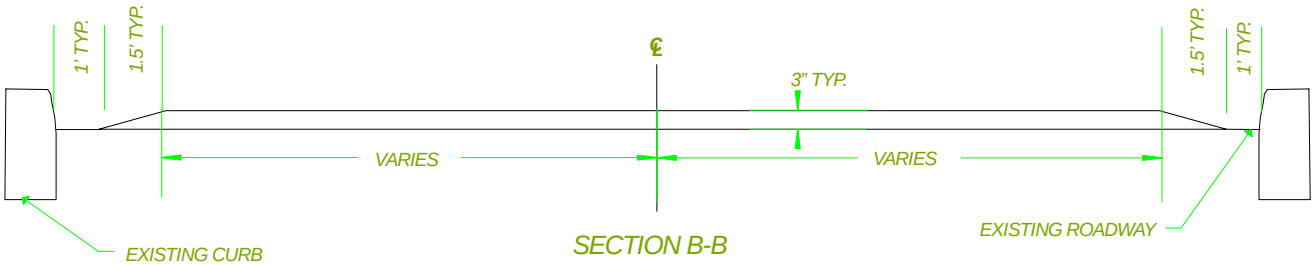
1. SPECIAL CONSIDERATIONS MUST BE MADE IF PEDESTRIAN CROSSING AND BIKE LANES ARE PRESENT. CROSSWALK IS OPTIONAL AND SHOULD FOLLOW CITY OF SPARKS STANDARDS.
2. ISLAND SIZE SHOULD BE AT LEAST 400 SF.
3. WIDTH VARIES WITH INNER CURB RADIUS AND ANGLE OF TURN.

NO	REVISION	DATE	STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION	SECTION SPARKS
			# FORCED TURN ISLAND (PLAN)	DRAWING NO. S-TC4
				DATE 9/06 / PAGE 8
APPROVED BY:				





SECTION A-A



SECTION B-B

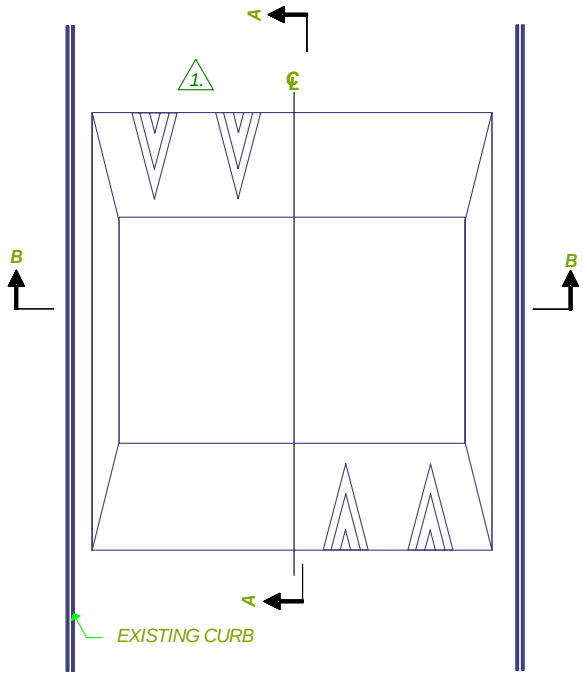
NOTES:

1. SPEED HUMP MARKINGS SHOULD BE IN ACCORDANCE WITH LATEST VERSION OF MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (MUTCD).

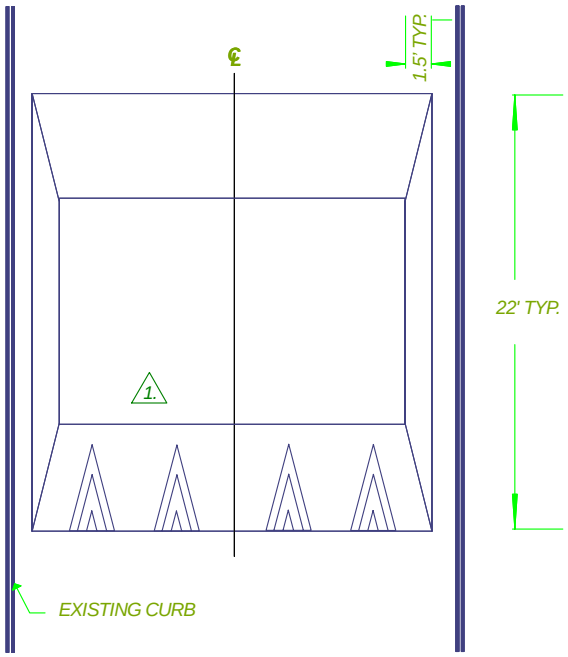
   TYP. SPEED HUMP MARKINGS SHOULD BE SERIES OF WHITE MARKINGS PLACED ON HUMP TO IDENTIFY ITS LOCATION. ADDITIONALLY, ADVANCED SPEED HUMP MARKINGS MAY ALSO BE PLACED ON PAVEMENT PRIOR TO SPEED HUMP.

2. SHOWN SPEED HUMP IS PARABOLIC IN SHAPE. SINUSOIDAL SHAPES MAY BE INSTALLED ON EXCEPTION.

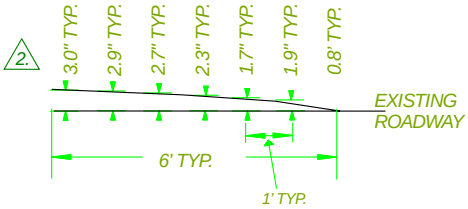
NO	REVISION	DATE	STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION	SECTION SPARKS	
			SPEED HUMP	DRAWING NO. S-TC5	
				DATE 9/06	PAGE 9
APPROVED BY:					

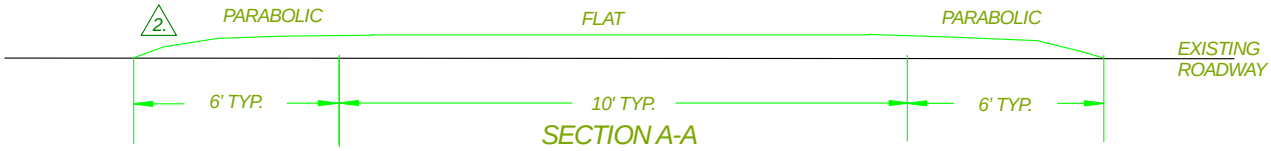


TWO -WAY ROADWAY

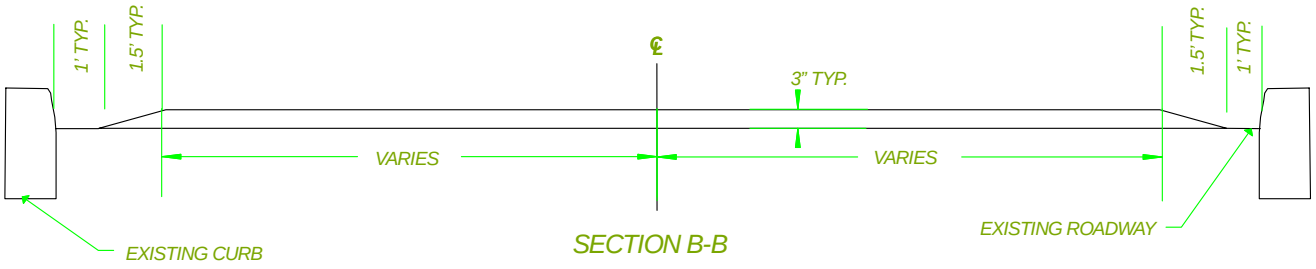


ONE -WAY ROADWAY





SECTION A-A



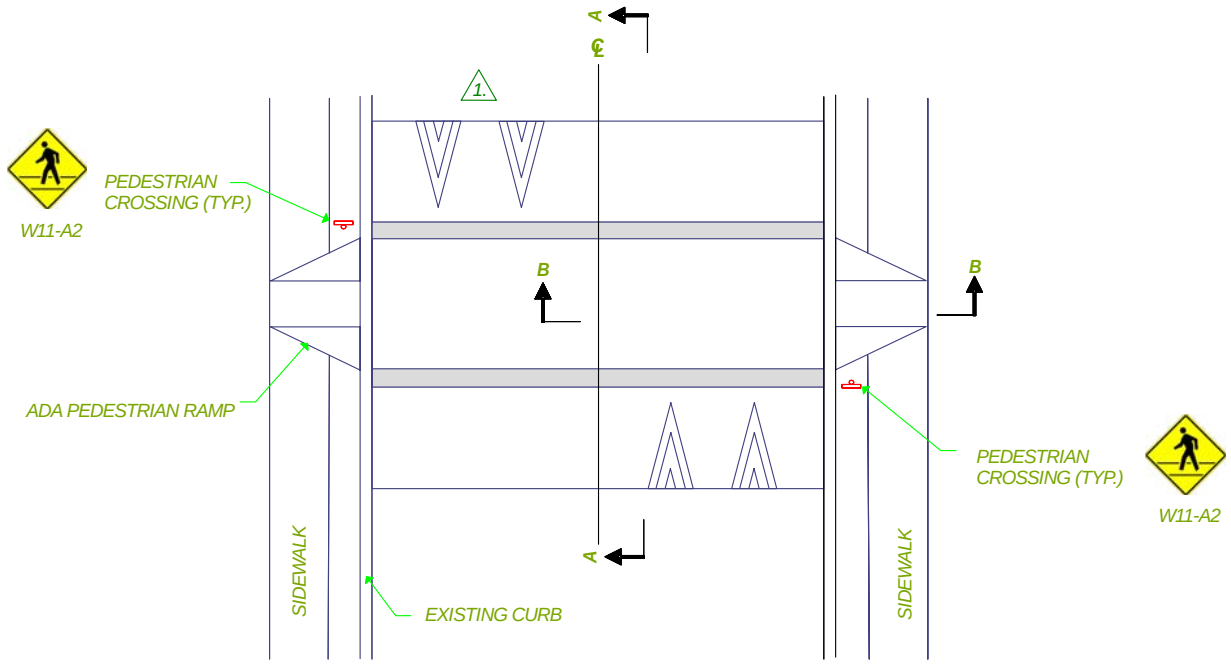
SECTION B-B

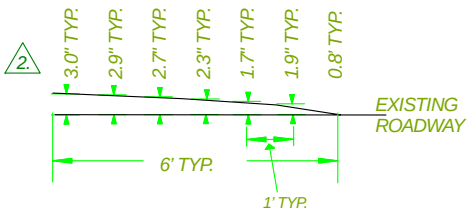
NOTES:

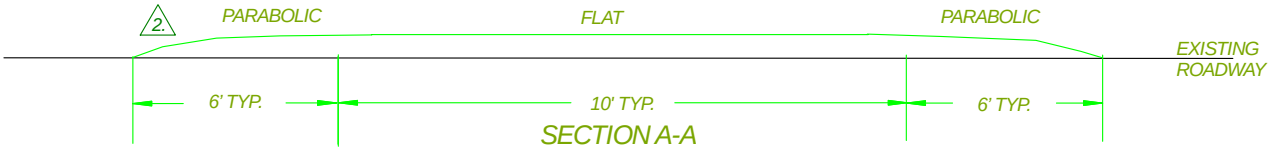
1. SPEED TABLE MARKINGS SHOULD INCLUDE A SERIES OF WHITE MARKINGS PLACED ON RAMP TO IDENTIFY ITS LOCATION. ADDITIONALLY, ADVANCED SPEED TABLES MARKINGS MAY ALSO BE PLACED ON PAVEMENT PRIOR TO SPEED TABLE.

2. SHOWN RAMP IS PARABOLIC IN SHAPE. RAMPS MAY BE SINUSOIDAL OR TRAPEZOIDAL IN SHAPE. TRAPEZOIDAL RAMPS SHOULD HAVE A SLOPE NO STEEPER THAN 1:10.

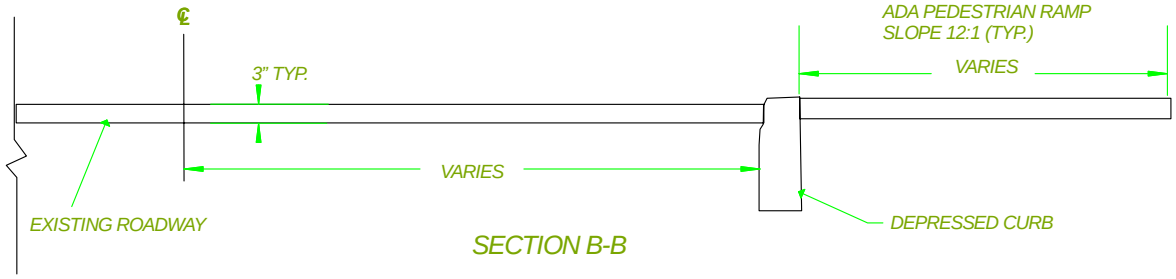
NO	REVISION	DATE	STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION	SECTION SPARKS
			SPEED TABLE	DRAWING NO. S-TC6
				DATE 9/06 / PAGE 10
APPROVED BY:				







SECTION A-A



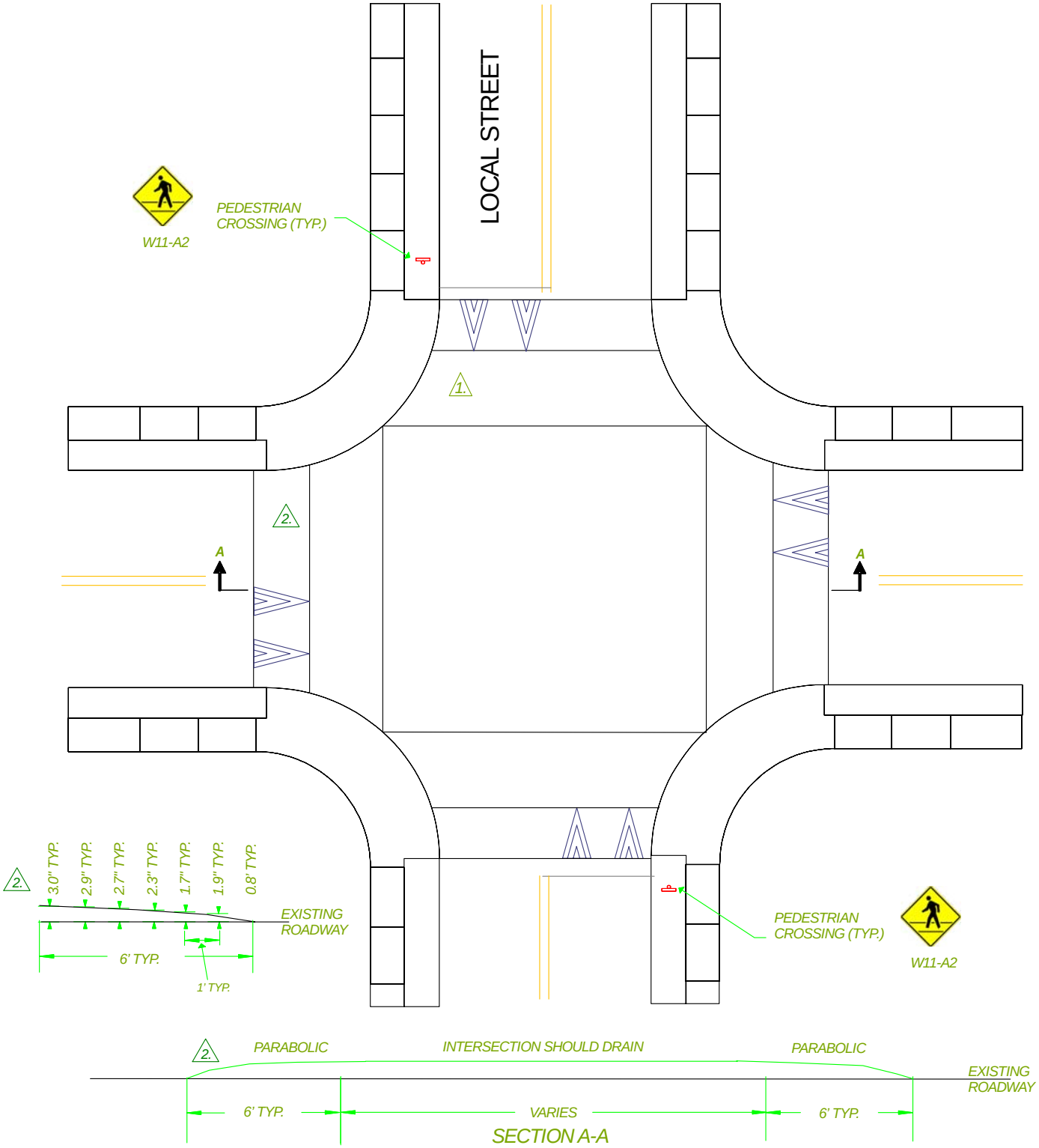
SECTION B-B

NOTES:

1. RAMP MARKINGS SHOULD INCLUDE A SERIES OF WHITE MARKINGS PLACED ON RAMP TO IDENTIFY ITS LOCATION. ADDITIONALLY, ADVANCED CROSSWALK MARKINGS MAY ALSO BE PLACED ON PAVEMENT.

2. SHOWN RAMP IS PARABOLIC IN SHAPE. RAMPS MAY BE SINUSOIDAL OR TRAPEZOIDAL IN SHAPE. TRAPEZOIDAL RAMPS SHOULD HAVE A SLOPE NO STEEPER THAN 1:10.

NO	REVISION	DATE	STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION	SECTION SPARKS
			RAISED CROSSWALK	DRAWING NO. S-TC7
				DATE 9/06 / PAGE 11
APPROVED BY:				

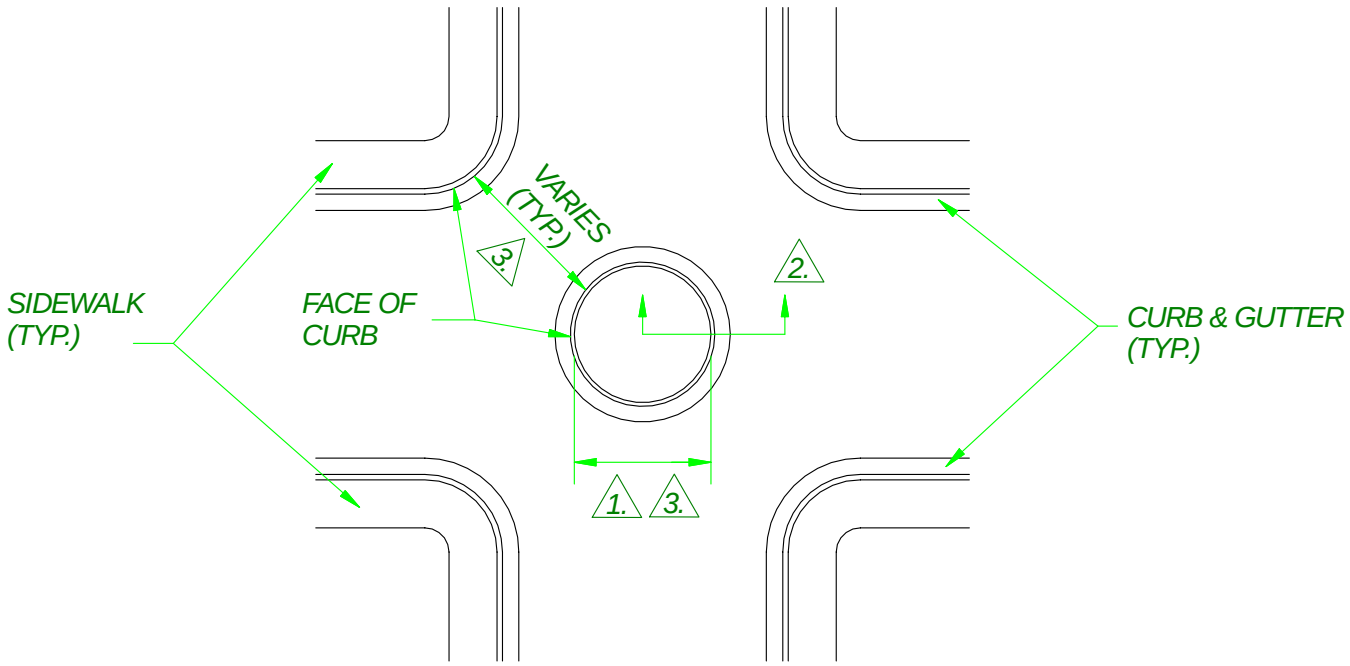


NOTES:

1. SPECIAL CONSIDERATIONS MUST BE MADE IF PEDESTRIAN CROSSING AND BIKE LANES ARE PRESENT.

2. SHOWN RAMP IS PARABOLIC IN SHAPE. RAMPS MAY BE SINUSOIDAL OR TRAPEZOIDAL IN SHAPE. TRAPEZOIDAL RAMPS SHOULD HAVE A SLOPE NO STEEPER THAN 1:10.

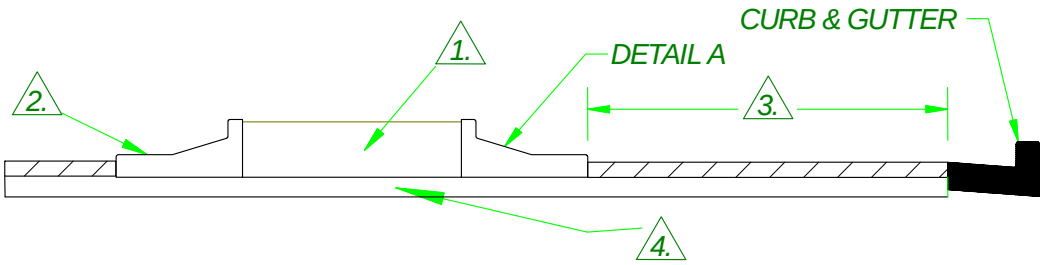
NO	REVISION	DATE	STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION	SECTION SPARKS
			RAISED INTERSECTION	DRAWING NO. S-TC8
				DATE 9/06 / PAGE 12
APPROVED BY:				



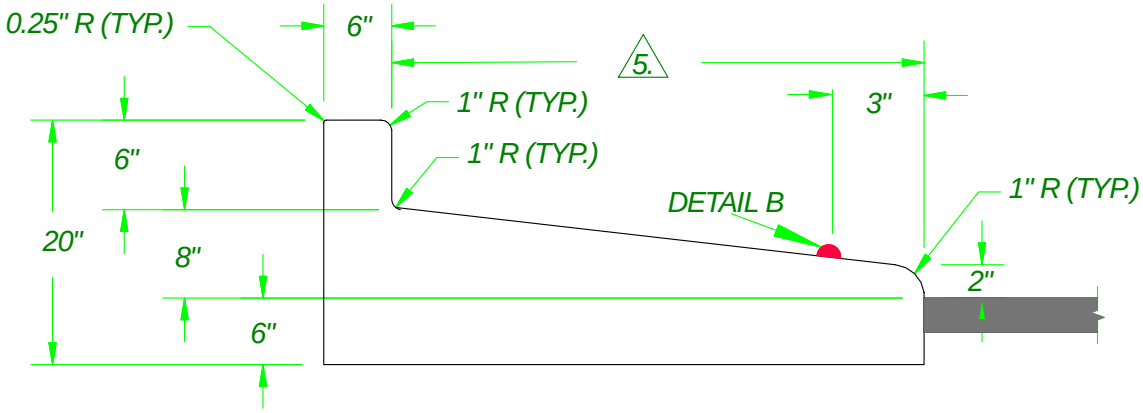
NOTES:

1. DIAMETER OF TRAFFIC CIRCLE VARIES.
2. REFER TO STANDARD DETAIL DRAWING NO. # FOR TRAFFIC CIRCLE DETAIL.
3. FINAL LOCATIONS, SEPARATION DISTANCES AND RADII OF TRAFFIC CIRCLE AND ISLANDS SHALL BE ABLE TO ACCOMODATE AT LEAST A FIRE TRUCK (I.E., AASHTO DESIGN VEHICLE-BUS) AT DESIGN SPEED.
4. SPECIAL CONSIDERATIONS MUST BE MADE WHEN T-INTERSECTIONS AND OTHER ENTRY LANES (E.G., FIVE LEG INTERSECTION OR PRIVATE DRIVEWAYS) ARE ENCOUNTERED.
5. ALL TRAFFIC CONTROL DEVICES SHALL CONFORM TO THE LATEST VERSION OF MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (MUTCD).
6. ALL FINAL DESIGN PLANS SHALL BE APPROVED BY THE CITY OF SPARKS PUBLIC WORKS.

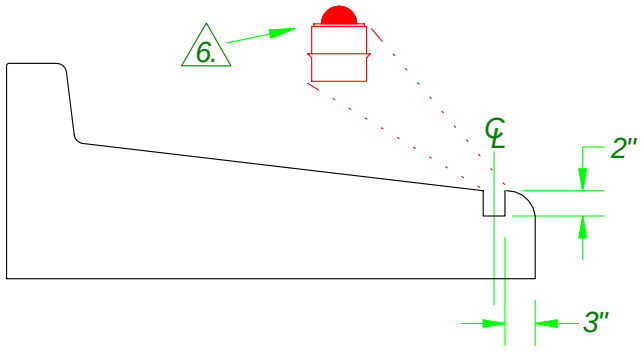
NO	REVISION	DATE	STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION	SECTION SPARKS
			# TRAFFIC CIRCLE (PLAN)	DRAWING NO. S-TC9
				DATE 09/06 / PAGE 13
APPROVED BY:				



TYPICAL PROFILE



DETAIL A

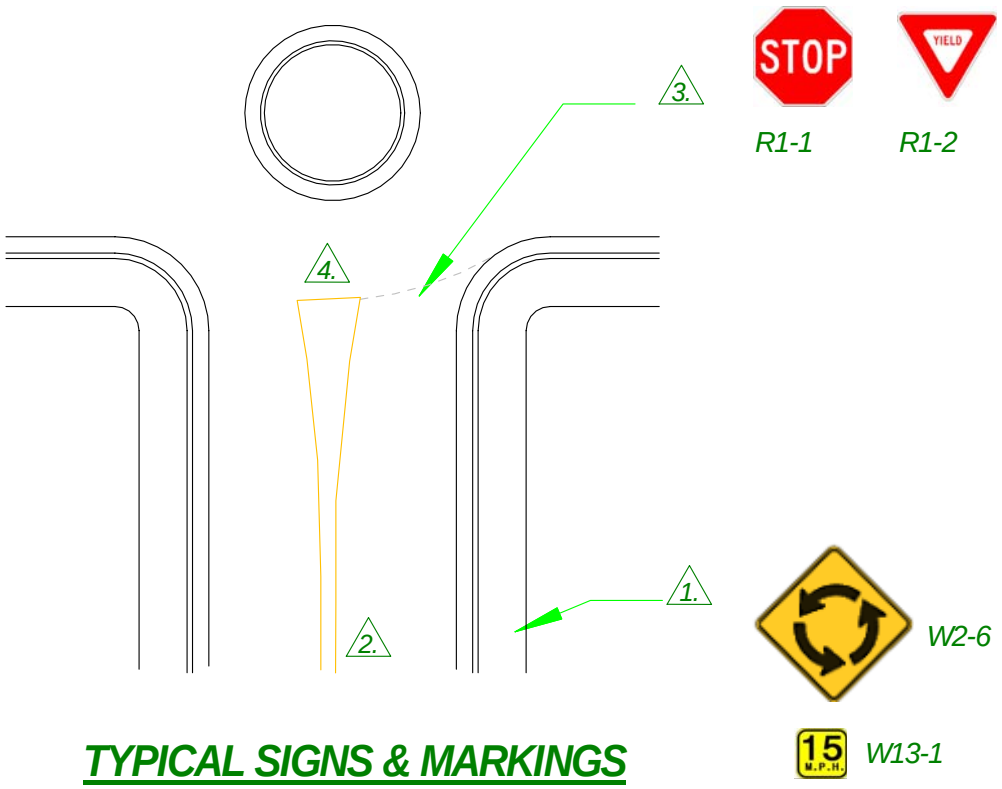


DETAIL B

NOTES:

1. INTERIOR OF TRAFFIC CIRCLE CAN BE LANDSCAPED IF APPROVED BY CITY ENGINEER. OTHERWISE, FILL WITH APPROVED MATERIAL (E.G., DECOMPOSED GRANITE) OVER BASE.
2. MOUNTABLE CONCRETE APRON WITH SLOPE LESS THAN -6% OUTWARD. SIZE OF APRON AND INTERIOR CURB DEPENDENT ON FINAL DESIGN.
3. WIDTH VARIES DEPENDING ON SITE.
4. COMPACT ACCORDING TO CITY SPECIFICATIONS. BASE LAYER SHOULD HAVE SAME DEPTH AS PAVEMENT SECTION BASE LAYER.
5. WIDTH VARIES ACCORDING TO DESIGN. TYPICAL APRON LENGTH IS 2' TO 4'.
6. UTILIZE REFLECTIVE RAISED PAVEMENT MARKERS (RPM) (E.G., 360 GLASS PRISM DELINEATOR) AT SPACING DETERMINED BY CITY ENGINEER.

NO	REVISION	DATE	STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION	SECTION SPARKS
			TRAFFIC CIRCLE (PROFILE)	DRAWING NO. S-T10
				DATE 9/06 / PAGE 14
APPROVED BY:				



TYPICAL SIGNS & MARKINGS

NOTES:

1. ADVANCE SIGNING ON EACH APPROACH IS OPTIONAL AND SHOULD BE IN ACCORDANCE WITH LATEST VERSION OF MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (MUTCD).

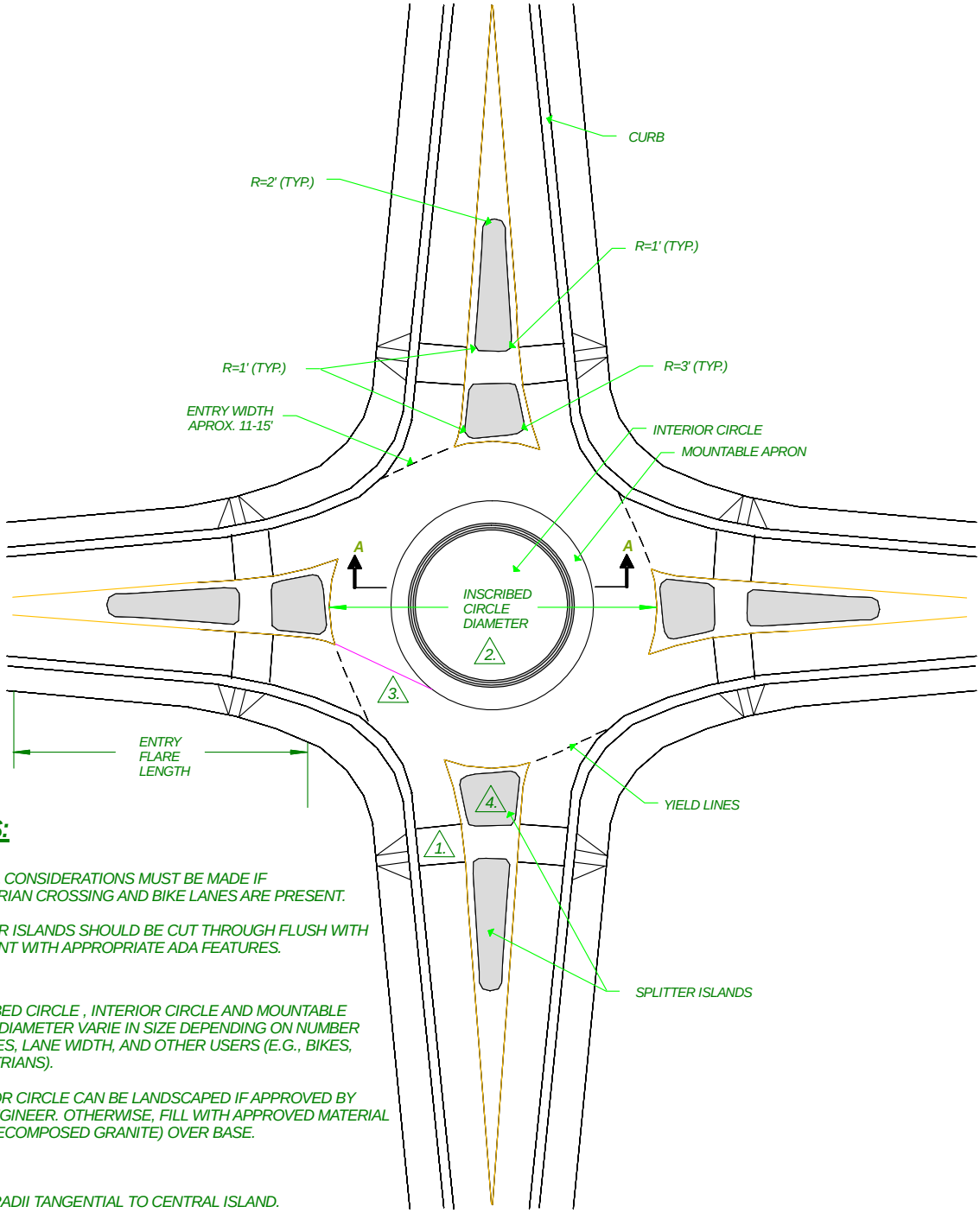
2. CENTERLINE AND REFLECTIVE RAISED PAVEMENT MARKERS (RPM) ARE OPTIONAL.

3. YIELD OR STOP SIGNS AND LINES ARE OPTIONAL.

4. SPLITTER ISLANDS ARE OPTIONAL.

5. SPECIAL CONSIDERATIONS MUST BE MADE IF PEDESTRIAN CROSSINGS AND BIKE LANES ARE PRESENT.

NO	REVISION	DATE	STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION	SECTION SPARKS	
			TRAFFIC CIRCLE (SIGNS & MARKINGS)	DRAWING NO. S-TC11	
				DATE 9/06	PAGE 15
APPROVED BY:					



NOTES:

1. SPECIAL CONSIDERATIONS MUST BE MADE IF PEDESTRIAN CROSSING AND BIKE LANES ARE PRESENT.

   SPLITTER ISLANDS SHOULD BE CUT THROUGH FLUSH WITH PAVEMENT WITH APPROPRIATE ADA FEATURES.

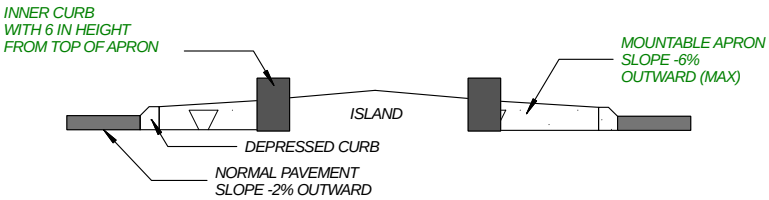
2. INSCRIBED CIRCLE , INTERIOR CIRCLE AND MOUNTABLE APRON DIAMETER VARIE IN SIZE DEPENDING ON NUMBER OF LANES, LANE WIDTH, AND OTHER USERS (E.G., BIKES, PEDESTRIANS).

   INTERIOR CIRCLE CAN BE LANDSCAPED IF APPROVED BY CITY ENGINEER. OTHERWISE, FILL WITH APPROVED MATERIAL (E.G., DECOMPOSED GRANITE) OVER BASE.

3. ENTRY RADII TANGENTIAL TO CENTRAL ISLAND.

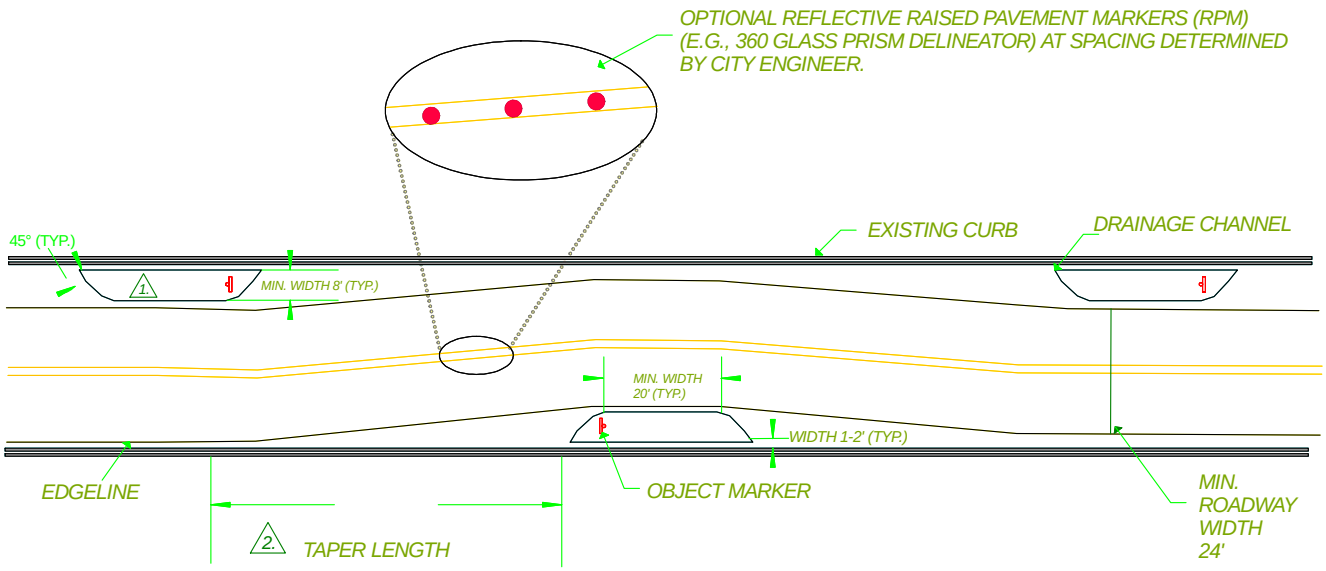
4. SPLITTER ISLAND GUIDE TRAFFIC INTO ROUNDABOUT. IF PEDESTRIANS ARE ANTICIPATED, THE SPLITTER ISLAND SHOULD EXTEND AT LEAST 30 FT FROM INTERSECTION.

   SPLITTER ISLANDS SHOULD BE CONSTRUCTED ACCORDING TO CITY OF SPARKS STANDARDS.



SECTION A-A

NO	REVISION	DATE	STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION	SECTION SPARKS
			ROUNDABOUT	DRAWING NO. S-TC12
				DATE 9/06 / PAGE 16
APPROVED BY:				



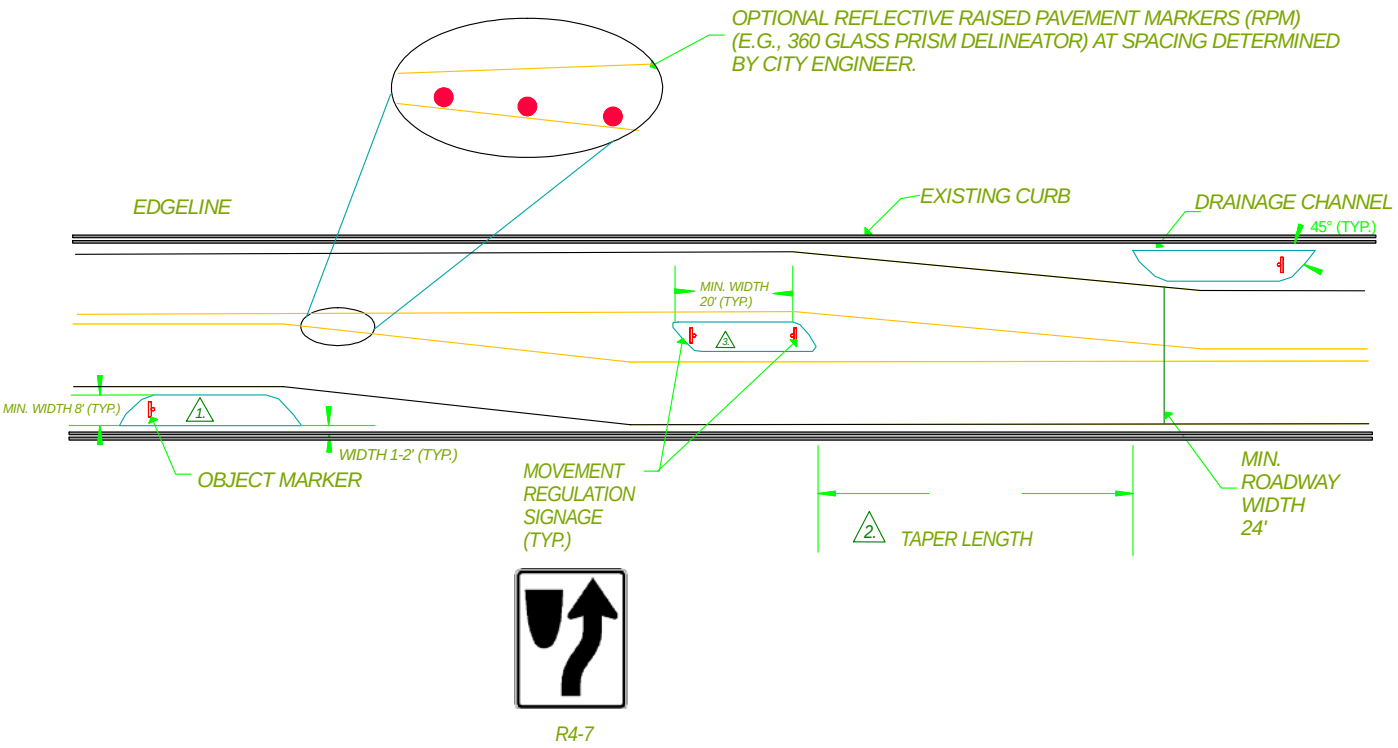
NOTES:

1. *CAN EITHER BE CURB EXTENSION OR EDGE ISLAND. THESE MAY BE SEMI-CIRCULAR, TRIANGULAR OR SQUARED OFF SHAPES. SHOWN IS TRAPEZOIDAL EDGE ISLAND.*

   ISLANDS SHOULD BE CONSTRUCTED ACCORDING TO CITY OF SPARKS STANDARDS.

2. *STRAIGHT LINE TAPER RATE IS 8:1. ON EXCEPTION, CURVE TAPERS MAY BE USED FOLLOWING GUIDANCE FROM AASHTO POLICY.*

NO	REVISION	DATE	STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION	SECTION SPARKS
			CHICANE (PLAN)	DRAWING NO. S-TC13
				DATE 9/06 / PAGE 17
APPROVED BY:				



NOTES:

1. CAN EITHER BE CURB EXTENSION OR EDGE ISLAND. THESE MAY BE SEMI-CIRCULAR, TRIANGULAR OR SQUARED OFF SHAPES. SHOWN IS TRAPEZOIDAL EDGE ISLAND.

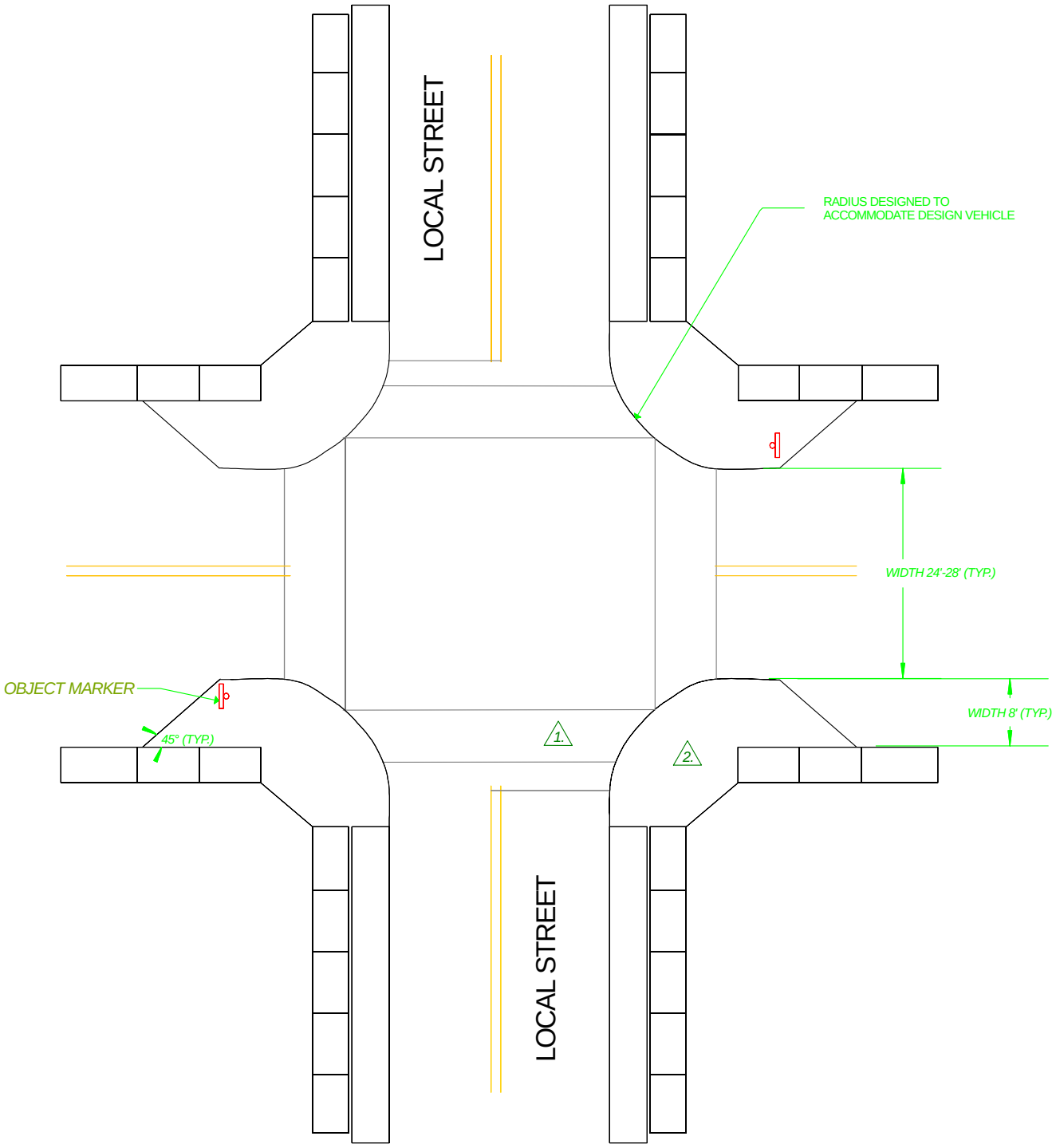
   ISLANDS SHOULD BE CONSTRUCTED ACCORDING TO CITY OF SPARKS STANDARDS.

2. STRAIGHT LINE TAPER RATE IS 8:1. ON EXCEPTION, CURVE TAPERS MAY BE USED FOLLOWING GUIDANCE FROM AASHTO POLICY.

3. CENTER ISLAND IS RECOMMENDED AND SHOULD BE AT MIN. 6 FT WIDE AND 20 FT LONG. THE APPROACH NOSE CAN BE OFFSET TO THE LEFT FROM THE PERSPECTIVE OF APPROACHING TRAFFIC.

   CENTER ISLAND CAN BE LANDSCAPED IF APPROVED BY CITY ENGINEER. OTHERWISE, FILL WITH APPROVED MATERIAL (E.G., DECOMPOSED GRANITE) OVER BASE.

NO	REVISION	DATE	STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION	SECTION SPARKS
			LATERAL SHIFT (PLAN)	DRAWING NO. S-TC14
				DATE 9/06 / PAGE 18
APPROVED BY:				

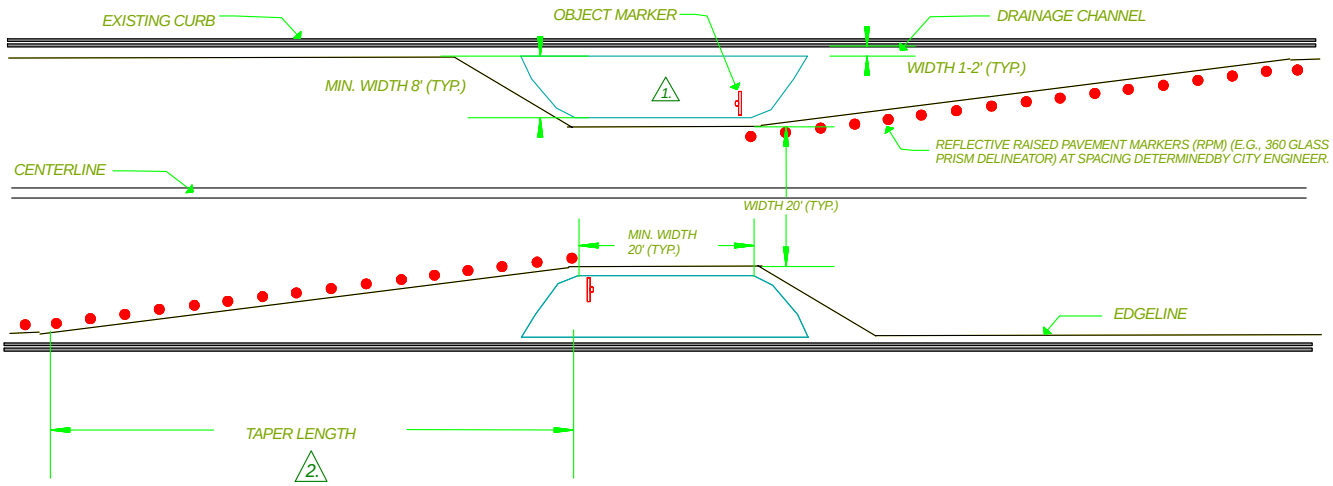


NOTES:

1. *SPECIAL CONSIDERATIONS MUST BE MADE IF PEDESTRIAN CROSSING AND BIKE LANES ARE PRESENT. CROSSWALK IS OPTIONAL AND SHOULD FOLLOW CITY OF SPARKS STANDARDS.*

2. *PEDESTRIAN RAMPS SHOULD BE ADA COMPLIANT.*

NO	REVISION	DATE	STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION	SECTION SPARKS
			# NECKDOWNS (PLAN)	DRAWING NO. S-TC15
				DATE 9/06 / PAGE 19
APPROVED BY:				



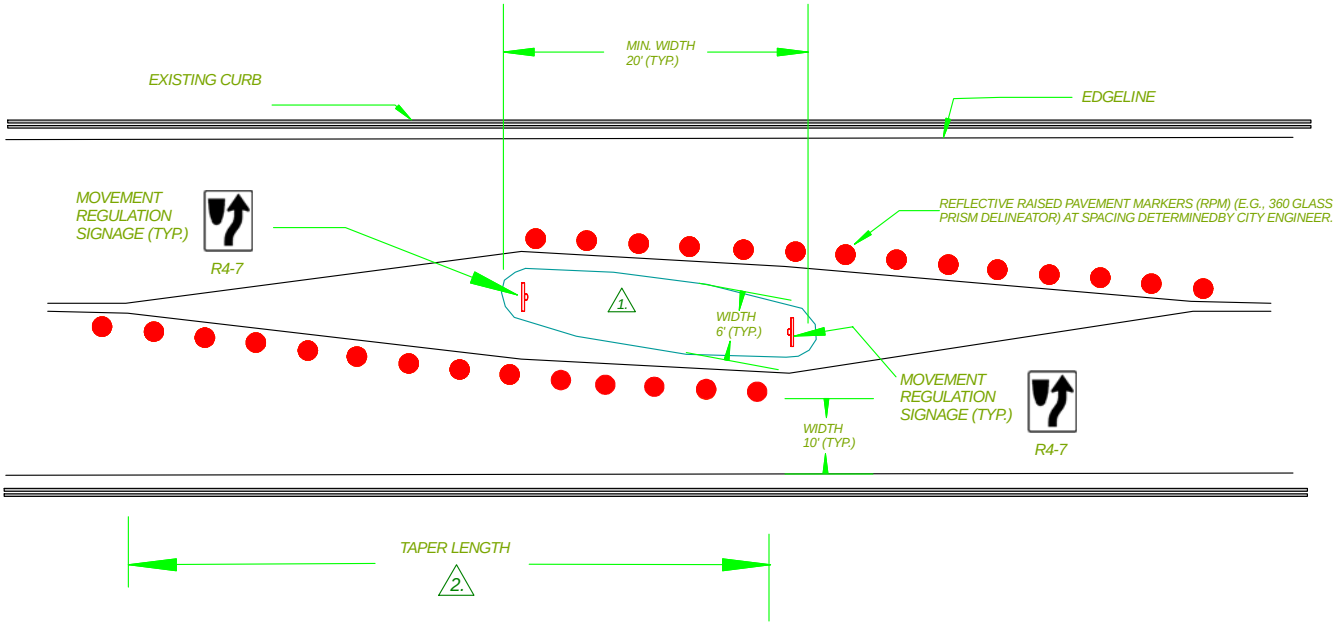
NOTES:

1. CAN EITHER BE CURB EXTENSION OR EDGE ISLAND. THESE MAY BE SEMI-CIRCULAR, TRIANGULAR OR SQUARED OFF SHAPES. SHOWN IS TRAPEZOIDAL EDGE ISLAND.

   ISLAND IS RECOMMENDED AND SHOULD BE AT MIN. 8 FT WIDE AND 20 FT LONG. IT CAN BE LANDSCAPED IF APPROVED BY CITY ENGINEER. OTHERWISE, FILL WITH APPROVED MATERIAL (E.G., DECOMPOSED GRANITE) OVER BASE. ISLANDS SHOULD BE CONSTRUCTED ACCORDING TO CITY OF SPARKS STANDARDS.

2. STRAIGHT LINE TAPER RATE IS 8:1. ON EXCEPTION, CURVE TAPERS MAY BE USED FOLLOWING GUIDANCE FROM AASHTO.

NO	REVISION	DATE	STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION	SECTION SPARKS	
			CHOKER (PLAN)	DRAWING NO. S-TC16	
				DATE 9/06	PAGE 20
APPROVED BY:					



NOTES:

1. CENTER ISLAND IS RECOMMENDED AND SHOULD BE AT MIN. 6 FT WIDE AND 20 FT LONG. THE APPROACH NOSE CAN BE OFFSET TO THE LEFT FROM THE PERSPECTIVE OF APPROACHING TRAFFIC. APPROACH NOSE HAS A TYP. RADIUS OF 4'.

   CENTER ISLAND CAN BE LANDSCAPED IF APPROVED BY CITY ENGINEER. OTHERWISE, FILL WITH APPROVED MATERIAL (E.G., DECOMPOSED GRANITE) OVER BASE. ISLANDS SHOULD BE CONSTRUCTED ACCORDING TO CITY OF SPARKS STANDARDS.

2. STRAIGHT LINE TAPER RATE IS 8:1. ON EXCEPTION, CURVE TAPERS MAY BE USED FOLLOWING GUIDANCE FROM AASHTO.

NO	REVISION	DATE	STANDARD DETAILS FOR PUBLIC WORKS CONSTRUCTION	SECTION SPARKS
			CENTER ISLAND (PLAN)	DRAWING NO. S-TC17
				DATE 9/06 / PAGE 21
APPROVED BY:				