GRANT ROAD Improvement Plan

Mobility | Vitality | Sustainability

DRAFT (July 8, 2009)

Roadway Alignment Design Criteria Memo

Prepared by:

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July 8, 2009

KHA Project # 098134000

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1. INTRODUCTION

1.1 Purpose

The Grant Road improvements, as defined by the RTA, will include the addition of one new travel lane in each direction as well as significant enhancements to the streetscape, landscape, transit, bicycle, and pedestrian facilities. The project limits include a five-mile segment of Grant Road between Oracle Road and Swan Road in north central Tucson. The study area is shown in **Exhibit 1-1**.

The purpose of this Roadway Alignment Design Criteria Memo is to present design criteria that will guide the design and development of the preliminary plans and provide the basis for final design and construction documents. Design criteria discussed in the memo are:

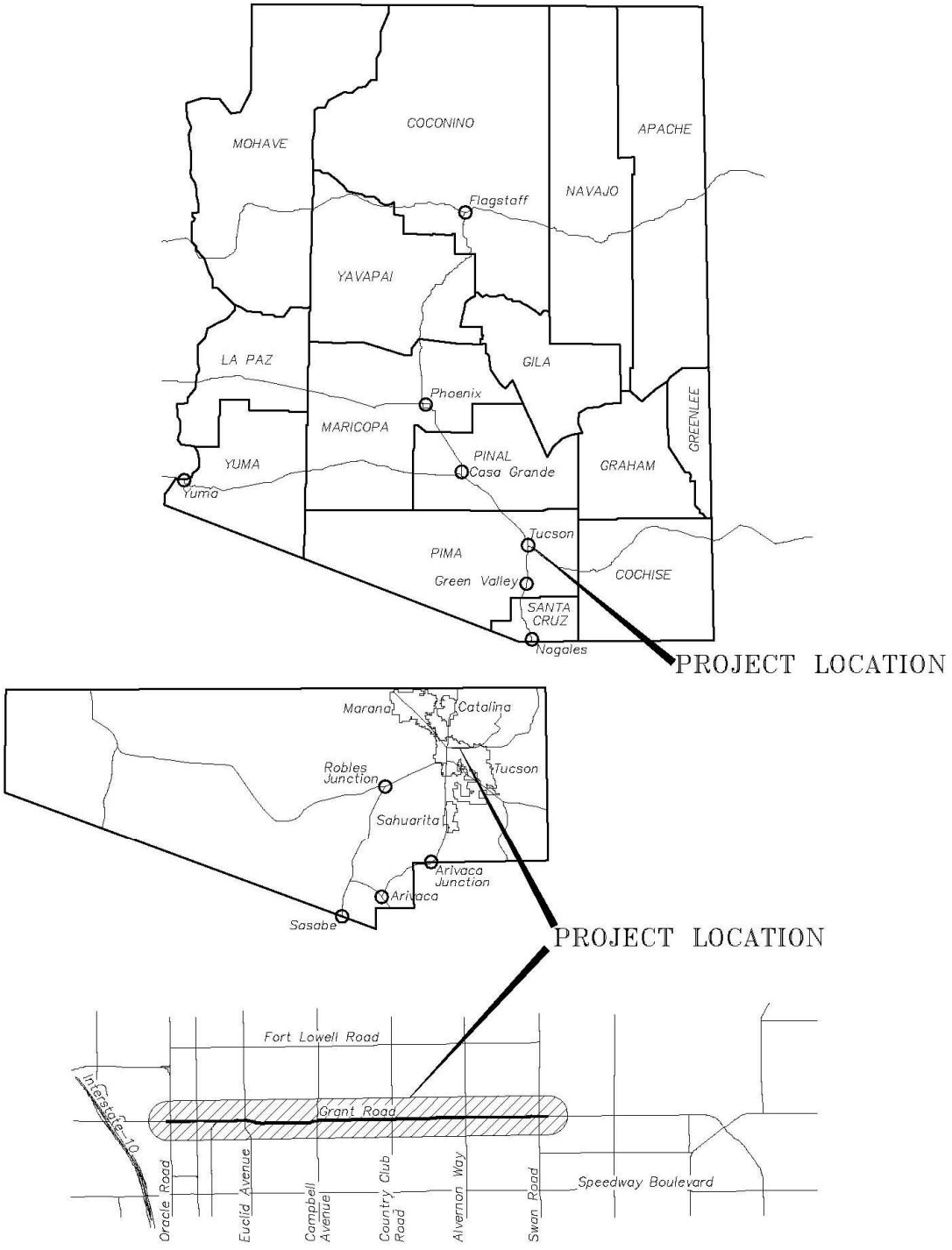
- Street Section (Right-of-Way)
- Target Speed and Design Speed
- Design Vehicle
- Sight Distance
- Geometric Alignment
- Intersection and Signalization
- Bicycle Lanes
- Bus Pullouts
- Bus Stops and Pullouts
- Pedestrian Crossings
  - Toucans (Two-Can Cross)
  - Pelicans (PEdestrian LIght CONtroled Crossing)

1.2 Design Criteria Reference Documents

The design criteria have been developed based on the following documents:

- A Policy on Geometric Design of Highways and Streets 2004, 5th Edition, American Association of State Highway and Transportation Officials
- Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities, Institute of Transportation Engineers
- A Guide for Achieving Flexibility in Highway Design, May 2004, American Association of State Highway and Transportation Officials
- Guide for the Development of Bicycle Facilities, 1999, American Association of State Highway and Transportation Officials

Exhibit 1-1 – Grant Road Improvement Plan, Study Area



1.3 Summary Table of Design Criteria

Exhibit 1-2 is a summary of design elements and design criteria that will serve to guide development and design of Grant Road improvements.

Exhibit 1-2 – Summary Table of Roadway Alignment Design Elements and Design Criteria

Design Element	Design Criteria
Design Year	2030
Design Speed/Posted Speed	35 mph/35 mph
Design Vehicle	Indirect Left Turn Around: WB-67 Dual Left Turn: SU (inside lane), WB-50 (outside lane) Right Turn: WB-50 Single Left Turn: WB-50
Lane Width	11-ft. curb/uncurbed – Grant Road and cross streets See Detail A and Detail B
Bike Lane Width	6-ft. plus 1-ft. buffer (7-ft. total) for outside and between lanes – Grant Road, see Detail A and Detail B 5-ft. outside lane and between lanes for cross streets
Median Width	17-ft. See Detail A and Detail B
Sidewalk Width	8-ft. min., 20-ft. sidewalk/landscape area See Detail A and Detail B
Right Turn Lane Width	12 feet – Grant Road and cross streets
Left Turn Lane Width	Single: 11-ft. – Grant Road and cross streets Dual: 11-ft. inside and 12-ft. outside plus 6-ft. offset/island
Minimum Radius	1400 feet
Minimum Length of Curve/Tangents	150 feet
Indirect Left Turn Around Layout	50-ft outside radius with linear taper See Detail C and Detail D
Cross Slope (%)	2% normal, 4% maximum
Superelevation (Max)	Normal Crown (4% maximum adverse crown)
Maximum Gradient (%)	3%
Minimum Gradient (%)	0.3% (0.5% desirable)
Curb Return Radii (Major intersections)	35 feet
Curb Return Radii (Minor intersections)	25 feet
Turn Lane Storage Length Requirements	See Exhibit A1

Exhibit 1-2 – Summary Table of Roadway Alignment Design Elements and Design Criteria (continued)

Design Element	Design Criteria
Left Turn Lane Taper	Single - 150 feet reverse curves Dual – 150 feet reverse curves
Right Turn Lane Taper	180 feet linear taper
Right Turn Lane Channel Return Radii (Merge Lane)	See Detail E
Right Turn Lane Channel Return Radii (Add Lane)	See Detail F

2. ROADWAY ALIGNMENT DESIGN CRITERIA

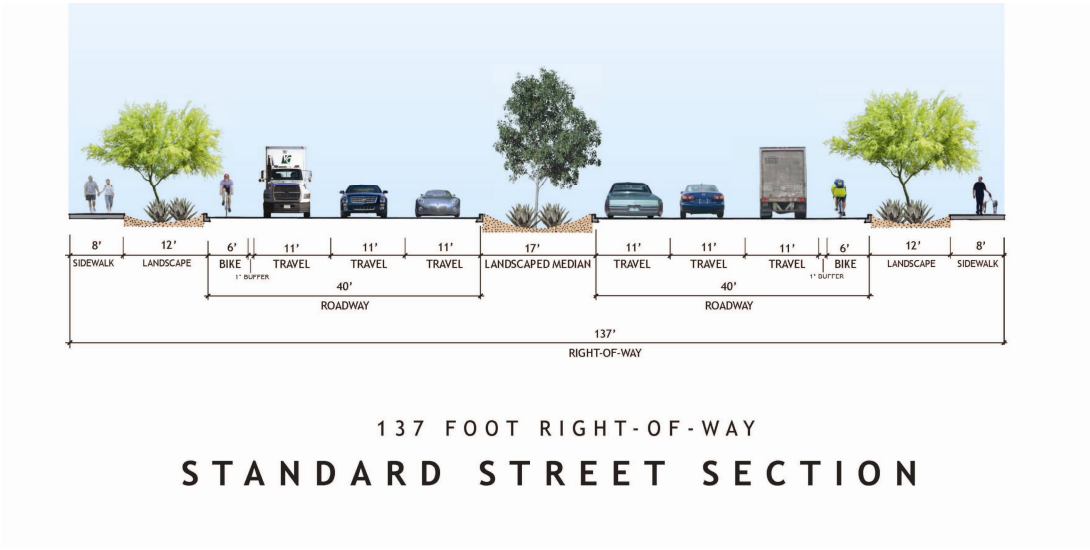
This section discusses in more detail many of the critical design criteria elements that are summarized in **Exhibit 1-1**.

2.1 Street Section (Right-of-Way)

The recommended alignment concept (RAC) approved by Mayor and Council in January 2009, includes two street sections. Each street section is presented below.

137-Foot Typical Section

The 137-foot street section is intended for segments of Grant Road where access to land uses is not a major requirement or for segments where access control strategies can be applied to minimize the adverse impacts of access on Grant Road operations and safety.



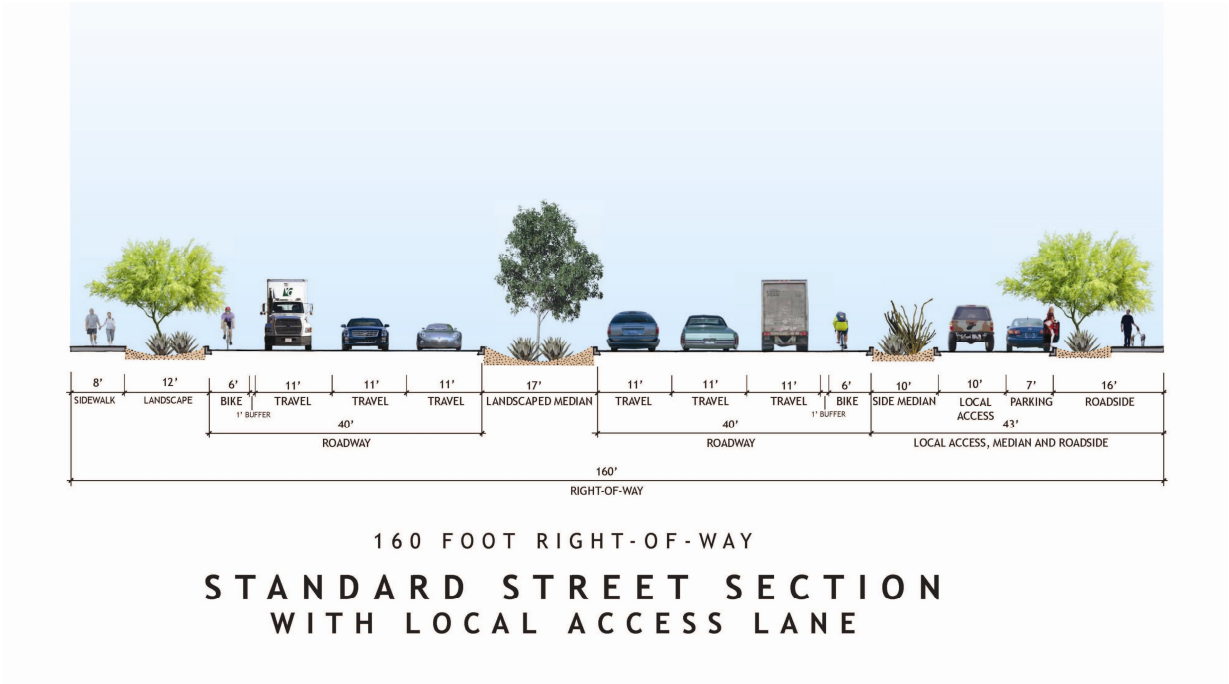
- The 17-foot median in the 137-foot right of way was sized to support the rainwater harvesting concept.
- The 11-foot travel lanes are proposed to minimize the street section width without compromising safety and be consistent with the "target speed" for Grant Road.

- The 6-foot bike lane with 1-foot buffer was developed in consultation with City and County staff and with a member of the Tucson/Pima Bicycle Advisory Committee. The bike lane will be colored green in motor vehicle conflict areas.
- The 20-foot pedestrian realm includes an 8-foot sidewalk and landscaped 12-foot buffer from Grant Road. The buffer is to be landscape with native plants irrigated with harvested rainwater.
- The 137-foot street section should be considered as the minimum street section and reducing the median width, travel lane width, and bike lane width should not be considered. However, minor reductions in the 20-foot pedestrian realm can be considered to avoid or minimize impacts.

A detail of the 137-ft typical section is presented in **Detail A**.

160-Foot Typical Section

The 160-foot street section is intended for segments of Grant Road where access to land uses is a major requirement and segments where access control strategies cannot be implemented to minimize the adverse impacts of direct access to Grant Road. It is also intended for areas where residential uses front onto Grant Road both to provide for access (curb cuts and on-street parking) as well as to provide additional separation and buffering from the through traffic lanes. It can also be used in locations where the nature of the businesses fronting onto Grant Road would support a more active retail frontage that would be well-served by on-street parking and the buffering from Grant Road through traffic.



160 FOOT RIGHT-OF-WAY

STANDARD STREET SECTION
WITH LOCAL ACCESS LANE

The 17-foot median in the 160-foot right of way was sized to support the rainwater harvesting concept.

- The 11-foot travel lanes are proposed to minimize the street section width without compromising safety and be consistent with the "target speed" for Grant Road.
- The 6-foot bike lane with 1-foot buffer was developed in consultation with City and County staff and with a member of the Tucson/Pima Bicycle Advisory Committee. The bike lane will be colored green in motor vehicle conflict areas.

- The 20-foot pedestrian realm includes an 8-foot sidewalk and landscaped 12-foot buffer from Grant Road, on the side of the street without the local access lane. The buffer is to be landscape with native plants irrigated with harvested rainwater.
- The 43-foot local access lane, side median, and pedestrian area consists of a 10-foot side median, 10-foot local access lane, 7-foot parallel parking lanes, and a 16-foot pedestrian areas that includes a sidewalk and landscaped buffer. The side median and buffer is to be landscape with native plants irrigated with harvested rainwater. Comments from the Tucson Fire Department included a request for wider access lane.
- The 160-foot street section should be considered as the minimum street section and reducing the center and side median widths, travel lane width, bike lane width, and local access lane and parking lane widths should not be considered. However, minor reductions in the 20-foot and/or 16-foot pedestrian realm can be considered to avoid or minimize impacts.

A detail of the 160-ft typical section is presented in **Detail B**.

2.2 Target Speed and Design Speed

In keeping with the Context Sensitive Solutions approach to planning and designing Grant Road improvements, ITE recommends the use of a target speed and design speed. Each are defined in the *ITE Proposed Recommended Practice for Walkable Major Urban Thoroughfares* (2006) as follows.

- **Target Speed** is the speed at which vehicles should operate on a thoroughfare in a specific context, consistent with the level of multi-modal activity generated by adjacent land uses to provide both mobility for motor vehicles and a safe environment for pedestrians and bicyclists. The target speed is usually the posted speed limit.
- **Design Speed** is the speed that governs certain geometric features of the thoroughfare, primarily horizontal curvature, super-elevation, and sight distance. Design speed is typically higher than the posted speed limit to result in conservative values for design criteria such as sight distance or roadway alignment. The ITE Proposed Recommended Practice recommends that the design speed be 5 mph over the target speed. NOTE: Consultant team staff report that the ITE Recommended Practice currently in development will recommend that design speed equal target speed.

A review of ITE and AASHTO guidelines for Grant Road suggests that the posted speed limit for an "intermediate principal arterial" should be in the range of 30 to 40 mph based on driveway density, existence of a median, on-street parking, signal density, pedestrian activity, and roadside development. The *ITE Proposed Recommended Practice for Walkable Major Urban Thoroughfares* (2006) recommends that a maximum speed limit of 35 mph be used for target speed on *walkable streets* like the future Grant Road.

2.3 Design Vehicle

In keeping with the Context Sensitive Solutions approach to planning and designing Grant Road improvements, ITE recommends the use of a design vehicle and a control vehicle. Each is defined in the *ITE Proposed Recommended Practice* (2006) as follows.

- A **Design Vehicle** must be accommodated without encroachment into the opposing traffic lanes.
- A **Control Vehicle** less-frequently uses a facility and must be accommodated, but encroachment into the opposing traffic lanes, multi-point turns, or minor encroachments are acceptable.

The design vehicle influences such design criteria as lane width and curb radii. Typically the largest vehicle that can use a thoroughfare is selected as the design vehicle. However, in some areas it is not practical or desirable to choose the largest vehicle because of impacts on pedestrian crossing distances, speed of turning vehicles, or other community goals for the thoroughfare. Of particular importance is the selection of appropriate control and design vehicles for use in defining curb radii at streets that intersect with Grant Road.

2.4 Sight Distance

Adequate sight distance is fundamental to the safety goals of the Context Sensitive Solutions approach to planning and designing Grant Road improvements. AASHTO criteria for stopping and intersection sight distance based on design speed should be used in the design of Grant Road.

2.5 Geometric Alignment

The design of horizontal and vertical curves is a controlling feature of roadway design which is effected by speed and affects speed. The public has expressed a desire to maintain the vertical alignment variations in Grant Road but also identified locations on Grant Road where adequate sight distance does not exist. Similarly, the public has expressed a desire to maintain and increase the frequency of horizontal curves as a community asset and for speed control. The use of AASHTO design for urban streets is recommended by the *ITE Proposed Recommended Practice* (2006) and the low-speed urban design criteria (no super-elevation) are well-suited to the context of Grant Road.

2.6 Intersection and Signalization Layout

2.6.1 Signalization

Several Grant Road intersections will employ Indirect Left Turn intersections, an innovative intersection design. The indirect-left turn intersection design removes the left-turning vehicles from the traffic stream without causing them to slow down or stop in a through-traffic lane, thereby reducing the potential for delay and rear-end crashes.

Indirect left turn intersections are proposed at the following intersections:

- Grant Road / Oracle Road
- Grant Road / Stone Ave
- Grant Road / 1st Avenue
- Grant Road / Campbell Avenue
- Grant Road / Country Club
- Grant Road / Alvernon Way
- Grant Road / Swan

A typical sign and marking layout of an indirect left turn intersection is displayed in **Detail C.**

2.6.2 Storage Lane Requirements

Storage lane requirements for Grant Road intersections are presented in **Appendix A**.

2.6.3 Indirect Left Turn-Around / Bulb-out

Indirect left turnarounds will be provided. The turnaround will be designed to accommodate a WB-67. A detail of an indirect left turnaround is displayed in **Detail D**.

2.6.4 Channelized Right Turn Lane

The Grant Road Recommended Alignment Concept identifies locations where channelized right turn lanes are justified and appropriate for traffic capacity.

These locations are:

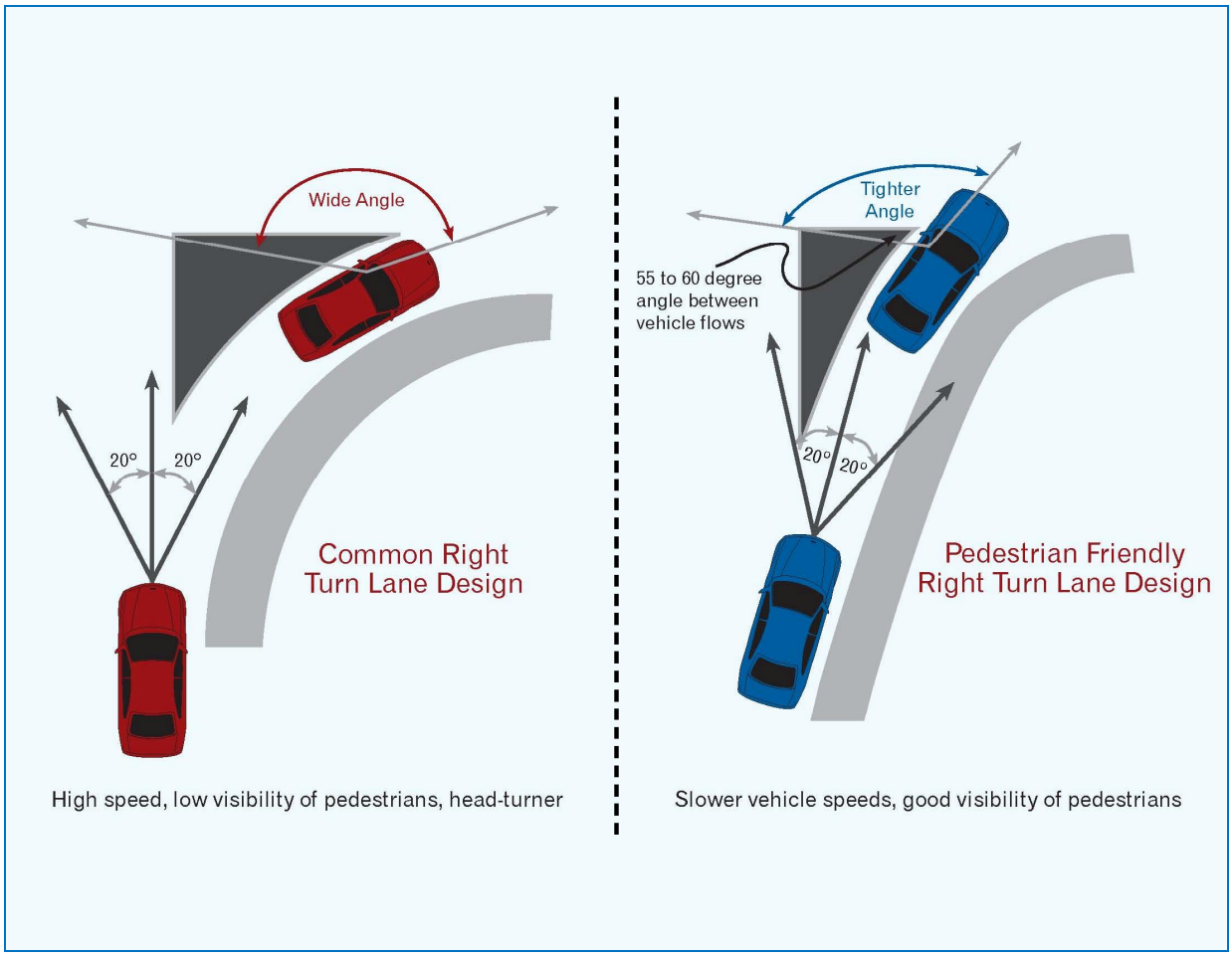
- Oracle Road, westbound to southbound, with merge lane
- Oracle Road, eastbound to northbound, with merge lane
- First Avenue, westbound to northbound, with add lane
- Campbell Ave, westbound to northbound, with add lane (not provided due to r/w constraints)
- Campbell Ave, eastbound to southbound, with add lane
- Alvernon Way, westbound to northbound, with merge lane
- Swan Road. westbound to northbound, with merge lane

A detail of the channelized right turn lane is presented in **Detail E** (channelized right turn) and **Detail F** (channelized right turn lane with add lane). A striping schematic is also shown in **Detail G** for a channelized right turn lane with add lane.

Channelized right turns will be designed to be pedestrian friendly. A schematic of a pedestrian friendly right turn lane is shown in **Exhibit 2-1**. Key design features of the pedestrian friendly channelized right turn lane are:

- Design speed of 5 to 10 mph
- Provide accessible islands: The island that forms the channelized right turn lane must be a raised island of sufficient size (at least 150 sq. ft.) for pedestrians to safely wait in a position where they are at least 4 ft. from the face of curb in all directions. A painted island is not satisfactory.
- Unless buses and large trucks are accommodated, the pavement width in the channelized right turn lane should be no wider than 16 ft. For any width right turn lane, mark edge lines and cross-hatching to restrict the painted width of the travel way of the channelized right turn lane to 12 ft. to slow smaller vehicles.

Exhibit 2-1 – Schematic of Pedestrian friendly Channelized Right Turn Lane



2.7 Bus Stops and Pullouts

Bus pullouts should be constructed to City of Tucson standards at high use stops and transfer points. Bus stops should generally be located as close as possible to the intersection and should be placed on the far side of an intersection. This will allow for the bus to wait until through traffic is stopped by a red light at the intersection, thus creating a gap in traffic flow sufficient for the bus to re-enter the through traffic lanes. Enhanced bus shelters should be provided at high use stops and transfer points.

Below are key design considerations for bus stops and pullouts.

- Bus stops should be provided at all bus stops at major intersections. A decision as to whether a bus pullout should be provided at minor intersections or other mid-block locations is dependent on ridership. Bus pullout should be provided at all high volume stops, as the dwell time of the bus is longer. Bus pullouts at low ridership locations contribute to service delay.
- Bus stops should generally be located at ¼ mile spacing.
- Bus stops and bus pullouts should be located on the far side of the intersection, especially at intersections with marked cross walks.

Bus Stop Shelter Design and Location:

- All bus stops must be constructed in compliance with ADA accessibility standards. TDOT requires that the wheelchair loading pads be a minimum of 9' x 5' to accommodate the bus ramp/lift plus an area for the wheelchair to easily access the ramp. A ramp and connecting sidewalk must also be provided.
- Single shelter pad dimensions are 4'8" x 22' long x 6" thick concrete.
- Double shelter pad dimensions are 6' wide x 34' long x 6" thick concrete.
- If a shelter is not constructed at a bus stop, the design should allow for sufficient space such that a shelter can be constructed in the future.

The Recommended Alignment Concept that was approved by mayor and council in January 2009 was reviewed by City of Tucson Department of Transportation Transit Services. Recommendations for bus pullouts and stops locations were provided, as summarized in **Exhibit 2-2**.

Exhibit 2-2 – Bus Stops Locations, Shelter Types, and Pullouts

Location		Comments	Shelter type (single/double)	Bus Pullout Required	
Grant/Oracle	NW	TDOT requested a bus pullout at this location.	Double	Bus Pullout Required	
Grant/Oracle	SE		Double	Bus Pullout Required	
Grant/Stone	NW		Double	Bus Pullout Required	
Grant/Stone	SE		Double	Bus Pullout Required	
Stone/Grant	*NE*	*Cross-street bus stop needed*	*Single*	*Bus Pullout Required*	
Stone/Grant	*SW*	*Cross-street bus stop needed*	*Single*	*Bus Pullout Required*	
Grant/6th Ave	NW		Single	Bus Pullout Required	
Grant/6th Ave	SE		Single	Bus Pullout Required	
Grant/1st Ave	NW		Double	Bus Pullout Required	
Grant/1st Ave	SE		Double	Bus Pullout Required	
1st Ave/Grant	*NE*	*Cross-street bus stop needed*	*Double*	*Bus Pullout Required*	
1st Ave/Grant	*SW*	*Cross-street bus stop needed*	*Double*	*Bus Pullout Required*	
Grant/Park	NW	Bus stop collocated with Indirect Left Turnaround	Single	Bus Pullout Required	
Grant/Park	SE		Single	Bus Pullout Required	
Grant/Mountain	NW		Single	Bus Pullout Required	
Grant/Mountain	SE		Single	Bus Pullout Required	
Grant/Cherry	NW		Single		
Grant/Cherry	SW		Single		
Grant/Campbell	NW		Double	Bus Pullout Required	
Grant/Campbell	SE		Double	Bus Pullout Required	
Campbell/Grant	NE	Cross-street bus stop needed	Single	Bus Pullout Required	

Exhibit 2-2 – Bus Stops Locations, Shelter Types, and Pullouts (continued)

Location		Comments	Shelter type (single/double)	Bus Pullout Required	
Grant/Plummer	NE		Single		
Grant/Plummer	SE		Single		
Grant/Tucson	NW		Single	Bus Pullout Required	
Grant/Tucson	SE		Single	Bus Pullout Required	
Grant/Treat	NW		Single		
Grant/Treat	SE		Single		
Grant/Country Club	NW		Double	Bus Pullout Required	
Grant/Country Club	SE		Double	Bus Pullout Required	
Grant/Country Club	NE	Pullout is for school buses.			
Country Club/Grant	*SW*	*Cross-street bus stop needed*	*Single*	*Bus Pullout Required*	
Grant/Edith	NE	Bus stop located at NW corner of Edith /Grant will be highly utilized by students.			
Grant/Northway	SE		Single		
Grant/Palo Verde	NW		Single		
Grant/Palo Verde	SE		Single		
Grant/Dodge	NW		Single		
Grant/Dodge	SE		Single		
Grant/Alvernon	NW		Double	Bus Pullout Required	
Grant/Alvernon	SE		Double	Bus Pullout Required	
Alvernon/Grant	*SW*	*Cross-street bus stop needed*	*Double*	*Bus Pullout Required*	
Grant/Walnut	NE	Consider moving to NW corner of Grant/Walnut for better spacing			
Grant/Walnut	SE		Single		
Grant/Columbus	NE			Bus Pullout Required	
Grant/Columbus	SE		Single		
Grant/Belvedere	NW		Single		
Grant/Belvedere	SW	`		Bus Pullout Required	

Exhibit 2-2 – Bus Stops Locations, Shelter Types, and Pullouts (continued)

Location		Comments	Shelter type (single/double)	Bus Pullout Required	
Grant/Swan	NW		Double		
Grant/Swan	SE		Double		
Swan/Grant	SW	Cross-street bus stop needed	Double	Bus Pullout Required	

2.8 Bicycle and Pedestrian Crossings

Pelican Pedestrian Crossings

Improving conditions for vehicles, as well as pedestrians and cyclists are important objectives of Grant Road improvements. To improve conditions for pedestrians crossing Grant Road, pedestrian crossings, known as "pelicans" will be implemented throughout the corridor. Pelicans are located in the median of roadways and include two separate traffic signals activated by pedestrians. The first signal stops traffic on half of the roadway and allows pedestrians to cross that half, while the traffic on the other half is allowed to continue. Once in the median, pedestrians then activate the second signal that stops traffic on the second half of the roadway, allowing pedestrians to complete their crossings. A typical pelican layout is presented in **Detail H.**

These pedestrian crossings will be at:

- Each Indirect Left Turn Around (westbound turn around, and eastbound turnaround), unless otherwise determined to be unnecessary or unfeasible
- 4th Avenue
- Between Fremont and Santa Rita
- Vine Avenue
- East of Plummer
- Forgeus Avenue
- Rita Avenue
- Belvedere Avenue

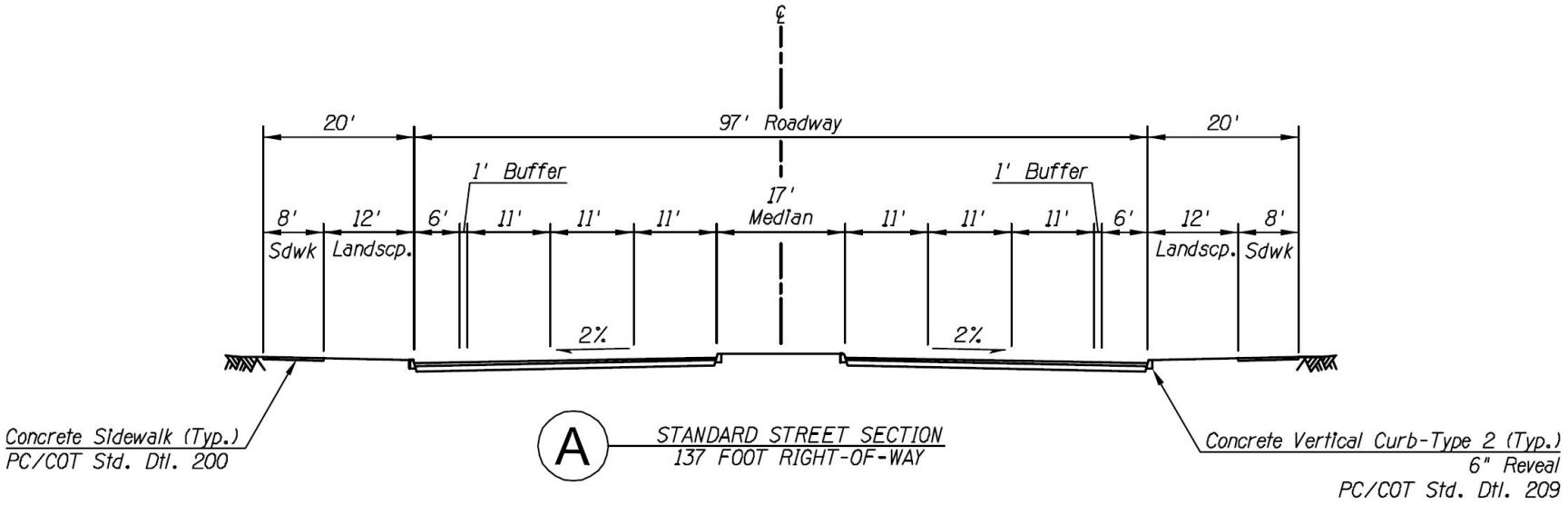
Toucan Bicycle and Pedestrian Crossings

To improve conditions for cyclists desiring to cross Grant Road, three bicycle/pedestrian crossings, known as toucans, are proposed. These bicycle/pedestrian crossings will be at:

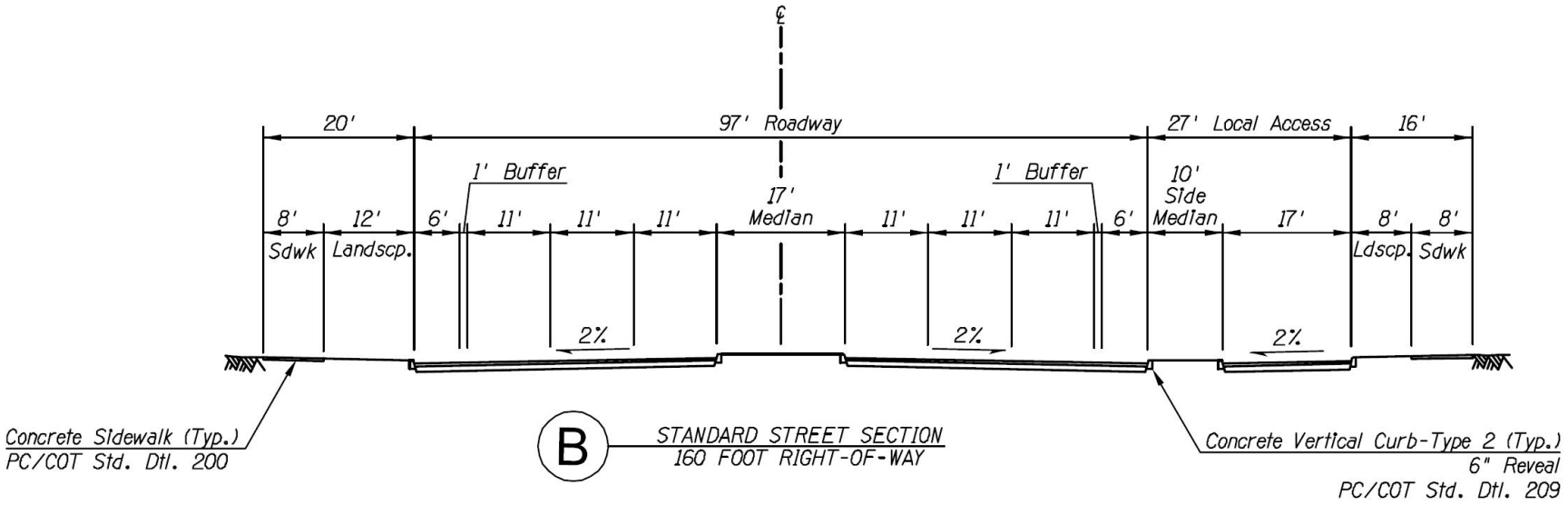
- 6th/Fontana Ave
- Treat Ave
- Dodge Blvd
- Palo Verde Blvd

The toucan is a signalized crossing that allows pedestrians and bicyclists to cross the intersections while drivers are restricted from crossing. Side street medians and raised islands prohibit all side street traffic crossing movements and only permit right turns from the side streets to Grant Road. Vehicles will be permitted to turn left from Grant Road to the sides streets. The toucan crossings stop motorists, upon activation, for short periods of time to allow the pedestrians and bicyclists to cross. A typical toucan layout is presented in **Detail I**.

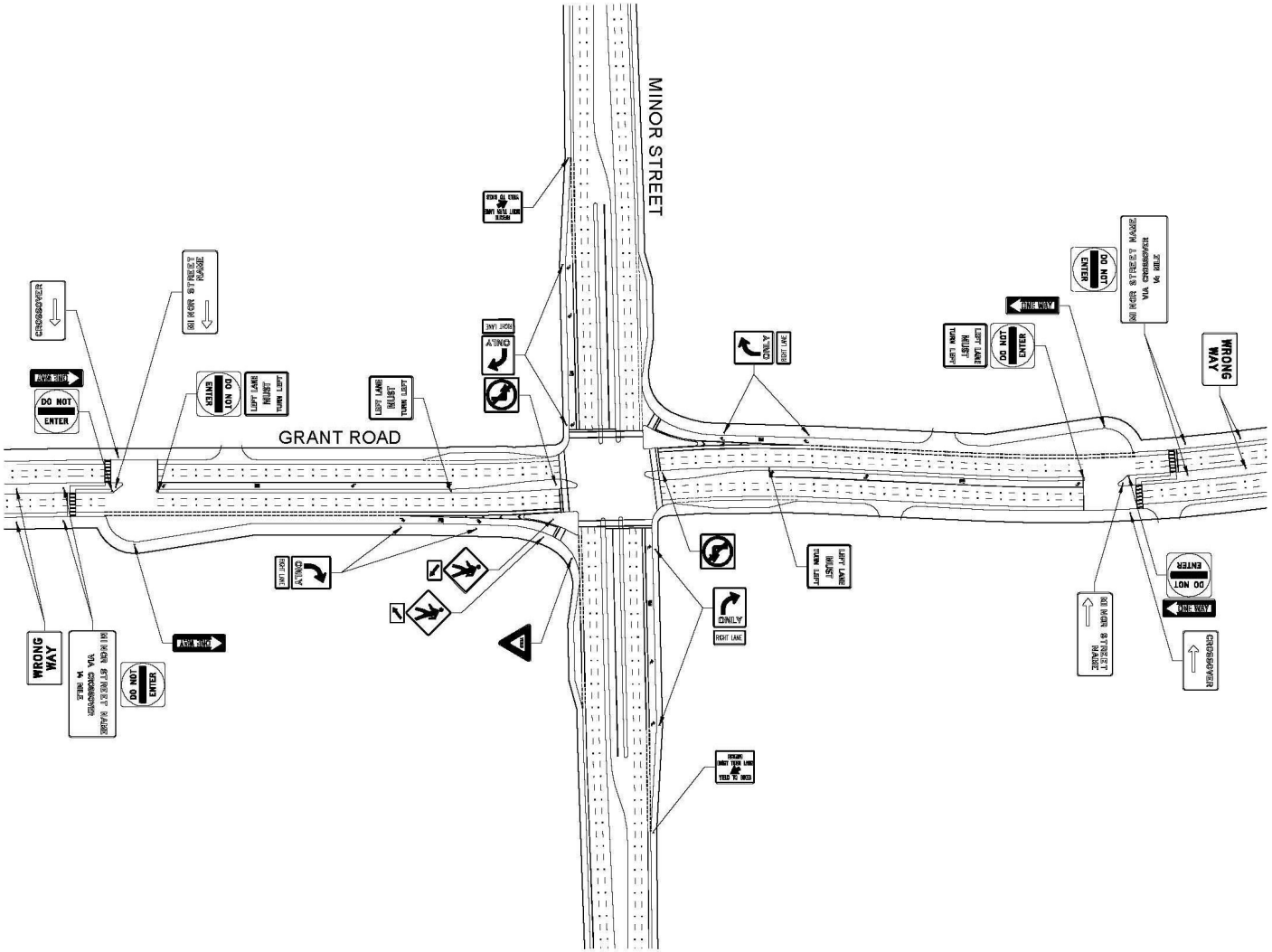
DETAIL A – 137- TYPICAL STREET SECTION



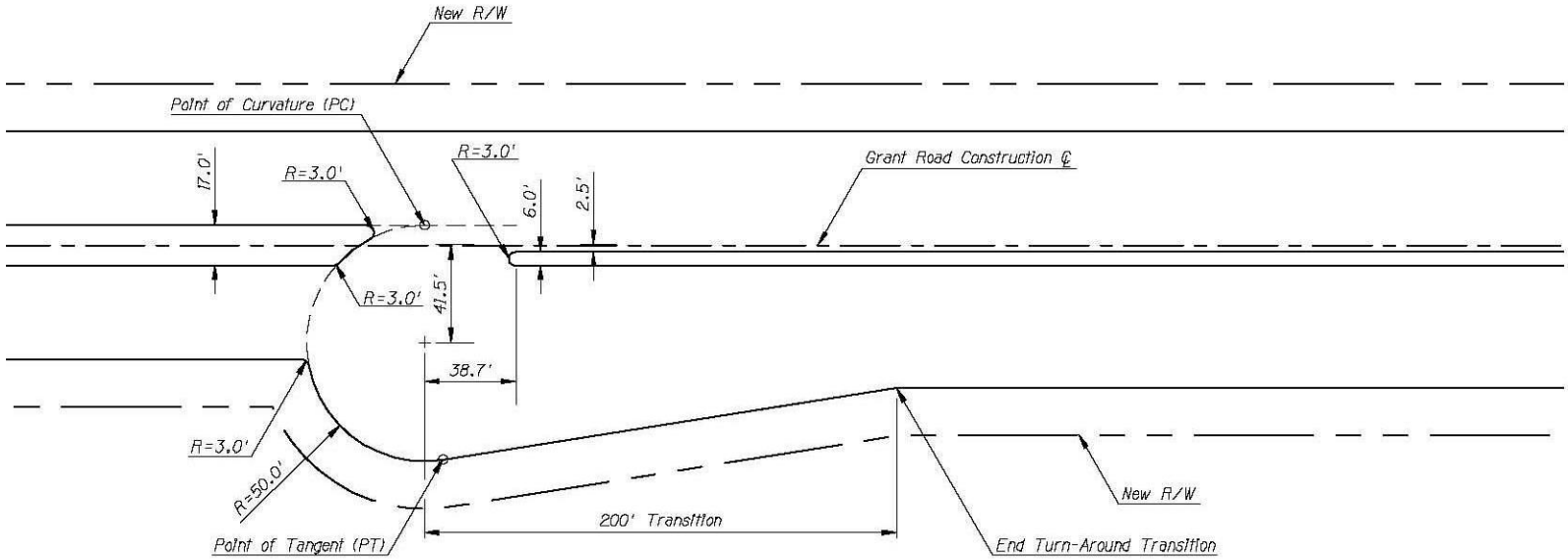
DETAIL B – 160- TYPICAL STREET SECTION



DETAIL C –INDIRECT LEFT SIGNING SCHEMATIC

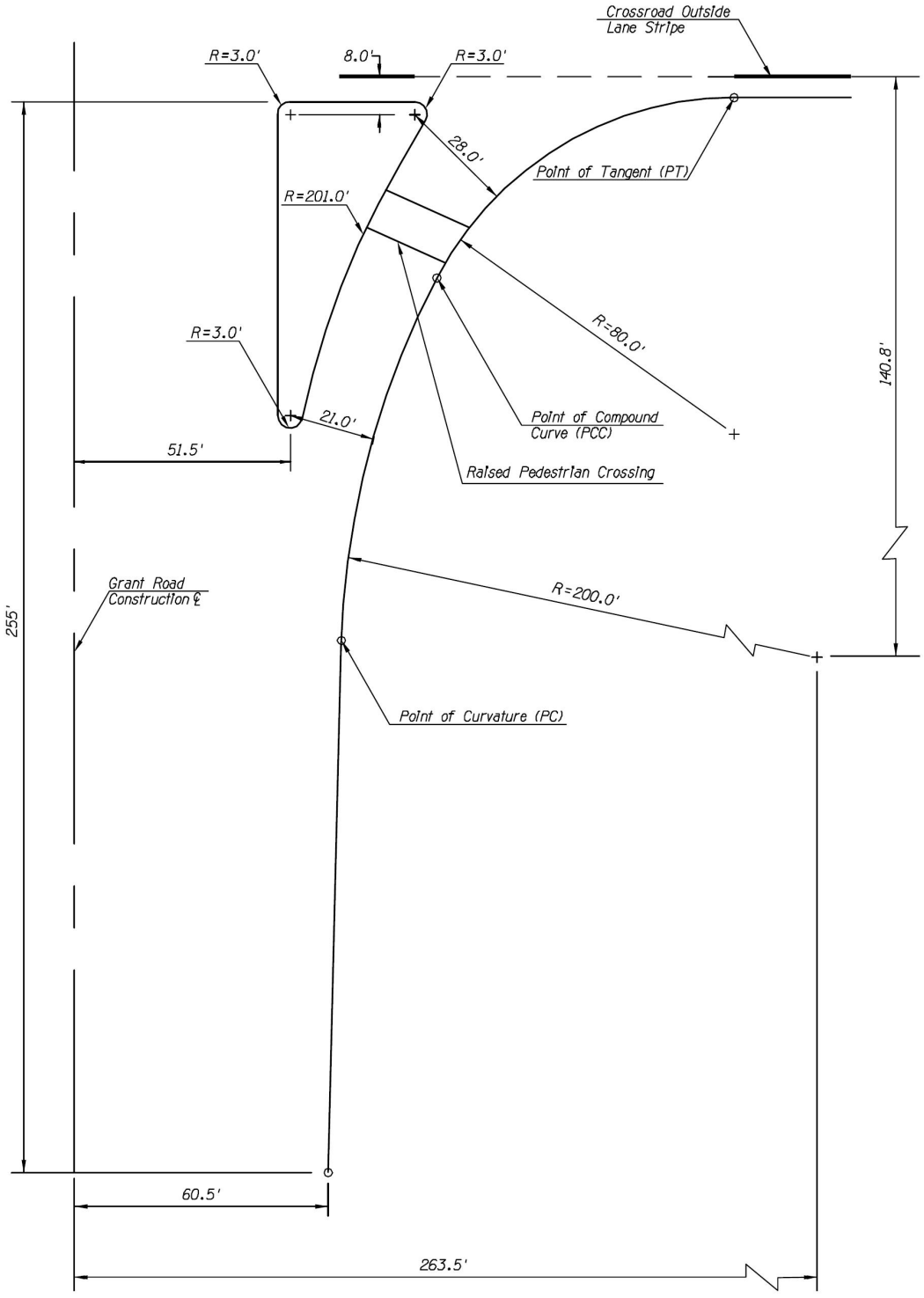


DETAIL D – INDIRECT LEFT TURN AROUND

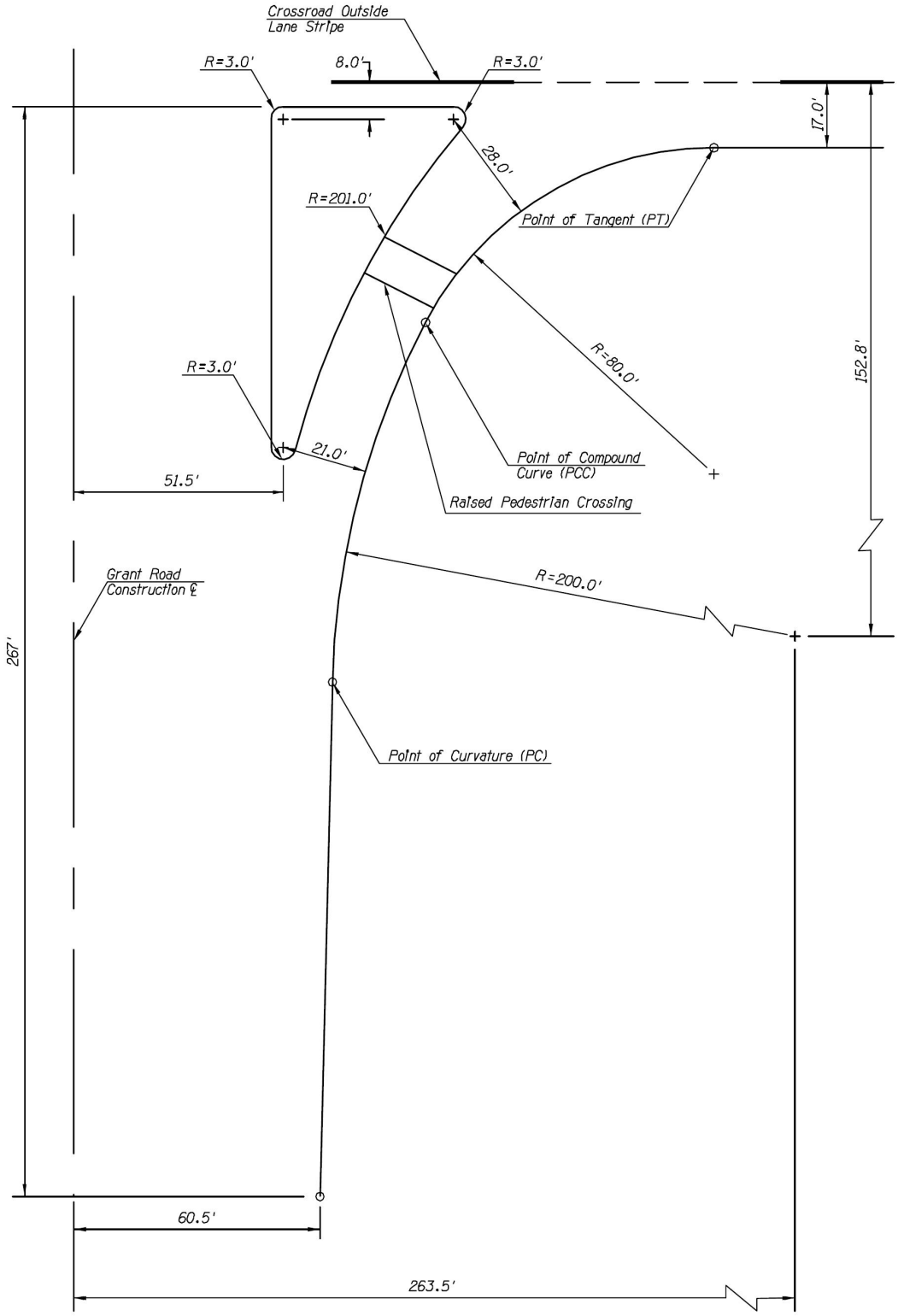


Note: All Dimensions shown to Face of Curb

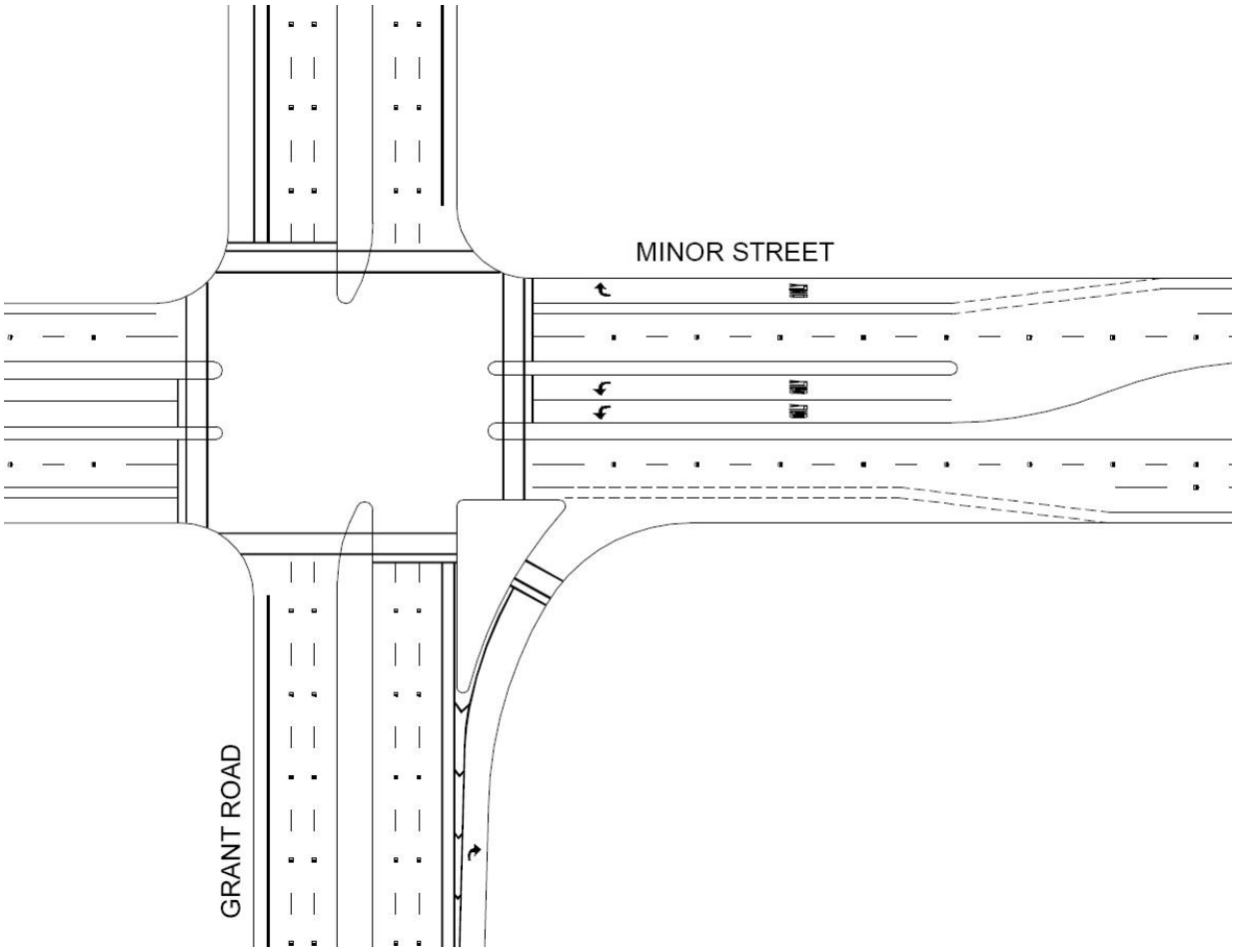
DETAIL E – CHANNELIZED RIGHT TURN LANE



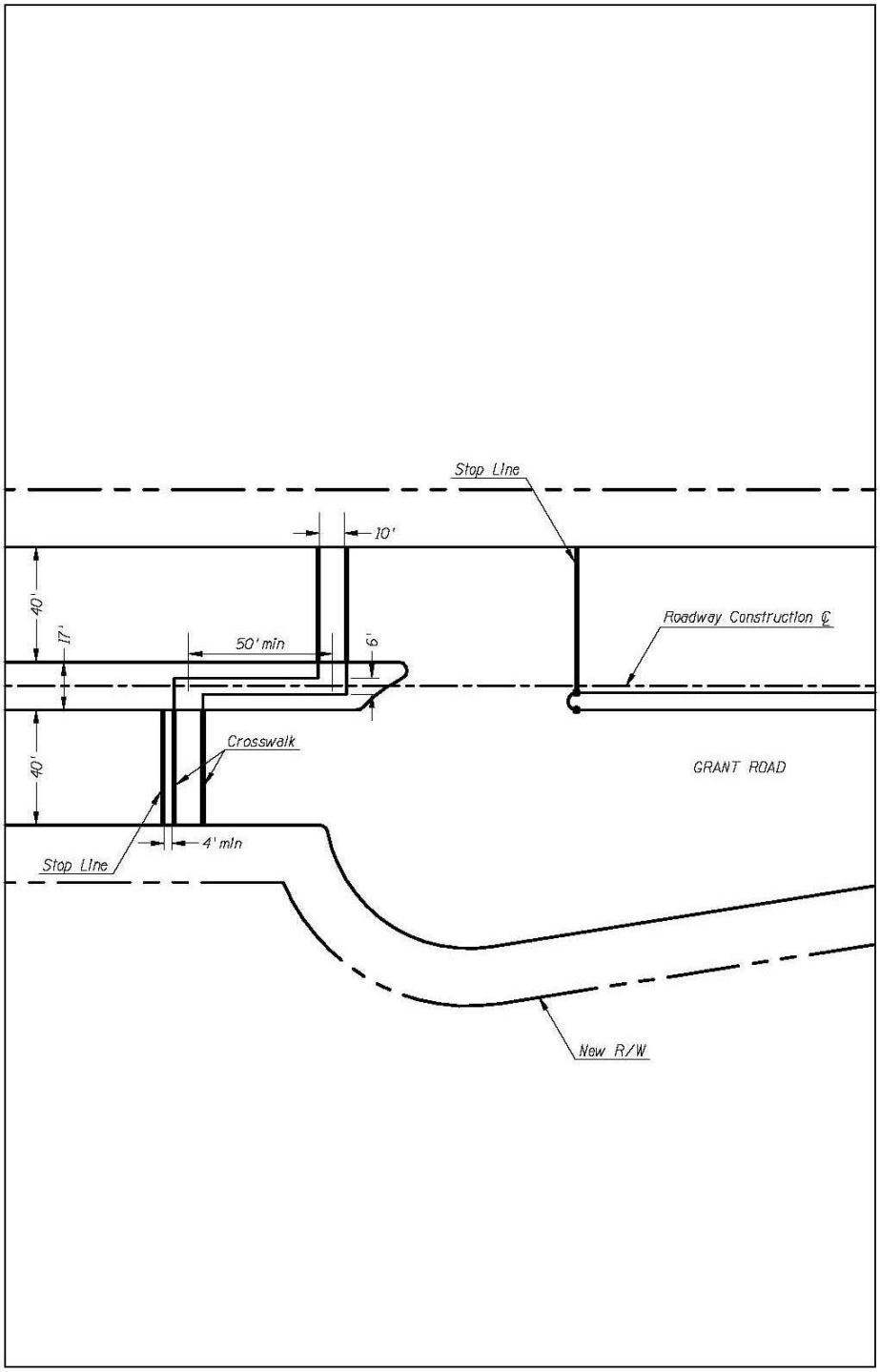
DETAIL F – CHANNELIZED RIGHT TURN LANE, WITH ADD LANE



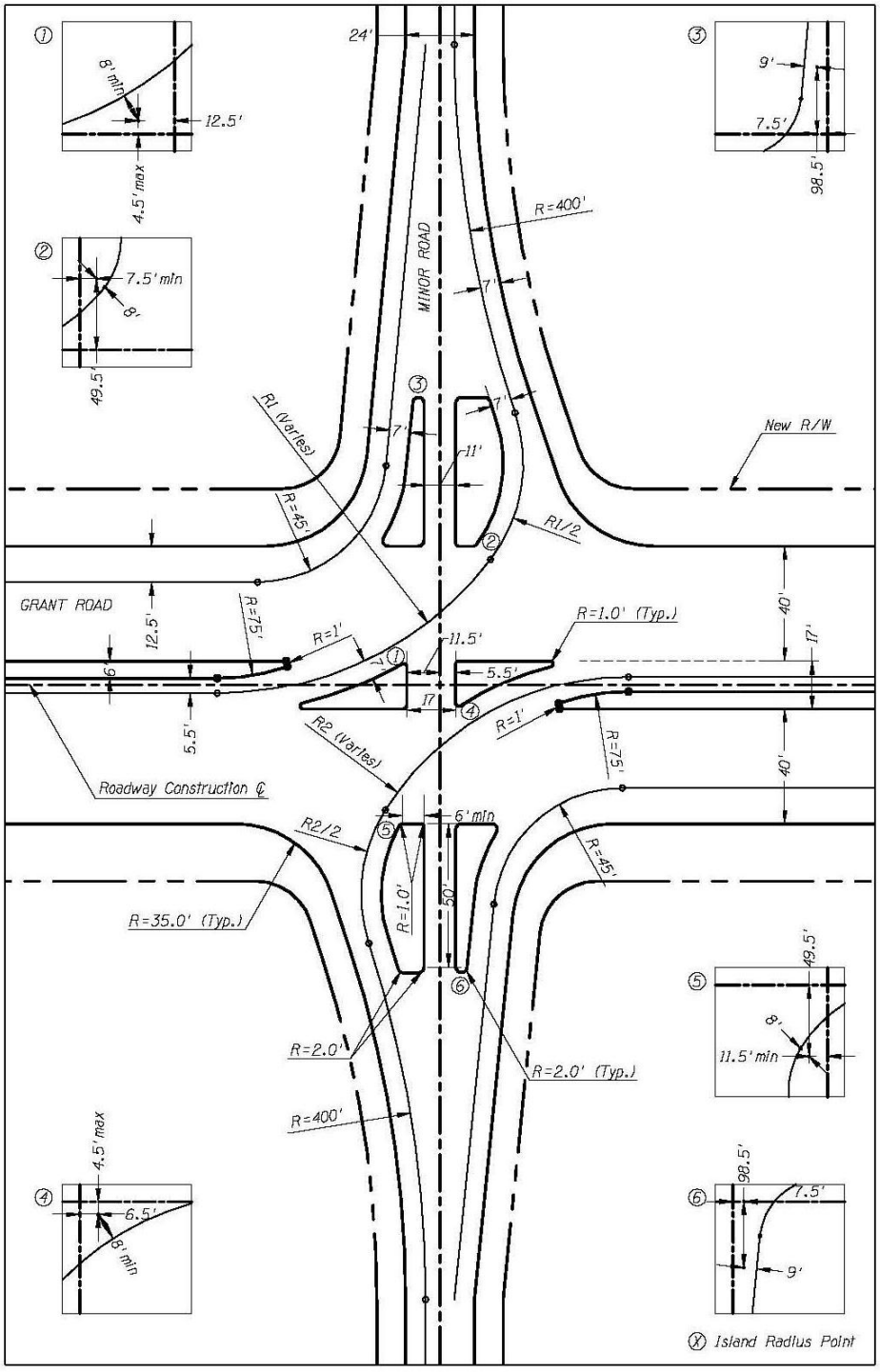
DETAIL G – CHANNELIZED RIGHT TURN LANE, WITH ADD LANE, STRIPING SCHEMATIC



DETAIL H – PELICAN PEDSTRIAN CROSSING



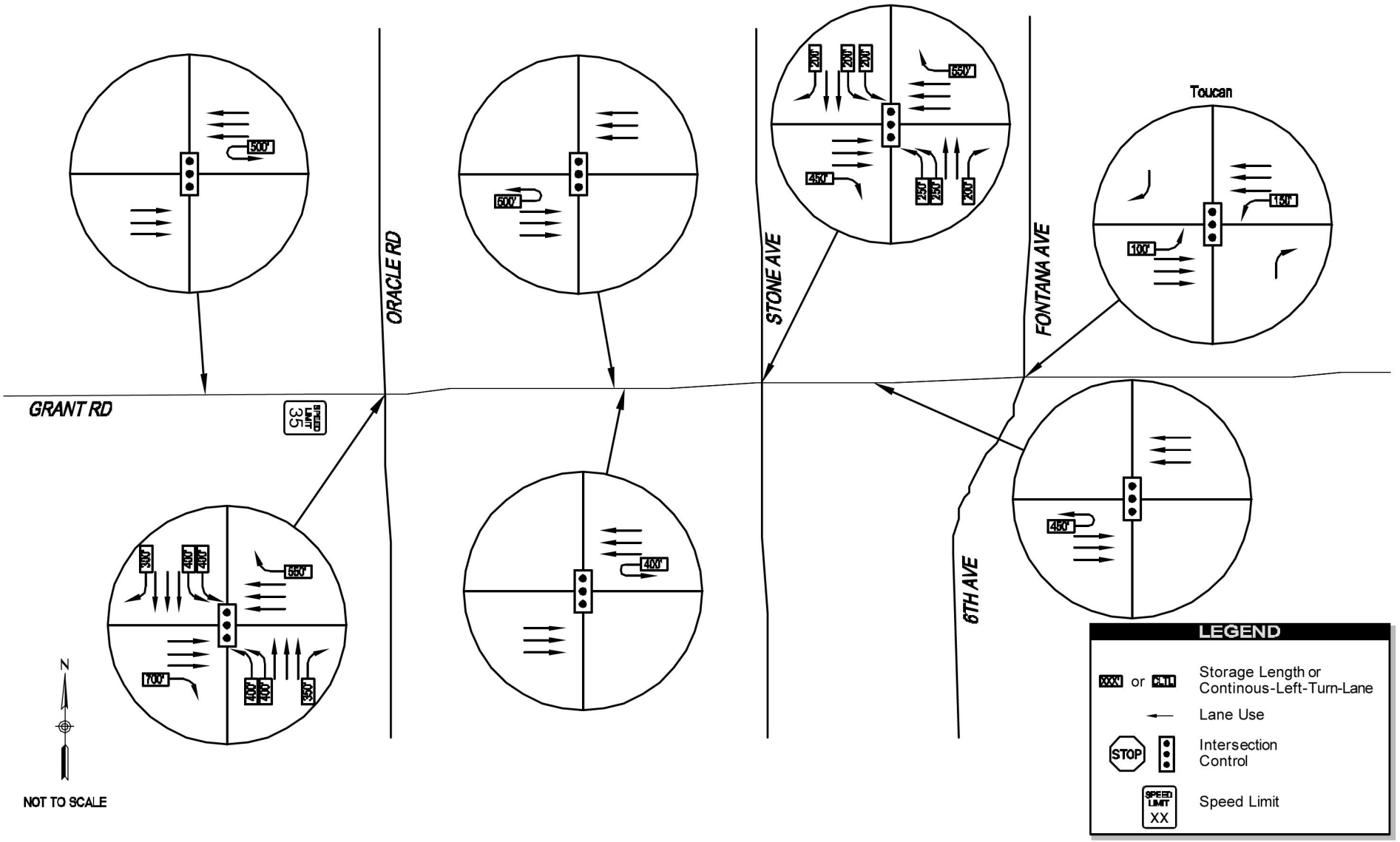
DETAIL I – TOUCAN PEDSTRIAN AND BICYCLE CROSSING



APPENDIX A – TURN LANE STORAGE REQUIREMENTS

Exhibit A1 – Turn Lane Storage Requirements

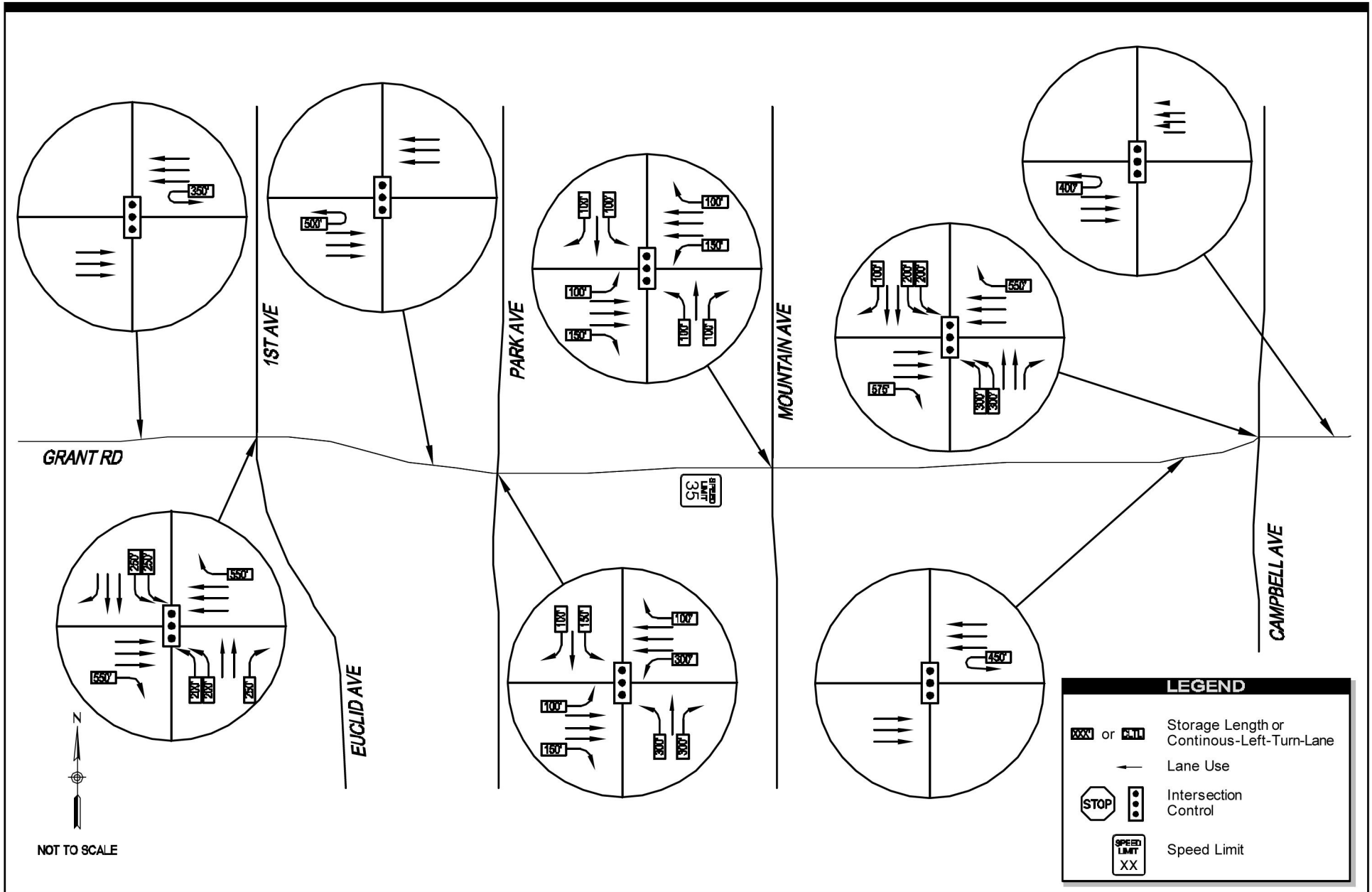
Kimley-Horn
and Associates, Inc.



Grant Road Plan

Indirect Left-Turn Concept - Future (2030) Intersection Laneage and Storage Length
Grant Road From Oracle Road to Fontana/6th Avenue

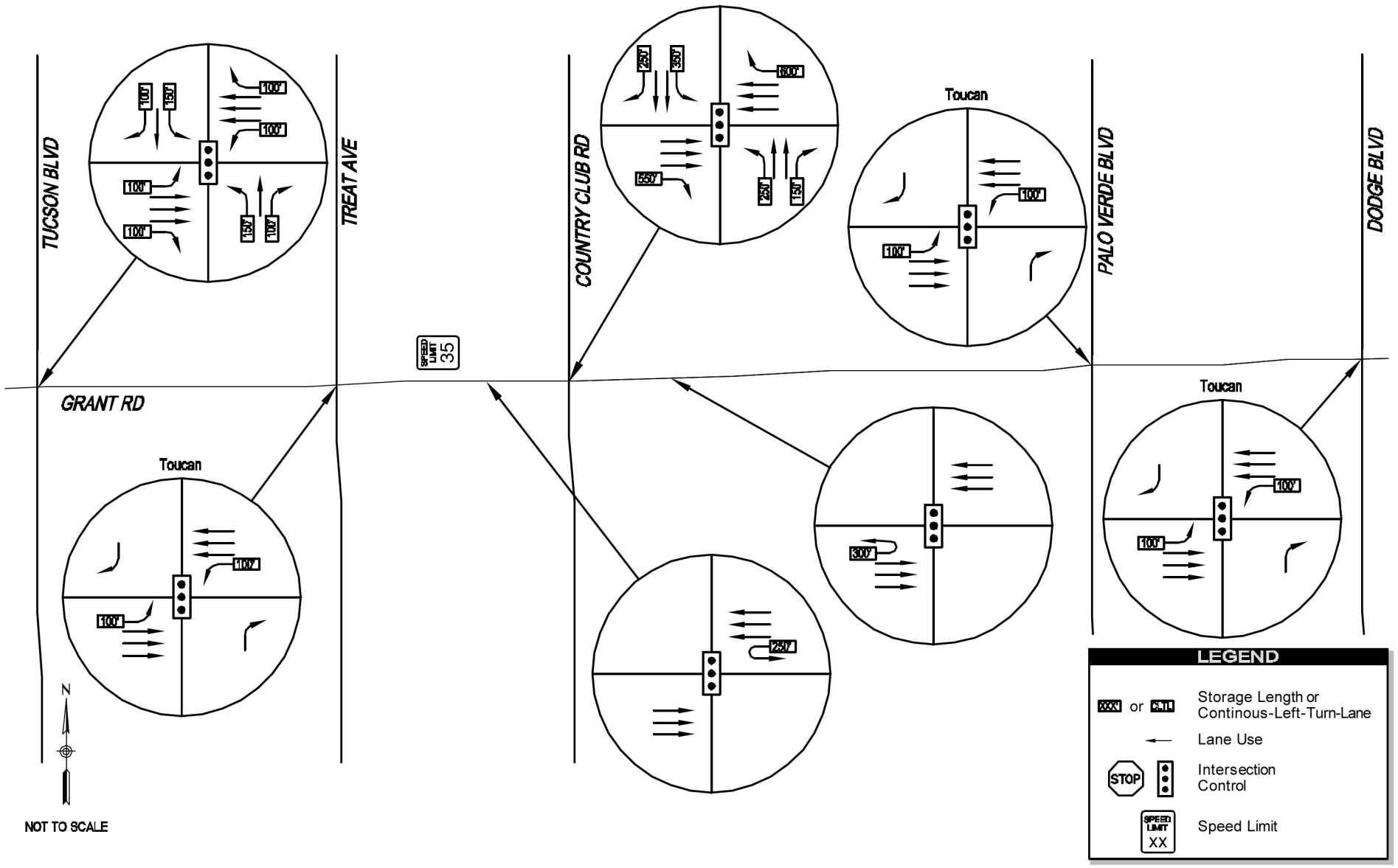
Kimley-Horn
and Associates, Inc.



Grant Road Plan

Indirect Left-Turn Concept - Future (2030) Intersection Laneage and Storage Length
Grant Road From 1st Avenue to Campbell Avenue

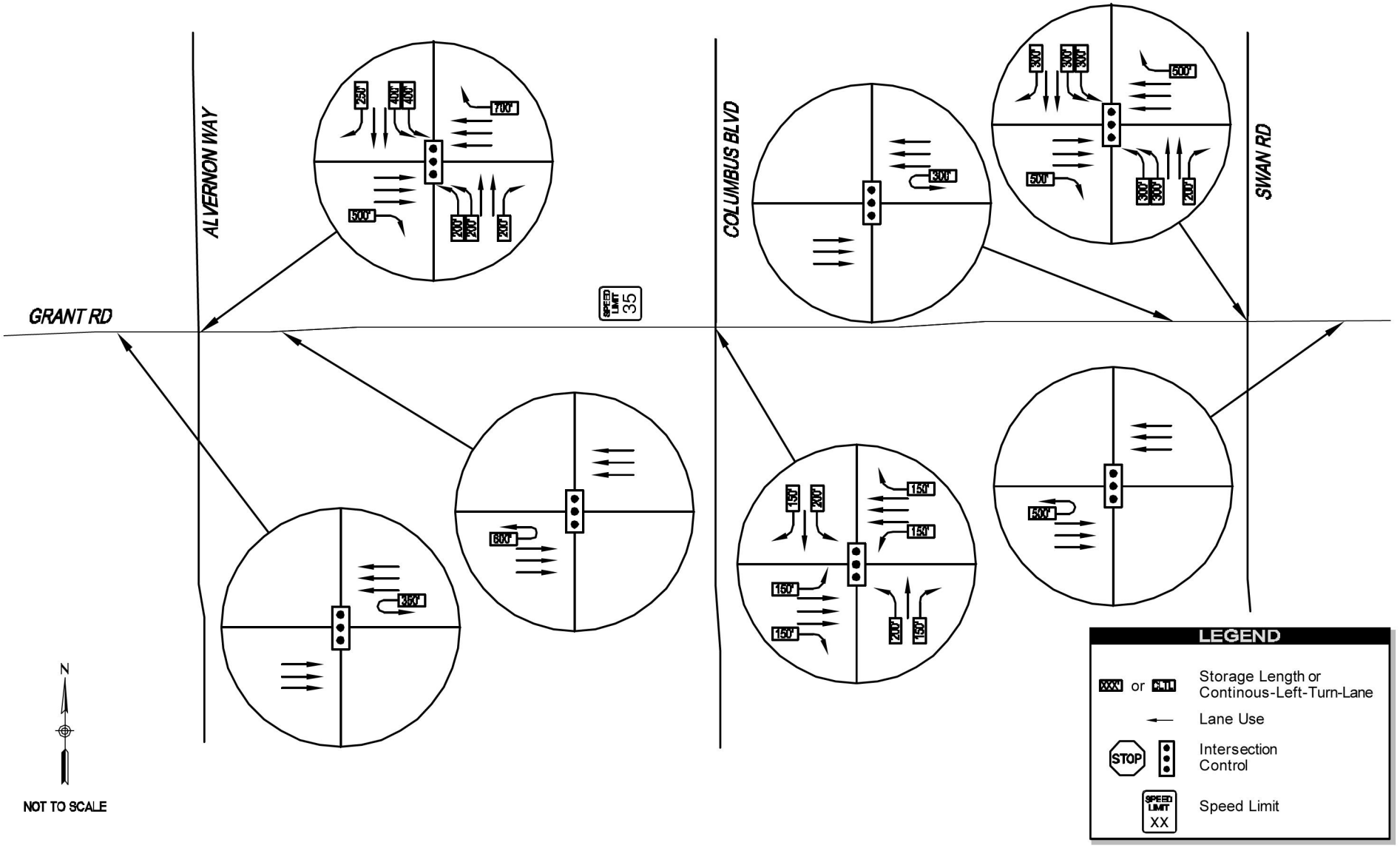
Kimley-Horn
and Associates, Inc.



Grant Road Plan

Indirect Left-Turn Concept - Future (2030) Intersection Laneage and Storage Length
Grant Road From Tucson Boulevard to Dodge Boulevard

Kimley-Horn
and Associates, Inc.



Grant Road Plan

Indirect Left-Turn Concept - Future (2030) Intersection Laneage and Storage Length
Grant Road From Alvernon Way to Swan Road