Technical Memorandum

To: Kathy Arnold
From: Seri Park
Company: Rosemont Copper
Date: June 25, 2009
Re: State Route 83 School Bus Stop Improvements
Doc #: 115/09-320842-5.3
CC: Jamie Sturgess (Rosemont)
David Krizek and Jamie Joggerst (Tt)

1.0 Introduction

This Technical Memorandum was prepared by Tetra Tech and presents potential improvements for the current school bus stops along State Route 83 (AZ-83). This memorandum also discusses the design criteria used for the improvements as well as the advantages and disadvantages related to the improvements.

Tetra Tech completed a field visit to document the locations and traffic patterns associated with the existing school bus stops along AZ-83. A total of seven (7) school bus stops were identified and are shown on Figure 1. The current school bus traffic pattern consists of two (2) separate loops. One (1) loop runs from Sahaurita Road to the Rest Stop at Milepost (MP) 46.9 on AZ-83. The Rest Stop is located just south of the proposed Primary Access Road leading to the Rosemont Copper Project. The second school bus loop runs from State Route 82 (AZ-82) to Greaterville Road. Figure 1 also shows the traffic patterns for the two (2) school bus loops. Currently the school bus pick-up and drop-off spots are located such that students do not have to cross the roadway in order to get to the bus stop (i.e., pick-up and drop-off occur at the same location on the respective side of AZ-83). With the exception of the Hilton Ranch Road school bus stop, the bus stops do not have a designated pull-off area along AZ-83 (i.e., the buses stop within the through lane of AZ-83). At the Hilton Ranch Road school bus stop, a wide compacted dirt area was observed on the east side of AZ-83.

Tetra Tech held a meeting with the Transportation Supervisor for the Vail School District on May 19, 2009. At this meeting, Tetra Tech learned that the district is open to improving the existing school bus stops along AZ-83 to avoid stopping in the through lane. The district also supports upgrades to any of the existing school bus stops in order to avoid any potential future traffic conflicts.
2.0  Design Vehicle

The large, S-BUS-40 school bus was chosen as the design vehicle for assessing potential improvements to the school bus stops. This vehicle was selected since it also satisfies requirements for the more common smaller school bus type, S-BUS-36. A detailed illustration of the S-BUS-40 is presented on Figure 2.

3.0  School Bus Stop Design Criteria

An example of a proposed improved school bus stop is illustrated on Figure 2. This figure is also specific to the proposed Hilton Ranch Road school bus stop improvement. The guidelines used in the design of this improved bus stop are discussed in the following paragraphs. In Attachment A, before and after photos are provided to illustrate the visual changes with regards to adding the proposed improved school bus stop at Hilton Ranch Road.

Geometric Design Element

The Vail School District does not have any specific design guidelines for school bus stops or turnouts. The Vail school district agreed that the American Association of State Highway and Transportation Officials (AASHTO) bus turnout Exhibit 4-27 (Attachment B), presented at the meeting, is an acceptable design guideline. The district was also willing to relocate existing bus stops up to 300 feet from their current location if the construction of the turnout would be more feasible within those limits. The only restriction the school district had is that buses cannot stop within 50 feet of any intersection. This restriction was considered when assessing improvements to the school bus stops.

Per AASHTO guidelines, bus turnouts should consist of the following three (3) items: 1) a deceleration lane or taper to permit easy entrance into the loading area, 2) a standing space sufficiently long enough to accommodate the maximum number of vehicles expected to occupy the space at one time, and 3) a merging lane or taper to enable easy re-entry into the through lane. AASHTO also recommends providing a 50-foot long loading area for the bus and entry and exit tapers. The entry taper should be no less than 5 to 1 length to width and the exit taper should be no less than 3 to 1. AASHTO’s Exhibit 4-27, provided in Attachment B, also indicates that the minimum width for a bus turnout is 20 feet. In this Technical Memorandum, the proposed turnouts for the school bus stops were designed to be 50 feet long and 20 feet wide with a 100-foot entry taper and a 60-foot exit taper in order to meet all the above mentioned guidelines. This proposed turnout for the school bus stops also conforms to the Arizona Department of Transportation (ADOT) Roadway Design Guidelines Section 105-4, Pullout.

Tetra Tech also proposes adding markings, striping, and asphalt at each bus stop. Markings would mainly consist of directional arrows to clarify the ingress and egress of the school bus. The striping would consist of 4 inch wide white strips located at the edge of the shoulder.
Sign Installation

Per the Manual on Uniform Traffic Control Devices (MUTCD) Figure 7B-1 (Attachment C), a “SCHOOL BUS STOP AHEAD” (S3-1) sign should be installed to warn drivers about the school bus stop. The sign should be placed approximately 500 feet in advance of the bus stop per Section 7B.10 of the MUTCD. An additional sign will also be posted to address concerns from the Vail school district about other vehicles using the school bus stops for non-school bus activities. Furthermore, sign installation should follow ADOT’s Roadway Design Guidelines, Section 303.2, which states:

“Roadside obstacles, non-traversable hazards and fixed objects, should be removed, made ‘breakaway’, relocated or shielded by a barrier if they are within the minimum recovery area width.”

Therefore, all new signs will need to be “breakaway”. In addition, roadside clearing of large trees will need to be coordinated with ADOT in order to maintain a safe clear recovery area beyond the pavement limits. This process will also conform to the guidelines specified in the Landscape and Irrigation Design Guidelines for Arizona Department of Transportation Encroachment Permit Applications as presented in Attachment D.

3.1 School Bus Stop Improvement Advantages and Disadvantages

Advantages:

- Adding a designated turnout area for the school bus stops along AZ-83 will improve traffic flow by allowing through traffic to proceed without impedance
- Increase traffic safety by providing better sight distance for through vehicles
- Safer students loading and unloading
- Eliminate potential rear-end accidents

Disadvantages:

- Ingress and egress point will need to be maintained
- Except for the Hilton Ranch Road school bus stop, the remaining six (6) bus stops will require grading
REFERENCES


Arizona Department of Transportation (2007) *Roadway Design Guidelines*


U.S. Department of Transportation Federal Highway Administration (2004) *Standard Highway Signs*

Vail School District (http://www.vail.k12.az.us/facilities_transportation/busroutes.htm)
SCHOOL BUS Proposed 20' Bus Turnout

Existing 12' Lane Existing 12' Lane

8' Bus Hot Mix Asphalt

Aggregate Base

SECTION A-A

40.00

20.00

7.00

S-BUS-40

Width: 8.00
Track: 8.00
Lock to Lock Time: 6.00
Steering Angle: 34.40

Legend:
ROW - Right of Way

Bus Turnout Designed Per:

Location:
Mile Post 49.1
Intersection of State Route 83 and Hilton Ranch Road

Legend:
M3-1 500' To Bus Stop

STATE ROUTE 83

500' To Bus Stop
ATTACHMENT A
PHOTOS OF HILTON RANCH ROAD SCHOOL BUS STOP
Existing School Bus Stop at Hilton Ranch Road (looking north)
Proposed School Bus Stop at Hilton Ranch Road (looking north)
ATTACHMENT B
AMERICAN ASSOCIATION OF STATE HIGHWAYS AND TRANSPORTATION OFFICIALS (AASHTO)
EXHIBIT 4-27
Exhibit 4-27. Bus Turnouts

Where the turnout is on the near side of an intersection, the width of cross street is usually great enough to provide the needed merging space.

The minimum total length of turnout for a two-bus loading area should be about 55 m [180 ft] for a midblock location, 45 m [150 ft] for a near-side location, and 40 m [130 ft] for a far-side location. These dimensions are based on a loading area width of 3.0 m [10 ft]. They should be increased by 4 to 5 m [13 to 16 ft] for a width of 3.6 m [12 ft]. Greater lengths of bus turnouts expedite bus maneuvers, encourage full compliance on the part of bus drivers, and lessen interference with through traffic.

Exhibit 4-28 shows a bus turnout at a midblock location. The width of the turnout is 3.0 m [10 ft], and the length of the turnout, including tapers, is 63 m [210 ft]. The deceleration and acceleration tapers are 4:1.
ATTACHMENT C
MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (MUTCD) FIGURE 7B-1
Figure 7B-1. School Area Signs

School Advance Warning Assembly

- S1-1
- W16-9p
- OR
- W16-2a
- OR
- W16-2
- OR
- W16-2a
- OR
- W16-2

School Crosswalk Warning Assembly

- S1-1
- OR
- W16-7p

School Speed Limit Assembly

- S4-3
- R2-1
- OR
- S4-1
- OR
- S4-2
- OR
- S4-4
- OR
- S4-6

- S4-3
- R2-1
- OR
- S4-1
- OR
- S4-1

School Bus Stop AHEAD

- S3-1

20 MPH SCHOOL ZONE AHEAD

- S4-5
- OR
- S4-5a

SCHOOL

- SPEED LIMIT 20
- WHEN FLASHING

- S5-1

SCHOOL

- SPEED LIMIT 30 km/h
- WHEN FLASHING

- S5-2

END SCHOOL ZONE

- S5-2
LANDSCAPE AND IRRIGATION
DESIGN GUIDELINES
ARIZONA DEPARTMENT OF TRANSPORTATION
ENCROACHMENT PERMIT APPLICATIONS

PREPARED BY:
ARIZONA DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
ROADSIDE DEVELOPMENT SERVICES
INTRODUCTION

The Arizona Department of Transportation, Highways Division, encourages the landscaping of its rights of way through the cooperative efforts with local governments and adjacent property owners. Because the right of way is a public area, of prime importance with relation to landscaping is the protection of the public and its safe access to the facilities as well as the improvement of aesthetic considerations.

Landscaping, being composed of living plant material, is in a constant state of change and must consider the ultimate growth of plants. Additionally, other considerations are the use of low water requirement plant materials and any other local jurisdictional requirements, such as sidewalks, signing setbacks and other requirements in relation to each specific roadway. After all of these factors have been considered the completion of the landscaping can greatly enhance the beauty of the roadway and the community.
An approved Encroachment Permit is required before any landscape improvements may be incorporated within the ADOT Highway right-of-way. This applies to work performed under nationwide programs such as Global Releaf as well as individual efforts. Landscaping by local governments may be constructed and maintained within the control of access on the crossroads of major highways under a fully executed Intergovernmental Landscape Maintenance Agreement prepared by the State and an approved Encroachment Permit.

The highway roadside is an integral unit of a total highway facility. The term "roadside" generally refers to the area between the outer edge of the roadway and the right-of-way boundary. These include all unpaved areas within the right-of-way.

Permit applicants are encouraged to employ competent design professionals such as Registered Landscape Architects, Architects or Engineers, and to direct their work toward securing a product that fully represents the owner's needs and desires and meets the Arizona Department of Transportation (ADOT) standards, before submitting such plans for review and approval. Permit applicants and design professionals are encouraged
to discuss landscape needs and proposals with District Permits Supervisors and Roadside Development Services Landscape Architects before commencing work on final construction plans.

All plans and specifications shall be sufficiently complete and detailed for easy analysis and compliance inspection. Plans shall be designed to select plant materials appropriate for the intended use and location, to arrange plants for optimum effect of color, texture, form and to ensure reasonable maintenance within the capability of the proposed permittee. Permit applications will be reviewed for consideration of the following factors which can affect the safe and efficient operation of the highway facility.

II. DRAWINGS

A. PLANS:

Drawings must be legible, accurate and drawn to scale. They shall include a north arrow, name of development, designer and design firm with appropriate phone numbers and location of project.

B. PLANT MATERIALS:

Plants proposed for use must be clearly located, showing mature sizes, and identified as to botanical name (genus species, variety), planting size, quantity and spacing used.
Areas within an Arizona Department of Water Resources Active Management Areas must adhere to the plant list provided for that area. (See attached Plant Lists.)

C. EXISTING FEATURES:

Existing features such as curbs, sidewalks, pipe culverts, drainage structures, retention basins, driveways, highway and non-highway signs, overhead lines, underground utilities, irrigation lines, manholes, service cabinets, etc., shall be shown. In addition, the posted speed limit for the highway shall be indicated. Existing trees and shrubs shall be incorporated into the design wherever feasible. Clearing of trees and shrubs will not be permitted unless approved through the permit process. When planters are cut out of existing sidewalk areas, sufficient space must remain for compliance with ARS statutes relating to accessibility by the physically handicapped. The use of steel tree grates is recommended to maximize usable sidewalk space and to maintain a safe walking surface.

D. SLOPES:

Existing or proposed slopes shall be identified with respect to elevation differences between top and bottom and rate of slope between.
III. DESIGN

A. EROSION CONTROL:

Erosion control measures must be employed to prevent surface drainage from eroding soil surfaces and carrying the resultant silt into natural or man made drainage systems, highways or private properties.

B. SAFETY SETBACKS FOR FIXED OBJECTS:

Minimum setbacks from the travel way for newly planted trees with an ultimate trunk diameter of more than 4 inches or other hazardous fixed objects should be as follows:

1. 50 MPH or Greater Design Speed:

   a. Minimum setback from the edge of the traffic lane should be 35 feet unless one of the following reasons will allow for a lesser distance.

      1) Cuts of 3 to 1 or steeper - obstacles are allowed 10 feet behind the point of vertical intersection (P.V.I.) at the toe of the slope. (See illustration 'A'.)

      2) Where concrete barriers, walls, abutments, or other rigid obstructions are used - fixed objects may be placed 4' behind the obstructions. (See illustration 'B')
3) Where flexible guardrail (box-beam, w-beam, or cable) is used - 6 to 20 feet behind the face of the guardrail, depending upon the type. (See illustration 'C'.)

4) Where there are barrier curbs (5" or more vertical face) near a traveled lane 6 feet behind the face of the curb (see illustration 'D'); adjacent to a parking lane - no definite setback distance.

b. Where limited right-of-way or the necessity for planting would result in less clearance, all factors in the particular problem area should be weighed to decide if a special exception is warranted.

2. 50 MPH or less design speed:

a. Minimum setback of a fixed object from the edge of the traffic lane may be 30 feet unless one of the reasons set forth under (1) will allow for a lesser distance.

b. On curves, adequate sight distance for the design speed of the highway must be maintained.

C. REQUIREMENTS FOR SIGHT DISTANCE:

A clear line of sight must be maintained at all highway intersections and entrances. Generally, shrubs, plantings or other obstructions in
this zone must be limited to an ultimate height of 18" or less to allow a clear line of sight down the highway in either direction for at least 400' from the front of the vehicle located 10' behind the edge of the highway to be entered. (See illustration 'E'.)

D. CULTURAL REQUIREMENTS FOR PLANTS:

Use plants that require minimal maintenance and are hardy to the area. Avoid plants that are messy, brittle, short lived or subject to infestations of insects or disease. Plants used in areas where sight distance must be maintained shall have a mature height of 18" or less.

E. VISIBILITY OF HIGHWAY FEATURES:

The visibility of highway signs, delineators, edges of sidewalks, curbs, roadway or guardrail must be maintained at all times. Therefore, provide sufficient plant setbacks and plants with mature sizes that will not outgrow spaces to avoid costly trimming as plants mature.

IV. DETAILS

A. Plans shall include, as appropriate, planting details for trees, shrubs, ground cover, vines, and cacti showing size of planting pit in relation to size of plant ball. (See planting details.)
B. Plans should include staking or guying details as required by the size and species of plant proposed. (See planting/staking details.)

C. Plans should identify problem soils and propose appropriate measures to overcome them.

D. If a mineral surface treatment is proposed, details should be included to indicate the depth, gradation, color and the vertical relationship to the roadway curb or sidewalk. A pre-emergent herbicide should be specified to preclude weeds in these areas. (See Granite and Rock Mulch details.)

E. Details for headers, signs, walls, sidewalks, planters, etc., should be included whenever proposed.

V. MAINTENANCE

A. Problems in maintenance shall be anticipated during the design phase. Changes in environmental conditions should be anticipated.

B. It shall be the responsibility of the permittee to assure that all landscaping and irrigation can be maintained to the satisfaction of ADOT.
ILLUSTRATION 'B'
ILLUSTRATION 'C'
Plants no taller than 18"