2) DETAILED PLANS

LEGEND

1	Two-lane Parkway with Roundabouts (4-lane R.O.W.)
2	Two-lane Street with Diagnal Parking
3	Two-lane Collector with Green Median and Roundabouts
3A	Two-lane Collector with Green Median
4	Two-lane Collector with Green Median and Urban Sidewalk
4A	Two-lane Collector with Green Median and Urban Sidewalk with Parallel Parking and Protected Bike Lane
5	Two-lane Collector
5A	Two-lane Collector with Urban Sidewalk
5AA	Two-lane Collector with Angled Parking and Protected Bike Lane on One Side
6	Two-lane Rural Road Preserve
7	Two-lane Residential Local Street
7A	Two-lane Residential Local Street with One Side Ribbon Curb
7AA	Two-lane Residential with Angled Parking on One Side
8	Two-lane Mixed Use Local Street with Urban Sidewalk
8A	Two-lane Mixed Use Local Street
8AA	Two-lane Mixed Use Local Street with Urban Sidewalk with Angled Parking
9	Foothills Two-lane Collector
10	Foothills Two-lane Local Street
11	Two-lane Commercial Alley
12	Two-lane Residential Alley
	Potential Roundabout
	Easement Access For United Water
	Secondary Emergency Access

Notes :

1. A traffic impact study may be required if there is a significant change in the current land use plan.

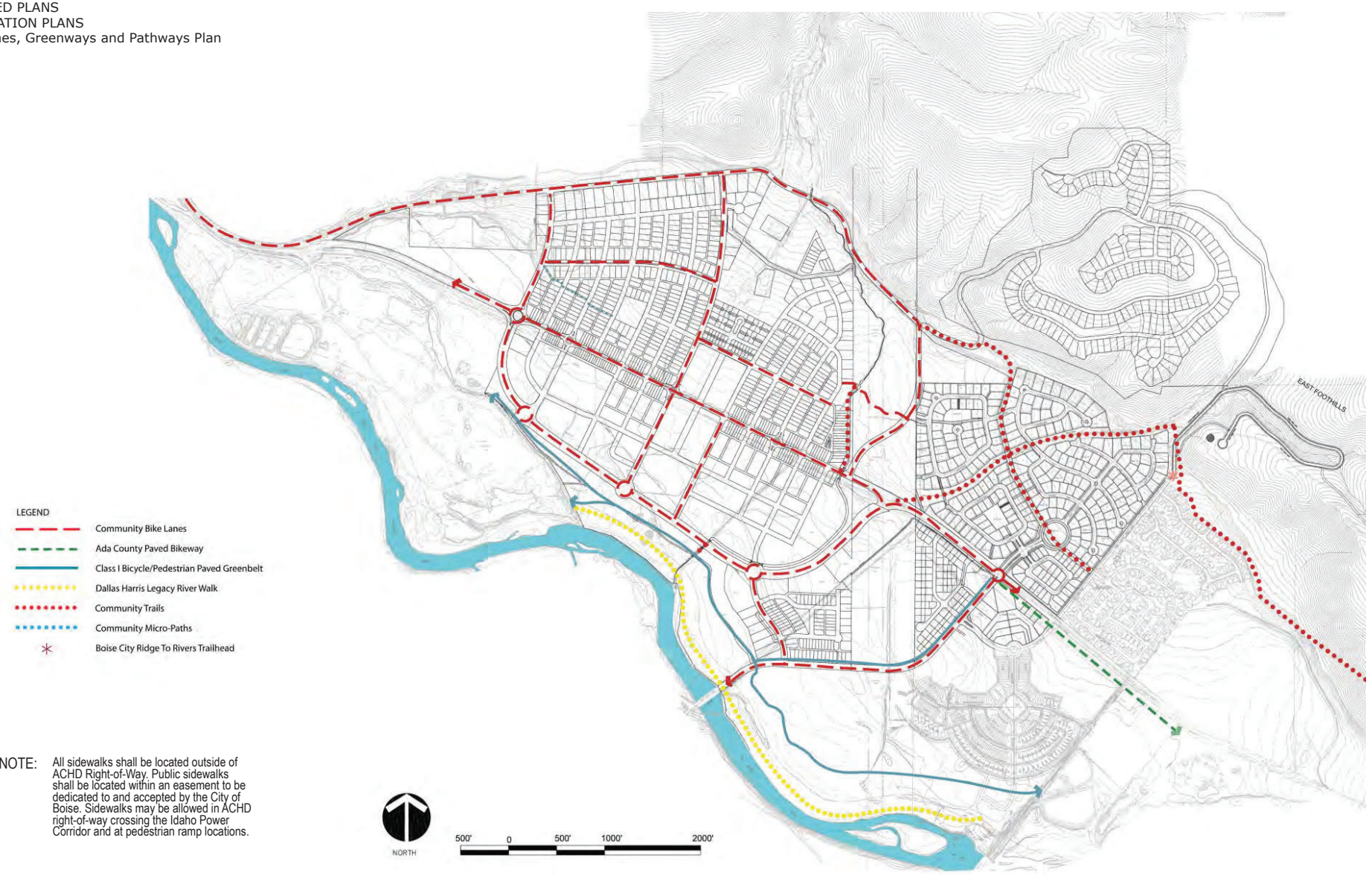
2. A turn lane warrant analysis may be required on a case by case basis depending on the proposed land use. Contact ACHD to determine if a turn lane analysis is required prior to submitting a development application.

3. When parcels abutting Warm Springs Avenue are preliminary platted, provide current roadway segment traffic counts and intersection counts (raw data) for the segment of Warm Springs Avenue abutting the site and the nearest intersection(s) (Wise Way/Warm Springs, Old Hickory Way/Warm Springs, or Millbrook Way/Warm Springs). ACHD will analyze the data to determine if roadway or intersection improvements are needed to mitigate the development.

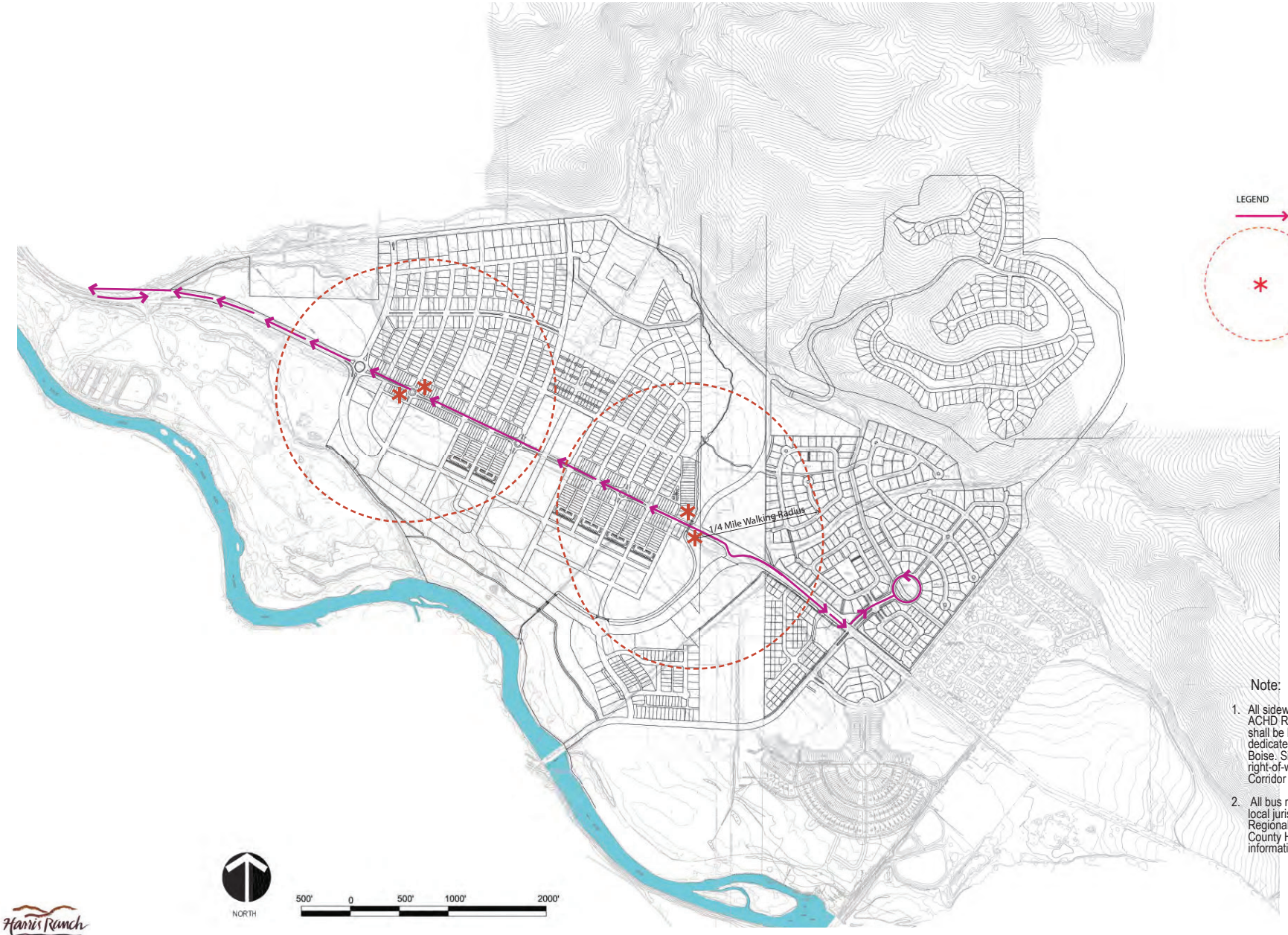
4. Requests for modifications of ACHD policy will be made with preliminary plat applications.

5. All sidewalks and off-street bike facilities shall be located outside of ACHD Right-of-Way. Public sidewalks/bike lanes/multi-use pathways shall be located within an easement to be dedicated to and accepted by the City of Boise. Sidewalks/bike lanes/ multi-use pathways may be allowed in ACHD right-of-way crossing the Idaho Power corridor and at pedestrian ramp and bike lane transition areas.

6. Roadway Section 2 (Two-lane Street with Diagonal Parking) may be removed from between the TC4 and TC5 or TC6 and TC7 blocks in the event the TC4 and TC5 or TC6 and TC7 blocks are combined as depicted on Block Prototypes 13 and 14.



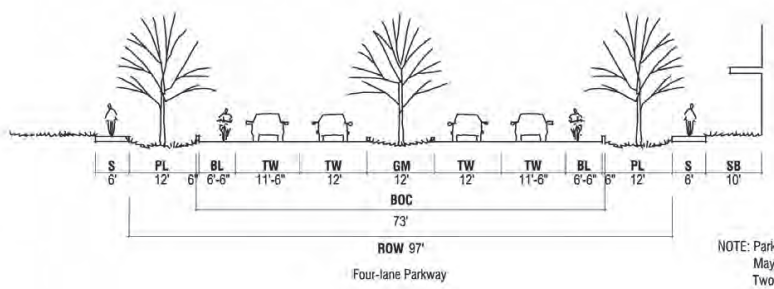
NOTE: All sidewalks shall be located outside of ACHD Right-of-Way. Public sidewalks shall be located within an easement to be dedicated to and accepted by the City of Boise. Sidewalks may be allowed in ACHD right-of-way crossing the Idaho Power Corridor and at pedestrian ramp locations.



Note:

1. All sidewalks shall be located outside of ACHD Right-of-Way. Public sidewalks shall be located within an easement to be dedicated to and accepted by the City of Boise. Sidewalks may be allowed in ACHD right-of-way crossing the Idaho Power Corridor and at pedestrian ramp locations.
2. All bus routes and bus stops subject to local jurisdiction control. Check with Valley Regional Transit, Boise City, and/or Ada County Highway District for most current information.

1

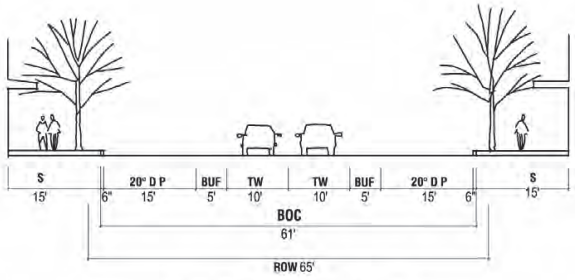


Four-lane Parkway

NOTE: Parkway Sections May Be Constructed As Two-Lane Streets Until 4-Lanes Are Warranted.

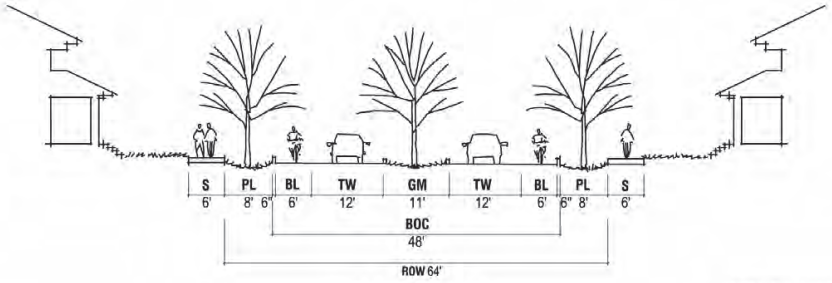
NOTE: No sidewalk on South side where greenbelt is adjacent.

2



Two-lane Street w/ 20° Diagonal Parking

3 3A



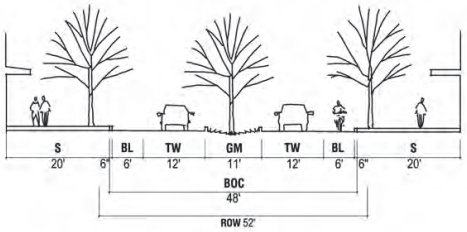
Two-lane Collector With Green Median

NOTE: See Landscape Plans.

LEGEND

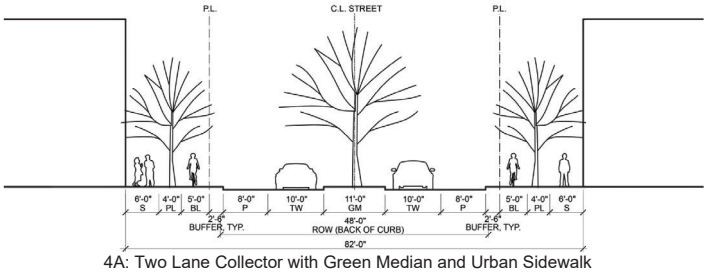
TW	Travel Way
BL	Bicycle Lane
P	Parking
PL	Planting
M	Median
S	Sidewalk
LTL	Left Turn Lane at Intersection
GM	Green Median
ROW	Right of Way
BOC	Back of Curb
SB	Setback

NOTE: All sidewalks shall be located outside of ACHD Right-of-Way. Public sidewalks shall be located within an easement to be dedicated to and accepted by the City of Boise. Sidewalks may be allowed in ACHD right-of-way crossing the Idaho Power Corridor and at pedestrian ramp locations. Access onto collector roadways shall be designed to meet ACHD's access policies in effect at the time of development. Roadway widths are subject to local government review and approval and may be modified in connection with entitlement applications. Any inconsistencies between the roadway sections shown herein and roadway sections identified with particular block prototypes are resolved in favor of the latter.



4

Two-lane Collector
w/ Green Median & Urban Sidewalk



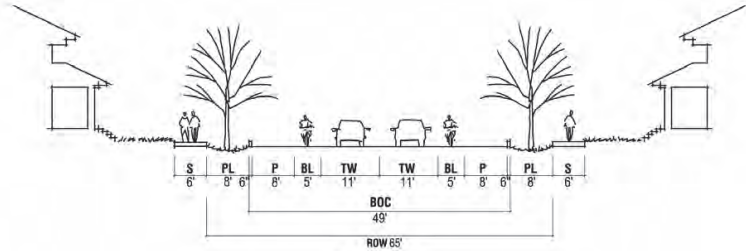
4A

4A: Two Lane Collector with Green Median and Urban Sidewalk with Parallel Parking and Protected Bike Lane
(ParkCenter Boulevard)

NOTE:
Tree planting strip option as approved by Harris Ranch.

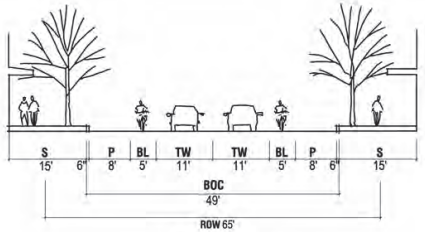
LEGEND

TW	Travel Way
BL	Bicycle Lane
P	Parking
PL	Planting
M	Median
S	Sidewalk
LTL	Left Turn Lane at Intersect
GM	Green Median
ROW	Right of Way
BOC	Back of Curb
SB	Setback



5

Two-lane Collector



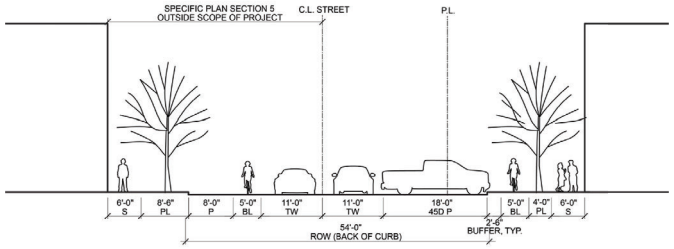
5A

Two-lane Collector
w/ Urban Sidewalk

NOTE: See Landscape Plans.

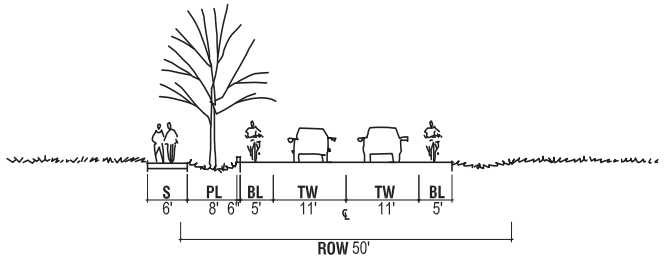
NOTE: All sidewalks shall be located outside of ACHD Right-of-Way. Public sidewalks shall be located within an easement to be dedicated to and accepted by the City of Boise. Sidewalks may be allowed in ACHD right-of-way crossing the Idaho Power Corridor and at pedestrian ramp locations. Access onto collector roadways shall be designed to meet ACHD's access policies in effect at the time of development. Roadway widths are subject to local government review and approval and may be modified in connection with entitlement applications. Any inconsistencies between the roadway sections shown herein and roadway sections identified with particular block prototypes are resolved in favor of the latter.

Angled parking shall be broken up with landscaping in configurations approved by ACHD (if within public right-of-way) or HRRB (in all other cases).



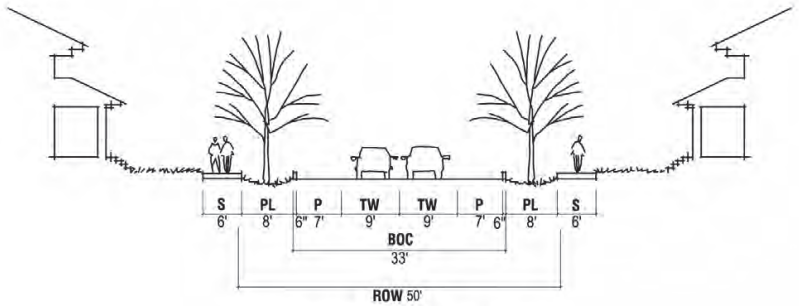
5AA

5AA: Two Lane Collector with Angled Parking and Protected Bike Lane on One Side
(Old Hickory Way & Barnside Way)



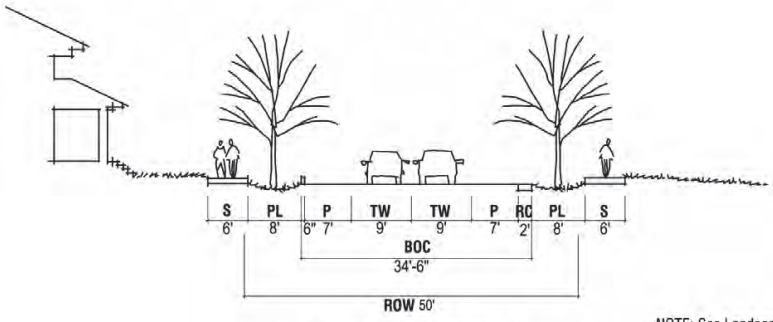
6

Two-lane Rural Road Preserve



7

Two-lane Residential Local Street



7A

Two-lane Residential Local Street
w/ One Side Ribbon Curb

NOTE: See Landscape Plans.

LEGEND

TW	Travel Way
BL	Bicycle Lane
P	Parking
PL	Planting
M	Median
S	Sidewalk
LTL	Left Turn Lane at Intersection
GM	Green Median
ROW	Right of Way
BOC	Back of Curb
SB	Setback
RC	Ribbon Curb

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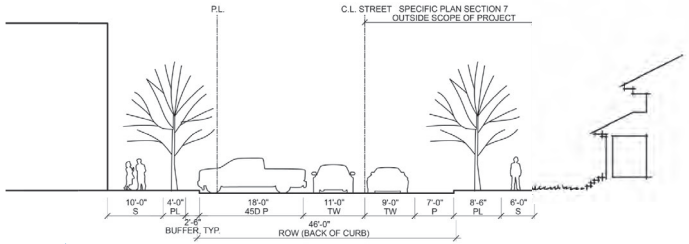
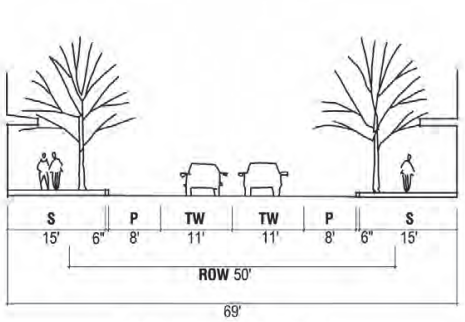


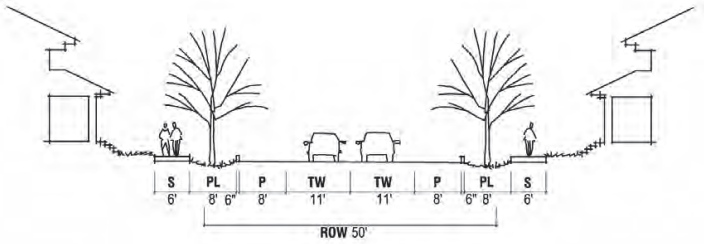
7AA

7AA: Two Lane Residential Local Street with Angled Parking on One Side
(Barnside Way (North of Parkcenter))



Two-lane Mixed Use Local Street
w/ Urban Sidewalk

8A



Two-lane Mixed Use Local Street

NOTE: See Landscape Plans.

LEGEND

TW	Travel Way
BL	Bicycle Lane
P	Parking
PL	Planting
M	Median
S	Sidewalk
LTL	Left Turn Lane at Intersection
GM	Green Median
ROW	Right of Way
BOC	Back of Curb
SB	Setback

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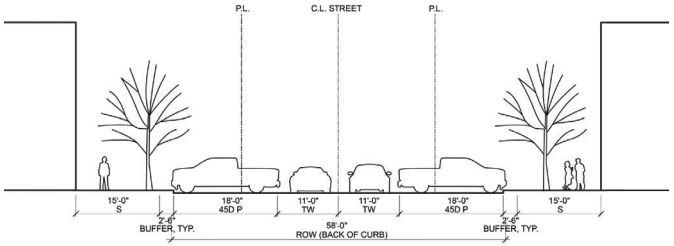
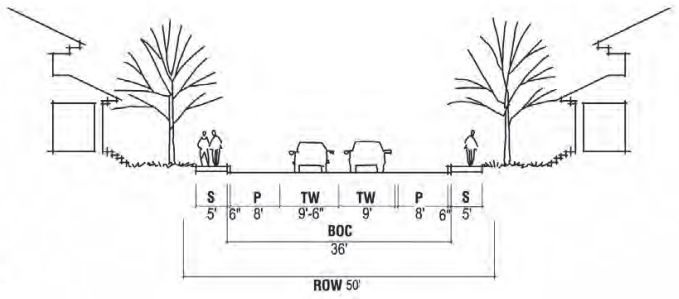


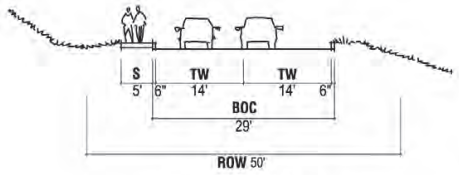
8AA

8AA: Two Lane Mixed Use Local Street with Urban Sidewalk and Angled Parking
(Haystack Street)



9

Foothills Two-lane Local Street



10

Foothills Two-lane Collector

NOTE: See Landscape Plans.

LEGEND

TW	Travel Way
BL	Bicycle Lane
P	Parking
PL	Planting
M	Median
S	Sidewalk
LTL	Left Turn Lane at Intersection
GM	Green Median
ROW	Right of Way
BOC	Back of Curb
SB	Setback

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LEGEND

TW	Travel Way
BL	Bicycle Lane
P	Parking
PL	Planting
M	Median
S	Sidewalk
LTL	Left Turn Lane at Intersection
GM	Green Median
ROW	Right of Way
BOC	Back of Curb
SB	Setback

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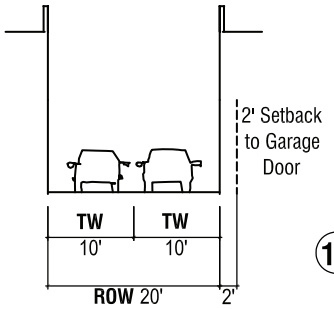
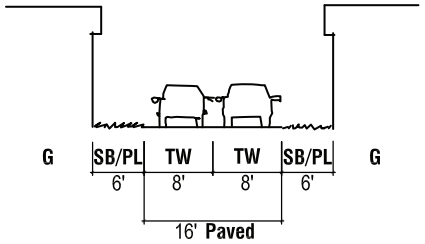
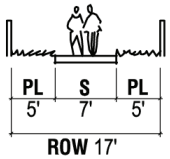


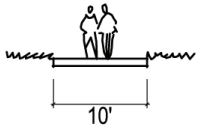
11 Two-lane Commercial Alley



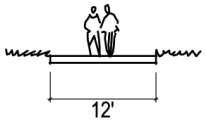
12 Two-lane Residential Alley



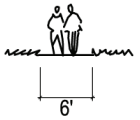
13 Community Micropath



14 Ada County Paved Bikeway



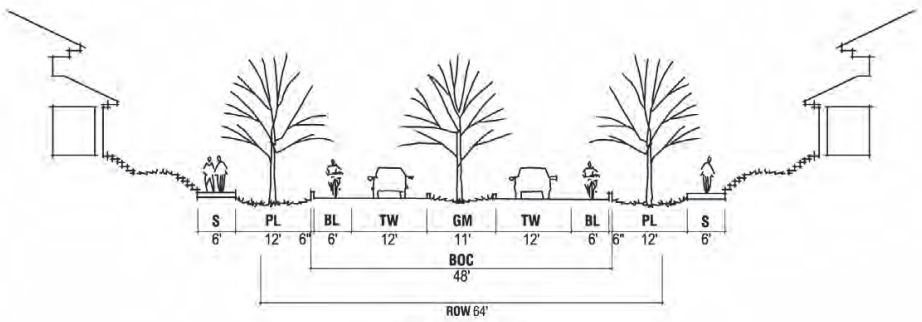
15 Class 1 Bicycle/Pedestrian Paved Greenbelt



16 Boise City Gravel Path, Dallas Harris Legacy River Walk, Harris Ranch Community Trails

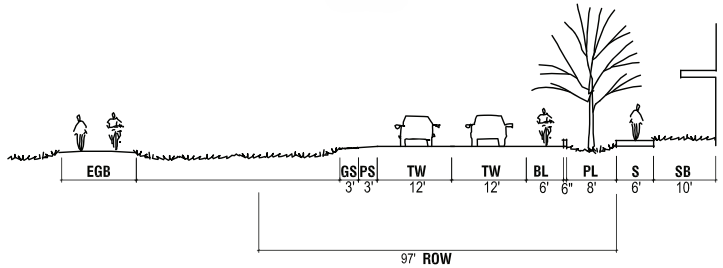
NOTE: See Landscape Plans.

17



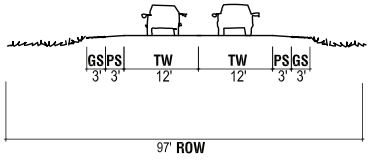
Two-lane Arterial With
Green Median

18



Alternative Parkway

19



Interim Parkway

LEGEND

TW	Travel Way
BL	Bicycle Lane
P	Parking
PL	Planting
M	Median
S	Sidewalk
LTL	Left Turn Lane at Intersection
GM	Green Median
ROW	Right of Way
BOC	Back of Curb
SB	Setback

NOTE: All sidewalks shall be located outside of ACHD Right-of-Way. Public sidewalks shall be located within an easement to be dedicated to and accepted by the City of Boise. Sidewalks may be allowed in ACHD right-of-way crossing the Idaho Power Corridor and at pedestrian ramp locations. Access onto collector roadways shall be designed to meet ACHD's access policies in effect at the time of development. Roadway widths are subject to local government review and approval and may be modified in connection with entitlement applications. Any inconsistencies between the roadway sections shown herein and roadway sections identified with particular block prototypes are resolved in favor of the latter.

INTRODUCTION

Ourston Roundabout Engineering presents the planning, design, safety, and operations related aspects of using roundabouts in the Harris Ranch development proposal. We have developed a single lane roundabout prototype shown on Figures 1 to 3b to accommodate the traffic forecasts to the 2020 horizon on the extension of Warm Springs Avenue. In addition, we developed a prototypical multi-lane roundabout for the by-pass road running roughly parallel and to the south of Warm Springs Avenue. The figures are attached to this report. The two lane roundabout prototypes were also analyzed for the horizon traffic forecasts.

This overview documents the basis for choosing roundabouts and their site specific application addressing the needs of vulnerable users, emergency services, transit and large trucks. The principles of design, lighting and landscaping are presented in the unique context of the Harris Ranch Specific Plan

BACKGROUND

Although the proposal to use roundabouts has generally been accepted by the project proponents and the approving agencies, it is worthwhile to restate the basis for their preference. When comparing and evaluating alternative controls to determine the preferred type of intersection, studies should base their conclusions on technical evidence from quantitative and qualitative comparisons of alternative control types. The quantitative and qualitative criteria for comparing intersection control alternatives and a simplified comparison of alternatives is presented on the adjacent table.

Factors in the success of roundabouts include the elimination of left turns against oncoming traffic, the elimination of right-angle collisions, and a reduction in rear-end collisions. Published statistics by the Insurance Institute for Highway Safety (IIHS) in the U.S.[1] showed that roundabouts reduce injury crashes by up to 76 percent. This statistic has been used as one measure of the roundabout's safety performance as compared to a traffic signal.

Pedestrians are generally well-served by roundabouts because of lower traffic speeds, crossing distances are shorter, and pedestrians need only consider traffic approaching from one direction at a time. The crossing location eliminates concern for vehicles turning from unexpected directions. Although a modern roundabout is a less direct route in terms of direct walking distance, the longer distance is offset by the fact that pedestrians don't have to wait for a "walk" signal.

There is sufficient evidence that modern roundabouts reduce traffic delays, vehicle emissions, fuel consumption, and noise; and, save the cost of installing and maintaining traffic signals

Public acceptance of roundabouts is not universal and unfamiliarity with their use has bred negative perceptions about their safety. Therefore, any new roundabout in an area where none exist requires careful planning and public education. By their nature, roundabouts are self-educating. The combination of correct geometry, signs and markings are vitally instructive to drivers.

Experience shows that the introductory period of a new roundabout is the safest time as users approach them cautiously. Public announcements and education pamphlets distributed through the planning stages and pre-opening are a must to ensure that most users are prepared and informed of the correct use of a modern roundabout.

Roundabouts require considerably more initial design development than traffic signals. Capacity and safety performance is very dependent on a roundabout's size and geometry, which in turn determines its ultimate construction cost and property impacts.

1 Persaud, B.N. R.A. Retting, P.E. Garder and D. Lord, *A Study of Crash Reductions Following Installation of Roundabouts in the United States*, Insurance Institute for Highway Safety, March 2000.

Summary of Comparison of Alternative Intersection Control

Evaluation Criteria	Comparison	
	Traffic Signals	**Roundabouts**
Construction Cost	Range from $150,000 to $500,000 depending on turn lane requirements and lane configuration	$500,000 to $1,000,000 depending on lane configuration, cost of land and aesthetic treatments.
Operations	Good levels of service for the traffic forecast horizon.	Ideal levels of service for the design year with residual capacity for changes in land use.
Safety	Signals are an improvement over the unsignalized condition but still allow high speed angle collisions.	Better than traffic signals and better than stop control by eliminating high speed crossing and turning movements.
Maintenance	Perpetual maintenance of the electrical equipment ($4,000/year).	Lower overall maintenance costs but maintenance of markings and landscaping is still required.
Construction Staging	Minimal impacts.	Significant impacts when retrofitted but 'gree street' implementation does not pose any staging complexity.
Education and Public Acceptance	Seldom necessary due to familiarity.	Prior buy-in from public is recommended and education of all stakeholders is essential.
Speed Control	Speeds controlled during peak times.	Potential to control speeds at all times through good design.
Pedestrians and Persons with Disabilities	May require push-button actuation. Audible signals possible.	Shorter crossing distances, and splitter islands provide refuge. Pedestrians only look one way and conflict speeds are lo . Education is required.
Cyclists	Crossing and left turn movements not accommodated under actuated control.	Slower motor vehicle speeds in the intersection area. Bike paths can be diverted or merged with traffic
Emergency Services, Maintenance, Transit	Pre-emption equipment required. Intersection congestion requires crossover into opposing traffic	Comparable travel time to traffic signals. No pre emption equipment required. Drivers must be educated to make space for Emergency services.
Compatibility with Area Land Use, Accesses and Corridor Travel Times	Standing queues are expected to block nearby accesses.	The roundabout can act as a gateway, reducing speed into the development area and breaking up platoons of cars.
Vehicle Noise, Fuel Consumption and Emissions	Status quo without reduction of emissions.	Expect reductions compared to signals due to reduced stops and delays and overall uniform speeds.
Aesthetic Value	Decorative paving materials possible.	Landscaping provides aesthetic features to enhance the adjacent development. Pavement area is reduced.

PROTOTYPE ROUNDABOUT CONCEPTS FOR HARRIS RANCH

Two corridors of roundabout intersections are proposed for the Harris Ranch Specific Plan. The extension of Warm Springs Avenue will have three compact urban roundabouts at approximately 1200 foot spacing. On the bypass roadway, the arterial intersections will have four roundabouts at approximately 1200 foot spacing. In both corridors the roadways between the roundabouts would be divided such that mid-block access or intersections would be limited to right-in and right-out movements only, but because of the opportunity for u-turns in a roundabout, reasonable access can be maintained.

In addition to providing for harmonization of transportation and land use through the central core of the development, the main benefit of the small roundabouts is efficient flow of cross street traffic with speed control on Warm Springs Avenue. The main purpose of the larger roundabouts on the by-pass roadway is to alternate the flow of traffic while providing a lower speed intersection. More is said of the purposes and design of the two roundabout prototypes throughout this documentation.

The two roundabout prototypes were designed for the traffic forecasts to the 2020 build-out horizon; for the space requirements of several design vehicle types; for use by bicyclists and pedestrians; and, for speed reduction while maintaining efficient traffic flo . The guidelines employed to aid this planning exercise are the FHWA Roundabout Informational Guide (2000) and the Ourston Roundabout Design Guide (2001). The roundabout prototypes are illustrated in the following figures which are appended to this report. These figures are referenced throughout this narrative with specific design information and illustrations of design composition, circle size and space for landscaping.

Refer to current ACHD approved Traffic Impact Study. Roundabouts shall be designed in conformity with ACHD's Roundabout Design Guide, District Policy 5188.

The intent of this narrative is to identify the benefits and impacts of using roundabouts, and to outline the principles of design that will be necessary for detailed design and project implementation.

Warm Springs Avenue:

Figure 1A – Horizontal Geometry

Figure 1B – Design Vehicle - WB 67

Figure 1C – Design Vehicle Fire Truck

Figure 1D – Design Vehicle Fire Truck

Figure 1E – Fastest Paths - Spline Method

Figure 1F – Fastest Paths - ACHD Method

By-Pass Roadway:

Figure 2A – West Roundabout Conceptual Layout

Figure 2B – West Roundabout Conceptual Layout with Dimensions

Figure 2C – West Roundabout Conceptual Lighting Layout

Figure 2D – West Roundabout Conceptual Clearview Diagram

Historically, a comprehensive research study of 86 roundabouts was undertaken in the United Kingdom in the late 1970s to establish the entry capacities of roundabouts. A very robust empirical formula for capacity prediction was developed from direct observations and measurements of entry and circulating flows for a range of geometric designs and over a range of traffic flows [2] The geometric data required to predict roundabout capacity are included in the software program RODEL[3] which was used to establish the predicted operating performance of the proposed roundabouts at the development build-out horizon. Although there may be site by site deviations from the U.K. predicted values, the relationships are reliable for predicting the major effects of roundabout geometric design changes. Recent experience with several large roundabouts in the U.S. is proving the validity of this model for design of roundabouts in North America.

The maximum daily service volume of a typical single-lane roundabout is approximately 20,000 vehicles per day, depending on the left-turn percentages and the distribution of traffic between the major and minor roads. A double-lane roundabout may service up to 40,000 vehicles per day with reasonable levels of traffic service

An examination of the 2020 traffic forecasts for Warm Springs Avenue and the by-pass road indicates the flowing traffic carrying capacity predictions for the build-out condition:

- On the prototype single lane roundabout immediately east of the westerly by-pass intersection, the predicted stopped delay is 13 seconds per vehicle for the overall intersection delay which is level of Service 'B'.
- The multi-lane roundabouts on the by-pass roadway each have varying forecasted traffic flows. However the predicted average delay ranges from 12 to 17 seconds per vehicle overall intersection delay, which is level of service 'B' also.

The by-pass roadway initial width of two lanes will be staged such that the full widening is postponed until it is evident that the traffic flows on both Warm Springs Avenue and the by-pass have reached a threshold of delay that would justify widening the by-pass to two lanes in each direction. The roundabout intersections on the by-pass could also be staged for the addition of one lane in each direction or initially built as two-lane roundabouts but with flared entries from single lane mid-block links

2 R.M. Kimber, *The Traffic Capacity of Roundabouts*, LR942, TRL, 1980.

3 RODEL 1 – Interactive Roundabout Design, Rodel Software Ltd. and Staffordshire County Council, United Kingdom.

Roundabout Geometry

The roundabouts on Warm Springs Avenue need only single lane entries in all four directions. The prototypical layout has an Inscribed Circle Diameter (ICD) of 120 feet. The multi-lane roundabouts will have inscribed circle diameters of between 165 and 175 feet depending on roadway alignment and lane configuration

The provision of a right-turn bypass lane on the west by-pass roundabout, similar to the adjacent photo, allows right-turning traffic to bypass the roundabout, providing additional capacity for the through and left-turn movements at the approach. They are most beneficial when the demand of an approach exceeds its capacity and a signific nt proportion of the traffic is turning right, which is the case at the west roundabout on the by-pass roadway.

Pedestrian Considerations

Pedestrian crossing areas with curb cuts and sidewalk connections would be included with these roundabouts; however, crosswalk markings are not recommended unless pedestrian volumes warrant. This ensures the correct perception that drivers may not stop therefore pedestrians must be vigilant.

Crossing areas shown are one vehicle length behind the yield line (or a multiple thereof) to separate conflicts for entering motorists with pedestrians and with circulating traffic. The above noted figures illustrate the correct crossing designs for both Warm Springs Avenue and the by-pass road.

Through careful adjustments to entry and exit geometry, the Warm Springs Avenue roundabouts are designed to slow the fastest path of a through vehicle to less than 21 mph to improve pedestrian comfort with traffic speeds. The speed reduction on the by-pass roundabouts will be proportionate to the greater emphasis on vehicular movements but the design speeds will still be below 25 mph.

The pedestrian refuge areas on the prototype roundabouts have a width greater than or equal to 10 feet in order to provide space for bicycles with trailers. The pedestrian refuge should be designed at street level, with shallow ramps into the splitter islands. It is recommended that a detectable warning surface, as recommended in the Americans with Disabilities Act Accessibility Guidelines, be applied to the surface of the refuge within the splitter island. The detectable warning surface would consist of raised truncated domes.

School crossing guards are commonly placed at all-way stop controls and often at traffic signals too. The same considerations and criteria are recommended for the proposed roundabouts adjacent to a planned school site.

Where visually impaired pedestrian traffic is identified, audible pedestrian signals may be warranted for either traffic signals or roundabouts. The design for roundabouts consists of a split crosswalk with individual push-button phases to allow independent crossing of the entry and exit lane of the leg where the pedestrian traffic is identified. Crosswalk signals are only placed on the legs of a roundabout that are warranted.

Considerations for Bicyclists

Cyclists that are comfortable in higher volume traffic will find the reduced speeds and additional circulatory road width convenient for traveling through roundabouts. Recreational cyclists may dismount and use the sidewalk. Therefore, for low to moderate volume, single lane roundabouts, like those proposed on Warm Springs Avenue, no separate bike facilities are required. The pavement width of 17 feet provides a standard 12-foot lane and adjacent to that a 5-foot shared bike lane. In general, bicyclists are better served by treating them as vehicles. However, the best design provides both options to allow cyclists of varying degrees of skill to choose their more comfortable method of navigating the roundabout. In the case of the multi-lane roundabouts on the Harris Ranch by-pass road, a shared sidewalk and bike path could be provided to allow unskilled cyclists to by-pass one of the busier roundabouts. These features have not been shown on the prototype multi-lane roundabout.

To accommodate bicyclists traveling as vehicles, bike lanes should be terminated in advance of the roundabout to encourage cyclists to mix with vehicle traffic. Under this treatment, it is recommended that bike lanes end 30 m (100 ft) upstream of the yield line to allow for merging with vehicles. This method is most successful at smaller roundabouts with speeds below 30 km/h (20 mph), where bicycle speeds can more closely match vehicle speeds. To accommodate bicyclists who prefer not to use the circulatory roadway, a widened sidewalk or a shared bicycle/pedestrian path may be provided physically separated from the circulatory roadway (not as a bike lane within the circulatory roadway). Ramps or other suitable connections can then be provided between this sidewalk or path and the bike lanes, shoulders, or road surface on the approaching and departing roadways.

Property Requirements

While roundabouts can require less land upstream and downstream of an intersection, they almost always require more at an intersection compared to stop control or traffic signals. In the Harris Ranch Specific Plan, Figures show the roundabout concepts and proximity to the property lines at the prototype intersections based on preferred sidewalk locations.

Speed Control

To determine the speed of a roundabout, the fastest path allowed by the geometry is drawn. This is the smoothest, flattest path possible for a single vehicle, in the absence of other traffic and ignoring all lane markings, traversing through the entry, around the central island, and out the exit. Usually the fastest possible path is the through movement, but in some cases it may be a right turn movement.

Special consideration for speed control was placed on the design of the Warm Springs Avenue roundabouts. The desired entry speeds will have a maximum of 21 mph for the fastest possible driving path. In most cases drivers are not capable or interested in driving a fast path, thus entry speeds would be between 15 mph and 20 mph for the majority of drivers. This makes pedestrian and bicycle activity more comfortable for those vulnerable users.

Maintenance, Transit and Emergency Vehicles

Roundabouts should always be designed for the largest vehicle that can be reasonably anticipated, the “design vehicle,” in this case a WB-50 truck. For single lane roundabouts, this requires the use of a mountable apron around the perimeter of the central island to provide the additional width needed for tracking the trailing wheels. In this design, public transit buses and fire trucks are not required to use a truck apron to navigate the proposed roundabout.

The circulatory roadway width, entry and exit widths, entry and exit radii, and entry and exit angles also play a significant role in accommodating the design vehicle and providing entry path deflectio . Careful selection of these geometric elements allowed for a smaller inscribed circle diameter to be used on Warm Springs Avenue.

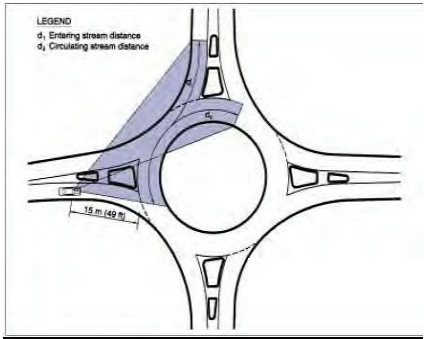
At multi-lane roundabouts, accommodating the design vehicle is not a constraint because the circulatory roadway is sufficiently wide for the largest vehicle and WB-65 to circulate. The addition of a truck apron guards against the possibility that a passenger car driver wishes to circulate through the roundabout side-by-side with the large truck.

The major concerns we have encountered with road authorities relate to operational constraints associated with larger vehicles, particularly winter maintenance. Field tests of minimum vehicle turning paths conducted by the author in 1999 evaluated the design of a smaller traffic circles. In some jurisdictions, the snow plough is the critical design vehicle requiring a 19 foot circulating lane on a turning radius of 45 feet due to the use of a wing blade. Graders, particularly those with articulated frames, can negotiate smaller radii.

Emergency response times through roundabouts are generally comparable to those through pre-emption equipped traffic signals and will depend on congestion and queuing.

Transit Bus Stops

If an approach to a roundabout has only one lane and capacity is not an issue as is the case on Warm Springs Avenue, the bus stops can be located just upstream of the pedestrian crossings in the lane of traffic. This is not recommended for roundabout entries with more than one lane because vehicles in the lane next to the bus may not see pedestrians. Therefore on a multi-lane roadway placing the bus stop on the exit side, downstream of the cross-walk is preferred.



Intersection Visibility, Aesthetics and Landscaping Constraints

Approaching the yield line drivers of all vehicles should be able to see the full width of a pedestrian crossing across the next exit and other drivers entering from an upstream approach. In urban areas sight triangles are required to maintain adequate sight distances. The same principles apply to roundabouts. The adjacent illustration shows the principles of intersection sight as applied to roundabouts. Figure 2D shows the sight distance areas according to intersection sight but are differentiated by planting and signage heights. The dark shaded areas denote where planting heights can be up to 3.4 feet or bottoms of signs or leaf cover as low as 6.4 feet. This ensures adequate sight windows for average height of driver’s eyes.

A roundabout provides opportunity to landscape the intersection and establish a focal point of aesthetic value. Communities have been known to allow residents to adopt the central island to plant flower beds. Given the ample space at the proposed intersections, there is opportunity to improve their appearances. The central island landscaping can enhance the safety of the intersection by making the intersection a focal point and by lowering speeds. Plant material should be selected so that sight distances are maintained, including consideration of future maintenance requirements to ensure adequate sight distance for the life of the project.

Landscaping in the central island, in splitter islands (where appropriate), and along the approaches can benefit public safety, stormwater management and community enhancement. The landscaping of the roundabout and approaches should ensure the following:

- Make the central island more conspicuous (the figure show an area of unlimited planting height);
- Improve the aesthetics of the area while complementing surrounding streetscapes as much as possible;
- Minimize introducing hazards to the intersection, such as trees, poles, walls;
- Avoidance of guide rail, statues, or large rocks;
- Avoid obscuring the form of the roundabout or the signing to the driver;
- Maintain adequate sight distances as previously discussed;
- Clearly indicate to the driver that they cannot pass straight through the intersection;
- Discourage pedestrian traffic through the central island; and,
- Help blind and visually impaired pedestrians locate sidewalks and crosswalks.

Grading Requirements of Roundabouts

The cross-section proposed for the four Warm Springs Avenue roundabouts is standard for single lane roundabouts. The truck apron is kept generally flat to avoid tipping large trucks. The central island is sloped outwards at 2% for simplified drainage and to make the central island conspicuous. The cross-section of the potentially multi-lane roundabouts is similar except for the circulatory cross-fall which is produced using a rolled crown in the center of the circulatory roadway. This requires one or two inlets to be placed adjacent to the truck apron.

Care must be taken when designing roundabouts where steep grades might exist. On roadways with grades steeper than 4 percent, it is difficult to produce a carefully graded circulatory roadway that does not tip trucks.

Property Access and Land Use Compatibility

The use of roundabouts facilitates access management of mid-block driveways and minor intersecting roadways. U-turns allow motorists to reach destinations that lessen the impact of restrictions that a central dividing median would normally impose on an access controlled roadway. The ability to use the roundabout for u-turns and the reduced speeds on entry and exit create a calmer environment for driveway access near an intersection. Where high volume commercial access is required near an intersection, less left turn storage space is needed as the approach design speeds are diminished with a roundabout.

Approximate Construction Costs

The construction cost of the prototype roundabout on Warm Springs Avenue including landscaping and lighting is approximately $500,000. The larger multi-lane roundabouts carry an approximate price tag of between $700,000 and $1,000,000 depending on drainage, landscaping and amenities such as bicycle diversion and shared path treatments.

Lighting

A driver must be able to perceive the general layout and operation of the intersection in time to make the appropriate maneuvers. Adequate lighting should therefore be provided at all roundabouts. The FHWA guide prescribes lighting levels for arterial and collector road roundabout intersections as follows:

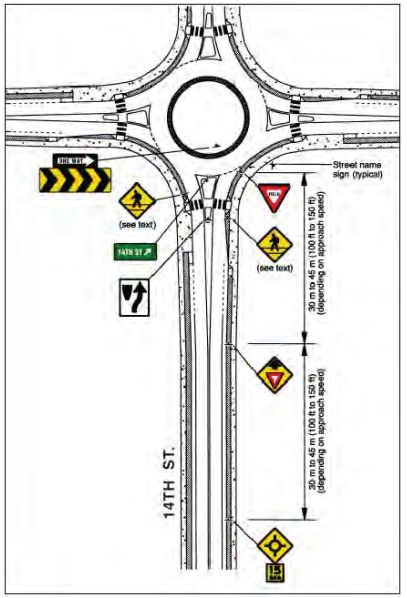
- Arterial with commercial development: 17 lux (1.7 foot-candles) average maintained luminance values and 3 to 1 luminance uniformity ratio (average to minimum)

- Collector with commercial development: 12 lux (1.2 foot-candles) average maintained luminance values and 4 to 1 luminance uniformity ratio (average to minimum)

Pole placements are shown on Figure 2C. These placements have critical regard for the conflict areas of a roundabout and the need for positive contrast vertical illumination of pedestrians in cross-walk areas. A photometric analysis would be required to select the appropriate fixture type and pole height

Signage and Pavement Markings

The overall concept for roundabout signage is similar to general intersection signage. Proper regulatory control,



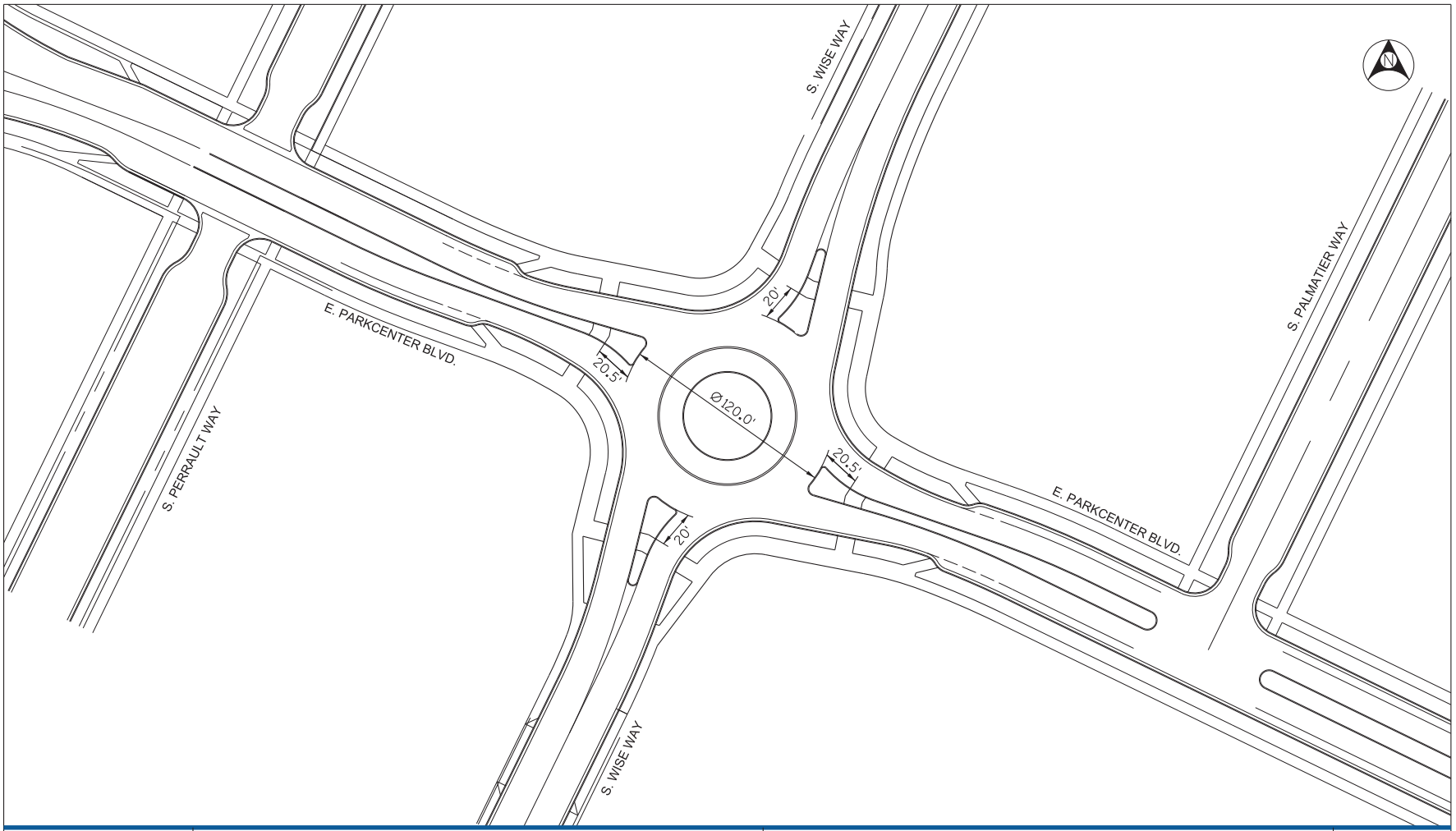
advance warning, and directional guidance are required to avoid driver expectancy related problems. Signs should be located where they have maximum visibility for road users but a minimal likelihood of even momentarily obscuring pedestrians as well as motorcyclists and bicyclists. Advance diagrammatic or map-type guide signs are recommended for the by-pass roadway roundabouts due to the higher demand for navigation in the traffic composition.

Maintenance

Maintenance on the proposed roundabouts is considered to be neutral in comparison to other types of intersections because the maintenance is limited to regular road maintenance. Roundabouts have less paved area but typically require more landscape maintenance.

Conclusion

At this stage in the process of determining the feasibility of alternative intersection controls, there are no technical reasons to reject roundabouts in the Harris Ranch roadway layout.



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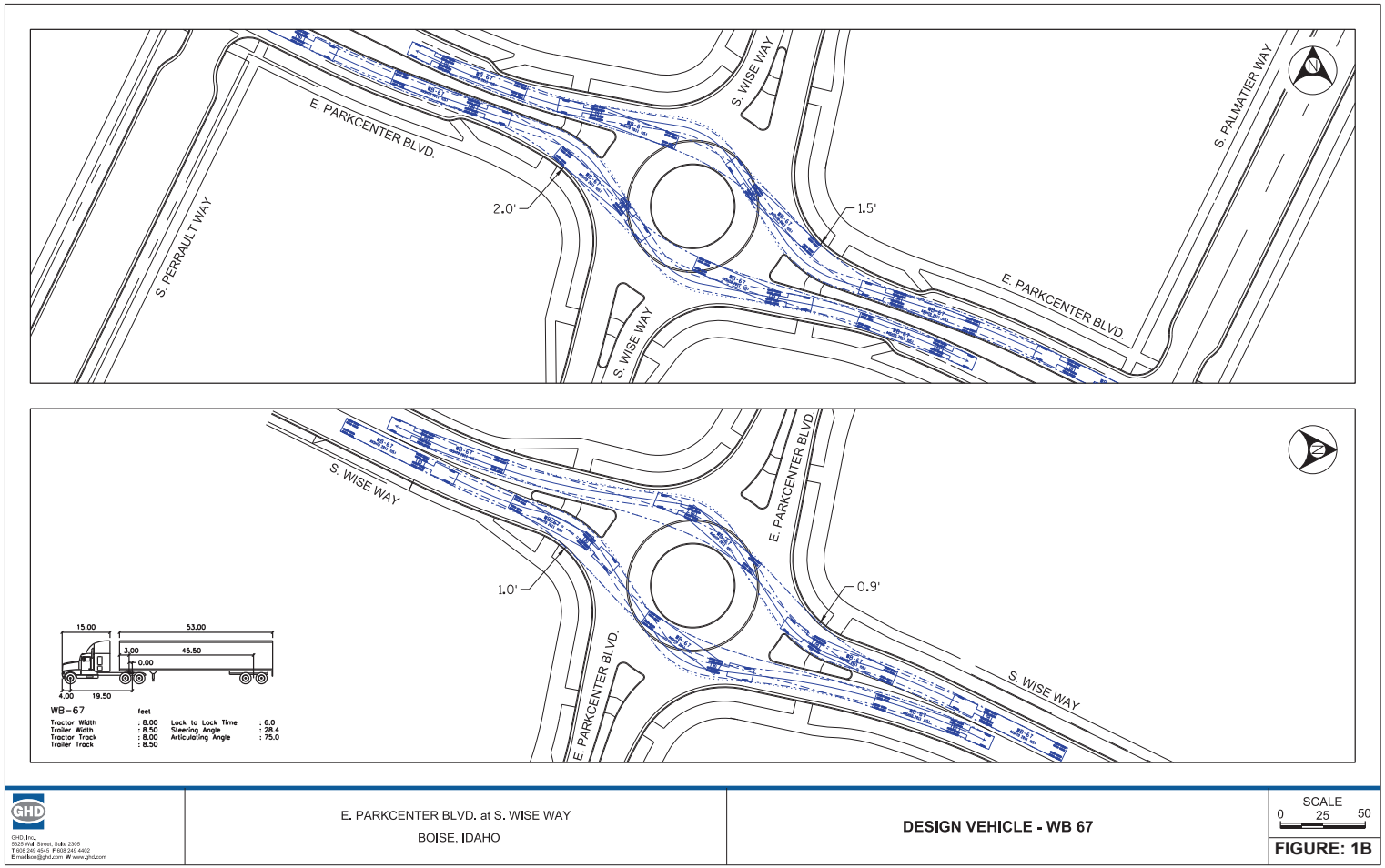
HORIZONTAL GEOMETRY

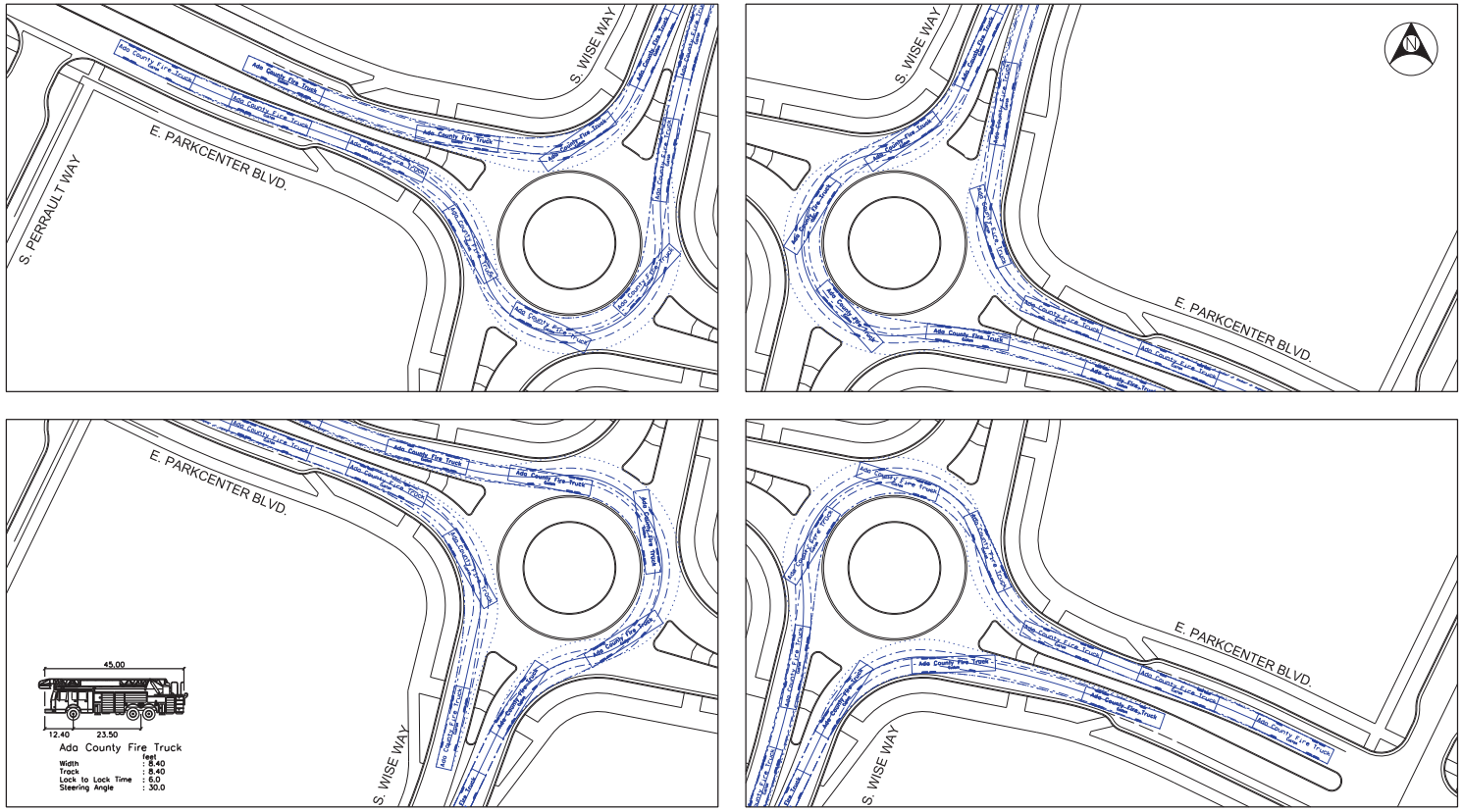
SCALE
0 25 50

FIGURE: 1

WARM SPRINGS AVENUE ROUNDABOUTS



WARM SPRINGS AVENUE ROUNDABOUTS



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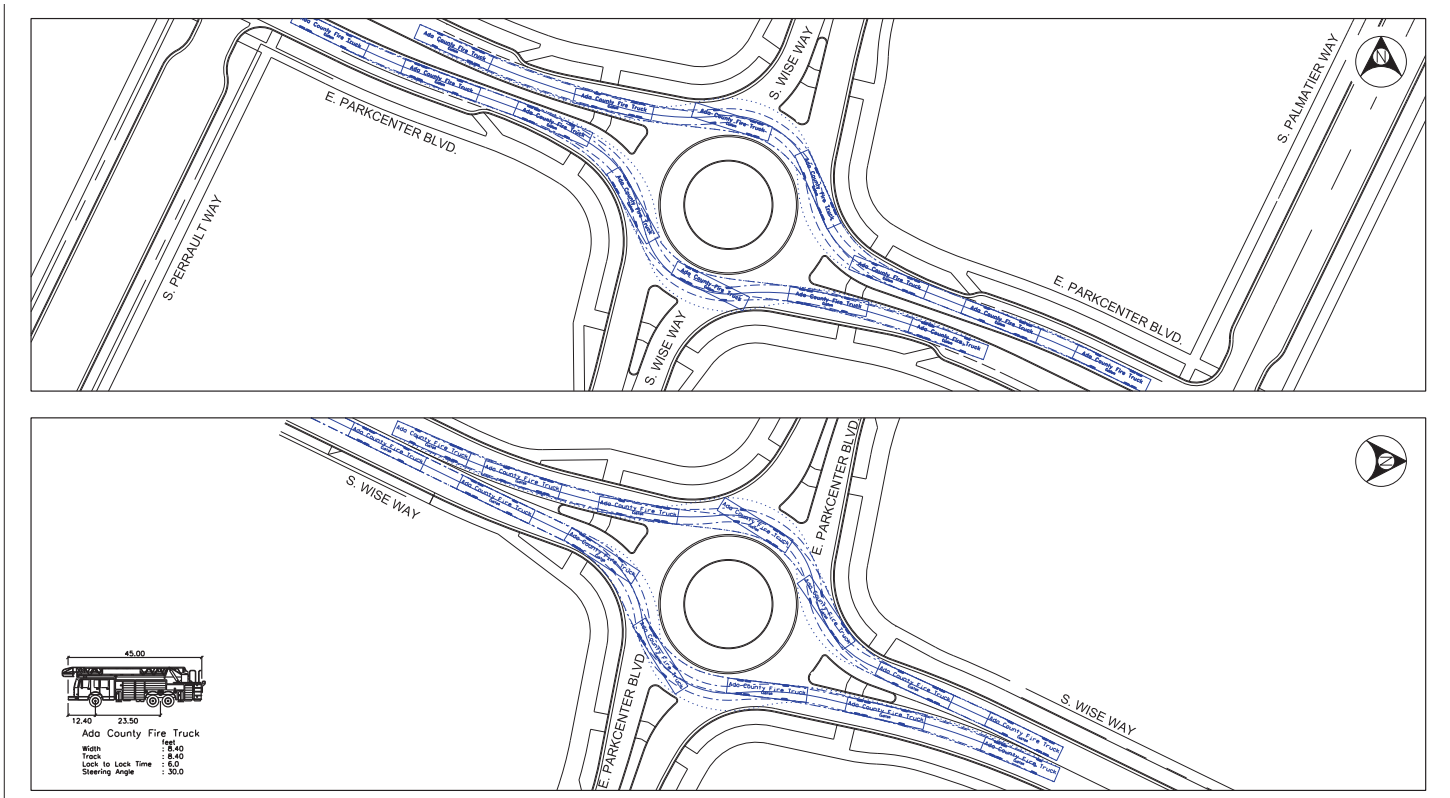
DESIGN VEHICLE - FIRE TRUCK

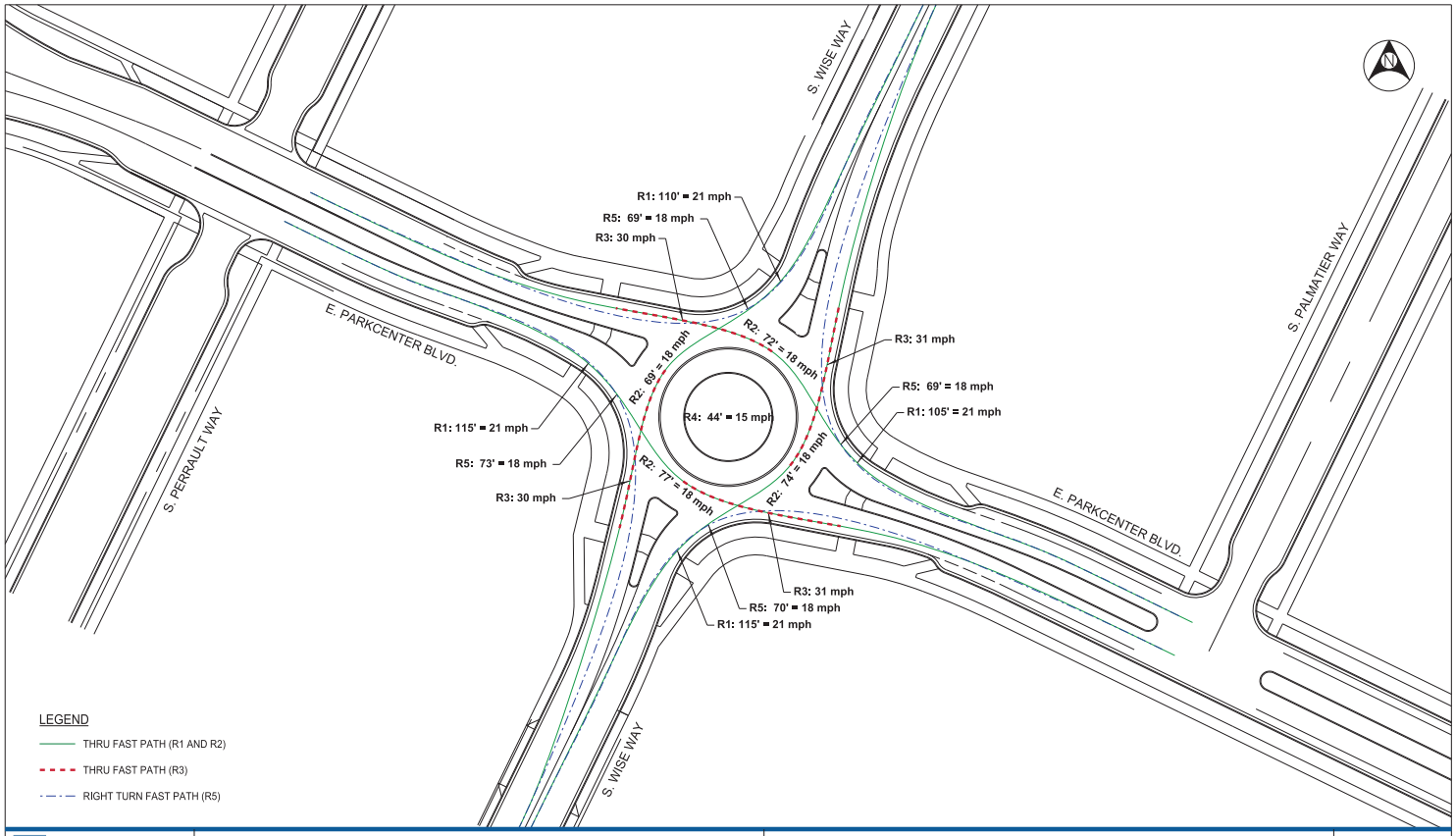
SCALE
0 25 50

FIGURE: 1C

WARM SPRINGS AVENUE ROUNDABOUTS



WARM SPRINGS AVENUE ROUNDABOUTS



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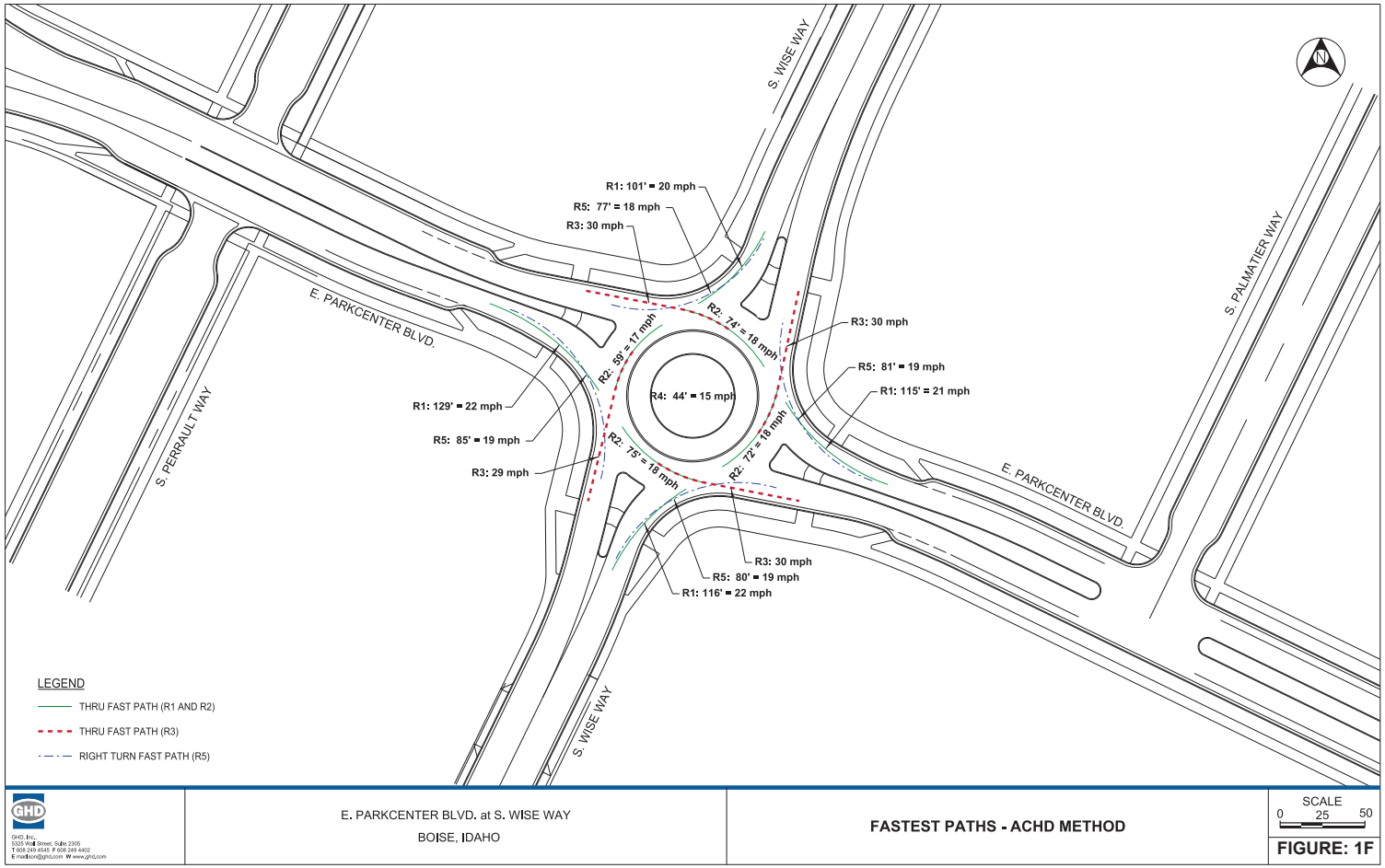

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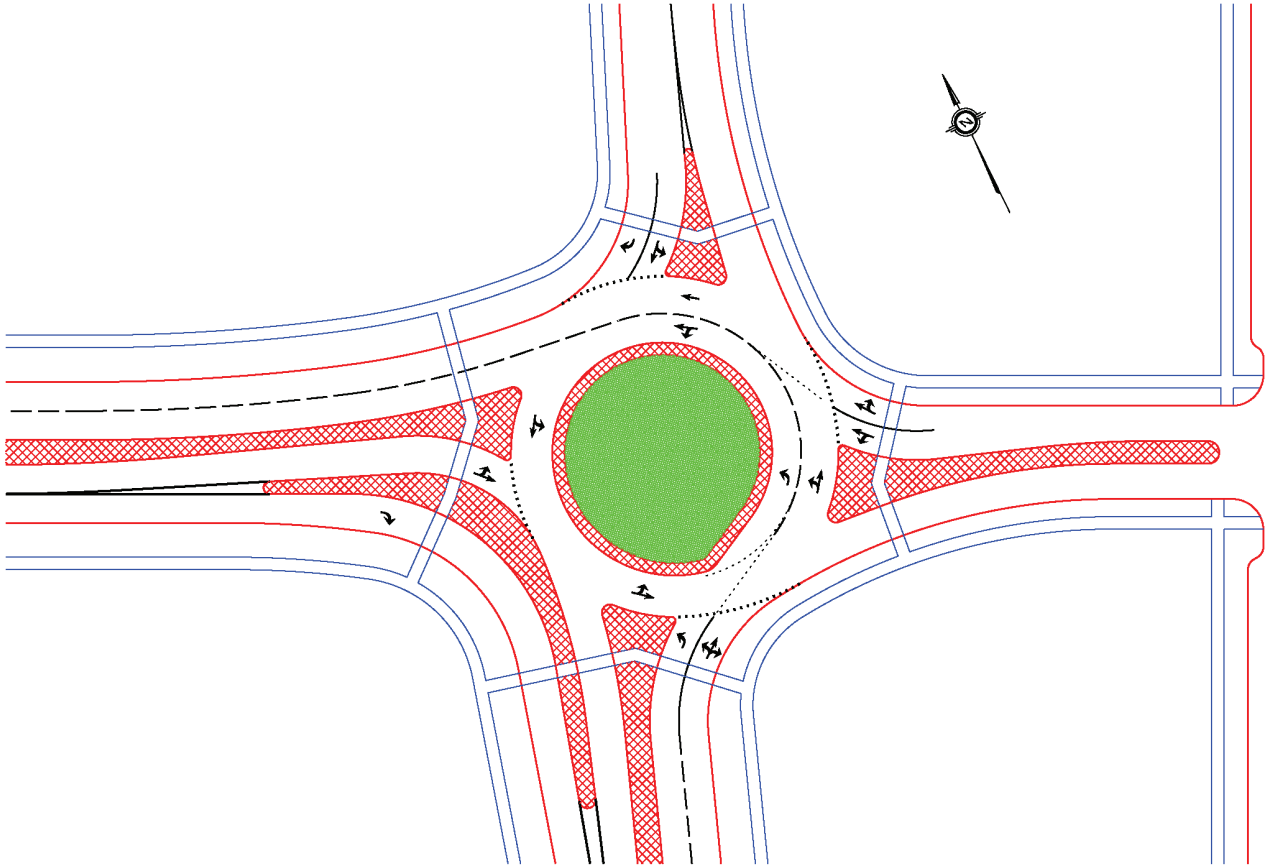
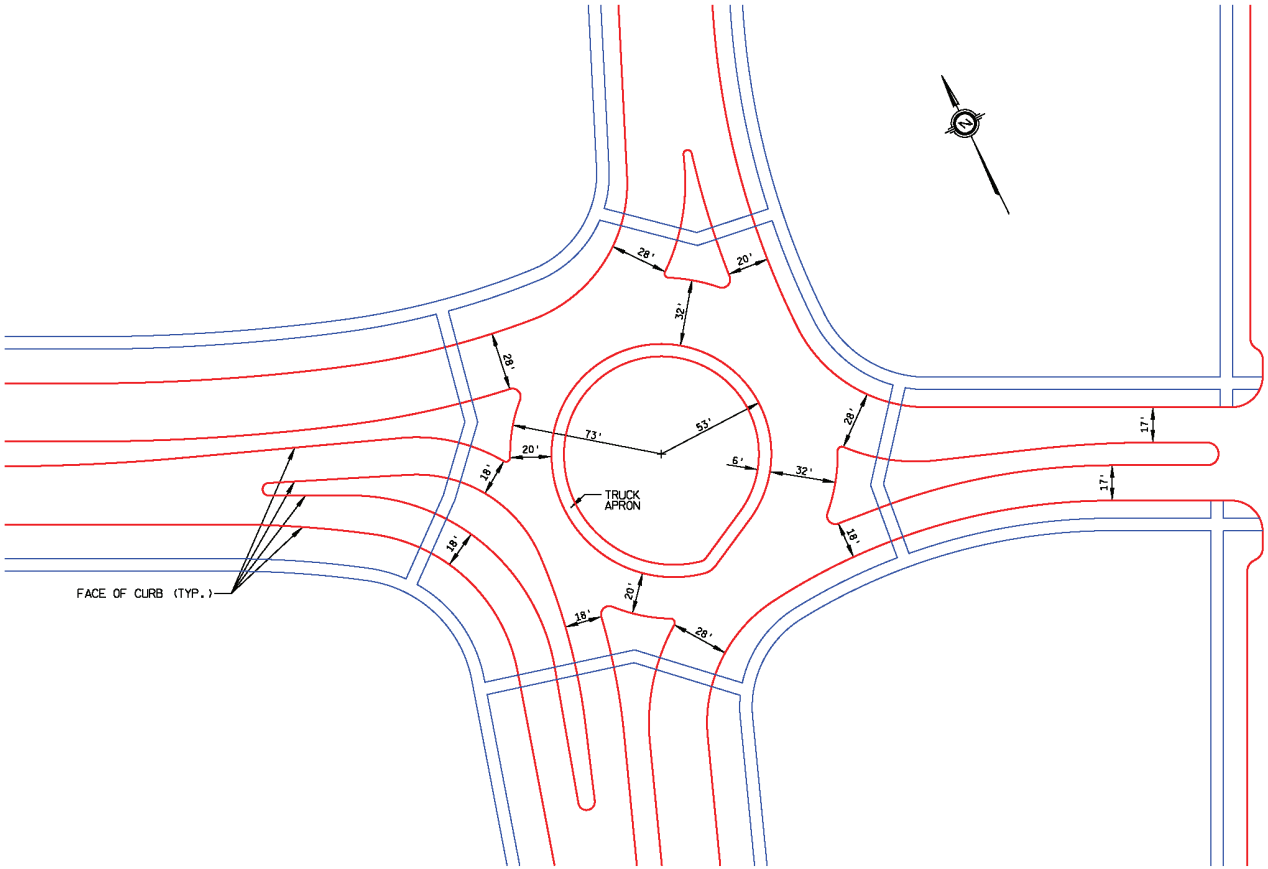


BY - PASS ROADWAY
WEST ROUNDABOUT CONCEPTUAL LAYOUT
FIGURE 2A



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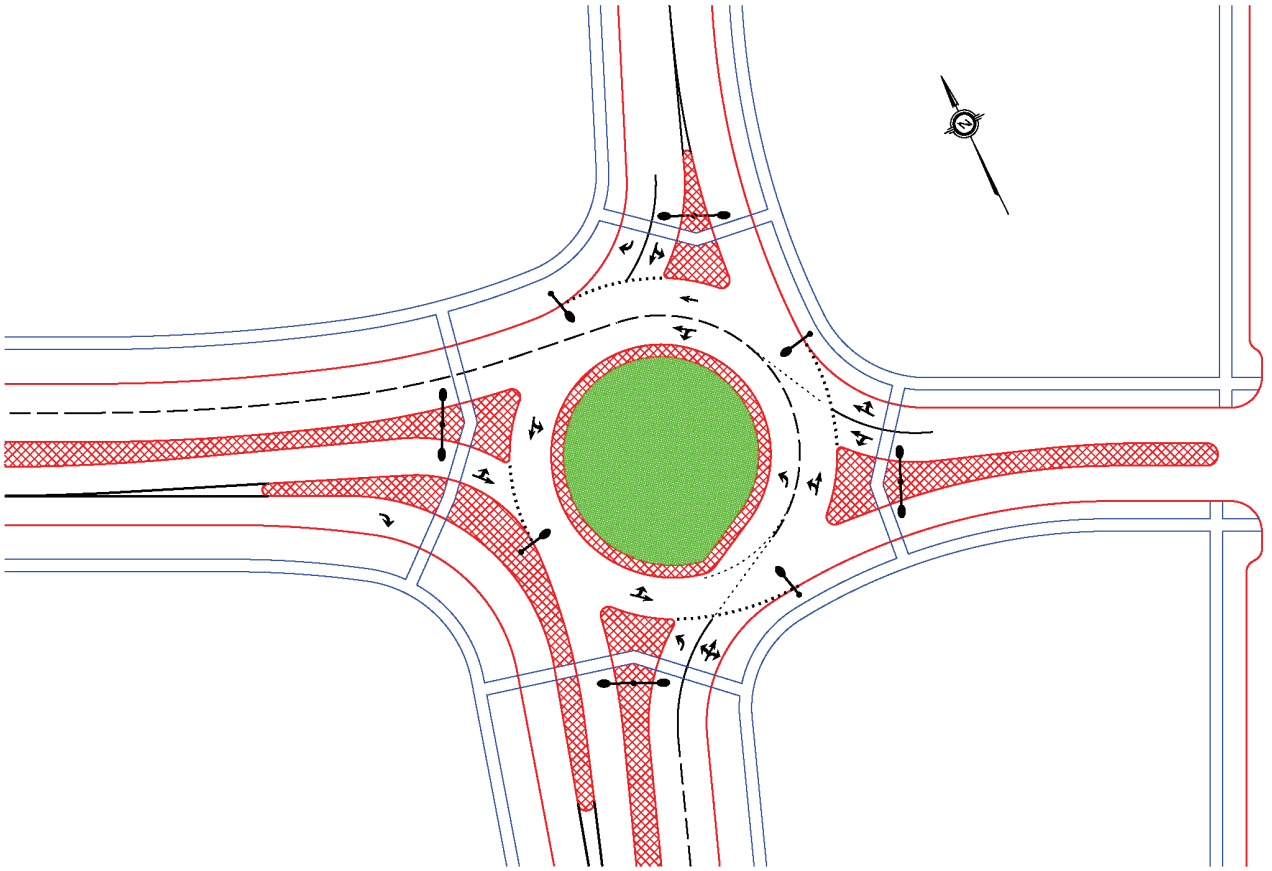
WEST ROUNDABOUT CONCEPTUAL LAYOUT WITH DIMENSIONS
FIGURE 2B



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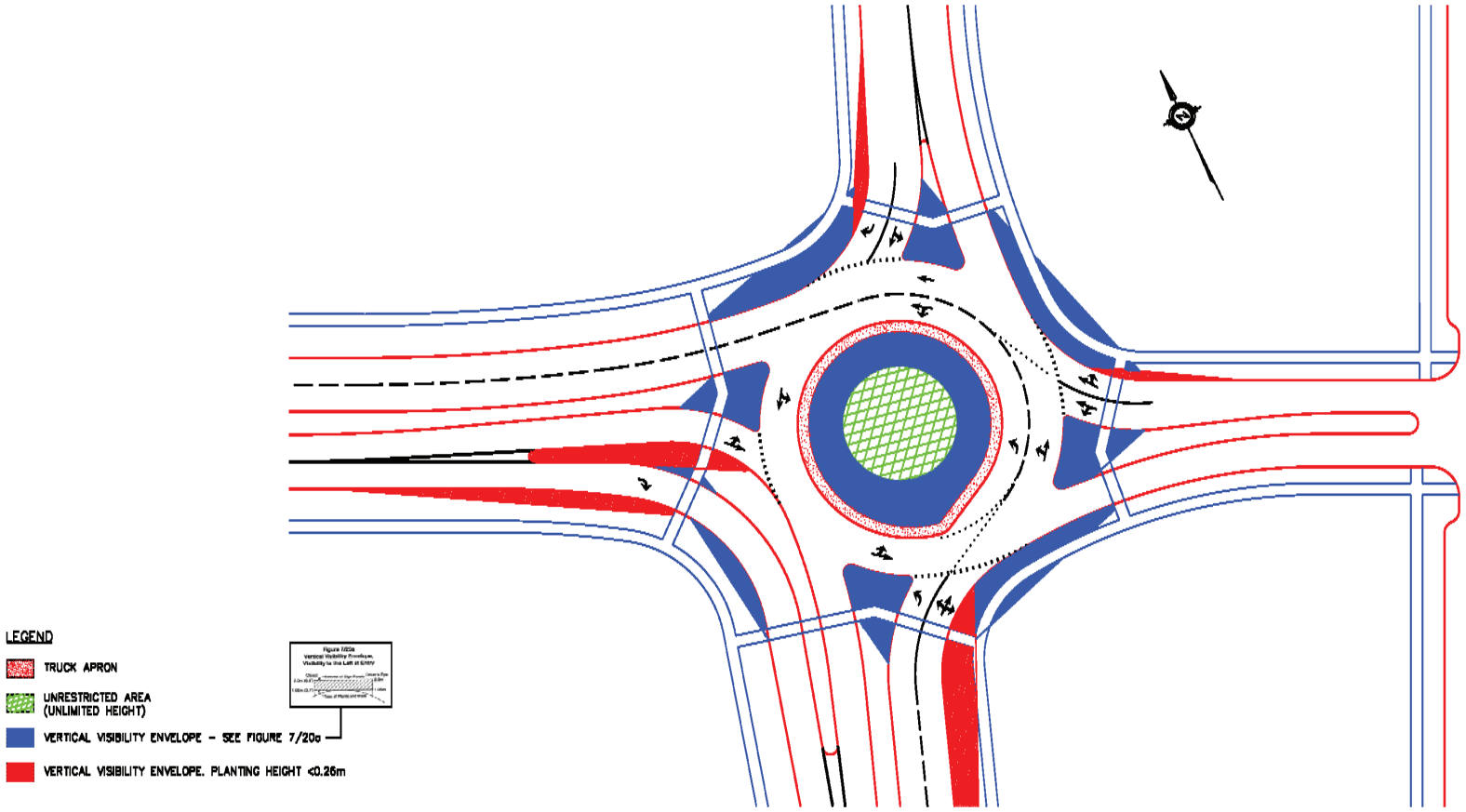
WEST ROUNDABOUT CONCEPTUAL LIGHTING LAYOUT
FIGURE 2C



BY - PASS ROADWAY
WEST ROUNDABOUT CONCEPTUAL CLEARVIEW DIAGRAM
FIGURE 2D