Texas Department of Transportation

MAY 2025

INNOVATIVE INTERSECTIONS DESIGN AIDS

Roundabout Spiral Design

OVERVIEW

As an extension of TxDOT's Roadway Design Manual Chapter 14, this aid provides designers with guidance for the development of multilane roundabout lane configurations that may require one or more spiral designs.

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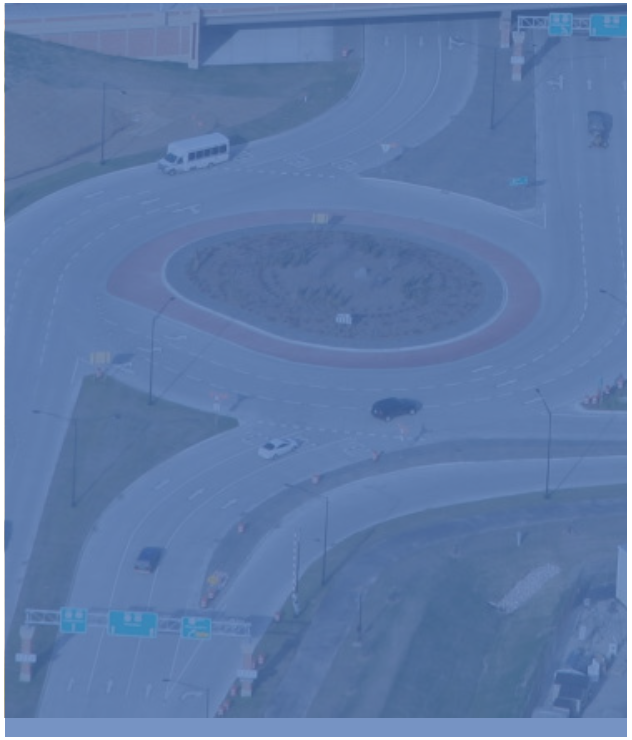

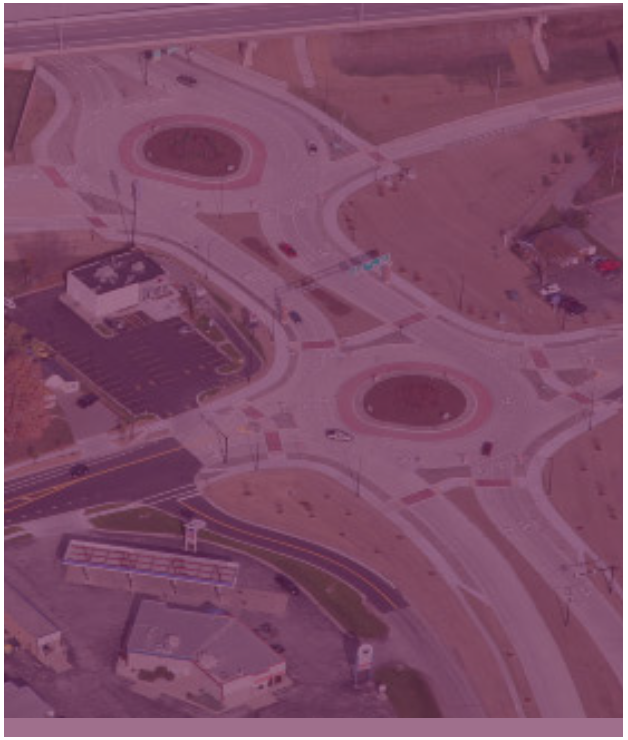

FIGURES

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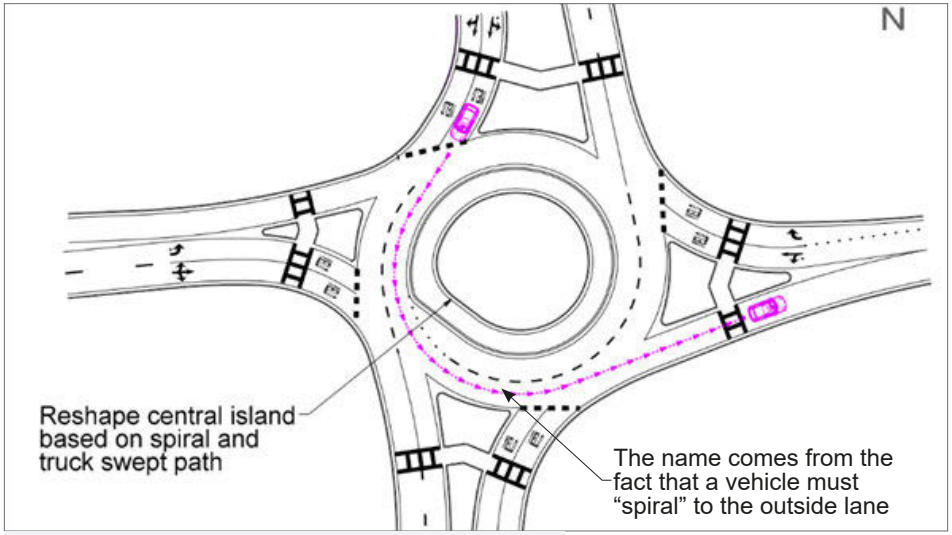
SPIRAL DESIGN CONSIDERATIONS

An emphasis on safety is woven throughout roundabout design decisions. Basing multilane roundabout lane configurations on the associated traffic volumes and traffic patterns is important for ensuring efficient operations within the roundabout and avoiding too much capacity, or not enough capacity. Part of the lane configuration process should also focus on avoiding unnecessarily complicated lane assignments that may confuse drivers. Within the operational analysis (capacity analysis) stage the development of lane configurations is a necessary and important step. Occasionally, lane configurations require spiral geometry to preserve lane continuity and to prevent improper lane changes within the circulatory roadway that would increase the potential for a crash to occur.

As illustrated in Figure 1 the spiral guides a driver from an inside lane to an outside lane. A spiral ensures that for a roundabout with an exclusive lane, such as an exclusive left, that other drivers don't get trapped in the exclusive lane, forcing them to exit by changing lanes.



» **FIGURE 1 –** Spiral Design Showing Vehicle Path to Exit Without Changing Lanes

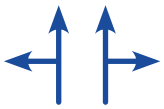
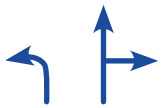
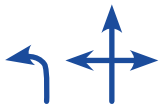
Design Optimization Criterion	Lane Configuration and Spiral Design Strategy
Operational Improvement	**Traffic volumes are the primary factor when considering spiral design.** Identify multiple lane configuration options and assess each using analysis software to determine the optimal capacity and whether that includes a spiral.
Safety Improvements	**Reducing fatal/injury crashes is the primary factor in deciding on a lane configuration. Document conflict patterns and determine alternative lane configurations to reduce complexity.** Focus on simplifying the driving task on approaches and through the roundabout. Lane drops through the use of exclusive lefts or exclusive rights decrease the exit conflict patterns by reducing the number of exit lanes. Exclusive lefts require spiraling-out the upstream left turns.
Cost and Practicality	Spiral geometry results in a slight increase in cost and complexity of construction due to the resulting asymmetric geometry.

» **TABLE 1 –** Lane Configuration and Spiral Design Considerations

**Trade-off potential is determined based on project needs and context and should be evaluated for each roundabout prior to identifying a lane configuration. A design may have multiple intended priorities.*

Table 2 presents three multilane approach configurations and their corresponding operational applications. These configurations may also be used to improve safety or maintain existing patterns as described in **Table 1**. Note that exclusive right-turn lanes may be applied where right turn movements are greater than or equal to half of the shared lane volume of one lane on a two lane approach. Spiral Design is only considered for multilane roundabout

» **TABLE 2 –** Approach Lane Configurations for Multilane Roundabouts

Approach Lane Configurations	Operational Application	Trade-off Considerations
 Configuration A	Used when volumes are mostly balanced and left or right turning movements do not "starve" a thru lane. **Spiral design not required.**	Creates 4 conflict points when coupled with two circulating lanes. The most common two-lane configuration.
 Configuration B	Used when left turns are greater than or equal to the sum of thru movements + right turns. ***Spiral design required on the upstream approach (see next section).***	Promotes a single lane exit downstream, reducing exit conflict points and associated crash risk.
 Configuration C	Used when left turns are greater than the sum of thru movements + right turns and an imbalanced queue is expected for Configuration B. ***Spiral design required on the upstream approach (see next section).***	More complex but applicable if entry demand for lefts is high. Promotes single lane exit downstream.

Source: Kyle Kruppa

SPIRAL DESIGN

Spiraled design should be developed from the central island using a vertical curb to guide the driver out to the next lane to exit without changing lanes. It develops off the truck apron curb, until a full lane width is available. Spiral crosshatch pavement markings are sometimes used, but observations of spirals without a 'hard surface' indicate that some drivers ignore the pavement markings, increasing the potential for vehicle conflict in the circulatory roadway.

Spiral designs prevent left-turning vehicles from becoming trapped in the inside lane. Where dual lefts are used, two lanes may be shifted. Spiraling lanes developed in the U.K. from observations of natural vehicle paths that drivers were tracking naturally to reach an exiting lane. If properly applied, spirals are intuitive to the driver.

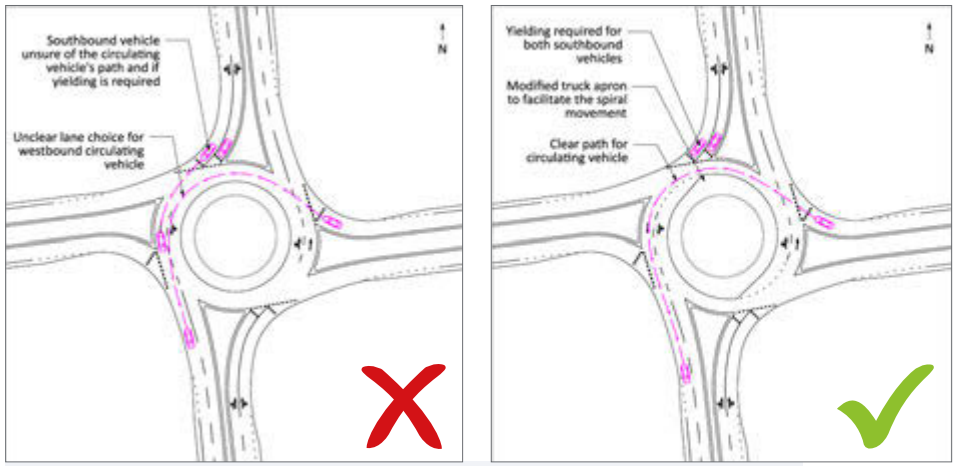
Spirals can be very effective on larger circles where the spiraling curves are long and are associated with a driver accelerating as they exit. Spirals apply the principle of rotational acceleration directing vehicles away from the center of a circle. Compact two-lane roundabouts do not function as well with spiral designs because arc lengths are short and the acceleration required to make a spiral effective is overlapped by deceleration from an entry into a circle. In such cases, speed reduction occurs in the circulatory roadway where the spiral begins. Drivers are more likely to turn tight across the spiral rather than follow it to the next outside lane.

APPLICATIONS FOR SPIRAL DESIGNS

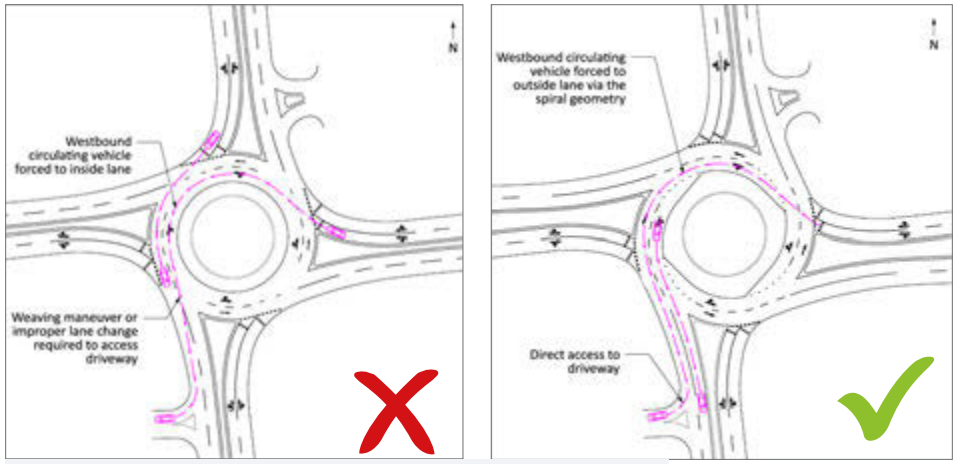
Spirals are required where an exclusive left-turn or dual left-turns are present. However, other circumstances may warrant the use of a spiral design. Engineering judgement should be used to determine if a spiral is beneficial for the intersection design. The following circumstances typically require the use of a spiral:

1. Where one or more entries require left-turn lanes for lane continuity or to accommodate traffic demand
2. 2x1 hybrid multilane roundabouts that are prone to unclean circulating paths for upstream left-turns. The example in **Figure 2** presents an improvement using spiraled design of the 2x1 lane configuration.
3. Commercial or urban areas with access needs whereby turning vehicles need to exit into the outside lane on one or more legs (**Figure 3**). The same applies to transit vehicles that need to exit roundabouts in the outside lane to access a roadside station or stop.

Spiral designs may negatively impact roundabouts with frequent U-turns because they require that a driver change lanes to overcome the spiral having displaced their path to the outside lane.



» **FIGURE 2 –** 2x1 Hybrid Multilane Roundabout Spiral Application



» **FIGURE 3 –** Multilane Roundabout Spiral Application for Business Access on Exits

SPIRAL DESIGN METHOD AND WORKFLOW

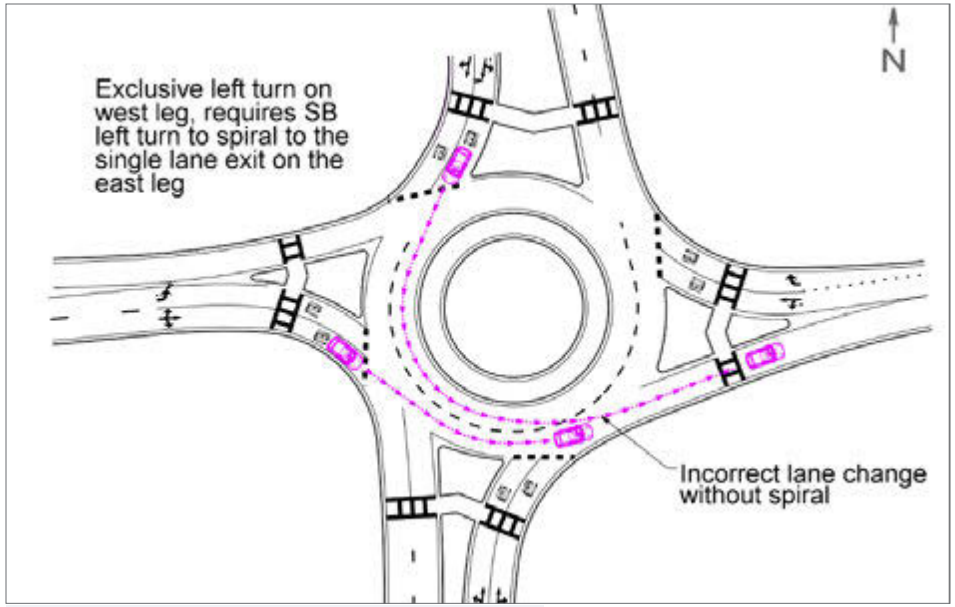
The following steps may be used to add a spiral to the circulatory roadway. Spirals should be developed after a preliminary sketch of the roundabout is available. The following figures were sourced from the Georgia Department of Transportation Roundabout Design Guide.

1. Identify the Need for a Spiral

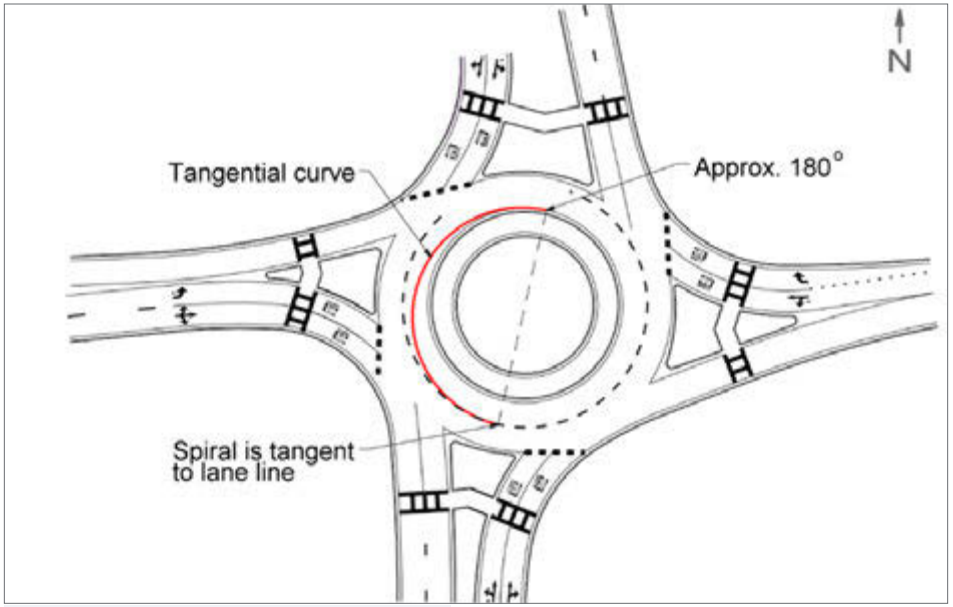
Start with original central island and identify potential conflict points due to unclear lane choices or incorrect lane changes. **Figure 4** shows what happens when a design does not account for the driver upstream of an exclusive lane. The southbound driver is forced to change lanes to exit the circle, and the southbound left conflicts with eastbound through movement.

2. Develop the Spiral Arc

Place an arc approximately 180° from where the spiral begins, tangent to the truck apron. The arc should begin at a point just before the entry that must spiral to the outside lane. The spiral arc should be tangent to the truck apron's edge of pavement and the circulatory lane line, as shown in **Figure 5**.



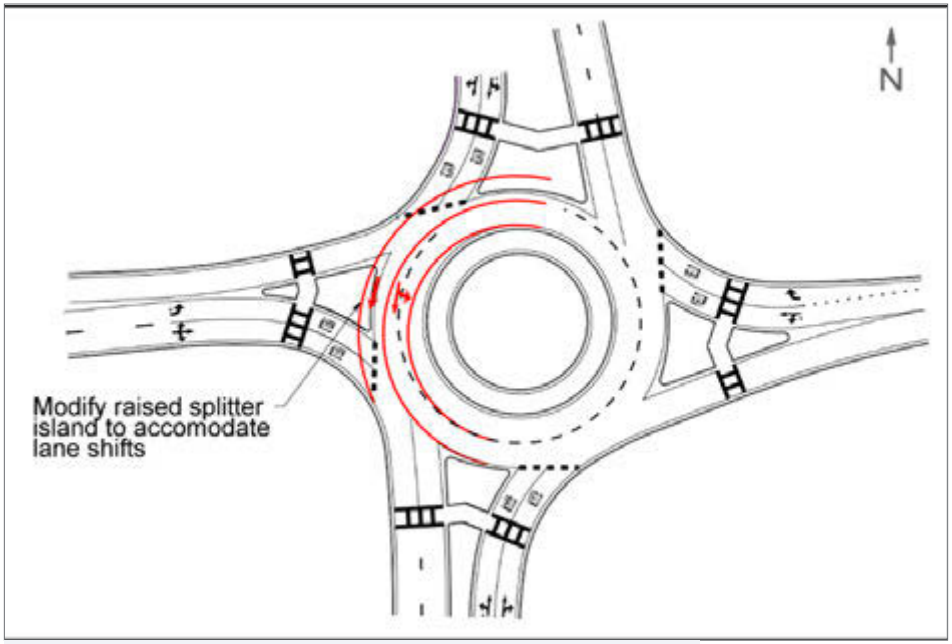
» **FIGURE 4 –** Exiting Lane Change Conflict



» **FIGURE 5 –** Spiral Arc Placement

3. Prep Circulatory Geometry to Account for the Spiral

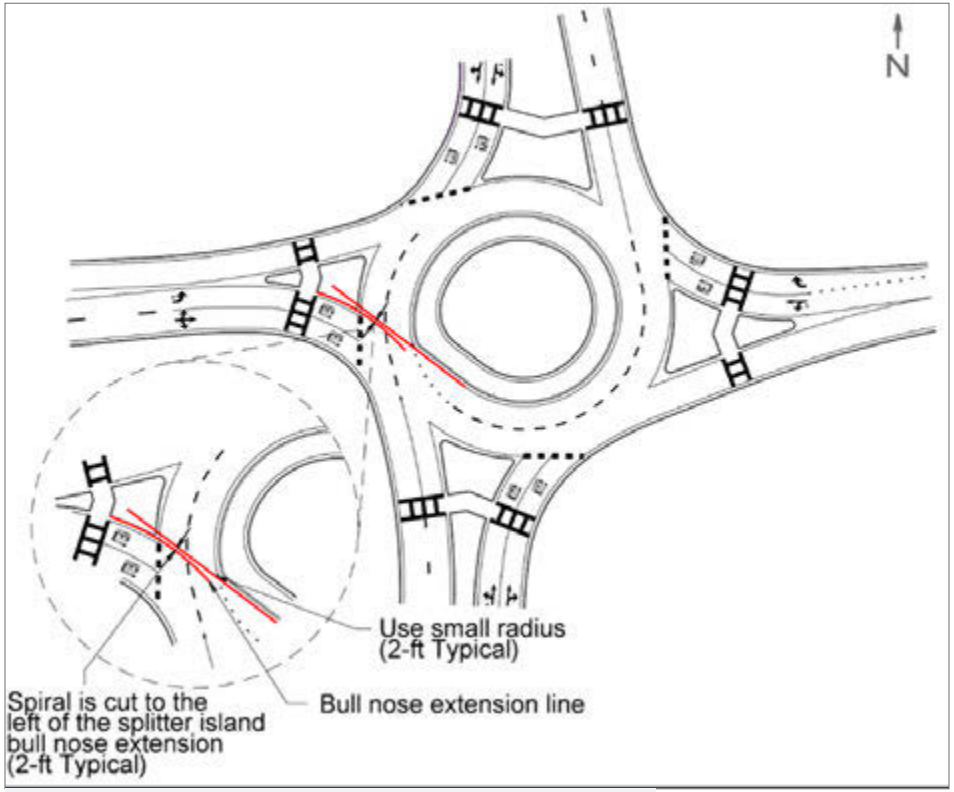
Offset the spiral arc by the width of travel lanes to modify the circle's geometry, ss shown in **Figure 6**. If adding a spiral to a buffered lane designed roundabout, any lane buffers in the original design should be modified to reflect the spiral arc.



» **FIGURE 6 –** Development of Spiraled Circulatory Lanes

4. Cut the Spiral to the Exclusive Turn Lane Trajectory and Modify Geometry

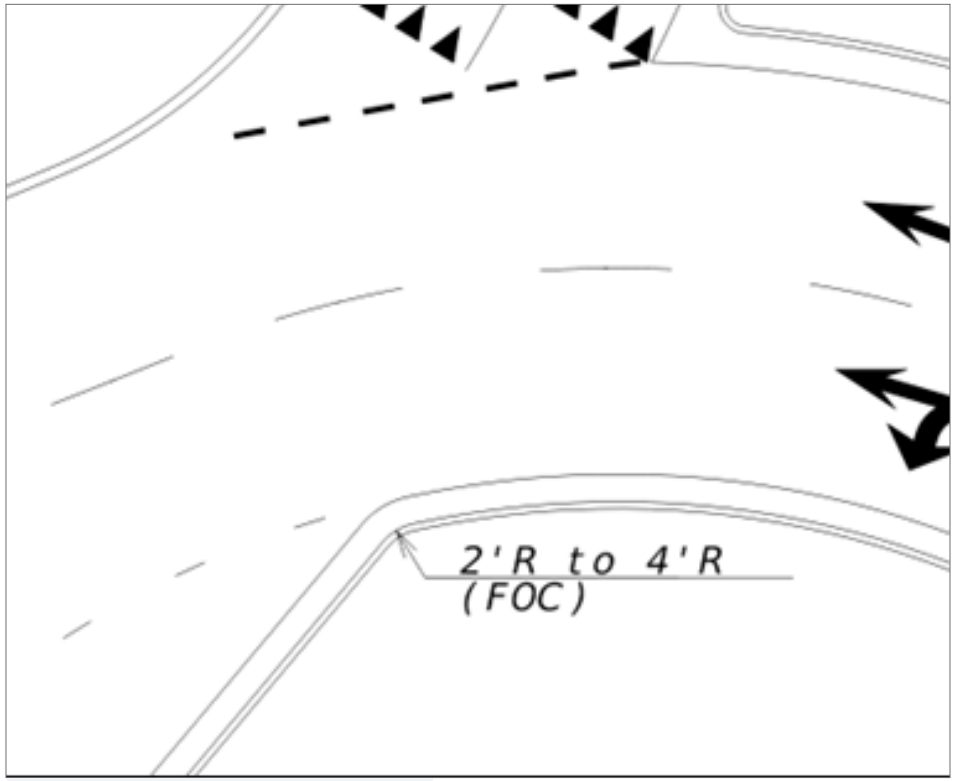
Offset the splitter island face of curb 2-feet to the left of the splitter island bull nose. Place a line tangent to the truck apron edge of pavement and the 2-foot offset to "cut the spiral". Trim the spiral and adjust the truck apron, entry, exit, and circulatory geometry to account for the lane shifts, shown in **Figure 7**.



» **FIGURE 7 –** Spiral Cut and Geometry Modifications

5. Place a Radius on the Spiral

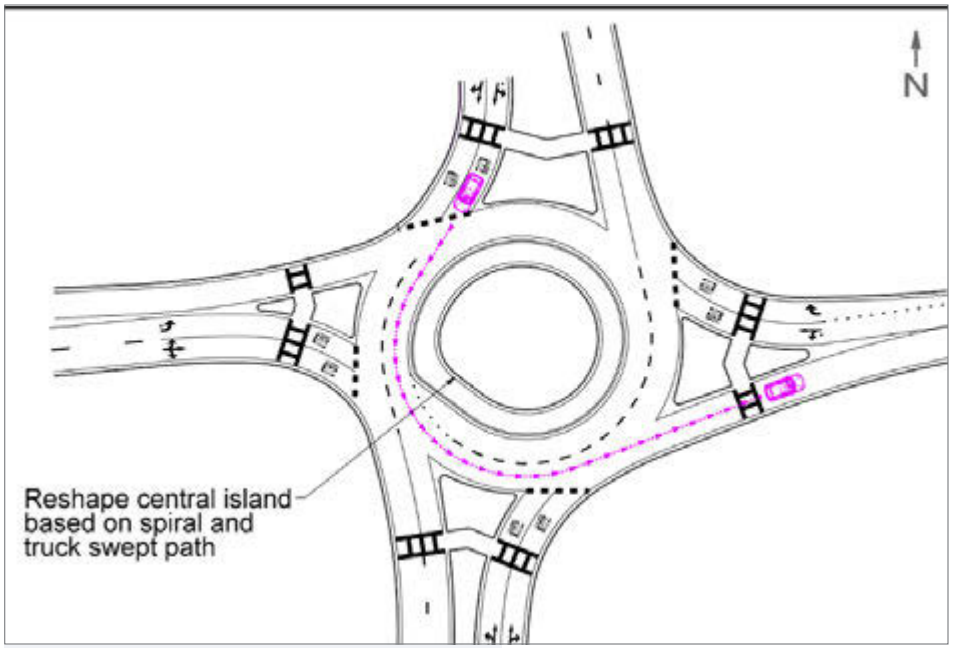
Radii between 2-ft and 4-ft should be placed on the spiral to discourage circulating vehicles from making left turns into the spiral. **Figure 8** shows that instead, drivers are guided to the outside lane and do not become "trapped" in the circle.



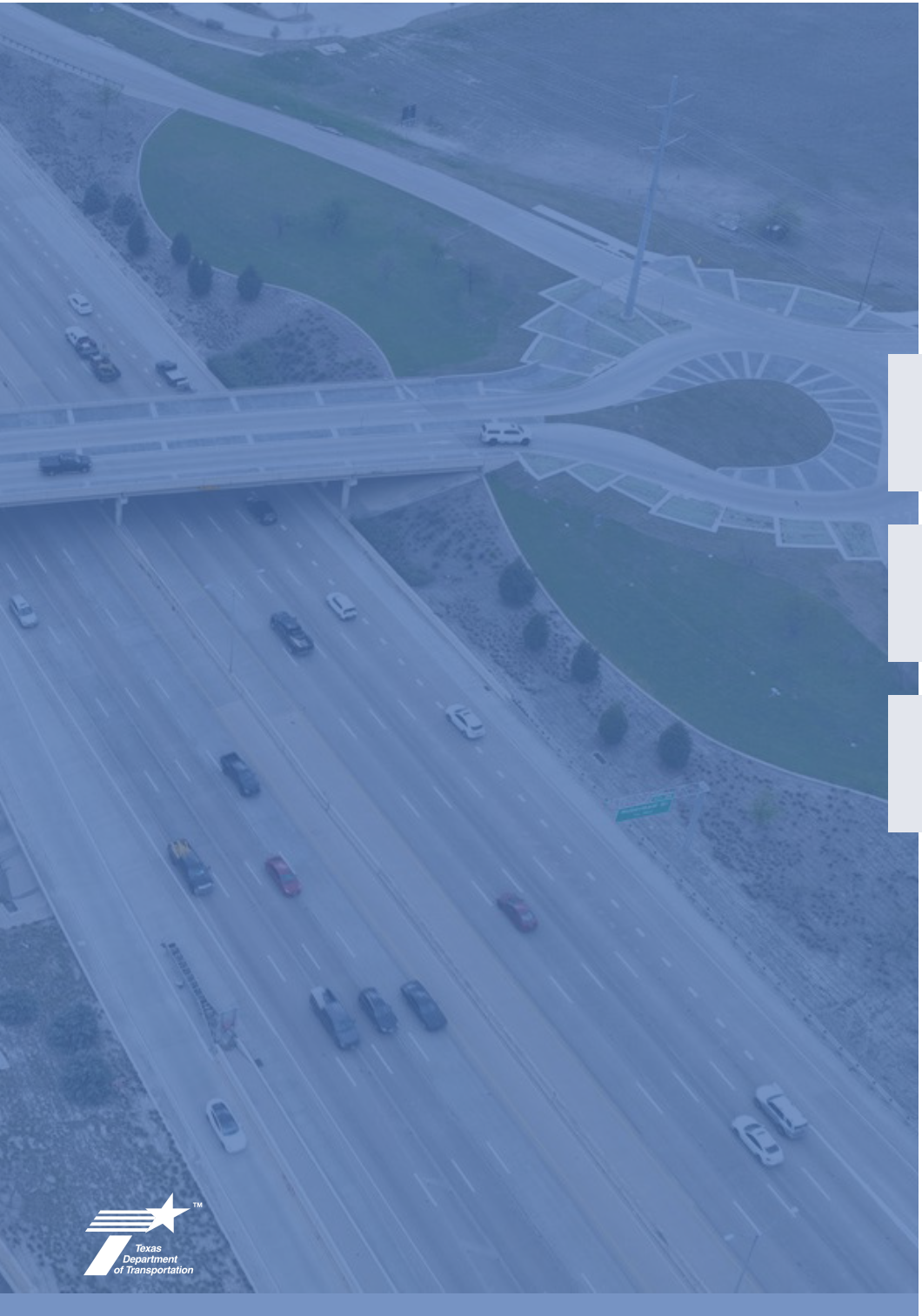
» **FIGURE 8 –** Spiral Nose Radius

6. Validate the Design

Check vehicle paths for the new spiral design. Reshape the landscaped area based on truck swept paths, shown in **Figure 9**.



» **FIGURE 9 –** Spiraled Vehicle Exit Path



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3 Roundabout Design Guide. Georgia Department of Transportation. Revision 2.3, 2023.