



# Conceptual Design Considerations for Special Purpose Truck Roadway Facilities



December 2014

# **Conceptual Design Considerations for Special Purpose Truck Roadway Facilities**

December 2014

This White Paper is one in a series developed as part of the Tampa Bay Regional Goods Movement Study. The purpose of this series of White Papers is to provide background and information for the freight community in the Tampa Bay Region.

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### INTRODUCTION

Truck only lanes have become a topic of discussion and research for the past several years. The primary reason for this discussion is urban congestion and how it affects the time value and reliability of moving freight so that it arrives when needed on time and with the least amount of associated transportation costs. According to the Federal Highway Administration (FHWA), the number of trucks on our nation's highways is expected to nearly double by 2040. At the same time congestion is expected to increase significantly unless the capacity of the system increases and numerous existing choke points are mitigated or eliminated.

A Reason Foundation Study noted that "trucks deliver 90 percent of the value of U.S. freight, and trucking charges are more than \$610 billion a year" and that truck crashes result in "nearly 5,000 deaths" annually.<sup>1</sup>

The cost of consumer goods is increasing in part because of the added transportation costs resulting from higher fuel prices, labor, and more importantly congestion. The Texas Transportation Institute (TTI) at Texas A&M University produces an annual congestion index report for major metropolitan areas. With few exceptions, the congestion indices for the reported areas have increased year-over-year. The report also estimates the hourly cost of congestion for both commuters and for commercial trucking. For 2010 (2011 report), the latest available year, the congestion cost for trucks was estimated at \$88.12 per hour. For the Tampa Bay Region the total truck congestion cost was estimated at \$210 million impacting transported goods valued at nearly \$62 billion.

Congestion also impacts delivery timeliness and reliability. Timeliness refers to the ability to deliver goods when needed. This is particularly critical to the manufacturing process where parts are needed at a specific point in the production cycle. Delay in receipt of the parts could shut down the assembly line resulting in higher costs to the manufacturer and ultimately to the consumer. Reliability refers to the ability of the logistics chain to meet the delivery deadlines a high percentage of the time. Lack of reliability results in adding travel time to delivery schedules in anticipation of delay caused by congested conditions. Lack of reliability also results in higher fuel and labor costs to the transportation company.

Additionally, State Departments of Transportation (DOT) are "starting to recognize..."

- The need for additional freight capacity on highways
- That separation of trucks can provide additional capacity
- That separation offers productivity gains/cost savings, and
- That productivity gains provide for revenue generation"<sup>2</sup>

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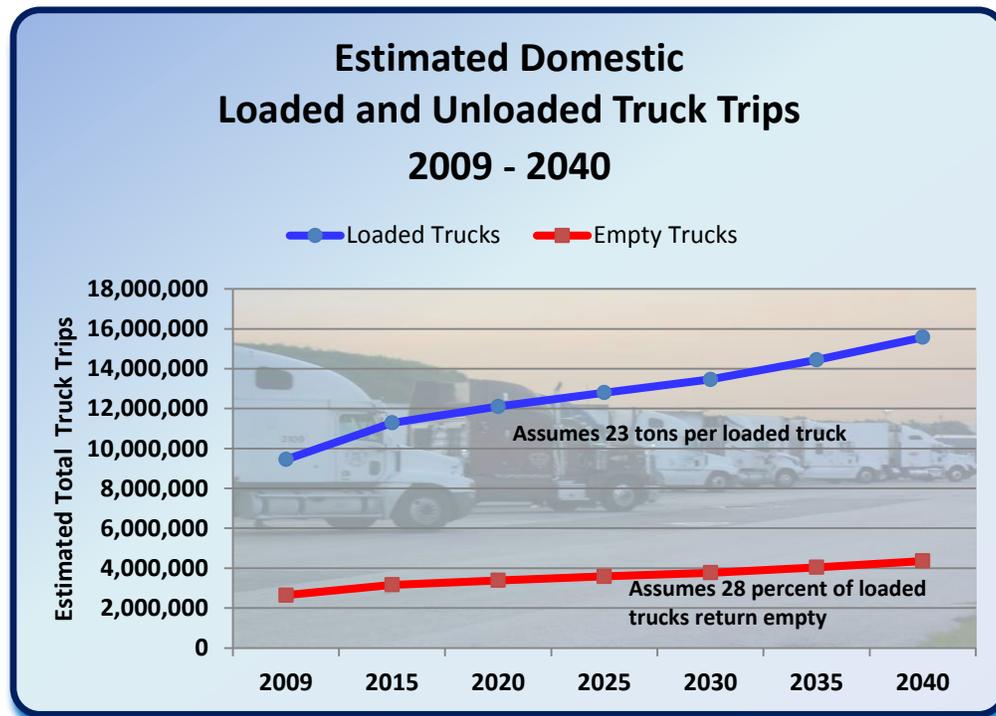
<sup>1</sup> Samuel, P. Poole, Jr. R., Holguin-Veras, J. Toll Truckways: A New Path Toward Safer and More Efficient Freight Transportation, Reason Foundation, Policy Summary No. 294.

<sup>2</sup> Ibid.

## Conceptual Design Considerations For Special Purpose Truck Roadway Facilities

The FHWA Freight Analysis Framework model predicts that truck traffic in the Tampa Bay Region will increase from approximately 12 million domestic trips in 2009 to over 20 million trips by 2040, an increase of 67 percent (**Figure 1**). At the same time, the capacity on our freeways and regional truck routes is not forecast to increase significantly. As a result, we must look for new ways to accommodate the movement of freight through our region.

**Figure 1: Estimated Domestic Loaded and Unloaded Truck Trips 2009-2040**



Source: FHWA, Freight Analysis Framework (FAF) data for the Tampa Bay Region

## PURPOSE

The purpose of this White Paper is to examine some of the design considerations that can be employed when developing truck lane alternatives. The discussion of each alternative is illustrated by conceptual engineering drawings. This White Paper illustrating conceptual design considerations is complementary to a separate White Paper dealing with the planning elements of exclusive truck facilities.

## ENGINEERING CONCEPTS

An engineering assessment was performed to evaluate the implementation of truck-only lanes on limited access facilities that include freeways and expressways within the Tampa Bay area and surrounding FDOT District Seven roadway network, as well as on non-limited or 'controlled' access facilities. Optional typical section concepts and schematic layouts for lane transitions, ramp terminals and interchange connections were prepared with proposed treatments or configurations based on Florida Department of Transportation Standards.

## **Conceptual Design Considerations For Special Purpose Truck Roadway Facilities**

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The conceptual designs considered operational aspects such as design speed, access, safety and stabilized traffic flow. The design concepts also addressed horizontal clearance, clear zone, as well as other roadside safety factors and drainage that might be applied to freeway segments in the Tampa Bay Region. Other concepts were developed for non-limited access facilities that could potentially be accommodated along specific facilities such as the US 19 Corridor in Pinellas County.

### **Limited Access Facilities Concepts**

Conceptual typical cross section design options were developed based on providing dedicated lanes for trucks separated from mixed-flow traffic. Three options were evaluated with alternative variations for the typical section treatments for limited access facilities:

- **Option 1** - Dedicated two-way truck lanes within the median area or inside portion of the roadway corridor with mixed flow traffic (general use lanes) along the outside in each direction. Option 1A makes use of concrete barrier separation of truck lanes from mixed traffic, while Option 1B makes use of a 36 foot median with guard rail in lieu of the concrete barriers.
- **Option 2** – Two-way mixed flow traffic lanes within the median or inside portion of the roadway corridor with dedicated truck lanes along the outside in each direction. Similarly, Option 2A makes use of concrete barrier separation, while Option 2B makes use of a 36 foot median with guard rail for separation.
- **Option 3** – Grade separating dedicated truck lanes from mixed flow traffic lanes with a continuous elevated structure. Option 3A places the dedicated truck lanes on an elevated structure, while Option 3B places the mixed flow lanes on an elevated structure.

A fourth option was evaluated, consisting of the separation of two-way mixed flow lanes on one side of the right-of-way, separated from two-way truck lanes on the other side of the right-of-way. It was determined that this option would result in considerable adverse operational concerns for access and connectivity at interchanges and other access points resulting in a need for required grade separated structures and flyovers occurring at frequent intervals. Therefore, this option was not considered viable.

### **Options 1A and 1B Truck Only Lanes within the Median Area/Inside-Mixed Traffic Flow Outside (Figures 2 – 5)**

The typical sections for Option 1 A and B consist of:

- Two (2) directional dedicated 12' truck lanes with median barrier wall and 12' inside and outside shoulders
- Three (3) or four (4) directional 12' mixed flow general purpose lanes with 12' inside and outside shoulders
- Minimum 36' clear recovery area
- Design Speed: 70 mph

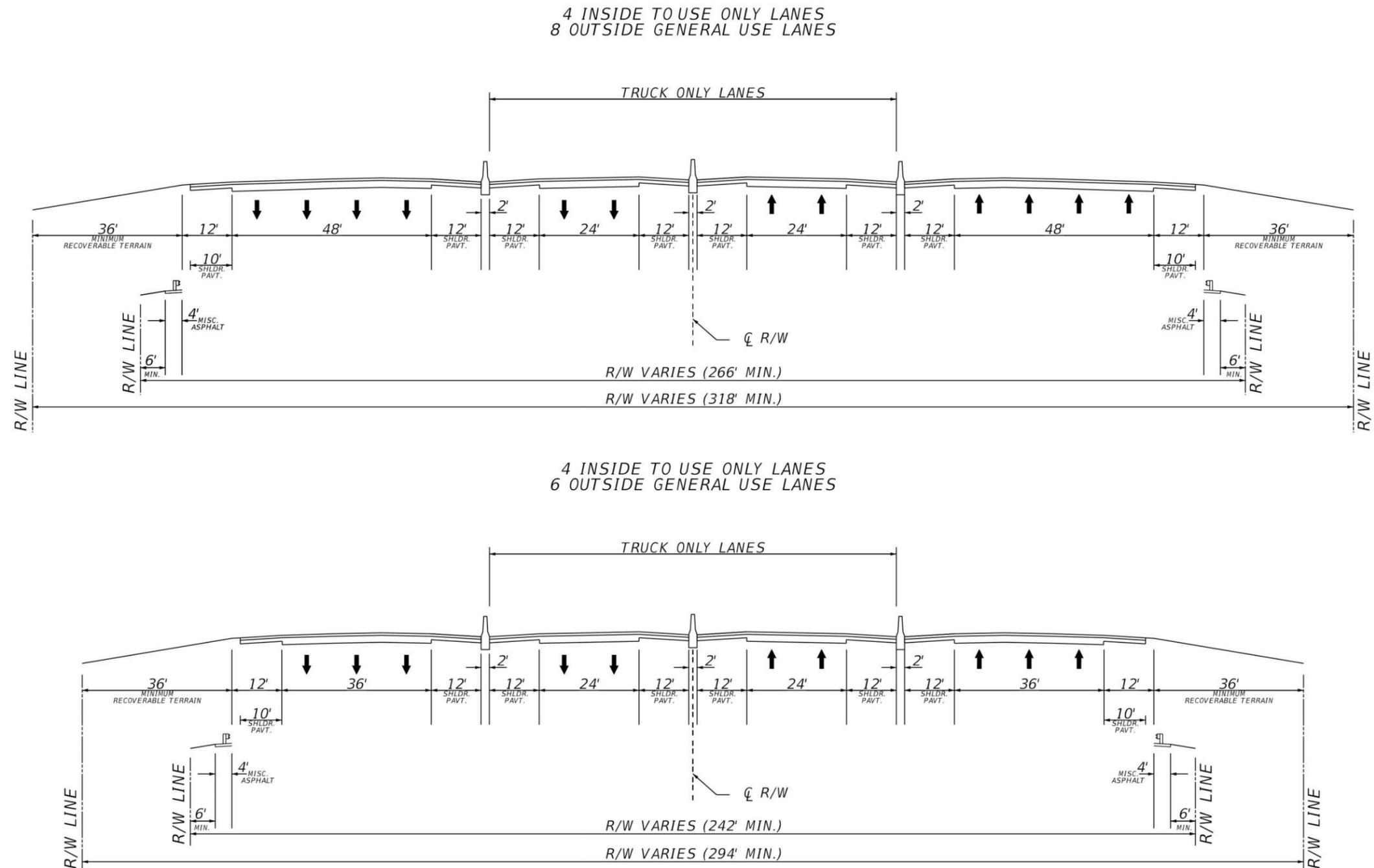


FIGURE 2  
OPTION 1A  
LIMITED ACCESS FACILITY

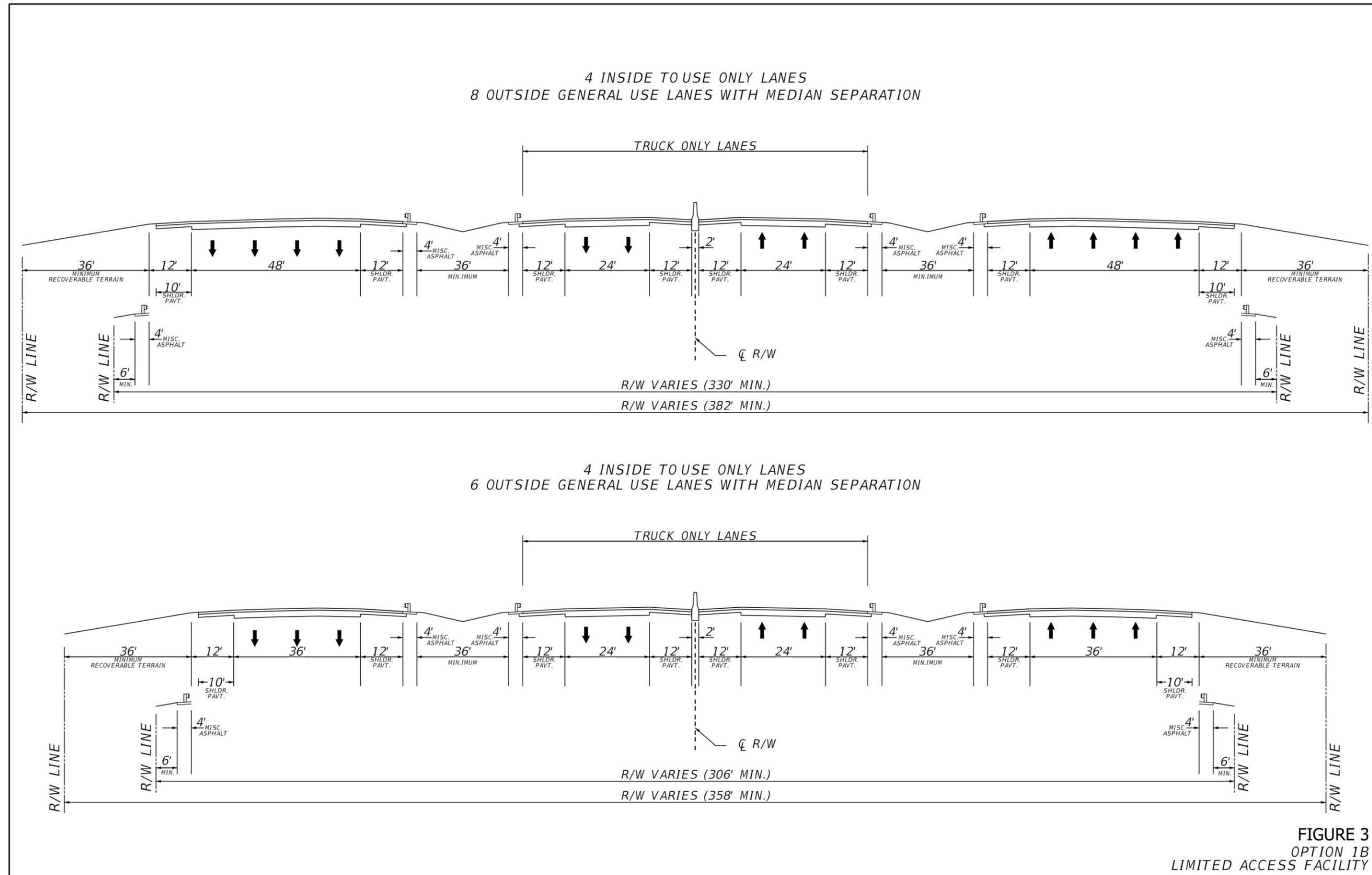


FIGURE 3  
OPTION 1B  
LIMITED ACCESS FACILITY

## **Conceptual Design Considerations For Special Purpose Truck Roadway Facilities**

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As noted previously, the difference between Options 1A and B is in how the truck only lanes are separated from the general use lanes. Option 1A uses barrier walls for separation while Option 1B incorporates a 36' median with guardrail.

Both options accommodate through trucks that do not require access to interchange ramps. The advantage of this is that through trucks are separated from the general traffic lanes that are generally congested resulting in significant delay during peak hours. The negative is that trucks desiring to access interchange ramps or the truck only lanes must weave through three or more lanes of mixed traffic when entering or exiting the facility.

Option 1A (**Figures 2**) requires less right-of-way (ROW) (294' – 318' depending on three or four general use lanes) than Option 1B (358' – 387'), however this option does not easily accommodate slip ramp transitions for interchanging traffic flow and access. This option also requires a more extensive drainage system with inlets at the three barrier wall locations and lateral pipe crossings.

Option 1B (**Figures 3**) accommodates slip ramp transitions for interchanging traffic flow and access. It also accommodates storm water trunk lines within grassed medians that allow for reduced maintenance concerns. The negative for Option 1B is the additional ROW required to accommodate the median separations resulting in higher costs.

### **Option 2A and 2B—Mixed Traffic Flow lanes Inside—Truck Only Lanes Outside (Figures 4 – 5)**

Two variations of this typical section were developed for Options 2A and B:

- Three (3) or four (4) directional 12' mixed flow general purpose lanes with 12' inside and outside shoulders
- Two (2) directional dedicated 12' truck lanes with median barrier wall and 12' inside and outside shoulders
- Minimum 36' clear recovery area
- Design Speed: 70 mph

Similar to Option 1, the difference between Options 2A and 2B is the separation of the truck lanes from the general use lanes. Option 2A uses barrier walls for separation while Option 2B incorporates a 36' median with guardrail.

The advantage of these typical sections is the ability of trucks to access the exit ramps and the truck only lanes without penetrating the mixed use lanes. The negative of this typical section is that the mixed use traffic must weave through two truck lanes to access the exits and general purpose lanes unless a separate exit ramp bridging these lanes is constructed. Potential interchange layouts are discussed later in the White Paper.

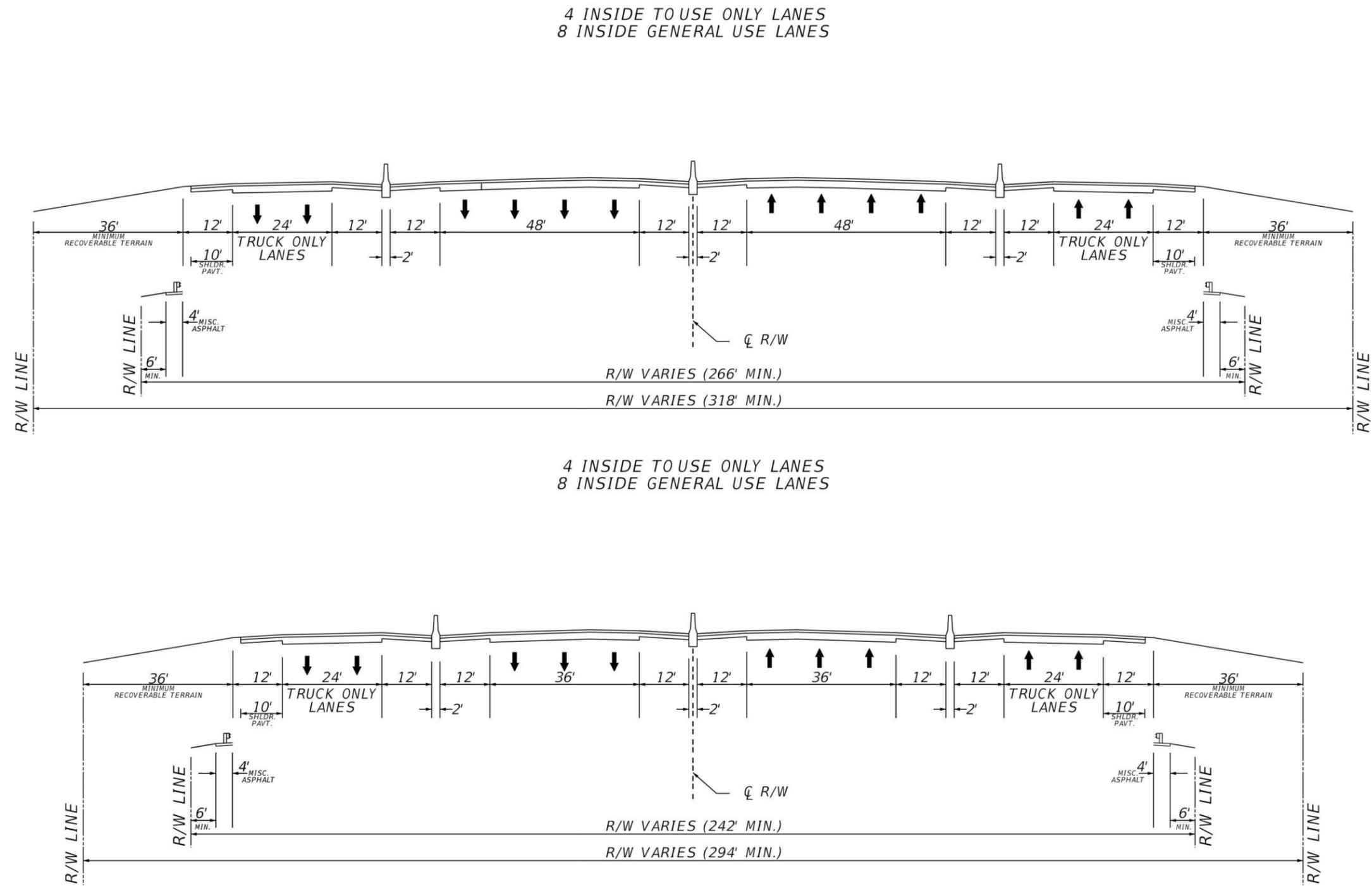


FIGURE 4  
OPTION 2A  
LIMITED ACCESS FACILITY

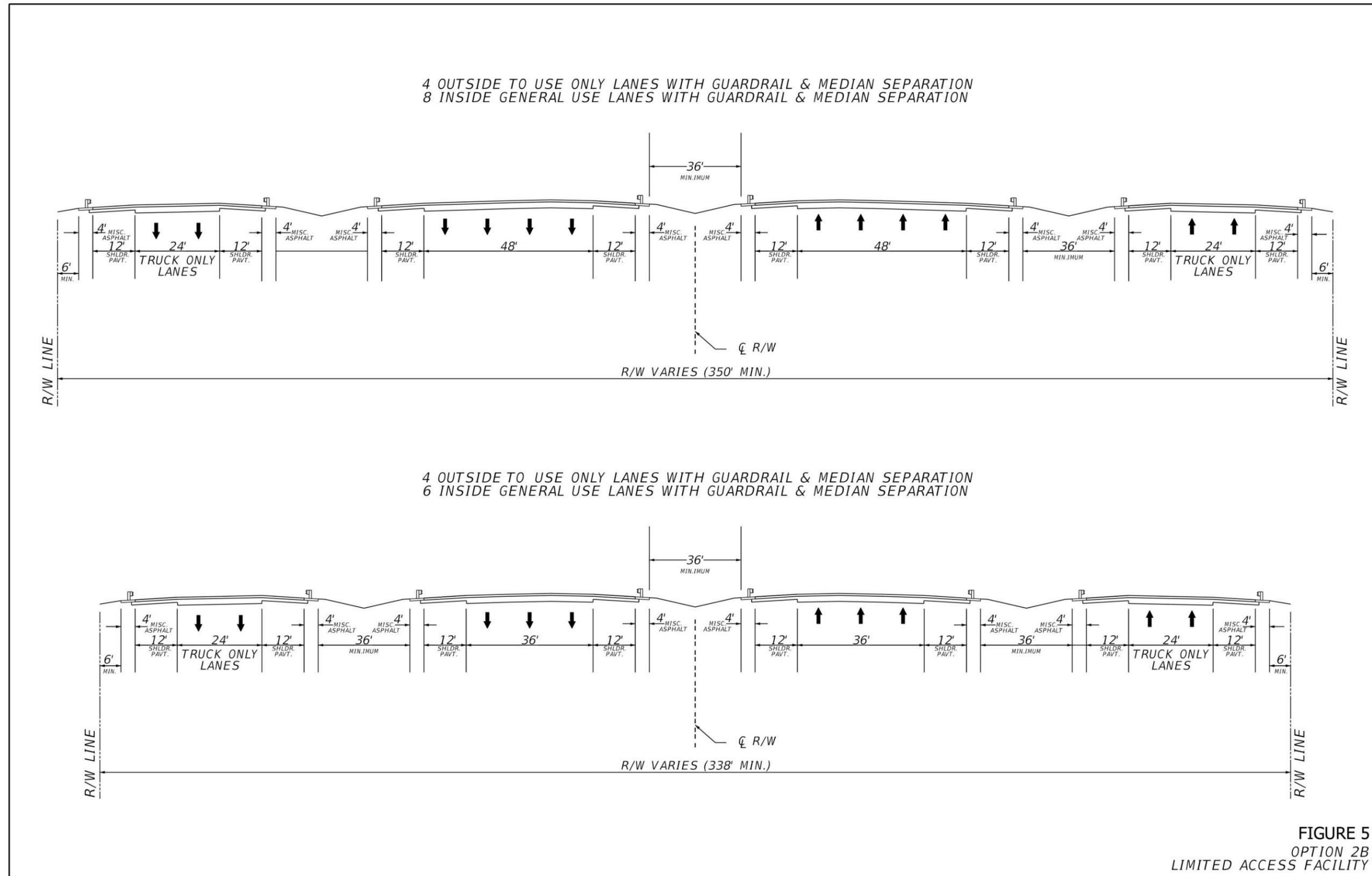


FIGURE 5  
OPTION 2B  
LIMITED ACCESS FACILITY

## **Conceptual Design Considerations For Special Purpose Truck Roadway Facilities**

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The primary advantage of Option 2 A is less ROW needs (294' – 318') compared to Option 2B (338' – 350'). The disadvantage of Option 2A is the inability to easily accommodate slip ramps for interchanging traffic flow. Option 2A also requires a more extensive drainage system.

The advantage of Option 2B is that it accommodates slip ramps within the median separating the general use lanes from the truck only lanes. The medians are also able to accommodate storm water trunk lines reducing maintenance costs. The disadvantage is the cost of the additional ROW needed to accommodate the median separators and slip ramps.

### **Option 3A and 3B—Grade Separated Truck Only Lanes (Figures 6 – 7)**

Two variations of this typical section option are provided based on a design speed of 70 mph. Option 3A (Figure 6) features elevated truck lanes as noted below::

- Two or three lane directional 12' dedicated truck lanes with 6'-10' inside shoulders / 10' outside shoulders with a variable auxiliary lane for ramp connections on an elevated structure
- At grade three or four lane directional 12' mixed flow traffic lanes with median barrier wall and 12' inside and outside shoulders
- 36' minimum clear recovery area

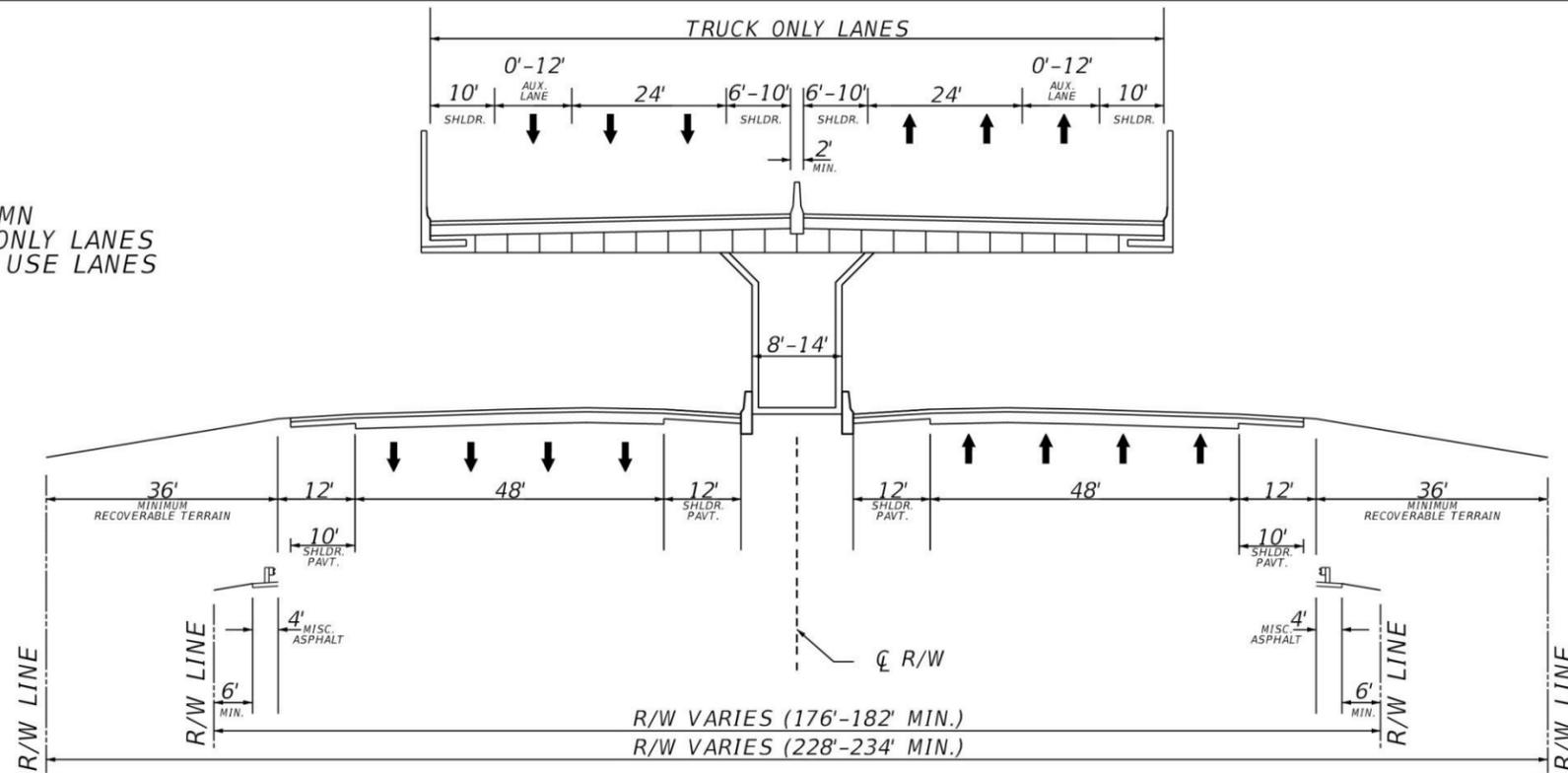
Option 3B (Figure 7) features at-grade truck lanes and elevated mixed flow lanes as noted below:

- Two or three lane directional 12' mixed-flow traffic lanes with 6-10' inside shoulders and 10' outside shoulders with a variable auxiliary lane for ramp connections on an elevated structure
- At grade two- lane directional dedicated 12' truck lanes with median barrier wall and 12' inside and outside shoulders
- 36' minimum clear recovery area

The advantages of Options 3A and B are that they result in a higher degree of safety by eliminating any potential need for weaving or interchanging with mixed flow traffic. This option requires substantially less ROW than Options 1 and 2 eliminating the potential need for ROW acquisition. Finally, this option accommodates continuous truck bypass lanes and access control for long distance through truck flow.

The primary disadvantage of this option is the substantial cost of the elevated section. In addition, Option 3 requires longer interchange ramp connections on structure than Options 1 or 2, which contributes to the overall higher cost. Option 3 requires a more extensive closed drainage system for collection of runoff within the piers and downspouts under the elevated lanes.

SINGLE COLUMN  
6 ELEVATED TO USE ONLY LANES  
8 AT GRADE GENERAL USE LANES



SINGLE COLUMN  
6 ELEVATED TO USE LANES  
6 AT GRADE GENERAL USE LANES

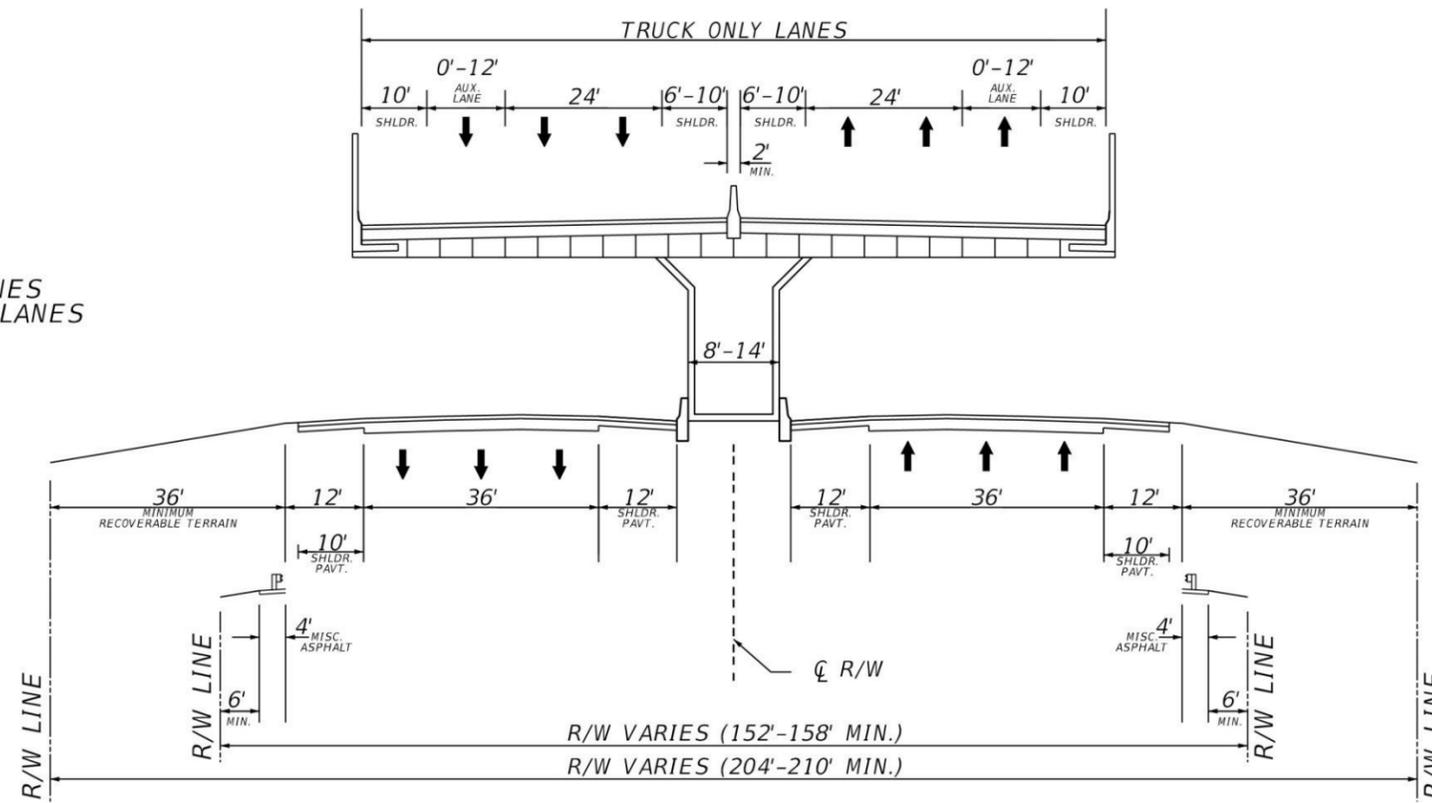


FIGURE 6  
OPTION 3A  
LIMITED ACCESS FACILITY

SINGLE COLUMN  
 6 ELEVATED GENERAL USE LANES  
 4 AT GRADE TO USE ONLY LANES

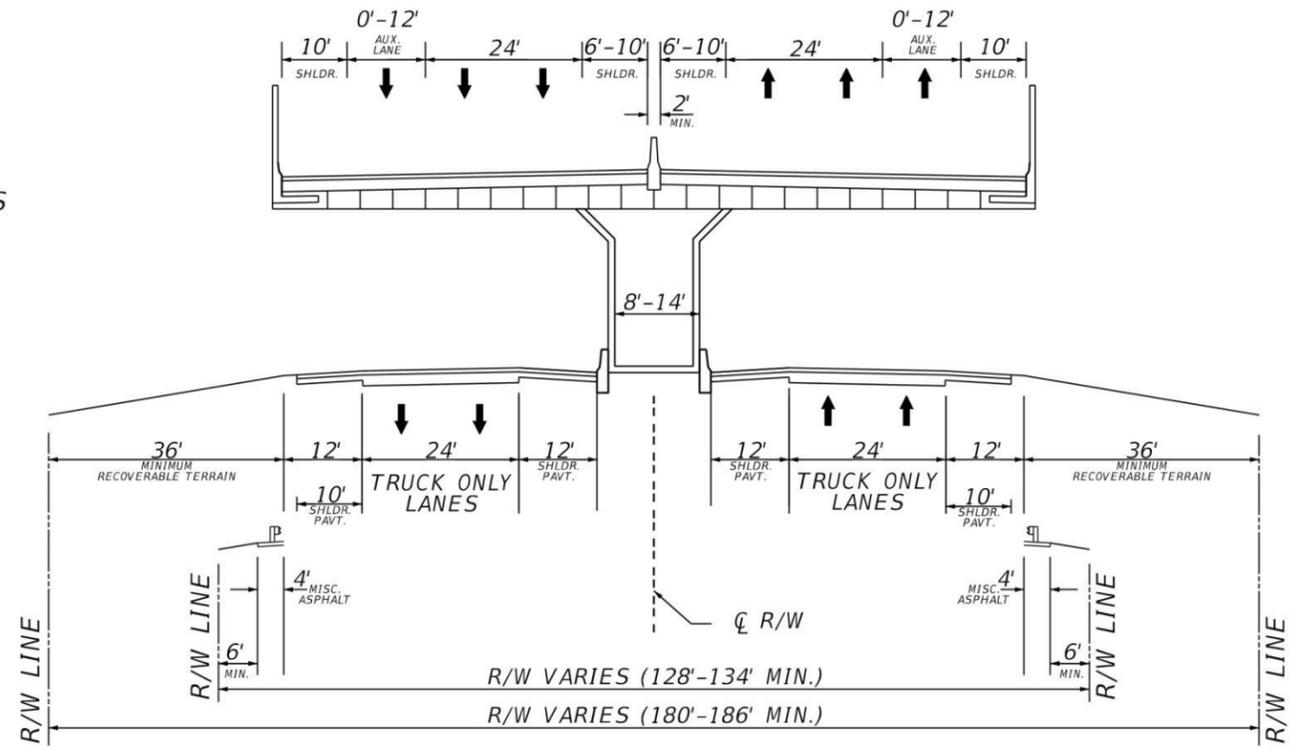


FIGURE 7  
 OPTION 3B  
 LIMITED ACCESS FACILITY

## **Conceptual Design Considerations For Special Purpose Truck Roadway Facilities**

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Due to the high cost, Option 3 is not a likely scenario with one exception—dense urban core with limited ROW, high value adjacent parcels that make ROW acquisitions cost prohibitive, and a high percentage of through trucks. Typically, the lanes would be tolled and to increase the revenue stream they may be shared with other though vehicles that do not require access to local interchanges. This option would eliminate most congestion because access could be restricted to very infrequent on and off locations. If carried across an urban area, the elevated lanes could come to grade and merge into general traffic after crossing the urban area.

### **Non-Limited Access Facility Concepts**

Conceptual typical sections were also developed for separate, dedicated lanes for trucks on non-limited access facilities, such as US 19 in Pinellas County, Florida. Two options were developed.

- **Option 1** - Dedicated two-way truck lanes proposed within the median area or inside portion of the roadway corridor with mixed flow traffic proposed along the outside in each direction with frontage roads.
- **Option 2** – Elevating dedicated truck lanes over mixed flow traffic lanes with a continuous elevated structure.

#### **Option 1-Truck Only Lanes Inside – Mixed Use Lanes Outside (Figure 8)**

Option 1 is provided on a design speed of 55 mph for the controlled access truck and mixed traffic travel lanes and 45 mph on adjoining urbanized frontage roads.

Option 1 consists of the following:

- Directional dedicated 12' truck lanes with median barrier wall and 8' inside / 10' outside shoulders
- Directional 11' mixed-flow traffic lanes with 8' inside shoulders
- Directional auxiliary lane with a 6.5' outside shoulder to accommodate slip ramp transitions to the frontage road
- One way directional frontage roads with 10' lanes with a 4' bike lane, curb and gutter and sidewalk
- Median barrier walls to separate directional truck only lanes from mixed flow traffic lanes
- Raised separator or median to separate controlled access mixed traffic flow lanes from frontage roads

The advantage of Option 1 is the opportunity for trucks to access frontage roads as well as interchanging to the truck only lanes. Option 1 also results in in lower overall costs than Option 2.

A major disadvantage of Option 1 is the weaving condition created for trucks needing to cross the mixed flow traffic to access the slip ramps for the frontage roads. Additionally, Option 1 requires grade separations with bridge structures at major signalized intersections. Option 1 requires full access control for signalized intersections. One way frontage roads and slip ramps are also required for access connections to and from surface streets. Finally, Option 1 requires an extensive drainage system.

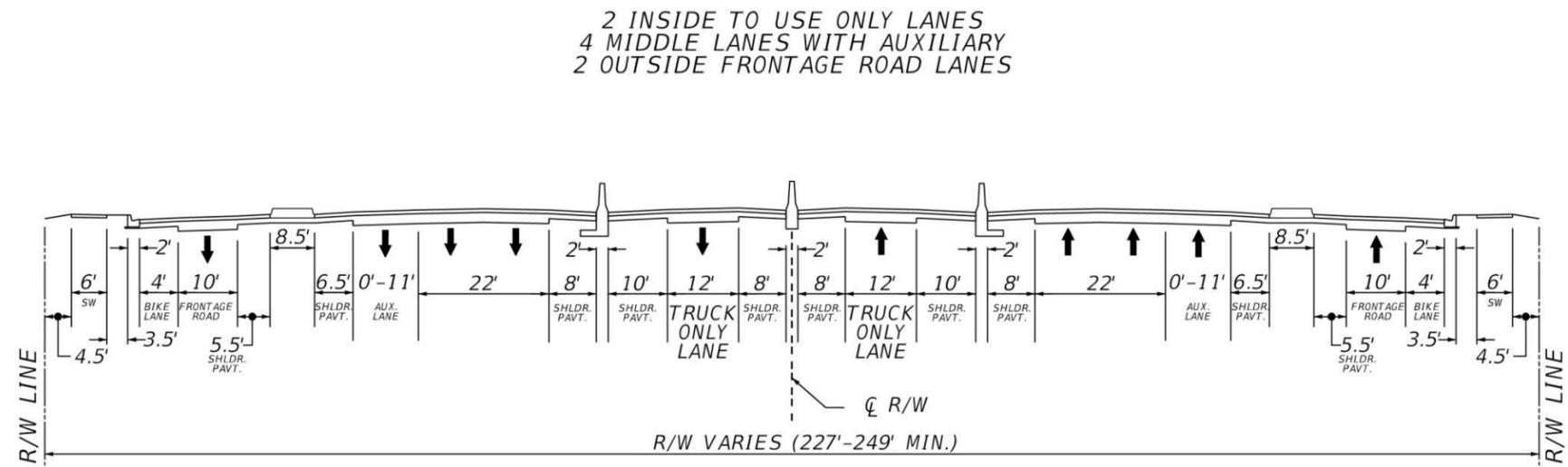
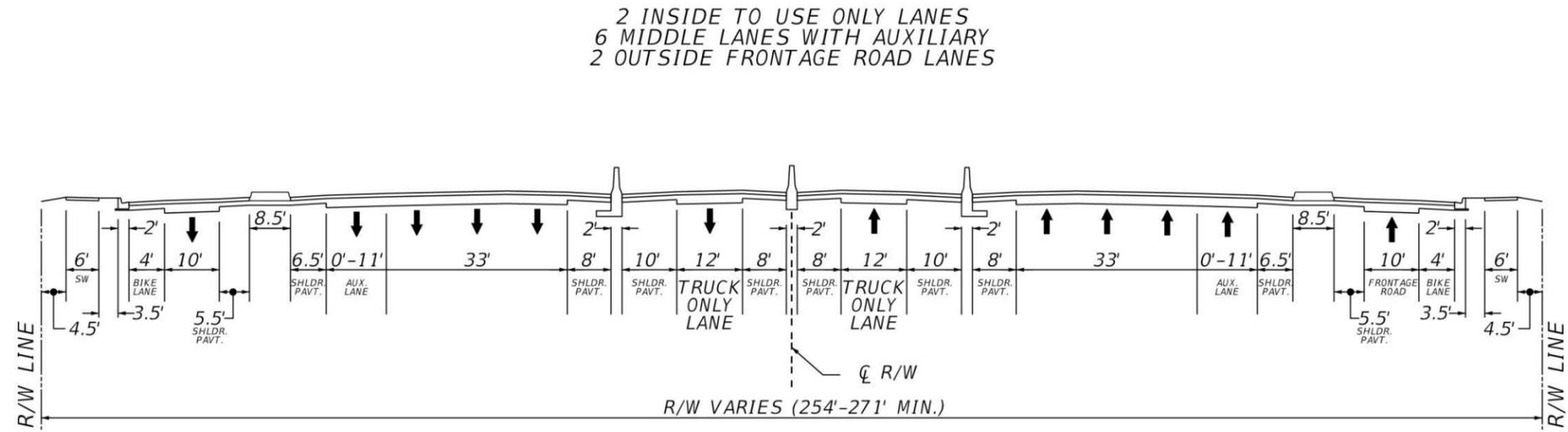


FIGURE 8  
OPTION 1  
NON-LIMITED ACCESS FACILITY

## **Conceptual Design Considerations For Special Purpose Truck Roadway Facilities**

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### **Option 2—Grade Separated Truck Only Lanes (Figure 9)**

This typical section option is provided based on a design speed of 55 mph for the controlled access truck and mixed traffic travel lanes and 45 mph on adjoining urbanized frontage roads.

Option 2 consists of the following:

- Two-lane directional dedicated 12' truck lanes with median barrier wall and 6-10' inside and 10' outside shoulders.
- A variable auxiliary lane for ramp connections on an elevated structure
- At-grade two or three-lane directional 11' mixed-flow traffic lanes with 8' inside shoulders
- Directional auxiliary lane with a 6.5' outside shoulder to accommodate slip ramp transitions to the frontage road
- One-way directional frontage roads with 10' lanes, a 4' bike lane, curb and gutter and sidewalk
- Eight foot' raised separator or median to separate controlled access mixed traffic flow lanes from frontage roads

Option 2 provides four advantages.

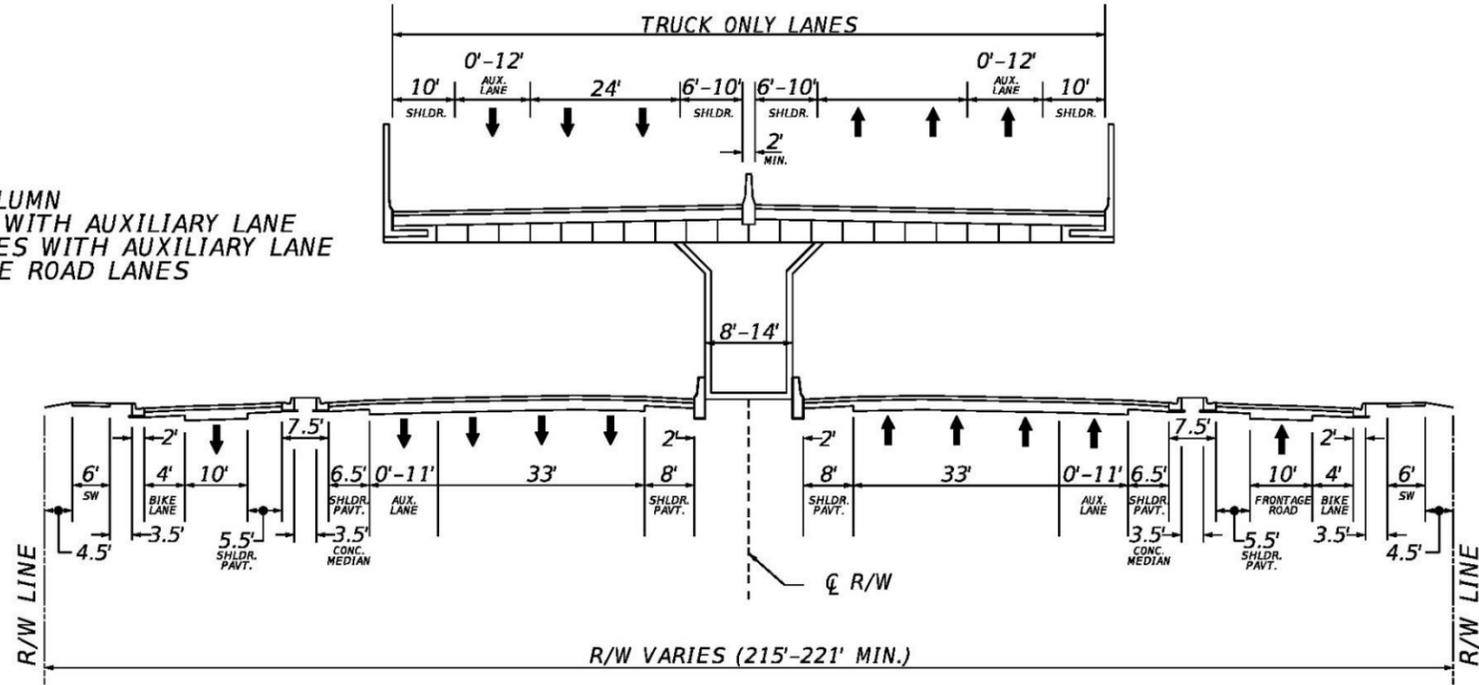
- First, it accommodates by-pass lanes for long distance truck traffic flow.
- Second it requires substantially less ROW than Option 1.
- Third, by eliminating any potential need for weaving or interchanging with mixed traffic flow. it results in a higher degree of operational safety,
- Finally, this option accommodates grade separated bridge structures at signalized intersections.

The disadvantages of Option 2 include considerably higher overall costs for the continuous elevated structures and ramps, full access control at signalized intersections, one way frontage roads and slip ramps are required for access to and from the surface street network, and the need for an extensive drainage system.

### **Conceptual Slip Ramp Terminal Layouts**

The Florida Department of Transportation Plans Preparation Manual Chapter 2 'Design Geometrics and Criteria' as well as the Design Standards Indexes were used to develop the following concepts. The American Association of State Highway and Transportation Officials (AASHTO) was also used as a reference source.

SINGLE COLUMN  
 4 ELEVATED TO USE LANES WITH AUXILIARY LANE  
 6 AT GRADE GENERAL USE LANES WITH AUXILIARY LANE  
 2 OUTSIDE FRONTAGE ROAD LANES



SINGLE COLUMN  
 4 ELEVATED TO USE LANES WITH AUXILIARY LANE  
 4 AT GRADE GENERAL USE LANES WITH AUXILIARY LANE  
 2 OUTSIDE FRONTAGE ROAD LANES

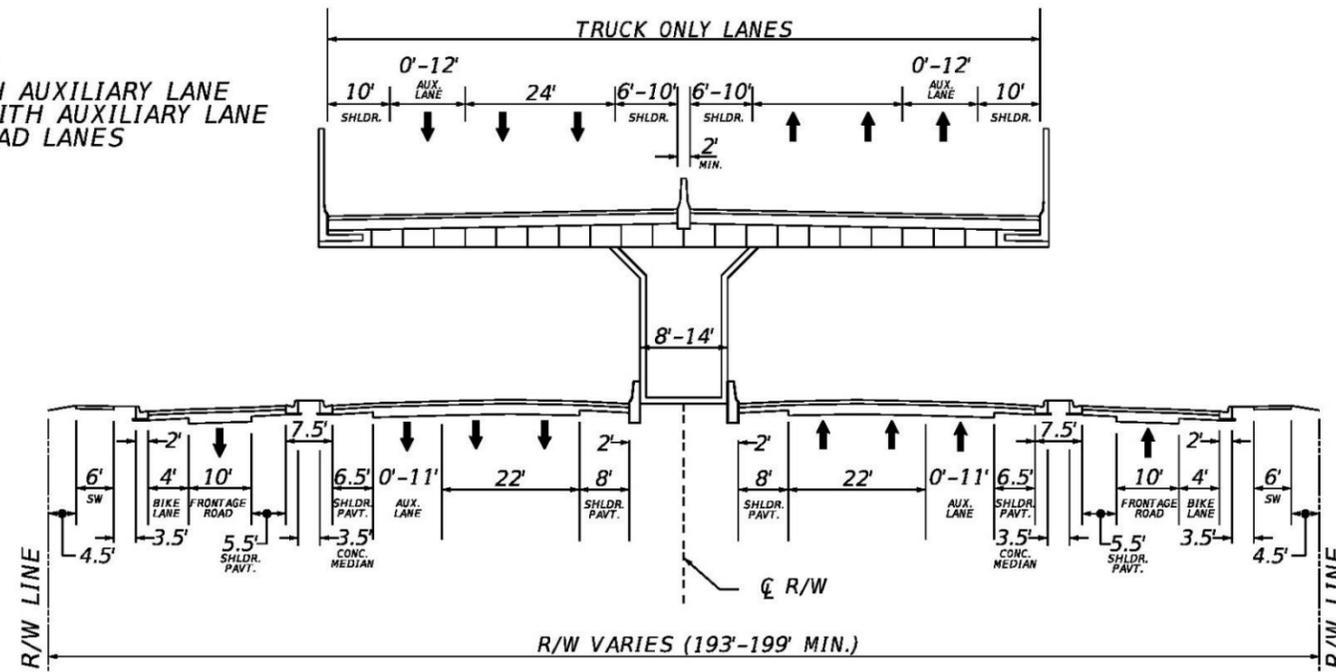


FIGURE 9  
 OPTION 2  
 NON-LIMITED ACCESS FACILITY

## **Conceptual Design Considerations For Special Purpose Truck Roadway Facilities**

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### **Concept 1—Limited Access Facilities (Figures 10 – 11)**

The schematic layouts for transitions between truck only and general use lanes on high speed limited access facilities include a dedicated 15' slip ramp terminal for both entrance (**Figure 10**) and exit (**Figure 11**) to and from the interior truck lane.

The advantage of this configuration is that it allows trucks to maintain 70 mph speed while slipping on and off the truck only lanes. It also provides a 12' recovery distance for exit and entrance and the ability to pass stalled vehicles on the ramps. Finally, it accommodates a 450' taper from a 15' lane to a 12' lane allowing more distance to merge.

The disadvantage in this concept is the creation of a weaving condition for trucks crossing mixed traffic flow lanes in order to access interchanges. As a result, considerations must be made for this weaving distance based on the speed and the number of lanes to be crossed. Weaving section lengths can vary from 1,100 feet to 3,600 feet based on freeway volumes upstream from the weaving section as well as entrance and exit ramp volumes and both freeway mainline flow speeds and exit and entrance ramp speeds.

### **Concept 2—Non-Limited Access Facilities (Figures 12 – 13)**

Slip ramps on non-limited access facilities can be more complicated if frontage roads are part of the facility. In this case, ramps to both the general use lanes and the frontage roads must be included and must have a significant distance to accommodate weaving between the truck only lanes and the frontage roads.

This concept includes the following elements:

- Dedicated 11' truck only acceleration lane entrance with a traffic separator
- Slips onto 12' truck only lanes at a 50:1 taper
- A 15' exit terminal that slips off at a 50:1 taper directly into designated 11' general use lanes
- Frontage road slip ramp terminal exits into a 11' general use lane
- Frontage road entrances slips on a 50:1 taper on top a 10' wide 450' long merge lane with a 50:1 taper.

The advantages of this concept allows for trucks to bypass general use traffic at a higher speed of 55 mph and there is no acceleration/deceleration distance need for traffic movements between general use lanes and the frontage roads.

The disadvantage of this concept is the creation of a weaving condition for trucks crossing the mixed flow lanes to access the frontage roads or ramps at interchanges. Weaving section lengths can vary from 1,100 feet to 3,600 feet based on freeway volumes upstream from the weaving section as well as entrance and exit ramp volumes and both freeway mainline flow speeds and exit and entrance ramp speeds.

LIMITED ACCESS FACILITY  
EXIT SLIP RAMP  
(DESIGN SPEED 70 MPH)

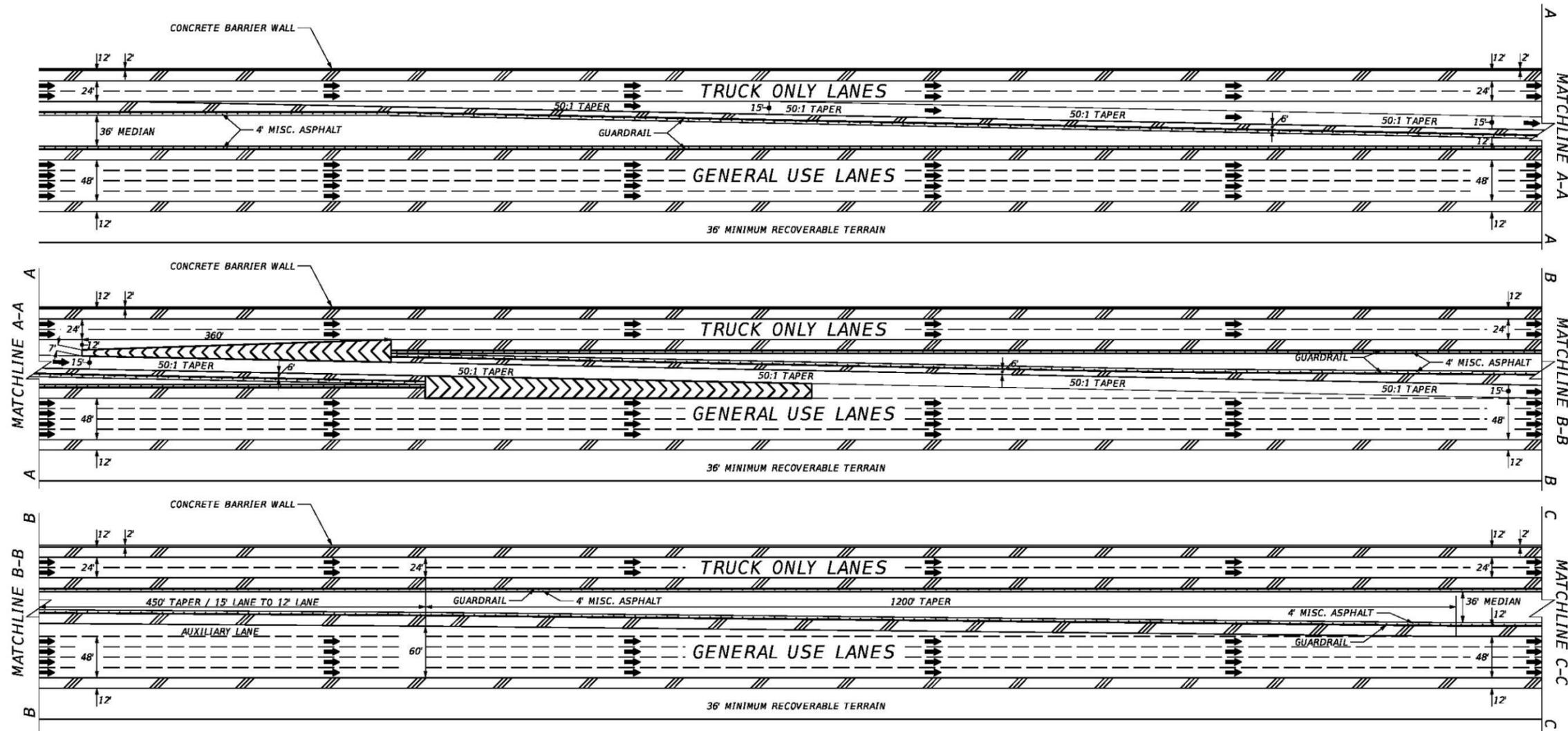


FIGURE 10  
CONCEPT 1 (ENTRANCE)  
LIMITED ACCESS FACILITY

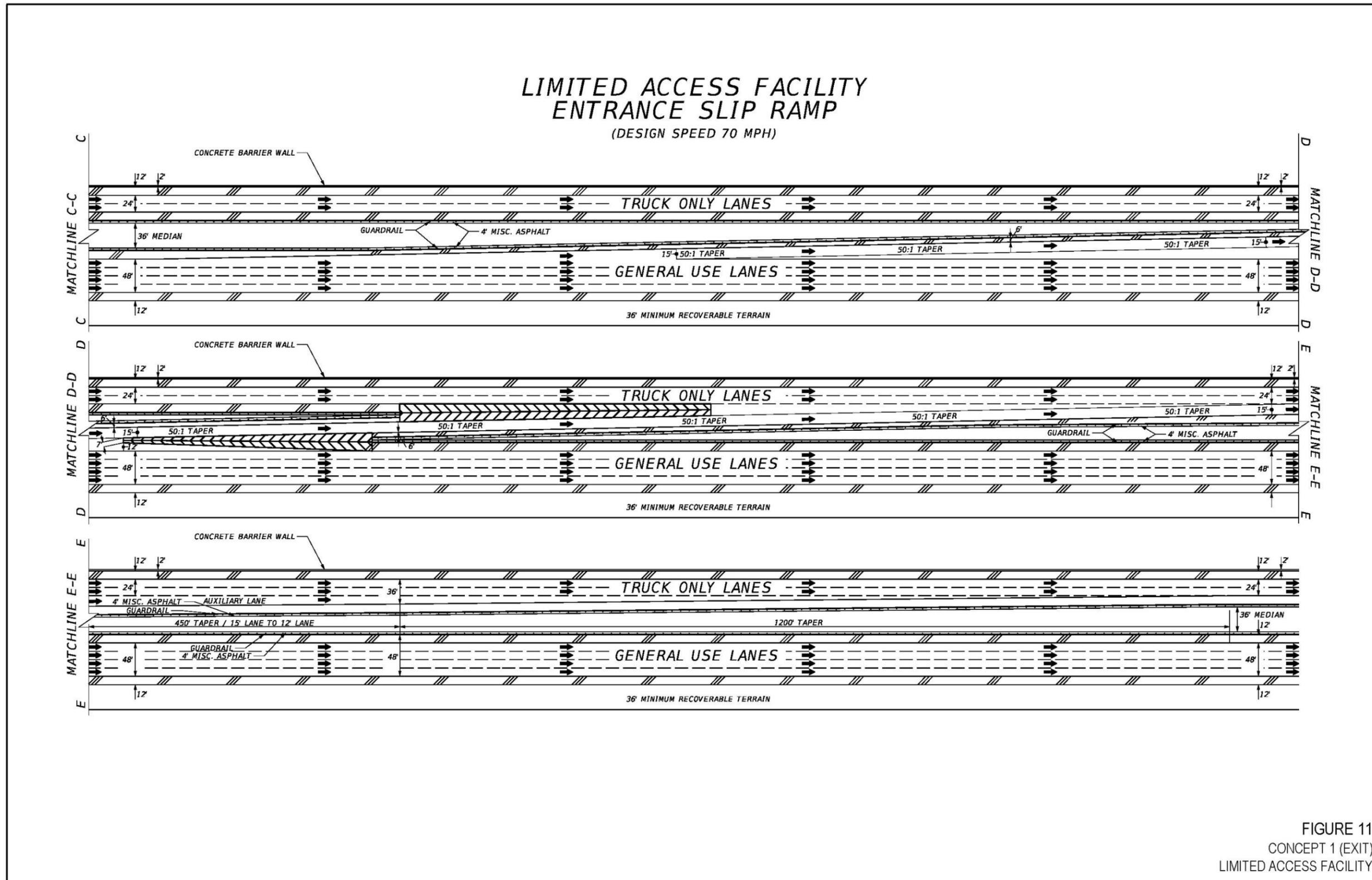


FIGURE 11  
CONCEPT 1 (EXIT)  
LIMITED ACCESS FACILITY

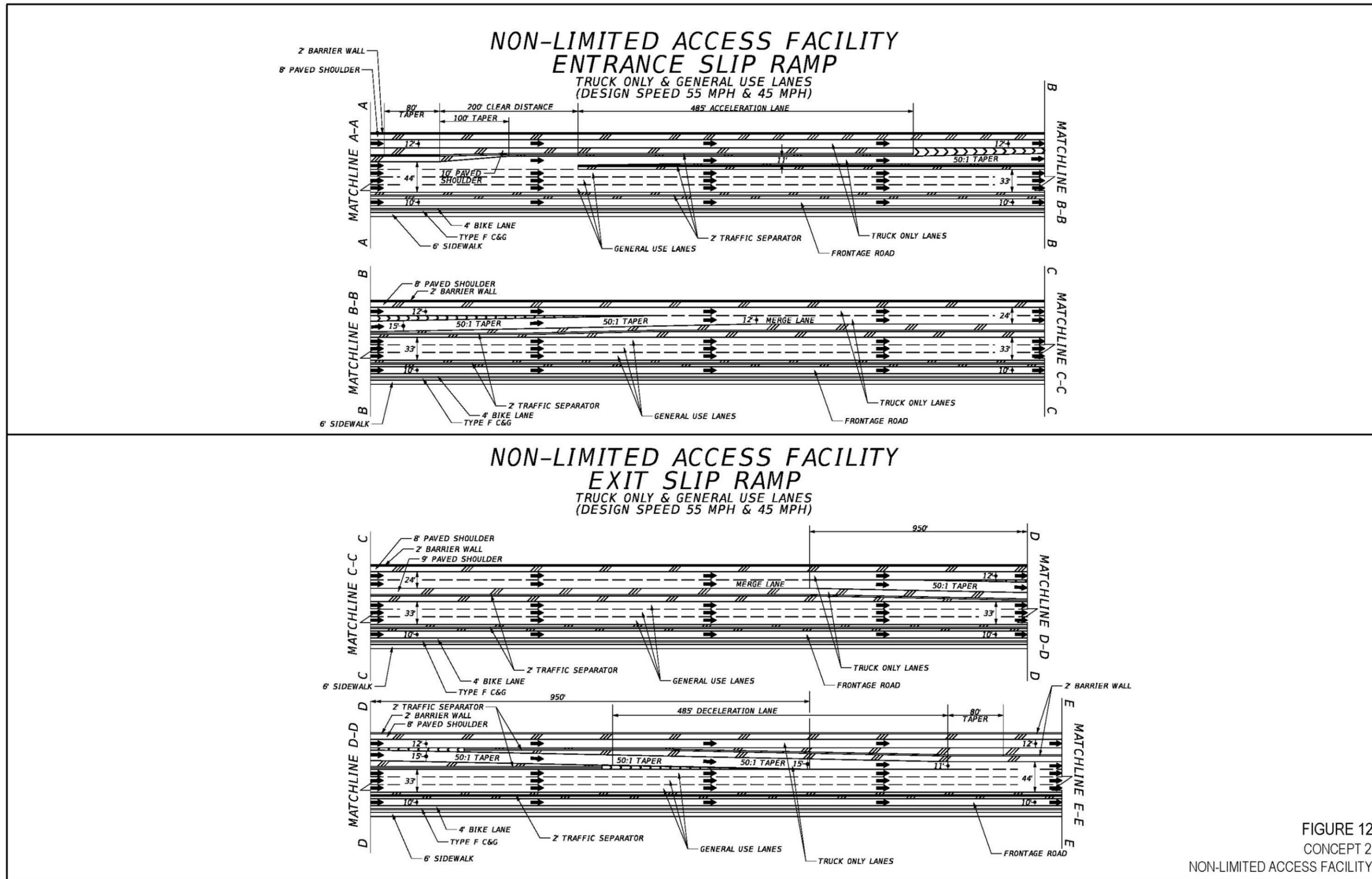


FIGURE 12  
CONCEPT 2  
NON-LIMITED ACCESS FACILITY

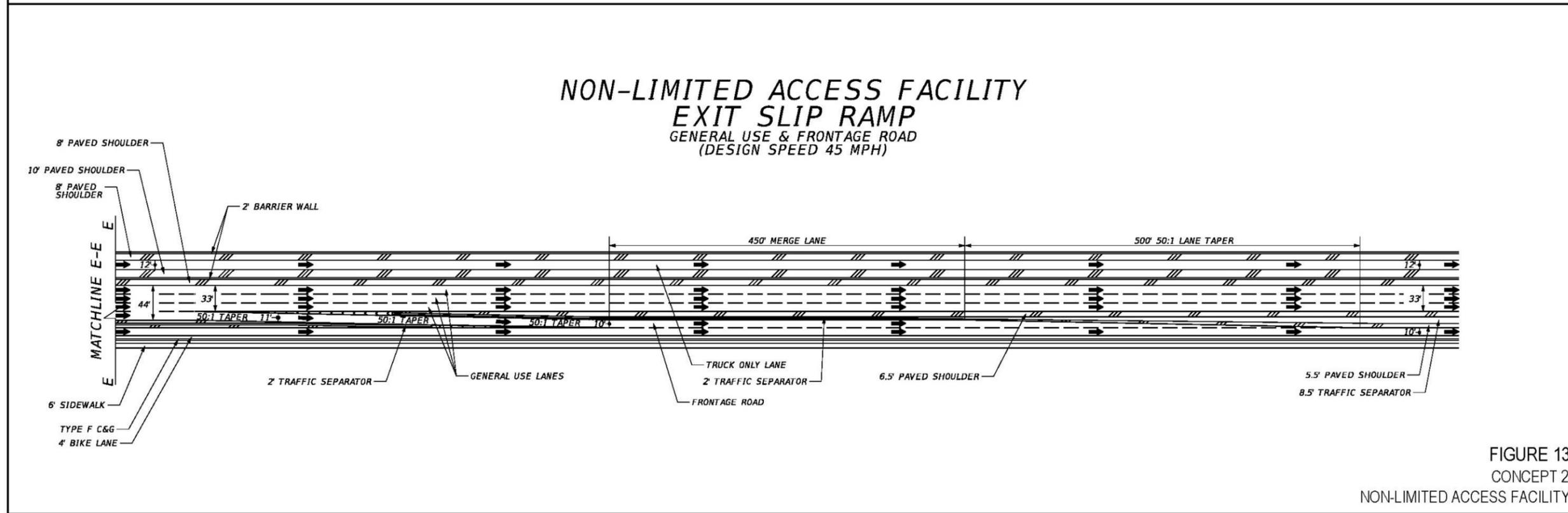
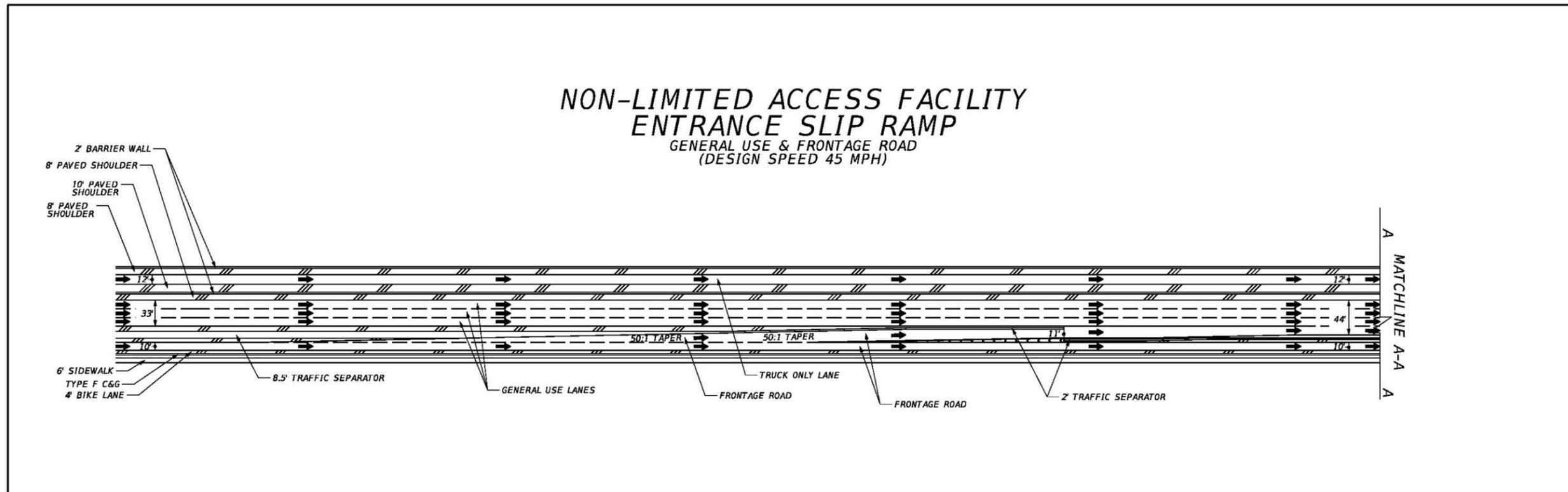


FIGURE 13  
CONCEPT 2  
NON-LIMITED ACCESS FACILITY

### **Direct Truck Only Lane Exit/Entrance Ramp Concepts (Figure 14A-E and Figure 15A-E)**

A major contributor to congestion occurs when separated express lanes (sometimes developed as exclusive truck lanes) use slip ramps for entry and exiting to mixed flow lanes to access exit ramps or to go from entry ramps to the express lanes. This results in a weaving action that can be unsafe to both truck drivers and mixed flow traffic. To mitigate this situation direct exit/entrance ramps to the separated lanes offer a safer solution because they do not interfere with the mixed flow lanes.

Three options are discussed below.

- Option 1A. Limited Access to Limited Access Ramps.
- Option 1B. Interchange Bypass
- Option 2A. Limited Access to Non-Limited Access ramps (New Jersey Turnpike method)
- Option 2B. Limited Access to Non-Limited Access (Seattle method)

#### **Option 1A Limited Access to Limited Access Ramps (Figure 14A–E)**

Option 1A assumes an interchange connecting two limited access highways with one highway containing the truck only lanes. Option 1A includes a joint use exit ramp from the median between the general use lanes and the truck only lanes. The exit ramps join in the center as a two lane ramp eventually splitting to two directional overhead ramps that connect to the crossing limited access facility. This concept includes:

- 12' barrier separated truck only and general use through lanes with 10' inside and outside shoulders
- 11' exit slip ramps from the truck only lanes and the general use lanes
- Two 11' barrier separated exit lanes dividing into single 11' directional grade separated ramps with 10' inside and outside shoulders.
- A total of eight exit and entrance ramp bridges

The primary advantage of Option 1 is the use of the median to merge the exits from the truck and the general use lanes into a single two-lane ramp that affords access to opposing directions of the crossing limited access facility at highway speeds. ROW is minimized as there is no requirement for outside general use exit ramps.

The disadvantages of this concept is the interweaving of trucks and automobiles prior to reaching the directional split in the exit ramps and the additional grade separated bridges required to connect to and from the crossing highway in all directions. This concept also requires an extensive drainage system.

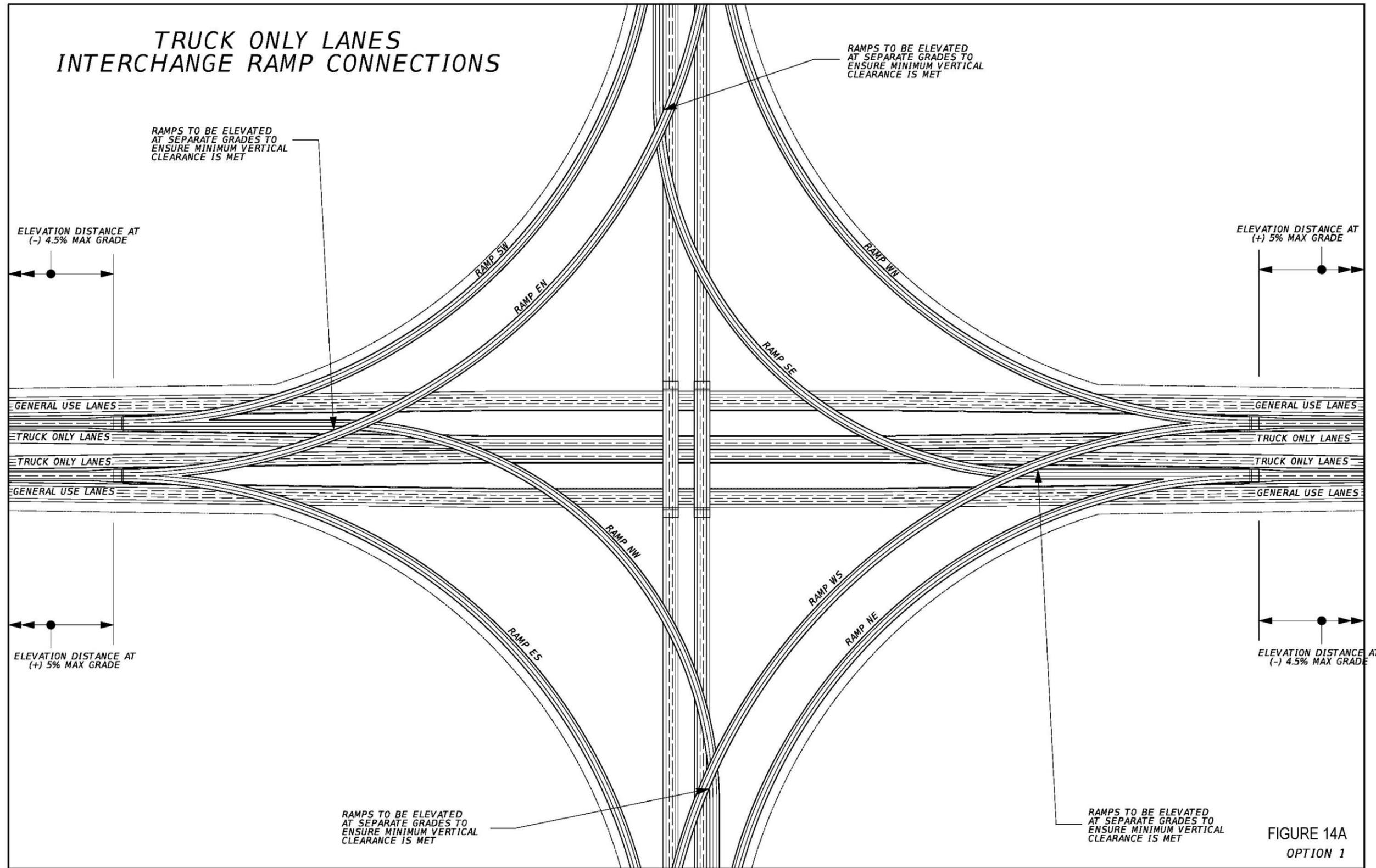


FIGURE 14A  
OPTION 1

# TRUCK ONLY LANES INTERCHANGE RAMP CONNECTIONS

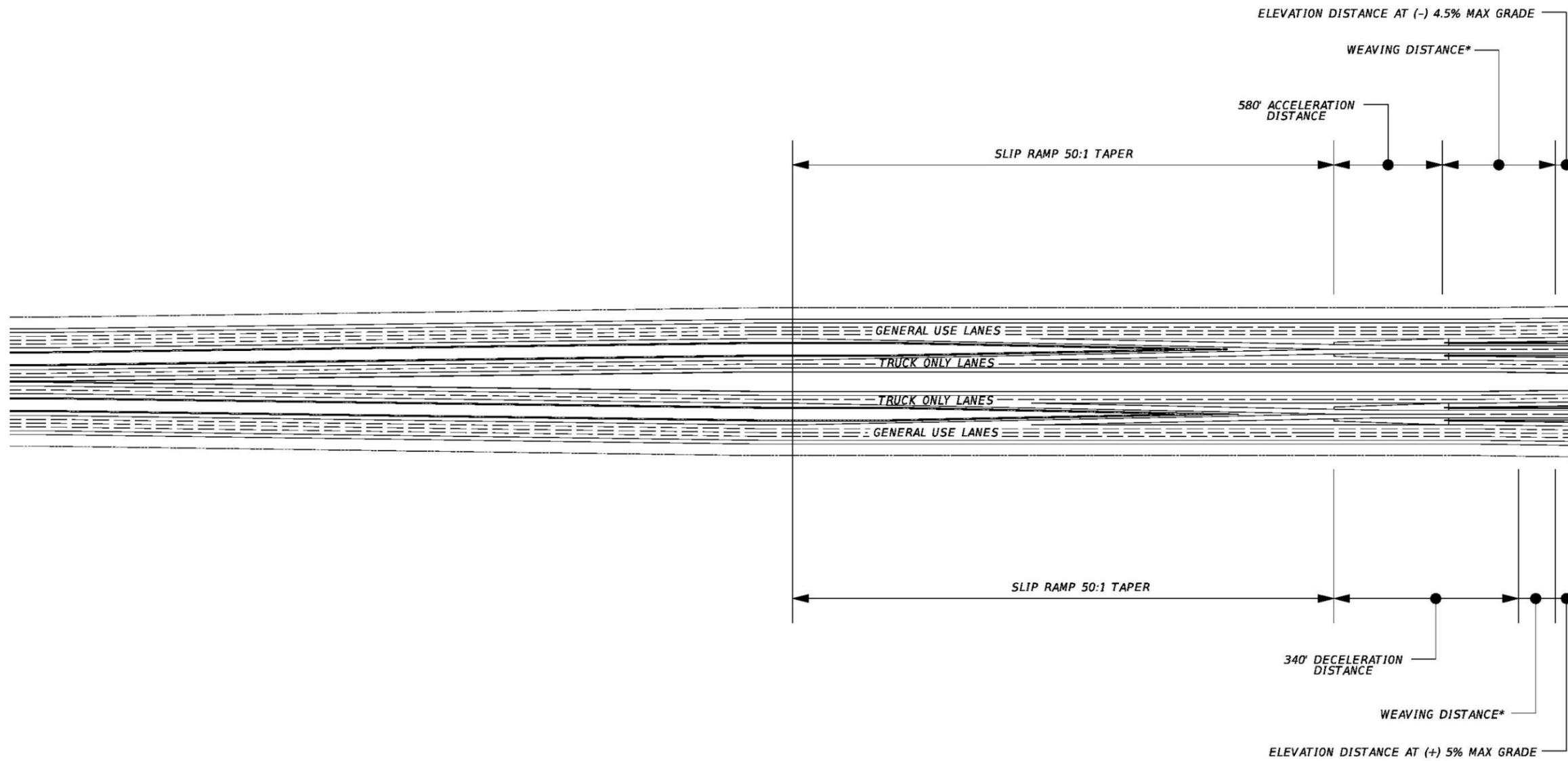


FIGURE 14B  
OPTION 1

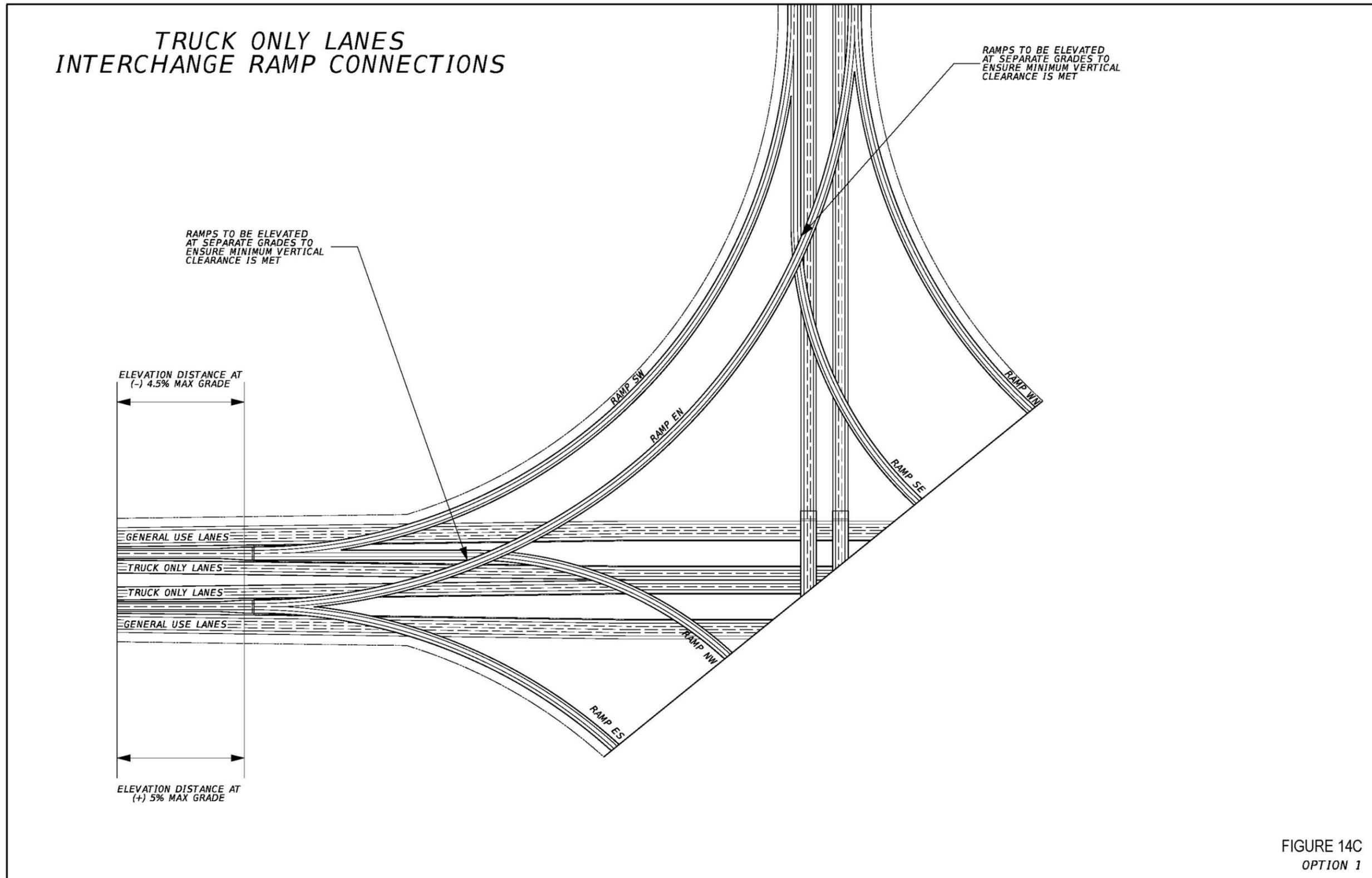


FIGURE 14C  
OPTION 1

# TRUCK ONLY LANES INTERCHANGE RAMP CONNECTIONS

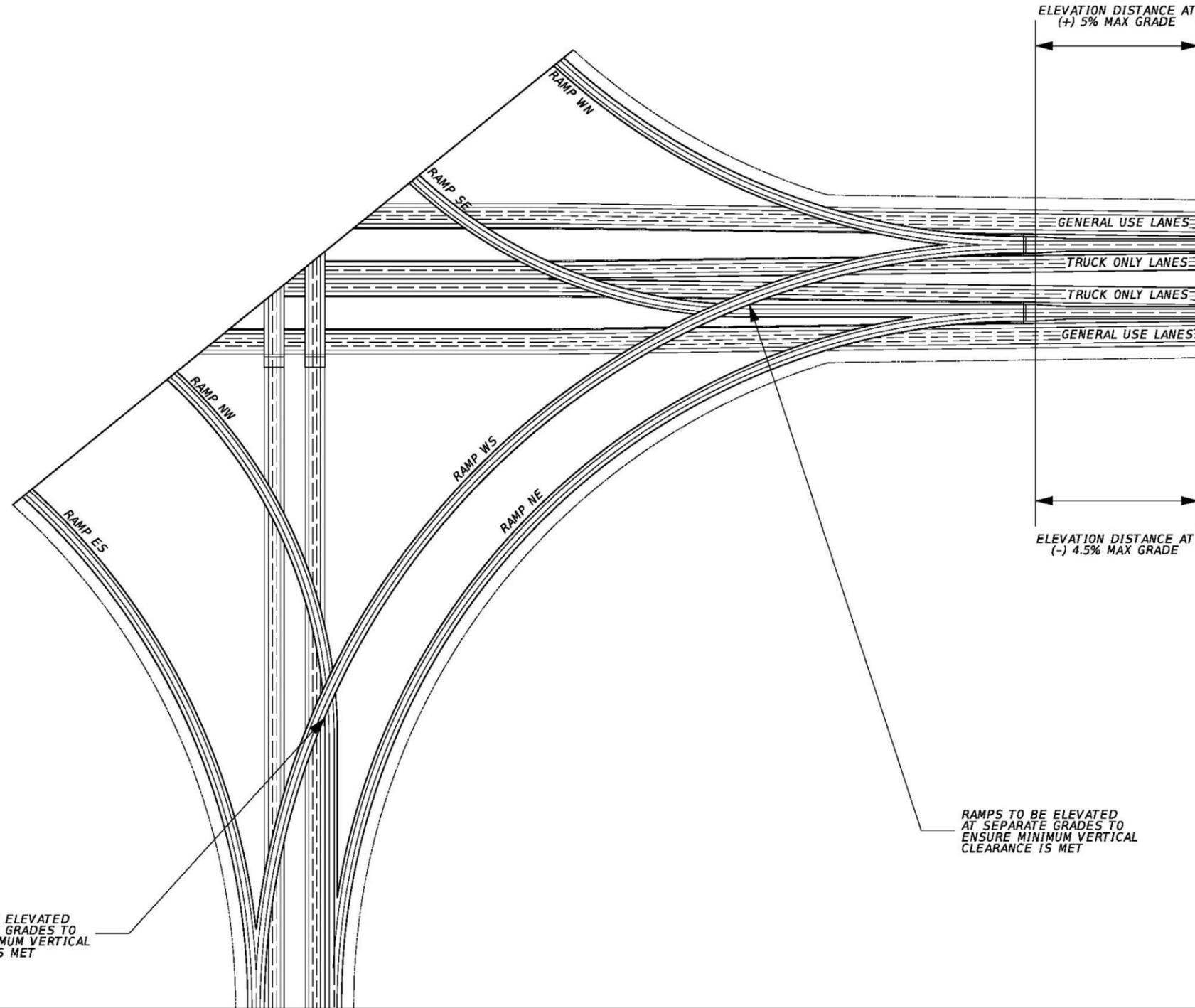


FIGURE 14D  
OPTION 1

# TRUCK ONLY LANES INTERCHANGE RAMP CONNECTIONS

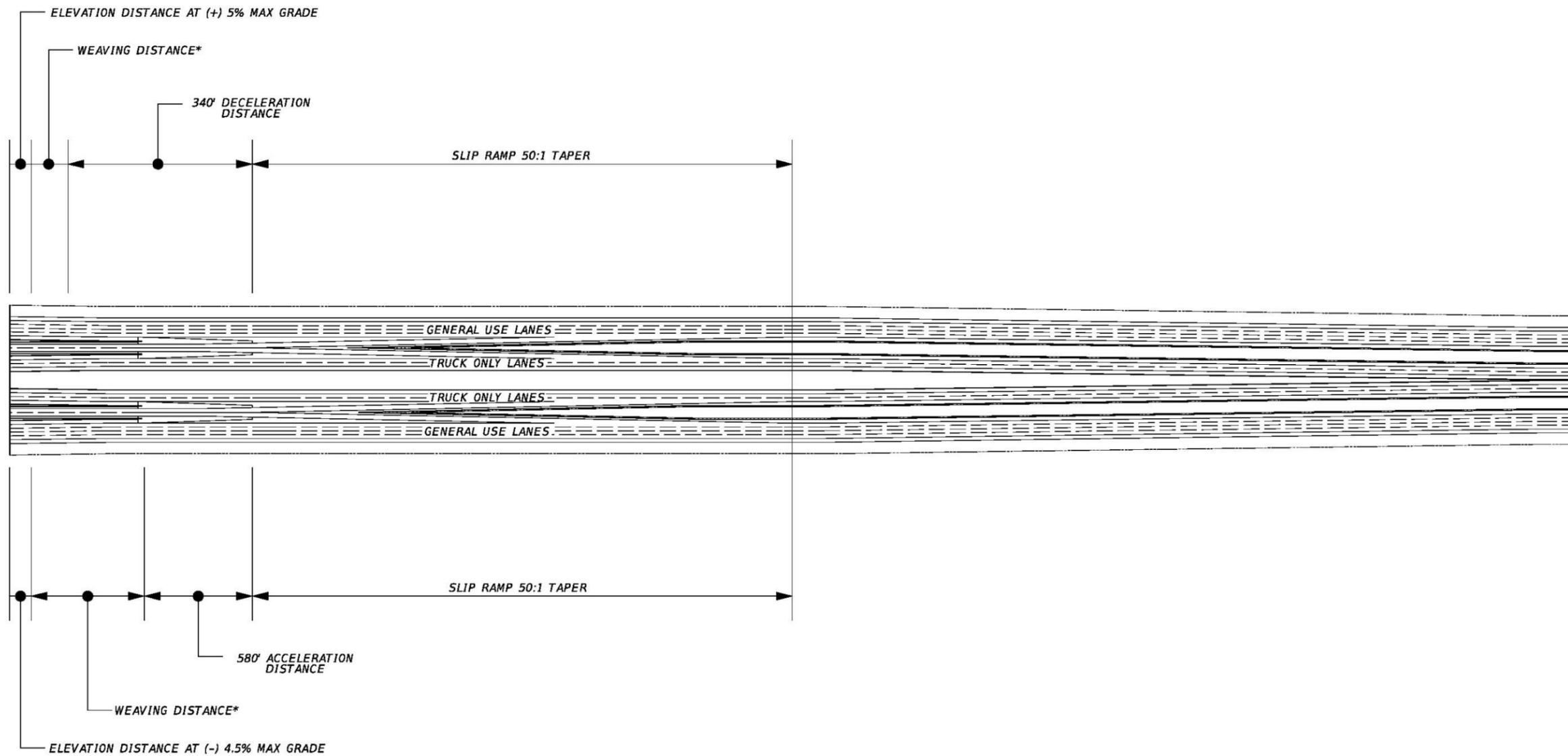


FIGURE 14E  
OPTION 1

### **Option 1B Truck Interchange By-Pass Lanes (Figures 15A-E)**

Option 1B is similar in design to Option 1A with one exception. The truck only lanes are through lane only without exit/entrance ramps. The purpose of this design is to provide truck only by pass lanes at interchanges not requiring truck access or to restrict access to the truck only lanes for a longer distance through a congested urban area with numerous interchanges accessing local streets. This concept includes:

- 12' barrier separated truck only and general use through lanes with 10' inside and outside shoulders
- 11' exit slip ramps from the general use lanes only
- A single 11' barrier separated exit lane dividing into single 11' directional grade separated ramps with 10' inside and outside shoulders.
- A total of eight exit and entrance ramp bridges

The primary advantage of this concept is truck throughput speed due to the separation of through trucks from local trucks and the general use lanes. A secondary advantage of Option 1B is the use of the median separating the truck only from the general use lanes for the inside access exit and entrance ramps. Although the exit and entrance ramps could be configured from the outside with four flyover ramps (instead of eight) splitting and merging to the four at-grade ramps, Option 1B presents a tighter configuration that uses less ROW and shorter bridge spans.

The disadvantage of this concept is that trucks needing access to exit ramps would be required to use the general use lanes, which may be congested especially during peak commuting periods.

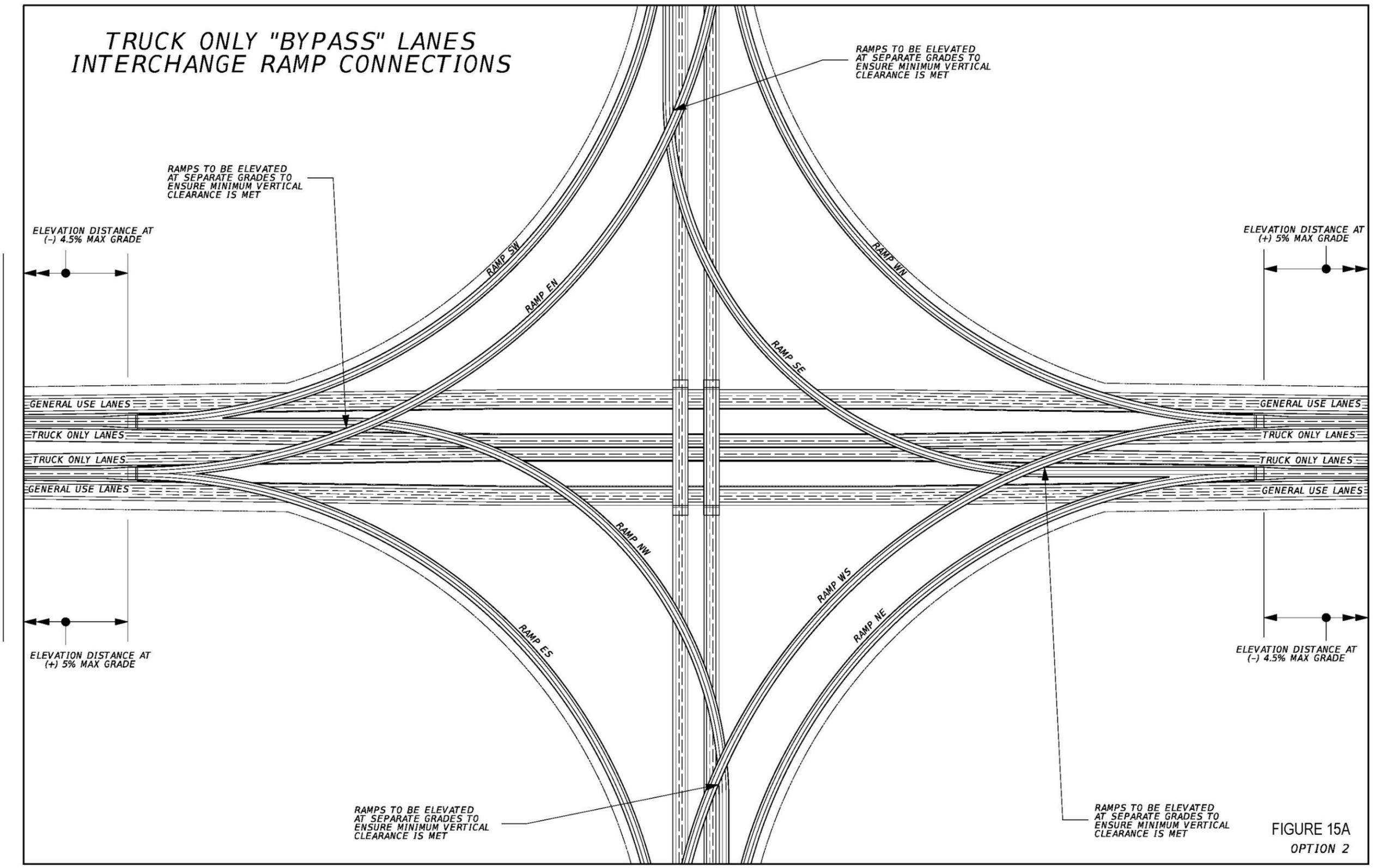


FIGURE 15A  
OPTION 2

# TRUCK ONLY "BYPASS" LANES INTERCHANGE RAMP CONNECTIONS

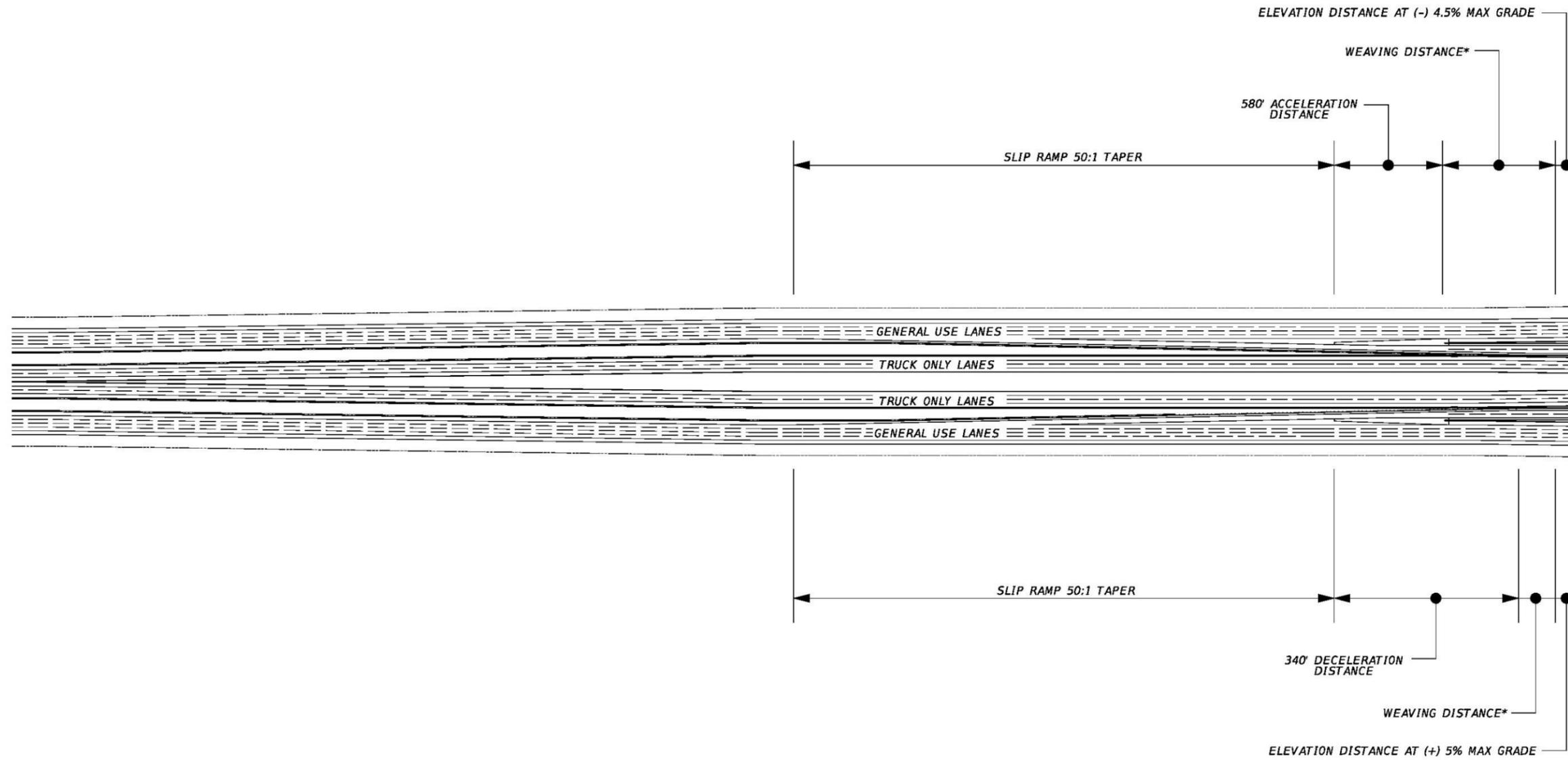


FIGURE 15B  
OPTION 2

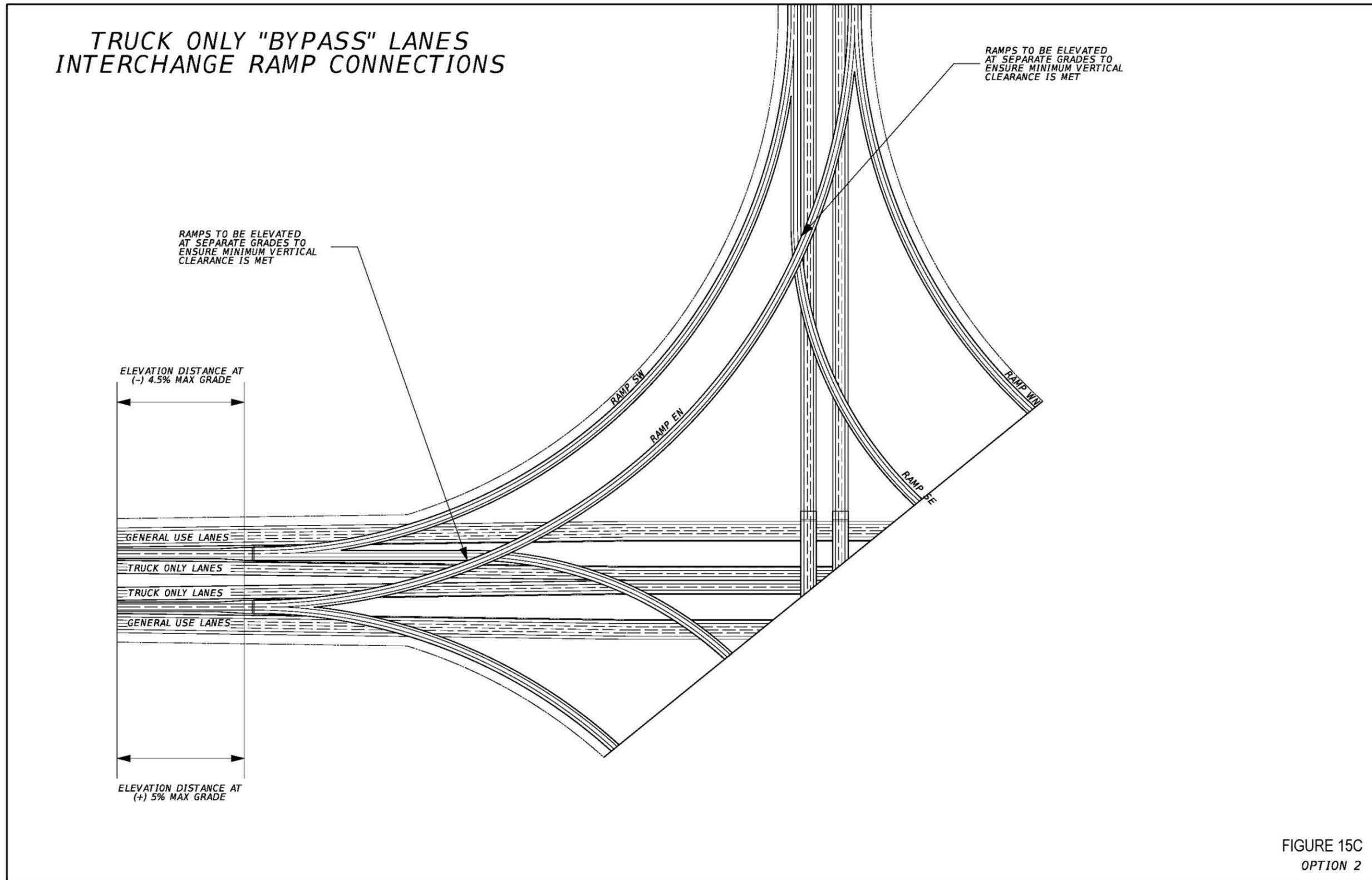


FIGURE 15C  
OPTION 2

# TRUCK ONLY "BYPASS" LANES INTERCHANGE RAMP CONNECTIONS

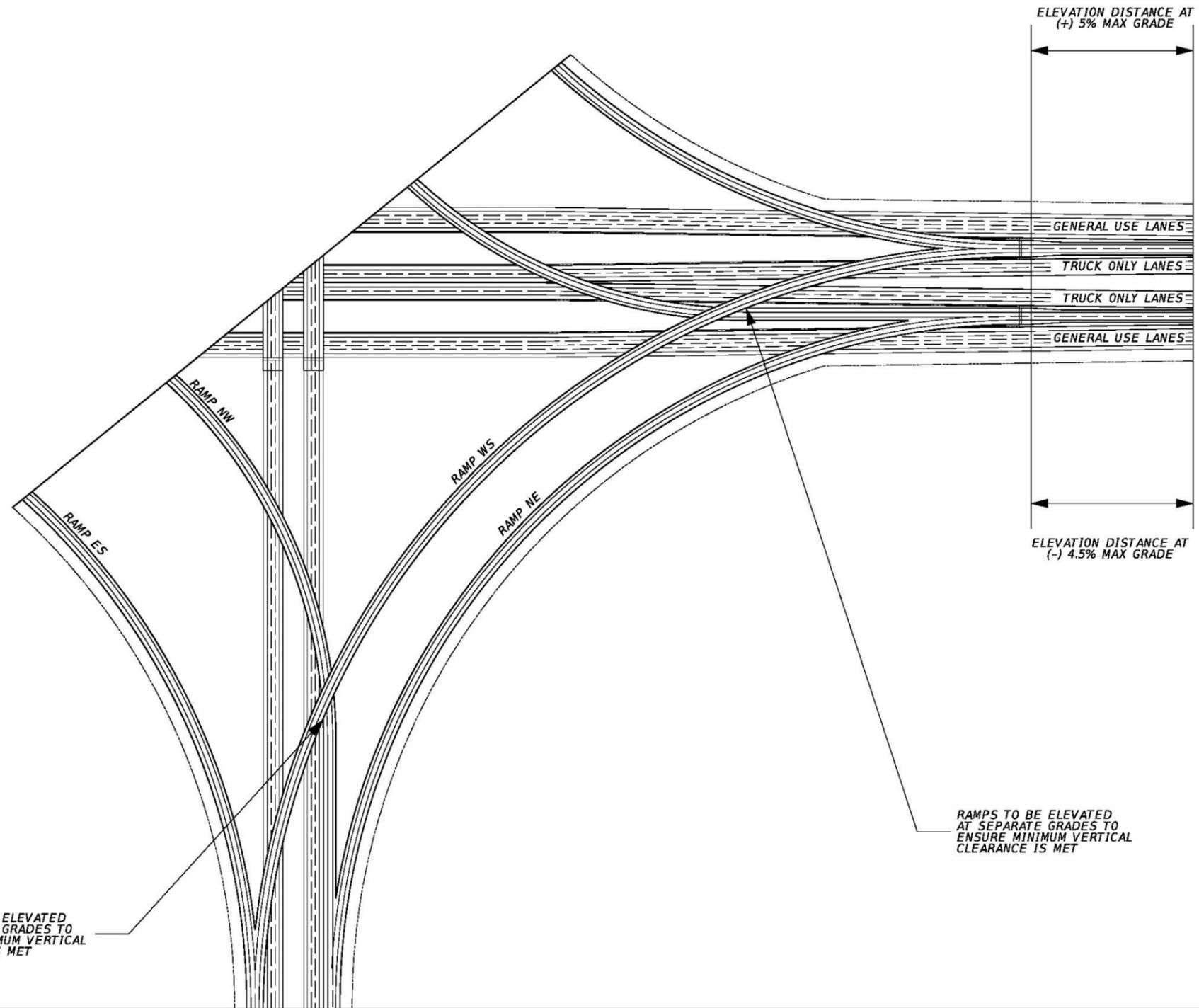


FIGURE 15D  
OPTION 2

# TRUCK ONLY "BYPASS" LANES INTERCHANGE RAMP CONNECTIONS

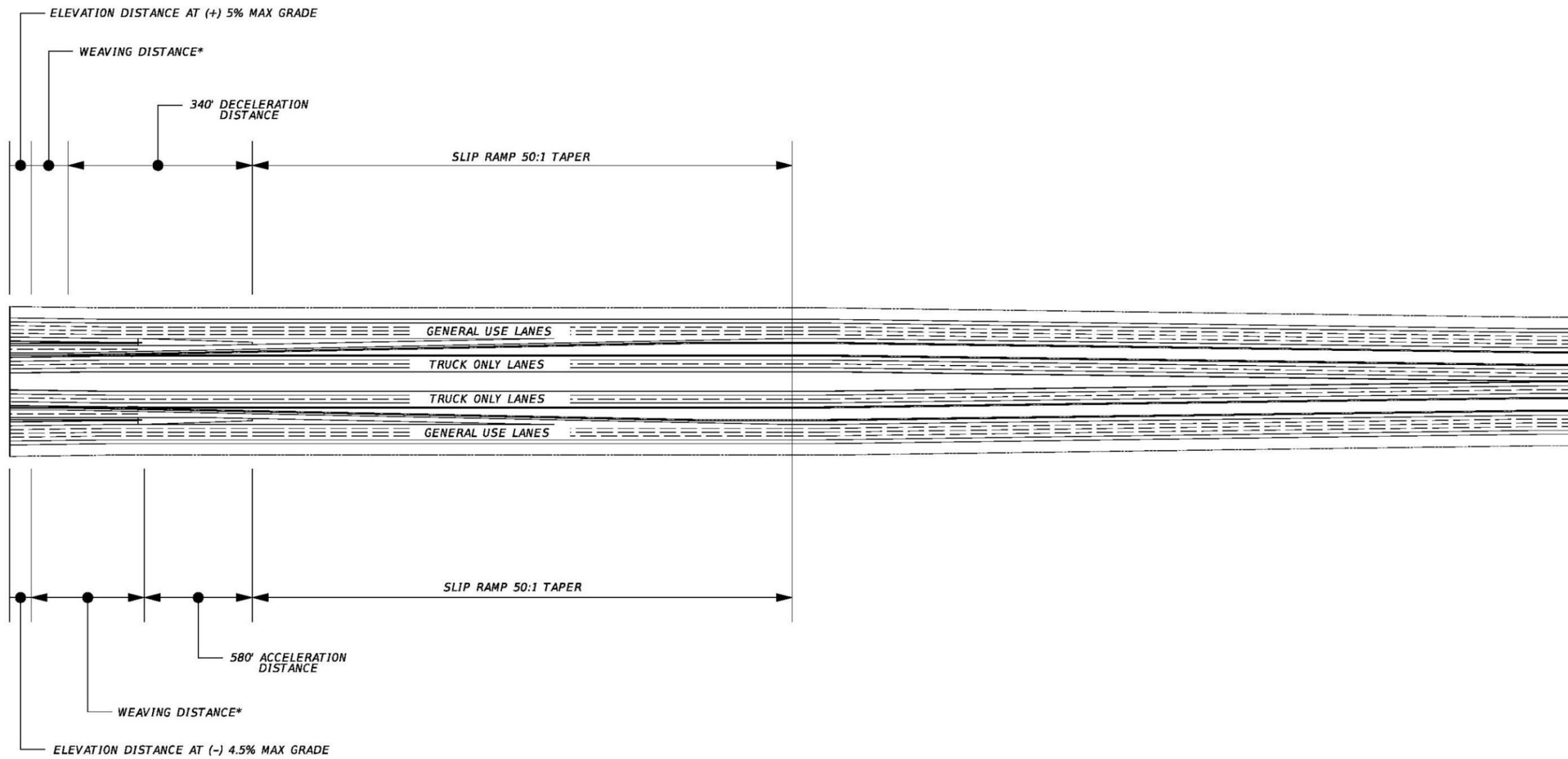


FIGURE 15E  
OPTION 2

## **Conceptual Design Considerations For Special Purpose Truck Roadway Facilities**

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### **Option 2A Limited Access to Non-Limited Access Ramps (New Jersey Turnpike Method)**

Option 2A includes the following features (**Figure 16 Aerial Photo**):

- Directional 12' ramps with 10' emergency shoulder from the inside truck only lanes that bridge the outside mixed-use lanes eventually merging with the outside exit ramps.
- Directional 12' entrance ramps with a 10' emergency shoulder that diverges from the outside lane entrance ramp and bridge the mixed-use lanes.
- Cross road access at a single traffic signal.

This option has several advantages. First, it eliminates the use of slip ramps and weaving through several lanes of traffic to reach the exit ramp. Next, it provides for a single point of access via a signalized intersection on one end of the cross road bridge. Finally, the grade-separated ramps are much safer than the slip ramp/weave method.

The disadvantage of this option is the number of bridges required (five) to flyover the mixed flow lanes as well as the main bridge for the cross road. Secondly, the amount of additional ROW required that adds to the overall cost.

### **Option 2B Limited Access to Non-Limited Access Ramps (Seattle Method)**

Option 2B is a simplified variation of 2A. In Seattle, the High Occupancy Vehicle (HOV) lanes as well as the reversible express lanes use variations of this inside lane ramp system. **Figure 17** shows an aerial view that illustrates this option. Option 2 B includes the following features:

- Bi-directional 12' barrier separated on/off ramps within the median or the inside lane.
- A "T" or "L" configuration at the top of the ramps connecting to a bridge over the mixed flow lanes on one side of the mainline (Half-bridge) or over both side of the mainline (full bridge).
- Connection to a parallel surface street that connects to the arterial cross road at a signalized intersection.

The advantages of this option include the use of a single, two-way ramp located within the median, the reduction from nine bridges as shown in Option 1A to two or three in this option. This option can be used with either a barrier separated system or a non-barrier separated truck lane in place of the HOV lane. In addition, ROW acquisition is minimized, which helps reduce costs.

The disadvantages include access to the cross road via one or two signalized intersections.



Figure 16: New Jersey Turnpike Method for Limited Access to Non-Limited Access Ramps

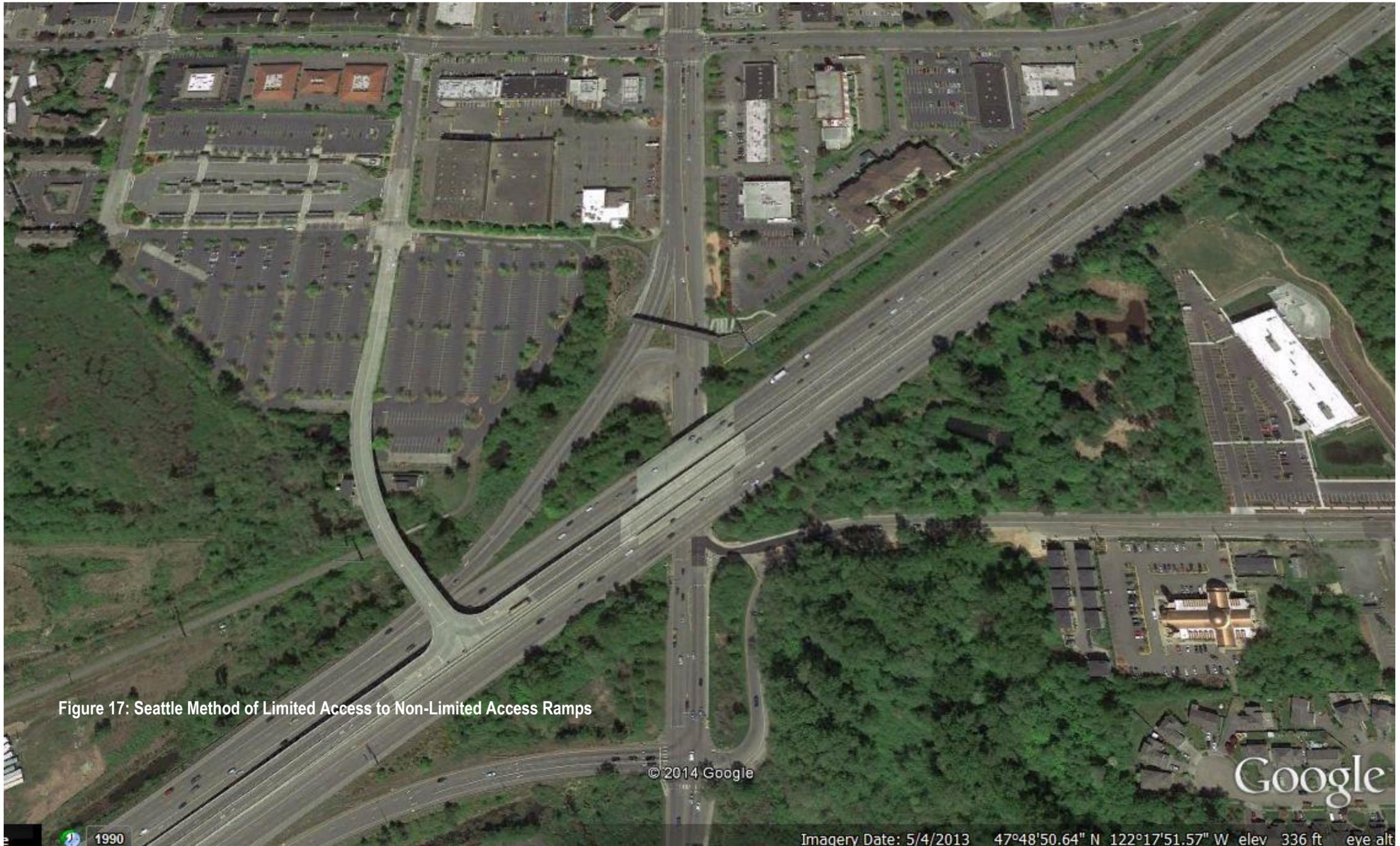


Figure 17: Seattle Method of Limited Access to Non-Limited Access Ramps

## **SUMMARY**

The concept drawings provided in this White Paper are a sampling of potential options for incorporating exclusive truck lanes. Each has its advantages and disadvantages relating to access between the general use lanes and the truck only lanes, weaving conditions between entry and exit ramps, direct truck lane only interchange ramps, inside versus outside truck only lanes, and safety for both trucks and other vehicles. Additional considerations include right-of-way requirements, overall construction costs, and potential revenue stream should the lanes be tolled.

The primary advantages of truck only lanes are improved travel time reliability of truck movement through congested areas including major interchanges where through trucks can proceed unimpeded by exiting and merging traffic. Additionally, physically separating trucks from smaller vehicles could provide an element of safety by reducing severe truck/auto related collisions.

The conceptual designs illustrated in this White Paper considered operational aspects such as design speed, access, safety and stabilized traffic flow. The design concepts also addressed horizontal clearance, clear zone, as well as other roadside safety factors and drainage that might be applied to freeway segments in the Tampa Bay Region. Finally, the planning issues associated with truck only lanes are discussed in a related White Paper, which include implementation criteria and potential application locations within the Tampa Bay area.