Audible & Vibratory Treatment: Arterials and Collectors

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Audible & Vibratory Treatment: Arterials and Collectors

Webinar Topics:

- Introduction
  - Standard Plans Process
  - Terminology
- Overview of results from Developmental Phase
- Roadway Design Bulletin 18-03
  - Standard Plans
  - FDOT Design Manual (FDM)
  - Basis of Estimates (Pay Items)
- Typical Scenario Renderings
- Project-Specific Examples

Audible & Vibratory Treatment: Arterials and Collectors

Standard Plans process and procedures are now clearly described in FDM 115:

FDOT Design Manual

To view the Implementation Bulletin for the 2018 FDM, please see **RDB17-12**

Development and Processes - Complete FDM Part 1 (*Link*)

Chapter	Errata	Bulletin	Webinar	Description
				Introduction
100			Webinar	Introduction
Link			Webinar	Context Classification
102				Glossary of Terms
103	12/01/17			Standard Forms
104				Public Involvement
105				Aesthetic Design
106				Exempt Public Documents
				Plans Development Processes
110				Initial Engineering Design Process
111				Final Engineering Design Process
112				Update Engineering Design Process
113				Right of Way Requirements
114			Webinar	Resurfacing, Restoration, and Rehabilitation (RRR)
115	12/27/17		Webinar	Standard Plans and Standard Specifications
116				Roundabout Evaluation (**Evaluation Forms**)
				Plans Submittal, Review, and Processing
120			Webinar	Design Submittals

Audible & Vibratory Treatment: Arterials and Collectors

Terminology:

- Rumble Striping
  - Ground-in Rumble Strip is in-line with pavement marking
- Rumble Strips
  - Refers to the ground-in rumble strip only, regardless of location of pavement marking
  - With new policy, either condition could be specified
- Profiled Thermoplastic
  - Thermoplastic bumps are always in line with thermoplastic pavement marking
- Audible and Vibratory Treatment (AVT)
  - General term which refers to both Ground-in Rumble Strips and Profiled Thermoplastic

Audible & Vibratory Treatment: Arterials and Collectors

Steps taken since the initial release of Rumble Striping:

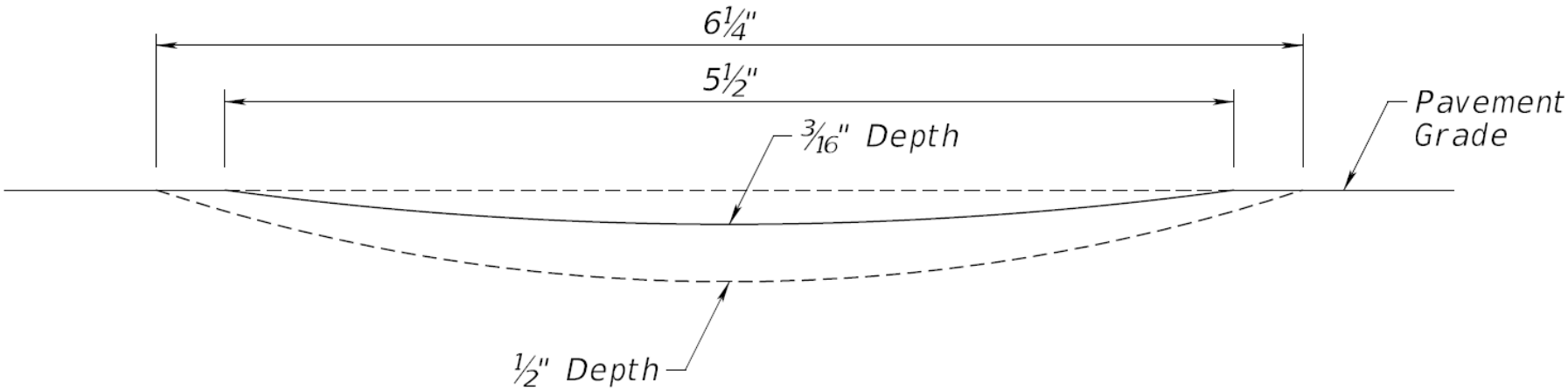
- Released Roadway Design Bulletin 16-07
  - Pulled the Design Standard back to a Developmental phase
  - Reduced the depth of the cylindrical patterns from ½" to 3/16"
  - Created new details to move rumble strips into shoulder where possible
  - Reviewed all projects in design and construction for context, made adjustments to reduce noise pollution based on context
- Performed noise testing on various patterns and depths
- Researched what other states are doing to reduce noise pollution
- Used experience gained in the noise testing and the review of all projects to draft the policy
- Worked closely with Districts to ensure policy met their needs
- Studied optional ground-in sinusoidal patterns to further reduce noise pollution

* Note: These requirements are applicable to flush-shoulder arterials and collectors with a posted speed of 50 MPH or greater; All rigid shoulder roadways will use Profiled Thermoplastic.

Audible & Vibratory Treatment: Arterials and Collectors

Depth of Cylindrical Rumble Strips for Arterials and Collectors:

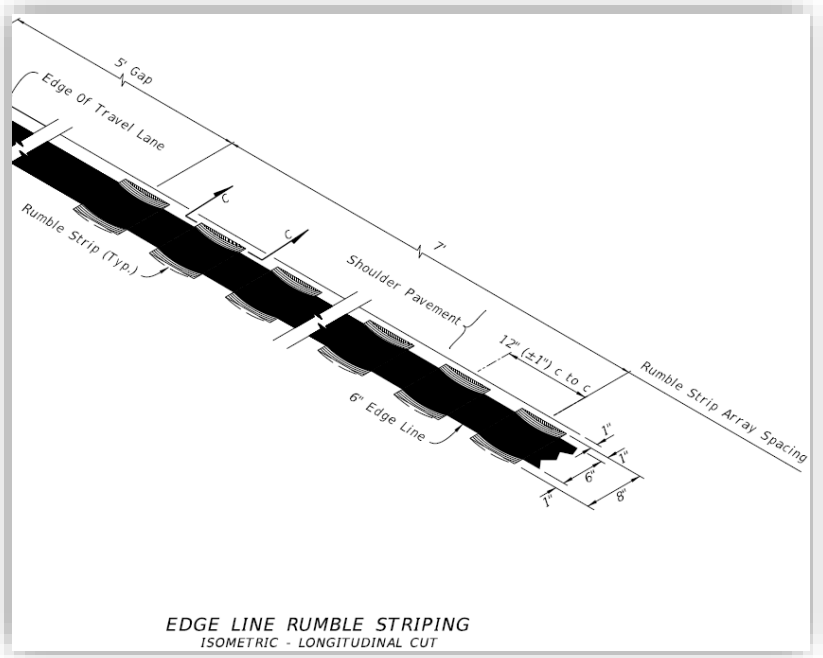
- Depth has been reduced from 1/2” to 3/16”
- Approx. 6 decibels above typical road noise
  - Sinusoidal Rumble Strips: Approx. 4 decibels
  - Profiled Thermoplastic: Approx. 2 decibels



RUMBLE STRIP DEPTH COMPARISON DETAIL

Audible & Vibratory Treatment: Arterials and Collectors

Changes to Location of Edge Line Rumble Strips for Arterials and Collectors:



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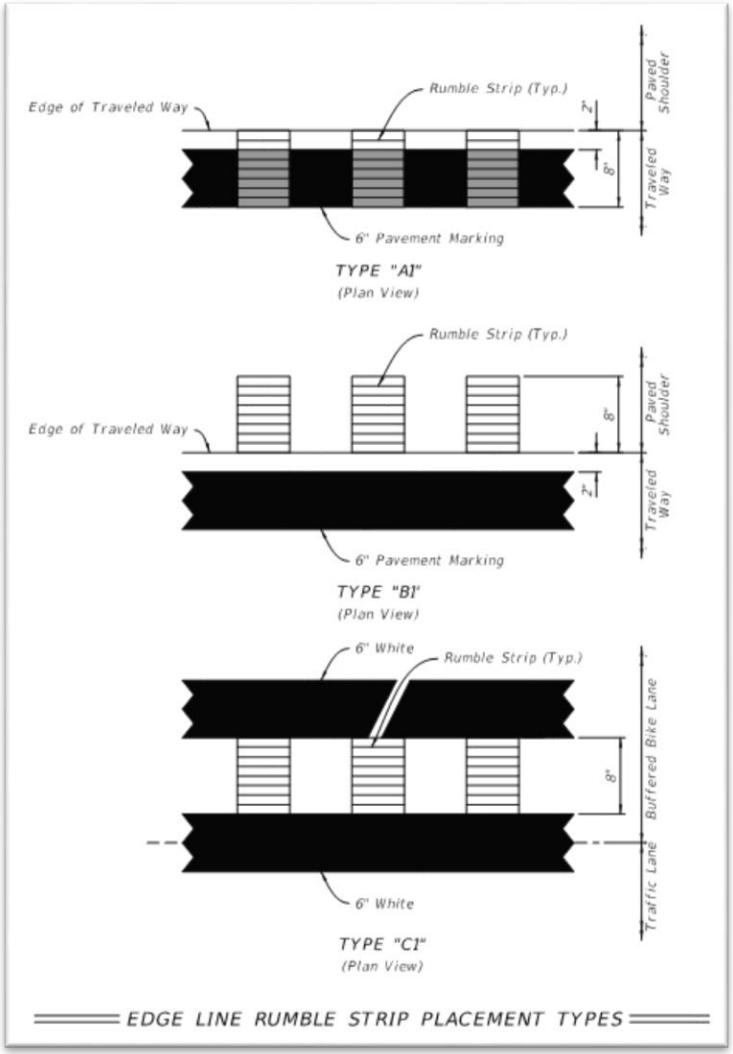
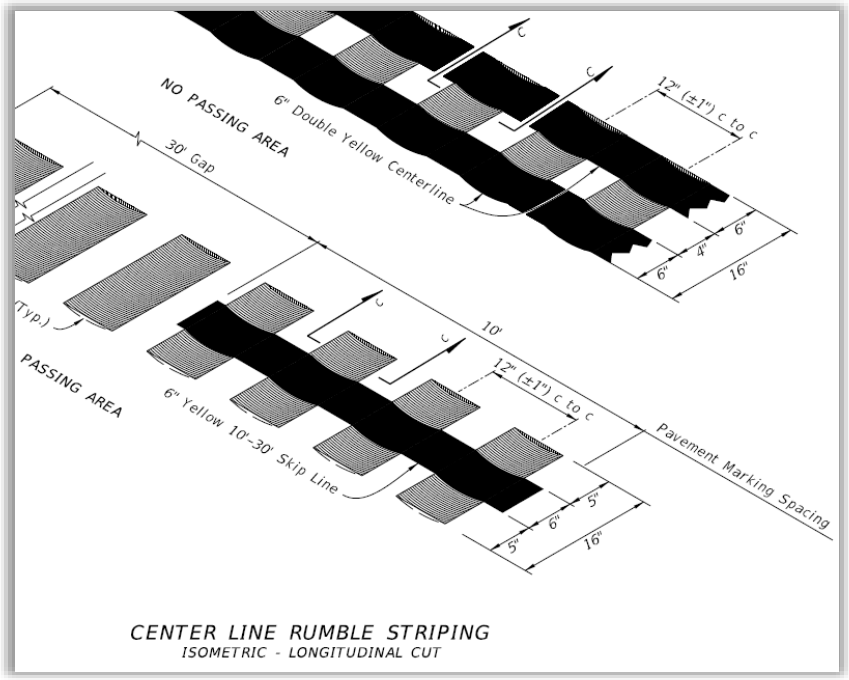


NEW

Audible & Vibratory Treatment: Arterials and Collectors

Changes to Location Center Line Ground-in Rumble Strips for Arterials and Collectors:



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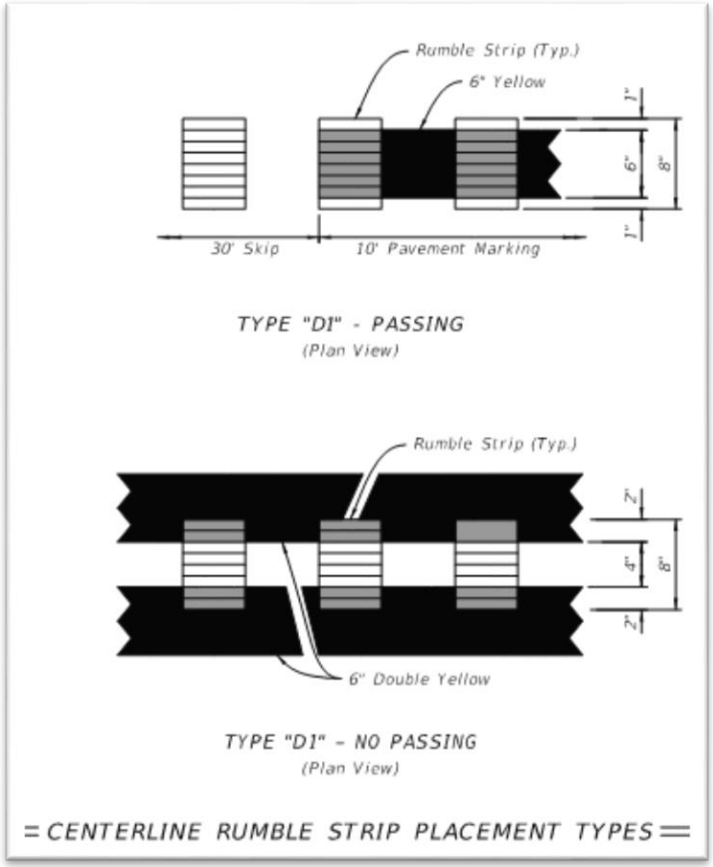


NEW

Audible & Vibratory Treatment: Arterials and Collectors

Roadway Design Bulletin 18-03:

- Released 03/14/18
- Introduced new context-based policy for the use of Audible and Vibratory Treatments on arterials and collectors
- Publications affected
  - Standard Plans (Interim Revision)
  - FDM
    - PPM (may still be used on some Design-Build projects)
  - BOE (simplified pay item structure)
- Standard Plans, Index 546-010 (Previously Design Standards, Index 518)
  - No changes to shoulder rumble strips on Limited Access Facilities
  - Added sheets for Arterials and Collectors
  - New Standard Plans Instructions
  - New “Type” designations for Arterials and Collectors

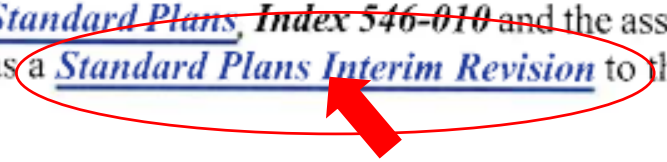
Audible & Vibratory Treatment: Arterials and Collectors

SUBJECT: Audible and Vibratory Treatments (AVTs)

This bulletin implements a new policy for the use of audible and vibratory treatments on arterials and collectors. **This new policy affects the Standard Plans, the Plans Preparation Manual (*PPM*) and the FDOT Design Manual (*FDM*).**

REQUIREMENTS FOR STANDARD PLANS

1. ***Standard Plans*, ~~Index 546-010~~** and the associated instructions have been updated and are released as a ***Standard Plans Interim Revision*** to the ***FY 2018-19 Standard Plans***.



Audible & Vibratory Treatment: Arterials and Collectors

Standard Plans for Road Construction

Standard Plans Index	Interim Revision or Errata	Index Title	Design Standards Index	Standard Plans Instructions	Design Tools	Contact
		Guardrail				
536-001	Errata	Guardrail	400	SPI	XLS	Roadway
536-002	Errata	Guardrail Transitions and Connections for Existing Bridges	402	SPI		
		Crash Cushions				
544-001		Crash Cushion Transition Details	430	SPI		Roadway
		Rumble Strips				
546-001		Raised Rumble Strips	517			Roadway
546-010	Interim	Ground-In Rumble Strips	518	SPI		

Audible & Vibratory Treatment: Arterials and Collectors

Office of Design

Office of Design / Standard Plans / Standard Plans Interim Revisions FY 2018-19

Standard Plans Interim Revisions - FY 2018-19

FDOT Standard Plans

N/A = Not Applicable
N/C = No Change
(*Site Updated: 3/16/18*)

Interim Revision Reference Number	Revised Sheets	Index Title	Design Information				
			Instructions	Design Tools	Data Table Cell Library	Borderless DGNs	Associated Design Bulletin
IR546-010-01	1-3 of 3	Ground-In Rumble Strips	SPI-546-010	N/A	N/A	N/A	RDB18-03

Audible & Vibratory Treatment: Arterials and Collectors

NOTES:

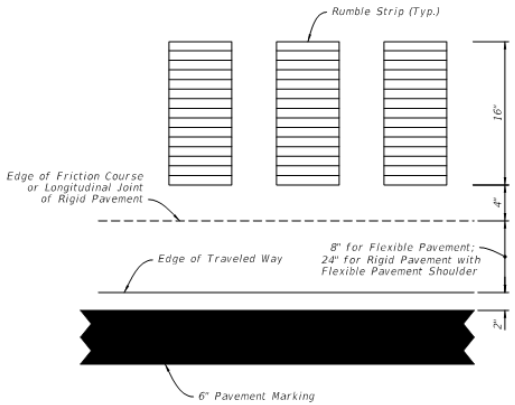
1. When friction course extends more than 8" beyond the edge of the traveled way, blade off the extended friction course to the 8" line prior to rumble strip grinding.

2. Use the continuous array on both inside and outside shoulders 1,000 feet in advance of bridge ends or back to the gore recovery area for mainline interchange bridges. Use the skip array for all other locations.

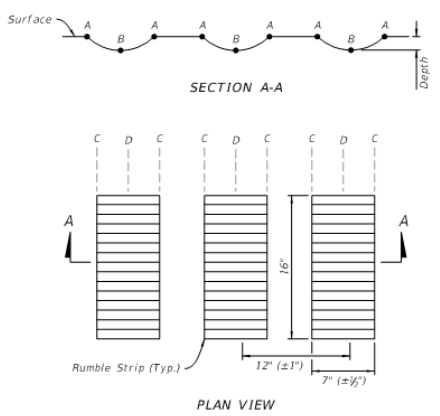
3. Exclude rumble strips at the following locations:

   A. At mainline tolling areas, terminate rumble strips at the end of the mainline normal section.
   B. At All Electronic Tolling (AET) facilities, terminate rumble strips within 50 feet of the centerline of the overhead gantry.
   C. On outside shoulders of entrance ramp terminals, terminate rumble strips at the point of the physical gore and resume at the end of the acceleration lane taper.
   D. On outside shoulders of exit ramp terminals, terminate rumble strips at the start of the deceleration lane taper and resume at the point of the physical gore.
   E. On approaches to bridges, terminate rumble strips at the approach slab joint.
   F. On either side of median crossover openings, terminate rumble strips within 400 feet.

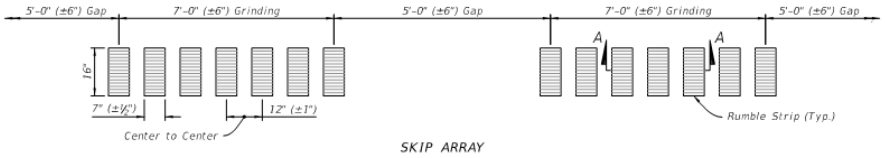
RUMBLE STRIP DEPTH TABLE	
LOCATION	DEPTH FROM SURFACE (IN.)
A	0
B	9/16 (±1/16)

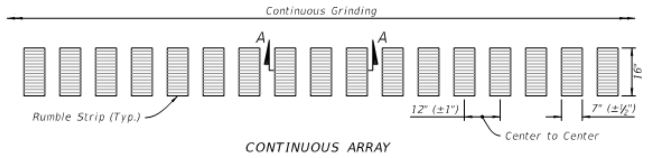


RUMBLE STRIP PLACEMENT
(Plan View)



RUMBLE STRIP DETAILS





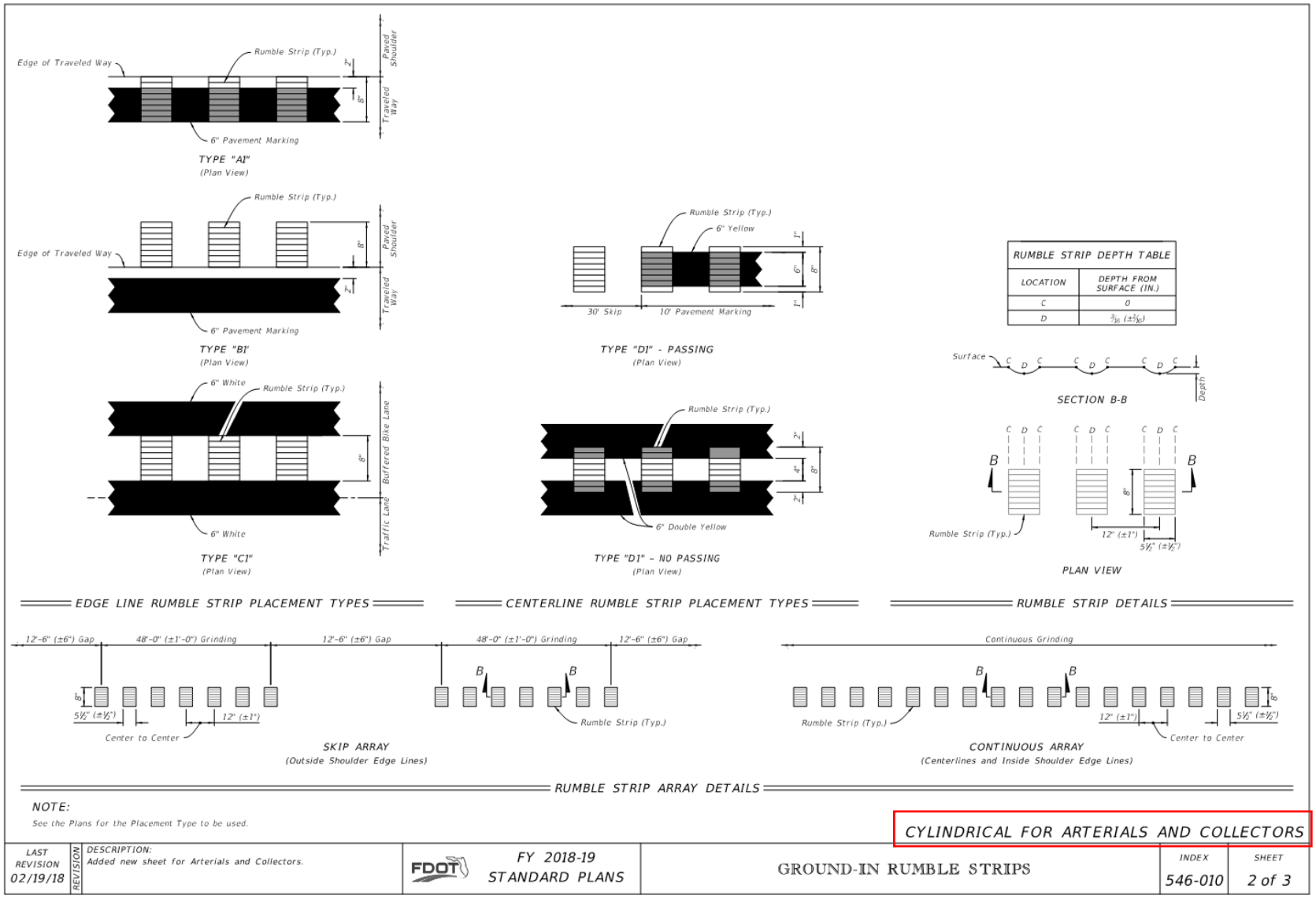
RUMBLE STRIP ARRAY DETAILS

LIMITED ACCESS ROADWAYS

LAST REVISION	REVISION	DESCRIPTION:			INDEX	SHEET
04/04/18		Revised sheet to incorporate Arterials and Collectors.	FDOT	FY 2018-19 STANDARD PLANS	546-010	1 of 3

GROUND-IN RUMBLE STRIPS

Audible & Vibratory Treatment: Arterials and Collectors



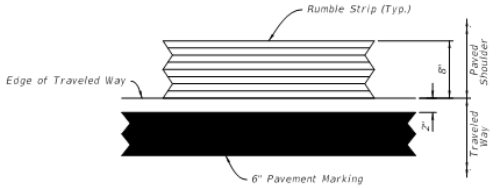
NOTE:
See the Plans for the Placement Type to be used.

CYLINDRICAL FOR ARTERIALS AND COLLECTORS

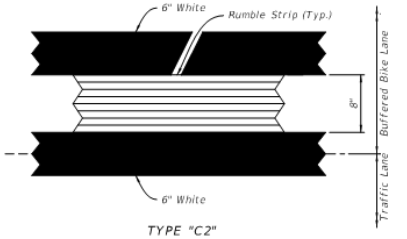
LAST REVISION	REVISION	DESCRIPTION:					
02/19/18		Added new sheet for Arterials and Collectors.	FDOT	FY 2018-19 STANDARD PLANS	GROUND-IN RUMBLE STRIPS	INDEX 546-010	SHEET 2 of 3

Audible & Vibratory Treatment: Arterials and Collectors

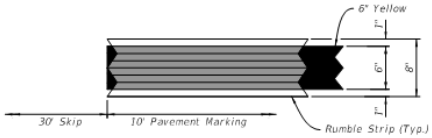
Why is there no Type “A2”?



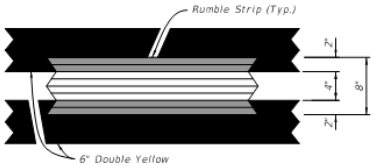
TYPE "B2"
(Plan View)



TYPE "C2"
(Plan View)



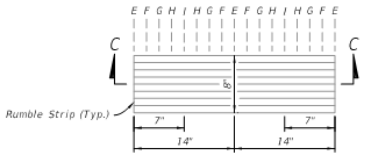
TYPE "D2" - PASSING
(Plan View)



TYPE "D2" – NO PASSING
(Plan View)

RUMBLE STRIP DEPTH TABLE	
LOCATION	DEPTH FROM SURFACE (IN.)
E	0
F	1/16
G	15/32
H	9/32
I	5/16

SECTION C-C

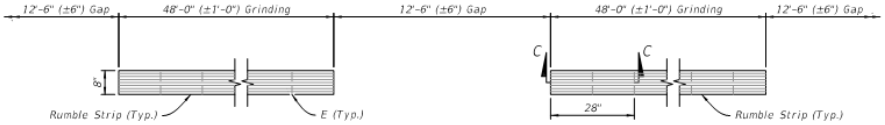


PLAN VIEW

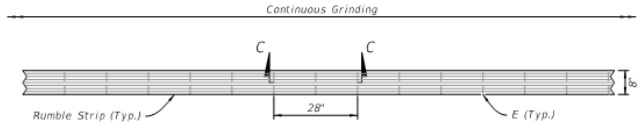
EDGE LINE RUMBLE STRIP PLACEMENT TYPES

CENTERLINE RUMBLE STRIP PLACEMENT TYPES

RUMBLE STRIP DETAILS



SKIP ARRAY
(Outside Shoulder Edge Lines)



CONTINUOUS ARRAY
(Centerlines and Inside Shoulder Edge Lines)

RUMBLE STRIP ARRAY DETAILS

NOTE:
See the Plans for the Placement Type to be used.

SINUSOIDAL FOR ARTERIALS AND COLLECTORS

LAST REVISION	REVISION	DESCRIPTION:	FDOT			INDEX	SHEET
02/19/18		Added new sheet for Arterials and Collectors.		FY 2018-19 STANDARD PLANS	GROUND-IN RUMBLE STRIPS	546-010	3 of 3

Audible & Vibratory Treatment: Arterials and Collectors

Office of Design

Office of Design / Standard Plans / Standard Plans Interim Revisions FY 2018-19

Standard Plans Interim Revisions - FY 2018-19

FDOT Standard Plans

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(*Site Updated: 3/16/18*)

Interim Revision Reference Number	Revised Sheets	Index Title	Design Information				
			Instructions	Design Tools	Data Table Cell Library	Borderless DGNs	Associated Design Bulletin
IR546-010-01	1-3 of 3	Ground-In Rumble Strips	SPI-546-010	N/A	N/A	N/A	RDB18-03

Audible & Vibratory Treatment: Arterials and Collectors

Standard Plans Instructions:

- Used by designers
- Determine limitations of use
- How to properly include it in the plans
- Includes some payment information

Index 546-010 Ground-In Rumble Strips

Design Criteria

FDOT Design Manual (FDM)

Usage Criteria

Limited Access – See ***FDM 211.4.4***.

Arterials and Collectors – See ***FDM 210.4.6***.

Plan Content Requirements

Limited Access Facilities – Tabulate quantities in the Roadway plans.

Arterials and Collectors – Identify and tabulate in the Signing and Pavement Marking plans. Include the "Type" (see Sheet 2-3 of ***Index 546-010*** for information) in the pavement marking callout labels (e.g., 6" White with Ground-In Rumble Strips, Type B1). It is not necessary to call out the array for Arterials and Collectors.

See ***FDM 325*** for plan content requirements.

Payment

Item number	Item Description	Unit Measure
546- 72- A	Ground-In Rumble Strips	GM

See the ***BOE*** and ***Specifications 546*** for additional information on payment, pay item use and compensation. In all cases, payment for ground-in rumble strips is separate from any accompanying permanent pavement markings.

Audible & Vibratory Treatment: Arterials and Collectors

Office of Design

Office of Design / Standard Plans / Standard Plans Interim Revisions FY 2018-19

Standard Plans Interim Revisions - FY 2018-19

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IR546-010-01	1-3 of 3	Ground-In Rumble Strips	SPI-546-010	N/A	N/A	N/A	RDB18-03

Audible & Vibratory Treatment: Arterials and Collectors

REQUIREMENTS FOR FDM

1. Replace ***FDM 210.4.6*** with the following:

210.4.6 Audible and Vibratory Treatment

Provide audible and vibratory treatment (AVT) on flush-shoulder roadways with a posted speed of 50 mph or greater. Do not exclude sections of the project where advisory speeds are used due to restricted horizontal or vertical geometry. Do not place AVTs within the limits of crosswalks.

Audible & Vibratory Treatment: Arterials and Collectors

Consider potential noise impacts to residents and businesses adjacent to the roadway when selecting an appropriate AVT. A higher probability of strikes should be expected on the inside radius of horizontal curves. The expected increase in noise levels over typical road noise is as follows:

- Approximately 6 decibels for cylindrical ground-in rumble strips.
- Approximately 4 decibels for sinusoidal ground-in rumble strips.
- Approximately 2 decibels for profiled thermoplastic.

AVT type selected for each edge line or centerline should be consistent throughout the project length; however, there may be a clear change in condition for which a change in AVT type is appropriate. Use the same type of treatment for centerlines as is used for edge lines on undivided roadways.

Determine the appropriate AVT in accordance with ***FDM 210.4.6.1*** and ***FDM 210.4.6.2***.

Audible & Vibratory Treatment: Arterials and Collectors

210.4.6.1 Ground-in Rumble Strips

Standard Plans*, *Index 546-010 provides three configurations (Types A, B, and C) for ground-in rumble strips along edge lines. The selection of Type A, B, or C is as follows:

- Use Type A on outside paved shoulder when width is between 1 and 5 feet. Do not use this type for sinusoidal ground-in rumble strips, or when there are residences within a minimum of 650 feet of the proposed edge line.
- Use Type B on outside paved shoulder when width is ≥ 5 feet, and on inside paved shoulder when width is ≥ 1 foot.
- Use Type C on flush shoulder roadways with buffered striping.

Sinusoidal ground-in rumble strips produce less noise, and are an alternative to the cylindrical ground-in rumble strips. They may be used for Types B and C in noise-sensitive locations.

Ground-in rumble strips are to be detailed (i.e., limits, Type A, B, or C) and quantified in the Signing and Marking Plans component set. Include "1" for cylindrical ground-in rumble strips or "2" for sinusoidal ground-in rumble strips; e.g., A1, B1, B2, C1, C2.

See ***Exhibit 210-7*** for common placement of AVTs.

Audible & Vibratory Treatment: Arterials and Collectors

210.4.6.2 Profiled Thermoplastic

Use profiled thermoplastic when any of the following conditions exist:

- Rigid pavement
- The requirements for installing ground-in rumble strips cannot be met
- Paved shoulder width prevents the construction phasing required for installation of ground-in rumble strips
- Restriping projects where the District Maintenance Engineer has determined ground-in rumble strips are not cost effective based on the remaining service life of the pavement
- Edge lines for bridges with narrow shoulders as a countermeasure for barrier impacts

Audible & Vibratory Treatment: Arterials and Collectors

Basis of Estimates:

- Simplified pay item structure for projects let July 2018 or later

Structure ID

546- 72- AB, -A

Title

Rumble Strips

Unit

GM

Plan Quantity?

Yes

Notes

Details

See the Standard Plans and Standard Plans Instructions.

Plan Summary Box

Limited Access Facilities: Show in the roadway plans. The pay item should be loaded in the Roadway Category.

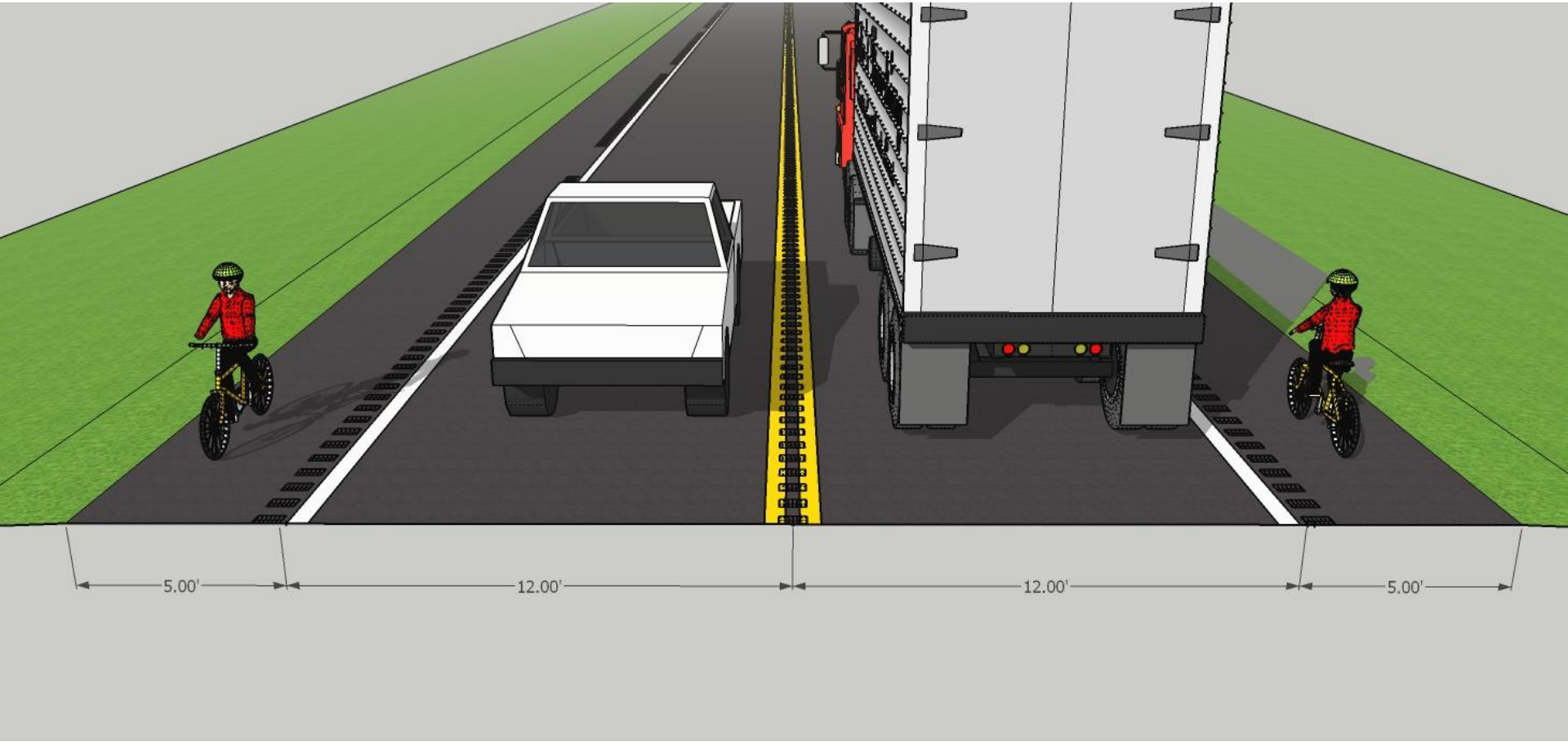
Arterials and Collectors: Show in the Signing and Pavement Marking plans. The pay items should be loaded in the Signing and Pavement Marking Category.

Struct.

546-72- A Ground-In Rumble Strips, GM Effective 1-1-2018
A= Description
1 (16") for limited access roadways, used on shoulders; Load in Roadway category
2 (8" Cylindrical) for arterials and collectors, used on shoulders or centerline; Load in Signing and Pavement Marking
3 (8" Sinusoidal) for arterials and collectors, used on shoulders or centerline; Load in Signing and Pavement Marking

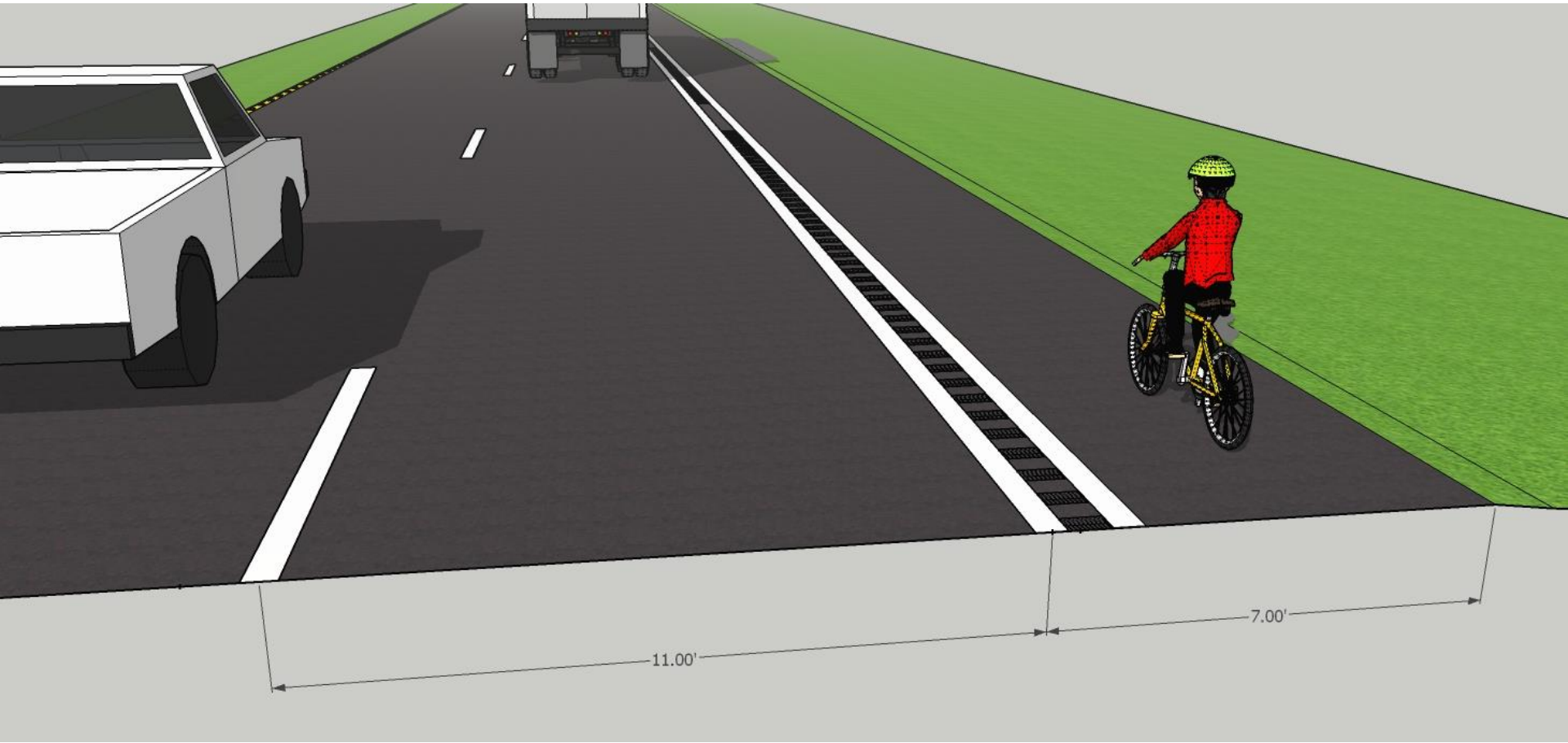
Audible & Vibratory Treatment: Arterials and Collectors

- For paved shoulders greater than or equal to 5’, use ground-in rumble strips located in the shoulder.



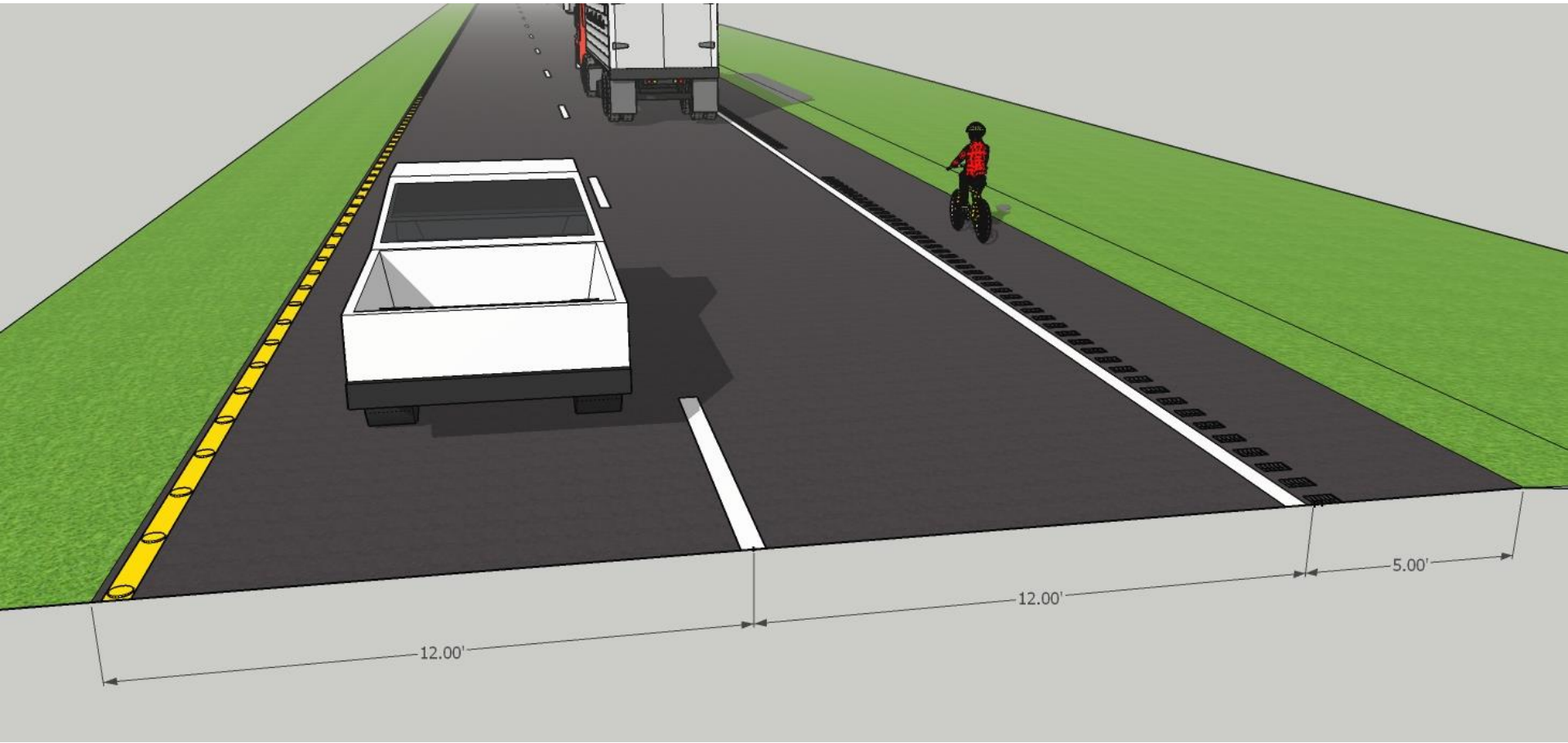
Audible & Vibratory Treatment: Arterials and Collectors

- For buffered bike lanes, use ground-in rumble strips between the longitudinal buffer lines.



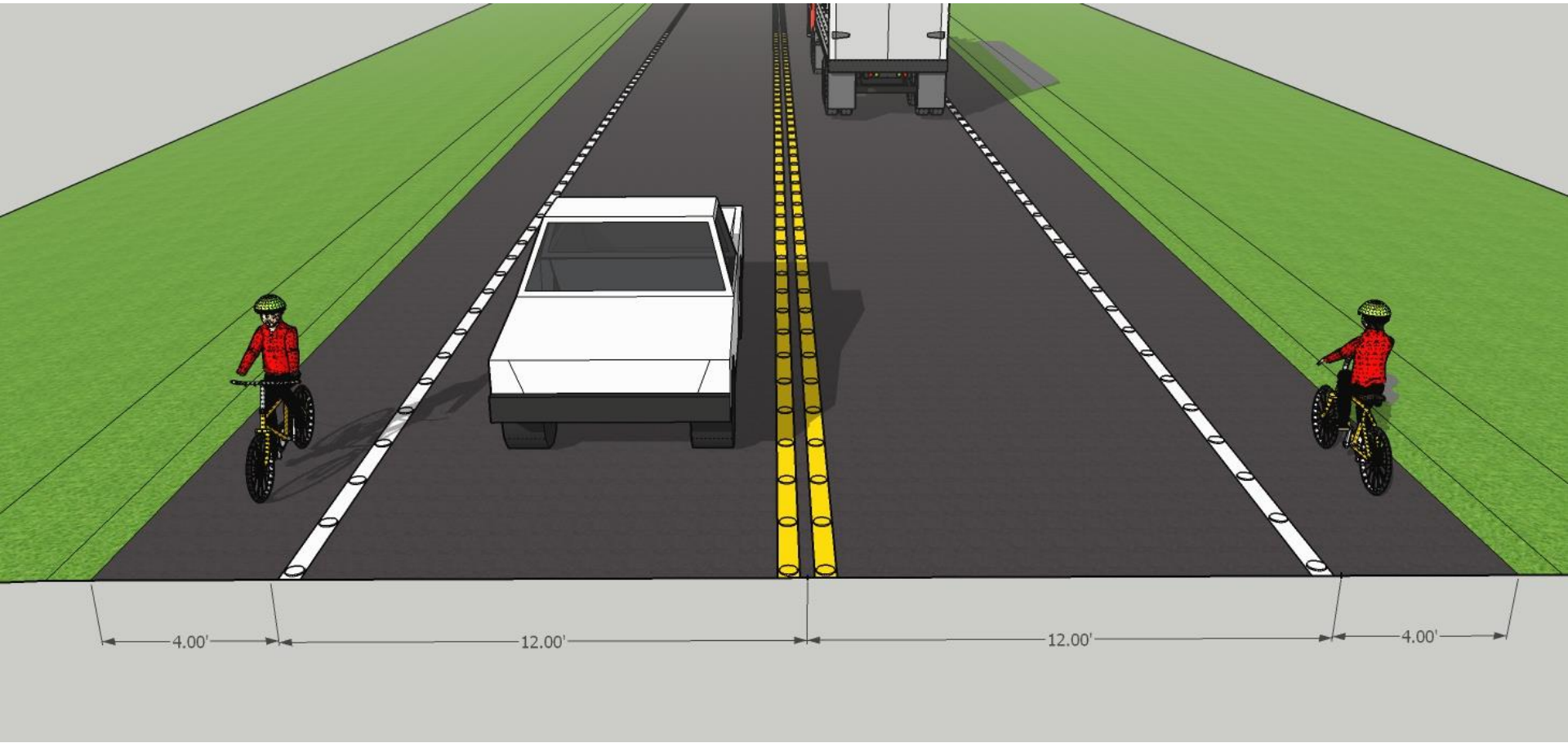
Audible & Vibratory Treatment: Arterials and Collectors

- Regardless of context, use Profiled Thermoplastic for paved shoulders 1’ or less. This is for durability of pavement and constructability. May be used with ground-in rumble strips on outside shoulder.



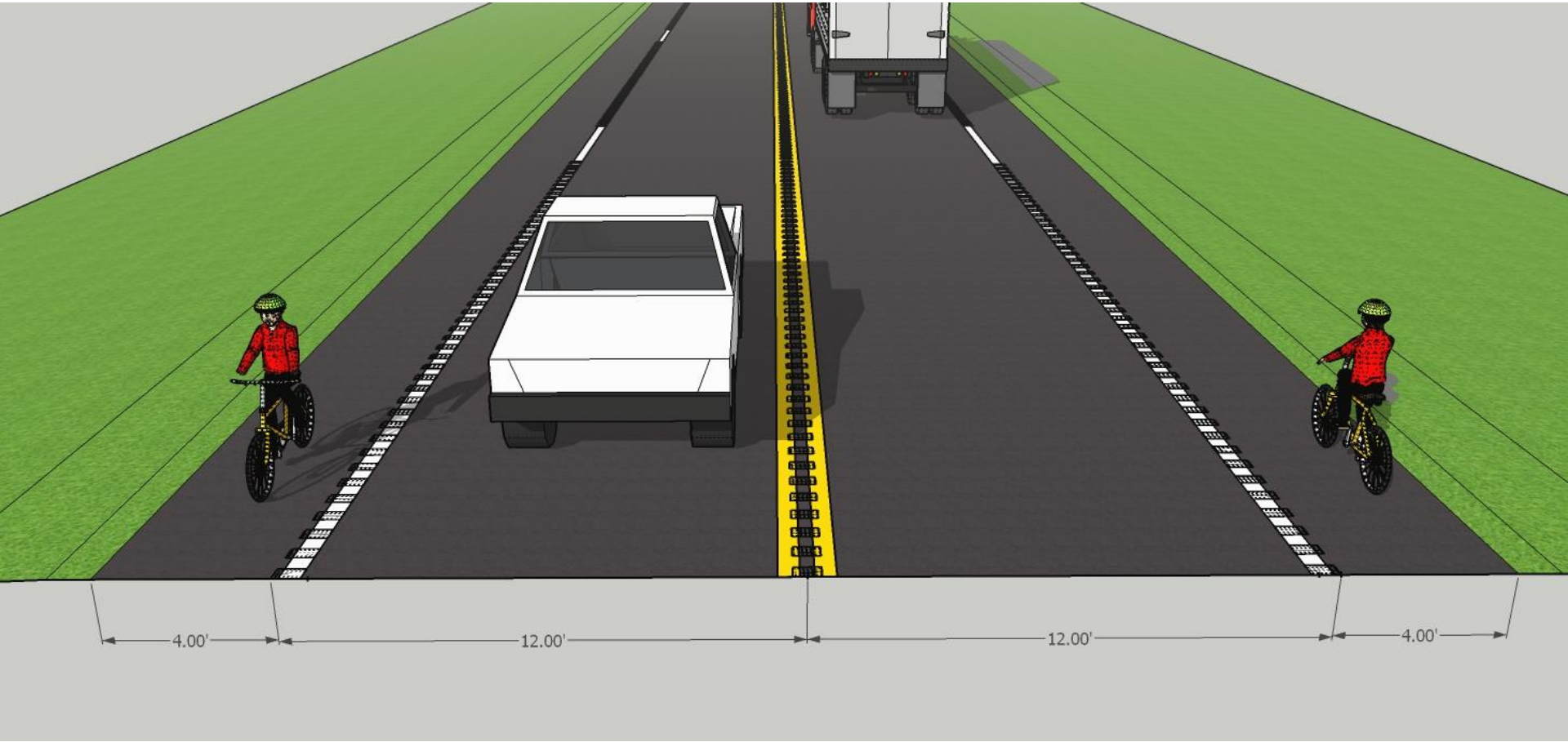
Audible & Vibratory Treatment: Arterials and Collectors

- With residences nearby and for paved shoulders greater than 1’ and less than 5’, use Profiled Thermoplastic. Residences are considered nearby when located within a minimum of a 650 ft radius. (650 ft radius is guidance only; the District may choose to increase this distance)



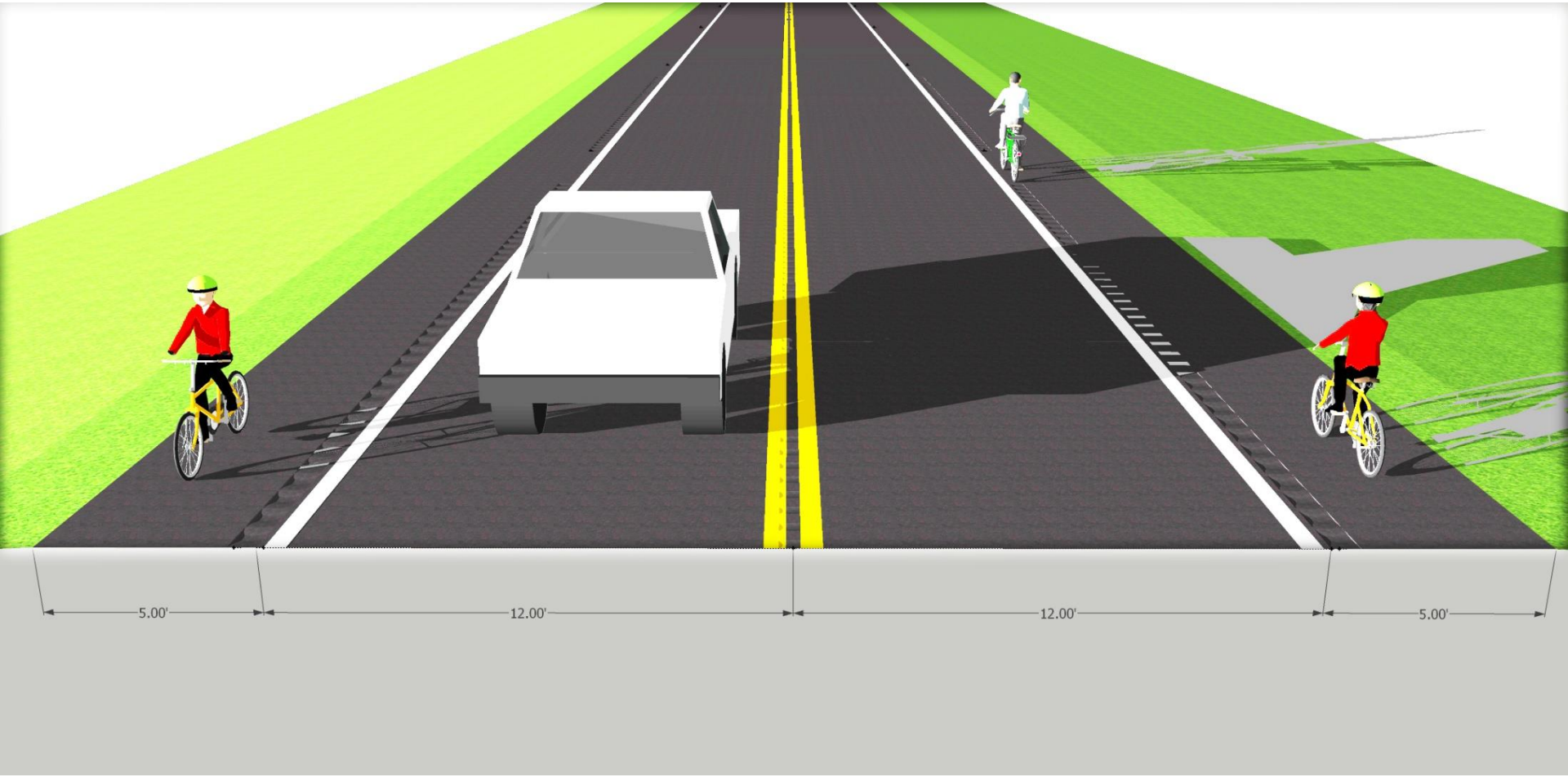
Audible & Vibratory Treatment: Arterials and Collectors

- With no residences nearby and for paved shoulders greater than 1’ and less than 5’, use ground-in rumble strips on the edge line. Residences are considered nearby when located within a minimum of a 650 ft radius. (650 ft radius is guidance only; the District may choose to increase this distance)



Audible & Vibratory Treatment: Arterials and Collectors

- Sinusoidal ground-in rumble strips show promising results with initial noise testing and will be used as an optional treatment to the 3/16” Cylindrical pattern.



Audible & Vibratory Treatment: Arterials and Collectors

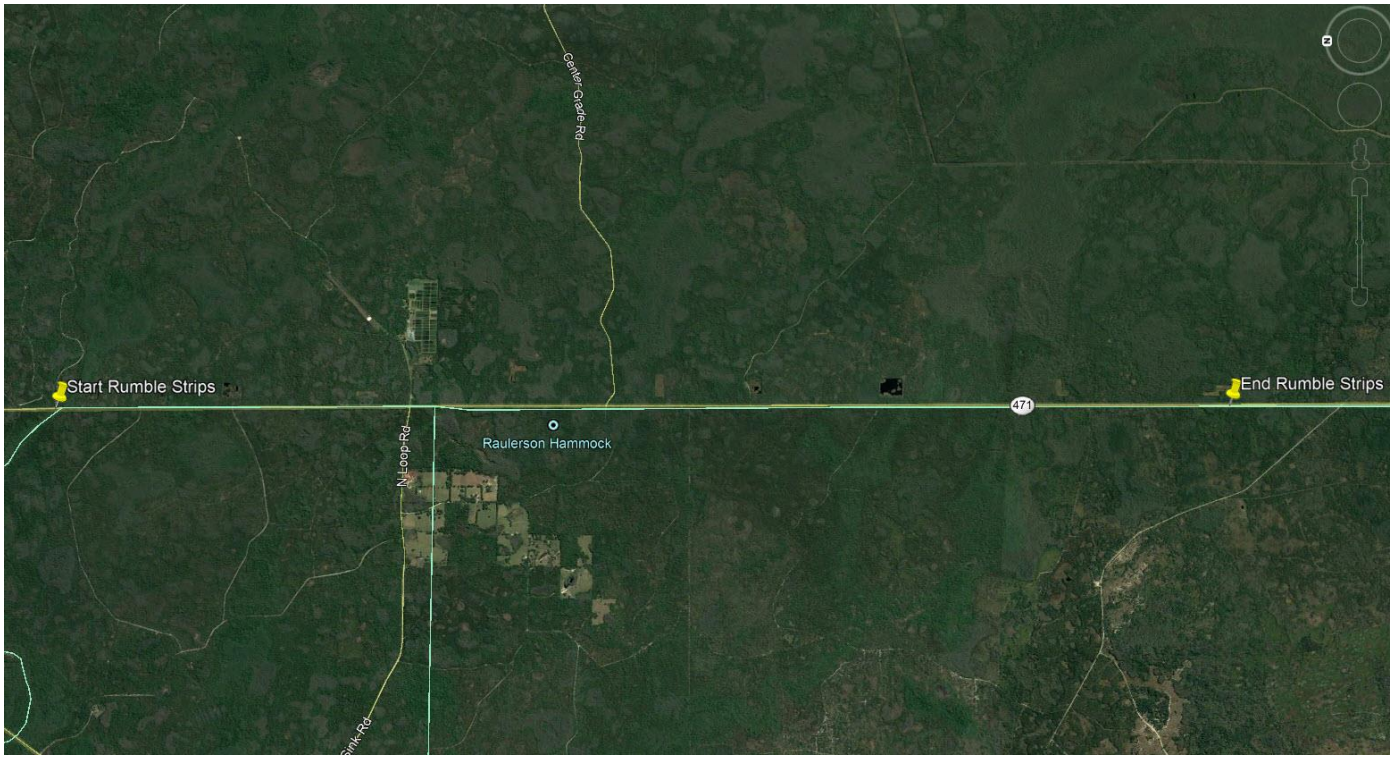
- 3/16” Cylindrical Edgeline Pattern

Audible & Vibratory Treatment: Arterials and Collectors

- Sinusoidal Edgeline Pattern

Audible & Vibratory Treatment: Example #1

- Existing Conditions:
  - Two-way, two-lane roadway
  - 4’ Paved Shoulders
  - No residences adjacent to the roadway
- Recommended Audible & Vibratory Treatment:
  - Cylindrical ground-in rumble strips for the entirety of the project



Audible & Vibratory Treatment: Example #2

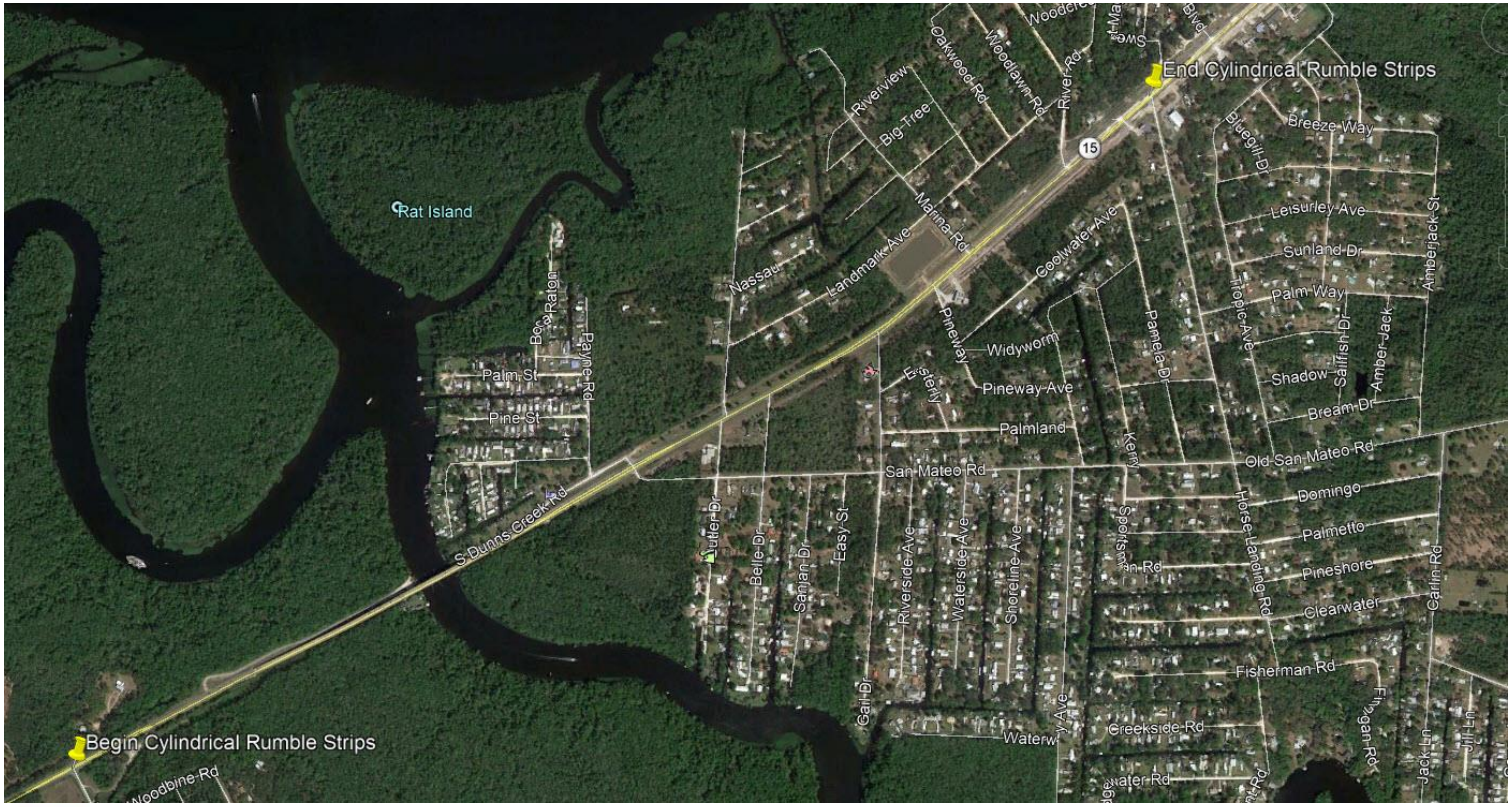
- Existing Conditions:
  - Divided, multilane roadway
  - 4’ outside paved shoulders
  - Industrial land north of the bridge (3.5 miles); residential land south of the bridge (1.4 miles)
- Recommended Audible & Vibratory Treatment:
  - Cylindrical ground-in rumble strips north of the bridge
  - Profiled thermoplastic markings south of the bridge

Audible & Vibratory Treatment: Example #3

- Existing Conditions:
  - Divided, multilane roadway
  - 5’ outside paved shoulders
  - Sporadic subdivisions along the length of the project with a significant risk for noise complaints
- Recommended Audible & Vibratory Treatment:
  - Sinusoidal ground-in rumble strips for the entirety of the project

Audible & Vibratory Treatment: Example #4

- Existing Conditions:
  - Divided, multilane roadway
  - 5’ outside paved shoulders
  - Residences adjacent to the roadway
- Recommended Audible & Vibratory Treatment
  - Cylindrical ground-in rumble strips for the entirety of the project.



Audible & Vibratory Treatment: Example #5

- Existing Conditions:
  - Divided, multilane roadway
  - 4’ - 5’ outside paved shoulders
  - Residences adjacent to the roadway
- Recommended Audible & Vibratory Treatment
  - Profiled thermoplastic for the entirety of the project

Questions

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