

## Shared Use Path Barrier Usage Guideline

The draft guidelines presented here are the result of research undertaken by UMass Dartmouth (UMassD) for the Vermont Agency of Transportation (VTrans) research project entitled “Shared Use Path Fencing Usage” dated May 2007. Please consult the full research report for further information on the development of this guideline.

This draft guideline was formulated based on a comprehensive literature review, field inspections of existing fencing in Vermont, interviews with shared use path users in Vermont, an Internet survey of bicycle facility experts throughout the world. This guideline is meant to be used as a guide to help determine the scenarios where barriers should be used. It is not meant as a replacement to any current AASHTO or VTrans specification.

### **Identification of Barrier Purposes**

The first step in the barrier decision process is determining what function the barrier serves. Barriers placed adjacent to a shared use path may serve one or more functions based on their design and placement. The main functions of a barrier are:

1. Access Control
2. Aesthetics/ Decoration
3. Property Separation/Delineation
4. Safety
5. Screening
6. Wind Abatement
7. Noise Abatement

*Note: The use of barriers for functions 6 and 7 is not very frequent, especially in the experience of VTrans.*

All of these functions, except safety, and their resultant barrier design and location decisions will need to be subjectively made on a case-by-case basis using good engineering judgment. Barriers for safety purposes are discussed later.

### **General Barrier Considerations**

In regards to barriers in general, the following items should be considered:

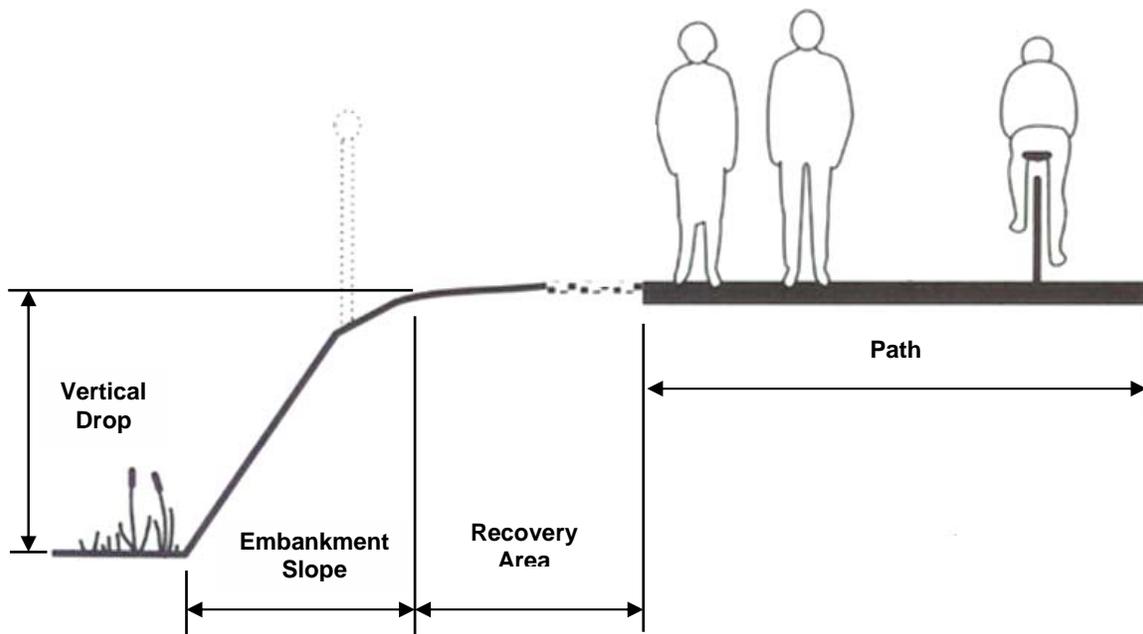
1. Barrier selection should be made based on user safety first and then aesthetics. With the wide variety of materials and fencing barrier types, the designer should be able to find a compromise in aesthetics without giving up safety.

2. Barriers themselves can be a safety hazard since they are a pathside obstruction. However, sometimes the placement of a barrier is required to protect path users from a more hazardous condition.
3. Caution should be used when curbing is part of a feature adjacent to a path. In some cases, curbed islands have been used to separate paths from adjacent roadways. However curbs should not be used as barriers from these hazards because they can cause hazardous conditions of their own and might restrict users with disabilities.
4. Barrier should be transitioned away from the path at the leading and trailing end, if possible. The ends of the barriers themselves can be hazardous to path users, thus a gradual transition of the barrier away from the path edge is recommended.
5. Live forms of barriers require much more maintenance and can produce their own hazards. Branches, leaves, and other vegetation can line the path surface, thus creating a possible hazardous condition for path users. Also, vegetation can easily overgrow the path if it is not maintained consistently. Hard barriers will still require maintenance, but careful selection of materials and construction should permit that these go longer periods of time without regular maintenance.

### **Barriers for Safety Purposes**

The need of barriers for protection of path users from hazards is based on a number of factors. This determination of the need for a barrier is dependent on the width of available clear zone (recovery area), embankment slope adjacent to the path, any vertical drop adjacent to the path, any hazardous condition (waterways, ravines, etc.) at the base of the slope adjacent to the path, and the material present on the side slope. The following tables present a means to determine if a barrier is required for safety purposes. Meeting all the requirements left-to-right on a single line identifies a condition where a barrier should be used. The first table is for paths with a paved surface and the second is for paths with an unpaved surface.

To use these tables, the designer must know the relative values for recovery area (clear zone), embankment slope, and vertical drop heights for their situation as outlined in Figure 1 below. Also, the designer must know what the final side slope material will be as well as if there is, or will be, a hazard condition at the bottom of the side slope. Then, starting on the left of the table, the designer enters the table at the value of the available recovery area. Next, the designer must examine each scenario presented for that value of recovery area and determine if any are a match for their particular case. For the specified recovery area range, all scenarios must be examined. If **ANY** of the scenarios match the known conditions, a barrier should be used unless otherwise noted in the notes or asterisk section at the bottom of the table. If **NONE** of the scenarios match, then a barrier is **NOT** required. The scenarios shown indicate when a barrier should be used adjacent to a shared use path. Some scenarios require the designer to subjectively assess the hazards and side slope material. Two examples of how one would use the guide are shown after the presentation of the tables.



**Figure 1: Description of Geometric Parameters Required for Barrier Usage Guideline**

*Adapted from: Vermont Pedestrian and Bicycle Facility Planning and Design Manual. December 2002.*

*Important Note:* Other parameters like clear distance to fixed objects, sharp curves, path grades, path width, and other geometric considerations should be taken into account when designing for safety. These items should also be considered for safety purposes and their minimum design values are widely known and published.

**Paved Shared Use Path Trail Surface**

Recovery Area	Scenario	Embankment Slope				Vertical Drop				Hazard** at Bottom of Slope		Side Slope Material***		Remarks
		1: 4 or Flatter	1:3	1:2	Steeper than 1:2*	10" - 2 ft (0.25 - 0.6m)	3 ft (0.9m)	4 ft (1.2m)	5 ft (1.5m) or Greater	Yes	No	Soft	Hard	
<3 ft (0.9 m)	1	X				Any Vertical Drop				Either		Either		See Notes 1-3
	2		X			Any Vertical Drop				Either		Either		
	3			X		Any Vertical Drop				Either		Either		
	4				X	Any Vertical Drop				Either		Either		
3 ft - <4 ft (0.9 - 1.2m)	1		X					X	Either		Either			
	2		X			Selected Vertical Drops			X				Note 2	
	3		X			Selected Vertical Drops				X		X	Note 3	
	4			X		Any Vertical Drop				Either		Either		
	5				X	Any Vertical Drop				Either		Either		
4 ft - <5 ft (1.2 - 1.5m)	1		X			Any Vertical Drop				X				Note 2
	2		X			Any Vertical Drop					X		X	Note 3
	3			X			Selected Vertical Drops							
	4			X		Selected Vertical Drops				X				Note 2
	5			X		Selected Vertical Drops					X		X	Note 3
	6				X	Any Vertical Drop				Either		Either		
>5 ft (1.5 m)	1	Any Embankment Slope				Any Vertical Drop				X				Note 2
	2	Any Embankment Slope				Any Vertical Drop					X		X	Note 3

\* Includes vertical drop-offs next to path.

\*\* Possible hazards include waterways, water bodies, ravines, active roadways, active railways, etc. A hazard can be any item that can comprise the safety of a path user if they encounter it.

\*\*\* Example of "Soft" materials is grass. "Hard" materials include rip-rap, rocks, boulders, etc.

**Note 1:** Generally no barrier necessary for 1:4 or flatter slopes. Evaluate on a case-by-case basis.

**Note 2:** Barrier use dependent on severity of hazard condition at bottom of slope. Evaluate on a case-by-case basis.

**Note 3:** Barrier use dependent on possible injury that could result from crash into side slope material. Evaluate on a case-by-case basis.

### Unpaved Shared Use Path Trail Surface

Recovery Area	Scenario	Embankment Slope				Vertical Drop				Hazard** at Bottom of Slope		Side Slope Material***		Remarks
		1: 4 or Flatter	1:3	1:2	Steeper than 1:2*	10" - 2 ft (0.25 - 0.6m)	3 ft (0.9m)	4 ft (1.2m)	5 ft (1.5m) or Greater	Yes	No	Soft	Hard	
<2 ft (0.6 m)	1	X				Any Vertical Drop				Either		Either		See Notes 1-3
	2		X			Any Vertical Drop				Either		Either		
	3			X		Any Vertical Drop				Either		Either		
	4				X	Any Vertical Drop				Either		Either		
2 ft - <3 ft (0.6 - 0.9m)	1		X					X	Either		Either			
	2		X			Selected Vertical Drops			X				Note 2	
	3		X			Selected Vertical Drops				X		X	Note 3	
	4			X		Any Vertical Drop				Either		Either		
	5				X	Any Vertical Drop				Either		Either		
3 ft - <5 ft (0.9 - 1.5 m)	1		X			Any Vertical Drop				X				Note 2
	2		X			Any Vertical Drop					X		X	Note 3
	3			X				Selected Vertical Drops						
	4			X		Selected Vertical Drops				X				Note 2
	5			X		Selected Vertical Drops					X		X	Note 3
	6				X	Any Vertical Drop				Either		Either		
>5 ft (1.5 m)	1	Any Embankment Slope				Any Vertical Drop				X				Note 2
	2	Any Embankment Slope				Any Vertical Drop					X		X	Note 3

\* Includes vertical drop-offs next to path.

\*\* Possible hazards include waterways, water bodies, ravines, active roadways, active railways, etc. A hazard can be any item that can comprise the safety of a path user if they encounter it.

\*\*\* Example of "Soft" materials is grass. "Hard" materials include rip-rap, rocks, boulders, etc.

**Note 1:** Generally no barrier necessary for 1:4 or flatter slopes. Evaluate on a case-by-case basis.

**Note 2:** Barrier use dependent on severity of hazard condition at bottom of slope. Evaluate on a case-by-case basis.

**Note 3:** Barrier use dependent on possible injury that could result from crash into side slope material. Evaluate on a case-by-case basis.

# Examples

## **Example 1**

Path Surface Type: **Paved**

Width of Recovery Area: **3.5ft**

Embankment Slope Adjacent to the Path: **1:3**

Vertical Drop Adjacent to the Path: **1ft**

Hazardous Condition at the Base of the Slope: **None**

Side Slope Material: **Grassed Surface**

**Step 1:** Select appropriate table based on path surface. For this example, the “*Paved Shared Use Path Trail Surface*” table is used because the path surface is paved.

**Step 2:** Enter into the table based on the available recovery area. For this example the recovery area is 3.5 ft. Thus, the 3ft -<4ft recovery area range is applicable.

**Step 3:** For the specified recovery area range, all scenarios must be examined. If **ANY** of the scenarios match the known conditions, a barrier should be used unless otherwise noted in the notes or asterisk section at the bottom of the table. If **NONE** of the scenarios match, then a barrier is **NOT** required.

For this example, the recovery area range is 3ft -<4ft. The embankment slope is 1:3. Only scenarios 1, 2 and 3 involve a side slope of 1:3 (denoted by an X in the table), thus scenarios 4 and 5 do not match and they need no further examination.

**Step 4:** Next, moving left to right in the table, the remaining scenarios 1, 2 and 3 are further examined by the corresponding vertical drop. For this example the vertical drop is 1 ft. Scenario 1 requires a vertical drop of 5ft or greater (as denoted by the X in the table), thus it does not match and it needs no further examination. Scenarios 2 and 3 both fall within the “Selected Vertical Drops” ranges. Explaining further, this means if the vertical drop falls into the range of the merged columns under the vertical drop it is a match. For scenarios 2 and 3, the “Selected Vertical Drops” include the 10”- 2ft range, 3ft, and 4ft. Values falling between the ranges or values noted in the table should be rounded up to the next highest value. For this example the vertical drop of 1 ft applies to both scenarios 2 and 3 as the vertical drop matches the “Selected Vertical Drops” range for each.

**Step 5:** Next, moving left to right in the table, the remaining scenarios 2 and 3 are further examined by the hazard condition at the bottom of the slope. For this example there is no hazard condition at the bottom of the slope. Since scenario 2 identifies a hazard condition at the bottom of the slope (denoted by an X under the “YES” column), it is not a match and it requires no further examination. Scenario 3 identifies no hazard condition at the bottom of the slope (denoted by an X under the “NO” column) which is a match for the conditions of this example.

**Step 6:** Next, moving left to right in the table, the remaining scenario 3 is further examined by the side slope material. For this example the side slope material is grassy, which by the asterisk footnote is considered “Soft”. Scenario 3 identifies a “Hard” side slope material (as denoted by the X under “Hard”), thus it is not a match and no further examination of this scenario is needed.

At this point all scenarios have been eliminated from examination. Thus, since there were no matching scenarios, a barrier is NOT required for path with these conditions given in the example. Please note all scenarios for a given recovery area must be examined (all columns from left to right) and eliminated before the decision to not use a barrier can be made.

## **Example 2**

**Path Surface Type:** Unpaved

**Width of Recovery Area:** 2.5ft

**Embankment Slope Adjacent to the Path:** 1:2

**Vertical Drop Adjacent to the Path:** 4ft

**Hazardous Condition at the Base of the Slope:** None

**Side Slope Material:** Rip-Rap

**Step 1:** Select appropriate table based on path surface. For this example, the “Unpaved Shared Use Path Trail Surface” table is used because the path surface is unpaved.

**Step 2:** Enter into the table based on the available recovery area. For this example the recovery area is 2.5 ft. Thus, the 2ft -<3ft recovery area range is applicable.

**Step 3:** For the specified recovery area range, all scenarios must be examined. If **ANY** of the scenarios match the known conditions, a barrier should be used unless otherwise noted in the notes or asterisk section at the bottom of the table. If **NONE** of the scenarios match, then a barrier is **NOT** required.

For this example, the recovery area range is 2ft -<3ft. The embankment slope is 1:2. Only scenario 4 involves a side slope of 1:2 (denoted by an X in the table), thus scenarios 1 through 3 and 5 do not match and they require no further examination.

**Step 4:** Next, moving left to right in the table, the remaining scenario 4 is further examined by the corresponding vertical drop. For this example the vertical drop is 4 ft. Scenario 4 identifies that “Any Vertical Drop” is a match. Explaining further, this means a vertical drop of any height is a match. For this example the vertical drop of 4 ft matches scenario 4.

**Step 5:** Next, moving left to right in the table, the remaining scenarios 4 is further examined by the hazard condition at the bottom of the slope. For this example there is no hazard condition at the bottom of the slope. Since scenario 4 identifies that a hazard condition may or may not exist (denoted by “Either”), it is a match for the conditions given in this example.

**Step 6:** Next, moving left to right in the table, the remaining scenario 4 is further examined by the side slope material. For this example the side slope material is rip rap, which by the asterisk footnote is considered “Hard”. Scenario 4 identifies that the side slope material may be hard or soft (as denoted by “Either”), thus it is a match for the conditions given in this example.

Since the given conditions of this example have been checked from left to right in the table and matches all the conditions denoted by scenario 4, a barrier is required for the shared use path. Please note that a barrier is required if all conditions left to right match for any one or multiple scenarios for a specific recovery area range.