Cycle Track Barrier Selection Matrix

DRAFT	Striped Buffer	Flexible Bollards	Turtle Bumps	Large Bumps	Oblong Low Bumps	Parking Stops	Linear Barrier
							
Cost/Benefit							
Cost per Foot of Barrier (per side of street) *Costs double for barriers on both sides	$1.50-3/ft. $8k-16k/mi.	$3-5/ft. $15k-30k/mi.	$2-4/ft. $10k-20k/mi.	$9-18/ft. $50k-90k/mi.	$12-24/ft. $60k-130k/mi.	$4-8/ft. $20k-40k/mi.	$4-8/ft. $20k-40k/mi.
Cost	★★★★	★★★	★★★	★★★	★★★	★★★	★★★
Cyclist Perceived Safety	★	★★★	★★★	★★★★	★★	★★★	★★★
Other Considerations							
Durability / Maintenance	★★	★	★★★	★★★	★★★	★★★	★★★
Sweeping	★★★★	Depends on Width	Depends on Width	Depends on Width	Depends on Width	Depends on Width	Depends on Width
Trash Collection	★★★★	★	★★★★	★	★★★★	★★★★	★★★★
Storm Water	★★★★	★★★	★★★	★★★	★★★	★★	★★★
Traffic Compatibility **(Motor vehicle / barrier interactions)**	★★★★	★★★★	★★	★★	★★★	★★★	★★★
Aesthetics **(factoring in damage over time)**	★★	★	★★	★★★	★★	★★	★★
Construction Impacts	★★★★	★★★	★★★	★★★	★★★	★★★	★★★
Width Required	1.5'	1.5'	1.5'	1.5'	1.5'	1/2'	1/2'
Notes							
General							
Cost	Least expensive option	Good cost per foot	Very good cost per foot	Good cost per foot	Very good cost per foot	Good cost per foot	Good cost per foot
Cyclist Perceived Safety	No physical element	Good vertical element	Good deterrant for motorist	Strong deterrant for motorist. Good vertical element.	Decent deterrent for motorists. Low contrast.	Good deterrant for motorist	Good deterrant for motorist
Durability / Maintenance	Thermo / paint needs to be maintained	Flexible bollards may require frequent replacement	Good durability	Good durability	Good durability	Good durability	Good durability
Sweeping	No obstruction	If barrier is less than 8.5' from curb special sweeping equipment will be necessary	If barrier is less than 8.5' from curb special sweeping equipment will be necessary	If barrier is less than 8.5' from curb special sweeping equipment will be necessary	If barrier is less than 8.5' from curb special sweeping equipment will be necessary	If barrier is less than 8.5' from curb special sweeping equipment will be necessary	If barrier is less than 8.5' from curb special sweeping equipment will be necessary
Trash Collection	No obstruction	Height of barrer obstructs collection vehicles. Barrier could be driven over but not optimal.	Collection vehicles can drive over barrier	Height of barrer obstructs collection vehicles	Collection vehicles can drive over barrier	Collection vehicles can drive over barrier	Collection vehicles can drive over barrier
Storm Water	No obstruction	No / minimal obstruction	No / minimal obstruction	No / minimal obstruction	No / minimal obstruction	Barriers could be spaced to allow storm water to curb	No / minimal obstruction
Traffic Compatibility **(Motor vehicle / barrier interactions)**	No high speed motor vehicle traffic concerns	No high speed motor vehicle traffic concerns	May have concerns adjacent to higher speed traffic	May have concerns adjacent to higher speed traffic	May have concerns adjacent to higher speed traffic	May have concerns adjacent to higher speed traffic	May have concerns adjacent to higher speed traffic
Aesthetics	Neutral asthetics	Damaged barriers quickly become ragged looking	Good asthetics over barrier life	Barrier enhances street asthetics	Neutral asthetics	Neutral asthetics	Neutral asthetics
Construction Impacts	Striping changes only	Barrier installation is quick and non-invasive. Bolt/glue solution.	Barrier installation is quick and non-invasive. Bolt/glue solution.	Barrier installation is quick and non-invasive. Bolt/glue solution.	Barrier installation is quick and non-invasive. Bolt/glue solution.	Barrier installation is quick and non-invasive. Bolt/glue solution.	Barrier installation is quick and non-invasive. Bolt/glue solution.
Width Required	Fairly compact barrier solution	Fairly compact barrier solution	Fairly compact barrier solution	Fairly compact barrier solution	Fairly compact barrier solution	Low-profile barrier solution	Low-profile barrier solution

Good Seperation Photos
http://www.peopleforbikes.org/blog/entry/tech-talk-19-beautiful-ways-to-protect-bike-lanes-photos

Cycle Track Barrier Selection Matrix

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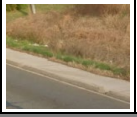
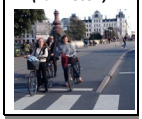
	6" Cast in Place Barrier Curb	Parked Cars	Jersey Barriers	Planters	Rigid Bollards	Cast in Place Barrier Curb	Precast Barrier Curb
							
Cost/Benefit							
Cost per Foot of Barrier (per side of street) *Costs double for barriers on both sides	$5-15/ft. $25k-75k/mi.	$15-60/ft. $80k-300k/mi.	$15-30/ft. $80k-160k/mi.	$15-75/ft. $80k-400k/mi.	$20-40/ft. $100k-200k/mi.	$20-40/ft. $100k-200k/mi.	$70-115/ft. $400k-600k/mi.
Cost	★★★	★★	★★	★★	★★	★★	★
Cyclist Perceived Safety	★★★	★★★★	★★★★	★★★★	★★★★	★★★★	★★★★
Other Considerations							
Durability / Maintenance	★★★	★★★★	★★★★	★	★★★	★★★★	★★★
Sweeping	Depends on Width	★★★	Depends on Width	Depends on Width	Depends on Width	Depends on Width	Depends on Width
Trash Collection	★★★★	Depends on Time of Day	★	★	★	★★★★	★★★★
Storm Water	★★★	★★★★	★★	★★	★★★	★★	★★
Traffic Compatibility (Motor vehicle / barrier interactions)	★★★★	★★★	★★★★	★★★	★★	★★★★	★★★
Aesthetics (factoring in damage over time)	★★	★★	★	★★★★	★★★	★★★	★★★
Construction Impacts	★★	★★★★	★★★	★★★	★★	★★	★★★
Width Required	1/2'	8' If not existing	2'	3'	2'	1'	1'
Notes							
General		Requires on-street parking					
Cost	Good cost per foot	ADA parking changes, pedestrian refuge islands, and ADA ramp changes can affect cost		Spacing of planters affects cost	Utility conflicts could affect cost	Cast in place curbs are much less expensive due to reduced handling time	Custom precast curbs significantly increases cost over cast in place barriers
Cyclist Perceived Safety	Good deterrant for motorist	Strong deterrant for motorist. Good vertical element.	Strong deterrant for motorist. Good vertical element.	Strong deterrant for motorist. Good vertical element.	Strong deterrant for motorist. Good vertical element.	Strong deterrant for motorist. Horizontal seperation.	Strong deterrant for motorist. Horizontal seperation.
Durability / Maintenance	Good durability	No element to maintain	Very durable barriers	Need a maintenance partner for watering and plant upkeep.	Good durability	Very durable barriers	Good durability
Sweeping	If barrier is less than 8.5' from curb special sweeping equipment will be necessary	Sweeping could be done in off-peak or no parking hours if cycle track narrow	If barrier is less than 8.5' from curb special sweeping equipment will be necessary	If barrier is less than 8.5' from curb special sweeping equipment will be necessary	If barrier is less than 8.5' from curb special sweeping equipment will be necessary	If barrier is less than 8.5' from curb special sweeping equipment will be necessary	If barrier is less than 8.5' from curb special sweeping equipment will be necessary
Trash Collection	Collection vehicles can drive over barrier	Collection could be done in off-peak or no parking hours if cycle track narrow	Height of barrer obstructs collection vehicles	Height of barrer obstructs collection vehicles	Height of barrer obstructs collection vehicles	Collection vehicles can drive over barrier	Collection vehicles can drive over barrier
Storm Water	No / minimal obstruction	No obstruction	Barriers could be spaced to allow storm water to curb	Barriers could be spaced to allow storm water to curb	No / minimal obstruction	Barriers could be spaced to allow storm water to curb	Barriers could be spaced to allow storm water to curb
Traffic Compatibility (Motor vehicle / barrier interactions)	No high speed motor vehicle traffic concerns	May have concerns adjacent to higher speed traffic	Compatible with higher speed traffic. Care must be given to end treatments	May have concerns adjacent to higher speed traffic	Appropriate for moderate traffic speeds	Curb profile can be varried based on context	Appropriate for moderate traffic speeds
Aesthetics	Good asthetics over barrier life	Good asthetics over barrier life	Strong visual impact on street. Can be painted for improved aesthetics	Barrier enhances street asthetics	Good asthetics over barrier life	Good asthetics over barrier life	Good asthetics over barrier life
Construction Impacts	Curbs have to be poured in place and dowled into street	Hard construction may not be required	Barrier installation is quick and non-invasive. Bolt/glue solution.	Barrier installation is quick and non-invasive.	Installation of bollards may have utility conflicts	Curbs have to be poured in place and dowled into street	Barrier installation is quick and non-invasive. Bolt/glue solution.
Width Required	Low-profile barrier solution	Good if on-street parking is existing	Wider barrier solution	Wider barrier solution	Wider barrier solution	Fairly compact barrier solution	Fairly compact barrier solution

Good Seperation Photos
http://www.peopleforbikes.org/blog/entry/tech-talk-19-beautiful-ways-to-protect-bike-lanes-photos

Raised Cycle Track
(Full Recon)



$1,500-5,000/ft.
$8,000k-26,000k/mi.

★

★★★★

★★★★

Depends on Width

★★★★

★

★★★★

★★★

★

0'

Reconstruction including storm water improvements is likely

Strong deterrant for motorist.

Very durable design

If barrier is less than 8.5' from curb special sweeping equipment will be necessary

Collection vehicles can drive over barrier

Requires reconstruction of street to redesign stormwater system

No high speed motor vehicle traffic concerns

Good asthetics over barrier life

Complete reconstruction is likely required

Low-profile barrier solution

All prices are installed

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					Calculated		Rounded		
Item	Value	Cost/ft	Cost EA	Frequency	Total Cost/ft	Total Cost/mi	Total Cost/ft	Total Cost/mi in thousands	Notes
Bicycle Lane with Parking (New Stripes)									
6" Line		$ 1.20			$ 1.20				
4" Line		$ 0.10			$ 0.10				
Total		$ 1.30			**$ 1.30**	**$ 6,864**			
Notes									
Low Estimate	75%				$ 0.98	$ 5,148	$ 1	$ 5	
Mid Estimate	100%				$ 1.30	$ 6,864		$ -	
High Estimate	150%				$ 1.95	$ 10,296	$ 2	$ 10	
Striped Buffer									
Width (ft)	3								
2x 4" Lines		$ 0.80			$ 0.80				
Gore Markings		$ 1.20	$ 5.09	40	$ 1.33				
Total					**$ 2.13**	**$ 11,232**			
Notes									
Low Estimate	75%				$ 1.60	$ 8,424	$ 1.5	$ 8	Parking one side, less pedestrian ameninties
Mid Estimate	100%				$ 2.13	$ 11,232		$ -	
High Estimate	150%				$ 3.19	$ 16,848	$ 3	$ 17	More pedestrian ammeneties, ADA parking cost
Flexible Bollards									
Width (ft)	3								
Striped Buffer Total			$ 2.13	1	$ 2.13				
Bollard w/ Installation			$ 60.00	40	$ 1.50				
Total					**$ 3.63**	**$ 19,152**			
Notes									
Low Estimate	75%				$ 2.72	$ 14,364	$ 3	$ 14	Parking one side, less pedestrian ameninties
Mid Estimate	100%				$ 3.63	$ 19,152		$ -	
High Estimate	150%				$ 5.44	$ 28,728	$ 5	$ 30	More pedestrian ammeneties, ADA parking cost
Turtle Bumps 3" Tall 10" Wide Circular									
Width (ft)	3								
2x 4" Lines		$ 0.80			$ 0.80				Added $5 to the unit cost of the smaller bumps. Have
Bump Cost - Turtle Bumps 3" Tall 10" Wide Circular			$ 12.00	10	$ 1.20				quote for 10" concrete buttons at $12 each 2x for
Installation (Adhesive and paint)			$ 5.00	10	$ 0.50				installed.
Total					**$ 2.50**	**$ 13,200**			
Notes	4' Spacing used on 4th Street								
Low Estimate	75%				$ 1.88	$ 9,900	$ 2	$ 10	Parking one side, less pedestrian ameninties
Mid Estimate	100%				$ 2.50	$ 13,200		$ -	
High Estimate	150%				$ 3.75	$ 19,800	$ 4	$ 20	More pedestrian ammeneties, ADA parking cost
Oblong Bumps - Recycled Plastic Bolt Down 5" High 32" Long									
Width (ft)	3								
2x 4" Lines		$ 0.80			$ 0.80				Added $5 to the unit cost of the smaller bumps. Have
Bump Cost - Recycled Plastic 5" high 20" long			$ 70.00	9	$ 7.78				quote for 10" concrete buttons at $12 each 2x for
Installation			$ 5.00	9	$ 0.56				installed.
Total					**$ 9.13**	**$ 48,224**			
Notes	4' Spacing used on 4th Street								
Low Estimate	75%				$ 6.85	$ 36,168	$ 7	$ 40	Parking one side, less pedestrian ameninties
Mid Estimate	100%				$ 9.13	$ 48,224		$ -	
High Estimate	150%				$ 13.70	$ 72,336	$ 14	$ 70	More pedestrian ammeneties, ADA parking cost
Oblong Bumps - Recycled Plastic Bolt Down 3" High 30" Long									
Width (ft)	3								
2x 4" Lines		$ 0.80			$ 0.80				Added $5 to the unit cost of the smaller bumps. Have
Bump Cost - Recycled Plastic 5" high 20" long			$ 62.00	9	$ 6.89				quote for 10" concrete buttons at $12 each 2x for
Installation			$ 5.00	9	$ 0.56				installed.
Total					**$ 8.24**	**$ 43,531**			
Notes	4' Spacing used on 4th Street								
Low Estimate	75%				$ 6.18	$ 32,648	$ 6	$ 30	Parking one side, less pedestrian ameninties
Mid Estimate	100%				$ 8.24	$ 43,531		$ -	
High Estimate	150%				$ 12.37	$ 65,296	$ 12	$ 70	More pedestrian ammeneties, ADA parking cost
Seville Style Bumps 10" High 8" Wide 20" Long									
Width (ft)	3								
2x 4" Lines		$ 0.80			$ 0.80				This is an estimate based on lower concrete buttons
Bump Cost - Seville Style Bumps 10" High 8" Wide 20" Long			$ 50.00	5	$ 10.00				that do not require rebar
Installation			$ 5.00	5	$ 1.00				Added $5 to the unit cost for installation
Total					**$ 11.80**	**$ 62,304**			
Notes	4' Spacing used on 4th Street								
Low Estimate	75%				$ 8.85	$ 46,728	$ 9	$ 50	Parking one side, less pedestrian ameninties
Mid Estimate	100%				$ 11.80	$ 62,304		$ -	
High Estimate	150%				$ 17.70	$ 93,456	$ 18	$ 90	More pedestrian ammeneties, ADA parking cost
Parking Stops & Linear Barrier									
Width (ft)	NA								
2x 4" Lines		$ 0.80			$ 0.80				
Parking Stop and Pins			$ 32.00	9	$ 3.56				
Freight Local			$ 1.50	9	$ 0.17				
Installation			$ 5.00	9	$ 0.56				
Total					**$ 5.08**	**$ 26,811**			
Notes	Quoted quantity at 1000 pieces.		Local freight assumes concrete is cast near Austin			8' Parking stop with a 2' gap			
Low Estimate	75%				$ 3.81	$ 20,108	$ 4	$ 20	Parking one side, less pedestrian ameninties
Mid Estimate	100%				$ 5.08	$ 26,811		$ -	
High Estimate	150%				$ 7.62	$ 40,216	$ 8	$ 40	More pedestrian ammeneties, ADA parking cost

					Calculated		Rounded		
Item	Value	Cost/ft	Cost EA	Frequency	Total Cost/ft	Total Cost/mi	Total Cost/ft	Total Cost/mi in thousands	Notes
Cast-in-Place 6" Barrier Curb									
Width (ft)	NA								
2x 4" Lines		$ 0.80			$ 0.80				
Prep, Dowling, Concrete Work			$ 9.00	1	$ 9.00				
Total					**$ 9.80**	**$ 51,744**			
Notes	Quoted quantity at 1000 pieces.		Local freight assumes concrete is cast near Austin			8' Parking stop with a 2' gap			
Low Estimate	50%				$ 4.90	$ 25,872	$ 5	$ 30	Parking one side, less pedestrian ameninties
Mid Estimate	100%				$ 9.80	$ 51,744		$ -	
High Estimate	150%				$ 14.70	$ 77,616	$ 15	$ 80	More pedestrian ammeneties, ADA parking cost
Curb Forming Machine									
Width (ft)	2								
Prep, Dowling, Concrete Work					$ 10.00				
Total					**$ 10.00**	**$ 52,800**			
Notes	Estimate from miller curb co was 8-10/ft. Don't know cost of machine and if that includes labor.								
Low Estimate	50%				$ 5.00	$ 26,400	$ 5	$ 30	Parking one side, less pedestrian ameninties
Mid Estimate	100%				$ 10.00	$ 52,800		$ -	
High Estimate	150%				$ 15.00	$ 79,200	$ 15	$ 80	More pedestrian ammeneties, ADA parking cost
Parked Cars									
Width (ft)	3								
2x 4" Lines		$ 0.80			$ 0.80				
Gore Markings		$ 1.20	$ 5.09	40	$ 1.33				
ADA Parking Spaces, 2% of total p	5		$ 10,000.00	1000	$ 10.00				
Pedestrian Improvements			$ 5,000.00	300	$ 16.67				
Total					**$ 28.79**	**$ 152,032**			
Notes	Pedestrian improvements include refuge islands, plantings, ramp relocations								
Low Estimate	50%				$ 14.40	$ 76,016	$ 14	$ 80	Parking one side, less pedestrian ameninties
Mid Estimate	100%				$ 28.79	$ 152,032		$ -	
High Estimate	200%				$ 57.59	$ 304,064	$ 58	$ 300	More pedestrian ammeneties, ADA parking, Islands for bus stops, relocated ramps
Jersey Barriers									
Width (ft)	NA								
Jersey Barrier			$ 200.00	10	$ 20.00				
Freight Local			$ 4.80	10	$ 0.48				
Installation			$ 5.00	10	$ 0.50				
Total					**$ 20.98**	**$ 110,774**			
Notes	Quoted quantity at 1000 pieces.		Local freight assumes concrete is cast near Austin			10' sections of jersey barrier			http://www.accentbarriers.com/Pricing.html
Low Estimate	75%				$ 15.74	$ 83,081	$ 16	$ 80	Parking one side, less pedestrian ameninties
Mid Estimate	100%				$ 20.98	$ 110,774		$ -	
High Estimate	150%				$ 31.47	$ 166,162	$ 31	$ 170	More pedestrian ammeneties, ADA parking cost
Planters									
Width (ft)	3								
2x 4" Lines		$ 0.80			$ 0.80				
Planter 6'			$ 250.00	10	$ 25.00				
Freight Local			$ 4.80	10	$ 0.48				
Installation			$ 250.00	10	$ 25.00				
Total					**$ 51.28**	**$ 270,758**			
Notes	6' planters spaced every 10' (4' gap)								
Low Estimate	33%				$ 16.92	$ 89,350	$ 17	$ 90	Lower Density
Mid Estimate	100%				$ 51.28	$ 270,758		$ -	
High Estimate	150%				$ 76.92	$ 406,138	$ 77	$ 410	Higher Density
Rigid Bollards									
Width (ft)	3								
2x 4" Lines		$ 0.80			$ 0.80				
Bollard Installed			$ 250.00	10	$ 25.00				
Total					**$ 25.80**	**$ 136,224**			
Notes									
Low Estimate	75%				$ 19.35	$ 102,168	$ 19	$ 100	Lower Density
Mid Estimate	100%				$ 25.80	$ 136,224		$ -	
High Estimate	150%				$ 38.70	$ 204,336	$ 39	$ 200	Higher Density
Cast-in-Place Barrier Curb									
Width (ft)	2'								Notes from Mopac Bike Bridge bid ($12M large
Height (in)	6"								project) - Austin, TX: Bid had a big split, but averaged
Cost of Barrier Curb Installed		$ 30.00			$ 30.00				right at $30/ft, but as low as $20/lf for the 2' wide, 6"
Total					**$ 30.00**	**$ 158,400**			tall version (most common).
Notes									
Low Estimate	75%				$ 22.50	$ 118,800	$ 23	$ 120	Lower Bids
Mid Estimate	100%				$ 30.00	$ 158,400		$ -	
High Estimate	125%				$ 37.50	$ 198,000	$ 38	$ 200	Higher Bids
Precast Barrier Curb									
Width (ft)	NA								
Barrier Curb Installed 10' segments		$ 90.00			$ 90.00				
Total					**$ 90.00**	**$ 475,200**			
Notes									
Low Estimate	75%				$ 67.50	$ 356,400	$ 70	$ 400	Lower Density
Mid Estimate	100%				$ 90.00	$ 475,200		$ -	
High Estimate	125%				$ 112.50	$ 594,000	$ 110	$ 600	Higher Density
Reconstruction (Raised Cycle Track)									
Reconstruction per Block			$ 1,000,000.00	300	$ 3,333.33				
Total					**$ 3,333.33**	**$ 17,600,000**			
Notes									
Low Estimate	50%				$ 1,666.67	$ 8,800,000	$ 1,670	$ 8,800	Lower Density
Mid Estimate	100%				$ 3,333.33	$ 17,600,000		$ -	
High Estimate	150%				$ 5,000.00	$ 26,400,000	$ 5,000	$ 26,400	Higher Density