

NJ TRANSIT Bus and Bike Interactions:

Bus Stop Design



Agenda

- 1** Project background
- 2** Workshop activity
- 3** Draft designs

Project background



2017 State of New Jersey Complete Streets Design Guide



Complete Streets planning in New Jersey has been gaining momentum in the last decade as we recognize the need for corridors to **safely accommodate all modes**.

As part of this effort, more **bicycle facilities** have and will be built along **bus routes**.

NJ TRANSIT has an opportunity to **design a framework** for safe bus service alongside bicycle infrastructure.

Introduction

Project Purpose

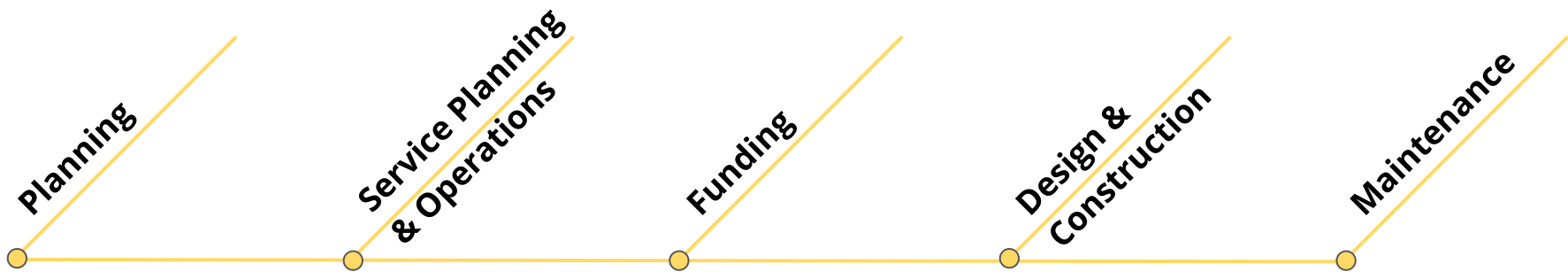
Reduce interactions between buses and bicyclists to ensure the safety of bus operators, passengers boarding and alighting at stops, bicyclists, and pedestrians

Workshop Goal

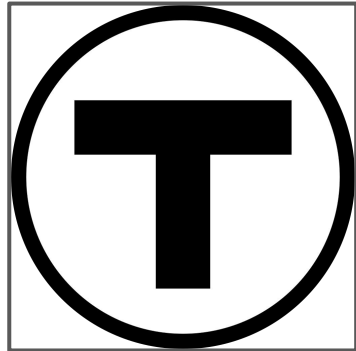
Bring road owners, bicycle advocates, and NJ TRANSIT together to brainstorm bus stop designs on Prospect Street

Designing Complete Streets

Planning, designing, and implementing a safe and complete street requires collaboration across stakeholders:



Peer Transit Agency Interviews



Interview takeaways:

- Mode separation benefits all users (MTA)
- Transit agency and road owner collaboration in the planning stage requires fewer changes later (RIPTA)
- Maintaining design standards and regular contact with road owners results in better designs (WMATA)
- Road owners increasingly require accommodating bicycles on roadways shared with transit (MBTA)

Common Bicycle/Bus Interactions

An **“interaction”** is defined as a situation in which one of the involved parties **performs an unexpected or risky maneuver** to avoid a collision or crash.¹

Six types of bus-bicycle interactions were identified to be relevant for this study from a literature review:

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- 1. Left Side Overtake
 - 2. Bus Curbing or Inability to Curb
 - 3. Right Side Overtake
 - 4. Sidewalk Cyclists
 - 5. Right-Hook or Pull Out
 - 6. Intersection Control Noncompliance

Toolkit to reduce bike-bus interactions

BIKE LANES & BARRIERS

Inspired by: 14 Ways to Protect A Bike Lane by Green Lane Project (research by Nathan Wilkes, City of Austin)



ARMADILLOS
Recommended width (barrier + bike lane)
6.5 feet - 8 feet
Protection Level
1 2 3 4
Installation Cost
\$ \$\$\$ \$\$\$\$
Armadillo Lifespan
Short Term → Mid Term



PARKING STOPS
Recommended width (barrier + bike lane)
5.5 feet - 8 feet
Protection Level
1 2 3 4
Installation Cost
\$ \$\$\$ \$\$\$\$
Parking Stop Lifespan
Short Term → Mid Term



CAST IN PLACE CURB
Recommended width (barrier + bike lane)
6 feet - 8 feet
Protection Level
1 2 3 4
Installation Cost
\$ \$\$\$ \$\$\$\$
Curb Lifespan
Mid Term → Long Term



PLANTERS
Recommended width (barrier + bike lane)
8 feet plus the planter width
Protection Level
1 2 3 4
Installation Cost
\$ \$\$\$ \$\$\$\$
Planter Lifespan
Pilot → Mid Term



CONCRETE BUTTONS
Recommended width (barrier + bike lane)
6.5 feet - 8 feet
Protection Level
1 2 3 4
Installation Cost
\$ \$\$\$ \$\$\$\$
Concrete Button Lifespan
Short Term → Mid Term



RAISED BIKEWAY
Recommended width (barrier + bike lane)
5.5 feet
Protection Level
1 2 3 4
Installation Cost
\$ \$\$\$ \$\$\$\$
Bikeway Lifespan
Mid Term → Long Term



CONCRETE JERSEY BARRIERS
Recommended width (barrier + bike lane)
7 feet - 8 feet
Protection Level
1 2 3 4
Installation Cost
\$ \$\$\$ \$\$\$\$
Jersey Barrier Lifespan
Mid Term → Long Term



RIGID BOLLARDS
Recommended width (barrier + bike lane)
7 feet - 8 feet
Protection Level
1 2 3 4
Installation Cost
\$ \$\$\$ \$\$\$\$
Rigid Bollard Lifespan
Short Term → Mid Term



FLEXIBLE DELINEATORS
Recommended width (barrier + bike lane)
8 feet
Protection Level
1 2 3 4
Installation Cost
\$ \$\$\$ \$\$\$\$
Delineator Lifespan
Pilot → Short Term



STRIPED BUFFER
Recommended width (barrier + bike lane)
8 feet
Protection Level
1 2 3 4
Installation Cost
\$ \$\$\$ \$\$\$\$
Striping Lifespan
Pilot → Long Term



PARKING PROTECTED*
Recommended width (barrier + bike lane)
1.4 feet - 1.6 feet
Protection Level
1 2 3 4
Installation Cost
\$ \$\$\$ \$\$\$\$
Delineator Lifespan
Pilot → Short Term
*With flexible delineators



TWO-WAY CYCLE TRACK
Recommended width (barrier + bike lane)
11.5 feet - 13 feet
Protection Level
1 2 3 4
Installation Cost
\$ \$\$\$ \$\$\$\$
Delineator Lifespan
Pilot → Short Term

SIGNAGE & PAVEMENT MARKINGS



BIKE BOX
Placement
Signalized intersections
Purpose
Increase cyclist visibility when queuing
Per-Unit Cost (Raw materials only)
\$250 - \$600
Lifespan
Pilot → Mid Term



PAVEMENT MARKINGS
Placement
Conflict areas
Purpose
Draw attention to conflict areas and direct behavior using clear visual cues
Per-Unit Cost (Raw materials only)
\$150 - \$500
Lifespan
Pilot → Mid Term



BIKES YIELD TO Peds SIGN
Placement
Bus stops and crosswalks
Purpose
Use in combination with other features to slow/stop bicyclists
Per-Unit Cost (Raw materials only)
\$25 - \$200
Lifespan
Pilot → Long Term



RADAR SPEED SIGN
Placement
Corridors on which speeding is an issue
Purpose
Encourage vehicles to slow down
Per-Unit Cost (Raw materials only)
\$2,500 - \$10,000
Lifespan
Mid Term → Long Term



CHANGE IN MATERIALS
Placement
Bus stops and crosswalks
Purpose
Alert bicyclists and signal to pedestrians where to safely stand and cross
Per-Unit Cost (Raw materials only)
\$10 - \$100 per square foot
Lifespan
Mid Term → Long Term



RAISED CROSSWALK
Shown with flashing beacon
Placement
Near-side, far-side, mid-block
Purpose
Increase pedestrian visibility and allows them to cross at sidewalk-level
Per-Unit Cost (not including beacon)
\$35,000 - \$75,000
Lifespan
Mid Term → Long Term



COLORS PAINT
Placement
Bike lane or bus lane
Purpose
Corridor treatment (i.e. length of bike lane) or spot treatment (i.e. conflict area)
Per-Unit Cost (Raw materials only)
\$1 - \$10 per square foot
Lifespan
Pilot → Long Term



STOP BAR
Placement
Bike lane or vehicle lane
Purpose
Maintain a safe distance from pedestrians
Per-Unit Cost (Raw materials only)
\$0.50 - \$5 per linear foot
Lifespan
Pilot → Long Term



CONTINENTAL CROSSWALK
With signage and yield line
Placement
Near-side, far-side, mid-block
Purpose
Provide safe crossing for pedestrians
Per-Unit Cost (Raw materials only)
\$0.50 - \$5 per linear foot
Lifespan
Pilot → Long Term



TACTILE INTERVENTIONS
Truncated domes (blister / lozenge pattern)
Placement
Conflict areas
Purpose
Provide safe crossing for pedestrians
Per-Unit Cost (Raw materials only)
\$50 - \$100 per square foot
Lifespan
Mid Term → Long Term



MODE SEPARATION SIGNAGE
Placement
Conflict areas
Purpose
Use in combination with other features to encourage mode separation
Per-Unit Cost (Raw materials only)
\$25 - \$500
Lifespan
Pilot → Long Term



YIELD LINE / SHARK TEETH
Placement
Conflict areas
Purpose
Use in combination with other features to encourage mode separation
Per-Unit Cost (Raw materials only)
\$0.50 - \$5 per linear foot
Lifespan
Pilot → Long Term

Bike lanes & barriers example



FLEXIBLE DELINEATORS

Recommended width (barrier + bike lane)
8 feet

Protection Level

1 2 3 4

Installation Cost

\$ \$\$ \$\$\$ \$\$\$\$

Delineator Lifespan

Pilot → Short Term

Protection Level

- 1 = No vertical barrier to reduce vehicle impact
- 2 = Vertical barrier improves driver behavior, with minimal change to vehicle impact
- 3 = Vertical barrier will slow vehicle before impact
- 4 = Vertical barrier will significantly slow or stop vehicle before impact

Installation Cost (estimate)

- \$ = \$8K-\$15K per lane-mile
- \$\$ = \$15K-\$30K per lane-mile
- \$\$\$ = \$30K-\$80K per lane-mile
- \$\$\$\$ = \$80K-\$20M per lane-mile

Additional source: Tactical Urbanism Guide

Lifespan (estimate)*

- Pilot = Some maintenance after few months
- Short Term = Some maintenance after 1 year
- Mid Term = Some maintenance after 5 years
- Long Term = Some maintenance after >5 years

**All materials dependent on volume and weather. Striping and markings may last 3-72 months.*

Signage & pavement markings example



BIKE BOX

Placement

Signalized intersections

Purpose

Increase cyclist visibility when queuing

Per-Unit Cost (Raw materials only)

\$250 - \$600

Lifespan

Pilot → Mid Term

Lifespan (estimate)*

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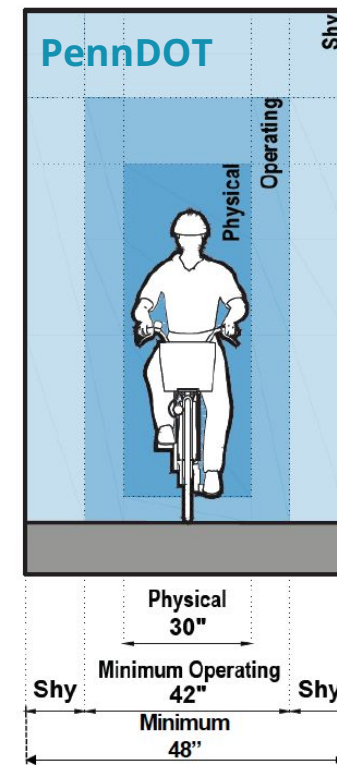
Striping and markings may last 3-72 months.

Parameters for bike lanes

Bicycle Facility Table, 2017 State of New Jersey Complete Streets Design Guide

ADT	85TH PERCENTILE SPEED ¹						
	≤ 20	25	30	35	40	45	≥50
≤ 2,500	ABCDEF	A ² BCDEF	CDEF	CDEF	CDEF	DEF	F
2,500–5,000	BCDEF	BCDEF	CDEF	CDEF	DEF	DEF	F
5,000–10,000	B ³ CDEF	B ³ CDEF	CDEF	DEF	DEF	EF	F
10,000–15,000	DEF	DEF	DEF	DEF	EF	EF	F
≥15,000	DEF	DEF	DEF	EF	EF	F	F

A: Shared Street/Bicycle Boulevard **B:** Shared-lane Markings **C:** Bicycle Lane **D:** Buffered Bicycle Lane
E: Separated Bicycle Lane **F:** Shared-use Path



City bus stop AADT
(Feb 2023, Prospect Village):

11,686

County bus stop AADT
(Feb 2023, Prospect & New Hillcrest):

10,372

Posted Speed
(both stops):

25 mph

Today's activity



Purpose of workshop

Bring road owners, bicycle advocates, and NJTRANSIT together to brainstorm bus stop designs on Prospect Street

Purpose of activity

Generate conceptual bus stop designs that account for the safety of all the following modes:

- Bicycles
- Private Vehicles
- Trucks
- Buses
- Pedestrians

Breakout groups

Each breakout group will consist of a road owner, bicycle advocate, NJT staff, and other involved stakeholders.

Roles in breakout groups:

- Facilitator (DVRPC staff)
- Timekeeper
- Scribe
- Someone to share



Bus stops and context

Prospect St at Parkway Ave



- County-owned road, AADT ~10,400
- Near-side bus stop
- Buffered bike lanes are present
- Nearby residential areas

Prospect St at Frazier St



- City-owned road, AADT ~11,700
- Mid-block bus stop
- No existing bicycle infrastructure
- Nearby senior and rec center, affordable housing

Why these locations?

- On the Vision Zero High Injury Network
- Trenton Complete Streets ordinance mandates that roads must safely accommodate all users
- Forthcoming plans
 - Trenton bicycle plan
 - City-owned segment of Prospect Street scheduled to be repaved next fiscal year
- Prospect Street is multimodal
 - NJT Bus Route 601 has approximately 40-60 minute headways, or about 21 buses per day
 - Bicycle counts taken across Trenton in April 2023 show that AADB is about 96

Activity framework

- Each *person* has a toolkit and parameters
- Each *group* has a mockup of each bus stop
- 30 minute work time
 - Draw your group's design on the mockup
 - If time allows, try to design both stops

Discussion questions

- What did your group struggle with?
- What do you like best about your design?

Next steps for these bus stops

Implementation

- Who leads?
- What is needed?

Funding

- What are some funding sources to pull from?
- Which funding has already been secured?

Maintenance

- What needs can be anticipated?
- What type of coordination needs to happen?
- Who is involved?