Bicycle Counts with Pneumatic Tube Counters

Boulder County

Research & Development:

We determined there are 3 necessary ingredients for counting both bicyclists and motor vehicles at the same time, with the same equipment:

Alex Hyde-Wright
Transportation Engineering Assistant
Boulder County
Transportation Department
303.441.4910
ahyde-wright@bouldercounty.org

Brian Graham, AICP
Bicycle Planner/
Employee Transportation Coordinator
Boulder County Transportation Department
720.564.2667
bgraham@bouldercounty.org

Krista Nordback, Ph.D, PE
Researcher
Oregon Transportation Research
and Education Consortium (OTREC)
503.725.2897
nordback@pdx.edu

the goal:

Prior to 2013, Boulder County has conducted annual motor vehicle traffic counts at approximately 175 locations using automated pneumatic tube counters. The counters provide detailed data including traffic volumes, speeds and types, or classes, of vehicles on the county's road network. By contrast, bicycle counts were limited to a handful of locations counted by volunteers for just two hours each.

The purpose of our research study was to determine if bicyclists could be counted accurately using the county's existing motor vehicle traffic counters, which would provide far better data about the county's bicycle traffic.

the impetus:

Speed vs. Wheelbase - Motorcycle Class
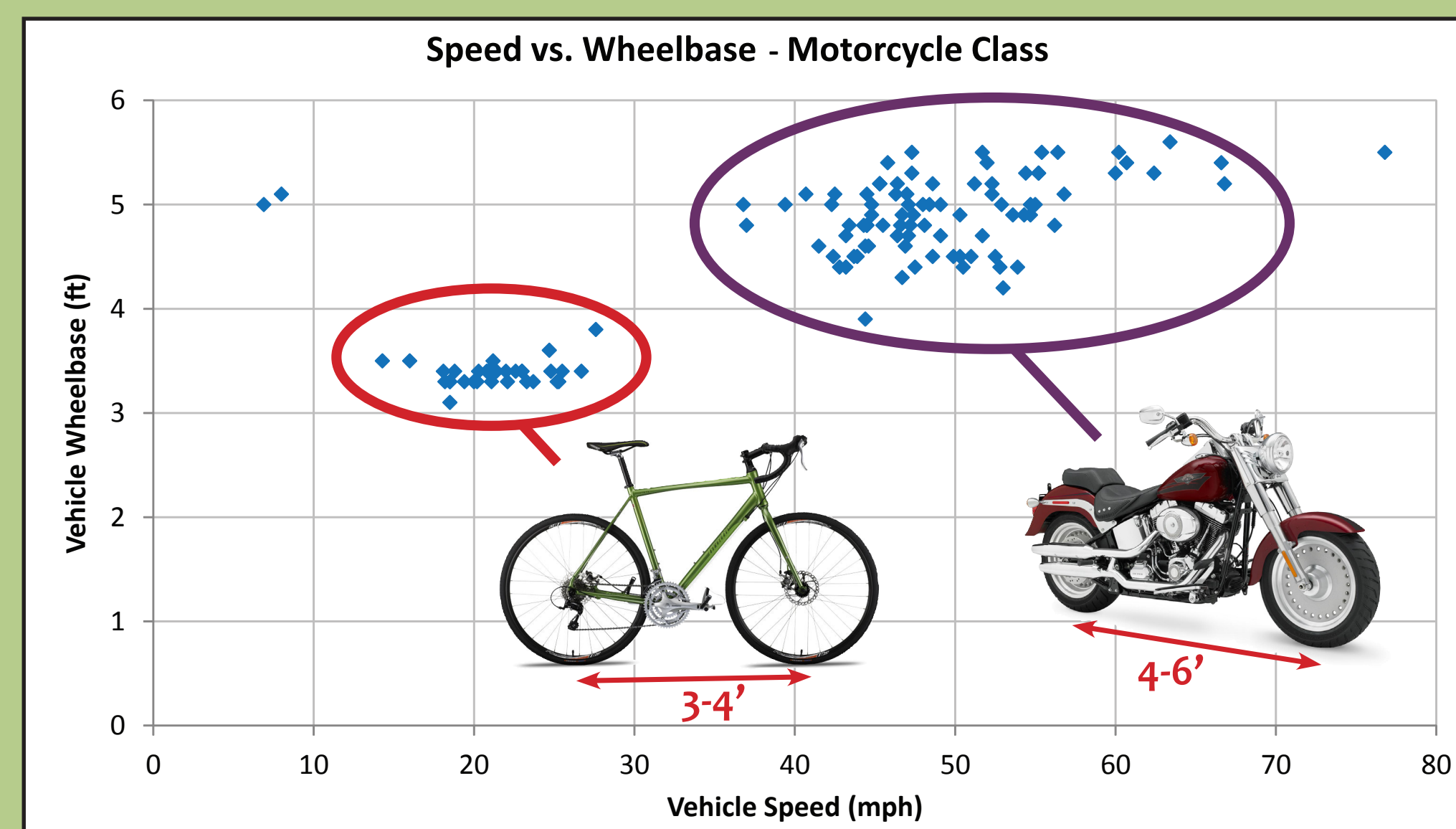
This graph plots the wheelbase and speed of each vehicle in the motorcycle class from a typical 24-hour traffic count. Our equipment was counting some bicyclists, though the accuracy was unknown.

the starting point:

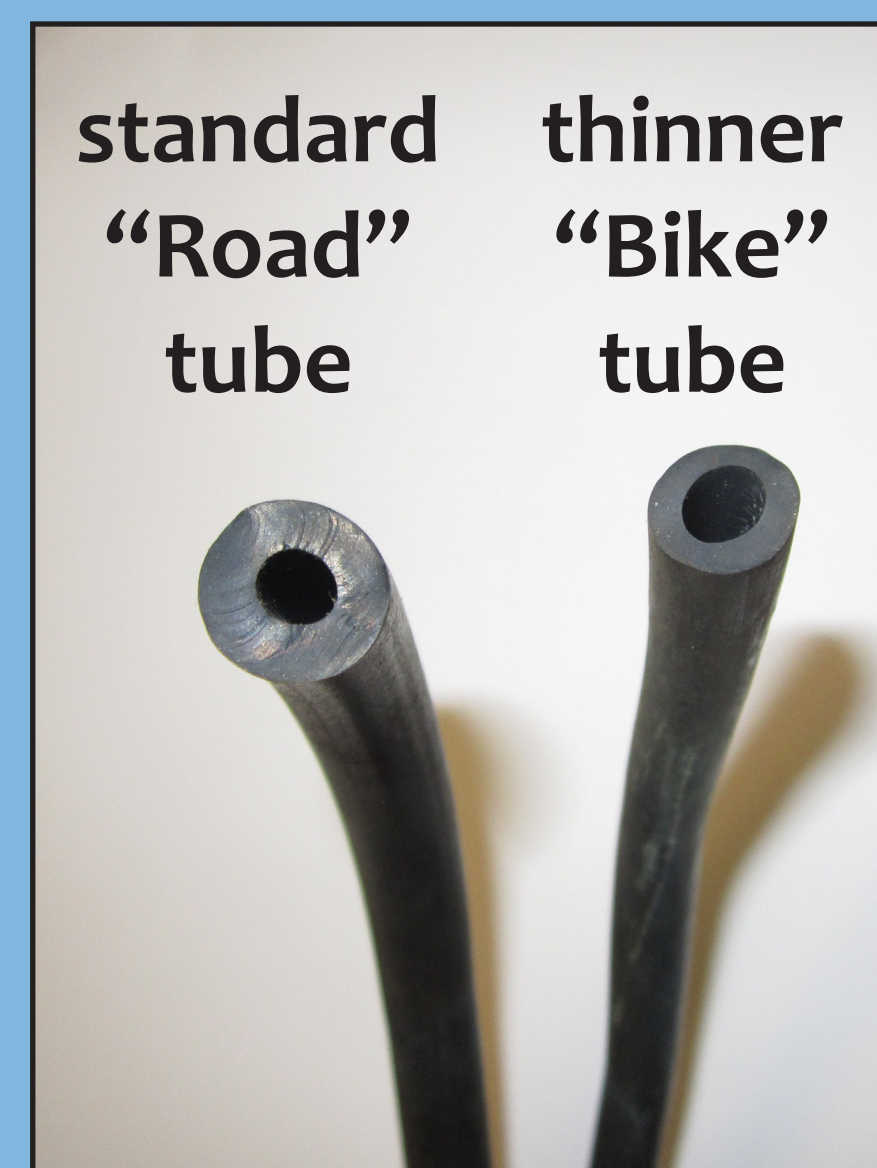▶ two tubes set across the road

▶ anchored with a metal bracket ▶

▶ plugged into a single counter ▶

1. thinner-walled "bicycle" tubes

standard "Road" tube   thinner "Bike" tube

Thinner-walled "bicycle" tubes allow bicyclists to generate stronger air pulses, which have a greater likelihood of being registered as axle hits.
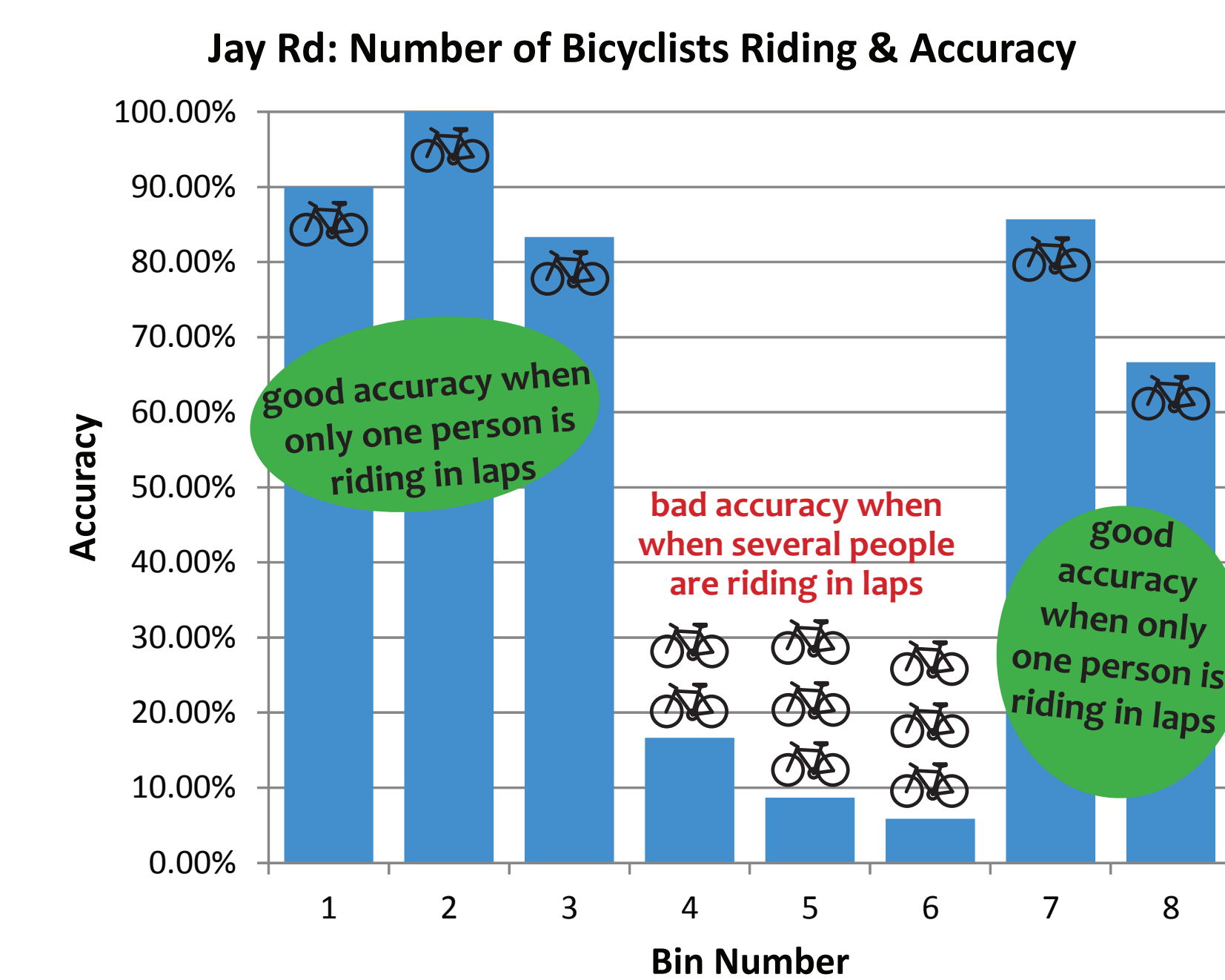
2. an attachment method that does not pinch the tubes

We discovered through trial and error that routing the "bicycle" tubes through a vinyl sleeve and securing the sleeve with a metal bracket secured the tubes tightly without pinching them.

3. the new BOULDER COUNTY (BOCO) classification scheme

Staff and volunteers rode in laps across the tubes to increase the amount of data collected, but whenever more than one person rode, we saw a large drop in accuracy.

Jay Rd: Number of Bicyclists Riding & Accuracy

Good accuracy when only one person is riding in laps

bad accuracy when when several people are riding in laps

good accuracy when only one person is riding in laps

Traffic counters use classification schemes to sort vehicles by type, or class. We determined groups of bicyclists were being misclassified by the ARX Cycle classification scheme the counters were using.

For example, even though bicyclists' axle hits were now being recorded, the ARX classification scheme was interpreting two bicyclists to be a T4 (four axle) truck.

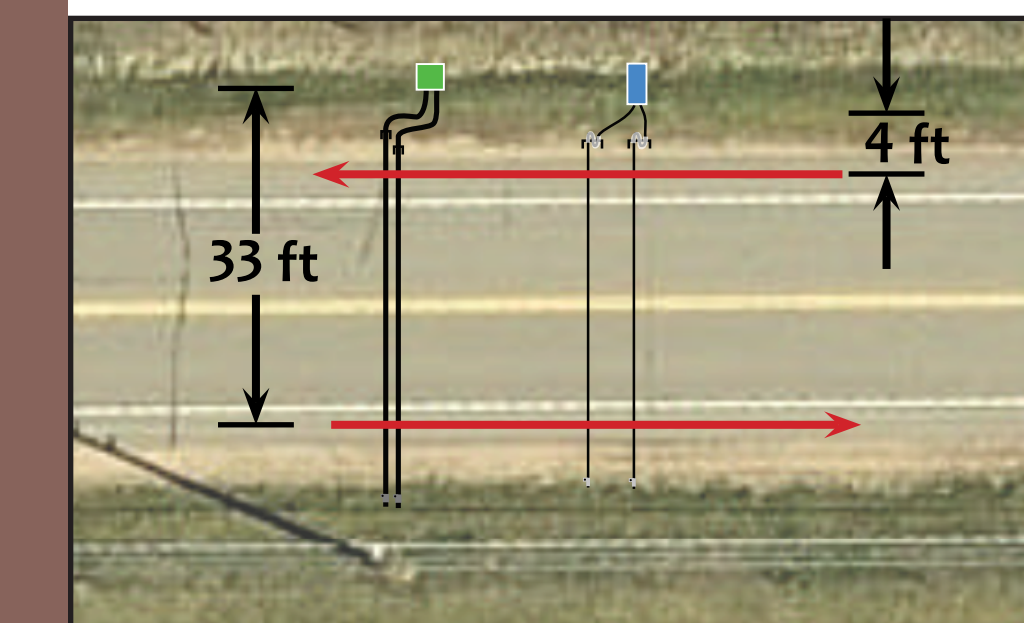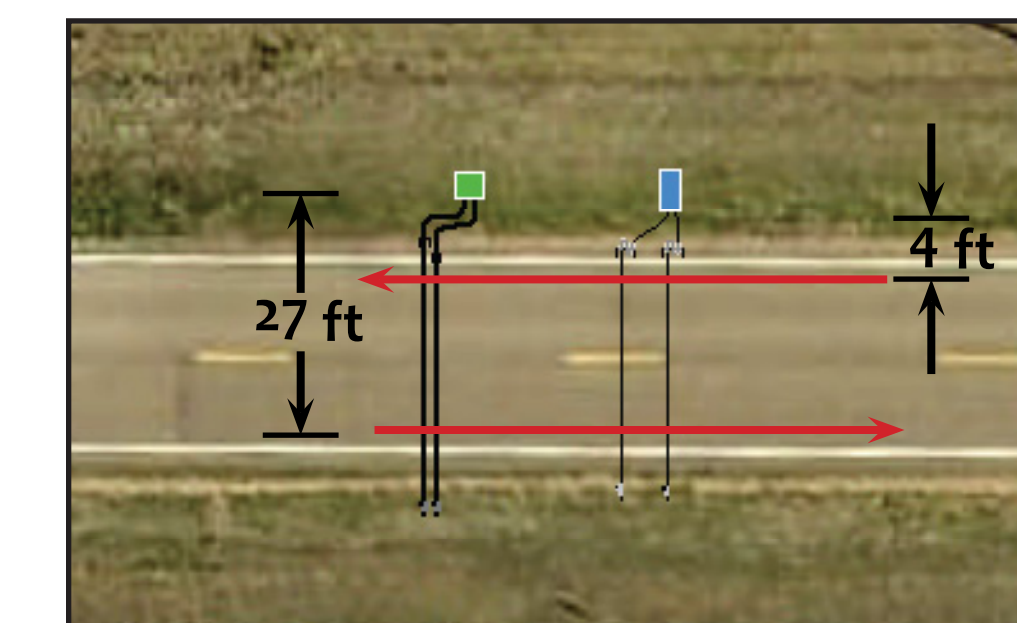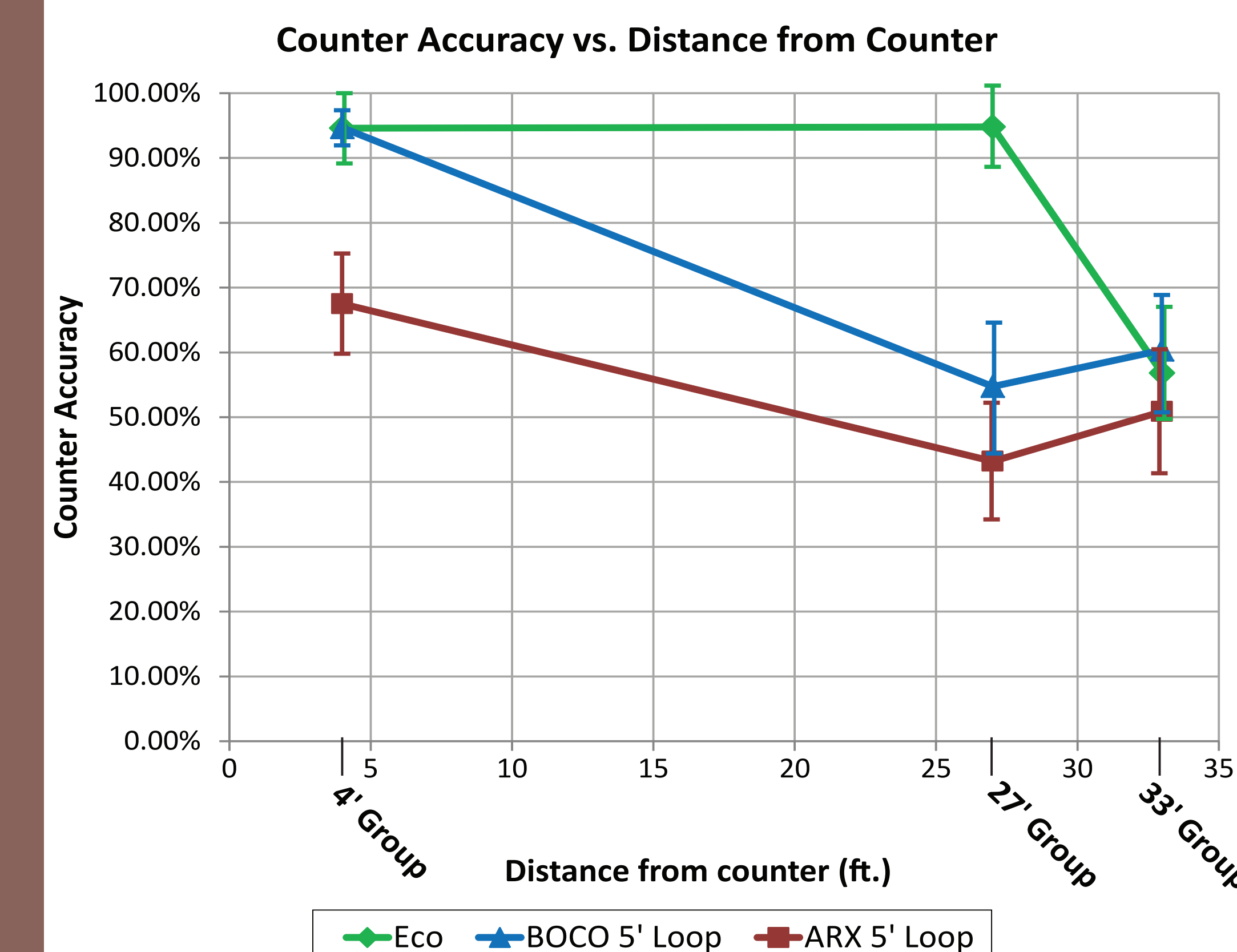| Speed	Wb	Hdwy	Gap	Ax	Cl	Nm	Vehicle
15.5	44.6	13.0	12.9	4	7	00000252	T4 oo ↔ oo

Our solution was to create a new classification scheme based on the ARX Cycle Scheme. We titled it "Boulder County" (BOCO). We edited the rules for the truck classes to exclude groups of bicyclists. Then we created new multi-bike classes to include groups of bicyclists.

Editing the T4 Class   **Creating the 2Bikes Class**
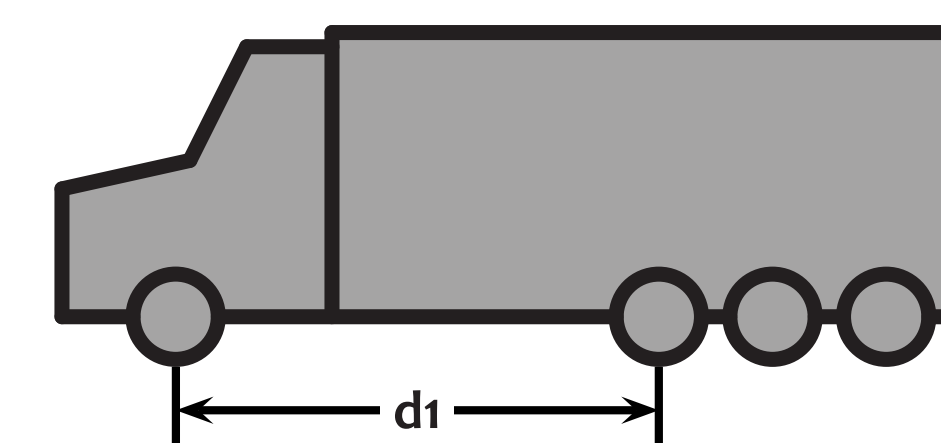
ARX Cycle Rules for T4:
4 or more axles
2 axle groups
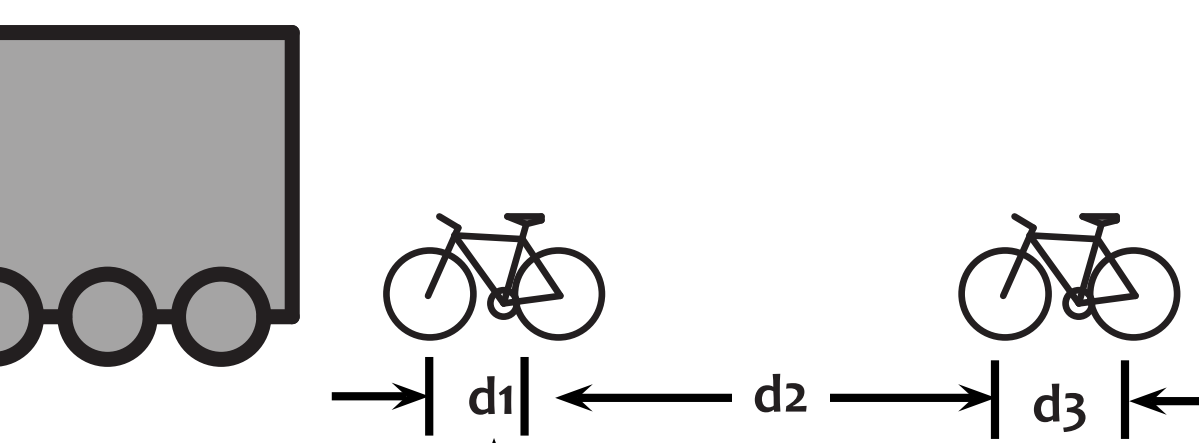
BOCO Rules for T4:
4 or more axles
2 axle groups
d1 > 4 ft

BOCO Rules for 2Bikes:
4 axles
2 axle groups
2.9 ft < d1 < 4 ft
2.9 ft < d3 < 4 ft

Multi-bike classes were necessary because once the counters determine that a group of bicyclists is one vehicle, the classification scheme cannot split the vehicle up. The new classes in the BOCO scheme allow all bicyclists to be counted. For example, a 2bike "vehicle" is actually two bicyclists.

ARX Cycle Vehicle Classes
1: Cycle (Bicycle)
2: MC (Motorcycle)
3: SV (Passenger Car)
4: SVT (Car with Trailer)
5: TB2 (Rigid-body 2 Axle Truck)
6: TB3 (Rigid-body 3 Axle Truck)
7: T4 (Rigid-body 4 Axle Truck)
8: ART3 (3 Axle Articulated Truck)
9: ART4 (4 Axle Articulated Truck)
10: ART5 (5 Axle Articulated Truck)
11: ART6 (6 Axle Articulated Truck)
12: BD (B-Double)
13: DRT (Double/ Road Train)

BOCO Vehicle Classes
1: 1Bike (1 Bicycle)
2: 2Bikes (2 Bicycles)
3: 3Bikes (3 Bicycles)
4: 4Bikes (4 Bicycles)
5: MC (Motorcycle)
6: SV (Passenger Car)
7: SVT (Car with Trailer)
8: TB2 (Rigid-body 2 Axle Truck)
9: TB3 (Rigid-body 3 Axle Truck)
10: T4 (Rigid-body 4 Axle Truck)
11: ART3 (3 Axle Articulated Truck)
12: ART4 (4 Axle Articulated Truck)
13: ART5 (5 Axle Articulated Truck)
14: ART6 (6 Axle Articulated Truck)
15: BD (B-Double)
16: DRT (Double/ Road Train)

Results & Implementation:

Roads without Shoulders   **Roads with Shoulders**
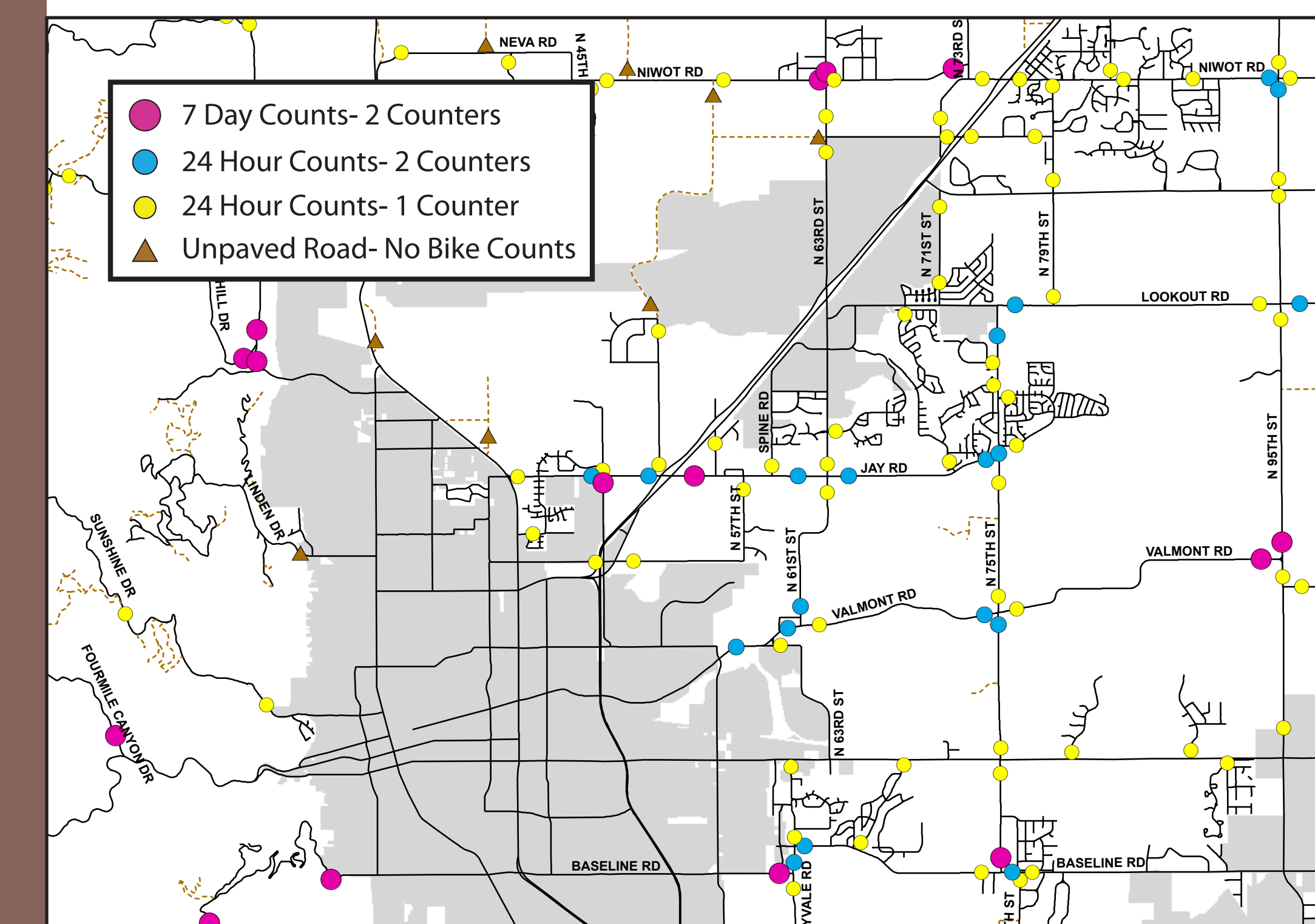
33 ft   4 ft   27 ft   4 ft

The accuracy of the counters was dependent on the distance from the counter bicyclists rode over the tubes. We split the data into three distance groups: a 4 ft group, a 27 ft group, and a 33 ft group.

Counter Accuracy vs. Distance from Counter

— Eco — BOCO 5' Loop — ARX 5' Loop

This graph shows the accuracy and margins of error for the Eco-Counter, and the MetroCount counters, using both the ARX and BOCO classification schemes.

Distance to Counter	Number of Bikes	Counter Accuracy	95% Confidence Interval	Number of bikes counted	Correction Factor (1/accuracy)	Corrected Number of Bikes	Margin of Error (bikes)
4'	1000	94.68%	2.68%	947	1.056	1000	± 27
27'	1000	54.72%	9.85%	547	1.827	1000	± 99
33'	1000	60.35%	8.95%	604	1.657	1000	± 90

This table shows the accuracy and margins of error for counting bicyclists using a MetroCount counter and our three ingredients for success.

● 7 Day Counts- 2 Counters
● 24 Hour Counts- 2 Counters
● 24 Hour Counts- 1 Counter
▲ Unpaved Road- No Bike Counts

In 2013, Boulder County is counting bicyclists and motor vehicles on all paved county roads!

Download this poster, our presentation/talking points and paper here: http://goo.gl/UtDyB