

Breathing While Biking: Do Limebike riders inhale harmful air pollution?

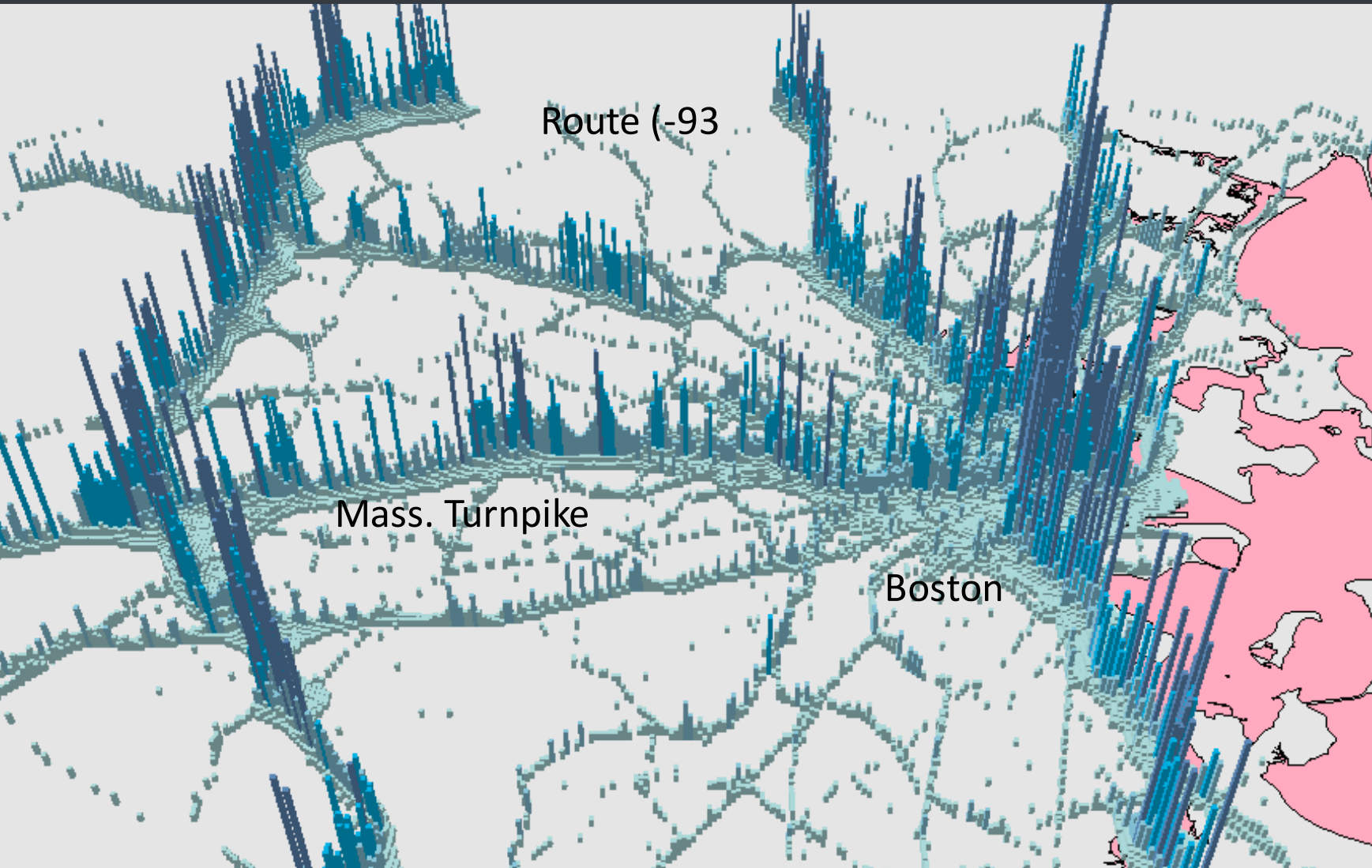
Introduction

Vehicle emissions from traffic are a major source of air pollution in American cities, and Americans who commute by car get 10 to 50% of their daily air pollution intake during commuting.³ This study aims to identify whether popular Limebike routes around Boston, have unhealthy levels of air pollution during peak traffic hours. Is it safe to breathe while bike commuting?

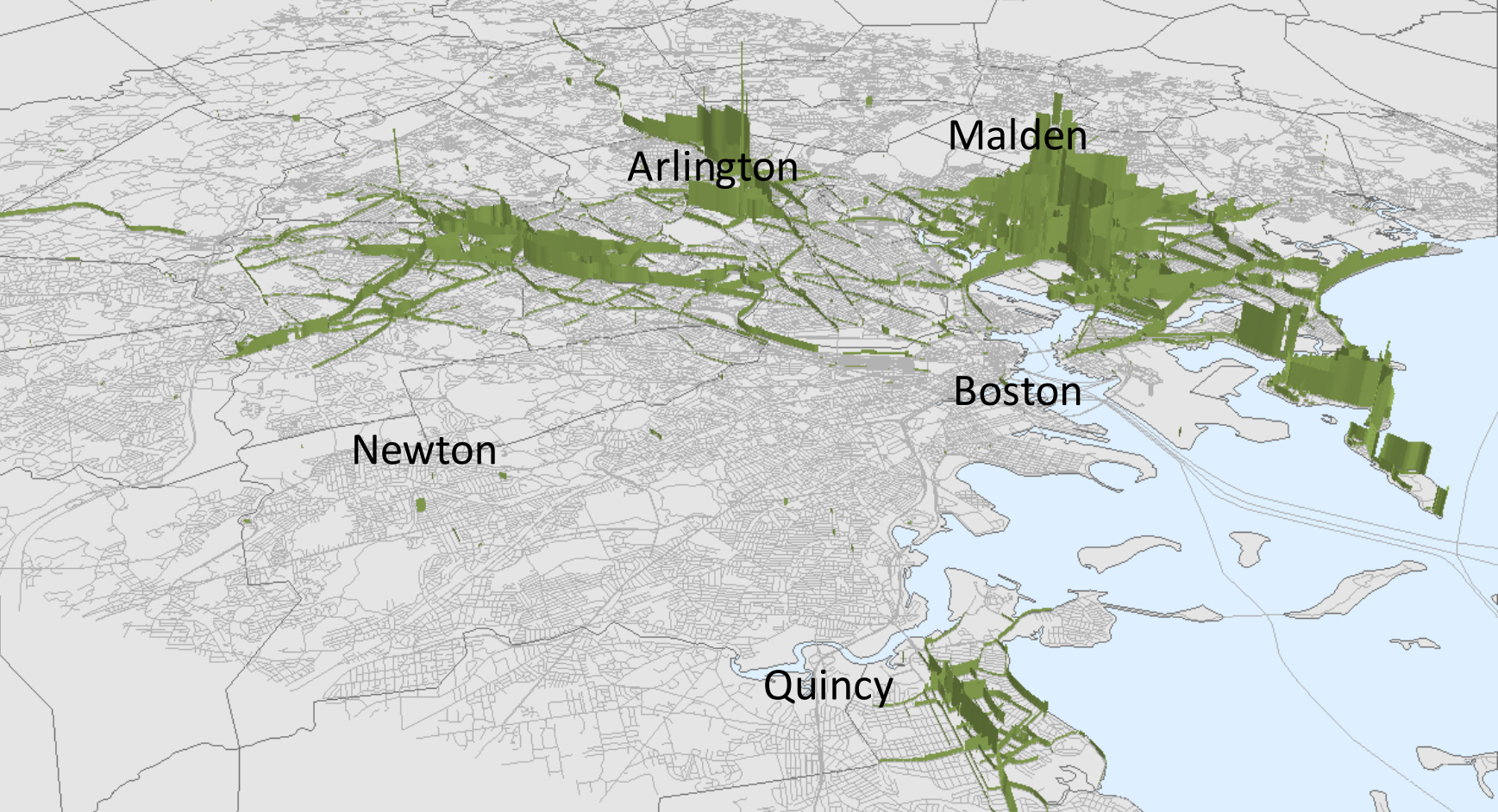


Limebike riders. Credit: Silicon Angle, July 1, 2018

Data



Annual average hourly vehicle emissions were modeled using the CLINE. Tool. This study uses weekday, winter, morning peak period traffic to capture the pollution levels morning commuters experience.¹



Weekday morning trip counts for Limebikes are used to represent bike commuting. Heights indicate the frequency of weekday use during the past year. Only trips with more than 50 users per quarter (approximately one a day) are shown.²

Analysis

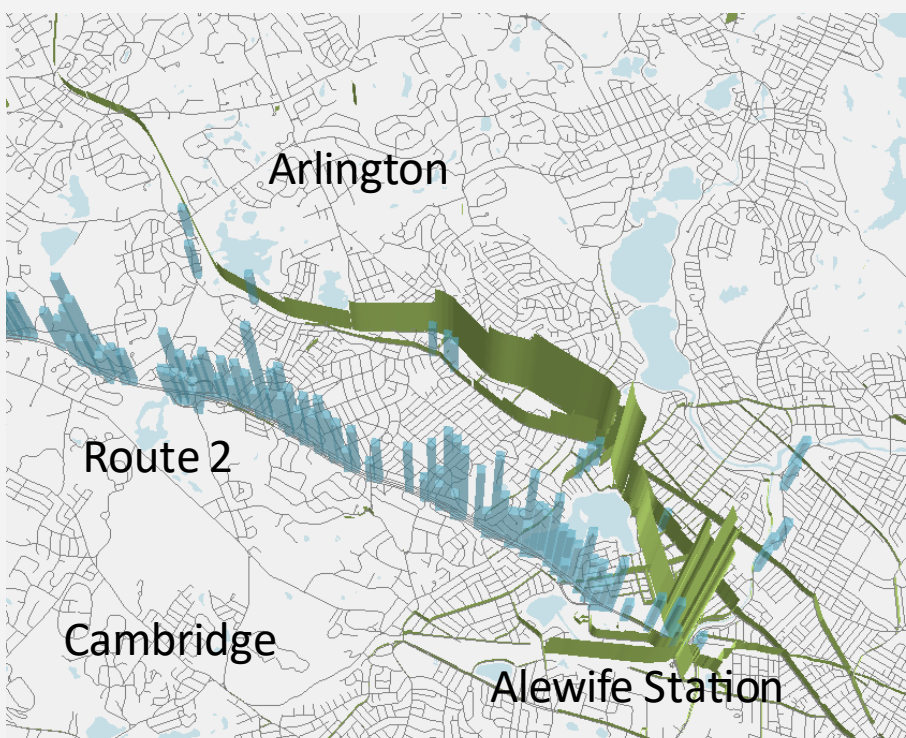


Step One: Compare popularity and air pollution exposure of Limebike routes.

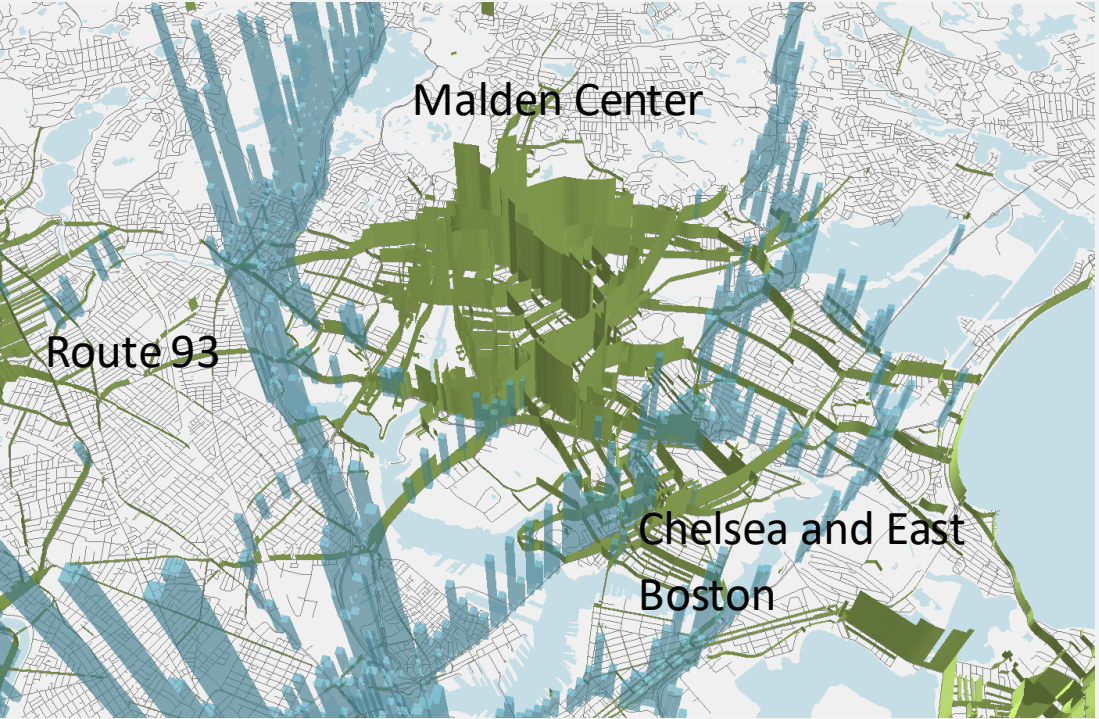
Green for popularity: Limebike paths with more than 50 trips per quarter (approximately one per workday) are extruded by trip count. (100% height exaggeration).

Blue for air pollution level: Grid squares where hourly average nitrogen oxides (NOx) concentration is greater than 10 ppb during the morning weekday commute (500% height exaggeration).

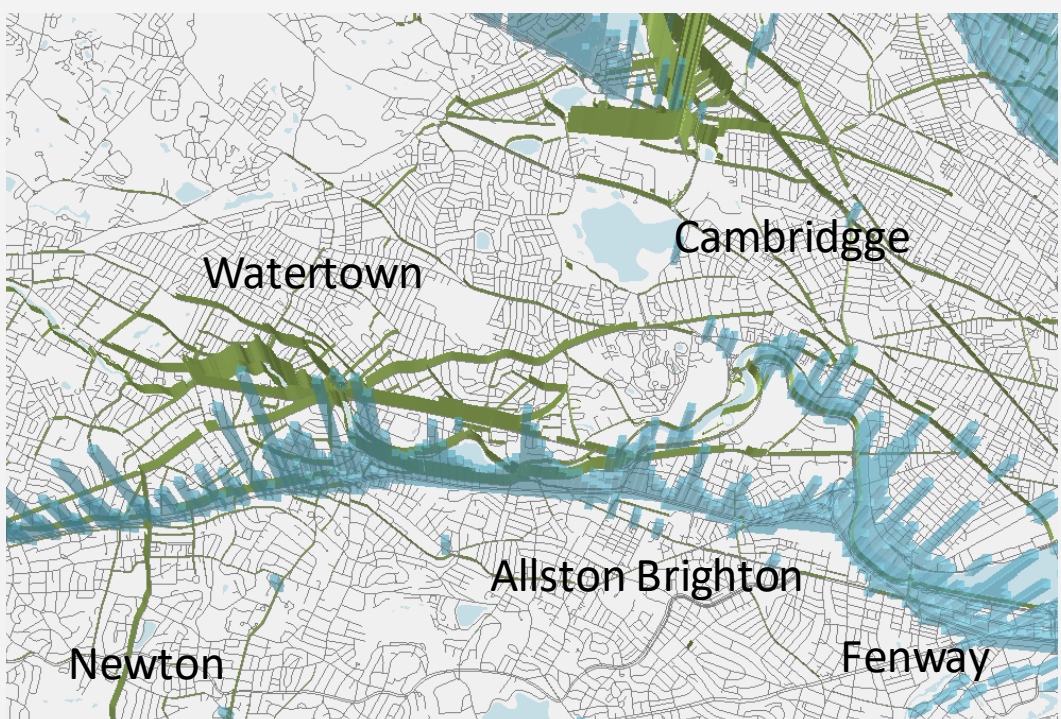
Step Two: Study areas where air pollution over 10 ppb meets popular Limebike routes:



Best case: In Arlington at Alewife Station, Limebikers use the Minuteman Bikeway, away from Route 2 emissions.



Mixed case: In Malden, some popular routes intersect high emissions roads but don't follow them for long.



Worst case: On the Paul Dudley White Bikepath along the Charles river, a popular Limebike route parallels busy roads.

Results

Emissions on the Paul Dudley White Bikepath, our worst case, pose low risk to a bike commuter's health.

- Average NOx exposure over this 45-minute trip is 12 ppb, well below the 100 ppb threshold established by the U.S. Environmental Protection Agency.
- It is also below 80 ppb, the hourly exposure that if experienced by an average commuter (5 hours a week), would increase their annual average exposure by 5 ppb. A 5 ppb annual increase is associated with 5-6% increase in all-cause mortality risk, and 13-22% increased risk for some other diseases.⁴

Data Sources:

1. CLINE is a free tool provided by the University of North Carolina Institute of the Environment.. Resolution is 80 meters.. Original projection is WGS 84 UTM 19N.
 2. Limebike data is from Metropolitan Area Planning Council Data Common. Selected data is path segments used November 1, 2018 to October 31, 2019. Projection is NAD 83 State Plane Massachusetts Mainland FIPS 5200.
- Roads and context layers from MassGIS and municipal sources.

References:

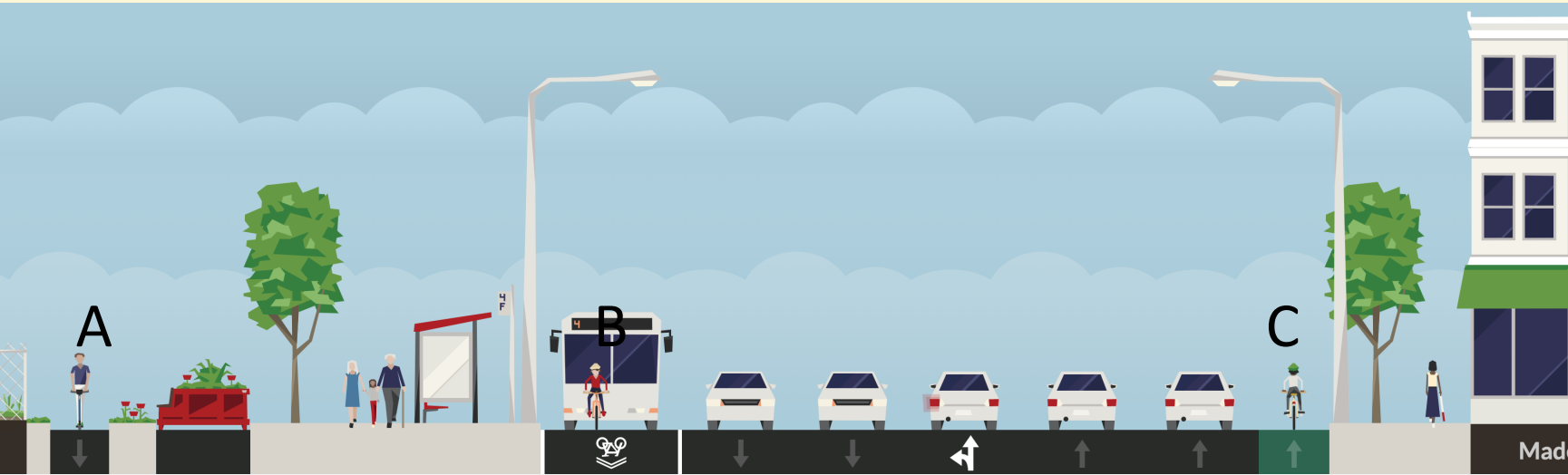
3. U.S. Dept. of Transportation Volpe Center, "Ongoing Transformation of the Global Transportation System," conference proceedings December 2017.
4. B. Brunekreef, R. Beelen, et al., Effects of longterm exposure to traffic-related air pollution on respiratory and cardiovascular mortality in the Netherlands.
5. Piers MacNaughton, Steven Melly, Jose Valerino et al. Impact of bicycle route type on exposure to traffic-related pollution. Science of the Total Environment 490 (2014) , 37-43
6. Hanna Boogaard, Frank Borgman et al. Exposure to fine and ultrafine particles and noise during cycling and driving in 11 Dutch cities Atmospheric Environment 43 (2009)

Conclusions

On average, Limebikers on popular routes are not exposed to unhealthy levels of vehicle exhaust. In fact, drivers in cars are likely to breathe much higher levels of air pollution than bikers travelling next to vehicle lanes.⁶

However, actual exposure while biking depends on factors including the following:

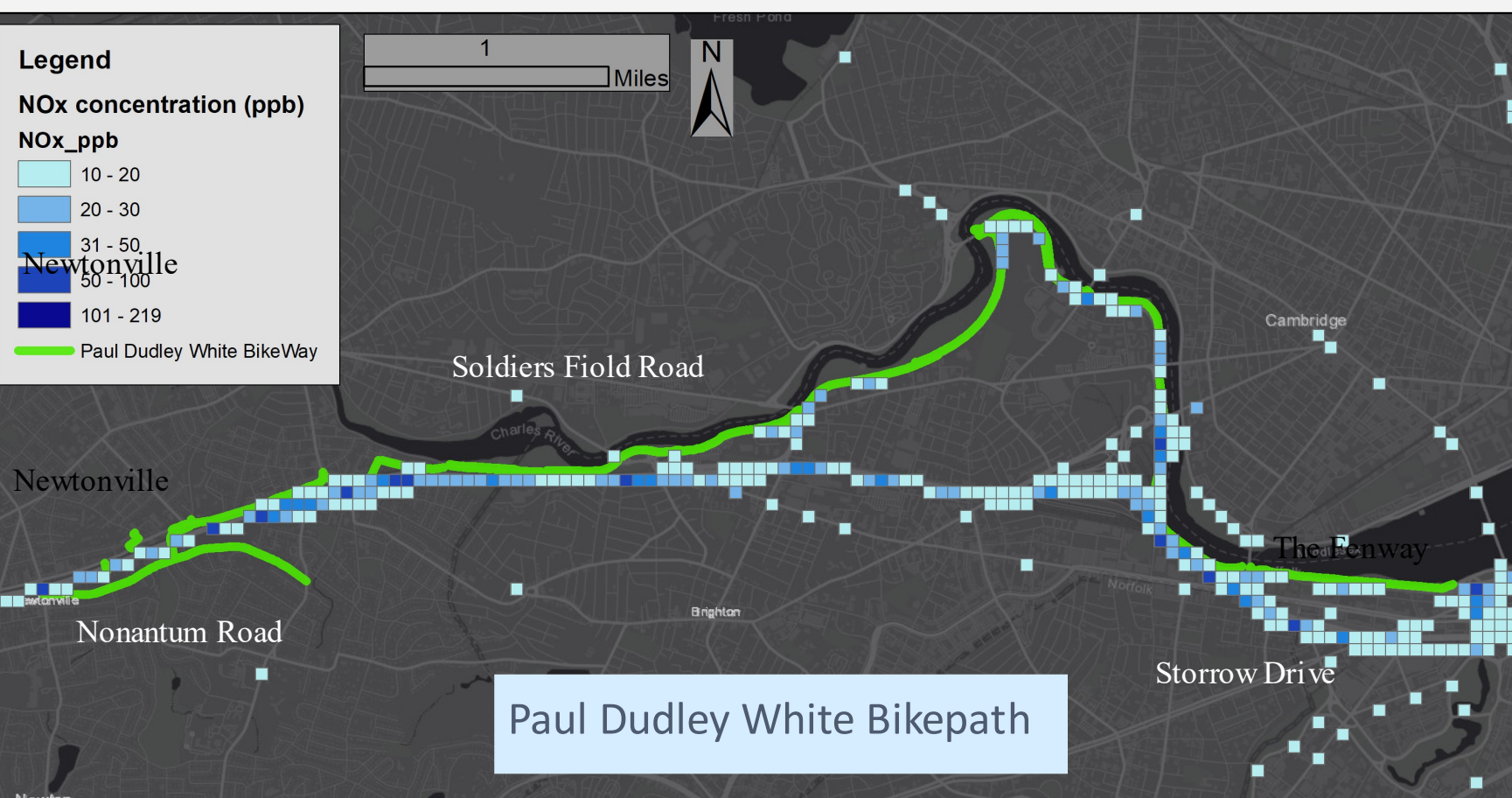
- the biker's position relative to traffic
- "street canyon" effects of wind and buildings,
- time spent waiting at busy intersections where exhaust is likely to be high, and
- breathing rate.⁴



Biker A, on a separated bikepath, may get 1/3 as much pollution as Biker B, in a "sharrow" lane. Biker C, in a bike lane, gets 2/3 as much as Biker B. Image creation software: Streetmix LLC

"We must establish more bike paths and trails throughout the country. I'd like to see everyone on a bike – not just once in a while, but regularly as a routine."

Dr. Paul Dudley White, 1886-1973, cardiologist, quote from .American Cycling, August 1968, "200,000 miles of bike trails".



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