Particulate Matter in New Haven:

Local Diesel Sources and Solutions

A Project of Environment Northeast's

New England Diesel Initiative

26 October, 2004

Conclusions

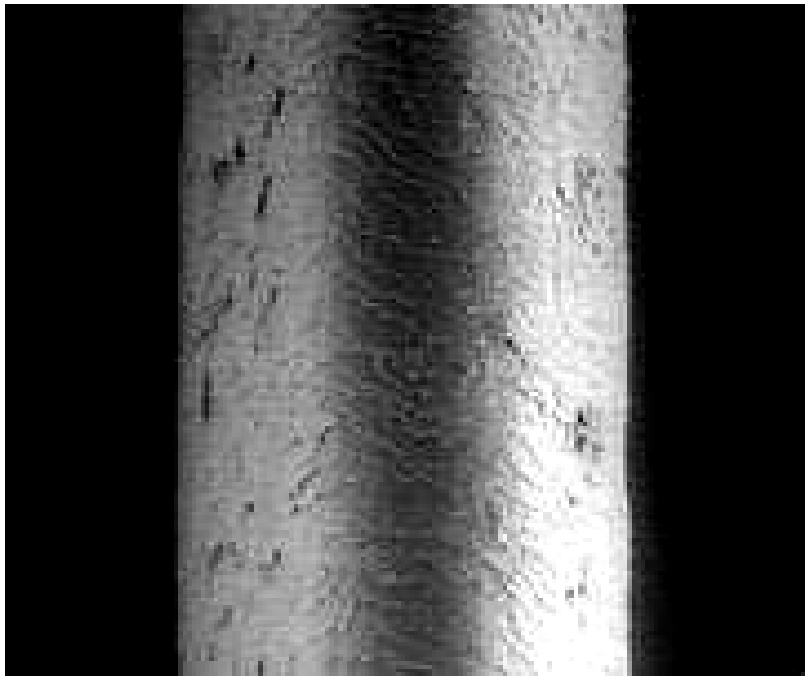
- New Haven is home to significant heavy duty diesel traffic
- Diesel traffic in New Haven generates fine particulate matter (PM2.5) and ultrafine particulate matter pollution which:
  - contributes to elevated levels of air pollution
  - is known to harm human health
- Solutions – cleaner fuels, retrofit emission controls, and reduced idling –
  - are readily available and affordable
  - will significantly cut local diesel particulate matter pollution, and
  - will improve local air quality and human health

Why Here, Why Now, Why Diesel?

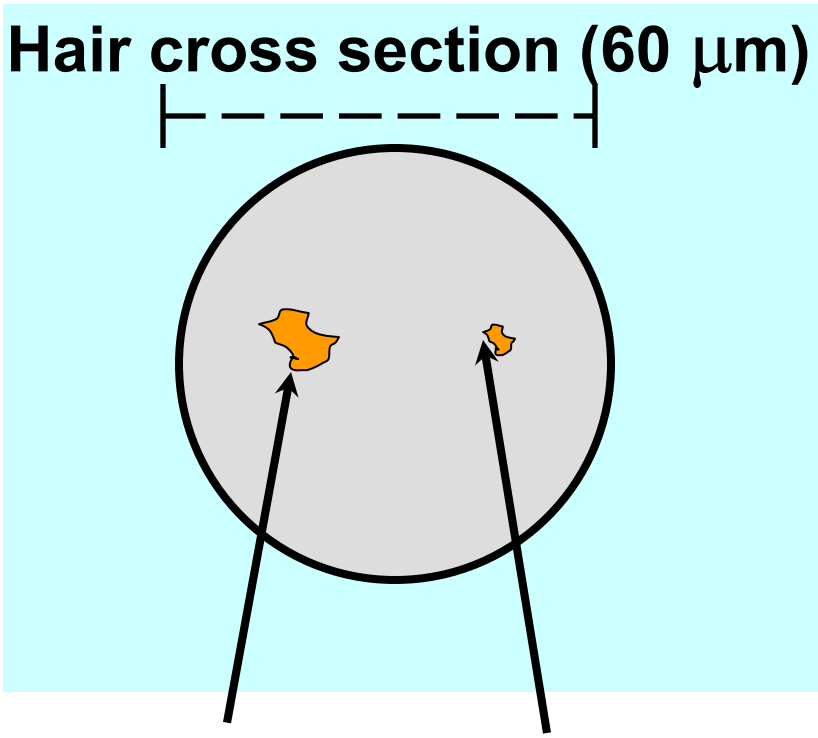
- Public health and environmental objectives
  - New Haven is experiencing high levels of fine particulate air pollution and high rates of respiratory illness
  - EPA preliminary designation of “non-attainment” for PM2.5
  - City of New Haven and the State of Connecticut are pursuing climate change goals
- Diesels emit high levels of fine particulates
  - Linked to respiratory illness
  - Linked to cancer and heart attacks
  - Linked to global warming
- Federal (EPA) rules do **not** adequately reduce pollution from currently “in-use” heavy duty diesel engines, which last decades
  - EPA rules only apply to “new” engine sales
  - New heavy duty diesels sold later the decade will be 90% cleaner than “in-use” diesels
- New fuels and technologies make diesel solutions achievable

PM2.5 = Fine particulate matter

Microscopic particles penetrate deep into lung tissue



Human Hair
(60 μm diameter)



Source: U.S. EPA

Diesels contribute to local health risk

- New Haven
  - 18% of school aged children have asthma
  - Highest asthma hospitalization rate in the state
- Connecticut
  - 202,000 adults and 75,000 children with asthma
  - Elevated levels of PM2.5 along highway corridors

PM2.5 air pollution is linked to:

- **Premature death from heart and lung disease**
- **Aggravation of heart and lung diseases**
  - Hospital admissions
  - Doctor and ER visits
  - Medication use
  - School and work absences
- **And possibly to**
  - Lung cancer deaths
  - Infant mortality
  - Developmental problems, such as low birth weight in children

Source: US EPA

Diesel PM contributes to local haze

Hartford
Oct. 8, 2002
4 p.m. EDT

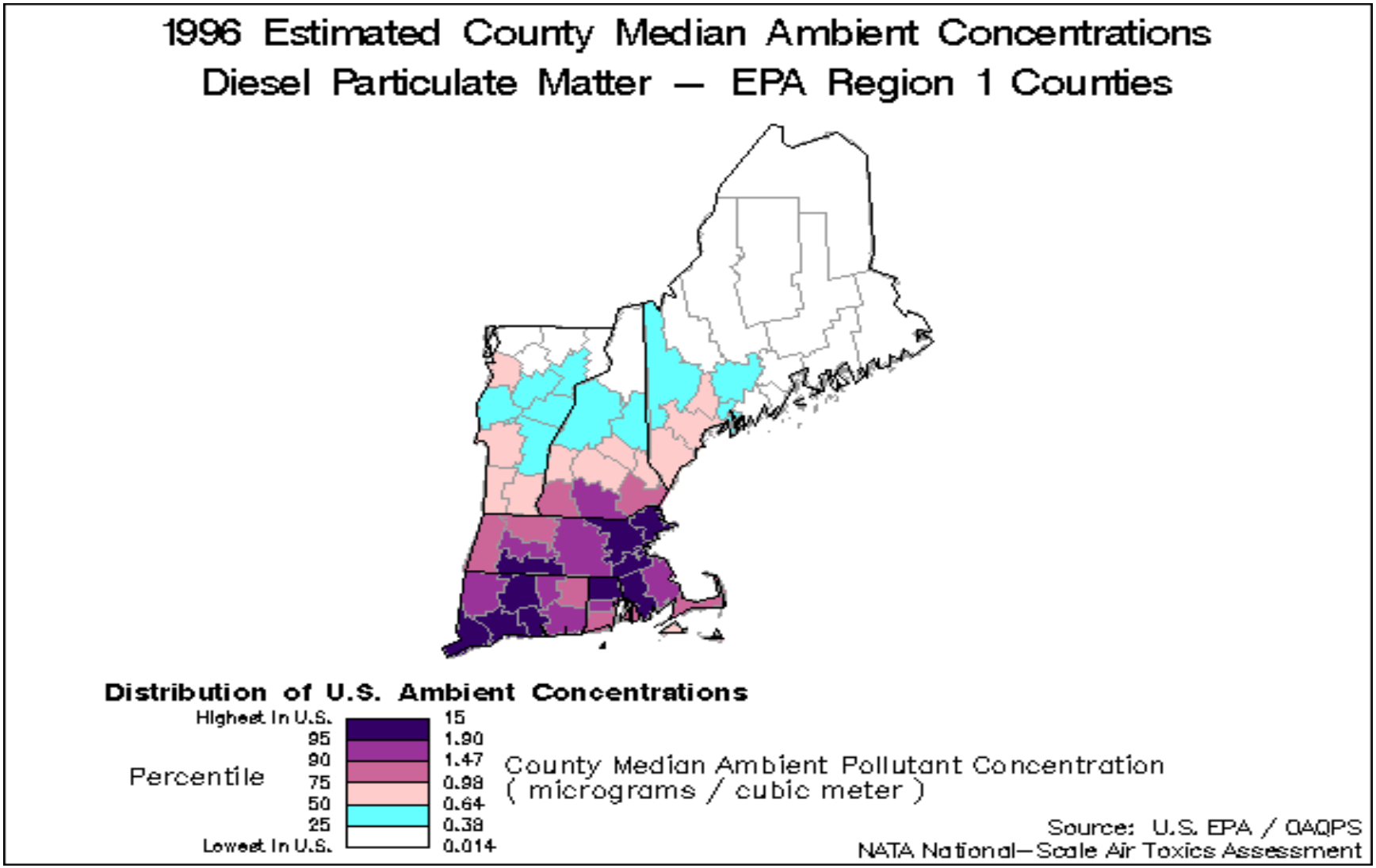
Hourly conc. of fine particles – 4 μg/m³

Hartford
Oct. 2, 2002
4 p.m. EDT

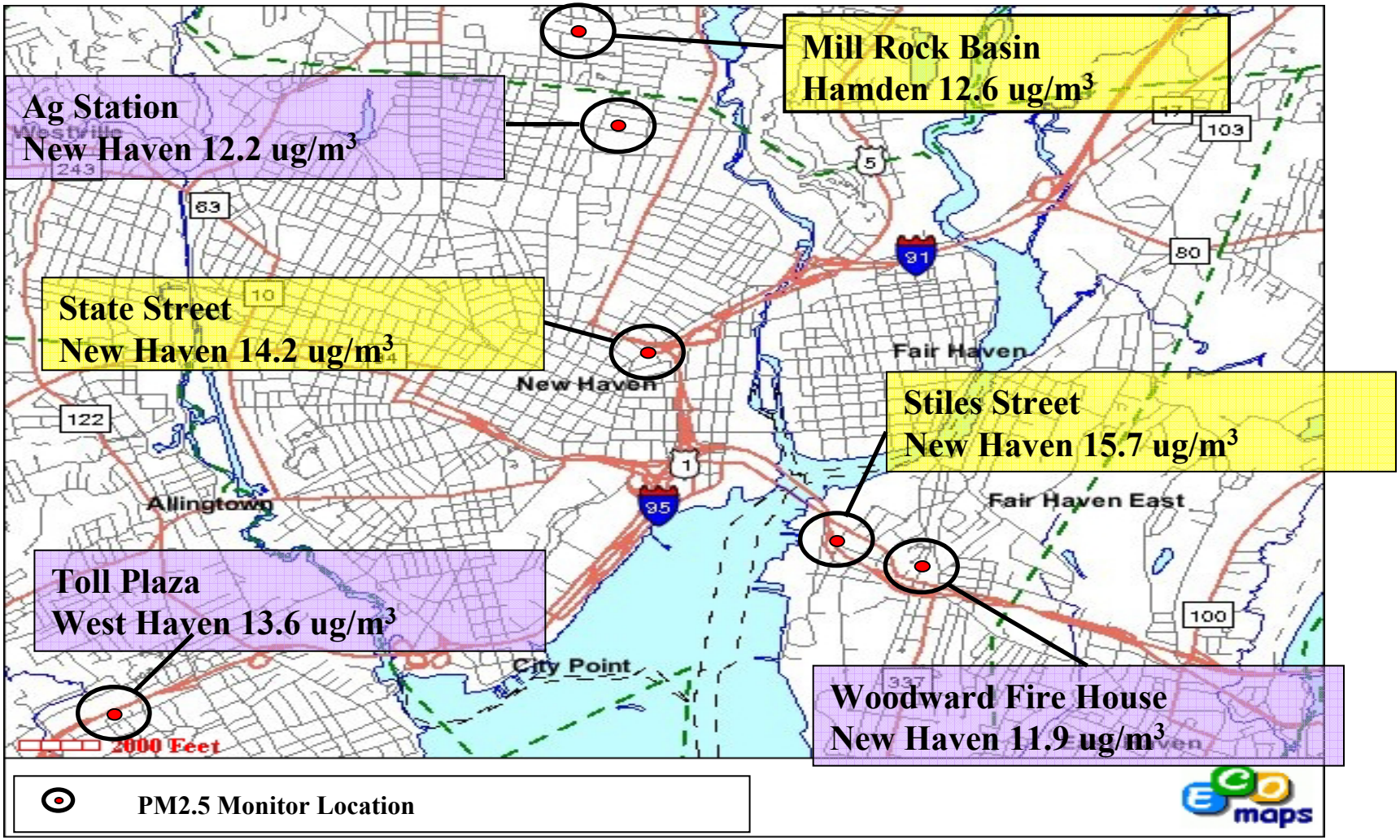
Hourly conc. of fine particles – 24 μg/m³

Source: CT DEP

CT among highest exposures to Diesel PM



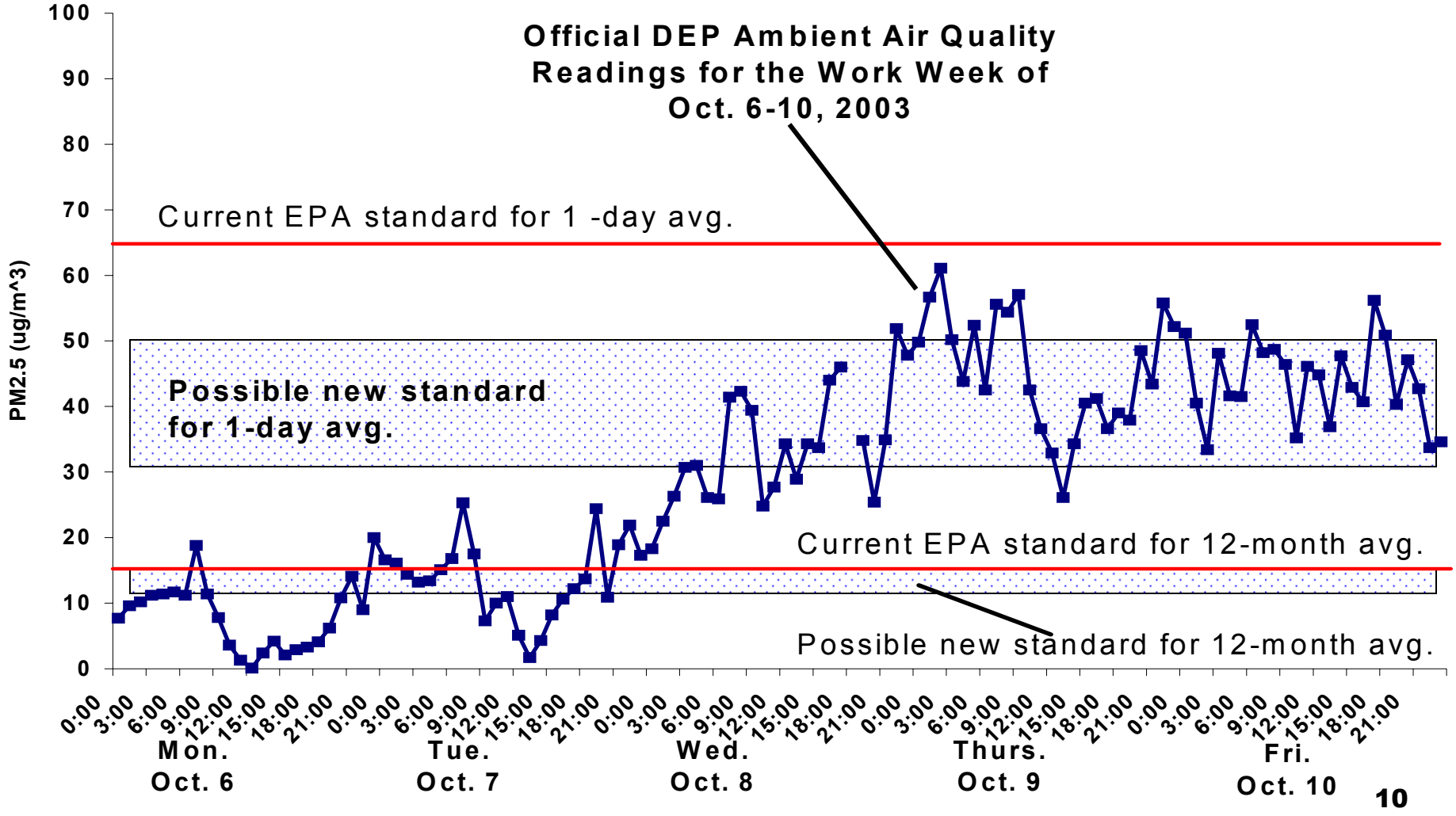
New Haven Area PM $_{2.5}$



Apr-Sept 2003 avg. from DEP air quality monitors located in New Haven. The annual federal standard is 15 ug (micrograms). EPA may lower standard in future. Map Source: CT DEP.

PM2.5 levels in New Haven

A Bad Week in 2003 (State St. Monitor)



Repercussions

of air pollution problem in CT

- EPA preliminary designation of “non-attainment” for PM2.5 in New Haven and Fairfield Counties
  - Final determination in November ’04
- EPA designated all of CT in “non-attainment” for ozone
- American Lung Association report card
  - CT received an “F” for air quality

Citizen Monitoring Project

May 4-6, 2004

October 26, 2003

Monitoring Local Sources

Environment Northeast is implementing a project to identify and report local sources of particulate pollution in New Haven while involving local constituencies.

- Raise awareness about the problem and solution
- Build local constituencies
- Identify priority local opportunities to cut pollution
  - study target areas of town
  - study different vehicle types
- Report findings to City's Clean Air Initiative - Diesel Reduction Strategy, and state policymakers

Gathering Data

Volunteers helped experts monitor particulate matter (PM) levels in the air near where diesel vehicles operate

- Volunteers from:
  - New Haven Environmental Justice Network
  - Common Ground High School
  - Conn. Fund for the Environment
  - Archdiocese of Hartford Office of Urban Affairs
  - Cold Spring School 4th and 5th Graders
  - Sierra Club
- Technical Experts
  - Clean Air Task Force
  - Environment and Human Health, Inc.
- Project Organizer
  - Environment Northeast
- Dates
  - October 26, 2003
  - May 4, 5, and 6, 2004

Findings: Graphs and Images

PM2.5 and Ultrafine Particle Measurements, May 4-6, 2004

Inquiry 1 – Construction

Inquiry 2 – Other Industrial Diesels

Inquiry 3 – Public Transportation

Inquiry 4 – School Buses

Summary Findings

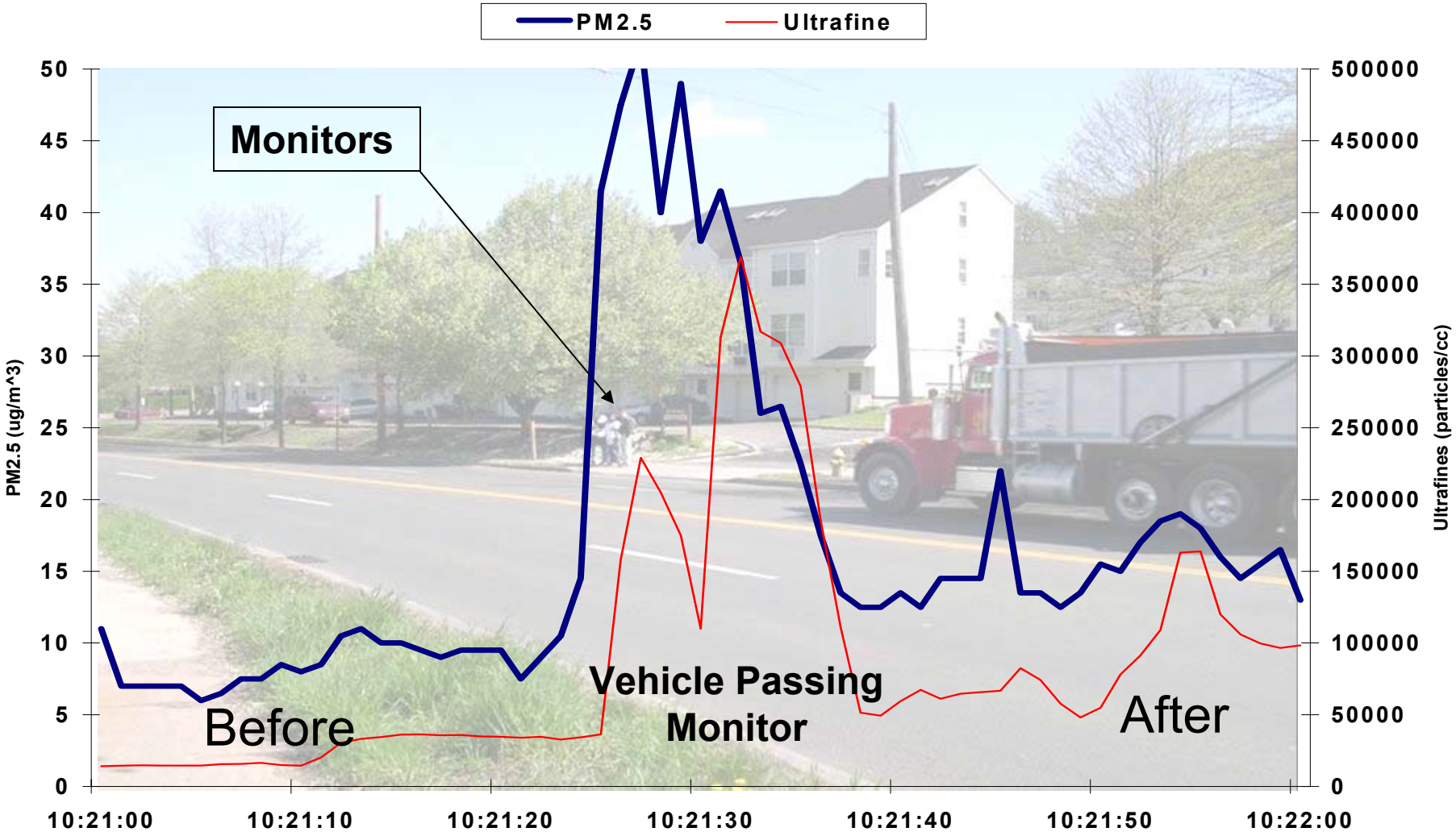
- Construction and Other Industrial Diesels
  - The concentration of construction work and local industrial diesel traffic in New Haven contributes to high PM2.5 levels in residential neighborhoods
  - Super-emitting diesels cause very high PM2.5 readings, and are avoiding detection/enforcement
- Public Transportation
  - Diesel trains idling at Union Station are causing high PM2.5 levels near apartments across the street
  - Older CT Transit and other buses cause high curbside PM2.5 readings
- School Buses
  - Cause high curbside PM2.5 readings at morning drop-off and afternoon-pickup, but problem should be addressed with planned retrofits
- For more info, see “Detailed Findings,” below.

Inquiry 1 -- Construction

- Non-Road Equipment
- Dump Trucks

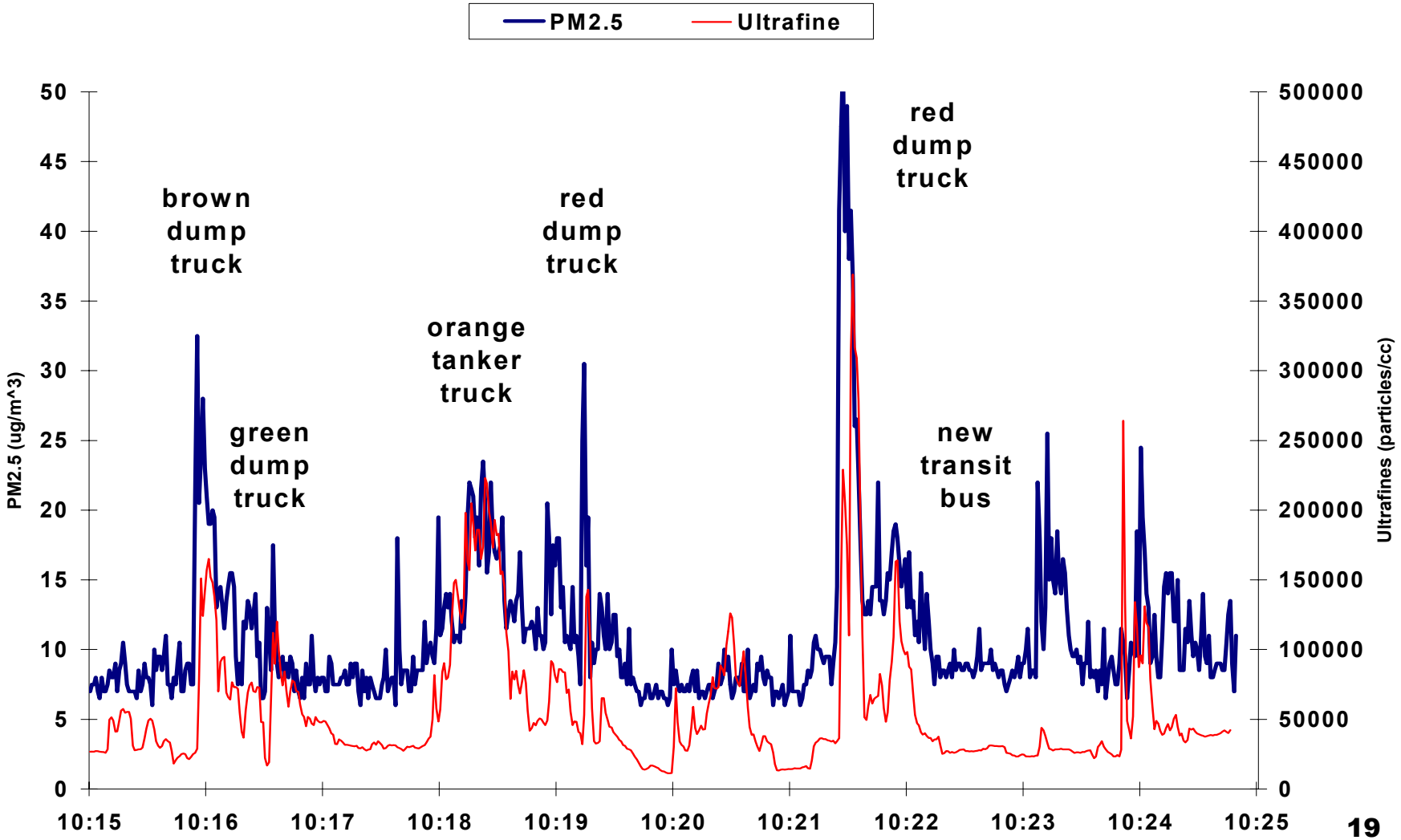
Profile: Dump Truck

Forbes Commons Apartments



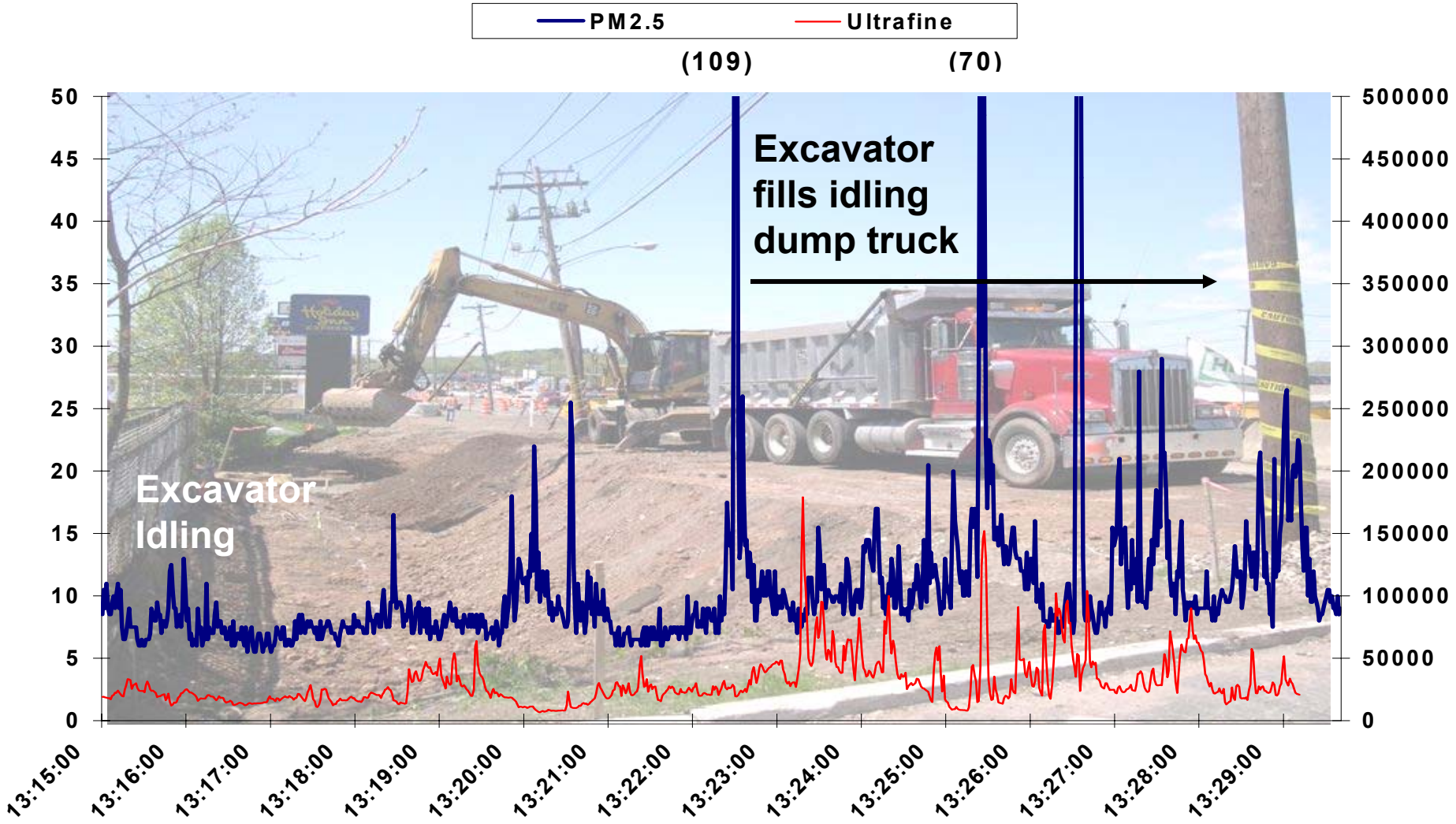
Episode: Construction Traffic

Forbes Commons Apartments



Episode: Construction

Frontage Ave, Q Bridge Work

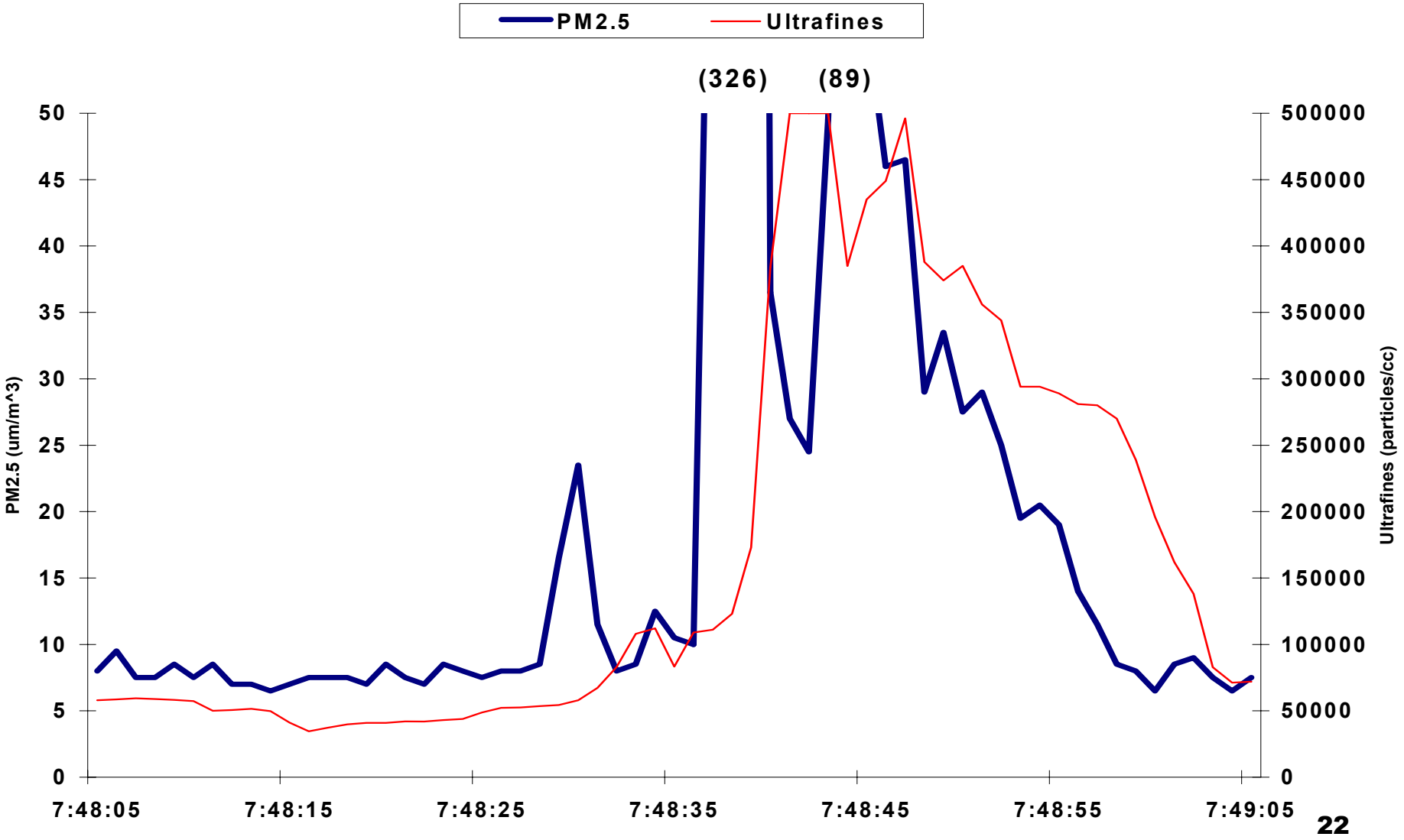


Inquiry 2 -- Other Industrial Diesels

- Solid Waste Haulers
- Fuel Tankers
- Cement Mixers

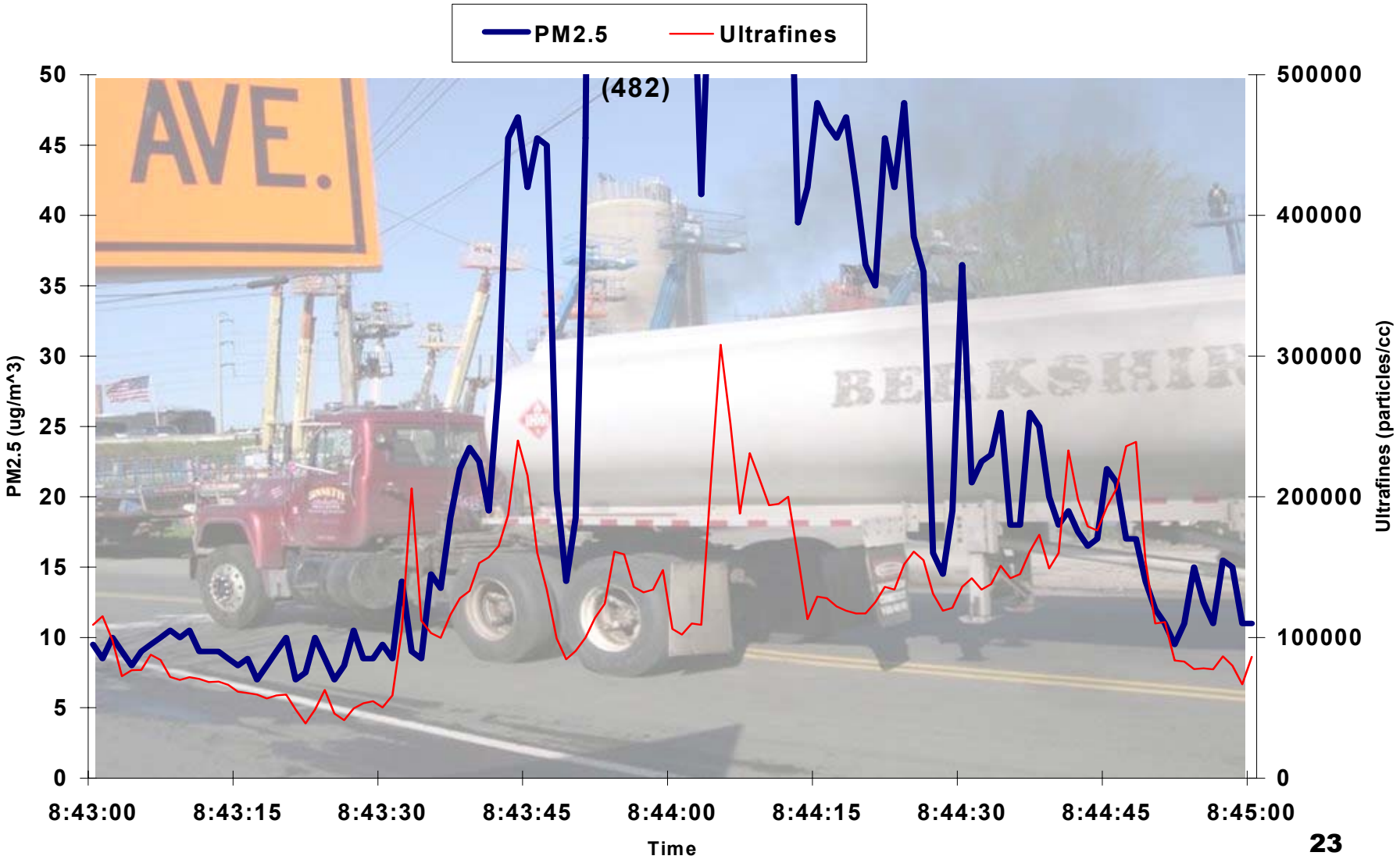
Solid Waste Hauler

Intersection of Forbes Ave. and Stiles St.



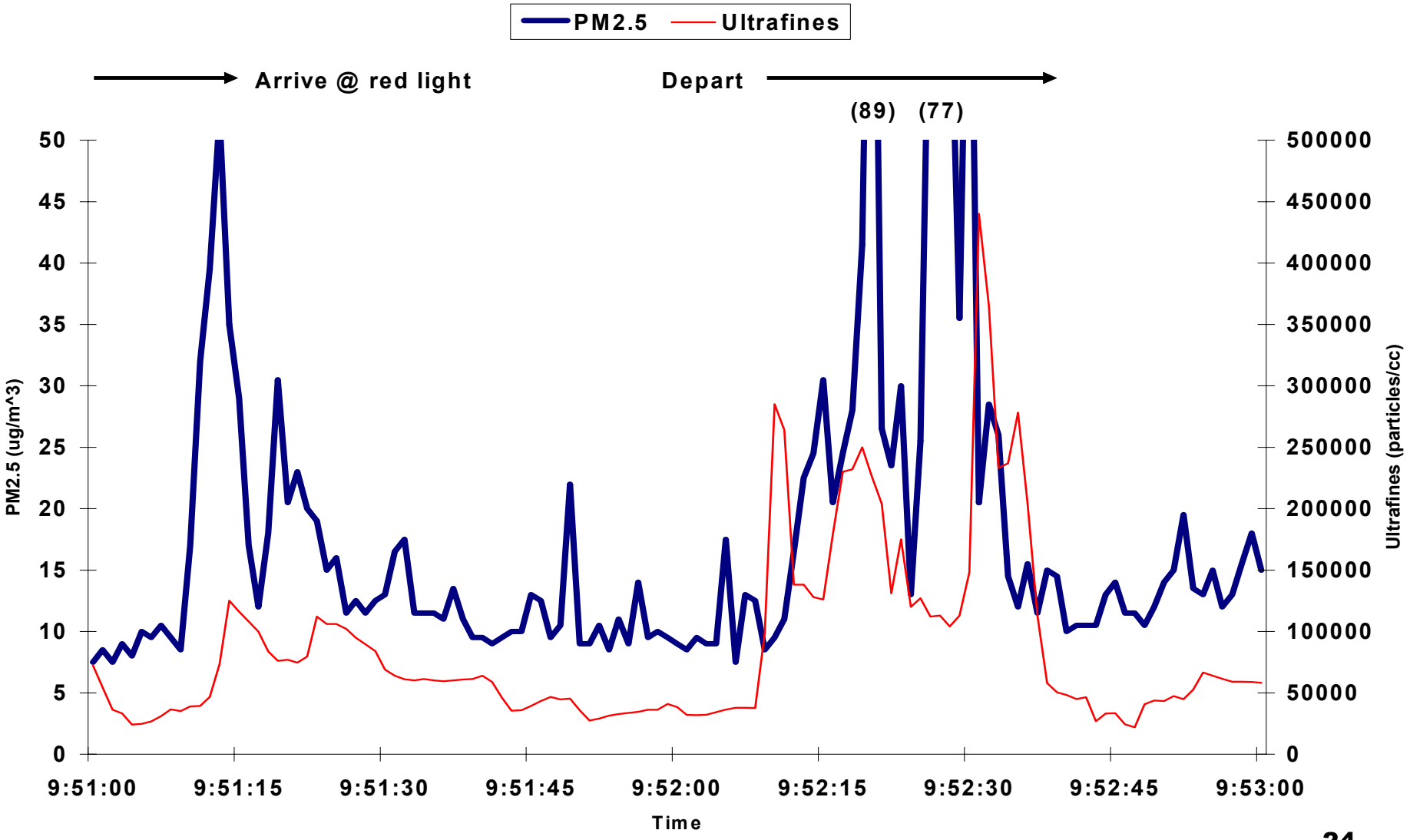
Fuel Tanker

Stiles St. On-ramp



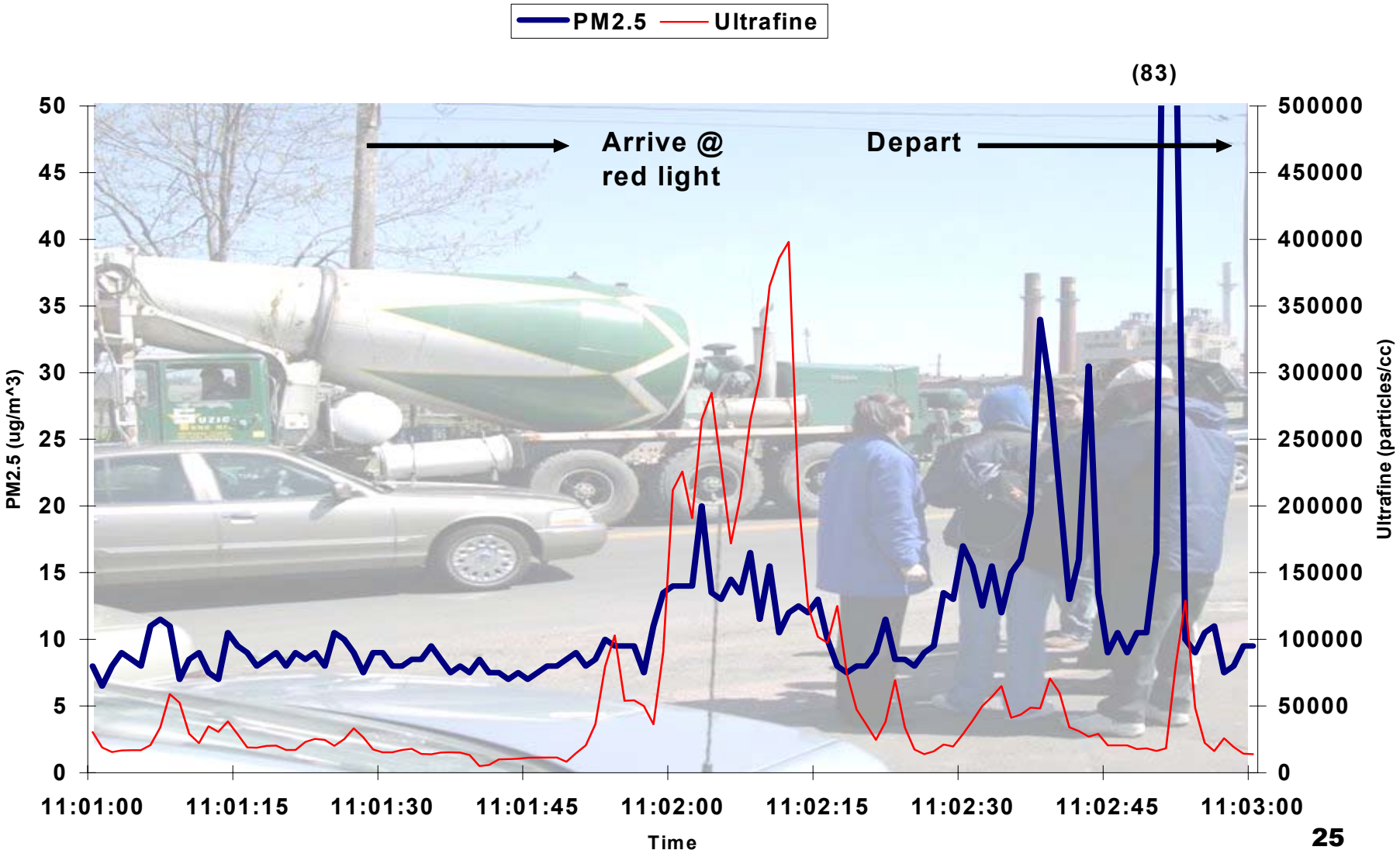
Profile: Cement Mixer

Intersection of Forbes Ave and Stiles St.



Profile: Cement Mixer (2)

Corner of East St. and Chapel St.

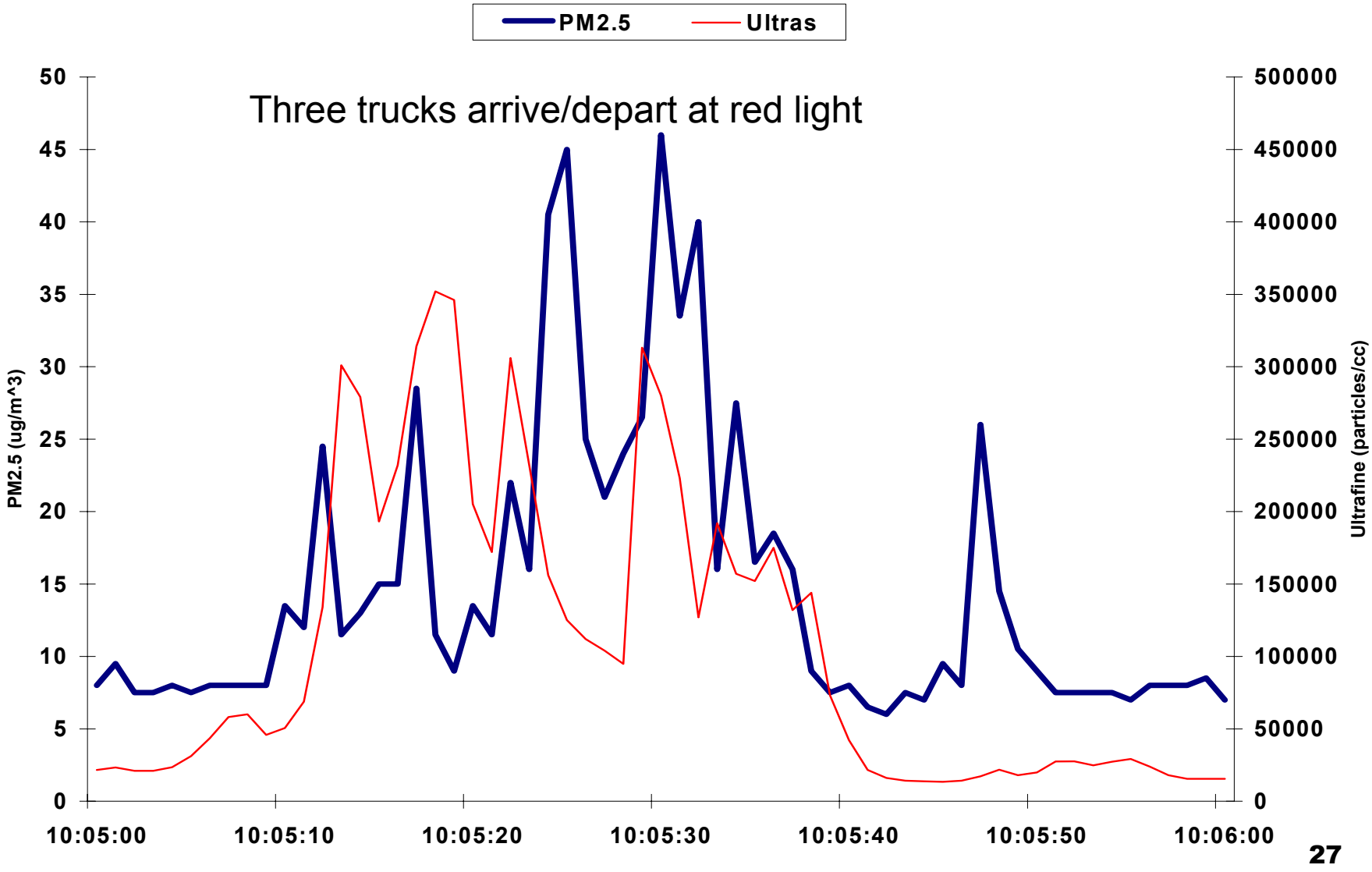


Episode: Industrial Trucks

Woodward School on Forbes Ave.

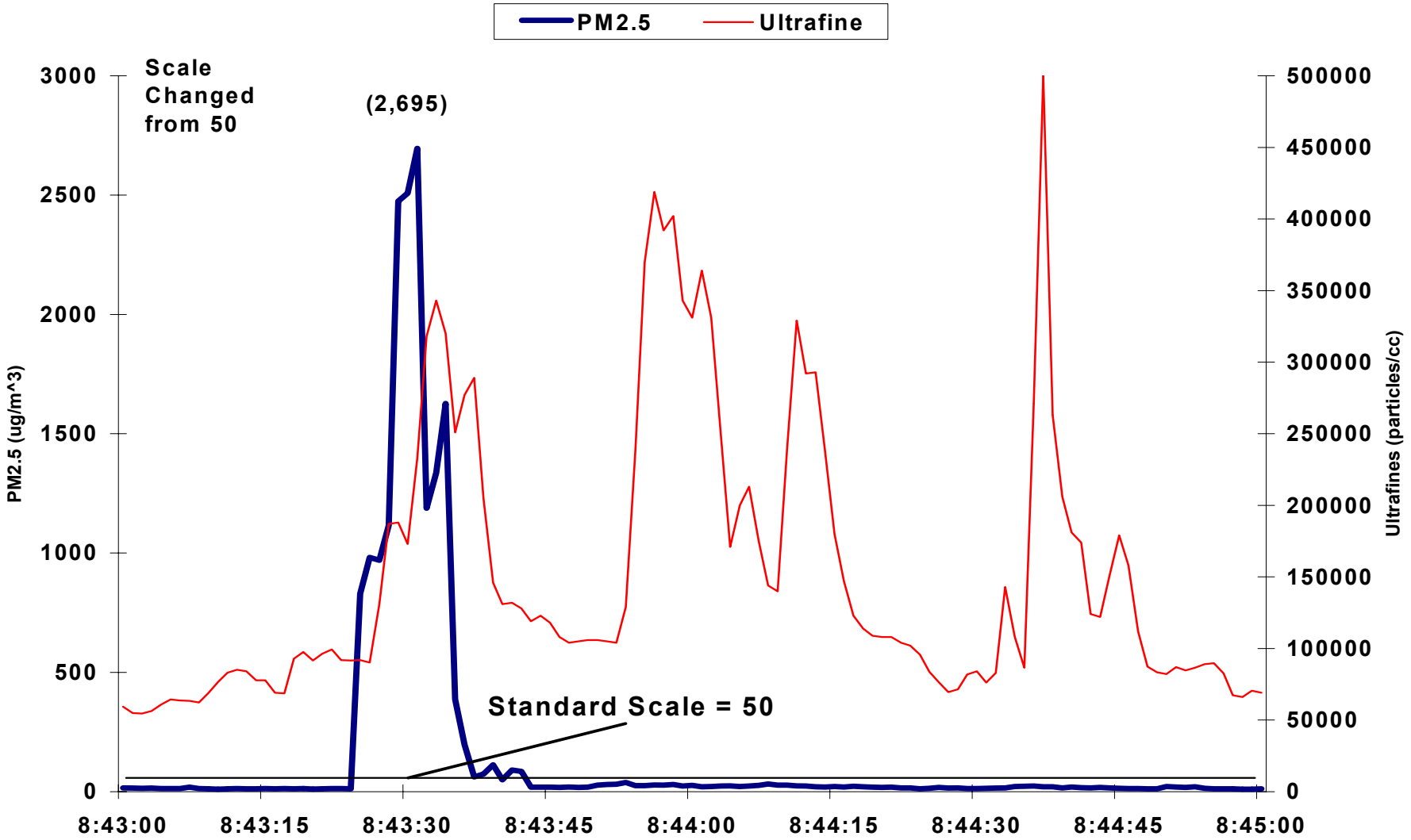
Episode: Three Trucks

Woodward School on Forbes Ave.



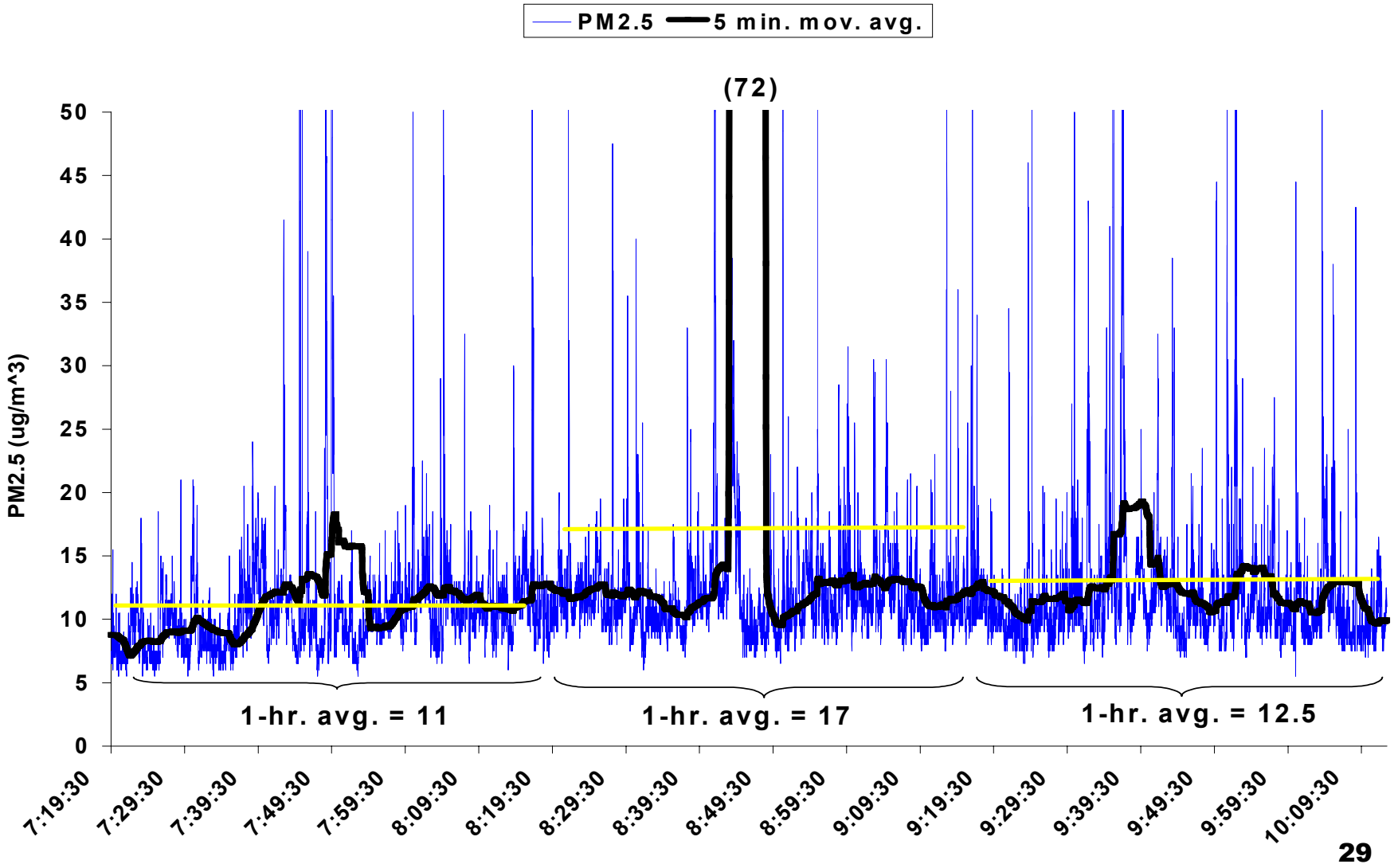
Episode: Waste Hauler + Delivery Truck

Arrive/depart intersection of Forbes Ave. and Stiles St.



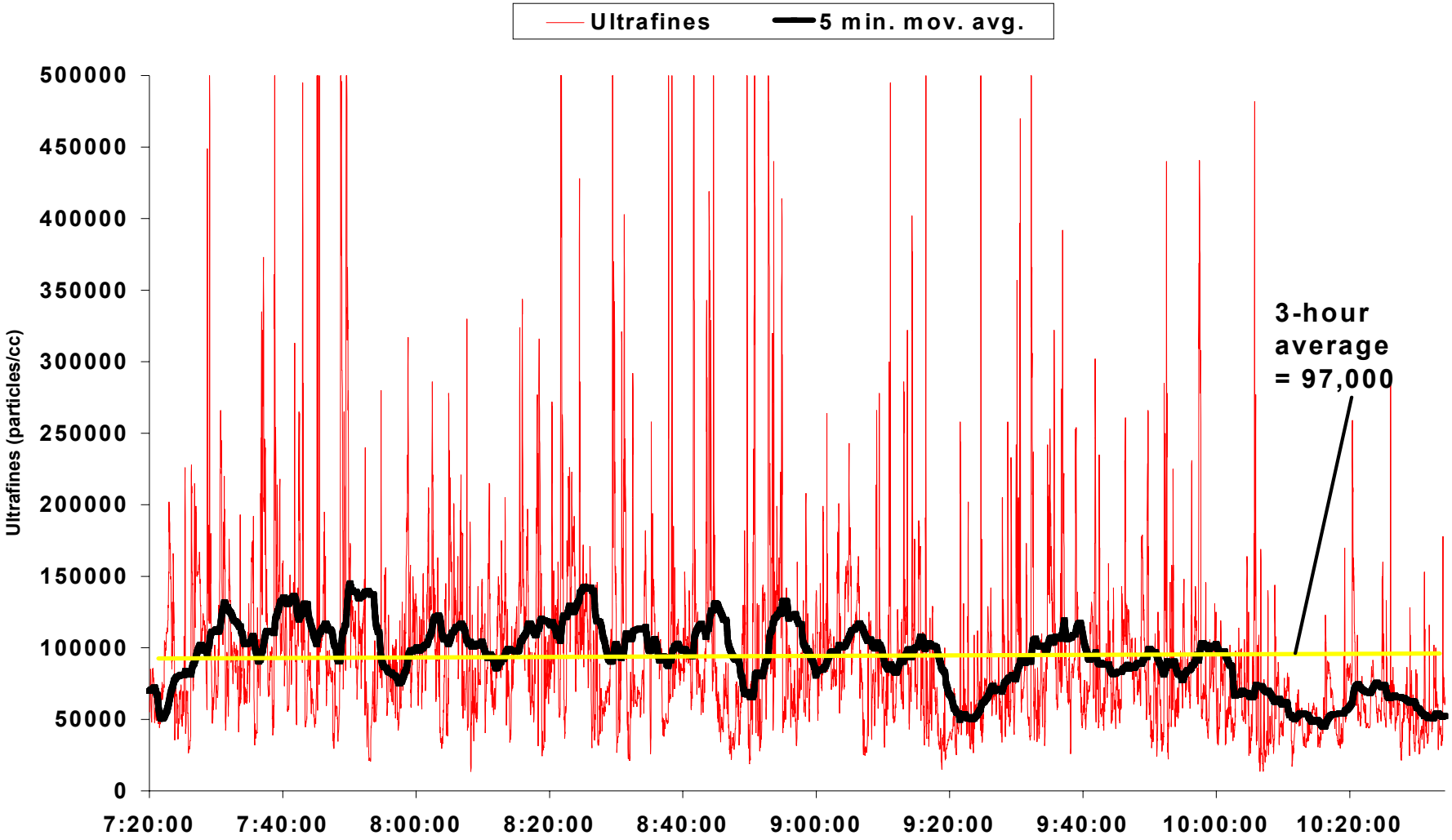
Cumulative Effect - PM2.5

Intersection of Forbes Ave. and Stiles St.



Cumulative Effect - Ultrafines

Intersection of Forbes Ave. and Stiles St.



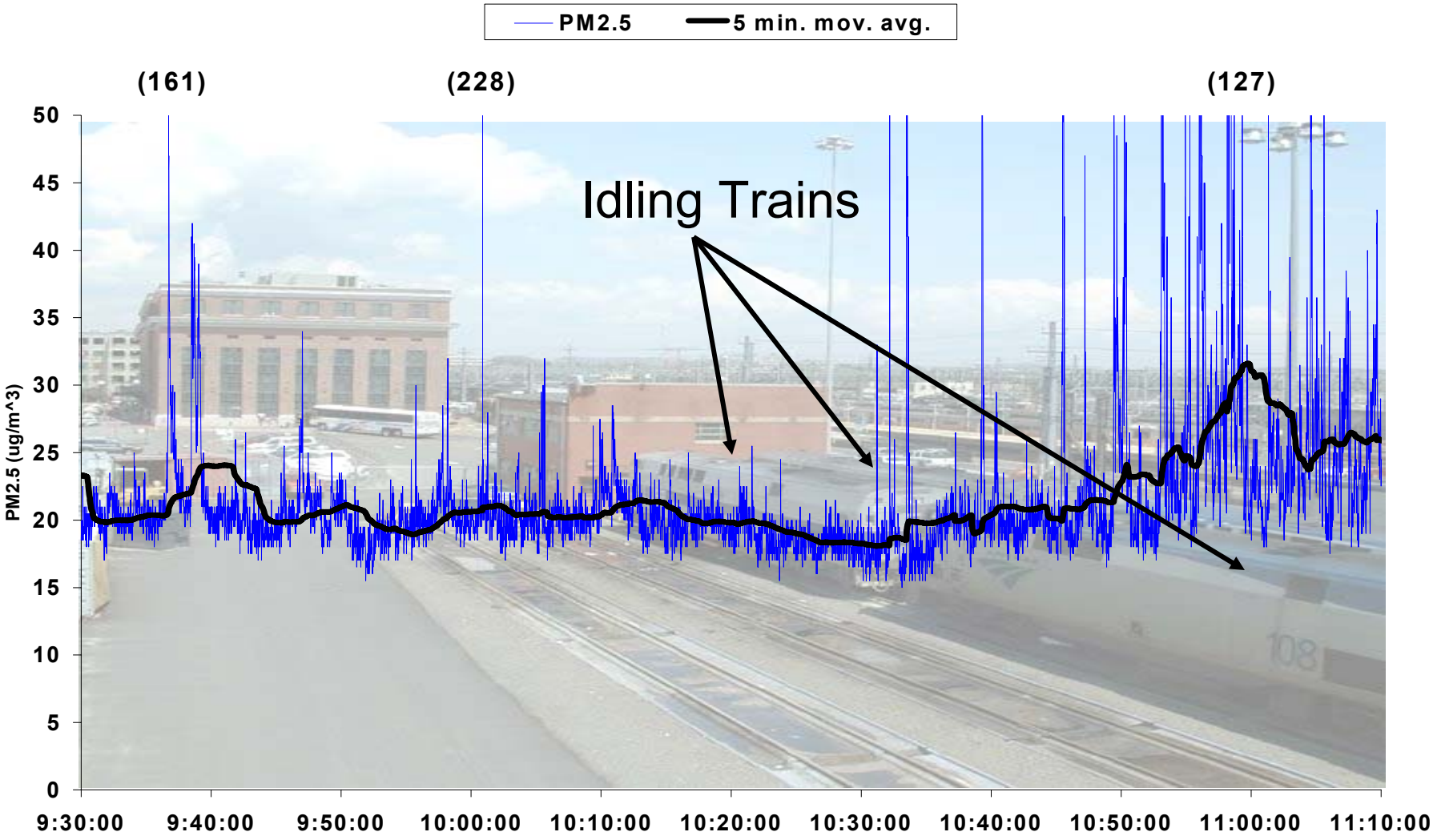
Industrial Traffic @ Forbes Commons Apts.

Inquiry 3 -- Public Transportation

- Trains
- Transit Buses

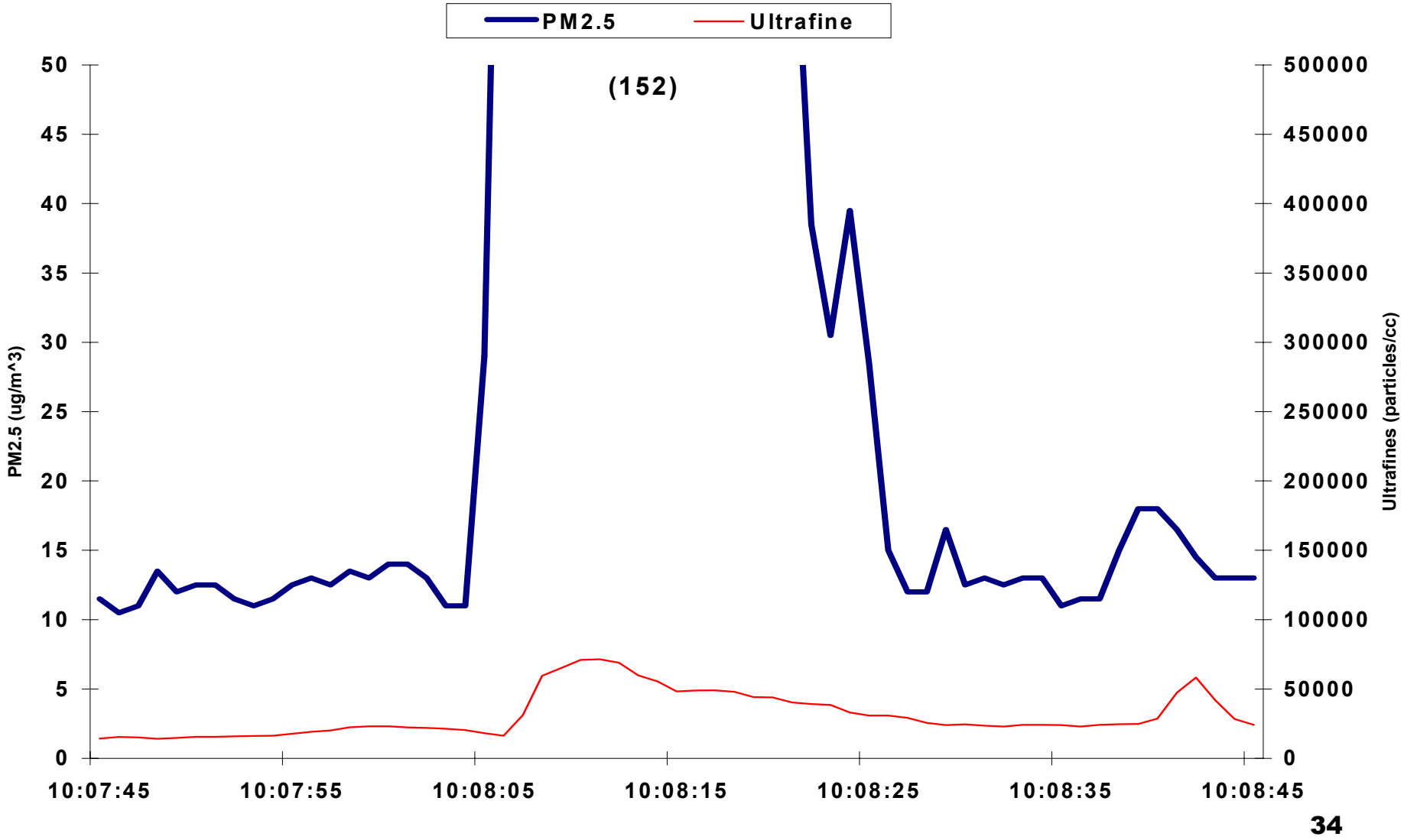
Cumulative Effect -- PM2.5

Passenger Trains @ Union Station



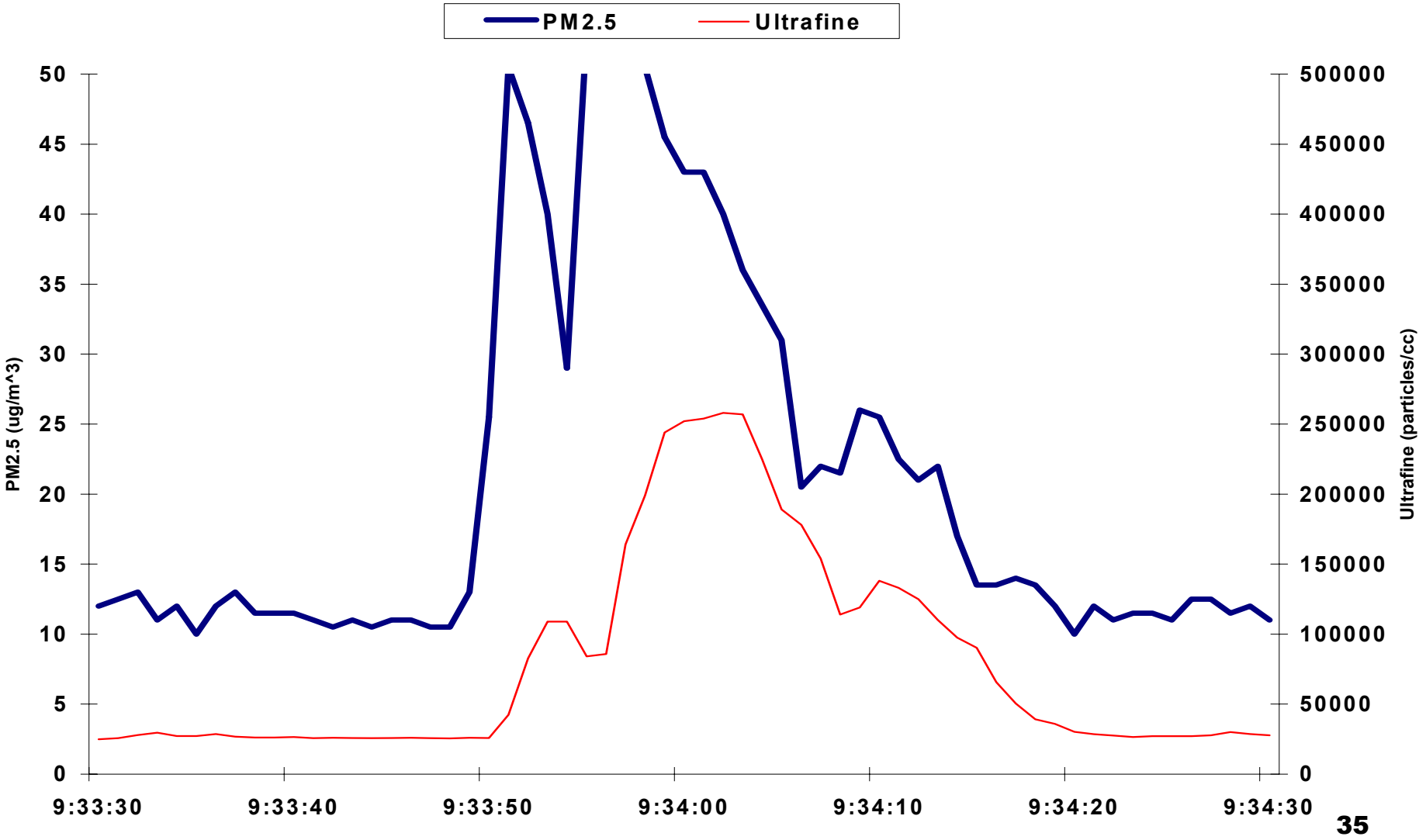
Profile: Older CT Transit Bus

Bus Stop on The Green



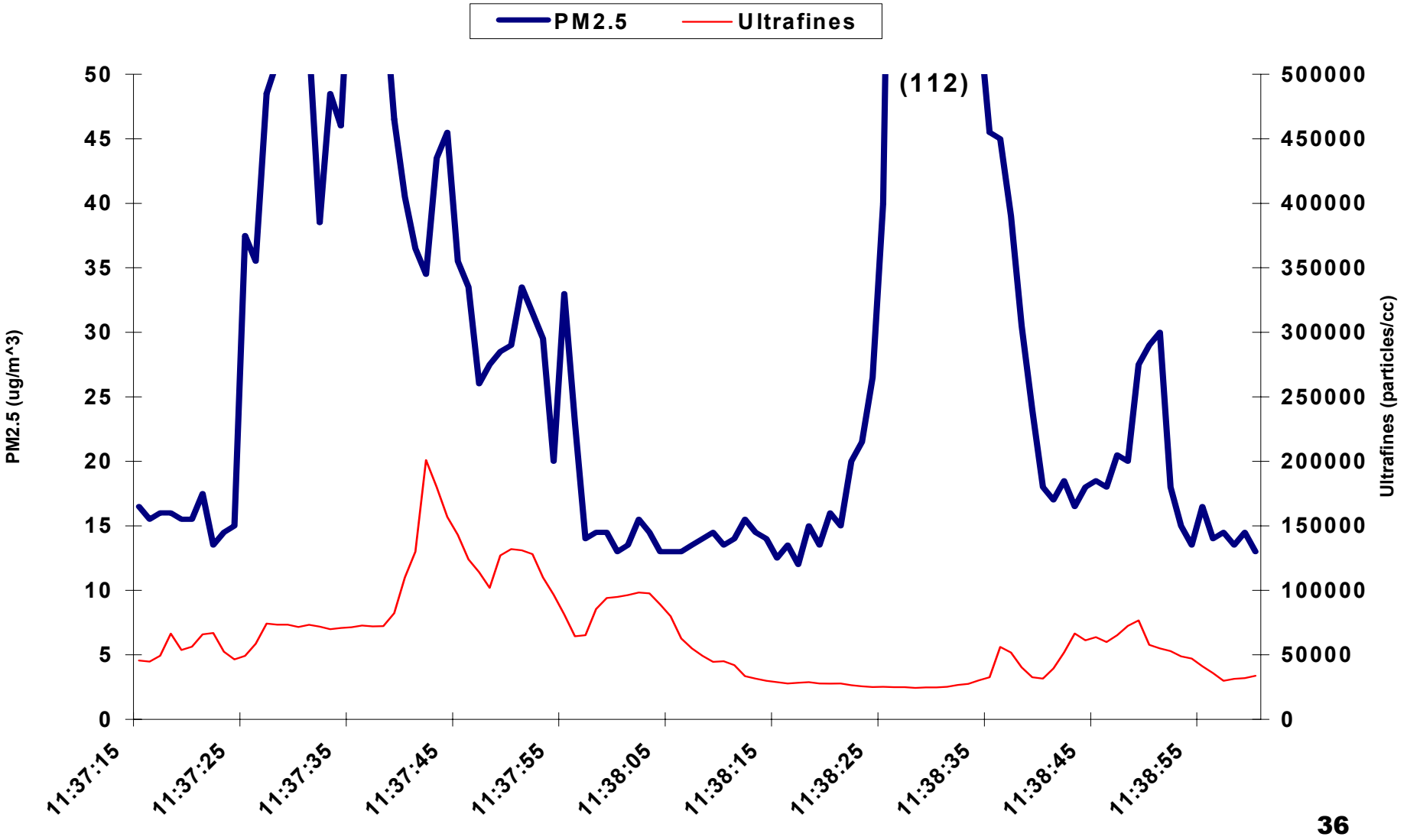
Profile: Transit Bus (#471)

Bus Stop on The Green



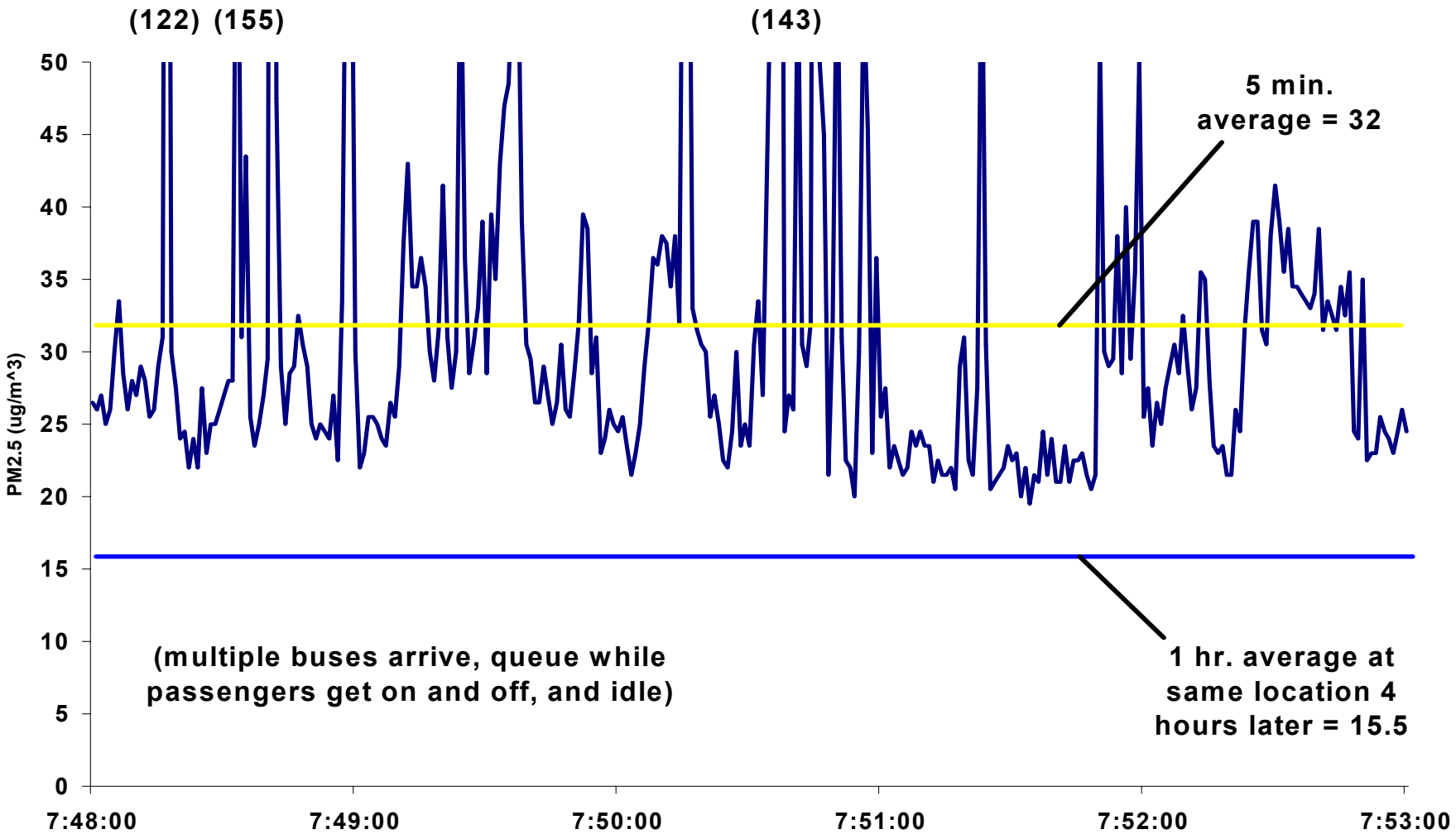
Profile: New Haven Bus Service

Chapel Street, Downtown



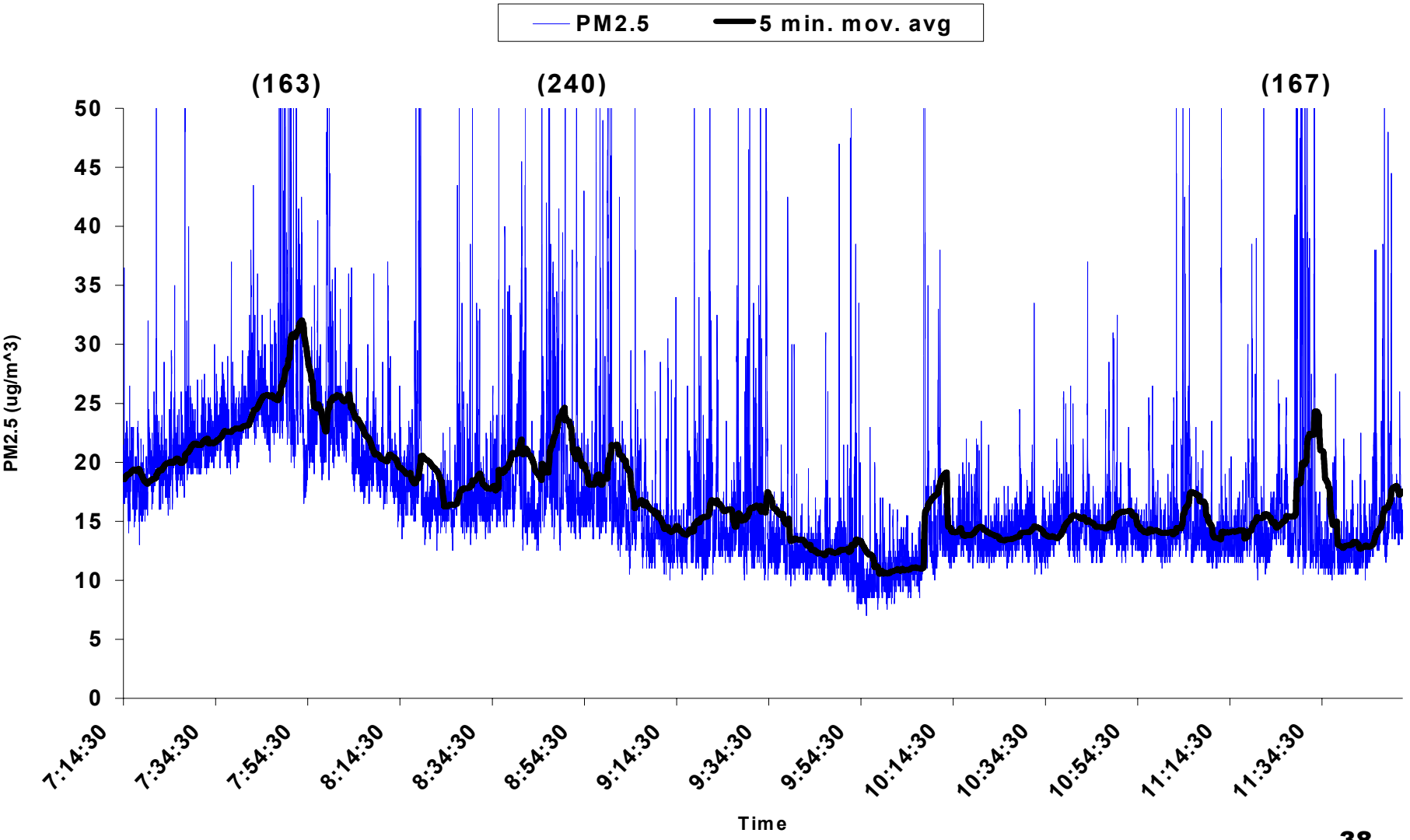
Episode: Transit Bus Queue

Temple St. Bus Stop on The Green



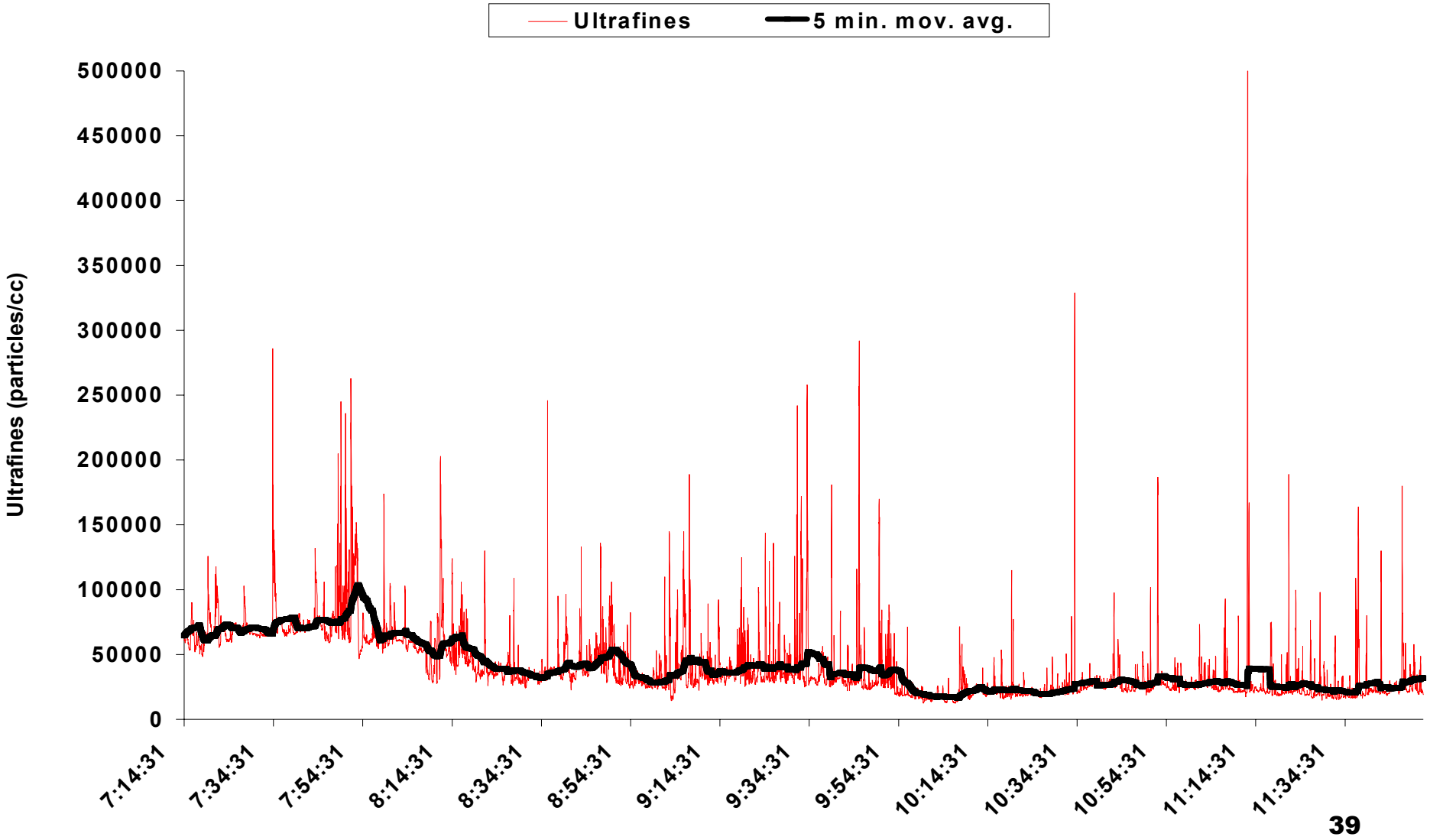
Cumulative Effect – PM2.5

Rush Hour @ Bus Stop on The Green



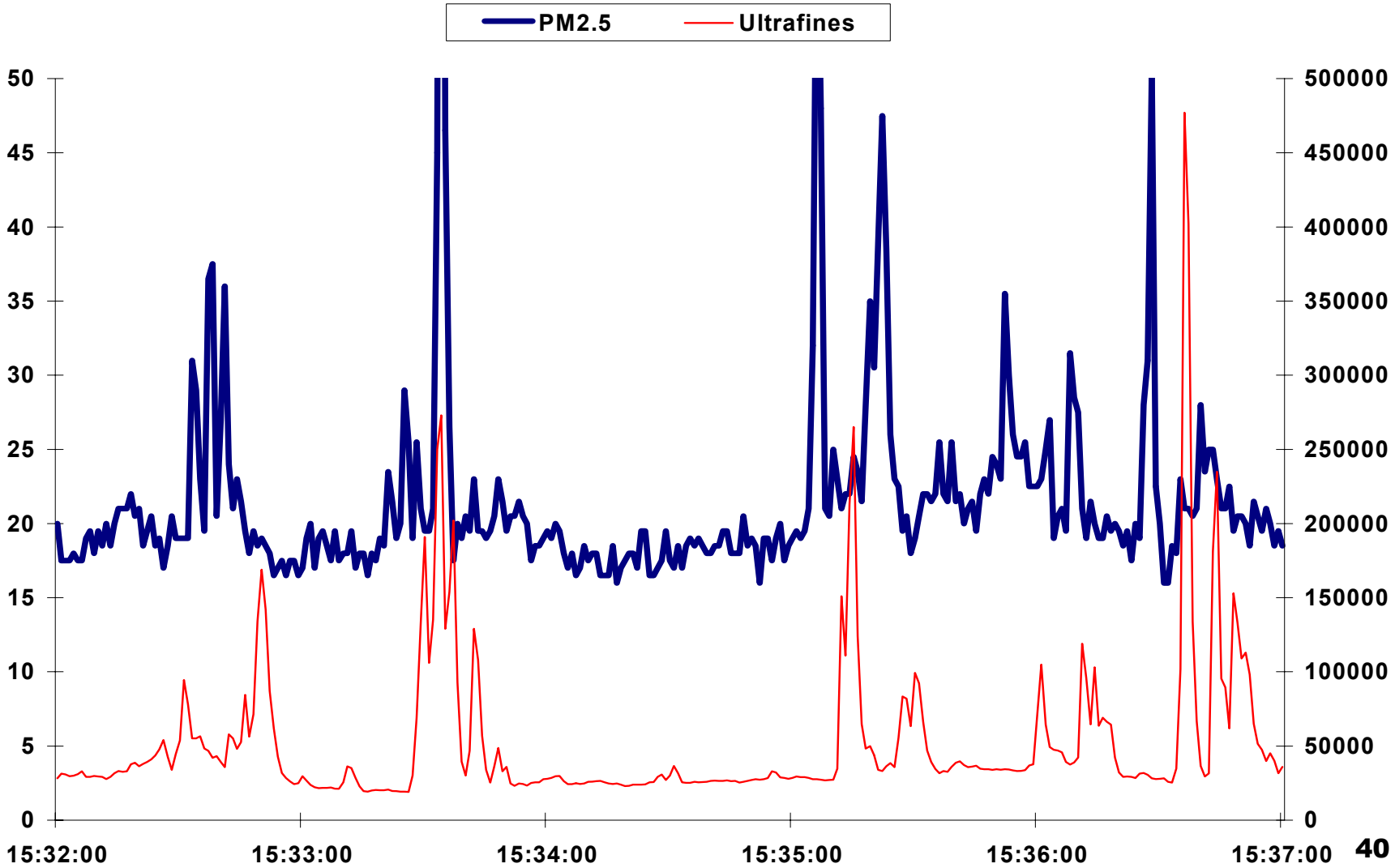
Cumulative Effect – Ultrafines

Rush Hour @ Bus Stop on The Green



Trailing a Transit Bus in Traffic

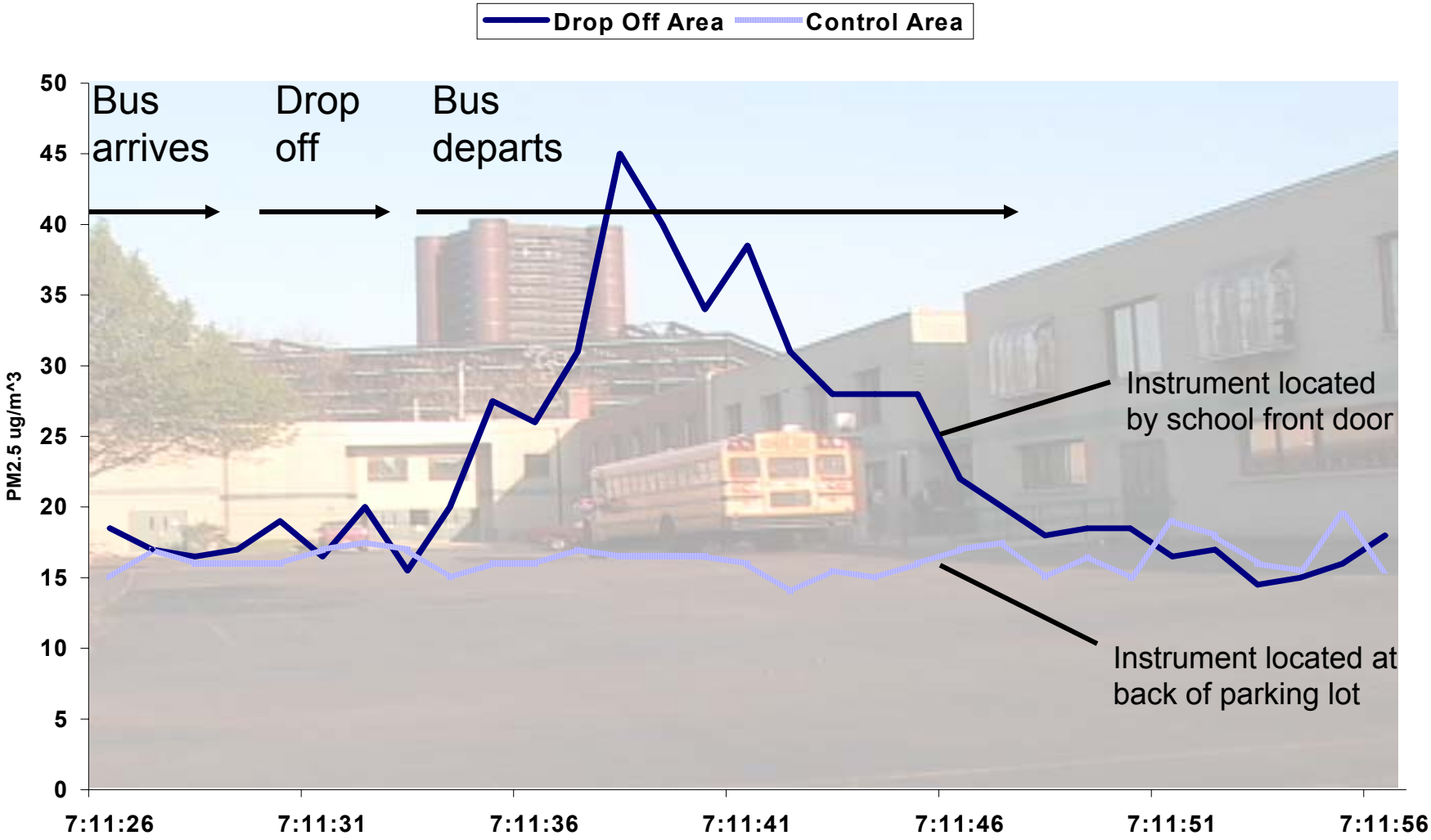
through downtown New Haven



Inquiry 4 -- School Buses

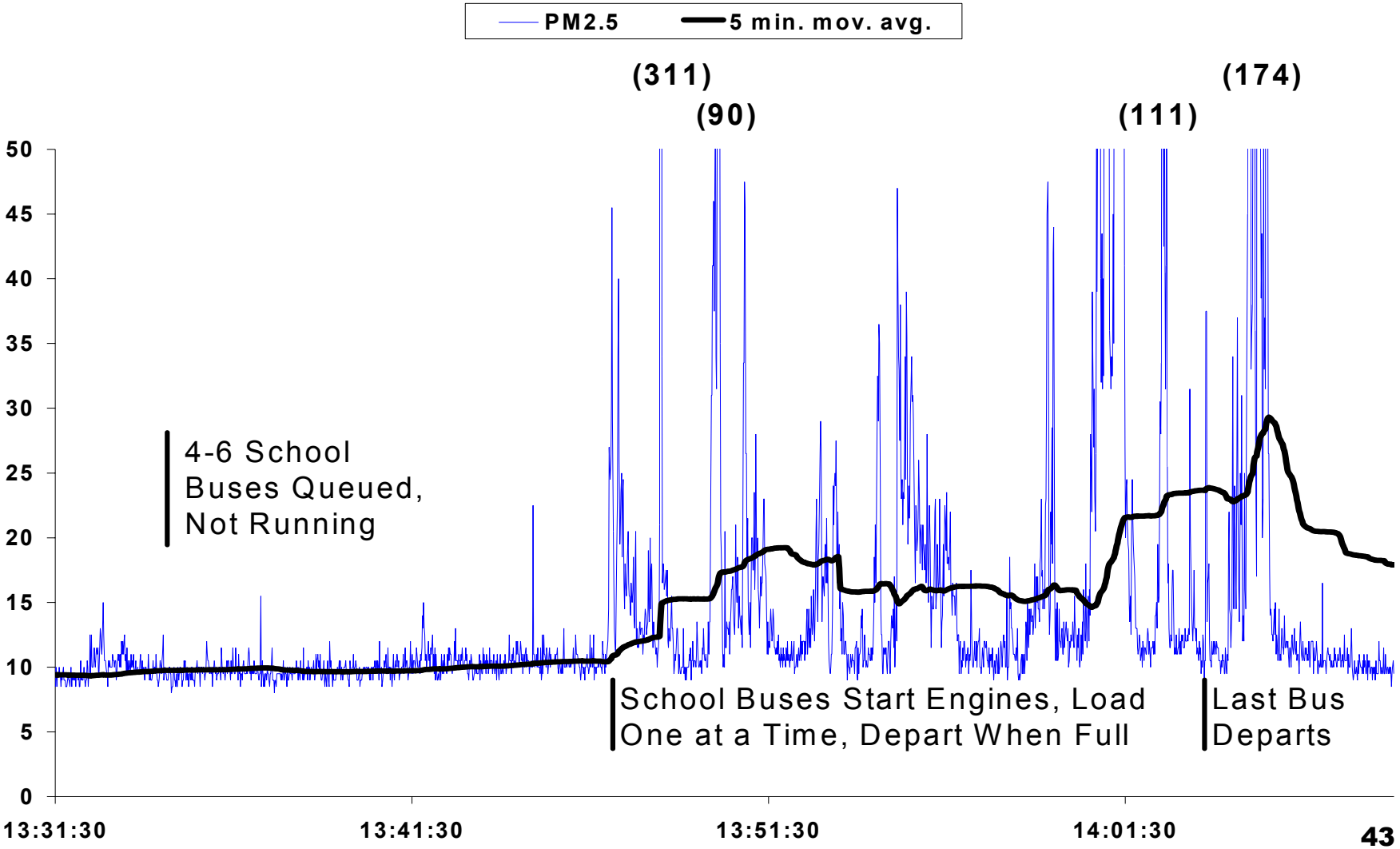
Profile: School Bus

High School in the Community



Episode: School Bus Pickup

East Rock Magnet School (Oct. 2003)



Detailed Findings

Findings – Construction Diesels

- Excavators, bulldozers, and dump trucks on the job site of the Q Bridge project are active in East Haven, Fair Haven, and moving toward downtown New Haven
- Dump trucks travel from the job site through neighborhood streets
- Curbside PM2.5 readings doubled
  - when an excavator filled an idling dump truck (this compared 1-minute averages before, during and after excavator was in operation)
- Notable “sensitive receptors” include Forbes Commons Apartments, Forbes Diner, workers at New Haven Terminal
  - At least 4 secondary schools are located within ¼ mile of upcoming Q Bridge construction
- The steady traffic and emissions of local heavy duty diesels around the New Haven Terminal and Forbes Avenue are compounded by
  - diesel emissions from advancing construction on the Q Bridge project and
  - interstate highway trucks

Findings – Other Industrial Diesels

- Solid waste haulers, fuel tankers and cement mixers concentrate around the New Haven Terminal and Forbes Ave.
  - Traffic – 168.2 industrial trucks/hour crossed the intersection of Forbes Ave. and Stiles St.
  - Curbside PM2.5 measurements @ Corner of Forbes and Stiles
    - Highest sustained 5-minute moving avg. PM2.5 = 72 ug/m^3
    - Average from 7:20 am – 8:20 am = 11 ug/m^3
    - Average from 8:20 am – 9:20 am = 17 ug/m^3
    - Average over 3.5 hours = 13.4 ug/m^3
  - Curbside ultrafine particle measurements
    - counter maxed out the monitoring instruments at 500,000 particles/cc on 18 separate occasions from 7 – 10:30 a.m.
    - Average over 3.5 hours = 97,000 particles/cc

- Numerous super-emitter (aka “smoker”) trucks passed from industrial zone through residential neighborhood
  - Highest measured curbside PM2.5 level -- 3000 ug/m^3
  - These trucks would NOT pass DMV emission (“opacity”) test but are not being caught on local streets

Findings – Public Transportation

- Trains at Union Station
  - Amtrak and other trains idle in the yard for extended periods
  - Large residential apartments are located within ¼ mile
  - Curbside PM2.5 measurements @ Union Ave.
    - 2 hour average = 21.5 ug/m^3
  - Curbside Ultrafine measurements @ Union Ave.
    - 2 hour average = 22,000 particles/cc
  - Cabin air quality on diesel commuter trains has not been measured

Findings – Public Transportation (2)

- CT Transit Buses on The Green
  - There is a temporary cumulative effect around bus stops, which is worse when buses queue at rush hour
    - Roughly 20 buses/hr stop at Elm and Temple Street during this period
  - PM2.5 measurements at @ Elm and Temple Streets
    - 7:30-8:30 a.m. avg. = 22.5 ug/m^3
    - 11-noon avg. = 15.5 ug/m^3
    - 5-minute moving avg. PM2.5 rose 50% (to 32 ug/m^3) as transit buses queued to drop off and pick up commuters
    - Older CT Transit buses temporarily caused curbside PM2.5 levels to spike from 13.5 ug/m^3 to over 150 ug/m^3.
  - The oldest CT Transit buses are recently retired, replaced with 2003-2004 buses. 20+ buses are from Model Year 1996-2000, some of which are being replaced
  - Trailing a transit bus in traffic causes extended exposure to higher PM2.5 levels

- New Haven Bus Service and Yale buses
  - Tend to be older and more polluting

Findings – Public School Buses

- Morning Drop-Off
  - Curbside PM2.5 increased about 50% as buses arrived/departed at morning drop-off at H.S. in the Community
- Afternoon pick-up @ East Rock School
  - Buses complied with anti-idling rule. While engines were off, background levels of PM2.5 were about 15 ug/m^3.
  - During 5-minute interval after buses started engines (but before they departed), PM2.5 levels exceeded 50 ug/m^3 more than 60 times
- New Haven Ahead of the Curve
  - All New Haven school buses already use Ultra Low Sulfur Diesel Fuel
  - 183 full size New Haven school buses will be retrofitted with emission controls this year; smaller buses are already using oxidation catalysts

Recommendations and Next Steps

Recommendations

1. Construction and Highway Maintenance

- On state owned, leased or contracted construction diesels and dump trucks ...
- require each engine to emit the lowest achievable particulate matter levels using ...
  - ultra-low sulfur diesel fuel (ULSD) and the best available emission control technology
    - filters if technically feasible, or oxidation catalysts if not
  - or any alternative that achieves an equivalent PM reduction
- Allow exceptions, e.g., for small contracts

2. Other Industrial Trucks around New Haven Terminal and Forbes Ave.

- Enhance State inspection and maintenance program to catch and fix “super-emitters”
- Develop incentive program to retire/replace or retrofit of priority fleets

Recommendations in New Haven (2)

3. Public Transportation

Trains

- Evaluate locomotive anti-idling options (APUs, electric, etc.)
- Require the lowest achievable PM levels, using ULSD and retrofit emission controls if technically feasible
- Study cabin air quality on diesel lines

Buses

- Replicate ConnDOT Stamford Program to New Haven Fleet
  - Convert all CT Transit buses to Ultra Low Sulfur Diesel (ULSD) fuel
  - Retire/replace or retrofit filters onto 20+ CTTransit buses MY1996 – 2000
  - Phase in filters onto remainder of new (blue) buses
- Encourage New Haven Bus Service to retrofit or retire dirty buses

4. School Buses

- Complete planned retrofit and use of ULSD fuel
- Consider needs/options for small buses and neighboring school districts
- Encourage Yale to retrofit or retire dirty buses

Next Steps (1)
Outreach

- Share results of this monitoring
  - Constituencies
    - Clean diesel advocates
    - Health care professionals
    - EJ community
    - School system
  - Policymakers
    - Mayor, City staff, Aldermen, State Legislators, Federal Delegation
    - DEP, DOT, Dept. of Health, EPA
  - Opinion-makers and the Media

Next Steps (2)
Policy Advocacy

- State Legislation
  - Construction and Highway Maintenance
    - Set rule for State owned and contracted fleets
  - Public Transportation
    - Trains – reduce idling, use low sulfur fuel, retrofit if feasible
    - Set timetable for CTTransit Buses to reach Best Available Control Technology standard
  - School Buses
    - Set timetable for retrofitting all school buses in CT
  - "Super-emitters"
    - Enhance identification and clean-up

- City Policies
  - Consider procurement rule for construction contracts
  - Retrofit other municipal fleets
  - Consider routing rules for industrial traffic

- Federal
  - Coordinated effort to seek federal help addressing interstate sources (e.g., long-haul trucks, marine vessels) as well as in-state sources
  - Resist any rollback of EPA standards for "new" diesel engines

Next Steps (3)
Research and Analysis

- Solutions:
  - settle definition of Best Available Control Technology
  - establish appropriate timetables for implementation
  - identify financial incentives
  - devise means to enhance inspection/testing
- Commuter train air cabin quality
- Projected local health impacts of diesel
- Other costs-benefits

Reference Info

Equipment

Instrumentation, technical support and video were provided by the Clean Air Task Force

- PM 2.5 Meter - DustTrak
  - measured **PM 2.5** mass
  - units: micrograms per cubic meter (ug/m^3)
  - NOT calibrated to DEP units
- Ultrafine Meter - PTrak
  - measures **ultrafine** particles (<0.1 um or microns)
  - Units: number of particles each second per cubic centimeter
- Black Carbon Aethelometer
  - marker for diesel PM
  - results not reported here
- Digital video and cameras

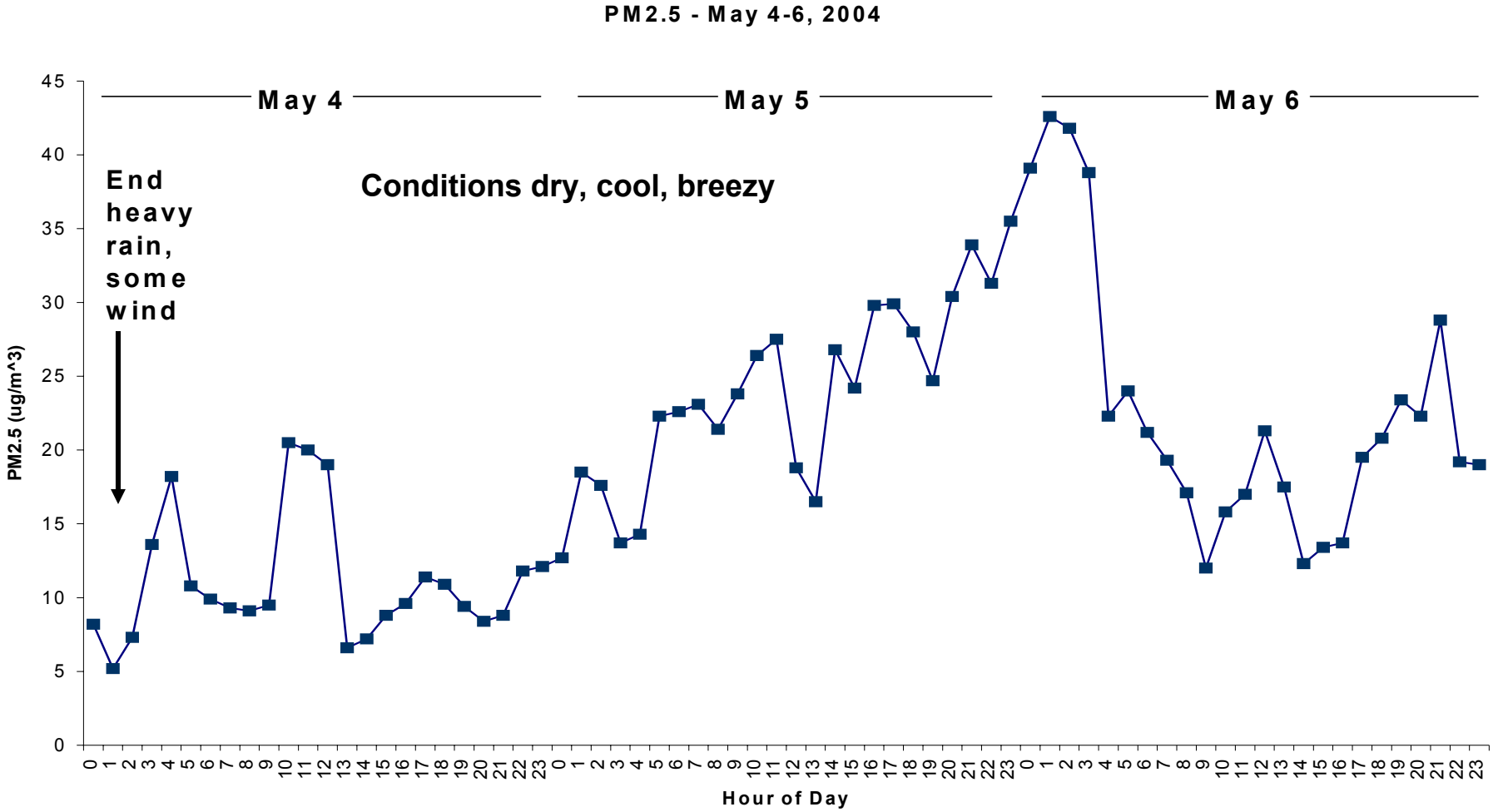
Calibration

Divide by 2 – Raw measurements of PM2.5 mass from the DustTrak were divided by two as an approximate calibration to DEP hourly monitoring data.

- "DustTrak reported higher PM2.5 concentrations than collocated 12-hr PM2.5 PEM samples, by approximately a factor of 2."
  - Li-Te Chang et al, "Laboratory and Field Evaluation of Measurement Methods for One-Hour Exposures to O3, PM2.5, and CO," *Journal of the Air & Waste Management Association* Volume 51, October 2001, p. 1414
  - See also, Levy, J., "Fine Particulate Matter and Polycyclic Aromatic Hydrocarbon Concentration Patterns in Roxbury, Massachusetts: A Community-Based GIS Analysis," *Environmental Health Perspectives* , VOLUME 109, NUMBER 4, April 2001, p. 342
  - DustTrak is calibrated by the manufacturer using emery oil aerosol and nominally adjusted to respirable mass of standard ISO 12103-1, A1 test dust (Arizona test dust).
- All graphs in the Environment Northeast presentations of New Haven monitoring reflect this calculation

Baseline Reference

DEP Downtown PM2.5 Levels during 3 days of ENE project



Calibration to ENE results would require simultaneous measurements in identical locations. This was not done. ENE results are best used to show relative changes over time.

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