

# EPA Stormwater Monitoring and Research Effort Summary

Mystic River Science Forum

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# Overview

- Region 1 applied for and received Regional Applied Research Effort (RARE) and Regional Methods (RM) ORD grants to develop bacterial source tracking “Stormwater Toolbox”
- Sampling conducted throughout eastern New England with emphasis on Mystic River Watershed
- Minimum Recommended Screening Methods
- Mystic Watershed Summary

# Project Goals

- Identify most effective and cost-efficient screening parameters; and
- Delineate and examine areas of possible illicit discharges; and
- Sampling coordination and collaboration within watershed.

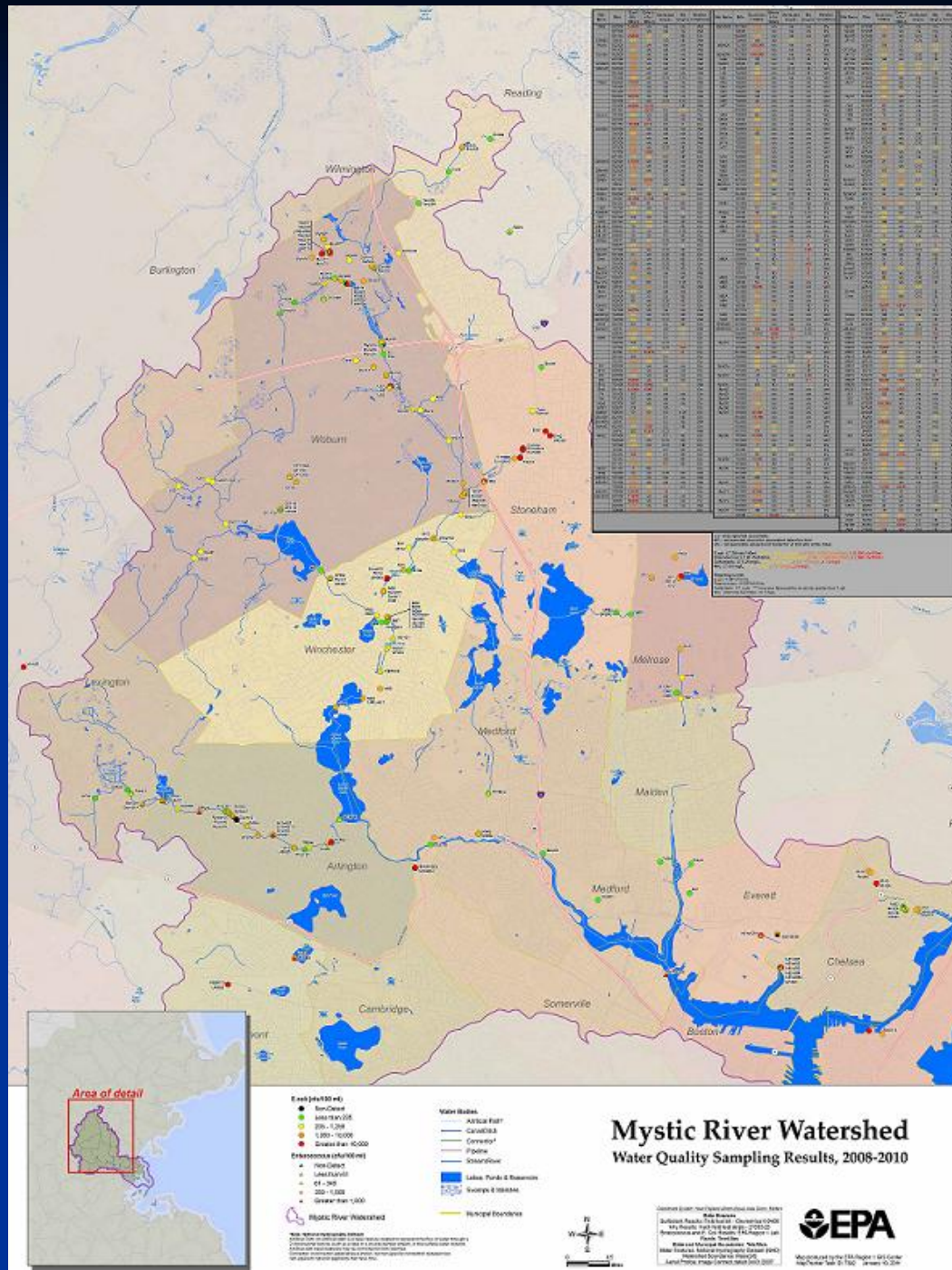
# RARE/RM 2009 - 2010

## Stormwater Sampling

### 2009 – 2010 Season:

- 335 sample sets were collected at 253 locations
- 1,110 laboratory samples
- 1,542 field kits or bench-top methods.
- Over 1,000 instrument readings
- Totaling over 3,657 water quality data points

# Sample Location Overview



Map Created by:  
EPA Region 1 GIS Dept.

# Analytes tested for...

- **\*E. coli**
- **\*Enterococcus**
- **\*Ammonia**
  - Alpha Analytical lab
  - Benchtop (DR-850 Hach)
  - Test kit – Hach (2 types)
  - Test strips
- **\*Surfactants**
  - Alpha Analytical lab
  - Benchtop (DR-850 Hach)
  - Test kit – Chemetrics
- **Potassium**
- **Free and Total Chlorine**
  - Alpha Analytical lab
  - Test kit – Hach
  - Test strips
- **Total Phosphorus**
- **Fluoride**
  - Alpha Analytical lab
  - Benchtop (DR-850 Hach)
- **Pharmaceuticals**
  - Atenolol
  - Acetaminophen
  - Cotinine
  - 1,7-Dimethylxanthine
  - Caffeine
  - Azithromycin
  - Primidone
  - Urobilin
  - Carbamazepine
  - Sulfamethazine
  - Sulfamethoxazole
- **Urine test strips**

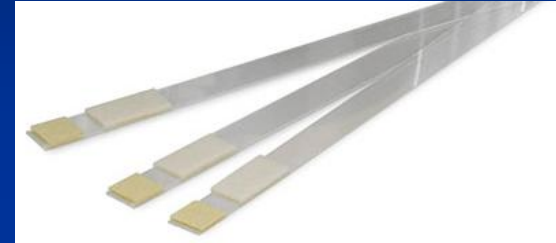


# Recommended Minimum Screening Tests



**Bacteria test**

E. coli or  
Enterococcus



**Ammonia test strips**



**Surfactant test kit**



**Chlorine (total) test kit**

# Target Compounds, Uses, and Reporting Limits

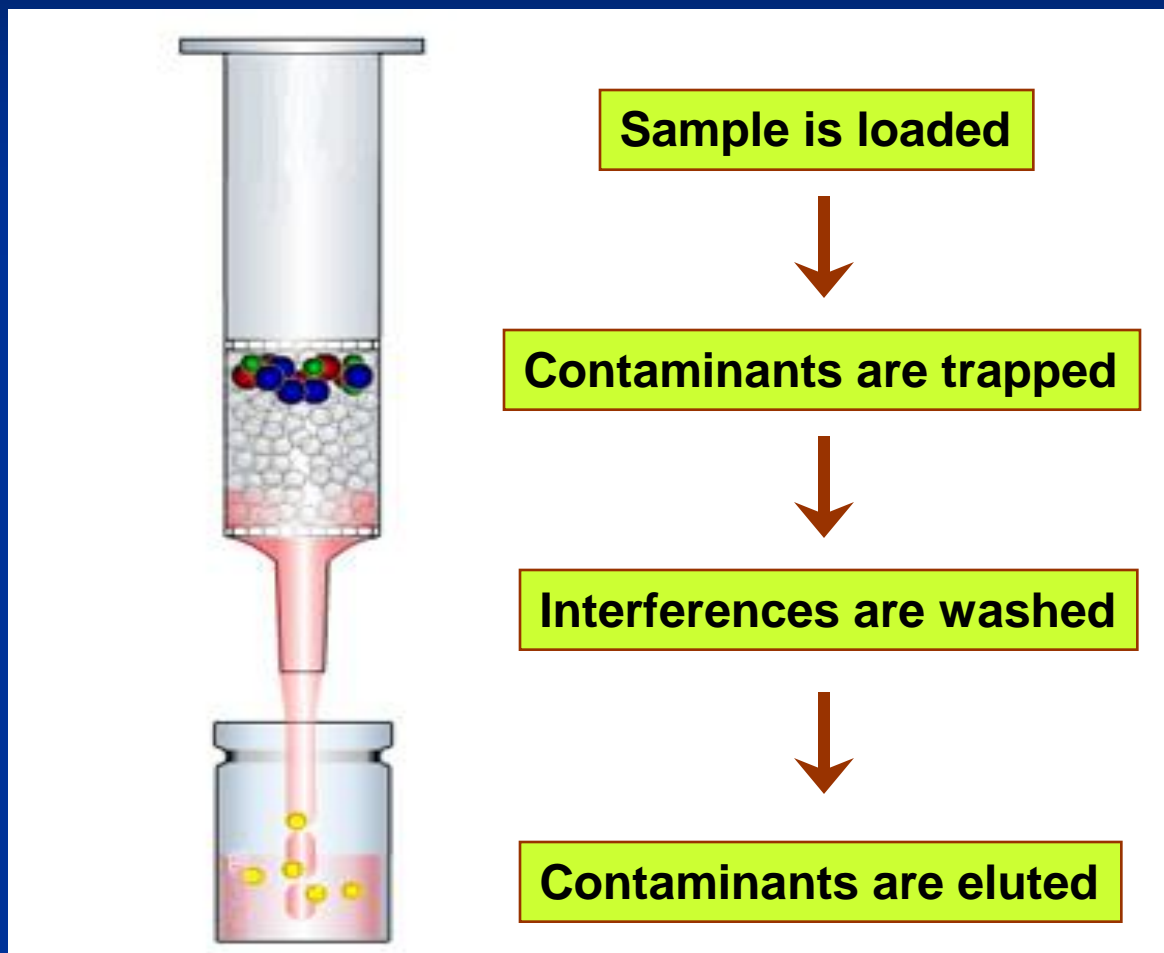
Target Compound	Major Use	RL (ng/L)	Daily Dose (ng)
Caffeine	Natural Stimulant	5.0	200,000,000
1,7-DMX	Metabolite of caffeine	2.5	N/A
Acetaminophen	Pain Reliever	2.5	650,000,000
Carbamazepine	Anti- depressant / bi-polar Anti-convulsant (epilepsy)	0.5	100,000,000
Primidone	Anti- epilepsy drug (AED)	5.0	100,000,000
Atenolol	Beta Blocker High Blood Pressure	2.5	50,000,000
Cotinine	Metabolite of Nicotine	0.5	3,500-7,200 (ng/mL)
Urobilin	By-product of hemoglobin breakdown (mammals)	5.0	1,300,000 ng/g in feces
Azithromycin	Antibiotic	1.6	200,000,000



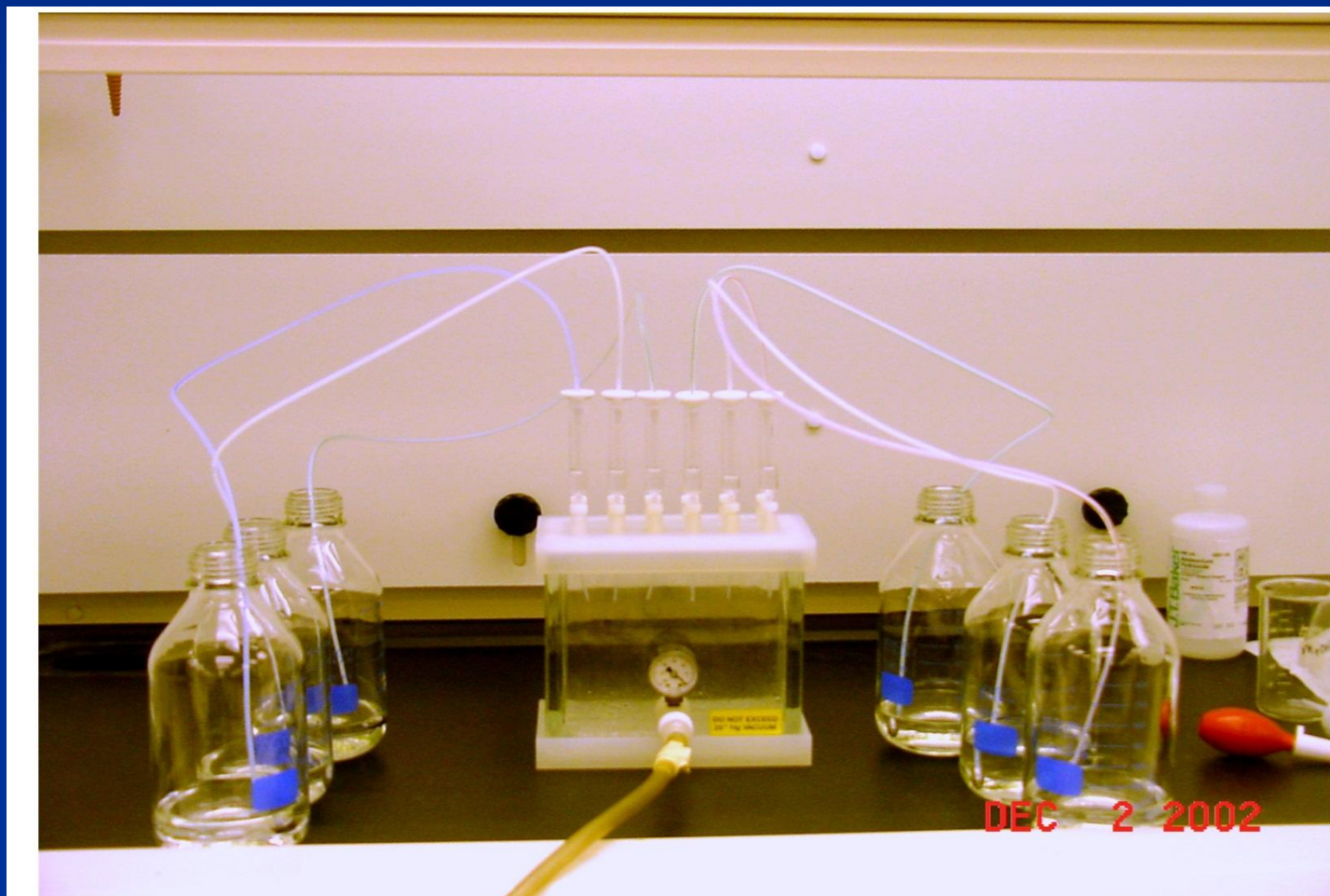
# Sample Prep and SPE

- Samples are filtered
- Extracted within 7 days of collection
- Waters Oasis HLB Cartridge
- 500 mL sample
- Elution 1 with 100% MeOH
- Elution 2 with 99% MeOH 1% Acetic acid
- Extracts are concentrated to 1mL

# Solid Phase Extraction (SPE)



# Solid Phase Extraction Manifold



# Synthesized Internal and Surrogate Standards

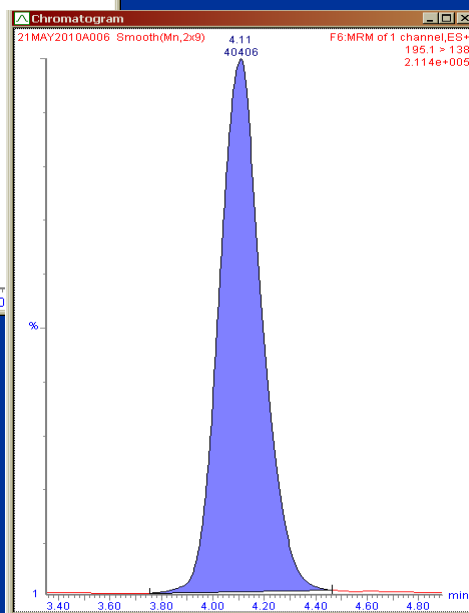
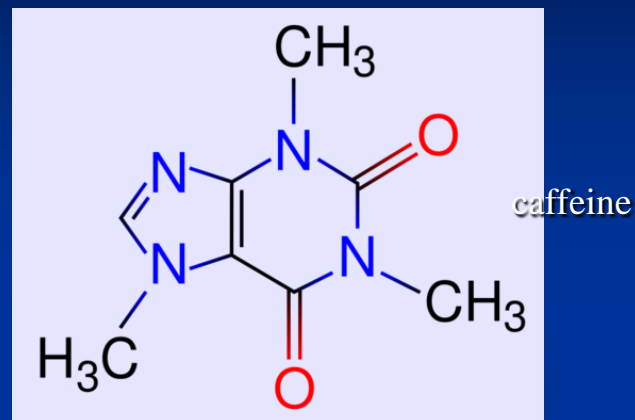
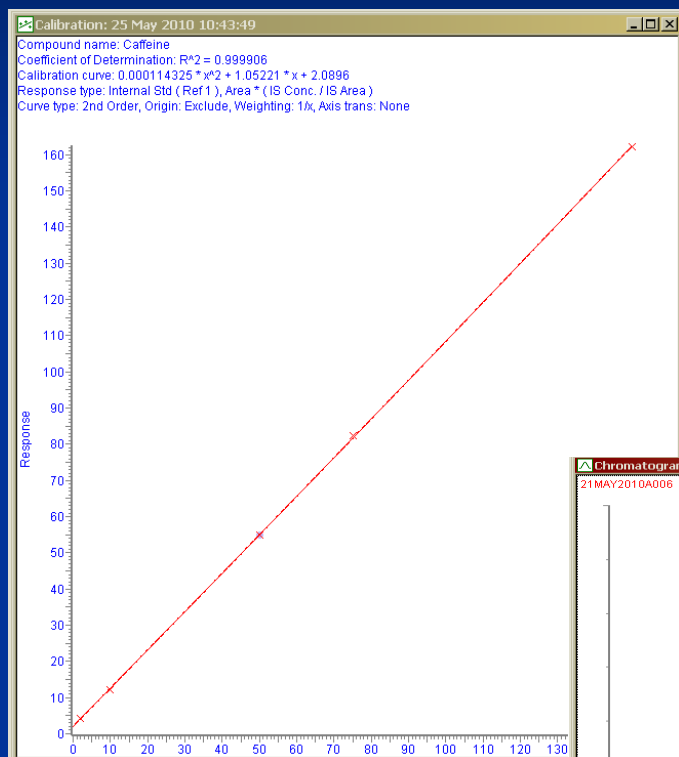
Caffeine 13C3	Surrogate Compound
Primidone d5	Surrogate Compound
Cotinine d3	Internal Standard
Carbamazepine d10	Internal Standard

# Instrumental Analysis

- Chromatographic Separation by HPLC
- Simple Methanol / Water Gradient
- Electrospray Ionization (ESI) Positive
- Detection by Tandem Quadrupole Mass Spectrometry (MS/MS)



# Calibration Curve and Quantitation



Compound	Conc. (ng/L)
1,7-Dimethylxanthine	1,800
Acetaminophen	8,800
Atenolol	920
Azithromycin	34
Caffeine	12,000
Carbamazepine	ND
Cotinine	86
Urobilin	79,000
Primidone	ND



# Why Not Test All Samples?

- Time Intensive: It Takes  $\sim 20$  Hours to Process each Batch of Samples (8 Field Samples)
- Instrumentation – The HPLC/MS/MS instrument costs  $\sim \$500\text{K}$
- Solvent, Filtration, Hazardous Waste Disposal, SPE Cartridges Costs Exceed \$50 per Sample.
- Deuterated/ Isotopically Labeled Standards \$\$\$
- Very Few Labs Do This Analysis

# Spot Pond Brook, Stoneham, MA



Analyte	Result
E. coli (MPN)	21
Surfactants	ND
Ammonia	ND
Caffeine	9.9 ng/L
1,7-Dimethylxanthine	7 ng/L
Urobilin	ND (2.0 ng/L)
Cotinine	ND (0.2 ng/L)
Acetaminophen	ND (1.0 ng/L)
Carbamazepine	ND (0.2 ng/L)
Atenolol	ND (2.0 ng/L)
Azithromycin	ND (2.0 ng/L)
Primidone	ND (2.0 ng/L)

# Ryder Mill – Arlington, MA



Analyte	Result
E. coli (MPN)	1,302
Surfactants	0.3 mg/L
Ammonia	3.0 mg/L
Caffeine	520 ng/L
1,7-Dimethylxanthine	170 ng/L
Urobilin	15,000 ng/L
Cotinine	3.3 ng/L
Acetaminophen	15,000 ng/L
Carbamazepine	ND (0.5 ng/L)
Atenolol	250 ng/L
Azithromycin	67 ng/L
Primidone	ND (5.0 ng/L)



# “Mill2a” - Chelsea Creek – Chelsea, MA



Analyte	Result
E. coli (MPN)	100
Surfactants	1 mg/L
Ammonia	6 mg/L
Caffeine	1,600 ng/L
1,7-Dimethylxanthine	67 ng/L
Urobilin	1,100 ng/L
Cotinine	46 ng/L
Acetaminophen	21 ng/L
Carbamazepine	9.8 ng/L
Atenolol	1.8 ng/L
Azithromycin	ND (2.0 ng/L)
Primidone	ND (2.0 ng/L)

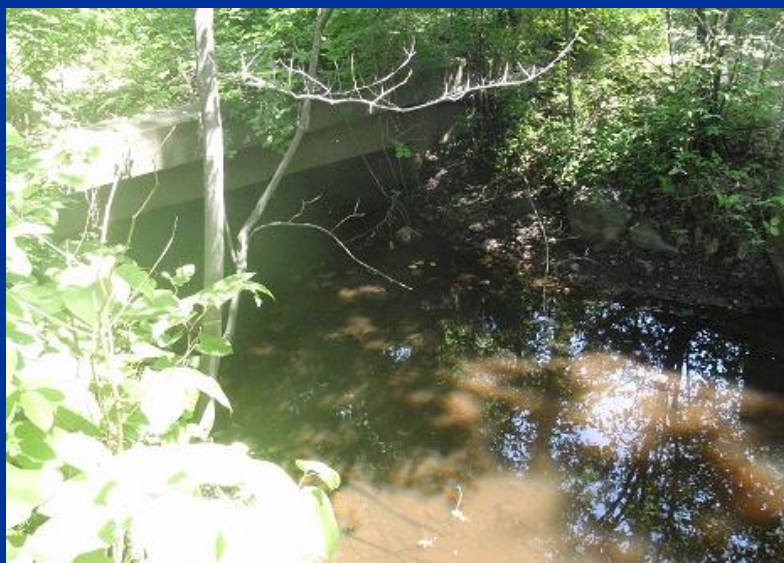
# Meetinghouse Brook, Medford, MA



Analyte	Result (Upstream)	Result (Downstream)
E. coli (MPN)	48	534
Surfactants	ND	0.1 mg/L
Ammonia	0.1 mg/L	ND
Caffeine	15 ng/L	33 ng/L
1,7-Dimethylxanthine	ND (2.0 ng/L)	21 ng/L
Urobilin	ND (4.0 ng/L)	230 ng/L
Cotinine	ND (0.4 ng/L)	ND (0.4 ng/L)
Acetaminophen	ND (2.0 ng/L)	170 ng/L
Carbamazepine	ND (0.4 ng/L)	6.0 ng/L
Atenolol	ND (2.0 ng/L)	6.9 ng/L
Azithromycin	ND (0.4 ng/L)	2.1 ng/L
Primidone	ND (4.0 ng/L)	ND (4.0 ng/L)



# Mill Brook, Arlington, MA



Analyte	Result (Upstream)	Result (Downstream)
E. coli (MPN)	16	2,318
Surfactants	ND	ND
Ammonia	ND	0.75
Caffeine	5.8 ng/L	98 ng/L
1,7-Dimethylxanthine	ND (2.5 ng/L)	19 ng/L
Urobilin	390 ng/L	2,700 ng/L
Cotinine	1.5 ng/L	12 ng/L
Acetaminophen	2.6 ng/L	23 ng/L
Carbamazepine	ND (0.5 ng/L)	1.9 ng/L
Atenolol	ND (2.5 ng/L)	32 ng/L
Azithromycin	ND (0.5 ng/L)	0.84 ng/L
Primidone	ND (5.0 ng/L)	ND (4.0 ng/L)



# Future Watershed Work

- MWRA 205/City of Somerville
- Arlington outfalls to Mill Brook
- Stoneham common manholes; illicit; chronic SSO
- Halls Brook (Woburn)
- Salem Street (Woburn)
- Mill Brook (Arlington/Lexington line)
- Winns Brook (Belmont)
- Wellington Brook (Belmont)
- City of Revere Judicial Consent Decree
- Boston Water and Sewer Commission outfalls

# RARE/RM Next Steps

- Complete data review, summary, recommendations
- Continued enforcement
- Bacteria, surfactant, ammonia, chlorine
- Volunteer monitoring equipment loan program
- Will post results, maps and related information on EPA Region 1 website for Mystic River, which can be found at:  
[www.epa.gov/mysticriver](http://www.epa.gov/mysticriver)

# Questions?