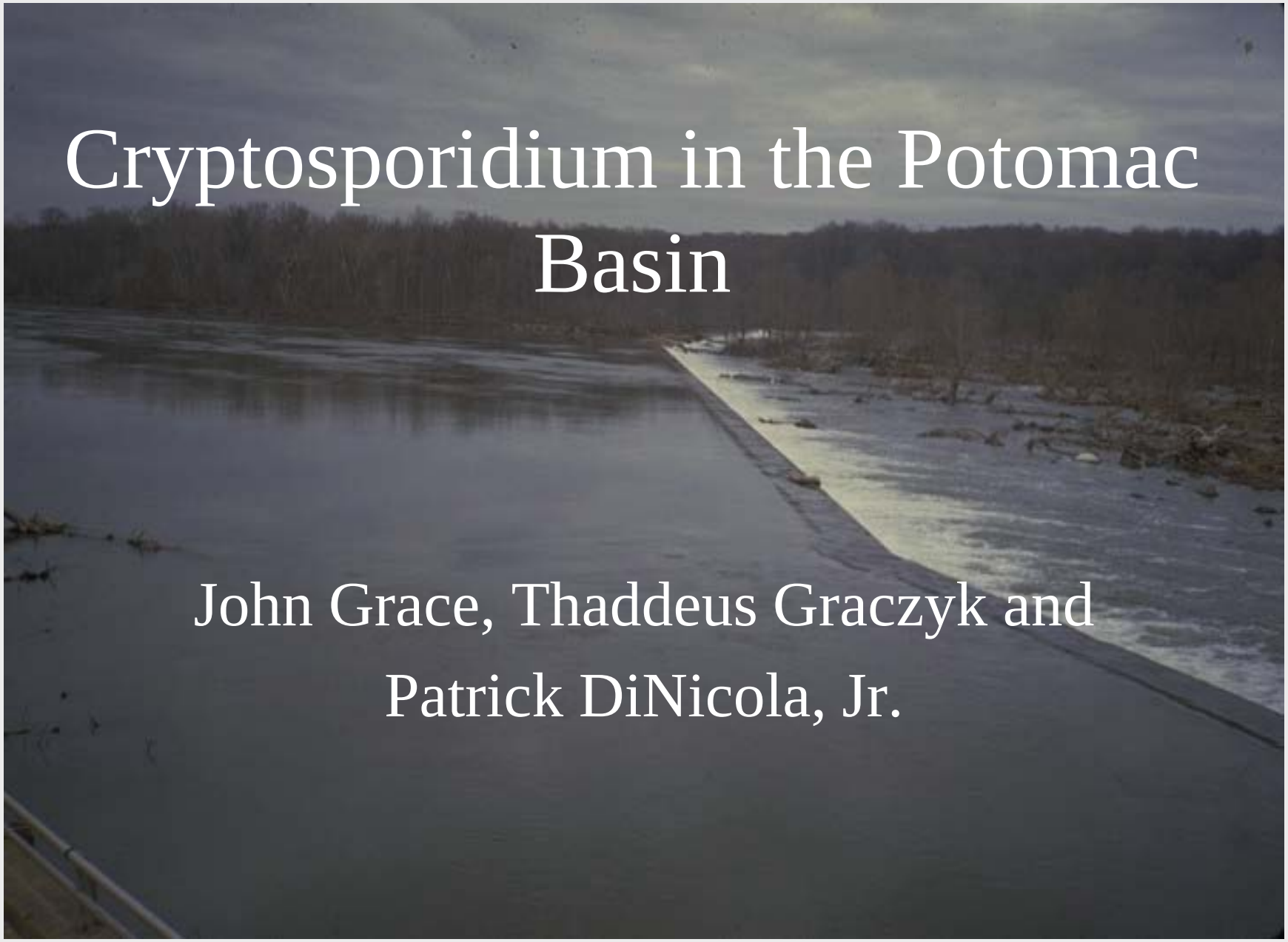
Cryptosporidium in the Potomac Basin



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Background

- Requests for increased municipal permit discharges into the Potomac Basin in Frederick, Montgomery and Loudon Counties totaling **47** mgd
- No measurements of *crypto* in MD WWTPs
- Three major water utilities downstream
- Research indicating first flush higher *crypto* levels
- 1994/95 crypto measurements **not** detecting *crypto*
- Water treatment not an absolute barrier

Objectives

- Select a method that can be easily used in field with acceptable recovery of *crypto*
- Characterize *crypto* input from WWTP in Potomac Basin
- Examine sedimentation on removal of *crypto* in river system
- Characterize *crypto* levels at different characteristic watersheds and during storm events within the Potomac

Benefits

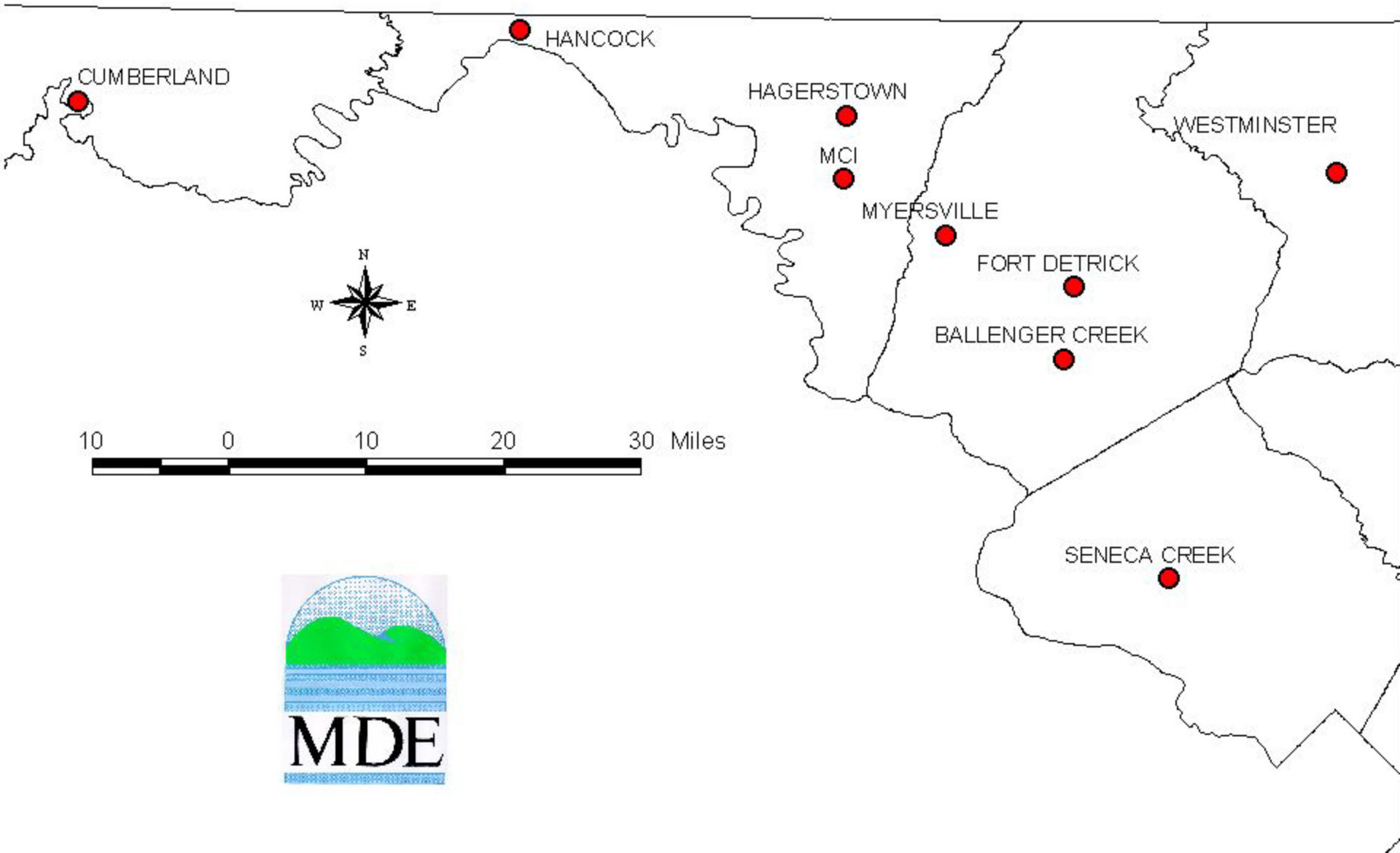
- Help evaluate impact of WWTP discharges on *crypto* loading at water plants
- Understand how watershed characteristics affect *crypto* levels
- Understand when water utilities should expect greater risks from *crypto*
- Support source water assessments and protection efforts

Approach

- PHASE I - Method selection
- PHASE II – Wastewater effluent sampling
- PHASE III – Sedimentation
- PHASE IV – Water Plant influent sampling
  - Base flow
  - Storm event
- PHASE V – Data evaluation/report prep. Etc. – What's next?

Potomac River Cryptosporidium Project

Waste Water Treatment Plant Sample Sites



MDE

PHASE II – Result Summary

- **7 / 9** WWTPs had *Cryptosporidium* Detections.
- **21 / 36** Samples were positive, ~ 58%.
- Out of **21** positive samples, **18** were Viable.
- **9** were also Infectious
- **7** Infectious samples were determined to be Genotype II.
- Sample Dataset:
  - Range: **3** oocysts/liter - **570** oocysts/liter
  - Average: **171** oocysts/liter
  - Median: **20** oocysts/liter

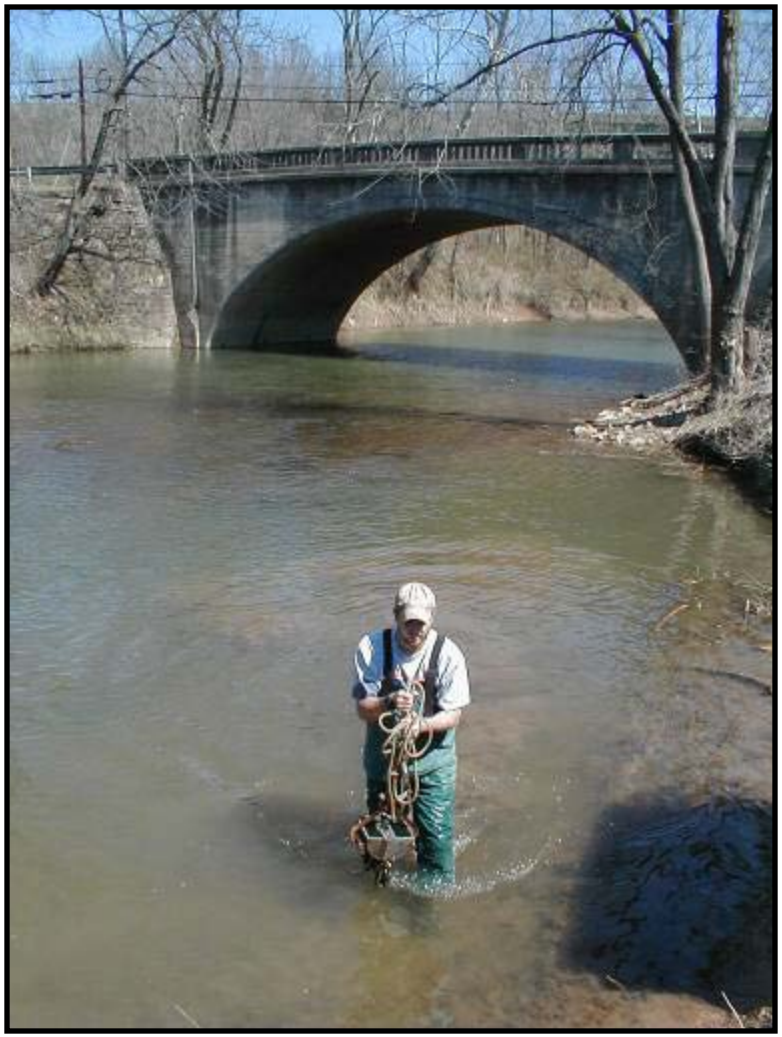
  Highest concentrations found in samples collected during plant failure

Hagerstown WWTP – 09/27/2000

View Downstream from Outfall

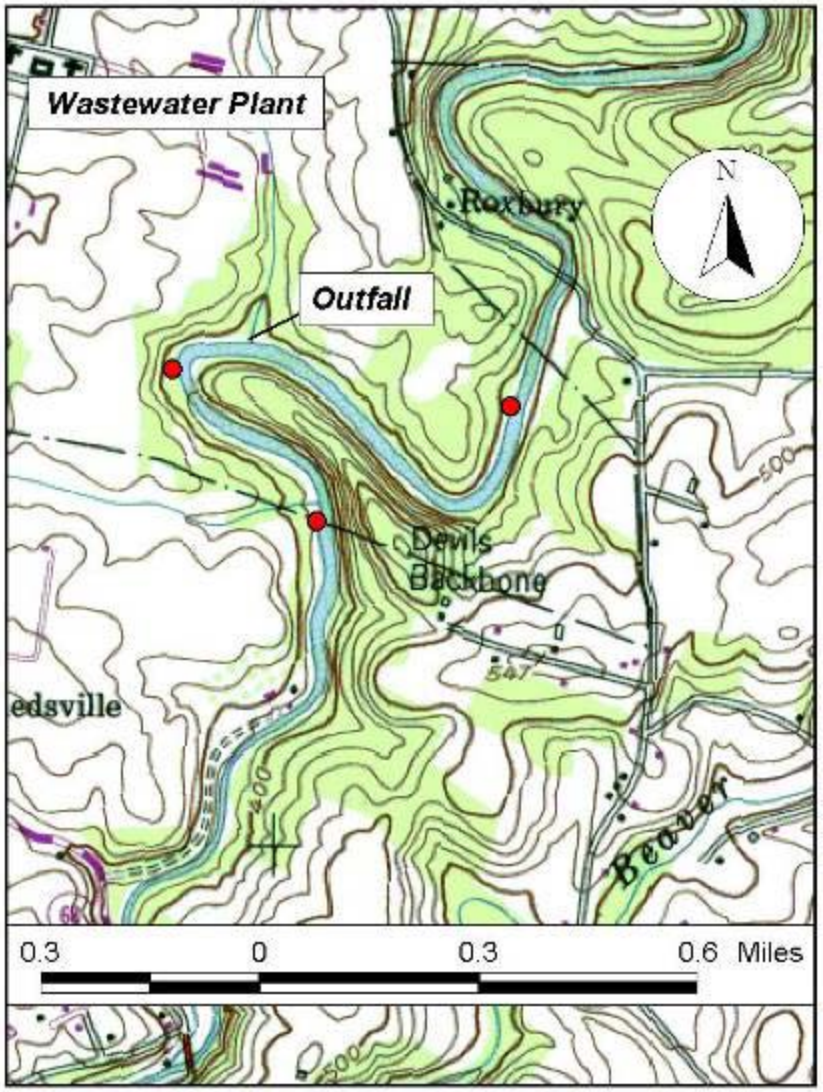
Outfall, Plant in Distance

PHASE III – Sediment Sampling



- Sediment samples taken from Antietam and Tolonoway Creeks in Washington, Co.
- Samples were taken above, just below, and downstream of the MCI WWTP and the Town of Hancock WWTP
- Three samples (cross-section) taken at each site
- 18 total samples collected and analyzed

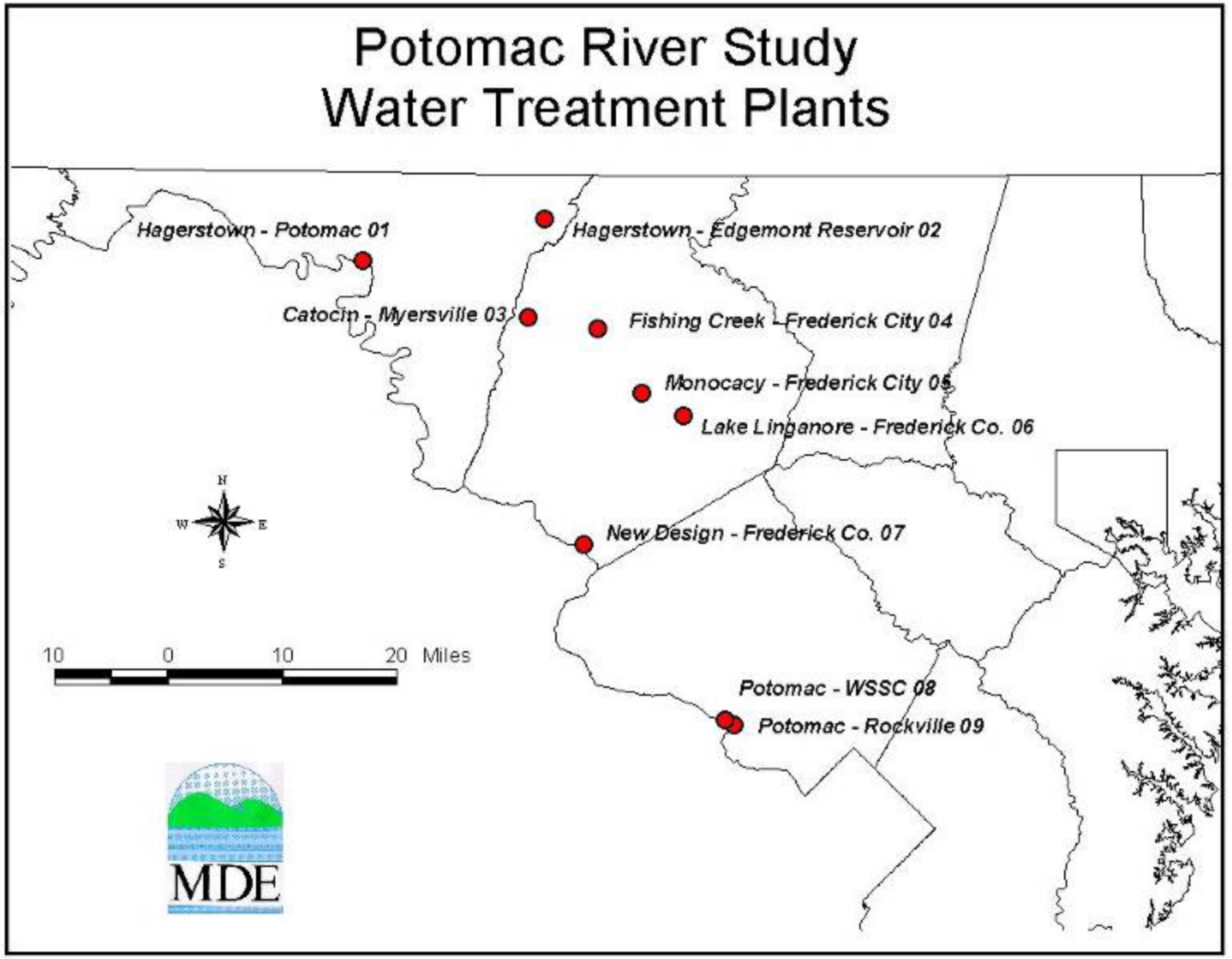
MCI-Antietam Sediment Sampling



Above	No	No	No	Stream Bank
Just Below	98	132	67	
Farthest Downstream	10	8	14	

- All samples were reported in oocysts/gram
- Samples from Hancock/Tolonoway showed similar trend

PHASE IV – Water Treatment Plants



PHASE IV – Water Treatment Plants

Hagerstown – Edgemont Reservoir, Raven Rock Diversion

- Phase IV includes base and storm flow sampling
- 144 samples collected (108 Storm & 36 Base) from “raw” water
- 3-gallon grab samples
- Three storm samples per storm event

PHASE IV – Selected Results

Base Flow

- Crypto detects in 22/36 samples, or 61% of samples.
- 7/9 raw water sources had a detection (NA - L. Catoctin Creek & Linganore Creek)
- Data ranges from <1 oocsyt/liter to 20 oocysts/liter.
- Potomac River plants averaged – 9.4 oocysts/liter.
- 15 samples Viable, 3 samples Infectious & Genotype II.

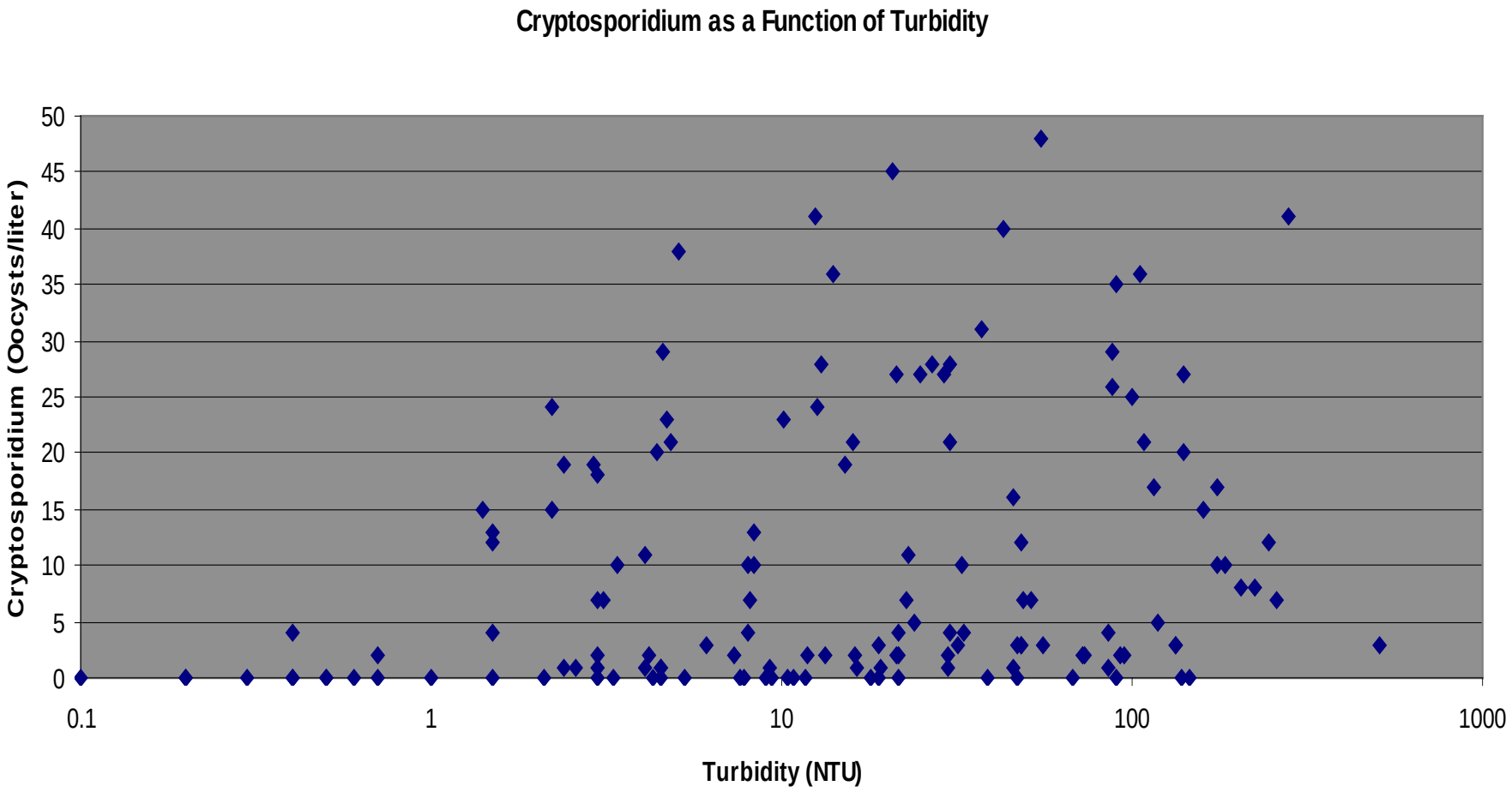
Storm Flow

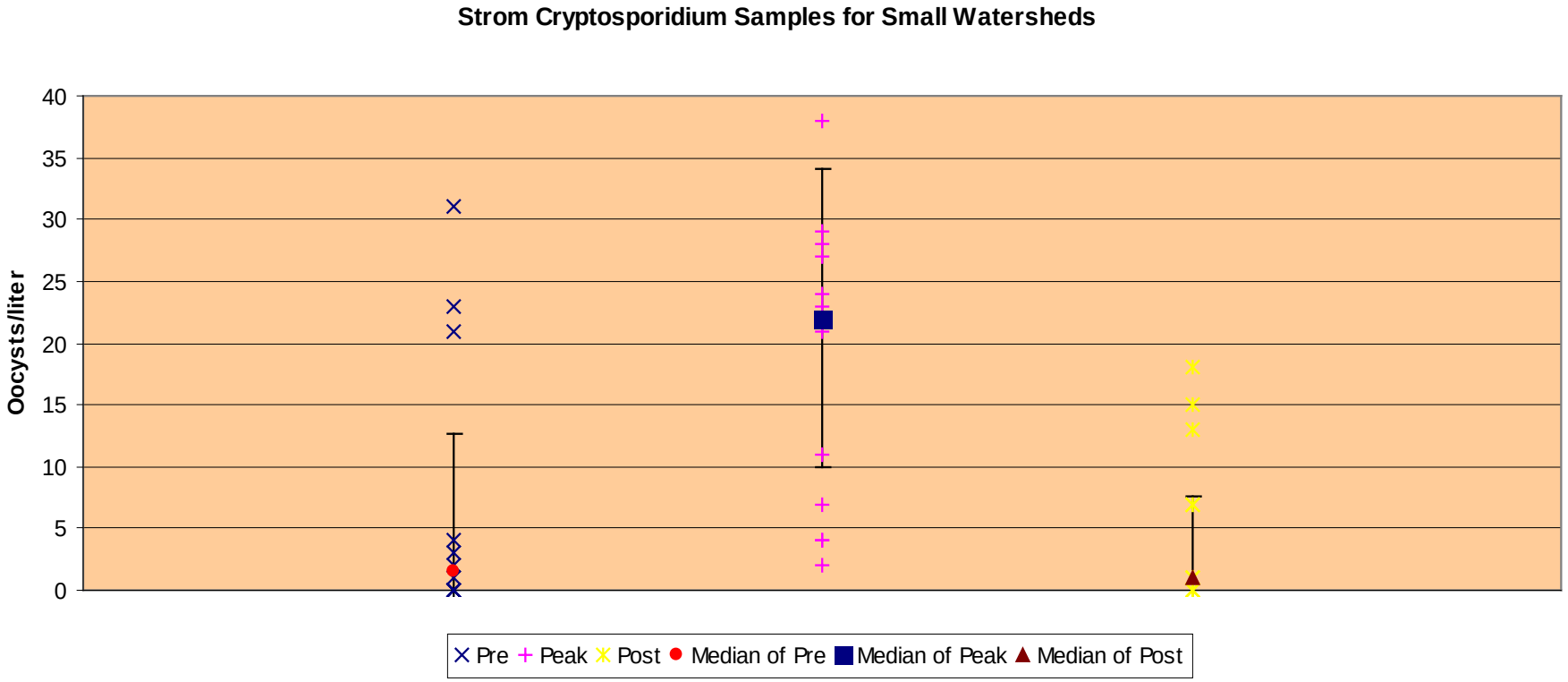
- Data ranged from <1 oocyst/liter to 48 oocysts/liter.
- Overall – Sample mean concentration = 12 oocysts/liter
- Storm Event: **Pre**: Mean - 5 oocysts/liter (Median – 2.5), **Peak**: Mean - 17 oocysts/liter (Median – 17), **Post**: Mean - 13 oocysts/liter (Median – 7)
- Potomac Plants – Mean was 13 oocysts/liter
- 18 samples were viable and infectious.
- Genotype I (non-human origin) – Four samples (Ling. Creek, Edgemont Reservoir).

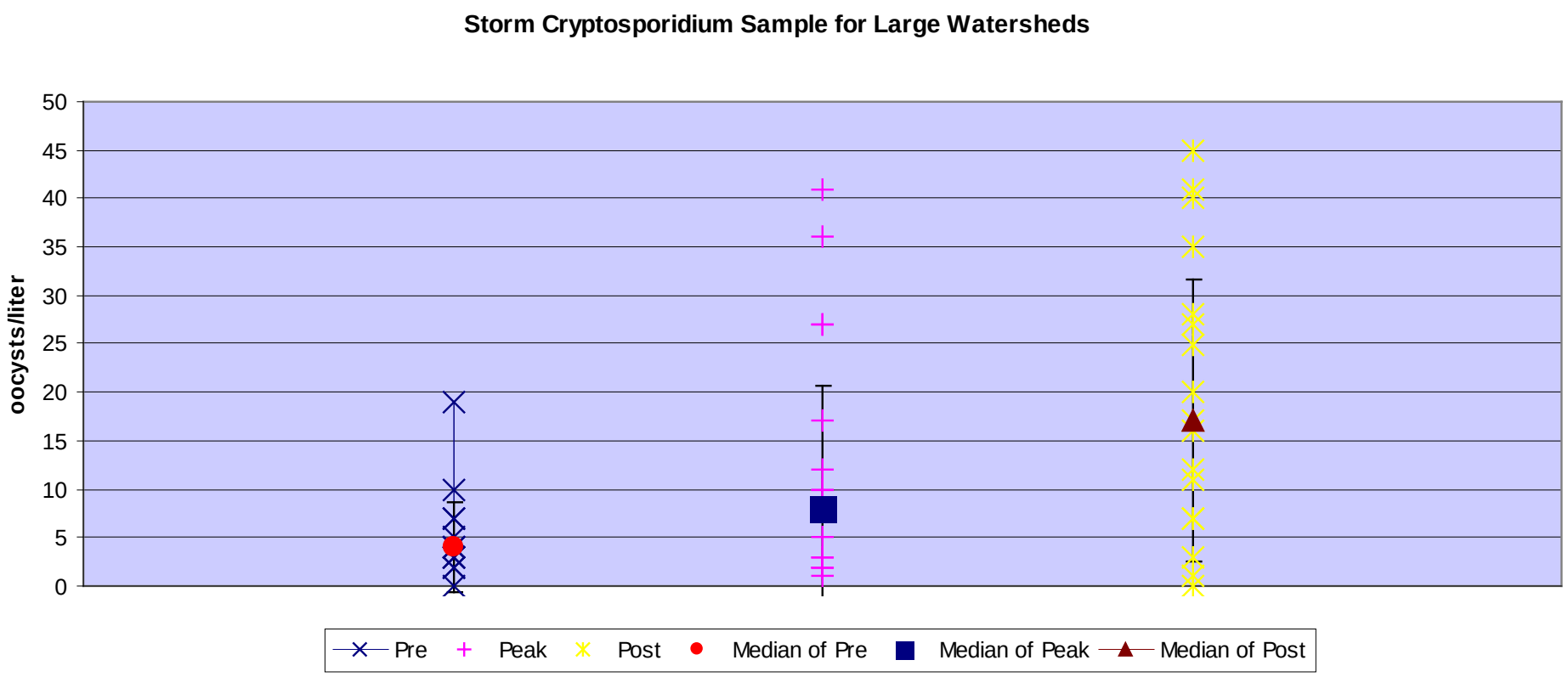
Phase IV – Cont.

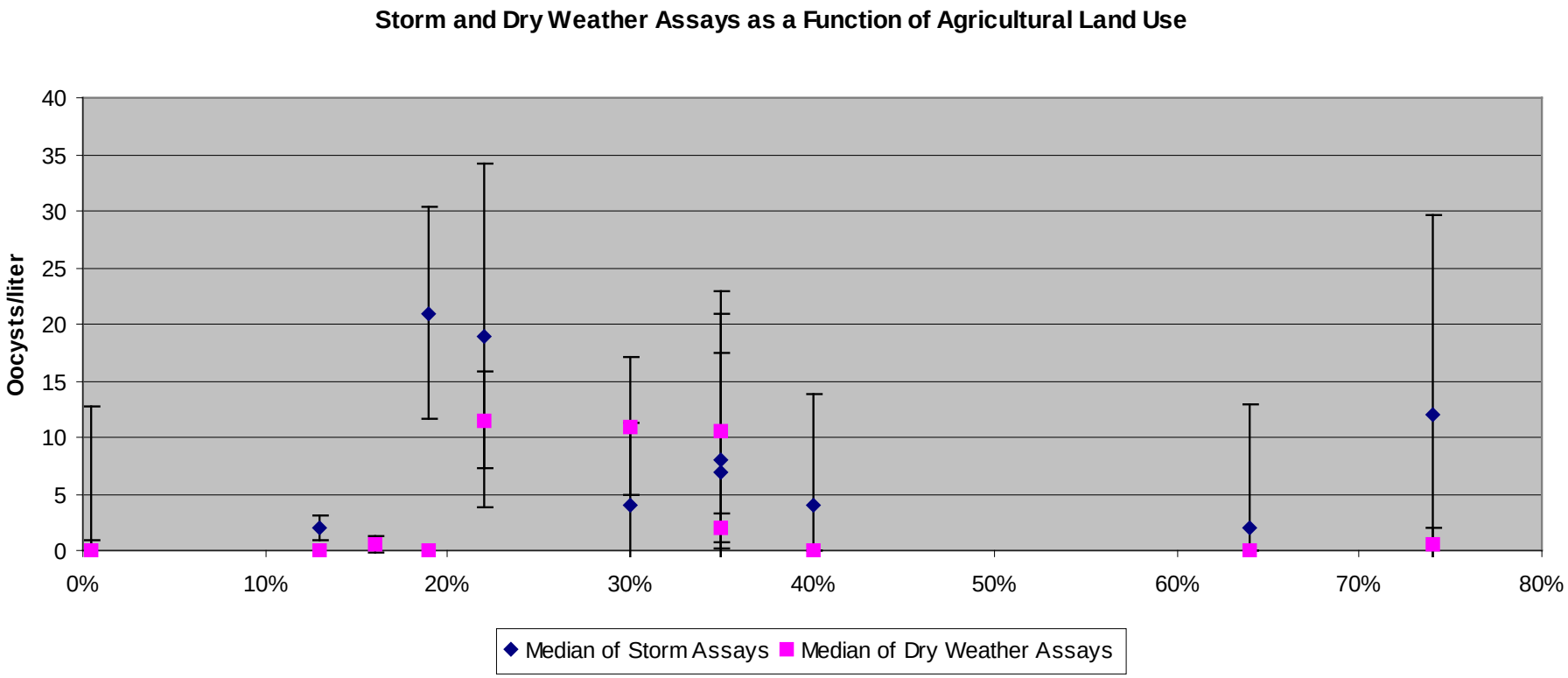
- Storm flow –
  - 90/106 positive
  - 28 Genotype II

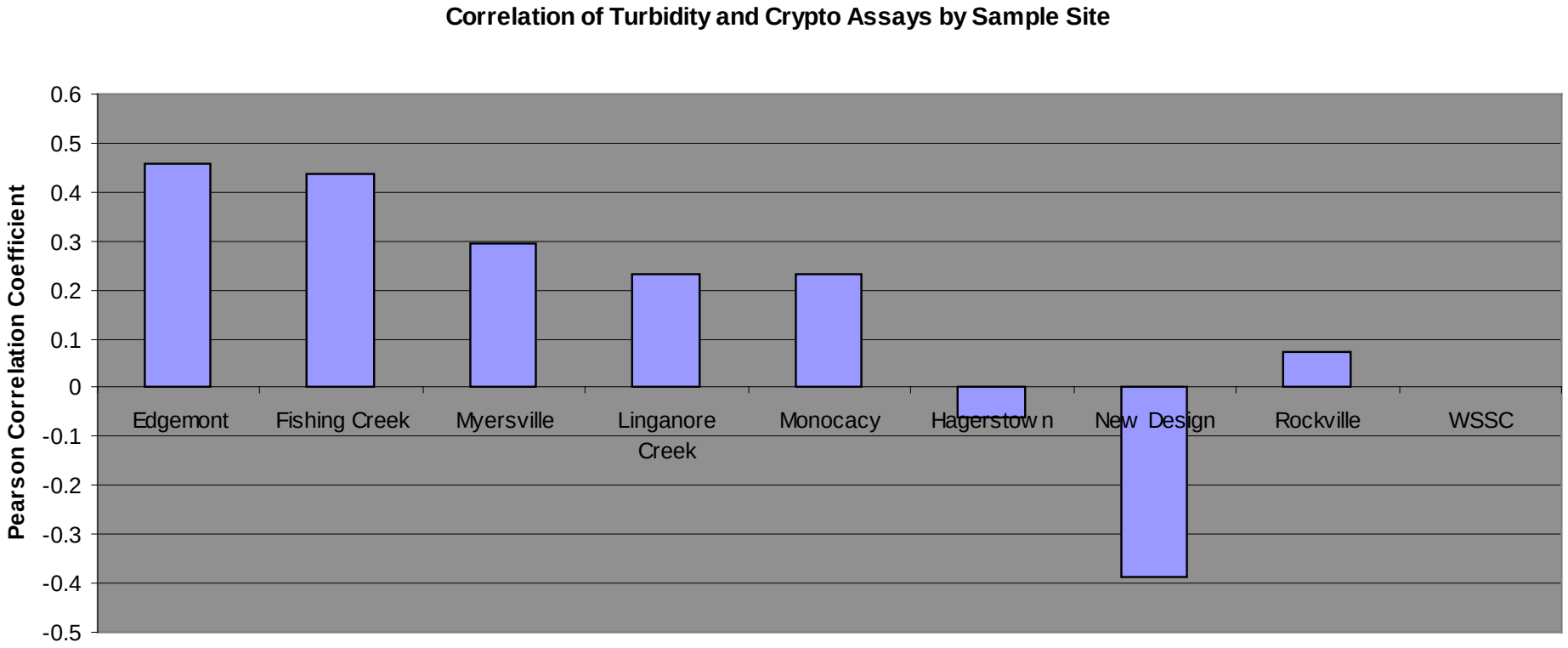
Analyzed data relationships considering :
Watershed Size, Time of Year, Turbidity,
Fecal Coliform

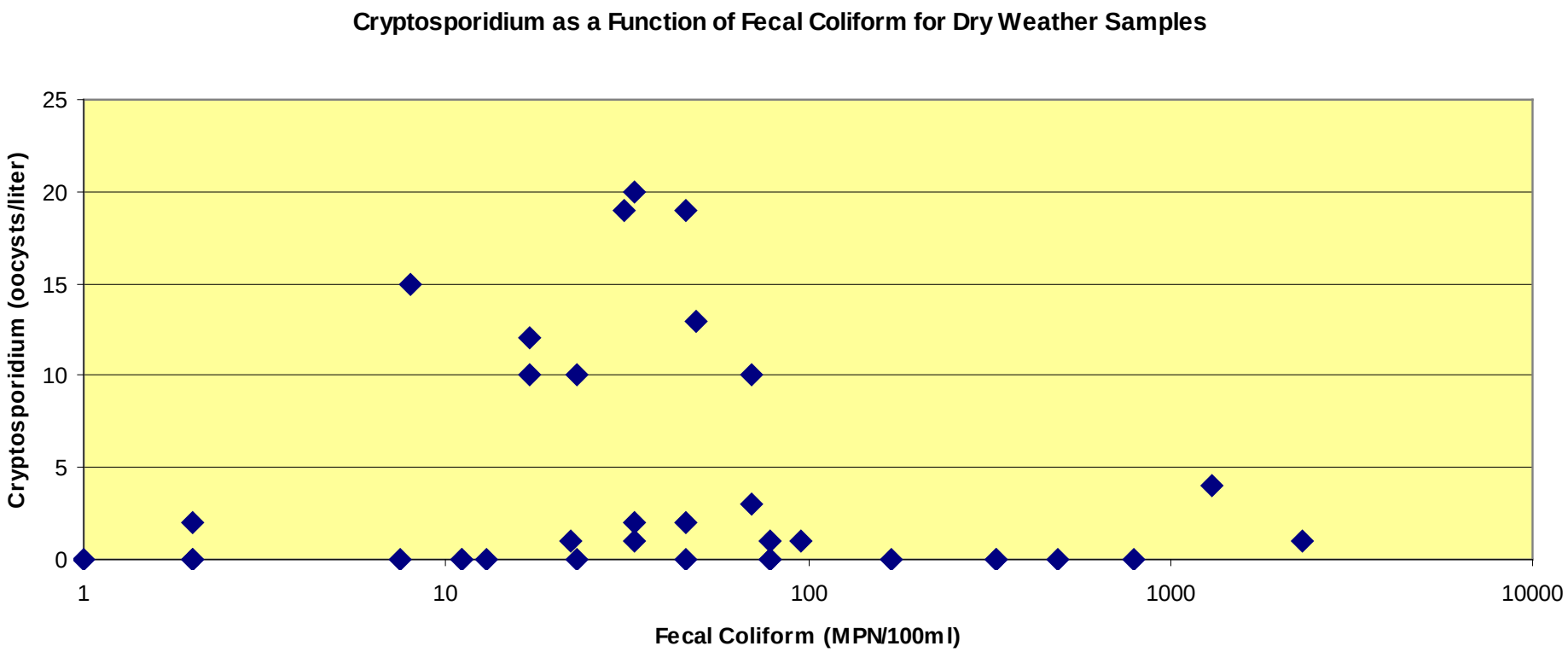

Cryptosporidium as a Function of Turbidity
Cryptosporidium (Oocysts/liter)
50
45
40
35
30
25
20
15
10
5
0
0.1
1
10
100
1000
Turbidity (NTU)


Strom Cryptosporidium Samples for Small Watersheds
Oocysts/liter
40
35
30
25
20
15
10
5
0
Pre
Peak
Post
Median of Pre
Median of Peak
Median of Post


Storm Cryptosporidium Sample for Large Watersheds
oocysts/liter
50
45
40
35
30
25
20
15
10
5
0
Pre
Peak
Post
Median of Pre
Median of Peak
Median of Post


Storm and Dry Weather Assays as a Function of Agricultural Land Use
Oocysts/liter
40
35
30
25
20
15
10
5
0
0%
10%
20%
30%
40%
50%
60%
70%
80%
Median of Storm Assays
Median of Dry Weather Assays


Correlation of Turbidity and Crypto Assays by Sample Site
Pearson Correlation Coefficient
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
Edgemont
Fishing Creek
Myersville
Linganore Creek
Monocacy
Hagerstown
New Design
Rockville
WSSC


Cryptosporidium as a Function of Fecal Coliform for Dry Weather Samples
Cryptosporidium (oocysts/liter)
25
20
15
10
5
0
1
10
100
1000
10000
Fecal Coliform (MPN/100ml)

The End