APPENDIX F

Supplemental Data on Results of Monitoring
Borough of Spring Lake Wreck Pond Environmental Study

1. Wreck Pond Sampling

Three stations were monitored within the Pond as show on Figure 21 in the main report. The stations were selected to reflect overall conditions in the Pond. Thus, the stations were located away from the eastern-most portion of the Pond and the outfall structure to limit the influence of ocean water on the sampling results. Two of the stations are located in the central portion of the Pond, one to the north closer to the Black Creek and Spring Lake inflows (WP2 or 1B) and one in the central portion closer to the Railroad Track Culverts separating the central and western portion of the Pond (WP3 or 1C). The third station, WP1 (or 1A), was located to provide information on the western portion of the Pond, which is not influenced by tidal exchange under most conditions. These sampling points will provide data on the variability of the quality of Wreck Pond by area, including any differences between the main portion of the pond and the narrower area upstream of the Railroad Bridge.

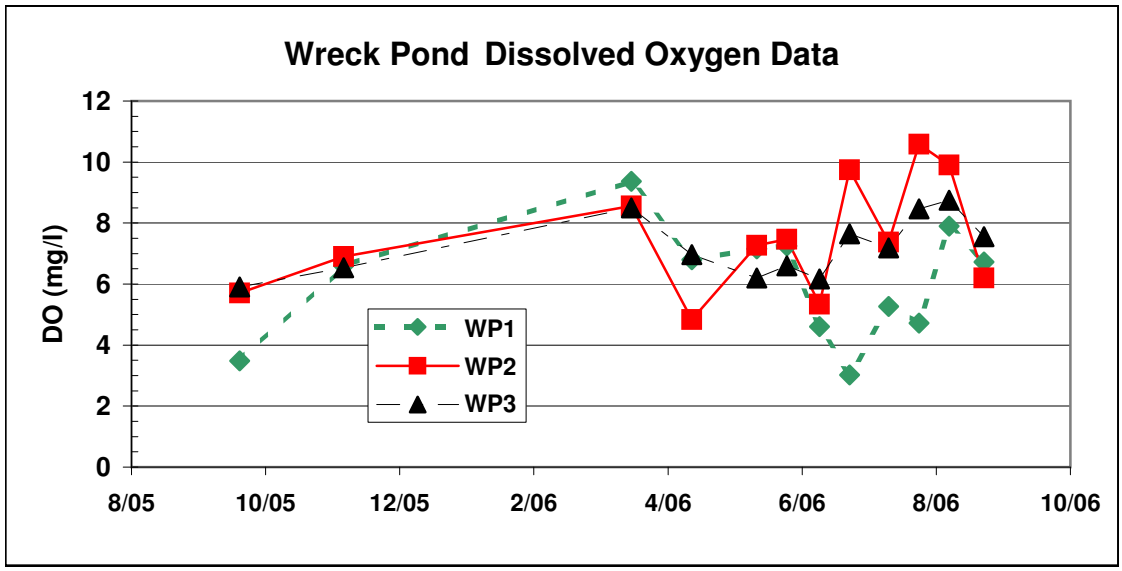
The specific sampling locations were selected by finding relatively deeper points in each respective area, according to a NJDEP hydrographic survey, performed approximately 2 years prior to initiation of sampling. During the initial sampling event, a GPS system was used to locate the sampling points and shoreline features were also recorded. Subsequent sampling events used the GPS, confirmed by the shoreline features, to ensure the same location was sampled.

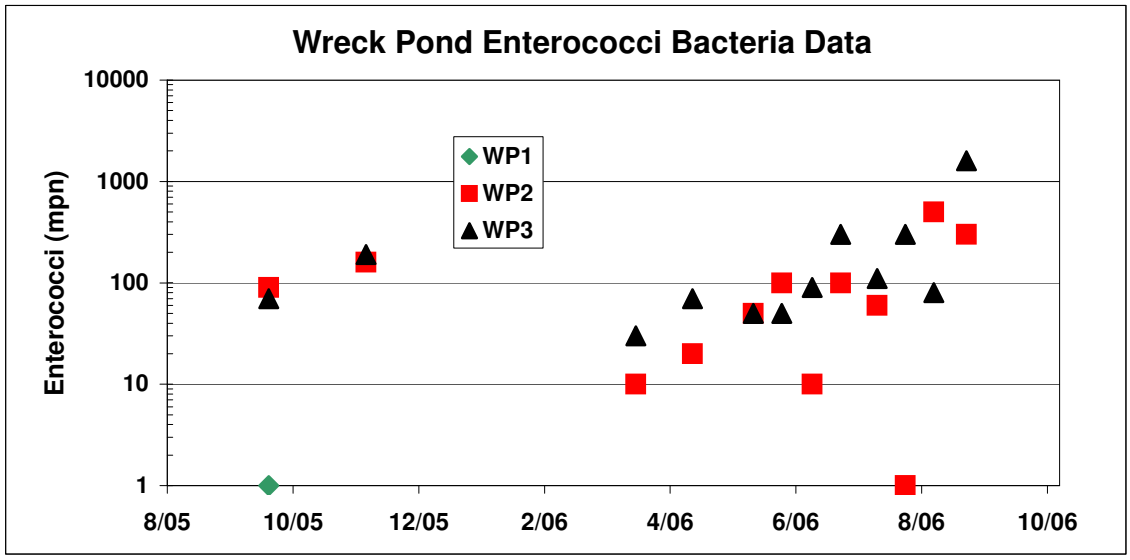
Water quality monitoring within Wreck Pond was conducted from September 2005 to August 2006. Surface water samples were collected monthly from September to November and March and April and twice a month during the summer period (May – August). The pond was not sampled during winter months to focus sampling effort during the warmer months when Pond water quality is typically of concern.

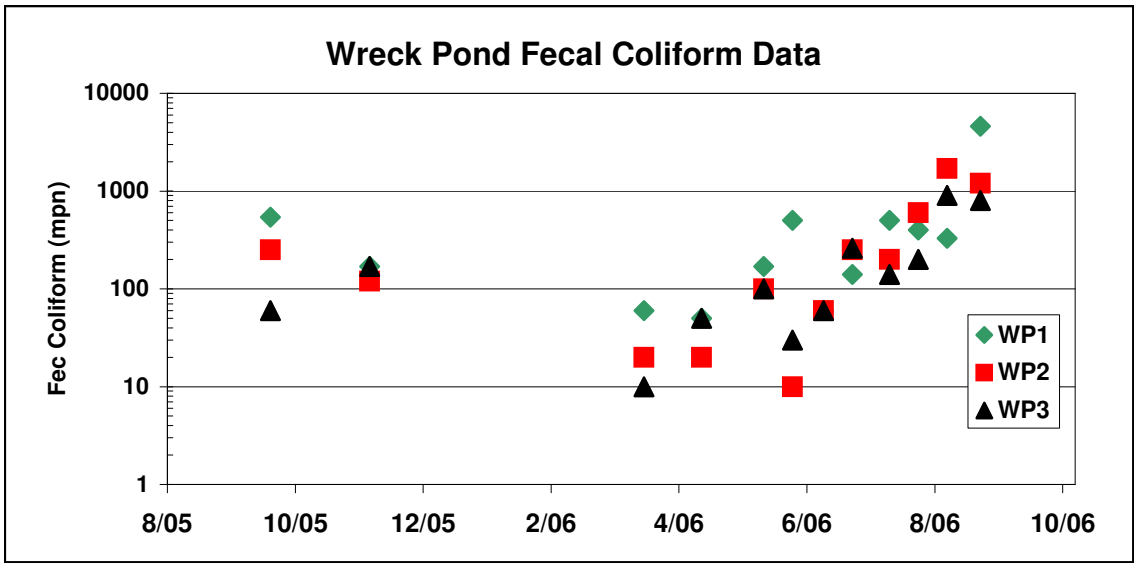
Wreck Pond exchanges tidal flow with the Atlantic Ocean. In order to sample the Pond itself, and not the incoming Ocean water, sample collections was timed to coincide with low tide to the extent possible. Thus, the predicted times of high and low tide within the Pond had to be projected. However, there is no tidal datum associated with Wreck Pond. The only tidal data available were 32 days of tidal elevations collected from December 2004 to January 2005 by Stevens Institute of Technology (Stevens), during studies for NJDEP related to the outfall pipe extension project. Stevens clearly noted tidal influence on the Pond, and determined that discharge from the Pond, as expected, would occur on average, “from just before mid-tide as the tide is falling to a point just prior to mid-tide as the tide is rising” (Stevens, 2005).

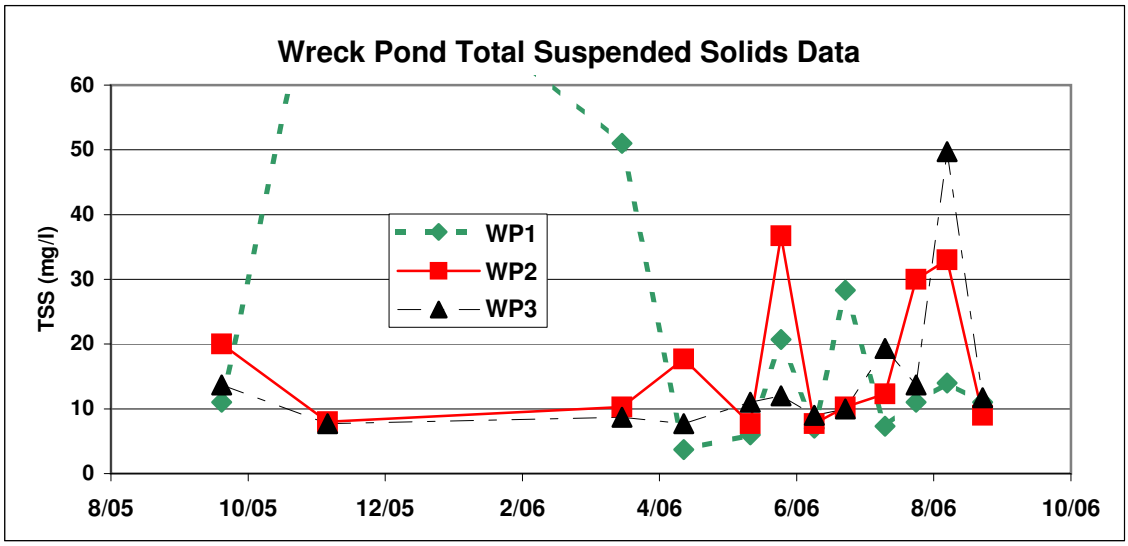
Using this information, prior to the scheduled sampling event predicted low and high tide elevations at Belmar, New Jersey were obtained. Pond sampling times were then determined to be mid-way between the Belmar low to high tide. Since the pond sampling consisted of three (3) sampling locations, during every event the schedule was adjusted such that the middle of the three (3) samples took place around the time of low tide in the Pond.

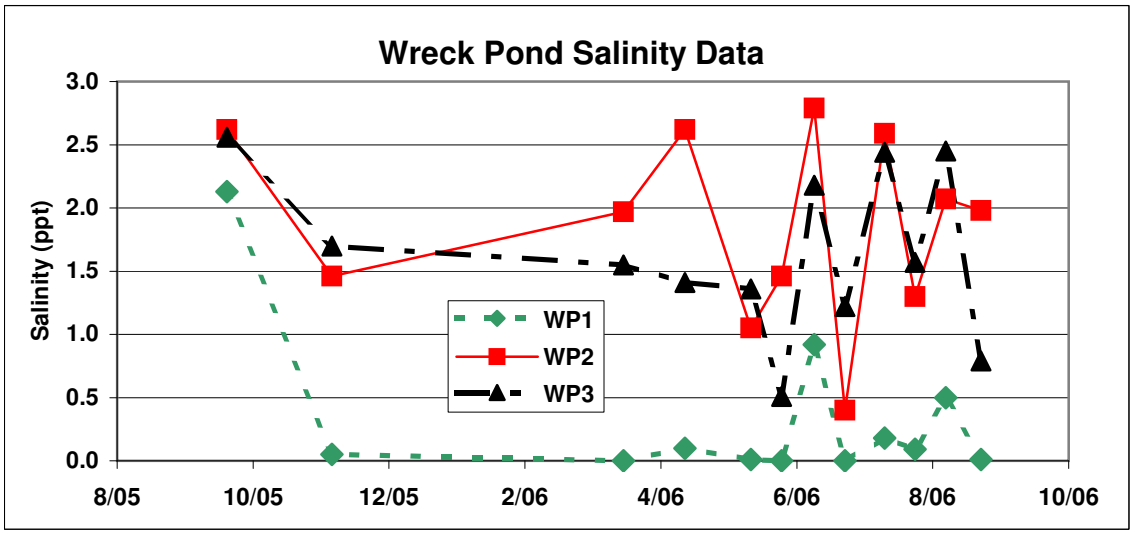
Representative Data Plots are shown in the following pages.

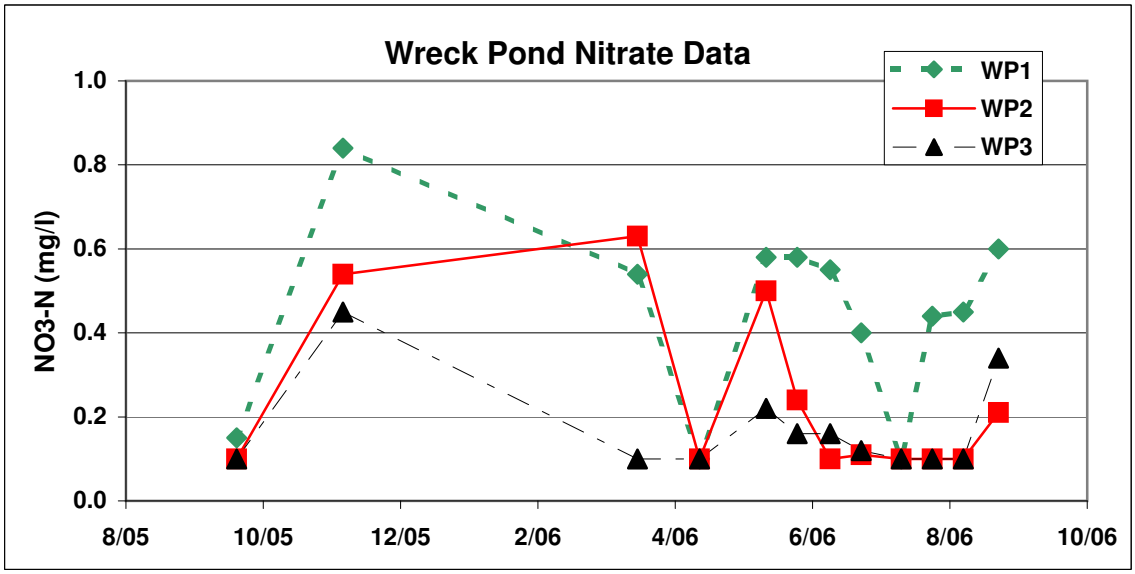

Wreck Pond Dissolved Oxygen Data
DO (mg/l)
12
10
8
6
4
2
0
8/05
10/05
12/05
2/06
4/06
6/06
8/06
10/06
WP1
WP2
WP3

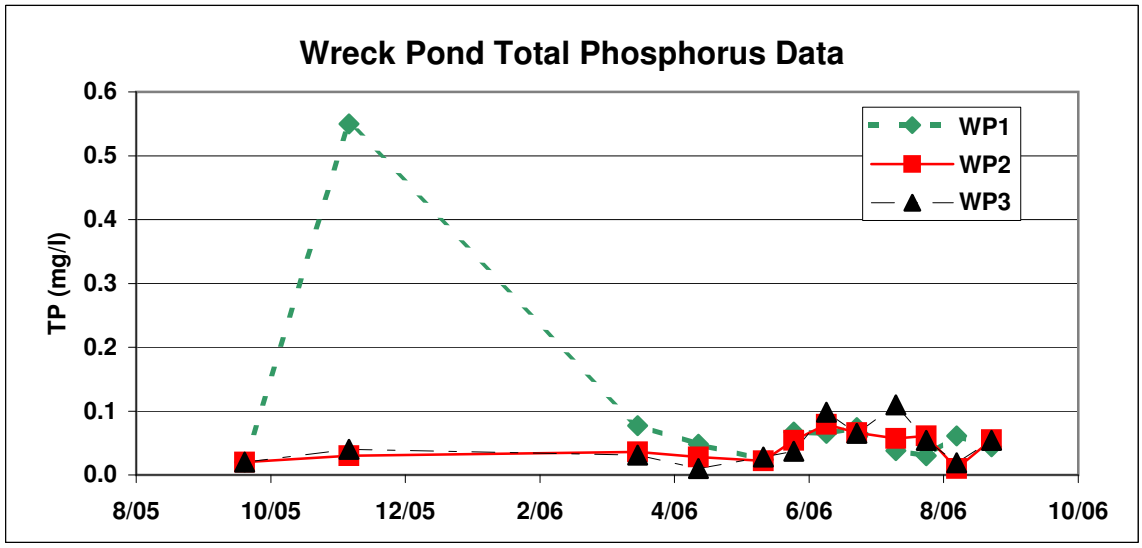

Wreck Pond Enterococci Bacteria Data
Enterococci (mpn)
10000
1000
100
10
1
8/05
10/05
12/05
2/06
4/06
6/06
8/06
10/06
WP1
WP2
WP3

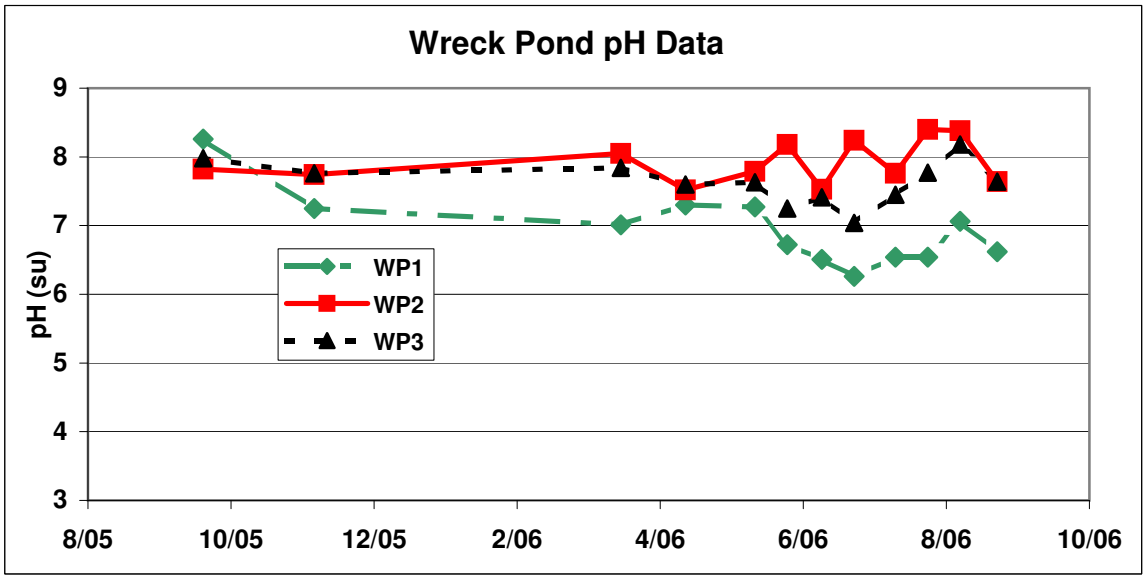

Wreck Pond Fecal Coliform Data
Fec Coliform (mpn)
10000
1000
100
10
1
8/05
10/05
12/05
2/06
4/06
6/06
8/06
10/06
WP1
WP2
WP3

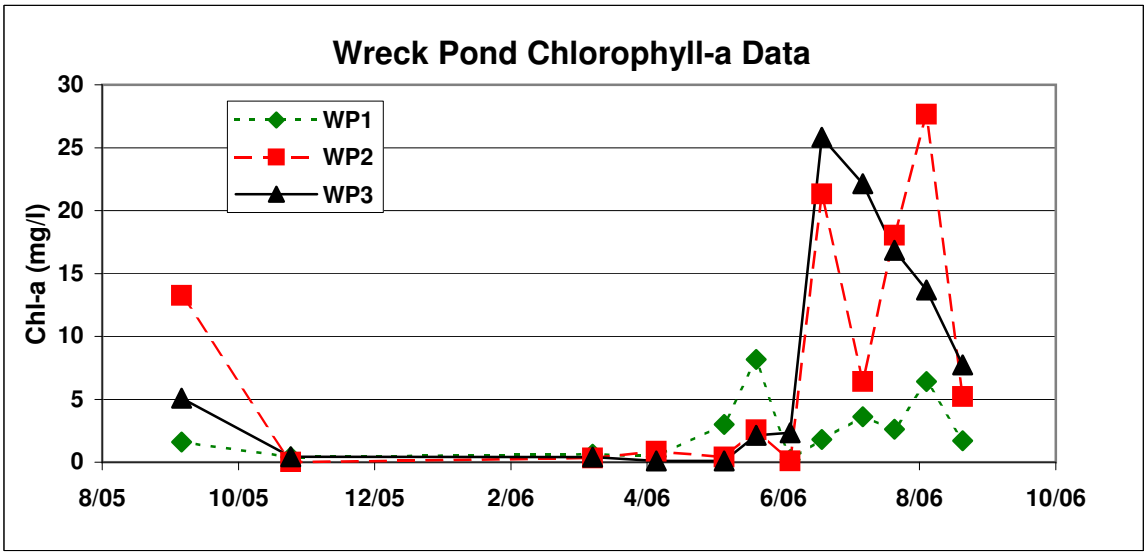

Wreck Pond Total Suspended Solids Data
TSS (mg/l)
60
50
40
30
20
10
0
8/05
10/05
12/05
2/06
4/06
6/06
8/06
10/06
WP1
WP2
WP3


Wreck Pond Salinity Data
Salinity (ppt)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
8/05
10/05
12/05
2/06
4/06
6/06
8/06
10/06
WP1
WP2
WP3


Wreck Pond Nitrate Data
NO3-N (mg/l)
1.0
0.8
0.6
0.4
0.2
0.0
8/05
10/05
12/05
2/06
4/06
6/06
8/06
10/06
WP1
WP2
WP3


Wreck Pond Total Phosphorus Data
TP (mg/l)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
8/05
10/05
12/05
2/06
4/06
6/06
8/06
10/06
WP1
WP2
WP3


Wreck Pond pH Data
pH (su)
9
8
7
6
5
4
3
8/05
10/05
12/05
2/06
4/06
6/06
8/06
10/06
WP1
WP2
WP3

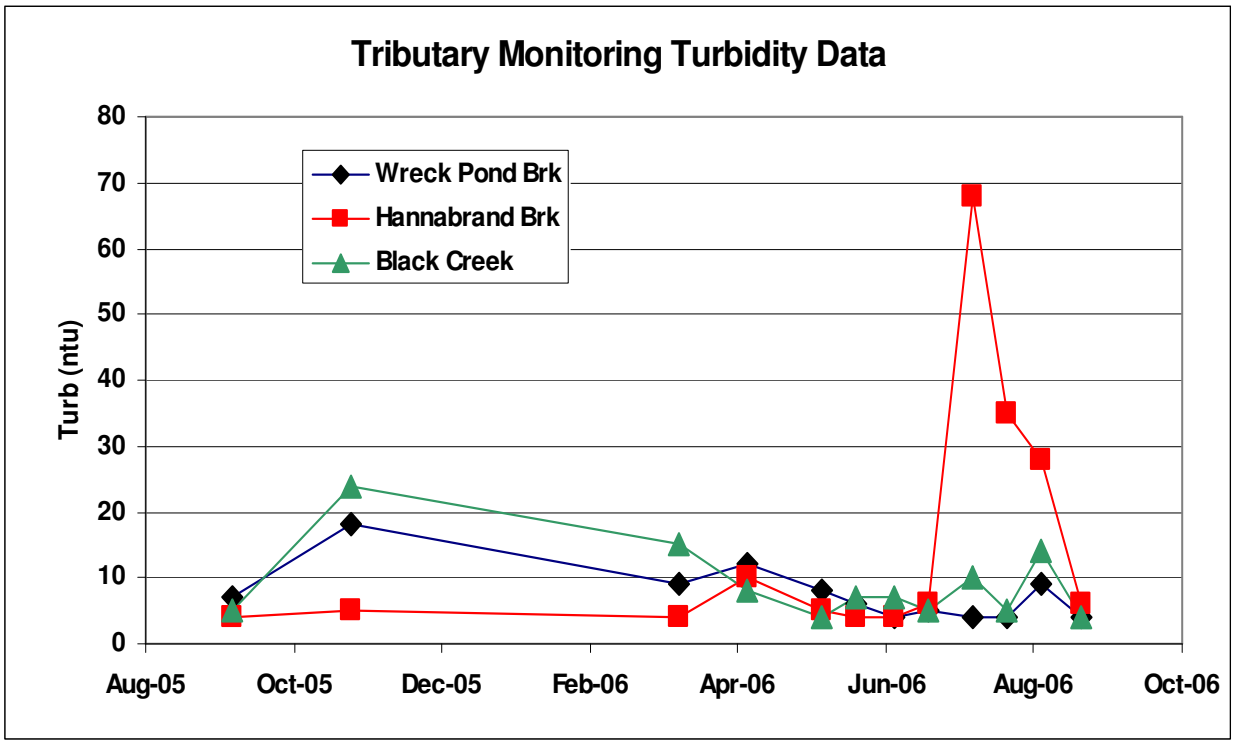

Wreck Pond Chlorophyll-a Data
Chl-a (mg/l)
30
25
20
15
10
5
0
8/05
10/05
12/05
2/06
4/06
6/06
8/06
10/06
WP1
WP2
WP3

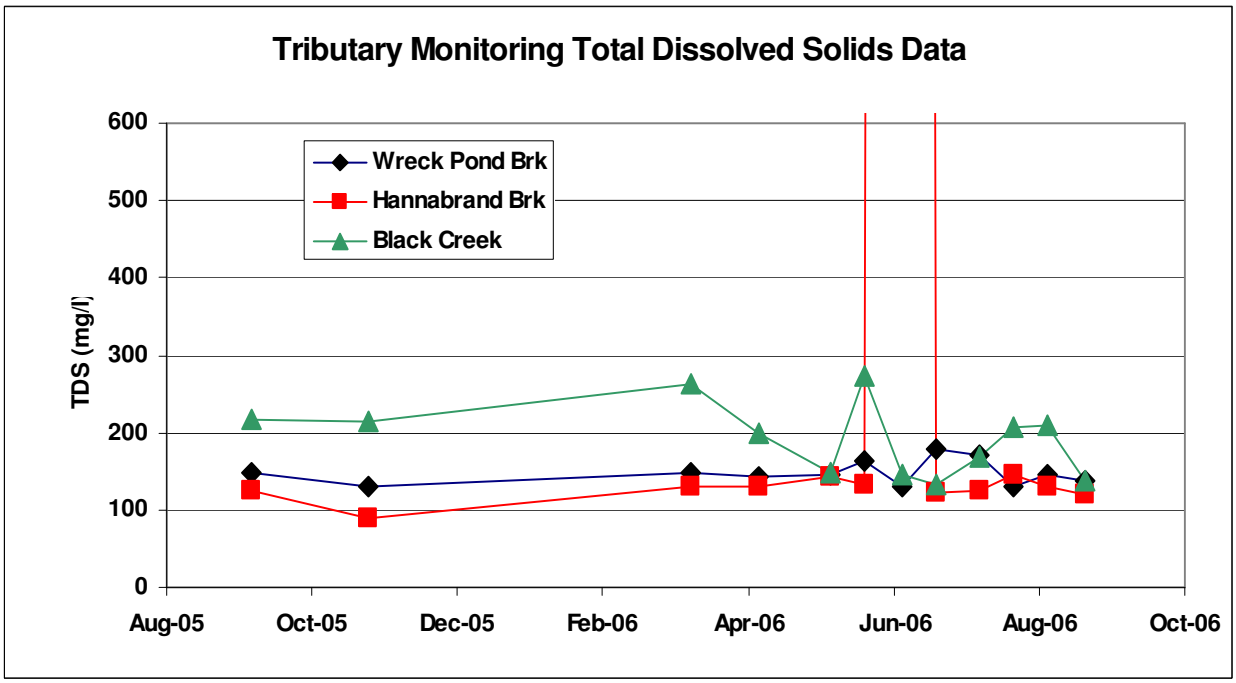
2. Tributary Sampling

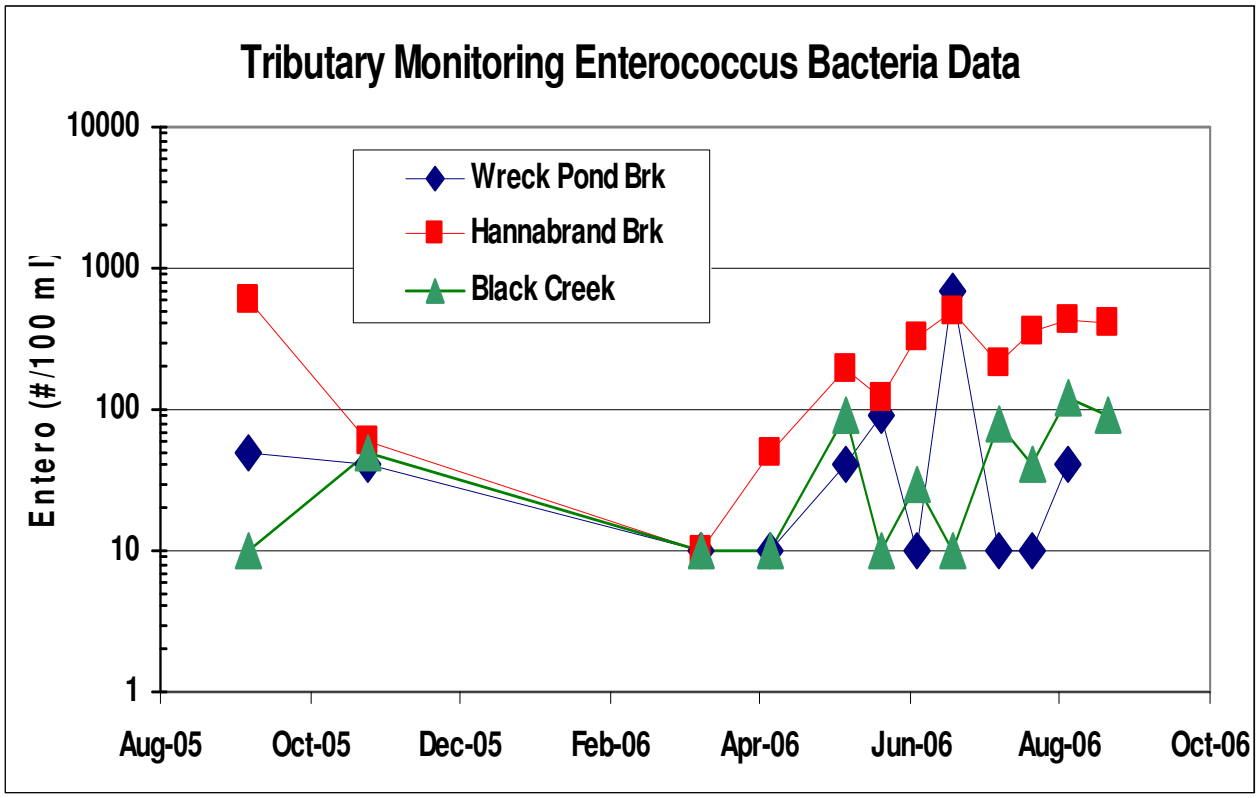
Tributary station locations are shown in the main report. Sampling timing and parameters are as for the Pond sampling, although chlorophyll-a was not collected in the streams.

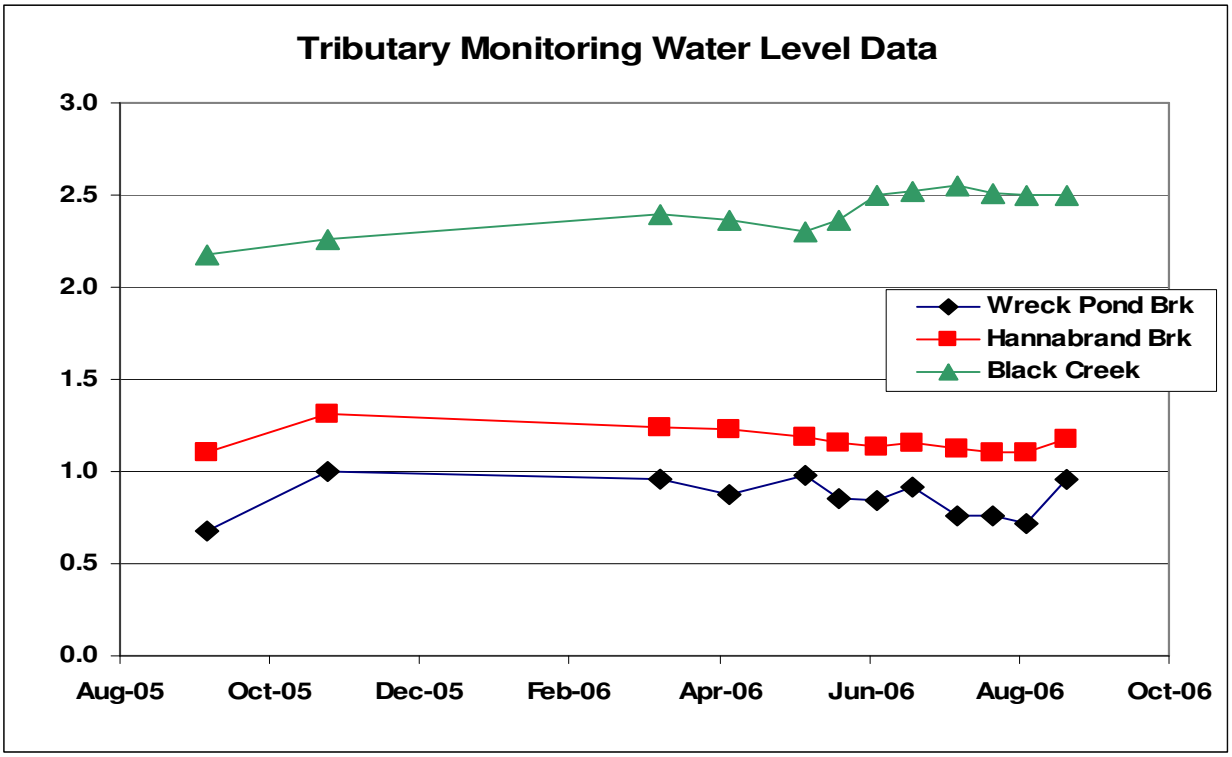
The tributary stations were accessible by foot. The staff gauges in place by Monmouth County were used to record the relative depths of water. A Gurley Precision velocity meter was used to measure the velocity of the flow at each station. In order to collect the water quality samples, a field technician in wading boots slowly waded to the collection point within the stream, walking from downstream to upstream. Once at the location, following a few seconds to allow any suspended sediments to drift downstream, sample water was collected just below the water surface.

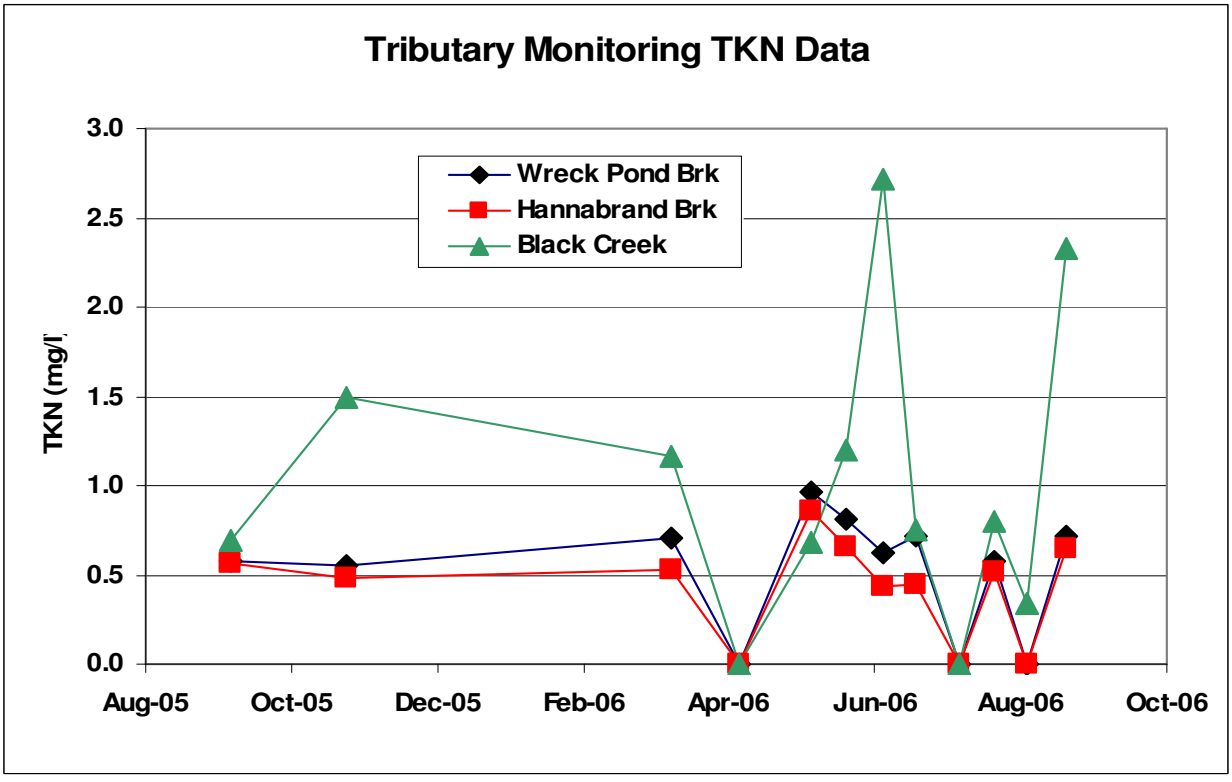
Graphs of results are provided in the main report for some parameters. Graphs of additional parameters follow.




Tributary Monitoring Total Dissolved Solids Data
TDS (mg/l)
600
500
400
300
200
100
0
Wreck Pond Brk
Hannabrand Brk
Black Creek
Aug-05
Oct-05
Dec-05
Feb-06
Apr-06
Jun-06
Aug-06
Oct-06


Tributary Monitoring Enterococcus Bacteria Data
Entero (#/100 ml)
10000
1000
100
10
1
Wreck Pond Brk
Hannabrand Brk
Black Creek
Aug-05
Oct-05
Dec-05
Feb-06
Apr-06
Jun-06
Aug-06
Oct-06


Tributary Monitoring Water Level Data
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Aug-05
Oct-05
Dec-05
Feb-06
Apr-06
Jun-06
Aug-06
Oct-06
Wreck Pond Brk
Hannabrand Brk
Black Creek


Tributary Monitoring TKN Data
TKN (mg/l
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Aug-05
Oct-05
Dec-05
Feb-06
Apr-06
Jun-06
Aug-06
Oct-06
Wreck Pond Brk
Hannabrand Brk
Black Creek

3. Sediment Core Sampling

Eleven (11) sediment core samples were collected within Wreck Pond and its tributaries. Seven (7) cores were taken within the Pond:

- 3B Western-most Portion of Wreck Pond
- 3C Wreck Pond, west of railroad bridge
- 3D Wreck Pond, northwestern corner
- 3E Wreck Pond, northeastern corner
- 3F Wreck Pond , western portion, near central part of shore
- 3G Wreck Pond, southwest of 3E
- 3H Wreck Pond, south central portion of pond

Four cores were taken outside of the Pond:

- 3A Old Mill Pond
- 1A Spring Lake Northwest
- 1B Spring Lake Southeast
- 1D Black Creek near weir

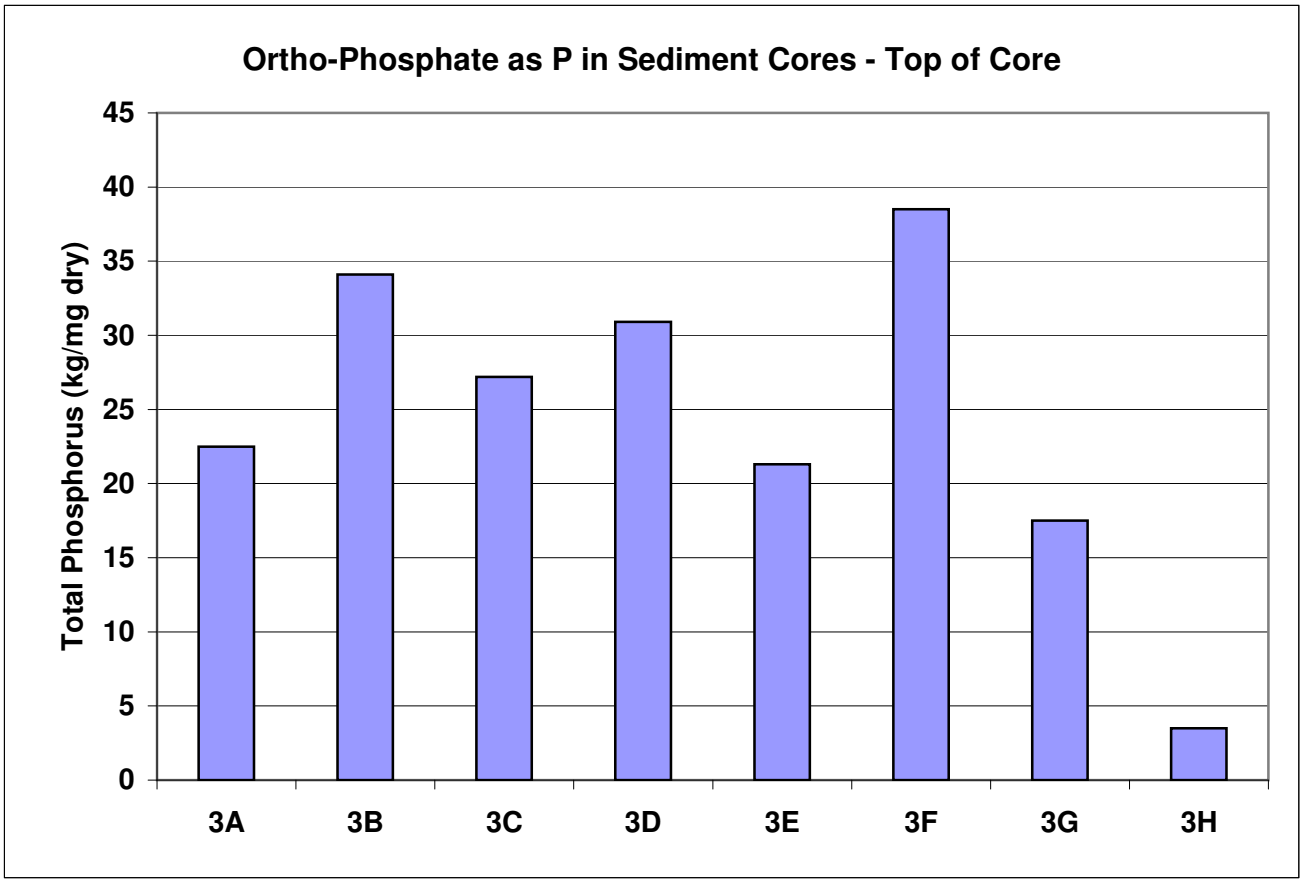
The location at which each core was taken were marked by GPS. Station 3A is designed to look at an upstream, small pond. Station 3B is in the western portion of the Pond. Stations 3C through 3H were placed within Wreck Pond in a grid formation to provide information on the ponds sediments and provide the most coverage of area. These stations were placed away from the area of the pond dredged by NJDEP in 2005. Stations 3D and 3E were located in the northeast and northwestern corners of the pond, close to the inflow points from Black Creek and the pipe from Spring Lake.

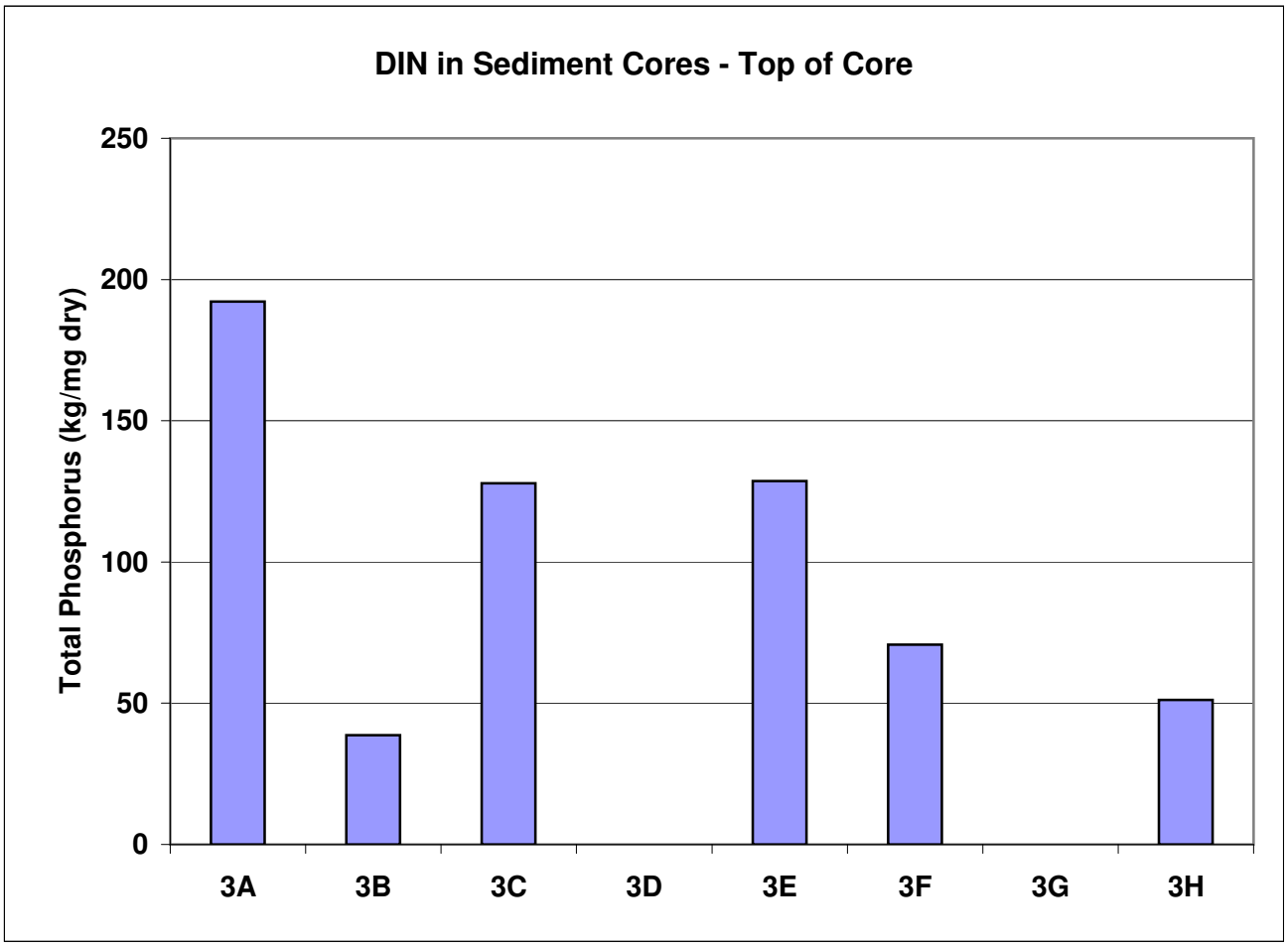
The sediment cores were collected over a four-day period by Aqua Survey, Inc. A geologist from NA logged each core.

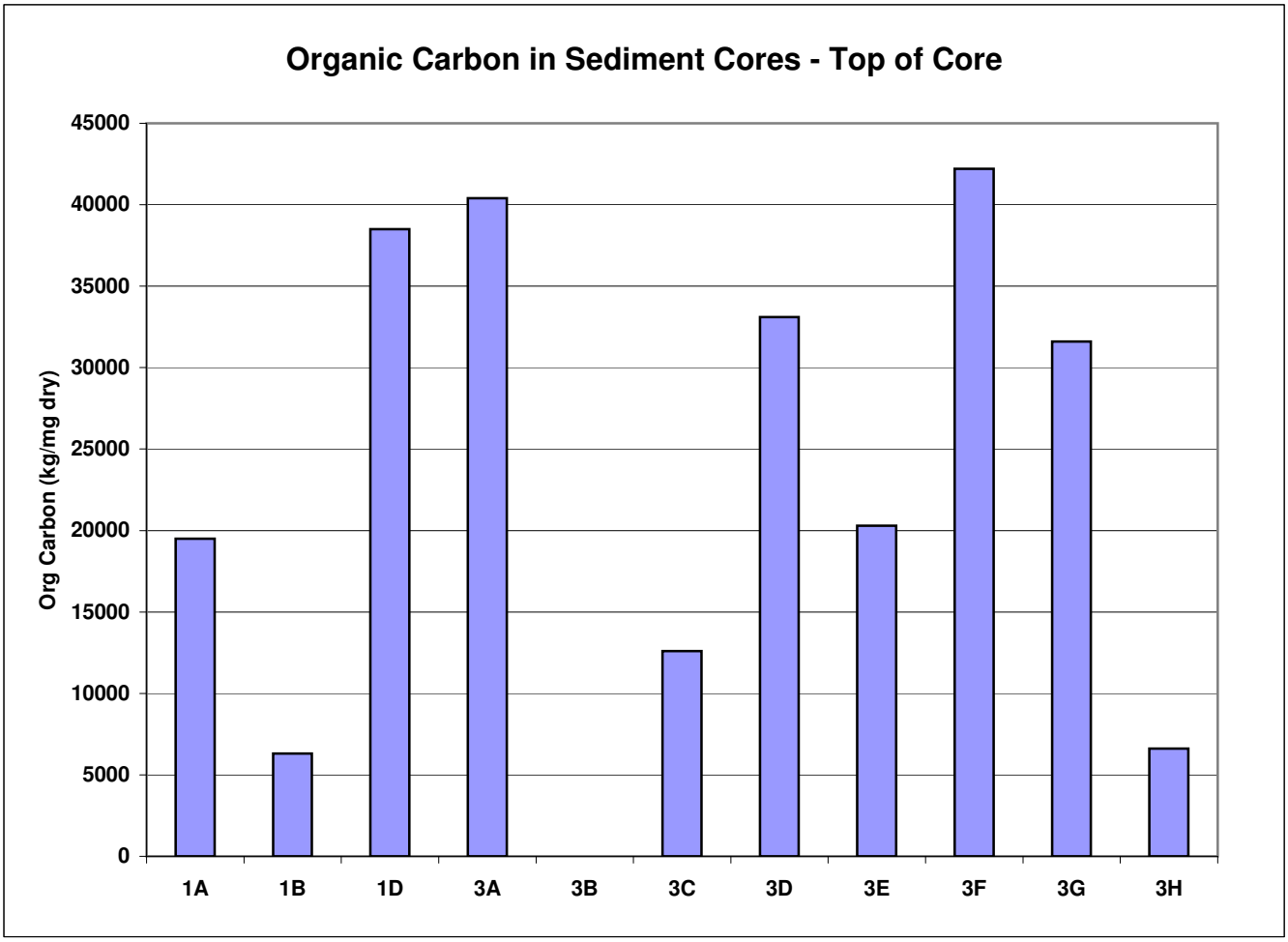
The samples were processed by NA. Samples from the top, mid and bottom of each core, as applicable, were collected and analyzed in accordance with the monitoring methods.

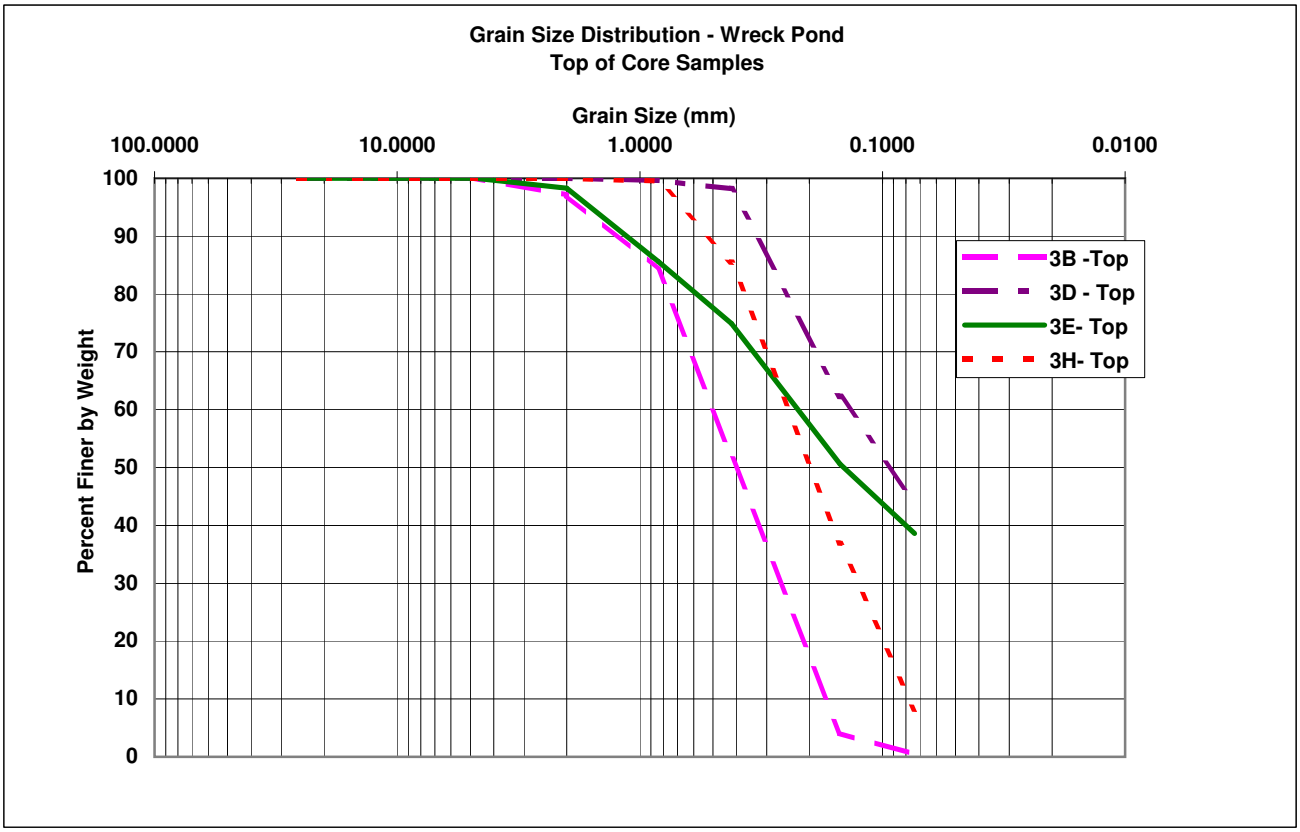
The tested parameters were:

- Sample Depth
- Grain Size
- TOC
- % Moisture
- PP + 40
- Herbicides
- Fecal Coliform
- Total Coliform
- Fecal Streptococcous
- Entercocci
- Clostridium Perfringens
- Nitrate
- Nitrite
- TKN
- Ammonia
- Total Phosphorous
- Ortho-Phosphate
- SOD


Ortho-Phosphate as P in Sediment Cores - Top of Core
Total Phosphorus (kg/mg dry)
45
40
35
30
25
20
15
10
5
0
3A
3B
3C
3D
3E
3F
3G
3H


DIN in Sediment Cores - Top of Core
Total Phosphorus (kg/mg dry)
250
200
150
100
50
0
3A
3B
3C
3D
3E
3F
3G
3H


Organic Carbon in Sediment Cores - Top of Core
Org Carbon (kg/mg dry)
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
1A
1B
1D
3A
3B
3C
3D
3E
3F
3G
3H


Grain Size Distribution - Wreck Pond
Top of Core Samples
Grain Size (mm)
100.0000
10.0000
1.0000
0.1000
0.0100
Percent Finer by Weight
100
90
80
70
60
50
40
30
20
10
0
3B -Top
3D - Top
3E- Top
3H- Top

Pond Sediment Core Analyses