College Creek water quality, SAV, & mussel results, 2008
(with graphs of 2003-2008 DO & clarity)
Peter Bergstrom, NOAA Chesapeake Bay Office, FINAL 4/16/09

Background:
The Friends of College Creek (FOCC), originally formed in 1997 to produce a watershed survey, was re-formed in 2007 to update that survey, and to continue promoting the protection and restoration of water quality and living resources in the College Creek watershed. Major driving forces in this effort include two environmental organizations in the watershed, the Chesapeake Ecology Center (CEC) located at Adams Academy at the north end of Clay Street, and the Maryland Department of Natural Resources (DNR) on Taylor Avenue. Other partners included Calvary United Methodist Church, Saint John's College, and the US Naval Academy, all in the watershed, and the NOAA Chesapeake Bay Office, also in Annapolis but on Spa Creek. The effort was done as a project of the Lower Western Shore Tributary Team, which is coordinated by DNR staff.

This report covers the results of two monitoring efforts led by the NOAA Chesapeake Bay Office as part of the FOCC effort: Submerged Aquatic Vegetation (SAV) monitoring done in 2007 and 2008, and monthly water quality monitoring done in 2008. The water quality monitoring was designed to continue five years of similar sampling in the creek funded by the state Highway Administration (SHA) to assess any water quality impacts of the recent rebuilding of the Rowe Boulevard bridge over the creek.

Methods
Volunteers Jake & Lora Bleacher sampled water quality monthly from April-August in a canoe provided by St. Johns College, using a YSI 600 QS meter loaned by NOAA, and I sampled the same sites in September and October when they were unable to sample due to rain and a holiday closing of the boat house. The sites sampled in 2008 were the same as those sampled by an SHA contractor from 2003-2007, except data from CC6 was added in 2008 (see Fig. 1 and Table 1 below).

FIGURE 1. Water quality monitoring stations in College Creek sampled by SHA contractors and FOCC volunteers (CC1-CC5) and by USNA staff and students (CC6).

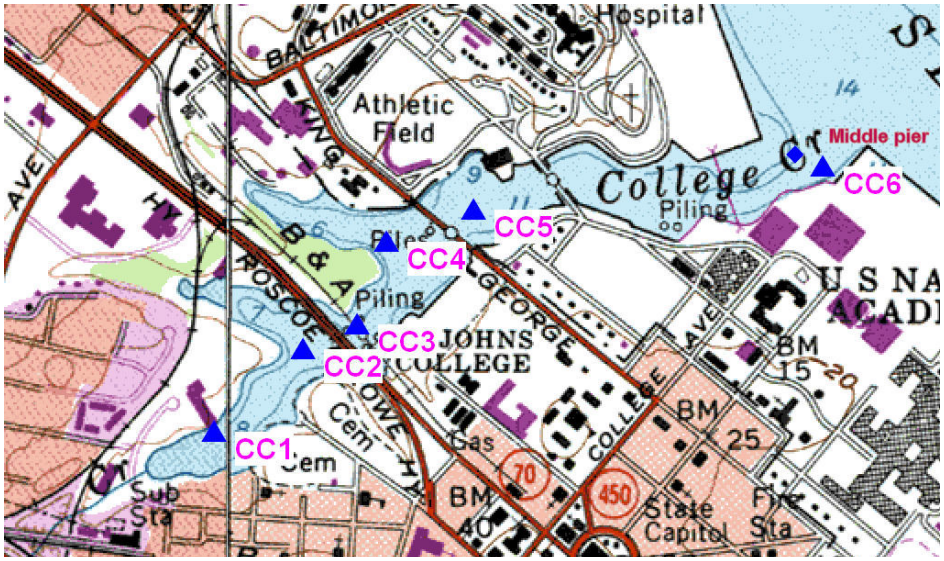


TABLE 1. Water quality monitoring stations in College Creek sampled by SHA contractors and FOCC volunteers (CC1-CC5) and by USNA staff and students (CC6).

Site	LAT	LONG	Mean depth (m), 2008	
CC1	38.98125	76.49993	1.8	
CC2	38.98282	76.49778	2.6	
CC3	38.98328	76.49648	2.7	
CC4	38.98485	76.49578	3.1	
CC5	38.98545	76.4937	3.4	
CC6	38.98629	76.48526	3.7	NOT sampled by SHA; sampled by USNA

At each site, the boat was anchored, Secchi depth measured, and meter readings taken at about 0.2 m below the surface and at about 0.3 m above the bottom. The meter recorded dissolved oxygen (DO), temperature, salinity, and pH. Cecily Steppe at USNA has added a 6th site (CC6) on a USNA pier to the 5 that SHA sampled, where she and her students sometimes sample daily. Jake & Lora visited CC6 twice, in April & May, but found it added too much time to continue sampling there, and it can be hard to reach by canoe on breezy days. This update does not include Cecily's data from CC6 but it will be included in future updates. In 2003-2007, the SHA contractor used similar methods, except DO was measured only once at each site, at 1.0 m off the bottom (no surface sample). Since most of the sites are only 2-3 m deep, this was more of a mid-water than a bottom sample.

The data analysis methods used in this report differ from the ones I used in a report in December 2007, titled "**Water Quality in College Creek, Annapolis, MD, 2003-2007."** In that report I calculated medians (50th percentile) of each parameter by site and year, and graphed them in the same way I did for the results in this report. In this report, I only included DO and clarity data, and I reported both as the **% of observations meeting a goal** (> 5 mg/l for DO, and > 0.97 m for Secchi depth). In both cases these goals were set by Chesapeake Bay Program (CBP) partners, based on research on what levels of DO (for fish) or clarity (for SAV) should allow survival. This new metric is being used in most "river report cards" instead of medians, and it seems to be more sensitive to changes in conditions over time, since it looks at one of the tails of the distribution (the one better than the goal) rather than the center of it (via the median).

SAV monitoring was done at least twice a year during the growing season in 2007 and 2008. We also made one visit in late July 2008 to do dark false mussel surveys after we found large numbers of these mussels during SAV surveys earlier in July. Volunteers and agency staff that I organized visited the creek to do SAV surveys in small boats in 2007 on 5/15/07 and 7/11/07, and in 2008 on 5/19/08, 7/14/08, 7/24/08, & 9/29/08. On each visit we followed the shallows around the upper part of the creek, looking and raking for SAV, and recording its species and locations with GPS when found. We did not usually look for downstream of the USNA boat house because surveys in 2007 showed that the shoreline was so extensively altered in the lower part of the creek that there was little shallow water left where SAV could grow.

No SAV beds have ever been mapped in College Creek by the aerial survey done each year by VIMS, so there are only SAV data when someone reported ground survey data.

The ground survey of SAV does not report bed size, just presence by species. The species symbols are shown on quad maps in the VIMS SAV survey reports, which are online from 1994 onward at www.vims.edu/bio/sav; most of College Creek is in the upper left corner of quad 31.

Results and discussion

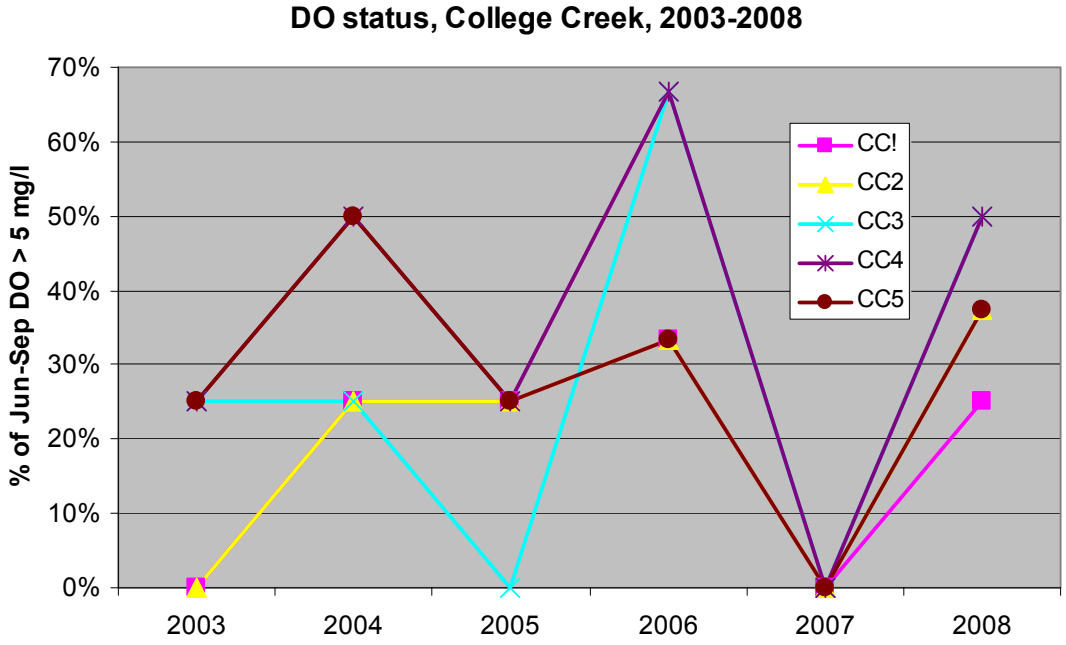
Dissolved oxygen (2003-2008)

The dissolved oxygen status by site and year for 2003-2008 is shown in Table 2 and Fig. 2.

TABLE 2. Dissolved Oxygen status (% of DO values > 5 mg/l, Jun-Sep) for College Creek sampling sites, 2003-2008. See text for method change in 2008.

	CC1	CC2	CC3	CC4	CC5	*MEAN*
2003	0%	0%	25%	25%	25%	*15%*
2004	25%	25%	25%	50%	50%	*35%*
2005	25%	25%	0%	25%	25%	*20%*
2006	33%	33%	67%	67%	33%	*47%*
2007	0%	0%	0%	0%	0%	*0%*
2008	25%	38%	50%	50%	38%	*40%*
MEAN	*18%*	*20%*	*28%*	*36%*	*28%*	*26%*

FIGURE 2. Dissolved Oxygen status (% of DO values > 5 mg/l, Jun-Sep) for College Creek sampling sites, 2003-2008. See text for method change in 2008.



Comparing DO status among years (rows), that status was better in 2004, 2006, and 2008, and worse in 2003, 2005, and 2007, especially in 2007 (0%). The improvement in 2008 could in part be due to the method change, since we added surface samples that year, and surface DO tends to be higher than DO lower in the water column. The cause of the low DO status in 2007 (0%) is not known.

Comparing DO status among sites (columns), DO levels are affected by a variety of factors, but they generally are worse at (1) sites farther up creeks in urbanized areas, (2) deeper sites, and (3) sites with black, highly organic mud on the bottom, which tends to use up DO. Of these three factors, distance up the creek was the only one with a consistent effect in the predicted direction, since CC1 and CC2 had slightly lower status than the other sites. Regarding depth, CC1 and CC2 are shallower than the other sites, yet they had slightly worse mean DO status, so creek position appears to be more important than depth. Regarding the bottom type, CC3 & CC4 were the two sites where I saw black mud on the anchor, but they had among the best DO status.

Comparing College Creek to Magothy River DO data, in the Magothy, 2005 had the worst recent mean DO status in that river and its creeks (46% of goal), not in 2007 as seen in College Creek. See Fig. 3 in the "Magothy River Index for 2008" at http://www.magothyriver.org/wp-content/uploads/2007/08/magothy_river_index_08_newsletter_v61.pdf . The mean 2007 DO status in the Magothy was 69% (including surface data), compared to 0% in College Creek (with no surface data, Table 2). The SHA contractor did not sample after August 2007, so the lack of September data may have contributed to the low 2007 status.

Water clarity (2003-2008)

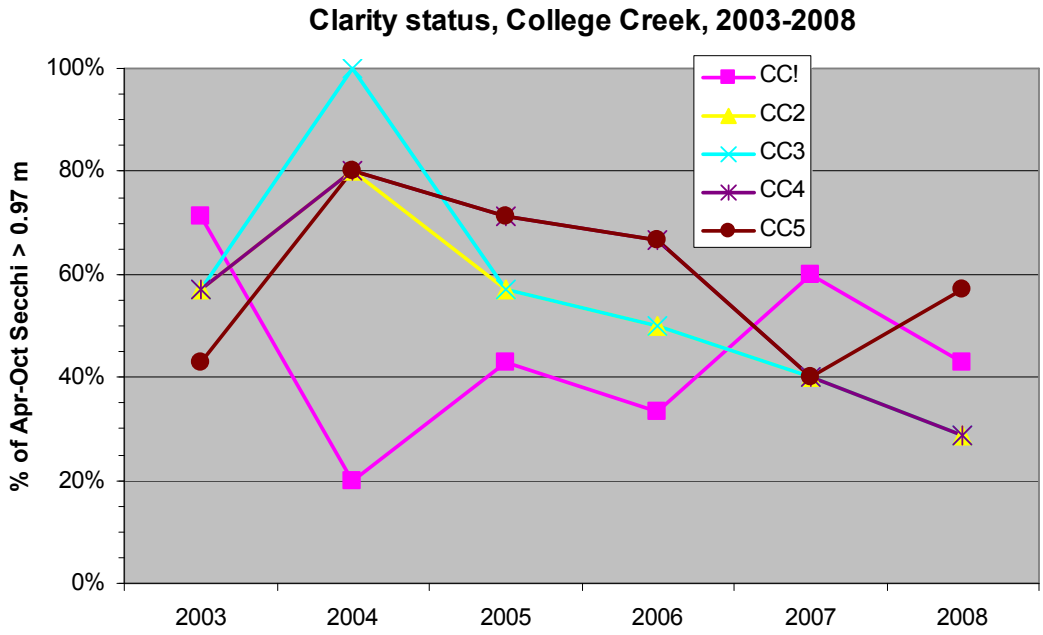
The water clarity status for 2003-2008 is shown in Table 3 and Figure 3.

TABLE 3. Water clarity (Secchi depth) status (% of Secchi > 0.97 m, Apr-Oct) for College Creek sampling sites, 2003-2008

	CC!	CC2	CC3	CC4	CC5	*MEAN*
2003	71%	57%	57%	57%	43%	*57%*
2004	20%	80%	100%	80%	80%	*72%*
2005	43%	57%	57%	71%	71%	*60%*
2006	33%	50%	50%	67%	67%	*53%*
2007	60%	40%	40%	40%	40%	*44%*
2008	43%	29%	29%	29%	57%	*37%*
MEAN	*45%*	*52%*	*55%*	*57%*	*60%*	*54%*

Comparing mean clarity status among years (rows), 2004 had the best status (72%), followed by 2005 (60%). It is likely that this improvement in 2004 was caused by dark false mussel filtration, since other Severn creeks had them that year. CC1 had its worst clarity status in 2004 (20%), but perhaps there were few or no mussels that far up the creek. We also found dark false mussels in College Creek in small numbers in 2007 and in larger numbers in 2008 (see below). Three creek sites in the Magothy River that had long-term clarity data had a dramatic increase in clarity in 2004 when mussels were common there, doubling the summer Secchi depths in some cases, followed by more modest improvements from previous years in 2005 as the mussels became less common. See Fig. 3 in which mean clarity over 8-12 sites peaked at 65% in 2004, in the "Magothy River Index for 2008" at http://www.magothyriver.org/wp-content/uploads/2007/08/magothy_river_index_08_newsletter_v61.pdf .

FIGURE 3. Water clarity (Secchi depth) status (% of Secchi > 0.97 m, Apr-Oct) for College Creek sampling sites, 2003-2008



Comparing status among sites (columns), clarity tends to be lower (worse) as you move up urbanized creeks, and Table 2 and Figure 2 show this pattern to some extent. The lowest site in the creek (CC5) had the best mean clarity status (60%), dropping slightly to 45% at CC1, closest to the head of tide. Sites farther up a creek often have more algae blooms, which reduce water clarity, although none were noticed in College Creek in 2008.

SAV& dark false mussels (2007-2008)

The general areas where we found SAV in the creek are shown in Fig. 4, and the species we found are in Table 4. Most of the SAV we found, and almost all of the SAV upstream of Peters Cove, was horned pondweed (*Zannichellia palustris*), a spring ephemeral species that grows in the spring and dies back by July.

FIGURE 4. General areas where we found SAV in the creek, 2007-2008.

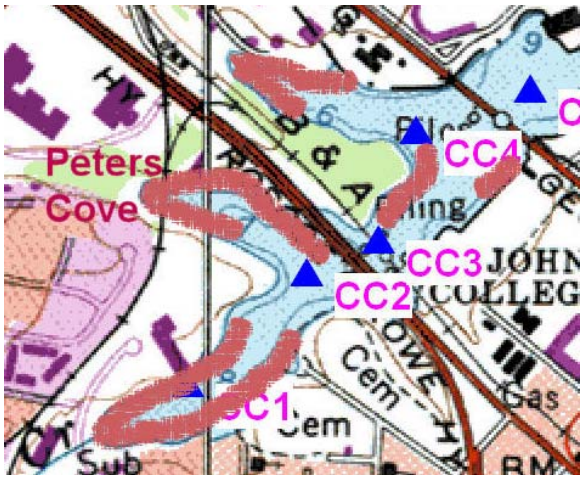


TABLE 4. SAV species we found in College Creek in 2007-2008 with the symbols used for them in SAV survey maps.

Common name	Latin name	Survey symbol
horned pondweed	*Zannichellia palustris*	Zp
redhead grass	*Potamogeton perfoliatus*	Ppf
sago pondweed	*Stuckenia pectinata*	Ppc
Eurasian watermilfoil	*Myriophyllum spicatum*	Ms
Widgeongrass	*Ruppia maritima*	Rm
common waterweed	*Elodea canadensis*	Ec

In our May 2007 visit, we found horned pondweed beds near CC1, and a few shoots of sago pondweed (*Stuckenia pectinata*) growing in Peters Cove, with more floating shoots that came from elsewhere. In July 2007 we found a few dense beds of redhead grass (*Potamogeton perfoliatus*) growing on the north shore between Rowe Boulevard and King George Street (between CC3 and CC4), but no SAV next to the living shoreline across the creek.

In May 2008 SAV surveys we found:

- Redhead grass (Ppf) was up sooner in 2008–we did not see any until July in 2007. We found redhead grass at several spots off the St Johns living shoreline in 2008 (in both May and July), and we did not find any SAV on that shore last year. I assume this was at least partly planted, some of it planted after the recent shoreline project was done. We also found a few redhead shoots across the creek from the shoreline project in May.
- The horned pondweed (Zp) seemed to be denser and more extensive in 2008, both in Peters Cove and in the upper creek near CC1. Its abundance it not usually related to the abundance of other species, however.

In July 2008, we found redhead grass in the same two spots where we found it in May, where it seemed to be more abundant than it was at the same spots in 2007. We also found large numbers of dark false mussels (*Mytilopsis leucophaeata*) in Peters Cove, mostly on the undersides of branches. These mussels were completely smothered by bryozoans in late September 2008.

In September 2008 I found a few dense beds of common waterweed (*Elodea canadensis* or Ec) in Peters Cove, a new species record for this creek. Ec has only been found in two other creeks on the Severn, Weems and Clements. It is near its upper salinity limit in the Severn, and has not been reported from the South, Rhode, or West rivers, which are farther south and thus usually have higher salinity.

Other SAV species we found in the creek in 2007-2008 included scattered, very sparse clumps of Eurasian watermilfoil or Ms (*Myriophyllum spicatum*) and widgeongrass or Rm (*Ruppia maritima*).

Past SAV species reports from College Creek include sago pondweed (Ppc) by MD DNR on 6/1/01; horned pondweed (Zp) by a citizen on 6/1/97; widgeongrass (Rm), Zp, and

redhead grass (Ppf) by a citizen on 7/3/95; and Zp by a citizen on 5/15/94. All of these were species we found in the creek in 2007-2008 (Table 4), but only horned pondweed (Zp) and redhead grass (Ppf) had any extensive beds in those years.

Compared to SAV that has been found in the other creeks in Annapolis (Weems to the north and Spa and Back creeks to the south), College Creek appears to have more SAV than any of the others in recent years, with the possible exception of Weems Creek, which had a few small SAV beds near its mouth recently, although none were large enough to map in the VIMS survey. The lower portion of Weems Creek is not bulkheaded as it is in College Creek, so it has more potential SAV habitat near its mouth.

For each detailed SAV and mussel observation from 2007-2008 (with date of visit), some including Weems Creek, see

http://web.vims.edu/bio/sav/historic_field_observations/2007_observations.html#noaa060807 (5/15/07)
http://web.vims.edu/bio/sav/historic_field_observations/2007_observations.html#noaa071307 (7/11/07)
http://thumper-web.vims.edu/bio/sav/wordpress/index.php/archives/21 (4/16/08)
http://thumper-web.vims.edu/bio/sav/wordpress/index.php/archives/76 (7/14/08)
http://thumper-web.vims.edu/bio/sav/wordpress/index.php/archives/120 (7/24/08)
http://thumper-web.vims.edu/bio/sav/wordpress/index.php/archives/314 (9/29/08)

Acknowledgments

- Jake and Lora Bleacher for doing most of the 2008 water monitoring
- St. John's College (Leo Pickens) for the use of their boats and launch site
- Calvary Methodist Church for providing a launch site
- Annapolis Canoe & Kayak (Ed Robinson) for loaning us kayaks for some of the surveys
- All of the volunteers and paid staff who helped with the surveys
- Claudia Donegan (MD DNR) and Zora Lathan (CEC) for their enthusiasm and encouragement