

White Clay Creek



State of the Watershed

REPORT



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Cover Photo: White Clay Creek
White Clay Creek State Park, near Newark, DE
Photo Location: 39.737995° -75.766635°
Photo by Rod Hampton

The State of the White Clay Creek Watershed

The Watershed

The White Clay Creek watershed encompasses 107 square miles in Delaware and Pennsylvania and is one of four sub-basins that make up the larger Christina Basin watershed. The White Clay Creek was designated a National Wild and Scenic River by an act of Congress in October 2000. This designation preserves its free flowing waters and highlights the importance of its natural resources to the public.

The Monitoring Sites

Technical Monitoring Volunteers monitor six locations along the White Clay Creek and its tributaries in Delaware. Upstream of the monitoring sites the White Clay Creek is federally designated as a Wild and Scenic River. However, the White Clay Creek monitoring sites are all in residential or commercial areas, not in parks or other protected natural areas. Five of the six monitoring sites are on tributaries of the White Clay Creek. Two sites located in the Deerfield Golf Course were added in 2003 and four sites in the Pike Creek sub-watershed were added in 2004. There is not enough data gathered for the data to be included in this report but the data will be included in the next five year report.

Mill Creek, a tributary of the White Clay Creek, is monitored at two locations, sites #1 and #4. Site #1 is on Mill Creek at Mill Creek Road. The site is in a residential area with mature trees. Site #4 is on Mill Creek at Old Capital Trail Bridge. This monitoring site is located upstream of where Mill Creek enters Delaware Park.

Site #2 is on a shaded section of the Pike Creek tributary on the grounds of the Independence School.

Middle Run is also monitored at two locations, sites #3 and #5. Site #3 is on Middle Run at Old Possum Park Rd. Site #5 is on Middle Run at Paper Mill Road. This monitoring site is probably the least pristine of all of the sites in this program and, as described below, the chemistry of the creek reflects that. There is a limited amount of shade over the stream at this location and most of the surrounding area consists of open fields.

Site #6 is the only site on the main stem of White Clay Creek. It is located behind a residence on White Clay Drive. The creek here is broad and well-shaded.

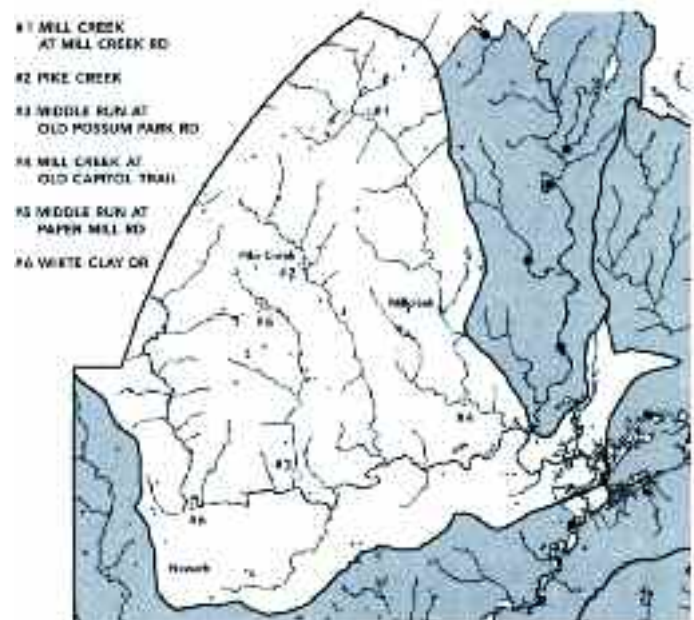
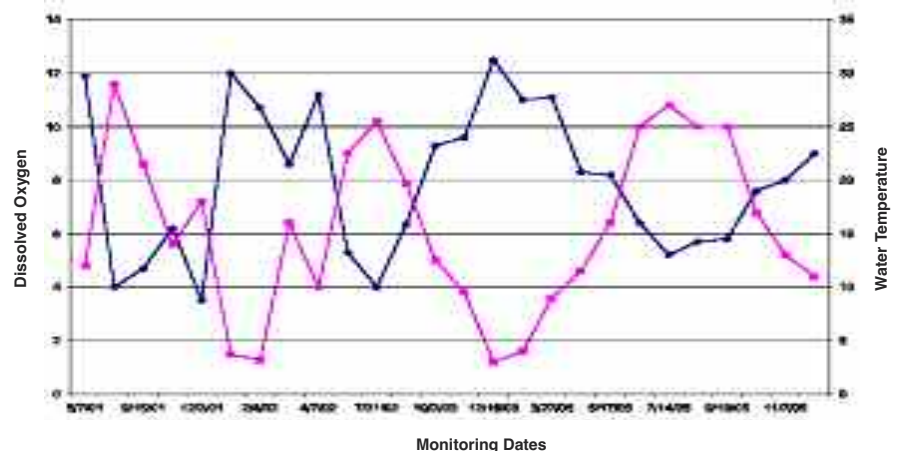


Figure 1. Dissolved oxygen and water temperature at Paper Mill Rd.. (Jan. 2001 to Dec. 2005)



■ Water Temp °C
◆ Dissolved Oxygen (mg/L)

Chemical Data Collected 2001 to 2005 in the White Clay Creek Watershed

Dissolved Oxygen (DO)

The DO standards set by the State of Delaware are a minimum of 4.0 mg/L and a seasonal average of greater than 5.5 mg/L in the months June to September. Based on data collected through the Technical Monitoring program, the minimum state standards for seasonal averages of DO were met at all six of the sampling sites on the White Clay Creek from 2001 to 2005 (Table 1). Average DO levels at the monitoring sites were between 5.9 mg/L and 8.8 mg/L during summer months. The seasonal cyclic patterns of dissolved oxygen and water temperature are clearly illustrated by data collected from Middle Run at Paper Mill Road (Figure 1).

Site lows for DO ranged from 4.0 mg/L (Middle Run at Paper Mill Rd.) to 7.85 mg/L (Pike Creek at Independence School). It is important to note that samples were taken during the day for the safety of our volunteers and may not reflect the lowest DO values possible at the sites.

Site highs for DO ranged from 6.4 mg/L (Middle Run at Paper Mill Rd.) to 11.3 mg/L (Middle Run at Old Possum Park Rd.).

pH

Site lows for pH ranged from 6.0 (Mill Creek at Old Capitol Trail) to 7.25 (White Clay Dr.) (Table 1). Site highs for pH ranged from 7.5 (Middle Run at Old Possum Park Rd.) to 8.5 (Mill Creek at Old Capitol Trail). The average pH values in the White Clay Creek fell within the standard range of 6.5 to 8.5 and tend not to vary drastically over time because of the buffering effect of alkaline ions in the water (Figure 2).

Alkalinity

The alkalinity standard set by the State of Delaware is greater than 20 mg/L. This standard was met at all of the White Clay Creek sites except Middle Run at Old Possum Park Rd. (Table 1). Site lows for alkalinity ranged from 12 mg/L (Middle Run at Old Possum Park Rd.) to 53 mg/L (Mill Creek at Village of Manley). Site highs for alkalinity ranged from 60 mg/L (Middle Run at Old Possum Park Rd) to 90

mg/L (White Clay Dr.). Tributary sites tend to have lower values of alkalinity because their watersheds are smaller, decreasing the opportunity for ions to become dissolved in the water. As part of a larger watershed, sites on the main stem of the White Clay Creek receive the combined input of several tributaries and therefore tend to have higher values of alkalinity.

Nitrate-Nitrogen

The target level for total nitrogen (all forms of nitrogen combined) in Delaware freshwater is 1.0 to 3.0 mg/L. The average level of nitrate-nitrogen alone has been equal to the upper limit of the desired range for total nitrogen only at a single site, Pike Creek at Independence School (Table 1). However, the target level for total nitrogen could still be exceeded as only one form was measured. At two sites (Mill Creek at Village of Manley and the mainstem at White Clay Drive) the total nitrate-nitrogen is very close to the upper limit of the target value for total nitrogen (2.92 mg/L and 2.81 mg/L respectively).

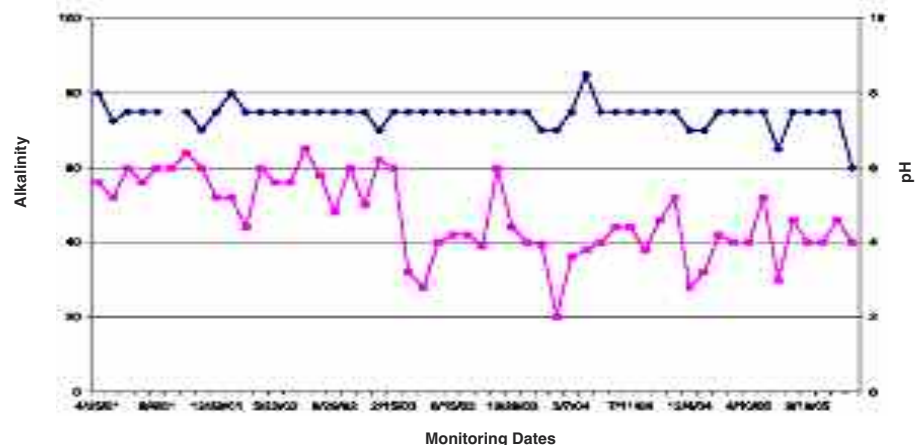
Site lows for nitrate-nitrogen ranged from 0.25 mg/L (Mill Creek at Village of Manley, Middle Run at Old Possum Park Rd., Mill Creek at Old Capitol Trail, Middle Run at Paper Mill Rd.) to 2.0 mg/L (Pike Creek at Independence School). Site highs for nitrate-nitrogen ranged from 2.0 mg/L (Middle Run at Paper Mill Rd.) to 6.0 mg/L (Mill Creek at Village of Manley, White Clay Drive).

Phosphate

Orthophosphate was added as parameter in the spring of 2002. Although there is not a full 5 years of data, there is enough to see trends. The Delaware target range for phosphate is 0.3 to 0.6 mg/L. The average phosphate values at all sites were below the lower end of the target range, except for Mill Creek at the Village of Manley which was just above the lower end at 0.34 mg/L.

The minimum phosphate value ranged from 0.00 mg/L (Middle Run at Old Possum Park Rd and Mill Creek at Old Capitol Trail) to 0.08 mg/L (Mill Creek at the Village of Manley). The maximum values ranged from 0.17 mg/L (Middle Run at Old Possum Park Rd) to 0.81 mg/L (Mill Creek at the Village of Manley).

Figure 2. Alkalinity and pH at Old Capitol Trail (Jan. 2001 to Dec. 2005)





Conductivity

The typical range of conductivity for Delaware piedmont streams is 120 to 400 ms. The average conductivity values in the White Clay Creek watershed fell within this range (Table 1). Site lows for conductivity ranged from 130 ms (Middle Run at Paper Mill Rd.) to 254 ms (Mill Creek at Village of Manley). Site highs for conductivity ranged from 228 ms (Middle Run at Paper Mill Rd.) to 1728 ms (Mill Creek at Old Capitol Trail). The concentration of ions that was found in the White Clay Creek probably does not affect wildlife and is low in comparison to seawater.

Conclusions on the Water Quality of the White Clay Creek Watershed in Delaware

Results indicate that while the average level of nitrate-nitrogen is below the suggested levels for total nitrogen at all sites in the White Clay Creek except one (Pike Creek at Independence School), it is still possible that total nitrogen is being exceeded in the White Clay as the results are measuring only one portion of total nitrogen. The number of samples that exceed the total nitrogen target level has dropped considerably as compared to the last State of the Watershed reports (1995 to 2000) and most of the samples that exceeded the upper limit were recorded in the first three years of this five year study, indicating that the nitrate-nitrogen levels are decreasing over time.

Three sites showed nitrate-nitrogen values that were over the upper limit (38%-15% of the samples), but those three sites in the previous study (1995 to 2000) had between 72% - 89% of the samples that exceeded the upper limit. There seems to be an overall decrease of nitrate-nitrogen levels in the White Clay Creek, especially in the more recent years. It will be interesting to see if this trend continues. This is an even more encouraging trend when the phosphate data results are considered. The average phosphate levels at all sites were at or below the minimum target level. With the addition of phosphate data, the nitrate

levels are seen in a different context. Since both phosphate and nitrate are needed for growth, a high level of one without a high level of the other will not produce the algae blooms that are the cause for concern. Phosphate is a limiting factor in this system as it is present in very low levels. The relatively high levels of nitrate present will not cause the problems associated with nutrient loading without higher levels of phosphate available.

While the data collected through this program indicate that dissolved oxygen values in the watershed generally meet state standards during the day, this may provide a false sense of security because the daylight sampling performed by this program does not capture pre-dawn minimums that occur in most waterbodies during the summer months. Even if daily averages meet the required standards, oxygen may fall to deadly levels for a few hours each day. This time is all that is required to diminish the diversity of organisms that can live in a given waterway and potentially cause fish kills.

All other parameter averages measured through the Technical Monitoring program were within the standard ranges established by the Delaware Department of Natural Resources and Environmental Control with only a single sample occasionally exceeding target values for alkalinity and phosphate(see Table 2). Several conductivity samples exceeded the typical range, but all were recorded in the winter months suggesting increased salt run-off from the roads.



White Clay Creek, 39.739351° -75.772517°

Table 1. Summary of data collected Jan. 2001 - Dec. 2005 at monitoring sites on the Brandywine Creek and its tributaries.**SITE #1 - VILLAGE OF MANLEY (Mill Creek)**

	Air Temp (oC)	Water Temp (oC)	*DO (mg/L)	pH	Alkalinity (mg/L)	Nitrate-N (mg/L)	Conductivity (microS)	Phosphate (mg/L)
minimum	7	6	5	7	53	0.25	254	0.08
maximum	32.2	23.3	8.45	8	81	6	1057	0.81
average	22.45	18.52	6.98	7.41	68	2.92	359	0.34
median	25.55	20.5	7.05	7.5	69	2.5	334	0.4
# of samples	20	11	9	21	20	16	20	11

SITE #2 - INDEPENDENCE SCHOOL (Pike Creek)

	Air Temp (oC)	Water Temp (oC)	*DO (mg/L)	pH	Alkalinity (mg/L)	Nitrate-N (mg/L)	Conductivity (microS)	Phosphate (mg/L)
minimum	-2.5	2.1	7.85	7	32	1	190	0.06
maximum	34	23.2	9.9	7.75	78	4.5	397	0.18
average	17	13.81	8.80	7.27	45.56	3.22	240	0.126
median	18.9	12.25	8.70	7.25	44	3	235	0.12
# of samples	33	24	11	34	34	34	33	23

SITE #3 - OLD POSSUM PARK ROAD (Middle Run)

	Air Temp (oC)	Water Temp (oC)	*DO (mg/L)	pH	Alkalinity (mg/L)	Nitrate-N (mg/L)	Conductivity (microS)	Phosphate (mg/L)
minimum	-4	-1	7.2	6.5	12	0.25	140	0
maximum	40	27	11.3	7.5	60	3	330	0.17
average	19.25	14.28	8.82	7.09	33	1.29	177	0.04
median	20	15	8.90	7	28.5	1	170	0.04
# of samples	51	51	19	52	52	48	50	27

SITE #4 - OLD CAPITOL TRAIL (Mill Creek)

	Air Temp (oC)	Water Temp (oC)	*DO (mg/L)	pH	Alkalinity (mg/L)	Nitrate-N (mg/L)	Conductivity (microS)	Phosphate (mg/L)
minimum	-4	0	7	6	20	0.25	215	0
maximum	41	30	10.7	8.5	65	4	1728	0.31
average	19.14	14.56	8.35	7.43	46.76	1.59	313	0.06
median	21.25	14.25	8.33	7.5	45	1.75	280	0.0
# of samples	52	52	18	51	52	49	50	28

SITE #5 - PAPER MILL ROAD (Middle Run)

	Air Temp (oC)	Water Temp (oC)	*DO (mg/L)	pH	Alkalinity (mg/L)	Nitrate-N (mg/L)	Conductivity (microS)	Phosphate (mg/L)
minimum	7	3	4	6.5	22	0.25	130	0.05
maximum	32.5	29	6.4	8	80	2	228	0.31
average	18.43	15.53	5.94	7.09	39.46	0.57	177	0.14
median	18	15	5.30	7	36.5	0.375	180	0.11
# of samples	25	26	9	26	26	26	25	14

SITE #6 - WHITE CLAY DRIVE

	Air Temp (oC)	Water Temp (oC)	*DO (mg/L)	pH	Alkalinity (mg/L)	Nitrate-N (mg/L)	Conductivity (microS)	Phosphate (mg/L)
minimum	8	3.5	5.8	7.25	50	0.5	233	0.04
maximum	30	26	10.5	8	90	6	371	0.59
average	18.69	14.62	8.16	7.63	66	2.81	305	0.22
median	18.75	13.5	8.2	7.5	65.5	3	306	0.17
# of samples	26	26	9	26	26	26	25	14

*Average, median, and # of samples for Dissolved Oxygen data are for the months of June through September only.

Table 2. Summary of site-by-site compliance with Delaware standards and recommendations

	Dissolved Oxygen	pH (SU)	Alkalinity	Nitrate-Nitrogen	Conductivity	Phosphate
State standard or guidelines	>4.0 mg/L and a seasonal average >5.5 mg/L	6.5 to 8.5	>20 mg/L	Target level: Total nitrogen 1.0 to 3.0 mg/L	Typical range for Delaware piedmont streams: 120 to 400 μ S Seawater: 17,500 μ S	Target level: 0.3 to 0.6 mg/L
Mill Creek (at Village of Manley)	Standards met*	Standards met	Standards met	38% of samples \geq 3.0 mg/L**	10% of samples >400 ms all during winter months	Single sample outside target range
Pike Creek (at Independence School)	Standards met*	Standards met	Standards met	32% of samples \geq 3.0 mg/L**	Results within typical range	Results within target range
Middle Run (at Old Possum Park Road)	Standards met*	Standards met	Single sample <20 mg/L	0% of samples \geq 3.0 mg/L**	Results within typical range	Results within target range
Mill Creek (at Old Capital Trail)	Standards met*	Single sample outside range	Standards met	Single sample \geq 3.0 mg/L**	6% of samples >400 ms all during winter months	Results within target range
Middle Run (at Paper Mill Road)	Standards met*	Standards met	Standards met	0% of samples \geq 3.0 mg/L**	Results within typical range	Results within target range
White Clay Drive	Standards met*	Standards met	Standards met	15% of samples \geq 3.0 mg/L**	Results within typical range	Results within target range

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* Based on daytime dissolved oxygen levels. These results do not reflect the lowest dissolved oxygen levels possible.

** Nitrate-nitrogen was the only form of nitrogen measured. It is assumed that values of total nitrogen would be even higher.

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