


# Red Clay Creek



*State of the Watershed*

# REPORT



Published by Delaware Nature Society, November, 2007  
Manuscript: Ginger North, Stream Watch Coordinator  
Publication Design: Rod Hampton, SightLines, Inc.

Cover Photo: Red Clay Creek at Rt. 82 Bridge near Ashland  
Photo Location: 39.801369° -75.652297°  
Photo by Rod Hampton

# The State of the Red Clay Creek Watershed

## The Watershed

The Red Clay Creek sub-watershed covers 54 square miles in Delaware and Pennsylvania and has a long industrial history, having served as the site of several mills.

The Wilmington and Western Railroad, which winds through the valley following the creek, once brought goods from the mills to the ports in Wilmington. The watershed was also the recipient of the Red Clay Valley Scenic Byway designation in April 2005. This designation recognizes that the quality of the remaining natural and scenic resources in this area is extremely significant.

## The Monitoring Sites

Technical Monitoring Volunteers monitor eight locations along the Red Clay Creek and its tributaries in Delaware.

Site #1 is on Burrows Run, near the DE/ PA boundary. Rural farms and residences in the rolling hills of the Delaware Piedmont surround this site.

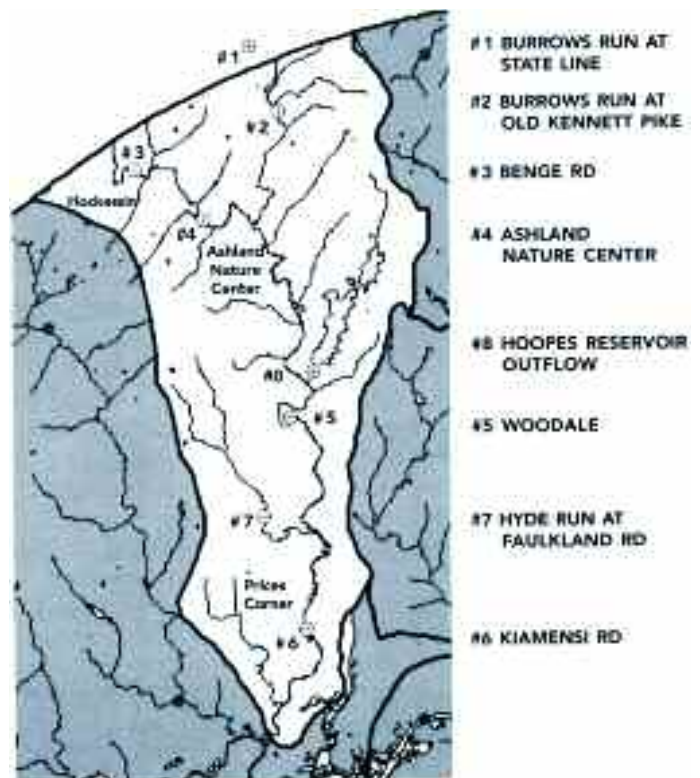
A second site on Burrows Run is monitored as the stream enters the Delaware Nature Society's Burrows Run Preserve. Currently, efforts are underway through several organizations in Delaware and Pennsylvania to restore forested buffers along Burrows Run. The two monitoring sites on Burrows Run will provide valuable information on the success of these efforts.

The next four sites are on the main stem of the Red Clay Creek, downstream of the Kennett Square wastewater treatment facility.

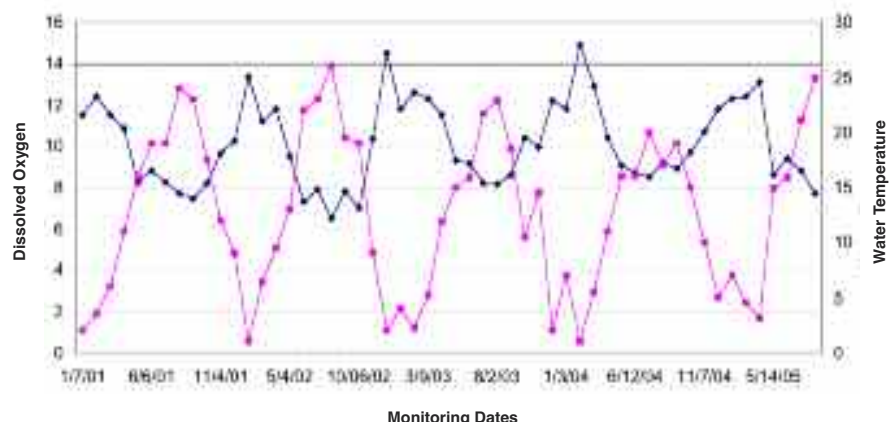
Site #3 is on Bengé Rd., at the site of the National Vulcanized Fiber Company. The company currently recycles its solid waste and disposes of hazardous materials off-site. However, past practices have left the soil around the creek contaminated with zinc.

Site #4 is at the wooden bridge at Ashland Nature Center. The land on which the Nature Center is located is owned by the Red Clay Reservation and has long been managed with the best interests of wildlife in mind. While this area is protected, it is vulnerable to the effects of upstream activities.

Site #5 is in Wooddale, on the grounds of the Hercules golf course. This site is adjacent to manicured grounds and receives some shade.



**Figure 1.** Dissolved oxygen and water temperature at Ashland Nature Center (Jan. 2001 to Dec. 2005)



Sites #6 and #7 are both in residential areas. Site #6 is on the main stem at Kiamensi Road. Site #7 is on the Hyde Run tributary at Faulkland Road.

Site #8 is at the outflow of the Hoopes Reservoir, before it enters the Red Clay Creek.

## Chemical Data Collected 2001 to 2005 in the Red 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 of DO were met at all sampling sites on the Red Clay Creek from 2001 to 2005 (Table 1). Average DO levels at the monitoring sites were between 8.0 mg/L and 8.9 mg/L during summer months. The seasonal cyclic patterns of dissolved oxygen and water temperature are clearly illustrated by data collected at Ashland Nature Center (Figure 1).

Site lows for DO ranged from 5.0 mg/L (Burrow's Run at the State Line) to 7.6 mg/L (Burrows Run at Old Kennett Pike). 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 9.0 mg/L (Burrow's Run at the State Line) to 10.5 mg/L (Benge Rd.). The average daytime DO level for the entire duration of the study was greater than 8.0 mg/L at all sites in the Red Clay Creek watershed during the months of June through September.

### pH

Site lows for pH ranged from 7.0 (all sites except Benge Rd. and Kiamensi Rd.) to 7.3 (Kiamensi Rd.) (Table 1). Site highs for pH ranged from 7.7 (Kiamensi Rd.) to 8.5 (Woodale). The average pH in the Red Clay Creek fell within the standard range of 6.5 to 8.5 and tended 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 each of the Red Clay Creek sites (Table 1). Site lows for alkalinity ranged from 24 mg/L (Burrows Run at Old Kennett Pike) to 56 mg/L (Borrows Run at the State Line, Kiamensi Rd.). Site highs for alkalinity ranged from 74 mg/L (Hyde Run) to 116 mg/L (Benge Rd., Ashland Nature Center). 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 mainstem of the Red Clay Creek receive the combined input of several tributaries and therefore tend to have higher values of alkalinity.

### Nitrate-Nitrogen

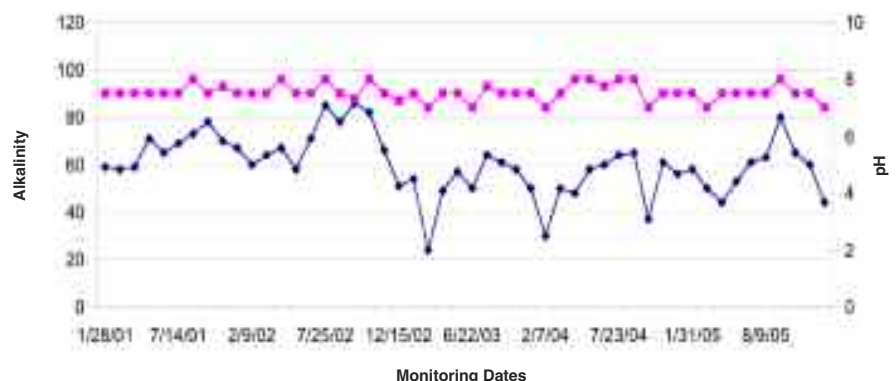
The target level for total nitrogen (all forms of nitrogen combined) in Delaware freshwater is 1.0 to 3.0 mg/L. Our data indicate that while this target is being exceeded in the Red Clay Creek, overall the levels of nitrate-nitrogen has decreased significantly when compared to the levels from the last State of the Watershed report (1995 to 2000). Only the mainstem sites had averages at or exceeding the total nitrogen target levels. The tributary sites all had nitrate-nitrogen levels below 3.0 mg/L for most (over 50%) of the monitoring dates. Hyde Run and Burrows Run at Old Kennett Pike haven't had any nitrate-nitrogen values of 3 mg/L or higher since 2001. Between 20% and 29% of the nitrate-nitrogen results, collected at mainstem sites fell below 3.0 mg/L.

Site lows for nitrate-nitrogen ranged from 0.0 mg/L (Burrows Run at Old Kennett Pike) to 0.75 mg/L (Hyde Run). This is a very narrow range compared to the last set of data collected (1995 to 2000), where the lows ranged from 0.0 mg/L to 3.0 mg/L. Site highs for nitrate-nitrogen ranged from 3.0 mg/L (Hoopes Reservoir outflow) to 6.0 mg/L (Burrows Run at Old Kennett Pike, Benge Rd., Ashland Nature Center).

### 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

**Figure 2.** Alkalinity and pH at Burrows Run at Old Kennett Pike Bridge (Jan.2001 to Dec. 2005)



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. The minimum phosphate value ranged from 0.00 mg/L (Burrows Run at both the State line and Old Kennett Pike, Hyde Run, Hoopes Reservoir Outflow) to 0.2 mg/L (Kiamensi Rd.). The maximum values ranged from 0.3 mg/L (Burrows Run at Old Kennett Pike) to 0.85 mg/L (Ashland Nature Center).

### **Conductivity**

The typical range of conductivity for Delaware piedmont streams is 120 to 400 ms. The average conductivity values in the Red Clay Creek watershed fell within this range, except for Bengé Rd. (431  $\mu$ S) and Ashland Nature Center sites (417  $\mu$ S)(Table 1). Site lows for conductivity ranged from 105 ms (Burrows Run at Old Kennett Pike) to 267 ms (Bengé Rd.). Site highs for conductivity ranged from 260 ms (Burrows Run at Old Kennett Pike) to 640 ms (Bengé Rd.).



### **Conclusions on the Water Quality of the Red Clay Creek Watershed in Delaware**

Although the suggested levels for total nitrogen are still being exceeded in the Red Clay Creek, at least on the main stem, overall the averages are significantly lower on several of the mainstem sites than the levels the previous study showed. In the previous State of the Watershed report (1995 to 2000) the average level of nitrate-nitrogen was at or exceeded recommended total nitrogen limits at all sites located on the main stem of the Red Clay Creek. Although the averages for this five year study were still above the recommended limit, two of the four mainstem sites (Ashland, Bengé Rd.) demonstrated a drop of 1.0 to 1.5 mg/L in nitrate-nitrogen.

The average nitrate-nitrogen values exceeded the desired range of total nitrogen at 37.5% (3 out of 8) of the sites. The total number of samples that exceeded the target range fell from a high of 100% at Ashland and Bengé Rd. site in the first study to a high of 80% at Woodale in this study. There seems to be an overall decrease of nitrate-nitrogen levels in the Red 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 were at or below the minimum target level except for two sites where they were both within the target range (0.33 mg/L – Woodale, 0.44 mg/L - Kiamensi Rd.). 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 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 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.

Conductivity data collected was within the typical range for Delaware piedmont streams with two exceptions. Bengé Rd. and Ashland Nature Center sites average levels for conductivity were above the typical range. In addition, both of these sites had over half of the samples above the upper level of the range. These results were obtained at all times of the year and do not reflect salting of the roads in winter. These results could be due to discharge from a wastewater treatment plant. Technical Monitoring volunteers have found higher levels of conductivity in the Red Clay Creek than in neighboring watersheds like the Brandywine. Both of the monitoring sites that exceeded the typical range are located on the mainstem downstream of the Kennett Square wastewater treatment facility. Dissolved ions such as chlorine, sodium, calcium and magnesium are typically released from wastewater treatment plants and are detected by measuring conductivity. The concentration of ions that was found in the Red Clay Creek probably does not affect wildlife and is low in comparison to seawater.

All other parameters measured through the Technical Monitoring program were within the standard ranges established by the Delaware Department of Natural Resources and Environmental Control.

**Table 1.** Summary of data collected Jan. 2001 - Dec. 2005 at monitoring sites on the Red Clay Creek and its tributaries.

**SITE #1 - BURROWS RUN (at State Line)**

	Air Temp (oC)	Water Temp (oC)	*DO (mg/L)	pH	Alkalinity (mg/L)	Nitrate-N (mg/L)	Conductivity (microS)	Phosphate (mg/L)
minimum	1	1	5	7	56	0.35	180	0
maximum	30	21	9	8	88	4	387	0.81
average	15.6	11.1	8.0	7.44	73.40	2.40	217	0.14
median	16	11	8.10	7.5	74.0	2.8	210	0.1
# of samples	36	35	9	36	36	35	33	15

**SITE #2 - BURROWS RUN (at Old Kennett Road)**

	Air Temp (oC)	Water Temp (oC)	*DO (mg/L)	pH	Alkalinity (mg/L)	Nitrate-N (mg/L)	Conductivity (microS)	Phosphate (mg/L)
minimum	-2	0.8	7.6	7	24	0	105	0
maximum	31	25.3	10	8	86	6	260	0.3
average	17.52	13.81	8.9	7.54	60.22	1.83	219	0.10
median	18.65	13.75	9.0	7.5	60	2	226	0.1
# of samples	48	44	16	50	50	49	48	33

**SITE #3 - BENGE ROAD**

	Air Temp (oC)	Water Temp (oC)	*DO (mg/L)	pH	Alkalinity (mg/L)	Nitrate-N (mg/L)	Conductivity (microS)	Phosphate (mg/L)
minimum	-2	0	6.75	7.25	50	0.5	267	0.02
maximum	32	28	10.5	8	116	6	640	0.68
average	16.70	13.44	8.5	7.71	85.20	3.78	431	0.27
median	18	15.3	8.3	7.75	82.5	4	410	0.275
# of samples	54	53	19	54	54	54	52	32

**SITE #4 - ASHLAND NATURE CENTER**

	Air Temp (oC)	Water Temp (oC)	*DO (mg/L)	pH	Alkalinity (mg/L)	Nitrate-N (mg/L)	Conductivity (microS)	Phosphate (mg/L)
minimum	-3	1	6.5	7	40	0.5	246	0.04
maximum	27	26	9.4	8	116	6	633	0.85
average	14.65	12.61	8.3	7.63	83.17	3.36	417	0.30
median	17	14.5	8.5	7.75	82	3	402	0.31
# of samples	55	53	19	55	55	55	54	33

**SITE #5 - WOODALE**

	Air Temp (oC)	Water Temp (oC)	*DO (mg/L)	pH	Alkalinity (mg/L)	Nitrate-N (mg/L)	Conductivity (microS)	Phosphate (mg/L)
minimum	-4	0.5	7.55	7	42	0.25	170	0.03
maximum	28	23	9.9	8.5	98	4	440	0.75
average	14.08	12.10	8.8	7.60	67.32	2.88	326	0.33
median	15.75	11.75	8.9	7.5	66	3	328.5	0.34
# of samples	42	40	11	43	42	40	36	26

**SITE #6 - KIAMENSI ROAD (no samples taken after 2002)**

	Air Temp (oC)	Water Temp (oC)	*DO (mg/L)	pH	Alkalinity (mg/L)	Nitrate-N (mg/L)	Conductivity (microS)	Phosphate (mg/L)
minimum	-4.5	0	7.4	7.3	56	0.5	260	0.2
maximum	26.1	24.9	10	7.7	100	4.5	550	0.6
average	12.21	13.65	8.5	7.40	77.36	3.22	342	0.44
median	12.25	14.5	8.3	7.35	78	3.75	335	0.5
# of samples	22	22	9	22	22	22	22	5

**SITE #7 - HYDE RUN (at Faulkland Road )**

	Air Temp (oC)	Water Temp (oC)	*DO (mg/L)	pH	Alkalinity (mg/L)	Nitrate-N (mg/L)	Conductivity (microS)	Phosphate (mg/L)
minimum	-1	1.5	6.7	7	42	0.75	208	0
maximum	29.5	27.9	10	8	74	3.5	330	0.32
average	18.34	15.80	8.3	7.47	53.77	2.44	275	0.12
median	22	15.95	8.2	7.3	52	3	270	0.14
# of samples	31	30	14	31	31	30	31	15

**SITE #8 - HOOPES RESERVOIR OUTFLOW**

	Air Temp (oC)	Water Temp (oC)	*DO (mg/L)	pH	Alkalinity (mg/L)	Nitrate-N (mg/L)	Conductivity (microS)	Phosphate (mg/L)
minimum	-2	3.5	7.15	7	36	0.25	140	0
maximum	30	26	9.5	8	78	3	320	0.6
average	16	14.35	8.3	7.16	53.15	0.40	191	0.08
median	15.5	13.85	8.25	7	52	0.25	190	0.02
# of samples	46	42	14	46	46	30	39	33

\*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
<b>State standard or guidelines</b>	>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 $\mu$ S Seawater: 17,500 $\mu$ S	Target level: 0.3 to 0.6 mg/L
<b>Burrow's Run (at State Line)</b>	Standards met*	Standards met	Standards met	49% of samples $\geq$ 3.0 mg/L of nitrate-nitrogen**	Results within typical range	A single sample was above target range
<b>Burrow's Run (at Old Kennett Pike)</b>	Standards met*	Standards met	Standards met	18% of samples $\geq$ 3.0 mg/L of nitrate-nitrogen**	Results within typical range	Results below minimum target level
<b>Benge Road</b>	Standards met*	Standards met	Standards met	74% of samples $\geq$ 3.0 mg/L of nitrate-nitrogen**	62% of samples were >400uS	A single sample was above target range
<b>Ashland Nature Center</b>	Standards met*	Standards met	Standards met	71% of samples $\geq$ 3.0 mg/L of nitrate-nitrogen**	54% of samples were >400uS	6% of samples >0.6 mg/L of phosphate
<b>Woodale</b>	Standards met*	Standards met	Standards met	80% of samples $\geq$ 3.0 mg/L of nitrate-nitrogen**	A single sample was above typical range	A single sample was above target range
<b>Kiamensi Road</b>	Standards met*	Standards met	Standards met	73% of samples $\geq$ 3.0 mg/L of nitrate-nitrogen**	A single sample was above typical range	Results within target level
<b>Hyde Run</b>	Standards met*	Standards met	Standards met	53% of samples $\geq$ 3.0 mg/L of nitrate-nitrogen**	Results within typical range	Results below minimum target level
<b>Hoopes Reservoir Outflow</b>	Standards met*	Standards met	Standards met	3% of samples $\geq$ 3.0 mg/L of nitrate-nitrogen**	Results within typical range	Results within target level

.....  
 \* 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.

+ No samples were taken after 2002

*This report is produced by the  
Delaware Nature Society*

*in affiliation with the*

*Delaware Department of Natural Resources and Environmental Control (DNREC),  
Division of Water Resources*

