

# **Total Maximum Daily Load**

**PCB**

**Red Clay Creek  
(Entire Basin)**

**Chester County**

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**Introduction**

Pennsylvania has conducted monitoring of fish tissue contaminants since 1976. Early efforts were comprised of special studies in major waterbodies as well as smaller waters with suspected sources of contaminants. Routine sampling for tissue contaminants began in 1979 with implementation of the EPA “CORE” monitoring network that mandated collection of whole fish samples. Because Pennsylvania wanted the fish tissue monitoring program to focus on protection of public health, we began sampling both the edible portion and whole body at one-half of the stations. In 1987, Pennsylvania began sampling the edible portion almost exclusively. In order to increase spatial coverage, we also began rotating sampling through our routine ambient monitoring network and provided both Department of Environmental Protection (DEP) and Fish and Boat Commission field biologists the opportunity to sample suspected problem areas.

Fishing is a wholesome, relaxing pastime, and fish are nutritious and good to eat. Some fish, however, may accumulate contaminants to levels that may be harmful to those who eat them over a long period of time. In an attempt to protect public health, the Commonwealth periodically (at least annually) issues fish consumption advisories based on monitoring data from a number of sources. Advisories are issued jointly by the Department of Health, the Fish and Boat Commission, and DEP. The list of advisories is published in the "Pennsylvania Summary of Fishing Regulations and Laws" which is provided to each fishing license buyer, and is also available from the Department in hard copy and through the Internet. In addition, the annual list and any individual advisories needed between lists are issued using press releases.

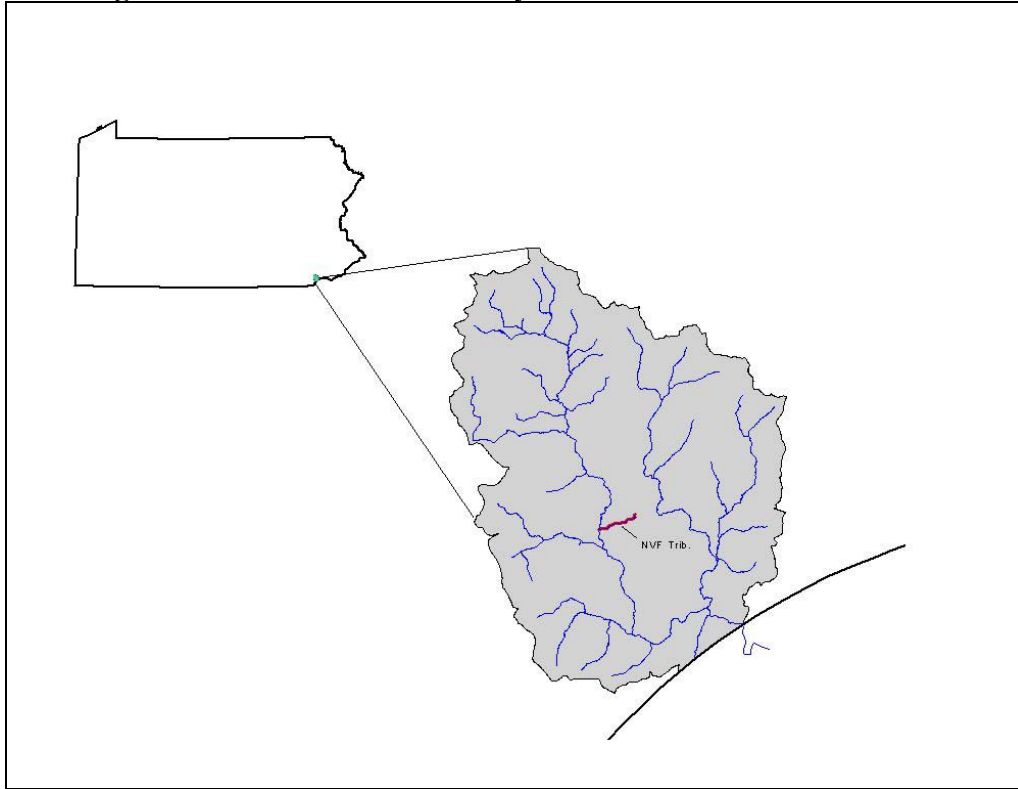
A number of Pennsylvania waterbodies with fish consumption advisories were listed on the Clean Water Act Section 303(d) List of Impaired Waters for 1996. They were listed because long-term, unrestricted consumption of these fish could potentially lead to human health problems. This document addresses contamination of fish tissue in Red Clay Creek in Chester County, by PCB.

### **Background and Source Assessment**

This Total Maximum Daily Load (TMDL) applies to the Red Clay Creek basin from the headwaters to the mouth including the East and West Branch Red Clay watersheds. Red Clay Creek was included on the 1996 Section 303(d) list as a low priority (Segment ID 374). It was also included on the 1998 303(d) list as a high priority for TMDL development. Red Clay Creek lies within State Water Plan watershed 3I in Hydrologic Unit Code 02040205.

The PCB contamination of fish in the Red Clay Creek was first documented in 1982 by the U.S. Fish and Wildlife Service. A 1983 DEP, then DER, survey concluded that the source of the PCBs was National Vulcanized Fiber's Kennett Square facility. More specifically, the source of contamination in the outfall discharge was determined to be from a manufacturing press pit. The manufacturing press pit is connected to the stormwater retention pond via a sump pump and underground pipe. The pond releases stormwater, non-contact cooling water and sewage water into a drainage swale that eventually flows into an unnamed tributary to Red Clay Creek (Segment ID 400).

## Map Showing the Location of the Red Clay Creek Watershed



PADEP collected water and sediment samples of the West Branch Red Clay Creek from 1983 to 1985 to establish the PCB source. A sediment sample collected at the confluence of the unnamed tributary where NVF discharges contained PCB levels up to 8,400 ug/kg. A sediment sample collected on the unnamed tributary upstream of where NVF discharges contained no detectable PCB levels.

Although the source of the PCBs in the Red Clay basin has been determined to be limited to the tributary to the West Branch Red Clay receiving NVF's discharge, the entire Red Clay Basin including East Branch Red Clay and Bucktoe Creek (another West Branch Red Clay tributary) have been listed as impaired due to PCBs. Sources of PCBs to the East Branch Red Clay were never found; however, the topography in the area around the NVF tributary leads to surface runoff in the area draining to both the East Branch and the NVF tributary. The possibility exists that the source of PCBs in the East Branch is contaminated material being transported from around the NVD tributary to the East Branch. Another possibility is the migration of contaminated White Suckers and Eels, both migratory species, from the West Branch to the East Branch and Bucktoe Creek. Atmospheric deposition could also be responsible for the PCBs being found in the East Branch Red Clay Creek. Atmospheric deposition of PCB plays a dominant role in PCB cycling in many freshwater systems. Monitoring conducted under the Integrated Air Deposition Network (IADN) and the Great Waters Program indicate that wet and dry deposition of PCB can vary greatly both regionally and by season. According to EPA's Lake Michigan Mass Balance (LMMB) Study, atmospheric transport and deposition of PCB provides about 82 percent of the total PCB load to Lake Michigan. Because PCB is

no longer produced, the major source of PCB to the atmosphere is volatilization from sites where they have been stored, disposed, or spilled; from incineration of PCB-containing products; and, to a lesser extent, from PCB formation during production processes.

## **TMDL Development**

### Endpoint Identification

The overall goal of a TMDL is to achieve the “fishable/swimmable” goal of the federal Clean Water Act. Because consumption advisories resulting in a “No Kill” regulation are in place, these goals are not being met in the Red Clay Creek basin.

The specific goal of a TMDL is to outline a plan to achieve water quality standards in the water body. For the Red Clay Creek watershed, the TMDL goal is for the level of PCB in the water column to be equal to or less than the Commonwealth’s water quality criterion. The criterion, found in the “Water Quality Toxics Management Strategy – Statement of Policy” (Chapter 16 of the Department’s rules and regulations) is 0.00004 µg/l (micrograms per liter, equivalent to parts per billion) for PCB. PCB is a probable human carcinogen and this is a human health criterion developed to protect against excess cancer risk. Specifically, the Department’s water quality toxics management program controls carcinogens to an overall risk management level of one excess case of cancer in a population of 1 million (1x 10<sup>-6</sup>). Expressing this another way, the probability of an individual getting cancer is increased by a factor of 1 in 1 million.

As a means to compare current conditions to the water quality criterion, an estimated water column concentration was calculated based on the fish tissue concentration and a bioconcentration factor. The calculation involves dividing the average fish tissue concentration by the bioconcentration factor to obtain a projected water column concentration. The equation is:

$$\frac{TC}{BCF} = WC \times 1000$$

TC = Tissue Concentration in mg/kg (equivalent to mg/L)

BCF = EPA Bioconcentration Factor in L/kg

WC = Water Column Concentration (estimated ) in mg/L  
and multiplied by 1000 to obtain µg/L

The average fish tissue concentration is the mean of all samples. The data are included as Appendix A. The average concentration is used for two main reasons. First, the fish tissue samples are composites. This means that the sample result represents the average tissue concentration in three to five individuals, and not an exact value. Second, use of an average value considers the natural variation in tissue burden found in wild fish populations. The PCB bioconcentration factor (BCF) of 31,200 from the EPA criteria development document (EPA 440/5-80-068, October 1980) was used. This BCF was used because no Bioaccumulation Factor (BAF) is available for statewide use. The use

of the BCF is consistent with the provisions of the Department's water quality toxics management strategy. An estimated water column concentration was calculated for each species. These were then averaged in order to provide a single estimated concentration for the segment.

The average PCB level in American Eels from the Red Clay Creek Watershed is .346 mg/kg. The estimated concentration of PCB in the water column is 0.011 µg/l. This estimated concentration exceeds the water quality criterion of 0.00004 µg/l.

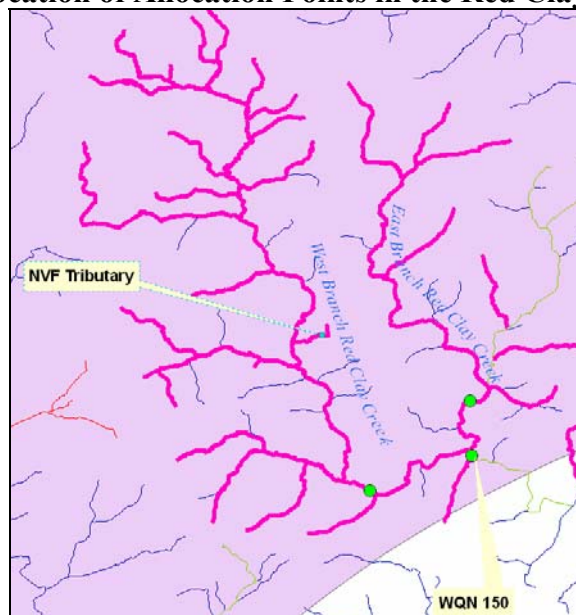
### **TMDL Calculation**

Development of TMDLs includes consideration of background pollutant contribution, appropriate and/or critical stream flow, and seasonal variation.

### **Monitoring for Background Concentrations of PCBs**

PCB concentrations in surface waters may be greater than zero in waters where no specific source, either point or nonpoint source, can be identified. Only site-specific data can be used for the TMDL calculations. However, because sufficient data does not exist for this particular waterbody segment that would allow the selection of such a background value for TMDL calculation purposes, a value of zero was used. In order to verify this assumption, or to properly select a background concentration for calculating a TMDL, site-specific water quality monitoring for PCBs may be conducted at this site some time in the future.

### **Map Showing the Location of Allocation Points in the Red Clay Creek Basin**



If future background sampling were to identify PCB levels greater than zero for this segment, Pennsylvania would review and appropriately revise the TMDL. Currently, there is no approved and widely available analytical method for analyzing water column

samples at the ultra low levels at which PCBs may be present. EPA method 1668-A may offer such capability, but is currently only approved for use in analyzing sewage sludge, is very expensive to run and of limited availability.

PCB is a probable human carcinogen. Carcinogenesis is a nonthreshold effect, an adverse impact that may occur at any exposure greater than zero. Such an effect is often related to long-term exposure to low levels of a particular chemical or compound, rather than an immediate effect due to a short duration exposure to a high level. As noted earlier, the Department's water quality toxics management program uses a cancer risk level of  $1 \times 10^{-6}$  to protect human health. Attainment of this risk level is predicated on exposure that includes drinking 2 liters of water and ingesting 6.5 grams of fish per day over a 70-year lifetime. The Department uses harmonic mean flow as the appropriate design condition for dealing with exposure to carcinogens. This is a long-term average exposure. Because seasonal increases and decreases in concentration are less important than the long-term exposure to a carcinogen, use of harmonic mean flow adequately considers seasonal variations in PCB concentrations.

The calculation of the Red Clay and East and West Branch Red Clay Creeks PCB TMDL uses the water quality criterion and flow data from the U.S. Geological Survey surface water gauging station located on red Clay Creek located near Kennett Square, PA(USGS Station # 01479820). The harmonic mean flow (Q<sub>hm</sub>) was calculated by dividing the flow at the gauge by the drainage area at the gauge and applying the yield (in cubic feet per second per square mile, or cfs/m) to the drainage area of the TMDL segment, as described in the Department's "Implementation Guidance – Design Stream Flows"(Document No. 391-2000-023). The segment Q<sub>hm</sub> for Red Clay Creek is 22.6 cfs.

The Segment Q<sub>hm</sub> is used in calculating the Total Maximum Daily Load by multiplying it by the water quality criterion and a multiplier to convert from cfs x µg/l to lbs/day(pounds per day). The TMDL for PCB is calculated as follows:

$$22.6 \text{ cfs} \times 0.00004 \text{ } \mu\text{g/l} = 0.000904 \text{ cfs} \times \mu\text{g/l} \times 0.00539 = 0.00000488 \text{ lbs/day}$$

The Total Maximum Daily Load of PCB for Red Clay Creek and its tributaries, the East and West Branches of Red Clay Creek, is 0.00000487 lbs/day.

### **Percent Reduction**

The goal of this TMDL is to achieve the water quality criterion in order to protect public health. In order to achieve this, the instream concentration must be reduced from the estimated current level to the criterion.

Percent reduction is calculated using the following formula:

$$\% \text{ Reduction} = ( 1 - \text{TMDL Goal} / \text{Existing concentration} ) \times 100$$

The percent reduction for PCB is calculated as follows:

$$\% \text{ Reduction} = ( 1 - 0.00004 / 0.29 ) \times 100$$

$$\% \text{ Reduction} = ( 1 - 0.00012 ) \times 100 = 99.9 \%$$

An overall reduction of 99.9 % for PCB is needed to achieve the TMDL goal.

**Margin of Safety**

Achievement of the TMDL will generally ensure achievement of the water quality criterion. To account for uncertainties that may be associated with the TMDL calculations, the Department proposes to hold 10 % of the TMDL in reserve. Applying this 10 % margin of safety results in a PCB TMDL of 0.00000439 pounds per day for allocation to all sources.

**Wasteload Allocations (WLAs) and Load Allocations (LAs)**

A wasteload allocation (WLA) is the portion of the TMDLs allowable pollutant load allocated to a point source of a pollutant. No known point sources of PCB to Red Clay and the East and West Branches of Red Clay Creek were found during development of this TMDL. As a result, the WLA is set to zero.

The load allocation (LA) is the portion of the TMDLs allowable pollutant load allocated to nonpoint sources of a pollutant. The NVF Tributary is the only known source of PCBs in Red Clay Creek. The NVF site represents an unquantifiable source of PCB in the watershed, as it has entered the stream sediments through transport of contaminated soils from the site. For this reason, to account for nonpoint sources of PCB, 100% of the remaining TMDL, or 0.00000439 lbs/day, is assigned to the load allocation (LA). TMDL Summary

The PCB TMDL for the Red Clay Creek basin, including The East and West Branches of Red Clay Creek, from the headwaters to the mouth, can be summarized as follows:

**TMDL Summary for Red Clay Creek**

Pollutant	TMDL	WLA	LA	MOS
PCB	0.00000488 lbs/day	0 lbs/day	0.00000439 lbs/day	0.000000488 lbs/day

Because fish tissue samples collected in both the East and West Branches of Red Clay Creeks violated standards, TMDL loadings were also calculated for these tributaries. Using the same methodology as above, the PCB TMDLs for these tributaries are summarized below:

**TMDL Summary for East Branch Red Clay Creek**

Pollutant	TMDL	WLA	LA	MOS
PCB	0.00000162 lbs/day	0 lbs/day	0.00000146 lbs/day	0.000000162 lbs/day



### TMDL Summary for West Branch Red Clay Creek

Pollutant	TMDL	WLA	LA	MOS
PCB	0.00000294 lbs/day	0 lbs/day	0.00000265 lbs/day	0.000000294 lbs/day

### TMDL Verification

The stated goal of this TMDL is to meet the PCB water quality criterion for the protection of public health in the Red Clay and East and West Branch Red Clay Creeks. Another way to state the goal is to reach a point where fish consumption advisories are no longer needed because tissue levels of PCB are no longer above levels of concern.

The three agencies involved with the issuance of fish consumption advisories in Pennsylvania currently apply the “Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory” (commonly referred to as the Great Lakes protocol) for issuance of consumption advisories due to PCB. Following this method, meal-specific consumption advice is issued by species. The first level of consumption advice, “eat no more than one meal per week,” is issued when the tissue PCB concentration is 0.06 to 0.2 mg/kg. The upper limit for unrestricted consumption is 0.05 mg/kg. In order to verify the protectiveness of the proposed TMDL for PCB, the estimated fish tissue concentration that would be expected to accumulate at a water column concentration of 0.00004 µg/l was calculated. Reaching the PCB criterion would result in an estimated tissue concentration of 0.001 mg/kg, well below the 0.05 mg/kg level for unrestricted consumption.

This TMDL analysis estimates, based on back calculations from fish tissue concentration, that the concentration of PCBs in the receiving water exceeds water quality standards. The TMDL analysis also shows that the existing loads of PCBs need to be reduced. The source analysis identifies various sources of this contamination including the NVF Site, a Superfund site. For this TMDL and the specific superfund site identified, it was assumed that controls associated with remediation of the identified sites will result in the removal of the pathway that is associated with sediment loading to the water. This elimination of the surface runoff and sediment loading pathway may reduce the associated runoff of soil-bound PCBs.

The TMDL focuses on the amount of PCBs that the water body can receive and still maintain water quality standards while the Superfund/CERLA programs focus on meeting environmental goals by eliminating the pathways of exposure of pollutants. Together, these programs can meet the allocations/goals set in this TMDL. The collaboration of the Superfund program and the TMDL program to address the impacts of legacy pollutants, such as PCBs, is the next step in an on-going and complex process of meeting water quality standards through the remediation of contaminated sediments. The integration of two often-separate programs is necessary in situations such as this where a land-based source contributes to the contamination of a waterbody. The goal of the TMDL is to reduce PCBs in the water column to water quality standards levels. This is separate from the Superfund goal which is to eliminate the pathway of contamination and not necessarily the elimination of the pollutant. Superfund balances remediation with risk

determinations of human health and feasibility. The TMDL program does not - it is absolute in its goal to meet standards.

A TMDL is a planning tool that may change over time as the data improves and the watersheds change. As additional data are collected the identified sources of PCBs are confirmed, a determination will be made as to whether this new data is significant and a TMDL revision is necessary. While it is expected that this TMDL will serve as a decision tool for those remediation plans, it may be found that the removal of the sediment/runoff pathway may not be feasible or acceptable for other reasons. If this should be the case, the TMDL would be reopened and the allocations redistributed, but still meeting the total allowable load from all sources, to take into consideration the final remediation plan. However, it is important at this time to provide a goal that is based on the need to meet water quality standards to serve as a focal point for site plan development.

### **Reasonable Assurance of Implementation**

In response to several Consent Orders and Agreements, remediation work has been ongoing at the NVF site. These efforts, summarized below, along with recommendations for future monitoring provide reasonable assurance that this TMDL will be implemented.

The following information was summarized from a report prepared by Halliburton NUS Corporation in September 1995:

To comply with a June 1987 Consent Orders and Agreement between EPA and NVF, Remcor, Incorporated, of Pittsburgh, Pennsylvania, was contracted to collect samples from the press pit, stormwater retention pond, 13 electrical substations at the facility, and other off-site locations in August 1987.

In response to a Consent Orders and Agreement between EPA and NVF dated January 21, 1988, Remcor conducted the following activities in May and June 1988: decontamination of the no. 7 press pit, adjoining sump, connecting pipe, and associated equipment and the encapsulation of the press pit and connecting pipe; collection and analysis of three soil samples from each of the drainage paths associated with two electrical substations; cleanup of the substations including soil removal and disposal; and collection and analysis of seven sediment samples from the stormwater retention pond.

On March 31, 1988, EPA ordered NVF to clean up the PCB contamination of soils and sediments leading to the West Branch Red Clay Creek. In July 1988, Remcor excavated approximately 6 to 10 inches of soil from the drainage ditch adjacent to the NVF facility. The soil was transported to the Chemical Waste Management (CWM) facility in Emelle, Alabama for disposal. In August 1988, Remcor removed approximately 230 tons of PCB-contaminated sediment from the drainage swale that was also transported to the CWM facility.

A November 10, 1992 administrative order required NVF to implement an EPA-approved plan for the drainage ditch cleanup and the EPA-approved response alternative for the swale and tributary. For financial reasons, NVF was unable to comply with the order and EPA took over response actions at the NVF facility.

Between January 1993 and September 1994, EPA conducted removal activities at the NVF facility. The removal activities included the following: construction of temporary dams in the swale and unnamed tributary; excavation, removal, transport, and disposal of 3, 572 tons of contaminated soil from the drainage ditch and swale areas; routing of drainage through a pipe in the northern half of the swale and construction of a riprap channel in the southern half of the swale; removal of contaminated sediment from the tributary by vacuum truck; and restoration of the excavated areas including backfilling and regarding the drainage ditch.

A second Unilateral Order was issued to NVF Company in 1992 to remove the additional contaminated soils/sediments from the drainage ditch, swale and unnamed tributary. NVF Company was not financially able to comply with the Unilateral Order at that time and in January of 1993, EPA took over removal response actions at the Site using the Federal Superfund Trust Fund. The removal actions by both the NVF Company and EPA have resulted in the removal or stabilization of PCB contaminated soil/sediments from the drainage ditch, swale and unnamed tributary. In 1997, NVF Company entered into a Consent Order to cap the sediments in the retention pond which is the subject of the current removal action. Installation of a geomembrane liner to immobilize PCB contamination in the retention pond was completed in November 1999.

## **Monitoring**

Under the Consent Order, NVF Company is also required to perform monitoring of the groundwater and pond sediments to detect if the migration of PCB contamination is occurring. Quarterly monitoring is on-going.

## **Public Participation**

### **Request for Comments and Notice of Public Meeting for the Proposed Total Maximum Daily Loads (TMDLs) Developed for the Red Clay Creek Watershed**

The Pennsylvania Department of Environmental Protection (PADEP) is holding a public meeting on March 1, 2007, at 10:00 a.m., at the PADEP Southeast Regional Office, 2 East Main Street, Norristown, Pennsylvania. The purpose of the meeting is to discuss and accept comments on the proposed TMDLs developed for the Red Clay Creek watershed in Chester County. In accordance with the requirements of Section 303(d) of the Clean Water Act, stream segments in Red Clay Creek watershed have been identified as impaired because excessive levels of PCB were found in fish tissue, resulting in a fish consumption advisory. The proposed plan provides calculations of the stream's total

capacity to absorb PCB without violating the water quality criterion of 0.00004 micrograms per liter. The maximum amount of PCB that can be safely absorbed by Red Clay Creek under design conditions is 0.00000488 lbs/day.

The data and all supporting documentation used to develop the proposed TMDLs are available from the PADEP. The proposed TMDL and information on the TMDL program can be viewed on PADEP's website ([www.dep.state.pa.us/watermanagement\\_apps/tmdl/](http://www.dep.state.pa.us/watermanagement_apps/tmdl/)). To request a copy of any of the TMDLs, contact Travis Stoe, PADEP, Watershed Protection Division, 400 Market Street, P.O. Box 8555, Harrisburg, PA 17105, (717)783-2284.

Written comments will be accepted at the above address and must be postmarked no later than thirty (30) days from the date of this bulletin notice. The PADEP will consider all comments in developing the final TMDL, which will be submitted to U.S. Environmental Protection Agency for approval.