

Final
Total Maximum Daily Load
for Cheat River, Fayette County
Chlordane

Cheat Lake Dam to mouth
February 24, 1999

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Introduction

Pennsylvania has conducted monitoring of fish tissue contaminants since 1976. Early efforts were comprised of special studies in major water bodies 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.

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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 the Cheat River, Fayette County, by chlordane.

Background

This Total Maximum Daily Load (TMDL) applies to the main stem of the Cheat River (Stream Code 41885) from the Cheat Lake Dam (River Mile 3.6) to the mouth (River Mile 0.0). This segment was included on the 1996 Section 303(d) list in State Water Plan Watershed 19-G as a low priority. It was also included on the 1998 303(d) list (Segment ID 9920) as a high priority for TMDL development.

The "Do Not Eat" advisory for white bass from this segment was issued January 19, 1990 due to a chlordane concentration of 0.40 ppm. The advisory was reissued in 1991 and 1992, and remains in place. Relatively recent sampling indicated values less than the FDA Action Level, but difficulties in obtaining samples of white bass have kept us from obtaining the two consecutive samples needed to lift the advisory.

TMDL Development

Endpoint Identification

The overall goal of a TMDL is to achieve the "fishable/swimmable" goal of the federal Clean Water Act. Because a consumption advisory for white bass is in place, these goals are not being met in this segment of the Cheat River.

The specific goal of a TMDL is to outline a plan to achieve water quality standards in the water body. For this segment of the Cheat River, the TMDL goal is for the level of chlordane in the water column to be equal to or less than the Commonwealth's water quality criterion from the "Water Quality Toxics Management Strategy – Statement of Policy" (Chapter 16 of the Department's rules and regulations). The human health criterion for chlordane in Chapter 16 is 0.0005 µg/L (micrograms per liter, equivalent to parts per billion). Chlordane 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 (1 x 10⁶). Expressing this another way, the probability of an individual getting cancer is increased by a factor of 1 in 1 million.

Two means were employed in an effort to obtain readily available data on stream chlordane levels for comparison to the criterion. First, the Department's Southwest Field Office was asked to search for chlordane data in or upstream from the Cheat River fish consumption advisory segment. That search failed to produce any in-stream data. Second, data from the EPA Storage and Retrieval System (STORET) was obtained. An "Inventory" retrieval that would include data collected by all agencies using STORET was run for an area with a five-mile radius around the Department's fish tissue sampling station. That location

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is Water Quality Network (WQN) Station 727 – Cheat River at the U.S. Route 119 bridge at Point Marion. Noinstream chlordane data was found.

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

Multiply by 1000 to obtain µg/L

The average fish tissue concentration is the mean of all samples. 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 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 chlordane bioconcentration factor (BCF) of 14,100 from the EPA criteria development document (EPA 440/5-80-027, 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.

The average chlordane concentration in white bass samples from this segment of the Cheat River is 0.252 mg/kg. The estimated chlordane water column concentration based on that average level and the EPA BCF is 0.01787 µg/L. This estimated concentration exceeds the water quality criterion. This value most likely does not represent the actual existing stream concentration due to the basis for the back-calculation. The back-calculation from tissue level to water column concentration was performed using data on a species for which a consumption advisory has been issued, i.e., fish with elevated tissue levels of chlordane. While the actual chlordane concentration in the Cheat River is not known, it is likely to be lower than this calculated estimate.

Source Assessment

Chlordane is a man-made organochlorine compound that was widely used as a broad-spectrum agricultural pesticide before its use was restricted to termite control around building foundations. All uses of chlordane have been banned since April 1988. Chlordane may be introduced to surface waters through contaminated ground water or surface runoff, i.e., it is a nonpoint source contaminant. Once in a waterbody, chlordane becomes associated with solids particles and enters the sediments. Fish are exposed to and accumulate chlordane from the water, through contact with or ingestion of sediments, and in the food they eat.

Three methods were employed in order to locate known sources of chlordane to the Cheat River. First, the Southwest Field Office was asked to provide information on known existing or historical sources that might contribute chlordane in or upstream from the fish consumption advisory reach. For any known sources, they were requested to provide the name and location as well as flow rate and the long-term discharge concentration (to help establish load). Second the EPA Permit Compliance System (PCS) database was searched for any major discharge permits containing chlordane as an effluent limitation. Third, the

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West Virginia Division of Environmental Protection was contacted to determine if there are known sources in the West Virginia portion of the watershed. No known existing or historic sources of chlordane to the Cheat River were found.

TMDL Calculation

Development of TMDLs includes consideration of background pollutant contribution, appropriate and/or critical stream flow, and seasonal variation. The natural instream background concentration of chlordane is assumed to be zero because chlordane is a man-made compound and there are no natural sources.

Chlordane 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 1×10^{-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 flow condition that will, when applied to the Total Maximum Daily Load, represent 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 chlordane concentrations.

The calculation of the Cheat River chlordane TMDL uses the water quality criterion and flow data from the U.S. Geological Survey surface water discharge station on Redstone Creek at Waltersburg, PA (03074500). The harmonic mean flow was calculated using the low flow yield method found in the Department's "Implementation Guidance - Design Stream Flows" (Document No. 391-2000-023, p 4). This method requires that the harmonic mean flow (Q_{hm}) from the USGS gage used be divided by the gage drainage area to arrive at a UnitQ_{hm} that is multiplied by the drainage area of the segment to produce a Segment Q_{hm} in cubic feet per second (cfs). The Segment Q_{hm} for the Cheat River is 985.87 cfs.

The Segment Q_{hm} is used in calculating the Total Daily Maximum Load (TMDL) by multiplying it by the water quality criterion (0.0005 µg/L) and a multiplier to convert from cfs x µg/L to lbs/day (pounds per day). The TMDL is calculated as follows:

$$985.87 \text{ cfs} \times 0.0005 \text{ } \mu\text{g/L} = 0.492935 \text{ cfs} \times \mu\text{g/L} \times 0.00539 = 0.0026569 \text{ lbs/day.}$$

The Total Maximum Daily Load of chlordane at the mouth of the Cheat River is 0.0026569 pounds per day.

Percent Reduction

The goal of this TMDL is to achieve the chlordane water quality criterion in order to protect public health. In order to achieve this, the instream chlordane concentration must be reduced from the estimated current level of 0.01787 µg/L to the criterion, which is 0.0005 µg/L. Percent reduction is calculated using the following formula:

$$\begin{aligned} \% \text{ Reduction} &= (1 - \text{TMDL Goal/ Existing Concentration}) \times 100 \\ \% \text{ Reduction} &= (1 - 0.0005/0.01787) \times 100 \\ \% \text{ Reduction} &= (1 - 0.0280) \times 100 = 97.2\% \end{aligned}$$

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An overall reduction of 97.2% is needed to achieve the TMDL goal.

Margin of Safety (MOS)

Achievement of the 0.0026569 pounds per day chlordane TMDL will generally ensure achievement of the water quality criterion. To account for uncertainties that may be associated with the TMDL calculation, the Department proposes to hold 10% of the TMDL in reserve. Applying this 10% margin of safety results in a TMDL of 0.0023912 pounds per day for allocation to all sources.

Wasteload Allocations (WLAs) and Load Allocations (LAs)

No data is available on chlordane concentrations in this segment of the Cheat River. For this reason, and because chlordane is a man-made compound, natural and background concentrations of chlordane in the Cheat River are assumed to be zero.

No known existing or historic sources of chlordane to the Cheat River were found during development of this TMDL. As a result, the Wasteload Allocation (WLA), the portion of the load contributed by point source discharges, is set to zero.

As noted in the Source Assessment, chlordane is a nonpoint source contaminant that may be introduced to surface water through contaminated ground water or surface runoff. As a result, the entire TMDL for chlordane in the Cheat River segment is assigned to the Load Allocation (LA), that portion of the load contributed by nonpoint sources. The Source Assessment also notes that once in a water body, chlordane becomes associated with soil particles and enters the sediments. Fish tissue contamination results from this sediment load. Because of this, the entire TMDL for chlordane in this reach of the Cheat River, 0.0023912 pounds per day, is assigned to a Load Allocation for the stream sediment.

TMDL Summary

The Chlordane TMDL for the Cheat River from the Cheat Lake Dam (RM 3.6) to the mouth (RM 0.0) can be summarized as follows:

TMDL Summary				
Pollutant	TMDL	WLA	LA	MOS
Chlordane	0.0026569 lbs/day	0	0.0023912 lbs/day	0.0002657 lbs/day

TMDL Verification

The stated goal of this TMDL is to meet the chlordane water quality criterion for the protection of public health in this reach of the Cheat River. Another way to state the goal is to reach a point where fish consumption advisories are no longer needed because tissue levels of chlordane are no longer above the level of concern.

The three agencies involved with the issuance of fish consumption advisories in Pennsylvania currently use the U.S. Food and Drug Administration (FDA)

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Action Level of 0.3 mg/kg for issuance of advisories due to chlordane contamination. In order to verify the protectiveness of the proposed chlordane TMDL, the estimated fish tissue concentration that would be expected to accumulate at a water column concentration of 0.0005 µg/L was determined. Achievement of the chlordane water quality criterion would result in an estimated fish tissue concentration of 0.007 mg/kg, much lower than the Action Level. The consumption advisory could be lifted at that level.

TMDL Implementation

Use of chlordane has been banned in the United States, so there should be no new point sources to which controls can be applied. There are no known current sources of chlordane in the Cheat River basin. Chlordane present in the system is believed to reside primarily in the sediment due to historical use.

Generally, the level of chlordane is expected to decline over time due to the ban on use through natural attenuation. Examples of processes in natural attenuation are covering of contaminated sediments with newer, less contaminated materials, and flushing of sediments during periods of high stream flow. Natural attenuation may be the best implementation method because it involves less habitat disturbance/destruction than active removal of contaminated sediments. Mechanical or vacuum dredging removes the habitat needed by certain benthic macroinvertebrates. In addition, some of these organisms will be killed during the dredging process. Suspension of sediments during dredging may also cause abrasive damage to the gills and/or sensory organs of benthic macroinvertebrates or the gills of fish. Suspended sediments can also affect the prey gathering ability of sight-feeding fish. In addition, active removal may cause resuspension of contaminated materials thus making chlordane available for additional uptake. This alternative is, of course, also the least costly option.

Monitoring

Pennsylvania will continue to monitor chlordane levels in white bass tissue in this reach of the Cheat River. Samples will be collected once every five years. The data will be used to evaluate the possible threat to public health and to determine progress toward meeting the TMDL. The consumption advisory will remain in place until the water quality criterion is achieved and an advisory is no longer needed.