Total Maximum Daily Load (TMDL) Documentation for Chlordane in Lake Roland

FINAL

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FINAL

TOTAL MAXIMUM DAILY LOAD (TMDL) FOR CHLORDANE IN LAKE ROLAND (JONES FALLS WATERSHED)

Watershed Code: 02-13-09-04

PREFACE

Section 303(d) of the federal Clean Water Act (CWA) directs States to identify and list waters, referred to as water quality limited segments (WQLSs), where current, required controls of a specified substance are inadequate to achieve water quality standards. For each WQLS, the State is to establish a Total Maximum Daily Load (TMDL) of the specified substance that the waterbody can receive without violating water quality standards.

On the basis of fish tissue data collected in Lake Roland, the Jones Falls Watershed was identified on the additions to Maryland's 1996 303(d) list of WQLSs as being impaired by the pesticide chlordane. This report documents the establishment of a proposed chlordane TMDL for Lake Roland.

Once approved by the U.S. Environmental Protection Agency (USEPA), the TMDL will be documented according to procedures described in the State's Continuing Planning Process. In the future, the established TMDL will support monitoring activities required to track restoration of the impaired resource with the eventual goal of lifting the associated fish consumption advisory.

EXECUTIVE SUMMARY

Chlordane, a pesticide no longer authorized for use in the United States, has been detected in certain Lake Roland fish tissues at levels requiring issuance of a fish consumption advisory. This advisory has been in place since February 5, 1986 (Attachment 1). As a consequence of impairment by chlordane, Lake Roland (in the Jones Falls Watershed) was identified as a WQLS on the 1996 additions to Maryland's 303(d) list.

The Maryland Department of the Environment (MDE) hereby proposes a TMDL of 0.00059 µg/L in the water column based on the early, most conservative USEPA water quality criterion for chlordane. In the absence of any defined, currently active sources of chlordane, other than sporadic low-level inputs from urban runoff, there is no opportunity to allocate loadings among point and non-point sources. The State intends to periodically monitor contaminant levels in fish tissues from Lake Roland to track the expected gradual decline in chlordane concentrations. The goal of the monitoring program will be to identify fish tissue levels that would allow for the withdrawal of the fish consumption advisory.

1.0 INTRODUCTION

The Clean Water Act (CWA), section 303(d)(1)(C), and federal regulation 40 CFR 130.7(c)(1) direct each State to develop a Total Maximum Daily Load (TMDL) for all impaired waters on its 303(d) list. A TMDL reflects the maximum amount of the impairing substance a waterbody can receive and still meet water quality standards. A TMDL can be expressed in mass per unit time, toxicity, or any other appropriate measure (40 CFR 130.2(i)). TMDLs must take into account seasonal variations and a margin of safety (MOS) to allow for uncertainty. Maryland's 1996 303(d) list, submitted to the U.S. Environmental Protection Agency (USEPA) by the Maryland Department of the Environment (MDE), identifies Lake Roland (Jones Falls) as impaired by the pesticide chlordane. Fish tissue data and an associated fish consumption advisory, based on monitoring of the fish resources during the 1980s, prompted the 1996 listing.

Chlordane has been identified as a pollutant of concern because it is a bioaccumulative pesticide that is carcinogenic and can cause both acute and chronic toxic effects. Chlordane was used as a broad-spectrum pesticide for agricultural, home, and commercial control of insects from its introduction in the 1940s until it was withdrawn from the market in 1988. Its polycyclic chlorinated organic structure produces deleterious biological effects similar to those of DDT, polychlorinated biphenyls (PCBs), and other related substances.

The Maryland Department of Agriculture suspended broad-based uses of chlordane in 1975 by restricting its use to termite control. Only certified applicators were authorized to purchase quantities greater than ½ gallon after that date. The USEPA reached an agreement with the sole producer of the product on July 1, 1986, which led to the further restriction of use to the exterior of buildings, and to the ultimate termination of all sales by April 15, 1988. The USEPA officially cancelled the product's registration in 1993.

Concerns with the substance were largely brought to the State's attention through results of its fish tissue monitoring program, which has been an element of the State's water quality monitoring efforts since the 1970s. Water quality impairments in Lake Roland were initially suggested as a result of fish taken from the lake in 1983. A more intensive survey in 1984 (Garreis and Murphy 1986) found that chlordane levels were of sufficient magnitude to justify issuance of a fish consumption advisory for carp (*Cyprinus carpio*) and black crappie (*Pomoxis nigromaculatus*). Data from similar studies suggest that the only current source of chlordane in fish tissues is the historical accumulation of chlordane in sediments of the waterbody (MDE 1999, MDE draft 2000); however, there are no available sediment data from Lake Roland to confirm this.

Lake Roland's designation as a WQLS is based upon violations of the use designation for the waterbody and the narrative standard for toxic substances in the State's regulations. Specifically, Lake Roland is designated as a Use I water. The Code of Maryland Regulations (COMAR) Title 26.08.02.01 B (2) (a), requires that all Use I "waters of this State shall be protected for the basic uses of water contact recreation, fish, other aquatic life, wildlife, and water supply." In COMAR 26.08.02.01 C, the narrative statement concerning toxic pollution states that "the waters of this State may not be polluted by: . . . (3) high temperature, toxic,

corrosive or other deleterious substances attributable to sewage, industrial wastes, or other waste in concentrations or combinations which: . . . (b) are harmful to human, animal, plant, or aquatic life." Because the fish inhabiting the waters cannot be consumed without restriction, Lake Roland does not comply with the Use I designation and is considered to be impaired.

2.0 SETTING AND WATER QUALITY DESCRIPTION

2.1 General Setting

Lake Roland is a 100-acre impoundment in the middle portion of Jones Falls, a tributary to the Patapsco River (see Attachment 2). Two smaller tributaries, Roland Run and Towson Run, also feed the lake. Lake Roland lies in the Patapsco/Back River Basin within the Jones Falls watershed (Maryland Eight-Digit Watershed Code: 02-13-09-04). The Jones Falls watershed lies within the Piedmont Plateau geological formation (Garrison 1996) and occupies 37,132 non-water acres (Maryland's Surf Your Watershed-Watershed Profile, http://www.dnr.state.md.us/watersheds/surf/prof/pdf/02130904_wp.pdf). Land use in this watershed is primarily urban with a mix of residential and commercial uses. Jones Falls was a major industrial area in the 18th century. Mills along the river manufactured up to 80% of the cotton used for the sails of the clipper ships employed by merchant marines to import and export goods. These mills are now occupied by various businesses (Jones Falls Watershed Association, http://www.greaterhomewood.org/page41.html).

2.2 Water Quality Characterization and Impairment

Water quality data on chlordane concentrations in surface waters draining to Lake Roland are unavailable. Data from an unpublished 1994 urban runoff study by MDE (MDE draft August 1997) suggest that the occurrence of chlordane is unpredictable in spatial and temporal scope. Continuing point sources of chlordane discharge are unlikely due to the 1988 ban of chlordane use as a broad-spectrum pesticide.

3.0 SUPPORTING DATA

3.1 Fish Tissue Data

Lake Roland was placed on Maryland's 303(d) list of water quality limited segments for chlordane based exclusively on fish tissue sample data collected by the Office of Environmental Programs (OEP, Department of Health and Mental Hygiene) in 1983 and 1984. The Baltimore City Department of Water and Wastewater requested that OEP test the fish in Lake Roland in 1983 after results from surveys by the State's fish tissue monitoring program indicated a potential for problems in selected urban areas (Garreis & Murphy, 1986). Composite samples collected from Lake Roland in 1983 were found to exceed the USFDA action level for chlordane (Table 1). These findings led to an intensive survey of Lake Roland in 1984. Results of this intensive monitoring are summarized in Table 2. Because chlordane was detected in a number of fish tissue samples above the 0.3 mg/kg level, the waterbody was considered to be impaired.

Chlordane has been identified in almost every fish tissue sample collected from all basins under the State's fish tissue monitoring program. This program was institutionalized in 1976 and targeted two or more fish species (representing bottom feeders and higher trophic level predators) for collection at each monitoring location. Species having a wide range of occurrence were targeted to allow for regional comparisons in addition to the temporal trends at each monitoring station. The fish tissue monitoring program currently consists of a network of over thirty monitoring locations where triennial sampling allows for statewide trend assessments. This network is supplemented with additional monitoring sites in areas of concern.

Statewide, most fish tissue chlordane levels have been well below the 0.3 mg/kg action level established by U.S. Food and Drug Administration (USFDA) guidelines. Elevated levels of chlordane in fish tissue have appeared most commonly in urban areas, especially those located near the head of tidal influence. Among the sites of greatest accumulation were Baltimore Harbor (Patapsco River) and Back River. In these water bodies, the levels of chlordane in selected fish tissues frequently exceeded the USFDA action levels.

Table 1: Chlordane Levels in Fish Tissue Collected in Lake Roland (1983): Composite samples.

Species	Number of specimens	Tissue Analyzed	Average Sample Weight (g)	Chlordane (ppm)
White Sucker	5	fillet	138	0.073
Carp	5	fillet	148	**0.597**
Black Crappie	7	edible portion	31	**0.827**

Concentrations in bold exceed the USFDA guidance level of 0.3 mg/kg

3.2 Sediment Data

There are no available sediment data for Lake Roland.

4.0 SOURCE ASSESSMENT

Chlordane is not a naturally occurring substance; therefore, background levels of the pesticide are expected to be zero unless there is a present or historical anthropogenic source. Although chlordane data associated with Lake Roland are limited, it is the Department's judgement that the only significant source of chlordane is the bottom sediments of Lake Roland. This conclusion is supported by two factors. First, upstream nonpoint sources are expected to contribute chlordane to the waterbody in very small amounts, released intermittently. Such sources are not practically quantifiable as demonstrated by a recent study of urban runoff of chlordane (MDE draft 1997). Such observations are consistent with our understanding that the sources are intermittent use of old stocks held by homeowners, and release from the erosion and transport of existing soils previously contaminated by chlordane and related compounds. Secondly, because chlordane chemically binds to

Table 2: Chlordane Levels in Fish Tissue Collected in Lake Roland (1984)

Water Quality Limited Segment	Watershed	Species	Tissue Analyzed	Weight of Whole Fish(g)	Concentration (ppm)
Lake Roland	Jones Falls	White Sucker	Fillet	360.0	0.149
Lake Roland	Jones Falls	White Sucker	Fillet	330.0	0.083
Lake Roland	Jones Falls	White Sucker	Fillet	364.0	0.240
Lake Roland	Jones Falls	White Sucker	Fillet	330.0	0.096
Lake Roland	Jones Falls	White Sucker	Fillet	458.0	0.104
Lake Roland	Jones Falls	White Sucker	Fillet	336.0	0.108
Lake Roland	Jones Falls	White Sucker	Fillet	420.0	0.212
Lake Roland	Jones Falls	White Sucker	Fillet	324.0	0.214
Lake Roland	Jones Falls	White Sucker	Fillet	448.0	0.108
Lake Roland	Jones Falls	White Sucker	Fillet	435.0	0.288
Lake Roland	Jones Falls	White Sucker	Fillet	400.0	0.263
Lake Roland	Jones Falls	White Sucker	Fillet	380.0	**0.360**
Lake Roland	Jones Falls	White Sucker	Fillet	455.0	0.047
Lake Roland	Jones Falls	White Sucker	Fillet	370.0	**0.300**
Lake Roland	Jones Falls	White Sucker	Fillet	360.0	0.234
Lake Roland	Jones Falls	White Sucker	Fillet	400.0	0.135
Lake Roland	Jones Falls	White Sucker	Fillet	410.0	0.049
Lake Roland	Jones Falls	White Sucker	Fillet	435.0	0.151
Lake Roland	Jones Falls	White Sucker	Fillet	378.0	0.060
Lake Roland	Jones Falls	White Sucker	Fillet	180.0	0.199
Lake Roland	Jones Falls	Black Crappie	Fillet	55.0	**0.913**
Lake Roland	Jones Falls	Black Crappie	Fillet	70.0	0.161
Lake Roland	Jones Falls	Black Crappie	Fillet	45.0	**0.690**
Lake Roland	Jones Falls	Black Crappie	Fillet	52.0	**0.628**
Lake Roland	Jones Falls	Black Crappie	Fillet	52.0	0.259
Lake Roland	Jones Falls	Black Crappie	Fillet	54.0	**0.708**
Lake Roland	Jones Falls	Black Crappie	Fillet	56.0	**0.435**
Lake Roland	Jones Falls	Black Crappie	Fillet	52.0	**0.311**
Lake Roland	Jones Falls	Black Crappie	Fillet	50.0	0.226
Lake Roland	Jones Falls	Black Crappie	Fillet	54.0	**1.033**
Lake Roland	Jones Falls	Black Crappie	Fillet	70.0	**0.339**
Lake Roland	Jones Falls	Black Crappie	Fillet	60.0	**0.499**
Lake Roland	Jones Falls	Black Crappie	Fillet	55.0	**0.741**
Lake Roland	Jones Falls	Black Crappie	Fillet	50.0	0.196
Lake Roland	Jones Falls	Black Crappie	Fillet	46.0	**0.810**
Lake Roland	Jones Falls	Black Crappie	Fillet	50.0	**0.825**
Lake Roland	Jones Falls	Black Crappie	Fillet	62.0	**0.695**
Lake Roland	Jones Falls	Black Crappie	Fillet	50.0	**0.682**
Lake Roland	Jones Falls	Black Crappie	Fillet	48.0	**0.375**
Lake Roland	Jones Falls	Black Crappie	Fillet	58.0	**0.802**
Lake Roland	Jones Falls	Black Crappie	Fillet	60.0	**0.403**

Table 2: Continued

Water Quality Limited Segment	Watershed	Species	Tissue Analyzed	Weight of Whole Fish(g)	Concentration (ppm)
Lake Roland	Jones Falls	Black Crappie	Fillet	51.0	**0.557**
Lake Roland	Jones Falls	Black Crappie	Fillet	53.0	**1.023**
Lake Roland	Jones Falls	Black Crappie	Fillet	56.0	**0.684**
Lake Roland	Jones Falls	Black Crappie	Fillet	40.0	**0.600**
Lake Roland	Jones Falls	Black Crappie	Fillet	52.0	**0.646**
Lake Roland	Jones Falls	Carp	Fillet	1020.6	0.270
Lake Roland	Jones Falls	Carp	Fillet	793.8	**0.800**
Lake Roland	Jones Falls	Carp	Fillet	907.2	**0.570**
Lake Roland	Jones Falls	Carp	Fillet	453.6	0.080
Lake Roland	Jones Falls	Carp	Fillet	793.8	**0.345**
Lake Roland	Jones Falls	Carp	Fillet	1020.6	**0.601**
Lake Roland	Jones Falls	Carp	Fillet	680.4	**0.661**
Lake Roland	Jones Falls	Carp	Fillet	907.2	0.188
Lake Roland	Jones Falls	Carp	Fillet	1020.6	**0.306**
Lake Roland	Jones Falls	Carp	Fillet	680.4	0.167
Lake Roland	Jones Falls	Carp	Fillet	793.8	**1.181**
Lake Roland	Jones Falls	Carp	Fillet	680.4	**0.740**
Lake Roland	Jones Falls	Carp	Fillet	680.4	**0.680**
Lake Roland	Jones Falls	Carp	Fillet	680.4	**0.423**
Lake Roland	Jones Falls	Carp	Fillet	907.2	0.200
Lake Roland	Jones Falls	Carp	Fillet	1134.0	**0.746**
Lake Roland	Jones Falls	Carp	Fillet	1179.4	**0.545**
Lake Roland	Jones Falls	Carp	Fillet	1088.6	**0.446**
Lake Roland	Jones Falls	Carp	Fillet	1474.2	**0.592**
Lake Roland	Jones Falls	Carp	Fillet	1360.8	**0.782**
Lake Roland	Jones Falls	Carp	Fillet	1224.7	0.246
Lake Roland	Jones Falls	Carp	Fillet	1474.2	**0.357**
Lake Roland	Jones Falls	Carp	Fillet	1360.8	**0.782**
Lake Roland	Jones Falls	Carp	Fillet	1179.4	**0.668**
Lake Roland	Jones Falls	Carp	Fillet	1043.3	**0.615**
Lake Roland	Jones Falls	Carp	Fillet	1224.7	**0.393**
Lake Roland	Jones Falls	Carp	Fillet	1360.8	**0.437**
Lake Roland	Jones Falls	Carp	Fillet	1406.2	**0.399**
Lake Roland	Jones Falls	Carp	Fillet	907.2	**1.061**
Lake Roland	Jones Falls	Carp	Fillet	952.6	0.285
Lake Roland	Jones Falls	Carp	Fillet	1179.4	**0.302**
Lake Roland	Jones Falls	Carp	Fillet	1678.3	**0.311**

Concentrations in bold exceed the USFDA guidance level of 0.3 mg/kg

sediments, any nonpoint sources quickly end up in bottom sediments. Thus, the bottom sediments effectively integrate any nonpoint sources.

Chlordane is not an expected substance in point source discharges, nor are there any current National Permit Discharge Elimination (NPDES) permits for this watershed. Municipal point sources are Villa Julie and St. Timothy's School Waste Water Treatment Plants. These are both <20,000 gallons per day (gpd) and have no potential for chlordane discharge. If chlordane were to occur in municipal discharges, it would be through intermittent, illicit, and generally untraceable sources. Therefore, further regulation and control of point sources is not considered to be a viable means of controlling the environmental occurrence of chlordane. Efforts to enhance these source reductions are being promoted by local governments through the offering of "household hazardous chemical disposal days." These offerings have been ongoing since the late 1980s and are continuing to provide local citizens with an environmentally acceptable means of disposal. Similar efforts have been extended to farmers for disposal of agricultural chemicals no longer suitable for use.

5.0 TARGETED WATER QUALITY GOALS

Although the State has not adopted any specific guidance levels for chlordane in its regulations, it does take action on environmental contaminants that significantly increase the risk to public health. The level of significance generally used by the State in these analyses for carcinogenic endpoints is the level that produces an increased risk to the population greater than one in 100,000. This is often expressed as a risk greater than 1.0×10^{-5}. Assuming that the public has a risk of cancer from all causes of at least 25%, or 25,000 in 100,000, the threshold of concern for a single substance would increase the risk to 25,001 in 100,000.

The USFDA has established specific guidance levels for fish tissue in the commercial market (0.3 mg/kg). This level was employed in the setting of the original fish consumption advisory for Lake Roland. The USEPA currently supports a purely risk based approach for developing fish consumption advisories. Using USEPA default assumptions: CSF_o (0.35/mg/kg/d), the average adult daily consumption of fish (6.5 grams/day), the average body weight of an adult (70 kg) and a risk factor of 10^{-5}, yields a fish tissue concentration of 0.3 mg/kg. This means that a fish tissue concentration of 0.3 mg/kg approximates a 10^{-5} risk level. Since both USEPA and USFDA support the same fish tissue concentration, this weight-of-evidence leads Maryland to conclude that an average fish tissue level of 0.3 mg/kg is reasonable for the purpose of deciding whether a fish consumption advisory may be warranted. The current USEPA ambient water quality criteria for the protection of human health from the consumption of contaminated fish is calculated similarly, but is conservatively based on a 10^{-6} risk level instead of 10^{-5}. This adds a factor of 10 safety margin to the most current USEPA water quality criteria of 0.0022 µg/L. Therefore, the endpoint for the control or mitigation of chlordane as it affects the edibility of fish taken from Lake Roland is linked to achieving a reduction of chlordane in the targeted fish tissues to a level of 0.3 mg/kg or less.

Water quality criteria have been developed by EPA to protect marine aquatic life from toxic effects (0.004 ug/L) and to protect humans from the consumption of contaminated aquatic organisms (0.0022 ug/L) (EPA 1999). These values were recently updated from earlier water quality criteria developed by EPA to 0.0043 µg/L for toxicity to marine aquatic life and 0.00059 µg/L for human health (EPA 1999). As an added margin of safety, the earlier and more conservative ambient water quality criteria for the protection of humans from the consumption of organisms was employed, adding a safety margin of over a factor of three to the TMDL.

6.0 TECHNICAL BASIS

Because chlordane was banned nearly 15 years ago, the best readily available information shows that chlordane loadings from sources other than existing bottom sediments is negligible. Consequently the bottom sediments are expected to be the dominant present-day source of chlordane in Lake Roland water and fish tissue. This expectation is based on the well-established propensity of chlordane to adsorb to sediments (Agency for Toxic Substances and Disease Registry. 1989). This means that the rate of reduction of chlordane concentrations in the biologically active sediment layer will ultimately control water column and fish tissue concentrations. Chlordane concentrations in sediments are reduced by a number of processes, including;

- Burial/dilution of contaminated sediments;
- Dissolution into, followed by vaporization from, the water column;
- Uptake by biota living in the sediment;
- Chemical degradation;
- Biological degradation; and
- Hydrologic transport from the system.

The dominant processes are likely burial and/or dissolution followed by volatilization from the water body. Howard (1991) provides estimated volatilization half-lives from a representative environmental pond, river and lake as 8-26, 3.6-5.2, and 14.4-20.6 days, respectively. Howard also states that adsorption to sediments can significantly affect the importance of volatilization. Within this system, neither uptake by biota or degradation are expected to significantly reduce chlordane levels in sediments.

7.0 TOTAL MAXIMUM DAILY LOADS AND LOAD ALLOCATIONS

Chlordane is a persistent substance, which has a high affinity for fine sediments and generally settles to the bottom with the sediment in a waterbody. Water column concentrations are thus generally extremely low and difficult to measure in a manner that would allow adequate characterization of a large impoundment. Sediment analyses are costly and provide information only on the precise location where sampling occurred. Fish tissue accumulates and integrates bioaccumulative contaminants, such as chlordane, and is, therefore, the ultimate endpoint Maryland is trying to protect.

7.1 Water Quality Endpoint

The water quality endpoint for this TMDL is expressed in terms of achieving the specific criterion for which Lake Roland was identified on the 303(d) list. The current USFDA guidance level for fish tissue concentrations of 0.3 mg/kg was used to determine the need to list Lake Roland as being impaired by chlordane. A water quality endpoint equivalent to the most conservative of the USEPA's water quality criteria for chlordane (0. 00059 µg/L) should be sufficient to attain fish tissue concentrations below the guidance level.

7.2 Total Maximum Daily Load

MDE is establishing a concentration of 0.00059 µg/L as the appropriate measure for the Lake Roland TMDL. The USEPA's current fish tissue levels of chlordane for fish consumption advisories and their ambient water quality criteria for the protection of human health from chlordane-contaminated fish are calculated using similar methods (see Section 5.0: Targeted Water Quality Goals). This provides a linkage between the fish tissue endpoint of 0.3 mg/kg and the water column concentration of 0.0022 µg/L. However, because the earlier USEPA water quality criterion (0.00059 µg/L) provides a greater margin of safety (factor of 30; see Section 7.5: Margin of Safety), it was used as the basis for this TMDL.

7.3 Seasonal Variations and Critical Conditions

The TMDL is represented as a concentration level that is protective against toxic human health effects *at all times*. Implicitly, the TMDL accounts for seasonal variations since it is protective throughout the year (i.e., "at all times"). This situation does not present an issue of controlling for critical conditions for several reasons. First, the notion of "critical conditions" does not arise in the traditional sense for this TMDL. The allowable concentrations of chlordane are based on human fish consumption over a long time period, which averages out any critical events. Additionally, human health standards, upon which the TMDL is founded, account for critical sub-populations that might be more susceptible to toxic risk. Second, the TMDL is protective at all times, which implies that any "critical conditions" within that timeframe are considered. Finally, the TMDL levels established to be protective of human health are more conservative than the chlordane levels established to protect environmental resources, implying that critical conditions for environmental resources are also addressed by the previous logic that applied to human health.

7.4 TMDL Allocation

The studies referenced above suggest that the transient events, in which minute levels of chlordane have been observed in association with point and non-point sources, are too insignificant to support the quantification of meaningful allocations to these sources. Furthermore, the bottom sediments integrate these and other sources. All readily available data for Baltimore Harbor and the Back River estuary TMDLs point to *in-situ* sediments as the sole remaining significant source of chlordane in those systems (MDE 1999, MDE draft 2000). Due to a lack of sediment data, it is not possible to directly allocate loading sources for Lake Roland. However, indirect evidence from the above TMDLs indicates that

sediments are the only significant source causing elevated fish tissue concentrations of chlordane in this system.

7.5 Margin of Safety

The USEPA's TMDL guidance requires each TMDL to include a margin of safety (MOS) that accounts for uncertainty in a matter that is conservative with respect to environmental protection. The USDA fish tissue guidance level, which serves as the water quality measurement endpoint, identified the specific need for a TMDL. The older and more conservative USEPA ambient water quality standard for the protection of humans from the ingestion of contaminated aquatic organisms (0.00059 µg/L) serves as the basis of the TMDL. This is more conservative than the current USEPA ambient water quality criterion (0.0022 µg/L) and was employed to add a margin of safety of a factor of 3. Additionally, the current USEPA water quality criterion of 0.0022 µg/L was calculated at a 10^{-6} risk level, whereas Maryland typically uses a 10^{-5} risk level for water quality criteria for the protection of human health due to fish ingestion. This adds an additional margin of safety by a factor of 10. When combined, these two margins of safety amount to a protection factor of 30.

7.6 TMDL Summary

Based on the previous discussion, the TMDL for chlordane may be summarized as follows:

TMDL	=	WLA	+	LA	+	MOS
0.00059	**=**	**0**	**+**	**0.00059**	**+**	**built-in**

(µg/l – at all times). No future allocation is provided.

Where, WLA is Waste Load Allocation
LA is Load Allocation, and
MOS is Margin of Safety

8.0 ASSUREDNESS OF IMPLEMENTATION

The State of Maryland is committed to protecting the State's rivers, streams, lakes, wetlands, and estuaries. A Phase II project of the Clean Lakes Program was undertaken for Lake Roland in an effort to address problems such as excess nutrients and sediments from development and street runoff, and poor fish habitat. These problems were addressed via management measures including agricultural BMPs and sediment controls in the watershed, and a stream restoration project, respectively (MDNR 1998).

Chlordane has not been commercially available since the late 1980's. It is, therefore, an intermittent contaminant the source of which is most likely stormwater or illegal disposal. Local governments are promoting efforts to enhance source reductions by offering "household hazardous chemical disposal days." These efforts have been ongoing since the late 1980s and are continuing to provide local citizens with an environmentally acceptable

means of disposal. Similar efforts have been extended to farmers for disposal of agricultural chemicals no longer suitable for use.

Aside from the processes of natural recovery, physical removal of the bottom sediments from this impoundment would be the only other means of removing the chlordane-contaminated sediments. Environmental concerns, coupled with the high costs associated with dredging and dredged material disposal, place chlordane impairment in Lake Roland in the category of "Extremely Difficult Problems" as defined in Chapter 6 of the Report of the Federal Advisory Committee on the TMDL Program (USEPA 1998).

Biologically available chlordane levels in Lake Roland's sediments are expected to decline over time due to natural processes including biodegradation, redistribution, and natural burial by sedimentation. Maryland has a fish tissue monitoring program in place that collects and analyzes samples for contamination in Lake Roland on a regular basis. Maryland is proposing triennial monitoring of the fish and surficial sediments in the lake to track the natural attenuation of chlordane. An evaluation of the required sampling frequency will be considered each year as information from the statewide monitoring network is developed. As contamination levels decline and appear low enough to protect human health and the environment, these data and results from additional samples will be evaluated to determine if the consumption advisory should be modified or withdrawn.

9.0 REFERENCES

- Agency for Toxic Substances and Disease Registry. 1989 (Dec). Toxicological Profile for Chlordane (ATSDR/TP-89/06). US Dept. of Commerce, National Technical Information Service, Springfield, VA.

- Garreis, M.J. and D. L. Murphy. 1986. Intensive survey for chlordane contamination in finfish in Lake Roland, Back River, and Patapsco River. Maryland Department of Health and Mental Hygiene, Office of Environmental Programs. Technical Report No. 24, January 1986.

- Howard, P.H. (ed.). 1991. Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Volume III, Pesticides. Lewis Publishers, Inc.

- MDE. 1997. Residential Use Pesticides in Streams of Four Metropolitan Baltimore Neighborhoods 1994 (draft).

- MDE. 1999. Total Maximum Daily Load (TMDL) Documentation for Chlordane in Back River. *Submitted to*: Water Protection Division, U.S. Environmental Protection Agency, Region III.

- MDE. 2000. Total Maximum Daily Load (TMDL) Documentation for Chlordane in Baltimore Harbor. *Submitted to*: Water Protection Division, U.S. Environmental Protection Agency, Region III (draft).

- Garrison, S. J., Ed. 1996. Maryland Water Quality Inventory, 1993-1995. Maryland Department of Natural Resources, Annapolis, MD.

- MDNR. 1998. Maryland Lake Water Quality Assessment Report, 1997. Maryland Department of Natural Resources, Resource Assessment Services, Annapolis, MD. March 1998.

- USEPA. 1980. "Ambient Water Quality Criteria for Chlordane". Office of Water, USEPA 440/5-80-027, October 1980.

- USEPA. 1998. Report of the Federal Advisory Committee on the Total Maximum Daily Load (TMDL) Program, EPA 100-R-98-006, July 1998.

- USEPA. 1999. "National Recommended Water Quality Criteria". Office of Water, May 21, 1999.

Attachment 1
Health Advisory

NEWS RELEASE

State of Maryland Department of Health and Mental Hygiene

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February 5, 1986

DHMH ISSUES HEALTH ADVISORY

Adele Wilzack, R.N., M.S., Secretary of the Department of Health and Mental Hygiene, today issued a health advisory concerning recreational fishing and the consumption of black crappie, carp, channel catfish and american eels from certain waters in the urban Baltimore area.

"This advisory is limited in nature," Ms. Wilzack said. "No health risk exists with the general consumption of oysters, crabs or finfish from Maryland waters, and commercial fisheries are not affected."

A recently concluded intensive investigation in Lake Roland, the Baltimore Harbor and Back River found that average chlordane concentrations in certain fish exceeded the FDA action level of 0.3 ppm.

Chlordane is an insecticide whose use in Maryland is now limited to subterraneous application to protect homes from termites. However, in the past, chlordane was also used as an insecticide in agriculture and was sprayed in homes and gardens. Chlordane remains for long periods of time in the environment and can become concentrated in fish. It has a relatively low acute toxicity, compared to other insecticides, but because it is a suspected carcinogen, continuing long-term exposure is considered a risk.

MORE

DHMH ISSUES HEALTH ADVISORY

"Individuals are advised to limit their consumption of carp and black crappie from Lake Roland," Ms. Wilzack said. "We are also advising residents to limit their consumption of channel catfish and american eels from both the Baltimore Harbor and Back River."

These fish should not be used as a substantial part of the daily diet and should be avoided by women of childbearing age, infants or children. To further reduce health risks, Secretary Wilzack recommends removal of the belly flap, skin and dark meat, because chlordane is most likely to be concentrated in fatty protions of fish. Secretary Wilzack indicated that other fish were tested in each body of water, but that the average chlordane levels in them were not found to exceed the FDA action level for chlordane.

To protect the consumer, the Food and Drug Administration has established a chlordane "action level" of 0.3 parts per million for fish. The possible lifetime cancer rish associated with consumption of over 100 lbs. of fish containing chlordane levels of 0.3 ppm. over a person's lifetime has been estimated at 1 in 100,000 for the average individual.

To give this value some perspective, it can be compared to the lifetime cancer risk for a person sharing an office with a smoker, which is 70 in 100,000 or the lifetime cancer risk from cosmic radiation associated with taking one transcontinental airplane flight annually, which is 3.5 in 100,000. To illustrate this another way, a person is at a 3.5 times greater risk from taking one such flight annually than from eating 100 lbs. of fish containing 0.3 ppm chlordane over a lifetime.

M O R E

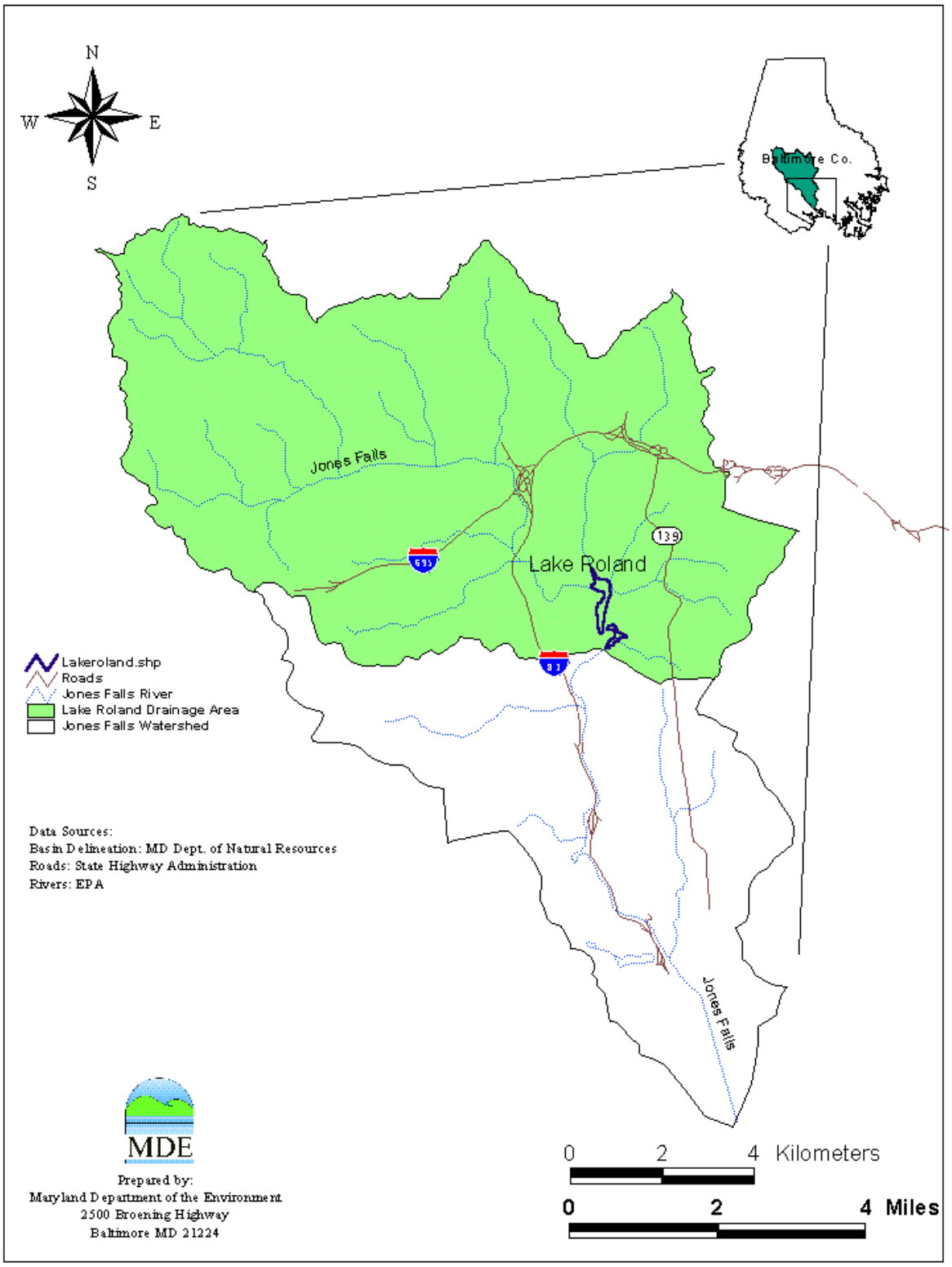
DHMH ISSUES HEALTH ADVISORY

"Similar advisories concerning chlordane have been issued in New York, New Jersey, Mississippi, Missouri, Illinois and Wisconsin," said Ms. Wilzack, who again emphasized that continual surveillance of Maryland fish, crabs and shellfish indicates there is no health risk associated with the general consumption of oysters, crabs and finfish from Maryland waters.

Indiviuaals desiring further information may contact Dr. Katherine Farrell, M.D., M.P.H. at (301) 225-5753.

# # #

Attachment 2
Location Map of the Lake Roland Drainage Basin within Baltimore County, Maryland



Attachment 3
MDE Facts About – Contaminants and Toxicity

In describing the environment, the terms "contaminant" and "toxic" and "toxicity" are widely used and often misunderstood. The mere presence of a "contaminant" or substance does not mean a threat exists to either human health or the health of the water body. Instead, the presence of a chemical contaminant indicates that further investigation is needed by environmental health scientists to determine if a threat to human health environment is possible. The following facts may assist in understanding this.

- All substances have the potential to be contaminants and to cause harmful effects, thereby demonstrating "toxicity".

- Even substances considered relatively harmless or beneficial, such as water and vitamin C, may be harmful if consumed in very large quantities or on a too frequent basis. Alcohol is another example. One drink per week is considered harmless, while several drinks per day can cause liver disease.

- Whether or not a substance exerts toxicity depends on the concentration in the environment, the dose received by humans and other species, and the duration of exposure. For example, because of the difference in alcohol content concentration (dose) and drinking a shot glass of whiskey each day is more harmful than drinking a shot glass of beer each day. Similarly drinking a shot glass of whiskey each day is more harmful than the same amount each week.

For more information contact:

Technical and Regulatory Services Administration
Environmental Risk Assessment Program
(410) 631-3906

Attachment 4
MDE Facts About – Monitoring Contaminant Levels in Fish, Shellfish, and Crabs

Fish, shellfish, and crabs have the potential to accumulate various contaminants in their tissues even when these materials cannot be measured in the water column. This makes these aquatic animals good indicators of environmental pollution in the aquatic environment. This is one of the reasons why the Maryland Department of the Environment (MDE) monitors chemical contaminant levels in the tissue of aquatic organisms. In addition to using tissue contaminant levels as a water quality indicator, monitoring tissue also allows MDE to determine if contaminant levels in these animals pose potential risks to public health from the consumption of fish, shellfish, and crab. In evaluating the human health risks associated with the consumption of fish, shellfish, and crabs, MDE evaluates all relevant information and utilizes the best professional knowledge and experience to inform the public of potential risk.

The relevant information used by MDE includes not only contaminants data on the edible portion of fish, shellfish, and crab tissue associated with a specific area, but also a number of additional considerations:

- Daily estimates of consumption of these aquatic animals and preparation and cooking behaviors used by consumers;
- Evaluation of the population at risk from the consumption of contaminated tissue (likelihood that sensitive individuals eat these animals);
- Types of aquatic organisms in the area and their traits and habits, which govern the ability of contaminants to accumulate in their tissues;
- Sources of chemical contaminants and the potential for each contaminant to persist in the aquatic environment and accumulate in tissues of aquatic animals;
- Human and animal health effects information for each contaminant, including limits established as safe by other environmental health or food safety agencies and organizations.

FISH

MDE has monitored chemical contaminant levels in Maryland's fish since the early 1970s. In the past, Maryland's monitoring program divided the State's waters into three monitoring zones: Western Maryland watersheds; Chesapeake Bay tributary watersheds; and Baltimore/Washington urban watersheds. Sampled fish vary and include important predatory game species (such as smallmouth bass and white perch), as well as "accumulator" species (such as channel catfish and American eel) that are bottom dwelling and of relatively high fat content. Maryland plans to routinely monitor watersheds within these zones on a 3-year cycle in the future. When routine monitoring indicates potential hazard to the public and environment, additional monitoring of the affected area is conducted to verify the initial findings and identify the appropriate species and size classes associated with harmful contaminant levels.

SHELLFISH

Since the 1960s, MDE has been surveying metal and pesticide levels in oysters and clams from the Chesapeake Bay and its tributaries. From the 1970s through 1987, this effort was conducted on an annual or biannual basis. In response to low levels of contaminants and negligible yearly changes in those levels, this baywide effort has been changed to a frequency of once every three years, with the

off years being devoted to analyses of results and the performance of small intensive shellstock surveys.

CRABS

MDE has monitored chemical contaminant levels in the Chesapeake Bay blue crab since the 1970s. In the future, Maryland plans to increase the frequency of monitoring chemical contaminants in this important living resource. Crabs will be collected baywide from both major urban and rural Chesapeake Bay tributaries on a cycle similar to that of shellfish.

FISH CONSUMPTION ADVISORIES IN MARYLAND WATERS

To date, analysis of all fish, crab, and shellfish data has identified four water bodies in Maryland where contaminants in certain fish species pose a possible health concern for consumers of these fish. The advice given to the public is:

Limit or avoid the consumption of…

eels and channel catfish from Baltimore Harbor and Back River

carp and black crappie from Lake Roland

…because of harmful levels of the banned insecticide chlordane.

Limit or avoid consumption of…

Large channel catfish (greater than 18 inches), eel and carp from the tidal Potomac River between the Woodrow Wilson Bridge and a line between Smith Point, MD and Brent Point, VA.

…because of harmful levels of polychlorinated biphenyls (PCBs).

For more information contact:

Maryland Department of the Environment
Technical and Regulatory Services Administration
Environmental Health and Risk Assessment Program
410-631-3906
website: www.mde.state.md.us/