COMMONWEALTH of VIRGINIA

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The Honorable Beverly Sherwood, Chair
House Committee on Agriculture, Chesapeake and Natural Resources

The Honorable Emmett Hanger, Chair
Senate Committee on Agriculture, Conservation and Natural Resources

From: David K. Paylor

Date: December 27, 2012

Subject: 2012 Report on Toxics Reduction in State Waters

I am pleased to provide you with a copy of the "2012 Report on Toxics Reduction in State Waters." This report has been prepared pursuant to § 62.1-44.17:3 of the *Code of Virginia* and summarizes the Department of Environmental Quality's toxic reduction activities during 2012.

This report also is being made available at http://www.deq.virginia.gov/LawsRegulations/ReportstotheGeneralAssembly.aspx. If you have any questions concerning this report or if you would like a hard copy of this report, please contact Angie Jenkins, Policy Director at (804) 698-4268.

2012 Report on Toxics Reduction in State Waters

The complete set of Tables, Folders with Figures, and Appendices associated with this report, as well as the text document, are available on the WebPages of the Department of Environmental Quality at http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/ToxicsReport.aspx.

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

JANUARY 1, 2013

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All Tables, Folders, Figures and Appendices referred to in the text are available as "Read Only" files on DEQ's WebPages:

(http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/ToxicsReport.aspx**).**

List of Tables

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List of Figures: Folders 3.2.1.1 through 6

The numbering of figure-containing **Folders** corresponds to the numbers of the associated **Tables 3 through 6**, which contain the complete results for the ambient monitoring of toxic materials from the past state fiscal year. The Microsoft Excel® workbooks that contain the graphs of historical toxics concentrations also include worksheets with descriptive statistical summaries of historical data arranged as follows:

(1) Historical data arranged by state fiscal year for all toxic parameters in the class;
(2) Historical data arranged by toxic parameter for years 1997 through the present.

Note: Because of restrictions for naming electronic folders and files, the names of some folders and files stored on disk may not appear exactly the same as those listed below.

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Glossary of Acronyms, Abbreviations and Technical Terms

Ambient Monitoring	The monitoring of physical and chemical characteristics within the Commonwealth's rivers, streams, lakes and estuaries. Ambient monitoring and assessment characterize ecological stressors and evaluate their potential impact on aquatic organisms and other wildlife, and on human health and recreational use of Virginia's waters.
AMD	Acid Mine Drainage
Aroclor	Aroclors ® - technical mixtures of PCBs made by Monsanto during the period of the 1930s through 1977.
ALU	Aquatic Life Designated Use
B4B	Businesses for the Bay Program
BDE	Bromated diphenyl ether
B-IBI	Benthic Index of Biotic Integrity
BTU	British Thermal Unit - the amount of energy required to increase the temperature of 1 pound of water by 1 degree Fahrenheit, at normal atmospheric pressure.
CBP	Chesapeake Bay Program
CEDS	Comprehensive Environmental Data System
CIMS	CBP Information Management System
Compliance Monitoring	The monitoring of in-pipe concentrations of permitted discharges, which is one element in the prevention of contamination by toxics. Compliance monitoring evaluates whether or not the concentrations of potential pollutants in industrial, municipal or other permitted discharges are within the allowable limits specified in their permits.
CPMI	Coastal Plain Macroinvertebrate Index – used to evaluate the health of freshwater benthic communities in the Coastal Plain Region of Virginia
CVs	Consensus-Based Sediment Quality Guidelines – Critical values for contaminants in freshwater sediment (replace freshwater use of previously utilized ER-L and ER-M values intended for assessment of estuarine and marine sediments; MacDonald et al. 2000). See also PEC, below.
CWA	Federal Clean Water Act (1983) that first described the scope and purpose of water quality standards and defined the authority and responsibility of the U.S. EPA and the various states in relation to the requirements for, submission of, and establishment of such standards.
DCLS	Division of Consolidated Laboratory Services
DEQ	Department of Environmental Quality
DMR	Discharge Monitoring Report
EDAS	Ecological Data Application System (database)
EEC	Extreme Effects Concentration – the concentration of a contaminant above which adverse effects to sediment-dwelling organisms frequently or always occur
ELG	Effluent Limitation Guidelines
EMAP	Environmental Monitoring and Assessment Program – US Environmental Protection Agency
EMS	Environmental Management System
ER-L	Effects Range-Low
ER-M	Effects Range-Moderate
EPA	Environmental Protection Agency
FY	Fiscal year
IBI	Index of Biological Integrity
ICPRB	Interstate Commission for the Potomac River Basin

IR "Integrated Report" – abbreviation for the 305(b)/303(d) Water Quality Integrated Assessment Report

IRIS Integrated Risk Information System - a database of human health effects that may result from exposure to various substances found in the environment. IRIS is provided online by EPA and its Office of Research and Development, National Center for Environmental Assessment. (http://cfpub.epa.gov/ncea/iris/index.cfm)

MAIA Mid-Atlantic Integrated Assessment carried out by the US EPA Environmental Monitoring and Assessment Program (EMAP)

MEC Midrange Effect Concentration – the concentration of a contaminant above which adverse effects to sediment-dwelling organisms frequently occur

MGD Millions of Gallons per Day

Microgram (µg or ug) One millionth of a gram.

MonPlan Annual Water Quality Monitoring Plan

MY Monitoring Year

Nanogram (ng) One billionth of a gram

NARS National Aquatic Resources Survey

NCCA National Coastal Condition Assessment

NELAP National Ecological Laboratory Accreditation Program

NOAA National Oceanic and Atmospheric Administration

NPEP National Partnership for Environmental Priorities

NPS Non-Point Source (pollution)

OC-Pesticides or OCP Organo-chlorinated Pesticide

OEE Office of Environmental Education

OP-Pesticides or OPP Organo-phosphorylated Pesticide

OPP or OP2 Office of Pollution Prevention

PAH Polycyclic Aromatic Hydrocarbon

PBTs Persistent Bioaccumulative Toxics – Toxic substances that accumulate (bio-concentrate) and persist in the tissues of living organisms.

PCB Polychlorinated biphenyl

PEC Consensus-based *Probable Effects Concentrations* for chemical contaminants in freshwater sediments (MacDonald et al. 2000). See also CV, above.

Picogram (pg) One trillionth of a gram

PMP Pollutant Minimalization Plan - An iterative plan with a programmed schedule and final goal for the reduction (minimalization) of toxic discharge (e.g. in particular PCBs) from a permitted point source. It supplants the necessity of establishing a reduced, fixed numerical limit which may be impossible to attain for a permitted discharge.

POTW Publicly Owned Treatment Works

P2 or PP Pollution Prevention Program

ProbMon Probabilistic Monitoring Program

QAPP Quality Assurance Program and Project Plan

RBP Rapid Bioassessment Protocol

SFY State Fiscal Year (July 1 – June 30)

SIC Standard Industrial Classification

SOP Standard Operating Procedure

SPMD Semi-Permeable Membrane Device

STORET EPA's legacy national ecological database (short for data 'STOrage and RETrieval' system)

SV Screening Value

TBT Tributyltin

TEC	Threshold Effect Concentration – the concentration of a contaminant below which adverse effects to sediment-dwelling organisms are unlikely to occur
TMDL	Total Maximum Daily Load
TMP	Toxics Management Program
TMR	Toxics Management Regulation
TOC	Toxics of Concern
TRE	Toxics Reduction Evaluation
TRI	Toxic Release Inventory - The Toxics Release Inventory documents the total quantities of EPA-listed toxic compounds that are released annually (to the waters, the air and the land) by permitted facilities within the Commonwealth. Changes in the quantities of toxics released are indicative of the effectiveness of pollution prevention programs, but are not an adequate or representative measure of environmental impact or impairment.
TRISW	Toxics Reduction in State Waters (report)
TSV	Tissue Screening Value – risk-based screening values used by DEQ and VDH for evaluating fish-tissues for human consumption
USGS	United States Geological Survey
VISE	Virginia Information Source for Energy (Website)
VDH	Virginia Department of Health
VEEP	Virginia Environmental Excellence Program
VELAP	Virginia Environmental Laboratory Accreditation Program
VERC	Virginia Emergency Response Council
VIMS	Virginia Institute of Marine Science
VMN	Virginia Mentoring Network
VPDES	Virginia Pollutant Discharge Elimination System
VPI	Virginia Polytechnic Institute and State University
VSCI	Virginia Stream Condition Index – used to evaluate the health of freshwater benthic communities in the Piedmont and Mountain Regions of Virginia.
WET	Whole Effluent Toxicity
WQBEL	Water Quality Based Effluent Limitation
WQM	Water Quality Monitoring
WQMA	Office of Water Quality Monitoring and Assessment
WQS	Water Quality Standard(s)
WQX	Water Quality Exchange – EPA's new generation water quality information storage database, which has replaced the legacy STORET database.
WTPs	Water Treatment Plants
WWTPs	Wastewater Treatment Plants

Executive Summary

The Virginia Department of Environmental Quality (DEQ) submits the annual Toxics Reduction in State Waters (TRISW) Report to the Governor and General Assembly of the Commonwealth on January 1st of each year, in accordance with Virginia Code § 62.1 - 44.17:3.

The primary objective of the TRISW Report is to document the Commonwealth's progress toward reducing toxics in state waters and consequently improving water quality. This commitment includes three principal types of activities: (1) the prevention of contamination of the Commonwealth's waters by toxics, (2) the continued monitoring of those waters for the presence of toxics and (3) the implementation of remedial measures to reduce and/or eliminate toxics found in the Commonwealth's waters.

Prevention

Permitting: Compliance monitoring, the monitoring of in-pipe concentrations of permitted discharges, is one essential element of the prevention of contamination by toxics of the Commonwealth's waters. During State Fiscal Year 2012 (SFY12), DEQ's Toxics Management Program (TMP) included 277 reporting facilities with 570 outfalls that had active permit-defined toxics limits in their effluents, as recorded in DEQ's Comprehensive Environmental Data System (CEDS) database. Approximately 2.23% of 4,080 individual parameter records exceeded the permitted average concentration and 1.75% of 6,067 exceeded their maximum permitted concentrations; almost all were incidental elevations of total metals (copper, zinc) in discharges from municipal wastewater treatment plants.

Pollution Prevention: The 2012 Pollution Prevention Annual Report should be available on the DEQ Website at http://www.deq.virginia.gov/Programs/PollutionPrevention.aspx on January 1, 2013. Among the highlights of Pollution Prevention successes affecting reduction of toxics in state waters in the past year are the following:

- Virginia still provides performance-based permit fee discounts (from 2 to 20%) for "going beyond compliance." In 2012, over $138,000 in fee discounts were distributed among Virginia Environmental Excellence Program (VEEP) facilities that implemented and carried out their Environmental Management System (EMS) plans.
- A review of VEEP annual performance for 2012 reported a 30% reduction in the use of hazardous materials and a decrease of 99% in hazardous waste disposal during the past two years.
- Total water use was reduced 5% during the past two years, and the reduction of energy consumption continues to be a priority.
- DEQ's Voluntary Mercury Reduction Initiatives also have been continued successfully. More than 30 facilities participating in the "Virginia Switch Out" Project for the recycling of automotive mercury switches have pledged to remove 1,500 switches, the equivalent of almost five pounds of mercury. To date nearly 67,000 switches have been collected, equating to more than 150 pounds of mercury. Nearly 40 facilities have also pledged to annually recycle over 55,000 energy efficient fluorescent light bulbs, which also contain small quantities of mercury. (Refer to DEQ's Mercury Reduction WebPages - http://www.deq.virginia.gov/Programs/PollutionPrevention/MercuryReduction.aspx.)

Environmental Education: In the past, DEQ's Office of Environmental Education (OEE) has contributed to toxics reduction in various ways. On July 1st 2012 various components of OEE were transferred from DEQ to the Department of Conservation and Recreation (DCR), including: the Virginia Naturally Program (website, newsletter, partners map), Environmental Educators Leadership Program, Regional Environmental Education Team coordination, and the Annual Environmental Education Conference. Virginia Naturally Partner Grants during 2012 totaled $11,083.00, awarded for 18 projects associated with

17 different organizations. Summaries of 2012 activities within these components of environmental education can be found at http://www.dcr.virginia.gov/virginia_naturally/index.shtml.

In SFY 2012 twenty-one additional educators enrolled in the Environmental Educators Leadership Program (EELP), with seventeen receiving recognition of their accomplishments in Water, Coastal, and Forestry education.

Project WET (Water Education for Teachers) - http://www.deq.virginia.gov/ConnectWithDEQ/EnvironmentalInformation/ProjectWet.aspx - has remained at DEQ. WET is an international organization whose mission is to reach children, parents, teachers and community members of the world with water education. In the past year 255 formal and non-formal educators have been trained in WET through a series of 6-hour workshops. These educators have learned about the state of Virginia waters, have gained a better understanding of Virginia watersheds, examined the impacts that humans have on our waters, and studied best management practices. Each of these educators received the Curriculum and Activity Guide 2.0, a full-color 592 page book with 64 multi-disciplinary water-related activities, to use as they educate Virginia's children.

The Watershed Educators Institute (WEI), unique to DEQ, was established three years ago with a grant from the National Oceanic and Atmospheric Association (NOAA). It consists of a series of ten one and two day workshops on a variety of water quality and watershed topics, and currently has 42 formal and non-formal educators enrolled. A participant who receives 30 hours of training is formally recognized as a watershed educator leader in Virginia. In SFY 2012 thirty-four educators received recognition while over 70 participated in one or more workshops.

Toxics Release Inventory (TRI): The Toxics Release Inventory documents the total quantities of EPA listed toxic compounds that are released annually to waters, air and the land by permitted facilities within the Commonwealth. Changes in the quantities of toxics released are indicative of the effectiveness of pollution prevention programs, but are not an adequate or representative measure of environmental impact or impairment.

The TRI Report is available on the DEQ Website at: http://www.deq.virginia.gov/Programs/Air/AirQualityPlanningEmissions/SARATitleIII.aspx. It summarizes data from calendar year 2010, during which 423 Virginia facilities filed 1,491 individual reports on the release, transfer, or management of TRI chemicals or chemical categories. Statewide toxic releases to the water totaled approximately 18.02 million pounds or 39% of the total onsite releases to all media during 2010. This quantity represents a 2.7% decrease compared to what was released to the water in 2009. Nitrate compounds (17.38 million pounds) represented 96.47% of all TRI chemicals released to water. Nitrates, however, are of much more concern for their effects as nutrients rather than as toxics. Toxics criteria for dissolved nitrates in drinking water were not exceeded during SFY 2012.

Monitoring

Water Quality Monitoring (WQM) Programs: Ambient water quality monitoring consists of the measurement of physical and chemical characteristics within the Commonwealth's streams, rivers, lakes, reservoirs and estuaries. Ambient monitoring and assessment characterizes ecological stressors and evaluates their potential impact on aquatic organisms and other wildlife, and on human health and recreational use of Virginia's waters.

Periodic updates and revisions of the agency's WQM Strategy are necessary as part of the continual planning process within DEQ's Water Quality Monitoring and Assessment (WQMA) Program. By 2008, the monitoring program had fully implemented two major changes in the 2007 WQMA Strategy that affected toxics monitoring and assessment; the adaptation of the monitoring program to the newly delineated sub-watersheds of the National Watershed Boundary Dataset (NWBD) and the realignment of the monitoring year to correspond with the calendar year rather than the state fiscal year. Between 2002 and 2012, more than 98% of the Commonwealth's 1247 small watersheds were monitored.

Summer (Jun-Sep) of 2012 was the twelfth year of DEQ's Estuarine Probabilistic Monitoring (ProbMon) Program and the spring and fall of 2012 comprised the twelfth year of its Freshwater ProbMon Program. Because of resource limitations, the sampling and analysis for sediment organic contaminants was suspended at freshwater ProbMon sites in SFY07. Sediment chemistry (metals and organics) sampling and toxicity testing were continued at estuarine ProbMon sites during the 2011 field season (SFY12) with resources provided by a probabilistic survey-targeted supplement to the federal §106 grant and DEQ general funds.

In the 2012 305(b)/303(d) Water Quality Integrated Assessment Reports (2012 Integrated Report), sediment chemistry, sediment toxicity and benthic taxonomic results from DEQ's Estuarine Probabilistic Monitoring Program were used for a toxics-related "Weight-of-Evidence" assessment of aquatic life use at 300 estuarine sites samples over the most recent six years (2005 – 2010). These results, primarily from minor tidal tributaries, complement those from the Chesapeake Bay Program's benthic probabilistic monitoring program, which emphasizes the Bay mainstem and extensive mainstem areas of major tidal tributaries. More recent ProbMon results from a 2010 survey at 50 near-shore oceanic sites were also incorporated into the 2012 Integrated Report. An additional line of chemical evidence, based on the solubility of polycyclic aromatic hydrocarbons (PAHs) present in the sediment, was added to the weight of evidence assessment procedure in 2006 (analysis of 2005 data). The analytical data from the 2011 Estuarine ProbMon Program (SFY2012) are included in the tables and folders of this TRISW Report.

DEQ's Fish Tissue and Sediment Monitoring Program was revived in the summer of 2012 after having been suspended since 2009 because of limited resources (http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/FishTissueMonitoring.aspx). Fish tissue and/or sediment samples were collected from 38 sites, primarily in the New River and James River basins (with special emphasis on the Elizabeth River). The sites were selected to gather supplemental analytical chemical data for the development and/or implementation of Total Maximum Daily Loads (TMDLs) for segments of water bodies which have been included in previous 305(b) Report /303(d) Impaired Water Listing due to contamination of fish by polychlorinated biphenyls (PCBs). All samples have been frozen and are being maintained at DEQ awaiting certification of the analytical labs contracted for sample analyses. Results from the analyses are expected in 2013, in time for inclusion in the 2014 305(b)/303(d) Water Quality Integrated Report.

Assessment and Remediation

Assessment: The 2012 Integrated Report identified 13,145 miles of impaired streams and rivers, 94,041acres of impaired lakes, and 2,128 square miles of impaired estuaries. Of those impaired by toxics, over 99% were listed for fish consumption advisories, primarily for PCBs (6% of impaired river miles, 66% of impaired lake acres, and 91% of impaired estuaries) or mercury (11% of river miles, 49% of lake acres, and less than 1% of estuaries). These figures will be updated with the completion of the 2014 Integrated Report. Because the number of segments united into each Total Maximum Daily Load (TMDL) varies with the hydrography and the extent of the impairment, the exact number and schedule of toxics-

related TMDLs to be developed and implemented is not certain. DEQ's PCB Strategy (2005) established priorities for TMDL development and discusses various options for remediation. Analyses for the 2014 Integrated Report will begin in 2013, and any new PCB-impaired segments will be integrated into the Strategy.

Remediation / Reduction: In April 2011 a TMDL for mercury in the North Fork Holston River was approved by EPA. Three additional toxics-related TMDLs have been phased for completion in 2013; (1) Levisa Fork and Garden Creek of the Big Sandy basin – PCBs, bacteria, sediment, (2) Smith River watershed – potential PAHs (phased benthic), and (3) Powell River of the Tennessee basin - TDS, TSS, potential PAHs (phased benthic).

PCB TMDL development initiated for the upper tidal James River and the Elizabeth River in 2009 has continued with periodic sampling for PCB model calibration. Public meetings were held in December (2010) and January (2011). Completion of this extensive TMDL is scheduled for 2014. The agency's TMDL history, current status and development plans are available at http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/TMDL.aspx.

As these TMDLs are completed and scheduled for implementation, and others are added, follow-up monitoring will be initiated to evaluate their effectiveness in reducing toxics contamination. The effective implementation of these TMDLs should result in measurable reductions of contaminants in a number of the state's watersheds within a few years.

A number of water bodies and/or segments previously listed for various toxics were recently removed from the 303(d) list (2012 Integrated Report). They are listed in "Appendix K.2 – Delisted Toxics-Impaired Segments 2012 IR."

Continued Commitment

DEQ continues its commitment to toxics reduction by the prevention of contamination, continued water quality monitoring, and the implementation of remedial measures. The Virginia Pollutant Discharge Elimination System, the Pollution Prevention Program, and the Environmental Education Program join with other agencies, programs and stakeholders to promote public awareness, as well as to control and reduce toxics releases. The Toxics Release Inventory and various water programs constantly monitor and document the release to, and the presence and movement of toxics in, aquatic environments. Close coordination between monitoring and assessment activities will identify new sources of contamination as they occur and document the effectiveness of load allocations and other remedial measures developed and implemented by the TMDL Program. The agency anticipates significant reductions of toxics in the state's waters as a result of continued TMDL implementation.

Foreword

State Fiscal Year 2012 Toxics Reduction in State Waters Report (January 2013)

The Virginia Department of Environmental Quality (DEQ) plans and executes its Ambient Water Quality Monitoring Program on an annual basis. Guidelines for the program include:

- A long-term Water Quality Monitoring and Assessment (WQMA) Strategy, revised and accepted by EPA Region 3 in April of 2007 (another revision will be prepared and submitted in 2013),
- Formal Quality Assurance Program and Project Plan (QAPP),
- Established Standard Operating Procedures (SOPs), and
- Standardized Sampling Protocols.

The agency's annual monitoring program plan (MonPlan) corresponds with the calendar year. This helps synchronize various monitoring activities and assessment periods with the 'ecological' or 'water year'. The Monitoring activities summarized in this Toxics Report, however, refer to the State Fiscal Year (SFY - July 1 of each year through June 30 of the following year) in order to provide complete analytical results by January 1.

The SFY12 Toxics Reduction in State Waters Report (TRISW - Jan 13 - fifteenth in the series) summarizes all toxics monitoring and reduction activities carried out between July 1, 2011 and June 30, 2012. The historical summaries of toxics monitoring results in Folders 3 through 6 are cumulative, with the addition of the corresponding year's results in each new report.

To minimize the size of the report, reduce production time and costs, and facilitate its distribution to interested parties, the data tables, figures and appendices of this report are presented in their complete form on, and may be downloaded from the DEQ WebPages at http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring.aspx. Electronic copies of the complete report, including tables, figures and appendices, are available on CD upon request.

In the Water Quality Monitoring section, data summaries of yearly sets of monitoring results are available in both tabular and graphical forms. Graphical summaries of historical toxics monitoring results (which use statistical interval estimates for median parameter values) will continue to appear with each annual report to assist in the evaluation of:

- Two- to five-year (short-term) changes in water and sediment quality,
- Differences among drainage basins (contemporary, geographic trends) year by year, and
- Differences among years within individual basins (basin-specific, short-term temporal variations).

Eventually, as each year's results are added to the report, historical results in the form of graphed statistical interval estimates will facilitate the visual evaluation of longer-term trends. Graphed historical summaries (SFY97 – SFY12) for each major drainage basin appear in this year's report, but the relatively short period of record and changes in methodologies and detection limits make the interpretation of trends difficult.

1.0 Introduction

The Virginia Department of Environmental Quality submits a Toxics Reduction in State Waters (TRISW) Report to the Governor and the General Assembly of the Commonwealth by January 1st of each year, in accordance with Chapter 3.1, Title 62.1, § 62.1-44.17:3 of the Code of Virginia.

1.1 The Report: Toxics Reduction in State Waters

The primary objective of the TRISW Report is to document the state's commitment to improving water quality, specifically, in relation to chemical contamination which may induce toxic effects on aquatic life, other wildlife or on human health. This commitment includes:

1. The prevention of contamination of the Commonwealth's waters by toxics,
2. The persistent monitoring of the those waters for the presence of toxics, and
3. The implementation of remedial measures to reduce and/or eliminate toxics found in the state's waters.

Each report provides a summary of the toxics-related prevention, monitoring and remediation activities of the previous State Fiscal Year.

Although the reduction of toxics in the state's waters is primarily the responsibility of the DEQ, various agencies and organizations participate in the process, including the Virginia Department of Conservation and Recreation (DCR), the Virginia Department of Health (VDH), the Environmental Protection Agency's (EPA) Interstate Chesapeake Bay Program Office (CBPO), and the U.S. Geological Survey (USGS). This report summarizes the results of current activities directed toward toxics reduction and provides guidance on how to access further resources and information on specific subjects.

DEQ submitted the first TRISW Report in January 1998. The January 1999 report provided basic background information related to the report's objectives and a basic model for its continued evolution. The current, fifteenth TRISW Report (January 2013) contains tables of both raw data and statistical summaries of SFY12 monitoring results, as well as cumulative graphical summaries of results from 1997 through the present.

1.2 Functional Definitions: Toxicity, Water Quality Criteria, and Water Quality Standards

1.2.1 Defining "Toxicity":

The Virginia Code (Chapter 3.1, Title 62.1, § 62.1-44.17:2) defines "toxicity" as "the inherent potential or capacity of a material to cause adverse effects on a living organism, including acute or chronic effects on aquatic life, detrimental effects on human health, or other adverse environmental effects." This definition is rather broad, since an excess or even a deficit of many non-toxic substances can also cause adverse effects, both acute and chronic, on living organisms. This report consequently restricts the definition of "toxicity" to include only those substances that are directly and "chemically" detrimental to living organisms when they are "in excess." Direct chemical effects would exclude the physical effects of excess sedimentation or the indirect effects of nutrient enrichment, for example, both of which would also be detrimental to aquatic life. Furthermore, the concept of "other adverse environmental effects" must be defined in biological terms, since toxicity can only be observed, described, and quantified in relation to living organisms. The classification of chemical substances ("a material") within the category of "toxics" (those that cause

toxicity) is always based on the observed effects of their presence on specific living organisms. In fact, the concept of "excess" itself is defined in terms of the concentrations at or above which living organisms experience detrimental effects.

Toxicity varies among chemical substances. The absolute amount and relative concentration of a substance necessary to demonstrate "deleterious effects" also varies. The Federal Clean Water Act (CWA) defined the responsibility of the Environmental Protection Agency in identifying the critical concentrations at which distinct chemical substances begin to elicit a specified degree of deleterious effect, and establishing the associated "Water Quality Criteria" to identify impaired waters.

1.2.2 Federal Water Quality Criteria:

The CWA first described the scope and purpose of water quality standards and defined the authority and responsibility of the EPA and the various states in relation to the requirements for, submission of, and establishment of, such standards. Since then, EPA has published various lists of toxic materials for which the movement, use, and/or release into the environment must be documented or for which concentrations in the environment must be monitored and their effects assessed and subsequently controlled. EPA reviews the results of published studies (both academic and commercial) and conducts its own research to determine what concentrations of chemical substances are detrimental to aquatic life, other wildlife and human health, and to what degree. Based on the results of this evaluation "Water Quality Criteria" may be established for freshwater, saltwater or drinking water, identifying the concentrations that induce direct chronic or acute toxic effects on aquatic life, subsequent poisonous effects on wildlife or humans, or long term carcinogenic (cancer producing) effects on human health.

- On December 22, 1992, the EPA published in the *Federal Register* a comprehensive list of 126 chemical substances for which it had established water quality criteria related to aquatic life in freshwater and saltwater and/or to human health risks.
- Subsequent studies often (1) identified additional toxics for which criteria were established, or (2) resulted in the establishment of new criteria for previously defined toxics. The list was modified during the ensuing years. For example, the EPA's publication of conversion factors in May 1995 lowered the acute and chronic freshwater criteria and the acute saltwater criteria for the dissolved metals arsenic, cadmium, chromium III and VI, copper, lead, mercury, nickel, silver, zinc, and selenium.
- The EPA provides its most recent complete list of nationally recommended water quality criteria for both priority (120) and non-priority (47) toxic pollutants in electronic form on the EPA website at: http://www.epa.gov/waterscience/criteria/wqcriteria.html.
- Additional modifications of existing criteria, as well as the establishment of criteria for new substances, continue to update the EPA list and help maintain or improve the quality of the nation's waters. Detailed information on recent updates may be found at:
    - Aquatic Life: http://www.epa.gov/waterscience/criteria/aqlife.html#final
    - Human Health: http://www.epa.gov/waterscience/criteria/humanhealth/15table-fs.htm

1.2.3 State Water Quality Standards - WQS:

Once federal "Water Quality Criteria" have been established for a chemical substance, it is the responsibility of the individual states to establish "Water Quality Standards" within state laws and regulations that are protective of the "designated uses" assigned to each body of water. The most commonly designated uses include the support of aquatic life, other wildlife, fish consumption, shellfish consumption, human primary contact (swimming) or secondary contact (fishing, boating) recreation, and public water supplies (where applicable).

The Commonwealth of Virginia has established and periodically revised its water quality standards, which EPA reviews and must approve prior to their application. These standards are set forth at 9 VAC 25-260. These state standards undergo a formal triennial review for periodic updating. In reality, the Commonwealth's WQS are almost constantly under review. The most recently adopted WQS (Jan 2011) are presented in their entirety in Appendix A and are also available on the DEQ website at http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityStandards.aspx. No toxics-related triennial review activities took place during SFY2012; the review process should resume in 2013. The current Virginia Water Quality Standards, with the most recent amendments, became effective upon EPA approval on January 6, 2011.

1.3 Federal Reporting Requirements

In addition to the biennial 305(b)/303(d) Water Quality Integrated Report, federal law requires reporting procedures for the production, movement, storage, use, and release of many of these toxic substances. These procedures, as well as Virginia's annual Toxics Release Inventory (TRI) Report, are discussed more fully below.

2.0 Activities Directed toward Toxics Reduction

As indicated above, DEQ's activities directed toward the reduction of toxics in state waters fall into three general categories: the prevention of contamination of the Commonwealth's waters by toxics, the monitoring of those waters for the presence of toxics, and the implementation of remediation to reduce and/or eliminate toxics found in the state's waters. All three classes of activity are geared toward maintaining the concentrations of potentially toxic substances in the state's waters below those concentrations that result in toxic effects, *i.e.*, within the bounds defined by water quality standards, with the knowledge that many such substances can never be completely eliminated from the environment.

2.1 Prevention

The primary prevention activities carried out by DEQ may be characterized as regulatory, non-regulatory, and educational.

The regulatory Virginia Pollutant Discharge Elimination System (VPDES) requires that concentration limits be established for all potentially toxic substances in permitted discharges from industrial, institutional, and/or municipal wastewater treatment facilities to ensure that Virginia's water quality standards are not violated in the water bodies receiving such discharges.

The non-regulatory programs of the Office of Pollution Prevention (OPP) encourage industries, commercial enterprises, governmental and private facilities throughout the Commonwealth to establish Environmental Management Plans (EMPs) to minimize the use of hazardous materials, and to maximize the recycling of wastes and the use of "green products and services."

In the past, the DEQ Office of Environmental Education (OEE) has provided environmental orientation and educational programs for teachers and students through electronic newsletters and other outreach activities (workshops and other training events, meaningful watershed experiences, oyster and fish festivals, etc.) to foster environmental stewardship, including non-competitive litter prevention and recycling grants. On July 1, 2012 various components and/or activities of OEE were transferred from DEQ to DCR: Virginia Naturally (website, newsletter, partners map), Environmental Educators Leadership Program, Regional Environmental Education Team coordination, and Annual Environmental Education Conference.

2.2 Monitoring and Assessment

The VPDES Program performs end of pipe compliance monitoring in the form of announced and unannounced facility inspections, as well as requiring permitted facilities (industrial and municipal) to monitor their discharges and to file periodic electronic Discharge Monitoring Reports (DMRs) to document their compliance with permit limit requirements.

DEQ's integrated ambient WQM Program collects water, sediment, benthic organisms, and fish tissue samples from the Commonwealth's streams, rivers, lakes and reservoirs, and estuaries to document compliance with water quality standards and sediment and fish tissue screening values. The structure and integration of the various components of the ambient WQM Program are described in detail in DEQ's Water Quality Monitoring Strategy, available on the DEQ website at:http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring.aspx . The major components involved with toxics monitoring include the freshwater and estuarine probabilistic monitoring networks, and special studies, including the TMDL Program. Some program specific monitoring also contributes to the toxics efforts: the Chesapeake Bay Program, the Lakes Monitoring Program, the Biological Monitoring Program, and the Targeted Fish Tissue and Sediment Monitoring Program.

DEQ's SARA Title III Program receives annual electronic TRI summaries from reporting facilities statewide, and produces an annual TRI Report, as prescribed by federal regulations, that documents the movement, on site disposal, off site transfer, and release of toxic materials to the air, water and land.

2.3 Remediation

Although DEQ participates in several programs that deal with the remediation of toxic contamination (e.g., Brownfields Program, Federal Facilities Program, Superfund Program, etc.), the primary agency driven program involved in remediation of toxics related impairments in aquatic environments is the Total Maximum Daily Load (TMDL) Program. Once impaired waters have been identified, it is the responsibility of the TMDL Program to confirm the cause of the impairment, identify its source(s), and develop plans to restore and maintain the water quality. TMDL is a term that represents the total pollutant (toxicant) a waterbody can assimilate and still meet water quality standards. Once a TMDL has been reviewed and approved by EPA, an implementation plan (based on the TMDL) is developed for reducing the input of the associated toxics into the system. Depending on the type of toxicant, its source(s), and the historical background of the contamination, implementation may include reducing permit limits for a toxicant in the discharge from a permitted facility or, in the specific case of PCBs, establishing programmed Pollutant Minimalization Plans (PMPs) with permitted point sources, executing Best Management Plans (BMPs) for non-point sources or, on occasion, the physical removal of contaminated substrate from legacy point sources.

2.4 Analysis of Toxics from Ambient Waters

The majority of toxics related samples collected by the ambient WQM Program are analyzed by the Division of Consolidated Laboratory Services (DCLS) of the Virginia Department of General Services, although academic or commercial laboratories may be contracted for some specialized analyses. Toxic elements and chemical compounds are generally categorized into several primary groups, each of which has specific codes to identify the procedures necessary for its complete chemical analysis by DCLS. The primary groups considered include:

- Clean dissolved and total trace metals in the water column,
- Toxic metals in the sediment,
- Dissolved organic contaminants,
- Organic contaminants in the sediment, and
- Toxic metals and organics in fish tissues.

The data summaries provided in the following sections of this report are organized to correspond to these categories. Various groups of toxic organic compounds (*e.g.*, PAHs, other semi-volatiles, and PCBs) are often evaluated together with pesticides.

3.0 Toxics-Related Results – SFY2012

3.1 Prevention

3.1.1 Reduction of Toxics by Pollution Prevention

DEQ's Office of Pollution Prevention (OPP) contributes to the reduction of toxics in the state's waters through its multimedia (i.e., air, water, and waste) non-regulatory Pollution Prevention (P2) Program. The

P2 Program focuses primarily on the reduction of resource consumption and solid wastes. The reduction of resource consumption and waste, however, also reduces the movement, use, and release of toxic materials. Such reductions occur not only within the consumer population but also among retail outlets and among industries using and/or producing toxic materials. .

The annual Pollution Prevention Report, submitted to the Governor and the General Assembly in December of each year, describes OPP's activities for the year. The 2012 report summarizes the pollution prevention strategies developed and implemented by the Virginia Pollution Prevention Program. The current annual report characterizes activities carried out by the major components of the Pollution Prevention Program during calendar year 2012, several of which are briefly summarized below.

- **Virginia Green Tourism** - Virginia Green (VG), the Commonwealth's voluntary initiative to promote pollution prevention within the tourism industry, began its pilot phase in 2006. In June of 2011, the program achieved its initial goal of 1000 participants, and at the end of September 2012 membership had reached 1,200. Among the participants are included permanent tourist attractions, conference and convention centers, tourist events, lodging facilities, restaurants, travel organizations, visitor centers and numerous other partners, all dedicated to minimizing their impact on the environment by maximizing the use of recyclable materials, reducing water and energy use, and purchasing and using eco-friendly "green" services and products. The addition of category specific VG applications has contributed to the growth of the program, with a "transportation facilities" category included in 2012 and "breweries" category currently under development. The Virginia Green Suppliers Network has grown to over 100 members since it was established in September 2010, and provides sources for, and offers specials to, VG participants interested in green products and services. DEQ and the Virginia Tourism Corporation work together to promote the VG Program. New efforts include the overhaul of the website and the production of posters, window placards, flags and promotional signs, and offer the free use of large banners for VG events. Partnership with the Keep Virginia Beautiful Program has provided a grant to purchase 275 recycling bins for the use of Virginia visitors; in the fall of 2012 special ceremonies were held at three of Virginia's state parks to showcase the recycling bins.

- **Virginia Environmental Excellence Program (VEEP) -** There are four types of participation options for interested facilities: (1) E2 (Environmental Enterprise) for facilities that have made significant progress toward the development of an Environmental Management System (EMS), have made a commitment to pollution prevention, and have a record of sustained compliance with environmental regulations, (2) E3 (Exemplary Environmental Enterprise) for facilities that have exceeded the E2 requirements and have a fully-implemented EMS, (3) E4 (Extraordinary Environmental Enterprise) for facilities that have exceeded the E3 requirements, have completed at least one full cycle of an EMS as verified by a third-party auditor, and have demonstrated a commitment to continuous and sustainable environmental progress and community involvement, and (4) SP (Sustainability Partners), the newest VEEP track, which is designed to encourage organizations to make environmental sustainability part of their culture through leadership, innovation, and continual improvement.

  Seventeen facilities were honored during ten special recognition ceremonies in 2012. Virginia still provides performance-based permit fee discounts for "going beyond compliance." Potential discounts vary by category: 5-20% for hazardous waste reduction, 10-20% for solid waste reduction, and 2-20% for reduction of water use and release. In 2012, over $138,000 in fee discounts were distributed among VEEP facilities.

- A review of VEEP annual performance reports for 2010-2012 indicated the following changes from baseline reference values. Total water use was reduced by 5% (2.645 billion gallons versus 2.795 billion gallons). The use of hazardous materials decreased by 30% (309 tons versus 440 tons), and hazardous waste disposal was reduced by 99% (1,440 tons versus 192,600 tons), along with a 19% increase in the recycling of hazardous materials. At least $32 million in cost savings were realized during this process.

- **Voluntary Mercury Reduction Initiatives** – The Voluntary Mercury Reduction Initiatives have also been successful. Members of the "Virginia Switch Out" Project for the recycling of automotive mercury switches have removed nearly 67,000 switches, and recycled more than 150 pounds of mercury since 2006, when the program was initiated. Other facilities have pledged to annually recycle over 55,000 energy efficient fluorescent light bulbs, which also contain small quantities of mercury. Additional information about the Voluntary Mercury Reduction Initiatives are available on DEQ's website at:http://www.deq.virginia.gov/Programs/PollutionPrevention/MercuryReduction.aspx.

For additional information concerning the Pollution Prevention (P2) Program, visit the DEQ website at http://www.deq.virginia.gov/Programs/PollutionPrevention.aspx.

3.1.2 Reduction of Toxics from Permitted Discharges and Compliance Monitoring of Permitted Facilities

Both private and public facilities that discharge effluents into the state's waters are required to obtain permits from the State Water Control Board. The Virginia Pollutant Discharge Elimination System (VPDES) program requires the establishment of limitations for such permits to ensure that Virginia's water quality standards are not violated in the water bodies receiving such discharges.

"Appendix B - Facilities & Outfalls with Toxics Parameter Limits SFY12" of this report lists facilities that currently have, or have applied for, permits that contain limits on the quantity or concentration of discharged toxics in their effluents. The same spreadsheet includes geographic locations, receiving streams, etc. During SFY12, 277 reporting facilities with 570 outfalls had one or more toxics limits in their permits. The effective limits (when specified) and reporting frequencies for toxics may vary, depending upon the chemical parameters involved. In some cases, a permit may have been modified, reissued, or adjusted in terms of the current limits within the past year. The current toxics parameters included in each permit, along with their limits and required reporting frequencies, are listed in "Appendix C – Permits, Parameters, Units & Frequencies SFY12." The compliance results of each permitted facility's Discharge Monitoring Reports (DMRs) during SFY12 are reported in "Appendix D – Permitted Toxics Parameters & DMR Results SFY12." Some facilities may hold permits requiring only that they report, without a limit-specified value with which they must comply. Since the facility's permit does not have a specified numerical limit, such DMR results cannot be used for compliance determinations. Of 7,459 parameter-specific DMRs filed in SFY 2012, 4,080 provided their average concentrations of a toxicant. Of these, 91 (2.23%) reports exceeded their permit limit for average concentration. Parameter-specific maximum concentrations were reported in 6,067 DMRs. Of these, 106 (1.75%) exceeded the limit specified in their permit. Almost all of these were short-term exceedances for total recoverable copper or total recoverable zinc at municipal wastewater treatment plants. Runs of three or more consecutive exceedances of maximum concentration limits were only observed ten times; eight times for total recoverable copper and twice for zinc, primarily at either municipal or institutional Waste Water Treatment (WWTP) or Sewage Treatment (STP) Plants.

3.1.3 Reduction of Toxics by Environmental Education

In the past, DEQ's Office of Environmental Education (OEE) has contributed to toxics reduction in various ways. On July 1st 2012 various components of OEE were transferred from DEQ to DCR: the Virginia Naturally Program (website, newsletter, partners map), Environmental Educators Leadership Program, Regional Environmental Education Team coordination, and the Annual Environmental Education Conference. Virginia Naturally Partner Grants during 2012 totaled $11,083.00, awarded for 18 projects associated with 17 different organizations. Summaries of additional 2012 activities within these components can be found at http://www.dcr.virginia.gov/virginia_naturally/index.shtml.

In SFY 2012 twenty-one additional educators enrolled in the Environmental Educators Leadership Program (EELP), with seventeen receiving recognition of their accomplishments in water, coastal, and forestry education.

Project WET (Water Education for Teachers) has remained at DEQ. WET is an international organization whose mission is to reach children, parents, teachers and community members of the world with water education. In the past year 255 formal and non-formal educators have been trained in WET through a series of 6-hour workshops. These educators have learned about the state of Virginia waters, have gained a better understanding of Virginia watersheds, examined the impacts that humans have on our waters, and studied best management practices. Each of these educators received the Curriculum and Activity Guide 2.0, a full-color 592 page book with 64 multi-disciplinary water related activities, to use as they educate Virginia's children. Additional information about Project WET can be found on DEQ's website at: http://www.deq.virginia.gov/ConnectWithDEQ/EnvironmentalInformation/ProjectWet.aspx.

The Watershed Educators Institute (WEI), unique to DEQ, was established three years ago with a grant from NOAA. It consists of a series of ten one- and two-day workshops on a variety of water quality and watershed topics, and currently has 42 formal and non-formal educators enrolled. A participant who receives 30 hours of training is formally recognized as a watershed educator leader in Virginia. In SFY 2012 thirty-four educators received recognition while over 70 participated in one or more workshops. The 2012-2013 Watershed Educators Institute brochure is available on DCR's website at: http://www.dcr.virginia.gov/virginia_naturally/documents/WEIbrochure12-13.pdf.

Additional information about the DCR Environmental Education Program is available at: http://www.dcr.virginia.gov/enviroed.shtml.

3.1.4 Virginia Toxics Release Inventory

Under the provisions of Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986, also known as SARA Title III, Virginia manufacturing and federal government facilities that release certain chemicals to the air, water or land, or that transfer these chemicals for off-site treatment, disposal, recycling, or energy recovery, are required to submit reports to the EPA. This information is reported on Form R - Toxic Chemical Release Inventory Reporting Form and is collectively referred to as the Toxic Release Inventory. Although the Report itself is an *a posteriori* monitoring tool, the intent of the program is to minimize the quantity, movement, and disposal of toxic materials.

The most recent Virginia Toxic Release Inventory Report (SARA Title III TRI, March 2012 for the 2010 calendar [activity] year) indicated that 423 Virginia facilities filed 1,491 individual reports on the release, transfer, or management of TRI chemicals or chemical categories:

http://www.deq.virginia.gov/Programs/Air/AirQualityPlanningEmissions/SARATitleIII/SARA313ToxicsReleaseInventory/VA2010ToxicsReleaseInventoryReport.aspx). These reports included 154 of more than 650 chemicals and chemical categories for which TRI reporting is required. This year's reporting represented an increase of approximately 0.5% from the 421 facilities and a 4.2% decrease from the 1,556 reports filed in 2009.

Statewide, the tallied toxic releases to the water totaled approximately 18.0 million pounds or 38.9% of the total onsite releases to all media during 2010. This quantity represents a 2.7% decrease from what was released to the water in 2009. On-site releases to water include discharges to surface waters, such as rivers, lakes, ponds, and streams. On-site releases to the land (~ 3.3 million lbs. or 7.2% of the total on-site releases) refer to discharges to landfills, surface impoundments, land treatment, application farming, or any other release of a TRI chemical to land within the boundaries of a facility. Some of these discharges may eventually find their way into the Commonwealth's surface waters as well. Virginia does not permit under-ground injection as a method of hazardous waste disposal; consequently, no under-ground injection of TRI chemicals was reported in 2010. An additional 24.9 million pounds (53.9%) was released to the air, either from stacks or as fugitive air. A portion of these releases may also return to the Commonwealth's soil and waterways in the form of aerial deposition.

The top ten chemicals and chemical categories accounted for more than 99.9% of the on-site TRI chemical releases to water. The top ten TRI chemicals released to water were:

TRI Chemical or Class	Annual Release to Water (2010)
1. Nitrate compounds	96.472% = 17,380,000 pounds
2. Zinc and zinc compounds	0.828% = 149,200 pounds
3. Manganese and manganese compoun	0.729% = 131,300 pounds
4. Ammonia	0.688% = 124,000 pounds
5. Barium and barium compounds	0.583% = 101,500 pounds
6. Dimethylamine	0.227% = 40,900 pounds
7. Cyclohexanol	0.207% = 37,300 pounds
8. Methanol	0.074% = 13,400 pounds
9. N-Methyl-2-pyrrolidone	0.042% = 7,600 pounds
10. Nickel and nickel compounds	0.039% = 7,000 pounds

All other releases to water totaled 0.130% and approximately 23,400 pounds. Nitrate compounds are a common byproduct of industrial and domestic wastewater treatment processes and have consistently been reported as the major chemical released to surface water. Nitrates often induce nutrient problems in water bodies at lower than toxic concentrations.

Additional information on specific groups of chemicals and the quantities of their chemical releases is available in analyses within the original report (2010 Virginia Toxics Release Inventory Report - March 2012) and is available on the DEQ Website at:
http://www.deq.virginia.gov/Programs/Air/AirQualityPlanningEmissions/SARATitleIII.aspx.

Additional sources of information on the TRI: Community Right-to-Know, including the access and use of TRI data and fact sheets for individual states, are available on EPA's website at: http://www.epa.gov/tri/. The next Virginia TRI report, summarizing toxic releases for calendar year 2011, will be available in March 2013.

3.2 Monitoring of Toxics in Ambient Waters – SFY2012

3.2.1 Surface Waters and Sediments

During the assessment process, concentrations of toxic contaminants found in the water column are compared with the corresponding Virginia Water Quality Standards (Appendix A - DEQ Water Quality Standards Jan 2011), and concentrations of toxic contaminants found in sediment are compared with the screening values found in "Appendix E - Summary of Sediment Screening Values SFY12." "Appendix G – WQM Toxics Monitoring Station Group Code List SFY12" lists all monitoring stations where water and/or sediment samples were collected for each DCLS toxics parameter group code during SFY12.

Numerous tables and folders containing raw and summarized monitoring results are described in the following sections of this report. The tables contain all the descriptive information (metadata) relative to each monitoring station, the raw data results for each analyte, and descriptive statistical summaries for the results from each major river basin during SFY12. Corresponding folders contain cumulative historical summaries of the results from each year in which a TRISW Report has been produced, by river basin and analyte. A Microsoft Excel® file titled "Introduction to Tables and Folders" is included in each of the two directories containing the Tables and Folders. This introductory file lists the specific analytes contained in each table and folder, and explains the meaning of the Program Codes associated with the samples.

At the present time, all existing water quality criteria and standards for toxic substances in water are defined in terms of dissolved concentrations. In many cases, the defined standards are extremely low concentrations, near or below the detection limits of common analytical instruments and methodologies. In the past, it was often necessary to collect and concentrate large volumes of water samples to produce meaningful results. Sampling of waters with such low concentrations of toxics also presents severe problems in terms of sample contamination. Consequently, careful planning and specific Standard Operating Procedures (SOPs) are necessary to ensure the quality control of sample collection, preservation, and transport of the sample, as well as subsequent chemical analyses, to guarantee the accuracy and defensibility of the results. A number of newly developed sampling and analytic technologies are now in use for improving the representativeness, accuracy, and precision of measuring dissolved toxics in the water column. For more detailed descriptions of these procedures, refer to the January 2007 TRISW Report.

3.2.1.1 Dissolved Metals in Surface Waters

DEQ's dissolved clean metals SOP (DEQ-WQA, 1998) is applied in the collection and analysis of 19 dissolved trace metals in freshwater and of 16 metals in brackish and saltwater samples. "Table 3.2.1.1 - Dissolved Metals in Surface Waters SFY12" presents the results of clean, dissolved metals monitoring during SFY12. Individual spreadsheets in Table 3 summarize the results from Freshwater and Estuarine Probabilistic Monitoring Programs, the Shenandoah River Basin Mercury Special Study and several TMDL and other Special Studies. Basin-by-basin historical summaries of clean dissolved metals results can be found in the Excel® workbooks of "Folder 3.2.1.1 – Historical Dissolved Metals in Surface Waters."

3.2.1.2 Total Metals in Surface Waters

Because there are no Water Quality Standards for total metals in the water column, the sampling of total metals has not historically been included in ambient water quality monitoring. In recent years, however,

sampling for benthic TMDL studies has revealed that the health of benthic communities in freshwater streams is often more highly correlated with the concentrations of total metals in the water column than with dissolved metals. Consequently, more recently total clean metals have been sampled along with dissolved metals at most probabilistic monitoring stations. During SFY12, DEQ researchers also collected clean total mercury samples from the Shenandoah River basin for the purpose of monitoring the transport of mercury (Hg) at many of the same sites where clean dissolved mercury samples were collected. Additional total metals samples were collected for several incident response studies and for industrial compliance monitoring. The resultant data from these samples are included in the spreadsheets of "Table 3.2.1.2 - Total Metals in Surface Waters - SFY12" and in the workbooks of "Folder 3.2.1.2 – Historical Total Metals in Surface Waters."

3.2.1.3 Total Metals in Sediments

"Table 3.2.1.3a - Total Metals in Sediments All Basins - SFY12" presents tabular results and a statistical data summary of the SFY12 WQM freshwater sediment metals data, primarily from freshwater probabilistic monitoring sites and analyzed by DCLS (Parameter Group Code MET1S). "Table 3.2.1.3b - Total Metals Sediment Estuarine ProbMon - SFY12," reports the results of sediment metals analyses from the Estuarine Probabilistic Monitoring Program samples that were collected during the 2012 fiscal year and analyzed by a DEQ-contracted commercial laboratory.

Screening Values for the evaluation of metal and organics concentrations in both freshwater and saltwater sediments can be found in "Appendix E - Summary of Sediment Screening Values SFY12."

The Excel® workbooks of "Folder 3.2.1.3 - Historic Metals Sediment All Basins," present historical summaries of sediment metals in both non-tidal freshwaters and tidal estuarine waters.

3.2.1.4 Dissolved Pesticides and Other Organic Contaminants

The concentrations of dissolved organic compounds in the water column are generally extremely low, often at or below the detection limits of generally available analytical methods. For this reason, DEQ has suspended most ambient monitoring of dissolved organics using traditional methods. Semi-Permeable Membrane Devices (SPMDs) have been employed in several special studies on the distribution of polychlorinated biphenyls (PCBs) in the past.

To assist in the generation of PCB data for use in the development of TMDLs, DEQ now utilizes EPA's low-detect Method 1668. Historically, PCBs were not detected in ambient river water or effluents using traditional compliance methods (EPA Method 608 and 8082). These methods have elevated detection levels and are selective toward mixed PCB Aroclor analysis. Recently, EPA recommended the use of Method 1668 for TMDL development since it is capable of detecting much lower concentrations of PCBs. It uses clean sampling techniques and a congener-specific, high resolution/low detection analytical method to measure concentrations in the pg/L (one picogram or one trillionth of a gram per liter) range. Data have been generated using this method for TMDL development within PCB impaired water bodies in the tidal Potomac River, the Roanoke (Staunton) River, Levisa Fork, New River, the upper tidal James River and the Elizabeth River watersheds. Some recent results from the Elizabeth River and the New River studies are presented in "Appendix J – Compiled PCB data 2011-2012" of this report.

3.2.1.5 Pesticides and Other Organics in Sediment

3.2.1.5.1 Chlorinated Pesticides in Sediment

"Table 3.2.1.5.1a - OC Pesticides Sediment Fw All Basins SFY12" indicates that no chlorinated pesticide analyses of freshwater sediment were carried out in SFY2012. "Table 3.2.1.5.1b – OC Pesticides Sediment Estuarine All Basins SFY12" summarizes the results of estuarine probabilistic sampling during SFY12. As can be seen from the table and the associated "Folder 3.2.1.5.1 - OC Historical Pesticides Sediment," chlorinated pesticide contamination was very limited in estuarine waters.

3.2.1.5.2 Phosphorylated Pesticides in Sediment

No analyses of phosphorylated pesticides were carried out during SFY12. Tables 3.2.1.5.2a (Group 1) and 3.2.1.5.2b (Group 2) are included in this Report only as placeholders. The historical phosphorylated pesticides in sediment results are maintained in "Folder 3.2.1.5.2 – Historical OP Pesticides Sediment."

3.2.1.5.3 Herbicides in Freshwater Sediment

No sediment herbicide samples from any basin were collected or analyzed during SFY 2012. Table 3.2.1.5.3 is included in this Report as a placeholder. "Folder_3.2.1.5.3_-_Historical_Herbicides_Sediment" contains the historical record of sediment herbicide results.

3.2.1.5.4 Polycyclic Aromatic Hydrocarbons (PAHs) in Sediment

"Table 3.2.1.5.4a - PAHs Sediment Grp1 All Basins SFY12" and "Table 3.2.1.5.4b - PAHs Sediment Grp2 All Basins SFY12" indicate that no PAH sampling or analyses of freshwater sediments were carried out during SFY12. "Table 3.2.1.5.4c - PAHs Sediment Estuarine All Basins SFY12" summarizes the PAH results from estuarine probabilistic monitoring during SFY12, which are also included in "Folder 3.2.1.5.4 - PAHs Sediment Historical."

The weight-of-evidence assessment of late summer 2011 (SFY12) probabilistic estuarine sites for Aquatic Life Designated Use (ALU) identified one site a minor tidal tributary to the York River (Adams Creek) which was highly contaminated with PAHs and had a very high risk of PAH-induced effects on the benthic community. Three different benthic indices revealed that the macro-benthic fauna at the site was degraded to severely degraded. A follow-up study is currently underway (late November 2012) to confirm the degree and local distribution of the contamination, prior to listing the water body as impaired, which would require developing a TMDL for its remediation.

3.2.1.5.5.1 Semi-volatile Organics in Freshwater Sediment

"Table 3.2.1.5.5.1 - Semi-Volatiles Sediment All Basins SFY12" shows that no semi-volatile organics analyses were performed on freshwater sediment samples in SFY12. Two semi-volatiles, biphenyl and dibenzothiophene (synfuel) were analyzed in sediments collected by the Estuarine Probabilistic Monitoring Program. Their results were included in "Table 3.2.1.5.4c - PAHs Sediment Estuarine All Basins SFY12."

3.2.1.5.5.2 Volatile Organics in Freshwater

Dissolved volatile organics were sampled and analyzed during two freshwater Facility Inspections. The results are summarized in "Table 3.2.1.5.5.2 – Volatiles Water All Basins SFY12." Almost all results were

below method detction limits. Since these results were from in-pipe samples rather than ambient monitoring results, they were not summarized elsewhere.

3.2.1.5.6 Polychlorinated Biphenyls (PCBs) in Sediment

No ambient freshwater sediment samples were collected or analyzed for PCBs during SFY2012. "Table 3.2.1.5.6a - PCBs Sediment Freshwater All Basins SFY12" is included in this Report as a placeholder. "Table 3.2.1.5.6b - PCBs Sediment Estuarine All Basins SFY12" summarizes the results of analyses of 21 PCB congeners in sediment from 50 estuarine probabilistic sites (plus five QA duplicates) sampled during the summer (late June – September) of 2011.

3.2.2 Fish Tissue Contamination

DEQ's specialized Fish Tissue and Sediment Monitoring Program was suspended during 2010 and 2011 because of resource limitations. This program was resumed on a reduced scale during the spring and summer of 2012. Fish tissue and/or sediment samples were collected from 38 sites, primarily in the New River and James River basins (with special emphasis on the Elizabeth River). The sites were selected to gather supplemental analytical chemical data for the development and/or implementation of Total Maximum Daily Loads (TMDLs) for segments of water bodies which had been included in previous 303(d) Impaired Water Listings due to contamination of fish by polychlorinated biphenyls (PCBs). Results from the analyses are expected in 2013, in time for inclusion in the 2014 305(b)/303(d) Water Quality Integrated Report.

Several recent reports on agency fish tissue and sediment results can be found on the DEQ website at http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/FishTissueMonitoring.aspx**.**

3.2.3 Benthic Monitoring

Benthic Community Evaluation: Field sampling and evaluation of both freshwater and estuarine benthic communities has proven to be an invaluable tool in the assessment of water and sediment quality. Significantly stressed benthic communities may indicate the impact of toxics in the environment, but follow-up evaluation is required to confirm the cause of the observed benthic impairment.

3.2.3.1 Freshwater Benthic Monitoring

"Appendix H1 – Freshwater Biological Stations SFY12" of this report lists the freshwater biological monitoring stations visited during the spring and fall of 2011. Many sites visited during the spring of 2012 have not yet been recorded in the Ecological Data Application System (EDAS) database used for freshwater biological data. Between spring of 2011 and spring of 2012 regional biologists carried out a total of 834 visits at 461 biological monitoring sites; 420 sites in the Piedmont and Appalachian Zones were subsequently evaluated using the Virginia Stream Condition Index (VSCI). Of those visits, approximately 16.91% resulted in evaluations of severe stress, possibly related to toxics. An additional 89 visits were made to 41 sites for evaluation using the Coastal Plain Macroinvertebrate Index (CPMI). Approximately 14.6% of those scores also indicated severe stress. The list in Appendix H1 includes a number of the freshwater probabilistic sites that are also described in Appendix H2.

"Appendix H2 - Freshwater Probabilistic Monitoring Sites SFY12" provides a comprehensive list of the freshwater probabilistic monitoring stations that were included in the ambient program during fiscal year

2012. Many of these (the wadeable sites) were also sampled for benthic invertebrate populations and are also included in Appendix H1. This list summarizes 206 site visits to 128 freshwater probabilistic stations, including autumn visits to calendar year 2011 sites, as well as a number of follow-up visits for other purposes (e.g., TMDL or other special study projects). Many spring visits in calendar year 2012 have not yet been entered into the EDAS database.

3.2.3.2 Estuarine Benthic Monitoring

Chesapeake Bay and other tidal waters: The Chesapeake Bay Program (CBP) conducts probabilistic monitoring of benthic communities. As a second phase of assessment based on the CBP Benthic Index of Biotic Integrity (B-IBI), a stressor diagnostic tool calculates the probability of contamination as a cause for each impaired benthic sample. Another benthic assessment methodology is used for estuarine probabilistic monitoring following National Coastal Condition Assessment (NCCA) sampling protocols in the Bay and other tidal estuarine waters. It consists of a weight-of-evidence evaluation based on the Sediment Quality Triad (SQT). Estuarine probabilistic monitoring following the NCCA protocols provides data on the chemical contamination of sediment, the acute toxicity of sediment, and an evaluation of benthic community wellbeing using three indices of stress, the CBP's B-IBI plus Diagnostic Tool in tidal Chesapeake Bay waters, the Middle Atlantic Region B-IBI for other tidal coastal waters, and EPA's Environmental Monitoring and Assessment Program's Mid-Atlantic Integrated Assessment (EMAP-MAIA) Index of Estuarine Condition discriminant function for the Virginia Biogeographic Province (VA-IEC) as a secondary index in all tidal waters. This methodology is described in detail in the current Assessment Guidance Manual for the 2012 Integrated Report (http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityAssessments.aspx).

Weight-of-evidence assessments for sites sampled during the 2005 – 2010 period were included in the 2012 Integrated Report (IR). The SFY2012 and SFY2013 estuarine probabilistic monitoring sites will be assessed using the same methodology and will be included in the 2014 IR.

3.2.4 Special Studies Related to Toxics

3.2.4.1 Regional Special Studies Involving Toxics

Special studies are often initiated independently at the Regional Office (RO) level in response to locally recognized problems. Often, these regional special studies are related to TMDL development for impaired waters, but they may also be initiated to evaluate new monitoring or analytical methods, or to investigate potential problems with new practices, etc. Regional special studies that dealt specifically with toxics during SFY12 are summarized within "Appendix I – Special Studies Related to Toxics SFY12." Briefly, they consist of:

Central Office	Artificial Hardness special study (with participation of NRO, PRO, and BRRO-Lynchburg)
Northern RO	Tripps Run/Holmes Run Benthic Study (metals) Broad Run Benthic Study (metals) Statewide Hardness Special Study (Central Office)
Piedmont RO	James River PCB Study Statewide Hardness Special Study (Central Office)

	Low level dissolved PCB sampling at various MS4 outfalls Four monthly sampling runs for total mercury in the Chickahominy, Mattaponi, Pamunkey and Rappahannock River watersheds in preparation for future Hg TMDLs for fish tissue consumption advisories
Blue Ridge RO **- Lynchburg** **- Roanoke**	Statewide Hardness Special Study (Central Office) Smith River Benthic Study (possible PAHs) Roanoke River PCB Study New River PCB Study
Southwest RO	Bluestone River PCB Study Levisa Fork PCB Study Clinch River Low Level Mercury Sampling Study Straight-pipe Sewage Benthic Study (complicated by toxic coal mine drainage)
Tidewater RO	Low Level PCB Study in Elizabeth and Lower James Rivers
Valley RO	Continuing South River Mercury Studies Meadow Creek/Schenks Branch/Moores Creek Benthic Study (PAHs) Shenandoah River PCB Study

Interim or final reports from various toxics-related studies are also available on the DEQ Website - "Water Reports" page (http://www.deq.virginia.gov/Programs/Water/ReportsPublications.aspx) and "TMDLs in Virginia" page (http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/TMDL.aspx).

3.2.5 Other Program Specific Studies

3.2.5.1 The Chesapeake Bay Program

3.2.5.1.1 Toxics Reduction and Prevention Strategy

The 1987 Chesapeake Bay Agreement committed the signatories to develop, adopt, and begin implementation of a basin wide toxics strategy to achieve a reduction of toxics, consistent with the Water Quality Act of 1987, which would ensure protection of human health and living resources. Following the implementation of a multi-jurisdictional effort to define the nature, extent, and magnitude of toxics problems, the initial strategy was further strengthened with the adoption of the 1994 Basin Wide Toxics Reduction and Prevention Strategy. The primary goal of the 1994 strategy was to have a:

> *"Bay free of toxics by reducing and eliminating the input of chemical contaminants from all controllable sources to levels that result in no toxic or bioaccumulative impact on living resources that inhabit the Bay or on human health."*

3.2.5.1.2 Toxics 2000 Strategy

Building upon progress achieved through the implementation of the 1994 Strategy, the Chesapeake Bay Program Executive Council adopted a revised strategy in December 2000 known as the "Toxics 2000

Strategy." With the retention of the 1994 goal, new objectives and commitments were developed and incorporated into the document. An important strategy objective was to strive for zero release of chemical contaminants from point and non-point sources through pollution prevention and other voluntary means. For those areas with known chemical contaminant problems and referenced as Regions of Concern, such as the Elizabeth River in Southeastern Virginia, the strategy included commitments leading to restoration. Finally, the strategy included commitments that would provide the means to measure progress toward meeting the overall strategy goal. One approach consisted of periodic toxics characterizations, accomplished in 1999 and again in 2008, in which information derived from biological and chemical monitoring were synthesized within the context of toxicological impacts. Those characterizations focused primarily on the Chesapeake Bay mainstem and major tidal tributaries. An additional characterization is now reaching its conclusion in November of 2012. The current efforts, based primarily on 305(b)/303(d) Water Quality Reports and Impaired Waters Listings and other published studies in member states (Virginia, Maryland, Pennsylvania, West Virginia, and Delaware) also include non-tidal waters of the Bay watershed (see below).

3.2.5.1.3 Current Toxics-Related Activities

A general organizational restructuring of the Chesapeake Bay Program was carried out in 2008 and activities of the former Toxics Subcommittee were temporarily suspended. The new structure does not expressly include a Toxics Subcommittee, but it does include a "team" with the objective to "Protect and Restore Water Quality." The current partial shift in alignment of CBP monitoring efforts from tidal to non-tidal watershed sources (both point and non-point) of nutrient and sediment input, and emphasis on the Bay-wide TMDL development for these stressors, temporarily resulted in less emphasis on toxics in tidal waters.

In October 2011 the EPA Interstate Chesapeake Bay Program Office (CBPO), Department of the Interior (DOI - USGS, FWS), National Oceanic and Atmospheric Administration (NOAA), and the US Department of Agriculture (USDA), along with various other state and academic stakeholders, held a workshop to initiate compliance with Executive Order 13508 – Chesapeake Bay Protection and Restoration (May 2009). The Chesapeake Bay Workgroup for Toxic Contaminants is to issue a report by November of 2012, summarizing the extent and seriousness of toxic contaminants in the Bay and its watershed (both estuarine and non-tidal waters).

Each summer during July, August, and September the DEQ Estuarine Probabilistic Monitoring Program collects sediment samples from 50 randomly selected estuarine sites within the Commonwealth. Thirty-five (70%) of those samples are collected within the Chesapeake Bay watershed, and the remaining 15 (30%) are collected from coastal Delmarva and the Back Bay/North Landing River region. Subsamples are chemically analyzed for 15 trace metals, 25 polycyclic aromatic hydrocarbons (PAHs), 21 congeners of polychlorinated biphenyls (PCBs), and 20 pesticides and their derivatives. The chemistry results from the SFY2012 sampling are included in Tables 5b through 6f of this report. Analytical results from samples collected during the summer of 2012 will be included in next year's TRISW Report.

Additional information on the concentrations and trends of toxic substances and other water quality parameters, in the Chesapeake Bay and its tributaries, is currently available on the Chesapeake Bay Program website at http://www.chesapeakebay.net/issues/issue/chemical_contaminants, or by using the search engine available at http://www.chesapeakebay.net/. Additional information about DEQ's Chesapeake Bay monitoring is available at: http://www.deq.virginia.gov/Programs/Water/ChesapeakeBay/ChesapeakeBayMonitoring.aspx.

3.2.5.2 The Elizabeth River Program

In 1997, in response to indications of water quality impairment by toxics in the Elizabeth River and its tributaries, DEQ and a group of Elizabeth River Project stakeholders collaborated to produce a comprehensive Water Quality Monitoring plan for the water bodies of concern. Under guidelines included in that plan, a baseline environmental study began in January 1998 with the goal of allowing the future assessment of trends in contaminant concentrations and their effects. Scientists from the Virginia Institute of Marine Science, Old Dominion University, and DEQ worked with representatives from state, federal, and local authorities and other stakeholders to design and conduct the monitoring effort.

While DEQ continues to monitor for conventional pollutants and nutrients, most studies specifically involving toxics and their effects in the Elizabeth River system have been concluded. Because of reduced regional office staff and lack of Elizabeth River funding, toxics-related activities during 2012 were restricted to sediment PAH study and continued sampling and public meetings related to PCB studies and TMDL model development.

The DEQ contracted with the Elizabeth River Project (ERP) to conduct a preliminary evaluation of PAHs off-shore of the former Atlantic Creosoting and Wood Preserving Works located on the Eastern branch of the Elizabeth River. This facility operated in the early part of the 1900's and historical documents describe a fire and explosion in 1907. Site assessments for the upland part of the site revealed creosote odors and sheen in drainage areas of the site. In January 2012, 45 near surface sediment samples were collected over a 32 acre investigation area. PAH concentrations ranged from non-detectable to 332.5 mg/Kg. Additional investigations are needed to further define the vertical and horizontal extent of PAH contamination at this site.

The Elizabeth River and its tributaries have VDH fish consumption advisories for PCBs. Ambient water samples for PCB analyses were collected under both "dry" and "wet" weather conditions from locations throughout the watershed during 2010-2011. Available results were reported in the January 2012 TRISW Report (Appendix J.1). More recent results are included in "Appendix J – Compiled PCB data 2011-2012" of this Report and will be used to support model calibration for a PCB TMDL within the watershed. Completion of this TMDL is now scheduled for 2014.

Additional information on the Elizabeth River Project is available at http://www.elizabethriver.org/.

3.3 The Calendar Year 2013 Water Quality Monitoring Plan

The Annual Monitoring Plan (MonPlan) provides a complete list of the ambient WQM stations that will be actively sampled during the corresponding calendar year and the types of samples that will be collected at each. The DEQ Monitoring Year now corresponds to the calendar year in order to synchronize various ambient monitoring program schedules with one another, with the ecological and water year cycles, and with the "assessment window" or monitoring period considered for each 305(b)/303(d) Water Quality Integrated Report assessment and listing cycle. The synchronization scheme is described in detail in the 2007 revision of DEQ's Water Quality Monitoring and Assessment Strategy (http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/DEQsWaterQualityMonitoringStrategy.aspx).

The MonPlan for each calendar year is normally completed in December and is implemented on January 1 of the following year. That portion of the new plan that deals with long-term trend stations continues with minimum modification. However, because 2012 completes the third two-year rotation (January 1, 2011

through December 31, 2012) in the second six-year cycle (2007 – 2012) of DEQ's statewide Watershed Monitoring Network, the new MonPlan will require significant reorganization. Other aspects of the Plan, which deal with TMDLs and other special studies or with shorter term rotations such as lake monitoring or citizen requests, also require significant updating for inclusion in each new MonPlan. A face-to-face statewide meeting of DEQ's monitoring staff was held in Harrisonburg in late October 2012, to discuss priorities for modifications in the 2013 MonPlan. Significant reductions in the resources available for monitoring during the past four years require a number of alterations to the WQ Monitoring Strategy. Once finalized, the annual Monitoring Plan will be summarized and posted on the DEQ Website at http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/AnnualWaterQualityMonitoringPlan2013.aspx.

Descriptions of program modifications introduced in the 2013 Monitoring Plan will be included in the 2013 revision of DEQ's WQMA Monitoring Strategy.

4.0 Assessment of Toxics in Ambient Waters

4.1 The 305(b)/303(d) Water Quality Integrated Assessment Report

A Water Quality Integrated Assessment Report (IR) was prepared and submitted to EPA in the spring of 2012. The assessment window for this IR extends from January 1, 2005 – December 31, 2010. The list of impaired segments submitted to EPA for delisting includes several segments that have previously been 303(d)-listed for toxics-related impairments. The complete list of toxic-related delistings is contained in "Appendix K.2 – Delisted Toxics-Impaired Segments – 2012 IR."

The 2010 IR, the associated 2010 Assessment Guidance Manual, and interactive maps are available on the DEQ Water Quality Assessment WebPages at: http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityAssessments.aspx . Any recent changes in assessment methodologies for toxics, such as revised or new water quality standards, are described in the 2012 Assessment Guidance Manual, which is available from the same web pages.

4.1.1 The 305(b) Water Quality Assessment

The 2012 Assessment identified a total of 13,145 miles of impaired rivers (25.1% of all assessed river miles; EPA Categories 4 - 10% and 5 - 15.1%), 94,041 acres of lakes (80.8% of all assessed significant lakes; EPA Categories 4 – 3% and 5 – 77.8%), and 2,128 square miles of impaired estuaries (79.3% of all assessed estuaries; EPA Categories 4 – 2.9% and 5 – 76.4%). In 2012, DEQ added 840 stream miles, 100 lake acres and 2 square miles of estuaries to the impaired waters list. Rather than reflecting worsening conditions, the increase in the number of water bodies is due primarily to the monitoring of waters that not previously been assessed. It should also be noted that DEQ removed 260 stream miles and 2700 lake acres from the Impaired Waters List due to improvements in water quality. The extents of current impairments caused by specifically identified toxics are summarized in Text Table 4.1.1 below. The total river miles, lake acres and estuarine square miles of toxics impairments summed at the foot of the table are not directly comparable to the totals cited above, because many of the impaired segments summarized in the table may be included under two or more causes (e.g., the same river mile may be listed under PCBs in fish tissue and mercury in fish tissue). Of the listings in the table, the vast majority were the result of fish consumption advisories. Fish consumption advisories were primarily for PCBs or mercury. Both of these contaminants

are persistent and bioaccumulative, that is, they are found in much higher concentrations in fish tissues than in the surrounding environment.

Aquatic Resource Class >	Rivers & Streams		Lakes & Reservoirs		Estuaries	
Categories of Toxic Compounds	Percentage of All River Miles Statewide	River Miles Impaired by Each Category	Percentage of All Lake Acres Statewide	Acres Impaired by Each Category	Percentage of All Estuarine Square Miles Statewide	Square Miles Impaired by Each Category
PCBs in Fish Tissue	1.98%	1036.4	64.02%	74496.3	77.79%	2088.0
PAHs in Fish Tissue	0.01%	7.3	0.06%	73.8	0.03%	0.7
PCBs in Water Column	0.40%	207.7	1.07%	1245.1	0.32%	8.6
Cadmium	0.02%	10.8	0.05%	52.8	0.00%	0.0
Copper	0.03%	17.7	0.99%	1148.2	0.00%	0.0
Mercury in Fish Tissue	3.94%	2058.9	47.95%	55794.8	0.76%	20.5
Zinc	0.03%	15.1	0.05%	52.8	0.00%	0.0
Aldrin	0.01%	6.0	0.00%	0.0	0.00%	0.0
Chlordane	0.01%	5.1	0.00%	0.0	0.00%	0.1
DDT & Derivatives	0.02%	10.1	0.11%	131.6	0.00%	0.0
Heptachlor Epoxide	0.01%	4.6	0.00%	0.0	0.00%	0.0
Mirex	0.10%	54.3	0.00%	0.0	0.00%	0.0
Totals		3,433.9		132,995.3		2,117.8

Text Table 4.1.1 Amount of each aquatic resource class impaired by a specifically identified category of toxic compounds, and its percentage of the total statewide resource in that class. (Extracted directly from Appendix K.1 – Segments Potentially Impaired by Toxics - 2012 303(d) Report.)

4.1.1.1 The 303(d) Impaired Waters List

The impaired waters list from the 2012 Integrated Report included a total of 8593 impaired waterbody segments. Of these, 1521 segments (17.7%) are directly related to contamination by toxic substances ("Appendix K.1 – Segments Potentially Impaired by Toxics – 2012 303d Report"). The percentages of total statewide stream miles, lake acres, and estuarine square miles represented by each category of toxic contaminant are summarized in Text Table 4.1.1 above. Bioassessment of benthic communities accounted for another 674 impaired segments (7.8%), but impaired benthic communities are more often the result of excessive sedimentation, eutrophication, hydrological modification, or other forms of habitat disturbance than a result of contamination.

Of the 1521 impairments associated with specifically identified contaminants, the vast majority (1453 segments or 95.5%) were for fish consumption. Fish consumption advisories were posted based on fish tissue screening values being exceeded by PCBs (1094 segments), metals (mercury - 316 segments), pesticides (15 segments), dioxin (20 segments), and PAHs (8 segments).

Future TMDLs will be developed to address the current listings, but because the size and number of segments united into each TMDL vary with the hydrography and the extent of the impairment, the exact number of TMDLs to be developed and implemented, and the schedule for doing so are not yet certain. DEQ's PCB Strategy (2005) establishes priorities for TMDL development and identifies various options for remediation. Any new PCB-impaired segments identified in the 2012 Integrated Report will be integrated into the strategy.

4.1.1.2 Delisted, previously impaired segments

Thirty-six segments with toxics-related impairments (fish consumption) were included in the delisting package prepared for submission to EPA in the spring of 2012 ("Appendix K.2 – Delisted Toxics Impaired Segments – 2012 IR"). They included 407.5 acres of reservoirs (3 segments in the Ni River reservoir – mercury in fish tissue), 9.6 miles of streams (3 segments in the New River – miscellaneous pesticides in fish tissue), and 8.9 square mile of estuary (30 segments – primarily minor tributaries and embayments to the southern Chesapeake Bay - PCB and/or mercury in fish tissue). That list has already been tentatively approved by EPA Region 3.

Although listings for benthic macroinvertebrate impairments are not necessarily related to toxics, they are used as a warning flag to prompt the search for causative stressors. In 2012, 130.9 miles of streams (22 segments) and 327.8 square miles of estuaries (91 segments) were delisted for benthic impairments because more recent evaluations of benthic macroinvertebrate communities scored the previously listed sites as now being non-degraded and having met benthic community goals.

4.2 Most Recent Virginia Department of Health Fishing Restrictions and Health Advisories

The Virginia Department of Health (VDH) regularly issues "Fish Consumption Advisories and Restrictions" for Virginia Waterways based upon the results from the DEQ Fish Tissue and Sediment Monitoring Program and other sources. All waters subject to these restrictions and advisories are included in DEQ's biennial 303(d) lists. The VDH website contains the most recently published updates to fishing restrictions and closures due to concerns related to human health and fish consumption. The complete VDH fishing restrictions and health advisories currently in effect for any waters in the state can be found summarized and mapped by basin at:
http://www.vdh.virginia.gov/epidemiology/DEE/PublicHealthToxicology/Advisories/index.htm.

The DEQ Fish Tissue and Sediment Monitoring Program was temporarily suspended in 2010 because financial resources were not available, but it was resumed on a limited basis in the summer of 2012. The final fish tissue and sediment sampling plan for 2012 can be found in Appendix F1. Sampling was concentrated primarily in the New River basin and lower James River basin. Resources were allocated for the analysis of fish tissue and sediment samples collected during 2012 and analytical services by the Virginia Institute of Marine Science are expected to be completed by June 30, 2013.

No new fishing restrictions or health advisories were issued during SFY2012. The most recent new advisories and modifications of previous advisories were issued during SFY 2010. Advisories on PCB contamination in blue crabs, specifically related to consumption of the hepatopancreas or "mustard," were issued in January 2009 for the Southern Branch Elizabeth River and for King Creek, a tributary to the York River. In October 2009, geographic extensions were added to several previous advisories on PCBs in fish tissues, among them tidal embayments and tributaries to the Potomac River, Mill Creek near Fort Monroe (Hampton City), Dan River below Danville, Lovills Creek Lake –Yadkin River, lower Nottoway River, Emporia Reservoir and lower Meherrin River, tidal Poquoson and Piankatank Rivers, Mattaponi and Pamunkey Rivers. An additional fish consumption advisory was announced by the Virginia Department of Health on November 18, 2009. This was in response to a North Carolina Division of Public Health advisory for mercury in walleye collected in the North Carolina portion of Lake Gaston.

A general description of the Fish Tissue and Sediment Monitoring Program and related current and past special studies, several recent reports as well as analytical results from fish tissue and sediment monitoring

by the agency are available on the DEQ website at http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/FishTissueMonitoring.aspx.

5.0 Remediation of Toxics in Ambient Waters

Total Maximum Daily Load (TMDL) Program

The TMDL Program is an important component of DEQ's toxics remediation in aquatic environments. A number of toxics-related TMDLs have been completed and approved in recent years. Completed TMDLs can be identified and viewed by using the search form on "TMDL Development" link on the DEQ website at http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/TMDL.aspx. Queries can be performed based on pollutant, major river basin, political jurisdiction, and water body name or watershed identification. A comprehensive list of all approved TMDLs (currently 283) can be queried out by leaving the search form blank and clicking on the "Search" button.

The development of additional toxics-related TMDLs has been on-going. TMDL investigations to identify PCB sources began in SFY 2009 and are scheduled to be completed in 2014 for the Tidal James River Basin, including the Elizabeth River. For purposes of calibrating the model, monthly PCB samples have also been collected at two stations in the James and Elizabeth Rivers (see Appendix J). PCB source investigation work has also been on-going in the New River Basin (data also presented in Appendix J) with TMDL development scheduled to begin in 2013. Several TMDLs have been phased (*i.e.*, developmental period extended), including the Levisa Fork for a PCB impairment, a benthic impairment for eleven segments in the Tennessee/Big Sandy basin (PAHs implicated) and a single benthic impairment (unknown toxicant) in the Roanoke Basin. PAHs are identified as a possible stressor in the phased benthic Powell River TMDL. The Phased TMDL monitoring plan will include additional benthic sampling to determine if the PAHs are bioavailable. If they are found to be bioavailable the determination will be made as to whether to include PAHs as a probable stressor. TMDLs are phased when there is substantial uncertainty in the TMDL (e.g., stressor has not been confirmed as the cause for the impairment; source(s) of the pollutant causing the impairment have not been identified or confirmed).

As additional TMDLs are completed and scheduled for implementation, and others are added, follow-up monitoring will be initiated to evaluate their effectiveness in reducing toxics contamination. The effective implementation of these TMDLs should result in measurable reductions of contaminants in the state's waters within a few years. The agency's TMDL history, current status, and other development plans are available at http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/TMDL.aspx.

Close coordination between monitoring and assessment activities identifies new sources of contamination as they occur and document the effectiveness of load allocations and other remedial measures developed and implemented by the TMDL Program. The agency anticipates significant reductions of toxics in the state's waters as a result of continued TMDL implementation.

6.0 References

A cumulative bibliography of general references and publications cited in this and previous TRISW Reports is included in "Appendix L – References."