COMMONWEALTH of VIRGINIA

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January 1, 2010

MEMORANDUM

TO: The Honorable Timothy M. Kaine

The Honorable Harvey B. Morgan, Chair
House Committee on Agriculture, Chesapeake and Natural Resources

The Honorable Patricia S. Ticer, Chair
Senate Committee on Agriculture, Conservation and Natural Resources

FROM: David K. Paylor

SUBJECT: Toxics Reduction in State Waters Report for 2009

Pursuant to VA. CODE ANN. § 62.1-44.17:3, the Virginia Department of Environmental Quality ("DEQ") forwards the attached 2009 Annual Report for Toxics Reduction in State Waters. The report describes DEQ's toxics reduction program and summarizes the activities completed in 2009, including monitoring state waters for the presence of toxics and implementing remedial measures to reduce and /or eliminate toxics. Should you have any questions concerning this report or wish to request a hard-copy, please contact Jeff Reynolds, Water Resource Policy Advisor, DEQ Office of Policy, at (804)698-4376. The report is available on the DEQ website at: http://www.deq.virginia.gov/regulations/reports/html.

2009 Report on Toxics Reduction in State Waters

The complete set of tables, figures and appendices associated with this report, as well as the text document, are available on the web pages of the Department of Environmental Quality at http://www.deq.virginia.gov/watermonitoring/.

VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

JANUARY 1, 2010

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AMD Acid Mine Drainage
ALU Aquatic Life Designated Use
B4B Businesses for the Bay Program
BDE Bromated diphenyl ether
B-IBI Benthic Index of Biotic Integrity
CBP Chesapeake Bay Program
CEDS Comprehensive Environmental Data System
CIMS Chesapeake Information Management System
CPMI Coastal Plain Macroinvertebrate Index
CVs Critical Values
DCLS Division of Consolidated Laboratory Services
DCR Virginia Department of Conservation and Recreation
DDT Dichloro-diphenyl-trichloroethane
DEQ Department of Environmental Quality
DMR Discharge Monitoring Report
EDAS Ecological Data Application System
EEC Extreme Effects Concentration
ELG Effluent Limitation Guidelines
EMAP Environmental Monitoring and Assessment Program
EMS Environmental Management System
ER-L Effects Range-Low
ER-M Effects Range-Moderate
EPA Environmental Protection Agency
ESB Equilibrium Partitioning Sediment Benchmarks
FY Fiscal year
IBI Index of Biological Integrity
ICPRB Interstate Commission for the Potomac River Basin
IR Virginia Water Quality Assessment 305(b)/303(d) Integrated Report
IRIS Integrated Risk Information System
MEC Midrange Effect Concentration
MGD Millions of Gallons per Day
MAIA Middle Atlantic Integrated Assessment
MonPlan Annual Water Quality Monitoring Plan
MY Monitoring year
NCA National Coastal Assessment
NOAA National Oceanic and Atmospheric Administration
NPEP National Partnership for Environmental Priorities
NPS Non-Point Source
NWBD National Watershed Boundary Dataset
OC-Pesticides or **OCP** - Organo-chlorine Pesticide
ODU Old Dominion University
OP-Pesticides or **OPP** - Organo-phosphorus Pesticide
OPP or OP2 Office of Pollution Prevention
PAH Polycyclic Aromatic Hydrocarbon
PCB Polychlorinated biphenyl
PEC Probable Effects Concentrations
POTW Publicly Owned Treatment Works

P2 or PP	DEQ's 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
SQT	Sediment Quality Triad
STORET	EPA's legacy national ecological database (short for data 'STOrage and RETrieval' system)
SV	Screening Value
TBT	Tributyltin
TEC	Threshold Effect Concentration
TMDL	Total Maximum Daily Load study
TMP	Toxics Management Program
TMR	Toxics Management Regulation
TOC	Toxics of Concern
TRE	Toxics Reduction Evaluation
TRI	Toxic Release Inventory
TRISW	Toxics Reduction in State Waters
TSV	Tissue Screening Value
USGS	United States Geological Survey
VDH	Virginia Department of Health
VEEP	Virginia Environmental Excellence Program
VERC	Virginia Emergency Response Council
VH2E	Virginia Hospitals for a Healthy Environment
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
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
WTPs	Water Treatment Plants

Executive Summary

The Virginia Department of Environmental Quality (DEQ) submits an Annual Toxics Reduction in State Waters (TRISW) Report to the Governor and General Assembly of the Commonwealth of Virginia 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 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 toxics contamination of the Commonwealth's waters. During State Fiscal Year 2009 (SFY09), DEQ's Toxics Management Program (TMP) included 311 reporting facilities with 592 outfalls that had active permit-defined toxics limits in their effluents, as recorded in DEQ's Comprehensive Environmental Data System (CEDS) database. Approximately 1.8% of 8,271 individual parameter records exceeded the permitted average concentration and 2.0% exceeded the maximum permitted concentrations; almost all were incidental elevations of total or dissolved metals in discharges from municipal wastewater treatment plants.

Pollution Prevention: The 2009 Pollution Prevention Annual Report is available on the DEQ web page at http://www.deq.virginia.gov/p2/pdf/report09.pdf. Among the highlights of Pollution Prevention successes affecting reduction of toxics in state waters in the past year are the following:

- At the end of 2009, there were over 450 facilities in the Virginia Environmental Excellence Program (VEEP), 23 of which received special recognition during 2009. Virginia still provides performance-based permit fee discounts from 2% to 20% for "going beyond compliance." In 2009 over $66,000 in fee discounts were distributed among more than 100 VEEP facility permits that implemented and carried out their Environmental Management System (EMS) Plans. A review of VEEP annual performance for 2009 reported a reduction of 4.8 tons in the use of hazardous materials and a decrease of 968 tons in the generation of hazardous wastes. The use of non-hazardous recycled materials increased by 14,032 tons.
- Total water use was reduced by 68.5 million gallons during the past year.
- Releases to the atmosphere were also significantly reduced. Emission of toxics, greenhouse gases (NOx and $CO_)$, were reduced by more than 2,000 tons.
- DEQ's Voluntary Mercury Reduction Initiatives also have been successful. The program for the recycling of automotive mercury switches removed 16,420 switches and recycled 36.12 pounds of mercury in 2008. Nearly 40 facilities have also pledged to annually recycle 53,000 energy efficient fluorescent light bulbs, which also contain small quantities of mercury. (Refer to DEQ's Mercury Reduction web page - http://www.deq.virginia.gov/p2/mercury/homepage.html.)
- Virginia participates in the National Partnership for Environmental Priorities (NPEP). Through NPEP, Virginia, Region 3 of the United States Environmental Protection Agency (EPA) and other Middle Atlantic States have committed to reduce priority chemical use by 88,000 pounds per year. A single Virginia Beach facility reduced the use of lead in its products by 85,000 pounds between 2006 and 2008.

Toxics Release Inventory (TRI): The Toxics Release Inventory documents the total quantities of EPA-listed toxic compounds that are released annually to the water, the air and the land by permitted facilities within the Commonwealth. Individual facilities file reports on their releases and/or management of these compounds during the first quarter of the following calendar year and DEQ prepares the statewide TRI Report once all individual reports have been received. The March 2009 TRI Report is available on the DEQ web page at

http://www.deq.virginia.gov/sara3. This Report summarizes data from calendar year 2007, during which 459 facilities filed 1741 individual reports. Statewide toxic releases to the water totaled approximately 18.4 million pounds or 29.1% of the total onsite releases to all media during 2007. This quantity represents a 5.64% decrease from the 19.5 million pounds released to the water in 2006. Nitrate compounds (17.63 million pounds) represented 98.8% of the top ten TRI chemicals released to water. Nitrates, however, are of much more concern for their effect as nutrients. Toxics criteria for dissolved nitrates in drinking water were not exceeded during SFY 2009.

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 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.

Periodic updates and revisions of the agency's WQM strategy are an important part of the planning process for DEQ's Water Quality Monitoring and Assessment Program. By 2008, the monitoring program fully implemented two major changes in the 2007 WQM 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 2009, more than 98 % of the Commonwealth's 1244 small watersheds were monitored. Minor interim revisions to the strategy planned for submission to EPA Region 3 in 2010 were among the subjects discussed at a statewide Water Quality Monitoring and Assessment meeting in February 2009.

2008 was the ninth year of DEQ's estuarine probabilistic monitoring (ProbMon) and 2009 comprised the ninth year of its freshwater ProbMon. Because of resource limitations, the sampling and analysis for organic contaminants in sediment 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 2008 field season (SFY09) with resources provided by a probabilistic survey-targeted supplement to the federal §106 grant and Chesapeake Bay Program support.

In 2006 and 2008, Water Quality Integrated Assessment Reports, sediment chemistry, sediment toxicity and benthic taxonomic results from DEQ's Estuarine ProbMon Program were used for a toxics-related "Weight-of-Evidence" assessment of aquatic life use at 100 estuarine sites. These results, primarily from minor tidal tributaries, complement those from the Chesapeake Bay Program's benthic ProbMon program, which emphasizes the mainstems of major tidal tributaries and the Bay itself. More recent Estuarine ProbMon results from 2006, 2007 and 2008, an additional 150 sites, are being incorporated into the 2010 Integrated Report. An additional line of chemical evidence, based on the solubility of polycyclic aromatic hydrocarbons (PAHs) present in the sediment, has now been added to the weight of evidence assessment procedure.

Analytical results from the 2008 Fish Tissue and Sediment Monitoring Program sampling are now available at http://www.deq.virginia.gov/fishtissue/. In all, a total of 701 individual or composite fish tissue samples were collected. Not all classes of contaminants were analyzed in all samples: 489 results were returned for tissue metals, 503 for polychlorinated biphenyls (PCBs) and 62 for pesticides. Only eight polycyclic aromatic hydrocarbons (PAH) analyses were carried out on 2008 samples. Although sediment samples were collected in association with each of the sampling sites, they have been archived as frozen reference samples and will only be analyzed if fish tissue results indicate a serious local problem. The most recent data and planning updates on this program are available at http://www.deq.virginia.gov/fishtissue/. The 2009 work plan for this program identified 81 tentative freshwater, brackish water and saltwater sampling sites.

The proposed sampling was completed during the summer of 2009, but all fish tissue and sediment samples have been frozen and archived until resources become available for their analysis. An additional five sites in the James River basin were sampled in early 2009 as part of a Kepone special study; the results from that study are already posted at the Fish Tissue web pages link provided above. Plans to sample fish tissue and sediment during the summer of 2010 are currently suspended, pending the availability of resources.

Extensive monitoring of toxics for more than three decades has revealed that the distribution and concentrations of contaminants vary greatly among sediment samples, whether they are nearby duplicates collected on the same day or sequential samples collected over various time spans. No definitive long-term trends have been detected to document consistent changes in toxics contamination. The probabilistic monitoring of toxics during the past eight years has demonstrated that statewide, concentrations of dissolved trace metals and organics in ambient waters are generally representative of global background levels, except near confirmed or suspected point sources. Periodic reports on the probabilistic results will provide a baseline for future comparisons. Recent developments of more efficient sampling designs, sampling technologies and analytical methods offer promise of more effective documentation of short-term changes and mid-term trends in the near future.

Assessment and Remediation

Assessment: The most recent Water Quality Integrated Report (2008) identified 2,448 miles of rivers, 111,384 acres of lakes, and 2,084 square miles of estuaries impaired by toxics. Of these, over 99% were listed for fish consumption advisories, primarily for PCBs (41.6% of toxics-impaired rivers, 64.9% of lakes, 99.0% of estuaries) or mercury (54.9% of rivers, 34.6% of lakes, <0.4% of estuaries). 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 is not certain. DEQ's PCB Strategy establishes priorities for TMDL development and discusses various options for remediation. Analyses for the 2010 Integrated Report have already begun, and any new PCB-impaired segments will be integrated into the Strategy.

Remediation / Reduction: A number of toxics related TMDLs have been approved; two in 2002, three in 2004, and 16 in 2007, all for PCBs in the Shenandoah (5) or in other Virginia tributaries of the Potomac (16 - Appendix M). The Potomac tributary PCB TMDLs were incorporated into the interstate Potomac River PCB TMDL developed under the auspices of the Interstate Commission for the Potomac River Basin. This TMDL was submitted in November 2007 and was subsequently approved by EPA. Two benthic TMDLs were completed for toxics parameters in 2006, one (copper and zinc) in the New River Basin and one (PAHs and lead) in the Shenandoah. The Smith River has a consent decree benthic TMDL within which a stressor analysis is ongoing. An eco-toxicological study with contributions from Martinsville DuPont and EPA is contributing to that TMDL development process.

A TMDL for nitrates in drinking water was developed in 2000 for the Muddy Creek – Dry River watershed. The most recent six years of water quality monitoring results for this watershed indicate these waters are now in compliance with required nitrate standards and will no longer be classified as impaired.

Several additional toxics-related TMDLs are in development. Four TMDLs for PCBs in the Roanoke River are scheduled for completion in the fall of 2009. In November 2008, EPA requested additional funding (total of $3.7 million) for the cleanup of a former West Virginia industrial site in the Bluestone River prior to completing TMDLs in the New River Basin. Seven Virginia Department of Health (VDH) fish advisory TMDLs for mercury are scheduled for 2010, three in the Shenandoah River and four in the North Fork Holston River. Benthic TMDLs for 11 PAH-impaired segments in the Tennessee/Big Sandy Basin and a single benthic TMDL in the Roanoke Basin will be developed by 2010. A source identification study for PCBs was initiated during 2009 for TMDL development on the upper tidal James River and the Elizabeth River. The agency's TMDL history, current status and development plans are available at http://www.deq.virginia.gov/tmdl/.

As TMDLs are completed, follow-up monitoring will be initiated to evaluate their effectiveness in reducing toxics contamination. The implementation of TMDLs is an effective method to achieve reductions of contaminants in a number of the state's watersheds.

Continued Commitment

DEQ is committed to toxics reduction through prevention of contamination, continued water quality monitoring and implementation of remedial measures. The Virginia Pollutant Discharge Elimination System (VPDES) and the Pollution Prevention (P2) Program are key programs necessary for the control and reduction of toxics releases. The Toxics Release Inventory is an additional program that monitors the release of toxics into aquatic environments. Close coordination between monitoring and assessment activities will identify new sources of contamination and measure the effectiveness of load allocations and other remedial measures implemented by the TMDL Program. DEQ anticipates reductions of toxics in state waters over time as a result of the continued employment of TMDL implementation.

Foreword

DEQ's Ambient Water Quality Monitoring Programs are planned and performed in adherence with formal guidance documents, including:

- Long-Term Water Quality Monitoring Strategy;
- Quality Assurance Program and Project Plans (QAPPs);
- Standard Operating Procedures (SOPs); and
- Standardized Sampling Protocols.

DEQ's annual monitoring program plan (MonPlan) now corresponds with the calendar year. This helps synchronize various monitoring activities and assessment periods with the 'ecological' or 'water year.' Monitoring activities summarized in this report, however, still 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 SFY09 Toxics Reduction in State Waters Report summarizes all toxics monitoring and reduction activities carried out between July 1, 2008 and June 30, 2009. 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 and to facilitate distribution to interested parties, data tables, figures and appendices of this report are presented in downloadable form at the DEQ web page at http://www.deq.virginia.gov/watermonitoring/tox.html. Electronic copies of the complete report, including tables, figures and appendices, are also available on CD from Don Smith at (804) 698-4429, Donald.Smith@deq.virginia.gov.

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

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 – SFY09) for each major drainage basin appear in this year's report.

1.0 Introduction

The Virginia Department of Environmental Quality submits a Toxics Reduction in State Waters 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 Toxics Reduction in State Waters

The primary objective of the TRISW Report is to document the state's commitment to improving water quality. This commitment includes:

1. The prevention of contamination of the Commonwealth's waters by toxics;
2. The continued monitoring of the state's 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.

The TRISW Report provides a summary of the toxics-related prevention, monitoring and remediation activities of the previous State Fiscal Year (SFY – July 1 – June 30).

Although the reduction of toxics in the state's waters is primarily the responsibility of DEQ, various agencies and organizations, including the Virginia Department of Conservation and Recreation (DCR), the Virginia Department of Health (VDH), EPA's Chesapeake Bay Program (CBP) and the U.S. Geological Survey (USGS) participate in the process. 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 1998 report provided basic background information related to the report's objectives and a basic model for its continued evolution. The current thirteenth TRISW Report contains tables of both raw data and statistical summaries of SFY09 monitoring results.

1.2 Functional Definitions, Water Quality Standards and Substrates Monitored

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 within the category of "toxics" is based on the observed effects of their presence on specific living organisms. The concept of "excess" is defined in terms of the concentrations at or above which living organisms experience detrimental effects.

1.2.2 Federal Water Quality Criteria: The Federal Clean Water Act (1983) first described the scope and purpose of water quality standards and defined the authority and responsibility of EPA and the

Commonwealth of Virginia to develop water quality standards for state waters. As early as 1990, the Chesapeake Bay Commission published its lists of Toxics of Concern (TOC) and Chemicals of Potential Concern that included 21 chemical substances and/or complexes of substances (forms or isomers of complex organic compounds) that endangered the waters of the Chesapeake Bay and its tributaries. The Chesapeake Bay Commission revised and approved these lists in 1996 with the removal of some chemicals and the addition of others. (Refer to Appendix A for a summary of each list). DEQ monitors all chemicals on the revised TOC list, although several still have no established federal water quality criteria or water quality standards. The proliferation of new chemical products in the market, as well as emerging concerns over the effects of established chemical and pharmaceutical products, makes the use of a static list inadvisable.

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.

- On December 22, 1992, EPA published in the *Federal Register* a comprehensive list of 126 chemical substances for which it established water quality criteria related to aquatic life in freshwater and saltwater and/or to human health risks (Appendix B).
- Subsequent studies have identified additional toxics and/or resulted in the establishment of new criteria for previously defined toxics. The list has been modified considerably during the ensuing years. For example, EPA's publication of conversion factors in May 1995 lowered acute and chronic freshwater criteria and acute saltwater criteria for dissolved metals, including arsenic, cadmium, chromium III and VI, copper, lead, mercury, nickel, silver, zinc and selenium.
- The most recent list of nationally recommended water quality criteria for both priority and non-priority toxic pollutants is available from EPA 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 as a whole. Detailed information on recent updates may be found at
    - Aquatic Life: http://www.epa.gov/waterscience/criteria/aqlife.html#final
        - EPA is revising the current aquatic life criteria for lead, silver and selenium. EPA is re-evaluating the current aquatic life criteria for ammonia and developing new aquatic life criteria for atrazine.
    - Human Health: http://www.epa.gov/waterscience/criteria/humanhealth/15table-fs.htm
        - EPA is recommending 15 updated national water quality criteria for the protection of human health: chlorobenzene, cyanide, 1,2-dichlorobenzene, 1,4-dichlorobenzene, 1,1-dichloroethylene, 1,3-dichloropropene, endrin, ethylbenzene, hexachlorocyclopentadiene, lindane, thallium, toluene, 1,2-transdichloroethylene, 1,2,4-trichlorobenzene and vinyl chloride.

1.2.3 Virginia Water Quality Standards (WQS): The Commonwealth of Virginia has established and periodically revises its water quality standards, which EPA reviews and must approve prior to their application. These state standards are currently subject to Triennial Review for periodic updating. The most recently adopted WQS are briefly summarized in Appendix C and are available in their complete form on the DEQ-WQS web page at http://www.deq.virginia.gov/wqs. New developments in the triennial review process and other information related to WQS are public-noticed and posted on the DEQ WQS web site at http://www.deq.virginia.gov/wqs/rule.html as they occur. The State Water Control Board (SWCB) approved all Triennial Review amendments to section 9 VAC 25-260-140 "Criteria for surface water" at

their October 17, 2008 meeting. The amendments will become effective upon EPA approval, which is expected in the last quarter of 2009.

Approximately 90 parameters in the criteria table in section 9 VAC 25-260-140 (Appendix C) have amendments that were approved by the SWCB. The majority of the amendments consist of changes to numeric criteria for human health based on updated EPA guidance that is more stringent. More stringent criteria are due either to a Relative Source Contribution factor or an increase to the estimated amount of fish tissue consumed being incorporated into the formula EPA utilizes in the updated criteria calculations. A complete list of SWCB approved amendments to toxic parameter criteria are in the table of parameters at http://www.deq.virginia.gov/export/sites/default/wqs/documents/TR_WQS08_Triennial_Review_FINAL_LANGUAGE.pdf .

Three new criteria for toxic analytes will be added to the WQS based on EPA updates: Diazinon, methylmercury (as a fish tissue concentration criterion) and nonylphenol. Two new footnotes have been added. One concerns the number of significant digits to be utilized when assessing the parameters and the other added to explain application of the methylmercury criterion to wet weight concentration in edible tissue and its application to commonly eaten species.

The regulation adoption process has begun for amendments for freshwater aquatic life criteria for cadmium and fresh/saltwater aquatic life criteria for lead in section 9 VAC 25-260-140. Criteria updates for cadmium and lead were approved by the SWCB on October 27, 2009 to proceed to a Notice of Public Comment (NOPC). The amendments incorporate the latest compilation of toxicity literature available for cadmium in freshwater and incorporate the EPA recommended conversion factor for lead criteria.

The proposed criteria for cadmium are more stringent than the current Virginia freshwater criteria for cadmium that are based on 1985 EPA criteria. However, compared to the 2001 EPA cadmium criteria, the proposed acute criterion is similar or slightly more stringent, while the chronic criterion is less stringent. The proposed criteria for cadmium and lead are available at http://www.deq.virginia.gov/wqs/documents/Triennial_Rev_Carryover/Carryover_Proposed_language_OCT2009.pdf .

For further information relative to Virginia's Water Quality Standards, contact David Whitehurst at (804) 698-4121, David.Whitehurst@deq.virginia.gov.

1.2.4 Toxic Substances in the Water Column: Water Quality Criteria and the derived Water Quality Standards for toxic substances in the water column are expressed on the basis of dissolved concentrations. DEQ monitors dissolved metals in the water column using specialized "clean sampling" procedures. Because of the low solubility of most toxic organic substances in the water column, traditional methods of sampling have generally resulted in values below the detection limits of the laboratory methods used for their analysis. Consequently, DEQ began using Semi-Permeable Membrane Devices (SPMDs) for the passive sampling of dissolved organic contaminants during the spring of 2003. The use of this methodology has subsequently been limited to more localized special studies because of the relatively high cost of analyses.

More recently, EPA has recommended the use of Method 1668 for dissolved PCBs in TMDL development. This method permits a much lower detection level than previously used methods. It uses clean sampling techniques and a congener-specific, high resolution/low detection analytical method to provide quantification in the pg/L range (picogram = one trillionth [10^{-12}] of a gram, per liter). DEQ has employed

this method for the development of PCB TMDLs within the tidal Potomac River, the Roanoke (Staunton) River, the Levisa Fork, the Upper Tidal James River and the Elizabeth River Watershed.

Although DEQ monitored the ambient concentrations of total metals in the water column in the past, this practice later became limited to special studies specifically targeting areas of known water quality problems. No criteria or water quality standards exist for total suspended (particulate) contaminants because they are generally not in a form available for uptake by aquatic organisms. The data are, however, useful for locating and identifying the sources of dissolved toxics or to calculate local chemical 'translator' values used to estimate dissolved concentrations from the total amount of metal in the water column. More recently, it was discovered that benthic community degradation is often more highly correlated with concentrations of total metals than with dissolved metals. Consequently, monitoring of total metals in the water column is again becoming more frequent.

A summary of current toxics-related water column monitoring activities is provided in Section 2.3.1 of this report.

1.2.5 Toxic Substances in Sediment: At present, neither the EPA nor the Commonwealth of Virginia has established standards for toxic substances in sediment. In the past, the analytical results of toxics in freshwater sediments were compared to ecological effects thresholds published in 1991 by the National Oceanic and Atmospheric Administration (NOAA) and in 1992 by the EPA. Thresholds for many metals in estuarine and marine sediments were further refined in 2005. These new screening values are now used for the assessment of estuarine and marine sediments. A summary of the Effects Range - Median (ER-M) values for selected chemicals in sediment appears in Appendix D of this report. The specific ER-M values used for the assessment of sediments in Virginia are updated as new guidelines become available. Beginning with the 2004 Virginia Water Quality Assessment 305(b)/303(d) Integrated Report (IR), the agency has used more recently published Consensus-Based Sediment Quality Guidelines (2000) and Probable Effects Concentrations (PECs) for the evaluation of toxic sediment contaminants in freshwater environments. A listing of current sediment quality guidelines is provided in Appendix D and in the most recent assessment guidance document for DEQ's Integrated Report (http://www.deq.virginia.gov/wqa/).

Beginning with its 2006 305(b)/303(d) IR DEQ has utilized such sediment quality guidelines in weight-of-evidence Aquatic Life Designated Use (ALU) assessments of estuarine probabilistic sites. The number of ER-M exceedances, the average ER-M Quotient[1] and Equilibrium Partitioning Sediment Benchmarks[2] (ESBs) for PAH mixtures are integrated with the results of sediment toxicity tests and the evaluation of benthic community structure and function for an overall evaluation of sediment contamination at approximately 50 estuarine sites per year.

A summary of current sediment monitoring activities is provided in Section 2.3.2 of this report.

1.2.6 Toxic Substances in Fish Tissues: DEQ evaluates levels of toxics in fish tissues by comparing them with human consumption risk screening values calculated from data in EPA's Integrated Risk Information System (IRIS). A summary table of the risk-based screening values DEQ uses for fish tissue consumption appears in the agency's biennial assessment guidance documents. These screening values are adjusted as

[1] An ER-M Quotient is the ratio of the observed concentration of a contaminant in the sediment to its published ER-M sediment quality guideline. Various studies (*e.g.*, MacDonald, DiPinto et al., 2000; McDonald, Ingersoll et al., 2000; Ingersoll et al., 2001; Field et al., 2002) have reported that the average ER-M Quotient, across numerous metallic and organic contaminants, may be a much more sensitive indicator of possible effects on the benthic community than individual ER-M exceedences.

[2] The summing of ESBs for designated groups of PAHs also may be a much more sensitive indicator of possible effects of low-level dissolved PAHs on the benthic community than individual ER-M exceedences. (US EPA, 2003). http://www.epa.gov/nheerl/publications/files/PAHESB.pdf)

necessary, following monthly updates in the IRIS database available at http://cfpub.epa.gov/ncea/iris/index.cfm. A current list of the Risk-Based Tissue Screening Values (TSVs) for fish tissue used for the 305(b)/303(d) IR can be found in the most recent assessment guidance manual at http://www.deq.virginia.gov/wqa/. Values for specific compounds can also be found listed in the tables of fish tissue analytical results posted on the DEQ web page at http://www.deq.virginia.gov/fishtissue/. A summary of current fish tissue monitoring activities is provided in Section 2.4 of this report.

1.3 Federal Reporting Requirements

In addition to the biennial 305(b)/303(d) IR, 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 TRI Report, are discussed more fully below.

1.4 DEQ's Water Quality Monitoring (WQM) Strategy

The revised 2007 edition of DEQ's Water Quality Monitoring Strategy was accepted by EPA Region 3 and is now available on the DEQ Water Quality Monitoring web page at http://www.deq.virginia.gov/watermonitoring/monstrat.html. Two major changes that affected toxics monitoring and assessment were the adaptation of the monitoring program to the 1,247 newly delineated sub-watersheds of the NWBD and the realignment of the monitoring year to correspond with the calendar year rather than the state fiscal year. The adaptation of the watershed monitoring program to characterize 1,247 individual sub-watersheds, in contrast with the 494 watershed units of the previous delineation, resulted in the redistribution of a number of monitoring sites. The necessary adaptations were initiated in January 2007. Monitoring years and watershed rotations now coincide with the limits of the expanded six-year assessment window initiated for the 2008 305(b)/303(d) IR in the 2008 Integrated Report included balanced comprehensive statewide monitoring coverage by the rotating watershed network, as well as by the freshwater and estuarine probabilistic monitoring networks. Additional minor revisions to the WQM Strategy will be completed and submitted for EPA approval in 2010.

1.5 Sampling Design and Monitoring Methodologies

Implementation of DEQ's 2000 Water Quality Monitoring Strategy (revised in 2004 and 2007) focused on the monitoring of toxics in a more systematic manner to assess their potential impact on ambient water quality. At that time, inclusion of toxics monitoring within the water column and/or sediment was included in both freshwater and estuarine probabilistic monitoring programs to provide statewide and resource-wide characterizations.

Several recent developments, however, have resulted in more restricted toxics monitoring within the Commonwealth. The very low solubility and consequent low concentrations of dissolved contaminants, both metals and organics, require special sampling and analytical methods. Traditional methods have routinely resulted in no "detectable" analytes present, while specialized methods reveal the presence of low but significant concentrations.

In addition, the first seven years of probabilistic toxics monitoring revealed that the observed concentrations of dissolved toxic metals in the water column of Virginia's rivers seldom exceed characteristic background levels, except near suspected or previously identified sources. Consequently, since 2004 the monitoring of toxics has shifted focus from ambient waters to major point source discharges and other known or suspected problem areas. Major point source discharges and other

targeted Standard Industrial Classifications (SICs), 303(d)[3] listed waters, acid mine drainage (AMD) sites and the Elizabeth River are prime areas where monitoring for dissolved metals has continued.

Prior to 2004, the WQM Strategy provided for sampling of trace metals and organic pesticide contaminants in sediments at all watershed stations once every five to six years, and once at each probabilistic monitoring station. The list of organic compounds being monitored has expanded considerably since then to include more current use compounds, and new sampling and analytic methods currently provide significantly lower detection limits for most substances on the list. Table 1, "DCLS Toxic Parameter Group Codes and Prices - SFY09", lists the toxic organic compounds monitored as target analytes in sediment. The acceptably low concentrations observed for most contaminants at most locations have allowed DEQ to more efficiently distribute available resources among sampling surveys of toxic organics. This was initially restricted to probabilistic sites under the 2005 Water Quality Monitoring and Assessment Strategy. More recently, it has been limited to more intensive localized special studies carried out within the TMDL Program to define the severity, extent and probable source of contamination problems that have already been identified. Supplemental federal grants still provide resources for the chemical analysis of sediment samples at estuarine probabilistic sites, but monitoring for toxics at most freshwater probabilistic sites has been temporarily suspended because of resource limitations.

2.0 Monitoring for Toxics in State Waters

Toxic chemicals fall into two principal classes of compounds: inorganic trace metals and synthetic organic chemicals. The Commonwealth of Virginia monitors both classes of toxics and their effects in the water column and sediment of the state's surface waters by both chemical and biological methods, and by chemical methods in fish tissues.

Chemical Monitoring: Monitoring of toxics consists of the direct, quantitative measurement of the concentrations of specific chemical elements and compounds in effluents, in the water column, in the underlying sediments and/or in animal tissues. Chemical monitoring is considered to be monitoring of the *potential causes* of ecological stress and environmental impairment.

Toxics in the Water Column: DEQ compares the results from water column analyses with water quality criteria and standards based on the acute and chronic toxicity of specific substances dissolved in fresh, brackish and salt waters. The standards used for these comparisons are listed in the current Assessment Guidance Manual (http://www.deq.virginia.gov/wqa/) for each 305(b)/303(d) IR and in Appendix C of this report, as well as in the Water Quality Standards document (http://www.deq.virginia.gov/wqs).

Toxics in Sediment: In most cases, there are no specific standards for toxics in sediment. Consequently, in marine and estuarine waters ecological risk assessments have generally compared toxics concentrations in sediment to ER-M concentration screening values (SVs). NOAA and EPA have provided sediment SVs to evaluate the potential effects of sediment contamination on aquatic life in estuarine and marine waters. Newly published "Consensus-Based" screening values are now used for freshwater sediments. A summary of current ER-M and Consensus screening values can be found in each 305(b)/303(d) IR Assessment Guidance document (http://www.deq.virginia.gov/wqa/), as well as in Appendix D of this report.

Toxics in Fish Tissue: To assess the human health risk from edible fish tissues, the analytical results from fish tissue analyses are compared to Human Health Screening Values for specific contaminants. The calculation of these SVs uses risk assessment techniques published by the EPA for chronic toxicity and for

[3] Total Maximum Daily Load Priority List of the biennial Water Quality Assessment 305(b)/303(d) Integrated Report, Virginia Department of Environmental Quality and Department of Conservation and Recreation.

both carcinogenic and non-carcinogenic effects (U.S. EPA, 1994; see also http://cfpub.epa.gov/ncea/iris/index.cfm). The current Water Quality Assessment Guidance Manual, as well as Appendix E – Risk Based Screening Values Fish Tissues SFY09, provides summaries of current fish tissue SVs. More specific details on the sampling and assessment of fish tissues and sediment appear in the 1998 Quality Assurance/Quality Control Project Plan for the Fish Tissue Monitoring Program.

Biological Monitoring consists of evaluating the survival, growth and reproduction of living organisms, or of assessing the structure and function of aquatic communities in comparison with those existing under known reference conditions. Such monitoring may be carried out in the field or in the laboratory. When carried out in the field, it is considered monitoring for the *observed effects* of environmental impairment. When impairment of biological communities occurs, however, it does not necessarily indicate toxic effects. Intensive follow-up monitoring is necessary to determine the specific cause(s) of biological impairment. Ecological or biological toxicity tests performed in the laboratory generally expose living organisms, belonging either to endemic (native) species or to nationally or internationally standardized species, to water and/or sediment samples collected in the field.

Under laboratory conditions, the results of toxicity testing can only be considered to be the measurement of the *potential effects* of toxicological stress on environmental impairment. DEQ no longer possesses the facilities to perform its own toxicity testing; when deemed necessary for special studies, however, DEQ does contract commercial or university laboratories to perform the desired tests. Each year, estuarine sediment samples collected in the Estuarine Probabilistic Monitoring Program are sent to a contracted commercial laboratory for toxicity testing. Additional toxicity testing, associated with freshwater benthic-related TMDL studies, is often carried out by EPA laboratories.

Many permitted facilities that have Whole Effluent Toxicity (WET) Limits described in their discharge permits must maintain laboratories for the programmed biological testing of toxicity of their own effluents and must report the results to DEQ. DEQ continually reviews these results and periodically collects effluent samples for analysis at independent laboratories to confirm the toxicity levels and the quality assurance/ quality control procedures the permitted facilities are using.

2.1 Chemical Monitoring

2.1.1. Monitoring Activities: DEQ has traditionally conducted chemical monitoring of the state's surface waters, fish tissues and associated sediments for toxics on a regular basis. Because of the high costs of analysis and successive reductions in the available resources, however, the ambient monitoring of toxic chemicals in sediment and the water column is currently restricted primarily to special studies, most often in association with TMDL development.

DEQ has traditionally conducted fish tissue and sediment sampling on a rotating basin schedule. In calendar year 2007, DEQ suspended the routine analysis of organics in sediment samples in the fish tissue program, as well as in the freshwater probabilistic program. Beginning in 2008, the frequency and number of fish species sampled was reduced in river basins not associated with TMDLs.

2.1.2 Matrices and Parameter Classes: Toxic elements and chemical compounds are generally categorized into several primary groups, each of which has specific chemical analysis codes to identify the procedures necessary for its complete analysis by DCLS of the Virginia Department of General Services, or by contracted academic or commercial laboratories. The primary groups normally considered include:

- Clean dissolved and total trace metals in the water column,
- Toxic metals in sediment,

- Dissolved organic contaminants,
- Organic contaminants in sediment, and
- Toxic metals and organics in fish tissues.

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

Table 1 of this report summarizes the currently active toxics-related Parameter Group Codes and the specifically associated analytes in the current DCLS laboratory catalogue within the DEQ CEDS database, including their associated reportable limits, costs and turnaround times. The exact reportable limits may vary from day to day, depending on the stability of the analytical apparatus, the purity of reference materials and blanks, and possible interference from other substances present in the samples collected in the field. It should be understood that various Parameter Group Codes included in this list are seldom utilized within the ambient Water Quality Monitoring (WQM) Program. Some are specific to other matrices, such as fish tissues, soil, etc., or are utilized specifically for industrial facilities. Other group codes have been updated and replaced with new codes because of concern with new chemical products, the availability of newer analytical methods and/or the availability of lower detection limits for the analytes of interest. Those parameter group codes actually employed by the ambient WQM Program during SFY09 are identified in Table 2.

Table 2.A summarizes the number of samples, the analytical expenses and the parameter group codes included in toxics-related analyses performed and billed by the state laboratory during 2009. Toxics samples, analytical costs, etc., that are associated with the fish tissue and sediment monitoring program, collected during various toxics-related special studies, or collected in the Estuarine Probabilistic Monitoring Program, are generally analyzed elsewhere via contracted services. The costs of contracted analytical services for the major toxics-related programs and special studies are summarized in Table 2.B.

2.2 Biological Monitoring and Results

Benthic Community Evaluation: Field sampling and evaluation of benthic communities has proven to be an invaluable tool in the assessment of water and sediment quality. Aquatic organisms often respond to extremely low concentrations of toxics and can indicate potentially contaminated waters at a much lower cost than chemical monitoring. Significantly stressed benthic communities often indicate the impact of toxics in the environment, but follow-up evaluation is required to confirm the specific cause of the observed benthic impairment. A number of biological sampling and assessment protocols are used within free-flowing mountain and piedmont streams, low gradient coastal plain streams and estuarine waters, including the Chesapeake Bay. Details of the respective monitoring programs and methods are described in the DEQ WQM Strategy (http://www.deq.virginia.gov/watermonitoring/monstrat.html) and the current Assessment Guidance Manual (http://www.deq.virginia.gov/wqa/homepage.html).

Appendix H1 of this report lists the freshwater biological monitoring stations visited during SFY09. Regional biologists sampled at 383 sites in the Piedmont and Appalachian Zones and subsequently performed evaluations using the Virginia Stream Condition Index (VSCI). Of those visits, approximately 9% resulted in evaluations of severe stress potentially caused by toxics. An additional 38 sites were evaluated with the Coastal Plain Macroinvertebrate Index (CPMI). Approximately 9% of those scores also indicated severe stress. The list in Appendix H1 includes a number of the 134 freshwater probabilistic sites that are also described in Appendix H2a.

Appendix H2a, "Freshwater Probabilistic Monitoring Sites Sampled in SFY09," provides a comprehensive list of the freshwater probabilistic monitoring stations that were included in the ambient program during fiscal year 2009. Many of these sites were also sampled for benthic invertebrate populations and are also included in Appendix H1. This list summarizes visits to 134 freshwater probabilistic stations, including autumn visits to calendar year 2008 sites and spring visits to calendar year 2009 sites.

Appendix H2b, "Prospective Freshwater Probabilistic Monitoring Sites MY2006-10," provides a comprehensive list of 70 potential probabilistic/biological stations that may be included in the ambient program during the spring and summer of 2010. The final annual list will become available after regional biologists perform both map and field reconnaissance prior to their spring sampling.

Chesapeake Bay and Other Tidal Waters: The Chesapeake Bay Program conducts probabilistic monitoring of benthic communities. As a second phase of assessment based on the CBP 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 the National Coastal Assessment (NCA) protocols in the Bay and other tidal coastal waters. It consists of a weight-of-evidence evaluation based on the Sediment Quality Triad (SQT). Estuarine probabilistic monitoring following the NCA protocols provides data on the chemical contamination of sediment, the toxicity of sediment and an evaluation of benthic community wellbeing using three indices of stress. The indices include the Chesapeake Bay Program's "Benthic Index of Biological Integrity" (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 - Middle Atlantic Integrated Assessment (EMAP-MAIA) Index of Estuarine Condition (IEC). This methodology is described in detail in the current Assessment Guidance Manual (http://www.deq.virginia.gov/wqa/) for the biennial 305(b)/303(d) IR.

Appendix G-2 provides a complete list of the DEQ estuarine probabilistic stations sampled during July - September 2008. Weight-of-evidence assessments for Aquatic Life Use at Estuarine ProbMon stations sampled during the six-year 2003 – 2008 period will appear in the 2010 305(b)/303(d) IR.

2.3 Toxics Monitoring and Results – Surface Waters and Sediments

Appendix F lists the ambient monitoring stations that were sampled for each toxics parameter group code during SFY09. Similar annual summary tables can be found in previous Toxics Reduction Reports (Jan 1999 – Jan 2009).

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 and 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 SFY09. 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 spreadsheet titled "Introduction to Tables and Folders" is included in 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.

2.3.1 Toxics in the Water Column

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 equipment 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 problems in terms of sample contamination. Consequently, careful planning and specific SOPs are necessary to ensure the quality control of sample collection, transport, subsequent chemical analyses and to guarantee the accuracy and defensibility of the results. A number of newly developed sampling and analytic technologies (*e.g.*, SPMDs and clean sampling techniques for metals and PCBs described elsewhere in this report) are now in use for improving the representativeness, accuracy and precision of measuring dissolved toxics in the water column.

2.3.1.1 Clean Dissolved Metals in Surface Waters

DEQ's dissolved clean metals SOP (DEQ-WQA, 1998) is currently being applied in the collection and analysis of 19 dissolved trace metals in freshwater and of 16 metals in brackish and saltwater samples. "Table 3 – Clean Dissolved Metals All Basins SFY09" presents the results of clean, dissolved metals monitoring during SFY09. Individual spreadsheets in Table 3 summarize the results from Freshwater and Estuarine Probabilistic Monitoring Programs, the Shenandoah River Basin Mercury Special Study and a tidal Appomattox River Special Study. Basin-by-basin historical summaries of clean dissolved metals results can be found in the Excel® workbooks of Folder 3 - "TRISWat Jan10 Folder 3 Metals Dissolved Historical."

2.3.1.2 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 normally 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. In recent years, total clean metals have been sampled along with dissolved metals at most probabilistic monitoring stations. During SFY09, 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 resulting data from these samples are included in the spreadsheets of Table 4 and in the workbooks of Folder 4 - "TRISW Jan10 Folder 4 Metals Total Water Historical."

2.3.1.3 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. SPMDs were employed in several special studies on the distribution of 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 PCB Aroclor analysis. Recently, EPA recommended the use of Method 1668 for TMDL development since it supports a much lower detection of PCBs. It uses clean sampling techniques and a congener-specific, high resolution/low detection analytical method to measure concentrations in the pg/L range. Data have been generated using this method for TMDL development within the following PCB impaired water bodies: the tidal Potomac River, the Roanoke (Staunton) River,

Levisa Fork, the upper tidal James River and the Elizabeth River watershed. Preliminary results from the James River study are described in Appendix I of this report.

Table 6h "PAHs Water - All Basins SFY09" indicates that limited ambient monitoring was conducted for PAHs or other semi-volatile organic analytes during 2009. Four samples were collected for incidental pollution complaint or incident response events.

2.3.1.3 Muddy Creek Nitrate TMDL

Although elevated concentrations of dissolved nitrates (NO_3^{-1}) are normally considered to be a nutrient enrichment problem rather than a toxic stressor, nitrate concentrations (as N) of 10,000 µg/L or above in drinking water supplies are considered detrimental to human health. Water quality monitoring in the 1990's indicated that, under certain low flow conditions, the nitrate standard for public drinking water supply potentially would be violated within the 5 mile stream reach above the Bridgewater and Harrisonburg Water Treatment Plant (WTP) intakes on the North River due to point and nonpoint source contributions. Therefore, 7.04 miles of Muddy Creek, Dry River and North River were designated as impaired due to nitrates on the Virginia 1998 303(d) list. The Muddy Creek/Dry River watershed is located in Rockingham County, Virginia approximately 15 miles to the west-northwest of Harrisonburg, Virginia. EPA approved the initial TMDL proposal in April 2000 and it was adopted by the SWCB in March 2004. Water quality monitoring results from this watershed (Jan 2003 – Dec 2008) indicate that these waters are now in compliance with the nitrate drinking water standard and will be reclassified from EPA Assessment Category 4A to category 1 or 2, depending upon whether or not all other uses are being supported.

2.3.2 Toxics in the Sediment

Beginning in 2001, DEQ restricted its collection of sediment samples primarily to its freshwater and estuarine probabilistic monitoring stations and to the fish tissue program. In 2007, DEQ suspended organic chemical analyses of sediments at most freshwater sites in order to conserve resources. During SFY 2008 and 2009, sediment metals samples were collected at freshwater probabilistic sites. Federal §106 grant supplements targeted for probabilistic monitoring have permitted DEQ to continue monitoring a reduced suite of contaminant analytes defined by the NCA Program at estuarine probabilistic monitoring sites. These analytes include 11 toxic metals, 22 PAHs, 21 PCBs congeners and approximately 20 pesticides and/or pesticide derivatives. Sediment samples were collected during studies carried out by the Fish Tissue and Sediment Program in SFY2009, but they are frozen and archived. No analyses will be carried out unless fish tissue results indicate a severe toxics problem. Consequently, no sediment results are reported in association with the SFY 2008 fish tissue samples, the results of which were received in SFY 2009. All fish tissue and associated sediment samples collected during SFY 2009 have been frozen and archived. They will not be analyzed until additional resources become available. The Fish Tissue and Sediment Monitoring Program has been suspended for SFY 2010 because of resource limitations.

2.3.2.2 Sediment Metals

Table 5a, Sediment Metals - All Basins - SFY09, presents tabular results and a statistical data summary of the SFY09 WQM freshwater sediment metals data. Table 5b, Metals Sediment Estuarine ProbMon SFY09, reports the results of sediment metals analyses from the Estuarine Probabilistic Monitoring Program samples that were collected during SFY 2009 fiscal and analyzed by contracted laboratories. Tables 5c through 5i summarize the results of sediment metals analyses from the Estuarine ProbMon Program for state fiscal years 2002 – 2008. These tables have been included because the data were added to the graphical summaries of Folder 5 for the first time in this report. Although sediment samples were collected

during studies carried out by the Fish Tissue and Sediment Program in SFY2007, SFY2008 and SFY2009, no chemical analyses were performed on the sediment because of resource limitations.

The Excel® workbooks of Folder 5 - TRISW Jan09 Folder 5 Metals Sediment Historical present historical summaries.

2.3.2.3 Sediment Pesticides and Other Organic Toxics

DEQ also monitors organic toxics deposited in the sediments underlying the Commonwealth's waters. In recent years, DEQ's ambient monitoring program expanded the suite of toxic sediment organics that it monitored from 13 to more than 200 compounds. The resulting analytical costs are as high as $1690 per sample. The sampling and analysis of organic contaminants in ambient freshwater sediment has temporarily been suspended until more resources are available.

Table 6a - Sediment OC Pesticides - All Basins – SFY09 and the corresponding Folder 6a indicate that only five ambient freshwater sediment samples were analyzed for organo-chlorine pesticides in the most recent fiscal year. Three sites in the lower tidal Appomattox River were sampled in a special study bracketing the Hopewell public water supply intake (see Appendix I – PRO - Appomattox-Hopewell Sediment Contamination Special Study [SS# 09017]). Although PEC freshwater sediment SVs for chlordane were exceeded at all three sites, no exceedances of water column standards were observed. Two additional sites in Charlottesville were sampled in conjunction with an upcoming benthic TMDL, Meadow Creek and Shencks Branch Benthic TMDL (SS # 07118). Chlordane also greatly exceeded the PEC freshwater sediment SVs at both sites. Further sediment sampling is being planned and a benthic TMDL is currently anticipated for this watershed in 2014.

Tables and Folders 6b (OP Pesticides), 6c (Herbicides), 6d (PAHs) and 6e (Semi-volatiles) follow the same format as Table 6a and Folder 6a. The results for sediment PCBs (6f) are irregular among congeners and are summarized only as total PCBs in Table 6f. Consequently, no separate basin-by-basin summary folders have been developed for PCBs.

Further information about the statewide Water Quality Monitoring Program is available from Roger E. Stewart at (804) 698-4449 (Roger.Stewart@deq.virginia.gov) or from Donald H. Smith at (804) 698-4429 (Donald.Smith@deq.virginia.gov) at DEQ's Central Office in Richmond.

2.4 Specialized Fish Tissue and Sediment Monitoring and Results

The collection of fish for fish tissue analyses requires specialized sampling techniques, equipment and training. A field team from Water Quality Monitoring and Assessment Group at DEQ's Central Office periodically samples all nine of Virginia's significant river basins on a rotating five year schedule. Sediment samples have traditionally been collected at the same locations and on the same dates as fish samples.

2.4.1 Fish tissue and sediment sampling plan for 2009

A copy of the complete 2009 sampling plan is available at http://www.deq.virginia.gov/fishtissue/ and as Appendix G1 to this report. A complete list of the proposed sites scheduled for sampling during summer 2009 can be found on pages 5 - 7 of the sampling plan. Summer 2009 sampling concentrated primarily on the Potomac-Shenandoah Basin and the New River Basin, plus a few sites from the Smith River (Roanoke River Basin) and the Waller Mill Reservoir of the York River Basin. The proposed sampling was

completed during the summer, but all fish tissue and sediment samples have been frozen and archived until resources become available for their analysis. There is currently no plan to sample fish tissues and sediment within this program during the summer of 2010. DEQ will collect and analyze estuarine fish tissue and sediment samples as part of the National Coastal Assessment Program.

2.4.2 Fish tissue results (2008) received in 2009

The results from tissue samples are compared with the screening values listed in Appendix E. Tables 7a-1 through 7a-4 Fish Tissue Metals, PCBs, PAHs and Pesticides, WQS 2008 (Received in 2009). These tables summarize the most recent results from fish tissue samples in relation to EPA-IRIS screening values. Not all analyte groups were analyzed at all sites – analytes expected to be most problematic at each site were prioritized. In the tables, sample results from prioritized analyte groups are listed in black font and those not analyzed are in gray font. Results that exceeded the VDH level of concern are presented in red font and those that exceeded DEQ's screening values are presented in blue font. In all, a total of 701 individual or composite fish tissue samples were collected. Not all classes of contaminants were analyzed in all samples: 489 results were returned for tissue metals, 503 for PCBs and 62 for pesticides. Only eight PAH analyses were carried out on 2008 samples.

Because of resource limitations, none of the sediment samples collected during the summer of 2008 were analyzed for comparisons with the NOAA ER-M and/or consensus-based PEC sediment screening values.

Several recent reports on fish tissue and sediment monitoring can be found on the DEQ web page at http://www.deq.virginia.gov/fishtissue. Additional information on the fish-tissue/sediment monitoring program is available from Gabriel Darkwah at (804) 698- 4127 or Gabriel.Darkwah@deq.virginia.gov.

2.5 PERMITTED DISCHARGES AND TOXICS MONITORING OF PERMITTED FACILITIES

Both private and public facilities that discharge effluent into state waters are required to obtain permits from the SWCB. The VPDES requires the establishment of limitations for such permits to ensure that Virginia's water quality standards are not violated. DEQ's Toxics Management Program (TMP) assesses all VPDES permit applicants for their potential to discharge specific toxic chemicals that could violate water quality standards. Facilities with the potential to discharge these substances are given *numerical effluent limits* in their permits and are required to monitor and report to DEQ on their compliance with these limits following permit-specified schedules. Based on evaluations done by the TMP, some permits may include WET limits, which require additional biological testing of effluent toxicity. The specific requirements for testing effluent toxicity criteria for compliance self-monitoring and toxics reduction evaluation (TRE) are included in the Water Permit Program's guidance documents.

DEQ chemically samples in-pipe concentrations of specified substances during inspections at permitted facilities. When permits include WET limits, the facilities are also required to perform toxicity tests on their effluent until such time that complete compliance is well established and potential toxic effects of the effluent have been minimized or eliminated. DEQ reviews the results of all toxicity monitoring tests for consistency and compliance.

Appendix J - Facilities & Outfalls with Toxics Parameter Limits SFY09, lists facilities that currently have or have applied for permits that contain limits on the quantity or concentration of discharged toxics in their effluent. The same spreadsheet includes their respective addresses, geographic locations, receiving streams, and other information. During SFY09, 311 reporting facilities with 592 outfalls had one or more toxics limits in their permits. The effective limits 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 K – Permits Parameters Units & Frequencies SFY09. The compliance results of each permitted facility's Discharge Monitoring Reports (DMRs) during SFY09 are reported in Appendix L – Permitted Toxics Parameters & DMR Results SFY09. Some facilities may hold permits requiring only that they report parameters of discharge. These permits do not have a specified limit with which they must comply. Since they do not have a numeric value limit, they cannot be used for compliance testing.

Further information on the compliance of specific permitted facilities is available from the corresponding regional Water Compliance Manager. The most current contact information for each regional office is available in Appendix I or on the DEQ web page at http://www.deq.virginia.gov/regions/.

2.6 SPECIAL STUDIES CONCERNING TOXICS

2.6.1 Regional Special Studies Involving Toxics

Special studies are often initiated independently at the Regional Office level in response to locally recognized problems. Regional special studies that dealt with toxics during SFY09 are summarized in detailed descriptions within Appendix I – Special Studies Related to Toxics SFY09. The names and contact information for the responsible individuals at the Regional and/or Central Offices are provided in Appendix I. Interim or final reports from various toxics-related studies are also available on the DEQ web pages http://www.deq.virginia.gov/water/reports.html and http://www.deq.virginia.gov/tmdl/.

2.6.2 Additional Special Studies Involving Toxics

Benthic and other TMDL Special Studies Involving Toxics - Because toxics must be considered as one possible cause of benthic impairments, water and/or sediment samples are often collected and shipped to the EPA Laboratory in Cincinnati, Ohio for toxicity testing. The execution schedules and status of benthic and other toxics-related TMDL studies through 2010 can be found linked to DEQ's TMDL web page at http://www.deq.virginia.gov/tmdl/homepage.html.

Benthic Impairments in Meadow Creek and Shencks Branch (SS # 07118)
Meadow Creek and Shencks Branch in Charlottesville are listed on Virginia's 2008 303(d) list as not supporting aquatic life use due to violations of the general benthic standard. In order to support TMDL work, additional monitoring was conducted in the watershed. Chemical analyses of preliminary sediment samples collected from Meadow Creek and Schenks Branch in early March of 2009 revealed very high concentrations of chlordane (Table 6a). Additional sediment sampling is currently being planned. This small watershed falls within the larger H28 = Upper Rivanna River/Moores Creek watershed, which is scheduled for development of a TMDL in 2012.

Appomattox-Hopewell Sediment Contamination Special Study (SS # 09017)
Weight-of-evidence sediment assessment results from a lower Appomattox River estuarine probabilistic station sampled in 2006 revealed severe benthic degradation, significant sediment toxicity and elevated levels of DDT in the sediment. The site presented a potential public health concern because it was located approximately 500 meters upstream from the City of Hopewell public water supply intake. A special study was carried out in early March of 2009 to investigate sediment and water column chemistry at the original site, at the Hopewell PWS intake, and 500 meters downstream from the intake. Although concentrations of chlordane exceeded freshwater PEC screening values (Table 6a), and several metals and PAHs were

significantly above normal background levels, no water quality standard violations were observed in the water column.

For further information on the results of specific toxics-related TMDLs, contact the individuals listed on the TMDL web pages. For more general information, contact Mark Richards at (804) 698-4392, Mark.Richards@deq.virginia.gov or Craig Lott at (804) 698-4240, Craig.Lott@deq.virginia.gov at DEQ's Central Office in Richmond.

2.7 THE CALENDAR YEAR 2010 WATER QUALITY MONITORING PLAN

The annual MonPlan provides a complete list of the ambient WQM stations that will be actively sampled during the corresponding calendar year. Beginning in 2006, the DEQ Monitoring Year has corresponded to the calendar year, rather than the state fiscal 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) IR assessment and listing cycle. The lake monitoring program, fish tissue and sediment monitoring program, and the beach monitoring program are based on summer or spring through fall sampling, and have traditionally bridged two monitoring/fiscal year periods. Under the old scheme, watershed and monitoring site rotations were carried out in mid-summer, which fragmented a single season's results into two separate monitoring year data sets. The new synchronization scheme is described in detail in the 2007 revision of DEQ's Water Quality Monitoring and Assessment Strategy at http://www.deq.virginia.gov/watermonitoring/monstrat.html.

The new MonPlan for calendar year 2010 will be completed in December 2009 and will be initiated on January 1, 2010. It will complete the second two-year rotation in the second six-year cycle of DEQ's statewide Watershed Monitoring Network. Once finalized, each annual MonPlan is summarized and posted on the DEQ web site at http://www.deq.virginia.gov/watermonitoring. Those portions of the new plan that deal with long-term trend stations will continue without significant modification. Because this constitutes the second year of a two-year rotation of the watershed monitoring network, it will not require the relocation of watershed monitoring sites. However, the sampling and analysis of some analytes at watershed stations have been temporarily suspended to conserve resources.

2.8 CHALLENGES IN THE EVALUATION OF TRENDS IN TOXICS

The distribution of toxic materials in ambient surface waters, especially in sediments, has high spatial and temporal variability. Sampling of the water column has conventionally consisted of temporal "point-samples" in which a water sample is collected at a specific point in time for subsequent analysis. Daily, monthly and yearly cycles and irregular fluctuations in input rates are generally not well documented, especially at the low frequency at which toxics are normally sampled and analyzed. A degree of uncertainty always exists relative to the representativeness of the specific point in time that the sample was collected. The effects of these factors have been noted in recent efforts to evaluate long-term trends in conventional water quality parameters and nutrients that were sampled on a much more frequent basis.

The 30-day integrated sampling of dissolved organic toxics using SPMDs partially alleviates this problem within the water column. In addition, when united with the confidence estimates provided by probabilistic sampling, chemical characterizations of specific resource classes (*i.e.*, stream types, drainage basins, ecoregions, etc.) can be formally compared statistically among themselves and between sampling periods. When resources become available, another probabilistic SPMD special study at some time in the future may permit DEQ to address whether contamination by specific dissolved organic compounds is decreasing, remaining stable or increasing.

The concentrations of toxics within a specific unit of sediment may be more stable in terms of temporal variation, but concentrations may vary considerably even on a local spatial scale. Most toxic substances are readily bound chemically to organic material suspended in the water column or precipitated onto the surface of the sediment. This organic matter is generally lighter than the majority of suspended minerals, which may precipitate out of more rapidly moving waters. The organics precipitate into the underlying sediments of more slowly moving waters where they may accumulate in relatively concentrated, localized deposits with the bound toxics. However, any significant change in water velocity or flow pattern may spatially redistribute both the organic material and the associated toxics, and the age of contaminants and the date of such depositions are seldom known.

Even when spatially stable under calm waters, sediments tend to be temporally heterogeneous (stratified). The uppermost sediment layer is generally the most recent, the deeper layers often having been deposited days, weeks, months or even years earlier. In the deeper, relatively undisturbed sediments, toxics may lie for years without reflecting more recent trends in concentrations. Careful sampling done by taking sediment cores and isolating the various strata of sediment for separate analyses may reveal temporal trends in toxics concentrations and deposition rates. Determining the appropriate time scale, however, is difficult and costly.

In summary, the same factors that generate temporal and spatial variations in toxics distribution also create difficulties in achieving reliable and definitive statistical analyses. Consequently, much of the historical toxics data available in the DEQ database are not amenable to trend analysis. These factors can never be eliminated, but taking them into consideration can lead to more efficient monitoring designs, sampling methods and better statistical evaluations that minimize their effects. DEQ's WQM staff is currently evaluating these factors. Continuing wide-scale probabilistic sampling of sediments, water and biological communities are providing reliable statistical descriptions of regional conditions that can be compared from one sampling cycle to the next. The association of trend monitoring stations with USGS and DEQ gauging stations will help compensate for variations in flow rates and consequent dilution of toxics in the water column. However, until consistent long-term datasets become available, meaningful trend analysis of toxics will be difficult.

3.0 Assessment and Remediation

3.1 The Virginia Water Quality Assessment 305(b)/303(d) Integrated Reports

A new Water Quality Integrated Assessment Report is in preparation for 2010, and its results will be summarized in the next Toxics Reduction in State Waters Report. The complete 2008 305(b)/303(d) IR, the associated 2008 Assessment Guidance Manual and interactive maps are available on the DEQ Water Quality Assessment web page at http://www.deq.virginia.gov/wqa/homepage.html .

The draft Water Quality Assessment Guidance Manual for the 2010 305(b)/303(d) IR is available at the same Internet address. Recent changes in assessment methodologies for toxics are described therein. These changes, resulting from the most recent triennial review, have been approved by the SWCB, but final application of several revised toxics criteria/standards still await final acceptance and approval by EPA. The assessment methodology using the Chesapeake Bay Benthic Index of Biotic Integrity (B-IBI) and the associated "Stressor Diagnostic Tool" will remain unchanged. The "Weight of Evidence" assessment method for ALU in minor tidal tributaries has added a new line of evidence based on EPA's Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic

Organisms: PAH Mixtures. This report is available on the EPA web page at http://www.epa.gov/nheerl/publications/files/PAHESB.pdf.

Appendix M - List of Segments not Fully Supporting Designated Uses Because of Toxics (2008 303(d) List), of the current Toxics Report presents a comprehensive list and description of all water-body segments that were assessed as impaired because of toxics in the 2008 305(b)/303(d) IR. This appendix will be revised and updated for the January 2011 Toxics Reduction Report.

The 2008 IR identified 2448 miles of rivers, 111,384 acres of lakes and 2,084 square miles of estuaries impaired by specifically identified toxics (see the summary table below). Of these, over 99% were listed for fish consumption advisories, primarily for PCBs (42% of the rivers impaired by toxics, 65% of the lakes and 99% of the estuaries) or mercury (55% of the impaired rivers, 35% of the lakes and <1% of estuaries). Because the size and number of segments united into each TMDL vary with the hydrography and the extent of the impairment, the number of TMDLs to be developed has not yet been determined. DEQ's PCB Strategy (2005) establishes priorities for TMDL development and discusses various options for remediation. Any new PCB-impaired segments identified in the 2008 Integrated Report will be integrated into the Strategy.

Extent of Impairments by Toxics in the 2008 303(b)/303(d) Integrated Report

Pollutant	Water Body Type (units)	Extent Impaired (whole numbers)
Aldrin (fish tissue)	Rivers (miles)	6
	Lakes (acres)	0
	Estuaries (sq. miles)	0
Ammonia (Un-ionized)	Rivers (miles)	3
	Lakes (acres)	0
	Estuaries (sq. miles)	0
Benzo(k)fluoranthene (fish tissue)	Rivers (miles)	0
	Lakes (acres)	0
	Estuaries (sq. miles)	1
Cadmium	Rivers (miles)	5
	Lakes (acres)	26
	Estuaries (sq. miles)	0
Chlordane (fish tissue)	Rivers (miles)	2
	Lakes (acres)	0
	Estuaries (sq. miles)	0
Copper	Rivers (miles)	10
	Lakes (acres)	524
	Estuaries (sq. miles)	0
DDE/DDT (fish tissue)	Rivers (miles)	19
	Lakes (acres)	0
	Estuaries (sq. miles)	0
Heptachlor Epoxide (fish tissue)	Rivers (miles)	14
	Lakes (acres)	0
	Estuaries (sq. miles)	0
Lead	Rivers (miles)	13
	Lakes (acres)	26
	Estuaries (sq. miles)	0
Mercury (fish tissue)	Rivers (miles)	1,344
	Lakes (acres)	38,493
	Estuaries (sq. miles)	8
Nitrogen (Nitrate) Public Water Supply	Rivers (miles)	2
	Lakes (acres)	0
	Estuaries (sq. miles)	0
PCBs (fish tissue)	Rivers (miles)	1,018
	Lakes (acres)	72,289
	Estuaries (sq. miles)	2,063
PCBs (SPMD)	Rivers (miles)	3
	Lakes (acres)	0
	Estuaries (sq. miles)	0
Sediment Bioassays for Estuarine and Marine Waters	Rivers (miles)	N/A
	Lakes (acres)	N/A
	Estuaries (sq. miles)	1
Tributyltin (TBT)	Rivers (miles)	0
	Lakes (acres)	0
	Estuaries (sq. miles)	11
Zinc	Rivers (miles)	9
	Lakes (acres)	26
	Estuaries (sq. miles)	0

Total Fish Consumption Impairments	Rivers (miles)	2,403
	Lakes (acres)	110,782
	Estuaries (sq. miles)	2,072
Total Toxics Impairments	Rivers (miles)	2,448
	Lakes (acres)	111,384
	Estuaries (sq. miles)	2,084

Additional information on the 305(b)/303(d) IR is available from Harry Augustine at (804) 698-4037 or Harry.Augustine@deq.virginia.gov.

3.2 Most Recent Virginia Department of Health (VDH) Fishing Restrictions and Health Advisories

VDH regularly issues Fish Consumption Advisories and Restrictions for Virginia waters based on the results of DEQ's 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 web pages contain 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.

Several new advisories and modifications of previous advisories have been issued within the past year. New advisories on PCB contamination in blue crabs, specifically related to consumption of their "mustard" or hepatopancreas, were issued in January 2009 for the Southern Branch Elizabeth River and for King Creek, a tributary to the York River. More recently (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, Dan River below Danville, Lovills Creek Lake –Yadkin River, lower Nottoway River, Emporia Reservoir and lower Meherrin River, tidal Poquoson River and Piankatank River, Mattaponi River and Pamunkey River. One recent additional fish consumption advisory was announced by the VDH 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.

Additional information from the fish-tissue/sediment monitoring program is available from Gabriel Darkwah at (804) 698-4127, Gabriel.Darkwah@deq.virginia.gov. Reports on fish tissue and sediment monitoring can be found on the DEQ web page at http://www.deq.virginia.gov/fishtissue.

3.3 Total Maximum Daily Load (TMDL) Program

The TMDL Program is DEQ's primary means of 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 DEQ's TMDL web page at https://www.deq.virginia.gov/TMDLDataSearch/ReportSearch.jspx. Queries can be performed based on pollutant, major river basin, political jurisdiction and water body name or watershed identification. Various other toxics-related TMDLs have completed the public comment phase and are currently in draft form. They are listed on DEQ's TMDL web page at https://www.deq.virginia.gov/TMDLDataSearch/DraftReports.jspx.

Other toxics-related TMDLs are in various stages of development. Four PCB TMDLs in the Roanoke River are scheduled for completion in 2009 and an additional four TMDLs for PCBs in the New River Basin will be completed by 2010. Seven VDH fish advisories for mercury are scheduled for 2010, three in the Shenandoah and four in the North Fork Holston. TMDLs for benthic impairments caused by PAHs will be completed for eleven impaired segments in the Tennessee/Big Sandy basin and a TMDL will be developed for a benthic impairment caused by an unknown toxicant in the Roanoke Basin, all by 2010. Extensive TMDL-related sampling of PCBs in the water column was carried out in the upper tidal James River from Richmond to Hopewell and in the Elizabeth River basin during SFY 2009.

Waters subject to Virginia's only TMDL for nitrate in a public water supply (Muddy Creek – Dry River in Rockingham County) no longer exceed the drinking water standard and will be removed from the impaired waters list.

As TMDLs are completed and scheduled for implementation, follow-up monitoring will be initiated to evaluate their effectiveness in reducing toxics contamination. The effective implementation of TMDLs is a significant part of DEQ's strategy to reduce contaminants in state waters. DEQ's TMDL history, current status and development plans are available at http://www.deq.virginia.gov/tmdl/.

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. As the TMDL program progresses, DEQ anticipates additional reductions of toxics in state waters.

4.0 The Chesapeake Bay Program

4.1 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, 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."*

4.2 Toxics 2000 Strategy

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

4.3 Current Toxics-Related Activities

A general organizational restructuring of the Chesapeake Bay Program was carried out in 2008. Activities of the former Toxics Subcommittee were suspended, at least temporarily, and the new structure does not expressly include a Toxics Subcommittee. It does however include a team with the objective to Protect and Restore Water Quality. Toxics-related goals and activities have not yet been redefined following the transition to the new structure. The current shift in realignment of CBP monitoring efforts from tidal to non-tidal watershed sources of nutrient and sediment input and the emphasis on the Bay-wide TMDL development has resulted in less emphasis on toxics in tidal waters.

Additional information on the concentrations and trends of toxic substances and other water quality parameters in the Chesapeake Bay and it tributaries is available at http://www.chesapeakebay.net/toxics1.htm or by using the search engine available at http://www.chesapeakebay.net/pubsearch.aspx?menuitem=14874

For additional information about DEQ's Chesapeake Bay monitoring program, contact Rick Hoffman at (804) 698-4334, Rick.Hoffman@deq.virginia.gov.

5.0 The Elizabeth River Program

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 1997 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 (ODU) and DEQ worked with representatives from state, federal, local and private interest stakeholders to design and conduct the monitoring effort.

While DEQ and ODU continue to monitor for conventional pollutants and nutrients, most studies specifically involving toxics and their effects in the Elizabeth River system have been concluded.

PCB TMDL: 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 spring and early summer of 2009. EPA Method 1668, an advanced analytical tool using high resolution gas chromatography / high resolution mass spectrometry, was used to analyze the samples. The results will be used to support development of a TMDL for PCBs within the watershed.

Benthic Index of Biotic Integrity (B-IBI) Monitoring: Dr. Dan Dauer of ODU initiated a study of the macrobenthic communities in the Elizabeth River watershed in the summer of 1999 as a means of characterizing the health of the benthic communities. This program continued for ten years and was terminated with the sampling carried out during the summer of 2008. The final report on the 2008 sampling was submitted in September 2009,[4] and no additional benthic sampling is planned for the near future. The executive summary from that report indicates that:

> The three objectives of the Benthic Biological Monitoring Program of the Elizabeth River watershed were: (1) to characterize the health of the tidal waters of the Elizabeth River watershed as indicated by the structure of the benthic communities; (2) to conduct trend analyses on long-term data at 14 fixed-point stations to relate temporal trends in the benthic communities to changes in water and/or sediment quality; (3) to produce a historical data base that would allow annual evaluations of biotic impacts by comparing trends in status within probability-based strata and trends at fixed-point stations to changes in water and/or sediment quality.
>
> Due to budget reductions, the sampling during the summer of 2008 was limited to the 14 fixed-point stations and probability-based sampling was not conducted as it had been in all previous

[4] Dauer, D.M. 2009. Benthic Biological Monitoring Program of the Elizabeth River Watershed (2008). Old Dominion University, Department of Biological Sciences, September 2009.

years. This program was terminated with the sampling in summer 2008 and no future benthic sampling will occur.

Trend analyses were conducted using the data from the 14 fixed-point stations for the period 1999-2008. No stations showed any significant trends. In general, for the Elizabeth River watershed, benthic community species diversity and biomass remain below reference condition levels while abundance was often above reference condition levels and considered excessive. Community composition was unbalanced with levels of pollution indicative species above, and levels of pollution sensitive species below, reference conditions.

Copies of this and other relevant Elizabeth River Reports by Dr. Dauer are available at http://sci.odu.edu/chesapeakebay/reports/elizabeth.shtml.

Additional information on the Elizabeth River Project is available from Roger Everton, Environmental Manager, DEQ Tidewater Regional Office, at (757) 518-2150, Roger.Everton@deq.virginia.gov.

6.0 Virginia Toxics Release Inventory (TRI)

(http://www.deq.virginia.gov/sara3/3132007.html)

Under the provisions of Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986, Virginia manufacturing and federal government facilities that release certain chemicals into the air, water or land, or that transfer these chemicals for off-site treatment, disposal, recycling or energy recovery, are required to report to EPA. This information is collectively referred to as the TRI.

The most recent Virginia TRI Report, published in March 2009 for the 2007 activity year, indicated that 459 Virginia facilities filed 1741 individual reports. This represented decreases of 1.7% from the 467 facilities and 3.9 % from the 1786 reports filed in 2006. Statewide, the tallied toxic releases to the water totaled approximately 18.4 million pounds or 29.1% of the total onsite releases to all media during 2007. This quantity represents a 5.64% decrease from the 19.5 million pounds released to the water in 2006.

On-site releases to water include discharges to surface waters, such as rivers, lakes, ponds and streams. On-site releases to the land (~ 4.51 million lbs. or 7% of the total 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 pose a potential risk of contaminating surface water. Virginia does not permit underground injection as a method of hazardous waste disposal.

The top ten chemicals and chemical categories accounted for more than 99.9% of the total on-site TRI chemical releases to water. They include nitrate compounds (98.82% of total releases to water = 17.634 million pounds), manganese (0.64% = 0.114 million pounds), zinc (0.24% = 0.044 million pounds), copper (0.11% = 0.020 million pounds), barium (0.11% = 0.019 million pounds), vanadium (0.03% = 0.006), arsenic (0.03% = 0.005 million pounds), various glycol ethers (0.006% = 0.001 million pounds), nickel (0.005% = 0.001 million pounds), and chromium (0.003% = 0.001 million pounds). All others totaled 0.003% and < 0.001 million pounds. Nitrate compounds are a common byproduct of wastewater treatment processes and have consistently been reported as the major chemical released to the surface water. Nitrates can pose a nutrient problem to water bodies at lower than toxic concentrations.

A considerable amount of additional information on specific groups of chemicals and the quantities of their chemical releases is available in analyses within the original 2007 TRI Report (March 2009). This report is available at http://www.deq.virginia.gov/sara3/3132007.html.

For further information on the Virginia TRI contact Nichelle D. McDaniel at (804) 698-4159, Nichelle.McDaniel@deq.virginia.gov or Sanjay Thirunagari at (804) 698-4193, Sanjay.Thirunagari@deq.virginia.gov.

Additional sources of information on the TRI are available at http://www.epa.gov/tri/.

The next Virginia TRI report, summarizing toxic releases for calendar year 2008, is scheduled to become available in spring 2010.

7.0 Reduction of Toxics by Pollution Prevention

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

OPP's activities for each fiscal year are summarized in the P2 Annual Report, submitted to the Governor and the General Assembly in December of each year. The 2009 report summarizes the P2 strategies developed and implemented by the Virginia P2 Program. The current annual report summarizes activities carried out by the major components of the P2 Program during 2009, several of which are briefly described here.

- **Virginia Green Tourism** - Virginia Green, the Commonwealth's initiative to promote voluntary pollution prevention within the tourism industry, began its pilot phase in 2006. It now includes 647 participants, among them 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 services and products.

- **Environmental Excellence Program (VEEP)** - At the end of 2009, there were more than 450 facilities in the Virginia Environmental Excellence Program (VEEP). This Program recognizes three levels of performance for participating facilities: (1) Environmental Enterprise (E2) 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) Exemplary Environmental Enterprise (E3) for facilities that have exceeded the E2 requirements and have a fully-implemented EMS and (3) Extraordinary Environmental Enterprise (E4) 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. At present, almost 60% of the facilities are at the E2 level, approximately 35% are at the E3 level and the remaining 5% are at the E4 level. Twenty-three of these facilities were honored with special recognition during 2009. Virginia still provides performance-based permit fee discounts from 2 to 10% for exceeding standardized compliance requirements. In 2009, over $66,000 in fee discounts were distributed among more than 100 VEEP facility permits.

- A review of VEEP annual performance reports for 2009 indicated changes from baseline reference values. Total water use was reduced by 68.5 million gallons and sediment from runoff was reduced by 21 tons. In addition, the use of hazardous materials decreased by 4.8 tons, hazardous waste generation was reduced by 968 tons, the amount of non-hazardous waste disposed of was reduced by 1,920 tons and the recycling of non-hazardous waste increased by 14,032 tons. The emission of NOx and CO into the air decreased by more than 2,000 tons. Over $9.3 million in cost savings were realized during this process.

- DEQ's Voluntary Mercury Reduction Initiatives have also been successful. The Virginia program for the recycling of automotive mercury switches removed 16,420 switches and recycled 36.12 pounds of mercury during the last year of record. Nearly 50 organizations have pledged to annually recycle almost 53,000 energy efficient fluorescent light bulbs, which also contain small quantities of mercury. More information is available at http://www.deq.virginia.gov/p2/mercury/homepage.html.)

- DEQ's OPP also administers the Commonwealth's participation in NPEP, which encourages public and private organizations to form voluntary partnerships with states and the EPA to reduce the use or release of substances that have been designated Priority Chemicals. These substances are persistent, bioaccumulative and toxic. Six new chemicals were added to the list in 2009, including benzene, methylene chloride, perchloroethylene, trichloroethylene, bisphenol A, formaldehyde and the chemical class of phthalates.

For additional information concerning the P2 Program, visit the DEQ web page at http://www.deq.virginia.gov/p2/ or contact: Sharon Baxter at (804) 698-4344, Sharon.Baxter@deq.virginia.gov.

8.0 Summary and Conclusions

DEQ's commitments to toxics reduction include: (1) the prevention of contamination of state waters by toxics, (2) the continued monitoring of those waters for the presence of toxics, (3) the development of TMDLs, and (4) the implementation of remedial measures to reduce and/or eliminate toxics found in state waters. The following summary is organized in relation to the interacting, cyclic relationship among these activities.

8.1 Pollution Prevention

Virginia Pollutant Discharge Elimination System (VPDES)

During SFY09, DEQ's Toxics Management Program included 311 reporting facilities with 592 outfalls that had toxics limits in their VPDES permits (Appendix J). All of the associated permits had start dates prior to July of 2009. Of the 8,271 parameter-specific results reported, 167 values (2.0%) had measured values that exceeded their permitted maximum concentration limits (Appendix L). In most cases, they resulted from minor isolated variations that occasionally exceeded the limit, almost always for total, or occasionally dissolved metals at municipal wastewater treatment plants. Copper and zinc were the most common limits exceeded. Parameter-specific exceedances by these metals persisted during multiple (≥5) reporting dates on only 11 occasions during the period.

Office of Pollution Prevention

The 2009 Pollution Prevention Annual Report is available at http://www.deq.virginia.gov/p2/homepage.html . At the end of 2009, the Virginia Environmental Excellence Program (VEEP) included more than 450 facilities. Virginia awarded over $66,000 in fee discounts for more than 100 VEEP facility permits. VEEP reported a 4.8 ton reduction in the use of hazardous materials. Hazardous waste generation was reduced by 968 tons. This was accompanied by a 1,920 ton reduction in the disposal of non-hazardous materials. Releases to the atmosphere were also significantly reduced. NOx emissions were reduced by 1,151 tons and CO emissions by 1087 tons. During 2008, voluntary mercury reduction incentives removed 16,429 mercury switches from recycled automobiles and recycled 13.26 pounds of mercury. Participating facilities also pledged to recycle almost 53,000 mercury-containing fluorescent light bulbs annually. In 2009, the National Partnership for Environmental Priorities (NPEP) Program added six priority chemicals to its list, including benzene, methylene chloride, perchloroethylene, trichloroethylene, bisphenol A, formaldehyde and the chemical class of phthalates.

Toxics Release Inventory

The March 2009 TRI Report is available at http://www.deq.virginia.gov/sara3/. It summarizes data from 2007, during which 459 Virginia facilities filed 1741 individual reports. Statewide toxic releases to the water totaled approximately 18.4 million pounds or 29.1% of the total onsite releases to all media during 2007. This quantity represents a 5.64% decrease from the 19.5 million pounds released to the water in 2006. Of the top ten TRI chemicals released to water, nitrate compounds represented 98.8% of the total (17.63 million lbs.).

8.2 Monitoring

Water Quality Monitoring Programs

DEQ's Water Quality Monitoring Programs collected and analyzed 1028 toxics-related samples at DCLS during SFY09, 118 from sediments and 910 from water. Much of the freshwater sampling was in association with mercury special studies in the Shenandoah and South Fork Shenandoah Rivers (21.5%) and the Freshwater and Estuarine Probabilistic Monitoring Programs (30.6% - sediment metals, and 15.1% - clean total and dissolved metals in water, respectively). TMDL and other toxics-related special studies accounted for another 10.6%. The Estuarine Probabilistic Monitoring Program also collected sediment samples from an additional 50 sites. These were analyzed for chemical contamination and toxicity at contracted commercial laboratories, and for benthic community health at the Benthic Ecology Laboratory at ODU. Scheduled activities from the current Water Quality Monitoring Plan are available at http://www.deq.virginia.gov/watermonitoring/.

The 2009 work plan for the Fish Tissue and Sediment Monitoring Program identified 81 tentative sampling sites that were sampled as scheduled in summer 2009. Chemical analyses of those samples have been postponed because of resource limitations. Fish tissue monitoring for the 2010 field season has also been suspended. Analytical results from the program's 2008 sampling are available at http://www.deq.virginia.gov/fishtissue/. In all, a total of 701 individual or composite fish tissue samples were collected; 489 results were returned for tissue metals, 503 for PCBs and 62 for pesticides. Only eight PAH analyses were carried out on tissue samples in 2008. Although sediment samples were collected in association with each of the sampling sites, they have been archived as frozen reference samples and will

only be analyzed if fish tissue results indicate a serious local problem. The most recent data and planning updates on this program are available at http://www.deq.virginia.gov/fishtissue/.

8.3 Assessment, Remediation, and the Continued Reduction of Toxics

Assessed Impairments – The 2008 Water Quality Assessment 305(b)/303(d) Integrated Report

The 2008 IR identified 2,448 miles of rivers, 111,384 acres of lakes and 2,084 square miles of estuaries impaired by toxics. Of these, over 99% were listed for fish consumption advisories, primarily for PCBs (41.6% of toxics impaired rivers, 64.9% of lakes and 99.0% of estuaries) or mercury (54.9% of rivers, 34.6% of lakes and <0.4% of estuaries). Because the number of segments united into each TMDL varies with the hydrography and the extent of the impairment, the number of TMDLs to be developed is subject to review. DEQ's PCB Strategy (2005) establishes priorities for TMDL development and discusses various options for remediation. Data analyses for the 2010 Integrated Report began in the spring of 2009, and any additional PCB impaired segments will be integrated into the Strategy.

Remediation / Reduction

Twenty-one toxics related TMDLs have been completed and approved since 2002, including two in 2002, three in 2004 and 16 in 2007. PCB TMDLS have been adopted in the Shenandoah (5) and in other Virginia tributaries to the Potomac (16) (Appendix M). The Potomac tributary PCB TMDLs were incorporated into the interstate Potomac River PCB TMDL developed under the auspices of the Interstate Commission for the Potomac River Basin. This TMDL was submitted in November 2007 and was subsequently approved by EPA. Two benthic TMDLs were completed for toxics parameters in 2006, one for copper and zinc in the New River basin and one PAH and lead in the Shenandoah. The Smith River has a consent decree benthic TMDL within which a stressor analysis is ongoing and an eco-toxicological study is enhancing the TMDL development process.

Several additional toxics related TMDLs are in development. Four TMDLs for PCBs in the Roanoke River are scheduled for completion in the fall of 2009. In November 2008, EPA requested $3.7M of additional funding for the cleanup of a former West Virginia industrial site in the Bluestone River. Seven VDH mercury fish advisory TMDLs are scheduled for 2010, three in the Shenandoah River and four in the North Fork Holston River. Benthic TMDLs for 11 PAH impaired segments in the Tennessee/Big Sandy Basin. A toxics related benthic impairment in the Roanoke Basin is currently under investigation and its TMDL development is planned for 2010. A source identification study for PCBs was initiated during 2009 for TMDL development on the upper tidal James River and the Elizabeth River. The agency's TMDL history, current status and development plans are available at http://www.deq.virginia.gov/tmdl/.

As these TMDLs are completed and scheduled for implementation, follow-up monitoring will be initiated to evaluate their effectiveness in reducing toxics contamination. The portion of the Muddy Creek-Dry River-North River watershed that was listed as impaired on the 1998 303(d) List has been in compliance for the past six years, reflecting the success of the TMDL approved for the area in 2000. The effective implementation of additional TMDLs will promote additional successes in the reduction of toxics in state waters.

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 VPDES and the P2 Program join

with other programs and stakeholders to control and reduce toxics releases. The TRI and various water programs constantly monitor and document the release, presence and movement of toxics in aquatic environments. Close coordination between monitoring and assessment activities will continue to identify new sources of contamination and document the effectiveness of load allocations and other remedial measures developed under the TMDL Program. The agency anticipates additional reductions of toxics in state waters as a result of continued TMDL program progress.

9.0 References

A cumulative bibliography of general references and publications cited in this report is included in Appendix N – References.