COMMONWEALTH of VIRGINIA

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December 20, 2004

MEMORANDUM:

TO: The Honorable Mark R. Warner

Senate Agriculture, Conservation and Natural Resources Committee

House Agriculture, Chesapeake and Natural Resources Committee

FROM: Robert G. Burnley *Bob Burnley*

SUBJECT: Annual Reduction of Toxics in State Waters Report

In accordance with § 62.1-44.17:3 of the *Code of Virginia*, the Department of Environmental Quality has completed its annual report on the status of the State Water Control Board's efforts to reduce the level of toxic substances in state waters.

The Department of Environmental Quality is committed to preventing the contamination of the Commonwealth's waters by toxics, monitoring state waters for the presence of toxics and implementing remedial measures to reduce and/or eliminate toxics found in the state's waters. The primary objective of this report is to document the Commonwealth's commitment.

The full report is being made available at www.deq.state.va.us/regulations/reports. If you need further information or would like a hard copy of this report, please contact Rick Linker at 804-698-4195.

**THE DEPARTMENT OF
ENVIRONMENTAL QUALITY**

The Reduction of Toxics in State Waters 2004

A REPORT TO

THE GENERAL ASSEMBLY OF VIRGINIA

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

**COMMONWEALTH OF VIRGINIA
RICHMOND
JANUARY 1, 2005**

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List of Tables

List of Figures: Folders 3 through 6

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

(1) Historical data arranged by monitoring year for all toxic parameters in the class, and
(2) Historical data arranged by toxic parameter for monitoring years 1997 through 2003.

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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	CBP Information Management System
CVs	Consensus-Based Sediment Quality Guidelines – Critical values for contaminants in freshwater sediment (replace previously utilized ER-L and ER-M values for assessment of freshwater sediment)
DCLS	Division of Consolidated Laboratory Services
DEQ	Department of Environmental Quality
DMR	Discharge Monitoring Report
EDAS	Ecological Data Application System [database]
ELG	Effluent Limitation Guidelines
EMS	Environmental Management System
ER-L	Effects Range-Low
ER-M	Effects Range-Moderate
EPA	Environmental Protection Agency
FY	Fiscal year
IBI	Index of Biological Integrity
MGD	Millions of Gallons per Day
MonPlan	Annual Water Quality Monitoring Plan
MY	Monitoring year
NOAA	National Oceanic and Atmospheric Administration
NPEP	National Partnership for Environmental Priorities
NPS	Non-Point Source (pollution)
OCP	Organochlorine Pesticide
OPP or OP2	Office of Pollution Prevention
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated biphenyl
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
SIC	Standard Industrial Classification
SOP	Standard Operating Procedure
SPMD	Semi-Permeable Membrane Device
STORET	Short for 'STOrage and RETrieval [EPA's national database]
SV	Screening Value
TBT	Tributyltin
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
TRISWat	Toxics Reduction in State Waters (report)
USGS	United States Geological Survey
VISE	Virginia Information Source for Energy (Website)
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
VIP2	Virginia Innovations in Pollution Prevention
VMN	Virginia Mentoring Network
VPDES	Virginia Pollutant Discharge Elimination System
VPI	Virginia Polytechnic Institute and State University
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)

Executive Summary

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

The primary objective of the TRISWat 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 those waters for the presence of toxics and
3. The implementation of remedial measures to reduce and/or eliminate toxics found in the state's waters.

This report serves to keep the members of the General Assembly informed of the on-going efforts to achieve these objectives and, as a public document, provides the general population with objective, summarized information not readily available from other sources.

Monitoring: DEQ has revised, updated and expanded its Water Quality Monitoring Strategy to include adaptations and new EPA guidelines developed since 2000. After integrating a number of suggestions received from EPA in April 2004, a revised draft was made available for public comment in August. The final draft was submitted to EPA on 27 September 2004. EPA has since indicated that it has no additional comments or suggestions, and the Strategy is now considered adopted and in effect until the next scheduled revision in 2007-2008.

The spring and summer of 2004 comprised the forth year of DEQ's freshwater probabilistic monitoring (ProbMon). An EPA grant provided for fifty semi-permeable membrane devices that were utilized for monitoring dissolved toxic organic compounds at probabilistic sites across the state during calendar year 2003. The USGS is currently analyzing the samples and the final report is due in February 2005. Results should be included in next year's TRISWat report. Sampling for dissolved trace metals, as well as sediment metals and organics, has continued at both freshwater and estuarine ProbMon sites. The results of this sampling for MY2004 are included in this report. Results from summer sampling (June-September) in 2004 will be included in next year's report.

Permitting: DEQ's Toxics Management Program (TMP) currently includes 279 facilities and 743 outfalls that have active permit-defined toxics limits in their effluents, and 42 new applications, in the CEDS database. The CEDS database now records Discharge Monitoring Reports (DMRs) on a monthly basis.

Toxics Release Inventory (TRI): The most recent Virginia Toxic Release Inventory Report (2002 VIRGINIA TOXICS RELEASE INVENTORY (TRI) REPORT - March 2004) indicated that 505 Virginia facilities reported to the TRI program for the 2002 activity year. Statewide toxic releases to the water totaled approximately 8,262,380 million pounds or 11.6 % of the total onsite releases to all media during 2002. This quantity (~8.3 million lbs.) represents a 2 % increase from 2001 releases.

Pollution Prevention: Among the highlights of Pollution Prevention successes in the past year were the following:

- The total number of facilities in the Virginia Environmental Excellence Program (VEEP) increased from 152 to over 200, an increase of approximately 33% in 2004, with 80% participating at the E2 level.

- DEQ's Pollution Prevention in Healthcare Program (Hospitals for a Health Environment) continued to promote the reduction of regulated medical wastes, to reduce toxic materials by encouraging environmentally preferable purchasing practices, and to eliminate mercury from health care purchases.
- Participants in the Businesses for the Bay (B4B) Program reported 167,700 tons of waste reduction and cost savings of $13.4 million. In 2004, Virginia facilities once again led the region in participation: approximately one-half of all members (279 out of 603) are in Virginia, almost twice as many as the next closest state.
- In 2003, OPP applied for and received approximately $6,500 in funding from the Environmental Protection Agency (EPA) to develop a single, comprehensive website for information on renewable energy and energy efficiency.
- DEQ administers Virginia's National Partnership for Environmental Priorities (NPEP) program, previously called the National Waste Minimization Program, which was renamed and re-energized in 2004. The NPEP program encourages public and private organizations to form voluntary partnerships, with states and the EPA, that reduce the use or release of any of the thirty-one substances that have been designated "Priority Chemicals".

Foreword 2004

MY2004 Toxics Reduction in State Waters Report (January 2005)

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

- A long-term Water Quality Monitoring (WQM) Strategy, submitted for EPA comments and approval in September of 2004
- Formal Quality Assurance Program and Project Plans (QAPPs),
- Established Standard Operating Procedures (SOPs), and
- Sampling Protocols.

The annual program plan (MonPlan) covers the period from 1 July of each year through 30 June of the following year. This period corresponds to the Commonwealth's fiscal year (FY), but is commonly referred to as the monitoring year (MY) in documents and reports related to water quality monitoring. The present document uses the terms monitoring year and fiscal year interchangeably.

The MY2004 Toxics Reduction in State Waters (TRISWat-05) Report is the eighth in a continuing annual series. The general formatting of the present report follows that of the previous TRISWat Reports, with only superficial changes to the general introduction, functional definitions, and descriptions of generic water quality monitoring. Many of the tables, lists, and appendices relating to toxics lists, water quality criteria and standards, and so forth, are in identical form to those of previous reports.

To minimize the physical bulk of the report, reduce production time and costs, and facilitate its distribution to interested parties, the data tables, figures and appendices of this report are presented in their complete form only on the DEQ Website at http://www.deq.virginia.gov/watermonitoring/, and are not provided in hardcopy form.

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 (which use statistical interval-estimates for median parameter values) will continue to appear with each annual report to assist in the visual evaluation of the following:

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

Eventually, as each year's results are added to the report, historical results in the form of graphed statistical interval-estimates will facilitate the visual evaluation of longer-term trends. Graphed historical summaries (MY1997 – 2004) for each major drainage basin appear in this year's report, but the short period of record and changes in methodologies and detection limits make the interpretation of trends difficult. The incorporation of historical, STORET-stored data into the water quality module of DEQ's new Comprehensive Environmental Data System (CEDS) 2000 database in 2001 unified all previously collected ambient toxics data into a single source and format. This will facilitate the statistical summary of historical data in the same graphical format as that used here, and will allow for more sophisticated statistical procedures as well. Future TRISWat reports will consequently include longer-term summaries that will permit more meaningful interpretation.

Introduction

On January 1st of each year, the Virginia DEQ submits the Toxics Reduction in State Waters (TRISWat) Report to the Governor and the General Assembly of the Commonwealth in accordance with Chapter 3.1, Title 62.1, § 62.1-44.17:3 of the Code of Virginia.

The primary objective of the TRISWat 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 those waters for the presence of toxics, and
3. The implementation of remedial measures to reduce and/or eliminate toxics found in the state's waters.

The annual report keeps the governor, members of the General Assembly informed of on-going efforts to achieve these objectives and, as a public document, provides the general population with objective, summarized information not readily available from other sources. Although the reduction of toxics in the state's waters is primarily the responsibility of the DEQ, various agencies and organizations, including the Virginia Department of Conservation and Recreation (DCR), the Virginia Department of Health (VDH), the U.S. EPA’s Chesapeake Bay Program, and the U.S. Geological Survey participate in the process. It is not possible to unite all available data on the status of toxics in Virginia’s waters in this report. Rather, the report summarizes the current results and activities directed toward toxics reduction, and provides guidance on how to access further resources and information on specific subjects. It is DEQ’s hope that the continued evolution of the reporting format and the expansion of the report's comprehensiveness will increase its utility to the state's legislators and to the public in general.

DEQ submitted the first TRISWat Report in January 1998. The January 1999 report provided basic background information related to the report's objectives and a basic model for its continued evolution. The current TRISWat Report (January 2005) contains tables of both raw data and statistical summaries of MY2004 monitoring results.

DEQ has also retained the results from toxics monitoring during previous years and has made these data available at the DEQ Webpage address, both in tabular form and as graphic historical statistical summaries. DEQ anticipates that, with the accumulation of future data, these summaries will facilitate visual evaluation of mid- to long-term trends in toxics concentrations within the various drainage basins of the Commonwealth’s waters.

Functional Definitions and Lists of Toxics

Defining “Toxicity”: Virginia legislation (Chapter 3.1, Title 62.1, § 62.1-44.17:2 of the Code of Virginia) 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 low concentrations of some substances, such as oxygen, can also cause adverse effects, both acute and chronic, on living organisms. However, this report applies “toxicity” only to those substances that “in excess" are detrimental to living organisms. Furthermore, the concept of "other adverse environmental effects" must be defined in biological terms, since toxicity can only be observed, quantified, and described in relation to living organisms. The classification of chemical substances ("a material") within the category of "toxics" (those that cause toxicity) is always based on the observed effects of their presence on specific living organisms. In fact, the concept of "excess" itself is defined in terms of the concentrations at or above which living organisms experience detrimental effects.

Federal Water Quality Standards*:* The Federal Clean Water Act (1983) first described the scope and purpose of water quality standards and defined the authority and responsibility of the U.S. EPA and the various states in relation to the requirements for, submission of, and establishment of such standards. As early as 1990, the Chesapeake Bay Commission published its Toxics of Concern (TOC) and Chemicals of Potential Concern lists, which 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, but views the current "Chemicals of Concern" list more as a watershed management tool than as a list to be widely publicized. (See Appendix A of this report for a summary of both lists.)

The U.S. government 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, the U.S. EPA published a comprehensive list in the *Federal Register* of 126 chemical substances for which it had established water quality criteria related to aquatic life in freshwater and saltwater and/or to human health risks (Appendix B).
- Subsequent studies have identified additional toxics and/or resulted in the establishment of new criteria for previously defined toxics, and have modified this list considerably during the ensuing years. For example, the EPA's publication of conversion factors in May 1995 lowered the acute and chronic freshwater criteria and the acute saltwater criteria for the dissolved metals arsenic, cadmium, chromium III and VI, copper, lead, mercury, nickel, silver, zinc, and selenium.
- The EPA provided its most recent list of nationally recommended water quality criteria for priority toxic pollutants in November 2002 in the publication EPA-822-R-02-047, National Recommended Water Quality Criteria, which is available in electronic form from the EPA WebPages at **http://www.epa.gov/ost/pc/revcom.pdf.**
- 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.

Virginia Water Quality Standards - WQS: The Commonwealth of Virginia has established and has periodically revised and added to its own water quality standards (9 VAC 25-260 Virginia Water Quality Standards. Statutory Authority: § 62.1-44.15 3a of the Code of Virginia. EFFECTIVE FEBRUARY 12, 2004), which the EPA has reviewed and approved. They serve for the regulation, environmental assessment, and enforcement of water quality criteria within the state's jurisdiction.

These state standards undergo a formal review and may be updated every three years. The Commonwealth's WQS have recently undergone their required triennial review. Several amendments related to toxics, from the most recent triennial review, are included in the February 2004 WQS. These amendments, along with others not directly related to toxics, were reviewed by the Office of the Attorney General for agency statutory authority and were approved by the State Water Control Board in March 2003. The adopted triennial review amendments of Virginia's Water Quality Standards are summarized in Appendix C and are available in their complete form on the DEQ-WQS WebPage at http://www.deq.virginia.gov/wqs. Further developments in this triennial review process and other information related to Water Quality Standards are public-noticed and/or posted on the DEQ Water Quality Standards Website at http://www.deq.virginia.gov/wqs/rule.html as they occur.

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 discussed elsewhere in this document. Because of the low solubility of organic substances in the water column, traditional methods of sampling them 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) to sample for dissolved organic contaminants during the spring of 2003. The high cost (approximately $5000 / sample) of this methodology limited its use to fifty statewide probabilistic sites during that first deployment. During the past year other sources of support, primarily for TMDL development, have allowed the employment of SPMDs in several special studies related to PCB contamination in the state's waters. Details of this sampling methodology and the specific studies in which it has been employed are discussed elsewhere in this document.

Although DEQ has in the past monitored the ambient concentrations of total suspended metals in the water column, this practice has now been limited to special studies specifically targeting areas of known water quality problems. No criteria or water quality standards exist for total suspended contaminants, because they are generally not in a form available for uptake by aquatic organisms. Consequently, no water quality assessment can be performed on the analytical results. The data are, however, useful for locating and identifying the sources of dissolved toxics or to calculate local chemical 'translator' values, for estimating dissolved concentrations from the total amount of metal in the water column..

Toxic Substances in Sediment: At present, neither the EPA nor the Commonwealth of Virginia has established criteria/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, 1991) and in 1992 by the EPA (U.S. EPA, 1992). Long et al. (1995) published new or refined thresholds for many metals in estuarine and marine sediments. They were derived from "Ecological Risk" assessments based on much of the same published data, from both laboratory and field studies, used by the EPA in establishing water quality criteria.

Such screening values are used for the assessment of estuarine and marine sediments. A summary of some of the Effects Range - Low (ER-L) and Effects Range - Moderate (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 regularly, as new guidelines become available. A table of the ER-M sediment screening values used for the 2004 Integrated 305(b)/303(d) Report can currently be found in the assessment guidance for the report on DEQ's WebPages at http://www.deq.virginia.gov/waterguidance/pdf/042006.pdf.

In the past, DEQ has used the same ER-M values for the assessment of sediments in freshwater, since there were no recommended criteria available for sediment toxics parameters in freshwater environments. Following recommendations by DEQ's Academic Advisory Committee, the use of these values for freshwater sediments has now been suspended. Beginning with the 2004 305(b) Report, the agency has used more recently published 'Consensus- Based Sediment Quality Guidelines' (MacDonald, *et al.*, 2000) for the evaluation of sediment toxics parameters in freshwater environments. A listing of these new guidelines is also provided in the assessment guidance for the 305(b) Report on DEQ's WebPages (**http://www.deq.virginia.gov/waterguidance/ pdf/042006.pdf**).

Toxic Substances in Fish Tissues: DEQ evaluates levels of toxics in fish tissues by comparing them with human consumption risk screening values calculated from EPA data (USEPA-IRIS). A summary table of risk-based screening values DEQ used for fish tissue consumption appears in the agency's biennial assessment guidance documents. These screening values are adjusted as necessary, following monthly updates in the EPA IRIS database, available at **http://www.epa.gov/iris**. An updated list of the Risk-Based Tissue Screening Values (TSVs) for fish tissue used for the 2004 Integrated 305(b)/303(d) Report can be found in Tables 6a and 6b on pages 44 through 46 of the Water Quality Assessment Guidance PDF document at **http://www.deq.virginia.gov/waterguidance/ pdf/042006.pdf**. Values for specific compounds can also be found listed in the tables of fish tissue analytical results posted on the DEQ Webpage at **http://www.deq.virginia.gov/fishtissue/**.

DEQ's Review of Pesticides and Chemicals: DEQ's Office of Water Quality Monitoring and Assessment (WQMA) has recently reviewed and updated the list of organic chemical parameters that it will monitor in Virginia's waters, as well as the monitoring schedule and methodologies with which it does so. This review is an activity explicitly described in the Water Quality Monitoring Strategy, and is in response to the release of many new organic pesticides and/or other chemical compounds into the market annually, as well as the disappearance of others from common usage. The development of new technologies, new methodologies, and the consequent lowering of Method Detection Limits (MDLs) also dictate the need for periodic revision of monitoring protocols and parameter selection. The most recent modifications to the EPA's National Recommended Water Quality Criteria, as well as the current triennial review and revision of the Commonwealth's WQS, further confirm the necessity of such periodic modifications in the Water Quality Monitoring Program. More details of this procedure, as well as a summary of its current status, are included later in this report in the section on DEQ's Water Quality Monitoring Strategy.

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

DEQ's Ambient Water Quality Monitoring Strategy

The DEQ 2000 Ambient Water Quality Monitoring Strategy, developed during several years of intense work and deliberation by DEQ's former Water Quality Monitoring Task Force, received favorable reviews from the Academic Advisory Committee assembled by the task force, as well as from the U.S.EPA. Both groups approved and praised the contents of the new strategy, offering only minor suggestions to improve its form. In May 2001, National EPA water quality scientists and EPA Region III water quality monitoring coordinators met with DEQ water program managers and Water Quality Monitoring Program coordinators in Northern Virginia. Following the meeting, which included a four-hour presentation and informal discussion of the details of DEQ's monitoring strategy, EPA voiced the opinion that Virginia's Water Quality Monitoring Strategy would serve as a model for the development of similar strategies in other states. The WQM Strategy document subsequently underwent an independent review, completed by a DEQ-appointed "Scientific Advisory Committee" in 2002. This group also provided a favorable evaluation of the Strategy, offering a number of constructive comments to improve its comprehensiveness.

DEQ's staff has continued to revise and improve its Water Quality Monitoring Program as well as the descriptive Strategy document. A revised edition of the Water Quality Monitoring Strategy document was developed and provided for review by EPA Region 3 in April 2004. Following the incorporation of several EPA suggestions, the subsequent draft was placed on the DEQ Water Quality Monitoring Website, for review by the general public (and EPA) from August 9 through September 10, 2004. The comments received required no modifications to the Strategy document, and the agency notified EPA Region 3 on

September 27 that the document they received in August should be considered the final draft. DEQ is currently awaiting tentative EPA approval of the 2004 Strategy. Under the continual planning process, the document will continue to adapt to new monitoring needs as they develop. The next (minor) revision is currently scheduled for completion in 2007, followed by major revisions every six years thereafter.

The WQM Strategy provides:

- Definitions of specific types of WQM stations for specific types of data uses, and formal protocols for the selection of monitoring sites.
- Additional emphasis on those watersheds with confirmed water quality problems and those identified as having high-risk potential of Non-Point Source (NPS) pollution.
- A Probabilistic Sampling Program ensuring that DEQ's statewide monitoring of both freshwater and tidal estuarine ecosystems is representative.

As noted above, DEQ plans and executes its Ambient Water Quality Monitoring Program on an annual basis, following guidelines provided by the agency's long-term Water Quality Monitoring Strategy, formal Quality Assurance Project Plans (QAPjPs), and established SOPs and sampling protocols. The annual plans cover the period from 1 July of each year through 30 June of the following year. This period corresponds to the Commonwealth's fiscal year (FY), but is commonly referred to as the monitoring year (MY) in documents and reports related to the subject. The present document uses the two terms "monitoring year" and "fiscal year" interchangeably.

The recently concluded MY2004, which began on 1 July 2003 and ended on 30 June 2004, terminated the first year of the second two-year rotational phase of the six-year monitoring cycle described in the WQM Strategy 2000 document. MY2005, which is currently in progress, is the second year of the rotation. This second two-year rotation, which was originally scheduled for 1 July 2003 through 30 June 2005, has been extended an additional year in order to synchronize the rotation of watershed stations with DEQ's 305(b) assessment cycle. By extending the second rotation for one year, and expanding the 305(b) assessment window to six years, the assessments will begin to include three two-year station rotations at the end of the 2006 monitoring year (30 June 2006). This will increase the representativeness of subsequent assessment reports by assuring that each report includes two complete years of continuous monitoring at all watershed stations statewide. This will provide the desired number of observations for a continuous two-year period at each site for assessment purposes and will include statewide coverage via both the watershed and the probabilistic monitoring networks.

Review of Toxic Chemical Parameters and Their Monitoring Methodologies

Implementation of the newly developed Water Quality Monitoring Strategy has focused on toxic chemical monitoring in a more concerted effort to assess the potential impact on water quality. Toxic chemicals fall into two general classes of compounds: inorganic trace metals and synthetic organic chemicals.

With the exception of sampling at all probabilistic sites, the guidance for monitoring dissolved toxic trace metals has recently shifted focus from ambient waters to major point source discharges and other known or suspected problem areas. Monitoring at all major point source discharges and other targeted Standard Industrial Classifications (SICs) based on their permit status, 303(d)[1] listed waters, acid mine drainage (AMD) sites, and the Elizabeth River, are prime areas where dissolved metals monitoring will continue to occur. This shift to target areas of known or suspected problems was based on results from previous

[1] Biennial 303(d) Total Maximum Daily Load Priority List and Report, Virginia Department of Environmental Quality and Department of Conservation and Recreation.

ambient trace metal sampling collection efforts. Beginning in May 1997, the Ambient Water Quality Monitoring Program began "clean" trace metal sampling in freshwaters. From then until the end of 1998, 113 samples were collected at 102 separate sites in all major basins, except for the most western basin, Tennessee / Big Sandy. The results of this effort indicated that the average dissolved concentrations of trace metals in Virginia rivers are consistent with the global distributions observed by other researchers. The continued monitoring of dissolved metals at freshwater probabilistic sites will provide annual summaries of the status of freshwaters on a statewide basis.

Since 1998 saltwater sampling in several areas of the state has indicated essentially the same results as those reported for freshwaters, with typical concentrations proving to be consistent with global concentrations. The probabilistic sampling of estuarine waters for dissolved metals was initiated in July of 2003, as part of the Coastal 2000 / National Coastal Assessment Program. The sampling of dissolved trace metals at probabilistic sites in tidal estuarine waters will continue with the sampling of approximately 50 new sites per year (~35 within the Chesapeake drainage and ~15 Atlantic coastal sites). The results from this first season of sampling (July - September 2003) are summarized in this Toxics Reduction in State Waters Report.

The tables of dissolved metals parameters on the following pages present the target analyte list for freshwater (Text Table 1) and saltwater (Text Table 2).

The 2000 WQM Strategy provided for sampling of trace organic toxic 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 to be monitored has been updated and expanded since then, to include more current use compounds, and new analysis methods currently provide significantly lower detection limits for most substances on the list. Text Table 3 lists the toxic organic compounds presently being monitored as target analytes in sediment using the Parameter Group Code AMB_TOX. Recommended changes suggested by DEQ's triennial review of Water Quality Standards have been approved at the state level and the updated status of this review process is available on the DEQ WebPages at http://www.deq.virginia.gov/wqs/. The elevated analytical costs of the new expanded analyte list, together with the reduced resources currently available for monitoring, have resulted in the limitation of sediment toxics monitoring to only probabilistic sites for the foreseeable future.

The concentration and distribution of dissolved trace organics in freshwater is being determined through a probabilistic sampling design as outlined in the strategy. In the spring of 2003, 50 semi-permeable membrane devices (SPMDs) were deployed in freshwater streams and rivers. The SPMD devices normally remain at the station for one month (~30 days) during which time they selectively absorb hydrophobic contaminants by a mechanism identical to the uptake by fishes and other aquatic organisms via epithelial cell contact. Three classes of contaminants are being identified from these samples. Organochlorine pesticides, polynuclear aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs), the concentrations of which will indicate the potential of adverse impacts from environmental contaminants. The samples also will be analyzed for endocrine disrupters and for mutagenic toxicity. The assessment of the results from these stations will be used to determine future study design for characterizing the statewide extent and severity of key trace organic toxic analytes. Several special studies using SPMDs, directed specifically toward the distribution and concentration of PCBs, were initiated in 2004 in response to concentrations detected in tissues of fish collected in Lake Anna, the Bluestone River and Bull Run (tributary to the Occoquan Reservoir). Additional details about these studies are described elsewhere in this report, but the final results of SPMD analyses, performed by the USGS laboratory in Columbia, Missouri, will not be available until next year.

Text Table 1. Clean, Dissolved Metals in Freshwater

Parameter Code	Freshwater Metals
1106	ALUMINUM, DISSOLVED (UG/L AS AL)
1095	ANTIMONY, DISSOLVED (UG/L AS SB)
1000	ARSENIC, DISSOLVED (UG/L AS AS)
1005	BARIUM, DISSOLVED (UG/L AS BA)
1010	BERYLLIUM, DISSOLVED (UG/L AS BE)
1025	CADMIUM, DISSOLVED (UG/L AS CD)
915	CALCIUM, DISSOLVED (MG/L AS CA)
1030	CHROMIUM, DISSOLVED (UG/L AS CR)
1040	COPPER, DISSOLVED (UG/L AS CU)
1046	IRON, DISSOLVED (UG/L AS FE)
1049	LEAD, DISSOLVED (UG/L AS PB)
925	MAGNESIUM, DISSOLVED (MG/L AS MG)
1056	MANGANESE, DISSOLVED (UG/L AS MN)
50091	MERCURY-TL FILTERED, ULTRATRACE METHOD NG/L
1065	NICKEL, DISSOLVED (UG/L AS NI)
1145	SELENIUM, DISSOLVED (UG/L AS SE)
1075	SILVER, DISSOLVED (UG/L)
1057	THALLIUM, DISSOLVED (UG/L AS TL)
1090	ZINC, DISSOLVED (UG/L AS ZN)

Text Table 2. Clean, Dissolved Metals in Saltwater

Parameter Code	Saltwater Metals
1106	ALUMINUM, DISSOLVED (UG/L AS AL)
1095	ANTIMONY, DISSOLVED (UG/L AS SB)
1000	ARSENIC, DISSOLVED (UG/L AS AS)
1025	CADMIUM, DISSOLVED (UG/L AS CD)
915	CALCIUM, DISSOLVED (MG/L AS CA)
1040	COPPER, DISSOLVED (UG/L AS CU)
1046	IRON, DISSOLVED (UG/L AS FE)
1049	LEAD, DISSOLVED (UG/L AS PB)
925	MAGNESIUM, DISSOLVED (MG/L AS MG)
1056	MANGANESE, DISSOLVED (UG/L AS MN)
50091	MERCURY-TL FILTERED, ULTRATRACE METHOD NG
1065	NICKEL, DISSOLVED (UG/L AS NI)
935	POTASSIUM, DISSOLVED (MG/L AS K)
1145	SELENIUM, DISSOLVED (UG/L AS SE)
930	SODIUM, DISSOLVED (MG/L AS NA)
1090	ZINC, DISSOLVED (UG/L AS ZN)

Text Table 3. Toxic Organic Parameters in the Sediment

Organophosphorus Pesticides			Organophosphorus Pesticides		
VADEQ OFFICIAL NAME	RL *	DEQ STORET Code	VADEQ OFFICIAL NAME	RL *	DEQ STORET Code
DICROTOPHOS SEDDRYWGTUG/KG	2 ppb	38456	TOKUTHION SEDDRYWGTUG/KG	2 ppb	38567
DIMETHOATE SEDDRYWGTUG/KG	2 ppb	38460	BOLSTAR SEDDRYWGTUG/KG	2 ppb	38718
DICHLOFENTHION SEDDRYWGTUG/KG	2 ppb	38773	CHLORPYRIFOS-METHYL SEDDRYWGTUG/KG	2 ppb	38743
DICHLORVOS SEDDRYWGTUG/KG	2 ppb	38777	FENSULFOTHION SEDDRYWGTUG/KG	2 ppb	38799
DIOXATHION SEDDRYWGTUG/KG	2 ppb	38785	STIROFOS SEDDRYWGTUG/KG	2 ppb	38880
FENTHION SEDDRYWGTUG/KG	2 ppb	38803	ETHION IN BOTTOM DEPOSITS (UG/KG DRY SOLIDS)	2 ppb	39399
TRICHLORONATE SEDDRYWGTUG/KG	2 ppb	38900	MALATHION IN BOT. DEPOS. (UG/KILOGRAM DRY SOLIDS)	2 ppb	39531
COUNTER (TERBUFOS) IN SEDIMENT DRY WGT UG/KG	2 ppb	38922	PARATHION IN BOT. DEPOS. (UG/KILOGRAM DRY SOLIDS)	2 ppb	39541
0,0-DIETHYL0,2-PYRAZINYL PHOSPHOROTHIOATE REGUG/KG	2 ppb	73359	GUTHION IN BOTTOM DEPOSITS (UG/KG DRY SOLIDS)	2 ppb	39581
TETRAETHYLDITHIOPYROPHOSPHATE,DRY WT,REG UG/KG	2 ppb	73388	TRITHION IN BOTTOM DEPOSITS (UG/KG DRY SOLIDS)	2 ppb	39787
CHLORPYRIFOS SEDIMENT,DRY,WT,UG/KG	2 ppb	79792	DIAZINON, DRY WEIGHT, SEDIMENT UG/KG	2 ppb	73151
PHORATE (THIMET),BOTTOM DEPOSITS,DRY WGT,UG/KG	2 ppb	81412	METHYL PARATHION, DRY WEIGHT, REGOLITH UG/KG	2 ppb	73363
RONNEL IN SEDIMENTS DRY WEIGHT UG/KG	2 ppb	81761	EPN (SANTOX), SEDIMENT, DRY WEIGHT UG/KG	2 ppb	82644
DISULFOTON IN SEDIMENT DRY WEIGHT UG/KG	2 ppb	81887	ETHYL GUTHION, SEDIMENT, DRY WEIGHT UG/KG	2 ppb	82645
MONOCROTOPHOS (AZODRIN) IN SEDIMENT DRY WEIGHT UG/KG	2 ppb	81889	IMIDAN, SEDIMENT, DRY WEIGHT UG/KG	2 ppb	82647
ETHOPROP (MOCAP), SEDIMENT, DRY WEIGHT UG/KG	2 ppb	82288	COUMAPHOS, SEDIMENT, DRY WEIGHT UG/KG	2 ppb	82648
DEMETON IN SEDIMENT (SYSTOX) DRY WEIGHT UG/KG	2 ppb	82400	ASPON, Sediment, dry wt. ppb (ug/kg)	2 ppb	ASPON
FONOFOS IN SEDIMENT (DYFONATE) DRY WEIGHT UG/KG	2 ppb	82408	CROTOXYPHOS, Sediment, dry wt. ppb (ug/kg)	2 ppb	CROTOX
PHOSDRIN (MEVINPHOS), SEDIMENT, DRY WEIGHT, UG/KG	2 ppb	82646	FENITROTHION, Sediment, dry wt. ppb (ug/kg)	2 ppb	FENITRO
CHLORFENVINPHOS, TOTAL, SEDIMENT UG/KG	2 ppb	04302	LEPTOPHOS, Sediment, dry wt. ppb (ug/kg)	2 ppb	LEPTO
FAMPHUR SEDDRYWGTUG/KG	2 ppb	38465	PHOSPHAMIDON (DIMECRON), Sediment, dry wt. ppb (ug/kg)	2 ppb	PHOS
MERPHOS SEDDRYWGTUG/KG	2 ppb	38498	*** Reporting Limit - RL is based upon the sample wet weight.**		

Organochlorine Pesticides			Organochlorine Pesticides		
VADEQ OFFICIAL NAME	RL *	DEQ STORET Code	VADEQ OFFICIAL NAME	RL *	DEQ STORET Code
DIBROMOCHLOROPROPANE SEDDRYWGTUG/KG	2 ppb	38440	CHLORDANE-CIS ISOMER BOTTOM DEPOS (UG/KG DRY SOL	2 ppb	39064
HEXACHLOROCYCLOPENTADIENE DRY WGTBOTUG/KG	2 ppb	34389	DDE IN BOTTOM DEPOS. (UG/KILOGRAM DRY SOLIDS)	2 ppb	39368
DIALLATE DRY WEIGHT, REGOLITH UG/KG	2 ppb	73386	DIELDRIN IN BOTTOM DEPOS. (UG/KILOGRAM DRY SOL.)	2 ppb	39383
BHC-ALPHA ISOMER BOTTOM DEPOS (UG/KG DRY SOL)	2 ppb	39076	ENDRIN IN BOTTOM DEPOS. (UG/KILOGRAM DRY SOLIDS)	2 ppb	39393
HEXACHLOROBENZENE SEDIMENT,DRY,WT,UG/KG	2 ppb	75042	CHLOROBENZILATE, UG/KG	2 ppb	30381
B-BHC-BETA DRY WGTBOTUG/KG	2 ppb	34257	ENDOSULFAN, BETA DRY WGTBOTUG/KG	2 ppb	34359
GAMMA-BHC (LINDANE) SEDIMENTS,DRY WGT,UG/KG	2 ppb	39343	DDD IN BOTTOM DEPOS. (UG/KILOGRAM DRY SOLIDS)	2 ppb	39363
DELTA BENZENE HEXACHLORIDE DRY WGTBOTUG/KG	2 ppb	34262	ENDRIN ALDEHYDE DRY WGTBOTUG/KG	2 ppb	34369
HEPTACHLOR IN BOT. DEP. (UG/KILOGRAM DRY SOLIDS)	2 ppb	39413	KEPONE IN SEDIMENT DRY WEIGHT UG/KG	2 ppb	81857
ALDRIN IN BOTTOM DEPOS. (UG/KILOGRAM DRY SOLIDS)	2 ppb	39333	ENDOSULFAN SULFATE DRY WGTBOTUG/KG	2 ppb	34354
ISODRIN IN BOTTOM DEPOS. (UG/KILOGRAM DRY SOLIDS)	2 ppb	39433	DDT IN BOTTOM DEPOS. (UG/KILOGRAM DRY SOLIDS)	2 ppb	39373
HEPTACHLOR EPOXIDE SEDIMENT,DRY,WT,UG/KG	2 ppb	75045	ENDRIN KETONE SEDIMENT, DRY WT (SE) UG/KG	2 ppb	85791

Text Table 3 (cont.). Toxic Organic Parameters in the Sediment

Herbicides			Herbicides		
VADEQ OFFICIAL NAME	**RL ***	**DEQ STORET Code**	**VADEQ OFFICIAL NAME**	**RL ***	**DEQ STORET Code**
DALAPON SEDDRYWGTUG/KG	3.3 ppb	38435	SILVEX IN BOTTOM DEPOSITS (UG/KG DRY SOLIDS)	3.3 ppb	39761
3,5-DCBA, Sediment, dry wt. ppb (ug/kg)	3.3 ppb	HERB35	AMIBEN (CHLORAMBEN), SEDIMENT, DRY WT. UG/KG	3.3 ppb	45611
4-NITROANISOLE, TOTAL, SEDIMENT UG/KG	3.3 ppb	4NIAN	TRICHLOROPHENOXYACETIC,2,4,5-ACD,DRY WT,REG UG/KG	3.3 ppb	73255
DICAMBA, DRY WEIGHT, REGOLITH UG/KG	3.3 ppb	73385	2,4-DB SEDDRYWGTUG/KG	3.3 ppb	38748
MCPP SEDDRYWGTUG/KG	3.3 ppb	38494	DINOSEB SEDDRYWGTUG/KG	3.3 ppb	38781
MCPA, DRY WEIGHT, REGOLITH UG/KG	3.3 ppb	73257	BENTAZON SEDDRYWGTUG/KG	3.3 ppb	38713
DICHLORPROP SEDDRYWGTUG/KG	3.3 ppb	38452	PICLORAM, Sediment, dry wt. ppb (ug/kg)	3.3 ppb	PICLO
DICHLOROPHENOXYACETIC ACID,2,4-,DRY WT,REG UG/KG	3.3 ppb	73258	DCPA(DACTHAL) IN SEDIMENT DRY WEIGHT UG/KG	3.3 ppb	81619
PCP (PENTACHLOROPHENOL) IN BOT DEPOS DRY SOL UG/KG	3.3 ppb	39061	ACIFLUORFEN (BLAZER), SEDIMENT, DRY WT. UG/KG	3.3 ppb	45610

PAH's and Phthalates			PAH's and Phthalates		
VADEQ OFFICIAL NAME	**RL ***	**DEQ STORET Code**	**VADEQ OFFICIAL NAME**	**RL ***	**DEQ STORET Code**
NAPHTHALENE DRY WGTBOTUG/KG	10 ppb	34445	9-METHYLANTHRACENE SED, UG/KG, DRY WGT	10 ppb	9MAXX
1-METHYLNAPHTHALENE, SEDIMENT, DRY WEIGHT NG/G	10 ppb	61285	3,6-DIMETHYLPHENANTHRENE SED, UG/KG, DRY WGT	10 ppb	36DMP
2-METHYLNAPHTHALENE IN SEDIMENT DRY WEIGHT UG/KG	10 ppb	78868	FLUORANTHENE DRY WGTBOTUG/KG	10 ppb	34379
BIPHENYL SEDIMENT,DRY WGT,UG/KG	10 ppb	75558	PYRENE DRY WGTBOTUG/KG	10 ppb	34472
2,6-DIMETHYLNAPHTHALENE DRY WEIGHT, SEDIMENTUG/KG	10 ppb	50943	9,10-DIMETHYLANTHRACENE SED, UG/KG, DRY WGT	10 ppb	910DMA
DIMETHYL PHTHALATE DRY WGTBOTUG/KG	10 ppb	34344	BUTYL BENZYL PHTHALATE IN SEDIMENT DRY WT UG/KG	10 ppb	78800
1,4-DIMETHYL NAPTHALENE IN SEDIMENT DRY WGT UG/KG	10 ppb	78823	BENZO(A)ANTHRACENE 1,2-BENZANTHRACEN DRY WGTBOTUG/KG	10 ppb	34529
ACENAPHTHYLENE DRY WGTBOTUG/KG	10 ppb	34203	TRIPHENYLENE SED, UG/KG, DRY WGT	10 ppb	TPXXX
ACENAPHTHENE DRY WGTBOTUG/KG	10 ppb	34208	CHRYSENE DRY WGTBOTUG/KG	10 ppb	34323
2,3,5-TRIMETHYLNAPHTHALENE SED, UG/KG, DRY WGT	10 ppb	235TMN	BIS(2-ETHYLHEXYL)PHTHALATE SEDIMENT,DRY WGT,UG/KG	10 ppb	39102
DIETHYL PHTHALATE DRY WGTBOTUG/KG	10 ppb	34339	DI-N-OCTYL PHTHALATE DRY WGTBOTUG/KG	10 ppb	34599
FLUORENE DRY WGTBOTUG/KG	10 ppb	34384	BENZO(B)FLUORANTHENE SEDIMENTS,DRY WGT,UG/KG	10 ppb	34233
METHYLFLUORENE IN SEDIMENT UG/KG	10 ppb	78644	BENZO(K)FLUORANTHENE DRY WT, SEDIMENT UG/KG	10 ppb	34255
PHENANTHRENE DRY WGTBOTUG/KG	10 ppb	34464	BENZO(E)PYRENE DRY WEIGHT, SEDIMENT UG/KG	10 ppb	49743
ANTHRACENE DRY WGTBOTUG/KG	10 ppb	34223	BENZO-A-PYRENE DRY WGTBOTUG/KG	10 ppb	34250
2-METHYLPHENANTHRENE SED, UG/KG, DRY WGT	10 ppb	2MPXX	PERYLENE DRY WEIGHT, SEDIMENT UG/KG	10 ppb	49724
2-METHYLANTHRACEN SED, UG/KG, DRY WGT	10 ppb	2MAXX	INDENO (1,2,3-CD) PYRENE DRY WGTBOTUG/KG	10 ppb	34406
DI-N-BUTYL PHTHALATE SEDIMENTS,DRY WGT,UG/KG	10 ppb	39122	1,2,5,6-DIBENZANTHRACENE DRY WGTBOTUG/KG	10 ppb	34559
1-METHYLPHENANTHRENE DRY WEIGHT, SEDIMENT UG/KG	10 ppb	50942	BENZO(GHI)PERYLENE IN SEDIMENT DRY WEIGHT UG/KG	10 ppb	78828

Text Table 3 (cont.). Toxic Organic Parameters in the Sediment

Polychlorinated Biphenyls (PCBs)			Polychlorinated Biphenyls (PCBs)		
VADEO OFFICIAL NAME	RL *	DEQ STORET Code	VADEO OFFICIAL NAME	RL *	DEQ STORET Code
PCB 5 Sediment, dry wt. ppb (ug/kg)	2 ppb	PCB05	PCB 153 Sediment, dry wt. ppb (ug/kg)	2 ppb	PCB153
PCB 8 Sediment, dry wt. ppb (ug/kg)	2 ppb	PCB08	PCB 170 Sediment, dry wt. ppb (ug/kg)	2 ppb	PCB170
PCB 1 Sediment, dry wt. ppb (ug/kg)	2 ppb	PCB01	PCB 180 Sediment, dry wt. ppb (ug/kg)	2 ppb	PCB180
PCB 18 Sediment, dry wt. ppb (ug/kg)	2 ppb	PCB18	PCB 183 Sediment, dry wt. ppb (ug/kg)	2 ppb	PCB183
PCB 28 Sediment, dry wt. ppb (ug/kg)	2 ppb	PCB28	PCB 187 Sediment, dry wt. ppb (ug/kg)	2 ppb	PCB187
PCB 31 Sediment, dry wt. ppb (ug/kg)	2 ppb	PCB31	PCB 206 Sediment, dry wt. ppb (ug/kg)	2 ppb	PCB206
PCB 44 Sediment, dry wt. ppb (ug/kg)	2 ppb	PCB44	PCB 77 Sediment, dry wt. ppb (ug/kg)	2 ppb	PCB77
PCB 52 Sediment, dry wt. ppb (ug/kg)	2 ppb	PCB52	PCB 118 Sediment, dry wt. ppb (ug/kg)	2 ppb	PCB118
PCB 66 Sediment, dry wt. ppb (ug/kg)	2 ppb	PCB66	PCB 105 Sediment, dry wt. ppb (ug/kg)	2 ppb	PCB105
PCB 87 Sediment, dry wt. ppb (ug/kg)	2 ppb	PCB87	PCB 128 Sediment, dry wt. ppb (ug/kg)	2 ppb	PCB128
PCB 81 Sediment, dry wt. ppb (ug/kg)	2 ppb	PCB81	PCB 126 Sediment, dry wt. ppb (ug/kg)	2 ppb	PCB126
PCB 101 Sediment, dry wt. ppb (ug/kg)	2 ppb	PCB101	PCB 156 Sediment, dry wt. ppb (ug/kg)	2 ppb	PCB156
PCB 110 Sediment, dry wt. ppb (ug/kg)	2 ppb	PCB110	PCB 169 Sediment, dry wt. ppb (ug/kg)	2 ppb	PCB169
PCB 138 Sediment, dry wt. ppb (ug/kg)	2 ppb	PCB138	PCB 195 Sediment, dry wt. ppb (ug/kg)	2 ppb	PCB195
PCB 141 Sediment, dry wt. ppb (ug/kg)	2 ppb	PCB141	PCBS TOTAL Sediment, dry wt. ppb (ug/kg)	??	39526
PCB 151 Sediment, dry wt. ppb (ug/kg)	2 ppb	PCB151	*** Reporting Limit - RL is based upon the sample wet weight.**		

Monitoring for Toxics in State Waters

The Commonwealth of Virginia monitors toxics and their effects in the state's surface waters by both chemical and biological methods in the water column and sediment, and by chemical methods in fish tissues. The specific state monitoring and analytical programs related to toxics are as follows:

- The regional office WQMA field staff carries out most chemical sampling for toxic substances in the water column and associated sediments at probabilistic, fixed-site, and/or rotating ambient monitoring stations.
- The Division of Consolidated Laboratory Services (DCLS) of the Virginia Department of General Services in Richmond analyzes most of the resulting samples, statewide.
- The U.S. Geological Survey laboratory in Columbia, Missouri, currently performs the extraction and analysis of organic compounds collected using the SPMD technology. It is possible that DCLS will assume this role in the future.
- EPA-contracted laboratories analyze sediment samples (metals, organics, and toxicity) and whole fish tissue samples (metals and organics) collected from the probabilistic sites of the Coastal 2000 Program (EPA Assistance Agreement No. R-82854401-0: 2000-2004).
- The field team from DEQ's Central Office of Water Quality Standards (WQS) performs additional chemical monitoring of toxics in sediments and fish tissues at selected sampling sites.
- The Virginia Institute of Marine Science (VIMS – Gloucester Point) and College of William and Mary (Williamsburg) laboratories usually analyze samples collected within the WQS Fish Tissue and Sediment Monitoring Program.
- DEQ's seven regional offices and, as required, permitted facilities whose discharge permits contain specified limits for toxics quantities or concentrations in their liquid effluents, carry out additional compliance monitoring and pollution complaint response monitoring for toxic substances.

More complete discussions of each of these monitoring programs are included later in this report.

C**hemical monitoring** of toxics consists of the direct, quantitative measurement of the concentrations of specific chemical elements and compounds in effluents, in the water column of the receiving water body, in the underlying sediments, and/or in animal tissues. Chemical monitoring is considered to be monitoring of the **potential causes of 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 and salt waters. The current standards used for these comparisons are listed in the Assessment Guidance document (**http://www.deq.state.va.us/wqa/**) for each 305(b)/303(d) Report, as well as in Appendix C of this Toxics Reduction Report.

***Toxics in Sediment*:** In most cases, there are as yet no specific standards for toxics present in the sediment. Consequently, ecological risk assessments have generally compared toxics concentrations in sediment to Effects Range - Moderate (ER-M) concentration screening values (SVs). NOAA (NOAA, 1991), the EPA (U.S. EPA, 1992), and others (e.g., Long et al. 1995) have provided these 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) Report Assessment Guidance document (**http://www.deq.virginia.gov/wqa/**). as well as in Appendix D of this toxics reduction report.

***Toxics in Fish Tissues*:** To assess the human health risk from edible fish tissues, the analytical results from fish tissue analyses are compared to human health contaminant Screening Values (SVs). The calculation of these SVs uses risk assessment techniques published by the EPA for chronic toxicity and for both carcinogenic and non-carcinogenic effects (U.S. EPA, 1994). The current 305(b) Report Assessment Guidance document (**http://www.deq.virginia.gov/wqa/**), as well as Appendix E – "EPA Risk-Based Screening Values for Fish Tissues – MY04" of this toxics reduction report, provide summaries of current SVs. More specific details on the sampling and assessment of fish tissues and sediment appear in the Quality Assurance/Quality Control Project Plan for the Fish Tissue and Sediment Monitoring Program (DEQ-SRU, 1998).

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, 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 the measurement of the **potential effects of environmental impairment**. DEQ no longer possesses the facilities to perform its own toxicity testing although, when necessary for special studies, DEQ does contract commercial or university laboratories to perform the desired tests when deemed necessary. As mentioned elsewhere in this report, estuarine sediment samples collected in the Coastal 2000 Program have undergone toxicity testing at an EPA-contracted laboratory and other contracted toxicity testing is currently being performed in conjunction with a number of freshwater benthic-related TMDL studies.

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 and sends them to independent laboratories to confirm the toxicity levels and the quality assurance/quality control procedures the permitted facilities are using.

DEQ's Water Quality Monitoring Program Strategy discusses more fully the relative merits of chemical versus biological monitoring and of field versus laboratory evaluations of environmental impact.[2] In summary, the costs of chemical sampling and analyses for toxics are high in comparison with the field evaluation of biological communities. Budgetary considerations limit the number of monitoring stations that can be sampled for chemical analyses as well as the frequency of sampling at each station. One specific objective of the Water Quality Monitoring Program is to increase the use of biological monitoring statewide, as an early warning system to detect toxic effects and to supplement chemical toxics monitoring. In addition, it will continue to use chemical monitoring to determine and evaluate the possible causes of observed biological impairment.

[2] The Water Quality Monitoring Strategy document, prepared by the DEQ Office of Water Quality Monitoring and Assessment, underwent a second review by U.S. EPA Region III and was released for public review and comment in August 2004. A revised, reformatted edition was submitted to EPA for evaluation on September 27, 2004. EPA subsequently indicated it had no additional comments or suggestions.

Chemical Monitoring

DEQ chemically monitors the state's surface waters, fish tissues, and associated sediments for toxics on a regular basis. Because of the high costs of analytisis, however, the monitoring of chemical toxics is normally carried out only at specified stations and on a periodic basis. The sites selected, as well as the frequencies sampled and parameters analyzed, depend upon several factors, including resource availability.

The Office of Water Quality Standards' Fish Tissue and Sediment Monitoring Program also considers:

- The past history of the water body,
- Known sources of toxics input, and
- The geographic typicality of specific sites.

In the recent past, the Ambient Water Quality Monitoring Program stations used for toxics monitoring have been divided into the following three distinct types:

1. Monitoring sites designated as "watershed mouth stations" or "trend stations" are considered representative of the quality of water moving from one geographically defined local drainage basin to another. Following the original WQM strategy, DEQ planned to sample such sites for toxics in the sediment and in the water column once during each six-year monitoring cycle. (Recent limitations on monitoring resources no longer permit toxics monitoring at such a large number of sites. DEQ has consequently suspended the monitoring of toxics at these sites and restricts its ambient monitoring for toxics to probabilistic stations, as described below.)
2. Additional sites, randomly selected each year from free-running freshwaters and from tidal estuarine waters, constitute the probabilistic monitoring module of the WQM strategy and are as a rule sampled only once, unless the first sampling event identifies a specific water quality problem. The results from chemical analyses of sediment and water and from benthic community analyses at these probabilistic sites provide unbiased characterizations of Virginia's ambient surface waters for a specific resource class, or on a regional, basin-wide, and/or statewide basis.
3. Sites identified as having unacceptably high concentrations of one or more toxic substances (based on analyses of previous samples from type 1 or type 2 sites), that have a known history of contamination by toxics, or that have a high risk of contamination, may be designated as "targeted stations." They may become part of a specific special study to document the geographic extension, severity, and cause of the contamination, or they may be included in the sampling plan of the Fish Tissue and Sediment Monitoring program carried out by the Special Research Unit of the Office of Water Quality Standards.

More complete descriptions of specific toxics monitoring activities appear below.

Toxic elements and chemical compounds are generally categorized into several primary groups, each of which has a specific chemical analysis code to identify the procedures necessary for its complete analysis by DCLS. The primary groups normally are:

- Clean dissolved and total toxic metals in the water column,
- Toxic metals in the sediment,
- Dissolved pesticides and other organics,
- Pesticides and other organics in the sediment, and
- Toxic metals and pesticides/organics in fish tissues.

Various other toxic organic compounds (*e.g.*, PAHs and PCBs), for which water quality standards have been established and which appear on toxics lists published by the U.S. EPA and the Chesapeake Bay Commission, are generally evaluated together with pesticides.

Table 1 of this report summarizes the specific parameters DCLS analyzed during the most recent monitoring year, their associated laboratory analysis group codes, 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.

Table 2 summarizes the number of samples, the analytical expenses, and the parameter group codes included in metal and pesticide analyses performed by the state laboratory (DCLS) during the 2004 monitoring year. This summary includes only those samples collected by the Ambient Water Quality Monitoring Program of the WQMA. (Not included are the numbers of samples, analytical costs, etc., of fish tissue and sediment samples collected by personnel from the WQS during various special studies or toxics samples collected in the Coastal 2000 Program.)

Biological Monitoring

Benthic Community Evaluation: Field sampling and evaluation of benthic communities has proved to be an invaluable tool in the assessment of water and sediment quality, in Virginia as well as in numerous other states. Highlights of the biological assessment program include the following:

- Assessments in free-flowing freshwater streams are carried out using standardized Rapid Bioassessment Protocols (RBPs) published by the EPA (U.S. EPA, 1989, 2000) and other federal and state organs.
- The Mid-Atlantic Coastal Streams Workgroup has produced a supplementary EPA manual for the evaluation of benthic communities in low-gradient, non-tidal coastal streams (U.S. EPA, 1997).
- Tetra Tech Inc., a Maryland-based ecological consulting firm, has utilized the results of DEQ studies of benthic macroinvertebrate communities in Virginia streams to develop an efficient Stream Condition Index (SCI) for non-coastal streams in the Commonwealth. A final report on this study was delivered to DEQ in the spring of 2003. A copy of this report is available on the DEQ Website at http://www.deq.virginia.gov/watermonitoring/pdf/vastrmcon.pdf. Comments received from public review of the SCI document and from DEQ's Academic Advisory Committee are currently being reviewed and integrated. Once this process is completed, all comments and responses will be posted on the Website with the SCI Report.
- Cooperative efforts among Virginia, Maryland, the federal Interstate Chesapeake Bay Program, and EPA Region 3 during 2003 resulted in a standardized, interstate methodology for analyzing and assessing the results of probabilistic benthic invertebrate monitoring in tidal areas of the Chesapeake Bay watershed for the 2004 integrated 305(B)/303(D) Reports of both states. Cooperative efforts among the members of this partnership continue to improve the quality of Benthic IBI assessments and causal evaluations for the 2006 and subsequent Reports. An additional product of this process is a benthic community Stressor Diagnostic Tool, being developed by Dr. Dan Dauer of Old Dominion University and Dr. Roberto Llansó of VERSAR Consulting (Columbia, MD), that will indicate the most probable cause of benthic community degradation (chemical contaminants, DO depletion, etc.). Depending upon decisions to be made by early 2005, evaluations performed using this tool may be included in Virginia's 2006 Integrated 305(b)/303(d) Assessment Report.

Because communities of benthic invertebrates and algae, as well as certain fish species, are permanent residents within the waterbodies of interest, they are able to integrate the various causes of impairment over time, rather than representing a single temporal point-sample from the water column or sediment. The status of the biological community as a whole also presents an integrated measure of the ***ecological effects*** of numerous physical conditions and chemical substances, incorporating any antagonistic and/or synergistic biological-chemical interactions into the overall evaluation of ecological impact. In this respect, biological monitoring for toxic effects is much more informative than chemical monitoring.

Based on the results of RBP-II biological evaluations, biologists classify Virginia's waterbodies and waterbody segments as *"fully supporting"* of the aquatic life designated use, as *"fully supporting but having observed effects"* for aquatic life use, or as *"impaired"* for aquatic life use, in comparison with regional reference conditions which are considered to be of acceptable water quality. Similarly, following the partnership consensus described above, sample benthic IBI scores, when compared with those of reference populations, can be used to assess benthic communities as impaired or not impaired for the aquatic life use assessment of tidal waters.

Advantages of Biological Monitoring: Although biological monitoring is generally incapable of identifying or accurately quantifying the exact cause of environmental impairment, it is rapid and relatively inexpensive in comparison with comprehensive chemical analyses and is able to identify waterbodies where more intensive studies are necessary. It has the added advantage that the organisms in an aquatic community are able to integrate the effects of various interacting stressors over an extended period of time. It permits the ambient monitoring of a larger geographic area with a minimum of additional cost, thus reserving limited financial and human resources for more intensive biological and chemical studies of areas where impacts have been confirmed.

Development of a Biological Monitoring Database: In 1998, the EPA awarded a two-year research grant (1999-2000) for Tetra Tech Inc., a Maryland-based ecological consulting firm, to collaborate with DEQ in developing a relational biological database and determining efficient Indices of Biological Integrity (IBIs) for additional ecoregions in Virginia. The resultant Ecological Data Application System (EDAS) database facilitates the integration of Virginia's biological data into a standardized format for the transferal of biological monitoring data from DEQ's various regional offices and, possibly, qualified data from citizens' monitoring groups to a unified statewide database at DEQ's central office in Richmond. The database also contains programs to automatically calculate a number of "metrics", numerical values used to measure and describe the community structure of the biological assemblage samples stored in the database. Eventually, the same database will be programmed to calculate an appropriate "Index of Biological Integrity" (IBI) to express the ecological health of the community for assessment purposes.

At the time the EDAS database was developed, the geographical distribution and number of sites in DEQ's biological monitoring database were not yet sufficient for determining optimal IBIs for each ecoregion in the state. The targeted and judgmental sites previously monitored, and the lack of strict definitions for the selection criteria for reference sites for regional streams, had created some bias in the results and had limited the database's utility for defining IBIs. The Biological Monitoring Program initiated probabilistic monitoring late in MY2001 (April-May, 2001) and has continued through MY2004. Plans to extend the ProbMon biological monitoring beyond the original five-year program are currently under consideration. The accumulated results from this completely randomized sampling are providing:

1. The data for an unbiased statewide characterization of freshwater benthic communities in free-running freshwaters, and
2. The information required for designating regional reference streams or conditions.

3. Concurrently collected chemical monitoring data will help establish regional and eco-regional criteria and/or standards for nutrients and other water quality parameters.

Appendix H1of this report lists the biological monitoring stations visited during 2004. Much additional information from these stations was recorded in individual databases at each regional office and later consolidated at DEQ's central office in Richmond. At the present time, the Comprehensive Ecological Data System (CEDS) database at DEQ's Central Office records only data from biological stations where researchers collect field parameter data (temperature, dissolved oxygen, pH, and conductivity) and water quality samples that are shipped to DCLS for chemical analysis. The EDAS database developed by the Tetra Tech Inc. consulting firm is being utilized to satisfy regional needs and formalize formats for data entry and transfer by regional biologists.

Appendix H2a, "Freshwater Probabilistic Monitoring Sites MY2004-05", provides a comprehensive list of the probabilistic monitoring stations that were included in the ambient program during calendar year 2004. Many of these (wadeable sites) were also sampled for benthic invertebrate populations.

Appendix H2b, "Prospective Freshwater Probabilistic Monitoring Sites MY2005-06", provides a comprehensive list of the possible probabilistic/biological stations that may be included in the ambient program during calendar year 2005. The final list will become available only after regional biologists perform both map and field reconnaissance prior to their sampling in the spring of 2005.

Toxics Monitoring – Surface Waters and Sediments

Appendix F1– "Historical Toxics-Monitoring Station List Oct1970-Oct2001" contains a complete list of all WQM stations where ambient toxics samples had been collected prior to October 18 of 2001. The list spans the period from October 1970 through October 2001 and includes all the sites from which analytical results of sediment metals samples were available in DEQ's CEDS 2000 database at that time. Researchers normally collect sediment pesticide samples simultaneously at the same sites. The list includes 2359 sites, which were visited a total of 26,783 times (average of 11.4 visits per site). A single visit may include the collection of multiple samples (e.g., sediment metals, sediment pesticides, dissolved and/or total metals in the water column, and dissolved pesticides), so the total number of samples collected during this period probably exceeds 50,000. (Not included are the recent samplings of clean dissolved and total metals during several special studies.) Samples collected since monitoring year 2002 are summarized in individual Toxics Reduction in State Waters Reports.

Text Box 1, below, presents the total number of ambient WQM toxics samples collected during MY2004 for which analytical results are currently available (November 2004). They include clean dissolved and clean total metals in the water column and metals and pesticide/organics analyses of sediment. Limitations to the analyses for the current year include the following:

- Budgetary restrictions experienced during the past several years have significantly reduced the number of toxics samples collected and analyzed during the period.
- There are no water quality criteria or standards for total metals in the water column. Consequently, the number of samples for total metals is generally much lower than for dissolved metals. (This year's sampling was restricted primarily to a long-term special study on mercury [Hg] distribution and mobility in impaired segments of the Shenandoah River basin.)
- Metals and pesticides in the sediment are generally sampled simultaneously and at the same stations, but their chemical analyses and the availability of results are independent. The number of results reported for organic toxics is often less than that reported for metals because the organic

analyses are more complex and take longer to perform. The new AMB_TOX parameter group code is still being developed, and additional analytes are being added at this time.

- Additional parameter group codes that include incidental water column metals are not included in Text Box 1.

As mentioned above, Appendix F1 of this report consists of a list of the ambient monitoring stations with a history of sampling metals or pesticides and other organics. These listings provide station identification, complete location descriptions including geographic coordinates, stream and basin names, hydrologic unit codes, and local watershed identifications, dates for the first and the most recent samplings prior to the query (October 2001), and the total number of visits to the site for toxics samples. (A single visit to a site may result in multiple samples for toxics analyses, e.g., metals and/or pesticides in water and/or sediment.) Appendix F2 lists the ambient monitoring stations that were sampled for each toxics parameter group code during Monitoring Year 2004. Similar annual summary tables can be found in previous Toxics Reduction Reports (Jan1999-Jan2004).

Basin Code	River Basin Name	Clean Dissolved Metals	Clean Total Metals	Sediment Metals	Sediment Pesticides[2]
		(water)	(water)		
1-	**Potomac / Shenandoah**	7 (+88[1])	107[1]	11	16
2-	**James (excluding Elizabeth River)**	21	0	25	26
2-	**Elizabeth River**	0	0	0	0
3-	**Rappahannock**	8	0	8	10
4A	**Roanoke**	17	0	21	18
5A	**Chowan**	11	0	13	15
5B	**Dismal Swamp / Albemarle Sound**	0	0	0	1
6-	**Tennessee / Big Sandy**	15	0	14	16
7-	**Chesapeake Bay and Coastal**	21	0	1	1
8-	**York**	5	0	19	19
9-	**New**	12	0	11	10
		-----	-----	-----	-----
	Total	**205**	**107**	**123**	**132**
	Grand Total	**567**			

Text Box 1. Summary of Ambient Toxics Monitoring Samples from Virginia's Surface Waters for which data are available - MY2004. (Excludes SPMD sampling)

[1] Mercury only, in conjunction with the Shenandoah Basin Mercury Special Study.
[2] Sediment samples for organics analysis were collected at approximately 60 freshwater probabilistic sites during the spring of 2003. Due to technical difficulties, it was necessary to recollect them in the fall, and the results are included in this year's toxics report. Samples reported were collected and analyzed under the new AMB_TOX parameter group code rather than the previous PES1S group code.

Toxics in the Water Column

At the present time, science defines all existing water quality criteria and standards for toxic substances 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. Often, it has been necessary to collect and concentrate large samples to produce meaningful results. Sampling of waters with such low concentrations of toxics also commonly presents severe problems in terms of sample contamination. Consequently, careful planning and specific SOPs are necessary to ensure the quality control of sample collection and transport and of the subsequent chemical analyses, and to guarantee the accuracy and defensibility of the results. A number of newly developed sampling and analytic technologies (discussed below) are now in use for improving the representativeness, accuracy, and precision of measuring dissolved toxics in the water column.

Clean Dissolved Metals in Surface Waters

From June 1995 through July 1996, DEQ carried out a pilot project (Project No. 50205) for the sampling and analysis of trace metals in the Pigg River Basin of Franklin County, Virginia. The purpose of the study was to gather the necessary background data and experience for formulating SOPs for the collection and analysis of freshwater and wastewater treatment plant effluents for trace metals. The final report from this project (DEQ-WQA, 1996) documents the precision requirements and the limits to recovery and detection of trace metals when applying the newly developed methodology. More recently, additional studies were carried out to validate this methodology for clean dissolved and total metals sampling and analyses in brackish and saltwater, primarily in the Elizabeth River.

The resultant sampling SOP (DEQ-WQA, 1998) is currently being applied in the collection and analysis of 19 dissolved trace metals in freshwater: aluminum (Al), antimony (Sb), arsenic (As), barium (Ba), beryllium (Be), cadmium (Cd), calcium (Ca), chromium (Cr), copper (Cu), iron (Fe), lead (Pb), magnesium (Mg), manganese (Mn), mercury (Hg), nickel (Ni), selenium (Se), silver (Ag), thallium (Tl), and zinc (Zn). The suite of 16 metals analyzed from brackish and saltwater samples differs slightly from those included above: aluminum (Al), antimony (Sb), arsenic (As), cadmium (Cd), calcium (Ca), copper (Cu), iron (Fe), lead (Pb), magnesium (Mg), manganese (Mn), mercury (Hg), nickel (Ni), potassium (K), selenium (Se), sodium (Na), and zinc (Zn).

Table 3 - "Clean Dissolved Metals - All Basins - MY2004" presents the results of clean, dissolved toxic metals monitoring during MY2004 in their raw form and statistically summarized, river basin by river basin. The second spreadsheet in Table 3 summarizes the results from a Shenandoah River Basin special study of dissolved mercury distribution. The program codes in the first column of the table identify the subdivisions of the overall ambient monitoring program for which each sample was collected: AQ = ambient monitoring; FP = freshwater probabilistic monitoring; RL = regional lakes monitoring; AT = AmbTox study (DEQ, Chesapeake Bay Program {CBP}, VIMS); ER = Elizabeth River Study; RB = regional biological monitoring; SS = Special Study; HG = Shenandoah Mercury Special Study. Basin-by-basin historical summaries of clean dissolved metals results appear in graphical format in the Excel® workbooks in Folder 3 - "Metals, Dissolved, Historical, …" along with year-by-year and metal-by-metal statistical summaries.

The most meaningful single statistic in these tables is the "median" concentration. This is the concentration that exactly half of the samples exceeded and half fell below. It can be used as an "average" value to compare the basin with the appropriate water quality standard. The "90^{th} percentile" value is the concentration that only ten percent of the samples exceeded. Similarly, the 75^{th}, 25^{th}, and 10^{th} percentiles are the respective concentrations that 25%, 75%, and 90% of the samples exceeded.

Where the results from multiple samples reveal the same (or very similar) values for the 90^{th} (and/or 75^{th}) percentile, the median, the 25^{th} and 10^{th} percentiles, and the minimum, the environmental concentration in the majority of the samples was at or below the detection limit for the methods used. That limit is generally quite similar to the value that is repeated in the table, although it may vary significantly from one sample to the next. Because samples with concentrations below the detection limits for a specific metal were reported at the detection limit, an upward bias has been introduced into many statistical summaries. When the detection limits are near or above the standard for the metal in question, the apparent results may suggest that the standard was exceeded, when in fact the actual concentrations were considerably lower. Such cases can be identified by the Remark Code "U" (non-detect) in the tabulated raw data summaries of Tables 3 through 6 of this report.

The two statistics that have been determined for the annual summaries since 1997, the upper quartile (75^{th} percentile) and lower quartile (25^{th} percentile) values, allow the estimation of 95 percent confidence intervals for the median values. They permit visual statistical comparisons among river basins (geographic variations within the same monitoring year), as well as among years in the same river basin (for analysis of temporal trends). When sample numbers were sufficient, the upper and lower 95 percent confidence limits on the median were calculated using a formula published by the EPA for the evaluation of trends in lake water quality (Reckhow, et al., 1993). The upper and lower limits are, respectively, the value of the median plus or minus the value of 1.57 times the interquartile interval (I) divided by the square root of the sample size (number of samples = n):

$$\text{Limits} = \text{Median} \pm (1.57\ [\ I / \sqrt{n}\ ])$$

Allowing for variation among the samples, it is possible to have a confidence of 95% that the true median concentration of the toxic metal is between the upper and lower limits. If the confidence intervals for two years (or for two basins) do not overlap, it is possible to conclude with 95 percent confidence that the medians of the two basins differ significantly. The vertical lines in the graphs of Folder 3 represent the 95 percent confidence intervals for the median concentrations observed in each year. The small black horizontal lines represent the medians (i.e., 50^{th} percentile). When all observations are near the detection limits for the parameter of interest, the interquartile interval and the resultant confidence interval may become zero. In such cases, comparisons among the groups of samples are not trustworthy. In any case, the presence of numerous 'non detect' values (>25% with 'U' remark codes) will bias the median and its confidence interval upward!

Total Metals in Surface Waters

As mentioned above, all water quality criteria for toxic metals that the EPA provides, and that subsequently become the basis for the Commonwealth's Water Quality Standards, are based on dissolved concentrations. The majority of the metals in the water column are bound to the surface of suspended mineral and organic particulate matter. For the most part, particle-bound metals are not considered to be biologically available to most aquatic organisms. Because there are no Water Quality Standards for total metals in the water column, the sampling of total metals is not normally included in ambient water quality monitoring. Incidental metals such as copper, iron and manganese are included in other parameter group codes, and calcium is often included to facilitate the calculation of 'hardness'. During MY2004, however, DEQ researchers again collected clean total metals 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. The resultant data from these samples, along with their statistical summaries, are included in a separate tab of Table 4. The statistical summaries in this table can be interpreted in the same manner as described above, for Table 3. In the Excel® workbooks of Folder 4 - Metals, Total in Water, Historical - MY2004, historical summaries of clean total metals results are presented in graphical format, by basin, along with year-by–year and metal-by-metal statistical summaries. As mentioned above, the vertical lines in the graphs represent the 95 percent confidence intervals for the median concentrations observed in each year. The small, horizontal black lines represent the medians (i.e., 50th percentile).

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 pesticides using traditional methods during the past several years. The results of several pilot studies employing newly developed sampling technologies offered the promise of significantly improving the monitoring of dissolved organics. Consequently, with the aid of a $250,000 EPA grant, DEQ deployed Semi-Permeable Membrane Devices (SPMDs) at 50 freshwater probabilistic monitoring sites during the spring and fall of 2003. This study is described in more detail below, but the final results are not yet available. SPMDs were also employed in a several special studies on the distribution of polychlorinated biphenyls (PCBs) during MY2004. These studies and some preliminary results are described elsewhere in this report.

Toxics in the Sediment

Two separate groups within DEQ monitor sediments in Virginia's surface waters. DEQ's WQM Program has normally evaluated metals from selected permanent and/or rotating ambient WQM stations on a periodic, cyclic basis. More recently, DEQ has added the collection and analysis of sediment samples from each of its approximately 60 freshwater probabilistic monitoring stations each year. Sediment samples for chemical analyses of metals and organics have routinely been collected at 50 probabilistic sites of the Coastal 2000 / National Coastal Assessment Program each summer since 2000, but these samples are shipped to EPA-contracted laboratories for analysis. In the past, results from these laboratories have not been received until several years following sample collection. Beginning in the summer (July-September) of 2005, DEQ’s Estuarine Probabilistic Monitoring Program will begin analyzing all samples at DCLS. Thereafter, sediment toxics data from this program will be available for the DEQ CEDS 2000 database within 60 days of sample collection.

The WQS Fish Tissue and Sediment Monitoring Program also routinely analyzes sediment samples collected at the same sites where fish tissue samples are collected. DEQ also collaborates with NOAA and the EPA's Chesapeake Bay Program and Coastal 2000 / National Coastal Assessment Program (see discussions above and below), as well as with various universities, in characterizing the sediments of Chesapeake Bay and tidal tributaries to the Bay and the Atlantic Ocean. DEQ collects sediment data from both tidal and non-tidal Chesapeake Bay tributaries, and DEQ data contribute directly to the CBP Information Management System (CIMS) database. In addition, assessment of the Commonwealth's waters uses sediment data collected by various universities and government organizations, once it has passed quality assurance and quality control checks, along with DEQ’s own database.

Sediment Metals

Table 5, "Sediment Metals - All Basins - MY2004" presents tabular results and a statistical data summary of the MY2004 WQM sediment metals data, arranged by major drainage basin. The statistical summaries in this table can be interpreted in the same manner as described above for Tables 3 and 4. Sediment results from studies carried out by the WQS Program and the CBP are discussed elsewhere, in separate sections.

The Excel® workbooks of Folder 5 - "Metals, Sediment, Historical MY04" present graphical summaries of the concentrations of selected metals observed in sediment samples, basin by basin, along with year-by–year and metal-by-metal statistical summaries. The vertical lines in the graphs of Folder 5 represent the 95 percent confidence intervals for the median concentrations observed in each basin. The small, horizontal black lines represent the medians (i.e., 50^{th} percentile).

Sediment Pesticides and Other Organic Toxics

DEQ also monitors organic toxics deposited in the sediments underlying the Commonwealth's waters. Table 6a - "Sediment Pesticides - All Basins - MY2004" presents the sediment pesticide data from MY2004 basin by basin, followed by their statistical summaries. The Excel® workbooks of Folder 6 – "Pesticides, Sediment, Historical MY04" present historical sediment pesticide results in graphical and tabular form, basin by basin. The vertical lines in the graphs of Folder 6 represent the 95 percent confidence intervals for the median concentrations observed in each year. Again, the small, horizontal black lines represent the medians (i.e., 50^{th} percentile). Interpretation of these tables and graphs can be carried out in the same manner as described previously.

Beginning in 2003, DEQ began the substitution of a new parameter group code (AMB_TOX) for that previously used (PES1S) for the monitoring of organic contaminants in sediment. Several analytes, primarily outdated pesticides, have been removed from the previous list and numerous new analytes have been added (refer to Text Table 3, above). Table 6a, referred to in the last paragraph, only includes MY2004 data for those analytes with names and STORET codes common to both analysis group codes. Table 6b – "Sediment OP Pesticides All Basins 2004" – contains a summary of results of 37 ogano-phosphorus pesticides analyzed under the new AMB_TOX group code. Because of the large number of analytes in this group of pesticides, the historical summaries initiated in Folder 6a – "6a TRISWat Jan05 Folder 6a OP Sediment Historical MY04" – are divided into two files per basin (*e.g.*, "1a_Potomac-Shenandoah_Historical_Organophosphorus_Pesticides-1_in_Sediment_04" and "1b_Potomac-Shenandoah_Historical_Organophosphorus_Pesticides-2_in_Sediment_04"). This separate file formatting for OP pesticides and several other groups of analytes from the AMB_TOX group code will be maintained in future TRISWat Reports. Difficulties with standardizing analyte names and codes for the transfer of data from the DCLS LIMS database to DEQ's CEDS database are currently being resolved for organochlorine pesticides, PAHs and PCBs, so reliable data are not yet available for the most recent monitoring year. Annual and historical summaries for these analytes will be added to the TRISWat Reports beginning in January 2006.

Further information about the statewide Ambient Water Quality Monitoring Program is available from Roger E. Stewart at (804) 698-4449 or from Donald H. Smith at (804) 698-4429. Stewart and Smith are environmental specialists at the Richmond Central Office of DEQ's WQMP.

Additional monitoring for pesticides and other toxic organic chemicals, primarily in sediment, is carried out by DEQ's Chesapeake Bay Office in collaboration with EPA's interstate Chesapeake Bay Program, and by the field team from the DEQ Office of Water Quality Standards. These two programs are discussed in more detail later in this report.

New Initiatives in the Ambient Monitoring of Toxics

During 1998 and 1999, a DEQ Water Quality Monitoring Task Force defined the strategies to be applied in the monitoring of the Commonwealth's ambient surface waters during the coming years. Two innovations integrated into the updated 2004 Water Quality Monitoring Strategy have significantly improved DEQ's toxics monitoring program. They involve the probabilistic sampling of surface waters and the monitoring of dissolved toxic organics with SPMDs.

Probabilistic Sampling for the Statewide Characterization of Surface Waters

The freshwater and estuarine sampling programs described in the Probabilistic Monitoring Module of the DEQ WQM strategy include the chemical monitoring of toxic metals and organic compounds in the sediment and the biological monitoring of benthic communities, in addition to the monitoring of conventional water quality variables such as pH, temperature, dissolved oxygen, conductivity or salinity, and nutrients. These probabilistic sampling programs ensure representative monitoring of all of the state's continental surface water resources.

Free Running Freshwaters

In 1999, EPA's ecological laboratory in Corvallis, Oregon, generated and provided DEQ with a list of 700 sites randomly selected from the state's non-tidal, freshwater streams and rivers. This list includes 70 random sites and a similar number of backup sites for each of the first five years of probabilistic freshwater sampling. The sampling of such sites is normally carried out only once, unless the first sampling event identifies a potential water quality problem. In such a case, a special study would be initiated to confirm, and to investigate the severity and geographic extension problem. For an adequate assessment of freshwater benthic communities, however, it was felt that each site should be evaluated in both the spring and in the fall. Biologists from DEQ's regional offices began sampling benthic invertebrates at the first group of these sites in the spring (April - May) and fall (October - November) of 2001. Such probabilistic sampling has continued on an annual basis. During the spring visits to each site, the biologists collect sediment samples for both metals and pesticides analyses, as well as water samples for other traditional water quality parameters (temperature, pH, dissolved oxygen, conductivity, nutrients, chlorophyll, bacteria, etc.). The results from this first year of freshwater probabilistic sampling were summarized in a freshwater probabilistic monitoring report that was completed in January of 2003. That report, "*The Quality of Virginia Non-Tidal Streams: First Year Report*", is currently available on the DEQ WebPages at http://www.deq.virginia.gov/water/probmon.pdf). Additional reports, summaries and presentations related to subsequent years of freshwater probabilistic monitoring are currently available on the DEQ WebPages at http://www.deq.virginia.gov/probmon/#reports. Appendix H2b provides a list of prospective probabilistic monitoring sites to be sampled during the spring and fall of 2005. This list will only be finalized after regional DEQ biologists have performed site reconnaissance and confirmed the suitability and accessibility of the sites.

Tidal Estuarine Waters –

The National Coastal Assessment Program and continued Estuarine Probabilistic Monitoring

In the spring of 2000, DEQ received a grant from EPA for the purpose of conducting probabilistic sampling of estuarine waters as part of the Coastal 2000 Program, later renamed the National Coastal Assessment (NCA) Program. This grant (EPA Assistance Agreement No. R-82854401-0) provided $200,000 per year for the planned five-year (summer 2000 - summer 2004) monitoring program. In support of this program, EPA's Office of Research and Development, Gulf Ecology Division (EPA/ORD/GED - Gulf Breeze, Florida) annually generated a list of 50 primary (plus a number of alternate) probabilistic sampling sites within Virginia's portion of the Chesapeake Bay and tidal tributaries to the bay and to the Atlantic coastline. Sediment chemistry and toxicity samples and benthic community samples were collected and analyzed from each probabilistic site in this program.

The expiration of the EPA grant, without a guarantee of continued federal funding after the summer of 2004, prompted DEQ to design, and procure resources for, a continuing (and hopefully permanent) Estuarine Probabilistic Monitoring Program. Consequently, beginning in the summer of 2005, design elements and financial support from three separate sources will contribute to this program. Some resources to support the collection and analysis of benthic community samples have been reallocated by the Chesapeake Bay Benthic Monitoring Program. Additional resources previously designated for the Ambient Toxicity Special Study Program within major tidal tributaries to the Bay have been reallocated to provide toxicity testing and chemical analyses of sediment samples. DEQ general funds are being added to provide for additional water column monitoring and to complement the geographic coverage of the program (to include coastal as well as Chesapeake Bay drainages). EPA's Office of Research and Development (ORD), Gulf Ecology Division (GED), has graciously agreed to continue providing gratuitous lists of primary and alternate probabilistic sites. An advanced list for the summers of 2005 through 2009 has already been requested.

Sampling during 2005 and subsequent years will continue to concentrate on minor tidal tributaries to the Chesapeake Bay, to Atlantic coastal waters of the Delmarva Peninsula, the southern Virginia coastline, and Back Bay/North Landing River, since the CBP adequately monitors toxics in the Bay mainstem and its major tidal tributaries (James, York, Rappahannock and Potomac Rivers). The selection of probabilistic sites for this program will follow the same guidelines as utilized for the past four years, concentrating on minor tidal tributaries with a 70% - 30% distribution within the Chesapeake Bay watershed and coastal drainages, respectively.

Appendix G-2 provides complete lists of the DEQ Coastal 2000 / NCA probabilistic stations sampled during the summers of 2000 through 2004. EPA has not yet provided the list of prospective stations for the summers of 2005 through 2009.

Monitoring Dissolved Toxic Organics with SPMDs

The newly developed probabilistic monitoring design and new methodologies for the sampling and analysis of dissolved metals have greatly enhanced statistical evaluations of the differences among watersheds and drainage basins, as well as providing a mechanism for improving the understanding of regional trends in the concentrations of toxic metals.

Traditional monitoring for toxic organic compounds has been confined to fish tissue and sediment samples in recent years. State statutes require the monitoring of fish tissue, and such monitoring will continue as described below. Fish tissue monitoring is an important program, as its purpose is to protect human health by preventing the consumption of contaminated fish. Sediment monitoring is useful to determine the movement and redistribution of toxics within and between the water column and the sediment, as well as for locating and identifying the sources of contamination.

Both fish tissue and sediment monitoring are important tools for the detection of toxic compounds, but both approaches have limitations.

1. Because fish are mobile, fish tissue analyses often may not accurately reflect spatial or temporal variations in water concentrations from a specific site. Furthermore, different fish species uptake, metabolize and depurate the toxic organic compounds at different rates. Some of these losses are significant enough to yield non-detectable concentrations of target compounds in their tissues.
2. Sediment may suffer loss of analytes because of their chemical reduction and/or oxidation. Sediment erosion and deposition rates are often highly variable, thereby creating confusing temporal and microgeographic variations. An additional factor that weakens the use of sediment toxics data is that sediment standards based on national criteria are not yet available.

Historically, the analysis of toxic organic compounds directly from ambient water has seldom been used because of the typically ultra-low concentrations present (picograms or billionths of a gram per liter - pg/L) and the inability of routine analytical instrumentation to detect contaminants within these low ranges. However, over the past 10 years, the U.S. Geological Survey (USGS) has developed a cost-effective sampling technique for trace organics in the water column using Semi-Permeable Membrane Devices (SPMDs) that can efficiently sample low concentrations of a large number of toxic organic compounds, including pesticides.

Purified lipids within semipermeable membranes are capable of absorbing and concentrating numerous dissolved organic substances from the water column, analogous to the uptake of such chemicals by animal tissues. SPMDs are specially prepared, thin-walled, high-density polyethylene tubes containing the ultra-purified fish oil triolein. Using the same mechanism through which fish uptake dissolved organic compounds by interchange at the epithelial cell layer, SPMDs uptake dissolved contaminants through the thin, porous plastic and into the triolein keeper solvent.

SPMDs are mounted in protective cages and exposed to sample water by direct deployment in the field for periods of up to 30 days. They consequently provide an integrated average of toxics concentrations over the whole sampling period.

SPMDs have several advantages over traditional sampling methods:

1. The results are representative of the waters at a specific site.
2. There is no loss of target analyte through metabolism or depuration.
3. Unlike grab samples or short-duration filtered samples, they are integrative because they are deployed for up to a month at a time.
4. Their use is considered a trace enrichment procedure because of the long duration of deployment. At typical background concentrations, trace organics are taken up in large enough quantities to be well above analytical detection limits by the time deployment is suspended.
5. They represent the dissolved phase of the contaminants, which is considered to be the toxic component and for which water quality standards exist.

6. Their extracts also can be used in estrogen assay studies to determine a relative endocrine disruption factor. Endocrine disrupters comprise a group of compounds not yet identified by national criteria. A number of studies have identified severe impairment in native fish species due to anthropogenic compounds that exhibit endocrine functions.

DEQ has recently developed this SPMD technology, for use in both fresh- and saltwater environments, through a two-year pilot program conducted by the Office of Water Quality Monitoring and Assessment. The results have been used to develop SOPs, followed by training of field personnel in the deployment and recovery of SPMDs for use in the probabilistic module of the DEQ Surface Water Monitoring Strategy and, when appropriate, in additional special studies. At the present time, the high costs of material, labor and analyses (~$5,000 per site for complete analyte analyses) limit their use in widespread monitoring programs such as the watershed monitoring network.

In 2002 EPA awarded a two-year, $250,000 probabilistic monitoring grant to DEQ. This grant money was consolidated into a single one-year study and used to provide SPMD sampling at 50 of Virginia's probabilistic monitoring sites in free-running fresh waters during the spring and fall of 2003. These SPMDs were initially deployed during April or May and were recovered approximately 30 days later. Because of the uncharacteristically abundant rainfall and flooding during the period, a number of the SPMDs were lost, damaged or destroyed. Consequently, during the fall (September-October) of 2003 sixteen replacement SPMDs were deployed at the sites where the originals were lost during the spring. All SPMDs were recovered after approximately 30 days of deployment and the samples were sent to the USGS Environmental Research Center Laboratory in Columbia, Missouri for extraction and analysis.

Because of the laborious and time-consuming processes of extraction and precision analyses of the trace organic compounds, the final results from sampling carried out during the spring and fall of 2003 are still not available, and will consequently be discussed in the January 2006 Toxics Reduction in State Waters Report. The toxic organic parameter list from the SPMDs contains essentially the same suite of analytes as was analyzed for during the SPMD estuarine pilot study in the Elizabeth River (USGS, 2001), and is comparable to the new suite of organic analytes that DCLS is now analyzing in sediment samples collected under the AMB_TOX group code.

SPMDs are currently being employed in several TMDL special studies related to the concentration, distribution and source identification of PCBs in ambient surface waters. In such studies, a reduced suite of analytes (only PCB isomers and total PCBs are quantified) has significantly reduced analytical costs per sample. More details on PCB special studies employing SPMDs can be found in the section on "Special Studies Concerning Toxics", below.

Expanded Organic Toxics Monitoring in the Sediment

Beginning with freshwater probabilistic monitoring sites in the spring of 2003, the Ambient Water Quality Monitoring Program has employed a new parameter group code for the determination of organic contaminant concentrations in the sediment. The Division of Consolidated Laboratory Services (DCLS) of the Virginia Department of General Services has adopted new technologies and methodologies, with significantly lower detection limits. Rather than using the "PES1S" parameter group code employed in the past, DEQ has started utilizing a new group code, "AMB_TOX", as summarized below. This will expand the number of organic compounds monitored from 13 to at least 115. The current parameter group code and its analyte list has been included in Table 1 - "DCLS Toxics Group Codes and Costs MY04" with this report, and in Text Table 3 above, but may still be modified prior to taking its final form.

Group Code	Description
AMB_TOX	**OC & OP pesticides; PCBs; Semi-Volatiles; Herbicides in sediment** **Price: $1402.26** **Turn-around Time: 54 days**

The cost of this organics analysis is currently estimated to be approximately $1402 per monitoring site, although it may change with the addition or removal of analytes, and increasing the total number of samples analyzed may reduce the costs for individual analyses.

The relocation of the DCLS laboratories to their new building during the spring and summer of 2003, and technical difficulties with their analytical equipment and LIMS database resulted in the loss of samples and/or analytical results from the spring 2003 sample collection. Sediment samples were consequently recollected during the fall visits to DEQ's freshwater probabilistic monitoring stations, and various resultant data are included in this, the January 2005 Toxics Reduction in State Waters Report. Database communications problems between the DCLS LIMS system and DEQ's CEDS system are still being resolved, but complete transfer of all data should soon be accomplished.

Statewide PCB Strategy

In 2004 the Virginia Department of Health (VDH) changed the trigger level at which they issue fish consumption advisories for polychlorinated biphenyls (PCBs) from 600 ppb to 50 ppb in edible fish tissues (http://www.vdh.virginia.gov/hhcontrol/fishing_advisories.htm). On a statewide basis, this significantly increased the quantity of VDH fish consumption restrictions and advisories in effect for Virginia waterways. DEQ had already used a 54 ppb screening value to assess fish tissues for its 2002 and 2004 303(b)/305(d) Water Quality Assessment Reports, so the VDH expansion in fish consumption advisories included many of those waters previously assessed as impaired for PCB contamination in fish. In addition to reevaluating historical DEQ data, however, VDH also included the most recent data collected by the DEQ in generating its most recent listing of fishing advisories. These data were not available at the time of the 305(b) assessments and 303(d) listings for the 2004 Report, so the VDH fish consumption advisories issued in 2004 may include additional waters not currently on the DEQ list of impaired waters. Those additional waters will be included in the 2006 assessment and listing process.

Over the past several years, DEQ staff has initiated a number of studies under its Toxics Contamination 'Source Assessment Policy' to determine the sources of PCBs found in fish tissue. In following that Policy, as well as the agency's 'Guidelines for Use of the Virginia Environmental Emergency Response Fund' (VEERF), these studies were approved for funding through VEERF. Since 1999, the Department has also been using the Total Maximum Daily Load (TMDL) program to address water quality impairments in state waters. The Agency has completed one TMDL study for PCBs and is in the process of developing several others.

TMDL studies identify the sources of pollution and the reductions needed from the identified sources to attain water quality standards. Pollution from both point sources such as residential, municipal, or industrial discharges and non-point sources such as residential, urban, or agricultural runoff are included. TMDL studies are based on monitoring data, and require source identification as well as the quantification of each source's contributions. Once the required pollutant reductions are identified, a cleanup plan is developed that identifies specific corrective actions, and their costs and benefits as well as timelines to restore water quality.

DEQ anticipates that additional agency monitoring, as well as VDH's change to the PCB trigger value, will result in the identification of more PCB-impaired waters throughout the Commonwealth, and that the additional advisories will impact the Agency's current programs at a time when there are limitations in both financial and human resources. Consequently, DEQ is elaborating a 'PCB Strategy for the Commonwealth of Virginia.' This strategy will provide a framework for agency use in implementing the Toxic Source Assessment Policy protocols in surface waters identified as contaminated by PCBs and for applying environmental management programs such as the TMDL and Voluntary Remediation programs. The draft strategy is currently under internal agency revision and will be published for public comment at some time in the near future.

Specialized Fish Tissue and Sediment Analyses

The collection of fish for fish tissue analyses is expensive and requires specialized sampling techniques, equipment, and training. A field team from DEQ's central Office of Water Quality Standards periodically samples all nine of Virginia's significant river basins (14 sub-basins) on a five-year, rotating schedule, as well as carrying out other relevant special studies. Sediment samples from the same sites are routinely collected at the same time.

Most samples, both fish and sediment, from this program are frozen until the end of the sampling season and sent to scientists at the Virginia Institute of Marine Science (VIMS – Gloucester Point) and the College of William and Mary (Williamsburg) for chemical analyses. Accumulating large numbers of samples prior to initiating analysis is convenient for the responsible laboratory, which will perform a number of identical analyses at the same time. Periodically reorganizing laboratory procedures for intermittent analyses during the monitoring year would be inefficient and more conducive to procedural errors, and would reduce the comparability of analytical results among river basins. The current procedure, however, often results in significant delays between the time of sampling and the availability of the resultant data for assessment, as well as for the dissemination of the information.

Appendix G-1 lists and identifies the stations where the WQS field team planned to sample fish tissues and sediments during the summer of 2004. (The normal summer sampling season spans parts of two consecutive monitoring years.) The results from these sediment and tissue samples will subsequently be compared with the screening values listed in Appendices D and E, respectively. Tables 7a 1 - "Fish Metals WQS MY2003" (Rec'd 2004), Table 7a 2 - "Fish PCBs WQS MY2003" (Rec'd 2004), Table 7a 3 – "Fish Pesticides WQS MY2003" (Rec'd 2004), and Table 7a 4 - "Fish PAHs WQS MY2003" (Rec'd 2003) summarize the most recent results from fish tissue samples in relation to the EPA-IRIS screening values. Table 7b 1 - "Sediment Metals WQS MY2003" (Rec'd 2004) summarizes the metals results of sediment samples from the same period, in relation to the NOAA ER-M and/or consensus-based PEC screening values. Table 7b 2 - "Sediment PCBs WQS MY2003" (Rec'd 2004) summarizes sediment PCB results from the same samples. The analyses of some samples collected in the summer of 2003 may not yet be complete. The majority of the results from sampling during the summer of 2004 should be available for next year's Toxics Reduction Report.

Additional information on the fish-tissue/sediment monitoring program is available from Alex M. Barron, Office of WQS at (804) 698-4119. Several reports on fish tissue and sediment monitoring by the Office of WQS can be found on the DEQ WebPages at http://www.deq.virginia.gov/fishtissue**.**

A few additional special studies and reports related to toxics in the water column, in sediment, or in fish tissues are discussed elsewhere in this document and are listed in Appendix I – “Special Studies Related to Toxics (MY2004)”.

Permitted Discharges and Toxics Monitoring of Permitted Facilities

Both private and public facilities that discharge effluents into the state’s waters are required to obtain permits from the State Water Control Board. The Virginia Pollutant Discharge Elimination System (VPDES) requires the establishment of limitations for such permits to ensure that Virginia's water quality standards are not violated in the water bodies receiving such discharges. These standards require that the state’s waters be free from toxic compounds in toxic amounts. The water board adopted a toxics management regulation (TMR) in 1988 and amended it in 1996 (VAC 250-31-220) to incorporate more recent federal terminology and to simplify the regulatory structure.

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 upon evaluations done by the TMP, some permits may include Whole Effluent Toxicity (WET) limits, which require additional biological testing of effluent toxicity. The specific requirements for testing effluent toxicity criteria (both chemical and biological), for compliance self-monitoring, and for toxics reduction evaluation (TRE) are included in the Water Permit Program's guidance documents.

DEQ chemically samples in-pipe concentrations of specified substances on both scheduled and surprise inspections at all permitted facilities. When permits include WET limits, the facilities themselves are also required to perform toxicity tests on their effluents 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 the self-ministered toxicity monitoring tests for consistency and compliance status and takes the appropriate measures, when necessary, to ensure complete compliance.

Appendix J - “Facilities with Toxics Parameter Limits MY04” of this report lists facilities that currently have or have applied for permits with limits on the quantity or concentration of discharged toxics in their effluents. The same spreadsheet includes their respective addresses, geographic locations, receiving streams, etc. The effective limits (when specified) and reporting frequencies for toxics may vary, depending upon the chemical parameters involved. In some cases, a permit may have been modified, reissued, or adjusted in terms of the current limits within the past year. The current toxics parameters included in each permit, along with their limits and required reporting frequencies, are listed in Appendix K – “Permitted Parameters Limits and Units MY04,” along with the effective dates of each permit. The compliance record of each permitted facility during the 2004 monitoring year is reported in Appendix L – “Permitted Toxics Parameters Compliance MY04.”

Some facilities may hold permits requiring only that they report, without a limit-specified value with which they must comply. Since they do not have a numeric value limit, they cannot be used for compliance testing. In the CEDS database, the limit may be an actual value, it can be blank, have "NL" for No Limit, or have "*********" for not required to report. Appendix L – “Permitted Toxics Parameters Compliance MY04” lists the most recently reported data (1 Jul 2003 – 30 Jun 2004) for those facilities with limits and reporting requirements on the quantity or concentration of toxic parameters, as provided in their Discharge Monitoring Reports (DMRs).

Further information on the compliance of permitted facilities with toxic substances in their discharges can be obtained from the appropriate Regional Office Compliance Auditor, who reports to the Regional Water Compliance Manager. In most regional offices, Deputy Regional Directors (see list below) have assumed the role and responsibilities of what was formerly the Compliance Enforcement Manager. The position (and title) of Compliance Enforcement Manager has now been eliminated.

Regional Office Compliance Auditors and Deputy Regional Directors

Regional Office	Compliance Auditor	Deputy Regional Director
Northern Virginia	**Christine Monroe** (703) 583-3844	**John Bowden** (703) 583-3880
Piedmont	**Patrick Bishop** (804) 527-5127	**James Golden** (804) 527-5052
Southwest	**Ruby Scott** (276) 676-4882	**Dallas Sizemore** (276) 676-4842
South Central	**Nonna Heagy** (434) 582-5120 Ext. 6019	**David Miles** (434) 582-5120 Ext. 6028
Tidewater	**Debbie Kay** (757) 518-2127 **Maria Nold** (Enforcement Manager) (757) 518-2173	**Harold Winer** (757) 518-2153
Valley	**Brennon Wion** (540) 574-7826	**Larry Simmons** (540) 574-7810
West Central	**Tammy Rogers** (540) 562-6776	**Norm Auldridge** (540) 562-6870

Special Studies Concerning Toxics:

Special studies that dealt with toxics during MY2004 are listed in Text Box 2 below. In the past, such special studies often were initiated independently at the Regional Office level in response to locally recognized problems. Consequently, it was often necessary to canvas the planners and monitoring coordinators at all Regional Offices to construct a comprehensive, centralized list of special studies. Although each newly initiated special study is now recorded in the CEDS database, a survey query to all Regional Office monitoring coordinators still serves to confirm that the list is complete, and to identify additional special studies that are still in the planning stages. The contents of Text Box 2 were obtained in this way.

Appendix I - "Special Studies Related to Toxics - MY2004" describes several of these studies in more detail, and interim or final reports on some are also available on the DEQ Website at http://www.deq.virginia.gov/water/reports.html. The names and contact information for the responsible individuals at the Regional and/or Central Office levels are provided in Text Box 2 as well as in the Appendix.

Northern Virginia Regional Office

NVRO performed toxicity sampling for benthic TMDLs in April 2004 on South Run in Fauquier County, two locations on Bull Run, and Popes Head Creek. These streams are all located in the Occoquan River watershed. All samples were sent to the U.S. EPA laboratory in Wheeling, West Virginia. No bioassay data are yet available for these sampling events.

In cooperation with the U.S. Army Corps of Engineers, Norfolk District, the Lake Anna Civic Association and other partners, NVRO developed a monitoring plan to investigate sources of PCB's and characterize potential metals contamination in Lake Anna. The monitoring plan was developed during monitoring year 2004, and was implemented August through October of 2004. The monitoring plan entailed sediment sampling and water column sampling through the use of semi-permeable membrane devices (SPMDs) throughout the lake and selected stream tributaries.

For further information on toxics monitoring in the Northern Virginia Region, contact:

Bryant Thomas
DEQ – Northern Virginia Regional Office
(703) 583-3843

Piedmont Regional Office

1. PCB Source Assessment in the James River, Richmond, VA, to Windmill Point, VA – 2002
A tiered study was begun in 2002 to localize the sources and determine the geographic distribution and severity of Carp and Blue catfish contamination by PCBs in the lower James River. DEQ sampled 59 stations between March and November 2003. Five tidal sites contained sediment PCBs in excess of the Effects Range – Medium screening value of 180 ppb. Nine non-tidal sites contained sediment or soil PCBs in excess of the Consensus Based Probable Effects Concentrations (PEC) of 676 ppb. DEQ reported to the USEPA Region III Hazardous Materials Cleanup Division on July 7, 2004, that one site at SIMS Metals exceeded the USEPA clean-up requirement of 50 ppb. DEQ stopped further sampling for the study pending development of a Statewide PCB Source Assessment policy.

2. PRO performed toxicity sampling for benthic TMDLs in April 2003 on the UT to Chickahominy River below a poultry processing plant and on Roses Creek below a municipal STP. For the UT to Chickahominy River both Ceriodaphnia reproduction and fathead minnow growth indicated a biologically adverse effect. No adverse impacts were noted in Roses Creek.

3. PRO started monitoring for the Dragon Swamp / Piankatank River Hg Source Assessment study in July 2004. Monitoring will continue for one year. The study also includes one year of atmospheric Hg monitoring at Harcum, VA. Results are pending.

4. PRO started toxicity testing for the Spring Branch Benthic TMDL in November 2004. Results are pending.

For further information on the status, results, reports, etc., of projects in the Piedmont Region contact:

Mark S. Alling
DEQ – Piedmont Regional Office
(804) 527-5021

Text Box 2. Toxics Related Special Studies Active during MY 2004.

South Central Regional Office

Results from toxicity testing carried out in 2003 for benthic TMDL development are summarized in Appendix I. No additional toxics-related special studies were carried out in the South Central Region during MY2004. PCB studies in the Roanoke River will probably begin in 2005, considering that the problem will likely will be addressed by a TMDL no later than 2006.

For additional information on toxics monitoring in the South Central Region, contact:

Kyle Winter
DEQ – South Central Regional Office
(434) 582-5120

Southwestern Regional Office

Additional information on several of the studies listed below is provided in Appendix I.

1. **Bluestone River**; PCBs:
   a. Fall 2003 through summer 2004; Stakeholder survey, Public Meetings for PCBs, & source assessment.
   b. Oct. 2003; BVWTP fish & sediment;
   c. 2004 - High & low flow SPMDs joint with USGS, EPA, WVDEP, WVDHHR, VDH (potential for future tests to include drinking water source assessment for both low level PCBs and ultra low level Dioxins);
   d. Spring & summer 2004; Sediment; joint with EPA/WVDEP.
2. **Southwestern VA Fish Hatcheries Study** - PCBs. (Winter 2004)
3. **Knox Creek** - PCBs:
   a. Oct. 2003; Fish rodeo trout stocking habitat study; Sediment and Fish; and
   b. Summer 2004; Sediment and Fish; VDH request for further info on water impaired for fish consumption.
4. **Levisa Fork** - PCBs in Sediment and Fish (2002)
5. **Beaver Creek** – PCBs (2003)
   a. Fall 2003; Survey; Public meeting; and
   b. Summer 2004; Sediment and Fish.
6. **Guest River** - PCBs in Sediment and Fish (2003)
7. **Bioassays Chronic** - Benthic TMDL - MY 2005 (These are being sampled in November 2004.)
   a. Knox Creek
   b. Pawpaw Creek
   c. Garden Creek
   d. Stock Creek
   e. Laurel Fork
   f. Chestnut Creek
8. **Bioassays Chronic** - Benthic TMDL - MY 2004 (Fall 2003)
   a. Clinch River
   b. Beaver Creek
   c. Guest River
   d. Lewis Creek
   e. Three Creeks (Hutton, Hall, Cedar and Byers Creeks)
9. **Bioassays Chronic** - Benthic TMDL - MY 2003 (Spring 2004)
   a. Hunting Camp Creek
   b. Middle Creek
   c. Russell Prater Creek
   d. Straight Creek
   e. North Fork Powell River
   f. Callahan Creek
10. **Holston** - Mercury TMDL (2005)

For additional information on toxics monitoring in the Southwestern Region, contact:

Frederick W. Kaurish
DEQ – Southwestern Regional Office
(540) 676-4840

Text Box 2. (cont.) Toxics Related Special Studies Active during MY 2004.

Tidewater Regional Office

Toxics-related studies in the Elizabeth River Basin are summarized in the body of this year's TRISWat Report.

For further information on the status of these projects, results, reports, etc., contact:

Roger K. Everton
DEQ – Tidewater Regional Office
(757) 518-2150

Text Box 2. (cont.) Toxics Related Special Studies Active during MY 2004.

Valley Regional Office

1. **Collection and Analysis of Fish Tissue for Mercury Content - South River and South Fork Shenandoah River - Spring 2002.** This monitoring project is the continuation of an ongoing DEQ mercury-monitoring program. Results of this effort were received in 2003 and are available at http://www.deq.virginia.gov/fishtissue/pdf/mercury2002.pdf. Data from the 2002 sampling did not result in any changes to the existing fish tissue health advisories in the South River and South Fork Shenandoah River. The next round of fish tissue sampling will occur in the spring of 2005.

2. **Water Sample Collection and Analysis for Mercury in the South River and South Fork Shenandoah River, Virginia.** This monitoring project is also the continuation of an ongoing DEQ mercury-monitoring program. Mercury was released to the environment in the South River in Waynesboro during the first half of this century from a manufacturing process at the E.I. DuPont plant. In a 1982 settlement between DuPont and the State Water Control Board, a fund was established to support monitoring of water, sediments, and fish tissue in the river system for a projected 100-year period. Monitoring through the 1990s rarely detected measurable amounts of mercury in water, due to analytical constraints. With the development of more sensitive techniques ("clean" metals sampling and analyses), quantifiable levels are now routinely recorded. Since 2001, DEQ staff collects total and dissolved mercury samples from sites on the South River and South Fork Shenandoah River bimonthly.

3. **South River Science Team.** DEQ staff is coordinating with members of the South River Science Team on a number of surveys in which data are gathered for water, sediments, floodplain soils, and biota in and along the South River. The South River Science team is comprised of representatives from industry; academic institutions; state and federal agencies; environmental groups; and independent researchers. This group meets every two months to coordinate efforts, collaborate on future work, and communicate results. Ongoing studies address mercury source identification, fate and transport, methylation processes, and ecological processes. This group is also working closely with the South River TMDL development team (DEQ and USGS) to ensure that all available data are used in assessment and modeling efforts.

4. **Lewis Creek TMDL Toxics Study**. Lewis Creek in Staunton, Virginia is on Virginia's 303d list of impaired waters for violation of the general aquatic life standard as assessed by benthic bioassessments. In previous sediment testing in Lewis Creek, mercury, chlordane, and 5 specific poly-aromatic hydrocarbon (PAH) compounds were found in concentrations above probable effect levels for aquatic organisms. DEQ is beginning a Total Maximum Daily Load (TMDL) study in Lewis Creek to address the benthic impairment. As a part of this study, sediment from 13 monitoring stations on Lewis Creek and its tributaries will be tested for mercury, PCBs, PAHs, and organochlorine pesticides. These constituents will also be measured in water column samples during base flow and storm flows. Testing will identify the extent and severity of contamination and help to locate potential sources. In addition, sediment toxicity tests will be conducted to determine if the identified toxics are responsible for the benthic impairment.

Contacts: South River Mercury:
Don Kain
DEQ - Valley Regional Office
(540) 574-7815

Lewis Creek and South River TMDLs:
Robert Brent
DEQ - Valley Regional Office
(540) 574-7848

Text Box 2. (cont.) Toxics Related Special Studies Active during MY 2004.

West Central Regional Office

1. The "Special Study of PCB Source Assessment in the New River, Radford, VA to the VA/WVA State Line - 2003" was initiated from the West Central Office in 2003. An inventory of facilities considered possible sources of PCBs was conducted from January through May 2003, and some site inspections and terrestrial sampling were conducted from June through September (see Appendix I). Further activities will depend upon the results of the sampling, which are not yet available.

2. A TMDL has been completed in Peak Creek that calls for reduction of copper and zinc loads in the watershed. The copper and zinc are believed to be from the allied superfund site located in the watershed. WCRO TMDL staff has been working closely with waste division staff and EPA Region III to get the site's cap repaired and metal hot spots removed from the site. More information on EPA's Region III response and timelines should be available in the near future.

   For further information on the status of the New River PCB project, results, reports, etc., contact:

   Kip Foster
   DEQ – West Central Regional Office
   (540) 562-6782

   For additional information on toxics-related TMDLs contact:

   Jason Hill
   DEQ – West Central Regional Office
   (540) 562-6724

Additional Special Studies Involving Toxics

1. **Elizabeth River Project** - Multiple sampling efforts have been involved in this extensive project (dissolved and total clean metals, dissolved organics – SPMD sampling, tributyltin sampling, and others). DEQ carries out some efforts and contracts out others. This project is discussed in more detail elsewhere in this report. The most recently released reports from the project are listed there, as well as in the References section of this TRISWat Report

   The Elizabeth River Project has also suffered from recent reductions in the resources available for ambient monitoring. This has been especially true of expensive analytical costs associated with the chemical analyses of toxics, and several aspects of the program have been at least temporarily suspended..

   For further information on the status of the project, results, reports, etc., contact:

Text Box 2. (cont.) Toxics Related Special Studies Active during MY 2004.

DEQ's CEDS 2000 database now includes a module that registers and tracks the progress of all special studies as they evolve. All special studies receive a unique, system-generated identification code that is maintained in a table along with a short title for the study. A Special Study Codes Screen (Text Figure 1 below) is linked to a Key Words Search function to identify all special studies related to a desired topic (e.g., toxics, metals, pesticides, etc.). The resultant Query lists the codes and short titles of all studies cross-referenced under the key words in the query, together with a "Detail" option that facilitates calling up further information about the study. The Special Study Detail Screen (Text Figure 2) provides the complete descriptive title of the study, a complete list of associated key words, links to the study's project plan and other documents (such as interim and/or final reports), and up-to-date lists of monitoring stations, parameter group codes, numbers of samples, and total analytical costs of the project.

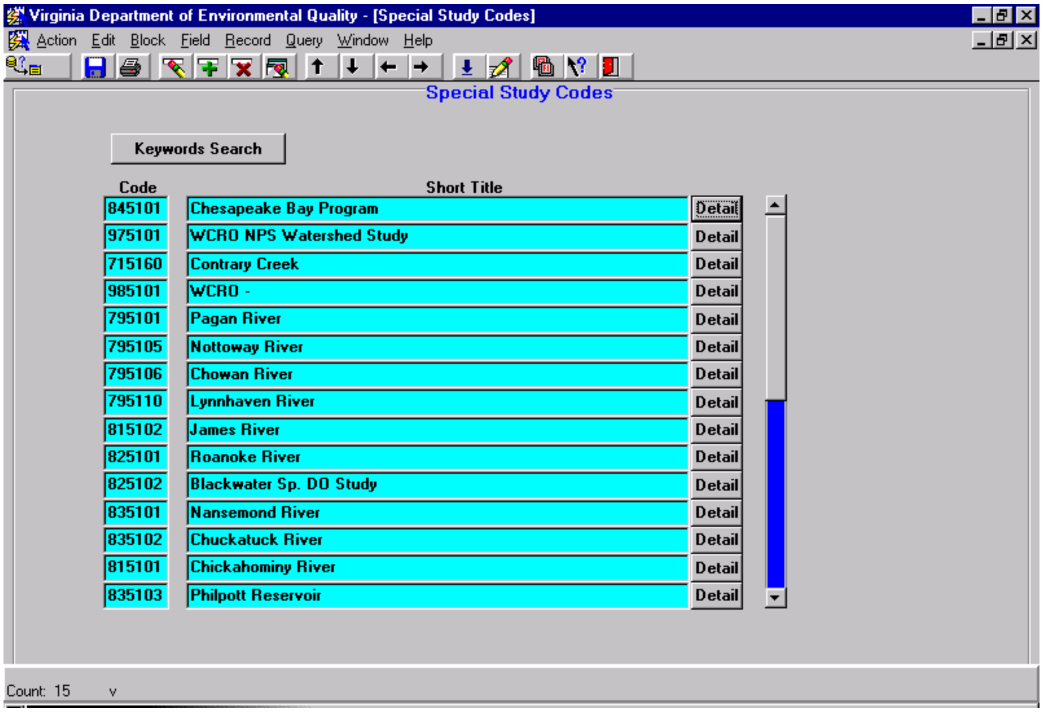
Now that final adjustments have been made to the formatting, the final installation of this module into the production database has been carried out. Its use is now required for the proposal, approval, and execution of all future special studies. All intermediate and final reports, sampling and analysis protocols, quality assurance plans, responsible personnel, and so on, that are associated with the study will be electronically linked to it in the CEDS database to facilitate the complete retrieval of all related information.

Benthic TMDL Special Studies Involving Toxicity Tests

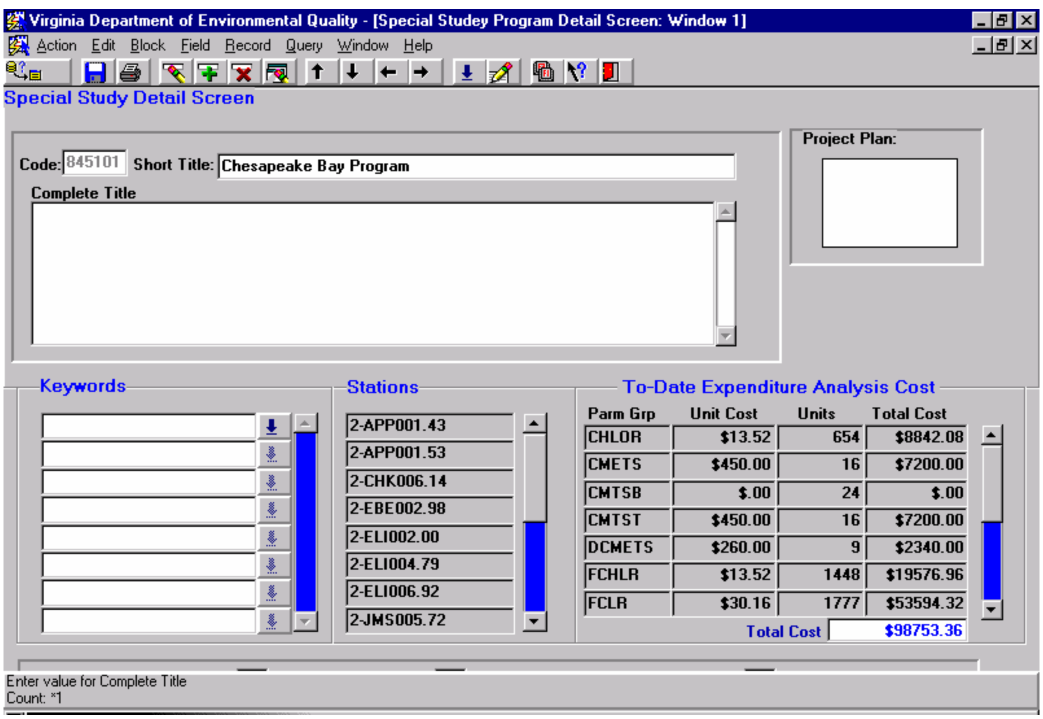
In many cases, determining the cause of benthic impairments can be quite difficult. A number of stressors, including toxicity, sedimentation, eutrophication, the introduction of non-native fish species, and other forms of habitat modification may be involved. Because toxics must be considered as one possible cause of benthic impairments, water samples have been collected and shipped to the EPA Laboratory in Cincinnati, Ohio, for toxicity testing related to TMDL studies of a number of stream segments impaired for benthic organisms since November of 2002. Lists of TMDL studies scheduled for 2003 through 2006 can be found linked to DEQ's TMDL Homepage at http://www.deq.virginia.gov/tmdl/homepage.html. The type of impairment, whether benthic or for specific toxic parameters (e.g., PCBs), can be identified in the linked tables. The ten-year implementation plan for DEQ's TMDL Program can be accessed from the same web address.

Appendix N, "Impaired Segments Selected for Toxicity Testing 2004", lists those benthic-impaired segments where toxicity tests were scheduled to be performed during the 2004 calendar year. Final results are yet available from these tests.

For further information on the results of specific TMDL-related toxicity tests contact the individuals listed in the two appendices or, for more general information, contact Jutta Schneider at DEQ's Central Office in Richmond (804) 698-4099.



Text Figure 1. The Special Study Codes Screen Developed for the Special Studies Module of DEQ's CEDS 2000 Database.



Text Figure 2. The Special Study Detail Screen Developed for the Special Studies Module of DEQ's CEDS 2000 Database.

The MY2004 Water Quality Monitoring Plan

The Annual Water Quality Monitoring Plan (or MonPlan) is generally elaborated in the first quarter of each calendar year and is usually finalized by early April. The MonPlan provides a complete list of the ambient WQM stations that will be actively sampled during the following monitoring year (1 July - 30 June). The MonPlan identifies specific programs associated with each site, the parameters that will be measured there, the number of samples that will be collected, and the frequency of sampling. The MonPlan also provides the information necessary to estimate the resources required for the following year's monitoring efforts and to advise the state's Division of Consolidated Laboratory Services in advance of the human, technical, and chemical resources that will be necessary for analytical purposes. In addition, it provides a convenient overview for the monitoring coordination group at DEQ's Central Office to evaluate the consistency of site and parameter selection among the agency's seven regional offices.

The annual Monitoring Plan for MY2005, which began on July 1 2004, is in a new format, because the vast majority of the information that it contains is now queried directly from the CEDS database in the form of a report, rather than requiring independent manual entry of the information by Regional Office monitoring personnel. Each year the annual Monitoring Plans are posted on the DEQ Website at http://www.deq.virginia.gov/watermonitoring/. The new plan for MY2006 will be finalized during the winter/spring of 2004/2005, and should be available at the DEQ Website address by mid-April 2005.

Evaluation of Trends in Toxics Concentrations in State Waters

The distribution of toxic materials in ambient surface waters, and especially in sediments, is heterogeneous in both space and time. This is so for numerous reasons. The problem of extremely low concentrations of dissolved toxics in the water column and the inherent difficulties of sampling and analysis have already been mentioned. In addition, 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 often not documented, especially at the low frequency at which toxics are normally sampled and analyzed, and the representativeness of the specific point in time that the sample was collected may be questioned. 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 (e.g., Zipper et al., 1998).

The concentrations of toxics within a specific unit of sediment may be more stable in terms of time, 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, and the organics precipitate into the underlying sediments of more slowly moving waters, where they and the bound toxics may accumulate in relatively concentrated, localized deposits. 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 or date of such deposition is 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. Very careful sampling, done by taking sediment cores and isolating the various strata of sediment for separate analyses, may reveal temporal trends in toxics concentrations. Determining the appropriate time scale, however, is very difficult, and the whole process is extremely 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 available historical database is not amenable to trend analyses. These factors can never be eliminated, but taking them into consideration can lead to more efficient sampling methods and better statistical evaluations that minimize their effects. DEQ's WQM staff is currently evaluating these factors. Periodic wide-scale probabilistic sampling of sediments, water, and biological communities will provide reliable statistical descriptions of regional conditions that can be compared from one sampling cycle to the next. Among the additional strategies being developed is the use of sampling devices such as the SPMDs mentioned above, which concentrate organic toxics and integrate concentrations over time (typically a 30-day period). The association of trend monitoring stations with USGS and DEQ gauging stations, to compensate for variations in flow rates and the consequent dilution of toxics in the water column, will also significantly improve sampling resolution. Once applied, these strategies will provide the data for more reliable mid-term and long-term trend analyses.

The historical water and sediment quality Figures in Folders 3 through 6 present graphical summaries of the statistical descriptions presented in Tables 3 through 6, basin by basin. Historical variations of water quality parameters within drainage basins (1997 through 2004) can be evaluated from these figures. As indicated earlier in the discussion of pesticide results, however, graphical comparisons can be misleading unless all pertinent information is considered.

The figures are presented as an example of how trends can be evaluated graphically when sufficient representative data are available. The six (or fewer) years of data included in the figures represent only a single five- to six-year cycle of toxics monitoring. Although the time series is still too short to allow perception and evaluation of long-term temporal trends, it is possible to evaluate differences among groups of stations (consecutive years) within the same drainage basin. In many instances, the low concentrations of toxic substances, near or below the detection limits of the methodologies used for sampling and analysis, result in graphs with no perceived variation among samples. The formal evaluation of trends is impossible under these conditions. In other cases, however, variations are sufficient to suggest micro-geographical differences within the same basin.

The 2004 305(b)/303(d) Water Quality Assessment Integrated Report

The 2004 305(b)/303(d) Water Quality Assessment Integrated Report was made available for public comment from March 22, 2004 through April 23, 2004. Comments were received from the public and the United States Environmental Protection Agency (EPA). In response to comments, the report was revised and resubmitted to EPA in August 2004 and later approved. EPA has recently (mid-November) indicated that a few general comments on the 305(b) Report are forthcoming. The total report, including interactive maps, is available on the DEQ Water Quality Assessment WebPages at http://www.deq.virginia.gov/wqa/ir2004.html. The Assessment Guidance Manual for this report can also be accessed from the DEQ Website at http://www. deq.virginia.gov/waterguidance/pdf/042006.pdf. Preparation of the 2004 report was somewhat delayed due to EPA's requirement for the inclusion of a newly developed Benthic Index of Biotic Integrity (B-IBI) for assessment of Chesapeake Bay probabilistic benthic monitoring results. Consultations among EPA Region 3, the Interstate Chesapeake Bay Program, the states of Maryland and Virginia, and VERSAR Consulting (Columbia, MD), from January through

October 2003, resulted in consensus on a standardized benthic assessment protocol that was utilized by both states in their 2004 305(b) Reports.

Appendix M - “List of Segments not Fully Supporting Designated Uses because of Toxics (2004)” of the current Toxics Report presents a comprehensive list and description of all water-body segments that were assessed as impaired because of toxics for the 2004 305(b)/303(d) Report. More detailed Fact Sheets related to each impaired segment can be accessed through the ‘Fact Sheet Search’ function on DEQ’s TMDL WebPages at http://www.deq.virginia.gov/tmdl/searchfs.html. Use the ‘Waterbody Id for Search Function’ value in the first column of Appendix M to facilitate the search for specific fact sheets. Text Box 3 (below) summarizes the total statewide impairments due to toxics, by pollutant, within specific water resource types.

Preparation of the Assessment Guidance Manual for the 2006 305(b)/303(d) Report has already begun. Among the toxics-related subjects that will be included are modified assessment methods for Aquatic Life Designated Use (ALU) in minor tidal tributaries using the sediment quality triad (SQT) of Benthic IBI score, sediment toxicity test results and sediment chemical analyses. ALU assessment in Chesapeake Bay drainages will be complemented with the use of a Benthic Diagnostic Tool being developed by Dr. Dan Dauer, of Old Dominion University, and Dr. Roberto Llansó, of Versar Inc. The Benthic Diagnostic Tool will provide an estimated probability that a benthic community’s is degraded by chemical contamination, utilizing a discriminant analysis model.

Additional information on the Integrated 303(d) / 305(b) Report is available from Harry Augustine, Environmental Program Planner, at the Richmond Central Office of Water Quality Assessment and Planning, (804) 698-4037.

Text Box 3. Quantity of Virginia Waters Impaired, by Various Categories of Toxics

(Extracted from TABLE 3.1-6 of the 2004 305(b)/303(d) Report)

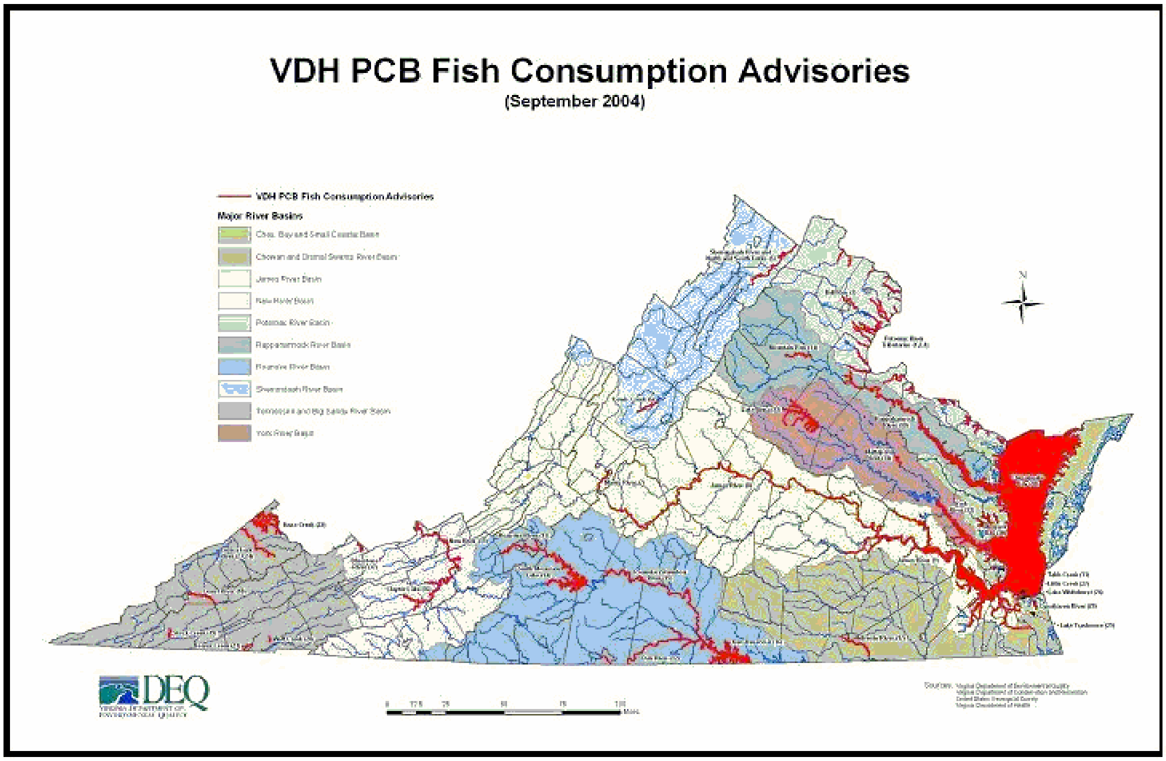
Areas listed because of benthic community degradation are considered to be 'potentially' toxics impaired.

Pollutant	Resource Type	Area Impaired (Rounded to nearest whole number)
Aldrin	River (mi)	7
	Lakes (acres)	0
	Estuary (mi^2)	0
Ammonia	River (mi)	1
	Lakes (acres)	0
	Estuary (mi^2)	1
Arsenic	River (mi)	3
	Lakes (acres)	0
	Estuary (mi2)	0
Freshwater Benthic Assessment	River (mi)	1,183
	Lakes (acres)	0
	Estuary (mi^2)	0
Benzo(k)fluoranthene	River (mi)	19
	Lakes (acres)	0
	Estuary (mi^2)	0
Chlordane	River (mi)	1
	Lakes (acres)	0
	Estuary (mi^2)	0
Chloride	River (mi)	33
	Lakes (acres)	0
	Estuary (mi^2)	96
Copper	River (mi)	1
	Lakes (acres)	530
	Estuary (mi^2)	0
DDE/DDT	River (mi)	19
	Lakes (acres)	0
	Estuary (mi^2)	0
Estuarine Benthic Assessment	River (mi)	-
	Lakes (acres)	-
	Estuary (mi^2)	596

Pollutant	Resource Type	Area Impaired (Rounded to nearest whole number)
Iron	River (mi)	7
	Lakes (acres)	0
	Estuary (mi^2)	0
Lead	River (mi)	7
	Lakes (acres)	0
	Estuary (mi^2)	0
Manganese	River (mi)	7
	Lakes (acres)	0
	Estuary (mi^2)	0
Mercury	River (mi)	275
	Lakes (acres)	0
	Estuary (mi^2)	2
Nitrates	River (mi)	2
	Lakes (acres)	0
	Estuary (mi^2)	96
PCB's	River (mi)	421
	Lakes (acres)	45,905
	Estuary (mi^2)	96
Phosphate	River (mi)	0
	Lakes (acres)	0
	Estuary (mi^2)	96
Sulfates	River (mi)	10
	Lakes (acres)	0
	Estuary (mi^2)	0
Tributyltin (TBT)	River (mi)	0
	Lakes (acres)	0
	Estuary (mi^2)	15

More Recent Virginia Department of Health Fishing Restrictions and Health Advisories

A number of additions to VDH fishing advisories occurred during or shortly after the close of MY2004. Most notable are those added as a result of the VDH's decision to lower the fish tissue PCB concentration that triggers fish consumption advisories from 600 ppb to 50 ppb. The general statewide distribution of PCB-based fish consumption advisories is summarized on the map below. The complete VDH fishing restrictions and health advisories currently in effect, for all contaminants, can be found on the VDH Website at http://www.vdh.virginia.gov/hhcontrol/fishing_advisories.htm. The VDH Website will always contain the most recently published updates to fishing restrictions and closures due to concerns related to human health and fish consumption.



The Chesapeake Bay Program

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 Clean Water Act of 1987, which would ensure protection of human health and living resources. Following the implementation of a multi-jurisdictional effort to define the nature, extent, and magnitude of toxics problems, the initial strategy was further strengthened with the adoption of the 1994 Basin Wide Toxics Reduction and Prevention Strategy. The primary goal of the 1994 strategy was to have a:

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

Toxics 2000 Strategy

Building upon progress achieved through the implementation of the 1994 Strategy, the Chesapeake Bay Program Executive Council adopted a revised strategy in December 2000 known as the "Toxics 2000 Strategy". With the retention of the 1994 goal, new objectives and commitments were developed and incorporated into the document. An important strategy objective is 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 referenced as Regions of Concern, such as the Elizabeth River in Southeastern Virginia, the strategy includes commitments leading to their restoration. Finally, the strategy includes commitments that will provide the means to measure progress toward meeting the overall strategy goal. One approach consists of a toxics characterization where information derived from concurrent biological and chemical monitoring are synthesized within the context of toxicological impacts.

Region of Concern Restoration

A revised Watershed Action Plan to help restore the Elizabeth River was developed by many stakeholders (ERP - Elizabeth River Project) in 2002. The plan contains fourteen action items known as the "clean fourteen". Some of the highest priority actions consist of cleaning up the Elizabeth River sediments (remove toxic pollutants), restoring wetlands, monitoring river trends, reducing toxics and nutrients in stormwater runoff, and educating school children and the public.

The Elizabeth River Project Sediment Remediation Partnership has continued in its effort to clean the river bottom. Various stages of study and clean-up have occurred at Scuffletown Creek, Paradise Creek, the Eppinger and Russel site, and at the Superfund site known as Atlantic wood.

Toxics Characterization

In 1999 the Chesapeake Bay Program's Toxics Subcommittee completed a toxics characterization of the tidal tributaries of the Chesapeake Bay, which included all of Virginia's tidal tributaries to the Bay (see EPA 903-R-99-010). The characterization served a dual purpose: (1) it was utilized as a guide in the development of the Toxics 2000 Strategy, and (2) it provided the basis from which management actions for chemical reductions could be targeted. The process characterized each pre-defined regional area into one of four categories based on chemical contaminant exposure and biological affects. *Regions of Concern* (e.g., Elizabeth River) are highly impacted areas, *Areas of Low Probability for Adverse Effects* are regional areas that are not impacted by chemical contaminants, and *Areas of Emphasis* have the potential for serious chemical contaminant-related impacts. A fourth category included *Areas of Insufficient or Inconclusive Data* where the data were not sufficient to place the area into one of the three categories above. An example of a management action could include additional ambient toxics monitoring in those regional areas characterized as *Areas of Insufficient Data*.

Recent Chemical Contaminant Monitoring in Areas of Insufficient Data

From 2000 through 2003 an Ambient Toxicity (AmbTox) Special Study was carried out to provide the toxicological characterization of sediment in tidal Virginia waters where earlier evaluation by the CBP had been inconclusive because of insufficient data. In brief, this study utilized the standard triad of benthic community diversity and structure, sediment toxicity, and sediment chemistry, at randomly selected sites in targeted water bodies, to evaluate the ecological condition of the sediments in selected regions of the Chesapeake Bay estuary. Results from the final field season of this study are summarized here.

2003 - Mattaponi and Pamunkey Rivers

Following the same protocol used on the Tidal James River studies (Roberts *et al.*, 2002a, 2002b) and within the Mouth of the York River (Roberts *et al*., 2003), the Mattaponi and Pamunkey Rivers were toxicologically characterized during the fall of 2003 (Roberts et al., 2004). The approach consisted of a sediment quality triad study that utilized sediment toxicity tests, chemical contaminant analysis, and a benthic community assessment. The main objective was to characterize the condition of sediment within this segment of the Chesapeake Bay.

With each river (Mattaponi and Pamunkey) defined as a stratum, the study design included a total of seven random stations within each stratum. The results from this study indicate there was no measurable toxicity and at most sites the chemical contaminant concentrations were below levels of perceived toxicological concern. At one station the heavy metal manganese was present at a level that exceeded its Effects Range-Median sediment toxicological benchmark. Several organophosphorus and organochlorine pesticides were detected at different stations within both rivers, but the concentrations were not analytically confirmed and quantified with Mass Spectrometry. Various PCB congeners were also detected, but at such low concentrations that only tentative identifications were made. With the exception of a single station in the Pamunkey River, the condition of the benthic community at all other stations in both rivers met the Chesapeake Bay Restoration Goal. Based on information provided from the other two components of the triad, it was unlikely that the Pamunkey station failed to meet the goal because of a toxicological response.

While these studies were designed to make statements relative to the chemical contamination of each of the two river segments, the generalized conclusions from the study do not rule out the possibility of locally impacted areas.

The 2003 Ambient Toxicity Study represented the final toxics characterization performed within the context of the original special study. Beginning in 2005 the resources utilized for the AmbTox studies will be redirected to a probability-based estuarine program (Estuarine ProbMon, described elsewhere in this report) which will include similar toxicological sediment screening using the triad approach. This ProbMon program will function as a continuation of the National Coastal Assessment (Coastal 2000 Program) that was supported by a five-year federal grant from the summer of 2000 through summer 2004.

Further information on the Chesapeake Bay Program's toxics studies is available from Mark Richards, Environmental Program Planner, DEQ Chesapeake Bay Office in Richmond, at (804) 698-4392. Additional information on the concentrations and trends of toxic substances and other water quality parameters, in the Chesapeake Bay and it tributaries, is currently available on the Chesapeake Bay Website at http://www.chesapeakebay.net/ or the search engine at http://www.chesapeakebay.net/search/pubs.htm.

Literature Cited:

Roberts, M.H. Jr., M. A. Vogelbein, M. A. Richards, L. Seivard, and P. F. De Lisle. 2002a. Chemical and Toxicological Characterization of Tidal Freshwater Areas in the James River, Virginia. Final Report to EPA Chesapeake Bay Program. 123 pp + Appendices.

Roberts, M.H. Jr., M. A. Vogelbein, M. A. Richards, L. Seivard, and P. F. De Lisle. 2002b. Chemical and Toxicological Characterization of Tidal Freshwater Areas in the James River, Virginia Between Jordan Point and Richmond. Final Report to VA Department of Environmental Quality. 37 pp + Appendices.

Roberts, M.H., Jr., M.A. Richards, and P.F. De Lisle. 2003. Chemical and Toxicological Characterization of Lower Mobjack Bay, York River, Virginia Segment of the Chesapeake Bay. Final Report to VA Department of Environmental Quality. 47 pp.

Roberts, M.H., Jr., M.A. Richards, and P.F. De Lisle. 2004. Chemical and Toxicological Characterization of the Upper York River, Virginia, The Mattaponi and Pamunkey Rivers. Final Report to VA Department of Environmental Quality. 59 pp + Appendices.

The Elizabeth River Program

Historically speaking, while significant research has been conducted in the Elizabeth River, it has been sporadic in nature and severely lacking in coordination among various research efforts. With Virginia's commitment to implement the Elizabeth River Watershed Action Plan as our toxics reduction strategy in this troubled river, a massive effort to restore this river is underway. In 1997, in response to indications of toxic impairment of water quality in the Elizabeth River and its tributaries, DEQ and a group of Elizabeth River Project stakeholders collaborated in contracting the consulting firm URS Greiner, Inc. to produce a comprehensive WQM plan for the water bodies of concern. Under guidelines included in that plan, a baseline environmental study began in January 1998, with the goal of allowing the future assessment of trends in contaminant concentrations and their effects. Scientists from the Virginia Institute of Marine Science, Old Dominion University, and the Department of Environmental Quality are working with representatives from state, federal, and local authorities and other stakeholders to design and conduct this monitoring effort. Unfortunately, recent economic crises have restricted financial resources for the Elizabeth River Program, and the intensity of monitoring and research has been reduced.

Several specific activities that have been continued under this initiative are described below.

Conventional Pollutants / Nutrients

DEQ and ODU continue to monitor for these parameters, which include such things as dissolved oxygen, nitrogen, phosphorus, pH, salinity and temperature. This monitoring, while done previously at a limited number of stations, was expanded to 14 stations in 1998 and now includes depth profiles and significantly more detailed nutrient analysis. Although the condition of nutrients and dissolved oxygen are still degraded, monitoring trends show significant improvements at many locations in the river (http://www.chesapeakebay.odu.edu/Reports/ reports.htm). Data can be viewed and downloaded from the Chesapeake Bay Information System (CIMS) at http://www.chesapeakebay.net/wquality.htm

Fish Tissue Histopathology

Recent academic studies indicate that a small, abundant and non-migratory fish, known as a mummichog, is an excellent indicator of adverse health effects attributable to pollutant exposure. An examination of internal organs has shown that numerous types of lesions, including cancer, can be observed and that the prevalence of these lesions may be directly related to the levels of certain pollutants in the environment. Working with Dr. Wolfgang Vogelbein of VIMS, DEQ has incorporated monitoring of this type into the Elizabeth River Monitoring Program at 12 stations in the Elizabeth River. Existing data generated by this

DEQ histopathology monitoring show that, for certain types of liver lesion, prevalence can range from a low of 1.7% in fish collected in the Lafayette River and Western Branch to as high as 85% of the fish collected in the Southern Branch. (Vogelbein and Zwerner, 2000).

Relevant research reports can be reviewed on the Internet at
http://www.elizabethriver.org/Publications/ScientificStudies.asp

TBT Monitoring

Dr. Mike Unger, from the Virginia Institute of Marine Science, has collected Tributyltin (TBT) data at 18 Stations in the Elizabeth River, Hampton Roads and the lower James River six times a year since August 1999. Only rarely have non-detectable (less than 1 part per trillion) levels of TBT shown up in these data. The highest measured concentrations occurred on September 20, 2001 with several stations near the confluence of the Eastern and Southern Branches of the Elizabeth River exceeding 20 ng/L; the highest measured concentration was greater than 70 ng/L at a station in the Southern Branch. However, no exceedences of the acute standard (360 pptr) have been observed. A summary of the monitoring results can be viewed at http://www.vims.edu/env/projects/tbt_deq/.

Benthic Index of Biotic Integrity (BIBI) monitoring

Dr. Dan Dauer (Old Dominion University) initiated a study of the macrobenthic communities of the Elizabeth River watershed in summer 1999 as a means of characterizing the health of the benthic communities of the Elizabeth River watershed. A probability-based sampling design allows calculation of confidence intervals for estimates of condition of the benthic communities and allows estimates of the geographic extent of degradation of the benthic communities. Based upon probability-based sampling, the estimate of bottom substrate not meeting the benthic restoration goals was 64 ± 10.1% in 1999, 72 ± 17.6% in 2000, 52 ± 19.6% in 2001, 72 ± 17.6 % in 2002, and 80 ± 15.7 % in2003. Average B-IBI values for the Elizabeth River watershed were 2.7, 2.6, 2.7, 2.4 and 2.3 respectively for the years 1999-2003. In general for the Elizabeth River watershed, species diversity and biomass were below reference condition levels, while abundance was above reference condition levels. Community composition was unbalanced, with levels of pollution-indicative species above, and levels of pollution sensitive species below reference conditions.

Copies of relevant Elizabeth River Monitoring Reports by Dr. Dauer are available at the ODU WebPages on the Internet at http://www.chesapeakebay.odu.edu/Reports/reports.htm.

Elizabeth River Monitoring Reports: 2003-2004

Dauer, D.M. 2003. Benthic Biological Monitoring Program of the Elizabeth River Watershed (2003). Old Dominion University, Department of Biological Sciences, October 2004.

Vogelbein, W.K. and M. Unger. 2003. The Elizabeth River Monitoring Program 2001 – 2002: Association between Mummichog Liver Histopathology and Sediment Chemical Contamination. Virginia Institute of Marine Science, November 2003

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

Virginia Toxics Release Inventory

Under the provisions of Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986, also known as SARA Title III, Virginia manufacturing and federal government facilities that release certain chemicals into the air or water or onto the land, or that transfer these chemicals for off-site treatment, disposal, recycling, or energy recovery, are required to submit reports to the EPA. This information is reported on Form R–Toxic Chemical Release Inventory Reporting Form and is collectively referred to as the Toxic Release Inventory (TRI).

The most recent Virginia Toxic Release Inventory Report (SARA Title III TRI, March 2004) indicated that 505 Virginia facilities filed 2010 individual reports on the release, transfer, or management of TRI chemicals or chemical categories for the 2002 activity year. Statewide toxic releases to the water totaled approximately 8,262,380 million pounds or 11.6 % of the total onsite releases to all media during 2002. This quantity (~8.3 million lbs.) represents a 2 % increase from 2001 releases.

On-site releases to water include discharges to surface waters, such as rivers, lakes, ponds, and streams. On-site releases to the land (~6 million lbs.) refer to landfilling, surface impoundment, land treatment/ application farming, or any other release of a TRI chemical to land within the boundaries of a facility. Some of these discharges may eventually find their way into the Commonwealth's surface waters as well. Virginia does not permit underground injection as a method of hazardous waste disposal, and no under-ground injection of TRI chemicals was reported in 2002.

Ten chemicals and chemical categories accounted for more than 99% of the on-site TRI chemical releases to the water. The top ten TRI chemicals released to water were: nitrate compounds (92.7% of total releases to water = 7.659 million lbs.), manganese and manganese compounds, ammonia, zinc and zinc compounds, methyl ethyl ketone, barium and barium compounds, methanol, copper and copper compounds, chlorine, and n-methyl-2-pyrrolidone. Nitrate compounds are a common byproduct of industrial 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.

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 report (2002 VIRGINIA TOXICS RELEASE INVENTORY (TRI) REPORT - March 2004). The March 2004 Virginia TRI Summary Report, summarizing data from CY2002 industry reports, is available on the DEQ Website at: http://www.deq.virginia.gov/sara3/3132002.html

For further information on the Virginia TRI, contact Dona Huang, Environmental Program Manager, SARA Title III, at (804) 698-4489.

Additional sources of information on the Toxic Release Inventory: Community Right-to-Know, including the access and use of TRI data and fact sheets for individual states, are available from the EPA's Internet site: **http://www.epa.gov/tri/** . A CD-ROM, containing all data from the 1987 through 1997 Toxic Release Inventory: Community Right-to-Know is also available from the EPA.

The next Virginia TRI report, summarizing toxic releases for calendar year 2003, should be available by March 2005.

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 pollution prevention 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, perhaps most important of all, among industries using and/or producing toxic materials.

OPP's activities for each fiscal year are summarized in the Pollution Prevention Annual Report, submitted to the governor and the General Assembly in December of each year. The 2004 report summarizes the pollution prevention strategies developed and implemented by the Virginia Innovations in Pollution Prevention (VIP2) Program, which is coordinated with other DEQ activities as well as with those of the Department of Conservation and Recreation and of the Chesapeake Bay Local Assistance Department. The annual report presents detailed summaries of the major components of VIP2 activities during 2004, several of which are briefly summarized here.

1. The total number of facilities in the Virginia Environmental Excellence Program (VEEP) increased from 152 to over 200, an increase of approximately 33% in 2004, with 80% participating at the E2 level. Virginia has continued to promote coordination and cooperation with EPA's National Environmental Performance Track Program, which rewards "high-performing" facilities with regulatory flexibility incentives. Significant changes to the program occurred in 2004 related to incentives, participation and administration:

- The new annual fee regulations adopted in June for waste and water permit holders include a discount for VEEP facilities at both the E2 and E3 levels.
- In June, both the Waste Management Board and the Air Pollution Control Board adopted regulatory changes that provide incentives for Virginia Performance Track facilities.
- At the end of the year, DEQ instituted new annual reporting guidelines for both E2 and E3 facilities that are intended to provide the agency with quantified performance results for reductions in waste generation, air emissions, energy use, water use, etc.

2. DEQ's Pollution Prevention in Healthcare Program (Hospitals for a Healthy Environment) continued to promote the reduction of regulated medical wastes, to reduce toxic materials by encouraging environmentally preferable purchasing practices, and to eliminate mercury from health care purchases.

On September 16, VH2E held a Charter Signing Recognition Event for the initial 74 facilities that joined the program. Secretary of Natural Resources Tayloe Murphy and Secretary of Health & Human Services Jane Woods jointly presided over the event. It was hosted by Bon Secours St. Mary's Hospital in Richmond and featured speakers from participating facilities and EPA Region III. Additional healthcare facilities have joined since the event, bringing membership at the end of the year to greater than 80 facilities, which includes half of all hospitals in the Commonwealth.

A website went live in the spring of 2004 to provide on-line access to all of the guidance materials and resources. Also in late 2004, DEQ secured contractor services to provide on-site assistance to a limited number of program participants.

3. Participants in the Businesses for the Bay (B4B) Program reported 167,700 tons of waste reduction and cost savings of $13.4 million. In 2004, Virginia facilities once again led the region in participation: approximately one-half of all members (279 out of 603) are in Virginia, almost twice as many as the next closest state. In October, fourteen Virginia-based entities received Businesses for the Bay Excellence

Awards. They were recognized for their pollution prevention efforts to conserve water and reduce toxic and nutrient releases. Earlier in the year, OPP developed a B4Bay website specific to Virginia to promote participation and recognize members' achievements: www.deq.virginia.gov/p2/b4b/homepage.html.

4. In 2003, OPP applied for and received approximately $6,500 in funding from the Environmental Protection Agency (EPA) to develop a single, comprehensive website for information on renewable energy and energy efficiency. The goals of the Virginia Information Source for Energy (VISE) Website were to increase awareness of the environmental and health impacts of energy use; promote renewable energy projects in the Commonwealth, and educate consumers about energy efficiency and renewable energy. Clean, renewable energy approaches provide an environmentally and economically preferable alternative to conventional end-of-pipe pollution control, representing a classic pollution prevention approach.

5. DEQ administers Virginia's National Partnership for Environmental Priorities (NPEP) program, previously called the National Waste Minimization Program, which was renamed and re-energized in 2004. The NPEP program encourages public and private organizations to form voluntary partnerships, with states and the EPA, that reduce the use or release of any of the thirty-one substances that have been designated "Priority Chemicals". It focuses on the reduction in the use or release of the priority chemicals, not only in waste generation but also in their use in products and their release to the air or water. EPA has established a goal of reducing the amount of target chemicals by ten percent by the year 2008, relative to a 2001 baseline.

The entire Pollution Prevention Annual Report (2004) is available from the 'Publications' tab at the head of the OPP (P2) page of the DEQ Website: http://www.deq.virginia.gov/p2/ . Additional information about the activities of the OPP during the past year also is available from the P2 Website and from Sharon Baxter, environmental program manager, at (804) 698-4344 / skbaxter@deq.virginia.gov.

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Glossary of Terms Used in the Toxics Management Program

Acute Toxicity - An adverse effect, that usually occurs shortly after exposure to a toxic substance. Lethality is one commonly used "end-point" for the evaluation of acute toxicity to an organism. When death is not easily verified, immobilization of an organism may be used as an alternative criterion.

Applicability Criteria - The basic criteria used to determine whether a facility must participate in the Toxics Management Program and conduct toxicity tests in order to assess the need for toxicity reduction evaluations and the development of Whole Effluent Toxicity (WET) limits. The criteria include the following:

1. A discharge that has demonstrated actual or potential toxicity or contains toxic pollutants;
2. Any industrial discharge that falls into one of the standard industrial classification (SIC) codes listed as a primary industry for the Toxics Management Program;
3. Any industry with a daily maximum wastewater flow greater than or equal to 50,000 gallons per day;
4. Publicly owned treatment works (POTWs) with flows greater than or equal to one million gallons per day (MGD);
5. Any POTW with a pretreatment program; and
6. Any other discharge that the Water Board deems has the potential for toxicity or in-stream impact based on an evaluation of manufacturing processes, indirect discharges, treatment processes, effluent or receiving stream data, or other relevant information.

Chronic Toxicity - An adverse effect that is irreversible or progressive or occurs because the rate of injury is greater than the rate of repair during prolonged exposure to a toxic pollutant. This includes low-level, long-term effects such as reduction in growth or reproduction.

Effluent Limitation Guidelines (ELGs) - ELGs are established by the EPA and are often used when more stringent water-quality-based effluent limitations (WQBELs) are not required to maintain water quality standards adopted by Virginia.

Toxics Management Plan - All facilities applying for Virginia Pollutant discharge Elimination System (VPDES) permits are assessed for the need for a toxics management plan. This plan is the process through which the facility assesses the toxicity of its discharge, evaluates potential toxicity reductions if the discharge fails toxicity tests, and develops the information that is the basis for a WET limit, if required.

Toxicity – The inherent potential or capacity of [an excess of] a material to cause adverse effects in a living organism, including acute or chronic effects to aquatic life, detrimental effects to human health or other adverse (biological) environmental effects.

Toxics Reduction Evaluation (TRE) – The process through which a facility determines what is causing the toxicity of its discharge and evaluates alternatives for reducing the toxicity.

Water-Quality-Based Effluent Limitations (WQBELs) – WQBELs for Whole Effluent Toxicity (WET) are established whenever necessary to ensure that effluents meet the toxicity decision criteria or to protect all reasonable and beneficial uses of the state's waters. WQBELs are developed for specific toxic pollutants if data developed during effluent monitoring indicate that violations of the standards or criteria would occur in the receiving waters and that compliance with technology-based effluent limits would not prevent the violation.

WET Limits - WQBELs for aquatic tests. Whole Effluent Toxicity (WET) limits are developed and incorporated into a VPDES permit after testing discharges for impact on fish or other aquatic organisms reveals the potential for toxic discharge.

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