VI. Data Analysis, Assessment and Reporting

A. Data Storage, Availability and Transfer:

Water quality monitoring data collected by the Virginia Department of Environmental Quality, and other Quality-Assured agencies and organizations that contribute to the agency's database, are made available to the public and to several other state and federal agencies and interstate programs and are reported upon in various formats (refer to VA-DEQ Data Collection and Information Flow [V-2.doc]). As soon as they are available in electronic format, physical and chemical data from the water column, sediment, and fish tissues are posted for agency and public access via the DEQ WebPages:

1. Ambient Water Quality Monitoring (including sediment)

Results from all ambient monitoring carried out by the Department and analyzed locally (Division of Consolidated Laboratory Services – DCLS) are stored in the Water Quality Monitoring (WQM) Module of the Comprehensive Environmental Data System (CEDS). This CEDS application contains all of the Department's historic data from the National Computing Center's (NCC) STORET application as well as all data generated post 31 December 1998, when NCC closed STORET to any new data storage. The CEDS data represent water quality measurements beginning in the summer of 1941 and continuing until the present. Those data will soon be available to the public via the EPA Water Quality Exchange (WQX) WebPages. [http://www.exchangenetwork.net/data-exchange/wqx/] A "WQX Web User Guide" manual is also available on line from the EPA National Service Center for Environmental Publications (NSCEP). [http://www.epa.gov/nscep/index.html] Use the term "WQX Web User Guide" in the search engine there.

Questions related to these data and direct requests of more sophisticated, large volume data files should be directed to:

Roger E. Stewart
629 East Main Street
Richmond, Virginia 23219
804.698.4449
Roger.Stewart@deq.virginia.gov

Queries from the CEDS database provide data for assessment and the subsequent 305(b)/303(d) Integrated Reports, as well as for various other summaries and reports listed below. The results of assessments related to the 305(b)/303(d) process are summarized in the biennial Reports themselves as well as and being stored in DEQ's Assessment Database (ADB).

All ambient WQM data collected specifically for the Chesapeake Bay Program are also electronically copied and transferred to the CBP Chesapeake Information Management System (CIMS) database. This includes fall-line data and non-tidal trend data collected by the USGS that resides in DEQ's CEDS database.

2. Probabilistic Monitoring (including sediment)

(1) Free-running Freshwater

As mentioned in Chapter V – Data Management, data from all field-measured parameters and from locally analyzed water and sediment sample results of the probabilistic monitoring programs are stored in and available from CEDS.

Habitat and benthic invertebrate data from the Freshwater ProbMon Program are stored in DEQ's EDAS biological database. The EDAS database calculates a series of specific benthic metrics and integrates them into the Virginia Stream Condition Index (VSCI) in the non-tidal areas of Virginia and the Coastal Plain Macroinvertebrate Index (CPMI) in the Coastal Plain. VSCI and CPMI scores from freshwater probabilistic benthic sampling will provide the basis for 305(b) assessment and reporting on the aquatic life designated use.

As pointed out in Chapter III, Section III.A.2 (b), several comprehensive reports and a number of presentations of probabilistic monitoring results have been produced. See Section III.B.3, below and refer to DEQ's Probabilistic Monitoring WebPages. [http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/ProbabilisticMonitoring.aspx]

Specific questions related to this program and requests for related data should be directed to:

Jason Hill
Freshwater Probabilistic Monitoring Coordinator
3019 Peters Creek Road
Roanoke, Virginia 24018
(540) 562-6724
Jason.Hill@deq.virginia.gov

(2) Estuarine Waters

Sediment chemistry, sediment toxicity and benthic community data from the Estuarine ProbMon (C2) Program are returned to DEQ from contracted commercial laboratories on electronic spreadsheets and are maintained in the same format. The manual transfer of these data into the CEDS database is dependent upon the availability of financial and human resources. Data related to the Sediment Quality Triad (SQT – sediment chemistry, sediment toxicity, and benthic community well-being) are subsequently integrated into a toxics-related 'Weight-of-Evidence' (WOE) assessment workbook (MS Excel®) associated with each specific estuarine probabilistic site, and assessments are executed and reported in biennial 305(b) Reports. Copies of these WOE workbooks are subsequently stored in annual summaries within the Special Study Module of the CEDS database, under the specific special study name and number associated with the program (015172 – Coastal 2000 Program).

Field data, and the results of water chemistry and sediment particle size/TOC analyzed at DCLS are retained in DEQ's CEDS database. The original data files from contracted laboratories, containing chemistry, toxicity and benthic results, as well as the 'Weight-of-Evidence' assessment workbooks are available from:

Donald H. Smith, PhD
Estuarine Probabilistic Monitoring Coordinator
629 East Main Street
Richmond, Virginia 23219
(804) 698-4429
Donald.Smith@deq.virginia.gov

3. Targeted Fish Tissue and Sediment Monitoring

Although a module for the storage of fish tissue and sediment data in the CEDS database has recently been completed and is being used for agency special studies results, the non-agency laboratories contracted for most fish tissue analyses have not yet developed an interface for the electronic shipment of data to CEDS. The Fish Tissue and Sediment Contaminants Monitoring Program (FT) unit of DEQ's Water Quality Monitoring Programs (WQM) currently receives fish tissue and sediment results in spreadsheet format. As soon as data return from the contracted analytical laboratories and are quality assured and assessed, spreadsheet summaries of all results are posted on the DEQ Fish Tissue and Sediment Monitoring Program WebPages. [http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/FishTissueMonitoring.aspx] The summarized results are also provided directly to Regional Office assessment personnel for preparation of the biennial 305(b)/303(d) Reports and stored in the agency's assessment database (ADB).

The original data are also provided to the Virginia Department of Health (VDH), which evaluates fish tissue data and determines whether or not to issue fish consumption advisories for those waters where fish tissue contaminant concentrations exceed VDH recommended levels of concern. The DEQ website identified above provides a direct link to the VDH Fish Consumption Advisories website. [http://www.vdh.state.va.us/epidemiology/DEE/publichealthtoxicology/Advisories/index.htm] The VDH Fish Consumption Advisories are updated when existing advisories are modified or new ones are issued, and the website lists all advisories currently in effect. Press releases related to new fish consumption advisories are also posted and maintained on the VDH Public Health Toxicology Press Releases website [http://www.vdh.state.va.us/epidemiology/DEE/PublicHealthToxicology/PressReleases.htm] until the end of each year. The press releases are then archived into annual files available via a link from the same VDH website. All current VDH fish and shellfish advisories are also listed in the Hunting and Fishing Regulations Pamphlets published by the Virginia Department of Game and Inland Fisheries (DGIF).

Requests for information about the Fish Tissue and Sediment Monitoring Program should be directed to:

Gabriel A. Darkwah
629 East Main Street
Richmond, Virginia 23219
(804) 698-4127
Gabriel.Darkwah@deq.virginia.gov

B. Summary Reports:

1. Integrated 305(b)/303(d) Water Quality Assessment and Impaired Waters Report

The primary use of the water quality monitoring data generated by or for DEQ is for reporting to US EPA and the Congress in the biennial Integrated 305(b)/303(d) Water Quality Assessment Report and Impaired Waters List.

DEQ's Office of Water Quality Assessment is responsible for the interpretation of water quality data and the preparation of the biennial 305(b)/303(d) Reports. Both the data and the assessments included in these reports come from various sources within the Commonwealth. All these data undergo QA/QC screenings

by DEQ before being used to classify the State's waters in relation to their designated uses. The survey and interpretation of land use data, the condition of riparian buffers, and other factors related to non-point pollution sources (NPS), which are carried out, summarized and reported by the Virginia Department of Conservation and Recreation (DCR), is also integrated into the 305(b) Report.

In addition to being assessed in-house, fecal coliform (and more recently, *Escherichia coli* and *Enterococcus*) bacterial data and toxics data (metals and organics) collected from the water column, sediments, and fish tissues by DEQ, are passed to the Virginia Department of Health (VDH) for further evaluation and the possible preparation of health advisories: fish or shellfish consumption, bathing and drinking, etc. VDH's Shellfish Sanitation Program also collects data for shellfish consumption advisories, and DEQ evaluates all VDH advisories for use in the 305(b) and 303(d) Reports using protocols described in the specific assessment guidance document prepared for each biennial report.

The Section 305(b) water quality inventory report, which includes Section 314 Lakes Assessments, characterizes the condition and quality trends of monitored waters within the State and is due to EPA on April 1 of even-numbered years. This is the primary State monitoring program report to EPA and draws upon information from the Clean Lakes program, non-point source program, TMDLs, and other national, State, and local assessments. Section 305(b) reports are provided as both hard copy and electronic updates (See Section 305(b) guidelines for content requirements.) and are available on the DEQ Water Quality Assessment WebPages [http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityAssessments.aspx].

The Section 303(d) impaired waters list identifies all impaired waters based on existing and readily available information. The list is also due to EPA on April 1 of even-numbered years and it too is available on the DEQ Water Quality Assessment WebPages at the same address.

EPA provides updated guidance for the preparation of the Water Quality Monitoring and Assessment Report for each assessment period. This orientation provides States, Territories, and authorized Tribes with guidance that will satisfy CWA data requirements for both Section 305(b) water quality reports and Section 303(d) lists, for integrating the development and the submission of 305(b) water quality reports and Section 303(d) lists of impaired waters. DEQ guidance for the preparation of the Virginia 305(b) and 303(d) Reports is also updated for each assessment cycle. Draft copies of the guidance document are posted on the DEQ Assessment WebPages [http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityAssessments.aspx] for public review and comment in the fall preceding each April that the reports are due.

For additional information concerning the Integrated 305(b)/303(d) Reports and the guidance for their preparation, contact:

Tish Robertson
Virginia Department of Environmental Quality
629 E. Main Street
P.O. Box 10009
Richmond, VA 23240
(804) 698-4309
Tish.Robertson@deq.virginia.gov

2. Toxics Reduction in State Waters Report

By January 1st of each year, the Virginia DEQ submits its annual Toxics Reduction in State Waters (TRISWat) Report [http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/ToxicsReportJanuary2013.aspx] to the Commonwealth's General Assembly. 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 Governor and the members of the General Assembly informed of the agency's 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.

Each year's report summarizes the agency's efforts during the previous state fiscal year (1 July through the following 30 June), which historically was also referred to as the "Monitoring Year". As a minimum, the report includes:

1.The location and number of monitoring stations and the period of time that monitoring has occurred at each location,
2. The sampling results from the monitoring stations for the previous year,
3.The identification of any segments that are designated as toxic impaired and any plans to address the impairment,
4.The identification of any segments for which the Water Control Board or the Director of the Department of Environmental Quality has made a decision to conduct additional evaluation or monitoring. Information regarding these segments includes, at a minimum, the geographic location of the stream segment within a named county or city,
5.The Water Control Board's plan for continued reduction of the discharge of toxics which includes, but is not limited to, additional monitoring activities, a work plan for the pollution prevention program, and any pilot projects established for the use of innovative technologies to reduce the discharge of toxics,
6.Compliance data on permits that have limits for toxics, along with the identification and location of permitted facilities,
7.The number of new permits or reissued permits that have toxic limits and the location of each permitted facility, and
8.A summary of pollution prevention and pollution control activities for the reduction of toxics in state waters.

In addition to a complete listing of the analytical results of toxic parameters in surface waters, sediments and fish tissues for each station monitored during the most recent year, the report includes descriptive statistical summaries of all annual results since 1997, 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 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.

The report also lists special studies targeted on toxics with information on data availability, preliminary and final reports, and contact persons within the agency. It also includes summaries of toxic reduction efforts

by various other programs within and outside of DEQ. These include the Chesapeake Bay Program (in Virginia waters), the Elizabeth River Program, the Virginia Toxics Release Inventory (TRI), the DEQ Permitting Program, and DEQ's Pollution Prevention Program (P3).

Originally, hard copies of this report were provided to the State Legislature on 1 January of each year and were circulated to interested agencies and individuals. More recently, in order to reduce the resources required for the Report's reproduction and distribution, State Legislators have simply been advised when an electronic copy of the report has been made available to the public on DEQ's Website. Copies are also available on compact discs upon request.

The production of this annual report is the responsibility of DEQ's Assistant Water Quality Monitoring Coordinator (Position Number P4028). For additional information about the Toxics Reduction in State Waters Report, contact:

Donald H. Smith, Ph.D.
Virginia Department of Environmental Quality
629 E. Main Street
Richmond, VA 23219
(804) 698-4429
Donald.Smith@deq.virginia.gov

Or

PO Box1105
Richmond, VA 23218

3. Freshwater Probabilistic Monitoring Report

Following the first year of freshwater probabilistic monitoring, in the spring and fall of 2001, DEQ produced its first Probabilistic Monitoring (ProbMon) Report. Several more comprehensive reports have since been produced, including sections in DEQ's biennial 395(b)/303(d) Integrated Water Quality Reports, and a number of presentations have been made at local and national meetings. These reports and others are available on the DEQ Probabilistic Monitoring WebPages [http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/ProbabilisticMonitoring.aspx]. Future ProbMon Reports will be posted at the same Website address, as they become available. The results of DEQ's Probabilistic Monitoring Program are also summarized biennially in each 305(b) Water Quality Assessment report, beginning with the 2004 edition.

For additional information concerning the annual ProbMon Reports, contact:

Jason Hill
Freshwater Probabilistic Monitoring Coordinator
DEQ West Central Regional Office
3019 Peters Creek Road
Roanoke, VA 24019
(540) 562-6724
Jason.Hill@deq.virginia.gov

4. Trend Analysis Reports

Trend analyses conducted by the Department's assessment staff first became a standard feature with the publication of the 2006 305(b)/303(d) Water Quality Integrated Report (IR). Because more recent short-term water quality changes have limited effects on long-term trend analyses, the trend chapter in the Integrated Report is only updated each six years. Trend analyses in the 2012 IR cover a sliding 20-year

block of data, such that the Report includes monitoring data from 1991 to 2010. Conventional site by site trend analyses are performed on 406 permanent trend sites using the Seasonal Kendall Procedure and software (WQ3) produced for DEQ by faculty at Virginia Tech (see more complete discussion in Section III-B-3 – Trend Monitoring Network).

The most recent trend analysis focused on the following water quality parameters:

(1) Bacteria (Fecal Coliform – FC or BACT, combination of 31615 and 31616), *
(2) Dissolved Oxygen expressed as DO % Saturation,
(3) Total Nitrogen TN, *
(4) Oxidized Nitrogen (nitrate plus nitrite = NOX),
(5) Total Kjeldahl Nitrogen (organic nitrogen plus ammonia = TKN),
(6) Total Phosphorus TP, *
(7) Acidity or pH PH,
(8) Water Temperature TEMP, and
(9) Total Suspended Solids TSS.*

Of the nine variables analyzed, four (BACT, TN, TP, and TSS, as indicated by asterisks in the list) are considered key variables because of their utility for interpreting the desirability of water quality changes. For each of these four variables, a negative trend (decreasing concentration) unequivocally indicates a desirable change in ambient water quality. Details of how data were reported in the integrated report are included in the Assessment Guidance Manual. [http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityAssessments.aspx], and the Trend Analysis Chapter 4.5 of the 2012 305(b)/303(d) Integrated Water Quality Report (IR) [III-B-3-1b].

Chapter 4.6 of the 2012 Integrated Report introduced a new trend analyses using procedure. An Integrated Water Quality Index (IWQ) was used to aggregate data from multiple monitoring sites within the same hydrological unit (10-digit, 5th order watersheds) to characterize watershed-wide changes in water quality during the past 20 years. The IWQ is a seasonally-derived nonparametric scoring procedure that is applied to various waterbody types at the watershed scale. The impetus for the creation of the IWQ was the desire to detect and explain interim changes in water quality over time more descriptively than the traditional impaired/non-impaired dichotomy as reported in the traditional 303(d)/305(b) Integrated Reports (see more complete discussion in Section III-B-3 – Trend Monitoring Network).

As new data become available from enhanced trend monitoring additional variables and trend scenarios will be incorporated into trend analysis. For example the addition of *E. coli* and Enterococci bacteria indicators to our parameter suite will eventually produce data useful for trend exploration.

Other DEQ activities related to the analysis of trends have included investigating the effects of duration, frequency and seasonality of sampling on the significance of trends. Pertinent questions included: "Is bimonthly or quarterly sampling sufficient to detect significant trends and if so, does the selection of odd or even months or the arbitrary definition of quarterly seasons influence the results?" DEQ is also investigating the feasibility of using automated, computer-generated queries to marry USGS and DEQ flow data with a specific site, date and time of water quality sampling. One of the many significant challenges to be confronted is how to integrate and interpret the appropriate phase of precipitation-induced changes in flow rate with the observed water quality parameter values.

Additional interest lies in investigating non-parametric statistical methods for examining mid-term changes in water quality. A pertinent question within this time scale is "Has the median value of this water quality parameter changed significantly since the last assessment cycle?" and "Why?"

For additional information on Trend Analyses, contact:

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629 E. Main Street
Richmond, VA 23219
(804) 698-4449
Roger.Stewart@deq.virginia.gov

5. Other DEQ Water Quality Reports

Various other incidental reports produced by the Virginia DEQ are program specific, and are discussed within each of the relevant monitoring subprograms. An example is the case of special studies reports.

DEQ's Regional and Central Offices initiate special studies for a number of reasons. One common category of special study is the intensive stream survey required to define the geographic extension, severity and cause of confirmed water quality problems (for TMDL development) or to establish reliable base-line information where problems are anticipated. A contemporary example would be the 2010 Near-Shore Oceanic Survey [III-A-1b-3-3a.pdf] used to characterize Virginia's near-shore marine waters prior to off-shore petroleum exploration and alternative energy projects. Other special studies may be initiated as research projects to evaluate new monitoring methods, alternative laboratory analytical procedures, etc. or simply to characterize regional reference streams.

Because such special studies are often targeted on problem areas or involve very specific research objectives, their data often are not uploaded to STORET. Although special studies sampling and data acquisition are subject to the same QA/QC protocols as other DEQ monitoring activities, their objectives and the data types produced are so varied that data analysis and interpretation procedures are often study-specific. The results of special studies are summarized in written reports, which are circulated to the appropriate Regional and Central Offices, linked to the Special Studies Module of DEQ's CEDS database, and/or linked to the DEQ Water Quality Monitoring WebPages [http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring.aspx].

For additional information on Special Studies and associated reports, contact:

Roger E. Stewart
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(804) 698-4449
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