VIII. General Support and Infrastructure Planning

As described in the preceding portions of this document, the water quality monitoring activities of the VA-DEQ comprise a complex, coordinated plan of intersecting monitoring subprograms. Many aspects of the overall Water Quality Monitoring Program are relatively easy to document, quantify and describe on a global basis, but determining the proportional allocations of resources related to specific monitoring activities is often impossible. For example, a single ambient monitoring run carried out by one field technician on a single day may include sampling at sites associated with the watershed monitoring network, the trend monitoring network and the Chesapeake Bay Program. Consequently, the exact allocation of human and logistical resources to each subprogram is difficult to ascertain. Similarly, resources devoted to logistical support such as vehicles, boats, other field equipment, equipment maintenance, etc. are shared by the diverse elements of the overall monitoring program.

Other resource allocations can be more specifically identified and easily quantified. For example, on a complex monitoring run such as that described above, each sample collected is identified by a program code, site location, date, time and depth, and is recorded in DEQ's CEDS database at the end of the day. Subsequent laboratory analyses carried out at the state laboratory, the Division of Consolidated Laboratory Services (DCLS) of the Virginia Department of General Services, and the resultant data, carry the same identification codes. Consequently, the numbers and types of samples and their associated analytical costs for each of the programs can easily be determined with properly designed database queries. In fact, this is done on a regular basis to estimate the analytical resources required for the annual monitoring plan, or to document analytical resources already expended for specific monitoring programs, special studies, etc. Similarly, the number and distribution of active monitoring sites associated with a specific program during a specified period can easily be determined. Such resource allocations have been addressed and described in relation to specific monitoring activities elsewhere in this document.

The following section summarizes resources that are often divided among various monitoring activities. The proportional allocation of these resources among subprograms is difficult to estimate with any degree of accuracy not only because of their integrated nature, but also due to the fact that they may vary monthly, seasonally or annually within similar monitoring runs.

A. Staff and Training:

1. Human Resources:

When resource restrictions require budgetary cutbacks, as has been the case in recent years, agency policy has been to maintain an average, agency-wide vacancy rate until conditions improve. Consequently, the current WQM human resource estimates summarized here represent a minimum requirement for maintaining the existing program, and are less than optimal for facilitating its further development. Additional land-use evaluations and Non-Point Source (NPS) characterizations that are integrated into the biennial 305(b) Report, have generally been carried out by the Virginia Department of Conservation and Recreation (DCR) and are not included in these estimates. Following the reorganization and transfer of many DCR functions to DEQ in 2012 and 2013, responsibility for the NPS evaluations may change agencies. If this should occur, DEQ human resource estimates will be updated accordingly. Resources required by the Virginia Department of Health (VDH) for source water and beach monitoring and by its Division of Shellfish Sanitation (DSS) for shellfish monitoring are also excluded from this summary.

Estimates of current (March 2013) staffing for VA-DEQ's Water Quality Monitoring Program are summarized in the 'Personnel Overview' tab of the Excel® workbook 'WQM_Human_Resources.xls' [VIII-A-1.xls]. This sheet summarizes the total 'Full Time Equivalents' (FTEs) of various Central and Regional Office monitoring programs itemized on the remaining worksheets of the workbook. As discussed above, however, a single field technician may participate in several different monitoring activities (programs) during a single monitoring run!

The December 2006 combined human resources of DEQ's Water Quality Monitoring and Assessment Programs, including the Chesapeake Bay Program, the Office of Water Quality Standards, and the Surface Water Investigations group, consisted of approximately 92.2 Full Time Equivalents (FTEs) without inclusion of the Wetlands Monitoring Program. Current combined human resources for the same programs and positions are 74.33 FTEs, a reduction of approximately 19.4% in the last six years, even with the addition of wetlands monitoring. Current status of the WQMA human resources indicates a 12.9% vacancy rate among the remaining 85 authorized positions.

The availability of human resources is just as important as financial and logistical resources for the development and maintenance of a monitoring program. Even when financial and logistical resources are provided, the attainment of monitoring goals may be severely limited if there is a shortage of human resources! Projections of human resource needs for meeting future monitoring requirements over the next ten to twenty years will parallel those for other resources, as discussed below.

2. Training:

All DEQ personnel receive periodic training in field-related activities. It is the responsibility of the Regional Office Monitoring Coordinators, Project or Program Managers, and the WQM Quality Assurance Officer to assure that proper training is carried out in a timely manner. Newly hired field monitoring personnel are trained on-the-job by experienced field monitoring technicians at the regional office(s) immediately upon assuming their responsibilities. They are required to study the DEQ water quality monitoring Quality Assurance Project Plans and related documents for all projects which fall within their job responsibilities. Mandatory documents and training required by all field staff include being familiar with:

1. Safety requirements and for areas and tasks associated with the position
2. Calibration and maintenance and preparation of field equipment and associated vehicles
3. Field sampling procedures
4. Sample transport and shipment procedures
5. Entering data and metadata into the CEDS database

Formal courses and on-line proficiency via the DEQ Office of Training Services was initiated in 2006.

Formal workshops or "hands-on" training sessions are organized for specialized sampling and/or data management techniques, as needed. In person training is usually conducted due to requiring staff to perform advance or highly technical sampling methods, significant changes to current procedures, or due to documented poor performance of affected staff. Specific examples include the "clean hands / dirty hands" procedures for sampling trace metals, the preparation and field deployment of Semi-Permeable Membrane Devices (SPMDs) for sampling dissolved organic contaminants, etc. Program specific training sessions are planned and scheduled by the responsible program/project managers and coordinators. Such training often is done by trained and proficient agency staff but may include participation/presentation by Regional and/or National EPA personnel. Examples include training in the "Rapid Biological Assessment Protocols"

(RBP2) and habitat assessment methods employed by the biological and freshwater probabilistic monitoring programs, and the use of Ponar dredges for the sampling of sediment for chemical, toxicological and benthic taxonomic analyses in estuarine probabilistic monitoring.

The potential importance that a WQM sample might attain in subsequent legal matters also makes it essential that agency water monitoring staff receive proper training in both sample collection and Chain of Custody procedures. Accordingly, all water monitoring staff that collect or ship samples, are required to both obtain and maintain updated training in water sample collection and applicable Chain of Custody procedures. The agency training program and guidelines (under constant revision) and the training to be conducted as outlined in guidance memo 00-2016.

The agency's 'Training Coordination Committee' (TCC) coordinates more generic training (initial and refresher) that is required for a more general cross section of DEQ staff. Training opportunities for monitoring as well as general staff are posted on the DEQ internal training web site and many classes are available on-line by accessing the automated training module, the Learning Management System (LMS), on DEQ's internal network.

The training module tracks staff training requirements and retraining and re-certification requirements for individual employees. Field staff members are required to have training in areas relative to their activities. Required training may include:

(a) First aid/CPR
(b) Boating Safety
(c) Confined Space Entry
(d) OSHA 24-hour safety course and refresher courses.
(e) Standard Operating Procedures
(f) Sample Chain of Custody
(g) Comprehensive Environmental Database System (CEDS)

Additional optional training is offered to enable staff to maintain their level of excellence and to expand their knowledge both beyond required levels and outside their scope of work. These opportunities as well as required training are offered as web-based, on-site, and off-site training, to include workshops and conferences, as well as institutions of higher learning.

Additional training opportunities are added to the LMS as additional needs are identified.

B. Laboratory Resources:

1. Analytical Services:

The great majority of laboratory analyses performed for DEQ's Ambient Water Quality Monitoring Program are performed by the Division of Consolidated Laboratory Services (DCLS), of the Virginia Department of General Services (VDGS). The majority of DEQ's analytical laboratory needs are defined annually during internal, late fall or early winter meetings or discussions/conference calls among the agency's WQM staff, including the appropriate program/project coordinators, the WQM QA/QC Officer, and the agency's Laboratory Liaison Officer. The availability of human, financial and logistical resources for the following calendar year are all considered during this process. The numbers of sites to be monitored, the sampling frequency, and the core and supplemental parameters to be measured under each element of

the overall program are all defined at this time. When required, this identical procedure is carried out for special studies and for incidental adjustments to ongoing ambient WQM programs. The agency's annual Monitoring Plan is one result of this process.

Regular (monthly) and supplemental meetings between DEQ's Laboratory Liaison Officer and the DCLS Laboratory Managers function to inform the laboratory of the agency's needs, to develop appropriate parameter groups to meet those needs, and to resolve the question of analytical costs, problems with the scheduling of sample shipments, analysis priorities, and integrated data management between the DCLS LIMS database and DEQ's CEDS 2000 database. In addition, designated WQM representatives are on-call 24 hours a day, seven days a week, to resolve problems with sample shipment, sample registration upon arrival at DCLS, or doubts about database entry and data flow. An emergency "Call List for Sample Related Issues" is updated as necessary and circulated to all appropriate DEQ WQM staff and is also stored on an agency network hard drive where it is readily available when needed.

DCLS factors estimated costs for the purchase and maintenance of laboratory equipment, supplies, labor, etc. into the price of their analytical services. Charges for laboratory services, as well as lists of the specific parameters to be analyzed, sample holding times, analysis methods, and turnaround times for the receipt of analytical results, are itemized in the Laboratory Catalog function of DEQ's CEDS database by 'Parameter Group Code', the analysis code associated with each sample container that is shipped to DCLS (CEDS Laboratory Catalog Figures [VIII-A-2.doc] – Figure VIII-1A). The second tab of the same screen (Figure VIII-1B) identifies the type of sample container and the method of preservation to be used, when required. The third tab (Figure VIII-1C) provides information relative to the method of analysis to be used for each analyte listed for the Parameter Group Code. To see the appropriate method, you must highlight the parameter of interest on the first screen, and then click on the "Method" tab, as illustrated for dissolved ammonia in Figures VIII-1A and VIII-1C.

Once the core parameter list and sampling frequencies have been specified for each monitoring activity, DEQ's Regional Office monitoring coordinators set up their yearly monitoring run schedules in the CEDS database. Ideally, this is accomplished by mid-December of each year. Immediately thereafter, database queries are utilized to elaborate the annual Monitoring Plan (MonPlan) for the following calendar year. This annual MonPlan, in turn, serves as the tool for estimating the total analytical budget for each year's ambient water quality monitoring program, as well as the expected analytical costs for each specific ambient monitoring activity and special study. See the 2013 Monitoring Plan [III-A-0aa.xls] for an example of this summary. The estimated 2013 global analytical budget totaled approximately $1,145,250 for the 2013 calendar year, approximately $776,315 to the state laboratory (DCLS) and $368,935 for other contracted analytical services.

As mentioned, certain programs and special projects within the agency contract for laboratory services to be performed by the private and/or academic sectors. The statewide Targeted Fish Tissue and Sediment Monitoring Program, for example, has traditionally contracted out tissue and sediment analyses to the Virginia Institute of Marine Science (VIMS, at Gloucester Point) and its parent institution, the College of William and Mary (at Williamsburg) – $462,000 in 2006 but, following precipitous declines in resource availability and temporary suspension of the Program, approximately $100,000 in 2013. Analyses for bacterial source tracking (BST) of many bacterial TMDL studies are also contracted out to private or academic laboratories. From 2000-2006 and again in 2010 the fish tissue and sediment samples collected within the National Coastal Assessment (Coastal 2000) and NARS/NCCA Programs were shipped to EPA-contracted laboratories for the analyses of organic and metallic contaminants and for toxicity testing of sediment. In 2006, approximately $77,689 of EPA National Coastal Assessment grant funds were budgeted for analyses of fish tissue and sediment chemistry and for sediment toxicity tests at EPA-contracted

laboratories. An additional $50,000 was expended at DEQ-contracted laboratories for the taxonomic identification of benthic invertebrates from 50 probabilistic estuarine sites. The resources available for these contracted laboratory services are determined and budgeted on an annual basis by the appropriate grant and project managers. The numbers of sites, the sampling frequencies, and/or the suite of parameters to be analyzed within each of these programs must be adjusted to coincide with resource availability.

Each sample shipped to DCLS during the monitoring year is identified with a 'Survey Program Code' that is entered into the LIMS database along with the cost and the analytical results. When transferred to the DEQ database, the same Program Codes identify the specific program or special study to which the analytical costs should be billed. Utilizing these same Program Codes, database queries can be performed whenever desired to determine the total analytical costs of a specific program during a specified period, and whether a specific program or project is within its specified budget.

2. Laboratory Equipment:

Although DEQ does not perform any of its own chemical analyses of ambient samples, each of the seven DEQ Regional Offices maintains its own field-preparation and biological laboratories. Field preparation laboratories are utilized for the preparation and/or temporary storage of materials for ambient monitoring runs. This includes sources of de-ionized water for the preparation of reagents and QA samples, sample containers and labels, and chemical sample preservatives, as well as materials for the calibration of water quality monitoring instruments. Equipment in such laboratories, and associated storage spaces, include analytical balances, ventilated fume exhaust hoods, ice machines, refrigerators/freezers, etc. The biological laboratories are used primarily for storage and taxonomic identification of biological samples (primarily benthic invertebrates) and house such equipment as dissecting microscopes, analytical balances, etc.

3. Logistical Resources:

Logistical requirements place a heavy demand on any ambient water quality monitoring program. The diversity of surface water habitats in the Commonwealth includes almost 50 thousand miles of free-flowing streams and rivers, 150 thousand acres of lakes and reservoirs, and 2,500 square miles of estuaries, as well as 120 miles of Atlantic Ocean coastline (see Chapter 2 – Virginia's Water Resources). In order to monitor the state's waters adequately, DEQ must consequently maintain its own fleet of motor vehicles, boats and trailers. The majority of the agency's ambient monitoring activities are carried out by 'car runs', circuitous highway routings, often of 100 miles or more, during which ambient samples are collected at from six to eight sites, primarily from highway bridges over streams and rivers. Another series of ambient monitoring runs, carried out in conjunction with the Chesapeake Bay Monitoring Program, are referred to as 'boat runs'. The CBP runs are restricted primarily to the tidal portions of the lower James, York, Rappahannock and Potomac Rivers and the Elizabeth River system. Some other boat runs occur in the Atlantic Coastal Bays (Lower Delmarva Peninsula), in the Back Bay / North Landing River systems, and in the Lake Monitoring Program. Ambient samples are collected from boats in open water at multiple sites during each boat run.

(1) Motor Vehicles

The numbers and types of motor vehicles required for water quality monitoring vary considerably among DEQ's seven regional offices, as well as among those programs operated directly from the Central Office in Richmond. Among the inland regional jurisdictions most daily monitoring 'runs', including those boat runs for monitoring small to medium sized lakes, can be accomplished with lightweight vehicles (e.g., cars, pickups, vans or mid-sized SUVs). Monitoring runs that include open water (Chesapeake Bay, coastal embayment waters, major tidal rivers and major lakes) are of prolonged distance/duration and require

heavy-duty vehicles (e.g., Chevy or GMC Suburbans, Ford Excursions, etc.) for towing medium to large boats and trailers. Some types of fieldwork (e.g., storm event sampling / flow measurements by SWI) may require heavy-duty vehicles for the transport of equipment/cargo. A February 2004 inventory of field vehicles used for water quality monitoring (WQM Vehicle List) included a total of 34 vehicles (WQM Equipment Inventory Summary [VIII-A-4.xls]), among which were 15 suburban tow or cargo vehicles. Based on an estimated average annual inflation rate at that time of 5% and a depreciation schedule of 8 years, the 2004 inventory represented an estimated total vehicle value of over $900,000 and an annual depreciation / replacement cost of approximately $113,000. This does not include the costs of vehicles leased from the Virginia Department of Transportation (VDOT - ≈ $23,000) or the cost of a number of monitoring-related activities (CBP, TMDL, QA/QC) that utilize the agency's general 'pool' of motor vehicles. Annual mileage of the vehicles included in the estimate above totaled in excess of 425,000 miles, with an estimated fuel/maintenance cost of at least $85,000 at 2006 prices! Total estimated annual costs for maintenance and replacement of WQM-assigned motor vehicles thus exceeded $220,000. Certain programs (e.g., many CBP, TMDL, and QA/QC activities) use state 'pool' vehicles for the majority of their travel for public meeting, training activities, etc. This may represent a resource requirement as high as 15% or more of the estimates above. Inflation rates from 2004 through 2013 varied from 0.1% to 4.1% (annual average of 2.39%). With a total inflation of 14.2% from 2006 to 2013 [http://www. usinflationcalculator.com/], the $220,000 annual maintenance/replacement figure above would represent at least $252,992.42 annually at current prices. (The rise in fuel prices has significantly outpaced average inflation rates!)

(2) Boats, Motors and Trailers

A January 2004 query of DEQ's property database (WQM Equipment Inventory Summary [VIII-A-4.xls]) for additional logistical equipment (boats, motors and trailers) associated with the water quality monitoring programs indicated the inventory summarized here. The WQM programs then had 32 boats of various sizes in their inventory. These boats varied from 35 years of age (small johnboat) to more recent and larger acquisitions (in 2003). In the linked summary the original acquisition prices were corrected to estimate updated replacement values by applying an average annual inflation rate of 5%. The estimated replacement value of the inventory at that point was approximately $360,000 for boats, $108,000 for motors (inboard and outboard) and over $64,000 for trailers. The updated replacement values of each item were subsequently divided by their expected service lives to estimate the average annual depreciation (i.e., annual resource requirements for maintaining and replacing the inventory in a timely manner). Totaled over the three classes of water transportation items, an annual allocation of approximately $56,000 ($63,572.43 in today's currency) would have been needed to maintain the inventory within recommended service life and in acceptable condition. Many of the items included in that inventory had already greatly exceeded their normally expected service lives and, unfortunately, investments in new capital equipment are often the first expenditures to be cut when resources are restricted.

(3) Water Quality Monitoring Instruments (field)

The same January 2004 database revealed an inventory of field sensors, recording instruments, data loggers, etc. with an estimated replacement value of $370,00. (The same methodology as described above was utilized to estimate the annual resource investment required to maintain that inventory up to date: approximately $46,000 (about $52,379.62 at 2013 prices). This inventory did not include the instrumentation for discharge measurement and real-time data transmission associated with the Surface Water Investigations Program!

In 2005 DEQ established a formal six-year rotational replacement schedule for the purchase of new multiprobe sondes (Hydrolab, Yellow Springs Instrument, InSitu, etc.) for the measurement of water quality field parameters: temperature, dissolved oxygen, pH and conductivity/salinity. From 2007 through 2012, five new instruments were to be purchased each year, at an estimated annual cost of $38,500 (2006

prices). That figure would be around $43,967.00 annually at 2013 prices. The potential addition of probes for the measurement of other parameters (*e.g.*, field turbidity, chlorophyll) may significantly increase the resource requirements beyond these estimates.

(4) Miscellaneous Equipment

Several other selected categories of miscellaneous equipment (e.g., field communications, electro-shockers, laboratory equipment) were included in the same inventory summary. They are not itemized or quantified here because, in many cases, such items are provided by other programs and the specific cost and program codes utilized for the query did not identify them. For example, water purification equipment, fume hoods, ice machines, refrigerators, freezers and other such equipment are often considered part of the generalized regional office infrastructure and are not specifically linked to WQM program cost codes. The lists of these items are consequently incomplete and trying to estimate the value of the inventory would not be beneficial with the data currently available.

(5) Other Support Resources:

No attempt has been made to itemize or summarize office and/or internal laboratory costs (‘Overhead’ or indirect costs - offices, services, etc.) specifically assigned to the WQM offices and/or programs described in this document. As a general figure, ‘overhead’ or indirect costs are normally estimated as a fixed percentage of human resource salary costs. Based on application of the federally approved standard figure (28.5%) for indirect cost rate, the total indirect costs would have totaled approximately $1,282,500 for state fiscal year 2006 - $1,464,615.00 for calendar 2013. This is probably a very conservative figure in relation to true overhead costs.