2. Lakes Monitoring Program

(1) Strategy

Targeted lake and reservoir monitoring is viewed as a subset of the overall agency ambient water quality monitoring effort. Although agency regional office field staffs monitor primarily man-made reservoirs rather than lakes, this program is commonly referred to as the Lake Monitoring Program. In 2001 a joint Central and Regional Office subcommittee of the agency's former Water Quality Monitoring Strategy Task Force redesigned the Lake Monitoring Program to increase the frequency of monitoring of significant lakes, in order to better meet agency data assessment needs. That approach allowed the regional offices to more effectively allocate existing lake monitoring resources and at the same time provide the data for various identified agency assessment goals. The revised plan focuses staff resources on more frequent sampling of significant, high priority lakes in order to have sufficient data to produce highly accurate and reliable assessments. A more comprehensive description of the lake monitoring plan is provided in the current Guidance Memo for "Targeted Lake and Reservoir Monitoring" [III-B-2a.pdf].

Objectives: The purpose of the agency's lake and reservoir monitoring program is to provide data for the following uses:

(1) Section 305(b) reports,
(2) Section 303(d) lists,
(3) Local citizen concerns, and
(4) Determinations whether the water quality is sufficient to maintain existing uses.

(2) Monitoring Design

Source List of Lakes: An updated version of the May 2000 public-noticed list now serves as the source of lakes for prioritization and selection for monitoring by DEQ. The current list can be found as Appendix G of DEQ's 2012 Water Quality Assessment Guidance Manual. Significant lakes are defined as "All publicly accessible lakes that are either public water supplies or 100 acres or more in size." This definition includes the federally owned lakes that meet these criteria, but other federally owned lakes are excluded from the agency's Lake Monitoring Program. Under the current (2012) classification, 122 reservoirs and one lake are included in the prioritization list. Seventy-six (76) of these are identified as Public Water Supply (PWS) sources. Only one of Virginia's two natural lakes, Lake Drummond within the Great Dismal Swamp National Wildlife Refuge, is currently included in the prioritization list. The other, Mountain Lake (48 ac), is privately owned and is intensively monitored by the University of Virginia.

Periodic Updates to the List: It is the responsibility of each DEQ Regional Office to periodically (at least once every two years) update the master list by deleting lakes that have been drained or converted to private ownership, and adding newly constructed lakes and reservoirs. A more comprehensive list of lakes and reservoirs associated with the recent development and application of lake nutrient standards [III-B-2c.xls] may also result in the expansion of the "Significant Lakes" list. Although this list may be updated and change slightly from one two-year assessment cycle to the next, most major reservoirs and lakes meet the criteria for inclusion and are monitored on a permanent basis. The mapping precision provided by Geographic Information Systems (GIS) has also resulted in more accurate area determinations, which may influence the inclusion or not of small reservoirs. An improved reservoir/lakes GIS layer, better representing all of the significant and assessed lakes in the state, was completed in 2006 using the high

resolution National Hydrography Dataset. This layer was used to more efficiently complete the 2006 Integrated Report and map products as well as to update the internet mapping applications.

Prioritization for Monitoring: All lakes must be publicly accessible to be considered for monitoring resources. A "Lakes Prioritization Matrix" [III-B-2c.doc] provides a standardized method for each DEQ Regional Office to rank the lakes within its geographic region for monitoring, based on their use and impairment history. After the lakes are prioritized, each region determines how many lakes they have resources to monitor in any given year.

Documentation of Alternative Basis for Selection for Monitoring: The prioritization matrix is a starting point for prioritizing lakes in need of monitoring, but it is not intended to prevent a region from using a different approach if required by a unique circumstance. If a region decides not to use the results of the matrix, regional staff must document the rationale for the deviations and describe the alternative approach used to prioritize lakes for monitoring.

(3) Site Selection

The sampling location(s) in each lake are determined by the lake's morphology. In lakes that are almost round in shape, one station located in the deepest part of the lake (usually the center of the lake) is considered adequate. Since a single sampling station should be representative of the overall lake water quality, it should not be located near a dam, close to shore, or near stream inflows or point source inputs. In lakes with distinctive sub-basins, coves, fingers or multiple inlets where significant water quality differences might exist, additional sampling sites may be required. Standard DEQ station identifications, as well as latitude and longitude descriptors, identify all monitoring sites.

(4) Sampling Method

In-lake water samples should be collected from an anchored boat with either a water bottle sampler or a pump and hose. At a minimum, water samples are collected at 0.3 meters below the surface. Additional sampling depths are optional. Hydrographic profiles of temperature and dissolved oxygen are measured from surface to bottom at one meter intervals with a multiprobe sonde (Hydrolab, YSI or InSitu).

(5) Sampling Frequency

The minimum sampling frequency for each lake is once monthly, from April through October, for the calendar year. This will result in a total of seven sampling events in each lake over one year. If resources are available, regional offices may elect to monitor their high priority lakes more frequently (e.g., semi-monthly or weekly) and/or on an annual basis or other rotational interval more frequent than every five years (see below). Such increased monitoring may be warranted in situations such as high recreational usage, shoreline development, or citizen concerns.

Lakes Monitoring Rotation: The data window for 305(b) Report assessments has now been expanded to six years. Thus, individual high priority lakes will generally be monitored on a six-year rotation, i.e. one sixth of the lakes would be monitored the first year, the next sixth would be monitored the second year, etc. The rotation would begin again in the seventh year.

Optional Questionnaires for Lower Priority Lakes: Since the emphasis is on using existing resources to sample and assess the high priority lakes, the lower priority lakes will often go unmonitored. In such situations, the regional office has the option to utilize questionnaires or desktop screening assessment tools to obtain use and impairment data from the lake owners, lake monitoring volunteers, public water supply managers, or others with knowledge of a particular lake.

(6) Core and Supplemental Water Quality Indicators

Parameter Selection for Lab Analysis: Minimum parameter lists and monitoring frequencies are identified for specific lake monitoring assessment goals. The table "Minimum Parameter List by Type of Assessment" [III-B-2d.doc] lists those parameters currently considered minimal for various assessment purposes. Regional offices may elect to have the laboratory analyze samples for additional parameters to meet other regional needs. For example, some regional offices with significant VPDES discharges to a lake might elect to run biochemical oxygen demand and suspended solids. For 305(b) assessment purposes, the minimum parameter list is dissolved oxygen, pH, temperature, *Escherichia coli* bacteria, and conductivity or salinity (where appropriate). At a minimum, samples should be collected in the epilimnion or at a depth of 0.3 meters if the lake is not stratified. To determine trophic status or potential need for regulatory designation as a nutrient enriched water, the following parameters need to be collected: alkalinity, hardness, Secchi disk depth, chlorophyll-a, dissolved oxygen/temperature depth profile, total nitrogen, total phosphorus and orthophosphorus. The minimum parametric coverage for toxicity assessment is ammonia, pesticide/herbicide scan in sediments, and metals scan in sediments. Sediment samples should only be collected once per six-year rotational cycle at one station in the mainstem of the lake. Lake monitoring parameter group codes for samples submitted to the state Division of Consolidated Laboratory Services (DCLS) for analysis are listed in the linked table of Parametric Coverage [III-A-0b.xls] under Program Code RL.

Field Measurements: Field measurements at each sampling station should include a temperature and dissolved oxygen profile with measurements taken at intervals of one meter (using a combined temperature/dissolved oxygen meter). Field measurements should also include pH, conductivity (or salinity where appropriate), and Secchi depth. All of these field measures, including the dissolved oxygen/ temperature depth-profile data, should be entered into the WQM CEDS 2000 database. Records of field observations are also useful and can prove to be helpful later when assessing the data results. For example, staff personnel are advised to not rely on chlorophyll-a data if algaecides were applied near the time of sampling. Such observations should also be entered into the "Comments" field of the Field Data Screen of the CEDS database.

(7) Quality Assurance Measures

QA measures for the Lakes Monitoring Program are the same as for the remainder of DEQ's Ambient Water Quality Monitoring Program, and are detailed in the agency's WQM Standard Operating Procedures Manual [IV-f.pdf]; updated versions will appear on the DEQ Quality Assurance/Quality Control Webpage [http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/QualityAssuranceQualityControl.aspx].

(8) Data Management/Assessment/Reporting Requirements

It is the responsibility of the DEQ Regional Office lake-monitoring team to provide the regional 305(b) planners with an electronic version of the WQM lakes data. Once the lake monitoring team and planners consult and reach agreement on the reliability and meaning of the data, it is the responsibility of the planner to retrieve and enter the data into the Assessment Database (ADB) for use in the biennial 305(b) Report.

(9) Periodic Review of Program

Until recently, administrative coordination of the Lake Monitoring Program was the responsibility of DEQ's Central Office of Water Quality Standards. Coordination of the Lake Monitoring and Biological Monitoring Programs has now been transferred to the Water Quality Monitoring and Assessment Program, with decentralized field implementation carried out by the DEQ Regional Offices. The Central Office revises the guidance memoranda as needed, with input and review from the Regional Offices. The most

recently updated version was approved on April 23, 2009 under the signature of the Director of the Water Division. It is the responsibility of each region to periodically (at least once every two years) update the 'Master List' by deleting lakes that have been drained or converted to private ownership and adding newly constructed lakes and reservoirs.

(10) General Support and Infrastructure

The Lakes Monitoring Program is supported by general state funding for ambient monitoring, with the State Department of General Services, Division of Consolidated Laboratory Services (DCLS) providing contractual analytical support. In a 2012 survey related to monitoring priorities under drastic resource declines, staffs at the DEQ Central and Regional Offices ranked Lake and Reservoir Monitoring as the lowest priority among the ambient monitoring programs.

(11) Lake Monitoring Program – 2013 and Beyond

Implementation of Lake Nutrient Criteria

The Department has amended the state's Surface Water Quality Standards (SWQS) to add new criteria to protect designated uses of 116 man-made lakes and reservoirs, as well as the two natural lakes in the state, from the impacts of nutrients:

- Addition of definitions for five terms (algaecides, epilimnion, lacustrine, man-made lake or reservoir, and natural lake) used in the text of the amendments;
- Clarification that during times of thermal stratification, the existing dissolved oxygen criteria applies only to the epilimnion in the lacustrine portion of the man-made lakes and reservoirs covered by nutrient criteria;
- Addition of a new section for numeric chlorophyll-*a* and total phosphorus criteria for the 116 listed man-made lakes, including an allowance for site specific modifications to the criteria if the nutrient criteria specified do not protect downstream waters;
- Clarification that water quality assessment of nutrient criteria (chlorophyll *a* and total phosphorus) will be based on the two most recent monitoring years with available data;
- Addition of a procedure for confirmation of use impairments when criteria are exceeded; and
- Addition of numeric nutrient criteria to maintain the current water quality of the two natural lakes in Virginia, Mountain Lake and Lake Drummond.

The Environmental Protection Agency reviewed and approved these amendments and new guidance was finalized on April 23, 2009. The updated Guidance Memo for "Targeted Lake and Reservoir Monitoring" [III-B-2a.pdf] did not introduce extensive changes, since the adopted criteria were based on the historical lake monitoring database and current monitoring program schedule of April through October.

Resources permitting, Virginia plans to continue their monitoring schedule, which follows a six year rotation of 100 or more lakes, and to add additional man-made lakes and reservoirs to the regulation as monitoring data become available from outside groups or future agency monitoring efforts.

Participation in the EPA National Lake Survey

The agency participated in EPA's NARS - National Lake Surveys in 2007 and again in the summer of 2012. The agency is planning to participate in the survey again in 2017. The Department's freshwater probabilistic team has conducted the probabilistic lake sampling in the past and plans to continue doing so, thus allowing the agency's seven regional offices to continue their routine lake monitoring in 2017 without any interruption to that established program. Department staff plans to assess the applicability of the

parametric coverage and sampling methodology from the National Survey to Virginia's statewide lake monitoring program and to implement appropriate adjustments to the state monitoring effort.

Need to Assess the Feasibility of Adding a Biological Monitoring Component

Within the next ten years, the Lake Monitoring Program needs to assess the feasibility and costs of adding a biological IBI component to lakes monitoring and, based on the evaluation, consider implementation of a pilot study. Benthic and/or algal indices are more cost effective than fish IBIs. Current contractual costs for algal identification and index calculations have been estimated at $100 - $400 per sample, if the algal component to lake monitoring were to be implemented. The addition of a position to perform this work in-house, or the contracting of skilled services for algal identification, would require additional resources.

In conjunction with this and other needs, the program may be able to draw some additional staffing assistance for lake monitoring from the recently (2007) acquired second biologist positions at most regional offices. These positions were not created specifically for the lake monitoring program, however, and at this point it is unknown how much of their time will be available for that purpose. Staffing resource constraints are always a consideration, since it requires a minimum of two staff members in a boat, and until recently the agency has only had a single biologist at each regional office. Coordination of the decentralized lakes monitoring program has recently been integrated into the job description for the position of Biological Monitoring Coordinator, concurrently with the program's administrative transfer to the Water Quality Monitoring and Assessment Program.

Contact: For additional information on the Lakes Monitoring Program, contact:

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