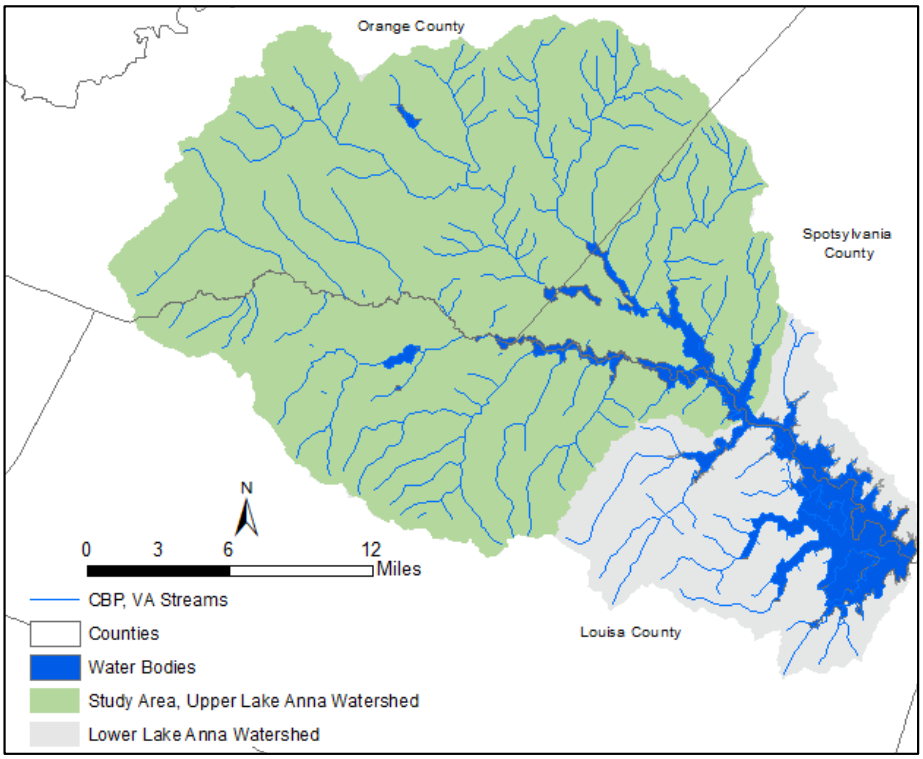
HAB Watershed Planning, Lake Anna, VA Task Descriptions

This document describes anticipated working tasks to develop a watershed plan to address Harmful Algae Blooms (HABs) in the upper Lake Anna watershed, Virginia, based on the nine-element requirements of watershed plans outlined in EPA's "Handbook for Developing Watershed Plans to Restore and Protect Our Waters". These tasks correlate to the Phase 2 objectives set forth by VA DEQ as part of the plan for implementing the HAB studies for the upper Lake Anna study area. The specifics of this document may need to evolve over time prior to the project start based on project Phase 1 results. Any changes will be made by mutual VA DEQ-ICPRB agreement in writing.

Objective

Prepare a Harmful Algae Bloom (HAB) watershed plan for the upper Lake Anna watershed, under the direction of and in collaboration with VA DEQ, in cooperation with partner organizations like VDH and USGS, and with input from the local community. The study area of this project focuses on the upper portion of Lake Anna where HABs have been identified and no swim advisories have been issued by VDH. The downstream extent of the study area is demarcated by the Rt. 208 bridge crossing. Figure 1 presents the study area which includes the riverine portions of the upper Lake as well as a portion of the transition zone.

Figure 1. Upper Lake Anna Watershed Study Area and Surrounding Areas.



Description of Activities

Specific tasks involved in developing the watershed plan are outlined in Tasks 1-11 below. Where applicable, the EPA element number (EPA 2008) that corresponds to the task is identified in *italics*. Except if/when explicitly approved by VA DEQ, completion of these tasks will follow the EPA guidance for developing watershed plans (EPA 2008). The task descriptions below include brief descriptions of the components of each activity. Additional details are available in EPA (2008).

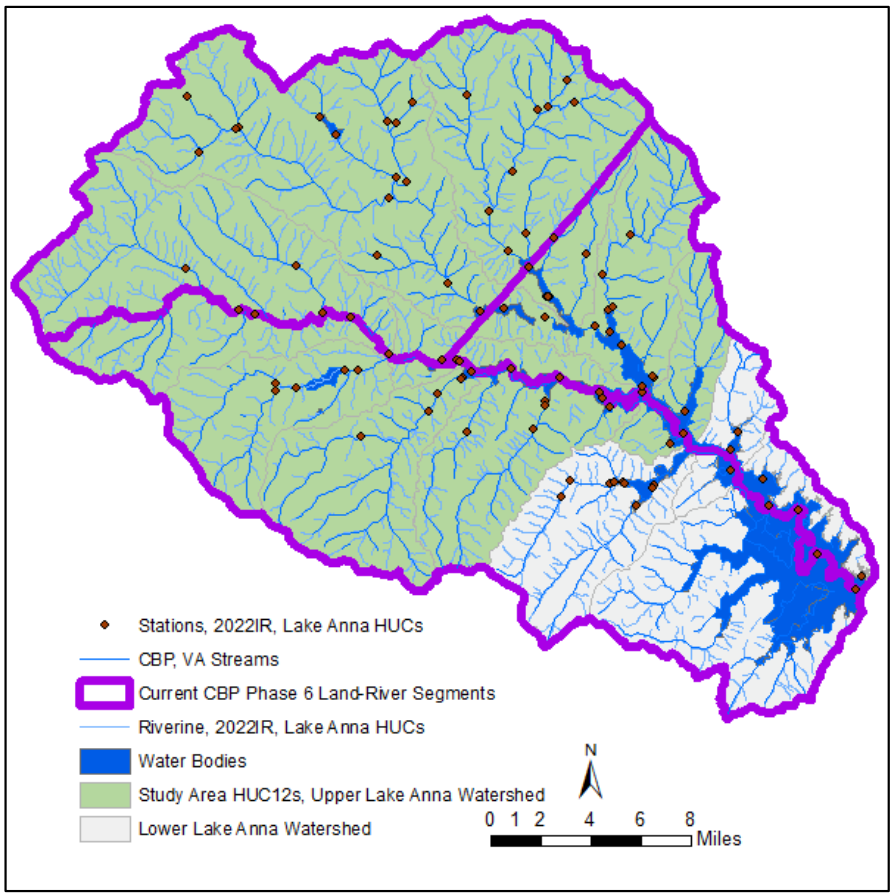
Task 1. Identify causes of impairment and pollution sources or groups of similar sources that need to be controlled to achieve needed load reductions and calculate baseline loads *(element a)*

The watershed plan requires a quantitative estimate of baseline conditions to serve as a foundation for understanding the level of effort needed to restore a watershed to target conditions (per relevant standards and/or criteria). The specific composition of these activities will depend on the results of Phase 1 of the VA DEQ approach to addressing HABs (the data collection, evaluation, and source identification phase). Based on the results of that phase, the management target(s) will be identified (e.g., chlorophyll-a, nutrients, and sediments). Baseline amounts (loads) of the management target(s) will then be estimated. Development of two models, a watershed model and a lake model, will inform baseline load calculations and, subsequently, long-term management options for controlling HABs in the upper Lake Anna watershed. Note that the models do not simulate HABs explicitly. ICPRB staff will work closely with VaDEQ and the project team to prioritize key model outputs to describe the system incident to HABs. Descriptions of the two models currently envisioned for this process are provided below. Changes to this approach may be made by mutual agreement between VA DEQ and ICPRB. Specifically, the data and tools needed to quantify baseline amounts may need to be adjusted depending on the selected management target(s) and applicable threshold(s) aimed to be protective of water quality limiting the formation of HABs.

The watershed model will capture the primary landscape-scale drivers and nutrient contributions to the lake and can simulate the effects of long-term, landscape-scale protection efforts on those contributions. The watershed modeling process will leverage the existing broader scale Chesapeake Bay Program (CBP) Phase 6 Watershed Model (Linker et al. 1999; EPA 2010; Shenk et al. 2012; EPA 2018). It is a fully calibrated, community-developed Hydrologic Simulation Program-FORTRAN (HSPF) model developed for the Chesapeake Bay watershed (EPA 2018). The CBP HSPF model is a continuous simulation model, with a simulation period of 1984-2005. It is modular in nature and is capable of simulating hydrology, sediment, nutrients, and toxics. The CBP Watershed Model, and HSPF in general, simulates land and river processes. In terms of hydrology, land processes represent the flow of water through the hydrological cycle. Simulated river processes include the routing of flow.

Figure 2, below, shows the three CBP land-river segments in the Lake Anna watershed. These segments can be further segmented (e.g., HUC12 or similar) to provide additional spatial resolution in the study area (above the Rt. 208 bridge). Water quantity and quality data collection efforts from Phase 1 of this project, ongoing VA DEQ monitoring in the watershed, and citizen monitoring will provide essential inputs for watershed model development and verification.

Figure 2. Chesapeake Bay Program's Phase 6 Watershed Model's (HSPF) Land-River Segments in the Lake Anna Watershed.



The lake model encompasses the physical and biological processes of the lake related to the end goal, reducing HAB occurrence (examples of lake modeling to address HABs are available in the literature and include Shen et al. 2019 and Myer et al. 2020). ICPRB will develop a CE-QUAL-W2 model (Cole and Wells 2003) for the lake above the Rt. 208 bridge. CE-QUAL-W2 is a "water quality and hydrodynamic model in 2D (longitudinal-vertical) for rivers, estuaries, lakes, reservoirs and river basin systems. W2 models basic eutrophication processes such as temperature-nutrient-algae-dissolved oxygen-organic matter and sediment relationships." Model capabilities include "Longitudinal-vertical hydrodynamics and water quality in stratified and non-stratified systems, nutrients-dissolved oxygen-organic matter interactions, fish habitat, selective withdrawal from stratified reservoir outlets, hypolimnetic aeration, multiple algae, epiphyton/periphyton, zooplankton, macrophyte, CBOD, sediment diagenesis model, and generic water quality groups, internal dynamic pipe/culvert model, hydraulic structures (weirs, spillways) algorithms including for submerged and 2-way flow over submerged hydraulic structures, dynamic shading algorithm based on topographic and vegetative cover." [1] CE-QUAL-W2 has been used in previous studies to assess the effect of nutrient loading on chlorophyll-a and dissolved oxygen (Wood and Rounds 1998; Gelda and Effler 2000) and to estimate appropriate ratios of chlorophyll a to algal biomass (Noren 2019).

[1] http://www.ce.pdx.edu/w2/home.html, accessed November 21, 2022.

Task 2. Estimate necessary load reductions *(element b)*

Load reductions needed to achieve goals (e.g., water quality standards, criteria, or other) utilizing the results of Task 1 will be estimated. The estimate of load reductions needed through management measures will be calculated as the difference between current loads (estimated in Task 1) and loads consistent with water quality standards or the relevant threshold/criteria. The watershed and lake models will be used to estimate the load reductions needed to achieve management target(s) at the models' spatial resolution.

Task 3. Description of management measures to achieve load reductions and the critical areas in which these need to be implemented *(element c)*

The purpose of this task is to generate a description of the nonpoint source management measures that will need to be implemented to achieve the load reductions estimated in Task 2 and an identification (using a map or a description) of the critical areas in which those measures will be needed. The list of management measures necessary to achieve required load reductions (quantified in Task 2) will be finalized in consultation with VA DEQ and stakeholders through the stakeholder participation process. High-risk areas for algae blooms will also be identified as high-priority areas for targeted implementation.

This task will depend heavily on Phase 1 USGS monitoring data as well as literature compilations of potential management measures and their reduction efficiencies.

Task 4. Estimate the technical and financial assistance needed to implement plan *(element d)*

For each of the proposed management alternatives (Task 3), the technical and financial assistance needed; costs; potential funding sources; necessary permits and review; and lead agency or organization will be described. Types of technical and financial assistance evaluated for each management measure will include, but are not limited to, administrative components (e.g., salaries, in-kind services); education; installation, operation, and maintenance of management measures; and monitoring, data analysis, and data management activities. The cost associated with each of these activities will also be estimated. The cost of implementation will be estimated using previously developed watershed and implementation plans, communication with professionals, and site-specific information where available. Potential funding sources to cover the costs will be identified to facilitate subsequent implementation of the management plan.

Task 5. An information and education component of the watershed plan, used to enhance public understanding of the project and to engage participation in implementing the identified management measures *(element e)*

The purpose of this task is to develop an information and education component of the watershed plan. ICPRB will work closely with VA DEQ to develop the information and education component and prepare the written portion of the plan for this element.

Task 6. Schedule for implementing management measures *(element f)*

A schedule for implementing the nonpoint source management measures identified in this plan that is reasonably expeditious will be developed with input from stakeholders and VA DEQ. ICPRB will prepare a draft schedule for implementing management measures for review and comment by the local stakeholders through informal communications and meeting(s). Input received by VA DEQ and the local stakeholders will be utilized to revise and finalize the implementation schedule. The schedule will include a timeline and the designation of responsible organizations.

Task 7. Description of interim measurable milestones to track progress in implementing management measures *(element g)*

A draft description of interim measurable milestones for determining progress in implementing nonpoint source management measures or other control actions will be developed and finalized with input from stakeholders and VA DEQ utilizing a process as described in Task 6. Short-term, mid-term, and long-term milestones will be developed as recommended by the EPA. Milestones will be specific, measurable, achievable, relevant to a particular management measure, and time-sensitive. Moreover, the plan will describe what will be done if the milestones are 1) achieved in a shorter time period than anticipated or 2) not being achieved.

Task 8. Criteria for determining progress towards meeting water quality standards *(element h)*

ICPRB will develop a draft set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made toward attaining water quality standards. The criteria may include both 1) measures based on monitoring data, such as the number of HAB advisories, and 2) measures based on the progress of implementation tasks, such as the number of implemented Best Management Practices. Established criteria will be compatible with the implementation schedule (developed under Task 6). The draft criteria will be made available to VA DEQ and relevant stakeholders. Feedback received will be utilized to develop a final set of criteria for determining progress towards meeting water quality standards.

Task 9. Monitoring component to evaluate effectiveness of implementation efforts over time *(element i)*

A monitoring component will be developed to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under Task 8. Phase 1 of the HAB work in the Lake Anna watershed will provide a strong foundation of monitoring. Other existing monitoring efforts (e.g., those described VA DEQ's Lake Anna Water Quality Monitoring Plan implemented by DEQ and LACA) and Phase 1 monitoring efforts will form the basis of the monitoring component; however, additional or specialized monitoring for effectiveness of implementation efforts may also be necessary. Additional monitoring efforts will be defined based on the final selection of management measures. The monitoring component will be finalized with input from VA DEQ, partner agencies, and local stakeholders.

Task 10. Preparation of the watershed plan document

One plan document will be prepared for the Lake Anna watershed based on the results of the efforts described in Tasks 1-9.

Task 11. Engagement

The purpose of this task is to enhance public understanding of the project and encourage early and continued participation in selecting, designing, and implementing the management measures that will be recommended for implementation as part of the plan. The counties of Louisa, Spotsylvania and Orange, the Rappahannock-Regional and Thomas Jefferson Planning District Commissions, the Culpeper and Thomas Jefferson Soil & Water Conservation Districts as well as the Lake Anna Civic Association (LACA) and Lake Anna Advisory Council (LAAC) are organizations that should be engaged in this process. They may also play a role in identifying and communicating with key stakeholders.

ICPRB staff are available to participate in public outreach and communications at up to five steering committee, working group, or public meetings. The number of meetings can be adjusted by mutual agreement between ICPRB and VA DEQ. ICPRB staff are also available to assist DEQ in responding to comments on the draft interim reports and the draft watershed plan. Participation in internal coordination and planning meetings that include VA DEQ, USGS, VDH, and ICPRB are also expected to occur throughout the duration of the project.

Deliverables and Schedule

The outcome of this work will be one watershed plan that includes the nine elements as described in the EPA's *Handbook for Developing Watershed Plans to Restore and Protect Our Waters*. The document is expected to provide a roadmap for addressing HABs in the Lake Anna watershed. All written deliverables will be submitted to VA DEQ electronically. The work schedule summary is provided in Table 1. While the bulk of the technical and participatory work for the watershed plan is expected to occur of two years (eight quarters), ICPRB's involvement under this scope of work is expected throughout the duration of the two-phase project in the upper Lake Anna watershed.

Table 1. Work schedule summary by task and quarter.

Task	Short Title	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
1	Current conditions/baseline loads (watershed and lake modeling)								
2	Load Reductions								
3	Management Measures								
4	Assistance Needed								
5	Information and Education								
6	Implementation Schedule								
7	Milestones								
8	Progress towards Water Quality Standard								
9	Monitoring Plan Development								
10	Document								
11	Engagement								

A draft schedule of deliverables is available in Table 2. Dates for submission of the milestones and deliverables associated with this effort, including quarterly reports, draft plans, and final plans, may need to be adjusted based on further discussion with VA DEQ and partner agencies and based on the progress and timelines of Phase 1 work. The schedule for participation in public meetings, steering committee meetings, and/or working group meetings will also be informed by those discussions. The schedule of deliverables may be adjusted by mutual VA DEQ-ICPRB agreement in writing (e.g., if the public participation schedule merits a change in deliverable due dates).

Table 2. Schedule of deliverables.*

Milestone or Deliverable	Date
Begin project	July 1, 2023
Phase 1, Participation and Assistance • *Memo summarizing activities*	Sept 30, 2024
Begin Phase 2, Task 1 activities	Oct 1, 2024
1st quarterly progress report	Jan 2, 2025
2nd quarterly progress report • *Memo summarizing progress on Task 1 modeling efforts*	April 1, 2025
3rd quarterly progress report	July 1, 2025
4th quarterly progress report • *Memo summarizing results of Task 1*	Sept 30, 2025
5th quarterly progress report • *Memo summarizing load reductions*	Jan 2, 2026
6th quarterly progress report • *Draft spreadsheet of management measures* • *Draft write-up of assessment of implementation actions needs along with measurable goals and milestones for attaining the water quality standard, submitted with quarterly report*	April 1, 2026
Draft Plan Components • *Electronic copies of draft technical report to VA DEQ*	July 1, 2026
7th quarterly progress report	Sept 30, 2026
Responses to public comments	Jan 30, 2027
Final Implementation Plan • *One electronic copy of the watershed plan and associated spatial files to VA DEQ*	April 1, 2027
Public participation and communication materials	To be determined by mutual agreement
Final (8th) quarterly progress report	July 1, 2027
End project	Dec 30, 2027

*The invoicing is based on fixed cost for each deliverable.

Budget

The total cost will be finalized in consultation with VA DEQ and is currently estimated at $253,028. Travel for three staff members for five trips from Rockville, Maryland to the Lake Anna watershed is included in the budget (216 miles roundtrip at 62.5 cents per mile, the current federal mileage rate). A $1,000 contribution to ICPRB's ESRI ArcGIS license and participation by two staff in a June 2024 CE-QUAL-W2 workshop are also included.

Table 2. Estimated costs for Lake Anna watershed planning including watershed and lake modeling.

Expense
Salary
Fringe*
Indirect**
Equipment/Supplies
Travel
Other (CE-QUAL_W2 Workshop)
Total

*Fringe benefits and costs are applicable to salaries and wages. The fringe rate used here, 50%, is provisional for FY2023 and based on experience to-date. Actual fringe costs are applied at the end of each fiscal year after the audit is performed. ICPRB complies with the cost principles of the OMB Circular A-87 (Cost Principles for State, Local and Indian Tribal Government).

**The indirect expense is based on ICPRB's approved provisional rate for FY2022, 58.23%.

References

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