# Draft Scope of Work for Delaware River Ecological Flows Study

# July 2011

# ****Study Goal****

Providing basin-wide goals and standards for river flow management is a priority for the Delaware River Basin Commission (DRBC), The Nature Conservancy (Conservancy), and other partners. This project will result in flow recommendations based on ecological responses to flow alteration that DRBC can incorporate into water management planning and permitting, while meeting demands for water use.

# ****A****pproa****ch****

The Conservancy proposes to facilitate a 12-month process to develop basin-wide ecosystem flow recommendations that can be implemented within the subwatersheds of the Delaware River. This process would follow the general model of other basin-scale projects that the Conservancy has been engaged in on large rivers, including a recent project on the Susquehanna River[[1]](#footnote-1) and a current project in the Pennsylvania portion of the Ohio River basin. The Conservancy will compile and interpret existing information on ecological health in relation to streamflow, including information from the Delaware basin and similar systems. The process incorporates at least two (possibly 3) technical workshops where relevant information and best professional judgment would be used to set ecosystem flow recommendations specific to the range of stream and river habitats within the basin.

Seasonal ecosystem-based flow recommendations would account for the range of flow conditions relevant ecosystem protection such as drought flows, seasonal base flows, and some high flow conditions. Along with magnitude of these flows, the process will also consider frequency and duration of flow conditions and the degree to which these conditions can deviate from minimally-altered flows conditions with limited ecological risk.

# ****Project Steps****

The process to develop ecosystem flow recommendations includes the following steps, following the approach published by Richter et al (2006)[[2]](#footnote-2) and the steps required to complete the Susquehanna River study.

1. **Form project management team and hold initial project management team meeting** – The project management team will include representatives from DRBC and the Conservancy, and may include individuals from other agencies and organizations at DRBC’s discretion. This team will be responsible for all aspects of project management and decisions related to project scope and deliverables. The first tasks of the project management team will be to:
2. Review the flow needs and recommendations developed through the Susquehanna River Ecosystem Flow Study to (a) identify potentially transferrable information and (b) begin to identify Delaware-specific issues and needs.
3. Identify project advisors to provide input on critical decisions during the course of the project. Project advisors will likely include staff from relevant agencies and organizations and invited academic researchers.
4. Review and agree on the project workplan and schedule.
5. **Host first project workshop: Orientation and Flow Hypotheses** – The objectives of the first 1.5-day workshop will be to:
6. Introduce the project to the project advisors and review project goals and workplan.
7. Solicit input on 1) flow-sensitive species, communities, and processes; 2) stream types within the basin and existing stream and river classifications applicable to structuring flow recommendations; and 3) available literature, models and data.
8. Develop draft flow hypotheses for how select species, communities and processes would respond to flow changes in various months and seasons.
9. **Begin literature and model review and summary –** In collaboration with DRBC and project advisors, the Conservancy will compile and review literature, existing reports, relevant studies, and available data and summarize the existing knowledge about flow-dependent biota and ecological processes within the Delaware River basin. This review will consider relevant information on hydrology, fluvial geomorphology, fisheries biology, and riparian ecology. Sources will include peer-reviewed journals, unpublished literature, technical reports, data and other information available from academic researchers, agency staff, and sources identified during the course of the project. Existing hydrological, hydraulic, and biological models will be reviewed for their potential relevance. Many relevant sources were likely reviewed and incorporated in the Susquehanna flow study; this effort will focus on (a) Delaware-specific sources; (b) studies that have been completed/published since the Susquehanna review was completed; and (c) incorporating relevant information from studies on other river basins.

Relevant information from the literature and model review will be organized to describe ecological flow needs for the various stream and river types that occur in the basin. In consultation with project advisors, the project management team will define a set of major stream and river habitat types and use them to organize information about flow needs for various species and natural communities in the basin. Major habitat types will likely be defined by combining relevant features and variables used in existing stream and river classifications, including watershed size, temperature, flow stability, physiography, and/or protection status.

1. **Complete hydrologic characterization to estimate range of baseline and current hydrological variability –** Following Richter et al (1997)[[3]](#footnote-3), the Conservancy and DRBC will complete an assessment to document the range of flow variability at selected points within the Delaware River basin. The goal of this step is to document hydrologic variability of streams that are minimally impacted by dam and reservoir operations, water withdrawals and diversions, and extensive land cover changes[[4]](#footnote-4). The characterization will include to the impacts of existing water management where baseline (minimally-altered) and current (altered by existing water management) flow conditions exist. This characterization helps frame ecosystem flow recommendations for various streamflow components, including:

* Monthly flow magnitude
* Annual extreme low flow magnitude and the intended frequency of occurrence, duration, and timing of extreme low flow events during the year
* High flow and flood pulses and their intended annual frequency or recurrence interval, as well as their duration, timing, and rates of rise and fall

Steps 3 & 4 will provide preliminary hydrological and ecological information needed to draft and review flow recommendations in a workshop setting.

1. **Draft ecosystem flow recommendations** **and hold flow recommendations workshop** – The project management team will host a 1.5-day workshop with the project advisors to define quantitative ecosystem flow recommendations for key flow components. Flow recommendations will be based on the flow needs defined at the previous workshop and review of relevant literature. Prior to the workshop, the Conservancy will develop and distribute draft flow recommendations as a starting point for discussion. Flow recommendations will

* address various flow components (e.g. high, median, low flows);
* be applicable to headwater streams and small and large rivers; and
* address naturally-occurring seasonal and interannual flow variation.

Taken together, the resulting suite of flow recommendations will seek to maintain the range of variability that supports the variety of taxonomic groups and ecological processes in the basin.

Workshop participants will likely be split into workgroups according to their familiarity with the different ecological systems or river sections. Each group will be charged with reviewing, revising, and adding, if necessary, flow recommendations that will meet the ecological requirements of their assigned riverine processes, habitats, or target species. Each group will document justifications for and describe uncertainties associated with each recommendation. All flow recommendations, including justifications, anticipated ecological benefits, and supporting literature, will be documented in the final report.

1. **Evaluate flow recommendations based on water management scenarios and hold scenario review workshop** – To better understand how existing or proposed withdrawals affect flow statistics and associated flow recommendations, the Conservancy and DRBC will develop several hypothetical water withdrawal scenarios and analyze them in context of the draft flow recommendations. Scenarios will represent water withdrawals or releases typically associated with various sectors, including shale gas development, golf course irrigation, public water supply, power generation. The Conservancy will run these scenarios, compare streamflow statistics before and after, and present the results in context of flow recommendations. This analysis helps put flow recommendations in context of existing water management and helps determine if the recommendations are constrained by the limitations of the statistic to detect change (or conversely, by extreme sensitivity). Scenario results will be presented to project advisors in a 1-day workshop and used to refine flow recommendations, if necessary.
2. **Draft literature summary and flow recommendations report** – The Conservancy will prepare a summary report describing existing data and knowledge relevant to ecosystem flows in the Delaware River basin. Major components of the report will include
   1. Description of the process for setting ecosystem flow goals
   2. Synthesis of existing reports, relevant studies, and available data that describe past and predicted ecological responses to flow alterations
   3. Summary of the hydrological characterization, including characterization of naturally-occurring variation in minimally-altered locations
   4. Flow recommendations, revised based on workshop input

The report will be circulated to project advisors for comments and revised as necessary before the final report is submitted to DRBC.

1. **Produce final summary report and ecosystem flow recommendations** – Following the workshop, the Conservancy will work with the project management team to finalize the report based on any comments received from project advisors and DRBC.

# ****Schedule and Deliverables****

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| **Task** | **Deliverable** | **Completion Date** |
| **1. Form project management team and hold initial project management team meeting** | Project management team meeting | End of Month 1 |
| **2. Host first project workshop: Orientation and Flow Hypotheses** | Workshop 1: orientation and flow hypotheses (1.5 days) | End of Month 3 |
| **3. Begin literature and model review and summary** | Summary of relevant literature | End of Month 10 (part of Task 7, Draft summary report) |
| **4. Complete hydrologic characterization to estimate range of variability** | Written hydrologic characterization | End of Month 10 (Part of Task 7) |
| **5. Draft flow recommendations and hold flow recommendations workshop** | Draft flow recommendations  Workshop 2: Flow recommendations (1.5 days) | End of Month 8 |
| **6. Evaluate flow recommendations based on water management scenarios** | Written evaluation of water management scenarios  Workshop 3: Scenario review (1 day) | End of Month 10 (Part of Task 7) |
| **7. Draft literature summary and flow recommendations report** | Draft summary report | End of Month 10 |
| **8. Produce final summary report and ecosystem flow recommendations** | Final report | End of Month 12 |

# ****Budget Summary****

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| **Salary and Fringe** | $77,780 |
| **Travel** | $1,000 |
| **Trainings & Meetings** | $5,500 |
| **Equipment & Supplies** | $500 |
| **Contractual (Printing & Photo)** | $250 |
| **Total Direct** | **$85,250** |
| **Indirect (22.55%)** | $19,231 |
|  |  |
| **Total Project Cost** | **$104,511** |

1. DePhilip, M., and Moberg, T., 2010. Ecosystem Flow Recommendations for the Susquehanna River Basin. The Nature Conservancy, Harrisburg, PA. [↑](#footnote-ref-1)
2. Richter, B.D., A.T. Warner, J.L. Meyer & K. Lutz. 2006. A collaborative and adaptive process for developing environmental flow recommendations. *River Research and Applications* 22: 297-318. [↑](#footnote-ref-2)
3. Richter, B., J.V. Baumgartner & D.P. Braun. 1997. How much water does a river need? *Freshwater Biology,* 37: 231-249. [↑](#footnote-ref-3)
4. This is a “minimally impacted” approach. Recognizing that all gages have various levels of upstream impervious surface and loss of forest cover due to ongoing forestry practices, agricultural uses and human settlement, gages that have had extreme land conversion upstream should not be used for setting baseline conditions. [↑](#footnote-ref-4)