Development of a Potomac Basin Water Quality Data Inventory

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Cover Photo

Photo of ICPRB staff conducting biological monitoring in the Potomac basin.

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Introduction

Careful monitoring of water quality conditions in the interstate Potomac basin will facilitate the long-term protection of this precious natural resource. The approximately 14,670 square mile Potomac River basin is home to over six million people and includes Washington, D.C., and portions of Maryland, Virginia, Pennsylvania, and West Virginia. The Potomac River is also the second largest contributor of fresh water to the Chesapeake Bay, a waterbody of national importance that faces a myriad of water quality challenges. The river and its tributaries are a primary source of drinking water for residents and support diverse aquatic ecosystems. Water quality problems in the Potomac basin include, but are not limited to, excessive nutrients from fertilizer applications and combined sewer overflows, trash from improper disposal, and sediment from poor land management techniques. Due to the significance of the river as a water supply and a pollution conduit to the Bay, prevention and management of water quality problems are essential.

The Interstate Commission on the Potomac River Basin's (ICPRB) mission is to enhance, protect, and conserve the water and associated land resources of the Potomac River basin and its tributaries through regional and interstate cooperation. Water quality issues are one component of this mission. Due to the nature of pollution generation and transport, interstate collaboration is essential to the protection and management of water quality. In some cases, pollutants are discharged directly into the waterways, while in other cases pollutants are generated by human activities across the landscape and travel with the water as it moves through the watershed, impacting downstream localities. One step towards identifying and assessing water quality issues of interstate concern in the Potomac basin is locating the data that have been or are being collected by the many agencies and organizations throughout the basin. Data sets that are important to understanding water quality issues include not only the water quality data themselves, but also watershed characteristics such as land use, zoning, elevation, and precipitation, to name a few. These characteristics can help explain the water quality results seen in the data. To this end, an inventory of available data sets was developed by ICPRB.

The inventory may serve as a resource for a number of potential users, each with unique applications. For example, water resources managers need to identify threats to water quality and develop plans to mitigate ongoing and potential problems. Water utilities determine potential sources of acute and chronic water quality concerns. Concerned citizens evaluate conditions near their homes or recreational areas. Personnel at state agencies need a reference for upstream, out-of-state data sources. In addition, the inventory may be used to identify and potentially quantify water quality issues of interstate concern as

part of the Potomac basin comprehensive planning process. These are only a couple of examples of the ways in which the inventory may be used.

The purpose of this document is to provide a summary of the inventory; a description of data sources and how to obtain data; an identification of gaps in the inventory; and a discussion of next steps.

Data Inventory Summary

The data inventory is comprised of more than 8,000 'data collections', the records of water quality, watershed characteristics, and field parameters measured and recorded by organizations throughout the Potomac River basin. The inventory was compiled in a spreadsheet format to be easily accessed, transferred, and manipulated. Many fields are included for each data collection that describe the contact information, spatial and temporal distribution, parameters, data formats, and technical and other information (Table 1). Fields were selected that facilitate obtaining the raw monitoring data, identifying parameters and locations of interest, and evaluating the quality of the monitoring data. This section reviews the general field categories found in the inventory.

Table 1. Water quality data inventory field categories, names, and definitions.

Category	**Field**		**Definition**
Contact information	Source		Agency/organization through which the metadata was obtained
	Originator		Agency/organization responsible for data collection
	Contact Information	Contact_Name	Name of contact to obtain additional information
		Contact_Phone	Phone number of contact person
		Contact_Email	Email of contact person
	Data_Link		Web link to download data
	Program_website		Web link for additional information on monitoring program and data
	Purpose		Purpose for collecting data
Spatial and temporal distribution	Station_ID		Monitoring station identification number, if applicable
	Site_Location		Location of the monitoring station/system
	Spatial Information	Spatial_Coverage	Spatial coverage of monitoring network (country, state, point, etc.)
		Coverage_Description	Monitoring location (United States, Virginia, Loudoun County, etc.)
	Time Period	Period_of_Record_Start_Date	Date data collection began
		Period_of_Record_End_Date	Most recent data as of date of validation
	Number_of_Sites_Sampled		Number of sites sampled
	Frequency_Sampled		Frequency sampled
Parameters	Metric_Parameter		Name of parameter
	Parameter_Group		More general groupings of data parameters
	Dataset Type		Indicates whether the data collection is comprised of water quality, watershed characteristic, or field parameter data
Data formats	Data_Type		Format of data available for download

Category	Field	Definition
Technical	Collection_Method	Method used to collect data
	Analysis_Method	Method used to analyze the sample - applicable to chemical parameters requiring lab analysis
	Detection_Limit	Detection limit of analysis method
	Quantitation_Limits	Information on practical quantitation limits
	Reporting_Limits	Indicates whether information is available on the reporting limits
	Lab_Used	Name of laboratory used
	Lab_Certification	Certification of the laboratory analyzing the data
	QA_QC_Program	Indicates whether a Quality Assurance/Quality Control Program is in place
	Funding_Source	Funding source and cost of program
Other	Update_Frequency	Frequency that the available data set is updated
	Lat_Long	Denotes whether latitude and longitude are available for the site(s)
	Public_or_Restricted_Data	Indicates whether the data is public or restricted
	Dataset_Fees	Indicates whether a fee is required to obtain the data set
Internal	Validation_Author	Name of person who validated the inventory record
	Validation_Date	Date that the record was validated

Each field category is described in more detail below.

Contact Information

The name and contact information of the monitoring organization and, if different, contact information for the organization that makes the data available to the public are provided in the inventory. In all, more than 50 monitoring organizations are included in the database (Table 2). Entities that collect the data include federal, state, county, and city agencies; educational institutions; public utilities; and volunteer organizations operating in the Potomac basin states. The data are collected for many purposes including drinking water source quality monitoring, stream flow monitoring, contamination monitoring, stream and watershed impairment assessments, and water resources management and planning.

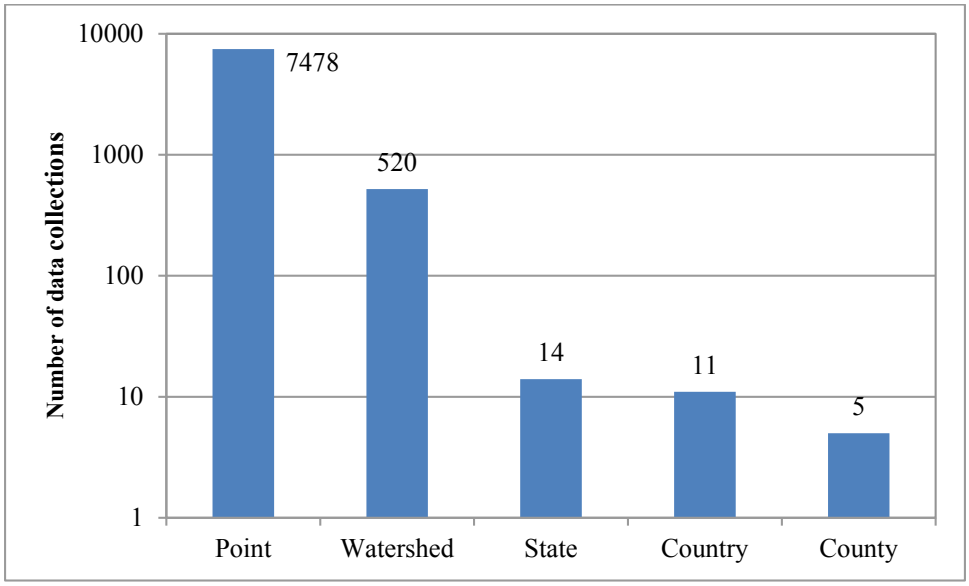
Table 2. Organizations whose Potomac basin monitoring data are described in the inventory.

Adams County Conservation District, Pa	George Mason University	Renfrew Institute
Adams County Office of Planning and Development, Pa	Harrisonburg, Va	Ridge and Valley Streamkeepers
Arlington County Office of Sustainability and Environmental Management, Va	King George County Health Department and Environmental Services, Va	Shenandoah County Geographic Information Systems Department, Va
Cacapon Institute	Loudoun County, Va	St. Mary's County Health Department, Md
Chesapeake Bay Program	Loudoun County Environmental Health Department, Va	United States Environmental Protection Agency
City of Rockville, Md	Maryland Biological Stream Survey	United States Fish and Wildlife Service
Community Collaborative Rain, Hail, and Snow Network	Maryland Department of Natural Resources	United States Geological Survey
Conococheague Watershed Alliance	Maryland Department of Planning	University of Maryland
District of Columbia Department of the Environment	Multi-Resolution Land Characteristics Consortium	Virginia Department of Environmental Quality
Environmental Alliance for Senior Involvement	National Climactic Data Center	Virginia Save Our Streams
Fairfax County Stormwater Management Department, Va	National Oceanic and Atmospheric Administration	Virginia Water Quality Monitoring Council
Fairfax County Department of Planning and Zoning, Va	National Park Service	Washington Suburban Sanitary Commission
Frederick County Community Development Division, Md	National Water Quality Monitoring Council	Watershed Alliance of Adams County
Friends of Accotink Creek	Occoquan Watershed Monitoring Laboratory	Watershed Resources Registry's Inter-governmental Group
Friends of Sligo Creek	Opequon Creek Project Team	West Virginia Department of Environmental Protection
Friends of the North Fork of the Shenandoah River	Pennsylvania Department of Conservation and Natural Resources	West Virginia Save Our Streams
Friends of the Shenandoah River	Pennsylvania Department of Environmental Protection	

Spatial and Temporal Distribution

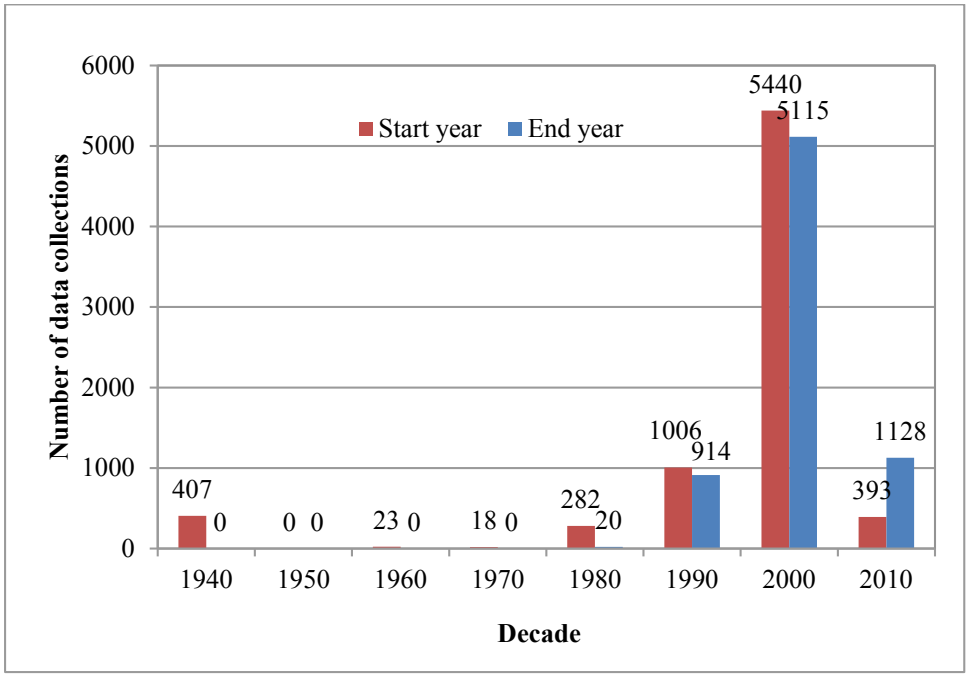
Spatially, the data collections in the inventory may cover a single sampling location (point), individual stream, watershed or basin, or geopolitical boundary such as counties and states (Figure 1). The geographic scope of the data collections listed in the inventory is related to the collected parameters, data analysis methods, and interpretation techniques. For example, chemical conditions like pH or iron values represent the conditions at a single sample location while macroinvertebrate counts reflect the general biological conditions of a stream reach or watershed.

Figure 1. Spatial coverage of data collections.



The data represent a broad temporal scale as well (Figure 2). The earliest data referenced in the inventory date back to 1948. A large amount of data continue to be collected today by active monitoring programs.

Figure 2. Number of data collections by decade.



Parameters

The data inventory identifies sources of current and historic water quality (biological, chemical, and physical quality), watershed characteristic, and field parameter information in the Potomac River basin. The inventory includes a parameter field that describes the specific parameter being monitored and a parameter group field that provides a broader description of the parameter type. For example, the parameter field may indicate monitoring for nitrate, nitrite, ammonia, or total nitrogen while the parameter group field for all of these parameters is nitrogen. More than 90 different parameter groups are represented in the inventory. Parameter groups describe one of the following: biological conditions, chemical conditions, field parameters, physical parameters, and watershed characteristics. The following tables and associated descriptions list the parameter groups in each of these categories. The parameter group field allows users to readily sort through the inventory.

There are eight different parameter groups that reflect the biological conditions (Table 3). These biological assessments are collected by various organizations from state agencies to volunteer watershed groups. Chemical parameter groups includes nutrients, inorganic chemicals, metals, oxygen content, and endocrine disrupting compounds to name a few (Table 4). Physical parameter groups include the parameters that describe physical conditions in the water body such as total suspended solids, turbidity, grain size of sediments, or stream gage stage height. These groups are shown in Table 5.

Table 3. Biological condition parameter groups. The generic "biological condition" parameter group includes data collections that do not fall into one of the other, more specific categories.

Assessment*	Habitat conditions**
Bacteriological***	Macroinvertebrates
Biological conditions**	Submerged Aquatic Vegetation (SAV)
Fish count	Sea nettle probability

*Includes rapid bioassessments and sampling conducted as part of the state integrated reports.
**Conducted under the Save Our Streams program.
***Includes fecal coliform and E. coliform bacteria colony counts.

Table 4. Chemical condition parameter groups.

Acid neutralizing capacity	Copper	Nitrogen
Acidity	Dissolved metals	Organics
Algae	Dissolved oxygen	Other chemical parameters
Alkalinity	Endocrine disrupting compounds	Pesticides
Aluminum	Fluoride	Pheophytin
Ammonia	Hardness	Phosphorus
Arsenic	Hot acidity	Polyaromatic hydrocarbon
Barium	Hydrocarbons	Poly-chlorinated biphenyl
Beryllium	Hydrogen	Potassium
Biological oxygen demand 5-day	Inorganics	Radionuclides
Boron	Iron	Salinity
Bromide	Lead	Selenium
Cadmium	Magnesium	Silica
Calcium	Major ions	Silver
Carbon	Manganese	Sodium
Chemical oxygen demand	Mercury	Sulfate
Chloride	Metals	Sulfide
Chlorophyll	Methylmercury	Toxics
Chromium	Nickel	Zinc

Table 5. Physical parameter groups.

Evaporation	Physical conditions
Fixed suspended solids	Sediment
Gage height	Specific gravity
Grain size	Total Dissolved Solids (TDS)
Light attenuation	Total Suspended Solids (TSS)
Physical Habitat Index (PHI)	Turbidity

Field parameters such as pH, specific conductance, and water temperature are frequently recorded by monitoring programs and are included in the inventory (Table 6). Field parameters are important to collect because they can help users understand baseline and impaired water quality conditions.

Table 6. Field parameters parameter group.

Color	Temperature
Conductance	Weather
pH	Pyncnocline depth

Watershed characteristic data are collected at many locations throughout the Potomac basin. Examples of these parameter groups are wastewater discharge locations, population, and land use (a full list is provided in Table 7). Watershed characteristic information can assist in understanding why a particular water quality condition exists.

Table 7. Watershed characteristic parameter groups. The generic "watershed characteristics" parameter group includes data collections that do not fall into one of the other, more specific categories.

Critical area boundaries	Planning
Cultural, political, and environmental spatial data sets	Population
Discharge	Sample locations
Multiple parameters	Watershed characteristics

Data Formats

The data described in the inventory span a wide range of formats including tabular formats such as Excel spreadsheets, database files, and tabular text tables; GIS mapping datasets such as vector and raster shapefiles; graphic output files such as maps in PDF files; and/or HTML. The inventory includes an indication of the data format for each source.

Technical Information

The inventory contains a number of fields describing the technical components of the data collections. These fields are intended to assist users in understanding the analysis methods used to obtain the data, detection and reporting limits, and information about the laboratories utilized to process the samples. In many cases, information has not been obtained for these fields due to the time required to obtain this detailed information for each data collection. Complete technical information will be compiled as time and funding become available.

Other Information

Several additional fields were compiled to assist users in obtaining the data including the update frequency, the presence of geospatial information, and availability. The update frequency field is provides a measure of how often the download-able data set is updated, providing users a sense of whether the data is up-to-date. Approximately 93% of the data collections in the inventory have latitude and longitude data associated with them[1]. This geospatial information is useful for mapping and spatial analysis. An indication of the availability of latitude and longitude information is included in the inventory. Two additional fields indicate whether the data collection is available to the public and whether there is a fee associated with obtaining the data.

Summary

As indicated by the contents of the inventory, there is a large amount of water quality and associated watershed characteristic data being collected by many diverse groups. Identifying and maintaining up-to-

[1] This figure is based on the March 2014 version of the inventory.

date information about all of them is a significant undertaking. This initial inventory is a first step in that process.

Gaps

The inventory is viewed as a work in progress with additions and improvements expected over time. There are known gaps in the inventory as a result of the extensive monitoring efforts underway throughout the basin. Gaps include data sets from organizations that have not been included due to time constraints and data gaps for water quality and watershed characteristic parameters of interest. Data gaps are discussed in more detail below. As additional time and funding become available to improve the inventory, efforts will be made to fill these gaps.

Several types of organizations known to collect data in the Potomac basin are poorly represented in the inventory at this time. First, a number of universities have water-related research and study in the region. Data collected as part of these efforts should be included in the inventory. Second, locally collected water quality and watershed characteristic data is invaluable to developing a complete picture of basin conditions because it is often collected at a higher spatial resolution and by people who often have first-hand knowledge of the area. To this end, additional county and municipal level data sets should be added to the inventory. It is anticipated that these data collections will add a large amount of information to the inventory. Finally, volunteer groups and watershed organizations collect data that could be included in the inventory. ICPRB maintains a list of watershed organizations that should be used to locate additional water quality information[2].

There are also additional water quality parameters that are not currently included that may interest inventory users. For example, emerging contaminant data may be of particular interest to water utilities, researchers, and concerned citizens. Emerging contaminant data sources, however, are currently limited in the inventory.

Additional watershed characteristics information would allow users to more thoroughly understand the water quality conditions. Characteristics that are not currently included but would be beneficial to add to the inventory are listed below.

- Municipal Separate Storm Sewer System (MS4) areas,
- Source water protection areas,
- Clean Water Act designated uses,
- Known areas of high water quality or good stream health,
- Transportation information, and
- Biological indicators.

How to Obtain the Inventory and the Described Data Collections

The data inventory is housed at ICPRB. A copy of the inventory can be obtained by contacting Jim Palmer at 301.274.8104, jpalmer@icprb.org, or via mail at 30 W. Gude Dr., Suite 450 in Rockville, MD

[2] http://www.potomacriver.org/maps/34-wildlife-habitat/restore-enhance-conserve-protect/186-watershed-group-dir-map, accessed March 12, 2014.

20850. The inventory is available in Microsoft Excel spreadsheet format, but can be converted to other formats upon request.

Data collections can be obtained through the respective monitoring program's data download website, if available, as listed in the inventory[3]. Also included in the inventory is the associated monitoring program's website, if applicable. To the extent possible, contact information for someone that can provide more information on each data collection is also listed.

Next Steps

The inventory will require updates to ensure it accurately describes the data available in the Potomac basin. A protocol to keep the inventory up-to-date is needed that includes recommendations on how often each entry should be reviewed, steps to conducting the review, and methods for identifying new data collections.

Making the inventory more readily accessible and user-friendly is a priority. For example, more meaningful spreadsheet filters can be developed with input from inventory users. The inventory may also be made available on the ICPRB website within a mapping framework, making it easy for users to zoom to a geographic area of interest and identify available data sets. In addition, developing a data server function[4] would enable users to obtain data collections of interest within a specified geographic area. Users would no longer need to manually download individual data collections.

Linking the inventory to large repositories of water quality data would assist in keeping the list of data collections current. For example, an interface to EPA's STORET/WQX database could be developed to automatically inventory Potomac basin data from the national database. Similar relationships could be developed with the National, Virginia, and Maryland Water Quality Monitoring Councils.

Discussion

The water quality data inventory provides a number of benefits. By documenting data sources from a myriad of organizations and geographic areas across the basin, the inventory can assist in identifying and addressing water quality issues that bridge political and organizational boundaries. Further, the inventory can facilitate awareness of the many existing programs and the diverse potential users for each program's data. The inventory can also encourage communication about basin conditions and protection of water quality between users in different parts of the basin.

To provide timely, relevant information to basin stakeholders, the inventory should be a living spreadsheet. As such, it will need ongoing review. Inventory users are encouraged to provide feedback including, but not limited to, corrections, updates, and suggestions for additional parameters. By providing feedback, users will help to make the inventory a meaningful addition to the water resources management toolbox in the Potomac basin.

[3] Some data collections are not available in electronic format and must be obtained in paper copy by contacting the organization. In these cases, contact information for the appropriate person at the organization is provided.
[4] The data server function is comprised of an automated interface that allows users to download selected data collections through the inventory

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