Secondary Data Quality Assurance Project Plan (QAPP) for the West Virginia Watershed Assessment Pilot Project

Prepared For: West Virginia Department of Environmental Protection (WVDEP)
601 57th Street
Charleston, WV 25304-2345

Prepared By: Keith E. Fisher
Ruth Thornton
Misty Downing
Diane Packett
The Nature Conservancy of West Virginia
21 Third Street
Elkins, West Virginia 26241

Submitted: October 1, 2011

Gauley River, West Virginia © Kent Mason

1.0 PROJECT MANAGEMENT – ORGANIZATION AND RESPONSIBILITIES

1.1 Title and Approval Page

Secondary Data Quality Assurance Project Plan for the
West Virginia Watershed Assessment Pilot Project

Date: October 1, 2011

Approved _____ Date _____
Ruth Thornton, TNC Project Manager

Approved _____ Date _____
Keith E. Fisher, TNC Project Director

Approved _____ Date _____
Dennis Stottlemyer, WVDEP Project Manager

Approved _____ Date _____
Joy Gillespie, EPA Project Officer

Approved _____ Date _____
Danielle Algazi, Senior Project Officer

1.2 Table of Contents

1.3 QAPP Distribution List

The final version of this document will be distributed to the following personnel who will be involved with assuring secondary data quality for the watershed assessment pilot project.

Name	Organization	Email	Phone	Mailing Address
Joy Gillespie Danielle Algazi	EPA	Gillespie.Joy@epa,gov Algazi.danielle@epa.gov	215-814-2793 215-814-2722	1650 Arch St Philadelphia, PA 19103-2029
Dennis Stottlemyer	WVDEP	dennis.o.stottlemyer@wv.gov	304-926-0499	601 57th Street Charleston, WV 25304-2345
Keith E. Fisher Ruth Thornton Misty Downing Diane Packett	The Nature Conservancy	keith_fisher@tnc.org rthornton@tnc.org mdowning@tnc.org dpackett@tnc.org	304-637-0160	21 Third Street Elkins, WV 26241

Table 1. List of Abbreviations

AMD	Acid Mine Drainage
DEM	Digital Elevation Model
EPA	United States Environmental Protection Agency
ERO	Eastern Regional Office (TNC)
ESRI	Environmental Systems Research Institute, Inc.
FEMA	Federal Emergency Management Agency
GIS	Geographic Information Systems
GLIMPSS	Genus Level Index of Most Probable Stream Status
NED	National Elevation Dataset
NHD	National Hydrography Dataset
NLCD	National Land Cover Dataset
NPDES	National Pollutant Discharge Elimination System
NWI	National Wetlands Inventory
PAFO	Pennsylvania Field Office (TNC)
PCS	Permit Compliance System
RBP	Rapid Bioassessment Protocol
SAMB	State Addressing and Mapping Board (WV)
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
USGS	United States Geological Survey
WVDA	West Virginia Department of Agriculture
WVDEP	West Virginia Department of Environmental Protection
WVDNR	West Virginia Division of Natural Resources
WVDOF	West Virginia Division of Forestry
WVFO	West Virginia Field Office (TNC)
WVGES	West Virginia Geological and Economic Survey
WVGISTC	West Virginia Geographic Information Systems Technical Center
WVSAMB	West Virginia Statewide Addressing and Mapping Board
WVU	West Virginia University

1.4 Project Organization

The West Virginia Department of Environmental Protection (DEP) was awarded a US Environmental Protection Agency (EPA) Region III Wetland Program Development Grant to complete a Watershed Assessment Pilot Project (WAPP) for five HUC8 watersheds in West Virginia. The WV DEP provided a sub-award grant through an agreement/contract with The Nature Conservancy of WV (TNC).

This document is a secondary data QAPP for the Watershed Assessment Pilot Project. The QAPP outlines the guiding principles used to ensure that all secondary data collected and analyzed within the project have been subjected to the highest standards of quality assurance/quality control (QA/QC) and are scientifically valid and defensible.

EPA Project Officer
Joy Gillespie, Office of Monitoring and Assessment
EPA Region III, 3EA50
Responsibilities: Monitoring of WV DEP grant award

EPA Senior Project Officer
Danielle Algazi, Environmental Assessment and Innovation Division
EPA Region III, 3EA00
Responsibilities: Oversight of wetland program development grants program

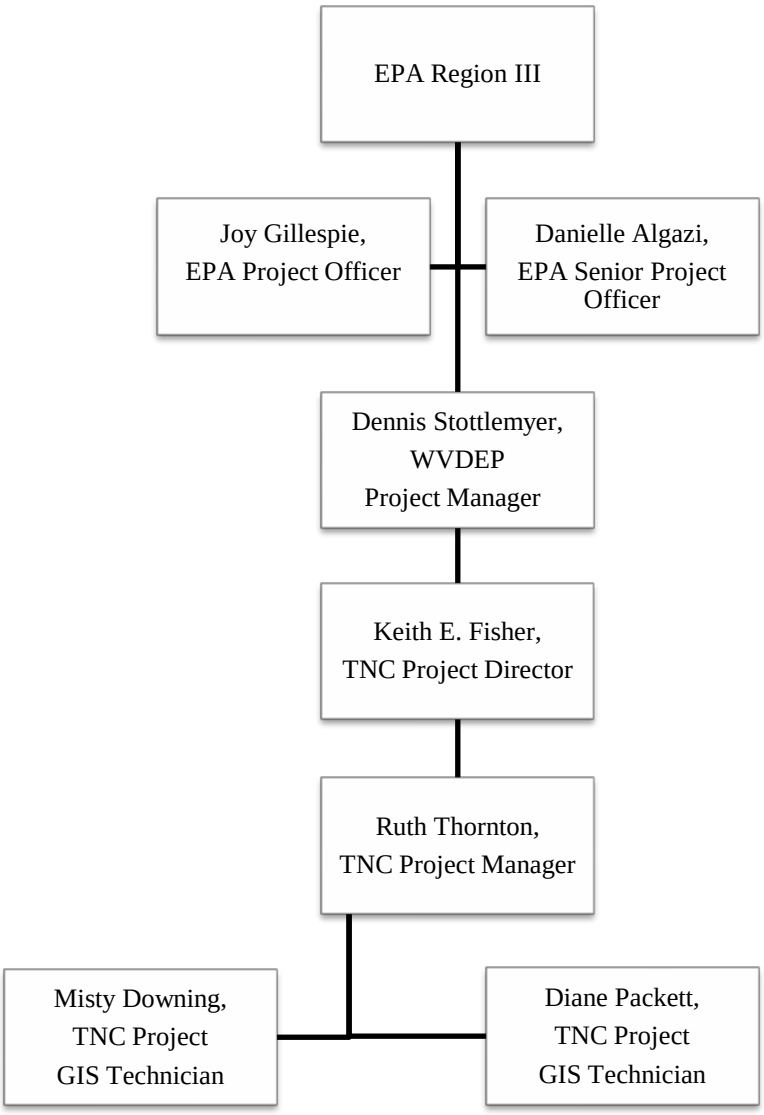
West Virginia DEP Project Manager
Dennis Stottlemyer, WVDEP
Responsibilities: Monitoring of TNC grant sub-award

Project Director
Keith E. Fisher, TNC
Responsibilities: Overall project direction and grant administrative duties

Project Manager
Ruth Thornton, TNC
Responsibilities: Overall project management (QA/QC and data management, assessment methodology design, report writing and review)

Project GIS Technicians
Misty Downing and Diane Packett, TNC
Responsibilities: Data compilation, QA/QC, geoprocessing, spatial analysis, research and report writing

Figure 1. Project Organizational Chart



1.5 Purpose of Study, Background Information and Problem Definition

Accurate, current, and scientifically defensible watershed assessments, and their corresponding tools and processes, are increasingly recognized as invaluable throughout the United States, as the data and knowledge generated from such assessments can be used in a variety of decision-making activities (regulatory, protection and restoration prioritization, funds allocation, etc). Within West Virginia, there is a significant need for evaluating the effectiveness of existing and potential wetland protection, restoration and mitigation projects and improving the evaluation of cumulative stream impacts.

Currently in West Virginia, many of the decisions regarding permitted impacts to aquatic systems are not based on a comprehensive view of a watershed. As a result, regulatory decisions regarding the suitability and placement of mitigation projects intended to offset impacts to aquatic resources are made based on incomplete information and without a comprehensive watershed assessment as part of the decision-making process. This creates a situation where regulatory permitting and resource allocation may not be directed toward areas within a watershed most critically in need of such consideration. Additionally, the lack of comprehensive watershed assessments with prioritized objectives limits the ability of potential partners to contribute to similar type projects, since there is a lack of guidance on where to target protection or restoration activities or knowledge of how partners' individual actions may contribute to the overall health of the aquatic ecosystem under consideration.

The primary desired outcome of the project is to advance scientific knowledge about, as well as protection of, aquatic resources within watersheds in West Virginia, with the intention of achieving a net increase in the quality and quantity of wetlands and other aquatic resources and their related ecosystem functions. A primary final goal is to establish priorities for the protection and restoration of assessed aquatic resources, in an effort to assist local, state and federal officials with permitting and resource allocation decisions. This will be accomplished through the completion of comprehensive watershed assessments, including cumulative watershed effects analyses, and prioritization of areas in need of protection or restoration. A desired secondary outcome is increased communication and collaboration regarding watershed protection and restoration among various decision-makers and stakeholders within the state. Additionally, a stated goal of the project is to identify data gaps/needs within West Virginia, thus providing suggestions to various partners for possible future projects involving data generation, compilation or modification.

1.6 Overview of Project Tasks

An initial goal of the project is to compile an exhaustive database of various data sources related to the health and function of each individual watershed. This will include data from multiple geographic and temporal scales, including the most currently available federal, state, regional, local and watershed level data, as well as any similar high quality historical data that may help to identify trends or patterns over time. In general, the primary categories of data that may contribute to a comprehensive watershed assessment include:

- physical geography data (elevation, soils)
- land use/land cover information (forested lands, impervious cover, aerial imagery)
- hydrology (watershed boundaries, stream networks, floodplains)
- water quality and quantity data (monitoring, biotic index, streamflow, water withdrawal and consumptive use data)
- species/habitat data (species occurrence, predicted habitat modeling)
- potential sources of contamination (mines, wells, wastewater outfalls, development)
- infrastructure (roads, railroads, transmission lines, pipelines, dams, bridges, city/county boundaries)
- demographic data (population and trends)

These data will be compiled, sorted and assessed for quality assurance and control.

Data sources will be selected or rejected for use based on relevance, completeness, accuracy, quality and the age of the data. The most current data available will be used, except in cases where historical data is sought as a means of comparison or trend prediction. For example, species occurrence data older than 20 years will not be used since it is unlikely to reflect current species composition, and oil and gas well data will be updated every 60 days to reflect the current state of this rapidly changing resource extraction. Particular factors that may cause data to be rejected include: lacking appropriate or complete metadata, which brings data quality assurance and quality control into question; data that are deemed too out-of-date to accurately reflect the current status of the watershed; data that appears incomplete or significantly conflicts with known quality-assured data (thus casting doubt about data quality); and data that is deemed irrelevant or redundant once analysis has begun (as it offers no contribution to the assessment or understanding of watershed health or function or it overlaps or duplicates other data). Data originally generated by state or federal agencies often has already met quality assurance standards; for example, water quality data obtained from West Virginia DEP are collected and documented according to a rigorous set of operating procedures (WV DEP 2011).

The final goal of the project is to analyze the gathered data using a geographic information systems (GIS) spatial analysis procedure that indexes and ranks project planning units in terms of relative priority and suitability for protection or restoration activities, distinguished by landscape (streams/riparian, wetlands, uplands). Prioritization will occur in two distinct phases: an initial ranking of planning units in terms of their relative suitability for

protection or restoration, and a second, more detailed, ranking of key areas, potential activities, and potential impacts of said activities, within each planning unit. These analyses will be accomplished using ArcGIS 10.0 (ESRI, Redlands, CA), Miradi Adaptive Management Software for Conservation Projects (Conservation Measures Partnership and Benetech), and statistical programs from Microsoft Excel Analysis Toolpak or other statistical packages such as SPSS (Statistical Package for the Social Sciences) or JMP.

A more detailed project description, assessment process and outline can be found in the original grant proposal document included as Appendix B.

1.7 Data Quality Objectives and Criteria

The final products of this project, that is, the watershed assessments and accompanying spatial decision support tool, are intended for use by federal, state and local officials, as well as any outside partners, who may wish to determine appropriate actions or paths regarding regulatory permitting and/or potential resource allocation. Thus, the data quality objective of this project is to compile, sort and analyze data that is scientifically valid and defensible, with a high level of transparency and data-sharing capabilities. Accurate and complete metadata are desired to ensure that the data source and collection methods are scientifically valid, defensible, and up-to-date. Metadata should include a thorough data description, originator, source of access, publication date, time period and/or specific time and date collection information (especially in the case of any sampling data), and spatial domain information (such as projection/coordinate systems used). There is also a secondary desire to ensure that data is compatible with the end user systems, such as the spatial decision support tool, and may be maintained and updated with relative ease.

2.0 DATA SELECTION AND MANAGEMENT

2.1 Sources of Existing Data

Table 2. Sources of Existing Data

Type	Description	Format	Source (Date Published)	Downloaded	Intended Use	Limitations	QA/QC*
BASE LAYERS							
NHDPlus (100k)	Catchments, flowline, flow direction grid	polygon, line, raster	USGS (2005)	5/2011	Planning unit delineation, base stream network, wetland distance to nearest surface water	100k (not consistent scale among various stream datasets)	Moderate
NHD24K with stream codes	Flowlines with additional attributes including DEP stream code	line shp	WVU Natural Resource Analysis Center (2010)	11/2010	Join with mussel stream survey data Excel file		None
City boundaries	Outline of city boundaries	polygon	US Census (1990)	5/2010	Spatial reference		None
County boundaries	Outline of county boundaries	polygon	USGS/WVDEP (2002)	2/2010	Spatial reference		None
Ecoregions	TNC defined ecoregions	polygon	TNC - ERO (2008)	2/2010	Join with ecoregional targets Excel file		None
Ecological Land Units	TNC defined ecological land units	polygon	TNC-ERO(2008)	2/2010	Predict rare species occurrence based on landscape and geology		None
Topographic maps	Relief maps of WV, by quad	image	USGS (varies)	Varies	Spatial reference, data verification, mining	Dated (mostly from 1970's)	None
Aerial imagery	Satellite imagery of WV	image	USDA (2007, 2009); ESRI online imagery (2009, 2010)	Online access; 6/2010	Spatial reference, data verification		None
WATER QUANTITY							
Public water supply (PWS)	Surface water intakes	points shp	WVDHHR (2011)	8/2011	Measure of water withdrawal along stream	Point locations required verification (not all outtakes along streams)	Limited
Large quantity users (LQU)	Withdrawal over 750,000 gal	points shp	WVDEP (2011)	8/2011	Measure of water withdrawal along stream	Self-reporting; table listed coordinates as “fuzzy”, required verification	Limited
USGS stream gages	Stream gage locations	points shp; Excel table	USGS (2003)	8/2011	Measure of flow variation along stream		None

Type	Description	Format	Source (Date Published)	Downloaded	Intended Use	Limitations	QA/QC*
WETLAND QUANTITY							
National Wetlands Inventory (NWI)	Locations of wetland features	polygon shp	FWS (2011)	4/2011	Identify locations of wetland features	Data derived from dated aerial imagery	Limited
Historical topo maps	Topo maps (from 1900-1930)	image	USGS/WVDEP (varies)	8/2011	Identify areas labeled as wetlands in the past		None
WATER QUALITY							
Impaired streams (303(d), TMDL)	303d and TMDL listed streams	line shp	WVDEP (1/11/2011)	2/2011	Identify streams with known impairments	Combined with AMD impaired streams	Limited
Impaired streams (AMD)	Acid mine drainage streams	line shp	WVDEP (2/11/2009)	3/2010	Identify streams with known impairments	Combined with 303(d), TMDL impaired streams	Limited
WAB database samples	Water quality samples (includes GLIMPSS, RBP scores)	points shp	WVDEP (12/7/2010)	12/2010	Measure of water quality parameters, biotic index and riparian habitat	Point locations required verification (not all samples along streams)	Limited
NLCD impervious cover	Impervious surfaces	raster	USGS (2/16/2011)	2/2011	Measure of contributing area of impervious cover	Data based on 2006 aerial images, low resolution	None
BIODIVERSITY							
Element occurrences	Natural Heritage Program rare species	points shp	WVDNR (2/14/2011)	2/2011	Identify areas with known rare species	Some geographic coordinate errors (outside WV boundaries); some data prior to 1991	Moderate
SGCNs	Species in greatest conservation need	Excel table	WVDNR (2005)	8/2011	Join with element occurrences		None
Odonates	Additional odonate occurrences	Excel table	WVDNR (8/2011)	8/2011	Join with element occurrences	Some element codes missing	Moderate
Hellbenders	Hellbender occurrences	Excel table	Researcher at the Good Zoo, Wheeling, WV (11/2010)	11/2010	Join with element occurrences	Locations required verification.	Limited
Crayfish	Crayfish occurrences	Excel table	Researcher at West Liberty University (12/2010)	12/2010	Join with element occurrences	Locations required verification, some geographic coordinate errors (outside WV boundaries)	Limited

Type	Description	Format	Source (Date Published)	Downloaded	Intended Use	Limitations	QA/QC*
Fish	Fish occurrences	Excel table	WVDNR (10/2010)	10/2010	Join with element occurrences		None
Ecoregional targets	TNC target species for 3 ecoregions of WV	Excel table	TNC - ERO (2007)	8/2011	Join with element occurrences	Some data prior to 1991	Moderate
Mussel streams	Stream reaches containing endangered mussels	Excel table	WVDNR (09/2011)	9/2011	Join with NHD 24K streams shapefile; prioritize streams with endangered mussel species or high quality habitat	No specific information beyond presence/absence of unspecified endangered species in stream reach; some stream codes outdated	Extensive
Trout streams	Naturally reproducing trout streams	line shp	WVDEP (2010)	8/2011	Identify DEP priorities for trout streams		None
PHYSICAL INTEGRITY							
Soils	Soils data by county	polygon shp	SSURGO (varies by county)	Varies	Determine highly erodible soils; high infiltration rate soils; soil buffering capacity	Varying resolution between county; generalized data	None
NLCD 2006	National Landcover dataset	raster	USGS (2/16/2011)	2/2011	Identify forested/natural/ wetland landcover types	Data based on 2006 aerial images, low resolution	None
Fire regime condition class (FRCC)	Degree of departure from reference condition vegetation	raster	USFS LANDFIRE (2007)	7/2011	Estimate of change in vegetation conditions	Low resolution	None
Heterogeneity	Landscape heterogeneity metric reflecting elevation change and landform variety	raster	TNC - ERO (03/2011)	3/2011	Indicate variation in landscape topography and landforms		None
HYDROLOGIC CONNECTIVITY							
Active River Area (ARA)	Riparian and material contribution zones along streams	raster	TNC - ERO (2009)	2/2011	Define riparian area		Moderate
Functional river network	Unimpeded stream networks	line shp	TNC - ERO (3/8/2011)	3/2011	Identify stream networks with no fragmenting features (i.e., dams)		None
Northeast Association of Fish and Wildlife Association (NEAFWA) streams	Stream classifications and stream order/size	line shp	TNC - ERO (2008)	8/2010	Determine headwaters streams		None

Type	Description	Format	Source (Date Published)	Downloaded	Intended Use	Limitations	QA/QC*
HABITAT CONNECTIVITY							
Forest blocks	Unfragmented forest blocks larger than 100 acres	polygon shp	TNC - PAFO (07/2011)	8/2011	Prioritize areas of unfragmented forest		None
Local integrity	Local integrity metric reflecting unfragmented natural habitat	raster	TNC - ERO (03/2011)	3/2011	Prioritize areas of unfragmented natural habitat (forest, grassland, wetland, stream)		None
PROTECTION PRIORITIES							
Aquatic portfolio	TNC priority streams	line shp	TNC - ERO (2/25/2011)	3/2011	Identify TNC priority streams		None
Terrestrial portfolio	TNC priority lands	polygon shp	TNC - ERO (07/2011)	8/2011	Identify TNC priority lands		None
Secured lands	Preserves and publicly owned lands	polygon shp	TNC – ERO/WVFO (6/27/2011)	NA	Identify lands already under protection or in public trust		None
National Forest proclamation boundary	USFS target area for land acquisition	polygon shp	USFS (2004)	2/2011	Identify USFS priority lands		None
Watershed assessment results	Division of Forestry analysis results for Water Quality and Forest Resource Areas	polygon shp	WVDOF (2010)	8/2011	Identify WVDOF priority lands	By HUC12	None
RESOURCE EXTRACTION							
Oil and gas wells	Locations of oil and gas wells	points shp	WVDEP (8/15/2011)	8/2011	Identify locations of active oil and gas wells	Point locations required verification	Limited
Marcellus Shale gas wells	Locations of Marcellus shale gas wells	points shp	WVGES (4/14/2011)	8/2011	Identify new and existing Marcellus wells	Point locations required verification	Limited
Surface mines (Appalachian Voices)	Digitized mining footprint for Elk River watershed based on aerial imagery	polygon shp	Appalachian Voices (2007)	9/2011	Identify areas with active surface mines as of 2007		None
Abandoned mine lands	Outline of abandoned mine areas	polygon shp	WVDEP (1996)	2/2010	Identify areas with possible residual effects from mining activity	Accuracy issues	Limited
Mining footprint	Outline of current mining activity	polygon shp	WVGES (3/10/2011)	3/2011	Identify areas with current surface and underground mining activity	Some conflicts with aerial imagery (mining land possibly already overgrown/ reclaimed)	Extensive
Valley fills	Valley fill locations from SMCRA permit maps	polygon shp	WVDEP (8/23/2011)	8/2011	Identify areas with surface mining refuse	Some overlap with other mining datasets	Limited

Type	Description	Format	Source (Date Published)	Downloaded	Intended Use	Limitations	QA/QC*
Coal refuse structures	Coal refuse (disposal area) locations	polygon shp	WVDEP (8/23/2011)	8/2011	Identify areas with surface mining refuse	Some overlap with other mining datasets	Limited
Coal production data	Measure of coal production per facility, by year	Excel table	US EIA (2007, 2008)	7/2011		No MSHA ID in state data; production data distributed by county/mine site	None
Mineral operations	Quarries, mineral extraction facilities	points shp	USGS (2002)	3/2010	Identify surface mineral extraction activities	Some duplicate data; not polygon data so unable to calculate area	Limited
Timber harvesting	Locations of timber permits and acreage	points shp	WVDOF (2010)	6/2011	Identify timber extraction activities	Not polygon data so unable to determine exact spatial location	Limited
DEVELOPMENT & AGRICULTURE							
National Pollutant Discharge Elimination System (NPDES)	Locations of permitted discharges to surface water	points shp	WVDEP (2011)	8/2011	Identify possible point source pollution along streams	Point locations required verification	Limited
NLCD 2006	National Landcover dataset	raster	USGS (2/16/2011)	2/2011	ID development/agriculture/ pasture landcover types	Data based on 2006 aerial images, low resolution	None
Buildings	Locations of structures	points shp	WVSAMB (2003)	8/2011	Used to identify land disturbance and generate septic systems points for structures outside of city boundaries		None
Solid waste facilities	Locations of landfills	points shp	WVDEP (2002)	5/2010	Identify possible source of pollution		None
HABITAT FRAGMENTATION							
Roads	Interstate, US and state highways, county road networks	line shp	WVDOT (2011)	9/2011	Roads as potential source of runoff/sedimentation pollution and as forest habitat and stream fragmenting features (road/stream crossings)		None
Railroads	Railroad networks	line shp	WVDNR (2010)	5/2010	Railroads as potential source of runoff/sedimentation pollution and as forest and stream fragmenting features (RR/stream crossings)		None
Energy transmission lines	Locations of energy lines, by voltage class	line shp	Ventyx (08/2011)	9/2011	Lines as habitat fragmenting features		None

Type	Description	Format	Source (Date Published)	Downloaded	Intended Use	Limitations	QA/QC*
Natural gas pipelines	Locations of pipelines, by diameter	line shp	Ventyx (08/2011)	9/2011	Lines as habitat fragmenting features		None
Wind turbines	Locations of wind turbines and wind farms	points shp	TNC - PAFO (12/25/2010)	5/2011	Points as habitat fragmenting features, source of pollution (sedimentation)		None
Bridges	Locations of bridges and culverts	polygon shp	WVDOT (2008)	8/2011	Structures as habitat fragmenting features	Locations required verification	Limited
Dams	Locations of impoundments	points shp	TNC - ERO (2/10/2011)	2/2011	Points as habitat fragmenting features; surface water capture & storage capacity	Point locations required verification	Limited
ECOLOGICAL THREATS							
Non-native invasive species	Locations of invasive species sitings	Excel table	WVDA (8/2011)	8/2011	Estimate of invasive species location and coverage	Data table contains entries/formats not compatible with import into GIS; some geographic coordinate errors	Moderate
Basal area loss, by species	National Insect and Disease Risk Maps	rasters	USFS (2006)	8/2011	Estimate of timber pests and pathogens		None
Quarantined counties	Infested/infected/quarantined counties	polygon shp	WVDA (2011)	8/2011	Used to estimate pests & pathogens threats	Resolution by county	Limited

* See Section 2.3 for a description of QA/QC categories. Detailed procedures for those datasets requiring moderate or extensive QA/QC are provided in Appendix A.

2.2 Intended Use of Existing Data

Physical geography data will be used to provide a general characterization of the watershed and to determine natural vulnerability. Elevation data will be used to derive slope and general topography. Geologic data will provide rock type classification, including coal formations. Soils data will be used to identify areas containing hydric soils, highly erodible soils and soil infiltration rates.

Hydrologic data, such as the NHDPlus data, will be used to define watershed boundaries and the project planning units, and to model stream characteristics and behaviors. Stream network data from this dataset will also be used to identify potential upstream or downstream contamination issues within the watershed.

Wetlands data, such as the National Wetlands Inventory (NWI) and the National Land Cover Dataset (NLCD) 2006 data, will be used to define wetland areas and types. Wetlands areas may also be verified using hydric soils data and digital orthophotography.

Monitoring data collected by state agencies will be used to evaluate water quality within each watershed, using standard parameters such as total suspended solids, pH, specific conductivity, sulfates, nitrogen, heavy metals, fecal coliform, GLIMPSS/RBP scores, etc. USGS stream gage monitoring data will be used to determine stream flow and identify stream types.

Species and habitat data will be used to identify element occurrences and vegetative communities and thus highlight areas that are particularly in need of restoration or protection activities. The incorporation of species and habitat data is intended to provide a description of relative biodiversity within each catchment. Of particular interest are areas with many rare species, which would be designated as very high quality areas and be ranked high on the priority list for protection.

Several datasets will be used to determine potential sources of contamination from resource extraction and pollutant loading activities within the watershed, including mines (abandoned, permitted and active mining areas), oil, gas and Marcellus shale gas wells, permitted wastewater outfalls that discharge treated effluent back into a stream, and land development data (to measure the potential contribution of industrial, commercial, and residential/urban development practices).

Sources of various forms of infrastructure, such as roads, railroads, dams and city/county boundaries, will be used as reference and landmark information to convey relative geographic data to end users. Some infrastructure, such as road and rail networks, may also be used to identify areas particularly vulnerable to runoff (nonpoint source pollution) from such sources. Infrastructure data will also be incorporated into the analysis of habitat fragmentation issues, which will be considered in the assessment process.

2.3 Limitations on the Use of Existing Data

General criteria for the selection of existing data to be used in the West Virginia Watershed Assessment Pilot Project are as follows:

- Datasets should include quality assurance/quality control metadata for precision and accuracy (at a minimum, metadata should include data description, originator, source of access, publication date, time period and spatial domain information); lacking sufficient metadata, some documentation must be available that identifies collection methods and dates
- Monitoring data must be generated under an approved quality assurance plan or similar document and be accompanied by a comprehensive sampling design (including type of sample, statistical approach, etc)
- Geographic data must be available at scale which will be useful at the smallest extent of the project analysis; that is, data points that have had the locations "blurred" for security reasons must still be accurate enough to use in the smallest planning unit

In the initial stages of data collection, datasets requiring varying degrees of QA/QC have been identified. These broad classes of data and examples are listed below. Further details for specific datasets are given in Appendix A.

- Little or no QA/QC required: National or state agency data such as the National Land Cover Dataset or WV DEP water quality data, and data generated by lead scientists at TNC Eastern Regional Office and published in the open literature, such as landscape connectivity and resiliency data (http://www.epa.gov/ncea/global/docs/bio-indicators/southeast/day2/1_TNC_vulnresil.pdf). Usually these data need only to be clipped to the desired geographic extent or possibly converted between vector and raster data types.
- Limited amount of QA/QC required**:** Data that may have been received as "fuzzy" or with point locations requiring verification, such as large quantity water withdrawals, public water supply data and wells locations. Generally, verification involves comparing against 2010 aerial imagery or address information to ensure that points are accurately located. Limited QA/QC often results in data being filtered by attributes to only those features that are most reliable (e.g., taking only active well locations).
- Moderate amount of QA/QC required: Data generated by TNC partners and maintained in internal databases, such as locations of rare species ("element occurrences") collected by West Virginia Natural Heritage Program. Such data may include blank, duplicate, or erroneous records, or data earlier than the time frame during which it can be reasonably expected that a species or environmental condition persists. In these cases, removal, addition, or correction of records renders the data acceptable. Moderate QA/QC may also be conducted on datasets to ensure compatibility with the formatting or resolution needs of the project, such as manual amendment of datasets generated from models.

- Extensive QA/QC required: Data that are found to be deficient for this analysis, irrespective of the data source, but that are necessary for a complete watershed assessment and for which no alternative exists, such as mining footprint data from West Virginia Department of Environmental Protection. Such data may need extensive additions or deletions of geographic features or attributes.

3.0 ASSESSMENTS AND OVERSIGHT

3.1 Project Assessment

The TNC project team (Director, Manager, and Technicians) will meet regularly, at least once a week but often more frequently, to assess project progress and to ensure that data quality objectives are being maintained. Determining data quality is a key step early in the project and will require additional oversight as data from a variety of sources are gathered, organized and processed. Critical progress deadlines will occur throughout the project timeline, identifying due dates for documents or assessment methodology, such as any technical advisory or expert meeting dates, as well as the final assessment reports due dates. Considering that the overall assessment procedure is a step-by-step process, regular communication will occur within the project team to ensure that efforts are not being duplicated or key data quality measures overlooked. Final information regarding data quality review procedures will be incorporated in the final assessment report for each watershed, with a detailed description of the QA/QC conducted for each relevant dataset.

3.2 Project Oversight

Project oversight will be documented through a series of nine quarterly/performance reports, beginning three months from the initial project start date and continuing through to project completion. Data collection and assessment will also be reviewed through weekly meetings, draft watershed assessment reports, and technical and expert advice during workshops. Completed draft reports will be peer reviewed and edited prior to final publication.

Near the beginning of the project, a technical advisory meeting will be held to help determine the most appropriate data sources for watershed analysis, as well as identify any gaps in assessment methodology or general data compilation. Later in the project, two expert workshops will be held to solicit input on precise assessment methodology and review initial assessment results, to ensure that project goals are being met and outputs are scientifically defensible and appropriate for use by the various partners, stakeholders and regulatory staff intended as end users.

Raw, often state-wide data will be compiled on a central GIS drive, with datasets clipped to the extent of the individual watersheds stored within ArcGIS 10.0 geodatabases created for each watershed (i.e., Mon.gdb, Elk.gdb, etc). These geodatabases will be stored on the central GIS drive as well as the hard drives of the GIS technicians, and all data and maps will be backed up to two external drives on a weekly basis. Data sources, descriptions, file paths, publication information and download dates are compiled in a central Access database, with a project-specific Excel table storing original data information as well as clipped file names and locations for the watershed-specific data.

Data collection and management, as well as decisions regarding data quality, will be made by the project technical team:

- Ruth Thornton, Conservation Information Manager III. M.S. Fisheries and Wildlife; experience in watershed assessments, conservation planning, data management in Micosoft Excel and Access, geographic information systems, statistical analysis.
- Misty Downing, Conservation Information Manager II. M.S. Geographic Information Systems; experience in watershed assessments, data management in Microsoft Excel and Access, geographic information systems.
- Diane Packett, Conservation Information Manager II. Ph. D. Chemistry, M.S. Wildlife Science; experience in large dataset validation, data management in Microsoft Excel and Access, geographic information systems, statistical analysis.

Project oversight will be the responsibility of project director Keith Fisher, Director of Conservation Programs, M.S. Biology.

3.3 Data Problem Resolution

Potential data problems include: lack of appropriate or complete metadata, incomplete datasets, confusing or misaligned data and/or data that conflict with other quality-assured data sources. Resolutions to such problems may be achieved through a variety of means, including:

- Contacting the data originator for more complete metadata or explanation regarding its absence
- Seeking out alternate data sources that have the same or similar coverage, or including data sources that may be provided in a different format but can be converted to adjoin the incomplete dataset (such as data presented in an Excel, Access or other database format that can be converted into spatial data)
- Verifying confusing or seemingly inaccurate data against alternate, quality-assured data sources (filtering out or discarding any highly conflicting data) and adjusting alignment or projection issues accordingly, where possible, either through georeferencing or applying projection/coordinate system conversion algorithms.

In certain instances problematic data may be the only data source available. In those cases, acceptance criteria may be lessened. It is beyond the scope of this project to collect primary field data. If certain data are deemed unacceptable, the related assessment metric may be dropped from the analysis or an alternative metric with more reliable data may be sought. Any data limitations will be documented in the assessment report and data inventory accordingly. Since an ancillary goal of the project is to identify data gaps relating to watershed assessment analysis, thoroughly documenting data sources and any limitations, including inadequate or questionable datasets, is considered a significant part of the work involved in the project.

A potentially serious problem with these numerous large datasets is data loss or corruption. Accordingly, working copies of each dataset will be created so that the originals remain intact, and the copies stored on the hard drives of the technical team's computers. The original data on the TNC server and the copies on the hard drives will be automatically backed up daily; in addition, the copied data and map products on individual computers will be duplicated on external hard drives.

4.0 DATA REVIEW

4.1 Data Verification and Validation

All secondary data will be reviewed to assess adequacy relative to stated acceptance criteria. This assessment will utilize various methods, including statistical analysis for completeness, comparison against field-verified data and thorough metadata review and investigation as necessary. All data collected throughout the study will be compared among datasets to determine if there is general consistency, given known variations such as seasonal, hydrologic, and land use changes.

Data sources will be selected for use based on relevance, completeness, accuracy, quality and the age of the data. Particular factors that may cause data to be rejected include: lacking appropriate, available or complete metadata; data that are deemed too out-of-date to accurately reflect the current status of the watershed; data that appear incomplete or significantly conflict with known quality-assured data; and data that are deemed irrelevant or redundant once analysis has begun.

In select instances data that have been deemed of lesser than desired quality will need to be incorporated in the project due to lack of sufficient replacement data. In those cases all limitations on how such data may be used and interpreted will be documented within both the data inventory and the assessment methodology. Low or suspect quality data will not be used for analysis, but rather representation or support, except in cases where the dataset is the only available source for such information in the watershed. In this situation, data will be verified against quality-assured data where possible and any limitations for analysis will be noted within the assessment report and the data inventory. Data will be reviewed for noticeable transcription errors (such as points with obviously incorrect or inverted latitude/longitude coordinates). Any features with apparent data entry errors will be corrected (if feasible) or removed as necessary.

As stated in Section 2.3 above, in the early stages of this project data requiring no or only limited QA/QC, as well as data requiring moderate or extensive QA/QC, have been identified. In the following section a general Standard Operating Procedure is given for dataset QA/QC, and specific details for procedures conducted for each dataset requiring moderate or extensive QA/QC are given in Appendix A.

4.2 Data Evaluation

Data evaluation will include an extensive review of all accompanying metadata. Most sources of project data will be federal, state or local agencies with complete metadata that thoroughly documents the methods for collecting data as well as any quality assurance and quality control procedures applied (see for example WV DEP 2011). Due to the secondary nature of the project data, the analysis team will have little control over data completeness or data collection methods. Where applicable, any datasets that contain overlapping information will be compared to ensure consistency among the varying sources.

The West Virginia Watershed Assessment Pilot Project Standard Operating Procedure for data evaluation consists of seven steps:

1) Visually inspect the data.
   a) If the data exist in an Excel or Access table, examine the table and data fields to ensure that the necessary information exists. Sort the data or display in a pivot table to examine the range of values for the attributes.
   b) If the data have a spatial component (latitude/longitude), display the data in GIS to visualize the data extent and determine if there are outlying data points. Examine the attribute tables for the spatial data to determine what information is present and the possible origin of any outliers.
   c) Display spatial data in GIS and compare features against aerial imagery and/or topographic maps or other quality assured data sources to verify extent and spatial/locational accuracy.
2) Examine the metadata or other available files from the generating agency regarding the data creation and make an objective determination of whether data collection/creation is of sufficient accuracy for project needs. If no documentation is available, contact personnel at the generating agency for details regarding data creation.
3) Create working copies of the data files so that the originals remain intact.
4) Remove from the copied data any records that are found to be erroneous; e.g., blank, duplicate, or incomplete records that will not contribute useful information to the analysis. Remove spatial features with locations or attributes of questionable accuracy (i.e., not able to be verified based on aerial imagery, topographic maps or other quality assured sources).
5) Edit the copied datasets so that the extent is to the area of interest; e.g., clip spatial data to West Virginia or remove data that do not apply to West Virginia from tables.
6) If feasible, repair or augment deficient data with other available datasets; e.g., create additional geographic shapefiles based on the latest aerial images to update agency geographic data, or join other data files that contain desired information.
7) Document reasons and procedures for data amendments, corrections, or exclusion.

5.0 PROJECT SCHEDULE

Table 3. Project Timeline

Month	Activity
March 18, 2011	Grant award signed by DEP
April 1, 2011	Sub-award agreement between DEP and TNC, project timeline starts
April 15, 2011	Quarterly report (1) for January, February, March due
June 1, 2011	Draft assessment methodology completed, Baseline data set identification and compilation begins for 2 watersheds, QAP Plan developed and submitted for review
June 13, 2011	Technical Advisory Team 1st meeting
July 15, 2011	Quarterly report (2) for April, May, June due
Oct 1, 2011	QAP Plan completed, Baseline data collection completed
Oct 15, 2011	Quarterly Report (3) for July, August, September submitted
Nov 1, 2011	1st Expert Workshop on 2 watersheds completed, Consolidated analysis data development and revisions begin
Jan 15, 2012	Quarterly Report (4) for October, November, December submitted
Feb 1, 2012	Consolidated analysis data development and revisions completed, 2nd expert workshop held, strategy development completed in 2 watersheds
March 1, 2012	Draft assessments completed in 2 watersheds
April 1, 2012	Decision maker and end user workshops held. Final revisions made and sent out for peer review.
April 15, 2012	Quarterly Report (5) for January, February, March submitted
June 1, 2012	Peer review completed. Final assessment reports on 2 watersheds completed, assessment methodology report completed. Begin Baseline data collection on remaining 3 watersheds.
June 15, 2012	Quarterly Report (6) for April, May, June submitted
Sept 1, 2012	Baseline data collection completed on remaining 3 watersheds
Oct 1, 2012	1st expert workshops on remaining watersheds, Consolidated analysis data development and revisions begin.
Oct 15, 2012	Quarterly Report (7) for July, August, September submitted
Dec 1, 2012	Consolidated analysis data development and revisions completed in remaining watersheds, 2nd expert workshops held, strategy development completed
Jan 1, 2013	Draft assessments completed in remaining 3 watersheds

Month	Activity
Jan 15, 2013	Quarterly Report (8) for October, November, December submitted
Feb 1, 2013	Decision maker and end user workshops held. Final revisions made and sent out for peer review on 3 watersheds.
April 1, 2013	Peer review completed. Final assessment reports on 3 watersheds completed, assessment methodology report revisions made. Final report and all completed deliverables submitted. Report published on DEP website.
April 15, 2013	Quarterly Report (9) for January, February, March submitted. Dissemination of results

6.0 PROJECT REPORTING

Project results will be reported in a series of five (5) watershed assessment reports, one for each of the following HUC 8 watersheds: Monongahela (Lower – 05020005, Upper - 0502003); Elk (05050007); Upper Guyandotte (05070101); Little Kanawha (05030203) and Gauley (05050005). An initial draft assessment methodology outline will be reviewed by the technical advisory team prior to the start of the first two watershed assessment analyses, and all draft assessment reports will be peer reviewed by experts involved in the project.

Proposed Watershed Assessment Report Outline

- Acknowledgements
- Executive Summary
- Introduction
- Project Summary
  - Background
  - Purpose
- Methodology
  - Study Area
    - Geography
    - Geology
    - History
    - Climate
  - Data Acquisition and Geoprocessing
  - Watershed Characterization
    - Condition/Function (Physical and Biological Factors)
      - Hydrologic connectivity
        - Stream network
        - Drainage areas
        - Floodplains
      - Land Use/Land Cover
        - Wetlands
        - Forested lands
        - Impervious cover
      - Water Quality & Quantity
        - Monitoring data
        - Impaired streams – 303(d), TMDL, AMD
        - Stream flow
      - Biodiversity
        - Species – element occurrences
        - Predicted habitat modeling
        - Vegetative communities
      - Protection priorities
        - TNC aquatic and terrestrial portfolios
        - Secured lands

- Other agency priority areas
- Physical Vulnerability
  - Elevation/Slope
  - Soils
  - Geology
- Threat (Ecological Risk Assessment)
  - Resource Extraction
    - Mines (abandoned, permitted, active mining areas)
    - Wells (oil/gas/Marcellus shale gas)
    - Mineral operations (quarries)
  - Pollutant Loading (point and nonpoint sources)
    - Wastewater outfalls
    - Landfills
    - Agriculture
    - Development (Industrial, Commercial, Residential)
  - Fragmentation
    - Roads
    - Railroads
    - Dams
    - Transmission lines
    - Pipelines
- Development and Structure of Prioritization Models
  - Restoration Priority Models
    - Riparian
    - Wetlands
    - Uplands
  - Protection Priority Models
    - Riparian
    - Wetlands
    - Uplands
- Consolidated Analysis
  - Cumulative Watershed Effects
    - Historical Conditions
    - Current Condition of Watershed
    - Possible Future Conditions (trends analysis)
  - Potential Protection and Restoration Sites & Strategies
- Interactive Web Mapping Application (Spatial Decision Support Tool)

Results of Final Assessment

Proposed Strategies/Actions

Appendix A. Data Inventory

Appendix B. Quality Assurance Project Plan

Appendix C. Meeting Notes/Results from Technical Advisory webinar, Expert Workshops I and II, and Decision-Maker/End User Workshop

Each of the final watershed assessment reports will include a comprehensive data inventory of all existing (secondary) data that were used in the project. Data inventories will be included in the reports as an appendix, and will contain information regarding data type, description, format, source, dates, intended use and any noted limitations. A detailed description of dataset-specific data review and QA/QC procedures will be included in each watershed assessment report. All data used within the spatial decision support tool will also be accompanied by corresponding metadata, which may be accessed through the website where the tool is located. An additional appendix will be created that details the quality assurance plan for the project.

REFERENCES

EPA, 2001. "EPA Requirements for Quality Assurance Project Plans" (EPA QA/R-5) EPA/240/B-01/003. USEPA Office of Environmental Information, Washington, D.C.

EPA, 2002. "Guidance for Quality Assurance Project Plans" (EPA QA/G-5) EPA/240/R-02/009. USEPA Office of Environmental Information, Washington, D.C.

EPA New England, 2009. "EPA New England Quality Assurance Project Plan Guidance for Environmental Projects Using Only Existing (Secondary) Data". Quality Assurance Unit, Office of Environmental Measurement and Evaluation.

West Virginia DEP 2011. Watershed Branch SOPs. http://www.dep.wv.gov/WWE/watershed/Pages/WBSOPs.aspx

Appendix A. Dataset QA/QC

I. Data requiring moderate QA/QC

Dataset: NHDPlus catchments and flowlines
Data problems: Both the NHDPlus catchments and flowlines were generated based on models, which created two main issues: some stream lines were fragmented or incomplete, and many of the catchments had residual slivers that drained to a different point than what was indicated by the polygon outline.
Data correction procedures: Stream lines were resolved by filling in NHDPlus flowlines based on topographic maps. The catchment multi-part features were exploded and the residual sliver was merged with the appropriate catchment based on elevation data and the NHDPlus flow direction grid.

Dataset: Element occurrences
Data problems: Data transcription errors resulted in point locations outside West Virginia state boundaries; data includes occurrences from as early as 1900; current data on odonate occurrences were missing.
Data correction procedures: Since it is impossible to obtain original datasets or field notes, points that fell outside West Virginia State lines were removed. Data collected before 1991 were removed to ensure that only the most current data are used.
Caveats: It is recognized that transcription errors by the original data file generators may have resulted in incorrect point locations that are not readily obvious.

Dataset: Odonate occurrences
Data problems: Some element codes (which identify each plant or animal to species) were missing from the file.
Data correction procedures: The missing codes were located in the NatureServe online database and added to the file so that it could be joined to the element occurrences shapefile.

Dataset: Ecoregional targets
Data problems: As with the element occurrence data, transcription errors resulted in point locations outside West Virginia state boundaries; data include occurrences from as early as 1900.
Data correction procedures: Since it was impossible to obtain original datasets or field notes, points that fell outside West Virginia State lines were removed. Data collected before 1991 were removed to ensure that only current locations are used.

Caveats: It is recognized that transcription errors by the original data file generators may have resulted in incorrect point locations that are not readily obvious.

Dataset: Active River Area (ARA)
Data problems: The ARA was based on modeling efforts and as a result certain elements were included in the dataset that did not properly reflect project needs, most notably the inclusion of isolated wetland features, which were often mining ponds.
Data correction procedures: Isolated features were removed from the ARA to leave only the riparian areas. Additionally, because the original streams dataset used to generate the ARA included some fragmented streams, these stream lines and adjacent active river areas were filled in based on topographic maps and hydrologic characteristics.

Dataset: Invasive species
Data problems: Attempts to display the data using the lat/long coordinates in a .csv version of the Excel table in GIS were unsuccessful.
Data correction procedures: Reformat table headings for compatibility with ArcGIS; remove blank rows from the table; remove records where textual descriptions were used instead of lat/long coordinates; remove obviously erroneous records (e.g., latitude = 0)
Caveats: It is recognized that transcription errors by the original data file generators may have resulted in incorrect point locations that are not readily obvious.

II. Data requiring extensive QA/QC

Dataset: Mussel streams
Data problems: This dataset consists of an Excel file of stream reaches in each county, identified by DEP stream code, and indications of whether the reach is of high quality with potential for mussels, has an endangered species present, or has potential for endangered species in the lower part of the reach. In cases where an endangered species is present, neither the location nor identity of the species is given. In some cases, the DEP stream code is out of date so that the data did not join properly with the NHD24K stream shapefile.
Data correction procedures: Where possible, the stream codes in the Excel file were changed to correspond to those in the streams shapefile so that they could be joined. Because the data did not contain specific mussel locations or identifications, they were not joined with the more precise “element occurrence” point data. Instead, a line shapefile was created indicating whether stream reaches contained endangered species or were of high quality (the information that an endangered species was possible in the lower part of the stream was considered too imprecise for use and was

rejected). These data will be given less weight in the final analysis than the other species data as they are less precise.

Dataset: Surface mining footprint
Data problems: The shapefiles provided to us were visually compared to designated strip mines on the most recent topographic maps (photorevised 1976-1982) as well as aerial images (NAIP 2009) and in many cases were found not to correspond to, or to be of different extent than, mines shown on maps and photos.
Data correction procedures: Correspondence with James Britton at WV Geologic Survey regarding the procedure for generation of these shapefiles revealed that they correspond more closely to the coal bed than to the actual mine. To generate a more accurate estimate of mining footprints the strip mines designated on topographic maps were digitized and designated as "legacy" mines in the feature attribute table, and mines clearly visible on aerial photos were digitized and designated as "active" mines. These shapefiles will likely be combined to generate a conservative picture of the full extent of surface mining within the last 50 years.

III. Rejected data

Dataset: Forest age
Source: USDA Forest Service
Format: Access database
Data problems: For security reasons, the geographic forest plot data was "blurred" so that the plot falls within a 1-2 mile diameter circle. Because some watershed planning units are as small as 100 acres, or 0.15 sq miles, the accuracy of these data are not sufficient for our use at the planning unit scale.

Appendix B

Original Grant Proposal

Project Title: West Virginia Watershed Assessment Pilot Project

Project Applicant: West Virginia Department of Environmental Protection

Geographic Location: This assessment will occur in five (5) HUC 8 watersheds within West Virginia including: Lower Monongahela (05020005), Elk (05050007), Upper Guyandotte (05070101), Little Kanawha (05030203), and Gauley (05050005)

Project Goals

1. Advance the science and protection of aquatic headwater resources within watersheds which link to the Mid-Atlantic Highlands.
2. Achieve a net increase in the quantity and quality of wetlands and other aquatic resources, and their resource function, within the watershed.
3. Protect, sustain, and restore the health of people, communities, and ecosystems using integrated and comprehensive approaches and partnerships.

Project Objectives

1. Design and test a process that assesses the condition of aquatic resources and the impacts to those resources within a watershed, including an assessment of cumulative impacts and integration of information with multiple sources within and outside of government agencies.
2. Provide relevant data, strategies, and a dynamic, updateable decision support matrix to assist regulatory staff and state and local officials with decisions affecting aquatic resources.
3. Establish priorities for protection and restoration of aquatic resources, with the goal of a net increase in functional wetland acres in the watershed.
4. Develop common and consistent strategies for various government agencies and non-governmental organizations to partner and utilize various protection and restoration tools to achieve goals established for the watershed.
5. Focus attention on headwater aquatic resources in areas where impacts to these resources are significant and potentially increasing.
6. Establish protocols for monitoring and assessment of aquatic resources to track changes within a watershed and provide an adaptive feedback loop to the decision making, protection, and restoration functions.

Proposed Planning Outline

I. Define and characterize the natural resources within the watershed.
   a. Characterize the wetland, stream, and upland natural resources within the watershed.
   b. Identify, describe, and locate unique and/or sensitive species (and their habitat requirements) and natural communities within the watershed.

c. Where data allows, characterize the functional values and ecological services provided by the natural resources in the watershed (surface water use, flood storage/abatement, groundwater use, sediment retention, pollutant assimilation, recreational benefits, etc.)
d. Identify existing conservation investments on the ground (local, state, federal, and private conservation lands; conservation easements; mitigation sites)
e. Document identified government and private conservation priorities within the watershed (protection and/or restoration priorities identified by conservation organizations and government agencies)
f. Characterize and assess hydrologic connections within the watershed, and connections upstream and downstream of the watershed (where appropriate), to determine how these affect watershed condition.

II. Assess the current condition of the watershed
a. Identify areas of high ecological value within the watershed (based on important species, natural communities, intactness, functional value, connectivity).
b. Where data allows, determine the extent and location of wetland, stream, and upland loss compared to historic conditions, including the loss of any species or natural communities.
c. Where data allows determine what natural resources, functions and/or services have been lost or degraded, where they area, and how significantly they have been impacted.
d. Identify impacts and stresses to natural resources and functions, and unique and/or sensitive species and natural communities in the watershed.
e. Document current and past land use changes in the watershed, and evaluate their cumulative impacts to natural resource value and function. (Mining, oil and gas development, residential/commercial development, agricultural conversion, road construction, etc.)
f. Document other sources of natural resource and function loss and their cumulative impacts (dams, facilities that discharge to water, etc.)
g. Document water quality impairments including 303d stream listings within the watershed and issues affecting hydrology and environmental flows.
h. Where data allows, assess the contribution of consumptive water use on resource quantity and function.
i. Identify areas of high restoration need and potential in the watershed.
j. Derive a spatially explicit characterization of conditions in the watershed

III. Assess Future Conditions
a. Evaluate land development/conversion trends in the watershed.
b. Evaluate permit trends
c. Assess trends in water quality, flow, water use (if data is available)
d. Evaluate how projected trends could impact current watershed condition or the success of restoration/protection projects.

IV. Establish Priorities for the Protection and Restoration of Aquatic Resources
a. Based on the assessment work completed, develop a collaborative vision for protecting or improving watershed condition, functionality, and ecological services with stakeholders, and target the goals and strategies to accomplish the overall vision.
b. Define appropriate metrics for parameters used to evaluate the importance or value/contribution of potential actions

i. Condition metrics – aquatic habitat type and quality, hydrology, flows, water quality, land use, connectivity, adjacent land use, watershed position, etc
ii. Ecosystem functions/services metrics – flood storage, surface water use, sediment retention
iii. Biodiversity metrics – aquatic and terrestrial habitat diversity, unique or sensitive species

c. Develop a prioritization matrix utilizing the above referenced metrics to rank potential actions.
i. Protection of high conservation value sites.
ii. Restoration needs, opportunities, and probability of success.
iii. Projects that abate or mitigate water quality, diversion, or water use issues.
iv. Projects that restore or maintain ecosystem functions/services.

V. Develop Strategies Designed to Address Issues within the Watershed (within the context of the project goals and objectives).
a. Develop strategies designed to accomplish the collaborative vision for the watershed and address specific issues identified through the assessment process.
b. Define success or improvement, and develop specific metrics to evaluate the agreed upon measure of success.
c. Establish an adaptive evaluation and management process.

VI. Host a workshop with decision makers and potential end users to obtain their input on the process utilized and the watershed assessment product.

Project Description

The proposed watershed assessment is designed around a multi-step process which includes the following steps.

1. Define the watershed **assessment methodology**.
2. Complete a **Baseline analysis** that describes watershed resources, impacts, and condition.
3. Conduct **expert workshop 1** to review the assessment process, evaluate the data collected, obtain local information on watershed specific resources, issues, and other relevant information, and define appropriate metrics for parameters used to evaluate the importance or value/contribution of potential actions.
4. Complete a **Consolodated analysis** using results from the expert workshop to incorporate local data and apply prioritization metrics to rank potential actions and sites within the watershed.
5. Conduct **expert workshop 2** to review the data collected, evaluate the conclusions of the prioritization process, and develop strategies designed to address issues within the watershed.
6. Complete **draft watershed assessment**.
7. Conduct a **decision maker/end user workshop**.
8. Complete **final assessment**

Assessment Methodology
To assist in developing the assessment methodology, the project team will identify and assemble a technical advisory team comprised of agency personnel, academic researchers, and individuals from the non-profit or private sector with relevant expertise. The advisory team will provide the project team

with guidance on structuring the assessments, data and data limitations, technical or scientific questions, or other technical issues that arise during the course of the project. They will also provide peer review of the products developed. Listed above is the draft planning process for the watershed assessment that will be presented to the technical advisory committee for review and input. The planning outline was compiled from an amalgam of watershed planning efforts from several states and is intended to address the specific goals and objectives of this project, and the potential data availability and limitations.

There are specific questions that will be posed to the technical advisory team during their review of this outline:

1. Will the planning outline capture the information necessary to achieve the proposed goals, outcomes, and outputs for the project?
2. What information, if any is missing?
3. What is the most effective planning unit to assess and prioritize information in the HUC 8 (e.g., HUC 12, HUC 14, NHD Plus catchments, other)?
4. What are the data needs and limitations?
5. Are there specific technical or scientific issues that will need to be addressed in the assessment?
6. Are you aware of other projects that might contribute to, or provide information into this process?

Baseline Analysis

The Baseline Analysis will include identifying, collecting, and conducting quality control of existing data sets describing watershed resources, impacts, and condition. This is a desk level assessment to capture and organize data characterizing items in Sections I, II, and III in the planning outline above. The following is a draft list of data considerations for the Baseline Analysis.

1. Identifying and characterizing upland, wetland, and stream resources in the watershed.
2. Identifying existing conservation lands (fee ownership, easement, other)
3. Identifying multi-partner conservation objectives.
4. Identifying rare or sensitive species and their habitats (may use habitat suitability modeling if available), and natural communities.
5. Documenting land use and habitat loss or conversion trends from multiple sources.
6. Information describing historic (where possible) and current wetland extent, location, and type.
7. Physical parameters such as hydrology, soils, slope.
8. Identifying chronic environmental problems such as flooding and poor water quality.
9. Identifying sources of watershed impairment.
10. Hydrologic connections and flow
11. Cumulative impacts
12. Water use
13. Requirements of other regulatory and non-regulatory programs (storm water management or habitat conservation plans).
14. Potential sites for protection and/or restoration of aquatic resources.

The project team will coordinate with multiple partners to identify and obtain the necessary datasets, including coordinating with ongoing projects at the West Virginia Department of Natural Resources to characterize and assess wetlands in West Virginia, document rare and sensitive species, and habitat suitability modeling; West Virginia University in their project to develop an Alternative Futures Modeling

System to Support Decisions for Mountaintop Removal which includes a cumulative hydrological impact assessment and an updated statewide landscape characterization of land use/cover classification and land forms; and within the Department of Environmental Protection with their watershed assessment work already completed on the Coal River Watershed and the methodology used to evaluate water quality impairment, total maximum daily load, and mine drainage issues. The Nature Conservancy will also integrate several of its new data products relating to landscape resiliency and connectivity. These include regional evaluations of land form diversity, connectivity at local and regional scales, analysis of intact functional forest blocks and aquatic systems, and circuitscape analysis of multiple connectivity pathways and pinch points between landscapes.

Products from this step will include maps and data that provide a spatially explicit characterization of the resources, impacts, and condition in the watershed, including cumulative impacts, trend information, and historical comparisons where possible. The products will be based on available data, but will also attempt to identify and fill data gaps where possible.

Expert Workshop 1
Information compiled during the Baseline analysis will be evaluated during the first of two workshops with local experts. During the workshop, experts will review the assessment process and data collected, and provide input on watershed specific resources, issues, or other relevant information; recommendations to the process; and identify any new data needs. The intent of this workshop is to obtain more specific local information addressing the data considerations defined above. Field assessments will be limited; however, there may be circumstances where field visits facilitated by local experts are conducted to verify or assess specific sites, issues, or opportunities. Experts will also help develop a collaborative vision for protecting or improving watershed condition, functionality, and ecological services; and define appropriate metrics for parameters used to evaluate the importance or value/contribution of potential actions.

Consolidated Analysis
The Consolidated analysis will incorporate information collected during the Level 1 analysis and add local information collected during the first expert workshop, incorporate changes or additions suggested by experts, and attempt to fill in any data gaps identified. The analysis will include:

1. A more detailed spatially explicit characterization of natural resources and resource conditions in the watershed, including a cumulative impacts analysis, that includes local information and knowledge that may not be available in statewide data sets.
2. An inventory and assessment of impacts and stresses to aquatic systems in the watershed, including any local information on flooding, stream condition, erosion and sedimentation, mine drainage, or other perturbations that may affect resource quality
3. Identification of high value ecological resources, landscape linkages, or other conservation objectives and where these occur in the watershed.
4. An inventory of potential protection and restoration sites and/or measures to eliminate, abate, or mitigate for impacts or stresses to the aquatic systems.

The overall vision and metrics defined in the expert workshop will be used to develop a prioritization matrix to rank potential actions in the watershed. These actions may include identifying key parcels for protection, identifying priority stream reaches for restoration, identifying mine drainage issues that may be addressed by AML/AMD programs, or identifying problematic water quality issues that may be addressed through other programs; all contributing to improving the condition of the watershed. The

prioritization process will also form the basis for a decision support tool, that will provide information and potential strategies to decision makers, regulatory staff, watershed groups, and others working to improve watershed conditions.

Expert Workshop 2
Information compiled during the Consolidated analysis, including the results of the prioritization process will be presented to experts and the advisory team for peer review during the second expert workshop. The objectives of the workshop will be to review the data collected and the conclusions made, review the results of the prioritization process and modify the process if necessary, and develop strategies designed to address issues within the watershed. In addition, participants in the workshop will work to define success and develop specific metrics to evaluate the agreed upon measure of success, and establish adaptive evaluation and management protocols that may be implemented by DEP or other regulatory agencies to determine what impact decisions and actions are having on the watershed.

Draft Watershed Assessment
The draft watershed assessment will include a compilation of all of the items defined in the proposed planning outline above, along with specific strategies and priorities developed to accomplish the goals and objectives (defined above) for the project. The draft assessment will also describe the methodology and references used to complete the assessments, and lessons learned during the process. It will include detailed descriptions of the prioritization process used to evaluate protection and restoration opportunities. One key aspect will be the protocols developed to integrate and use monitoring and assessment to provide an adaptive feedback loop to the regulatory and restoration decision making process.

The draft watershed assessment will also present a framework for an interactive decision support tool targeted to regulatory personnel, state and local decision makers and planning staff, government and non-government conservation organizations, watershed groups, and other potential partner organizations. The framework will present a web or server based interactive GIS application that allows a user to search data and information presented in the watershed assessment. The framework will also include the prioritization process utilized in the assessment. The prioritization matrix will be structured so that an end user can change or filter the priorities evaluated or the weighting of attributes in order to evaluate other specific objectives (for example evaluating stream restoration opportunities based on stream order and available water quality information). The framework format will be determined based on recommendations from the technical advisory committee and input from partners and end users involved with the project. The supporting information will present the data sources, methods used to organize and analyze the data, and strategies for how the data and results can be maintained and updated; including recommendations on other data sources to incorporate and integrate once available and recommendations on collection and analysis of existing data that will allow better integration between data sources. The framework will be provided as an interactive GIS application on a DVD or other suitable external storage device for each watershed. Making the tool live on the web or a server, or maintaining and updating the tool is outside of the scope of the current proposal.

Decision Maker/End User Workshop
The project team will them host a workshop with decision makers and potential end users to obtain their input on the process utilized and the watershed assessment product. This group may include decision makers at all levels of government, potential partners in protection and restoration efforts, industry representatives, watershed groups, or other interested public. The primary objectives of this

step are to find the best method to make this a usable product by the target audience and make them aware of the assessment methodology and end products.

Final Watershed Assessment

The completed watershed assessment will include all of the specific items described in the Draft Watershed section above. However, it will reflect input obtained during the Decision Maker/End User Workshop. The assessment methodology and products will be shared through peer to peer networks, at scientific or technical conferences, and published on the DEP website or in other venues as determined appropriate. The information will be targeted to regulatory personnel, state and local decision makers and planning staff, government and non-government conservation organizations, watershed groups, and other potential partner organizations.

The Final Watershed Assessment will provide the methodology, information and tools necessary to meet the project objectives stated above. The intent is to provide a tested, peer reviewed assessment process that can be duplicated in other watersheds throughout West Virginia along with the other listed outcomes (see Outcomes section below). The information and tools presented in the assessment will provide guidance to regulatory agencies, decision makers, non-governmental organizations, and other partners on key strategies and places to work within the watersheds that contribute to the protection and restoration of critical aquatic resources. A few examples would include: identifying areas of high conservation value for protection by state government or NGO's, identifying high priority sites for conducting mitigation activities, and identifying cumulative impacts contributing to the degradation of aquatic resources.

The project will coordinate with other new or ongoing stream, wetland, or watershed related efforts in West Virginia. If the proposed Green Infrastructure planning effort moves forward in West Virginia, the process, information, results and strategies provided by this project can be incorporated into the Green Infrastructure process to evaluate freshwater aquatic resources at a watershed scale. WV DNR is working on several projects intended to conserve wetlands in the state including: completing assessments of wetlands, developing functional assessment indices, re-mapping wetlands, and identifying unique or exceptional wetlands. This project can utilize data and tools developed by DNR (when available) and incorporate them into the watershed level planning framework defined above. In addition, this project can coordinate with and assist DNR to meet part of their project goals such as identifying unique or exceptional aquatic resources and assisting with the development of strategies for assessing and protecting streams and wetlands, and their overarching goal of conserving wetlands in the state.

Project Implementation

This assessment will occur in five (5) HUC 8 watersheds within West Virginia including: Lower Monongahela (05020005), Elk (05050007), Upper Guyandotte (05070101), Little Kanawha (05030203), and Gauley (05050005). One watershed in this list (the Upper Guyandotte) overlaps with the Alternative Futures Modeling project recently initiated by researchers at West Virginia University. However, this provides a unique opportunity to compare and evaluate the results of the two different processes, and perhaps determine where to integrate the two to achieve the best outcomes.

Watershed assessments will be completed in two of the five identified watersheds first, the Lower Monongahela and the Elk. After these watersheds are completed, the project team will utilize the assessment methodology to complete assessments in the final three watersheds. The intent is to

ensure, through replication, that the process is transferable to other watersheds and that we have more fully evaluated the potential variability from one watershed to the next. These watersheds will be evaluated using the same general process, with adjustments made based on lessons learned completing the earlier watersheds. The project team will complete a final report on each of the last three watersheds.

Project Outputs

Project Outputs	Completion Date
Interim Product: Draft assessment methodology (reviewed by advisory team)	July 1, 2011
Interim Product: Draft QAP Plan	July 1, 2011
Interim Product: GIS based geodatabase containing maps and data reflecting results of Baseline Analysis (watersheds 1 and 2)	Nov. 1, 2011
Final Product: QAP Plan	Nov 1, 2011
Interim Product: GIS based geodatabase containing maps and data reflecting results of Consolidated Analysis (watersheds 1 and 2)	Mar 1, 2012
Interim Product: Prioritization matrix	Mar 1, 2012
Interim Product: Draft assessment for watersheds 1 and 2	Apr 1, 2012
Final Products: Final Watershed Assessments for watersheds 1 and 2	July 1, 2012
Interim Product: GIS based geodatabase containing maps and data reflecting results of Baseline Analysis (watersheds 3, 4, and 5)	Oct 1, 2012
Interim Product: GIS based geodatabase containing maps and data reflecting results of Consolidated Analysis (watersheds 3, 4, and 5)	Jan 1, 2013
Interim Product: Draft assessment for watersheds 3, 4, and 5	Feb 1, 2013
Final Products: Final Watershed Assessments for watersheds 3, 4, and 5	May 1, 2013

Project Outcomes

Project Outcomes	Completion Date
A tested and peer reviewed watershed assessment process that integrates information from multiple sources within and outside of government agencies and documents the condition of aquatic resources and the impacts to those resources within a watershed, including an assessment of cumulative impacts.	May 1, 2013
Relevant data, strategies, and a model decision support tool to assist regulatory staff and state and local officials with decisions affecting aquatic resources	May 1, 2013

within the watersheds.	
Priorities for protection and restoration of aquatic resources, with the goal of a net increase in functional wetland acres in the watersheds.	May 1, 2013
Common and consistent strategies for use by various government agencies and non-governmental organizations to partner and utilize various protection and restoration tools to achieve goals established for the watersheds.	May 1, 2013
Increased focus on headwater aquatic resources within the watersheds through targeted regulatory, protection, and restoration strategies; including consideration of landscape integrity strategies that work to protect surrounding forestland.	May 1, 2013
Monitoring and assessment protocols that track the changes in watershed condition through time and provide an adaptive feedback loop to regulatory or land use decisions, and protection and restoration efforts.	May 1, 2013
Incorporation of watershed assessments into the regulatory decision making process, and in other decisions by state and local officials affecting environmental issues.	Long-term
Integration of information and establishment of consistent goals relating to aquatic resources protection and restoration across relevant agencies and non-governmental partners	Long term