Appendix H
National Hydrography Requirements and Benefits Study
Benefits and Examples

1. Methods for estimating financial and other tangible benefits

For USGS's prior National Enhanced Elevation Assessment (NEEA), USGS documented the range of cost benefits that would result from enhanced elevation data and justified expanded budgets for the current 3D Elevation Program (3DEP) without adversely impacting the budgets of those agencies that indicated they would receive major time/cost savings as well as improved operational benefits and customer service benefits from enhanced elevation data they considered to be mission critical.

Similarly, for this National Hydrography Requirements and Benefits Study, we need questionnaire responders to translate their intangible benefits into tangible benefits for each of your Mission Critical Activities. Questionnaire responders should think in terms of tangible benefits that yield quantifiable cost savings, mission compliance, products and service improvements, and customer experience benefits. Do not include dollar benefits for societal benefits (improved education and safety, environmental benefits, human lives saved).

For activities you consider to be mission critical, using hydrography data currently available or enhanced hydrography data that you might receive in the future, please consider the following:

1.1. Operational Benefits:

Operational benefits may fall into several categories including direct dollar savings from reduced data acquisition; reduced labor costs; annual savings or percent improvement in operational efficiency or effectiveness; or improvements to mission critical programs through improved modeling, analysis, or planning. Examples may include:

Data Acquisition

- Reduced data acquisition costs
- Work hour savings by having readily available enhanced hydrography data in all areas of interest
- Work hour savings by having authoritative data readily available and not having to search for the best available data
- Reduced possibility of errors resulting from use of disparate datasets

Labor Savings

- Reduced labor costs on design and construction of new projects
- Reduced labor costs by having stakeholders perform some of their own analyses
- Reduction in time necessary for analysts to execute mission critical tasks
- Reduced labor and travel costs by being able to perform tasks in the office and not having to collect field data for your modeling/analyses or perform field inspections
- Costs avoided by not having to perform tasks that you previously performed

Operational Improvements

- Improved operational efficiency in performing your Mission Critical Activity
- Improved operational effectiveness:
    - Satisfying compliance requirements where you are currently in non-compliance
    - Providing customer service benefits that you previously could not provide

- Modeling of stormwater as well as point source and nonpoint source pollution of water and environmental cleanup of rivers and streams, wetlands, beaches, etc.
- Dollar benefits or losses avoided from environmental restoration that results in less flooding or other hazards
- Savings to taxpayers from mitigation of risks to public infrastructure such as drinking water, waste water, critical facilities, etc.

Improved Modeling, Analysis, Planning

- Higher-accuracy and/or higher-resolution hydrography data to make computer models more effective
- Automated hydrologic or hydraulic modeling, for example, compared with field surveys
- More reliably deliver natural resource enhancement benefits thereby focusing more funding on nonstructural hydrologic restoration rather than water treatment and flood control
- More reliably delineate restorable and existing wetlands over traditional mapping approaches
- More efficient engineering plans/designs for restoration of watersheds, stream banks, wetlands, forests, grasslands, dams, infrastructure, etc.

1.2. Customer Service Benefits:

Customer service benefits may be similar to operational benefits, but would be experienced by your customers through using improved data or products that you deliver to them and that would improve their ability to accomplish their mission. Examples may include:

- Availability of consistent, accurate and up-to-date down-loadable hydrography data nationwide, compared with data that exist today
- Ability to use accurate and authoritative hydrography data for pipeline routings or facility sitings, for example
- Reduced time necessary for their staff to execute their mission critical tasks
- Improved operational efficiency in performing their tasks
- Improved operational effectiveness in performing their mission critical tasks, perhaps satisfying compliance requirements where they are currently in non-compliance
- Estimated reduction in annual flood losses or crop losses as a result of enhanced hydrography data
- Annual savings for fish, shellfish, recreation, and/or other industries

1.3. Societal Benefits:

Societal benefits may fall into categories such as improved education or public safety, protection of the environment, or human lives saved. Examples may include:

- Improved safety of citizens by using enhanced hydrography data for improved decision making, e.g., to avoid natural or manmade disasters
- Safer communities by taking proactive steps to mitigate risks by informed siting of drinking water, waste water, and other infrastructure facilities
- Reduction in annual loss of life due to flooding or other hazards
- Enhancements to the environment from restoration of watersheds, stream banks, wetlands, forests, grasslands, dams, infrastructure, etc.

2. Example Operational Benefits

2.1. Prioritizing Stormwater BMPs

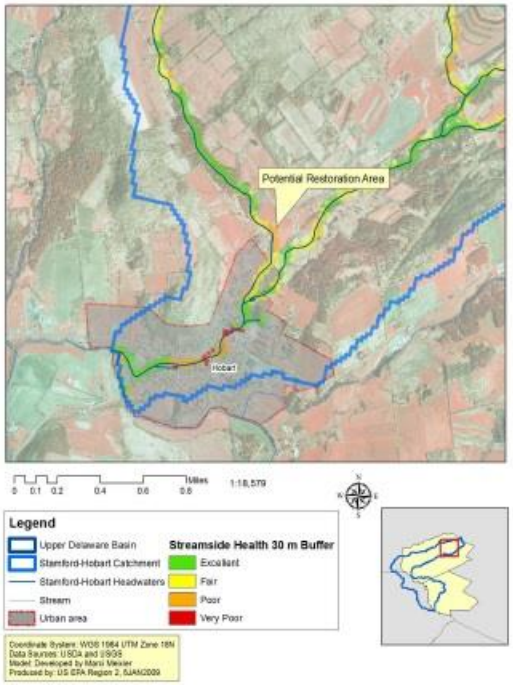

Figure H-1- Potential Stream Restoration or Stormwater BMPs

In response to numerous flood events within the Upper Delaware Basin of New York, which threaten New York City's municipal water supply watersheds, a coalition of researchers and officials investigated water quality and flood management strategies which utilized ecosystem services. The study relied on analyses which featured NHD*Plus* along with the National Wetlands Inventory. Researchers then made a case for selecting conservation design-based stormwater best management practices (BMPs) through cost benefit analyses by computing the replacement value of, e.g., the stormwater detention naturally provided by the basin's wetlands. The stormwater BMPs were selected with reference to hydrologic, ecological, and urban growth indicators and included a range of solutions, including restored wetlands and stream corridors, compact development, and bioswales. The researchers propose that this framework for reducing the incidence of flooding in urbanizing areas, while simultaneously preserving or improving a basin's water quality, could be replicated globally.

2.2. Streamlining Water Protection Analyses

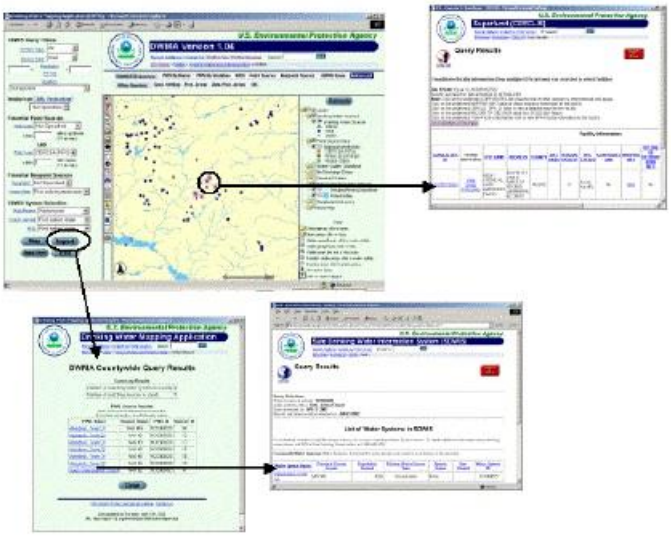

Figure H-2- Existing EPA Reports Linked to Spatial Features

The Environmental Protection Agency created a geospatial application, the Drinking Water Mapping Application, to better serve the needs of staff and clients with respect to agency programs. The NHD*Plus* dataset is used to represent surface waters and serves as the basis for upstream/downstream and proximity analyses, which inform the identification and development of Source Protection Areas. The tool is an important asset for program administration, streamlining the process by which staff can obtain reports and maps across multiple program areas.

2.3. Improved Data Dissemination and Accessibility

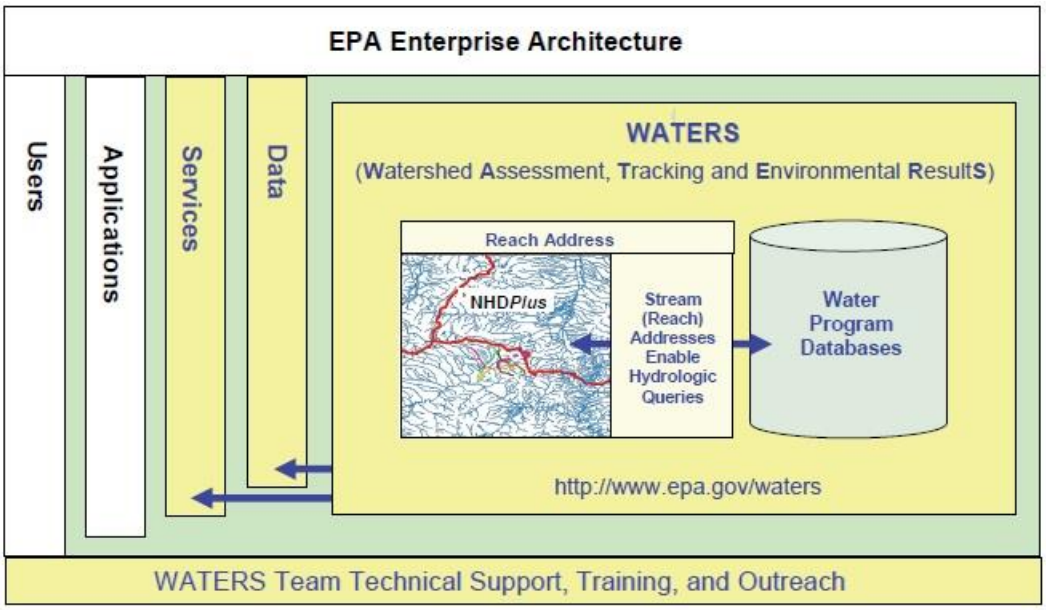

Figure H-3- EPA WATERS Architecture

Motivated by the desire to reduce the costs of data dissemination while also enhancing accessibility to those data, the Environmental Protection Agency developed the Watershed Assessment, Tracking & Environmental Results architecture. In this framework, databases for multiple programs are

indexed to the NHD*Plus* dataset. Consequently, program managers are able to investigate relationships between agency programs as well as national and interstate water quality issues.

2.4. Cost Savings by Prioritizing Field Efforts

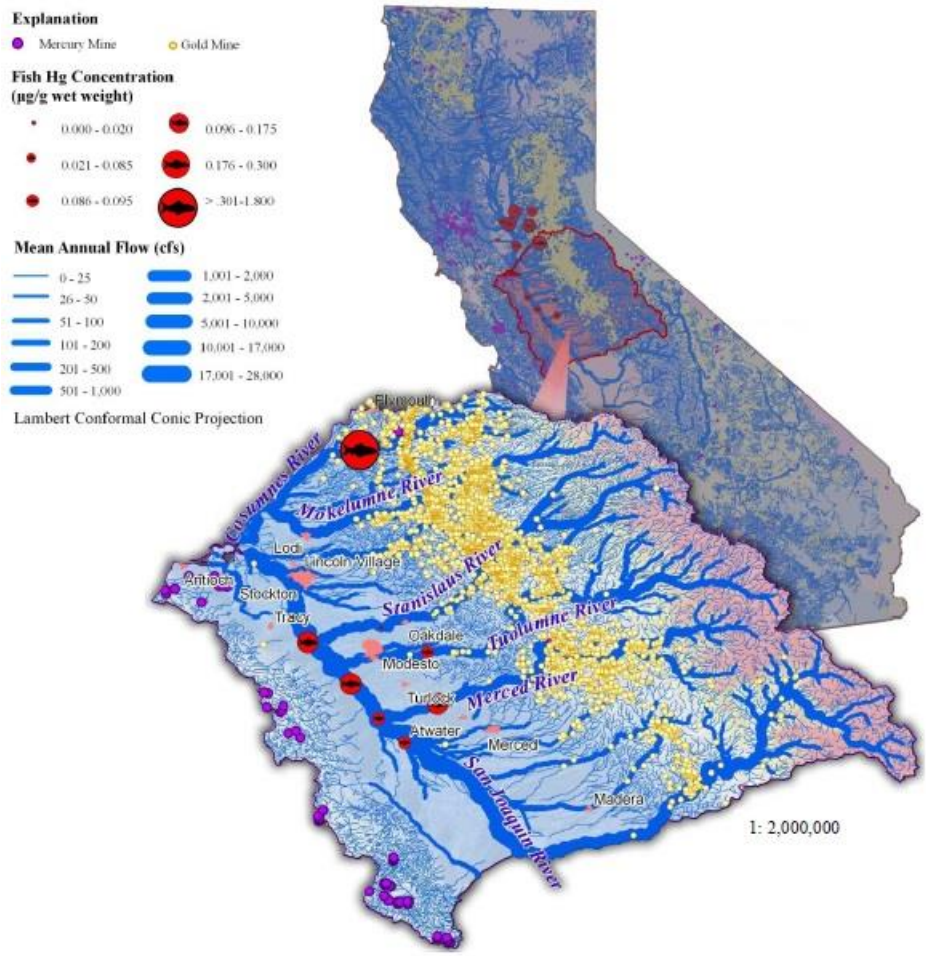

Figure H-4- Mercury Concentrations in Fish Samples Relative to Gold and Mercury Mines and Stream Locations and Flow

NHD*Plus* can be used in combination with numerous other datasets to facilitate visualization and analysis. One example is a USGS study that included depiction of fish mercury concentrations against the backdrop of perennial streams and mine locations, with stream line weights indicating mean annual streamflow. This type of visualization is a powerful way to begin considering possible relationships between mercury concentration and drainage patterns and may ultimately be useful for prioritizing additional sampling locations and analyses.

2.5. Disaster Mitigation

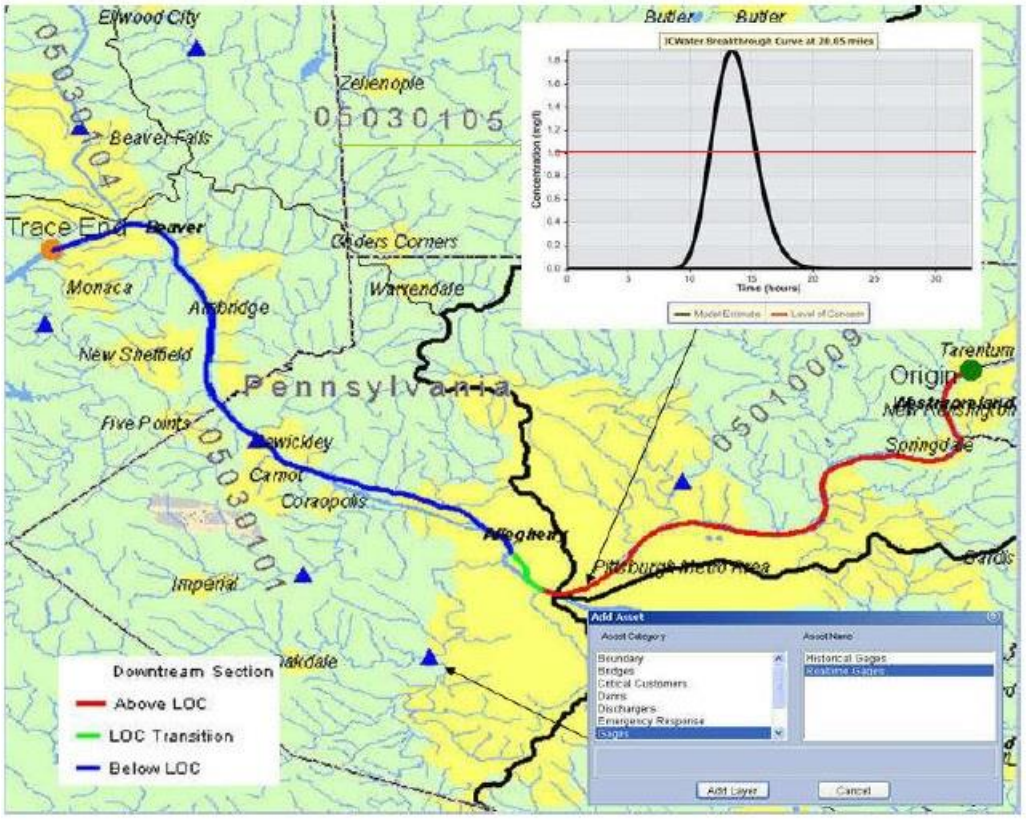

Figure H-5 - Incident Command Tool for Drinking Water

U.S. Forest Service leadership prompted the development of the Incident Command Tool for Drinking Water Protection, which is a GIS-based tool for modeling the origination and dispersion of contaminants. Using the mean flow and velocity attributes for each reach in the NHD*Plus* dataset along with real-time flow data, the GIS tool allows users to predict contaminant concentration at drinking water intakes. This tool has also been incorporated into the Defense Threat Reduction Agency's Consequences Assessment Tool Suite and is an important tool for post-spill decision-making.

2.6. Prioritization of Water Quality Issues

The Environmental Protection Agency developed the National Aquatic Resource Surveys with the objective of creating a nationally-consistent estimate of the condition of our national aquatic resources. The NHD*Plus* dataset was used to ensure representative sampling of different sizes and classes of water bodies. NHD*Plus,* along with the Basin Delineator tool and the Catchment Attribute Allocation and Accumulation Tool, was also used to parameterize drainage areas for surveyed water bodies. The surveys identify potential influences on the nation's water quality in terms of biological condition, water quality and physical habitat, assisting in the determination of predominant ecological stressors for a given water body. Results drive prioritization of national and regional water quality issues, and the ability to track surveys over time will permit evaluation of the effectiveness of water quality protection and restoration activities.

2.7. Maximizing Watershed Planning Resources

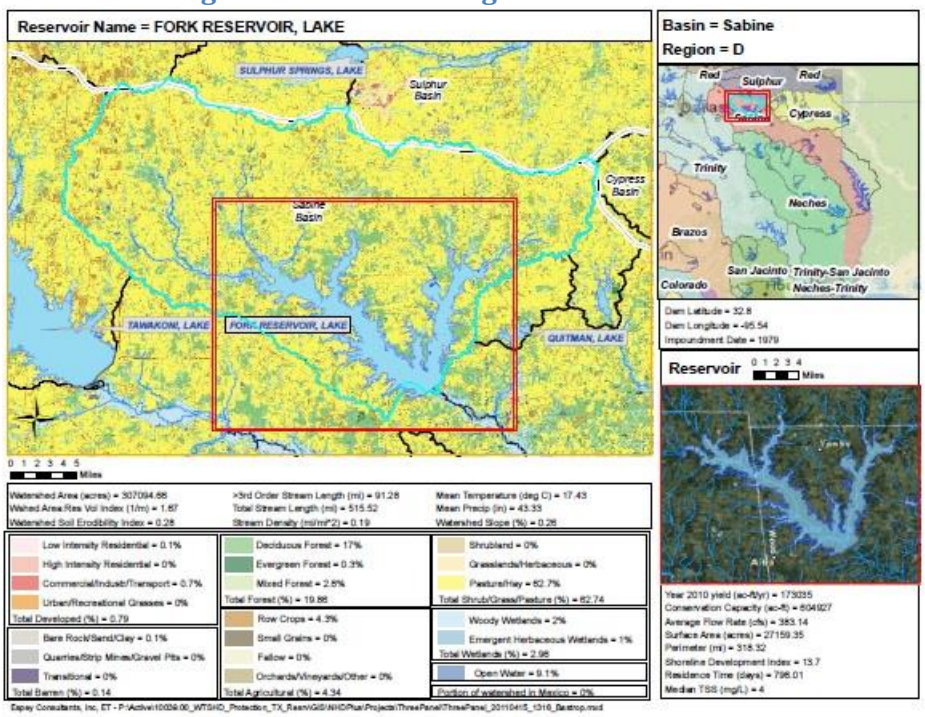

Figure H-6 - Summary Map for Fork Reservoir, TX

To address issues of water quality and water availability due to reservoir sedimentation, the Texas Water Development Board commissioned a study to determine landscape and climate factors contributing to sedimentation and to identify those reservoirs most at risk for sedimentation-related impacts. NHD*Plus* was a significant source of the risk-related criteria developed to help prioritize at-risk reservoirs, which informed the output of the study's decision-support tool. The tool also includes a matrix of landscape-specific structural BMPs, providing excellent insight into potential locations for BMP implementation. Information of this sort is highly valuable in today's resource-constrained environment, and can be used to inform watershed management plans, particularly those with a sedimentation focus.

2.7 Better Focused Site Monitoring

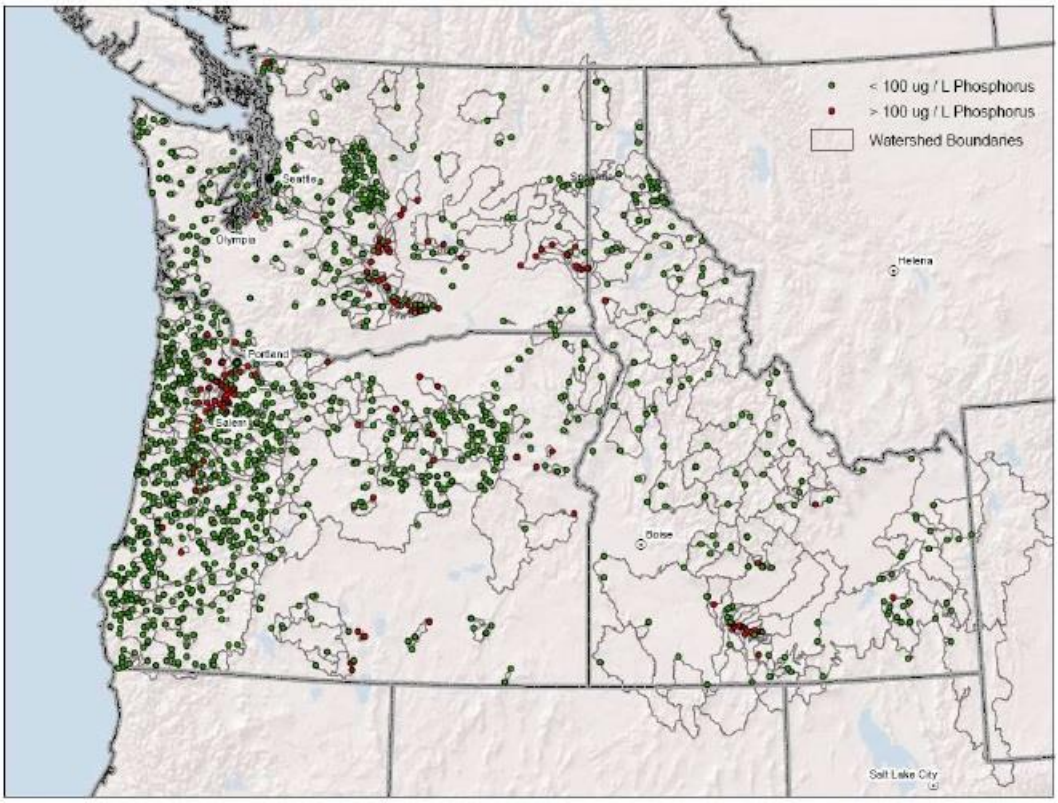

Figure H-7- Stream Sample Locations and Upstream Basins

In pursuit of the Environmental Protection Agency's goal to focus site-monitoring efforts, an analytical framework is being constructed using NHD*Plus,* the National Land Cover Database, the National Elevation Database, U.S. Census data, and several other physical and administrative variables. Using a network of 1,312 sample sites throughout the Pacific Northwest, the framework is designed to support the modeling of stream health. The project's initial focus was on nitrogen and phosphorous, with the ultimate objective of building more complex models linking landscape stressors to water quality.

3. Example Customer Service Benefits

3.1. Improved Access to Data and Reports

Figure H-8- Stream Report in the Connecticut River Watershed Atlas

The Connecticut River Watershed Atlas leverages the NHD*Plus* dataset in combination with Google Maps, Esri products, and other GIS web applications to provide users with the ability to create queries, locate features, and explore data, including near real-time stream gage data. The application provides access to information for approximately 12,500 stream segments. Outputs include watershed delineation maps and summaries of spatial attributes. The Atlas is an innovative format that substantially improves access to data and basic geospatial analysis capabilities to a number of interested user groups.

3.2. New Value-Added Services

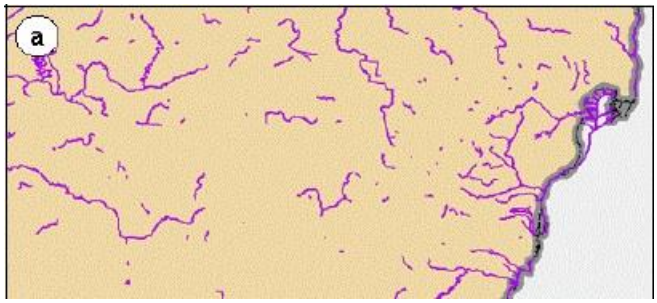

Figure H-9 - Impaired Waters

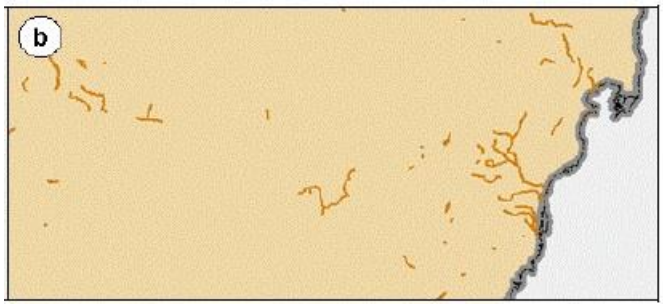

Figure H-10- TMDLs

Many organizations and agencies accumulate significant resources that are available to users, and innovative organization can substantially improve access to those resources. The Environmental Protection Agency compiles GIS versions of the state 303(d) impaired waters and has developed a geospatial dataset containing Total Maximum Daily Loads (TMDLs) for those waters. NHD*Plus* thereby serves as the nationally consistent organizing framework against which impaired water data is indexed. Further, EPA has created links between the TMDL ID attributes and related TMDL documents. This unique setup facilitates efficient access to impaired waters information, mapped waters with TMDLs, as well as TMDL documents.

4. Examples of Societal Benefits

4.1. Saved Lives and Environmental Protection

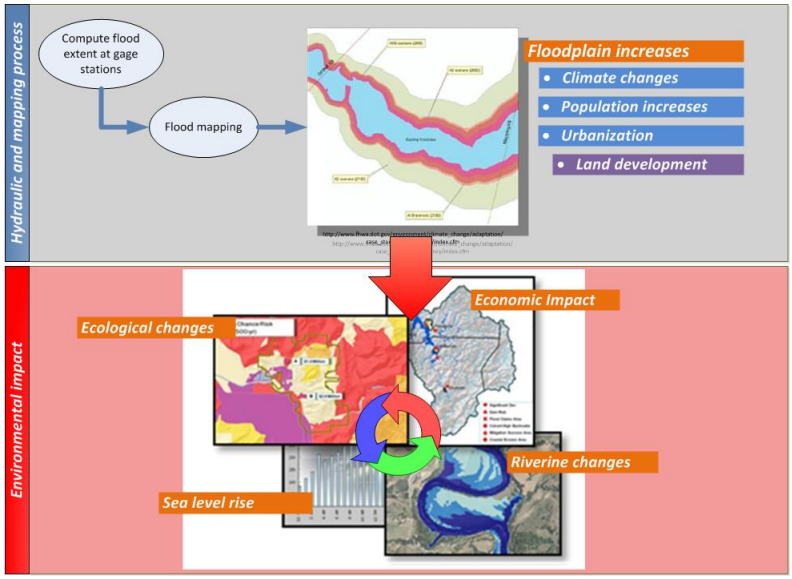

Figure H-11- FEMA Environmental Impact Study

As part of the effort to develop alternative program standards for the Federal Emergency Management Agency's National Flood Insurance Program, the mapping, floodplain management, and insurance components of the program were examined. One element of the analysis included projecting future coastal and riverine Special Flood Hazard Areas nationwide and identification of affected populations, landscape, and endangered species. The future riverine floodplain analysis relied heavily on NHD*Plus* for drainage basin characteristics and the development of flow accumulation information. The study has positive implications for the prospective adoption of enhanced program standards to reduce the risk to human lives and property due to unsound floodplain development and will also protect environmentally sensitive areas.

4.3. Improved Conservation Metrics and Education

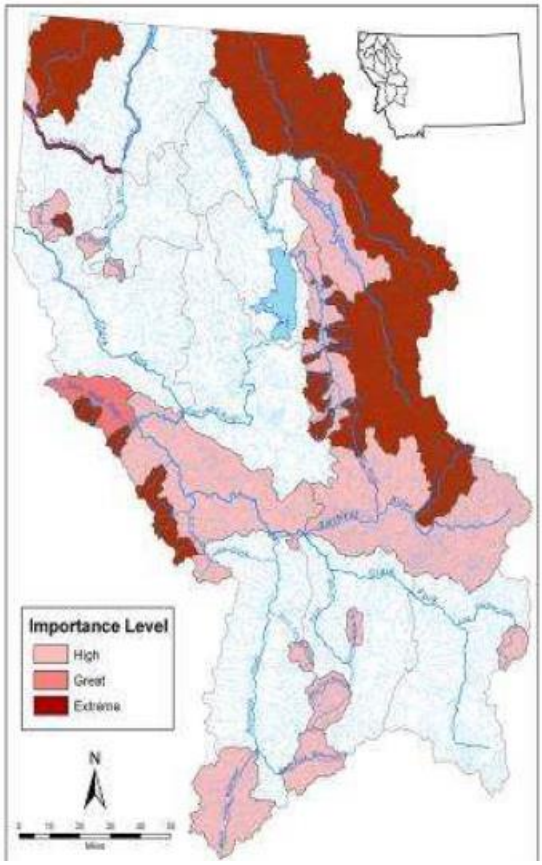

Figure H-12- Montana Catchments Prioritized for Conservation

Montana Fish, Wildlife and Parks created a seven-part, landscape-based classification system for stream segments in the NHD*Plus* dataset. The resulting classifications were used to develop ecosystem profiles, which were then analyzed against native aquatic biological samples. The resulting analysis was used to prioritize catchments in western Montana according to maximum conservation value with respect to preserving aquatic biodiversity. This information is also available to help educate land managers about aquatic resources.

4.4. Improved Conservation Planning

Sensitive aquatic ecosystems at high elevations in the Rocky Mountains are vulnerable to atmospheric nitrogen deposition. Atmospheric deposition of nitrogen was mapped against estimated critical loads for nitrogen (i.e. the level below which ecological effects are thought not to occur). Critical load estimates were informed by basin characteristics. The NHD*Plus* dataset provided the organizing framework for the project's models, which used the deposition and critical load estimates to predict surface water nitrate concentrations in high-elevation areas across the Rockies. This methodology is potentially replicable at other high-elevation locations globally and has excellent potential for identifying vulnerable high-elevation aquatic ecosystems.