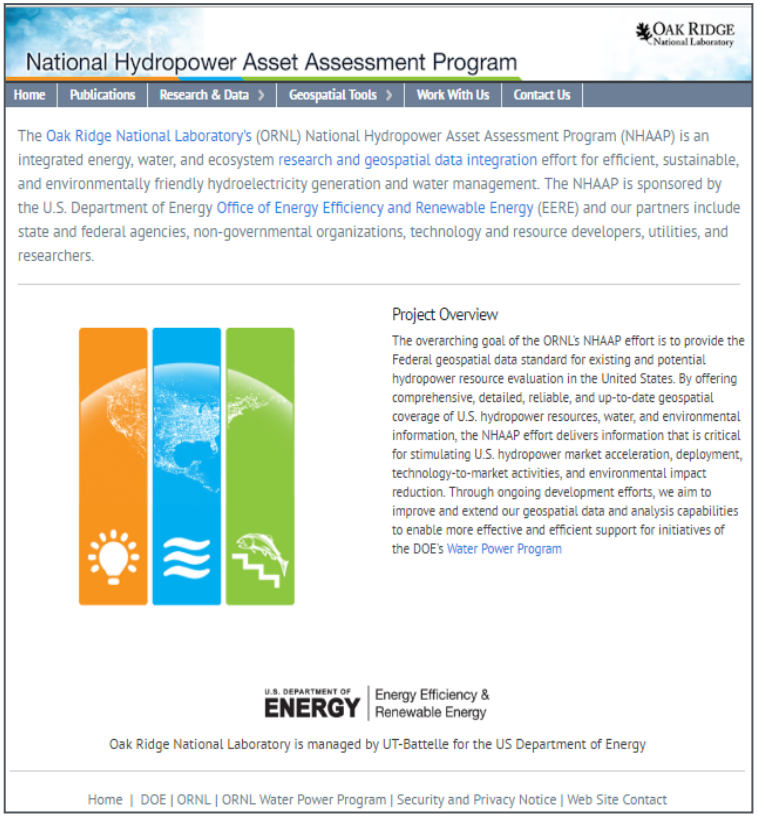

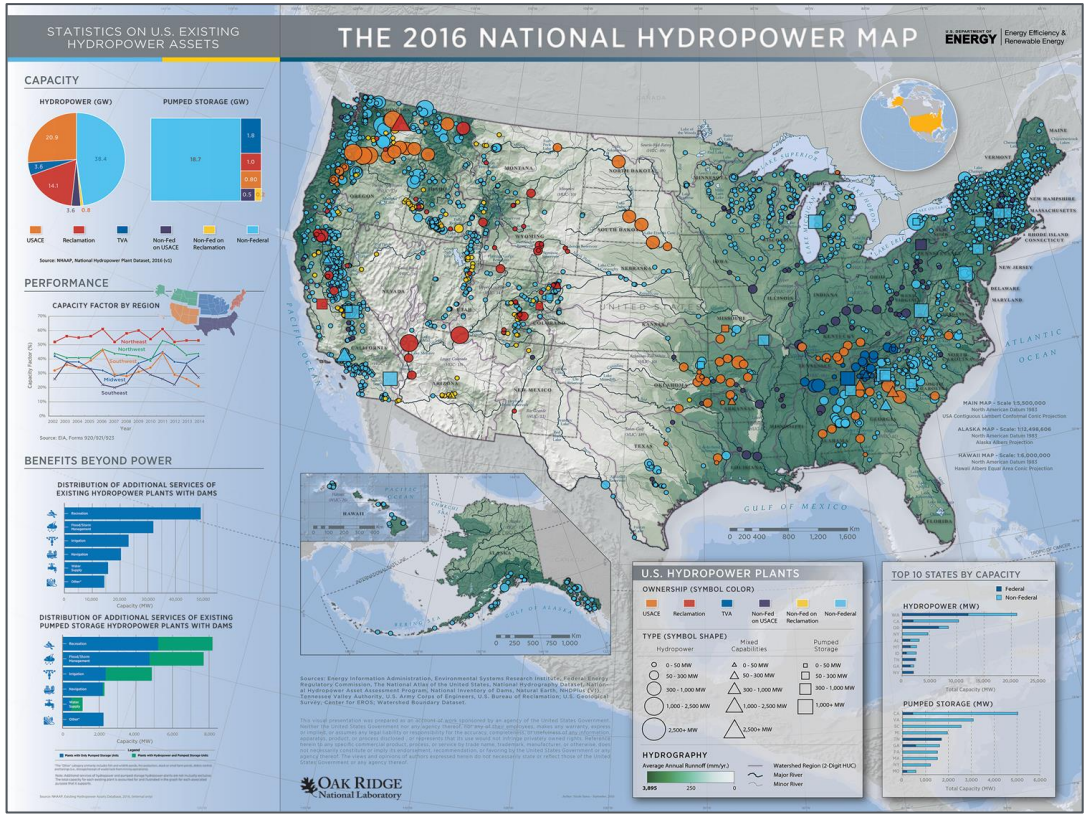

National Hydropower Asset Assessment Program (NHAAP)

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February XX, 2017

OAK RIDGE National Laboratory

National Hydropower Asset Assessment Program (NHAAP)

The Challenge

Fulfill the hydropower community's need for a comprehensive U.S. hydropower data set

- Existing asset
- Growth potential
- Environmental concerns

Partners

Bureau of Reclamation (Reclamation), U.S. Army Corps of Engineers (USACE), Federal Regulatory Energy Commission (FERC), and the Energy Information Administration (EIA).

Next Generation Hydropower (HydroNEXT)

Optimization

- Optimize technical, environmental, and water-use efficiency of existing fleet
- **Collect and disseminate data on new and existing assets**
- Facilitate interagency collaboration to increase regulatory process efficiency
- Identify revenue streams for ancillary services

Growth

- Lower costs of hydropower components and civil works
- Increase power train efficiency for low-head, variable flow applications
- Facilitate mechanisms for testing and advancing new hydropower systems and components
- Reduce costs and deployment timelines of new PSH plants
- Prepare the incoming hydropower workforce

Sustainability

- Design new hydropower systems that minimize or avoid environmental impacts
- Support development of new fish passage technologies and approaches
- **Develop technologies, tools, and strategies to evaluate and address environmental impacts**
- Increase resilience to climate change

Next Generation Hydropower (HydroNEXT)

Optimization

- Optimize technical, environmental, and water-use efficiency of existing fleet.
- **Collect and disseminate data on new and existing assets.**
- Facilitate interagency collaboration to increase regulatory process efficiency.
- Increase revenue streams for ancillary services.

The Impacts

- Provide best-available baseline U.S. hydropower information to support national R&D:
  - Existing hydropower asset
  - Future potential
  - Environmental characterization
- Help identify potential market opportunities and barriers to stimulate hydropower market acceleration
- Identify data gaps and recommend further collaborative actions to collect and expand U.S. hydropower knowledge base.

Next Generation Hydropower (HydroNEXT)

Sustainability

- Design new hydropower systems that minimize or avoid environmental impacts
- Support development of new fish passage technologies and approaches
- **Develop technologies, tools, and strategies of evaluate and address environmental impacts**
- Increase resilience to climate change

The Impacts

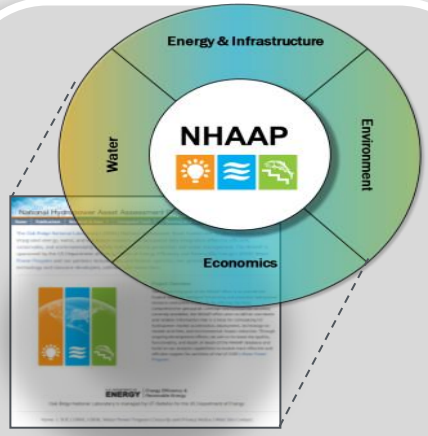
- Understanding of environmental impacts (e.g. Environmental Considerations in the *Hydropower Vision*)
- Develop tools to increase the objectiveness, efficiency, and effectiveness of environmental improvement strategies (e.g. environmental metrics and the sustainability of hydropower development)
- Inform the design parameters (e.g. head and flow), co-objectives (e.g. species passage, WQ enhancement, recreation), and market potential that multiple DOE-funded tech developments are targeting.
- Identify environmental and science and knowledge gaps through data exploration and creation, respectively (e.g. Stream Classification and Mitigation Prediction).

NHAAP Operations

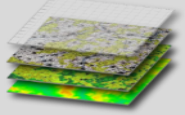
Collection

Public & Proprietary Information

Synthesis



Data Stewardship



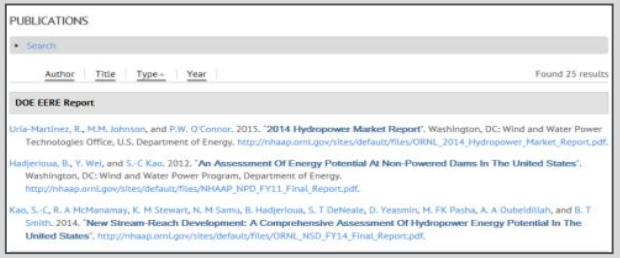
Maintenance

Collaboration

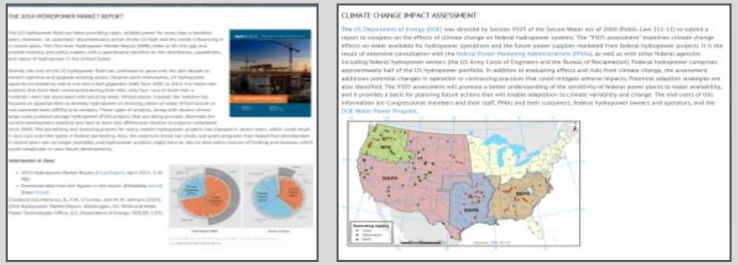
- FERC
- USACE
- Reclamation

Public Outreach

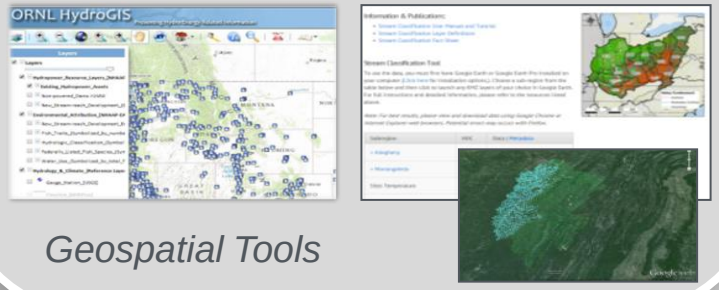
Publications



Research & Data



Geospatial Tools

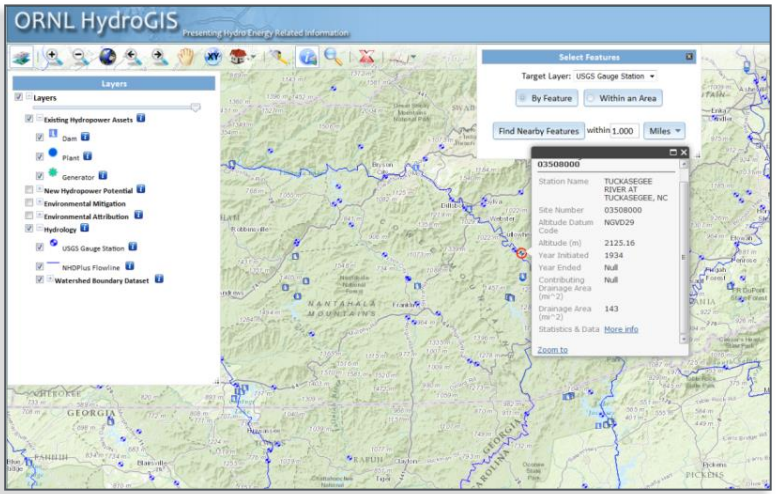


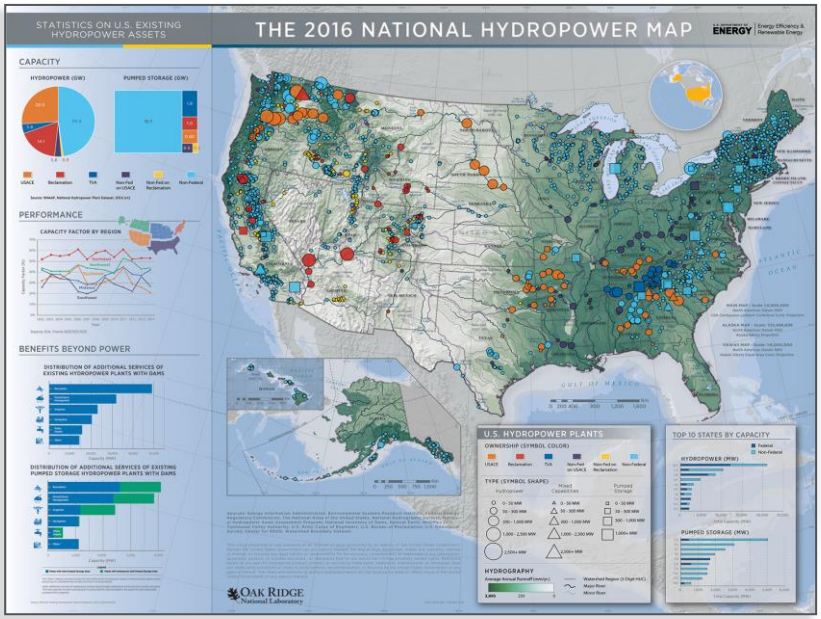
Overview of NHAAP Data Holdings

Data Efforts	Description
Baseline – Baseline Data	A collection of most recent water, energy, infrastructure, and environment data from EIA, FERC, and other sources (http://nhaap.ornl.gov/content/nhaap-data-sources)
EHA – Existing Hydropower Asset	Location, power plant capacity, historic generation, and other facility information of U.S. existing hydropower fleet and newly licensed projects (updated every quarter)
NPD – Non-Powered Dams	Undeveloped U.S. hydropower resource potential from over 45000 national non-power dams (DOE 2012 NPD study)
NSD – New Stream-Reach	Undeveloped U.S. hydropower resource potential from over 2.7 million national new stream-reaches (DOE 2014 NSD study)
EA – Environmental Attribution	Comprehensive national geospatial polygons summarizing environmental concerns for hydropower development and operation.
SCT – Stream Classification Tool	A national stream-reach classification system that geospatially characterizes the biophysical settings of stream environments
MPT – Mitigation Data Set and Prediction Tool	A mitigation prediction model based on mitigation records summarized from over 380 FERC licenses issued within the last 15 years

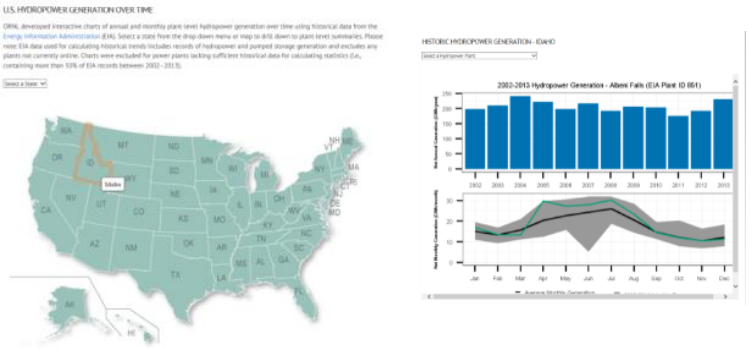
NHAAP Baseline Services

- Provided fundamental asset, resource, and environmental data to support the DOE Hydropower Vision Study.
- Provided maps, summary tables, and visualizations to support the broader hydropower community.





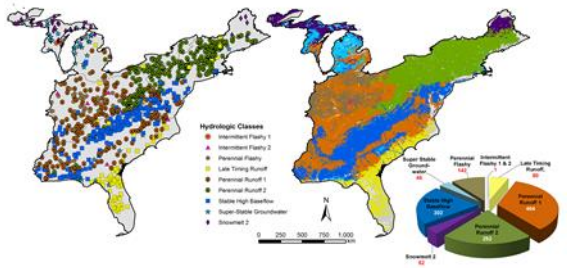
Historic hydropower Generation

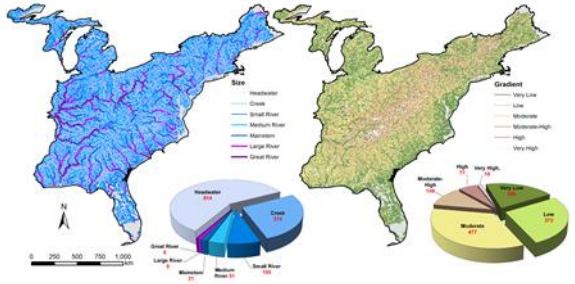


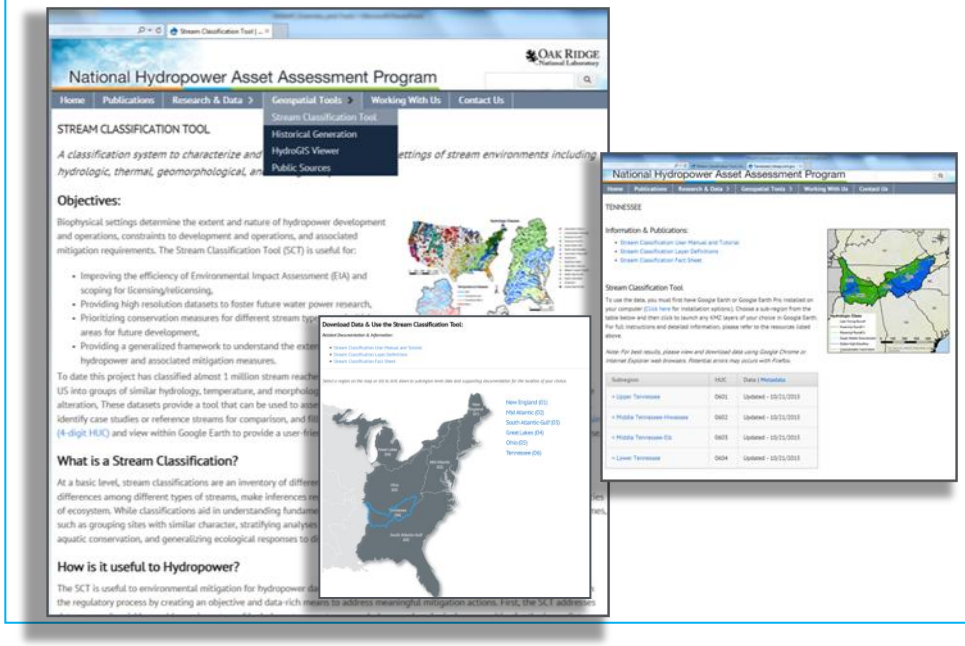
Accomplishments and Progress (II)

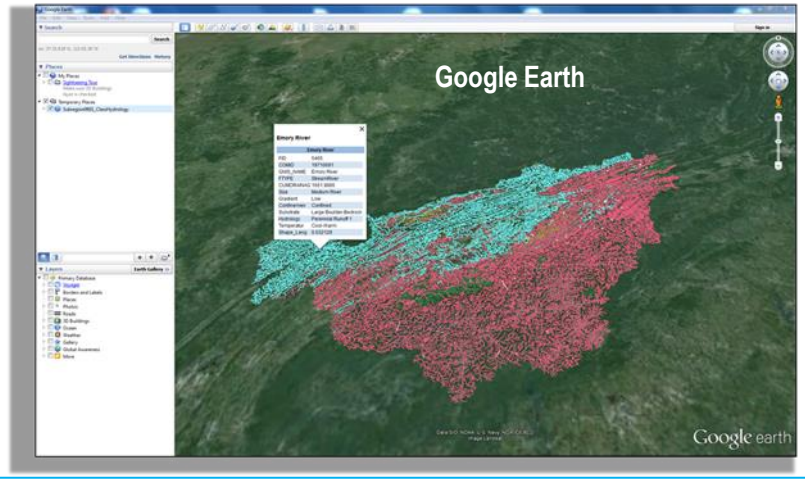
Stream Classification Tool

- Completed classification of ~ 1million stream reaches in Eastern US
- 6 Layers: Hydrology, temperature, size, gradient, confinement, substrate
- Provided 11 different Google Earth layers (.kmz) for each region to be used in licensing/relicensing agreements



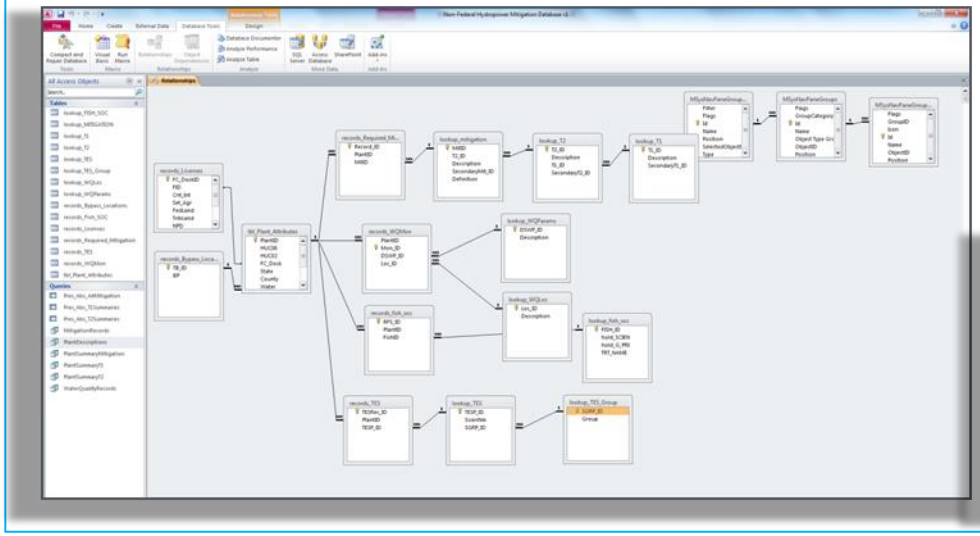


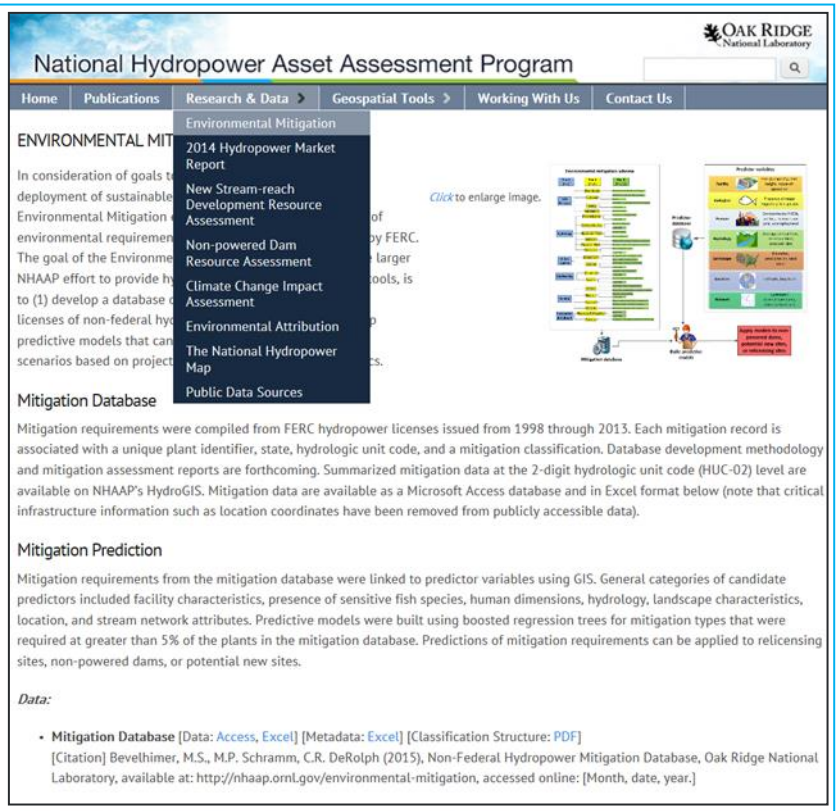


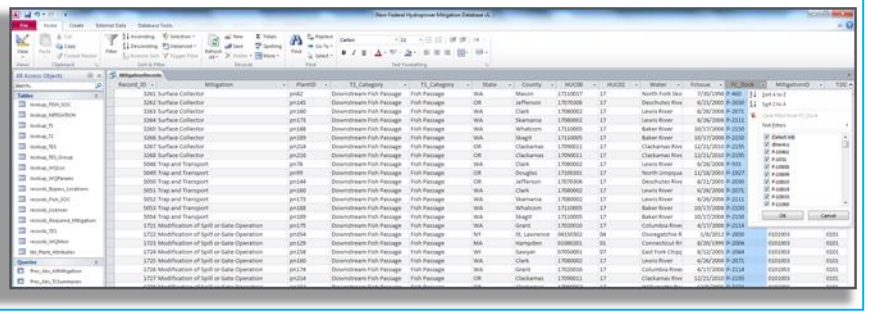


Environmental Mitigation Tool

- Developed database of mitigation records for hydropower facilities
- Searched over 380 FERC licenses issued within the last 15 years
- Developed mitigation classification framework
- Developed prediction of mitigation requirements at non-powered dams







Project Plan and Schedule

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

	FY2014	FY2015	FY2016
Q1	Released national NPD and NSD maps		
Q2	Released final NSD assessment report		Released list of non-federal hydropower on USACE facilities
Q3		Released 2015 HMR data	Released 2016 updated HMR data
Q4	Released National Hydropower Map (v2014)	Evaluated NHAAP public outreach efforts Released environmental mitigation data	Released National Hydropower Map (v2016) Released Hydropower Plant Data Set

- Main project components
  - NHAAP Baseline Services (FY2014 – present)
  - Stream Classification Tool (eastern US, FY2014 – FY2015)
    - New effort in FY2017 on CONUS
  - Mitigation Data Set and Prediction Tool (FY2014 – FY2015)
- Go/No-Go decision point
  - FY2015 Q4 evaluation of NHAAP public outreach efforts
    - Accept and proceed

Project Budget

Budget History					
FY2014		FY2015		FY2016	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
$958K	$0K	$858K	$0K	$438K	$0K

- Cost by main project components:
  - NHAAP Baseline Services: ~$500K/FY (FY2014 – FY2016)
    - Outreach and external data support
    - Visualization and program support
    - Data update and expansion
    - IT operation and maintenance
  - Stream Classification Tool: 200K / FY (FY2014 – FY2015)
  - Mitigation Data Set and Prediction Tool: 200K / FY (FY2014 – FY2015)

Research Integration & Collaboration

Collaborating agencies

- U.S. Bureau of Reclamation (Reclamation), U.S. Army Corps of Engineers (USACE), Federal Energy Regulatory Commission (FERC), and Energy Information Administration (EIA)

Summary of major data support during FY14–16

- Hydropower Vision
  - Provided asset, resource, and environmental data support Hydropower Vision modeling and analysis
- Argonne National Laboratory (ANL)
  - Provided mode-of-operation data to support hydropower-storage study
- Congressional Research Service (CRS)
  - Provided NHAAP existing hydropower asset data
- Massachusetts Department of Protection
  - Provided detailed NSD data to support waste-site remediation study

Next Steps and Future Research

Next Steps

- Continue to maintain NHAAP as 'a comprehensive data service effort to support the DOE Water Power Program for various U.S. hydropower R&D data needs'

FY17/Current research

- NHAAP Baseline Services
  - Interagency and Hydropower Industry Engagement
    - Coordination with National Park Service, U.S. Forest Service, National Oceanic and Atmospheric Administration, and other broader hydropower industry / stakeholder groups to increase the usefulness of NHAAP data
  - Information Resource Management and User Services
  - Data Update and Expansion
- U.S. Stream Classification System
  - Development of a U.S. Stream Classification System (SCS) for the entire United States at the NHDPlus stream reach level based on hydrology, temperature, gradient, size, and valley confinement.