Example Applications

The following example applications are intended to present how the tools developed for Trout Unlimited's Brook Trout Conservation Portfolio and Range-wide Assessment of Habitat Condition and Threats can be used to help evaluate and identify potential projects.

We present the following examples:

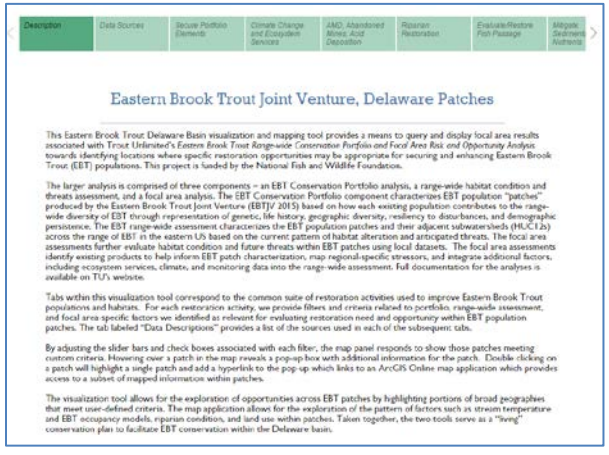
- Identifying populations within regions with specific restoration needs (Riparian restoration in Delaware Basin, AMD projects in Susquehanna basin, cold water source protection in Chesapeake basin)
- Identifying conservation need of populations within a specific geography (Upper Lehigh River in Delaware basin)
- Placing local restoration efforts within the broader Brook Trout conservation context (Ammonoosuc barrier removal, Connecticut basin)

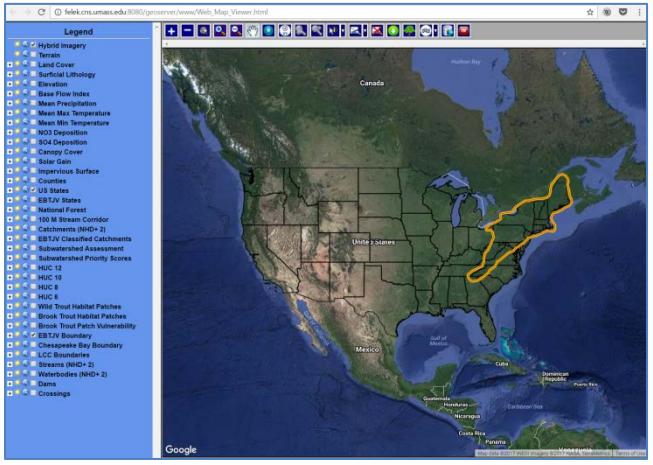
Example 1: Identifying priority EBT populations requiring specific restoration activities – riparian restoration

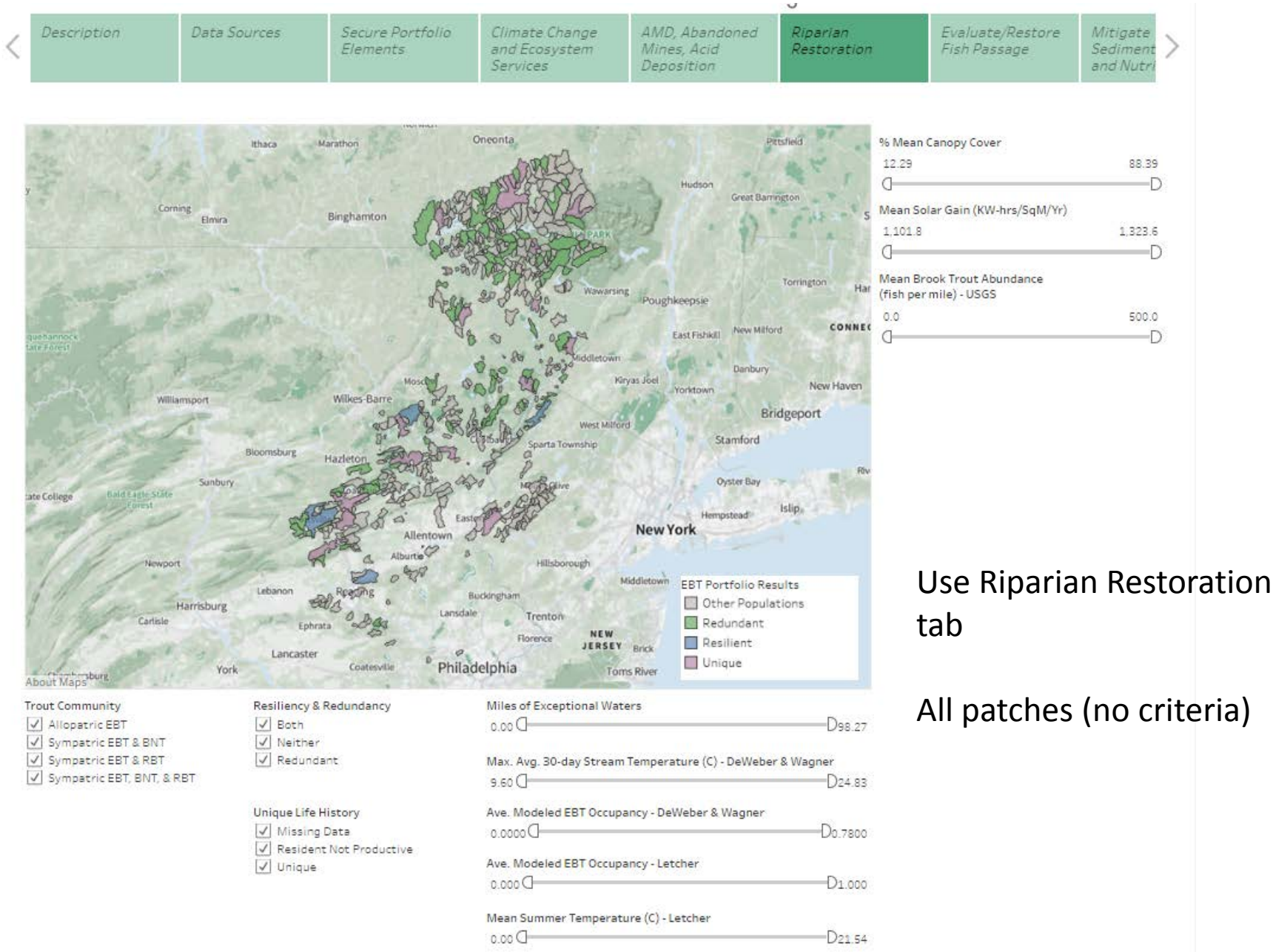
In this example, EBT populations in the Delaware basin are prioritized based on riparian restoration need using the DE basin focal area visualization tool, and on-the-ground opportunities are evaluated within one priority population using the Riparian Restoration Decision Support Tool viewer.

Criteria for prioritizing riparian restoration at the basin-scale:

- Patch has coldwater habitat likely to remain viable under future climate scenarios (Mean summer temperature in Letcher (Ecosheds) model ranges 0 – 17 °C)
- Patch has some riparian restoration need (% mean canopy cover range is 60-80%)
- Patch is high value EBT population (is resilient or redundant)



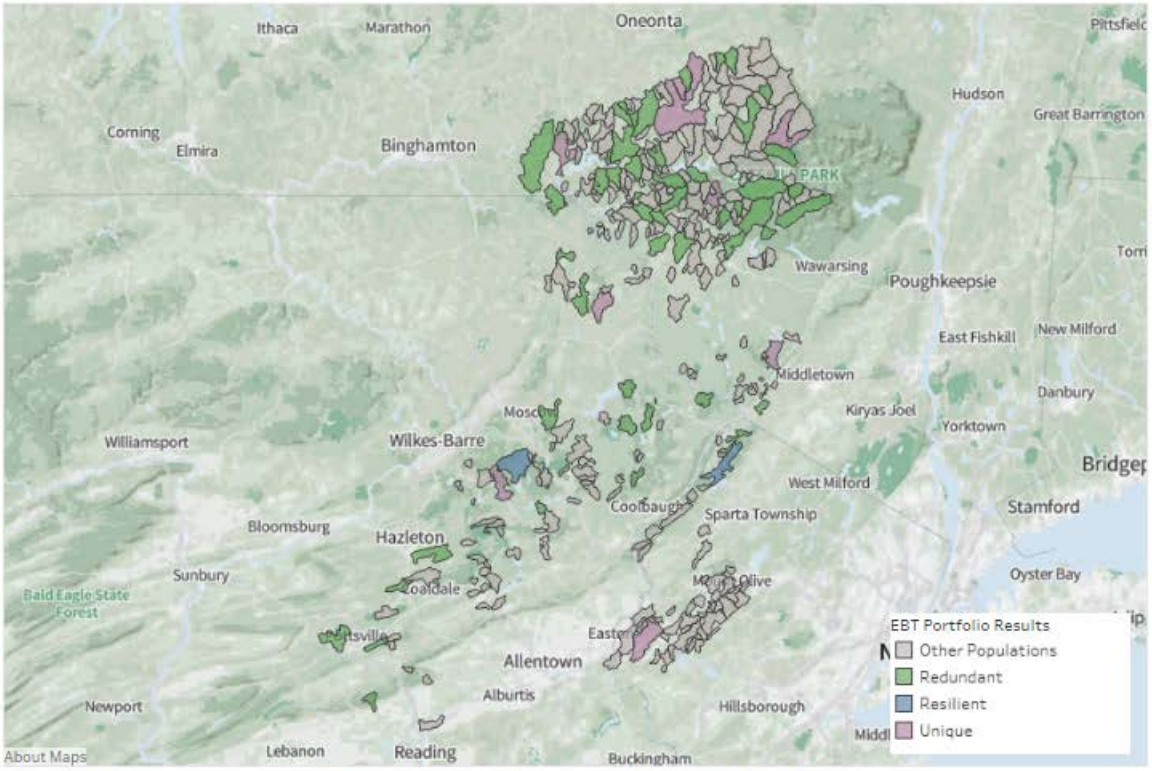




Use Riparian Restoration tab

All patches (no criteria)

Description | Data Sources | Secure Portfolio Elements | Climate Change and Ecosystem Services | AMD, Abandoned Mines, Acid Deposition | Riparian Restoration | Evaluate/Restore Fish Passage | Mitigate Sediment and Nutri



% Mean Canopy Cover
12.29 — 88.39

Mean Solar Gain (KW-hrs/SqM/Yr)
1,101.8 — 1,323.6

Mean Brook Trout Abundance (fish per mile) - USGS
0.0 — 500.0

Trout Community
- [x] Allopatric EBT
- [x] Sympatric EBT & BNT
- [x] Sympatric EBT & RBT
- [x] Sympatric EBT, BNT, & RBT

Resiliency & Redundancy
- [x] Both
- [x] Neither
- [x] Redundant

Unique Life History
- [x] Missing Data
- [x] Resident Not Productive
- [x] Unique

Miles of Exceptional Waters
0.00 — 98.27

Max. Avg. 30-day Stream Temperature (C) - DeWeber & Wagner
9.60 — 24.83

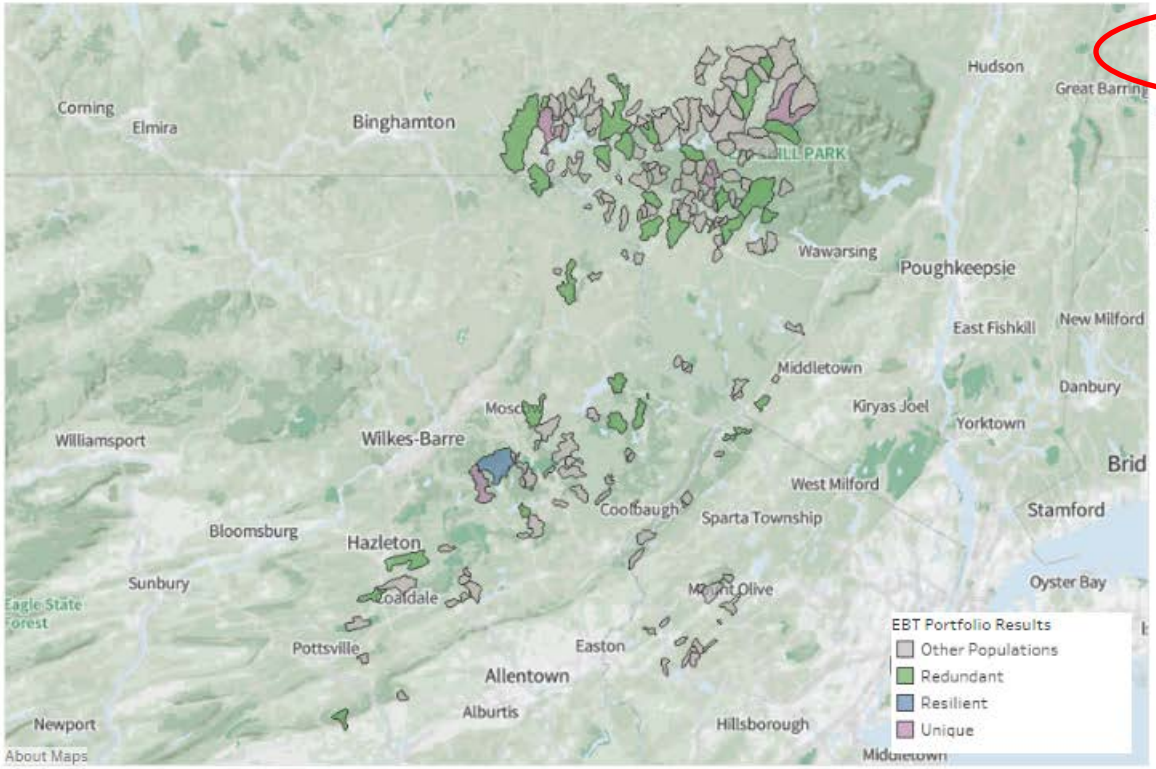
Ave. Modeled EBT Occupancy - DeWeber & Wagner
0.0000 — 0.7800

Ave. Modeled EBT Occupancy - Letcher
0.000 — 1.000

Mean Summer Temperature (C) - Letcher
0.00 — 17.00

Stream temp. criterion

Description | Data Sources | Secure Portfolio Elements | Climate Change and Ecosystem Services | AMD, Abandoned Mines, Acid Deposition | Riparian Restoration | Evaluate/Restore Fish Passage | Mitigate Sediment and Nutri



% Mean Canopy Cover
60.00 — 80.00

Mean Solar Gain (KW-hrs/SqM/Yr)
1,101.8 — 1,323.6

Mean Brook Trout Abundance (fish per mile) - USGS
0.0 — 500.0

Trout Community
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- [x] Both
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Unique Life History
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Miles of Exceptional Waters
0.00 — 69.40

Max. Avg. 30-day Stream Temperature (C) - DeWeber & Wagner
9.60 — 24.83

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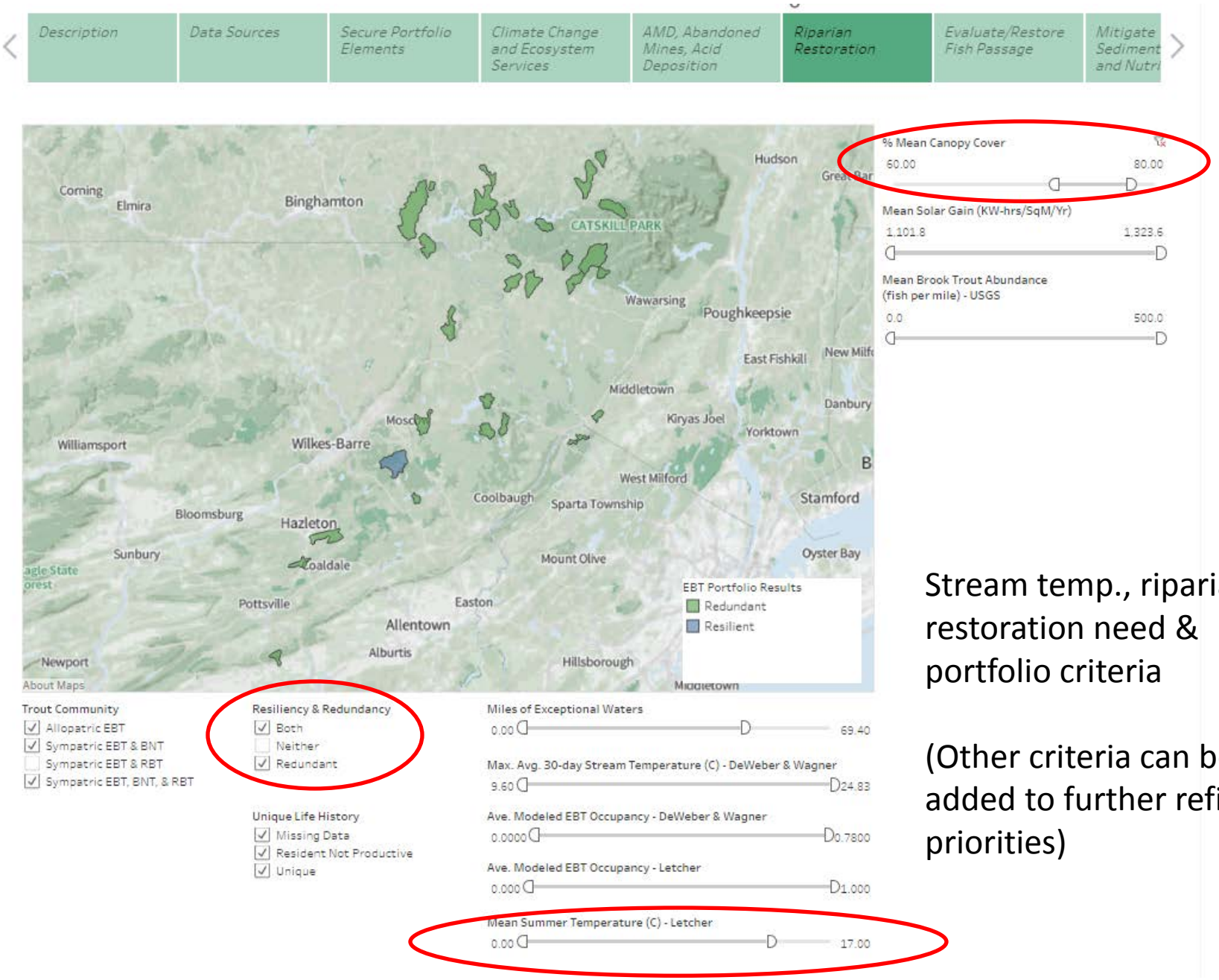
0.0000 — 0.7800

Ave. Modeled EBT Occupancy - Letcher
0.000 — 1.000

Mean Summer Temperature (C) - Letcher
0.00 — 17.00

Stream temp. & riparian restoration need criteria

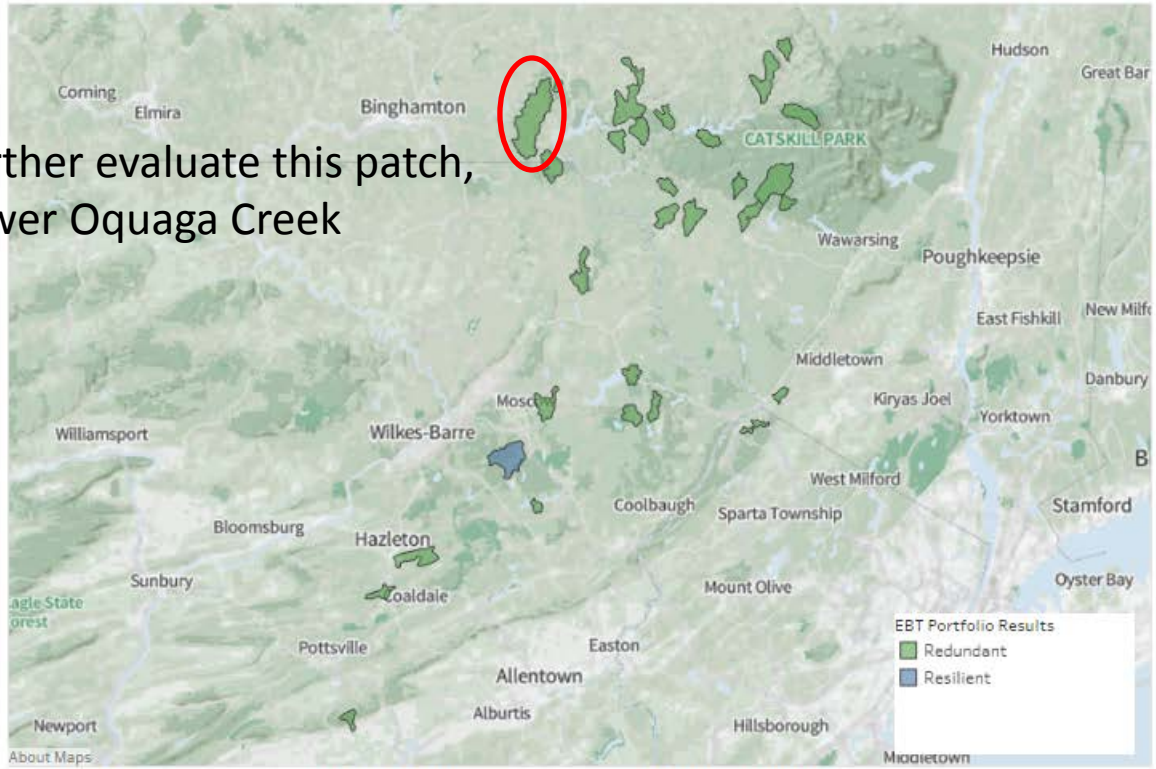


Stream temp., riparian restoration need & portfolio criteria

(Other criteria can be added to further refine priorities)

Description | Data Sources | Secure Portfolio Elements | Climate Change and Ecosystem Services | AMD, Abandoned Mines, Acid Deposition | **Riparian Restoration** | Evaluate/Restore Fish Passage | Mitigate Sediment and Nutri

Further evaluate this patch, Lower Oquaga Creek



% Mean Canopy Cover
60.00 — 80.00

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Mean Brook Trout Abundance (fish per mile) - USGS
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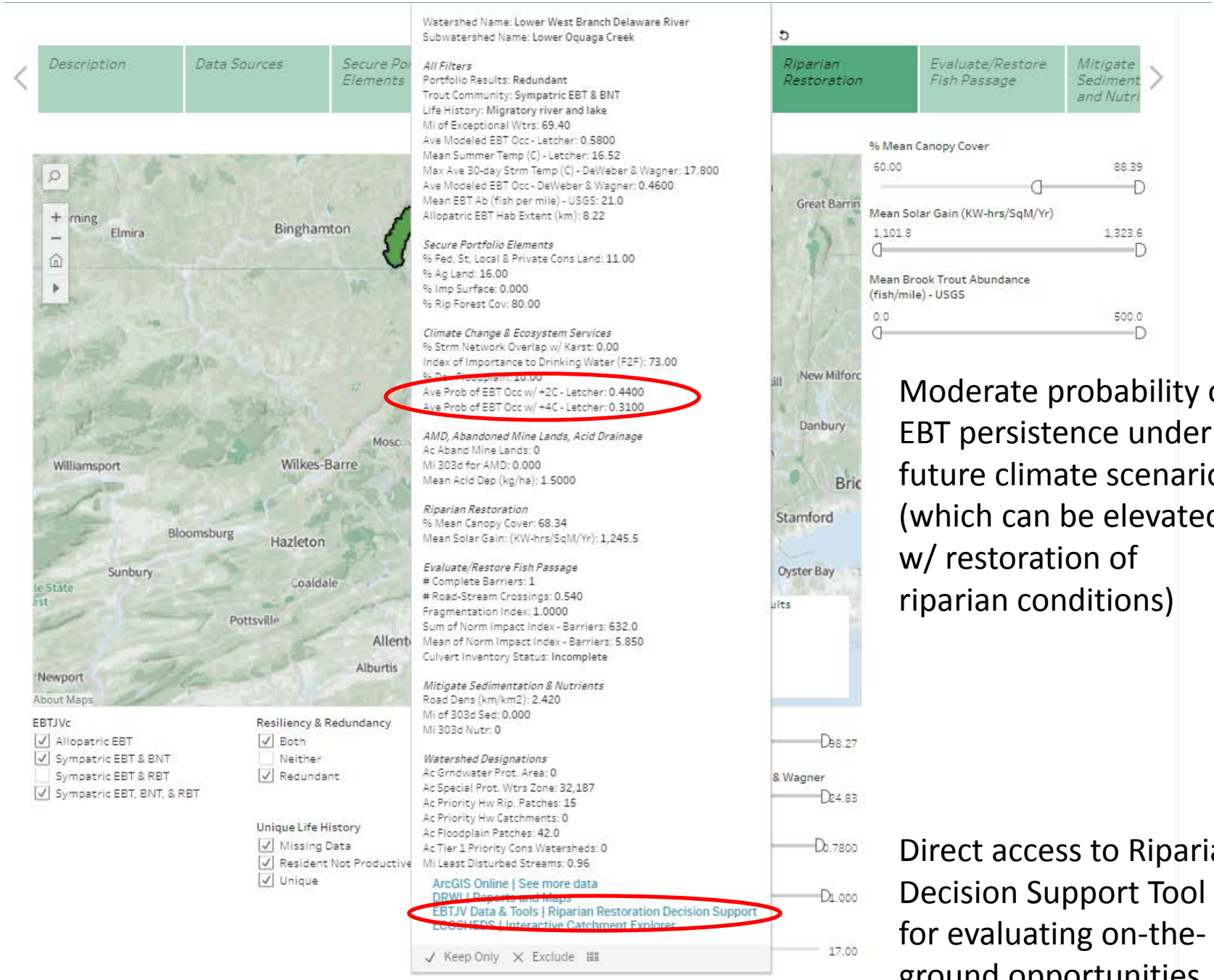
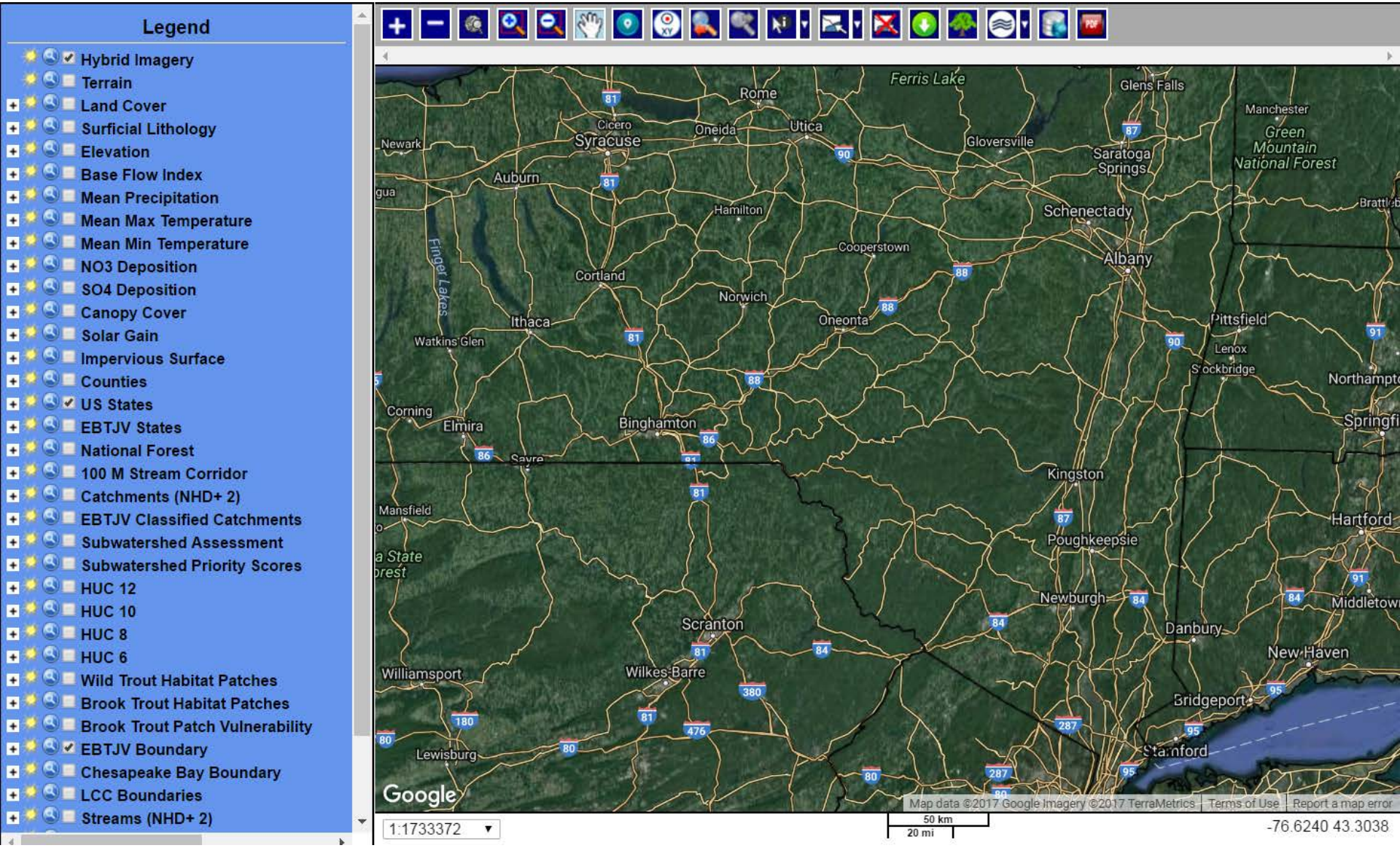


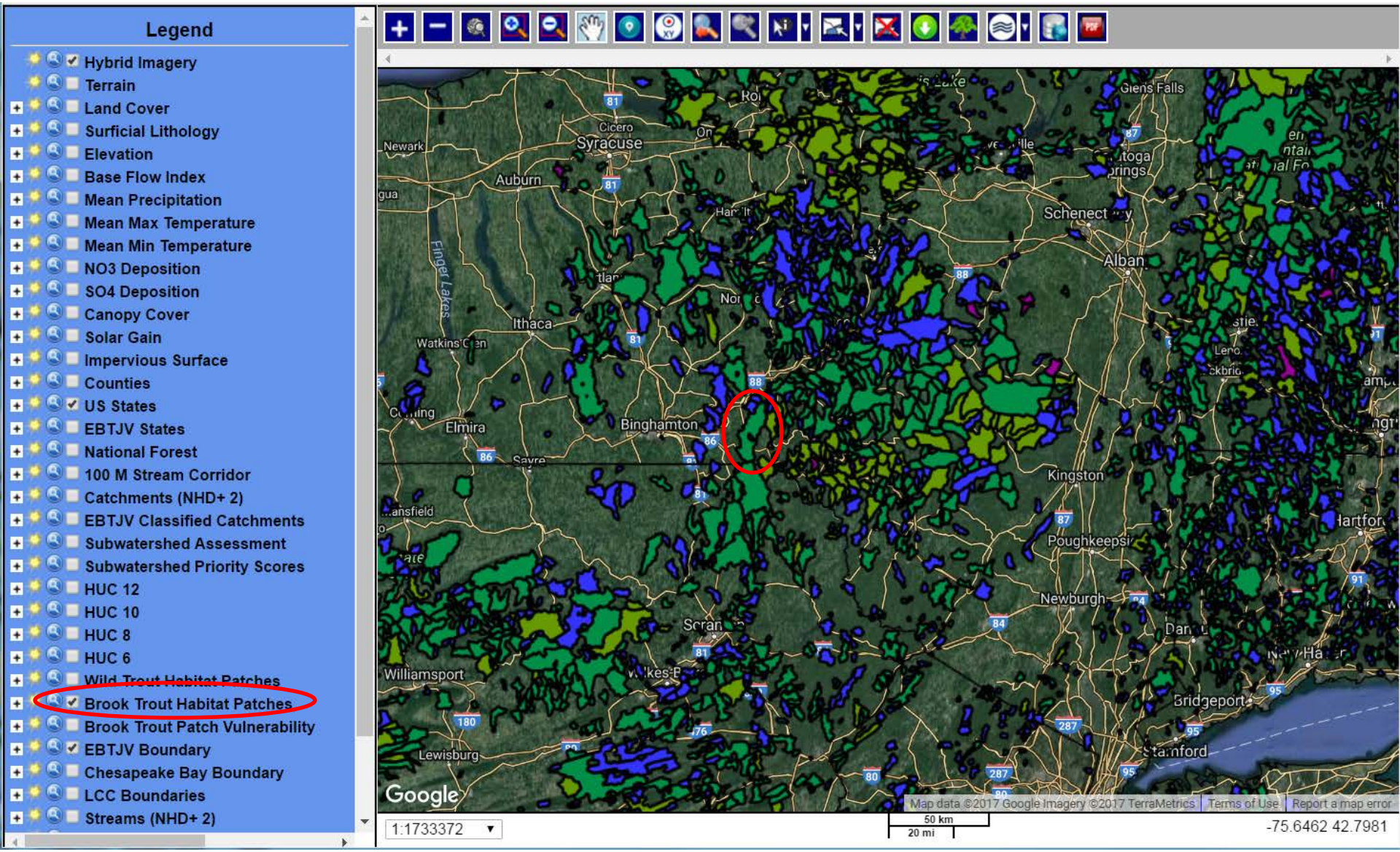
Moderate probability of EBT persistence under future climate scenarios (which can be elevated w/ restoration of riparian conditions)

Direct access to Riparian Decision Support Tool for evaluating on-the-ground opportunities

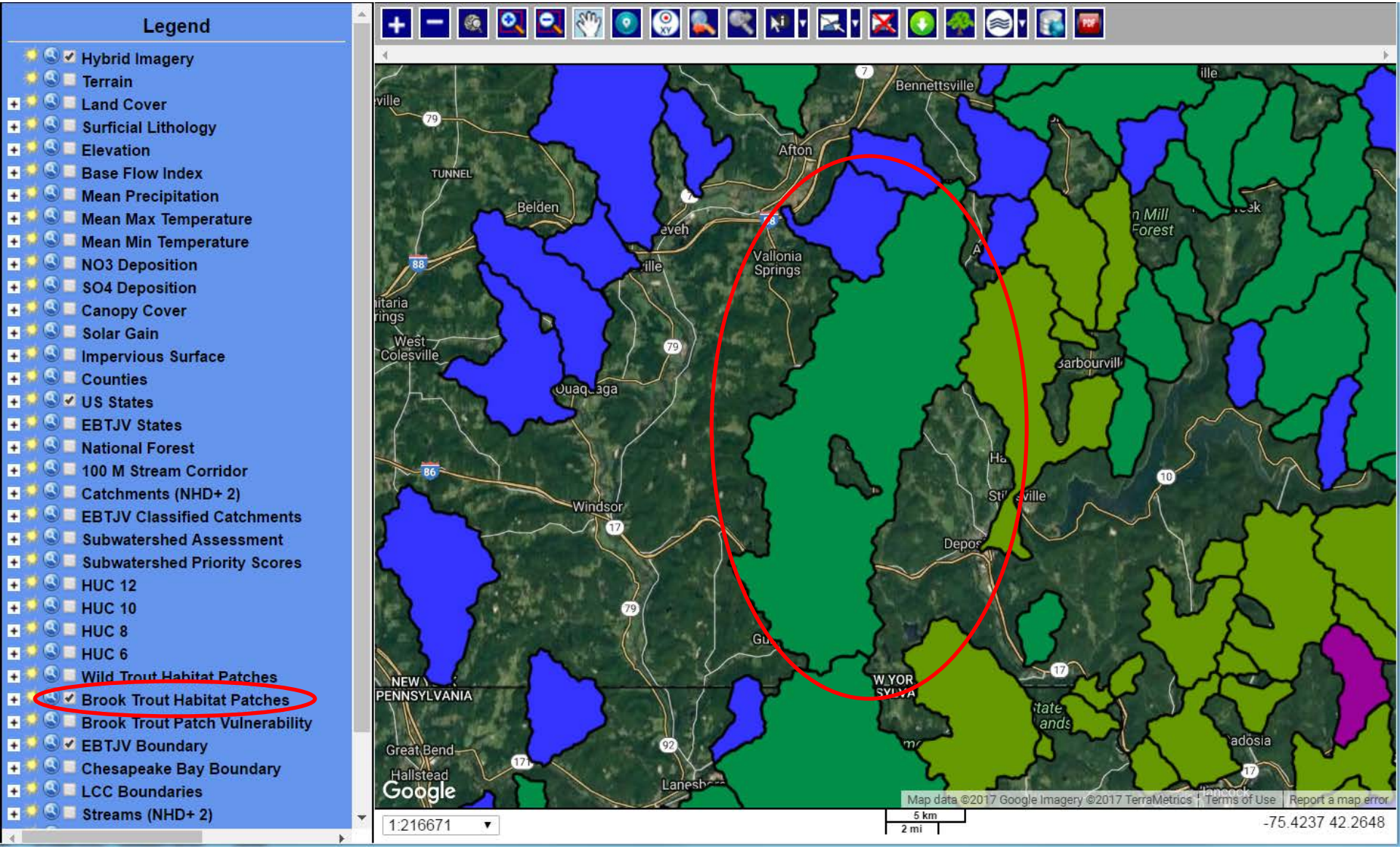
Within Riparian Restoration Decision Support tool, zoom to NE PA



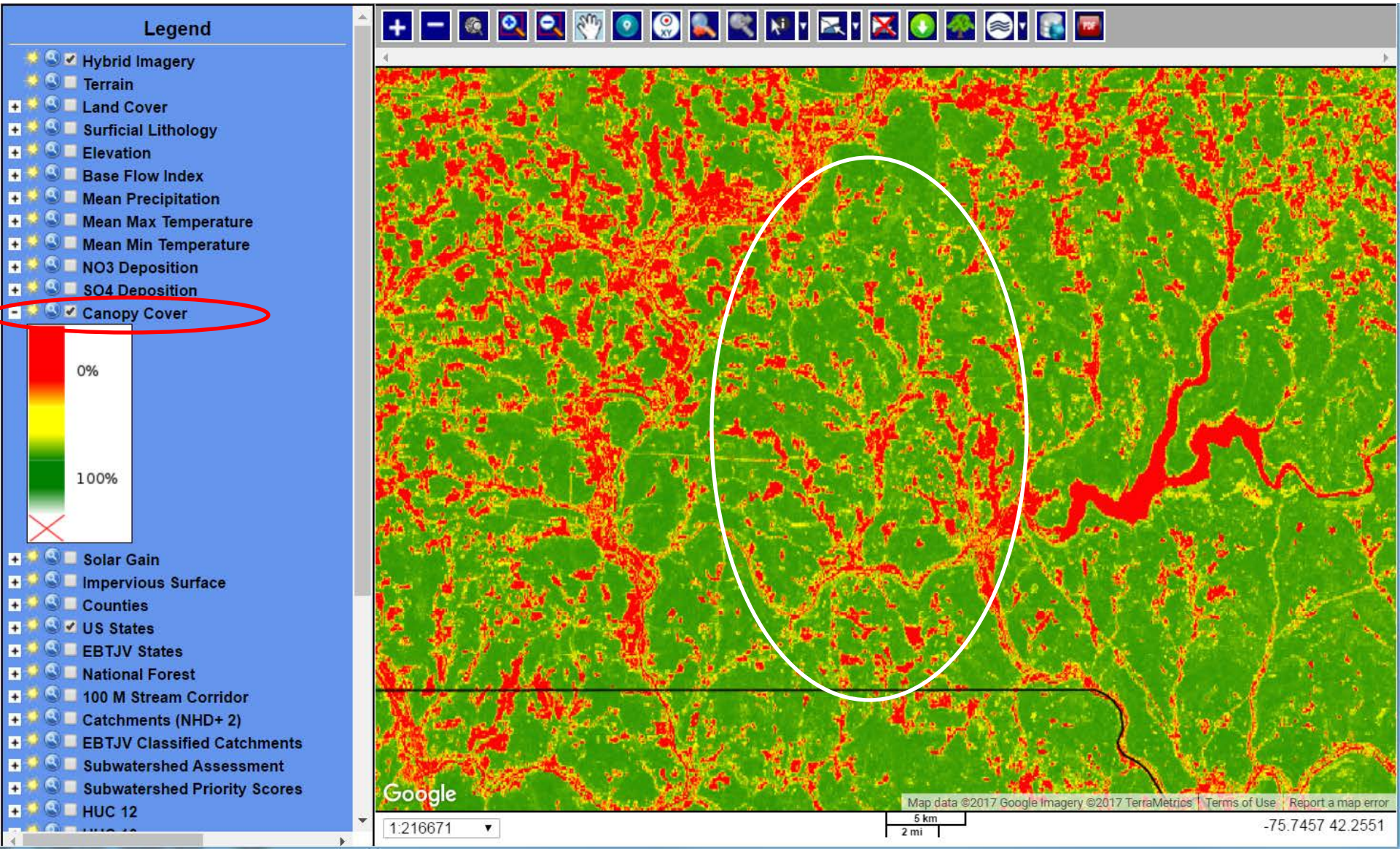
Locate patch of interest



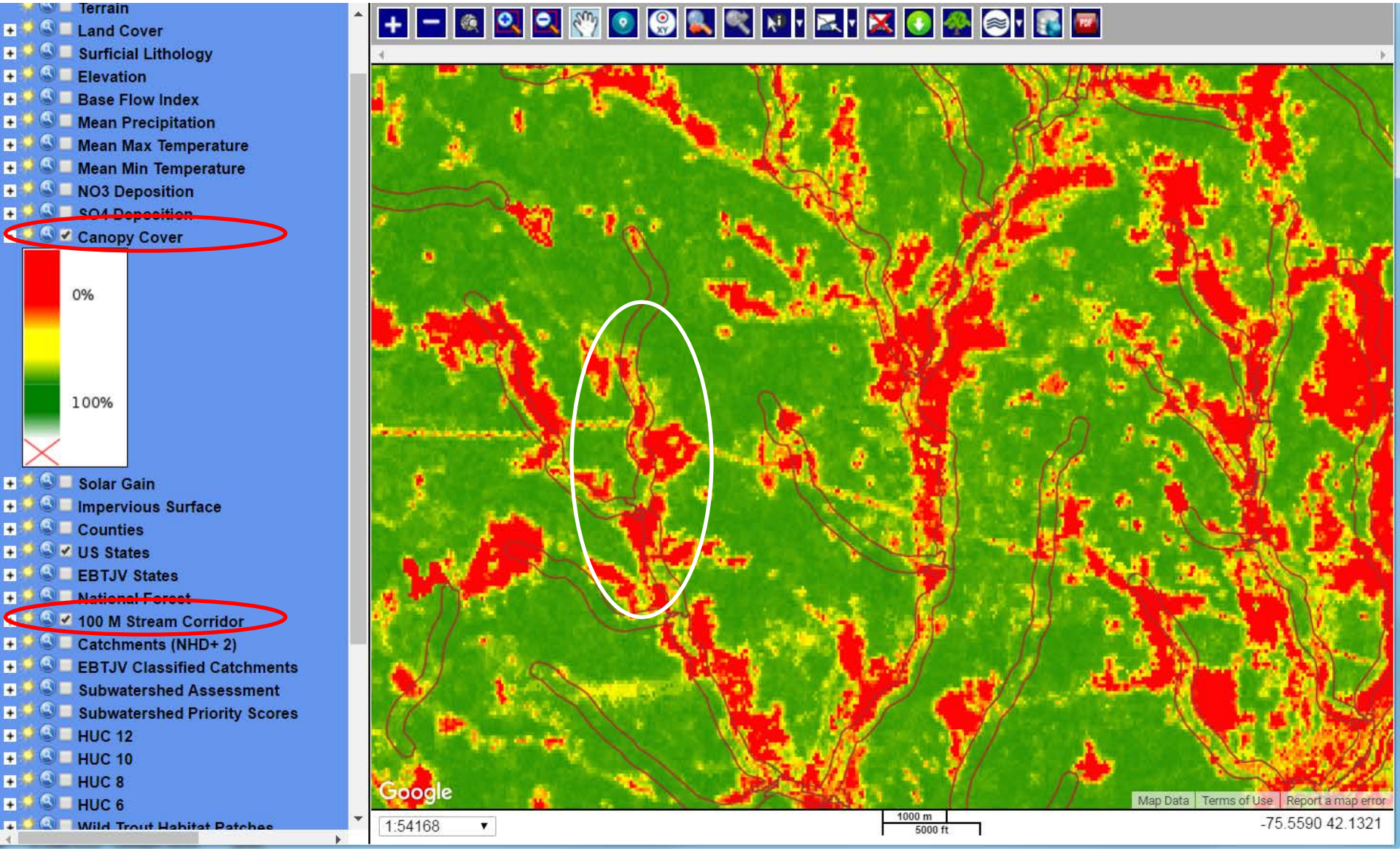
Locate patch of interest



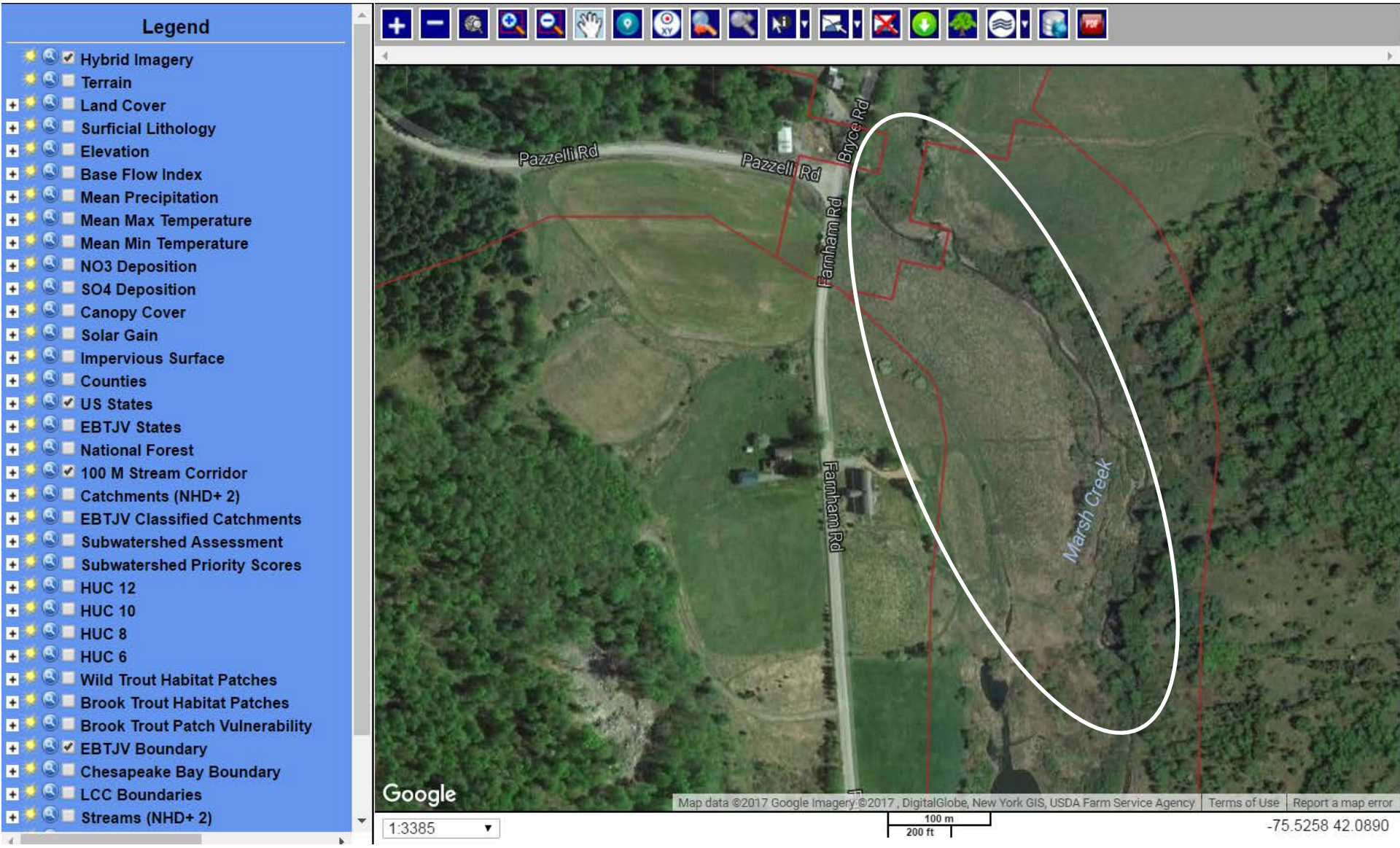
Turn on canopy cover layer



Turn on stream corridor, zoom to area with low canopy cover in corridor



Turn off canopy cover and explore aerial imagery



Example 2: Evaluating restoration needs of EBT patches in a particular geography

In this example, EBT populations are evaluated through the lens of a particular funding source, the National Fish and Wildlife Foundation's Delaware River Restoration Fund. Upper Lehigh Basin EBT populations are selected using the DE basin focal area visualization tool and compared within an Excel spreadsheet table.

NFWF

Delaware River Restoration Fund *continued*

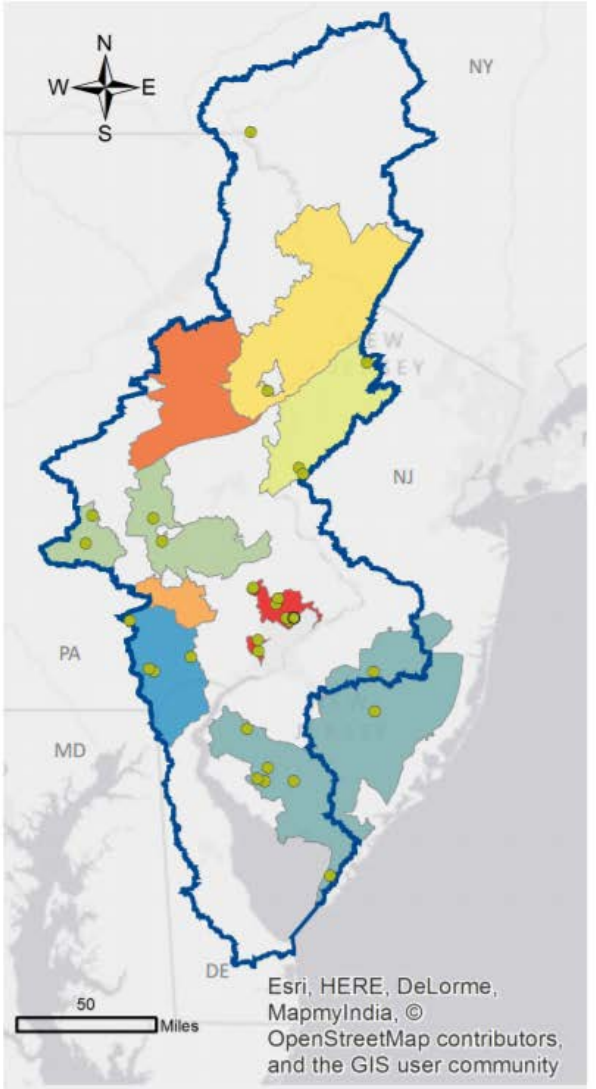
GOALS AND OBJECTIVES

The goals of the DRRF include:

- Increase delivery of agriculture BMPs to reduce nutrient and sediment loads
- Expand conservation outreach to new farmers and landowners
- Restore stream banks, shoreline and wetlands
- Establish, expand and improve riparian buffers
- Promote and install green stormwater infrastructure BMPs and reduce suburban runoff
- Improve municipal policies for green stormwater infrastructure
- Reach, train and provide technical assistance to new audiences
- Engage significant numbers of new volunteers

The DRRF's investments are targeted primarily to DRWI "Clusters," sub-watersheds within the broader Delaware River Watershed where investments in restoration are expected to realize the greatest return. These geographies include important habitat and are critical for improving water quality.

The strategy for restoration in these places is determined by a team of local partners with on-the-ground knowledge of conservation needs and opportunities. The DRRF awards grants to projects that address these strategies.

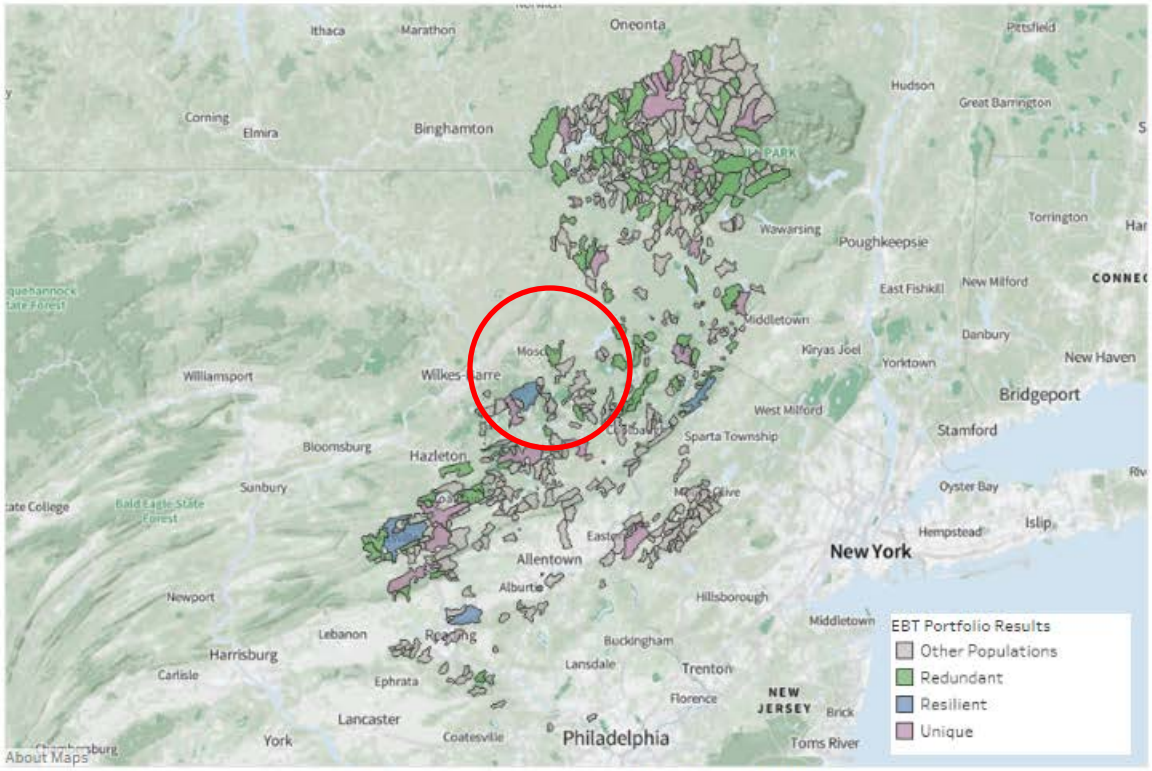


CONSERVATION IN THE DELAWARE WATERSHED

In its first two years, the fund has invested a total of $4.45 million in 30 projects (shown as green dots in the map above) to improve water quality and restore habitats. DRWI targeted geographies include:

- Poconos and Kittatinny
- Upper Lehigh
- New Jersey Highlands
- Middle Schuylkill
- Schuylkill Highlands
- Upstream Suburban Philadelphia
- Brandywine and Christina
- Kirkwood Cohansey Aquifer

Description | Data Sources | Secure Portfolio Elements | Climate Change and Ecosystem Services | AMD, Abandoned Mines, Acid Deposition | Riparian Restoration | Evaluate/Restore Fish Passage | Mitigate Sediment and Nutri



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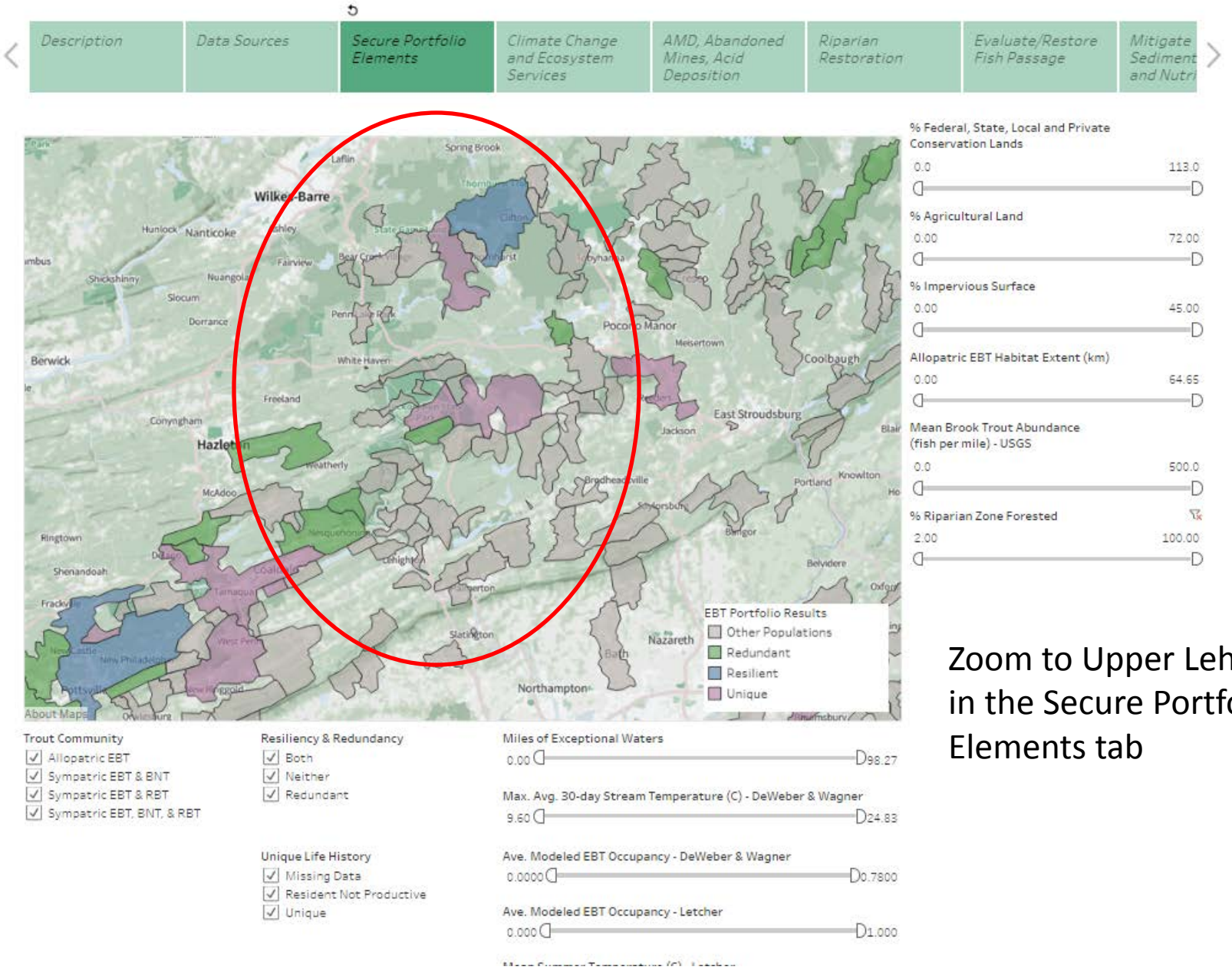
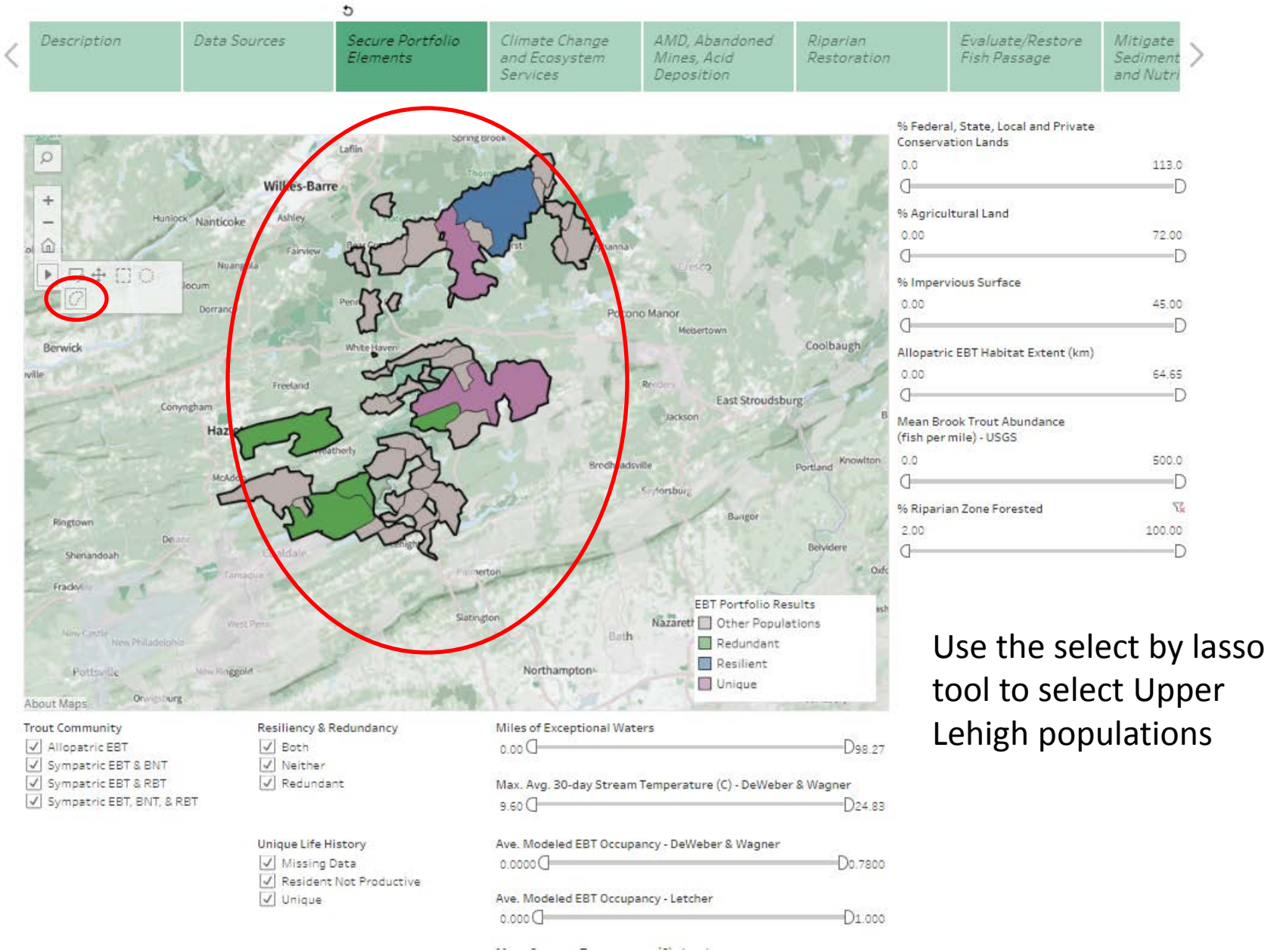
0.000 — 1.000

Mean Summer Temperature (C) - Letcher
0.00 — 21.54

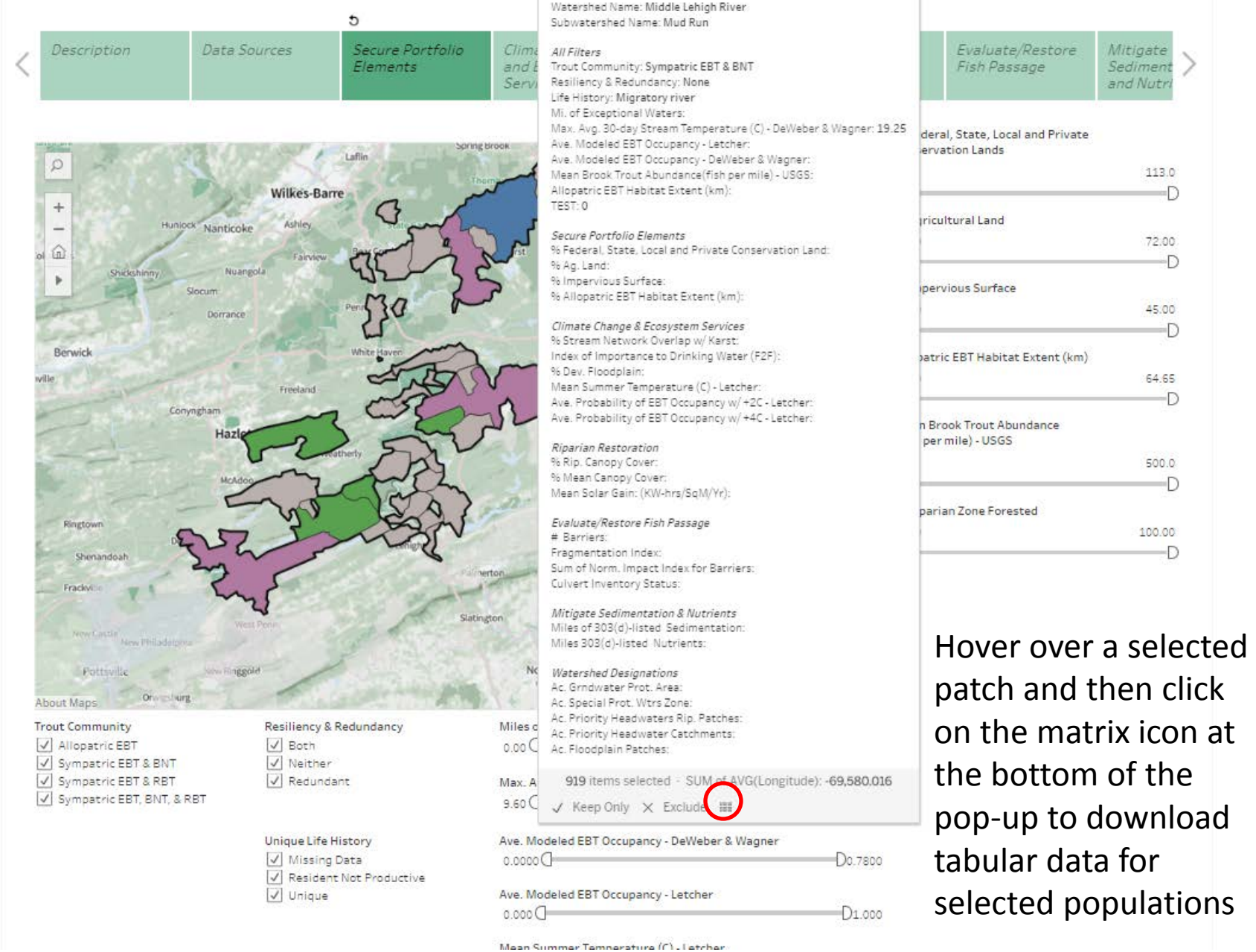
Zoom to Upper Lehigh in the Secure Portfolio Elements tab



Zoom to Upper Lehigh in the Secure Portfolio Elements tab

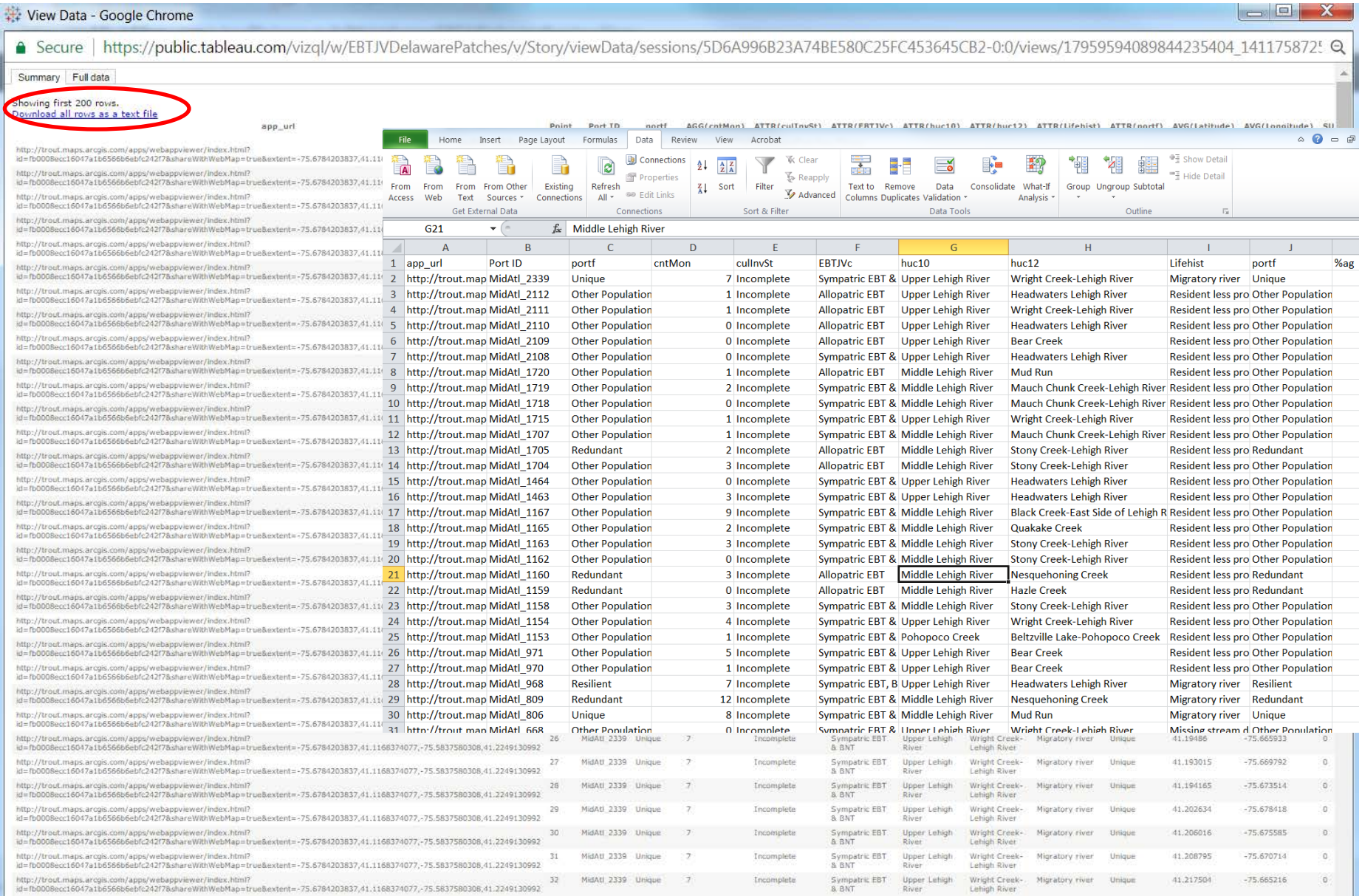


Use the select by lasso tool to select Upper Lehigh populations



Hover over a selected patch and then click on the matrix icon at the bottom of the pop-up to download tabular data for selected populations

Download tabular data, open in Excel, remove duplicate records following the instructions in the General User's Guide, and filter to just Upper Lehigh and Middle Lehigh HUC10 watersheds



Looking populations in the Upper and Middle Lehigh, the following habitat condition or future threat attributes stand out. Conditions are listed with restoration actions in parenthesis, and *italicized* if they align with an activity eligible for NFWF funding:

- All populations meeting portfolio criteria for resiliency, redundancy, or unique life history (Hazle Cr., Nesquehoning Cr., Mud Run, Wright Cr., Stony Cr., Headwaters Lehigh) have incomplete barrier assessments (barrier assessment)

- *2 redundant populations have 1% agricultural lands (Hazle Cr. and Nesquehoning Cr.,) and 4 other populations have 10-30% agricultural lands (agricultural BMPs)*

- *2 redundant populations have 2-5% impervious surfaces (Hazle Cr. and Nesquehoning Cr.; stormwater runoff BMPs)*

- 2 redundant populations have abandoned mine lands, 303d listing, and lower amounts of forested riparian zones (Hazle Cr. and Nesquehoning Cr.; AMD restoration or treatment and reforestation of abandoned lands)

- 2 redundant populations (Wright Cr. and Stony Cr.) have around 40% public or private conservation lands (conservation easements around public lands)

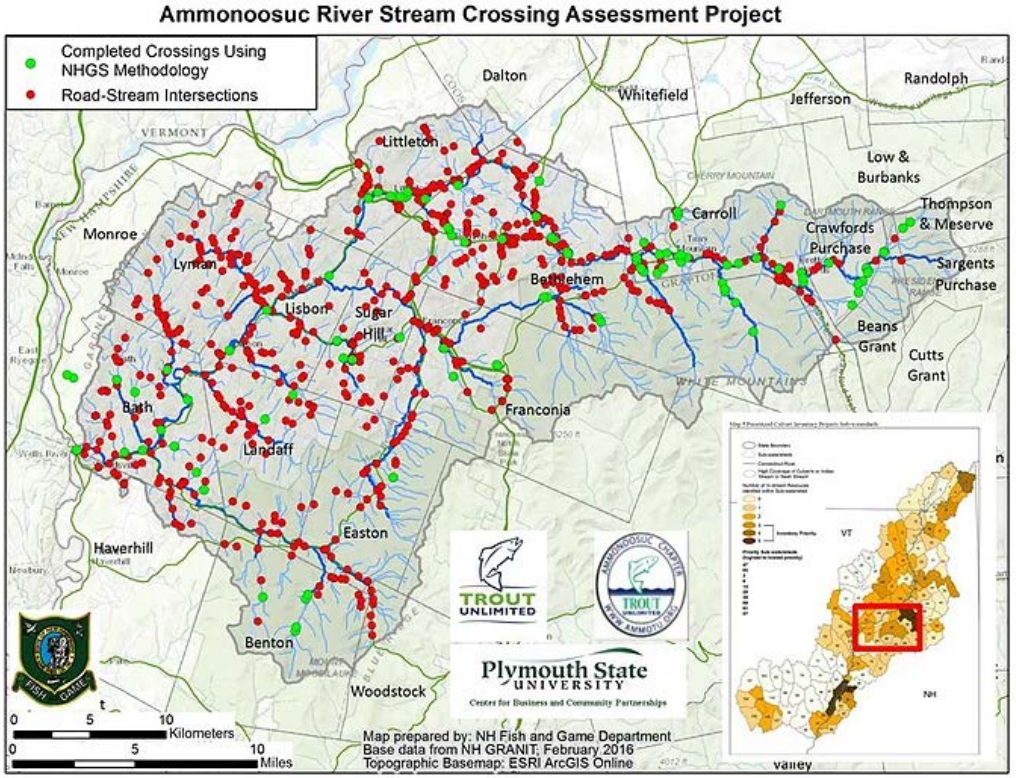
- *1 unique life history population (Mud Run) falls within the proposed path of a natural gas pipeline (citizen science and monitoring)*

Example 3: Placing a local restoration effort within a range-wide brook trout context

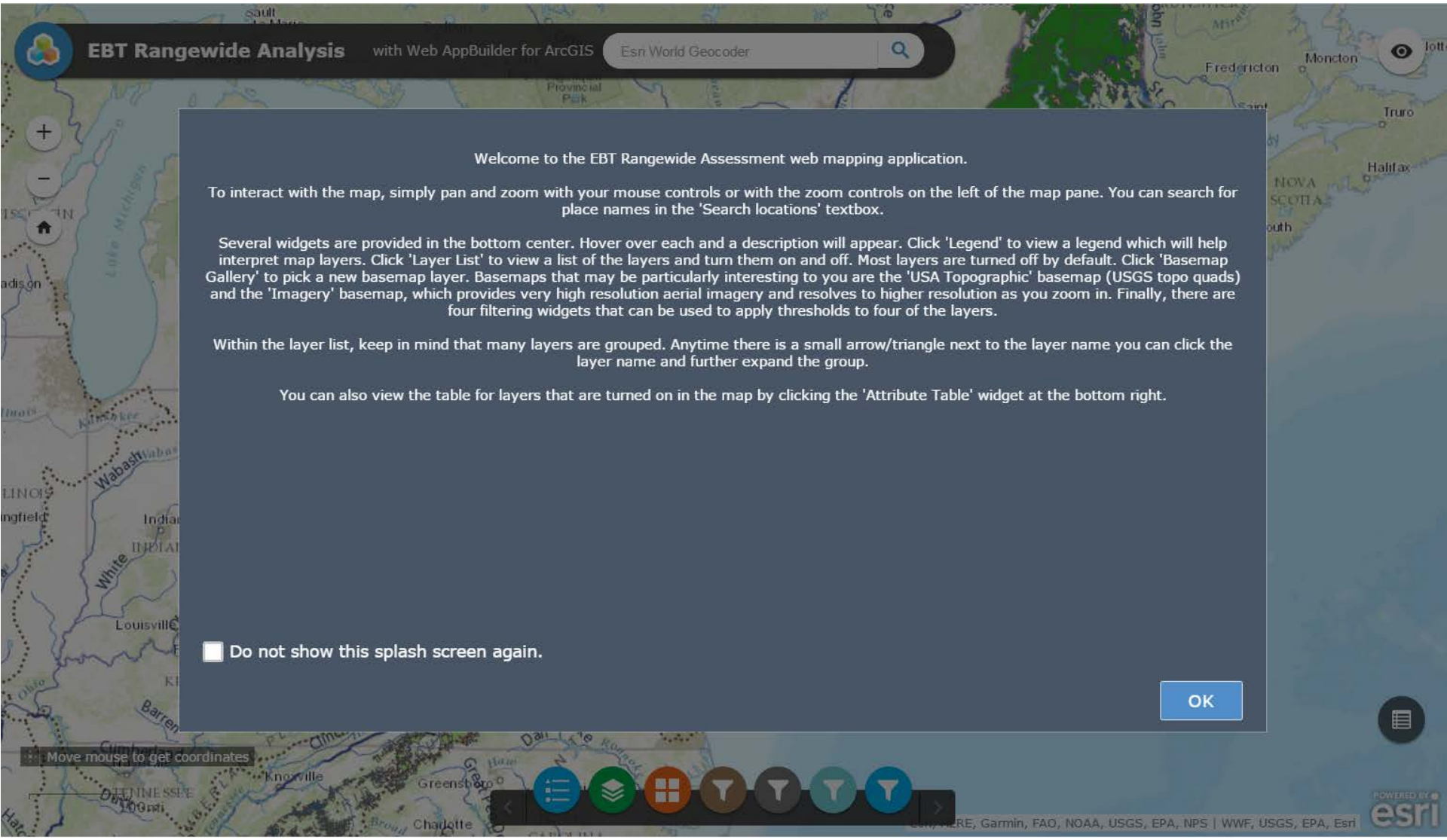
In this example, we evaluate several potential culvert removal projects in the Ammonoosuc River basin of NH and show how the conservation portfolio and range-wide assessment results can be used to articulate project value to brook trout. This process may assist entities that conduct culvert replacement work (such as towns or counties) in accessing information about local brook trout fisheries values.

Process:

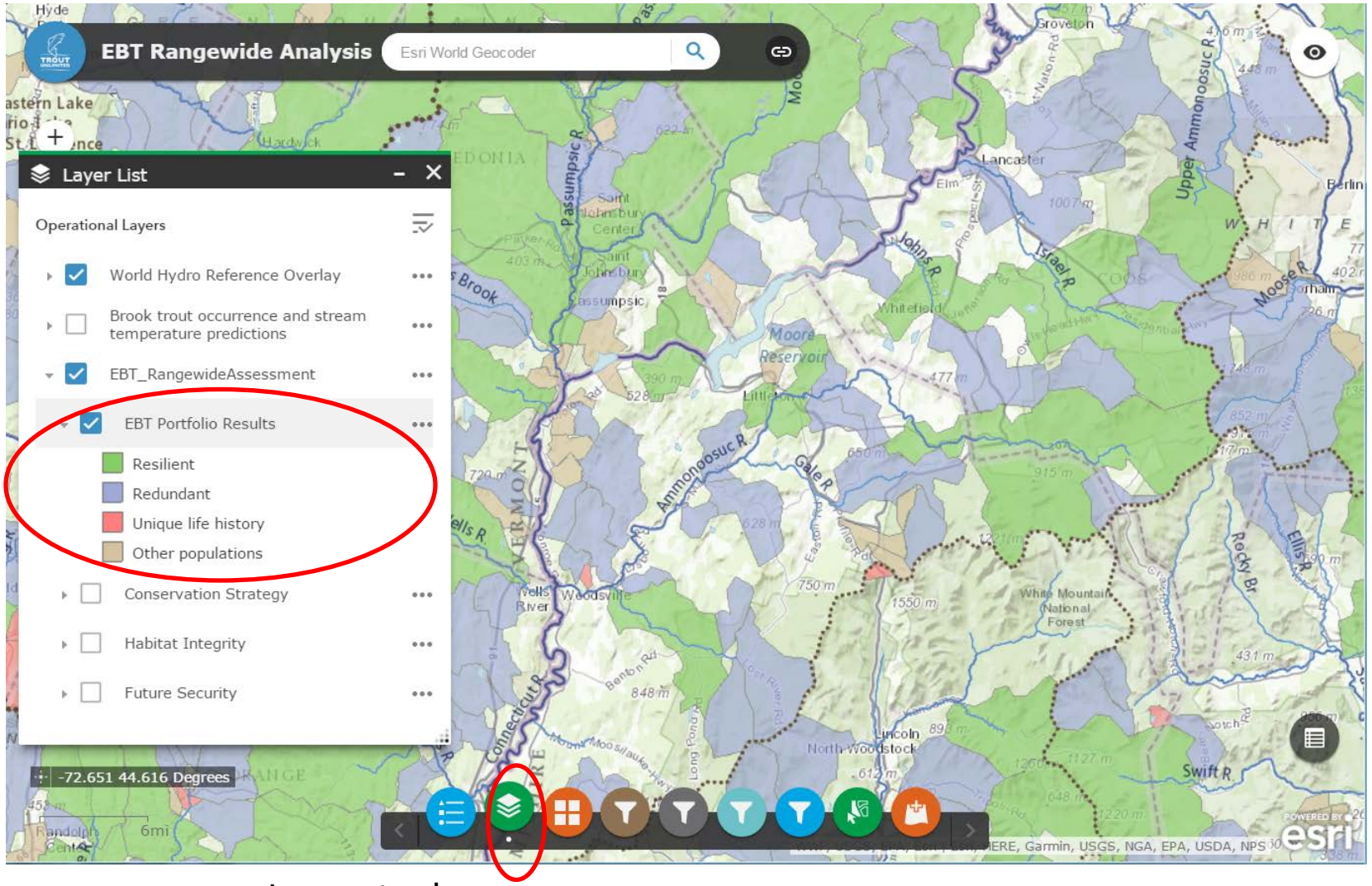
- Use conservation portfolio and range-wide assessment map viewer to overlay a recent barrier survey to place a local restoration opportunity within a broader brook trout conservation context using patch habitat condition and future security percentile scores.



Open the Eastern Brook Trout Conservation Portfolio and Rangewide Assessment map application:
http://www.arcgis.com/apps/webappviewer/index.html?id=f70da52f45304ab8be440885d32d3866

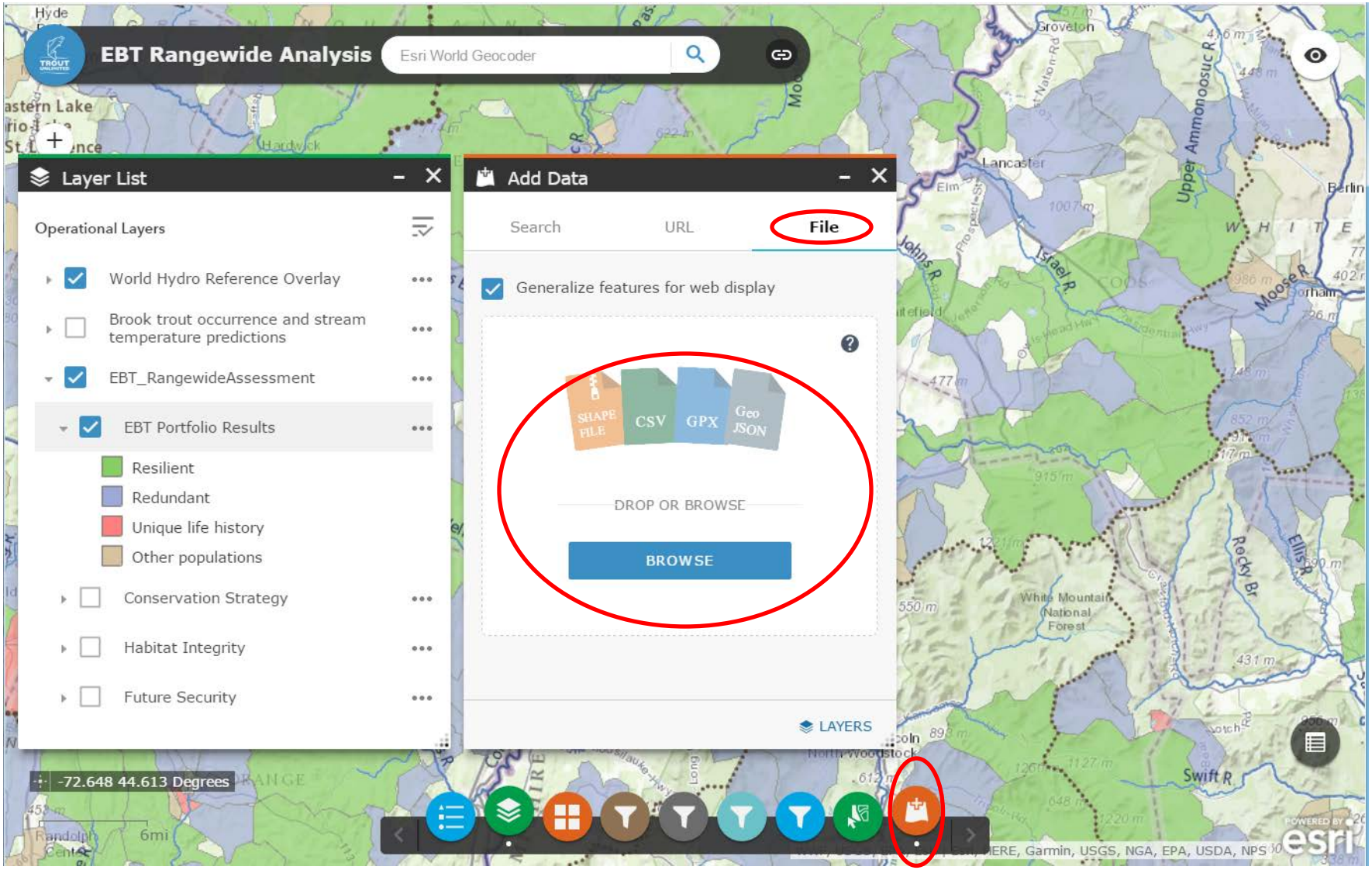


Zoom to the Ammonoosuc River basin and change the visible layer in the layer list to show the portfolio results – resilient (green) and redundant (blue) brook trout populations are populations that TU has identified as highly likely to be viable in the long-term based on the amount of connected habitat available to populations based on the Conservation Portfolio analysis.

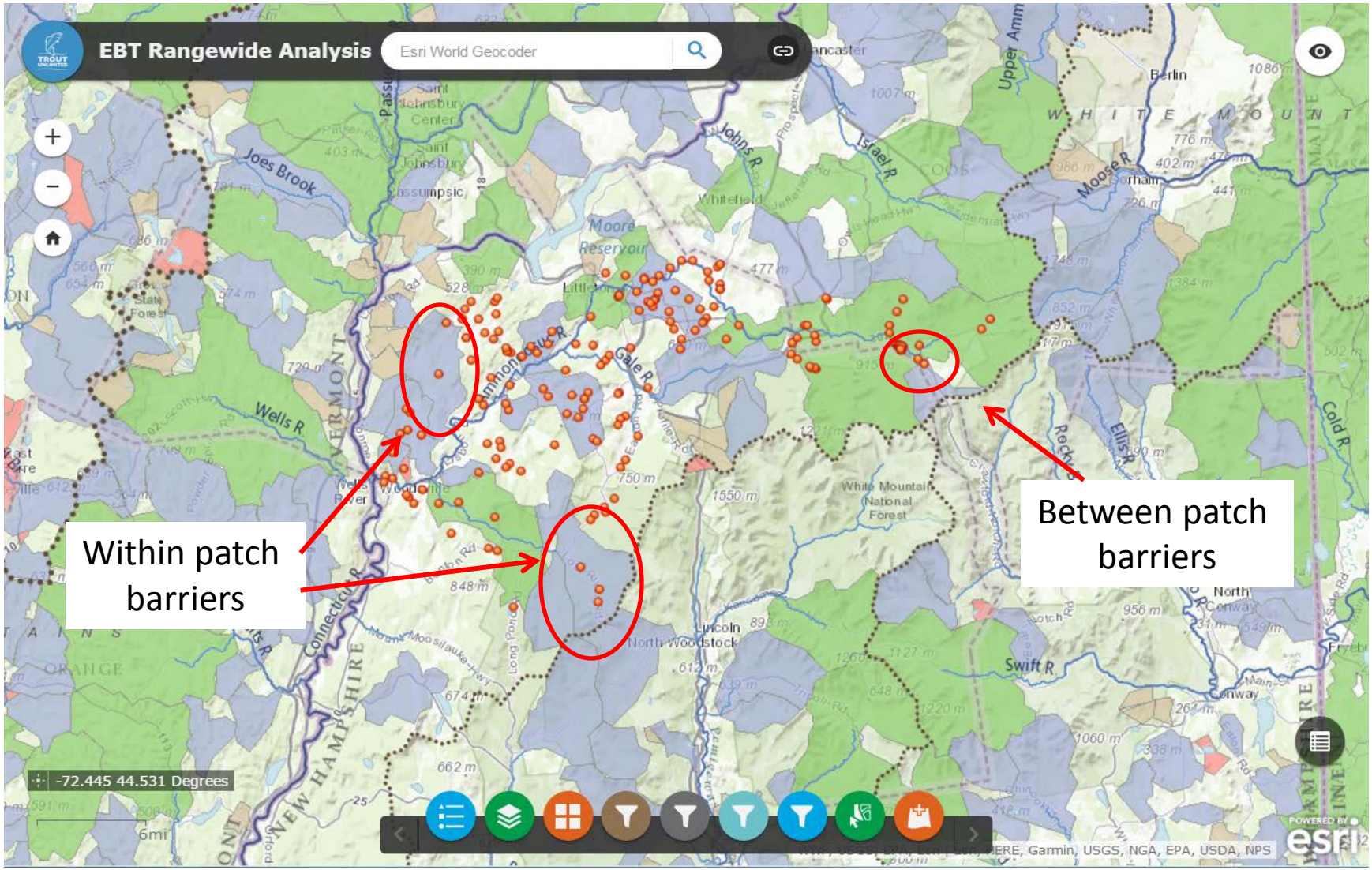


Layers tool

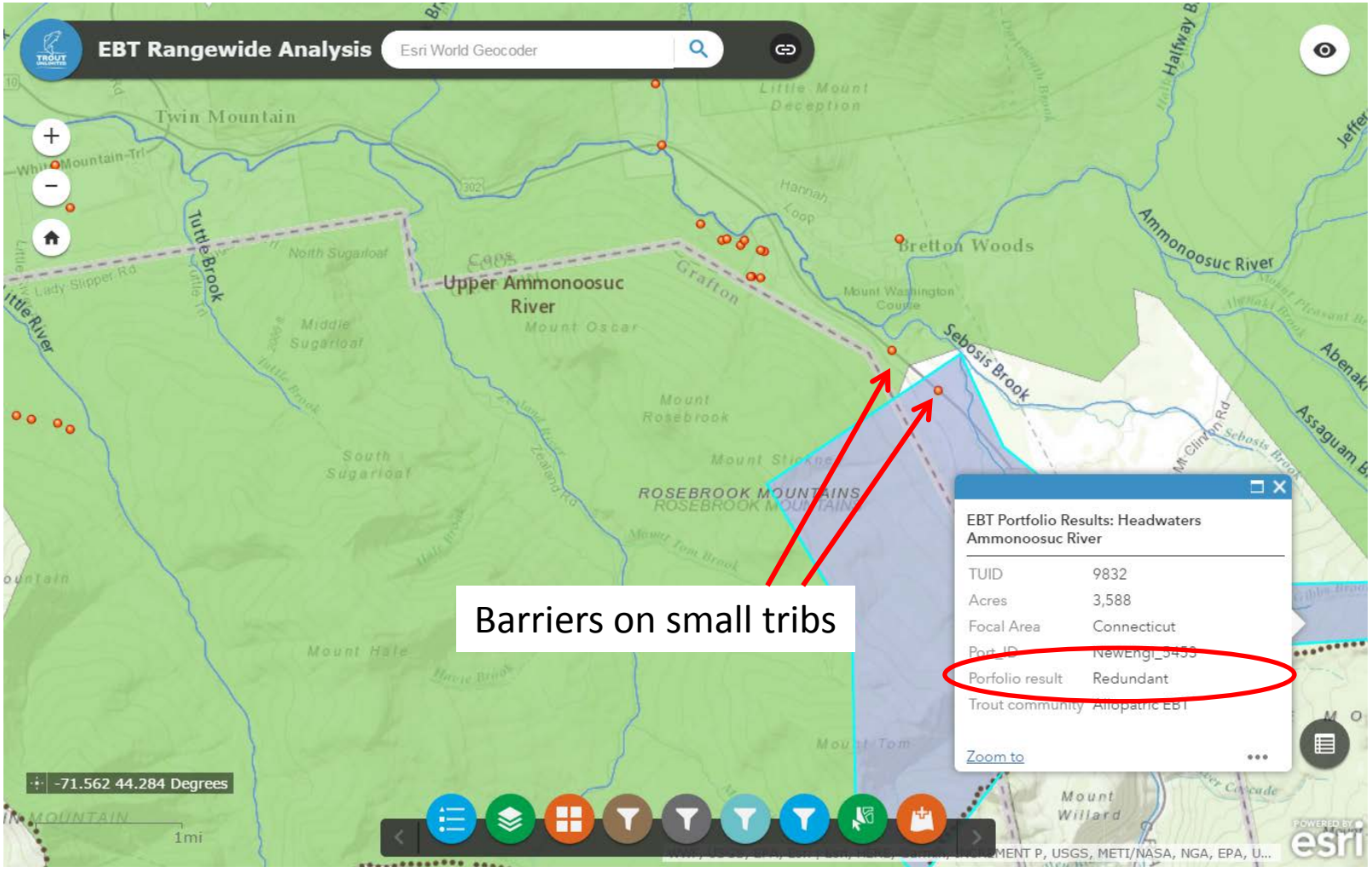
Add a local barrier survey dataset. The dataset we are using was provided as an excel spreadsheet – to make it visible in the map and limit the amount of data shown, filter the dataset to just show crossings with “Reduced AOP” status, save the dataset as a .csv file, and drag onto the map.



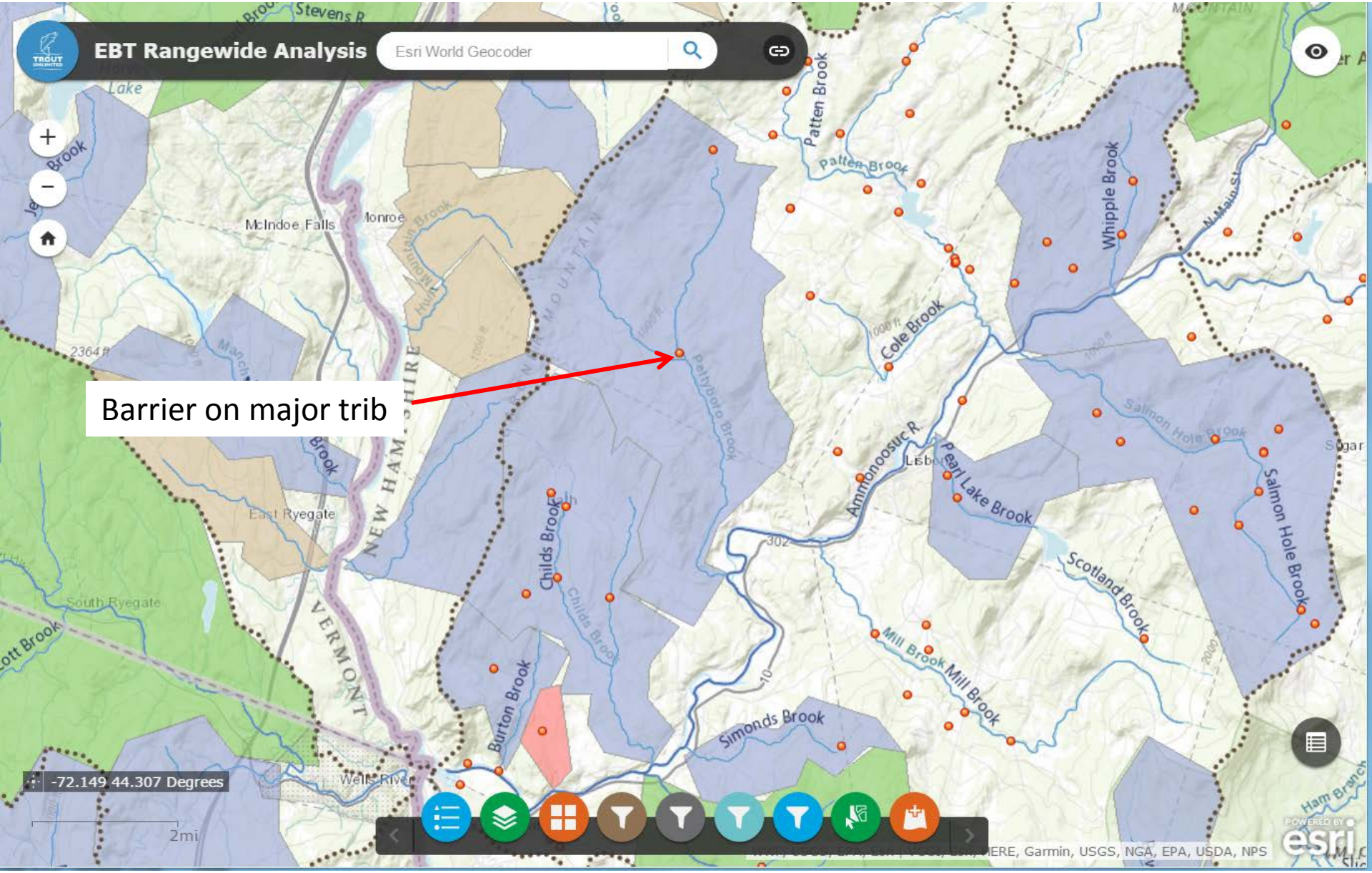
A quick scan of the map reveals several types of critical barriers – those that appear to fall within existing population patches (and were not accounted for in the patch delineation process) and those that appear to be at the downstream extent of patches and fall between patches.



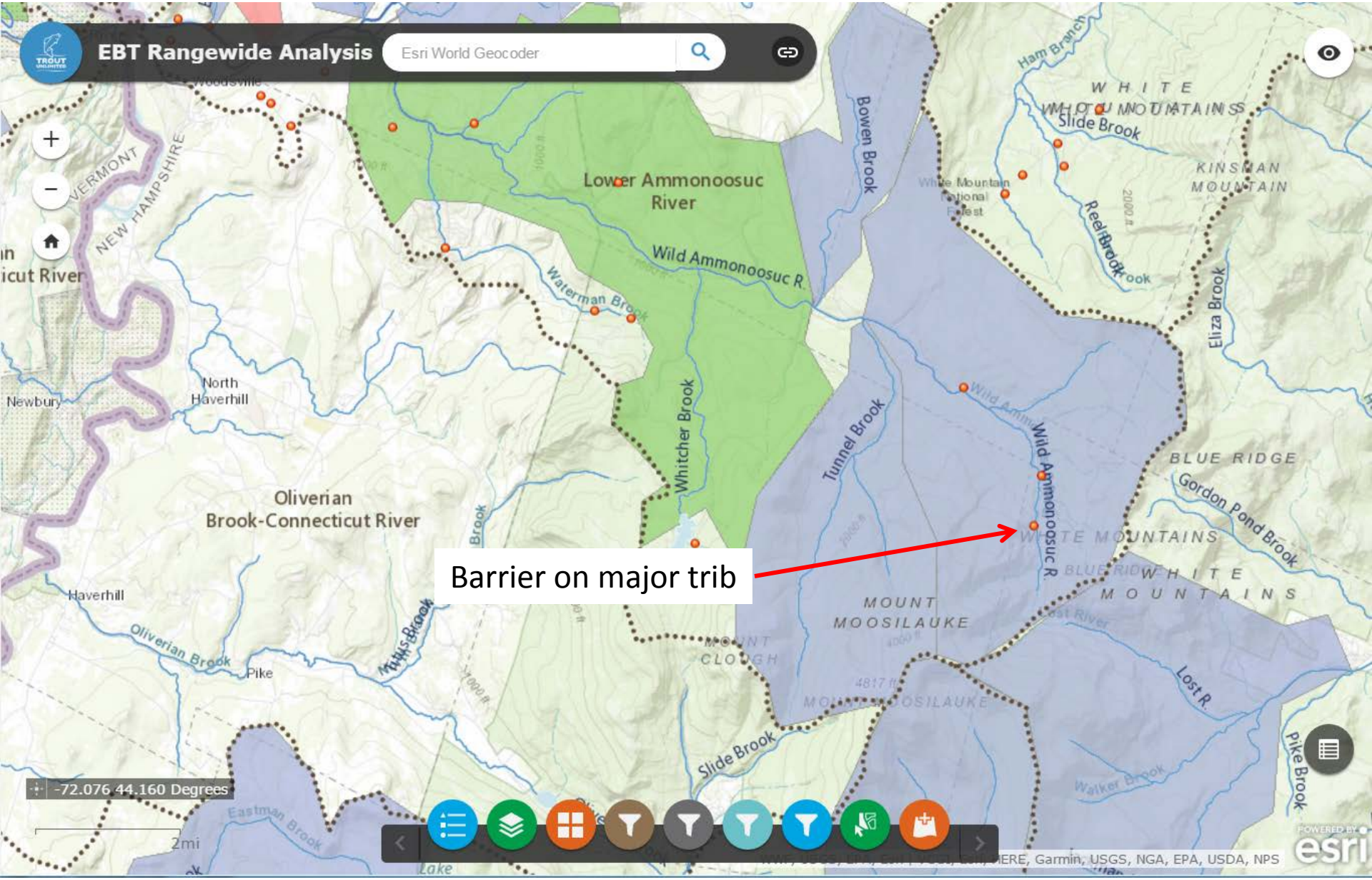
Zooming into the map shows that the between patch barriers are actually road crossings on smaller tributaries within the patches – not significant obstacles to stream connectivity. Even if the barriers were between patches, clicking on the map shows that the adjacent trout communities differ – the redundant patch (blue) is brook trout-only, while the downstream patch is mixed brook trout and brown or rainbow trout – given the competitive interaction of brook trout and brown trout, reconnecting the brook trout-only patch to downstream brown trout would not be a brook trout priority.



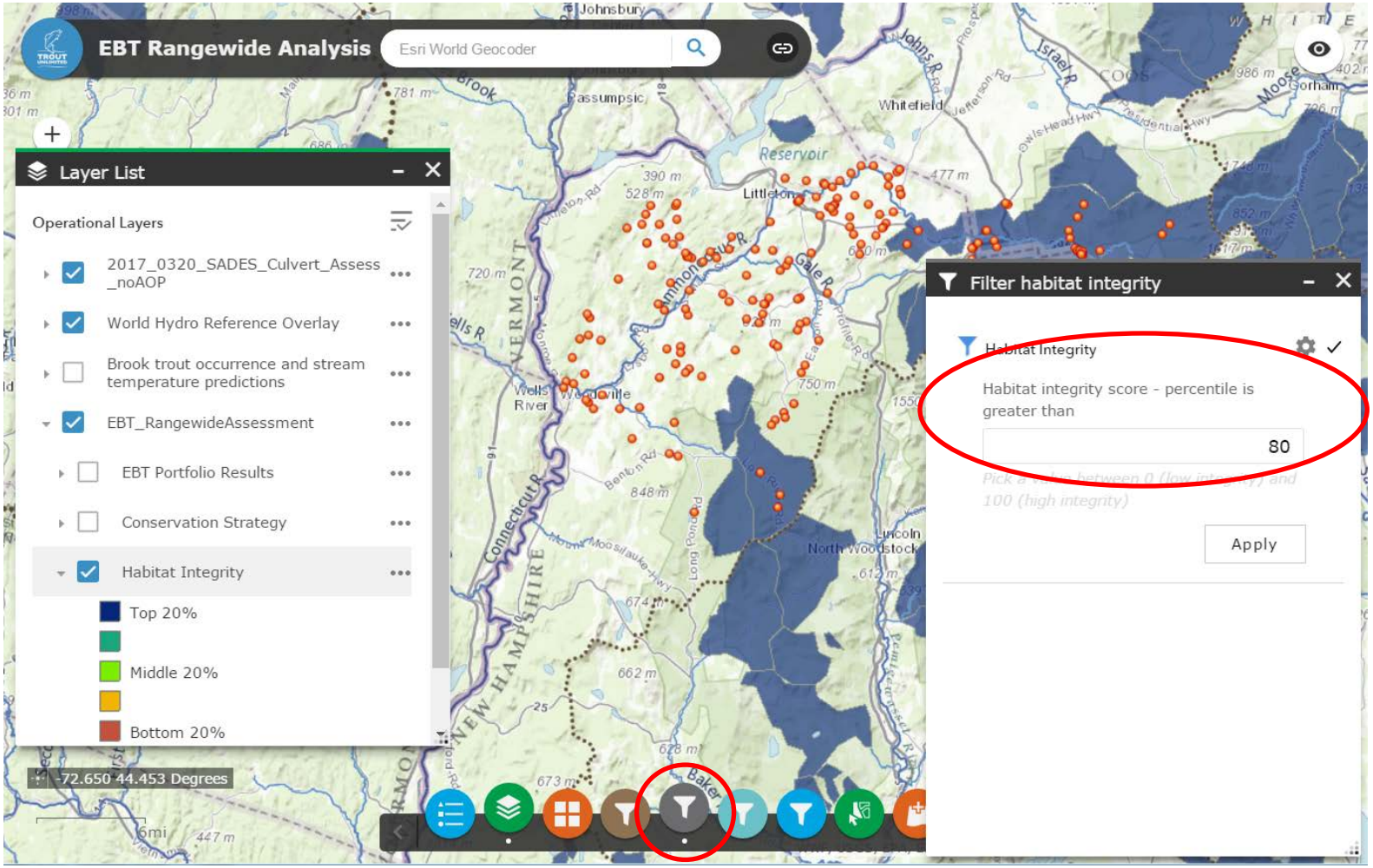
Zooming into the map to explore the within patch barriers shows that both fall on major streams – Pettyboro Brook.



Zooming into the map to explore the within patch barriers shows that both fall on major streams - Upper Wild Ammonoosuc River.

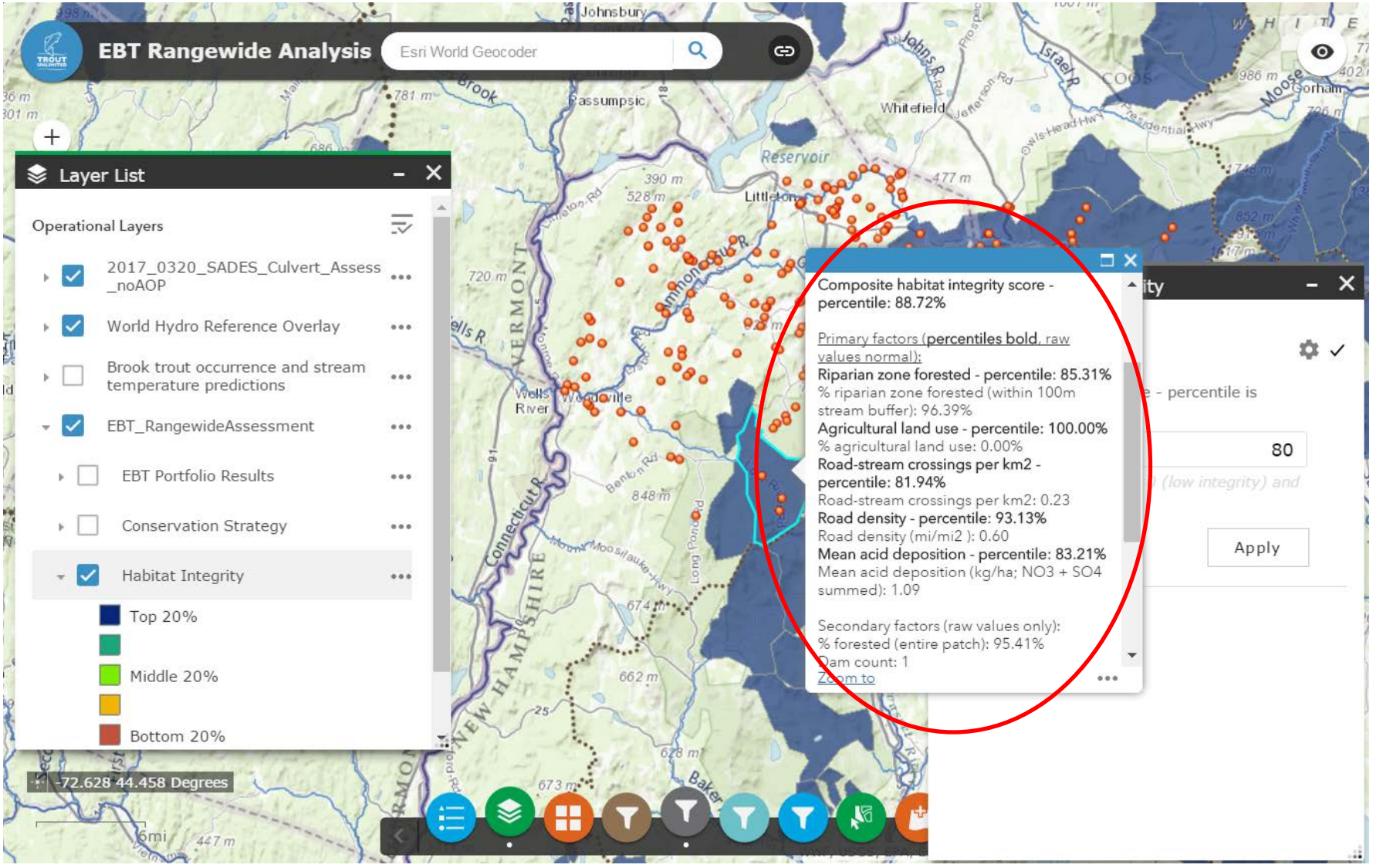


To further evaluate the potential benefit of the two potential project areas, filter the habitat integrity results show only those habitat patches with average habitat condition percentile scores of 80 or higher. The habitat condition score is based on agricultural land use, riparian forest cover, road density, road x stream crossing density, and acid deposition within patches. The patches remaining on the map are among the top 20% least impaired watersheds in brook trout range in the eastern US. Of the 2 populations, only the Upper Wild Ammonoosuc population has very high condition.

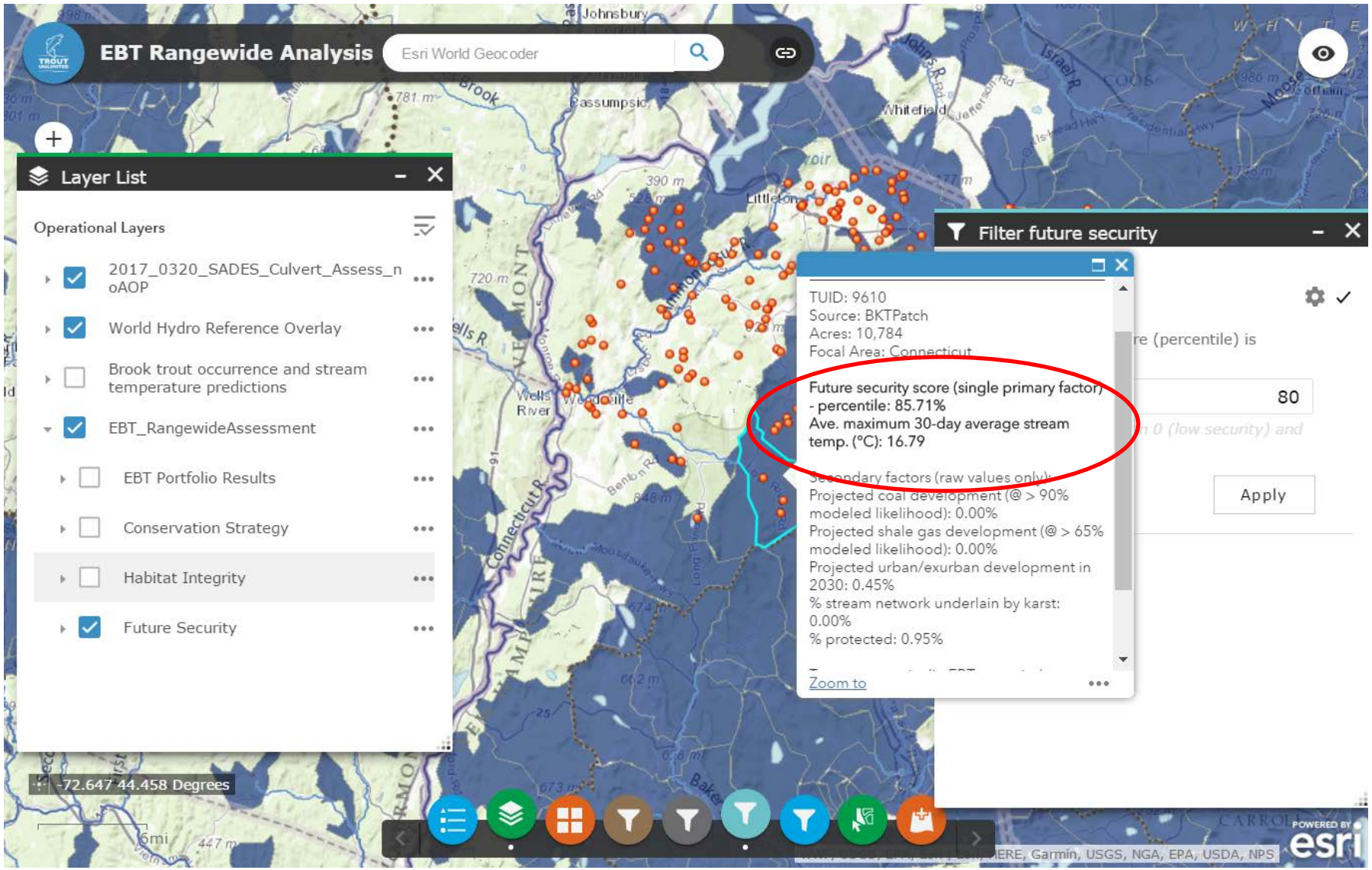


Habitat integrity filter tool

Click on the Upper Wild Ammonoosuc River patch to learn about the scores for that population. This population is in the 88th percentile for overall habitat integrity and in the 80th percentile or higher (among the top 20% of brook trout populations) for agricultural land use, road densities, acid deposition, and riparian forest cover. These numbers suggest that these populations have high habitat integrity relative to other brook trout populations.



Repeat these steps for the future security layer. The future security factor is based on stream temperature within patches. The Upper Wild Ammonoosuc River population has very high percentile scores – 85.7%, placing it within the top 15% coldest watersheds in brook trout range in the eastern US.

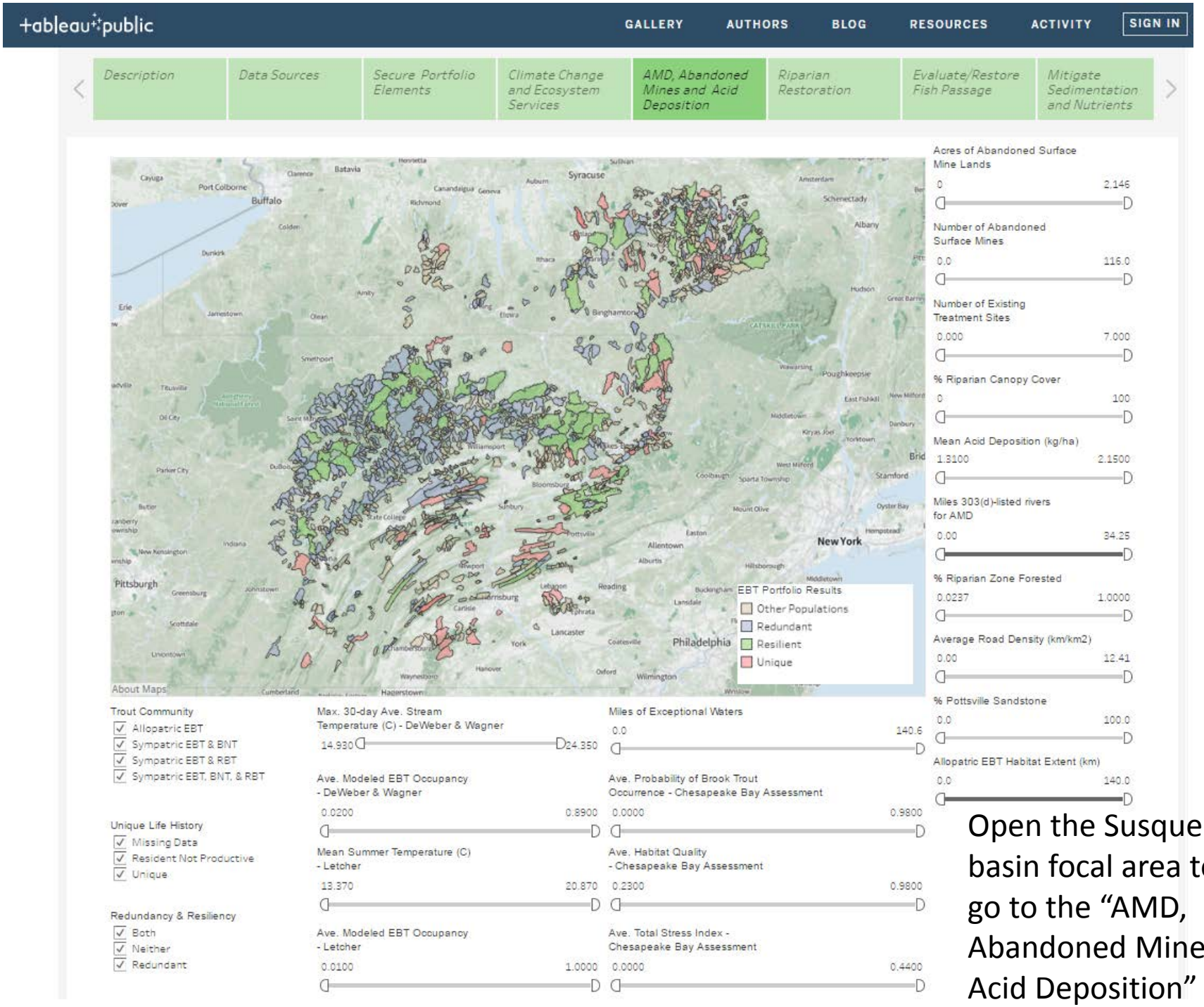

EBT Rangewide Analysis
Esri World Geocoder
Layer List
Operational Layers
2017_0320_SADES_Culvert_Assess_noAOP
World Hydro Reference Overlay
Brook trout occurrence and stream temperature predictions
EBT_RangewideAssessment
EBT Portfolio Results
Conservation Strategy
Habitat Integrity
Future Security
Filter future security
TUID: 9610
Source: BKTPatch
Acres: 10,784
Focal Area: Connecticut
Future security score (single primary factor) - percentile: 85.71%
Ave. maximum 30-day average stream temp. (°C): 16.79
Projected coal development (@ > 90% modeled likelihood): 0.00%
Projected shale gas development (@ > 65% modeled likelihood): 0.00%
Projected urban/exurban development in 2030: 0.45%
% stream network underlain by karst: 0.00%
% protected: 0.95%
Zoom to
(percentile) is
80
Apply
-72.647 44.458 Degrees
Johnsbury
Whitefield
Littleton
Wells River
Wells
Connecticut R
Ammonoosuc R
Israel R
Baker
Moose
Brook
Passumpsic
Benton R
Long Pond
Bog Brook
Jefferson Rd
Cherry Pond
Dodge Pond
Duck Pond
Mud Pond
Mud Pond Rd
Ammonoosuc Rd
Littleton Rd
Whitefield Rd
Israel River Rd
Jefferson Hwy
Presidential Hwy
Cherry Pond Rd
Dodge Pond Rd
Duck Pond Rd

Example 4: Identifying priority EBT populations requiring specific restoration activities – AMD treatment

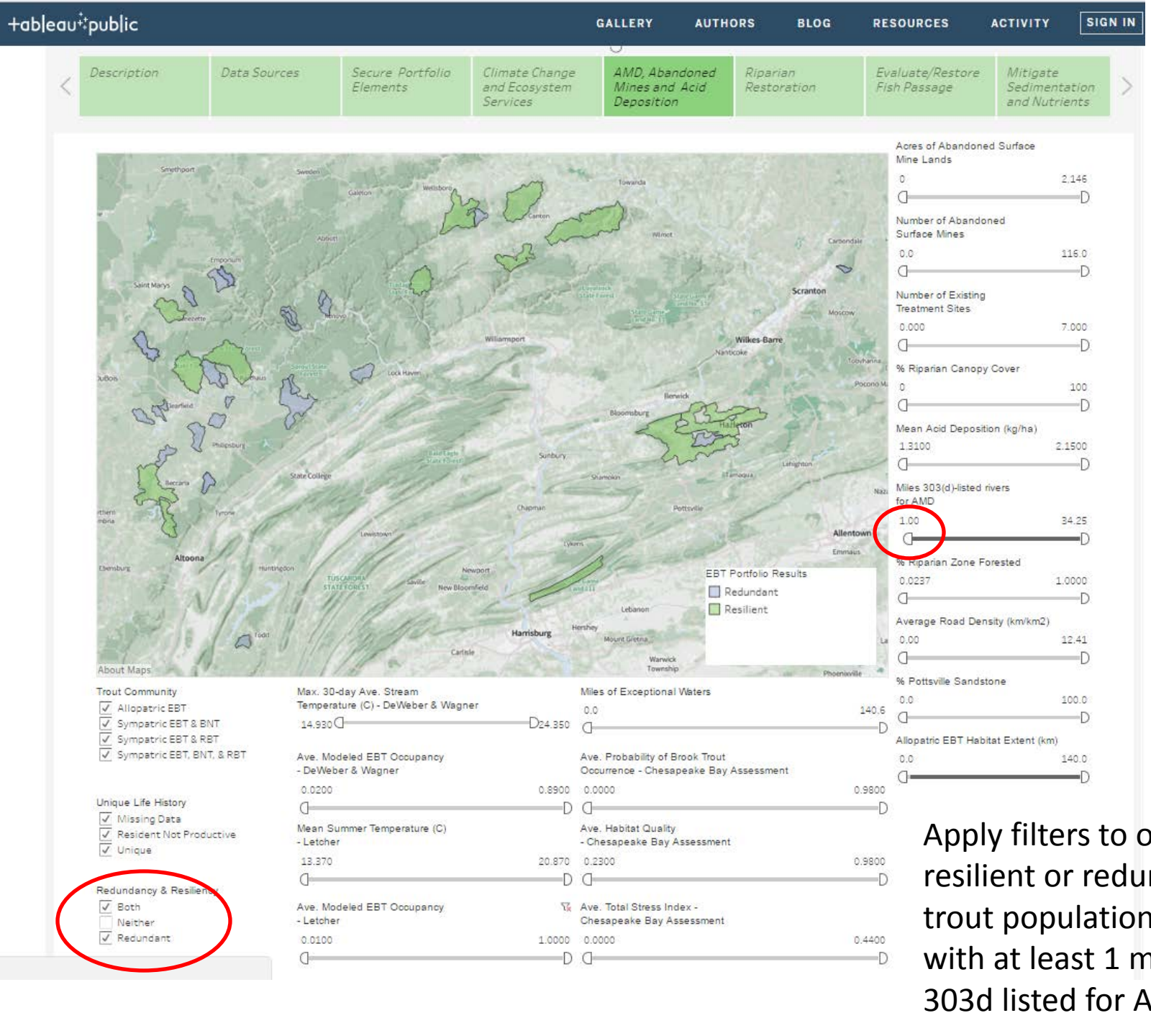
In this example, EBT populations in the Susquehanna basin are evaluated to identify abandoned mine drainage (AMD) restoration opportunities in high value brook trout populations using the Susquehanna basin focal area visualization tool.

Criteria for identifying AMD restoration opportunities likely to have significant benefit to brook trout:

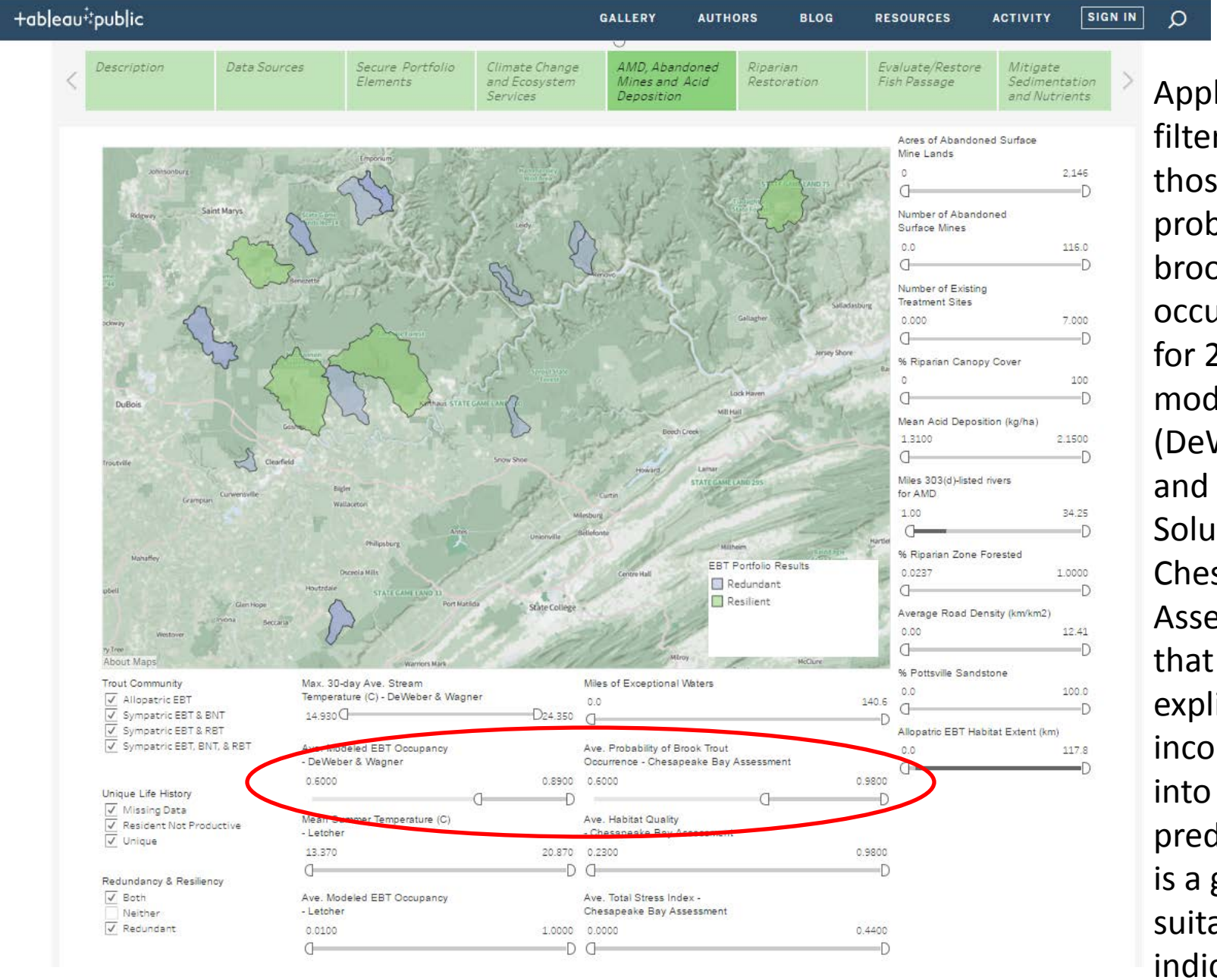
- High Portfolio value – resilient or redundant patch
- A 303d listed stream with AMD impairment
- High brook trout habitat suitability
- Contains an exceptional value stream



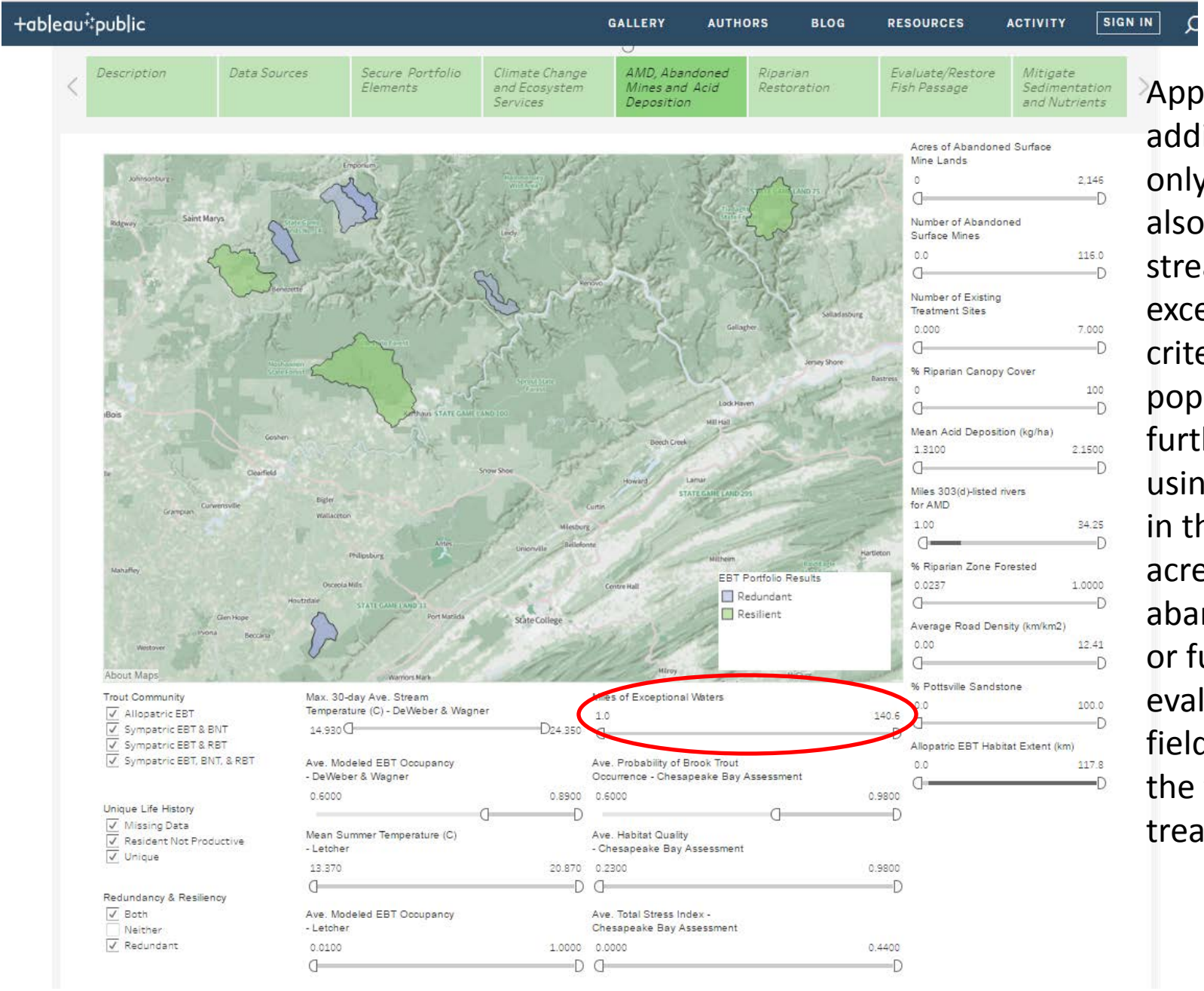
Open the Susquehanna basin focal area tool and go to the “AMD, Abandoned Mines, and Acid Deposition” tab



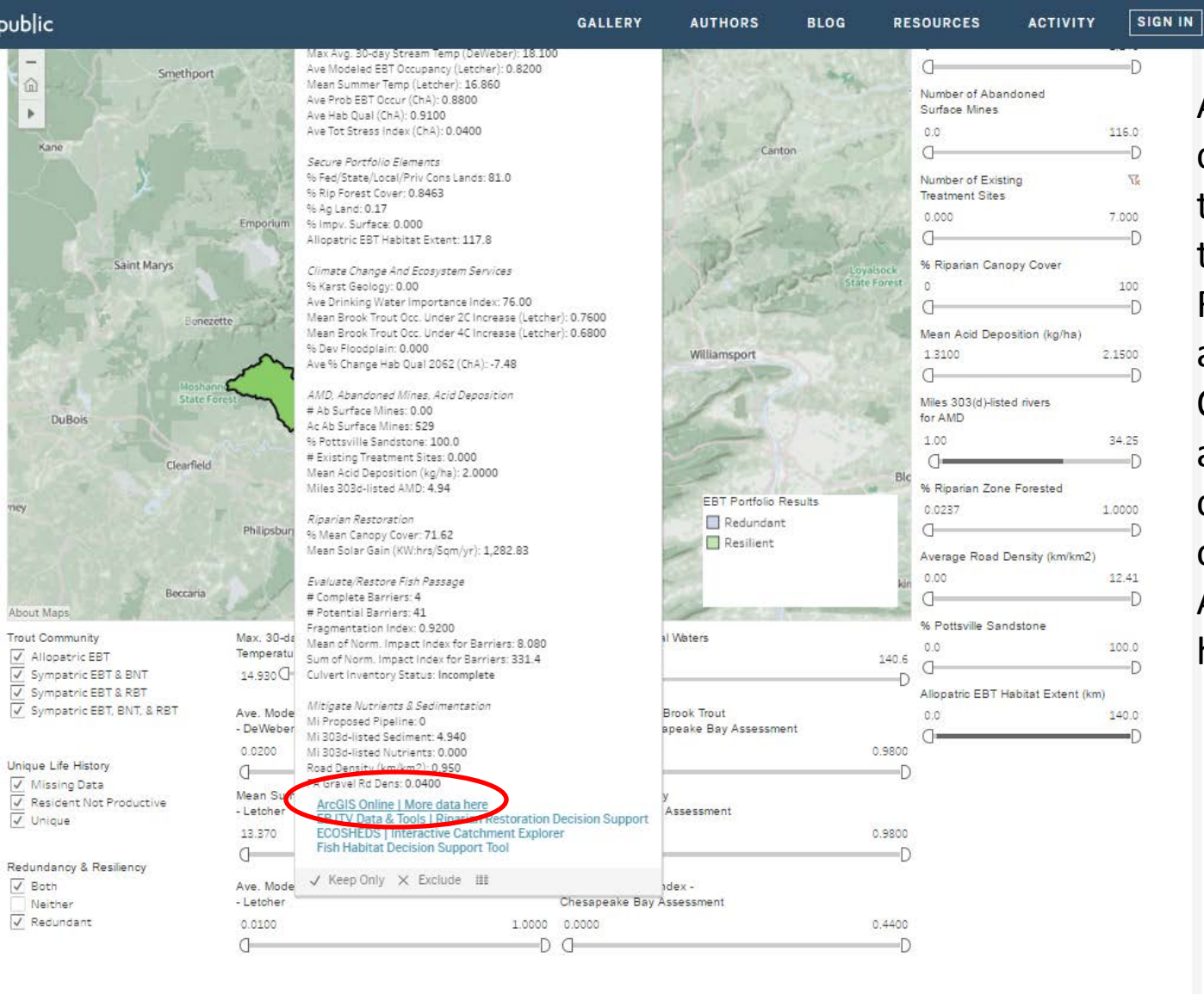
Apply filters to only show resilient or redundant brook trout populations and those with at least 1 mile of stream 303d listed for AMD



Apply additional filters to only show those with high probability of brook trout occurrence (>0.6) for 2 different models (DeWeber/Wagner and Downstream Solutions' Chesapeake Bay Assessment). Note that neither model explicitly incorporates AMD into their predictions, so this is a general habitat suitability filter indicating that other stressors are largely absent



Apply an additional filters to only show those also containing a stream meeting exceptional water criteria. The 9 populations can be further evaluated using other criteria in the tool (e.g., acres of abandoned mines), or further evaluated in the field to determine the feasibility of treatment.

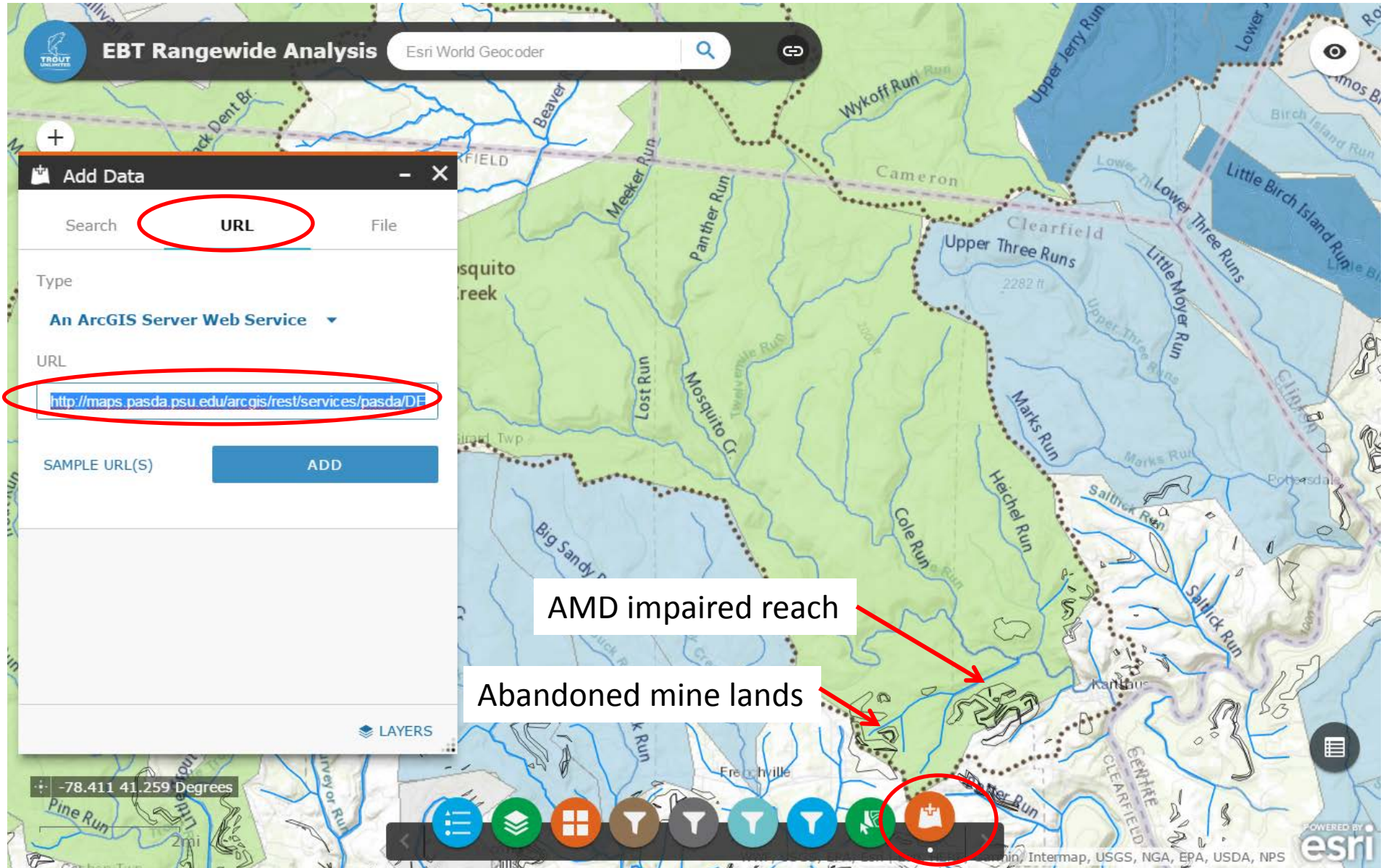


Additional datasets can by overlaid on the patches using the Portfolio and Range-wide assessment ArcGIS Online tool accessed by clicking on a patch of interest and the ArcGIS Online hyperlink.

Here we can add the PA DEP 303d impaired streams layer to further explore where AMD impaired reaches fall within individual patches and the location of abandoned mine lands.

http://maps.pasda.psu.edu/arcgis/rest/services/pasda/DEP/MapServer/17

http://maps.pasda.psu.edu/arcgis/rest/services/pasda/DEP/MapServer/1

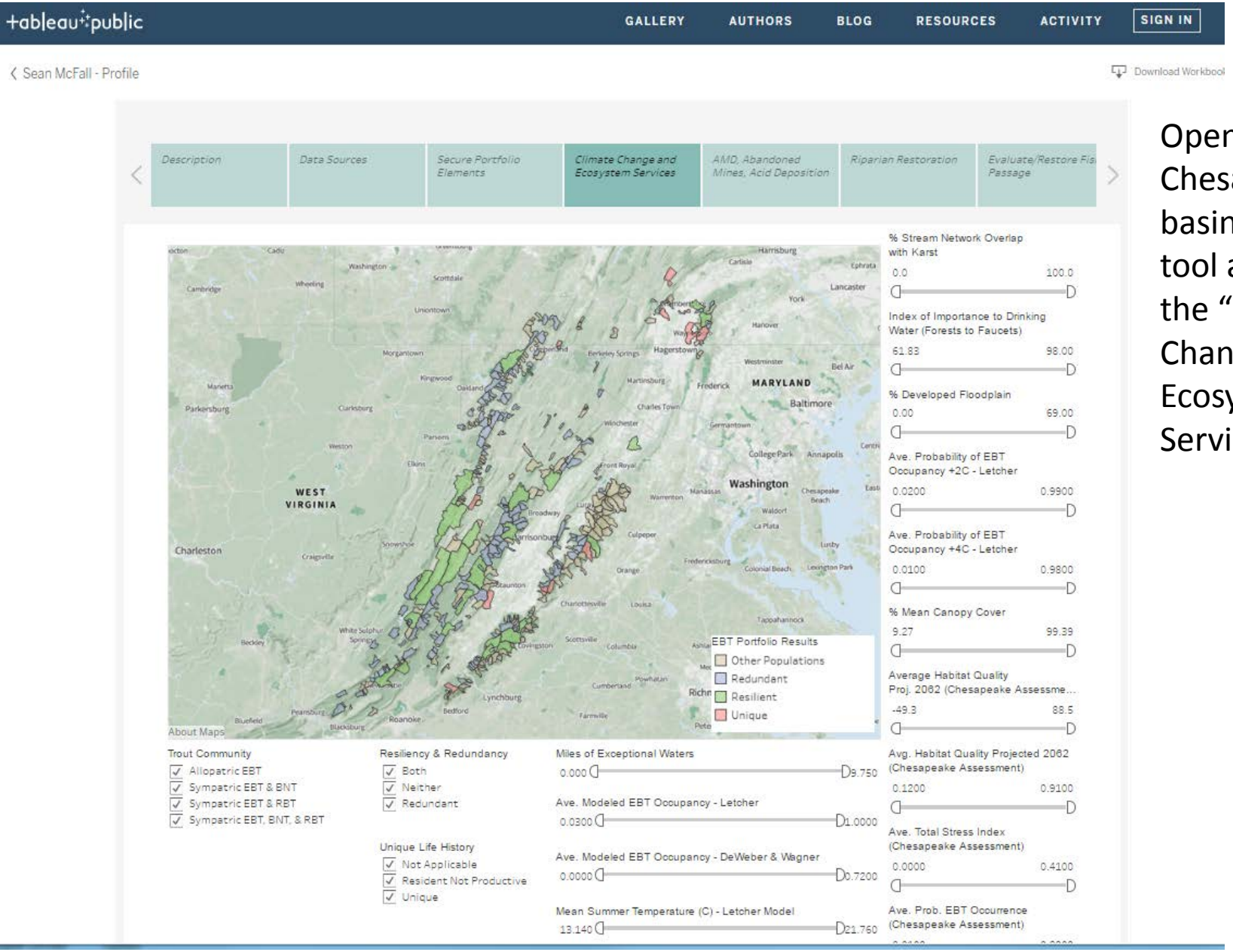


Example 5: Identifying priority EBT populations requiring specific restoration activities – cold water source protection

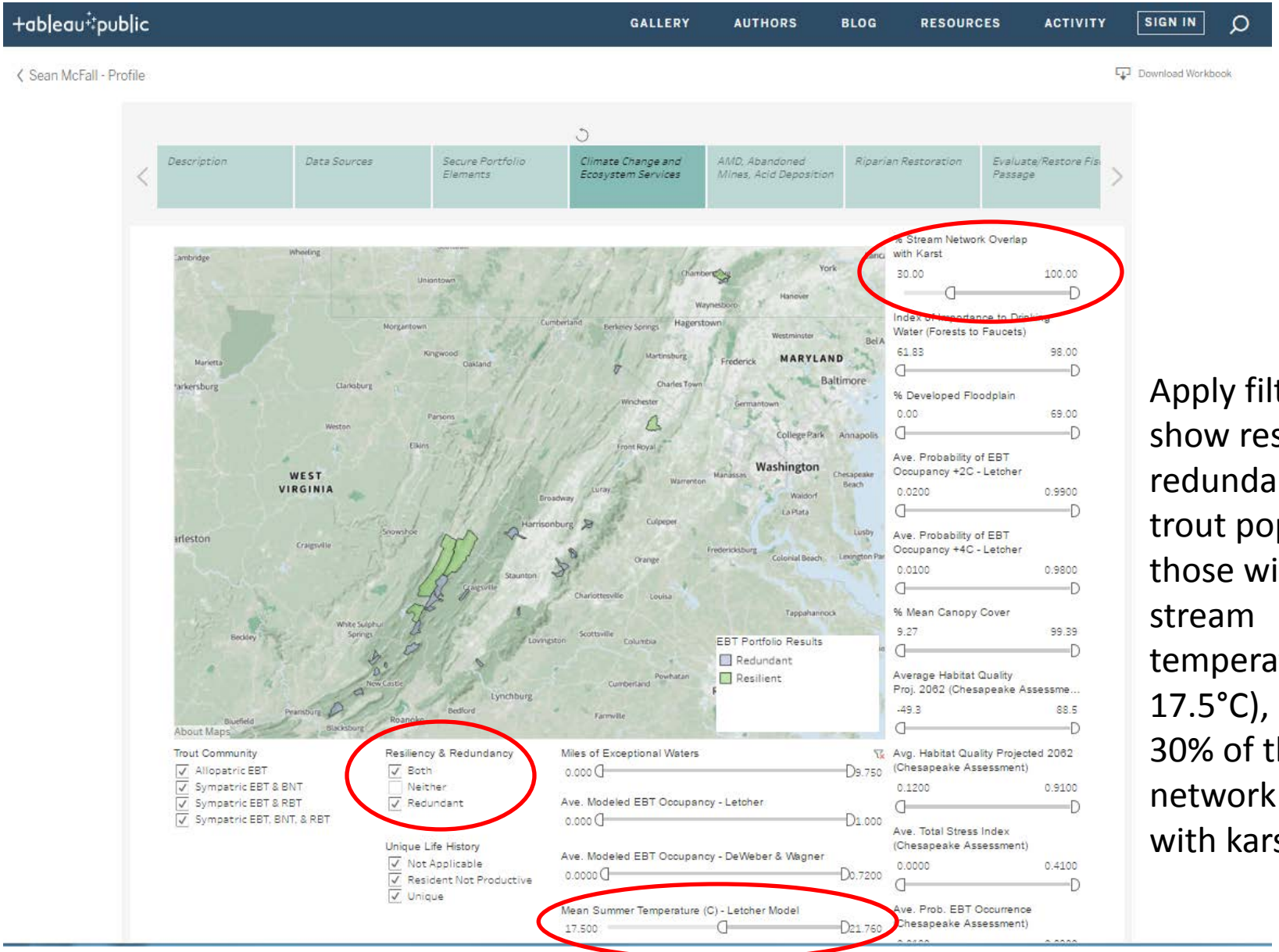
In this example, EBT populations in the Chesapeake basin are evaluated to identify cold water source protection opportunities in high value Brook Trout populations using the Chesapeake basin focal area visualization tool.

Criteria for identifying cold water source protection opportunities likely to have significant benefit to brook trout:

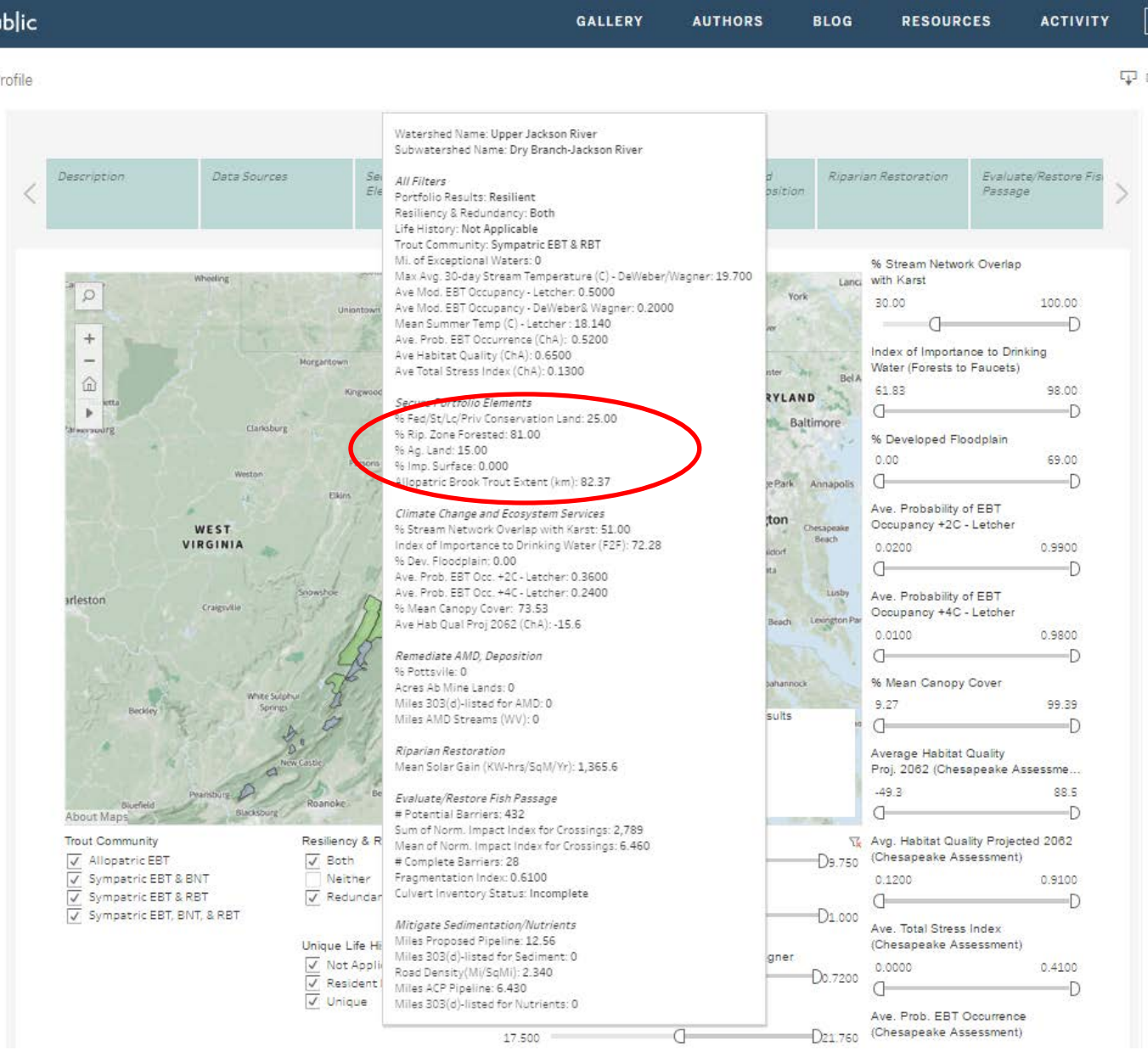
- High Portfolio value – resilient or redundant patch
- High modeled stream temperature
- Presence of karst geology on stream network
- Some agricultural land use



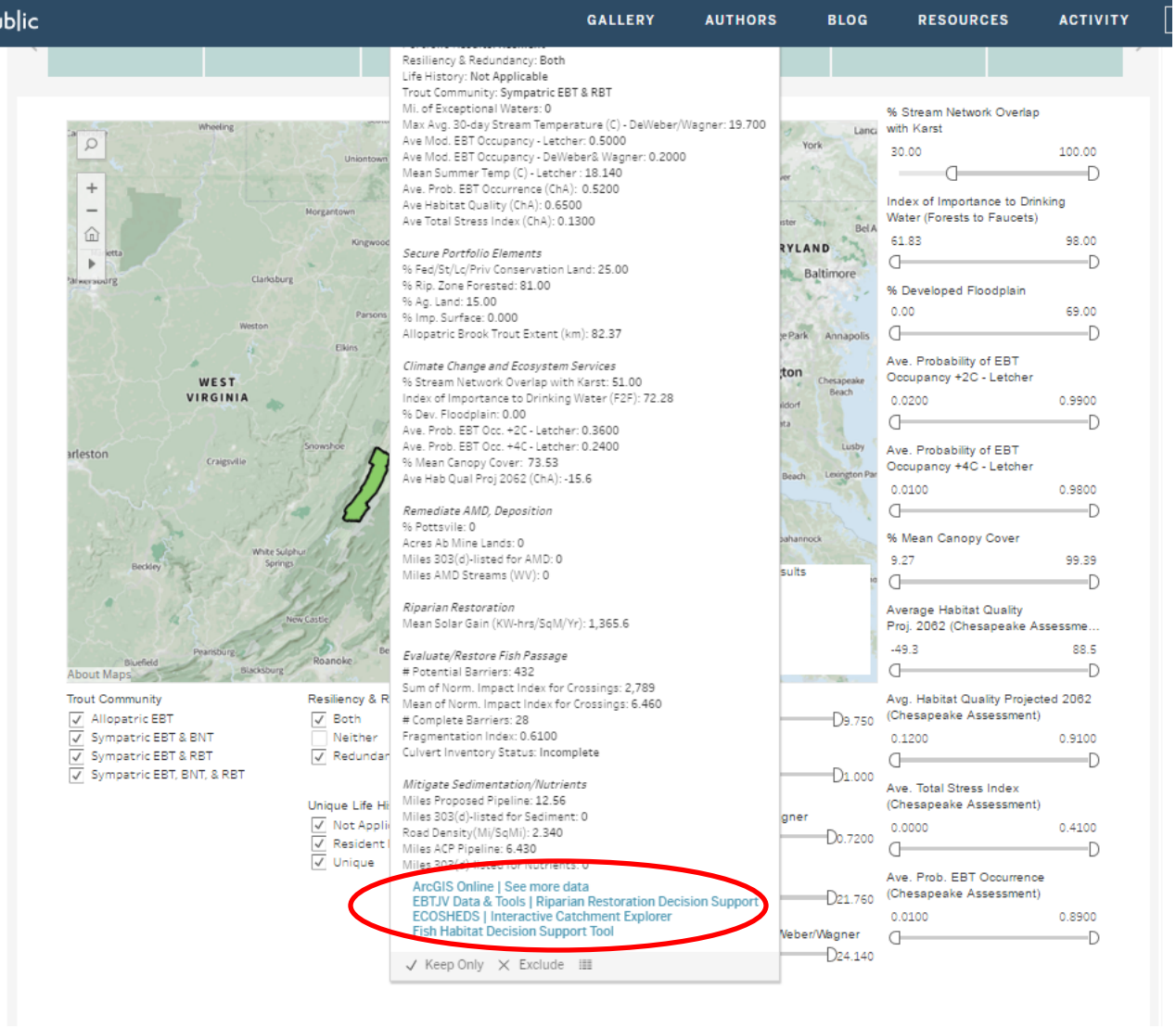
Open the Chesapeake basin focal area tool and go to the “Climate Change and Ecosystem Services” tab



Apply filters to only show resilient or redundant brook trout populations, those with warmer stream temperatures (> 17.5°C), and at least 30% of the stream network overlapping with karst geology



Hover the mouse over individual patches and evaluate other stressors present, looking for some with agricultural land use, since those patches may have degraded pasture lands and spring systems that could be restored and protected.



Other tools can be explored using the hyperlinks at the bottom of the pop-up, including the Downstream Strategies' Chesapeake Bay assessment tool (Fish Habitat Decision Support Tool) and ECOSHEDS Interactive Catchment Explorer