Spring 2014

Stream Crossing Barrier Prioritization Methods for Increasing Eastern Brook Trout Habitat in the Little Androscoggin River Watershed

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Abstract

Eastern Brook Trout (Salvelinas fontanalis) are an important cold water fishery in the state of Maine. While populations in Maine are relatively abundant there has been decline in some parts of its range due in part to loss of habitat connectivity. Brook trout require access to specific types of stream habitat for spawning, feeding, and seasonal thermal refuges. Stream crossing structures such as undersized, poorly installed, or blocked culverts, as well as small remnant dams, can create barriers to accessing important stream habitat for brook trout. A recent Fish Barrier/Culvert Survey in the Little Androscoggin River Watershed provided data about crossing structures and stream conditions that was used to identify barriers that were limiting connectivity of stream habitat. The data was used to prioritize identified barriers in terms of creating better access to higher quality and quantity of stream habitat. To accomplish this the survey data was processed using the Barrier Assessment Tool, a GIS tool that is used to calculate quantities of stream habitat that could be gained both up and downstream of identified barriers. Then raster data for several key parameters of high quality brook trout habitat was created, re-classified and given weighted values. Overlays of the weighted rasters were used to identify the stream reaches with best habitat value. Using the combination of these two methods, identified barriers can be prioritized for future remediation, assisting with efforts to strategically reconnect fragmented Eastern Brook Trout habitat.

Project Description

The Little Androscoggin River watershed is located in Oxford and Androscoggin Counties in south central Maine. It is a major tributary to the Androscoggin River which drains to the Gulf of Maine (Atlantic Ocean). Most of the streams and rivers in this rivers network is documented wild brook trout habitat. In the summer of 2013 a Fish Barrier and Culvert Survey of the Little Androscoggin River watershed was conducted. The objective of this project was to survey and collect data on all dams and stream crossings in the Little Androscoggin River Watershed and prioritize them for removal. GIS tools and methods were used to locate stream crossing sites (Figure 1), identify barriers and prioritize the barriers for removal or mitigation with the objective of identifying the barriers which, if removed or by-passed, would increase access and connectivity to the highest quality Eastern Brook Trout (EBT) habitat.

A study by Maine Inland Fisheries and Wildlife (MIFW) on Eastern Brook Trout (Photo 1) and their movements within stream, river and pond systems revealed that they can easily migrate 35 to 72 miles seasonally (Boucher, MIFW, 2008) and that their movements reflect the need for different types of habitat based on feeding, spawning and refuge related to thermal changes (summer warming of water temperatures and winter freezing). By using GIS tools to identify barriers that are 1) blocking significant amounts of stream habitat 2) blocking high quality habitat, in stream systems that are already known to be utilized by Eastern Brook Trout, we can more effectively prioritize those barriers which will have the most beneficial effects on the connectivity of brook trout habitat if mitigated or removed.

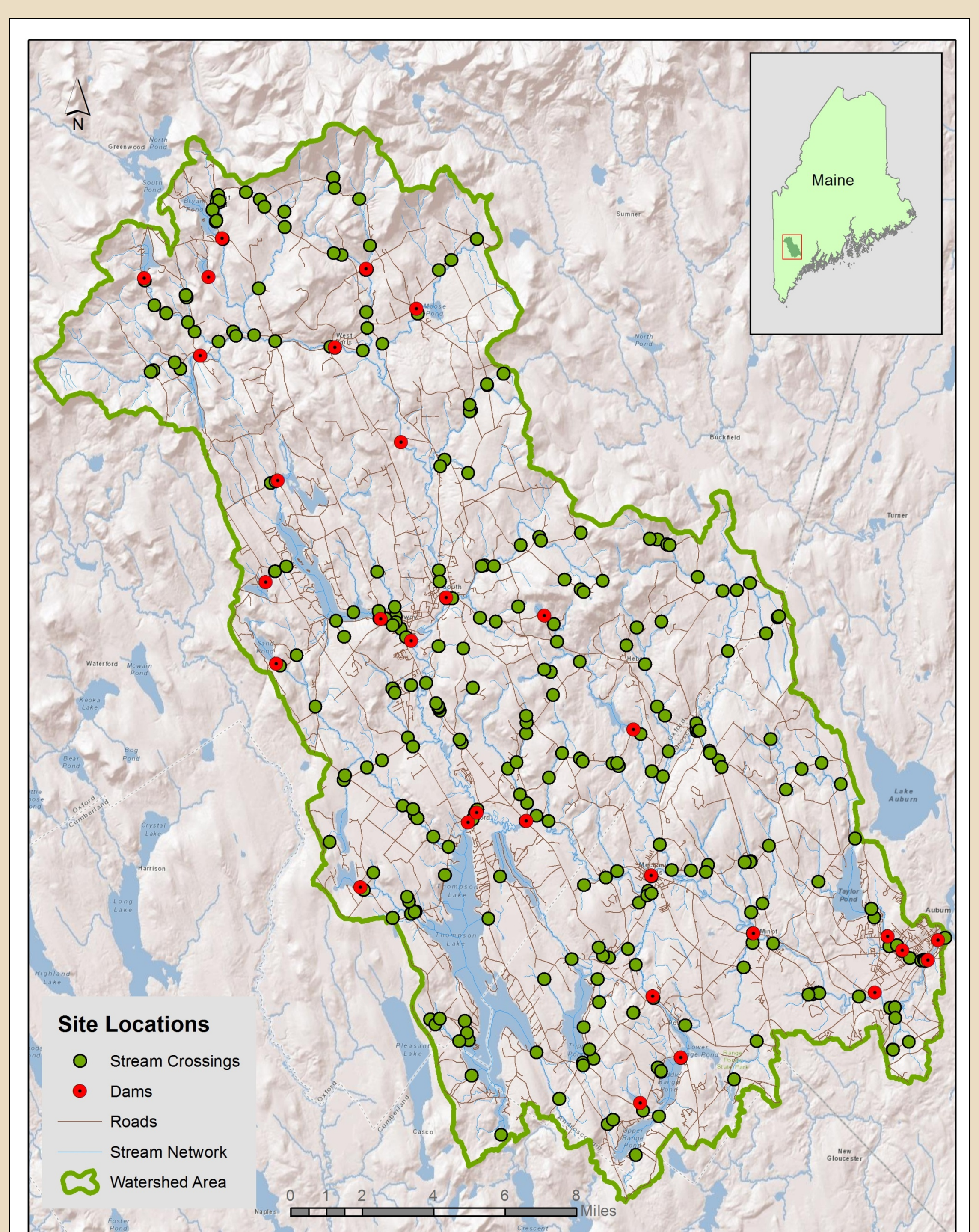


Figure 1. Stream crossing survey sites were identified by locating the intersection point of streams and roads and given unique identification numbers.

Photo 1. Eastern brook trout in spawning habitat.

Photo 2. A partially blocked culvert.

Photo 3. A perched culvert.

Methodology & Analysis

Data was collected by surveying all the stream crossing site locations in the watershed and included: photographs, GPS coordinates, crossing structure condition and dimensions, and stream conditions. The survey data was entered into an excel spreadsheet and imported into ArcMap (Figure 2). Crossing structures that were blocked, perched or severely deformed enough to prevent fish passage were identified as "Barriers" (Photos 2 & 3).

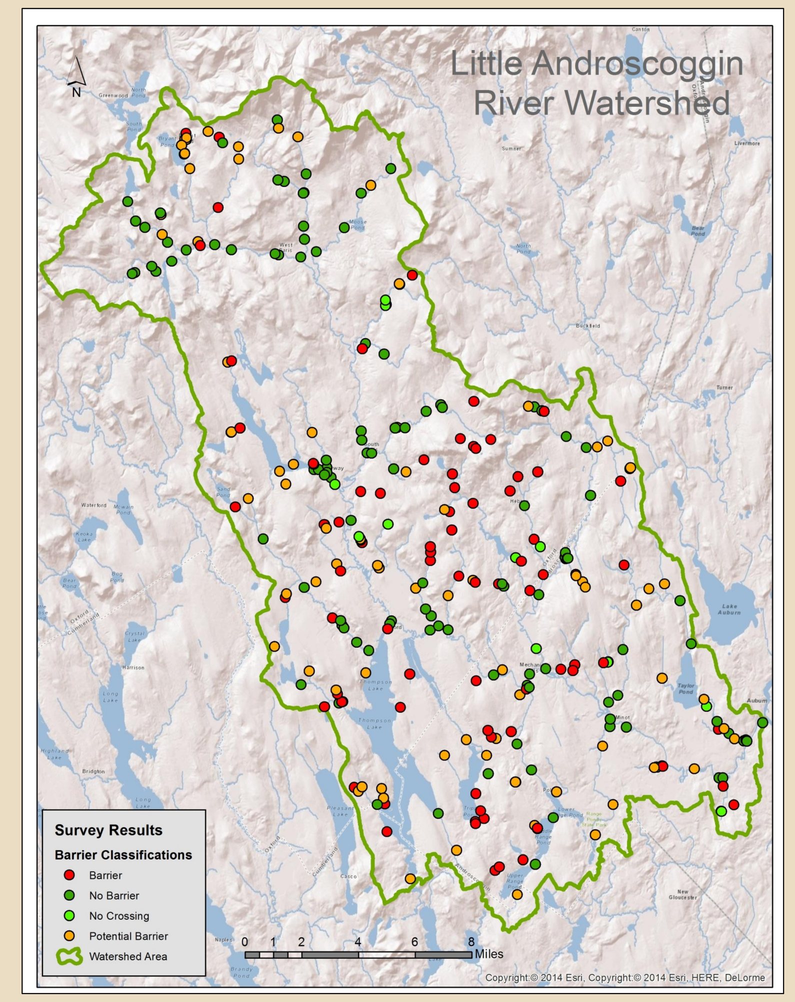


Figure 2. Survey data was imported into ArcMap and the barriers were classified by severity.

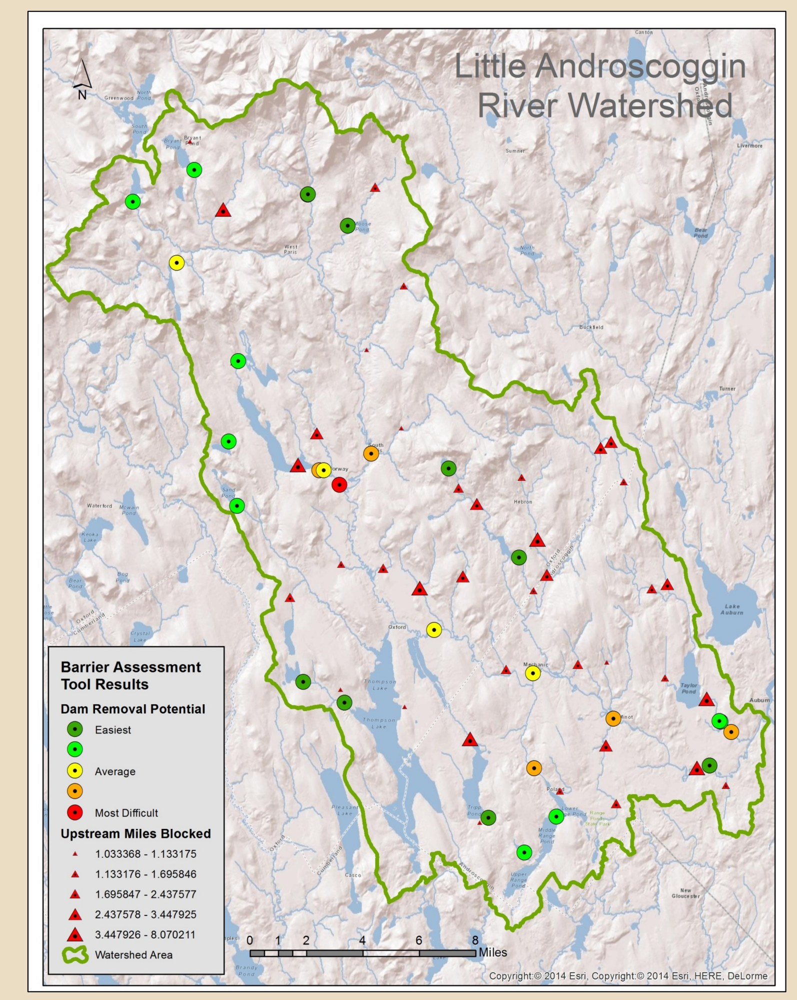
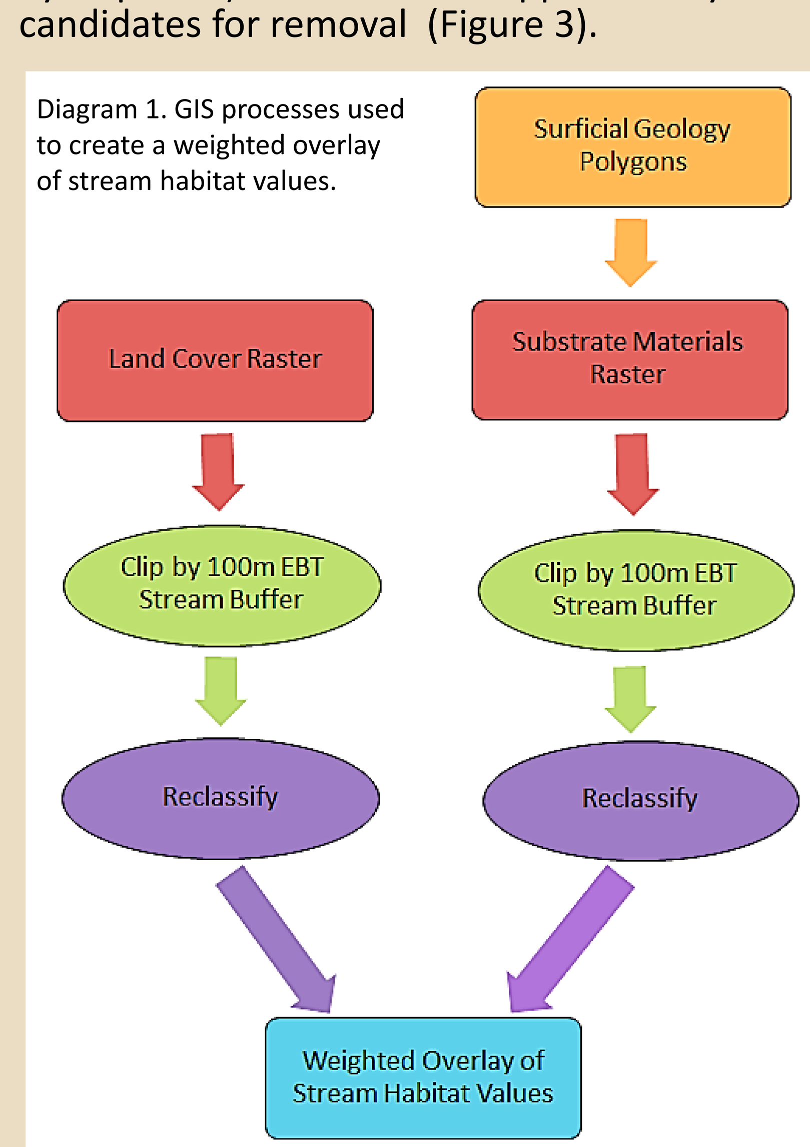


Figure 3. Barriers prioritized by amount of stream habitat blocked and best dams for removal based on size and use.

Survey data was processed with the Barrier Assessment Tool, a GIS tool developed to analyze barrier points on stream networks, measure the lengths of up and down stream habitat, and numbers of barriers on a stream network. The stream crossing barriers blocking significant amounts of stream habitat were identified and symbolized using graduated symbols to represent stream habitat gain above barriers. Additional data queries of dam barriers were performed to identify dams that were small or remnant dams that were not serving a vital function (i.e. providing flood control or hydropower). These were mapped and symbolized using color to show the dams that would be best candidates for removal (Figure 3).



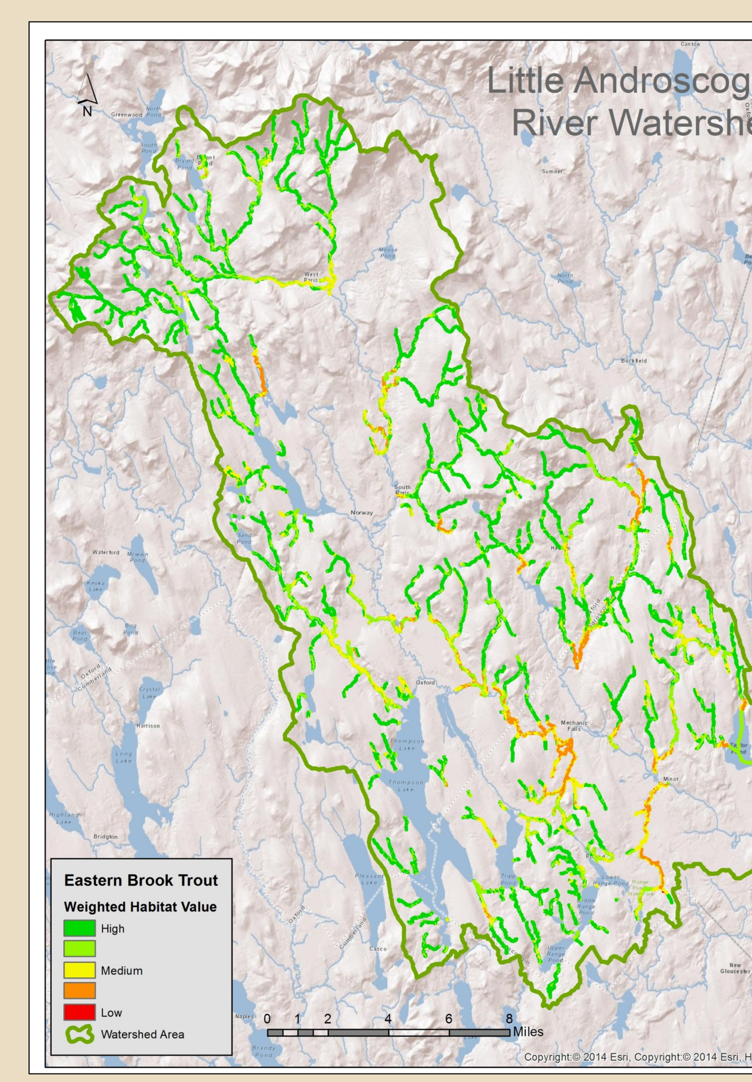


Figure 4. Highest quality stream habitat values were mapped within the watershed's documented brook trout habitat.

To take into consideration trout habitat quality or suitability, several key habitat parameters for brook trout were examined using raster data readily available. Stream Substrate, critical for spawning, was determined using "surficial geology" data. Glacial till materials of greater size and coarseness were preferable to finer silt and clay materials. Stream shading, important both to stream cooling and providing food supply (insects), was determined using "land cover" data. Mature forests in the immediate flood plain were preferable to developed areas or areas of low growing vegetation. Habitat parameter data was converted into 100 meter stream buffer rasters which were re-classified for brook trout habitat preferences, and used to create a weighted overlay (Diagram 1.) The weighted overlay was used to identify and map areas within a 100 meter buffer area in the river/stream floodplain that had the best habitat conditions for brook trout. (Figure 4.)

Results

Once all the habitat data was mapped, the barriers were selected by query. The resulting map identified stream barriers in the Little Androscoggin River Watershed that blocked more than 1 mile of stream containing the best cover and substrate habitat for brook trout (Figure 5). Towns within the watershed can use this information to plan budgets for future culvert replacements. Dams identified may require additional examination of social, environmental and safety concerns (Hoenke, 2012). In either case the cost of mitigation or removal is a prime consideration. With limited availability of financial resources for fish passage improvement, the ability to prioritize stream crossings that are creating barriers to habitat connectivity for brook trout is critical to the planning and implementation of future mitigation efforts. By prioritizing barriers, natural resource managers can create more effective proposals for grant funding based on greatest ecological benefit per funding dollar by focusing efforts on barriers which result in increased connectivity to the best quality and quantity of trout habitat in the river and stream system.

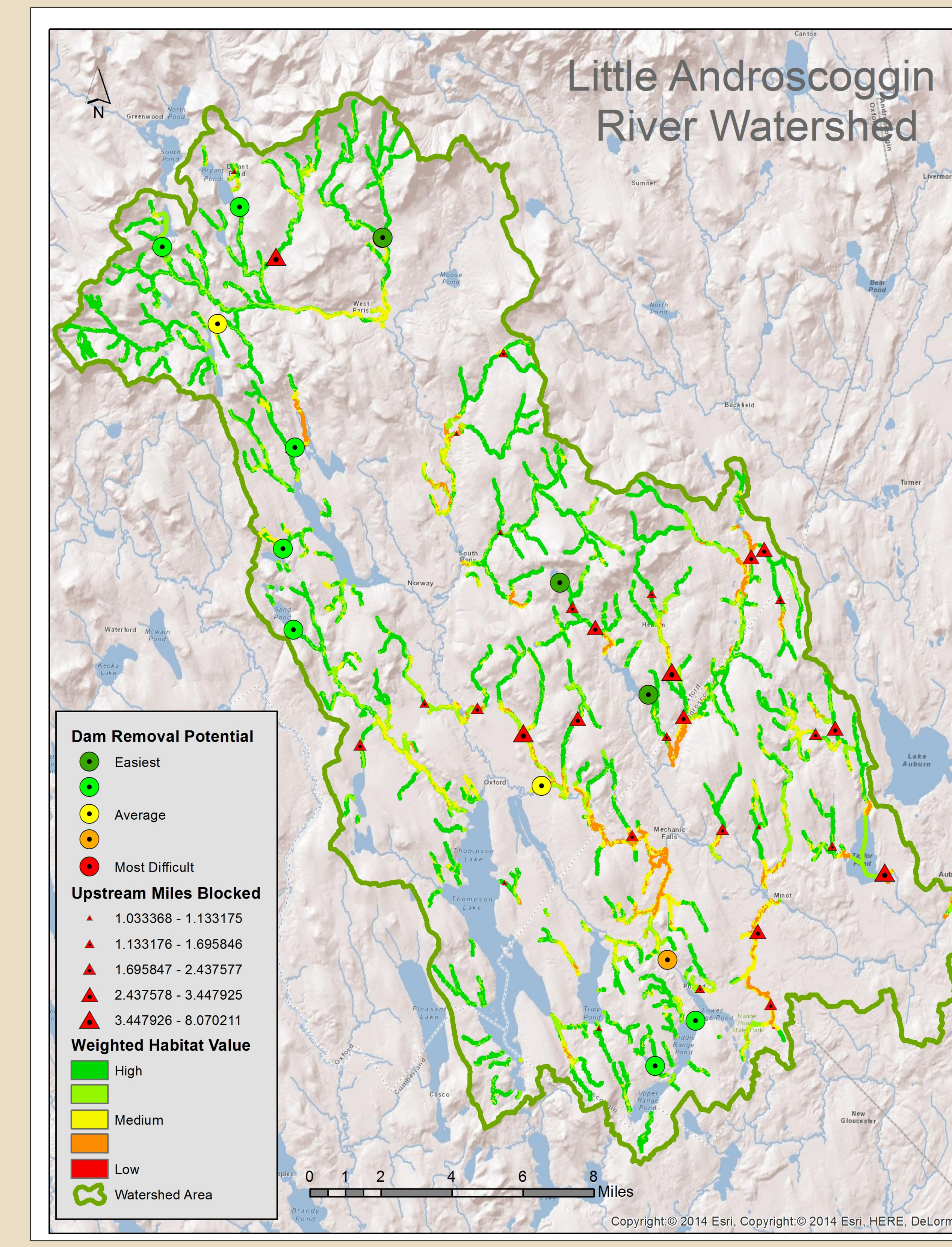


Figure 5. Barrier sites prioritized to increase connectivity to the highest value brook trout habitat.

Data Sources & Bibliography

Most barrier data was developed from field survey data using GIS tools. Other data such as surficial geology, land cover, and most watershed polygons were obtained from the Maine Office of Geographic Information Systems. The roads data is from the Maine Department of Transportation dataset. Dam data originated from the Maine Department of Environmental Protection. Hydrography data came from high resolution National Hydrography Dataset (NHD). Brook trout stream data was developed by the Maine Department of Inland Fisheries and Wildlife based on survey data of fish occurrences and habitat surveys. The Shaded Relief base map was obtained from ESRI. The Barrier Assessment Tool was provided by The Nature Conservancy.

Similar projects and supporting studies that were utilized in researching and developing this project include:

- Boucher, David P. and Dianne Timmins. "Fishery Final Report Series No. 08-01 *Seasonal Movements and Habitat Use of Brook Trout in the Magalloway River*". Maine Department of Inland Fisheries and Wildlife, Augusta, ME (2008).
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Acknowledgements

Many thanks to all the project partners: Sue Gammon, Androscoggin Valley SWCD; Jeff Stern, Androscoggin River Watershed Council; Alex Abbott, U.S. Fish & Wildlife Service, Gulf of Maine Coastal Program; The Nature Conservancy for providing the Barrier Assessment Tool; and the Research Applications in GIS class for their helpful critique of this work. Special Thanks to Sienna Tinsley, for all her volunteer hours assisting me in collecting the data used in this project, and to the Maine Outdoor Heritage Fund for their generous funding of the Little Androscoggin Fish Barrier & Culvert Survey.