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December 31, 2009

Attn: dSGEIS Comments
Bureau of Oil & Gas Regulation
NYSDEC Division of Mineral Resources
625 Broadway, Third Floor
Albany, NY 12233-6500

VIA EMAIL: dmnsgeis@gw.dec.state.ny.us

Re: New York State Department of Environmental Conservation's Draft Supplemental Generic Environmental Impact Statement on the Oil, Gas, and Solution Mining Regulatory Program

To Whom It May Concern:

On behalf of Trout Unlimited and the NY State Council of Trout Unlimited, we are hereby submitting written comments on the New York State Department of Environmental Conservation's (DEC) Draft Supplemental Generic Environmental Impact Statement (SGEIS) on the Oil, Gas and Solution Mining Regulatory Program: Well Permit Issuance for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low-Permeability Gas Reservoirs dated September 30, 2009.

Trout Unlimited has been working since 1959 to conserve, protect, and restore North America's trout and salmon fisheries and their watersheds. Today, Trout Unlimited has 140,000 members organized in more than 400 local chapters across the country including over 7,500 members in 35 chapters across New York. Trout Unlimited has significant experience in oil and gas drilling activities in the western United States as well as other states in the Marcellus Shale region. Trout Unlimited and our membership have significant and multiple concerns about the impact that Marcellus and Utica Shale gas well development could have on New York's natural areas, and most specifically on the state's wild and native trout habitat. Trout Unlimited is not opposed to the development of the Marcellus and other gas shales in New York state, but it is imperative that such drilling be done in a responsible fashion that safeguards New York's unique natural resources.

After significant analysis of the 800+ page draft SGEIS it has become increasingly clear to Trout Unlimited that the draft document does not: (1) adequately protect New York's water resources or the fish and wildlife that depend on them; or (2) comply with the necessary requirements for such documents as determined under the State's Environmental Quality Review Act. As such we respectfully request that the DEC set aside the current draft SGEIS and develop a new process that includes the promulgation of state regulations in order to provide the necessary protections for New York's natural resources.

While the draft SGEIS is flawed in multiple and significant areas, Trout Unlimited will limit our comments on the document to the following two areas: (1) developing water withdrawal requirements that will adequately protect coldwater streams; and (2) identifying sensitive coldwater habitat areas in which gas drilling activities should be prohibited.

1. The Draft SGEIS Should Develop Water Withdrawal Requirements that Adequately Protect New York's Coldwater Streams.

Trout Unlimited supports the use of the Natural Flow Regime Method as a means of setting by-pass flow requirements for water withdrawals for Marcellus Shale drilling [draft SGEIS p. 7-18 to 7-22]. However, we believe that in order to adequately protect New York's streams, the way in which the draft SGEIS implements this approach needs to be improved in several important respects. We are particularly concerned that the draft SGEIS is inadequate to prevent environmental harm to small streams.

The natural flow method used in the draft SGEIS is an important step forward for by-pass flow protection in New York. The methodology recognizes the need to protect streams across a range of flows throughout the year and to maintain seasonable variability in flows, in order to protect the hydrologic and biological functioning of rivers and streams. Historic methods of focusing on a single minimum flow number applicable throughout the year, or even seasonal minimal flow numbers, do not protect a full range of stream functions, and often condemns the stream to long-term biological impairment. Therefore, Trout Unlimited supports the use of a percentage of average monthly flow (or, if available, average daily flow) to establish by-pass flows. We hope that the use of this approach in the draft SGEIS is the first step in a broader effort to implement this method in New York.

However, the details of this approach in the draft SGEIS include flaws that risk undermining the benefits of the approach, particularly for smaller streams. The draft SGEIS should be improved by adding the following provisions:

- A limit on the total percentage of streamflow that may be withdrawn in connection with Marcellus Shale withdrawals.
- Better protections for streams already affected by other water withdrawals and flow alterations.
- Improved monitoring.
- Extending the provisions of the draft SGEIS to lower volume withdrawals from small streams.

The draft SGEIS, in general, understates the potential effects of Marcellus Shale related water withdrawals on surface water flows, or, at the very least, fails to fully analyze those effects. The draft SGEIS acknowledges that the total amount of water needed for hydrologic fracturing in New York is not known, but nevertheless characterizes those water needs as "relatively low, compared with existing everyday consumptive water losses" [draft SGEIS at p. 6-10]. The draft SGEIS goes on to point out that water use for gas drilling in the Susquehanna River basin represents six percent of the total water use for water supply, power, and recreation in the basin [draft SGEIS at p. 6-11]. Although gas drilling certainly ranks behind many uses in volume, the six percent number is far from negligible. More importantly, the significance of withdrawals is critically dependent on where and how water will be withdrawn. A total annual withdrawal of 30 mgd (to take the number from the Susquehanna basin) may well have minimal effect if withdrawn at a constant rate from larger streams over the course of the year. However, withdrawals for particular hydro-fracturing wells can be very concentrated in terms of time, resulting in a relatively large amount of water being withdrawn in a relatively short period of time compared to other water uses. All the water for a given well is used in a matter of a few weeks to a month**.** Many wells, moreover, can be located in remote areas high in a given watershed. Small, headwater streams are the closest, most convenient source of water for such wells. Such streams can be acutely affected by the short-term, high-withdrawals needed for the hydro-fracturing process.

The draft SGEIS does not include sufficient geographic analysis to determine the potential for acute short-term withdrawals from small streams by assessing where drilling is likely to take place or where producers are likely to seek water. In particular, the draft SGEIS fails to analyze the extent to which producers are likely to seek water from small headwater streams or the biologic effects of potential withdrawals on such streams (which include much of New York's trout habitat. The draft SGEIS should include additional analysis of this issue, and should also include enhancements to its by-pass flow requirements, in order to ensure that the potential benefits of the Natural Flow Methodology are fully achieved for all streams, especially small headwater streams.

A. The Draft SGEIS Should Supplement its Natural Flow Regime Methodology with a Limit on the Volume of Withdrawals.

Although the natural flow proposal in the draft SGEIS has the potential to protect streams from the impacts of both annual and seasonal low flows much more effectively than a single, annually applicable by-pass flow, it does not protect streams from large withdrawals that take a significant percentage of a stream's flow. In even the most protected category of stream, the minimum by-pass flow requirement of 30 percent of the average monthly flow could allow a drilling operation to extract a significant percentage of a stream's flows – potentially in excess of 70 percent of total stream flow during periods where flows were above average. Although this is much less likely to occur in larger, higher order streams, there is a real risk of such withdrawals occurring in smaller streams. For example, water withdrawals for Marcellus Shale drilling can include a series of water trucks pumping a significant percentage, or even all, of a very small streams flow for a short period, and then transporting that water to a nearby well. Such withdrawals could deprive the stream of the benefits of high flows and might impair hydrologic functions such as flushing and channel forming flows. Such withdrawals could also impair important components of the life cycles of certain fish and other species, including migration, spawning, and rearing. In extreme cases such pumping might result in flow deprivation sufficient to cause fish kills or other damage to the stream's ecosystem

The risk of these impacts could be significantly mitigated by including a limit on total withdrawals for gas drilling from individual streams at any given time. The withdrawal limitation could be based on a fixed percentage of annual monthly flow or other streamflow statistic. One proposed method for accomplishing this is the approach embodied in the current draft Connecticut streamflow regulations [proposed amendments to Regulations of Connecticut State Agencies, sections 26-141b-1 to 26-141b-9], which is based on a seasonally varying percentage of the estimated Q99 flow, accounts for local conditions, and provides for stricter withdrawal limits on streams with less water available, due to size, ecological needs, or hydrologic conditions. Coupling such an approach with the by-pass flow requirement would minimize the risk of excessive short-term withdrawals and provide much better protection for natural stream functions.

B. The draft SGEIS Should Provide Better Protections for Streams Already Affected by Water Withdrawals or other Flow-Alteration.

The draft SGEIS fails to adequately account for the potential for streams to be affected by existing water withdrawals, and for the potential of withdrawal for hydro-fracturing to exacerbate the effects of existing withdrawals. This failure compromises the goal of the natural flow regime method to "retain naturalized annual stream flow patterns (hydrographs) and . . . avoid non-naturalized flows that may degrade stream conditions and result in adverse impacts" [draft SGEIS at p. 7-19].

When describing the natural flow regime method, the draft SGEIS acknowledges that "[d]ata on historic stream flows must be of sufficient duration and *quality* to represent the natural flow regimes of the stream [because] prescriptions for passby flows are only as good as the hydrologic records on which they are based" [draft SGEIS at p. 7-19]. It further acknowledges that "data that are not based on natural flow conditions . . . will influence the calculation of passby flows and may not support fishery management objectives" [draft SGEIS at p. 7-19 – 7-20]. Although the draft SGEIS acknowledges the potential problem of withdrawals in the context of existing flow alterations and data based on altered flows, the draft SGEIS does not propose clear limitations or mitigation in those cases. As a result, the draft SGEIS fails to mitigate the risk that gas drilling water withdrawals will exacerbate the effects of existing withdrawals.

SEQRA regulations promulgated by the Department state that generic EISs created for projects that will be developed in phases or stages – such as the drilling projects at issue here – "must discuss the important elements and constraints present in the natural and cultural environment that may bear on the conditions of an agency decision on the immediate project" [6 NYCRR 617.10(e)]. Existing withdrawals and other flow alterations (such as upstream withdrawals or dam releases) certainly qualify as "important elements [or] constraints present in the natural . . . environment" and therefore should "bear on the conditions" under which new water withdrawals will be allowed.

There are two improvements DEC should make to the existing draft SGEIS. First, DEC should develop an approach that ensures that the data used to calculate the by-pass flow is based on natural, unimpaired conditions. Where a given flow gage is affected by upstream flow alterations, even ten years of good data from that gage will not reflect the stream's natural flow regime. DEC should rely either on unregulated flow gage data or, where that is not available, appropriate reconstruction of natural flows. Statistical methods for calculating natural flows have improved greatly. We recommended that DEC work with the U.S. Geological Survey to improve the flow statistics available from StreamStats New York in order to calculate natural flows and by-pass flows at sites without gages or at gauged sites subject to upstream flow alteration.

Use of data adjustments and surrogate data is already contemplated by the draft SGEIS, but it is only explicitly required when gauge data is unavailable for the withdrawal location, not when data has been compromised by unnatural flow alterations. Therefore, whatever method DEC chooses, the draft SGEIS should be amended to explicitly account for existing, unnatural flow alterations such as withdrawals and dam releases that occur upstream from a Marcellus drilling withdrawal location.

C. The SGEIS Should Provide Improved Monitoring Requirements.

Neither the draft SGEIS, nor the original 1992 GEIS for gas drilling [New York State Dept. of Environmental Conservation, 1992 GEIS on the Oil, Gas and Solution Mining Regulatory Program, ch. 17], provide much guidance in terms of how much producers governed by the SGEIS will be required to monitor streamflow while they withdraw water. The draft SGEIS merely states that the DRBC and SRBC permitting requirements include the metering of withdrawals and may include "stream flow and stage measurements for surface water withdrawals" [SGEIS at p. 6-9]. The draft SGEIS does not make clear under what circumstances parties covered by the draft SGEIS will be subject to such monitoring requirements, or in fact under what circumstances DEC will require them to monitor stream flows before an after their withdrawal. Monitoring is critical, particularly if a large percentage of streamflow is being withdrawn, to ensure that an adequate amount of water remains in the stream to comply with the draft SGEIS natural flow requirements and to protect the streams. For example, if the Department's monitoring regime only examines daily passby flow averages, a drilling company could take all the water in a stream for a few hours then allow the stream to flow as normal for the rest of the day in order to bring up the average. This, of course, would result in significant adverse environmental impacts. "Gaming" the regulatory system in this way can only be avoided by adequate monitoring. It would seem particularly appropriate to require long term flow monitoring at sites where applicants propose larger, long-term withdrawals.

The draft SGEIS should be amended to specify when DEC will require monitoring of stream flow during withdrawals, and to specify techniques for monitoring streamflow. In particular, monitoring should be sufficiently frequent to ensure that passby flow requirements are satisfied at all times, not just on average over an extended period of time.

2. The Draft SGEIS Should Identify Sensitive Coldwater Habitat Areas in which Gas Drilling Activities Should be Prohibited.

The draft SGEIS fails both to adequately address the cumulative impacts of gas drilling activities on coldwater habitats or to identify sensitive coldwater habitat areas that should be off limits to gas drilling activities [draft SGEIS section 9.2.1]. Both of these failures are of significant concern to Trout Unlimited due to the potential for adverse effects stemming from the development of the Marcellus and Utica shale on remaining populations of native eastern brook trout in New York.

Using a broad scale analysis, Trout Unlimited has identified protection priorities for sensitive coldwater habitat areas in which the DEC should consider prohibiting or severely limiting any gas drilling activities [Figure 1]. Because Trout Unlimited's assessment is broad with limited site-specific information on brook trout distribution and instream habitat conditions, detailed site-specific assessments may highlight additional priority conservation areas or reveal local conditions in an identified area that preclude implementation of an effective conservation strategy. Attachment A provides additional analysis and further explanation of this recommendation.

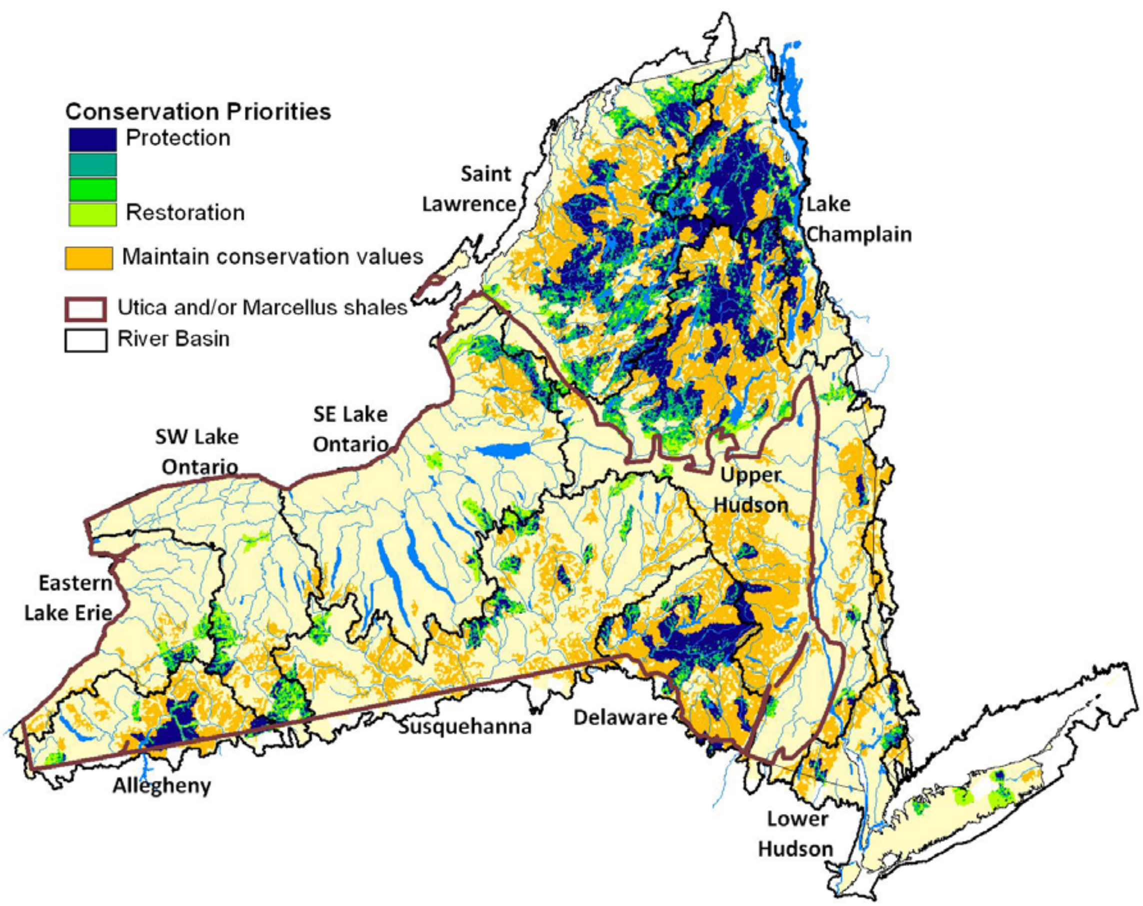

Figure 1. Coldwater conservation priority areas for Eastern brook trout.

Thank you for your consideration of these comments. We look forward to working with the DEC to protect New York's rivers and streams by ensuring that the development of the Marcellus and Utica shales moves forward in an ecologically responsible manner. Please do not hesitate to contact us if you have any questions about the above comments.

Sincerely,

EBMaclin Ron Urban /ebm

Elizabeth Maclin Ron Urban

ATTACHMENT A

Broad-scale Analysis of the Potential Impacts of Proposed Marcellus and Utica Shale Development on Eastern Brook Trout in the State of New York

Prepared by:
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Trout Unlimited, Boise, Idaho

December 31, 2009

The proposed development of the Marcellus and Utica shale in New York is of concern to Trout Unlimited due to the potential for adverse effects on remaining populations of native eastern brook trout. Eastern brook trout are the primary native trout in much of the eastern United States. Historically they occupied cold water rivers and streams as well as many lakes, ponds, and estuaries from the headwaters of the Chattahoochee River in northern Georgia well into the northeastern provinces of Canada. An assessment completed by the Eastern Brook Trout Joint Venture (EBTJV) found that brook trout have been extirpated from over 20 percent of their historically occupied subwatersheds due primarily to habitat degradation and the introduction of non-native species and only 5 percent of historically occupied subwatersheds are considered intact.[1] Most of the remaining populations are fragmented and isolated in small headwater streams where they are vulnerable to local extirpation from stochastic events or may simply lack the population size necessary for long-term persistence.

According to the EBTJV, brook trout in New York have been extirpated from 23 percent of historically occupied watersheds and are considered intact in just 5 percent of the watersheds. Figure 1 shows the findings of the EBTJV for stream populations in New York. The only remaining intact watersheds are found in the northern part of the state around Adirondack State Park. With the exception of one watershed in the upper reaches of the Delaware River basin, the Adirondacks are the only region in the state that still contains lake populations.

The project boundary for development of Utica and Marcellus shale (shown as a brown line on Figure 1) overlaps the watersheds that have experienced the greatest reductions in populations and overall distribution. All of the watersheds where brook trout have been extirpated in the state are located in this area and most of the remaining occupied watersheds are classified as greatly reduced. Over one-third of the watersheds in the Susquehanna and SE Lake Ontario basins are classified as ‘qualitative presence’ meaning brook trout are known to exist in these drainages but there is not any current information regarding their status. Additional inventory work is needed before a site-specific conservation strategy can be developed for these populations.

[1] Brook trout subwatershed classifications used by EBTJV: Intact - 90-100% of historic habitat is occupied; Reduced - 50-90% of historic habitat is occupied; and Greatly Reduced - 1-50% of historic habitat is occupied.

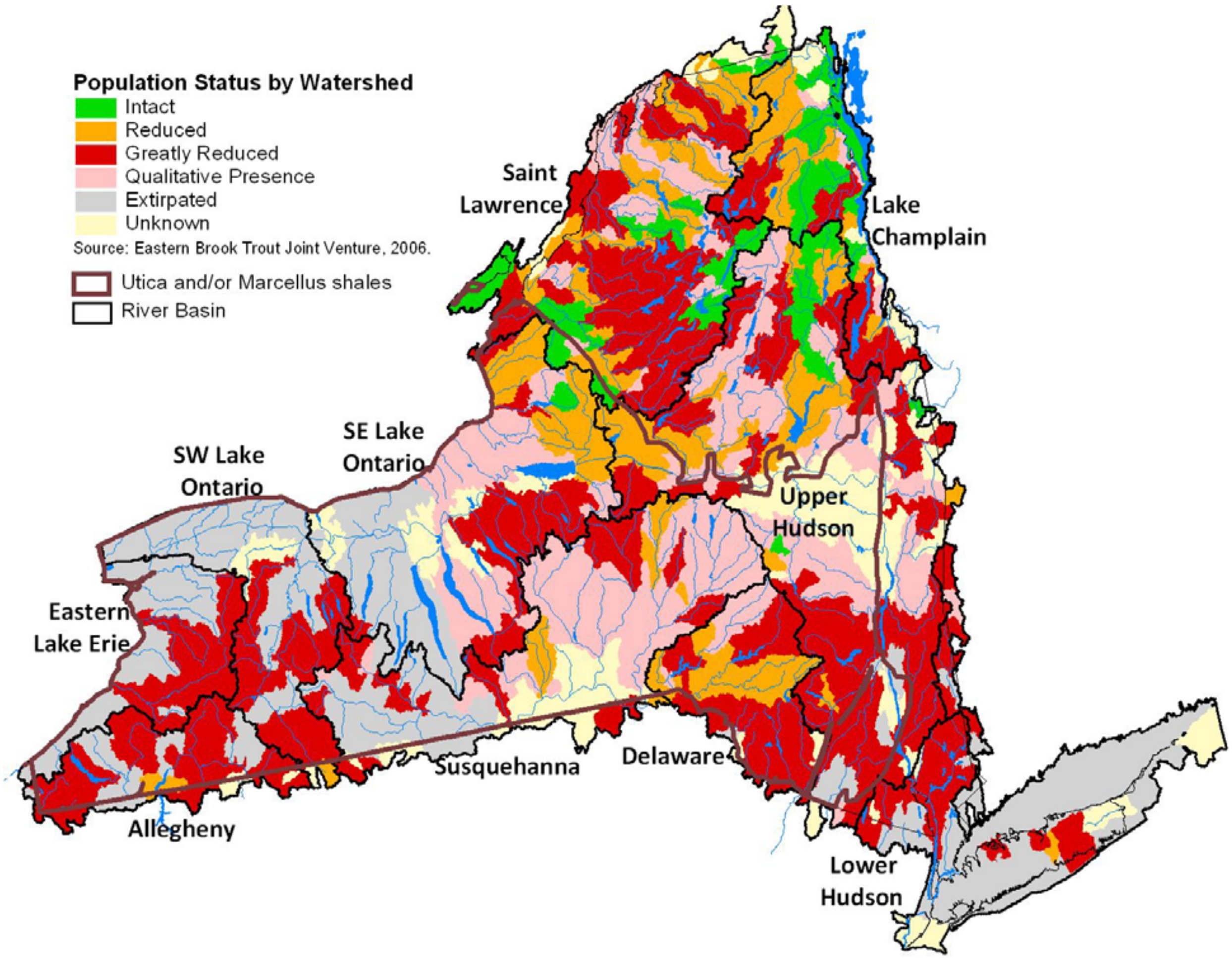

Figure 1. Population status by watershed of eastern brook trout in New York. Green watersheds are considered intact with 90-100% of historically occupied habitat still occupied while less than 50% of the historic habitat is still occupied in the red watersheds.

Conservation Success Index

Trout Unlimited has applied the habitat integrity component of its Conservation Success Index analysis (see www.tu.org/science/conservation-success-index) to the population information developed by the EBTJV in order to identify priority conservation areas for native trout in New York. The habitat integrity analysis was conducted at the subwatershed scale (mean size of 20,000 acres) and included four indicators of habitat quality: stream connectivity, watershed conditions, water quality, and flow. When data were not specifically available statewide for a metric of interest, surrogates such as road density and land cover were used.

Figure 2 shows the results of the habitat integrity analysis. Not surprisingly, the remaining intact watersheds are associated with areas of higher habitat quality (green on map) while watersheds that have been extirpated are in areas with the most degraded habitats (red on map). Within the project area there are drainages with moderate to high habitat quality that could provide for the protection and restoration of wild brook trout populations.

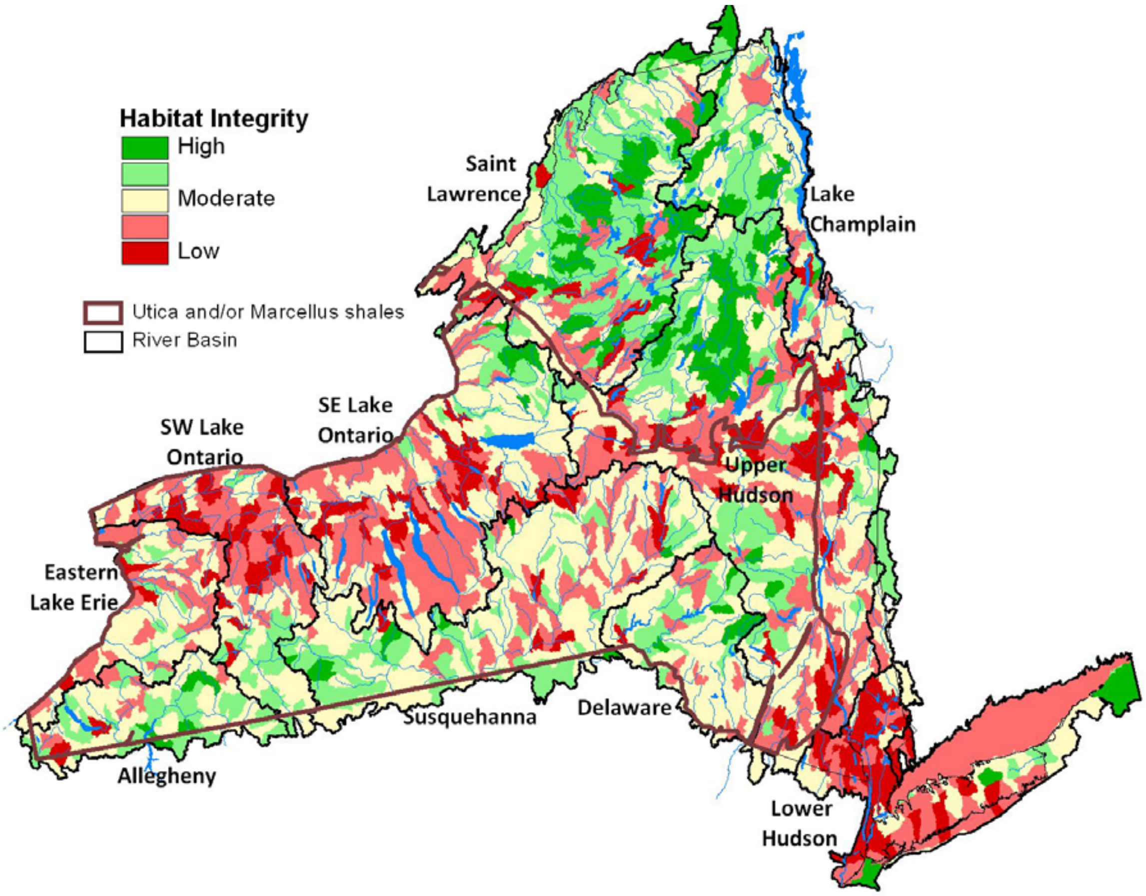

Figure 2. Habitat integrity analysis. Four indicators of habitat integrity are analyzed at the subwatershed scale. Based on these metrics dark green subwatersheds have the highest quality habitat while dark red have the lowest.

By combining the subwatershed scale data on habitat with the watershed scale data on population status, we are able to start identifying priority conservation areas. Figure 3 shows the results from integrating these two analyses. The dark blue areas on the map represent those subwatersheds with high quality habitat that are within a larger watershed where at least 50% of the historic habitat is currently occupied. These areas are a high conservation priority for protection and/or restoration. The dark red subwatersheds have the same population classification but are in a subwatershed with low habitat quality. Given how sensitive brook trout are to water quality and habitat conditions, these subwatersheds may not actually contain brook trout populations but rather existing populations may be present in other drainages within the larger watershed that have a higher quality habitat. Populations in the light pink areas have been extirpated and the habitat is low quality so the reintroduction potential is poor. In contrast the light blue subwatersheds have also been extirpated but they contain high quality habitat and therefore may provide opportunities for reintroductions or increasing the extent of existing populations by reconnecting isolated populations with larger downstream systems.

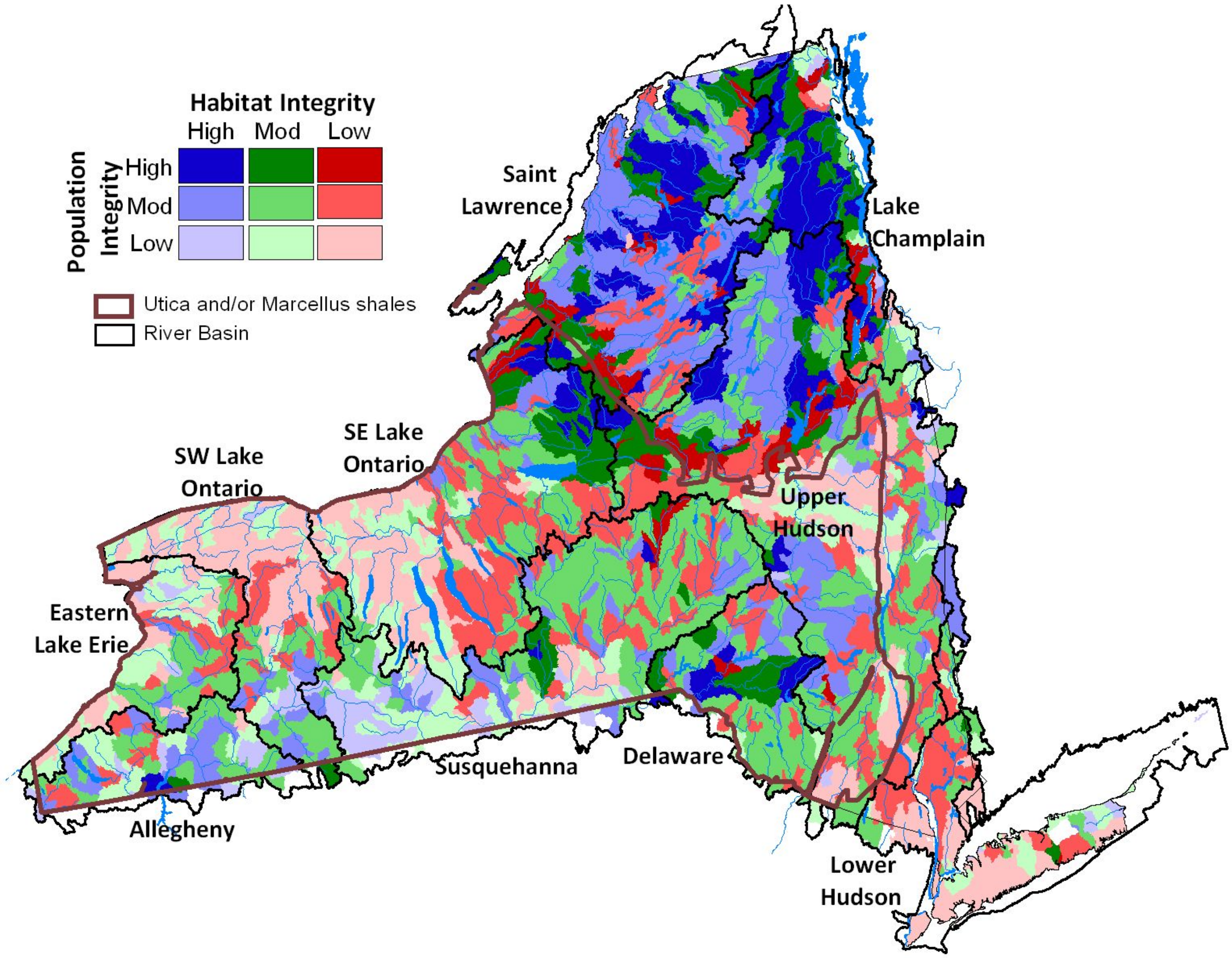

Figure 3. Integration of population and habitat integrity indicators. Dark blue subwatersheds have high quality habitat and are within a watershed where at least 50% of the historic habitat is still occupied.

Figure 4 integrates the results presented in Figure 3 with stream survey data collected between 1994 and 2004 by the New York Department of Environmental Conservation. The survey data identifies specific reaches where wild brook trout were found during this time period but it does not indicate survey sites where brook trout were not found. Therefore, this data was used to inform but not replace the results of the EBTJV. Subwatersheds where brook trout were found between 1994 and 2004 within an occupied watershed as defined by the EBTJV are considered a priority area and are shown in dark blue in Figure 4. The potential priority areas (light blue) have moderate to high quality habitat and are within a watershed that contains brook trout. Subwatersheds with low quality habitat within these larger watersheds were dropped as a priority under the assumption that brook trout are more likely to occur in the higher quality drainages. The green areas represent high quality habitat where populations have been extirpated but conditions may be suitable for reintroduction. Taken together, these regions represent the foundation for development of a long-term conservation strategy for native trout in New York that captures the historic range of life history types and addresses projected impacts from climate change.

It is important to keep in mind that this is a broadscale assessment with limited site-specific information on brook trout distribution and instream habitat conditions. Detailed site-specific assessments may highlight additional priority conservation areas or reveal local conditions in an identified area that preclude implementation of an effective conservation strategy.

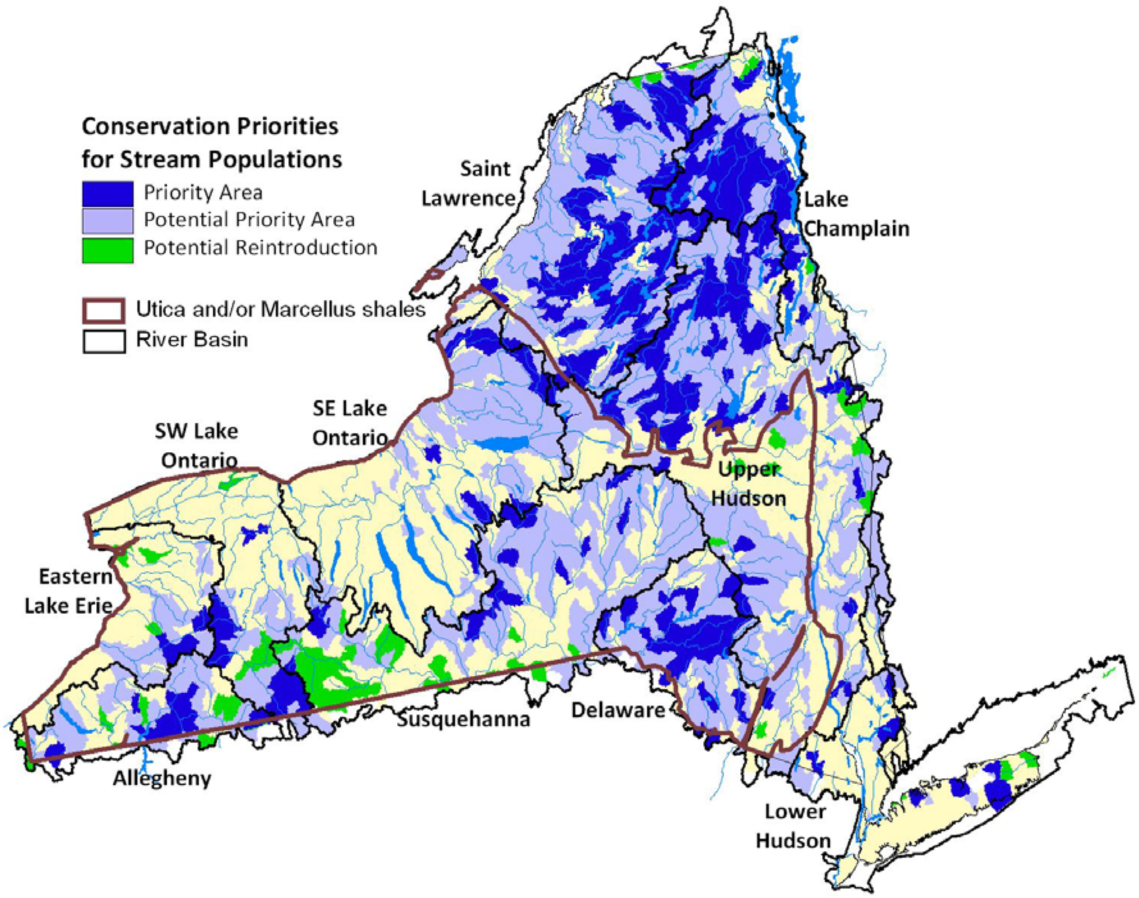

Figure 4. Broadscale identification of conservation priorities based on habitat integrity and current population status. Dark blue subwatersheds are priority areas and potential reintroduction sites are shown in green.

<u>Project Impacts</u>

Most of the conservation areas identified within the project boundary contain small isolated populations in watersheds that have been degraded and fragmented by land conversion and roads. Of the habitat factors analyzed, water quality and connectivity were the primary limiting factors in this region, both of which may be adversely effected by proposed energy development. Currently roads and agriculture are the primary sources of surface water pollution throughout much of the region. However, wastewater disposal and leakage from storage tanks, pipelines or well-casings pose a threat to surface and groundwater quality around the development site that could degrade downstream habitats and contribute to local extirpations.

Primitive roads with poorly designed culverts are also a significant cause of habitat fragmentation for brook trout throughout much of their range. Additional roads associated with drilling operations may further exacerbate these problems and prove detrimental to remaining brook trout populations that are already stressed by current conditions. Increased habitat fragmentation from road and pipeline crossings that impede fish movement upriver is contrary to conservation goals for reconnecting habitats and extending isolated headwater populations downstream to larger river systems.

In addition to fragmenting stream habitat with culverts and bridges, gas development will also fragment landscape features. Of particular concern is forest cover, a critical component in the long-term survival of brook trout and one that has already been heavily compromised by anthropogenic effects. Brook trout evolved with forested ecosystems that historically provided a consistent source for cold clean water, resulting in a low tolerance for cool/warm degraded waters. Recent studies underscore the importance of a healthy forested landscape to brook trout persistence. Stranko et al. (2008) found that forested land cover within a catchment was the best predictor of brook trout occurrence in Maryland. Sites with large proportions of forest cover had high numbers of brook trout while sites with little or no forest cover supported few if any brook trout populations. Hudy et al. (2008) reporting on the findings of the EBTJV had similar results. They found that 94% of the subwatersheds with intact populations of brook trout had a forest cover of at least 68% and a road density less than 2 km/km^2.

Gas development and the associated loss of forest cover will have a direct adverse effect on brook trout populations within the developed watersheds. Although the actual acreage of forest cover cleared for infrastructure development may be minimal, the fragmentation and resulting decrease in patch size and increase in edge of the remaining forest cover is significant. The exposed edges will be more vulnerable to damage from wind and other weather events leading to further contraction of the forest patch. Typical site reclamation plans for re-vegetation will not result in the restoration of forest cover, this will take decades, if it occurs at all.

<u>Exacerbating Effects of Climate Change</u>

Loss of forest cover not only has immediate implications for brook trout populations, it is also particularly troubling when viewed in the context of climate change and associated environmental impacts. The annual average temperature for the Northeast has increased 2°F since 1970 and is expected to rise an additional 1.5°F to 3.5°F in the summer and 2.5°F to 4.0°F in the winter over the next several decades regardless of emission reductions (Karl et al. 2009 and Frumhoff et al. 2007). This warming trend has significant implications for remaining populations of brook trout, particularly with regard to thermally suitable summer habitat. The EBTJV found that high water temperature was already the single biggest threat to stream populations of brook trout in New York. Increasing winter temperatures will result in more precipitation falling as rain rather than snow leading to a reduced snowpack and earlier spring run-off. This will likely cause lower late season flows, leaving trout even more vulnerable to higher summer temperatures.

Climate models for the region also show that the Northeast is expected to experience an altered hydrologic regime characterized by increased runoff in the winter and spring due to heavy precipitation events and warmer temperatures (Karl et al. 2009 and Hayhoe et al. 2007). According to Karl et al. (2007), the Northeast has already experienced a 58 percent increase in the number of days with very heavy precipitation since 1958. Large-scale flooding associated with rapid runoff from heavy rainfall or rain on snow events may result in direct mortality of isolated populations and render existing habitat unsuitable for a period of years. Barriers that inhibit upstream movement will prevent fish from recolonizing these streams after they have recovered. Even moderate flood events in the winter and spring can destroy redds and be lethal to juveniles that emerge during this timeframe.

Removal of forest cover exacerbates these climate change effects, particularly if the clearing occurs along the stream channel where riparian shading is critical to the maintenance of thermally suitable summer temperatures. At the watershed scale, forest cover can mitigate the effects of increased runoff by increasing water storage capacity and slowing overland flow. This not only improves late season flows but also reduces the deposition of sediment into the stream channel and can lessen the direct effects of a flood. The creation of openings in the forest cover will increase snowmelt by direct exposure to the sun in the opening and surrounding forest edge. Trees in these exposed edges are more susceptible to breaking under increased snow loads caused by an increase in snow density with the warmer temperatures. The edges are also more vulnerable to extreme climatic events such as wind and ice storms that may result in the openings expanding over time rather than contracting.

In recognition of the importance of forest cover in mitigating the effects of climate change and securing healthy populations of brook trout, we conducted an additional analysis of forest fragmentation to highlight those areas with the largest remaining patches of forest cover. Figure 5 shows the results of the fragmentation analysis. The percentages shown are not canopy cover but rather the amount of forest habitat found in a 1 km x 1 km area surrounding each 100 meter cell. This approach eliminates some of the ‘noise’ that is inherent in land cover data while identifying larger homogenous areas. The dark green areas are at least 80 percent forested while the lighter tan colors are more heavily fragmented.

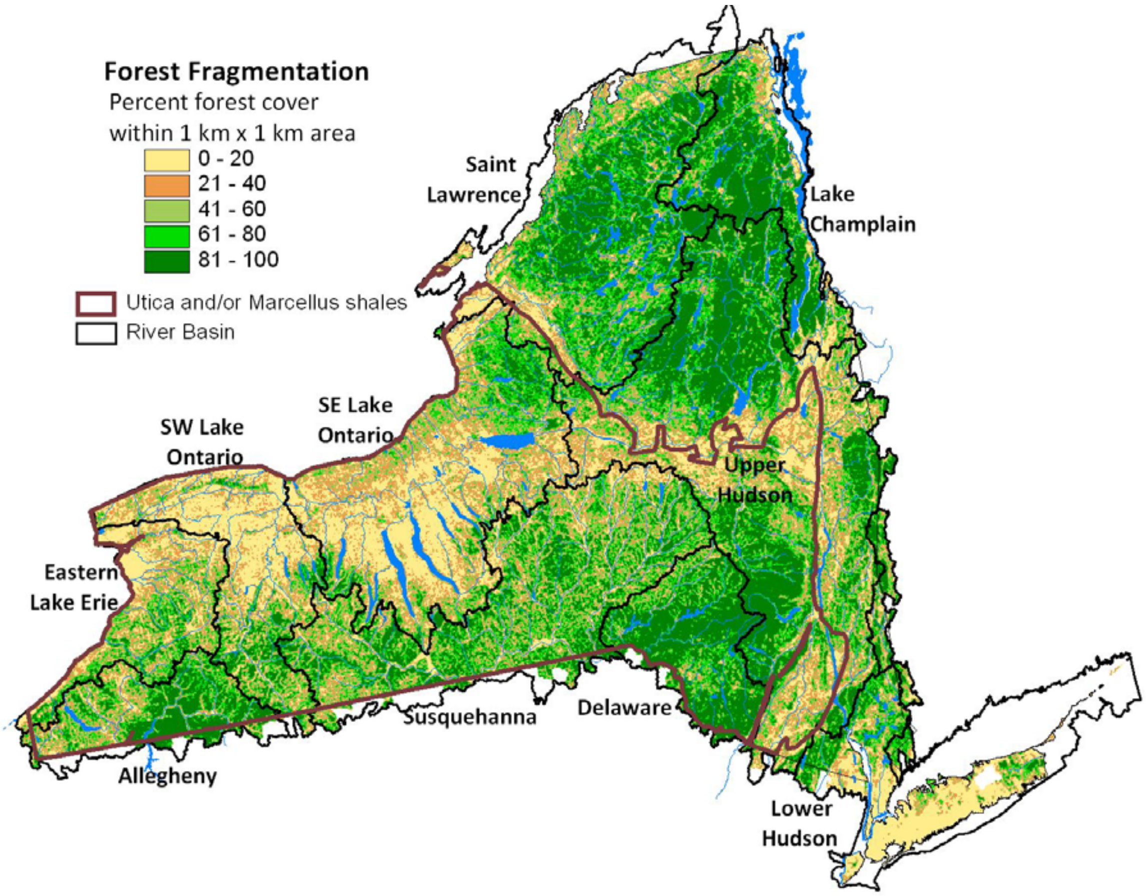

Figure 5. Forest fragmentation. The dark green areas are over 80% forested within a surrounding 1 km x 1 km region.

Figure 6 shows the fragmentation levels associated with the high priority areas identified in Figure 4. The dark blue areas represent regions with the least amount of fragmentation where conservation strategies may contain a protection emphasis as opposed to the more highly fragmented light green areas where habitat restoration may be required to protect and expand existing populations of brook trout. In order to provide additional refinement to the potential priority areas we selected patches that were at least 68 percent forested (in keeping with findings of Hudy et al. 2008) and had a spatial extent of at least 5,000 acres. These areas are shown in orange in Figure 6 and should be managed to maintain the conservation values associated with the forest cover, particularly as it pertains to the long-term protection of brook trout populations and mitigation of climate change impacts.

Further fragmentation of these remaining forest patches by roads and clearing could lead to local brook trout extirpations, particularly over the next few decades as temperatures continue to rise.

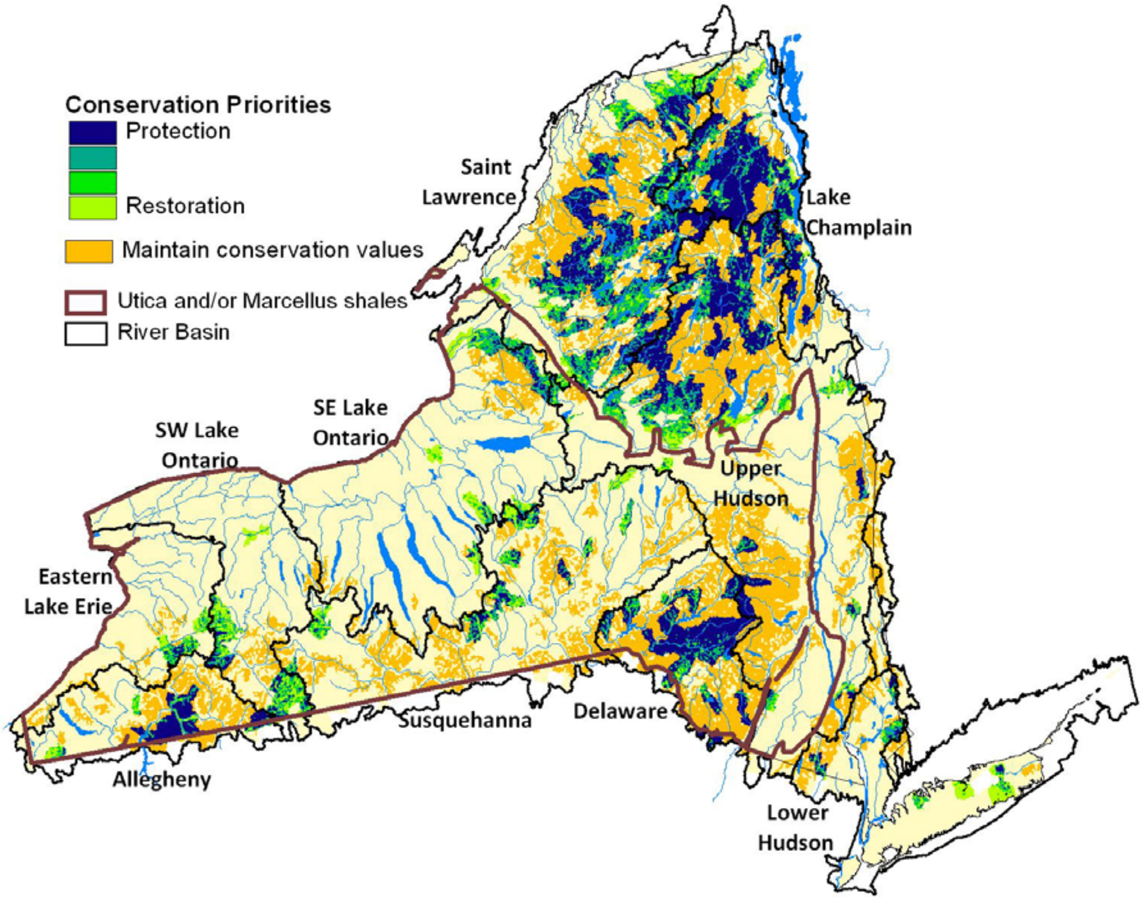

Figure 6. Conservation strategies based on population and habitat factors in conjunction with remaining forest patches.

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