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1 August 2020

Lake Roland Nature Council
% Kurt Davis, President
1000 Lakeside Drive
Baltimore, MD 21210

To the Lake Roland Nature Council,

This letter shall constitute an agreement between Roger Latham and the Lake Roland Nature Council (LRNC) that Roger Latham will provide the services and deliverables listed under Phases 1–4 on the attached budget and scope of work spreadsheet for the Bare Hills Barrens Ecological Restoration and Maintenance Plan ("the plan"). Compensation for remaining work to be done is not to exceed $33,162, as specified on the attached spreadsheet. Payments will be made based on invoices submitted by Roger Latham and will be noted on later versions of the spreadsheet.

Completion dates are estimated as follows:

Phase 1—30 October 2020

Phase 2—28 February 2021

Phase 3—31 August 2021

Phase 4—TBD

Phase 4 includes a PowerPoint presentation explaining the BHB Serpentine Restoration Plan to an audience selected by LRNC. When and how to deliver this presentation will be decided in consultation with LRNC, and will be guided by public health considerations.

Signed by

Roger Latham

Kurt Davis, President, LRNC

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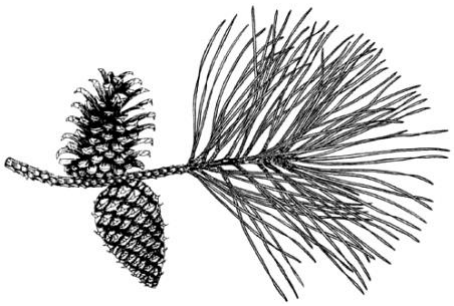

Proposal: Bare Hills Serpentine Barrens Ecological Restoration and Maintenance Plan

Bare Hills likely got its name from the ancient grasslands that early European settlers found covering slopes and summits of serpentinite outcrops overlooking the valleys of the Jones Falls and its tributaries north and northwest of Mount Washington. The oak-dotted grasslands and surrounding conifer woods are collectively known as serpentine barrens—serpentine because they are associated with soils weathered from serpentinite bedrock, a rare geological formation, and barrens because early farmers found them to be unsuited to cultivation. In fact they are anything but barren, harboring exceptional numbers of rare, threatened and endangered species and having national or even global significance for science and conservation. Despite their importance serpentine barrens have been losing ground for the past several decades, shrinking in area and declining in native species diversity with the waning of the disturbance regime that formerly sustained them, in all likelihood for a timespan of several thousand years. This proposal outlines a plan for how the decline of Lake Roland park's treasured piece of natural (and cultural) heritage can be reversed and key processes restored to insure the long-term sustainability of the ecosystem and its component species.

At least half of the individual serpentine barrens documented historically in the eastern United States have been entirely lost to development or neglect. In nearly all that remain, the serpentine grassland component has been rapidly shrinking. At Bare Hills, between 3 and 4 acres of remnant serpentine savanna is all that remains of a once much larger grassland. The remnants are in scattered patches, the largest not much more than 1 acre in size, within roughly 80 acres of Virginia pine – eastern red-cedar forest on the west side of Lake Roland park (Figure 1). Less than 80 years ago the largest contiguous area of serpentine grassland at Bare Hills covered perhaps 125 acres, including all of the present-day area of mostly forested barrens vegetation (Figure 2). The 97% loss of grassland area at Bare Hills is more severe than at most other sites.

Nearly all of the distinctive species of serpentine barrens, including those that are rare, threatened or endangered, depend on grassland habitat. With habitat shrinkage comes population decline and local extirpation. There is typically a time lag between habitat contraction and species extirpation, especially of plants. Members of rare species in a shrinking habitat can be the "walking dead"—functionally extirpated even though a few individuals are still hanging on. With a habitat-limited population's decline also comes decreased genetic variation, which results in lowered evolutionary potential in the face of new challenges such as climate change or a newly arrived disease or competitor. Low genetic variation can also lead to inbreeding depression. Countering these bleak trends is the "rescue effect"—the occasional chance arrival of seeds, pregnant females or other immigrants, which can increase numbers and genetic variation in a declining population. However, as long as the area of a specialized habitat is smaller than it used to be or is still shrinking, the likelihood of continued species loss will be high. Wild populations fluctuate as a matter of course

with year-to-year differences in weather, predator abundance, disease outbreaks and other factors. Small, isolated populations are especially vulnerable to disaster from causes such as disease, prolonged drought, or a management error based on inadequate knowledge. When populations are small, their chances of dipping to zero during ordinary fluctuation greatly increase.

At least five vascular plant species of greatest conservation need in Maryland have long been known to live in Bare Hills grasslands:

- whorled milkweed, *Asclepias verticillata* (G5, S3)
- annual fimbry, *Fimbristylis annua* (G5, S3)
- papillose nutrush, *Scleria pauciflora* (G5, S3)
- serpentine aster, *Symphyotrichum depauperatum* (G2, S1, state-endangered)
- fameflower, *Phemeranthus teretifolius* (G4, S1, state-threatened)

The high-diversity grasslands are home for many other uncommon plants, including lesser snakeroot (*Ageratina aromatica*), lyre-leaf rockcress (*Arabidopsis lyrata*), arrow-feather three-awn (*Aristida purpurascens*), green milkweed (*Asclepias viridiflora*), barrens chickweed (*Cerastium velutinum*), awned flatsedge (*Cyperus squarrosus*), Maryland tick-trefoil (*Desmodium marilandicum*), Heller's witchgrass (*Dichanthelium oligosanthes*), Small's ragwort (*Packera anonyma*), blackjack oak (*Quercus marilandica*), and rose-pink (*Sabatia angularis*). It is likely that additional plants and animals of immediate or cautionary conservation concern will be found with concentrated effort. Insect species have not yet been systematically surveyed at Bare Hills but "island" populations of rare specialist-feeding herbivorous moths, beetles, and true bugs have been found at all of the eastern North American serpentine barrens where surveys have targeted them.

If further losses are to be averted, it is urgent that the grassland be expanded to a much larger fraction of its former extent (ecological restoration) and effective substitutes for the historical disturbance regime and other dynamic ecosystem processes be put in place and sustained long-term (ecological maintenance). The most powerful and effective way to accomplish these ends is within the framework of *adaptive management*.

In brief, adaptive management is a recursive process of carrying out a set of actions, quantitatively monitoring the results, reconsidering the methods in light of those results, and adjusting the next round of implementation accordingly. Specific, measurable objectives—desired conditions—are developed based on all available knowledge about the ecosystem, including comparison with high-quality reference sites. Desired conditions are itemized as target ranges of a carefully selected set of measurable indicators, and then compared with existing conditions to serve as the basis for strategies to narrow the gap between the two. Trials of promising alternative methods for achieving objectives are carried out as a part of routine management, but following the principles of scientific experimental design so valid inferences can be drawn from the results.

The indicator-monitoring component of adaptive management is in essence an audit—a systematic, disciplined approach to evaluate and improve the effectiveness of management over time. The aim is to make the rigorous tracking of outcomes efficient enough to be realistically feasible.

Adaptive management typically also brings resource managers, researchers, and other stakeholders together and encourages long-term collaboration by creating and strengthening institutional ties. These ties are crucial to sustain the level of support needed and to encourage stakeholders to stay involved over the life of an adaptive management project. Adaptive management has become the "industry standard" for managers of wild lands, including the National Park Service, U.S. Fish and Wildlife Service, U.S. Forest Service, The Nature Conservancy, and other agencies and organizations involved in ecological restoration and sustained maintenance of forests, grasslands, shrublands, wetlands, and all types of wildlife habitat.

Proposed phasing of tasks involved in preparing the proposed plan is given on the next page, together with estimated time and ancillary costs for each. The project should take approximately 18 months, but the duration can be extended in the event that funding is delayed or interrupted.

Bare Hills Barrens Ecological Restoration and Maintenance Plan
phases, tasks, rough timeline, estimated costs (rev. 2020-07-31)

Bare Hills Barrens Ecological Restoration and Monitoring Plan phase/task	hourly rate	estimated hours	estimated time cost	travel expenses	supplies	sum of costs
Phase 1. Assemble GIS and plant species cover data needed for desired conditions determination Deliverables: installed species cover sampling array and first progress report						
Site meeting with Lake Roland Natural Council (completed 14 May 2018)	$240 – 50% = $ 120	10	$ 1,200	$ 99		$ 1,299
Compile and review maps, historical aerial photos, historical floral and faunal surveys, herbarium records, land-use history, GIS base layers, other available site information (with help from Lake Roland Nature Council)	$240 – 50% = $ 120	8	$ 960			$ 960
	$ 150	13.333	$ 2,000			$ 2,000
Conduct GIS classification of current vegetation and existing grassland edge/interior status using multi-channel satellite imagery and LiDAR (with GIS consultants)	$240 – 50% = $ 120	4	$ 480			$ 480
	$ 150	40	$ 6,000			$ 6,000
Design and install stratified random sampling array for long-term monitoring, using existing grasslands and concentric zones outward as strata; conduct quantitative baseline survey of plant species cover (with GIS and botanical inventory consultants)	$240 – 50% = $ 120	10	$ 1,200			$ 1,200
	$ 150	13.333	$ 2,000			$ 2,000
	$77.56	35	$ 2,715	$ 661	$ 60	$ 3,436
Analyze and interpret data; write up first progress report of initial findings	$240 – 50% = $ 120	14	$ 1,680			$ 1,680
subtotal						$ 19,055
Phase 2. Continue GIS analysis; collect data on key plant and animal populations, reference sites, stakeholder views Deliverable: second progress report						
Conduct GIS analysis of chronosequence of aerial photos showing spatial distribution of succession rates (with GIS consultants)	$240 – 50% = $ 120	4	$ 480			$ 480
	$ 150	20	$ 3,000			$ 3,000
Develop order-of-magnitude population estimates of plant species of greatest conservation need (with botanical inventory consultant)	$240 – 50% = $ 120	4	$ 480			$ 480
	$77.56	9	$ 698	$ 132		$ 830
Work with Lake Roland Nature Council to recruit qualified entomologist to conduct externally funded monthly surveys of butterfly and moth species for one year to serve as baseline	$240 – 50% = $ 120	4	$ 480			$ 480
Work with Lake Roland Nature Council to recruit skilled birders to conduct pro bono surveys of breeding, winter resident, and migratory bird species for one year to serve as baseline	$240 – 50% = $ 120	2	$ 240			$ 240
Canvass Lake Roland Nature Council and other stakeholders for views on Bare Hills Barrens conservation issues	$240 – 50% = $ 120	9	$ 1,080			$ 1,080
Identify appropriate serpentine barrens reference sites; compile existing information on their historical and present-day species composition, landscape dynamics, management history	$240 – 50% = $ 120	4	$ 480			$ 480
Analyze and interpret data; write up second progress report with additional findings	$240 – 50% = $ 120	10	$ 1,200			$ 1,200
subtotal						$ 8,270
Phase 3. Prepare draft barrens stewardship plan within adaptive management framework Deliverable: draft of Bare Hills Barrens Ecological Restoration and Maintenance Plan for review, including maps						
Identify focal conservation targets and management objectives in terms of a carefully selected group of measurable quantitative indicators and their desired ranges	$240 – 50% = $ 120	12	$ 1,440			$ 1,440
Assess present and likely future threats; develop and rank scenarios of climate change impacts based on best available information	$240 – 50% = $ 120	8	$ 960			$ 960
Recommend specific conservation practices to narrow the gap between present and desired conditions; include adaptive management trials and a monitoring program designed to enable valid inference and practical learning toward improving future management	$240 – 50% = $ 120	8	$ 960			$ 960
Produce maps of existing trails and projected trail system, vehicular access routes, firebreaks, features of conservation concern and historical significance, restoration and maintenance land units, long-term monitoring quadrats/transects, classification of existing grassland edge/interior status (with GIS consultants)	$240 – 50% = $ 120	4	$ 480			$ 480
	$ 150	20	$ 3,000			$ 3,000
			$ -			
Prioritize management tasks; propose near-term and long-term schedules for implementation	$240 – 50% = $ 120	4	$ 480			$ 480
Write and circulate draft plan to stakeholders for review; compile comments and input	$240 – 50% = $ 120	6	$ 720	$ 99		$ 819
subtotal						$ 8,139
Phase 4. Complete first iteration of Bare Hills Barrens Ecological Restoration and Maintenance Plan Deliverable: completed Bare Hills Barrens Restoration and Maintenance Plan						
Complete plan; submit PDF and 5 paper copies	$240 – 50% = $ 120	8	$ 960		$ 350	$ 1,310
Give PowerPoint presentation of plan to audience selected by Lake Roland Nature Council	$240 – 50% = $ 120	9	$ 1,080	$ 99		$ 1,179
subtotal						$ 2,489
Total estimated cost						$ 37,953
paid on 14 May 2018 invoice						$ 1,299
paid on 28 January 2020 invoice						$ 3,492
paid on 4 March 2021 invoice						$ 3,510
Total remaining cost						$ 29,652

Figure 1. Bare Hills Barrens area of Lake Roland park (on 2014 imagery)

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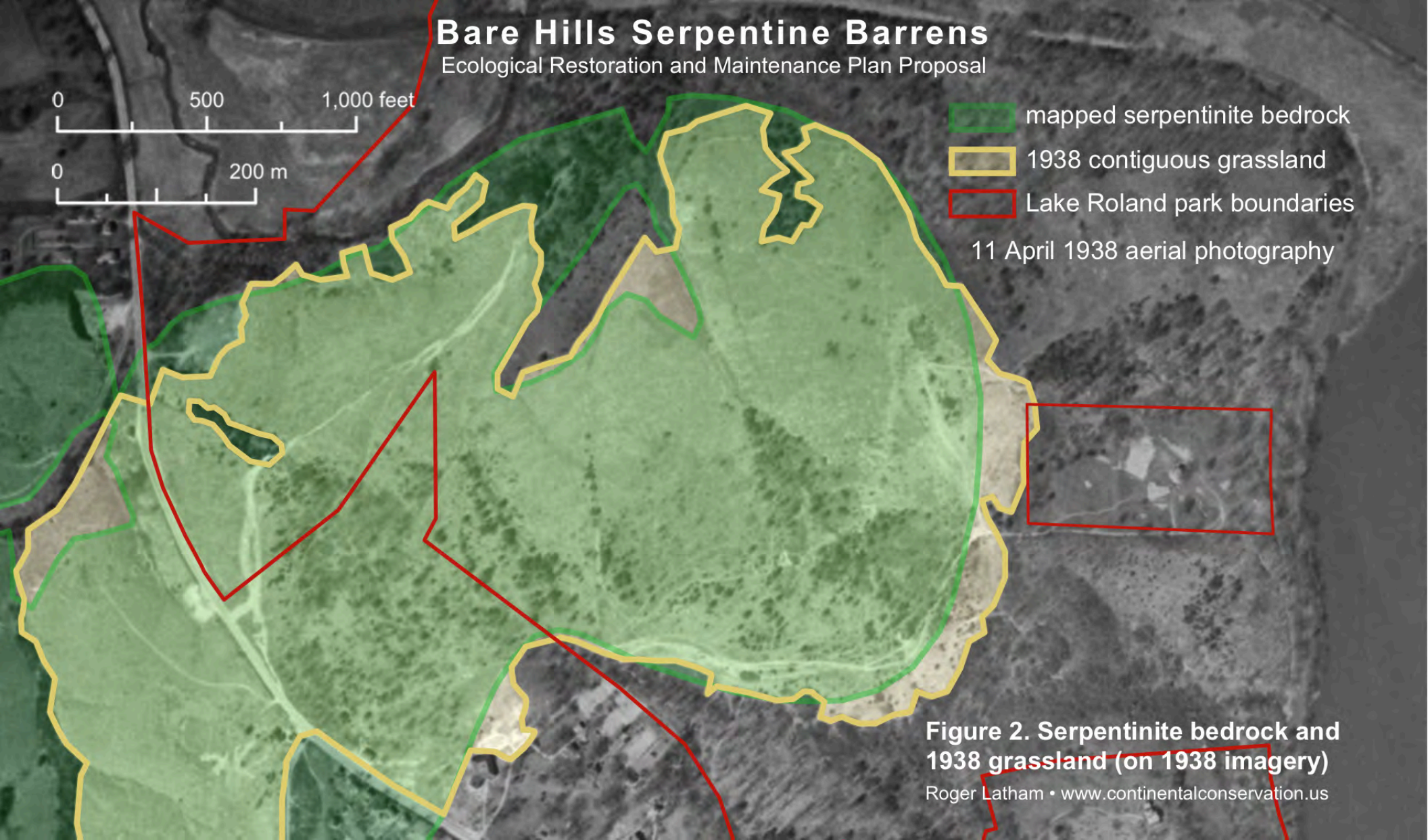

Figure 2. Serpentinite bedrock and 1938 grassland (on 1938 imagery)

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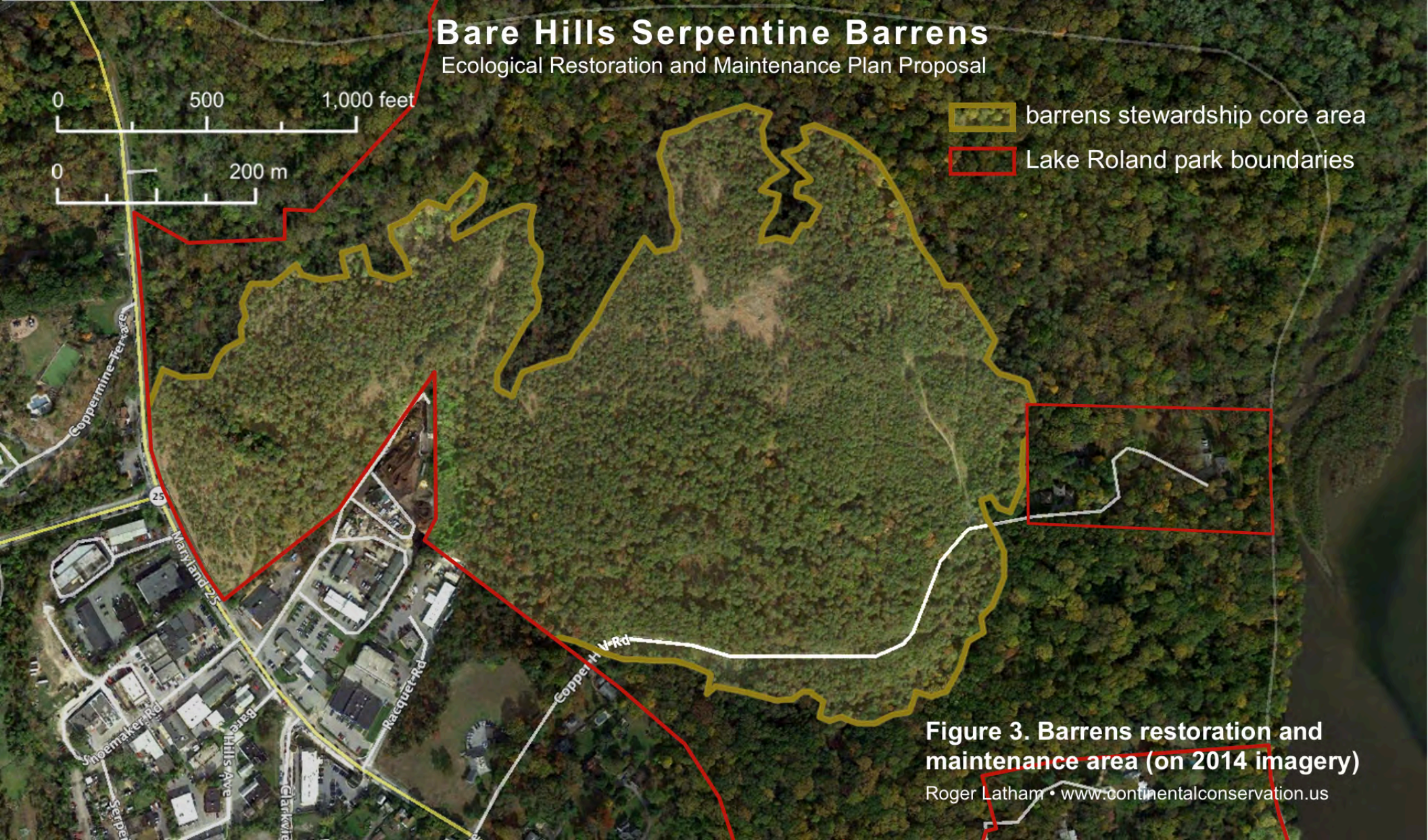

Figure 3. Barrens restoration and maintenance area (on 2014 imagery)

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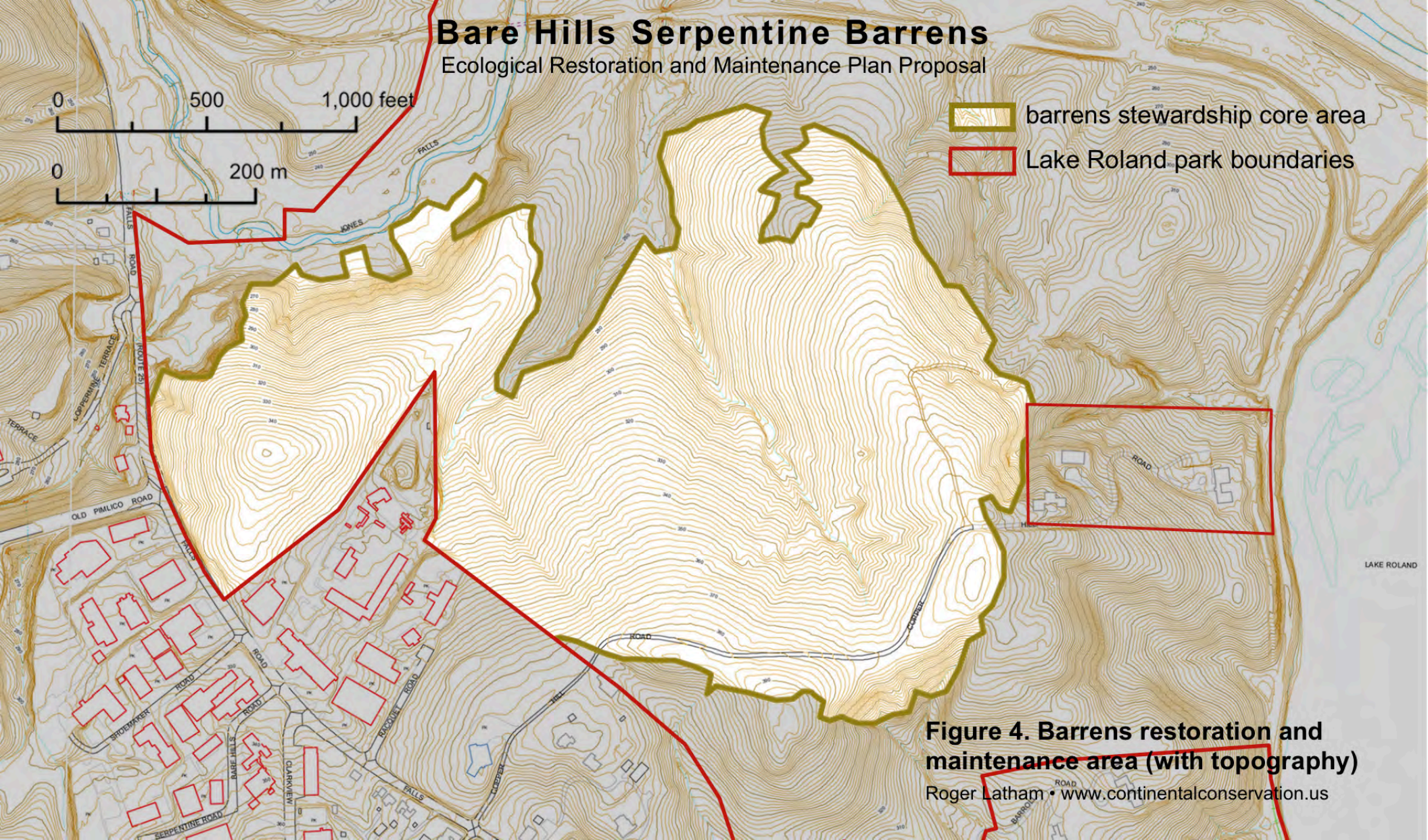

Figure 4. Barrens restoration and maintenance area (with topography)

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