Rapid Ecological Assessment for Rockefeller State Park Preserve

In preparation for the development of an ecological management plan
Natural Heritage Trust Contract # 2014-04-08

September 2014

Mianus River Gorge, Inc.
167 Mianus River Road
Bedford, NY 10506

Contents

Purpose and Objectives

The Rockefeller State Park Preserve (RSPP) is in the beginning stages of prioritizing ecological management goals and planning management efforts. The primary objective of this project was to inform the site- specific prioritization of management goals and actions. This document and the accompanying GIS map are to be used to prioritize and target specific areas for management interventions.

Scope

The scope of this project was limited to the forested areas of the RSPP. While this project did not assess the RSPP fields, the effects of the fields on the adjacent forest are discussed (e.g. in many cases field edges harbor invasive species that appear to be dispersing into the forest). This report contains brief comments on field management (except for the fields that are managed for production), and the Mianus River Gorge (MRG) is available to discuss field management goals and strategies further.

Methods

Indicators

Together, RSPP and MRG identified indicators to be used to prioritize site- specific management efforts. On 28 April 2014, 7 May 2014, 20 May 2014, 23 May 2014, and 4 June 2014, MRG mapped and described areas with:

- Potential for diverse species assemblages
- Refugia for rare communities or species
- Zones of relatively “abundant” tree regeneration
- Unique early successional stages (identified by RSPP as a limited successional class)
- Locations of wetlands/ vernal pools

MRG’s assessment of these indicators was based on MRG’s expert opinion and observations (i.e. no quantitative data were collected). MRG’s visits were timed to observe seasonal shifts in the indicators (e.g. to observe locations and abundance of spring ephemerals and later season species). MRG surveyed RSPP by driving each carriage road and viewing smaller sections from the road (i.e. when the entire section could be seen from the road) and walking through sections that could not be seen from the road. MRG also assessed invasive plant species (based on distributions of invasive plants and total area covered) and deer use (based on browsing pressure) within each section, as these factors heavily influence the indicators.

Management zones

Based on MRG's assessment of the indicators, MRG then delineated "management zones". The boundaries of the management zones generally follow the established carriage roads 1) to easily navigate when sending staff to the field to implement management activities, 2) because the roads can be used as lines of delineation to prevent invasive species from spreading (for some species), and 3) because the indicators, invasive plant species status, and deer use were generally uniform within each section.

The management zones were divided into four types (A, B, C, D; see map) based on the indicators and the feasibility of management interventions realistically having an effect.

Management Zone Type	Description/ rationale for type	Recommended management actions
A	Greatest potential for diverse species assemblages and unique species. Very few non-native species.	Prioritize invasive species control in these zones. Monitor annually for invasive species. Prioritize deer management in these zones.
B	Lower potential for diverse/ unique species than A, but includes zones with relatively abundant native species and in many cases tree regeneration and early successional stages. Includes zones that are adjacent to "A's", thus could be used to buffer "A's".	After treating "A" sections for invasive species, "B" sections are the next priority. Monitor annually for invasive species. Prioritize deer management in these zones.
C	Relatively low potential for diverse/ unique species. Average/ few native species, relatively low tree regeneration, few areas with early successional stages. Pockets that are heavily invaded with non-native species.	It is not possible to control invasive species in these zones, only to mitigate their spread and establishment. Spot treat invasive species, especially isolated/ newly established populations and mature adults that are spreading propagules.
D	Almost completely dominated by invasive species. Pockets of native overstory species, but the understory is predominately non-native.	Little or no management (excepting "focal points" within "D" zone types, see map). Attempting to control or mitigate invasive species is very difficult, and in most cases would require a full restoration.

Map and accompanying information

Below is a copy of the map showing the management zone types and waypoints. The management zones are labeled with a letter and number that correspond to Table 1.

The waypoints on the map correspond to Table 2. For ease of use with the interactive GIS map, the points are divided into “focal”, “invasive”, and “other” categories. “Focal” points designate specific areas within management zones on which to focus management actions (e.g. a particular grassy knoll with potential for a diverse species assemblage). “Invasive” points designate locations of specific invasions of concern (e.g. an isolated Wisteria patch that could be contained). (MRG did not completely monitor all of RSPP for invasive species, as this was beyond the scope of the project). “Other” points are locations of interest, but without specific management recommendations, for RSPP’s interpretation (e.g. fern glens, ridge tops).

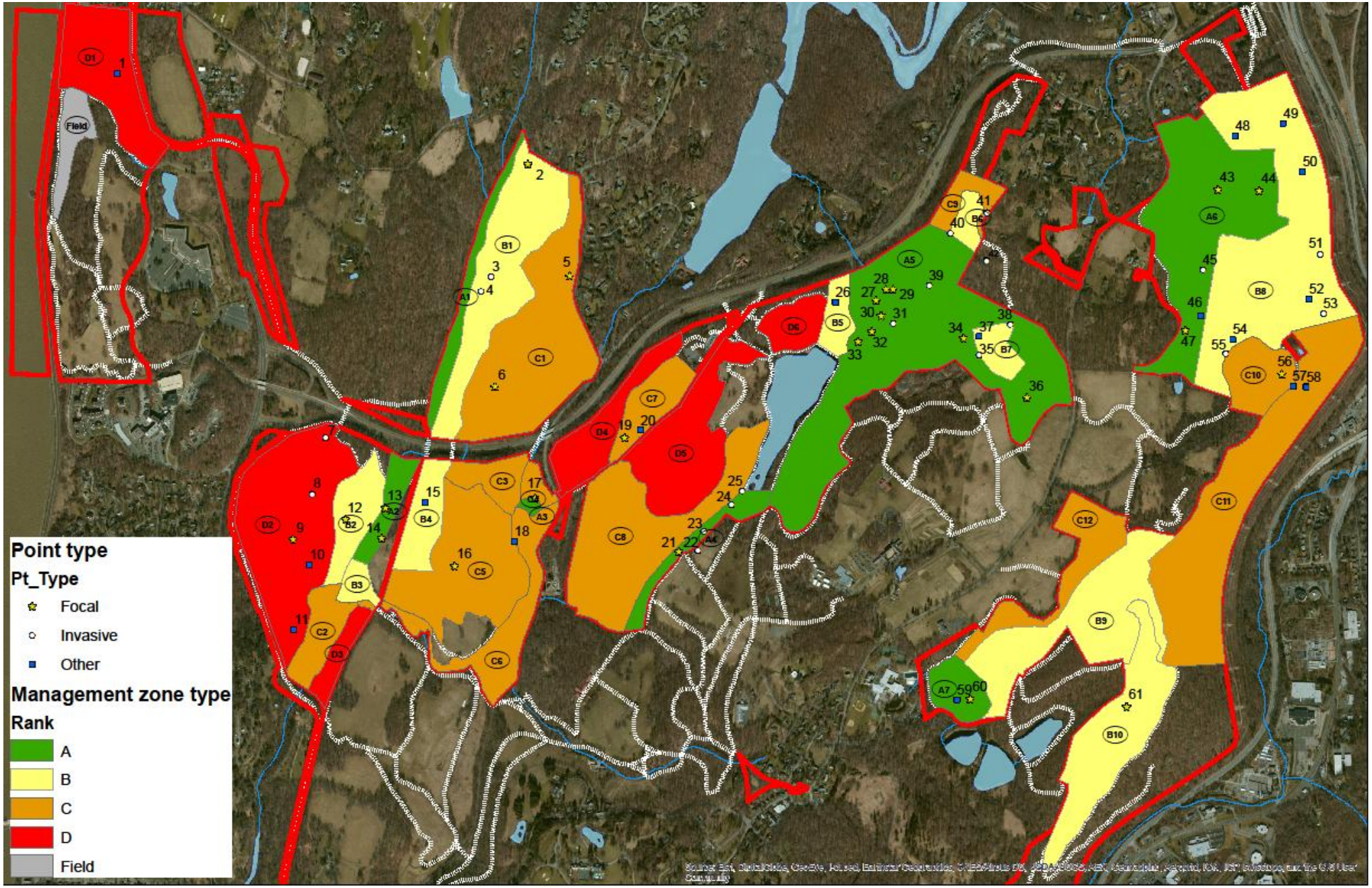

Point type
Pt_Type
Focal
Invasive
Other
Management zone type
Rank
A
B
C
D
Field

Table 1. Management zone type descriptions.

Section	MapID	Rank	MU Description	Acres
Rockwood Hall	D1	D	Heavily invaded, beyond control. Ground cover 100% lesser celandine. Akebia vine reaching overstory. Still some spicebush in understory. Good bird habitat. Stream is too fast, not enough topography for turtles & herring, perhaps good for eels when low.	32.73
	Field	Field	Meadow has milkweed mixed in. Perfect monarch habitat, esp because close to river. Mow late for monarch habitat. Spurge is invading meadow. Ailanthus along eastern edge. Consider clearing trees along eastern edge, use sheep & mow to maintain as field.	9.39
North Central	A1	A	Stream corridor has diverse native species assemblage. Focus on spot treating barberry and deer management.	10.51
	B1	B	Very few invaders. Spot treat, Aralia and barberry, which are in canopy gaps. Deer management important because deer use is currently high. Focus on spot treating invasive species in wetland & tributary (waypoint 2) to 13 Bridges River.	48.69
	C1	C	Oak woodland with barberry in understory. Spot treat barberry to mitigate reproduction and spread.	64.37
Southwest Central	A2	A	Closed canopy, few invasive species.	8.74
	B2	B	Spotty barberry control. Control reproduction and spread to prevent from reaching the 13 Bridges River corridor.	15.14
	B3	B	Few invaders, with the exception of a knotweed patch. Not a diverse section of the river corridor.	4.69
	C2	C	Heavily invaded section of the river corridor: knotweed, lesser celandine, stiltgrass, porcelainberry, but native species mixed in. Focus on knotweed mitigation.	13.02
	D2	D	Heavily invaded, especially barberry. Heavy deer use	63.85
	D3	D	Heavily invaded	7.04

Southeast Central	A3	A	Buttonbush wetland with diverse native species assemblage. Invaders mixed in, focus on Phragmites control to mitigate spread, and deer control.	1.10
	B4	B	Few invaders on this steep, relatively dry slope. Focus on spot control.	13.67
	C3	C	Less deer use, moderately invaded. This section of river corridor is influence by the highway, so will likely always have invasive species issues. Focus on mitigating propagule dispersal downstream.	10.24
	C4	C	Less deer use, moderately invaded. This section of river corridor is influenced by the highway, so will likely always have invasive species issues. Focus on mitigating propagule dispersal downstream.	3.45
	C5	C	Focus on Ailthanus & Aralia control, especially mature individuals before they produce seed. First focus on controlling mature individuals on the top of the hill so that they do not seed into the forest below.	48.27
	C6	C	This section of stream corridor is invaded with knotweed. Mitigating knotweed a priority. Begin knotweed control upstream, & push downstream. Deer use heavy, deer control a priority to help native plant species compete with invaders.	24.29
Swan Lake	A4	A	Stream flowing into Swan Lake. Focus on invasive control along stream corridor.	9.50
	A5	A	High priority stream system. Relatively few invaders.	112.14
	B5	B	Invasive control to buffer "A" rank stream/ wetland system. Some good native herbaceous species populations.	7.52
	B6	B	Good native species populations, but invaded.	4.92
	B7	B	Heavy barberry infestation. Focus on preventing barberry from dispersing along the stream corridor.	6.89
	C7	C	Control wetland edges & invasives coming into wetland.	13.64
	C8	C	Control Aralia to reduce propagule pressure along lake edge. Control invaders along boundary with "A" section to the south to keep out of "A" section.	57.16

	C9	C	Wisteria, Aralia patches.	6.89
	D4	D	Heavily invaded. Invasives are beyond control. Good bird habitat.	18.90
	D5	D	Forest is almost 100% stiltgrass, Aralia, Ailanthus. Invasives are beyond control.	37.62
	D6	D	Heavy stiltgrass. Few native species.	10.52
East	A6	A	Good maple regeneration. Important to protect stream corridor. Need intense invader control along western road.	69.66
	A7	A	Wetland complex. Good species assemblage.	10.88
	B8	B	Heavy deer management. Need barberry control. "B" rank due to good forest regeneration, mid- successional forest.	93.39
	B9	B	Good native mix, spot treat invaders.	48.39
	B10	B	Good regeneration, low invader pressure. Dense blueberry.	41.28
	C10	C	Mix of native- non-native. Focus on managing the two fields in this section. Manage invaders on edge of large field. Focus on controlling Wisteria patch on the west side of unit.	15.63
	C11	C	Nice oak forest. Treat mature barberry, euonymus, Aralia, Ailanthus before seed. Focus on satellite patches, larger patches are lower priority.	75.17
	C12	C	Heavily invaded. Prevent invaders from moving east and toward wetland.	21.28

Table 2. Point descriptions.

Section	MapID	Pt Type	Description	Latitude	Longitude
Rockwood Hall	1	Other	Wet forest. Few deer. Ground cover is 100% invasives. Invasives (e.g. Akebia, lesser celandine) are beyond control in this forest area. However, good bird habitat, especially because close to river.	41.12143340	-73.86498836
North Central	2	Focal	Wetland, feeds tribuary to 13 Bridges River. Skunk cabbage, spicebush, sarsaparilla. Control invasives along tributary, focus on barberry.	41.11802674	-73.84571602
	3	Invasive	Barberry and stiltgrass coming in through a seep.	41.11404056	-73.84752089
	4	Invasive	Aralia and barberry coming in forest gap.	41.11352004	-73.84798533
	5	Focal	Sweet pepperbush wetland. Skunk cabbage, ferns, jewel weed. Wood frogs breeding, potential for salamanders. Patchy Arelia, stiltgrass, barberry. Heavy deer use.	41.11399370	-73.84327990
	6	Focal	Wetland/ wet meadow with native- invasive mix (stiltgrass, garlic mustard).	41.11013006	-73.84741008
Southwest Central	7	Invasive	Knotweed meadow. Wet, but no standing water. Knotweed monoculture, no natives mixed in.	41.10840239	-73.85540265
	8	Invasive	Dense, extensive black swallowwort patch along road.	41.10640397	-73.85606465
	9	Focal	Vernal pool does not hold enough water late into the season (topography/soil). Potentially viable for wood frogs, not later frog spp. or salamanders. Surrounded by barberry/ euonymus- cut in area draining into pool to reduce competition for water.	41.10478995	-73.85700770

	10	Other	Dry grass knoll (similar to RSP61). No invasives on knoll. Area between roads heavily invaded with barberry, non-native viburnam, wineberry	41.10388513	-73.85624369
	11	Other	Dry grassy knoll. Pennsylvania sedge, blueberry, chestnut oak. No invasives on knoll, but Ailanthus, barberry surrounding knoll. Knolls likely resistant to invaders because dry, but monitor to prevent invasion. May be a refuge for sedge, blueberry.	41.10157482	-73.85700577
	12	Focal	Small wetland. Heavy deer browse. Skunk cabbage, spicebush. Sparse barberry, wineberry; can likely still control barberry infestation. Drains into 13 Bridges River. Control invaders to prevent propagules from spreading along river corridor.	41.10548372	-73.85452699
	13	Focal	Stream & area from east of stream to Eagle Hill. Sporadic patches of barberry. Worthwhile to treat stream corridor.	41.10587583	-73.85264299
	14	Focal	Stream system by meadow. Native wet mix (false hellebore, skunk cabbage, spicebush). Lesser celandine, multiflora rose, stiltgrass mixed in. Barberry rimming field. Field is potential turtle habitat, consider in mowing strategy. Heavy deer use.	41.10478610	-73.85283871
Southeast Central	15	Other	Eagle Hill. West side; white-red-chestnut oak overstory; witch hazel in understory; pennsylvania sedge; few invaders (sparse garlic mustard, barberry- can easily control). East side; heavily invaded w/ barberry & wineberry.	41.10606602	-73.85075262

	16	Focal	Top of Eagle Hill. Spotty invasives. Ailanthus in overstory, control to mitigate seed. Black swallowwort, honeysuckle, Aralia. Mow field to control invaders. Try to maintain view at top.	41.10378304	-73.84941051
	17	Focal	One of the most diverse wetland communities (royal & sensitive fern, spicebush, buttonbush, skunk cabbage, slippery elm, bull rush, jewelweed). Invasives mixed in (mf rose, ailanthus). Good bird, frog habitat. Heavy deer use. Mitigate invaders.	41.10614740	-73.84559079
	18	Other	Heavily invaded floodplain, influenced by road that parallels river.	41.10463162	-73.84658782
Swan Lake	19	Focal	Point taken on the Nature's Way trail. Surrounded by invasives (barberry, multiflora rose). Good bird habitat. Perhaps cut multiflora rose on east side of trail so that birders can look down onto marsh.	41.10825545	-73.84134410
	20	Other	Standing water, enough to support amphibians. Phrag patch with tussock sedge, willow, skunk cabbage mixed in. Red winged black birds nesting in Phrag. Lesser celandine patches coming downstream.	41.10851420	-73.84057540
	21	Focal	Wetland. Leave multiflora rose (for birds), potential turtle habitat. Control Aralia, black swallowwort. Stream corridor is "C", focus on invasive control because flow into lake.	41.10416844	-73.83885241
	22	Invasive	Small patch Aralia on field edge- next to drainage- worth treating.	41.10419777	-73.83795882
	23	Invasive	Small patches Aralia & lesser celandine to east of road next to drainage. Important to keep out of drainage. West of road small non-native Spiraea & multiflora rose patches.	41.10489129	-73.83766436

24	Invasive	Small Phrag patch at southern end of lake, surrounded by skunk cabbage.	41.10582411	-73.83633642
25	Invasive	Small Aralia tree to west of road. Small stiltgrass patch to east of road with locust. Painted & snapping turtles, great blue heron, cormorant in Swan Lake.	41.11420803	-73.82675095
26	Other	Blue cohosh patch.	41.11296617	-73.83132328
27	Focal	Multiple streams meet. Nice complexity, dead wood in stream. Native species mix (jewelweed, ferns, spicebush, highbush blueberry, musclewood). Sparse stiltgrass, Phrag, garlic mustard, multiflora rose- potentially coming from upstream source.	41.11257238	-73.83005368
28	Focal	High quality area, high priority for deer/ invasive control. Ground water. Nice wildflower community. Spring ephemerals, spicebush, solomon seal, toothwort, ferns. Red maple- black birch- black oak overstory. Heavy deer use, but few invaders.	41.11339800	-73.82860700
29	Focal	High quality area, high priority for deer/ invasive control. Vernal pool/ wetland complex. Potential turtle habitat (hummocks & proximity to stream) but did not detect turtles. Wood frogs present. Native mix (skunk cabbage, maple leaf viburnam.)	41.11339775	-73.82860704
30	Focal	High priority deer/ invasive control. Small Phrag patch,find upstream source. Skunk cabbage, Bebb willow mixed. Sparse stiltgrass, mf rose, barberry, privet, garlic mustard. Tussock sedge ideal turtles & salamanders, deeper pools would help.	41.11248043	-73.82918539
31	Invasive	Control invaders along road (mugwort, barberry, euonmyus, multiflora rose) to protect wetland/stream complex on either side of road.	41.11219428	-73.82862012

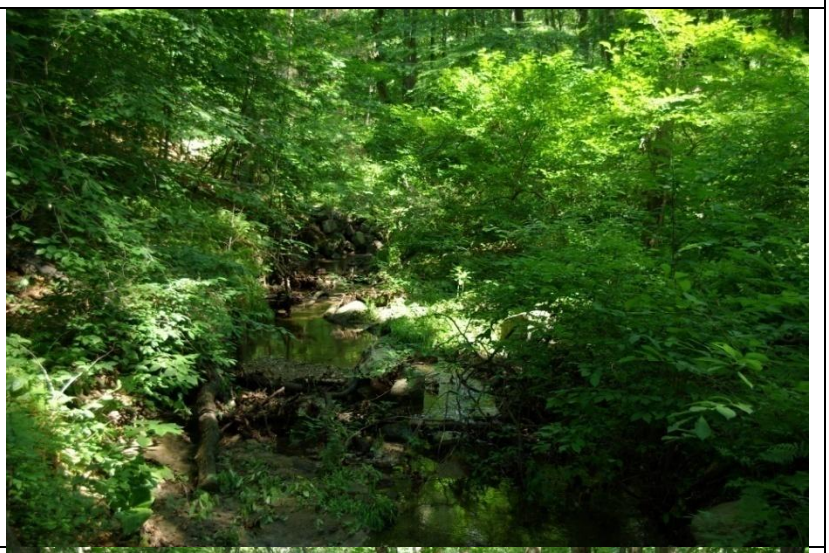
32	Focal	Upstream from 27. Mature eunomyus hanging over river, likely dropping seeds in water. Euonymus, barberry, garlic mustard, multiflora rose may be moving down from lake? Control invaders along this stream corridor to protect wetland complex downstream.	41.11190887	-73.82963810
33	Focal	Meadow may be used by turtles because part of a lake, wetland, stream complex. Perhaps worthwhile to adapt mowing strategy around turtle use. Bufferfly weed & wild flowers. Canadian thistle patch. Barberry on field edge, control so don't go downstream.	41.11156706	-73.83029625
34	Focal	Stream corridor. Few invaders in this section. Native cover (spicebush, trout lilly, wood anemone).	41.11164082	-73.82532100
35	Invasive	Upstream from 34 heavily invaded. Barberry control, garlic mustard, multiflora rose control important so doesn't spread downstream. Invaders may be coming in from private field. North of carriage road heavily invaded with barberry.	41.11102752	-73.82458641
36	Focal	Wetland. Dense skunk cabbage, cat brier, spicebush, dwarf ginseng, jack in pulpit, tussock sedge. Important wetland because feeds wetland complex downstream. Good nesting- old snags. Patch of black tupelo. Few invaders (sparse garlic mustard).	41.10948851	-73.82238340
37	Other	Mature oak- tulip forest.	41.11168943	-73.82458457
38	Invasive	Barberry infestation between 37- 38. Non-native viburnam to control before spread seed.	41.11210182	-73.82310608
39	Invasive	Small, isolated siltgrass patch on rocky knoll. High priority to control because isolated. Patchy barberry surrounding knoll.	41.11353421	-73.82690342
40	Invasive	Large Wisteria patch, high priority to contain.	41.11537219	-73.82587966

	41	Invasive	Jetbead and multiflora rose are moving downstream from here, priorize preventing from moving farther downstream.	41.11608792	-73.82414008
	42	Invasive	Small Phrag patch, sparse barberry, stiltgrass, multiflora rose. Important to control invaders here so that they do not travel downstream. Consider deer management on these private lands along with invasives plan.	41.11438472	-73.82419515
	43	Focal	Two Phragmites stands are on either side of this point in the wetland system. The center of the wetland is not yet invaded. High priority for Phragmites removal.	41.11680332	-73.81326112
	44	Focal	Wetland system with relatively diverse native mix (e.g. mayflower, troutlilly, skunk cabbage, hemlocks, maple leaf viburnam, dwarf ginseng, partridge berry, sphagnum, jewelweed, pyrola, wintergreen, highbush blueberry, wild celery, elderberry.)	41.11673467	-73.81131208
East	45	Invasive	Palonia, knotweed to remove. Good stand of native black cohosh.	41.11395657	-73.81401432
	46	Other	Large tulip tree (120.5 cm dbh)	41.11231456	-73.81414030
	47	Focal	Diverse & abundant native ground cover (e.g. red trillium) along stream. Not heavily invaded but risk invasion from upstream fields & road runoff. Stream corridor is a high priority for invasive control, especially because of wetland system downstream.	41.11182086	-73.81487975
	48	Other	Dry, grassy knoll. Native species mix (grasses, sessile bellwort; black cherry, hickory, birch in overstory). Focus on removing multiflora rose patches.	41.11869302	-73.81241094

49	Other	White oak on knolls. Good regeneration (black cherry, ash), moderate deer browse. Maple leaf viburnam, Pennsylvania sedge, Solomon seal, blackberry, hay scented fern. Moderately invaded. Try deer management only to see native vs non-native interaction.	41.16597039	-73.62365208
50	Other	Grassy knoll. Native species mix (blueberry, pyrola). Few invaders, but monitor. Deer control recommended.	41.11737941	-73.80926312
51	Invasive	Heavily invaded drainage. Multiflora rose, garlic mustard likely dispersing down drainage. Drainage likely habitat for salamanders (but did not detect any). The presence of maidenhair fern & sugar maple seedlings indicate low deer pressure.	41.11442009	-73.80847891
52	Other	Large fern glen (interrupted, maidenhair fern)	41.11285645	-73.80903614
53	Invasive	Slope has dense barberry infestation (60m swath). High priority to control because isolated barberry infestation and there are wildflowers close by. Area north of this point is not heavily invaded.	41.11233375	-73.80837204
54	Other	Ridge. Oak- maple forest. Few invasives, sparse native ground cover. Pyrola.	41.11145684	-73.81265159
55	Invasive	Wisteria patch on east side of road- high priority to control. West side of road less invaded, with native mix (e.g. baneberry, violet). Prevent Wisteria from invading west side of road	41.11095937	-73.81298896
56	Focal	Small field at hill top. Manage for native sedges, good bird/ butterfly stopover, nice viewshed in winter. Focus on invader control, there is multiflora rose, honeysuckle, mugwort on edges.	0.00000000	0.00000000
57	Other	Big patch of blue berry. Oaks.	41.10976537	-73.80983887

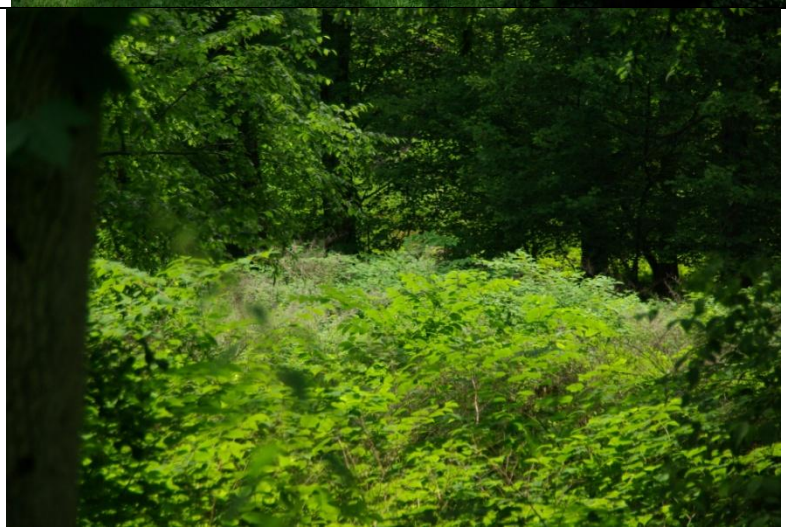
58	Other	Chestnut oak, white oak, hickory mix in overstory. South of point is heavily invaded for 200m.	41.10973712	-73.80922230
59	Other	Mid- successional forest, good regeneration. Area around pond has blueberry and saxifrage.	41.09877451	-73.82585971
60	Focal	Wetland complex. Good native mix (e.g. dwarf ginseng, skunk cabbage, spicebush). Few deer, few invaders. Prioritize barberry removal along road around wetland. Deer management important here.	41.09879589	-73.82523073
61	Focal	Relatively good regeneration, especially in gaps. Extensive blueberry in understory. Dry oak savanna on top of knoll. Few invasives. High priority to spot treat invasives to maintain this area. Deer management important here.	41.09846145	-73.81788768

Examples of management zones (pictures taken 16 July 2014)

Management zone in which picture taken	**Description of image**	
A5 (photo taken at point 34)	The "A" management types tend to be wetlands/ vernal pools with relatively diverse native species assemblages.	
B8 (photo taken just north of point 50)	Relatively "abundant" understory regeneration typical of "B" management types.	

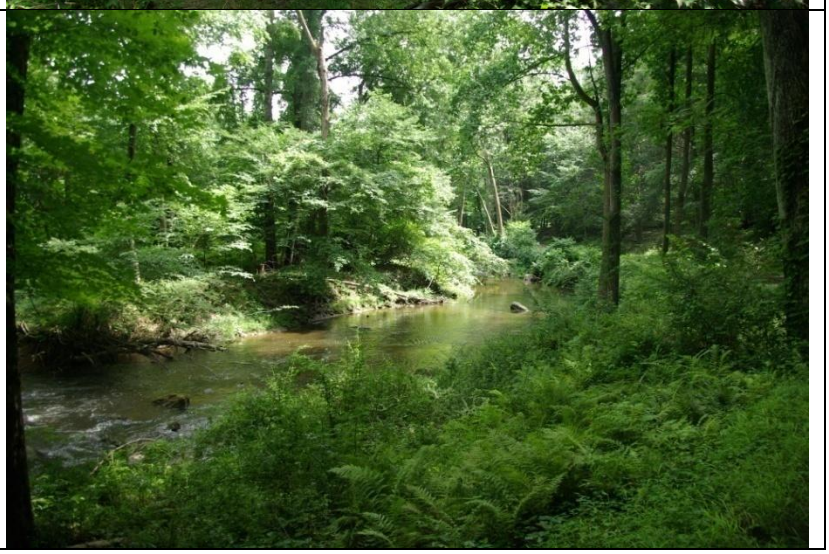
C5 (photo taken at point 16)	"C" types tend to be heavily invaded, but spot treating invaders can mitigate spread and establishment of new populations.	
D5 (photo taken from Overlook Trail)	"D" types are heavily invaded.	

Taken at point 7. The photo above, or this photo look like the best representations of the "red" management type. Which do you prefer?



Points of particular interest (pictures taken 16 July 2014)

Map ID #	Description	
14	Field- stream system is potential turtle habitat.	
9	Vernal pool does not hold water late into the season. Barberry completely rings the pool, thus controlling barberry may reduce competition for water and enhance water retention. An example of a "focal" area for management within a "D" management type.	

48	Example of a dry, grassy knoll. The knolls tend to have a species mix not found elsewhere in RSPP, with relatively few invasive species.	
18	The Pocantico River floodplain is heavily invaded, likely partly due to the influence of the nearby road. Focus on mitigating propagule and fragment dispersal downsteam. Begin with knotweed mitigation.	

General observations & recommendations

1. **Invasive Plant Species:**
   Not surprisingly, the wide-spread abundance of invasive plant species in RSPP is a primary impediment to the persistence of native species, and to some extent drove the delineation of the management zones.

   A. The distribution of invasive plant species in RSPP seems to be a function of recreational use. For example, the eastern section generally has less invaded area than the western parcels, which have been used for recreation longer and more heavily. The recreational carriage roads are likely vectors of dispersal in a few ways:
      i. Propagules and fragments can be dispersed from staff and recreational user footwear, clothing, and vehicles. A boot washing station at trailheads may be a method to educate recreational users, and reduce this vector of dispersal.
      ii. In several places, the carriages roads camber towards streams, and invasive plant species are establishing on stream banks. Propagules and fragments that are on the roads are likely running off the roads into the streams, from which they can disperse long distances.
      iii. The practice of clearing corridors along the carriage roads increases the light penetration into the forest, which can enhance the establishment and growth of fast-growing, light adapted invasive plant species. Would it be possible to reduce the width of the clearing along the roads to reduce light penetration? Would planting low stature grasses or shrubs along the roads in some of the "A" zones to reduce invader establishment along the roads be feasible?

   B. The numerous field- forest boundaries throughout RSPP likely enhance the establishment and persistence of invasive plant species. The field edges tend to harbor invasive species, which are dispersing into the forest, especially in the high- light boundary area. MRG noted particular field- forest boundaries on which to focus for monitoring and control, based on their proximity to "high quality" areas with diverse native species.

2. **Fields:**
   The fields that are not managed for production could be managed for insect, bird, and turtle use.
   A. Old fields in the northeast are becoming rarer as landowners allow them to go to forest. If managed for a forb- grass mix, RSPP's fields could be important for insect and bird use. In particular, the large field in the Rockwood Hall section that parallels the Hudson River may be important for migrating monarchs or birds. Recreation is central to the mission of RSPP, so enhancing bird and butterfly habitat may attract wildlife enthusiasts.

B. MRG designated several meadows on the map that are close to streams, and could thus be managed for turtle habitat by mowing in the late fall to avoid turtles (e.g. point #14).

3. **<u>Forest Systems:</u>**
Some of the key building blocks of a "functional" forest system in our region appear to be relatively intact at RSPP.

A. RSPP has several oak- dominated stands. The extent of the oak- dominated forest will be mapped by the Natural Heritage Program. In the pre-settlement era, fires in the spring were common and oaks dominated the forest in the region. Now, partly due to fire suppression, oaks are generally declining in our region. Thus, RSPP's oak forest may be a critical food source. The Natural Heritage Program map could be used to focus on areas where deer exclosures could be used to enhance oak regeneration.

i. MRG is experimenting with creating artificial forest gaps that enhance light penetration to the forest floor and herbaceous species establishment. MRG is also beginning to experiment with facilitating regeneration in natural tree canopy gaps by excluding deer with fencing and brush. MRG could discuss the possibility of RSPP establishing replicate plots.

B. Topography on the forest floor (i.e. boulders, pit and mounds) create different microclimates within a given area. The subtle differences in these microclimates enhance the potential for a diverse species assemblage within that area. Observationally, RSPP appears to have intact forest floor topography in many places. The forest floor topography can be enhanced by adopting a practice of allowing dying trees to fall over and then decompose in place (i.e do not "clean up" for aesthetics). The tip up mounds expose mineral soil for seed germination, and the decomposing tree creates variable microclimates.

4. **<u>River/ Stream Systems:</u>**
The stream/ river systems would benefit from more microtopography (i.e. pools and riffles). An important and simple step towards restoring microtopography is to leave dead and fallen wood in streams/rivers. Also, the practice of clearing along the carriage road corridors for views/ aesthetics is detrimental to the stream/ river systems because leaf detritus is a critical component of the aquatic food web.

Supplemental information: Preliminary water quality assessment using bioindicators

On 16 July 2014, MRG took two kick net samples in a 13 Bridges Stream riffle near waypoint #4. Using the Stream Biotic index guidelines (available http://www.stroudcenter.org/lpn/learn/data.shtm), macroinvertebrates were grouped to order or family and counted. The count data were used to calculate an index of water quality.

The Biotic Index method indicates "Fair" (i.e. substantial pollution likely) water quality (see below).

Major Group	Count (D)	Biotic Index Weight	Group Value (E)
Mayfly	1	*3.6*	3.6
Stonefly	1	*1*	1
Non-netspinner caddisflies	7	*2.8*	19.6
Netspinner caddisflies	23	*5*	115
Dobsonflies, fishflies	1	*3*	3
Alderflies	0	*4*	0
Water pennies	0	*4*	0
Whirligig beetles	0	*4*	0
Other beetles	0	*4.6*	0
Crane flies	3	*3*	9
Watersnipe flies	0	*2*	0
Other Diptera (inc. deer and horse flies)	2	*6*	12
Black flies	0	*6*	0
Midges	46	*6*	276
Dragonflies	0	*4*	0
Damselflies	0	*7*	0
Crayfish	2	*5*	10
Scuds	0	*6*	0
Sowbugs	0	*8*	0
Clams	0	*6*	0
Snails	3	*7*	21
Leeches	1	*8*	8
Planarians	0	*8*	0
Aquatic worms	17	*8*	136
Totals	**107**		**614.2**

Biotic Index = E/D **5.74** **Fair (i.e., substantial pollution)**

Table 3. Evaluation of Water Quality from Biotic Index

Biotic Index	Water Quality	Degree of Organic Pollution
Less than or equal to 3.75	Excellent	Organic pollution unlikely
3.76 to 5.0	Good	Some organic pollution
5.1 to 6.5	Fair	Substantial pollution likely
6.6 to10.0	Poor	Severe organic pollution likely