Forest Management Plan

Bracken Mountain Recreation Area

City of Brevard North Carolina

PIN:8576-46-6776

By: Blair B. Bishop RF #1575, Forest Land Management and Mapping, PLLC.

March 29, 2013

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FOREST MANAGEMENT PLAN

LANDOWNER: City of Brevard
95 West Main Street
Brevard, NC 28712

LOCATION: Bracken Mountain Recreation Area
Lat.: 35° 14' 27.02”N
Long.: 82° 45' 20.78"W
Access to ROW made from Pinnacle Road
Brevard, North Carolina
PIN: 8576-46-6776

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PURPOSE OF THE BRACKEN MOUNTAIN RECREATION AREA FOREST MANAGEMENT PLAN

The purpose of the Bracken Mountain Recreation Area (here after known as the BMRA) Forest Management Plan, is to provide a decade long planning guide that will allow the City of Brevard and its constituents, to sustainably manage and improve the ecological function and services of BMRA’s forests. To achieve this goal the BMRA forest management plan identifies four focus areas:

Forest Health: Identify, suppress, and/or eradicate invasive flora and fauna that impact ecosystem function, through the implementation of mechanical and chemical control methods.

Ecological Restoration and Protection: Restore and maintain native plant communities that provide wildlife habitat. Protect and preserve federally threatened and endangered species if found on the property.

Water Quality Protection: Protect water quality of all stream drainages on the property through the implementation of “Best Management Practices” ensuring that recreational use and management activities do not impair water quality.

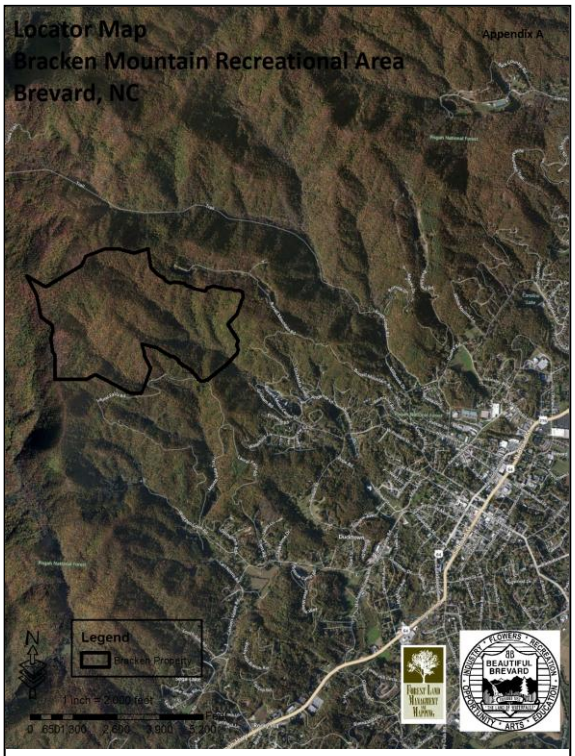
Recreation and Education: Enhance and maintain diverse recreation and educational opportunities on the property, which serve the citizens and visitors of Brevard.

Theses focus areas are in conformance with the Retails and Conservation Purposes stated in the Conservation Easement made between the City of Brevard and the State of North Carolina, and are further aligned with the "Bracken Mountain Master Plan".

The BMRA management plan should be viewed as a working document that can be modified or changed to better meet the four focus areas stated above. Yearly monitoring and assessment should be performed by the City to ensure that management activities have met each focus area, and to determine if any augmentation of the plan is needed. Monitoring efforts can be implemented through the reestablishment of forest inventory plots. These locations can be found on the attached maps.

Throughout this document the reader will find hyperlinks to supporting information that will guide the City towards the implementation of their management plan. Along with these links, there are several attachments including maps, timeline of activities, and budget.

PROPERTY DESCRIPTION

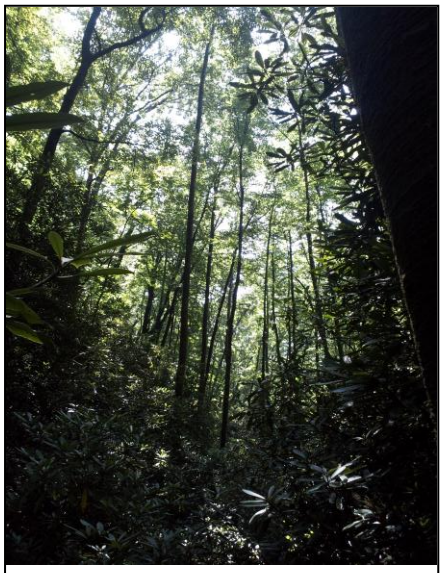


Locator map BRMA, Transylvania County North Carolina.

The BMRA is comprised of 400+/- acres with the PIN# 8576-46-6776 and is located inside the city limits of Brevard, in Transylvania County, NC (Lat.: 35° 14' 27.02"N and Long.: 82° 45' 20.78"W). See Appendix A for the property locator map. Access to the property can be made by an established right-of-way located at the end of Pinnacle Road. The property is surrounded by both private and public lands, with the south and eastern property boundaries adjoining private residences and north and west boundaries adjoining the Pisgah National Forest.

The property is comprised of many southeast facing side slopes and coves with the property's northern boundary forming the main ridge of Cedar Rock Mountain. Elevation for the property ranges from 2,680 feet at the southern boundary to 3,640 feet at the northwest corner of the property.

Slopes range from gradual in some bottom land coves to extremely steep along the property's upper side slopes. A majority of the soils found on the property are relatively deep and well drained and are underlain with a muscovite-biotite, geneiss, parent material.

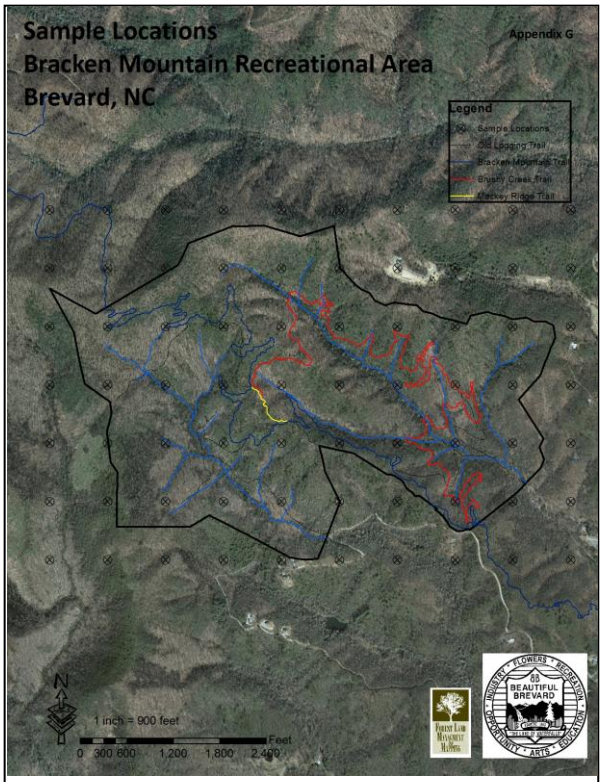


A dense understory of Rhododendron covers the forest floor along Bracken Creek. The vegetation along the stream corridor plays an important role in the protection of water quality.

BMRA contains the headwaters of both Bracken Creek and Brushy Creek, both of which are perennial streams that drain in the French Broad River Basin. Also, many seeps, ephemeral, and intermittent drainages are found throughout the property.

Given the varying biotic and abiotic factors exhibited, the BMRA's forests are comprised of many different forest cover types including: Yellow-poplar (SAF Cover Type 57), Yellow-poplar-white oak- northern red oak (SAF Cover Type 59), White oak-black oak- northern red oak (SAF Cover Type 52), Yellow poplar – eastern hemlock (SAF Cover Type 58), Chestnut oak (SAF Cover Type 44), Shortleaf pine – oak (SAF Cover Type 76) and Pitch pine (SAF Cover Type 45).

Like much of the forest land located in the Southern Appalachians, the BMRA appears to have been harvested around the turn of the last century, with sporadic "selective" harvests implemented through the early 1960's. It appears that the lower, more gradual portions of the property may have also been woodland grazed by cattle and goats. Between 1910 and 1915 the City of Brevard purchased four parcels of land totaling 395.64 acres. The BMRA was the City's public water supply until 1979.



Map of BMRA's sample locations, Transylvania County, North Carolina

FOREST INVENTORY METHODS

A systematic forest inventory of the BRMA was conducted during the months of July and August of 2012. See Appendix G for a map of sample locations.

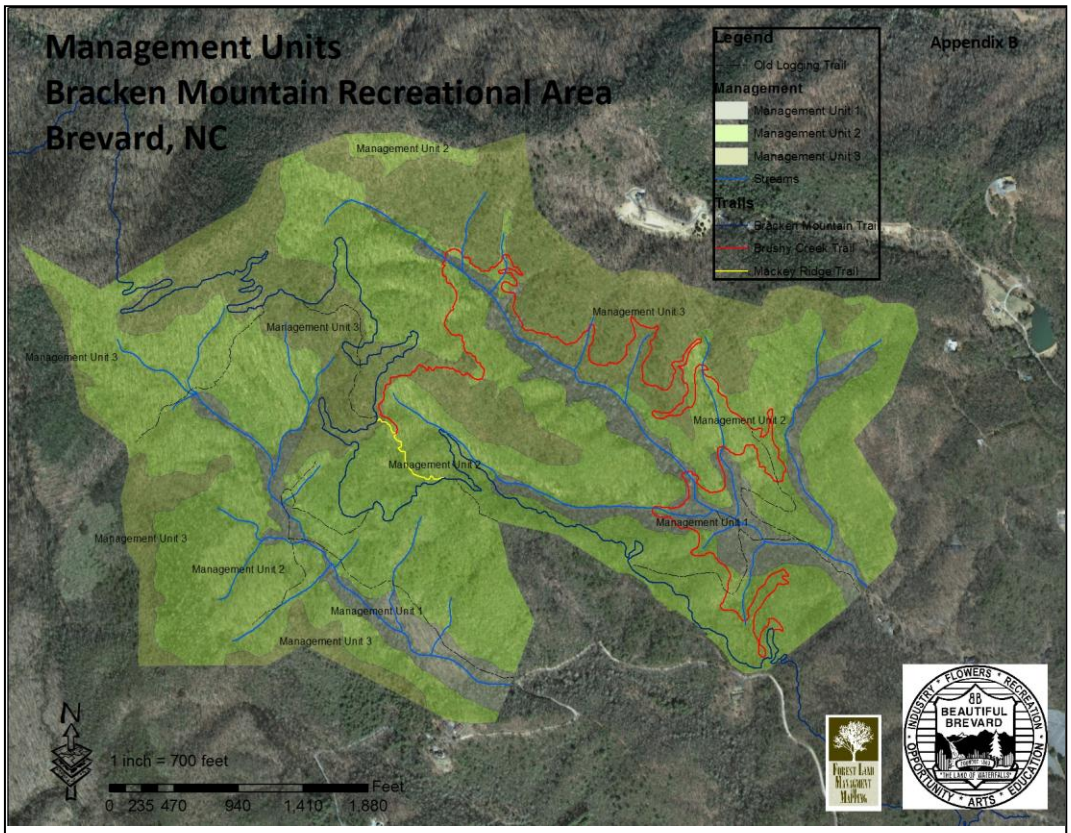
Prior to field data collection, thirty sample locations were established based on a 750 foot x 750 foot grid. These

locations were then transferred to a Trimble Nomad mapping grade GPS for field navigation. At each sample location a 10 BAF prism was used to tally and measure canopy and mid-story trees (all "tally" trees that were greater than 5 inches in DBH were measured). Also, at each plot a 1/500ac fixed radius plot was used to inventory advanced regeneration as well as woody and herbaceous plants. Aspect, slope, site index, canopy tree growth rate, forest health, and wildlife signs were also noted at each plot. While navigating between plots qualitative notes were taken.

Following the data collection phase, total volume, volume per acre, basal area, trees per/acre, regeneration per acre, average DBH, and site index were determined. Data collected from this inventory was also used in conjunction with the "Bracken Mountain Property, Baseline Documentation" qualitative and spatial descriptions gathered in 2006.

MANAGEMENT UNITS

The BMRA has been broken into 3 management units. With the classification of each of these management unit based upon the forest inventory and the Baseline Document



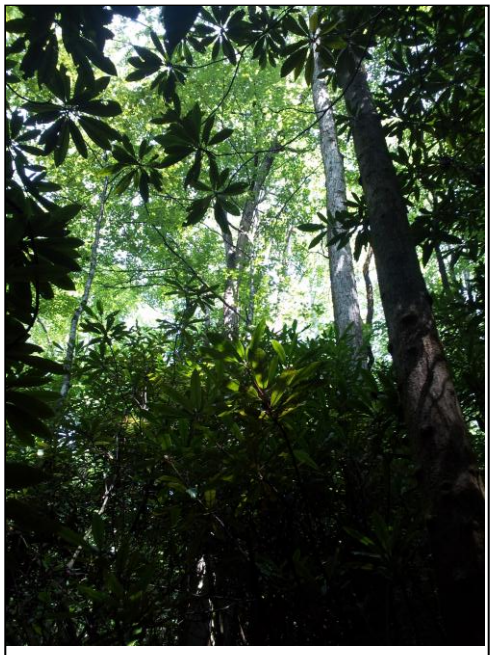
Map of BMRAs Management Units, Transylvania County, North Carolina

developed by Equinox Environmental. See Appendix B and C for a map of the location of these areas. For the purpose of this plan, management activities are made at the

management unit level with the exception of property wide activities which are summarized in the next section.

Management Unit 1 Cove Forest

Present Condition



A dense understory of Rhododendron can be found covering the forest floor in many portions of Management unit 1. Forest management efforts should focus on the protection of water quality by suppressing HWA and implementing erosion control measures along recreational trails.

Size: 41.76 Acres

Age: Even aged and Two-Aged Stand, in locals that where harvest approximately 50 years ago.

Site Index: Approximately 98 for yellow poplar.

Soil Types: BeV, TeE, FaG, and EdG

Aspect: Predominately southeast

Vegetation: Management unit 1 is comprised of trees and herbaceous plants found growing allowing the BRMA's drainages. A large portion of this management unit is an "Acidic Cove" forest with a dense understory of rhododendron. Overstory trees found include: yellow poplar, red maple, black birch, eastern hemlock, pignut hickory, and white ash. Presently, the management unit is fully stocked with an average basal area of 87 sq. ft./acre and an approximate tree spacing of 16.6' X 16.6' (for a summary of stand volume, average tree diameter, density, and number of trees, see Table 1).

The current stand density and the proliferation of rhododendron throughout the understory may have been fostered by selective harvesting practices, allowing conducive light levels for its growth.

A small portion of the acreage of this management unit can be classified as a "Rich Cove" forest. In this forest, the understory is rather open and comprised of a diverse mix of woody and herbaceous plants, and fungi. A good example of this "Rich cove" can be found at the lower portion of Bracken Creek.

Rich cove forest found in Management unit 1. A diverse and abundant mix of wood and herbaceous plants can be found.

This management unit, including the upper seeps, spring, and the headwaters of Bracken and Brushy Creeks, has a diverse mix of herbaceous plants. Rare and commercially threatened species were also identified in the 2006 Baseline Documentation by Equinox.

Shown above is crowned-tipped coral fungus found growing in an upper slope portion of this management unit's "rich" cove forest.

A majority of the Eastern hemlock trees throughout this management unit have succumbed to the hemlock woolly adelgid (HWA). The HWA is a small aphid-like insect that is native to Asia and was introduced in the northeastern United States during the early 1950s. This insect feeds by sucking phloem from tender growth and when doing so also injects a toxin into the tree. http://www.na.fs.fed.us/fhp/hwa/

HWA can be identified by the small white egg sacs found on the underside of hemlock branches. Also, infested hemlocks needle coloration can change from a vibrant grayish green appearance to a dark green color. HWA reproduces asexually and can have two generations per year. During the spring larvae emerge and are commonly spread by wind, birds, and mammals.

Eastern hemlock sapling found growing in Management unit 1. Young saplings can be found growing throughout this management unit and could be treated. By protecting these saplings a riparian corridor with evergreen trees may be maintained, protecting stream water quality.

Given the presence of this invasive insect, preservation of remnant living hemlocks trees in the overstory and understory should be considered for chemical treatments. These treatments could be performed during the spring and late summer. For additional information about the treatment of eastern hemlock please see the management recommendation section.

There were no other forest health issues found in this management unit. However, it should be noted that some Japanese stilt grass was found in an inventory point in the "rich" cove forest where Bracken Creek drains off the property. For additional information on the eradication of non-native invasive plants please see the property wide management recommendation section.

Table 1. Overstory Volume Inventory of Management Unit 1, BMRA, Transylvania County, NC.

Management Unit 1	Prism Cruise Volume Summary									3/1/2013
	Per Acre			41.76 - Acres		Ave Tree		Cruise		
Product	Volume	Trees	BA	Volume	Trees	Volume	DBH	Plts	Size	%Cr
Sawtimber	**bdft.**									
yellow poplar	2403.94	8.6	13.3	100389	359	279.53	16.8	3	0.15	1.1
fraser magnolia	1679.69	12.3	13.4	70144	514	136.56	14.1	3	0.11	0.8
northern red	647.98	0.9	3.3	27060	38	719.98	25.9	3	0.37	2.6
black oak	236.14	4.2	3.3	9861	175	56.22	12.0	3	0.08	0.6
chestnut oak	675.35	7.6	6.6	28203	317	88.86	12.6	3	0.09	0.6
scarlet oak	236.14	4.2	3.3	9861	175	56.22	12.0	3	0.08	0.6
southern red	421.85	2.7	3.3	17616	113	156.24	15.0	3	0.12	0.9
black birch	652.45	8.5	6.6	27246	355	76.76	11.9	3	0.08	0.6
pignut hickory	452.43	1.5	3.3	18893	63	301.62	20.1	3	0.22	1.6
mockernut	222.92	6.1	3.3	9309	255	36.54	10.0	3	0.05	0.4
Eastern	588.38	1.9	3.3	24571	79	309.67	17.8	3	0.17	1.2
red maple	660.66	6.2	6.7	27589	259	106.56	14.1	3	0.11	0.8
Sawtimber	**8877.93**	**64.7**	**69.7**	**370742**	**2702**	**137.22**	**14.1**	**3**	**0.11**	**0.8**
Hardwood	**cuft.**									
hardwood pulp	137.50	70.9	13.3	5742	2961	1.94	5.9	3	0.02	0.1
Hardwood	**137.50**	**70.9**	**13.3**	**5742**	**2961**	**1.94**	**5.9**	**3**	**0.02**	**0.1**
Pine	**cuft.**									
softwood pulp	26.65	17.0	3.3	1113	710	1.57	6.0	3	0.02	0.1
Pine	**26.65**	**17.0**	**3.3**	**1113**	**710**	**1.57**	**6.0**	**3**	**0.02**	**0.1**

Management Assessment and Recommendations:

As previously mentioned, many of the hemlock trees within this management unit have succumbed to the hemlock woolly adelgid, however, there are a few canopy trees and several seedlings and saplings in the understory that could be treated. By mapping, treating, and monitoring these species the City would be meeting the Recitals and Conservation Purposes of the Conservation Easement. By treating the residual trees, current and future stream water quality, stream temperature, and forest carbon cycling may be protected. (For information about HWA and control are response, visit: http://www.srs.fs.fed.us/pubs/ja/2013/ja_2013_vose_001.pdf.

All living hemlocks two feet or higher should be mapped using a recreational grade or mapping grade GPS. Following the inventory GPS, data should be transferred and converted in to a GIS shapefile or geodatabase file. This can be used for future navigation and to keep track of the frequency of treatment. Given that a majority of the treatment will be for smaller more vigorously growing trees and the limited access throughout this management unit, a soil injection treatment should be used (remember

that there are restrictions regarding the use of herbicides in proximity to water, the label is the law).

Co-dominate eastern hemlock found growing in management unit 1. Mapping, treatment, and monitoring of Eastern hemlock is required to preserve and protect this species, and the important ecological role it plays in the protection of water quality and nutrient cycling.

The following is from the Proceedings of Hemlock Woolly Adelgid in the Eastern United States Symposium 2002, written by Charles Silcox Ph.D. http://na.fs.fed.us/fhp/hwa/pubs/proceedings/2002_proceedings/imidacloprid.pdf

Soil treatment with imidacloprid provides the longest duration of hemlock woolly adelgid control, but it also is the slowest acting, and two or more months may pass before acceptable control is achieved. There are three methods by which soil may be treated with imidacloprid. Soil drenches that uniformly apply the desired application rate in no less than ten gallons of water per 1,000 ft should be directed to the root zone around the base of the tree. High-volume soil injection using hydraulic sprayers with specialized soil injector nozzles may be applied using one of three application patterns. Using the Grid System, injection holes should be spaced on 2.5-ft centers in a grid pattern extending to the drip line of the tree. Using the Circle System, injection holes should be evenly spaced in circles beneath the drip line of the tree and extending inward from that line. The number of circles used depends on the size of the tree. Using the Basal System, injection holes should be evenly spaced around the base of the trunk and the holes should be located 6 to 12 in. from the trunk. The basal system is most commonly used for hemlock woolly adelgid control. Low-volume soil injection may be applied using the specialized Kioritz® injector. This finely engineered piece of equipment applies low volumes (typically 1 fluid oz/in. of tree diameter at breast height) of a highly concentrated dilution of Merit® 75WP using one of the three application patterns described above. Directions for applying Merit ® 75WP with the Kioritz soil injector are listed in Table 1. A minimum of four injection sites per tree must be used for each of the soil injection methods.

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Calculations for soil treatment with Merit® 75WP using high volume injection or drench applications involve the following five steps:

1) Calibrate the sprayer to determine its flow rate in gallons per minute.

2) Select an injection volume per inch of tree diameter at breast height.

3) Refer to Table 2 (Injection Times) to determine the amount of time required to deliver the desired volume per injection site. The example highlighted in Table 2 shows that ten seconds are required per in. of tree diameter at breast height when injecting one qt. of solution per site using a sprayer flow rate of 1.5 gal. per minute.

4) Decide how much solution is required.

Table 2. Merit® 75WP Injection Times

Volume per Site	*Sprayer Flow Rate (Gallons per Minute)					
	0.5 gallons	0.75 gallons	1.0 gallon	1.5 gallons	2.0 gallons	3.0 gallons
1 pint	15.0 sec.	10.0 sec.	7.5 sec.	5.0 sec.	3.75 sec.	2.5 sec.
1 quart	30.0 sec.	20.0 sec.	15.0 sec.	**10.0 sec.**	7.5 sec.	5.0 sec.
2 quarts	60.0 sec.	40.0 sec.	30.0 sec.	20.0 sec.	15.0 sec.	10.0 sec.
1 gallon	120.0 sec.	80.0 sec.	60.0 sec.	40.0 sec.	30.0 sec.	20.0 sec.

* Site = Soil injection site – the selected volume is applied per inch of tree diameter at breast height.

5) Refer to Table 3 (Fill Rates) to determine the amount of Merit® 75WP that should be mixed in the desired volume of water based on the injection volume identified above. The example highlighted in Table 3 shows that 26.8 ozs. of Merit® 75WP should be mixed in 100 gal. of water when applying the maximum application rate using 1 qt./in. of tree diameter at breast height.

Table 3. Merit® 75WP Fill Rates

Volume Per Site*	Label Rate Per Inch or Foot	Product Per 100 Gallons	Product Per 50 Gallons	Product Per 25 Gallons	Product Per 10 Gallons	Product Per 1 Gallon
1 Pint	Minimum	26.8 ozs.	13.4 ozs.	6.7 ozs.	2.68 ozs.	0.268 ozs.
1 Pint	Maximum	53.6 ozs.	26.8 ozs.	13.4 ozs.	5.36 ozs.	0.536 ozs.
1 Quart	Minimum	13.4 ozs.	6.7 ozs.	3.35 ozs.	1.34 ozs.	0.134 ozs.
1 Quart	Maximum	**26.8 ozs.**	13.4 ozs.	6.7 ozs.	2.68 ozs.	0.268 ozs.
2 Quarts	Minimum	6.7 ozs.	3.35 ozs.	1.675 ozs.	0.67 ozs.	0.067 ozs.
2 Quarts	Maximum	13.4 ozs.	6.7 ozs.	3.35 ozs.	1.34 ozs.	0.134 ozs.
1 Gallon	Minimum	3.35 ozs.	1.675 ozs.	0.84 ozs.	0.335 ozs.	0.034 ozs.
1 Gallon	Maximum	6.7 ozs.	3.35 ozs.	1.675 ozs.	0.67 ozs.	0.067 ozs.

* Site = Soil injection site – the selected volume is applied per inch of tree diameter at breast height.

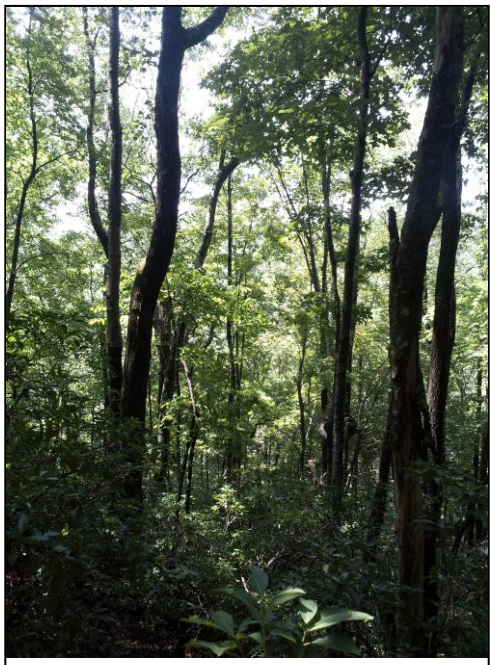
Trunk injection with imidacloprid for hemlock woolly adelgid control may be accomplished using either Imicide® or Pointer® Insecticide (described earlier). Imicide® is typically injected into the root flare of the tree using a self-pressurizing 2 ml capsule. The number of capsules used is a function of the circumference of the tree at breast height. One capsule is used for each 6 in. of tree circumference. Given that Imicide® contains 10% imidacloprid and the specific gravity of the formulation is 1.05, this treatment provides 35 mg of active ingredient per inch of tree circumference. Pointer® Insecticide is typically applied using the Wedgle® or Arborjet injector. The volume of formulation applied is a function of the circumference of the tree at breast height. formulation is injected for each 4 to 6 in. of tree circumference. Given that Pointer® contains 5% imidacloprid and the specific gravity of the formulation is 1.073, this treatment provides 8.9 to 13.4mg of active ingredient per inch of tree circumference.

The City should also consider the possibility of planting Eastern white pine in this management unit. Eastern white pine grows well on many of the same sites that Eastern hemlock can be found growing. By establishing white pine near the stream, fluctuations in stream temperature could be mitigated. Currently, as the hemlocks have succumbed to the HWA, hardwoods species have begun to occupy the space left in the canopy. Chemical and mechanical methods would need to be applied so that planted white pine would not be suppressed by hardwoods and allow for enough sunlight for this species establishment and growth.

Partnerships could be sought with research institutions looking toward the development of blight resistant eastern hemlock. Currently, the Department of Entomology in conjunction with CAMCORE is conducting research on the development and breeding of blight resistant hemlock. The City should enter with caution regarding experimental programs, given the Recitals and Conservation Purposes of the Easement. Great potential could come out of a partnership with state and federal research projects geared toward the preservation of native tree species. http://www.camcore.org/

Management Unit 2 Upland Oak – Mixed Hardwoods

Present Condition



Management unit 2 is comprised of a mix of hardwoods species found growing on side slopes and upper coves. This management unit is primarily even-aged and regenerated from harvests that occurred during the first part of the twenty century.

Size: 242.28 Acres

Age: Primarily Even-aged with some Multi-cohort stands

Site Index: Approximately 75 for red oaks.

Soil Type: AnE, BeV, CbE, FaG, FaE, FaF and EdG

Aspect: Predominately southeast

Vegetation: Management unit 2 is comprised of trees and herbaceous plants found growing on mixed mesic side slopes and upper coves. Tree species found included: chestnut oak, red maple, white oak, black oak, scarlet oak, yellow poplar, sassafras, sourwood, black gum, pignut hickory, and pitch pine. Presently, the management unit is slightly understocked with an average basal area of 77 sq. ft./acre and an approximate tree spacing of 17.7' X 17.7' (for a summary of stand volume, average tree diameter, density, and number of trees, see Table 1).

It appears that this management unit is even-aged with a majority of the canopy trees being approximately 95 to 110 years old. While there is no recent record of fires on the property over the last two decades, signs of fire scars were present on trees in this management unit.

Portions of this management unit are relatively "open" and lack the dense ericaceous vegetation found in management unit 1 and 3. These conditions in some locales have allowed for the development of advanced oak regeneration, that given time and the

right disturbance, will have a chance to occupy the canopy. In more xeric locations a dense understory of Vaccinium spp. can be found.

Portions of management unit 2 have an establish understory comprised of northern red oak, black oak, scarlet oak, and chestnut oak. The use of fire including mechanical removal of the mid-story could support the future growth of these species.

American chestnut trees were also found growing throughout this management unit from old stumps and root systems. A majority of the chestnut can be found growing along upper side slope positions and along the northern property boundary. No signs of fruit producing chestnuts were found while on the property, but there were several chestnuts that were over twenty feet in height.

Cryphonectria parasitica (Chestnut Blight) is responsible for the mortality of the American chestnuts. However, it can take some time for this pathogenic fungus to "kill" a tree. Given the large presence of American chestnut in this management unit, efforts could be made on establishing blight resistant chestnuts. For more information of the establishment of American chestnut please see the management recommendations portion of this document.

With the exception of HWA and the Chestnut Blight there were no other non-native invasive pest or pathogens found in this management unit.

Table 2. Overstory Volume Inventory of Management Unit 2, BRMA, Transylvania County, NC.

Management Unit 2 **Prism Cruise Volume Summary** **3/1/2013**

	Per Acre			242.28 - Acres		Ave Tree		Cruise		
Product	**Volume**	**Trees**	**BA**	**Volume**	**Trees**	**Volume**	**DBH**	**Plts**	**Size**	**%Cr**
Sawtimber	**bdft.**									
chestnut oak	1115.42	8.9	10.6	270244	2156	125.33	14.8	13	0.12	0.6
white oak	816.41	3.8	7.0	197800	921	214.84	18.4	13	0.18	1.0
red maple	864.22	7.1	9.3	209383	1720	121.72	15.5	13	0.13	0.7
scarlet oak	548.86	2.8	4.6	132978	678	196.02	17.4	13	0.16	0.9
southern red	150.56	2.0	1.6	36478	485	75.28	12.1	13	0.08	0.4
northern red	443.91	2.0	3.2	107551	485	221.96	17.1	13	0.16	0.9
black gum	130.72	1.7	1.6	31671	412	76.89	13.1	13	0.09	0.5
black oak	313.37	1.1	2.3	75923	267	284.88	19.6	13	0.21	1.1
pitch pine	172.55	1.3	1.6	41805	315	132.73	15.0	13	0.12	0.7
yellow poplar	149.03	0.4	0.8	36107	97	372.58	19.1	13	0.20	1.1
black locust	164.49	0.9	1.6	39853	218	182.77	18.1	13	0.18	1.0
Sawtimber	**4869.54**	**32.0**	**44.2**	**1179792**	**7753**	**152.17**	**15.9**	**13**	**0.14**	**0.7**
Hardwood	**cuft.**									
hardwood pulp	393.10	106.5	33.1	95240	25803	3.69	7.5	13	0.03	0.2
Hardwood	**393.10**	**106.5**	**33.1**	**95240**	**25803**	**3.69**	**7.5**	**13**	**0.03**	**0.2**
STAND		**138.5**	**77.3**		**33556**		**10.1**	**13**	**0.06**	**0.3**

Management Assessment and Recommendations:

Prescribed Fire

Given the management objectives, easement constraints, current species composition, structure, and growth; prescribe fire could be used as an integral tool to: promote oak regeneration, suppress and control ericaceous vegetation, establish warm season grasses, and reduce the changes of catastrophic wildfire.

The historical use and frequency of fire is well known in the southern Appalachians. Over the last century, fire suppression techniques, and the continued decline in use by humans, has altered forest conditions from their pre-settlement state. The reintroduction of fire in management unit 2 and 3 through a series of periodic rotational prescribed burns could be implemented. By doing so, varying successional, structural, and habitat conditions could be developed that would meet the City's

Large southern red oak found growing in management unit 2. In many portions of this management unit red oak and white oak dominate the canopy, and provide excellent hard mast for both game and non-game species.

restorative and forest health focus areas. The intensity and frequency of fire will have diverse and lasting effects on management units 2 and 3, therefore implementation of prescribe burning must be carefully planned. Prior to burning, the effects of each of the recommendations listed here should be evaluated to ensure that the intensity, frequency, and size of the burn area meet the plan's overarching goals.

When planning each burn the following areas and rationale should be addressed:

- **Fuel reduction:** A series of low intensity fall and/or spring burns could be used to reduce fuel loading that has occurred do to the lack of fire and past land use of the property. According to the "Bracken Mountain Pre-Attack Fire Plan" written by Kenneth McJunkin of the NCFS, no fires have been record by the Transylvania County Forest Rangers office over the past 25 years (duration in which record keeping started). Fuel reduction burns could be implemented on a 2 year to 3 years basis until fuels are at desired level. These burns would also meet other management objectives.

- **Hardwood and Ericaceous vegetation control:** Given the lack of fire on BMRA, the amount of ericaceous vegetation and the relative density of this vegetation continues to grow and expand across the forest. Also, with the absence of fire, non-adapted species like red maple have also become prolific.

  By implementing relatively hot fires, and possibly in conjunction with the mechanical removal of mountain laurel and rhododendron, mortality of these species may be accomplished. This would allow for additional light and growing space for grasses, woody and herbaceous plants.

- **Establishment of oak and pine regeneration:** In both management unit 2 and particularly in management unit 3, periodic and occasionally stand replacement fires once occurred. These fires allowed for the scarification of the forest floor, clearing organic matter allowing for acorns and pine seed to germinate on bare mineral soil. Some of the species found in management unit 3 have serotinous and semi-serotinous cones requiring fire to open the cones so the seed could disperse. While these fires would kill oaks and other hardwood species, (red maple, yellow poplar, black birch) given the growth strategy, oak would continue to re-sprout following periodic fires where the other hardwoods could not.

  In portions of management unit 2 that exhibit a relatively open understory, low intensity repetitive fires implemented on a two to three year base could be used to foster the establishment of oak regeneration as well as control the competition from other hardwoods. In the ericaceous, oak – pine forests of management unit 3, particularly in portions of this management unit where growing conditions are poor, and selective logging practices are evident. Hot stand replacing fires could be used to cause mortality in overstory trees, creating an environment that would be conducive to the establishment of a young vigorously growing forest.

To effectively implement the use of fire within management unit 2 and 3, a generalized pre-burn map has been developed. See appendix E for map. The units on this map have been delineated in a manner to reduce the construction of fire lines by using existing trails and old skid trails. Additional onsite evaluation of each unit should be performed before executing a burn to assess the conditions of the burn area and to shape a specific burn plan that reflects the ecological goals for the area.

While the use of fire to "restore" forests has become popular among land managers, and studies have indicated the benefits or lack of detriment to the ecosystem. Care should be exercised, particularly given the Retails and Conservation Purposes of the Easement, regarding water quality. Excessively "hot" frequent burns can completely volatize the litter and duff and leave large areas of exposed mineral soil causing the potential for erosion. While some studies have indicated that repetitive burning has little effect on nutrient transport, alternations in soil chemistry should also be noted. Keeping a diverse landscape of varying conditions is the key, and the use of fires should be implemented judiciously.

I would highly encourage the City to partner with the Upland Ecology Work Group (USFS), NC Wildlife Resources Commission, and NC Forest Service. These agencies and work groups can provide the technical expertise, manpower, tools, and equipment to safely execute a fire. Should the Upland Ecology Work Group need additional study sites, I would encourage the City to join in partnership to further the scientific knowledge on the effects of fire on forests in the southern Appalachians.

This link discusses the use and ecology of using fire as a tool in the southern Appalachians: http://www.firescience.gov/projects/briefs/01-3-3-14_FSBrief35.pdf

This link discusses the history and change in the landscape due to the lack of fire: http://coweeta.uga.edu/publications/2233.pdf

This link discusses the development and use of a burn plan and provides an example of a burn plan: http://www.tncfiremanual.org/burnplan.HTM

American Chestnut Restoration

Presently, there is a great deal of research taking place in the Pisgah National Forest on the re-establishment and restoration of the American chestnut. Initial studies have indicated some challenges in the restoration of this species including hardwood competition and phytophthora. http://www.mdpi.com/1999-4907/3/4/1017

A partnership could be established with the City, USFS, and the American Chestnut Foundation to experiment with various plants under different soil, light, and possibly fire regimes to study the effectiveness of species establishment. By partnering, the City would gain first-hand experience on how to make the re-establishment of this species a success. http://www.fs.fed.us/r8/chestnut/

If a partnership cannot be established, the City could request and/or possibly purchase B3F3 resistant chestnuts and under plant them in various light conditions, where current chestnut seedling and saplings are found. Chestnut is relatively shade intolerant, so plantings that are in rather sunny areas will do best. If this approach is used, I would recommend that the city plant only 100 to 200 trees during the first planting, then monitor the survivability for two years before continuing with additional plantings.

Management Unit 3 Ericaceous, Oak – Pine Forest

Present Condition

A dense understory of mountain laurel can be found throughout management unit 3. Management unit 3 provides for excellent thermal cover for game and non-game species.

Size: 115.38 Acres

Age: Primarily Even-aged with some Multi-cohort stands

Site Index: Approximately 58 for oaks

Soil Type: AnE, BeV, CbE, FaG, FaE, and FaF

Aspect: Predominately southeast to southwest facing

Vegetation: Management unit 3 is comprised of trees and herbaceous plants found growing on xeric ridge lines and steep south facing side slopes. Two common forest types occur in this management unit, including a xeric almost "stunted" oak forest and an oak - pine heath forest. Tree species found included: chestnut oak, sourwood, blackgum, pitch pine, scarlet oak, and table mountain pine.

Shown above is a large shortleaf pine. While this tree is rather large, a majority of this management unit is comprised of very xeric sites, with trees that exhibit poor growth and form.

Presently, the management unit is slightly understocked with an average basal area of 64 sq. ft./acre and an approximate tree spacing of 16.2' X 16.2' (for a summary of stand volume, average tree diameter, density, and number of trees, see Table 1). Growing conditions are harsh with very shallow, rocky, well drained soils. Mountain laurel in many of these locals dominates the understory. Fire scars are evident in these areas and species composition indicates

that these forests are fire dependent communities.

Like management unit 2, it appears that the forest was established following harvesting at the turn of the last century with possible human or natural fires occurring in the past 50 to 60 years.

Management efforts should focus on fuel reduction where mortality and growth characteristics warrant fires that create a young, vigorously growing forest.

Table 3. Overstory Volume Inventory of Management Unit 3, BRMA, Transylvania County, NC.

Management Unit 3				Prism Cruise Volume Summary						3/1/2013
	Per Acre			115.38 - Acres		Ave Tree		Cruise		
Product	Volume	Trees	BA	Volume	Trees	Volume	DBH	Plts	Size	%Cr
Sawtimber	bdft.									
chestnut oak	817.05	7.1	8.8	94271	819	115.08	15.1	9	0.12	1.0
pitch pine	686.47	3.3	5.5	79205	381	208.02	17.5	9	0.17	1.3
scarlet oak	695.39	4.5	6.6	80234	519	154.53	16.4	9	0.15	1.1
red maple	157.43	2.8	2.2	18164	323	56.23	12.0	9	0.08	0.6
black gum	74.31	2.0	1.1	8574	231	37.16	10.0	9	0.06	0.4
black oak	85.75	0.6	1.1	9894	69	142.92	18.3	9	0.18	1.4
Sawtimber	**2516.40**	**20.3**	**25.3**	**290342**	**2342**	**123.96**	**15.1**	**9**	**0.12**	**1.0**
Hardwood	cuft.									
hardwood pulp	425.63	129.6	37.8	49109	14953	3.28	7.3	9	0.03	0.2
Hardwood	**425.63**	**129.6**	**37.8**	**49109**	**14953**	**3.28**	**7.3**	**9**	**0.03**	**0.2**
Pine	cuft.									
softwood pulp	31.99	14.8	3.3	3691	1708	2.16	6.4	9	0.02	0.2
Pine	**31.99**	**14.8**	**3.3**	**3691**	**1708**	**2.16**	**6.4**	**9**	**0.02**	**0.2**
STAND		**164.7**	**66.4**		**19003**		**8.6**	**9**	**0.04**	**0.3**

Management Assessment and Recommendations:

With the exception of the establishment of American chestnut, the recommendation for this management unit is the same as management unit 2. A greater focus should be given to stands within this management unit that seem to be experiencing mortality as a function of loss of vigor and growth. By using fire to regenerate these stands, a new age class of fire adapted trees could become established.

BMRA, Property Wide Management Assessments and Recommendations

Trail System

Additional erosion control measures are needed on the BMRAs trails. These measures include establishing vegetation, board based dips, water turnouts, and piling and stacking of brush.

Three single track trails can be found on the BRMA. These trails provide excellent access to a large portion of the property and tie into a trail allowing access to the Pisgah National Forest. The BRMA's trail system is well designed allowing for an excellent recreational experience for forest visitors.

To continue to enhance and improve the trail system several measures should be taken:

- **Erosion control:** Given the relatively recent construction of the trail system on the property and the immediate interest and use by the public, additional erosion control measures should be put in place. Presently, there are several areas that still exhibit exposed soil with little to no vegetation or erosion control.

Brush should be place on cut and fill slopes of the trail. The brush will reduce the impact of rain droplets and slow the flow runoff. By placing brush on the cut slope portions, users are less likely to walk or ride their bicycle on the embankment.

Cut slope portions of the trail are eroding do to users riding and walking on the embankment. Overtime this will undercut the bank and causing accelerated soil erosion.

In larger areas of exposed dirt and where slope will allow native grasses, legumes, and/or forbs should be established. See link for information about possible ground cover that could be used.
http://fwf.ag.utk.edu/personnel/charper/pdfs/PB1769.pdf
While this is a guide is for wildlife food plots, the plantings and cultural treatments that are recommended are very applicable, with a secondary benefit of providing potential browse for wildlife.

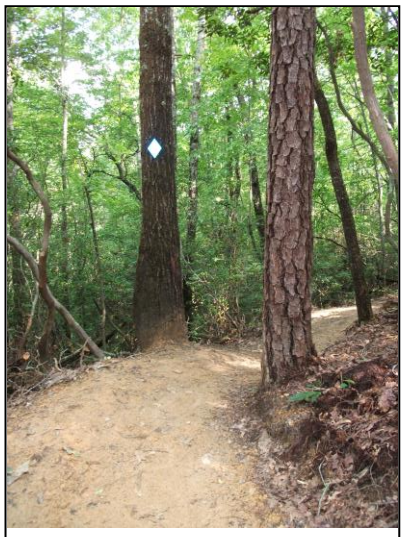
On steeper cut and fill slopes erosion control blankets could be staked to foster the

establishment of vegetation. Erosion control blankets are excellent for establishing vegetation, but the City should use caution and select blankets that do not use invasive grasses.

While the trail bed exhibits good drainage, portions of the trail could be out sloped to allow for better drainage. Also, broad base dips and water turnouts may need to be constructed along areas of steep grade, particularly along the right-of-way that is used to access the property. These measures will slow the travel of water and divert it off the trail.

For a comprehensive guide on trail maintenance, click on the following link to access the USFS "Trail Construction and Maintenance Notebook": http://www.fs.fed.us/t-d/pubs/htmlpubs/htm07232806/index.htm

- **Hazard Tree Removal:** Several hazard trees were identified while on the property. These trees need to be directionally felled away from the trail system and delimbed. The delimbed tops and branches could be placed on cut slope and fill slope portions of the trail. During trail construction, the contractor did an excellent job with trail placement, removing and/or damaging very few trees. In the contractor's effort to remove as few trees as possible, there are many areas that might limit access should emergency personnel need to perform a rescue. Where the trail goes between two trees the City should determine if the width will allow for emergency access. Hazard tree inventories should occur at least twice a year and following major storm events.



There are several locations were hazard trees or trees that may block access need to be removed. Trees should be directionally felled. Tops and branches should be used for erosion control measures and brush piles for wildlife.

- **Trail Marque:** An excellent trail Marque has been constructed. Updated maps should be placed on the Marque and also include a larger scale, "blown up" version of each of the three color coded trails. Maps could be sold at the trail Marque for a suggested donation, with donation collected in a USFS style fee collection tube: http://www.fs.fed.us/t-d/pubs/pdfpubs/pdf98232343/pdf98232343.pdf

- **Alternating Trail Use:** Given the interest and diverse user groups that were seen on the property, consideration of scheduling or alternating use of trails should be considered. For instance, closing Bracken Trail for just mountain biking and Brushy Trail for hiking, both user groups may have a more enjoyable experience.

Alternating use may be particularly important during times of heavy use. To view and example of scheduling practices used by the USFS for the Tsali Recreation Area visit the following site: http://main.nc.us/graham/hiking/tsali.html

- **Trail User Survey:** A user study and census should be implemented on the property. This census will allow the town to determine peak times of use, number of users, recreation types. This data could be important in scheduling maintenance times, budgeting, marketing, and aid in obtaining grant funding. http://www.railstotrails.org/resources/documents/resource_docs/UserSurveyMethodology.pdf

- **User Created Trails:** There are several areas on the property that exhibit the formation of user created trails. These areas can be found near switch backs or in areas that the user has a clear view of a lower portion of the trail. Brush piles should be made in these areas to dissuaded use. Also brush piles should be established where the fire breaks meet the trail. Currently there is not ample brush in place to deter use.

Additional brush or other measures could be put in place to reduce the creation of user created trails.

Right-of-Way

Several non-native invasive plants were found on the right-of –way that accesses the property. Eradication and control of these species is of immediate need.

Vegetation management will be required for BMRA's right-of-way and fire breaks. Several invasive plants were found along the ROW that include: oriental bitter sweet, multi-flora rose, Japanese stilt grass, Japanese honeysuckle, autumn olive, and sericea lespedeza. Please see http://www.srs.fs.fed.us/pubs/gtr/gtr_srs119.pdf for an excellent guide for identifying non-native invasive plants.

Given that the ROW is used by visitors and their pets, this area could allow for rapid dispersal of invasive plants into the BRMA. Both chemical and mechanical treatments should be applied starting Spring 2013. There are many methods that could be employed for the eradication of these species depending on the time of year, plant species, and size. Before treatment, the City should make an Invasive Plant and Pest Management Plan that addresses the following areas: elimination of entry and spread, mapping and monitoring, eradication and control, and rehabilitation of native vegetation. The city should focus on foliar applications during the growing season with

basal and stump spraying during dormant months or when large invasive plant stems are or have been severed. Foliar applications along the ROW should be applied by hand to avoid overspray and mortality of native vegetation. Hack and squirt methods using concentrated herbicide could also be used, but should be applied during late summer and early fall; this will prevent the herbicide from being "pitched" out. Remember the use of any herbicide must comply with its label. Given the type of herbicide and if the area is heavily used by people, signs and or closure may need to be considered for a short period of time. To access "A Management Guide for Invasive Plants in Southern Forests" click on the following link: http://www.srs.fs.fed.us/pubs/gtr/gtr_srs131.pdf

Many portions of the fire break have already started regenerate. A series of chemical and mechanical methods could be employed to control woody vegetation. Fire could also be used to control wood plants and promote the establishment of grasses and herbaceous plants.

Fire Break

The fire break which was put in by NCFS in 2011 provided the City with an excellent containment line should a wildfire occur on the property, as well as a fire line for the potential use of prescribed fire. There are several management activities that should be considered to maintain this break.

There are two sections where the fire break was not constructed due to slope, or is narrow due to the steepness of terrain. Efforts to complete and/or widen the control line should be implemented.

Woody plant and broadleaf vegetation control: The woody vegetation in the fire break has begun to regenerate (from seed and vegetative) following the NCFS clearing. To keep this fire break accessible and to function as it is intended; a combination of herbicide and mechanical treatments should be applied. All stumps could be sprayed with Garlon 4A or equivalent and a basal spray application should also be made on stump sprouts and saplings found within the fire break. For use and application of this herbicide see: http://msdssearch.dow.com/PublishedLiteratureDAS/dh_08aa/0901b803808aa10c.pdf?filepath=ivm/pdfs/noreg/010-50685.pdf&fromPage=GetDoc

During the growing season a mixture of foliar and broadleaf herbicides could be applied using a spray boom mounted on an ATV. This method would be effective in vegetation control but could reduce the potential of the fire break to provide beneficial early successional vegetation for wildlife.

In an effort to reduce the use of herbicide, vegetation could be mechanically removed using brush cutters (http://www.stihlusa.com/products/trimmers-and-brushcutters/brushcutters-and-clearing-saws/fs560cem/) and where slopes permit a bush hog, however, stumps would still need to be treated. A continued partnership should be maintained with the NCFS to access possible grant funding for wild land fire prevention. This partnership could also extend to maintaining the fire line through continued application of forestry mulching. The need for forest mulching should be evaluated in 5 years to measure the effectiveness of chemical and mechanical treatments

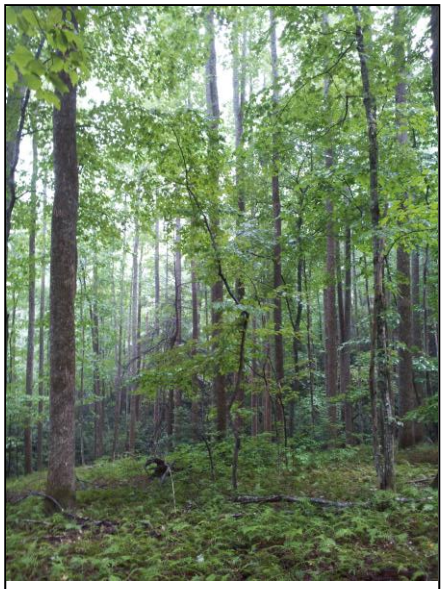
While it may seem counter intuitive, prescribed fire could be used along the fire break to promote the growth of native warm season grasses and other beneficial wildlife browse, and at the same time providing wood plant control. Secondary benefits of burning the corridor is reducing the fuel loading left from the mulching operation and decreasing the changes of fire being carried across the break.

Widening and finishing line: There are two steep locations on the property where slope either hindered or prevented the construction of a fire line. See appendix E for a map of the line locations. A small portion of the fire line on the southeast side is very narrow due to terrain and the limitation of mulching equipment to make multiple passes. In an effort to improve the efficacy of the line it could be widen by another 5 to 7 feet.

Along the northeast portion of the property on the ridge that forms Burr Mountain, a steep drop off prevented the access of the mulching machine. A hand line approximately 10 feet wide could be constructed in this area allowing for the property to be completely encircled.

Limitation of access: In effort to reduce user created trails, the City should consider whether gates or brush piles should be put in place to detour access by the general public. Access to these areas could become a public health and safety issues.

Recreation and Education



Some of the property's rich cove forest could be excellent places to establish a back country group camping area. Shown above is an area off of Brushy Creek Trail. Establishment of a camping site in this area would require minimal grading.

There are many possible educational opportunities for visitors of the BMRA. While recommendations on recreational and particularly educational opportunities are outside the scope of a forest management plan, opportunities have been listed below:

Level I:

- Installation of interpretative signage describing the property's forests and the management that is occurring in it. Should research partnerships be made with outside organizations signage could also be used, as long it does not impact research or bring unintended attention to the project. An example of interpretative signage can be found at: http://envirosigns.com/

- Scheduled naturalist hikes that are open to the public. Hikes initially could be announced using local news sources to encourage City residents to explore the property. Advertisement campaigns could be extended in the future to attract visitors to recreate in Brevard. These walks could be led by local naturalists or the City's Forest Technician.

Level II:

- Wooden benches could be built around the property to allow users a place to rest. A picnic table and benches could be constructed near the primitive camping area and/or at the parking area of Pinnacle Road.

- Creating overnight primitive camping areas. There are several possible areas that could be selected for this purpose. One of which is located in a cove right off the Brushy Creek Trail, see appendix F for its approximate location. The ground is level and a small area could easily be cleared and graded by hand or with a small track hoe. Camping could be made by permit only with permits obtained from City Hall. For information regarding

The City of Brevard has developed excellent trail signage for BRMA's trails. Should the City desire a series of interpretive education, signs could be developed in areas of interest on the property.

campground design please see the following publication:http://www.fs.fed.us/recreation/programs/accessibility/htmlpubs/htm06232801/page15.htm

Level III:

- Development of Interpretative and environmental educational programs for local youth. Programs could be part of the local school system as well as partnerships with regional educational groups (ex. Muddy Sneakers) and other summer camps. Interpretative and environmental educational programs could expand to the City's visitors.

- The opportunity to establish a viewing platform was listed in the Recitals and Agreement of the Conservation Easement. This tower would be strictly for recreational enjoyment, allowing visitors a view of the City and surrounding peaks. Currently many fire towers are being decommissioned on both federal and state lands and could possibly be acquired and assembled on sight.

- The development of a "Friends" groups could be helpful to the City. Friends groups, similar to the one at DuPont State Forest could provide the City with constructive input and a basis for community involvement and communication. The development of friends groups cannot be contrived. Encouraging and working with Citizens that have been involved in the earlier stages of meeting and planning is a great place to start.

Trespass and Enforcement of Game Laws:

Additional signage is needed to delineate the BMRA property boundaries. Demarcation of property boundaries will assist the City in the enforcement of BRMA's recitals and indicate to users that they are on City property.

Additional posting of boundary signs and demarcation is needed. Adjoining federal and state game lands are well marked but lack of signage on BRMA could cause liability issues and confusion of use. Additional signage and applying purple blaze markers would help users differentiate between federal, state, and private land possibly reducing resource related violations.

By painting an 8 inch strip of purple paint 3 to 5 feet above ground and visible from each boundary tree, wildlife officers, sheriff deputies, and/or City police can enforce hunting, trapping, and fishing regulations without the requirement of a search warrant. For more information regarding the Landowner Protection Act please visit the following links:

http://www.ncwildlife.org/Portals/0/Conserving/documents/LandownerProtectionAct/Landowner_Ad.pdf

(Proper way to mark trees)

http://www.ncga.state.nc.us/Sessions/2011/Bills/House/PDF/H762v6.pd f

(Landowner Protection Act State Statue, H762)

http://www.ncwildlife.org/Portals/0/Hunting/Documents/LPAFAQ_2011.pdf

(FAQ about the Landowner Protection Act)

Forest Management Personnel

It would be my recommendation that the City consider hiring a full-time Forest Technician to implement the BMRA management plan. By hiring an employee at a technician level, the City would be gaining an individual that could physically implement the forest management plan, while at the same time, having the education and technical ability to interface with BMRA users, City staff, and external partners. The technician must be self-directed and be able to implement the plan without day-to-day oversight. While it should not be the primary duty of the technician, an individual that can lead interpretive walks and educational programs is a must. The BMRA is an excellent resource for the Citizens of Brevard and its visitors. A technician that realizes this potential and the future opportunities the forest provides to the City is a must.

Should the City hire a Forest Technician, I would encourage them to search for someone with a two year A.A.S degree in Forest Management Technology and/or Fish and Wildlife Management Technology from an accredited school. Individuals that go through a technical college program have the competencies required to implement the forest management plan and realize the physical nature of the worked need to meet the plans goals. Listed are a set of skills and characteristics an employee could possess for this position:

- Possess an AAS degree in Forest Management Technology and/or Fish and Wildlife Management Technology from an accredited school. While a comparable education in related fields could be listed, the City should insure that their employee's education is based on "hand-on" field application. While the position could be offered to those with a Bachelors degree or higher in forestry or related fields, a majority of the work required is at the technician level.
- Basic knowledge and ability to operate equipment: Tractor, ATV, and possibly track hoe.
- Experience using the following hand tools: chainsaw, brush cutter, backpack sprayer, brush axe, and paint gun.

- Possess NCDA Commercial Pesticide Applicator's License or could obtain within the first six months of employment.
- Experience performing invasive plant and forest pest control, removal, and eradication.
- Proficient in ArcGIS 10. Able to develop, update, and maintain the property's GIS data.
- Proficient in GPS technologies. Ability to use a Trimble Mapping Grade GPS for data collection, correction, and update. Able to collect and record data using recreation grade GPS units for GIS.
- ISA Certified Arborist and/or could meet educational and experience requirements for this credential following commensuration of employment.
- Ability to lead interpretative walks and educational programs. Develop educational opportunities for users.
- Educational training such as Project Learning Tree, Project Wild, Project Wild Aquatic are preferred.
- Experience developing and implementing prescribe burns. Ability to coordinate prescribed burn operations with State and Federal Partners.
- During dormant season and periods of reduced recreational activity, technician could perform street tree, park maintenance, and possibly landscaping.
- Work with Friends group of BMRA.
- Interface, foster, and develop relationship with State and Federal natural resource management agencies.
- Coordinate user activities and user requests.
- Cite users that are not following BMRA rules. Work with City Police and Fire to enforce existing laws and protect users.
- Good interpersonal communication skills and willingness to interact on a daily basis with BMRA users.
- First aid and CPR training preferred.

Budgeted Time Line of Activities Bracken Mountain Recreation Area					
Recommendation	**Year**	**MU**	**Activity**	**Budget**	**Applicable Cost Share**
Prescribe Fire	2013 to 2024	2 & 3	Cyclical burns to promote a diverse ecosystem of varying ecological conditions. Reduce fuel loads to prevent the chance of catastrophic wildfire. Prescribe fire could be rotated on a 2 to 3 year basis.	Partnership and grant based. To be determined.	List of federal and state grant resources for fire protection and management. http://www.firewise.org/communities/usa-recognition-program/grants-and-funding.aspx Partnerships with USFS, NCFS, and NCWRC.
Fire Break Vegetation Control	2013 to 2024	NA	Stump spray and basal spray mulched trees along the corridor. Foliar application of herbicide during growing seasons. Mechanical cutting of unwanted vegetation. Mulching of break should be revisited every 5 years. Evaluate the use of prescribed fire in the break to reduce fuel loading, control hardwoods, and promote germination of herbaceous plants and grasses.	$2000 to $3000 for chemical excluding labor cost per year. Mechanical treatment and removal of vegetation $2,000 to $3,000 annually. Forestry mulching could cost upwards to 300 dollars an hour.	List of federal and state grant resources for fire protection and management. http://www.firewise.org/communities/usa-recognition-program/grants-and-funding.aspx Partnership with NCFS for use of forestry mulcher to maintain break.
Fire Break Completion	2013 to 2015	NA	Complete fire break in the northeastern portion of the property. Line should be cleared by hand. Line could be widened in the southeastern property where slopes limited machine access.	Approximately $3,000 to $5,000 dollars, labor included in this cost.	List of federal and state grant resources for fire protection and management. http://www.firewise.org/communities/usa-recognition-program/grants-and-funding.aspx Partnerships with USFS, NCFS, and NCWRC.
Invasive Plant and Pest Eradication Plan	2013	ROW, Fire Break,	Develop a plan that will guide the City with the identification, mapping, monitor, control, and eradication of	Contracted plan development would be 1,000 to	National Urban and Community Forestry Advisory Council:

		and MUS	invasive plants and pests. Completed prior to chemical treatment.	2,000 dollars (excluding mapping cost which could be done by the city). All treatments should be compliant with pesticide labeling.	http://www.fs.fed.us/ucf/nucfac.html#grants NCFS Urban & Community Forestry Branch: http://ncforestservice.gov/Urban/Urban_Forestry.htm
Invasive plant and pest monitoring	Annual	BMRA wide	As part of the invasive plant and pest plan, continually monitor, map, and treat invasive plants and pests.	TBD	NA
Hemlock Treatment	2 year cycle	MU1	As part of the eradication plan hemlocks showing vigor in the both canopy and understory should be treated. Treated trees should be mapped, monitored, and then retreated. Chemical treatment of HWA will be the most effective to control and mitigate the impact of the adelgid.	Soil injector $400 dollars. Merit 75 for soil injection $1,500. Could increase depending on the number of hemlocks found in MU1. Treatment would need to be repeated every two years (all treatments should be compliant with pesticide labeling).	Partnership with CAMCORE: http://www.camcore.org/
American Chestnut	TBD	MU2 and/or MU3	Establish partnerships with American chestnut foundation and USFS. Assess partnership and possible studies. Regardless of partnerships the City	TBD	Partnership with the American Chestnut Foundation: http://www.acf.org/ and USFS Upland Hardwood Ecology Work Group

			could focus on planting a minimum of 100 to 200 B3F3 chestnuts in various light conditions		
Trail Maintenance	Annual	BMRA wide	Implement erosion control measures that will prolong the use of the property's trails. Establish vegetation, brush, and physical controls, preventing the chance erosion and sedimentation.	Grass mats, stakes, and seed $2,000. Labor for installation as well as piling and stacking brush $3000 annually.	NA
Hazard Tree Removal	Bi-annual	BMRA wide	Identify trees with excessive lean, decay, fungal fruiting bodies, crooked tops and limbs that may jeopardize users. Fell trees and use brush for trail erosion control and brush piles for wildlife habitat.	$2,000 to 3,000 dollars annually.	NA
Backcountry Campground	TBD	MU1 or MU2	Develop a backcountry campground which will allow users to enjoy the property.	$3,000 to $8,000	
Interpretive Signage	TBD	BMRA wide	Development of educational signage that highlights management efforts as well as provides environmental educational opportunities for users.	Depending on material and design work estimated cost of $1,000 to $1,500 per sign	National Urban and Community Forestry Advisory Council: http://www.fs.fed.us/ucf/nucfac.html#grants NCFS Urban & Community Forestry Branch: http://ncforestservice.gov/Urban/Urban_Forestry.htm National Arbor Day Foundation: http://www.arborday.org
Educational and Interpretive Programs	TBD	BMRA wide	Provide interpretative walks of the forest for citizens and visitors. Expand environmental education partnerships with local environmental ed programs.	TBD	National Urban and Community Forestry Advisory Council: http://www.fs.fed.us/ucf/nucfac.html#grants NCFS Urban & Community Forestry Branch: http://ncforestservice.gov/Urban/Urban_Forestry.ht

			Potential partnership with summer camps and other community partners.		m National Arbor Day Foundation: http://www.arborday.org
Viewing area	TBD	TBD	Development of a viewing area to see property and surrounding vistas. Viewing structure could be a decommissioned fire tower.	TBD	NA
Forest Technician	TBD	NA	Implement and coordinate all management efforts on the BMRA. Develop BMRA as a model Municipal forest.	$30,000 to $40,000 annually	NA