

SOUTH MOUNTAIN RESERVATION

LANDSCAPE AND INFRASTRUCTURE ASSESSMENT AND RESTORATION MANAGEMENT PLAN

MARCH 2006



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Prepared For
The County of Essex Department of Parks, Recreation and Cultural Affairs

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Professional Planning and Engineering Corporation

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Executive Summary

South Mountain Reservation is a complex system whose ecology and historic fabric are affected by human forces both within and outside the Reservation. The successful improvement of the Reservation will only occur when all factors affecting the ecological health, the usage and the long-term management of the Reservation are addressed. The factors include:

- Deer management
- Forest regeneration including replacement of understory vegetation
- Invasive plant management
- Storm water management
- Erosion control
- Rehabilitation of wood road and trail systems
- Rehabilitation of elements of the cultural landscape
- Rebuilding other critical parts of the infrastructure
- Enforcement of appropriate use
- An adequate well-trained staff with adequate funding

This report documents and analyzes the existing conditions of these factors. It also provides recommendations for improvements, management and further investigations. These recommendations should be actively consulted as the restoration and rehabilitation of South Mountain Reservation proceeds forward.

EXISTING CONDITIONS ANALYSIS

The existing conditions in the Reservation were observed and analyzed from January 2005 through December 2005. Through this time site visits uncovered a wide range of issues relating to erosion, ecology and general use of the Reservation. Further investigations were conducted into the nature of the underlying geology, soil and hydrology. Reviewing the history of the Reservation's design and development compared to what exists today aids in understanding how many of these issues have developed over the years.

The Olmsted firm first considered the land for the South Mountain Reservation as early as 1899. The firm maintained consistent involvement with the Reservation until at least 1934, however, the Olmsted firm continued to be involved with Essex County Parks into the 1950s suggesting that the firm could have continued to make additional recommendations in this later period.

The most ambitious task that was proposed for South Mountain Reservation by the Olmsted firm was to use aesthetic forestry to create a varied and scenic experience through the strategic use of new plantings, pruning, and vegetation removal. This vision was never fully realized due to a lack of funding and the enormity of the task. Today many areas of the Reservation have reverted back to their original state: that of a monoculture forest. A

deciduous forest, unlike the planned large open meadows and coniferous pockets planned by the Olmsted firm, dominates the current Reservation. In addition, strains on the environment have led to a decline in the health of the forest.

Erosion within the forest ecosystem is occurring in areas of highly erodible soil, areas with a lack of soil cover, and in areas with steep slopes. It is also occurring along the West Branch of the Rahway River due to the natural change in the river alignment and sedimentation. The erosion has become exaggerated in areas where steep ravines are located, and in areas where man-made influences no longer allow for the natural flow of water through the forest. The erosion is causing an instability within the forest ecosystem and is also causing water quality degradation within the West Branch of the Rahway River. Invasive species are prevalent in areas of disturbance, forest edges and open canopies. Pockets of dead or declining trees have also been observed.

The aquatic systems identified in the Reservation include wetlands, tributaries, springs and open waters (West Branch of the Rahway River and associated ponds). The wetlands are in generally healthy condition with some observances of invasive vegetation. The intermittent, headwater tributaries are exhibiting erosion and undercutting.

The West Branch of the Rahway River as well as its associated ponds have been impacted by the construction of trails and roadways. Some erosion and invasive plants were observed along the banks. Some areas along the ponds have limited vegetation due to mowing or access by fishermen. The River has been classified by the New Jersey Department of Environmental Protection (1999) and United States Environmental Protection Agency (2002) as moderately impaired primarily due to the paucity of clean water organisms found there and contaminant exceedances including copper, lead, zinc and fecal coliform. A qualitative assessment of the River, based upon site visits and NJDEP and USEPA data, concluded the overall condition of the River is marginal, while the water quality has been determined to be moderately impaired.

Deer are a major component of the landscape throughout the South Mountain Reservation, and appear to be overabundant in many areas. The Reservation acts as a deer refuge, providing habitat in an area dominated by suburban residential development. The undeveloped portions of the Reservation provide the deer with the essential requirements of food, cover and fresh water. Continued development in the areas around the Reservation, converting the small remnant patches of wooded areas to residential development, will increase the deer's dependence on the Reservation.

From a population reduced to a handful of deer in the early 1900s, the deer have rebounded within Essex County during the latter part of the 20th century. A deer survey conducted in March 2004 revealed a population density of 63 deer per square mile, or roughly 200 deer (Predl 2005). Since then, the females have given birth to one to three fawns, raising the

possible number of deer to 300, or 93 deer per square mile. These populations have been browsing on the understory of the forest at levels that are changing the vegetative species composition and disrupting the natural landscape, the visitor's visual experience, and historic scenic value of many areas. Past studies have indicated that deer densities in excess of 20 deer per square mile will prevent natural forest regeneration.

South Mountain Reservation, with an estimated a deer population of 93 per square mile, has a deer population 215% higher than the Reservation's ecological carrying capacity can support. This is evidenced through the low to absent natural forest regeneration. The dense vegetation layer, presence of tree seedlings, forbs, shrubs, and wildflowers, even the accumulation of fallen leaves that forms much of the litter layer on the forest floor, has largely disappeared within most areas of the Reservation. Areas where trees are dying are not regenerating, largely due to browse of new seedlings. The areas with the most abundant understory are the areas containing freshwater forested wetlands and areas dominated by an invasive understory, typically in areas where the tree canopy is thin or nonexistent.

The Reservation trail system is one of the most heavily utilized resources in the Reservation. It was originally designed as a network of pleasure drives and pedestrian trails. However a lack of funding necessitated the development of the trails primarily into a series of unpaved bridle paths and blazed hiking trails. Two pleasure drives were paved, Crest Drive and a portion of Valley View Drive. (Valley View Drive is not open to vehicular traffic.) Trail alignments differ greatly in many areas compared to the original design. The bridle paths, many initially planned as pedestrian trails, were constructed on highly erodible soils often on very steep slopes. These trails are now exhibiting severe erosion. Many trails were also built in a deep cut situation, where the trail bed is lower than the adjacent land, turning many trails into drainage channels further adding to the erosion. The natural springs found throughout the Reservation also provide a constant source of water that often ends up flowing down the trails.

The soil has eroded to or near bedrock in many areas limiting absorption and increasing water flows. Management of the site's storm water has been through the use of swales, pipes and culverts. Many of these have become clogged or broken. Others are undersized due to the development outside the Reservation increasing the quantity and rate of flow through drainage courses. The erosion has caused headwalls around bridges and culverts to fail. Debris from these failures along with build-up of sediment has caused water to find new directions to get down the mountain, most often across the trails.

Many people visit the numerous picnic areas and open fields throughout the Reservation. Common problems in many of these areas include erosion from high use and storm water flow, closed restrooms, broken or nonfunctioning furnishings such as picnic tables and water fountains, lack of handicap accessible routes, lack of defined parking limits, lack of a design vocabulary for both furnishings and buildings and a lack of a coherent wayfinding system of maps and signage.

RECOMMENDATIONS

Recommendations for the factors noted above are included in the following categories: Design Guidelines, Aesthetic Forestry, Forest and Meadow Ecology, Trail Network, Aquatic Ecology, Roadways, Buildings and Structures, General Use Areas, Wayfinding System (Signs), Utilities, Tier One – Management Areas and Tasks, Tier Two – Overall Reservation Tasks, and Maintenance and Management.

Design Guidelines

Because the Reservation is a large and complex landscape, improvements are suggested over a ten-year period. It is therefore recommended that a coherent set of Design Guidelines be prepared as a first year task. Over the upcoming years, these Guidelines can direct the work of various landscape architects, engineers, foresters, architects, County maintenance personnel and volunteers in the appropriate design of the landscape and the facilities inserted into it. Thus, the style and materials of construction will be readily understood and can be applied to the Reservation over many years. Descriptions, scale drawings, historic photographs, plant lists and material lists should be contained in the guidelines and should be used as a reference for future work at the Reservation. Specific recommendations are presented in Chapter 4 Section 1.0.

Aesthetic Forestry

It is clear from analyzing the history of South Mountain Reservation that the site-wide program of forest management defined by the Olmsted firm did not succeed. After more than 25 years of the firm's attempts at detailed plantings and clearing, the task was clearly too ambitious to be realistic. Although there are many principles described by the firm that could and should be implemented, they should be done very selectively, in areas related to facility improvements and along highly used roadways. Such forestry, which would include selective clearing for vistas, planting of evergreen species to increase woodland diversity, and enhancement of under story vegetation, should be done on a 'project by project' basis as funding allows. This approach would allow the scenic quality, so strongly defined in the Olmsted plans for the Reservation, to be successfully implemented and managed in selected areas, so that the effect could be affordable and manageable.

In addition, it is recommended that areas designated on the Olmsted plans as open spaces, especially on ridge tops, be cleared and the meadow acreage increased to more closely follow the Olmsted plans. An opportunity exists in these upland open areas to establish shallow meadow bio-retention areas to capture and detain storm water to reduce erosion and drainage structure needs downstream in the lower elevations of the park. Additional consideration and evaluation would be needed to determine feasibility of meadow bio-retention areas. Specific recommendations are presented in Chapter 4 Section 2.0.

Forest and Meadow Ecology

The original Olmsted vision for the Reservation included maintaining the area both as a healthy ecosystem and as an aesthetic and educational resource. The native vegetation augmented according to the Olmsted aesthetic principles was to provide textural diversity for its own sake and as a backdrop to frame the significant vistas contained within the Reservation and looking outward. Maintaining the Reservation for aesthetic purposes requires a great deal of maintenance or, as referenced earlier, in the words of Frederick Law Olmsted “judicious use of the axe.” However, at the current time, maintenance and management of this important resource is limited due to economic constraints. Therefore, management of the forest ecosystem and enhancing the ecological and aesthetic strengths associated with this system need to be tied together with the current economics. The management plan must be adaptive, focusing on the diversity, connectedness and dynamics of the Reservation with the surrounding communities.

The location of the South Mountain Reservation, within the New York metropolitan area, can make a difference in the quality of life of those who live in the surrounding area. As the surrounding area continues to experience further development, the Reservation will become even more significant while becoming even more affected by outside influences. There is no one factor contributing to the forest health and aesthetics and therefore no one tool should be used to manage the Reservation’s forest ecosystem. Rather, the following management tools can be used in varying degrees, dependent on the budget allocated for Reservation management in any particular year and the degree to which a particular area or problem is perceived to be a priority.

A summary of the forest and meadow management tools include deer control, erosion control, forest regeneration and invasive species management and pest control. Please reference Chapter 4 Section 3.0 for more information.

Deer Management

Choosing an appropriate management program to address high deer populations in urban and suburban communities must take into account local interests, personal values, and community objectives. Residents who support active deer management programs, such as hunting, should have the same opportunity to express their views as people who defend more passive measures. After reviewing all available management programs hunting is the first recommended management option, with sharp shooting a second recommended option.

Hunting is a deer management option that even groups viewed as anti-hunting are beginning to endorse. Recent Star-Ledger articles contend that The Nature Conservancy, the Audubon Society, and the New Jersey Conservation Foundation all support the use of hunting as a viable, cost-effective deer management option. Hunting would incur few if any costs upon Essex County and can actually raise money for Essex County. Sharp-shooting can also be considered a cost-effective deer management option, but unlike hunting, requires some financial expenditure. The concept of using trained professionals to control deer populations

in a controlled setting has been successfully adopted by communities such as Millburn, Summit, and Princeton, and has been implemented in large public areas like Watchung Reservation in Union County.

Erosion Control

Within the southern and western central areas, planting of native, deer-resistant vegetation should be considered. Additional information is needed, due to the lack of soil cover and soil compaction within these areas, to determine the appropriate species. Coupled with these new plantings, dead wood should be staked parallel to the slopes to allow for the natural decaying of the tree and to slow sheet flow down the slopes.

Culverts and ditches must be kept free of debris and obstructions. The debris should not be side cast if there is a chance it will reenter the system. In areas where regular maintenance is not feasible due to a lack of manpower and resources, areas should be stabilized and, if possible, culverts should be removed and replaced with open ditches that can drain more freely without chance of obstruction.

In some areas, particularly along the Reservoir Trail behind the Turtle Back Zoo and Orange Reservoir, the wood road and trail have obstructed flow and scouring on both sides of the trail and road are visible. The road and trail should be regraded, culverts removed, and specific low points reinforced with stone to maintain drainage flow while still allowing access along the road. Also, within this area, there is a large flat section near the southeast end of the zoo where a freshwater wetland area could potentially be located to slow some of the sheet flow and provide water storage. Further investigation of this option is necessary to determine the feasibility by understanding the underlying soils, the potential effects to the surrounding area, and whether the benefits of the wetland creation will indeed slow erosion and improve overall water quality.

Forest Regeneration

Early successional forest, evidenced by seedling and sapling stands, are lacking in a majority of areas of the Reservation. In addition, within specific areas of the Reservation, particularly within the southern tip, the existing trees all appear to be of similar age. This raises concern about forest regeneration.

The County should utilize the services of an arborist or an Certified Tree Expert to study the lack of successional forest and similar age of the forest. Professional advice concerning forest regeneration should be made within the context of the Olmsted plans for these woodlands. The numerous notes on the various Olmsted plans for Job #2128, including plans 45 and 68, as well as the Reservation Chronology developed as a part of this report should be consulted when developing treatment plans for the forest health. These resources contain a wealth of recommendations for historic forest management and replanting.

In addition, selective planting within areas of concern should be accomplished. Selected vegetation should be native, diverse, within the parameters of the Olmsted design intent but non-invasive. Until the deer population are brought under control the vegetation should either deer-resistant or protected by tubes and repellent.

Another area of concern is the tree die-off that has been evidenced around the Reservation. A study of the die-off should determine whether the die-off is occurring in the red oak or white oak groups in the spring of 2006 to determine if the trees are dying as a result of "oak decline." Oak decline affects more than just oak species and could potentially change the nature of the forest in areas where the natural understory is nonexistent. Other features that should be checked are whether or not bore holes are symptomatic on the dead and dying trees, and what type of insects are observed on the various trees.

Invasive species and pest control

Priority areas for the treatment of invasive vegetation should be any areas where vegetation will be disturbed due to ongoing Reservation maintenance, restoration and rehabilitation activities. Immediately following any activities that disturb the vegetation and potentially increase edge habitat or increase light penetration into the forest, the areas should be seeded with an appropriate native grass (and forb, if appropriate) seed mixture and planted with native deer-resistant trees and shrubs. Selected vegetation should be native, diverse, within the parameters of the Olmsted design intent but non-invasive. Invasive species should also be removed in areas highly visible from main roads and at park entrances. Federal, State, and private funds should be sought under existing grant programs to assist in financing this effort with a long-term goal of Reservation - wide invasive vegetation management.

Trail Network

The current trail system and the proposed modifications below are based on the constructive elements on the ground. However, it should not be overlooked that the trails were, and are, an integral part of a planned system of experiences. Not only were they intended to provide sure footing, but they were also planned to lead to a range of woodland vistas. Additionally, the trailside vegetation, understory, middle and upper canopy, were planned to add important visual and sensual elements to the trail users' experience.

Trail Modifications

The possible modifications include improvements with existing configuration, narrow or convert bridle trail to hiking trail, relocate trail and remove trail. These were evaluated against criteria noted in Chapter 4 Section 4.1.1. The results are trail modifications that address the drainage and erosion problems and pedestrian access. The type of modification and trail affected is noted below. The locations of the trails are shown on Map 4.1.

Narrow or convert bridle trail to hiking trail: Mayapple Hill (outer loop-adjacent to Northfield Village), Hillspur Trail, Ravine Trail

Reestablish trail: Summit Trail to Mines Point and Ball's Bluff

Remove trail: Connector trail from Crest Trail to Swampy Trail (South of Deer Paddock), Openwood Trail, Rahway Trail (portions), Sunset Trail Crest Trail to Lenape Trail

Relocation: Reservoir Trail

Trail Maintenance Tools

There are several different tools that may be utilized for trail improvements. Each tool may be used individually or in combination with other tools dependent upon the specific site situation. Utilizing the tools in combination will be the most effective means to manage the trails.

In the design of all such constructed elements, every effort should be made to make these solutions reflect the historic setting and Olmsted plan for the Reservation. Constructed stone solutions should be made using rusticated boulders of stone native to the site wherever possible, set into the slopes in a natural manner. Design guidelines should be developed as an immediate task and utilized with the implementation of the types of management tools noted below. Chapter 4 Section 4.5 goes into detail to the appropriate use of each tool.

- Cobble crossing where drainage currently crosses the trail.
- Regrade trail to low spot with a cobble crossing.
- Enlarge swale adjacent to trail.
- Place stone within swale adjacent to trail.
- Replace broken pipe with same size pipe.
- Replace broken pipe with larger diameter pipe.
- Rebuild trail bed with crown
- Rebuild trail bed with cross slope
- Construct a water bar across the trail to direct the water across the trail
- Redesign and reconstruct existing bridge
- Replace pipe with a box culvert bridge with stone façade and walls.
- Replace pipe with elevated footbridge.
- Install a boardwalk in low-lying areas.

Other trail improvements are recommended that will allow for better circulation in the Reservation. These improvements include the reconstruction of the River crossing along east-west bridle trail/wood road just to the south of South Orange Avenue and the re-establishment of reinforced pedestrian trails from Summit Field to Mines Point and Ball's Bluff

Aquatic Ecology

The first step in developing a restoration design is to evaluate the existing stream channel for evidence of instabilities and determine the specific project goals. Each stream, along with its riparian zone and overall watershed, must be assessed individually, as suitable restoration measures will depend on factors such as type of instability, flow volumes, velocities, channel substrate, and existing topography. As man-made constraints are often determining factors in the selection of restoration measures, it is imperative that existing and future constraints and their affects are considered during the initial evaluation. An overall restoration approach that promotes stream stability and enhances aquatic and riparian habitat is then selected; oftentimes, the simple and least invasive approach is best. The plan can also include other corrective actions, such as upstream erosion control or reduction of impervious areas.

The next step is to perform technical studies to determine if the restoration design plan achieves the project goals. Examples include hydraulic and hydrologic analyses, sediment transport analyses, and habitat assessment of existing and proposed conditions. The final restoration design is an iteration of integrating the results of these studies and site constraints, resulting in selection of specific restoration measures that meet the restoration goals.

Typical stream instabilities that require restoration measures include bank erosion, bed degradation/erosion, and degraded habitat. Restoration measures involve adjusting the dimension, pattern, and profile of the stream to provide for a more stable channel geometry, alignment/sinuosity, and slope. Examples of restoration measures include:

Channel Bank Erosion Control Measures - Installation of root wads and other instream structures, recontouring of channel geometry, bankfull bench establishment, and revegetation / live staking of channel banks.

Channel Bed Erosion Control Measures - Installation of grade control structures such as cross vanes (rock or log) and step pools, and stream channel realignment.

Habitat Improvement Measures - Removal of fish passage obstructions, Installation of fish passage structures, installation of large woody debris for habitat creation, control of channel bed and bank erosion.

As can be seen from the overlap of restoration measures within the three categories above, installation of one measure often addresses multiple stream instability issues. Therefore, a successful restoration plan considers the interconnection of these instabilities and addresses the stream system as a whole. Chapter 4 Section 5.1 lists specific tasks to be completed.

Roadways

Physical barrier exist that impeade pedestrian curculation from the west side of the Reservation to the east side. These include County roadways and the West Branch of the Rahway River. These barriers coupled with poor signage directing users from the parking areas on the west side of Brookside Drive to the trail system on the east make it difficult for the Reservation to be fully utilized. It is important to provide safe visible areas to cross these roadways and the River. South Orange Avenue and Northfield Avenue have a pedestrian/equestrian bridge. An additional safe means to cross Northfield Avenue is needed where the West Ridge Trail crosses Northfield Avenue.

The only pedestrian bridge crossing the River is in Tulip Springs picnic area. Brookside Drive / Cherry Lane does not have any identified areas for pedestrians to cross. The existing parking areas on the west should be made into designated trailhead parking areas with signage noting trail access. Roadway crossings utilizing different pavement and signage should be developed and implemented. The County should work closely with the City of Orange to repair Campbell's Pond dam and pedestrian bridge. This is a critical pedestrian connection across the River. A new parking area should be developed on the east side of Brookside Drive just south of the maintenance facility. Parking areas on the west side of Brookside Drive between Dogwood Hillside and the maintenance facility should be discontinued and replanted with vegetation, similar in process as noted above in other sections.

Buildings and Structures

Work on all buildings and structures should be in accordance with the Secretary of the Interior's Standards. Design guidelines should be developed as an immediate task to provide direction for the rehabilitations and reconstruction improvements noted below and in Chapter 4 Section 7.2. Further research should be completed to date the construction of those buildings and structures where it is not noted herein and to create accurate detailed sketches with dimensions. This is important so their historic importance can be considered in the context of their rehabilitation. Prior to beginning any design or construction on the Reservation's buildings and structures the original condition should be keyed to historic fabric though primary and secondary sources of photographs, correspondence, plans, etc. and field documentation of measurements, materials and condition.

There are two main types of buildings within the Reservation: restrooms and what appear to be concession stands. Most restrooms are not functioning and have portable toilets brought in each year for the users. There were plans to replace existing restroom buildings and add new ones at additional locations in the 1980's that were never implemented. The need still exists today for these restroom facilities. The current restroom buildings should be renovated or demolished and reconstructed as planned in 1987. A new restroom facility at Shady Nook Picnic Area should also be constructed as planned in 1987. It is not appropriate, however, for a restroom facility to be located at Dogwood Hillside. All facades should be constructed with stone finish consistent with the historic plans.

There are two buildings that appear to have been concession stands when in use. One is located in the Oakdale Picnic Area should be restored and reopened as a concession stand. It can be run by a vendor. This is a good opportunity for the County to generate revenue off of concession sales. The building will need new electric and water service, both already existing nearby. Additional picnic tables should be located near the concession stand.

The other concession building located at the end of Valley View Drive should be maintained as a cultural artifact. Further investigation should be done for the adaptive reuse of this structure as an overlook or shelter. This location would provide good views of the First Mountain and a good resting spot for those utilizing Valley View Drive as a pedestrian trail. It is close to historic view points located along Valley View Drive.

Other buildings are located at the maintenance facility. The maintenance building is adequately screened from the adjacent roadways and from within the reservation. Regular maintenance is recommended. A new facility for the K-9 Police Unit is under construction. This facility should be screened from South Orange Avenue with vegetation in a design in keeping with the Olmsted plans and plant list. Olmsted plans 45, 68 and correspondence should be consulted to design and implement the vegetative screen.

There are several different types of structures within the Reservation. These include: overlooks, picnic shelters, dams, bridges (pedestrian, vehicular, equestrian / pedestrian), deer paddock pole barn, Boy and Girl Scout cabins and out houses, archery storage shed, site furnishings (BBQ grills, campfire grills, picnic tables, benches). These structures are in various conditions with needed rehabilitation ranging from minor repair to need for replacement. Chapter 4 Section 7.2 lists the recommendations for these structures. Overall, as noted before, the structures should be repaired and maintained in accordance with the Olmsted plans and correspondence.

General Use Areas

The general use areas are those areas within the reservation that are utilized for specific purposes such as picnic areas and the Scout Camps. These areas are: Locust Grove picnic area, Washington Rock overlook, NJ American Water Company structure, Summit Field picnic area, Bear Lane stairway, Bramhall Terrace, Brookside Drive, Elmdale picnic area, Hawk Hill, Painters Point, Dogwood Hillside, Shady Nook, Tulip Springs, Boy Scout Camp, Oakdale picnic area, Mayapple Hill, Turtle Back picnic area and the Girl Scout Camp. In general short term tasks include repair of site furnishings, stabilization of structures, and completion of further studies. Intermediate tasks include repair / replacement of restroom facilities, defining / paving parking areas and improving vehicular and pedestrian access, adding appropriate signage and implementation of further studies findings. Long term tasks include gradual replacement of site furnishings and shelters with historically appropriate designs when they are in need of replacement and control of invasive species. Chapter 4 Section 8.0 lists the specific tasks for each area.

Wayfinding System

Signage should be kept to the minimum needed and should be developed with a clear and consistent hierarchy of sizes for various functions. A consistent language of form, color and graphic design should also be developed for the park. All entrances to the park should be clearly marked with such consistent signage. Informational signage could be placed at historically significant locations describing the location such as Washington Rock., and Bramhall Terrace. The wayfinding system should be developed of a rustic design consistent with the materials and design of other historic structures still existent in the reservation today.

A larger, two sided, folded map should be developed consistent with the trail system and should include topography to aid the Reservation user. The map should also identify points of interest and include descriptions of each. It should be able reproducible in color and in black and white. The map could also include a brief description of the Reservation and it's history, the flora and fauna and the various recreational opportunities within the Reservation.

The map should be available at all trail head parking locations and picnic areas in map boxes with the major trail heads to have a kiosk where Reservation, County and community activities can be posted. The maps should also be located at County and local municipal facilities and libraries. Chapter 4 Section 9.3 lists tasks to be completed.

Utilities

Dialogue should be maintained with the City of Orange and West Orange Township to encourage any future work to modify the appearance of the utility structures and fences to be more in keeping with the historic character of the reservation. Adaptive reuse opportunities exist for the historic pump house at Campbell's Pond. It could be used as a ranger station or for educational use with exhibits on local historic water works and the Reservation. Any re-use would be dependent on cooperation with the City of Orange Township and a detailed historic, structural and programmatic analysis of the building. Any modification to the trail system needs to take into account where vehicular access is required to be maintained by the water company. The existing sanitary system provides the opportunity to construct new restroom facilities as has been proposed in the past.

Tier One – Management Areas

When restoration and maintenance are being completed a holistic approach should be taken that address all of the areas of concern at the same time. i.e.: Trail and Forest Road Restoration and Drainage; Forest & Meadow Ecology; Aquatic Ecology; Historic Integrity; General Usage; Other Infrastructure; and Maintenance and Management Policies. These tasks should be implemented with design guidelines appropriate to the historic character of the Reservation. The design guidelines should be developed as a Tier Two immediate task prior to the implementation of the Tier One recommendations.

One overall task and three priority management areas were selected for the first year of the management plan. The areas selected were observed to be those for which immediate management efforts would save time and money if accomplished now. However, if these areas are not managed immediately, the areas will continue to deteriorate and require more costly management efforts in the future. The management areas include (A) Southern tip of the reservation from the southern boundary to Washington Rock to Maple Falls and River Trail, (B) Reservoir trail behind Turtle Back Zoo and Orange Reservoir and associated drainage courses and (C) Mayapple Hill. In addition all areas within the Reservation that are disturbed as a part of the maintenance, restoration, rehabilitation process should be addressed as a part of each effort. Chapter 4 Section 11.0 lists specific tasks. The following are general descriptions of each management area.

Area A is heavily used by the public, and areas of active erosion are evident throughout the trails and within the forest. The forest is evenly aged with little or no undergrowth, so when the current crop of trees die out there is concern that forest regeneration will not occur and the site will be overrun with non-native invasive species with little or no tree canopy, similar to what is now occurring at the base of the old quarry and in the area mapped as Disturbed Forest.

Area B includes the area located near Reservoir Trail, Ravine Trail and Hillspur Trail, east of the Turtle Back Zoo and Orange Reservoir. Areas of erosion are evident in this area, undercutting old stands of trees. The large movement of sediment out of this area will result in a shallow cover of topsoil and a loss of a number of large trees if allowed to continue. The current road and trail system were not designed to work with the existing steep topography and are causing additional scouring and erosion, creating an unstable environment.

The area adjacent to Mayapple Hill (Area C) is currently being developed, greatly increasing edge habitat and light penetration into the forest. Also, there is already a large proportion of open spaces and roadway relative to forest within this area, so that the amount of edge habitat provides a stronger presence than overall interior forest habitat. This area of the forest was the primary area where invasive trees were observed – while the trees are not yet dominant, management during this period is recommended and would be cost efficient.

Tier Two – Overall Reservation Tasks

These tasks are to be completed concurrently with those in the Tier One Recommendations. Tier Two Recommendation tasks should be implemented with design guidelines appropriate to the historic character of the Reservation. These design guidelines are to be developed as an immediate task. Chapter 4 Section 12.0 lists the specific tasks. They include general tasks to be applied to the entire Reservation as well as tasks specific to maintenance and management policies and aquatic restoration.

Maintenance and Management

There can be a misunderstanding that 'restoration' of woodlands, can be accomplished as a discrete capital project designed, bid out and done within a short construction time of one year or less. This approach can be very destructive to woodlands and remnant habitats. Such an approach, by definition, concentrates site disturbance, involving removal of large amounts of vegetation all at once before initiating replanting and stabilization. A large project, done in a typical capital project manner, may span several seasons and even though it affects a portion of the site, may have a much larger impact.

Struggling natural vegetation is impacted. When forest restoration is viewed in the spirit of a capital project, the sheer amount of work undertaken becomes a severe stress to fragile remnant systems. Large-scale grading operations, extensive soil reworking, and massive planting efforts are, sources of disturbance and should be undertaken only where the landscape is in collapse, completely overwhelmed by invasive vegetation, or with severely and extensive erosion. Similarly, where the vegetation is a mix of desirable species and pests, complete elimination of all invasive vegetation at once may actually open up the landscape so much that a reinvasion, perhaps even greater in scale than before, is invited.

The habit of wholesale reconstruction is poorly suited to forest restoration. Forests themselves take a long time to develop. This approach also requires that the designer must make many assumptions about the site with very little information. Trees, for example, are routinely evaluated and only healthy specimen's preserved, yet in a natural landscape, many misshapen trees are the norm, and every stage from birth to mortality is found.

Another difficult aspect of restoration to comprehend, and the reason behind many unsuccessful capital projects, is the assumption that a complex living system can simply be installed in a season or two and then requires only maintenance. This misperception also lies behind the idea that a detailed comprehensive plan should, or even can, be developed before any restoration is initiated. Effective woodland restoration should be carried out over the long-term. Many sensitive species should not be planted until greater levels of stability have been achieved. In some areas this will take many years because native canopy and understory layers need to be established before enhancement of more fragile ground layer vegetation can be undertaken. Elsewhere it is impossible to assess the potential of natural recovery processes until the destructive impacts of misuse, exotics and invasive species are controlled. Restoring a landscape is like raising a child; you can't really do it all at once or even plan for it

all at once. This appraisal, however, should not be taken to mean no planning is necessary, only that a continuing planning process, with assessment and revision over time, is more realistic than a fixed comprehensive plan. Long-term goals for each area must be reviewed and agreed upon in concept and a comprehensive plan developed for each set of management actions before they are initiated. The overall process must be clear even if every detail of every stage is not yet fully worked out.

An incremental design and implementation process should proceed holistically. A good analogy is the holograph, which is from the same root work. A holographic image has depth and is more realistic than a two-dimensional figure. When a holographic negative is cut in half, each piece bears a whole image, but with slightly less detail. No matter how small and how many pieces, the image is always whole. This process of landscape restoration is like putting the pieces of this cut negative back together again, making it whole once more. Each stage of the design process must be whole, but a greater level of detail will emerge at each level. The implementation process, and later the management process, should be as incremental as each proceeding step. This process flows rather than proceeding from one discreet phase to the next.

Maintenance is one of the most frequently discussed issues in park management and perceived of as one of the most intractable. There is no faster way to get an emphatic negative answer than by requesting a significant increase in a maintenance budget, yet virtual every problem that's found in the Reservation woodlands, as well as most parks, for that matter, is ultimately tied to maintenance. Obviously, if the woodlands had been adequately maintained, there would be no need for wholesale ecological restoration. Yet, the willingness to spend money on new capital projects is matched only by the reluctance to spend money on staff, equipment, training and materials for maintenance. Ironically, such capital projects, once finished, rarely receive the maintenance they require and typically deteriorate rapidly, which just continues the cycles of "restore/decline", construction followed by neglect. This approach will be even less successful in the woodlands if the long-term goal is to establish relatively self-sustaining landscapes and largely native habitats. Even though designers today are urged to plant "low-maintenance" landscapes, a new landscape needs continuing care especially during the establishment period –from planting up to 3-5 years after.

The difference between a conventional capital project approach and that required for effective long-term landscape management of the woodlands is very different. The approach which is needed for management and maintenance of woodland areas is labor intensive and is best done by individuals who are familiar with the site and have a clear understanding of the difference between a typical landscape and a woodland landscape.

Ecological restoration is a long-term process requiring sound planning, monitoring, and coordinated staff and volunteer efforts using hand tools, small equipment and ongoing review and maintenance. A major area for cooperation between the South Mountain Conservancy and the County could be in the area of ecological restoration and programming of the Reservation woodlands. The woodlands and "ecological restoration" practices are terrific

opportunities for volunteers, and to develop educational programs for schools, boy and girl scout troupes and other volunteer organizations. The willingness of County workers to accept the use of volunteers is crucial to developing and implementing volunteer initiatives without requiring cumbersome and time-consuming union approvals. In addition, joint training sessions that included County staff, Conservancy staff and volunteers would help to build a sense of team-work and mutual cooperation and understanding. Chapter 4 Section 13.0 lists specific initiatives the South Mountain Conservancy and the County can undertake.

The best model that is appropriate for management of the South Mountain Reservation woodlands is a specially trained team supplemented with volunteers and targeted outside contractors. A specialized in-house team dedicated to woodland management would get more "bang for the buck", because good forest management is a lot more like maintenance than a traditional capital project. This maintenance team will require the appropriate equipment, training and budget to complete the necessary tasks. Many of the structures and buildings found in the woodlands require the same level of skill and sensitivity for their reconstruction and maintenance as do the woodland's natural systems. Skilled staff will be needed to rebuild the bridges, trails, shelters, and drainage systems in the woodlands. Woodland staff will need to be a multi-skilled with not only ecological restoration skills, but simple landscape construction skills such as the proper implanting of boulders in the landscape for erosion control, simple trail repair, simple carpentry skills, etc.

In addition, outside contractors will need the proper supervision for rebuilding of the shelters, bridges and other structures and masonry repair. Based upon a comparative analysis of similar woodlands we estimate the team should include a total of nine County staff (including full time and part time) and an annual budget (in 2006 dollars) of \$650,000 to adequately maintain the Reservation's woodlands.

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CHAPTER 1

Introduction



Chapter 1 – Introduction

1.0 GENERAL DESCRIPTION

South Mountain Reservation (SMR) is a valuable ecological, social and historic resource located in highly populated Essex County, New Jersey. The Olmsted Brothers firm designed South Mountain Reservation.

They were involved with the implementation of their design from the early 20th Century through the 1930's. Their design was unable to be fully implemented, however, due to lack of funding.

South Mountain Reservation is located within the Townships of Maplewood, Millburn and West Orange. South Orange Village borders portions of the eastern side of the Reservation. The City of Newark, the third largest city in the state, is only 10 miles away. Other municipalities within 10 miles include municipalities in Essex County and Union County to the south.

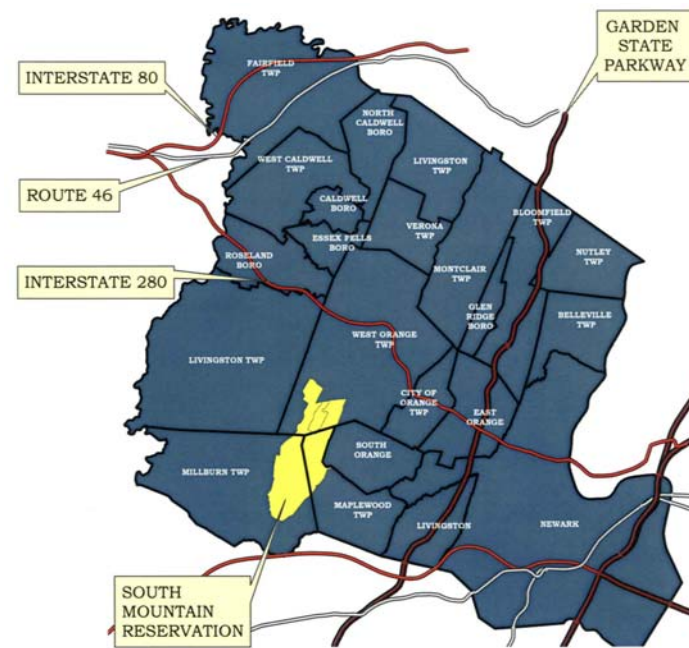


Figure 1 ~ South Mountain Reservation context in Essex County

The Reservation is easily accessible by car and NJ Transit. A bus stop located at the newly constructed park-and-ride parking garage at Richard J. Cody Arena off of Northfield Avenue in South Mountain Reservation. The Millburn train station is located across from the Locust Grove area between Grove Street and Essex Street and provides easy access on the Morris and Essex line from New York City in the east and Somerset, Morris and Warren Counties to the west.

The Essex County park system was severely neglected during the past administrations. South Mountain Reservation was not immune to this neglect. It was believed that due to the nature of the reservation being primarily forested lands with unpaved trails that little maintenance was required. This lack of maintenance has resulted in areas of forest dieback with little regeneration, erosion in many areas including along trails and drainage courses, and the loss of historic cultural artifacts.

The new Essex County administration understands the importance of parks and reservations to Essex County not only from a social standpoint, but also an economic one. Good parks and reservations make places more desirable to live. Residents of the local communities also see the benefit to parks and reservations and specifically South Mountain Reservation. They have formed a group called the South Mountain Conservancy to aid the County with maintenance and improvements within the Reservation. In 2004 members of the South Mountain Conservancy partnered with Essex County to gain state funding for up to four years of improvements in the Reservation.

Essex County voters established an Open Space Trust Fund in 1998 for the acquisition and restoration of park land. The Open Space Advisory Board, created to direct that fund, launched a broad assessment of the county park system in 2000. This culminated in a Park, Recreation and Open Space Master Plan in April 2003. While the report underscored the need for forest management and itemized a number of problems in the South Mountain Reservation, it did not provide a foundation for developing a long-term restoration plan after the years of neglect. This led to the advocacy by the South Mountain Conservancy and neighboring towns for a comprehensive assessment and plan that would set the vision for the Reservations restoration. Essex County provided a commitment to fund such a study by in early 2004.

This report, the Landscape and Infrastructure Assessment and Restoration Management Plan (LIA-RMP), sets the vision for the Reservation's restoration. The LIA-RMP is the result of the collaboration between the project team, South Mountain Conservancy and Essex County. The LIA-RMP is also commonly called the Master Plan.

2.0 PURPOSE

The LIA-RMP is a master plan for the Reservation. A master plan is an important tool developed to manage a study area and guide its future. A master plan takes into account not only the physical environment, but also the economic and social aspects that have impacts on the study area's growth and management.

The purpose of this master plan is to provide a framework, or roadmap, for the restoration and future improvements within South Mountain Reservation. The master plan provides for responsible stewardship of a valuable ecological, social, and historic resource amidst a suburban environment. Goals are understood as a part of the process. They are tested against historic, current and anticipated conditions and needs. From this process a series of treatments were developed for implementation throughout the restoration process.

The LIA-RMP is a living document and should be continuously consulted and updated as the restoration and rehabilitation efforts continue in the Reservation.

3.0 STUDY BOUNDARY

The study area includes the 2047 acres of land that is currently designated as South Mountain Reservation and extends from the ridge of the First Watchung Mountain to the west to the ridge of the Second Watchung Mountain. South Mountain Reservation is located within the Townships of Maplewood, Millburn and West Orange. South Orange Village borders portions of the eastern side of the Reservation. Map 1.1 Identifies the Reservation boundary and use areas within the Reservation.

Within this boundary includes land owned by the Essex County, including the Turtle Back Zoo and Essex County Richard J. Codey Arena, and the City of Orange. The City of Orange Township land holdings include areas along the West Branch of the Rahway River, some of which are accessible to the public such as Campbell's Pond and one major land form, Orange Reservoir, is not accessible to the public. The Turtle Back Zoo has a master plan completed in 2000. This report briefly discusses how the recommendations in the 2000 Master Plan would affect the remainder of South Mountain Reservation. The Richard J. Codey Arena has a master plan in progress. This report includes information provided by Essex County on past improvements.

The site is bounded by single-family residential development on all sides excluding the north along Northfield Avenue. Map 1.2 presents the different land uses within and surrounding the Reservation. Northfield Avenue, a county road, is a commercial district with restaurants and service industry businesses. At the time this study began in January 2005 the northwestern portion of the Reservation at Mayapple Hill was bordered by a farm on the south, undeveloped land to the west, single family residential to the north

and Pleasant Valley Way, a county road with commercial and multi-family residential, to the east. Currently the farmland is being developed into town homes and condominiums. The undeveloped land is being developed into single-family homes.

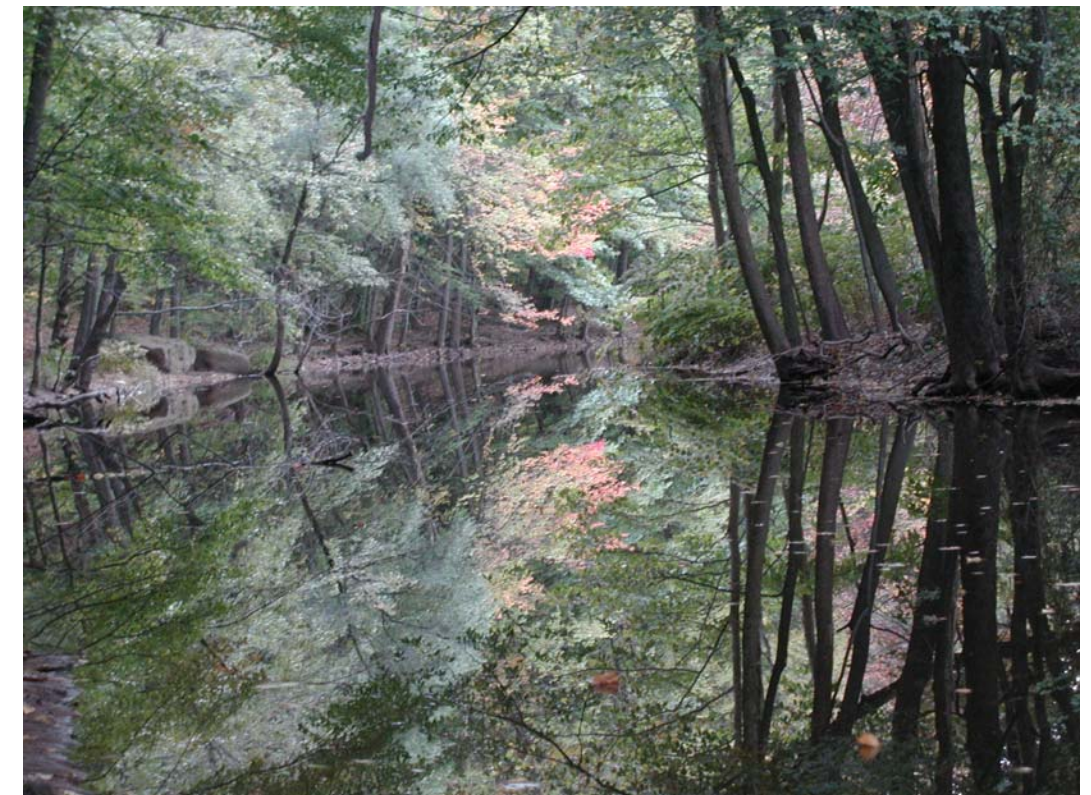


Figure 2 ~Present day Thistle Mill Ford in the fall.

4.0 GOALS

This section identifies the goals that are necessary to be undertaken for the sustainable restoration and rehabilitation of South Mountain Reservation. Please refer to section 6.2 in this chapter for further discussion of the terms restoration and rehabilitation.

Goal 1 Provide a holistic approach to the restoration and rehabilitation of South Mountain Reservation.

South Mountain Reservation is a complex system whose ecology and historic fabric are affected by human forces both within and outside the Reservation. The successful improvement of the Reservation will only occur when all factors affecting the ecological health, the usage and the long-term management of the Reservation are addressed. This includes forest regeneration including replacement of understory vegetation, invasive plant management, deer management, storm water management, erosion control, rehabilitation of wood road and trail systems; rebuilding of other critical parts of the infrastructure, and rehabilitation of elements of the cultural landscape, appropriate use enforcement, and an adequate well-trained staff with adequate funding.

Goal 2 Provide long-term support for the restoration and rehabilitation of South Mountain Reservation.

South Mountain Reservation is 2047 acres. It has been a struggle throughout the history of this Reservation to develop its features and maintain it to a level appropriate to its considerable resources. It has been subject to neglect, deterioration and inconsistent management for decades. The improvement of the Reservation cannot be accomplished with a couple capital projects over two or three years but will require continued long-range comprehensive planning for management and maintenance, coupled with appropriate funding. Improvements should be phased if necessary. The successful improvement will require a commitment to continued planning and design, ongoing monitoring, review and maintenance and adequate and coordinated staff and volunteer efforts.

Goal 3 Update the Landscape Infrastructure Assessment and Restoration Management Plan (LIA-RMP) every five years.

The LIA-RMP is not intended to be the definitive plan for the Reservation. Instead, the LIA-RMP provides a framework for developing a plan for ongoing, long-term restoration and management efforts. In fact, in the course of work on the LIA-RMP several problematic issues concerning the Reservation were identified which will require further study. The restoration process will undoubtedly reveal refinements to the treatments noted herein and will identify further techniques to be utilized and opportunities to be explored in the Reservation. The LIA-RMP should be updated every five years to reflect an analysis of the work done and evaluate the applicability of new methodologies and technologies available. The additional studies should be undertaken as soon as feasible, and the findings from these studies used in planning for future work in the Reservation.

Goal 4 Provide maintenance and management policies, staff and budget that support the Reservation's holistic best management practices and the County's goals.

The Essex County Park, Recreation and Open Space Master Plan states as some of the County goals:

“To provide for the care and maintenance of the Essex County Park System in a manner consistent with the Olmsted vision. Rehabilitate each County Park for the full use and enjoyment of all County residents. Maintain each County Park to a superior level. Protect the significant natural resources of Essex County. Promote the preservation and restoration of cultural, archaeological and historic sites”.

To accomplish the goals stated herein for South Mountain Reservation as well as the County goals requires a dedicated crew of a size appropriate to such a large rugged woodland area. They must be well trained in the specialized techniques appropriate to maintaining a woodland and a historic reservation. The staff must be willing to cooperatively work with well-trained volunteers. The crew must have a budget that supports the restoration and rehabilitation work as well as the ongoing monitoring, review and maintenance activities. They must be backed up by adequate enforcement in order to protect the capital and volunteer investment.

Goal 5 Establish performance standards and monitoring protocols to measure the attainment of each objective.

Goal number three in the Essex County Park, Recreation and Open Space Master Plan stated the County would “implement standards and programs to regularly monitor park maintenance.” Successful restoration and rehabilitation is dependent upon early detection of issues that affect the health and stability of the Reservation’s resources and the proper implementation of the management techniques. This monitoring will also assess the effectiveness of the management techniques and provide early detection for modifications prior to it becoming a major improvement.

Goal 6 Support the South Mountain Conservancy volunteer efforts.

The County has a large system of parks and reservations to restore and maintain. Volunteers are a great benefit to aid in those tasks. The County sees this benefit and has already engaged numerous local volunteer community groups throughout Essex County. Most of the volunteer groups are fledgling and need guidance and support both with staff and funding. Some additional support for the volunteer groups is available through other like-minded groups such as the Morris Land Conservancy’s Partners for Parks Program. A County policy statement for goal number six states that a “Partnership for Parks” program will be developed. Supporting the South Mountain Conservancy in this manner could be a step toward implementing this program.

Goal 7 Provide educational/training opportunities for Essex County crews, volunteers and Reservation users.

Successful restoration and rehabilitation is dependent upon the collective knowledge of County staff, volunteer and Reservation users about the Reservation’s ecosystems, cultural history and appropriate use. Educational / training opportunities should be provided and supported. When successful, trained staff and volunteers develop a shared vision, pride and responsibility in their tasks the effectiveness of the work is enhanced and subsequently, the protection of the resources is increased.

The South Mountain Conservancy could spearhead the effort of developing an effective public-private partnership outreach that could raise money and awareness about the importance of this Reservation both locally and nationally. One such project would be raising the resources necessary to train staff and volunteers in the techniques appropriate to restore and rehabilitate and maintain an historic woodland Reservation.

5.0 METHODOLOGY

Collection and analysis of relevant data concerning Olmsted firm planning for this site as a Reservation was completed as the first task in developing a detailed chronology for South Mountain Reservation. Sources for this research included Olmsted Job Numbers 2120, 2128 and 10100 from the Olmsted national Historic Site in Brookline Massachusetts, and the Manuscript Room at the Library of Congress in Washington D.C. Essex County Park Commission records from Essex County Parks, Recreation and Cultural Affairs archives were also collected and analyzed concerning the construction and development of the Reservation. Minimal research was conducted at the Newark Library New Jersey Room. Three site visits were carried out, one with some members of the team, to assess the conditions on the ground to compare their current state with 1) their historic condition as indicated by the documents and historic photographs and with 2) their intended condition as designed by the Olmsted firm planning.

Based on an analysis of available records as noted above, a detailed chronology was prepared to document the physical development of the site and its features, with particular emphasis on the management of the vegetation for diversity and vista retention. This data provides a remarkable history of the problems and alterations over the more than five decades of the Olmsted firm involvement; the various and changing desires of the Park Commission, the County and the users over this extensive period, and the changing management practices and capabilities over time.

Research materials related to historic landscape design of the Reservation were gathered by the project historian, and were used as the basis for analysis of design intent of the Olmsted Firm. These materials included the Olmsted Firm reports, chronology of site design and implementation prepared by the project historian, photographs, Essex County Park Commission Reports for the period studied, and review and analysis of original drawings from the Essex County Archive of Historic Drawings. Determination of Historic Fabric was made by analyzing contemporary aerial photography provided by the prime consultant, and comparing these with the drawings of the Olmsted firm. Limited site investigation was conducted to field verify the results of these comparisons. Photographs of similar projects by the Olmsted firm were also studied, including Iroquois Park, Louisville, Kentucky, and Prospect Park, Brooklyn, New York.

To assess the natural features of the Reservation and its biological integrity, Berger first reviewed the history of the ecosystem and the original plans for the park. The New Jersey Department of Environmental Protection and New Jersey Division of Fish and Wildlife (NJDFW) online Geographic Information System (GIS) databases (<http://www.state.nj.us/dep/gis/newmapping.htm> and <http://www.njfishandwildlife.com/ensp/landscape/download.htm>) were also reviewed. Along with aerial and topographic maps of the site, a draft vegetative cover map was developed. The vegetative cover map includes general descriptions of dominant land use cover type, including: Deciduous Forest, Coniferous Forest, Mixed Forest, Disturbed Forest, Modified Wetland, Urban, Old Field, Wetland Deciduous Forest.

A field check of the draft vegetative map was then conducted. The field check included walking the trails of the Reservation and a number of transects between trail areas from east to west. Within the area north of South Orange Avenue and east of Cherry Lane, three transects were walked, and south of South Orange Avenue four transects were walked. West of Cherry Lane and south of South Orange Avenue, two transects were walked, and within the Mayapple Hill Area one transect was walked. The field check included noting vegetation observed and conditions. These qualitative site surveys were completed in the spring and summer of 2005. A list of vegetative types was derived from the field checks. The list of the vegetative types is not inclusive, but provides an indication of the dominant vegetation types commonly observed within the Reservation. Also, during the field checks, signs and sightings of fauna and avian species were noted. A formal study of the fauna and avian species that reside and use the South Mountain Reservation was not conducted for this investigation.

The East Branch of the Rahway River and its tributaries and related wetlands were also observed and noted in the summer and spring of 2005. Dominant vegetation, fauna, and avian species associated with these areas were noted, along with the conditions of the water bodies. The Orange Reservoir was not included within this field investigation, as it is owned by the City of Orange. Also, a qualitative assessment of the East Branch of the Rahway River was completed, based on observations made at the site in the summer of 2005 and the guidelines provided by the New Jersey Department of Environmental Protection Bureau of Freshwater and Biological Monitoring's "*Habitat Assessment for Low Gradient Streams.*"

An inventory of infrastructure was compiled and documented. The Reservation's infrastructure includes roadways, parking areas, trails, utilities, buildings, structures, furnishings and drainage pipes and culverts. On-site investigations were conducted from January 2005 to December 2005 to observe general conditions, take measurements, photographs and verify locations. Locations of problem areas were recorded using a GPS receiver. Information was mapped using a Geographic Information System (GIS) program. Field data was combined with information from New Jersey Department of Environmental Protection (NJDEP), New Jersey Geologic Survey, New Jersey Department of Transportation and the New Jersey Image Warehouse. Information about utilities was obtained through conversations with and receipt of reports from representatives from the City of Orange Township, United Water Company, New Jersey American Water Company and the Townships of Millburn and West Orange and the Village of South Orange. Information was collected from the Essex County Department of Public Works and the Essex County Department of Parks, Recreation and Cultural Affairs.

Maintenance and management of the Reservation was compiled by conducting interviews with park personnel. Existing budget and staffing information was provided by the County Parks Department. Inspection of equipment and maintenance facilities was completed during a site visit. Information concerning other parks usage and facilities was compiled from websites as well as telephone interviews with park staff.

6.0 TERMINOLOGY

6.1 Definitions

There are two terms used within this report that have different meanings when applied to ecology and historic preservation; restoration and rehabilitation. The definitions and commentary below clarifies the purpose of each of these terms.

Ecological Restoration (Restoration): The process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed.

Commentary: We cannot return the reservation into what it once was, particularly in light of the current urban context, nor to what the Olmsted vision was, but we can help it to recover so that it functions in a way that a natural system should function.

Historic Rehabilitation (Rehabilitation): The act or process of making possible a compatible use for a property through repair, alterations, and additions while preserving those portions or features which convey its historical, cultural, or architectural values.

Commentary: Standards are set forth by the Secretary of the Interior called *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for the Treatment of Cultural Landscapes*. There are four different types of treatment under which a resource may be managed: preservation, rehabilitation, restoration, and reconstruction. The management treatment most appropriate for South Mountain Reservation is rehabilitation. It has been a struggle throughout the history of this Reservation to develop its features and maintain it to a level appropriate to its considerable resources. It would be unrealistic to think the Reservation could be restored to accurately depict the form, features and character of Olmsted plans.

Riparian Zone: The riparian zone connects the upland zone to the aquatic zone, controlling the flow of water, sediment, nutrients, and organisms between the two. Without a proper functioning riparian zone, the other zones suffer. The riparian zone is critical to the health of every stream and its surroundings environment.

6.2 Historic Terminology

It is important to utilize the historic terminology when trying to evaluate the design intent of the Olmsted Brothers firm. This terminology was used on Olmsted maps and in correspondence, Essex County Park Commission annual reports and National Park Service plans completed for the Civilian Conservation Corps (CCC). The primary source for the terminology is the Olmsted maps and correspondence. Many of these terms are still in use today. There are, however, some differences noted below. Due to the extent of utilizing three layers for the place names i.e. Notting Grove within Longwood within Long Hill, many of the place names have been

forgotten over time. The historic place names are used in this report with the common name in parenthesis.

6.2.1 General Place Names

Character areas within the Reservation were determined from Olmsted Brothers Plan No. 68. *West Fields* includes current place name areas of Shady Nook Picnic area and the maintenance facilities. *East Fields* includes a portion of Tulip Springs Picnic Area. *North Field* includes the Oakdale Picnic Area and the archery fields. *Oak Field* is now the location of the Turtle Back Zoo. *Ridge Field* is now the Girl Scout Camp. *Spring Meadow* includes a portion of Tulip Springs Picnic Area and the Boy Scout Camp Area. *West Over Wood* in Mayapple Hill is now simply know as Mayapple Hill Picnic Area. *Bass Pond* has been renamed to Campbell's Pond while *Orange Lake* is now known as Orange Reservoir.

6.2.2 Streams and Waterfalls

There are several drainage courses throughout the reservation. Many of them are named on the Olmsted maps. The names of the drainage courses have been lost over time except Hemlock Stream and Maple Stream due to their association with waterfalls along their path to the West Branch of the Rahway River (the River).

6.2.3 Pleasure Drives and Pedestrian Trails

Historically there was to be a series of pleasure drives and pedestrian trails throughout the Reservation. Due to inadequate funding this was never fully realized. A couple pleasure drives were paved, *West Ridge Drive* (Crest Drive), *Valley View Drive* and *Mayapple Hill* entrance drive and circuit drive. The Mayapple Hill circuit drive however was not constructed in the location historically planned.

Several of the pleasure drives were constructed but not paved and are currently used as part of the pedestrian (hiking) trail network in the Reservation. These current hiking trails have been given the historic place names of the pleasure drives. These include, *West Ridge Drive* (West Ridge Trail), *Turtle Back Drive* (portion of which is now North Trail), and *Overlook Drive* (Swampy Trail). These are interchangeably called bridal trails and wood roads within this report.



Figure 3 ~Historic road.

Historic pedestrian trails have been developed to the level of the unpaved pleasure drives. These include the River Trail, Crest Trail, Grassy Trail, Summit Trail, Balls Bluff Trail, Hillspur Trail and the Ravine Trail. These did not have place names noted on Olmsted Plan 68 and were named from nearby features or were not named at all.

A new network of blazed hiking trails was introduced. These are named after nearby historic place names or as the continuation of a county-wide trail, the Lenape Trail. These include the Rahway (white blaze), Elmdale (blue blaze), Oakdale (Red blaze), Turtle Back (orange blaze) and interpretive trail that was indicated by a series of interpretive posts.

6.2.4 Buildings

There are few buildings within South Mountain Reservation. The buildings that exist include picnic area restrooms; City of Orange well houses and historic pumping station building and the Township of West Orange sanitary pumping station. The buildings are named according to their general area within the reservation with the exception of the non-County holdings that are known by their uses.

6.2.5 Structures

There are several different types of structures within South Mountain Reservation. These structures include overlooks, picnic shelters, bridges, dams, and benches, bar-BQ grills and fireplaces what we term today site furnishings.

Overlooks

The names assigned to the overlooks are named after people, *Washington Rock Overlook* and *Bramhall Terrace Overlook*. They are also named after landscape character place names, *Ball's Bluff Overlook*, *Mines Point* and, *The Craig*.



Figure 4 ~ Washington Rock Overlook.



Figure 5 ~ Thistle Mill Ford showing West Branch of the Rahway River and pedestrian bridge crossing.



Figure 6 ~ Historic Pumping station for the City of Orange.

Picnic Shelters

Shelters are named after the picnic area where they are located. The historic plans reviewed do not name each shelter in the picnic areas that have more than one shelter. With the exception of the shelters as Tulip Springs, these shelters do have signs identifying them. This report identifies these shelters by compass location.

Bridges

Some bridges within the Reservation are not named and others are named after general area names. The named bridges include *Hemlock Falls Bridge (1) and (2)*, *Maple Falls Pedestrian Bridge*, *Hawk Hill Vehicular Bridge*, and *Elmdale Bridge*. The bridges that are not named are identified by their location within the trail network i.e. on River Trail just south of Hemlock Falls Trail.

Dams and Ponds

The dams are named after the ponds they are associated with. *Diamond Mill Pond* was named after the mill that utilized the water diverted from the dam to run the mill operations. *Campbell's Pond* was located on the property acquired from the Campbell's. Campbell's Pond is also known also as *Bass Pond*.







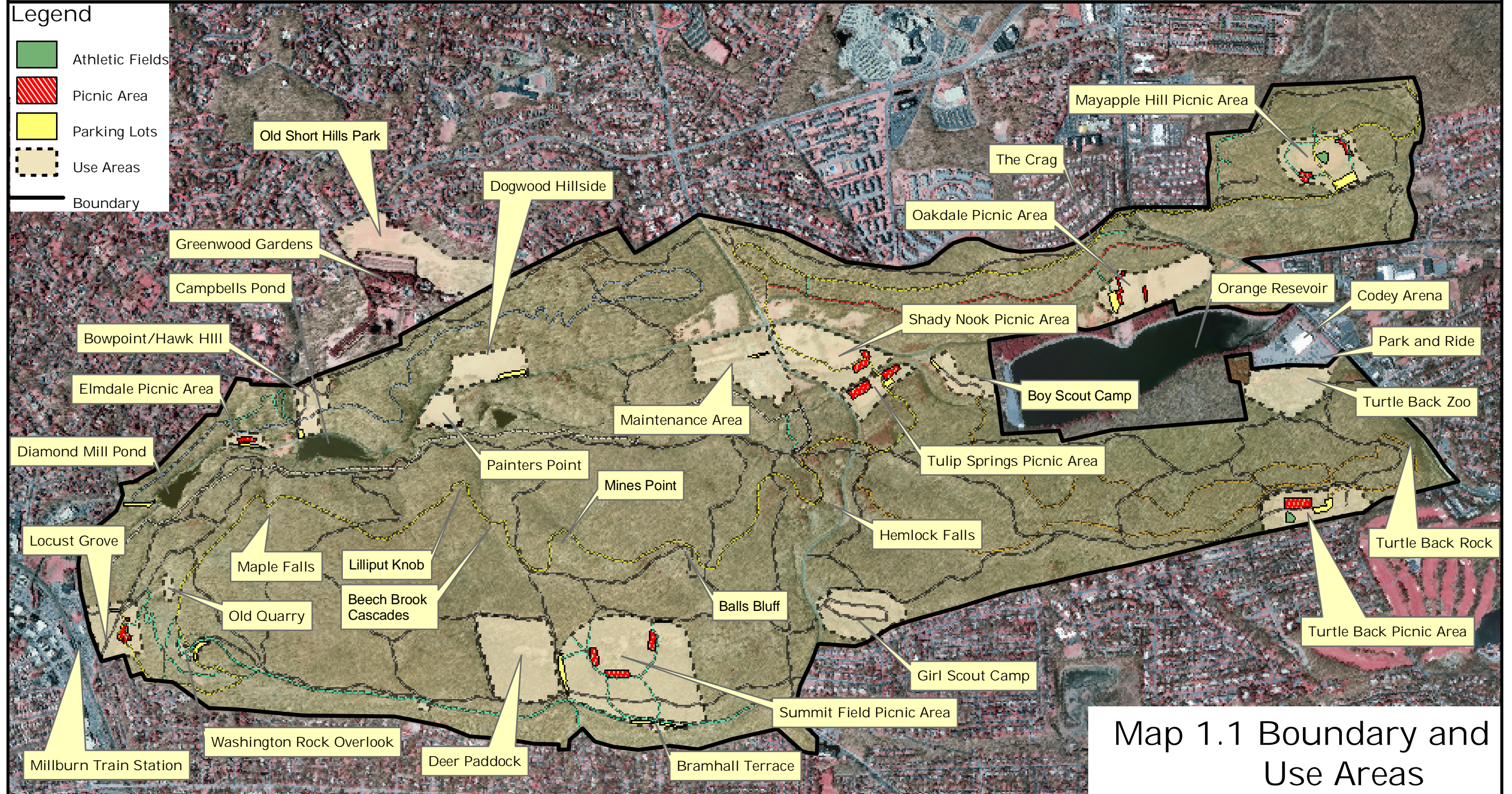
Figure 7 ~ Campbell's Pond with the pumping station in the distance.

SOUTH MOUNTAIN RESERVATION

LANDSCAPE AND INFRASTRUCTURE ASSESSMENT AND RESTORATION MANAGEMENT PLAN

Legend

-  Athletic Fields
-  Picnic Area
-  Parking Lots
-  Use Areas
-  Boundary



Map 1.1 Boundary and Use Areas

INFORMATION SOURCES: NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, BUREAU OF GEOGRAPHIC INFORMATION SYSTEMS

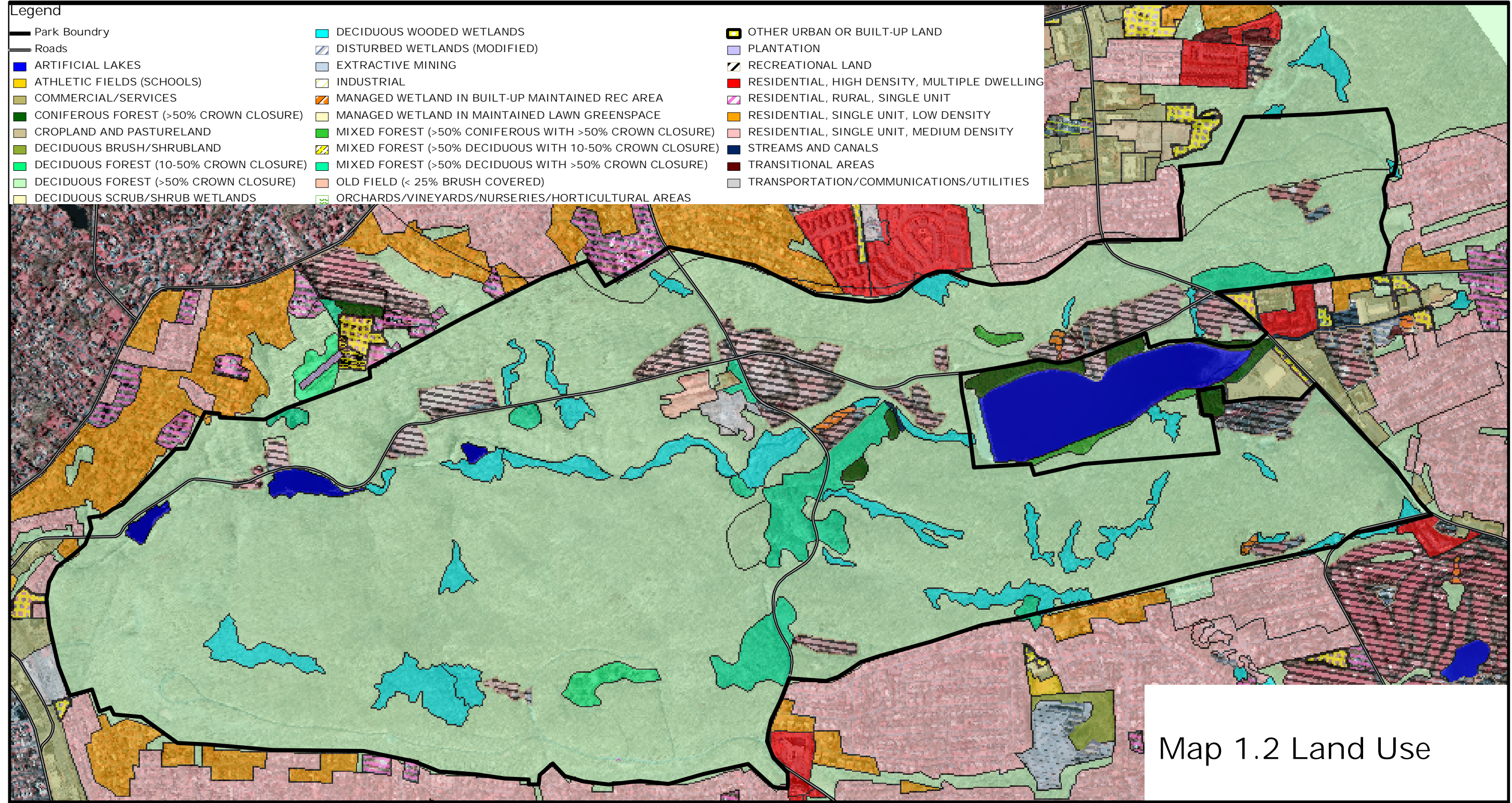
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SOUTH MOUNTAIN RESERVATION

LANDSCAPE AND INFRASTRUCTURE ASSESSMENT AND RESTORATION MANAGEMENT PLAN



Map 1.2 Land Use

INFORMATION SOURCES: NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, BUREAU OF GEOGRAPHIC INFORMATION SYSTEMS

<http://www.nj.gov/dep.gis/index.html>

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http://njig.nj.gov/OIT_IW/index.jsp



CHAPTER 2

Reservation History



Chapter 2 - Reservation History

1.0 BRIEF CHRONOLOGY

The Olmsted firm first considered the land for the South Mountain Reservation as early as 1899. The firm maintained consistent involvement with the Reservation until at least 1934, however, the Olmsted firm continued to be involved with Essex County Parks into the 1950s suggesting that the firm could have continued to make additional recommendations in this later period.

The beauty of this site was a compelling reason for its acquisition. In the 1897 report the Commissioners talk about its “stretches of mountain and mead” but noted that its acquisition was a tangle of establishing property titles. In their report of this date John Olmsted calls it “the great South Mountain Reservation” with its variety of scenery and interior vistas and its large scale which would enable a real distancing from city bustle while protecting unique scenic features for posterity. This purpose was the reason behind the original establishment of the Boston Metropolitan Park System, on which the Essex County system was modeled, and which led to Essex County having the first county park system in the United States.



Figure 8 ~ View from South Orange Avenue and Cedar Lane

Besides establishing the property lines to encompass as much scenery, and whole units of features such as ridge lines and adjoining mountain sides and water courses, as possible,



Figure 9 ~ Gentle character of woods on First Mountain

much of the Olmsted firm’s early work consisted of assessing the character and quality of the woodlands in order to thin and prune them for good forestry health as well as for aesthetic purposes. A woodland left to its own devices, in John Olmsted’s opinion, would soon become monotonous. In this he was following Fredric Law Olmsted’s (J.C. Olmsted’s step-father) edict about “the judicious use of the axe.”

John Olmsted’s vision for the woodlands consisted of subtle manipulation, through pruning and judicious planting to increase the textural

richness, especially that to be seen from the paths and trails, and to create an interplay of dark shadowy woods in contrast to open sunny areas and hence a variety of plant materials. He also recommended pruning to enhance the scenery so that features could be seen to best advantage. At this period, these woodland practices were called “aesthetic forestry.” In replanting, his palette included mostly native materials from groundscape to upper canopy, with an eye to flowers, berries, therefore a boon to bird life. Even in this turn-of-the century period, there were public objections to thinning of the existing woodlands, but these were mostly overcome during the years of the Olmsted’s involvement.

Many of the plans over the years of the Olmsted’s involvement, after initial construction of user amenities such as roads, paths, etc., consisted of review of woodland conditions and recommendations for forestry management (See the chronology report under separate cover for more detailed information on the evolution of South Mountain Reservation.)

2.0 DESIGN INTENT

2.1 An Overview of The Olmsted Plans

“To the casual observer the forest which covers most of South Mountain Reservation appears to be much the same from one end of the reservation to the other. An occasional tree of large proportions perhaps may arrest his attention, but, on the whole, the effect is mainly that of monotony.” (p.1)

So begins the 1909 *“Report of the Improvement of South Mountain Reservation”* written by the Olmsted firm. These same words could be used to describe South Mountain Reservation today. Almost 100 years later, the Olmsted firm’s observations resonate with familiarity, and many of the same conditions noted by the Olmsted firm continue to exist. Compounded by additional ecological problems and heavy use, the reservation resembles, in many ways, the mountain as the Olmsted firm first found it. With its steep terrain rising over 182 feet above Orange Lake, as well as its ravines, meadows and woods, South Mountain is similar to other



Figure 10 ~ Rustic structure provides shelter in the hilltop meadow. Iroquois Park, Louisville, Kentucky

reservations planned by the firm, such as Mount Royal in Montreal, Canada and Iroquois Park in Louisville, Kentucky. In all of these reservations the Olmsted firm’s goals for use of the site had more to do with managing woodlands for the experience of dramatic views and diverse landscapes than it did with recreation of the more urban sort created in the firm’s parks. They wrote, *“To secure the real value of the reservation, therefore, a policy of carefully studied, long continued aesthetic forestry should be institute throughout the reservations...”*. Coining the term ‘aesthetic forestry’, they recommended that *“by cutting some poor trees, views out over the forest to distant landscape could be opened up....”* and the forest diversity could be supplemented by adding *“interesting and striking evergreen trees, such as pine and hemlock... (and)... various desirable sorts of ground-covering herbs and bushy undergrowth that will harmonize with either the trees above them or with the form of the land itself”*. (p.2-3).

The Olmsted firm’s approach to designing the landscape of the reservation was bold and visionary, and where they noted that cutting ‘some poor trees’ would be valuable, they envisioned such cutting on the scale of acres, thus deliberately removing large areas of woodlands for the sake of developing the most dramatic and varied scenic qualities for the reservation. They also strongly emphasized that such clearing



Figure 11 ~ Historic vista and clearing

should only be done with an artistic vision, and directed by those for whom art was of paramount importance. They wrote, *“The woodland scenery of the reservation is by far the most important element in its composition as a place to be visited for recreation and change of scene; and it is through the care and development of this element that the reservation is to become to the public what it was originally purchased for.”* (p. 24) *“...on South Mountain Reservation, the work consists of carefully cutting away unnecessary trees to develop...picture quality.”* (p.26) *“Sufficient has been said to show that the proper improvement of woodland scenery is governed by the laws of art and should be undertaken only under the direction of one having a true artistic feeling for the work.”* (p.27)

The clarity of this guiding design concept can be easily seen in the 1902 plan, (Map 2.1). The plan shows a series of textures defining various types of woodlands, shrublands and open meadows. Perhaps even more revealing, however, is a drawing titled Plan 45 (See Map 2.2). This drawing clearly delineates open meadows, woodlands, and areas intended to be vegetated with various densities of evergreen trees, described in further detail with numerical classifications for tree species’ density and diversity, as well as general listings of specific plant types. In addition, the plan shows twenty-five specific view points, or places where managed vistas and controlled views of meadow, forest, and terrain could be managed to provide scenic diversity and a rich landscape experience (Figure 12). These viewpoints are a refinement of many of the ‘overlooks’ and ‘points’ shown on the 1902 plan.



Figure 12 ~ Historic vista and clearing

2.1.1 Landscape Units

Crucial to the Olmsted design for the reservation was the concept of Landscape Units. The firm carefully defined a variety of scenery types which could be developed at South Mountain, taking what was a very homogenous woodland landscape and carving it into a rich tapestry of visual experience, unfolding as the visitor traveled the gently curving road and pathway system. The Olmsted plan describes five general types of landscape unit, each with its own distinctive character (See Map 2.3). These are further refined in Plan 45 of 1909, and the descriptions accompanying it. Although the five landscape units delineated on the 1902 plan were Fells, Close Woods, Groves, Broad Vistas, and Openings, only four landscape categories are drawn on Plan 45: Evergreens, Deciduous Growth, Open fields of Low Growth, and Important Views. The difference between the two descriptions suggests the constantly evolving, serious thought by the Olmsted firm as they tackled the question of creating a visionary and artistic landscape at such an enormous scale. Plan 45 was later followed by

plan 69 and other plans, showing additional instructions for forest management, new plantings, and other design refinements. In 1927, suggestions for specific planting adjustments, plant removals, new plantings, and additional forest management were meticulously written on a 1904 plan which in itself had been amended in 1909, 1914, and 1922. The 1927 annotations provide very detailed descriptions of the landscape types in the numbered areas.

Unfortunately, the task of implementing such a detailed vision over such a large site area proved impossible to implement even during the years of the Olmsted firm’s active involvement. Although many of the pathways and roads, bridges and plantings of the Olmsted plan were accomplished, the goal of ongoing, ‘aesthetic forestry’ was never reached. Thus, despite more than 25 years of consistent work by the Olmsted firm, the design for South Mountain Reservation as a whole was never truly completed, and there never was a period when the management of what existed on the ground matched what was on the plans. Because of this constantly evolving landscape development, with much unrealized design, and the continuation of work in the park by the CCC under the direction of Hans Kohler, also of the firm, the period of significance is difficult to determine (Figure 13). Thus, the period between 1901, when the Olmsted firm prepared their early plans, and the CCC era, up to approximately 1935 appears reasonable as a designation as the period of significance.



Figure 13 ~ Historic pathway

2.2 The Landscape Today

2.2.1 Current Landscape Conditions

Perhaps the most prescient statement the Olmsted firm made in its report dealt with the consequences of allowing the woodlands to remain unmanaged. They wrote: *“If left untouched, the woodlands of South Mountain Reservation would themselves develop certain types of forest growth and certain types of scenes; but these would be in many cases poor or undesirable types and would usually fail to take advantage of surrounding conditions for the production of the highest type of beauty available for each particular locality.”* Today, a lack of forest management has resulted in just the type of landscape the Olmsted



Figure 14 ~ The view from Bramhall Terrace, obscured by incoming tree growth.

firm predicted, one of generally homogeneous woodland, without any particular scenic character. Instead, scenic experiences are enjoyed today primarily at the larger overlooks, such as Washington Overlook, Bramhall Terrace, and others, as well as at more intimate, streamside or hillside interior spaces such as Hemlock Falls. With the exception of the a few areas described in Section 4 of this report, and shown on the Vegetation Cover map, (See Vegetation Cover Map 4.1), the remains of the thousands of rhododendrons planted under the direction of the Olmsted firm no longer exist.

In analyzing the landscape at the reservation today, it is useful to compare current conditions with the Olmsted’s scenic categories originally delineated on the 1902 plan for the Reservation.

Fells

“Steep, rocky ground, clothed with wild shrubby growth, rich in spring bloom and autumn color. Trees should be entirely eliminated, which should be attended to annually. Suggested plantings: rosa hugonis, meadowsweet, beebalm, goldenrod, woodbine, blueberry bushes, mountain laurel, staghorn sumacs.”

This landscape category generally does not exist today as envisioned by the Olmsted firm. However, a few slopes near the Washington Overlook have a character similar to this description, allowing long, dramatic views to the far distance. Because the areas have not been managed to retain the shrubby character, young trees are beginning to become established in these areas as well, limiting the desired views.

Close Woods



Figure 15 ~ An extensive and severe Japanese knotweed infestation is a major landscape management problem throughout the Reservation.

“The natural condition of the northeastern woods, with a variety of tree species and shrubby undergrowths. The character of these woods depends upon the quality of the undergrowth. Goal should be to refine the setting with mosses, ferns, bearberry, mountain laurel, viburnums, inkberry, spicebush, dogwoods.”

Although much of the reservation is wooded, most of the woods are limited in diversity of tree species, and the understory is essentially missing throughout, due to erosion, heavy use of some areas, and overpopulation by deer. Massive infestations of Japanese knotweed are prevalent along most of the roads, along the edges of activity areas and eroded areas as well as at the edges of meadows. In some areas where the stands of mature Rhododendrons still exist, as described and planted by the Olmsted firm, a special quality persists in the landscape recalling the ‘close woods’ they describe.

Groves

“Pure stands of one species, or of the predominance of one species, distinguished by the full, mature development of the trees with the absence of undergrowth species and a breadth of interior vies as a result.

- Beechwood: deep and cool character.
- White oak: bright and sunny: grasses grow well under oak
- White pine: deep shade and a sense of silence
- Paper birch: (sic)”.

From most of the roads within the reservation, there is no evidence of groves of singular species as described by the Olmsted firm. However, the mature stand of beech and tulip poplar in the interior woodlands just north of the Dogwood Hillside meadow gives a suggestion of what such a woodland might be.



Figure 16 ~ Stands of mature evergreens (here a stand of hemlock) found in a few areas reflect today the concept of a Grove described by the Olmsted firm.



Figure 17 ~ Historic meadow and site scale.

Broad Vistas

“from the hills: Lookout areas should be enframed with detail plantings.”

Lookout areas and view points exist today, many as shown on the Olmsted plans. However, the delicacy of planting described is not present. Invasive vegetation and stands of successional and invasive forest have begun to compromise the opportunity for long vistas and dramatic views described by the Olmsted firm (Figure 17).

Plan 45 of 1909, clearly shows views and vistas originally envisioned by the Olmsted firm, and was used as the basis of this historic analysis of view points. An additional plan, Plan 68, was produced by the firm in 1925. Plan 68, an informal study drawing, is not shown in this report, since it is heavily annotated by hand and difficult to read even at full scale. In addition, Plan 68 included many additional view and vistas, adding much more detail than shown in the 1909 plan, as well as extensive notes for plantings throughout the Reservation. Even more ambitious from a planting and landscape management standpoint than the original design for the park, and suggesting a great deal of frustration on the part of the firm that their design was not being properly carried out, much of this plan was also not implemented, although it is of great interest to demonstrate the thought process of the later Olmsted firm, and the opportunity for adding richness of planting and forest management.

Openings

“Mowed fields or pastureland abundant with meadow flowers. Boundaries should not be a stiff wall of vegetation, but should dovetail with the woodland in an undulating line, with masses of different textures.”

Many of the open areas defined by the Olmsted design exist today. Unlike the romantic description of scenic meadow, however, open areas in the reservation today are primarily used for activities such as picnicking, camping or an occasional informal ball field. In addition to mowed turf, parking, small structures, and eroded patches occupy the spaces originally designed as ‘meadow’ (Figure 1.25). Turtleback Zoo occupies one of the major open spaces at the lower elevation, called the Oak Field in the Olmsted plan. Acres of woodland have grown in to occupy the edges of the Olmsted open spaces, including the Summit Field, Oak Dale, Ridge Field (Girl Scout Camp), and West Fields (Shady Nook Picnic Area) (Figure 1.24).

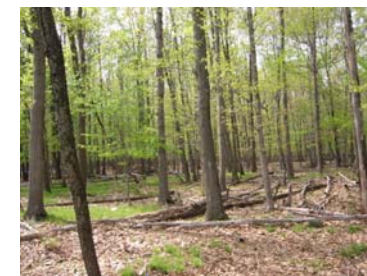


Figure 18 ~ Much of the forest cover is uniform, without significant mature trees. The deer ‘browse line’ is clear in this photo. The area shown here, near Washington Overlook, was designated as open meadow in the Olmsted plan.



Figure 19 ~ Open areas exist in the reservation today, but they are typically mowed lawn, parking or built areas, not the luxuriant meadows described in the Olmsted plan.



Figure 20 ~ Tulip Spring: Severe erosion and compaction threatens trees. Bank configuration is compromised and utilities are exposed.

Erosion is another dominant landscape condition in the reservation. Some areas along streams are so badly eroded that tree roots are exposed, and in others, such as the Tulip Springs, streams are so heavily silted in that the banks are missing, and grades run flat from the adjacent ground to the centerline of the channel.

2.2.2 Contributing Resources

Landscape Units

Resources that should be considered contributing to the historic fabric of South Mountain Reservation are shown on Map 2.4. The open meadows, forested areas, special places within the Reservation, and denser forest areas, despite their current condition as described above, are among the resources that date back to the origin of the plan, and they help define the spatial quality of the Reservation today. The overlooks, vista points and water bodies also

contribute to the spatial definition of the design for the Reservation, and many of them exist today and could be upgraded to more closely resemble the intent of the Olmsted design.



Figure 21 ~ Native rocks and boulders



Figure 22 ~ Historic vista and water bodies.

The Rhododendron Collection

The Olmsted firm planted thousands of native Rhododendrons during the years of their work at South Mountain Reservation. The plants that remain today are therefore an important component of the Reservation's historic fabric.

Roads and Paths

Many of the roads and paths at the Reservation today, constitute historic fabric. Although much of the roadway system originally envisioned by the Olmsted firm was never realized, enough remains that the plan can be considered largely intact. Map 2.4 shows the fragments of paths and roads that were part of the Olmsted plans for the Reservation. See also Map 3.12 that presents the historic bridal trail and path network overlaid with the existing trail network.

Built Objects

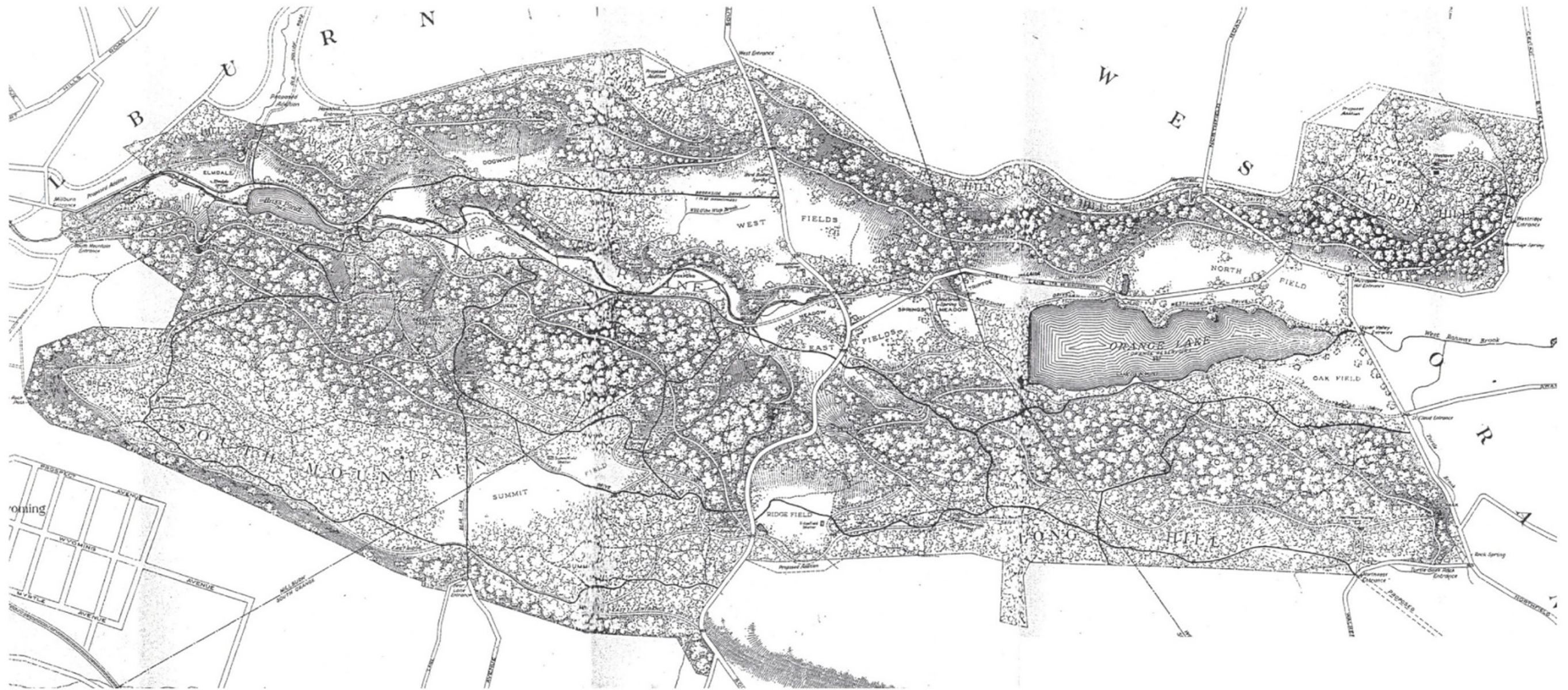
Many of the pedestrian bridges, cobble drainage gutters, and other small structures such as culverts and retaining wall were built during the early years of the establishment of the park, either during the period of the Olmsted firm involvement, or during the CCC period that followed. The details and configuration of these structures are valuable historic fabric and should be of utmost consideration in rehabilitation of the Reservation. They should be preserved and protected to the greatest possible extent.



Figure 23 ~ Historic pedestrian bridge at Thistle Mill Ford.

SOUTH MOUNTAIN RESERVATION

LANDSCAPE AND INFRASTRUCTURE ASSESSMENT AND RESTORATION MANAGEMENT PLAN



Map 2.1 1902 Olmsted Master Plan

INFORMATION SOURCES:
NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF GEOGRAPHIC INFORMATION SYSTEMS
<http://www.nj.gov/dep/gis/index.html>

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SOUTH MOUNTAIN RESERVATION

LANDSCAPE AND INFRASTRUCTURE ASSESSMENT AND RESTORATION MANAGEMENT PLAN



Map 2.2 South Mountain Master Plan - Plan 45 (1909)

INFORMATION SOURCES:
NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF GEOGRAPHIC INFORMATION SYSTEMS
<http://www.nj.gov/dep/gis/index.html>

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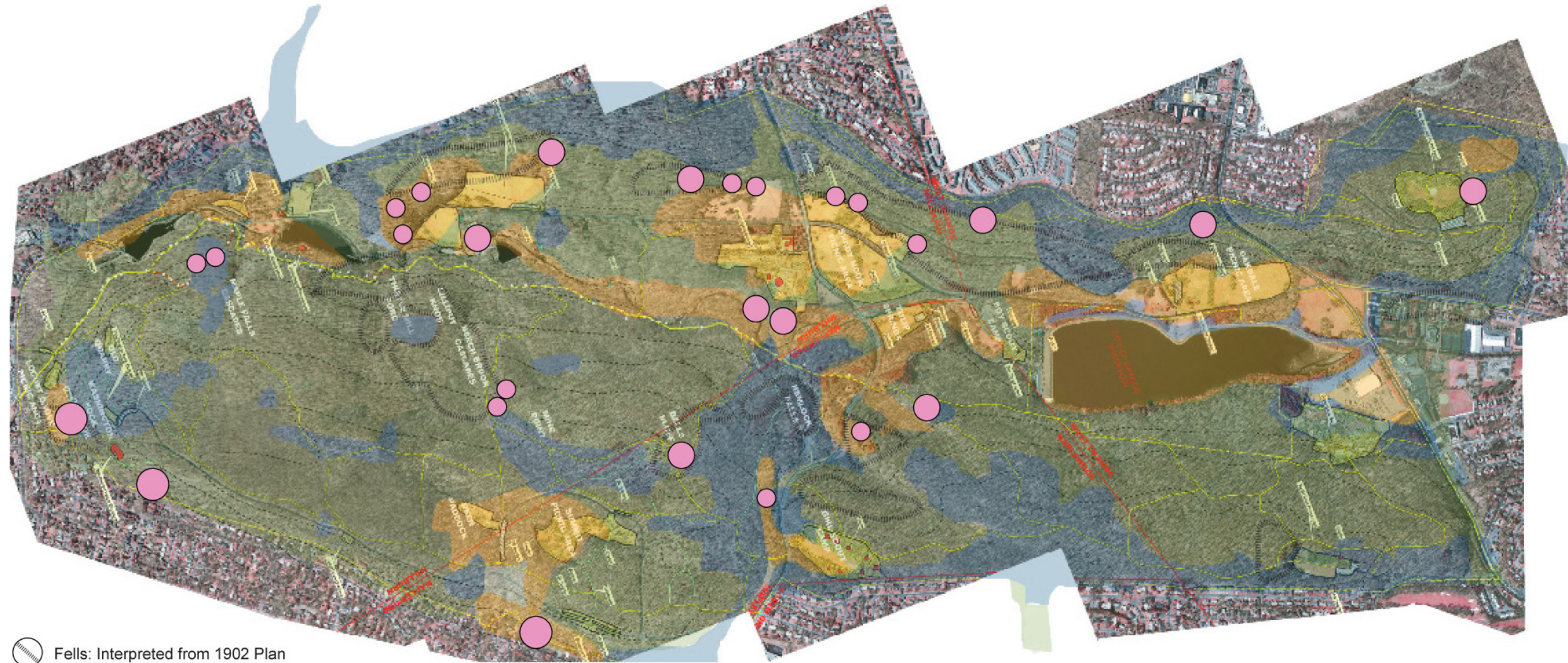








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LANDSCAPE AND INFRASTRUCTURE ASSESSMENT AND RESTORATION MANAGEMENT PLAN



-  Fells: Interpreted from 1902 Plan
-   Close Woods: Northeast deciduous woods, evergreens added.
-  Groves: Not shown on either the 1902 or 1909 plans but described in the report
-  Broad Vistas: Lookout areas from hills
note: Vistas shown as interpreted from 1909 plan no. 45; large circles are broad views; small circles are narrower views
-  Openings: As shown on 1902 and 1909 plan.
note: Ravine is wooded but show as 'opening' on the 1909 plan no. 45

Map 2.3 Historic Landscape Units
AS SHOWN ON 1902 AND 1909 PLANS

INFORMATION SOURCES:
NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF GEOGRAPHIC INFORMATION SYSTEMS
<http://www.nj.gov/dep/gis/index.html>







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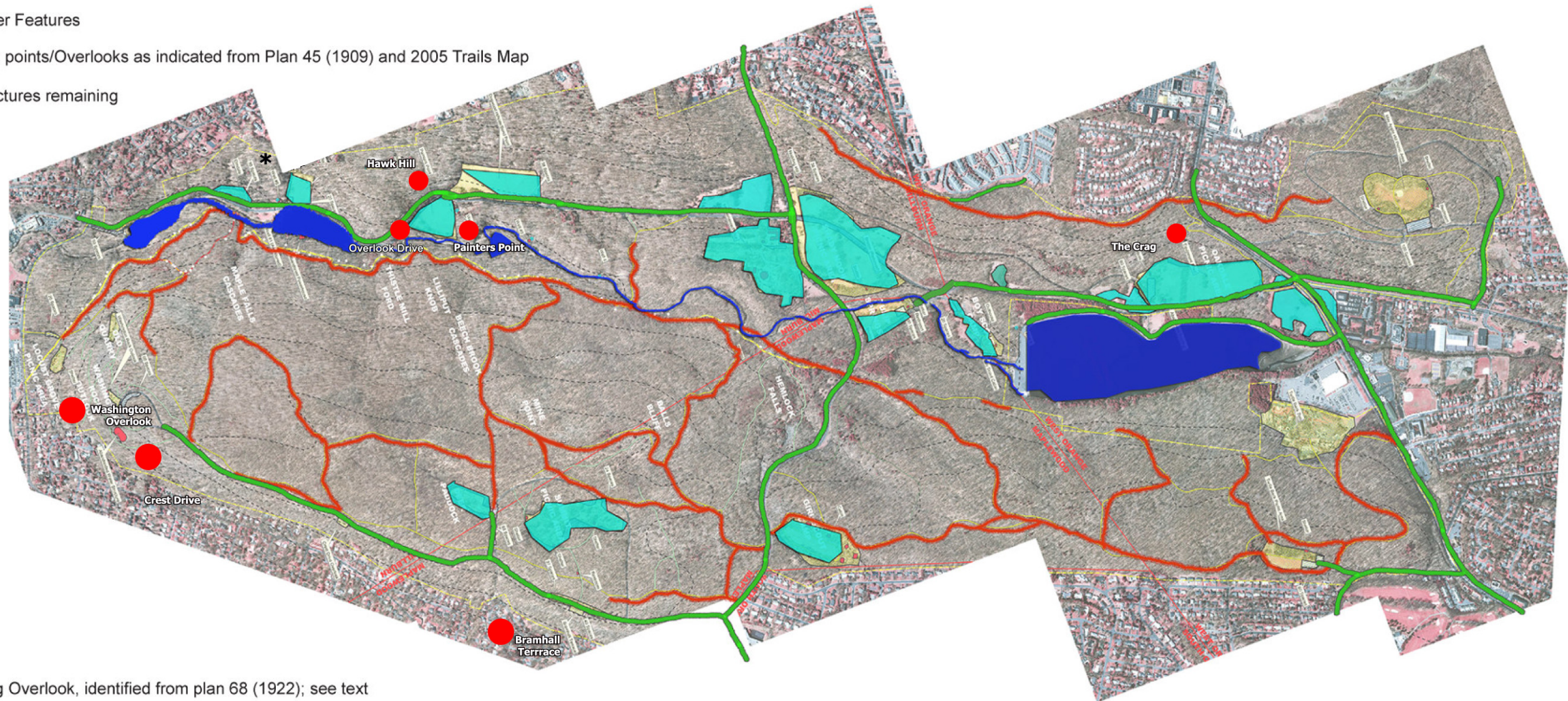


SOUTH MOUNTAIN RESERVATION

LANDSCAPE AND INFRASTRUCTURE ASSESSMENT AND RESTORATION MANAGEMENT PLAN

Legend Key

-  Open Spaces
-  Roads
-  Trails
-  Water Features
-  Vista points/Overlooks as indicated from Plan 45 (1909) and 2005 Trails Map
-  Structures remaining



* Existing Overlook, identified from plan 68 (1922); see text

Map 2.4 Remaining Historic Fabric
AS SHOWN ON THE 1902 PLAN

INFORMATION SOURCES:
NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF GEOGRAPHIC INFORMATION SYSTEMS
<http://www.nj.gov/dep/gis/index.html>

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CHAPTER 3

Inventory and Analysis of the Reservations Physical Environment



Chapter 3 - Inventory and Analysis of the Reservation's Physical Environment

The significance of the South Mountain Reservation within Essex County and the New York Metropolitan area along with the strong influence the surrounding environment has on the Reservation make sustainability a critical issue in managing the Reservation. To determine the most sustainable management plan for the Reservation that focuses on the diversity, connectedness and dynamics of the Reservation while keeping within future County budgets, a plan is presented below that encourages decisions that will support sustainability through the implementation of collaborative and adaptive management.

1.0 TOPOGRAPHY

South Mountain Reservation is located on two mountain sides, the west side of the First Watchung Mountain and the east side of the Second Watchung Mountain. The West Branch of the Rahway River is located in the valley between the two mountains and also runs through South Mountain Reservation. Map 3.1 presents the topography overlaid with the current trail system.

The topography within the Reservation varies greatly with the ridgeline on the east and the valley floor exhibiting gentle grades from 0 to 8 percent. There are also a couple of isolated gently sloping areas which are where picnic areas, Mayapple Hill, Summit Field, Locust Grove, Shady Nook and the Boy Scout and Girl Scout camps are located. The sides of both mountains range from steep to very steep with grades from 15 to 60 percent. The topography slopes east to west on the First Mountain and from the west to the east on the Second Mountain toward the valley where the West Branch of the Rahway River runs. The highest point in the Reservation at 590 feet is located at Mayapple Hill. The lowest point in the Reservation at 150 feet is in the valley along the West Branch of the Rahway River as the River exits the Reservation.

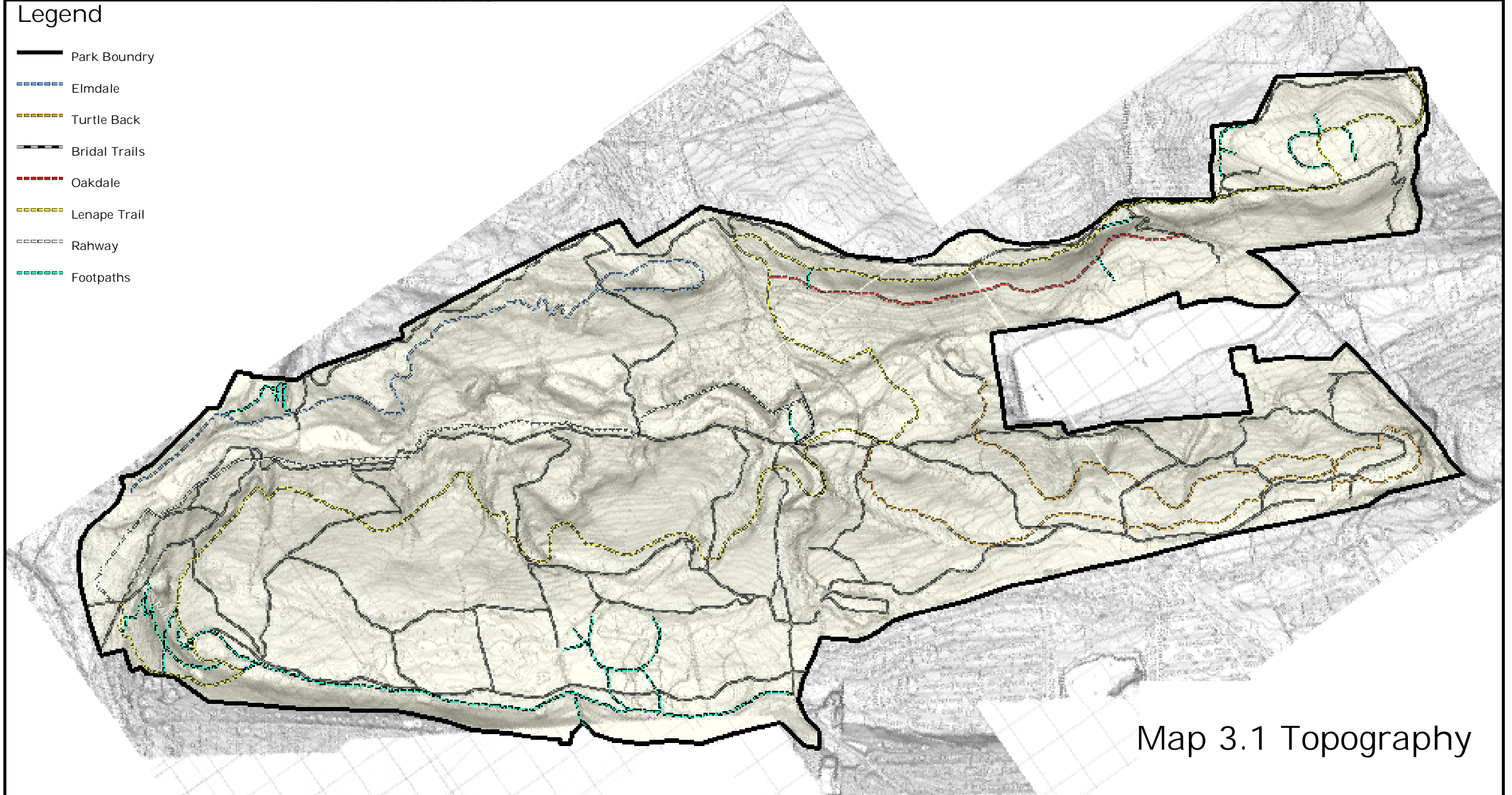
The escarpment of the First Watchung Mountain, trending from northeast to southwest across the middle part of Essex County, rises 400 feet above the gently rolling plain to the east; the breadth of the First and Second Watchung Mountains varies from one to two miles. (Nichols, 1968, p.3)

SOUTH MOUNTAIN RESERVATION

LANDSCAPE AND INFRASTRUCTURE ASSESSMENT AND RESTORATION MANAGEMENT PLAN

Legend

- Park Boundry
- - - - Elmdale
- - - - Turtle Back
- - - - Bridal Trails
- - - - Oakdale
- - - - Lenape Trail
- - - - Rahway
- - - - Footpaths



Map 3.1 Topography

INFORMATION SOURCES: NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, BUREAU OF GEOGRAPHIC INFORMATION SYSTEMS

<http://www.nj.gov/dep/gis/index.html>

NEW JERSEY IMAGE WHAREHOUSE
http://njig.nj.gov/OIT_IW/index.jsp

0 500 1,000 2,000 3,000
Feet



2.0 GEOLOGY

Surficial geology (bedrock), associated reservoirs (aquifers) and the overlying soils have a direct relation to how fast the water drains from the land surface, how saturated (soggy) the soil gets and how long it stays that way. New Jersey is divided into four geological provinces with South Mountain Reservation located within the Piedmont Physiographic Province (Figure 24). (Nichols, 1968). The Brunswick Formation and the Watchung Basalt of the Newark Group of Late Triassic Age underlie all of Essex County.

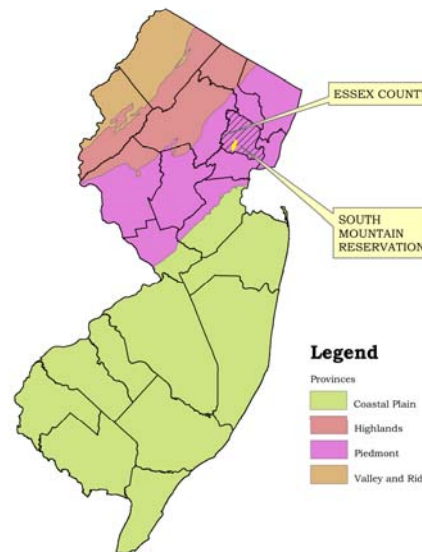


Figure 24 ~ New Jersey Physiographic Provinces

2.1 Consolidated Rock

The Watchung Basalt consists of three consecutive sequences of basalt flows intercalated with the shale and limestone of the Brunswick Formation. The two of the lowest sequences of basalt flows make up the Watchung Mountains; the third is represented by Riker Hill. These basalt flows were formed by lava that was extruded at three different times during the accumulation of the sedimentary rocks of the formation. Each of these sheets was made up of several lava flows. In some cases thin sheets of shale occur between the lava flows. The lower part of the Watchung basalt which comprises the First Watchung Mountain, is from 600 to 650 feet thick. This is called Orange Mountain Basalt. (Map 3.2) The Watchung Basalt in the Second Watchung Mountain varies from 750 to 900 feet in thickness. (Nichols, 1968, p.6) This is called Preakness Basalt.

First and Second Watchung Mountains are parallel and in places have double-crested ridges reflecting the presence of interbedded sedimentary rock; the ridges generally rise between 300 and 400 feet above the adjacent county. The trend in the ridges reflects the general strike of the sedimentary rocks of the Brunswick formation in that the beds dip 10 degrees to the northwest. (Nichols, 1968, p.6)

An abandoned quarry is located in the southern park of South Mountain Reservation near Locust Grove.

2.2 Unconsolidated Sediments

The Brunswick Formation [Feltville Formation] is predominantly shale and sandstone but also includes minor amounts of conglomerate. (Nichols, 1968) Overlaying the rocks of the Newark Group are unconsolidated clay and gravel deposited during the Pleistocene and recent epochs. Pleistocene deposits are the most widely spread and are found throughout Essex

County. Pleistocene deposits in South Mountain Reservation primarily consist of ground moraine deposits with some small deposits of stratified drift and end moraine (Nichols, 1968)

Ground moraine (unstratified drift) is a heterogeneous mixture of clay, silt, sand gravel, cobbles, and boulders, which were deposited by ice. End moraine is formed from the accumulation of ground moraine into a ridge like deposit along the margin of a glacier. Stratified drift is deposited by glacier melt water in streams and lakes. (Nichols, 1968, p.6)

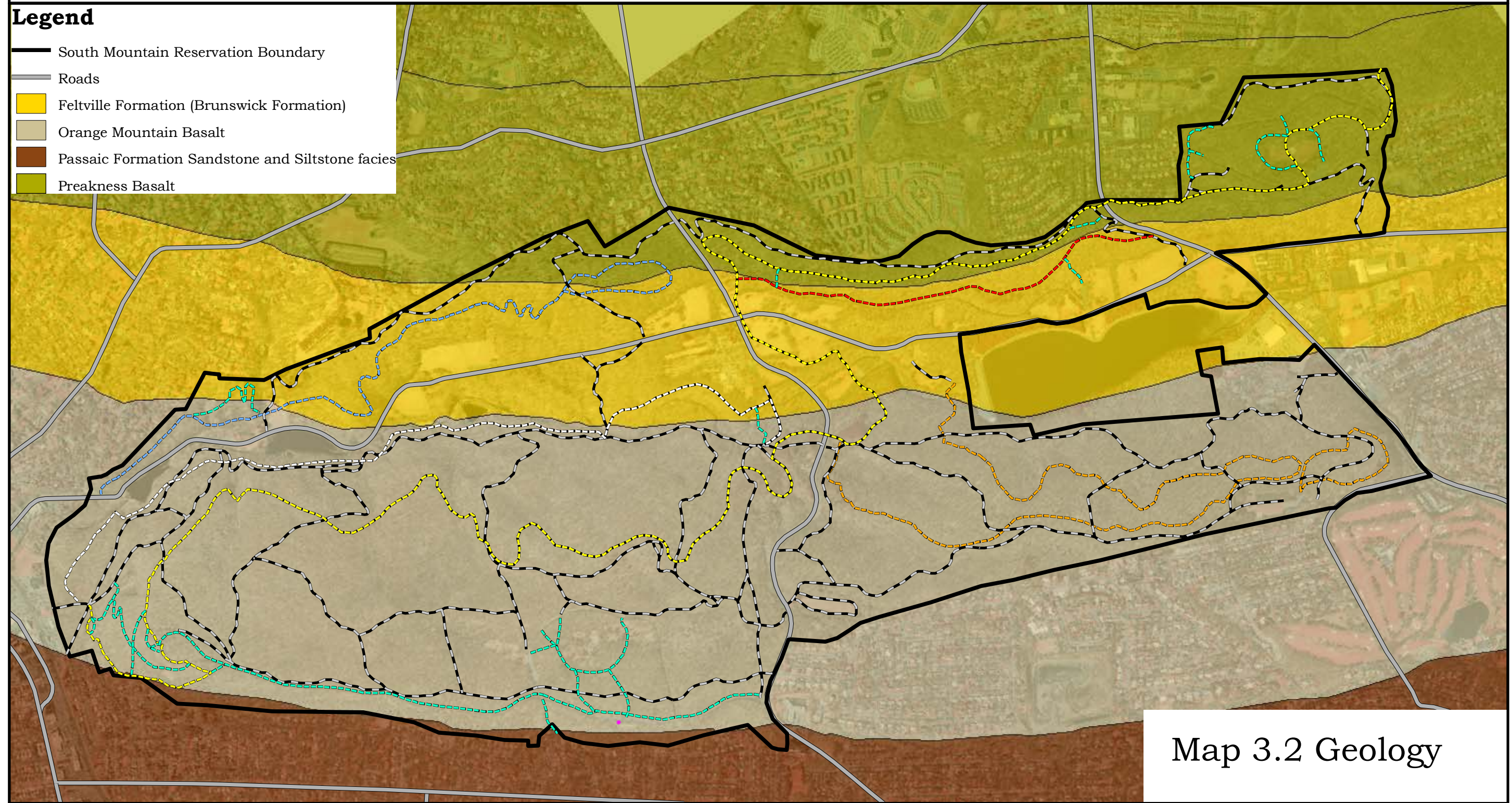
The present day valley between First and Second Watchung Mountains is underlain by approximately 100 feet of stratified drift in both Cedar Grove in the north and Millburn Township in the south. These deposits consist mostly of stratified sand and gravel. The maximum thickness appears to occur under that part of the valley west of the Rahway and Peckman Rivers; east of the rivers, the bedrock surface is shallow (30 to 50 feet below the valley floor), and the unconsolidated deposits are thin. There is not enough data to define the thickness and character of the subsurface glacial deposits in the valley of Verona and most of West Orange. (Nichols, 1968, p.7) Between the First and Second Mountains the Brunswick formation is dominantly sandstone. (Nichols, 1968, p5)

SOUTH MOUNTAIN RESERVATION

LANDSCAPE AND INFRASTRUCTURE ASSESSMENT AND RESTORATION MANAGEMENT PLAN

Legend

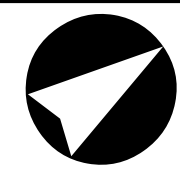
- South Mountain Reservation Boundary
- Roads
- Feltville Formation (Brunswick Formation)
- Orange Mountain Basalt
- Passaic Formation Sandstone and Siltstone facies
- Preakness Basalt



Map 3.2 Geology

INFORMATION SOURCES:
NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF GEOGRAPHIC INFORMATION SYSTEMS
<http://www.nj.gov/dep/gis/index.html>

NEW JERSEY IMAGE WHAREHOUSE
http://njig.nj.gov/OIT_IW/index.jsp

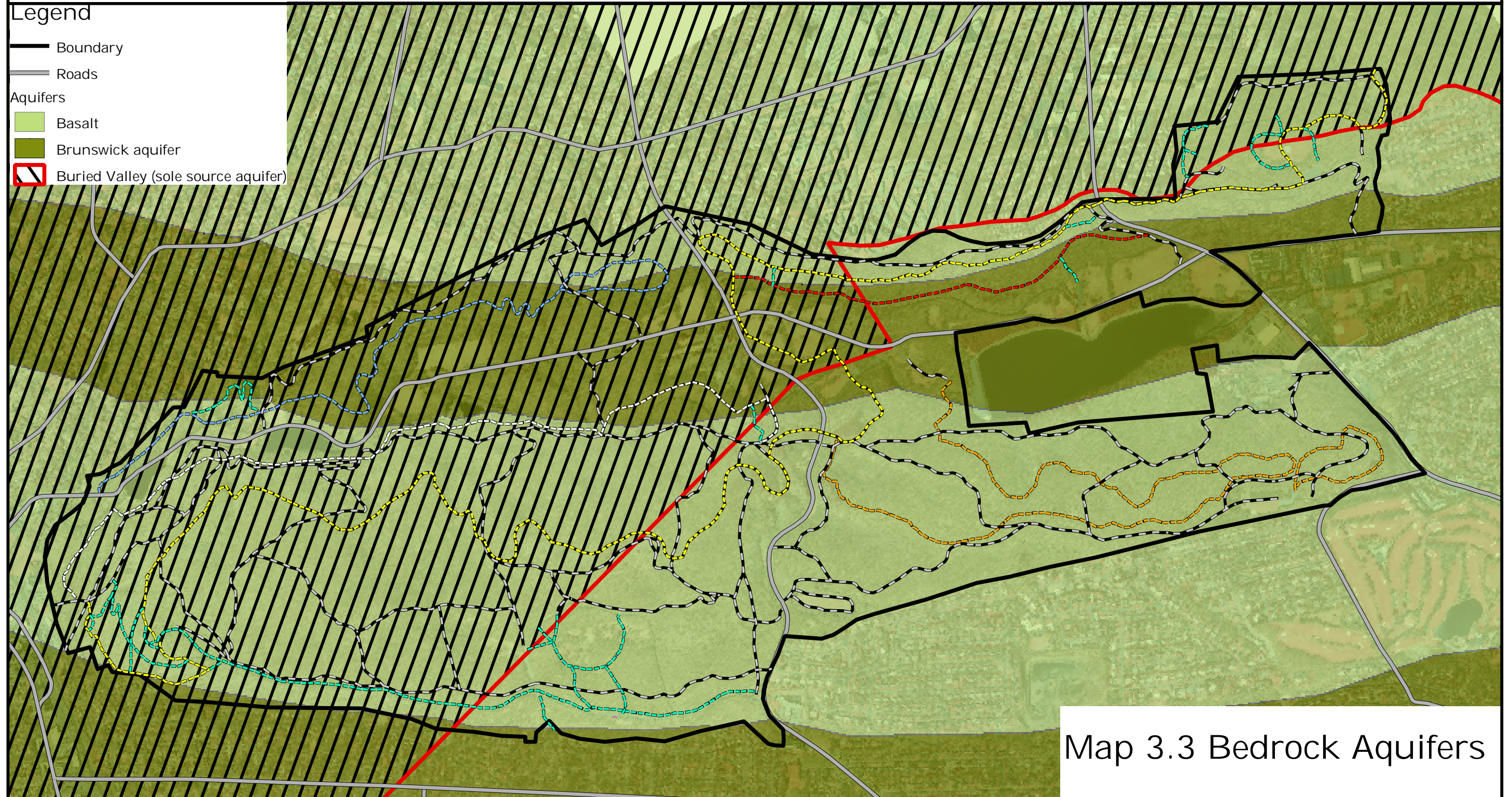


SOUTH MOUNTAIN RESERVATION

LANDSCAPE AND INFRASTRUCTURE ASSESSMENT AND RESTORATION MANAGEMENT PLAN

Legend

- Boundary
- Roads
- Aquifers
 - Basalt
 - Brunswick aquifer
 - Buried Valley (sole source aquifer)



Map 3.3 Bedrock Aquifers

INFORMATION SOURCES: NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, BUREAU OF GEOGRAPHIC INFORMATION SYSTEMS

<http://www.nj.gov/dep/gis/index.html>

NEW JERSEY IMAGE WHAREHOUSE
http://njig.nj.gov/OIT_IW/index.jsp

0 500 1,000 2,000 3,000 Feet



3.0 HYDROLOGIC SYSTEMS

3.1 Consolidated Rocks

Rocks of the Brunswick Formation [Feltville Formation] are the main source of ground water in Essex County with the Brunswick Aquifer located under South Mountain Reservation in the valley (Map 3.3). The shale and sandstone are generally capable of sustaining moderate to large yields in wells. There are five active wells located in South Mountain Reservation. See the Utility section of this chapter for more information on the wells.

The Watchung Basalt commonly is capable of yielding only small to moderate quantities of water. Watchung Basalt is intercalated with rocks of the Brunswick Formation yield commonly yield small to moderate water supplies (Nichols, 1968). For basalt to yield water fault lines, fault zones or fracture plates need to occur. There may be a fault line located within the First Mountain in the Reservation. According to a paper published by Rutgers Geology Department a fault lies within the First Mountain in the Reservation (Figure 25). The Rutgers data was modified from Schlische (1992) and Olsen et al. (1966). However, according to NJDEP there are no fault lines, fault zones or fracture plates located within the Reservation. Further site-specific investigations need to be completed to confirm.

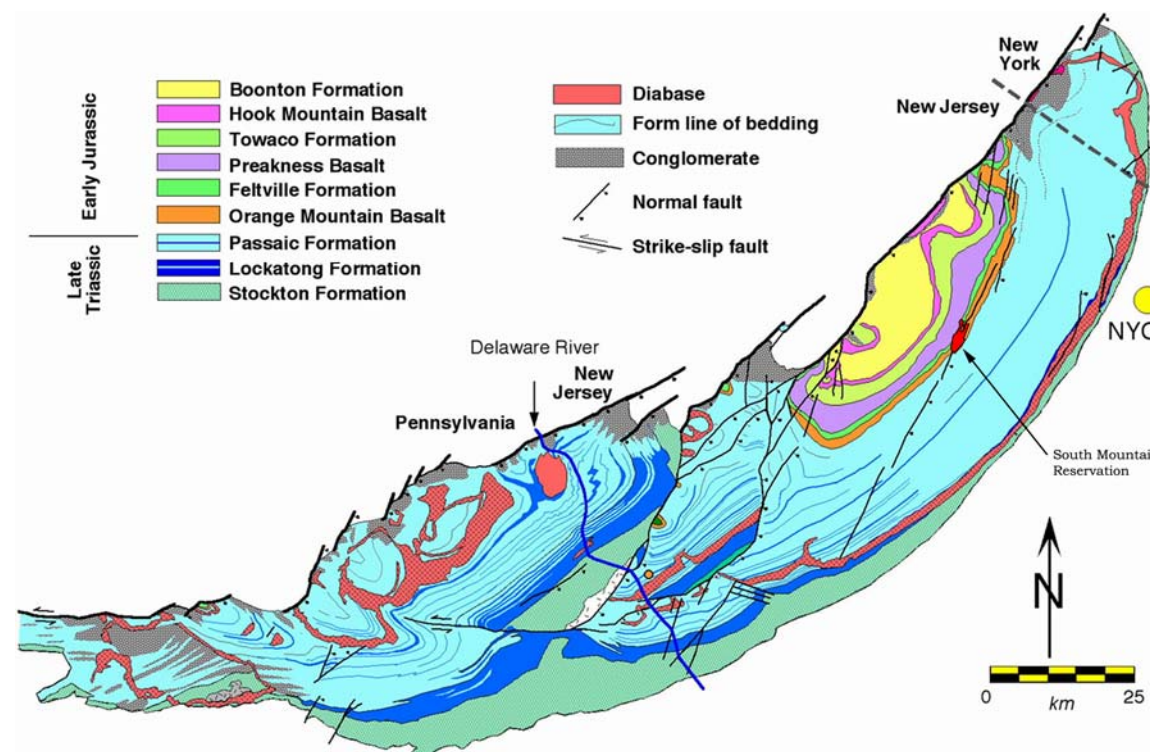


Figure 25 ~ Geologic Map of the Newark Basin. South Mountain Reservation is shown in red on the right side. (Modified from Rutgers which was modified from Schlische(1992) and Olsen et al. (1996)).

The Buried Valley Sole Source Aquifer is located within the majority of the area south of South Orange Avenue (Map 3.3). A sole-source aquifer contributes to more than 50% of the drinking water to a specific area. This water is also deemed impossible to replace if the aquifer were contaminated. Four of the five active wells in the Reservation fall within the sole source aquifer area. Any federally funded project in an area that could affect ground water in a sole-source aquifer must be reviewed by the USEPA. The project review area includes the aquifer's recharge zone and it's stream-flow source zone. The recharge zone is the area through which water recharges the aquifer. The source zone is the upstream area that contributes recharge water to the aquifer (New Jersey Geological Society, 1998).

3.2 Unconsolidated Sediments

Only sand and gravel aquifers in stratified drift deposits contain sufficient quantities of water to discuss their water bearing properties. The most productive artesian (confined) and semi-artesian aquifers in the stratified drift in Essex County occur as valley fill in stream valleys that were cut into the bedrock before the last glaciations.

Surficial aquifers exist in the valley in South Mountain Reservation. There are three types of aquifers, till, moronic deposits and sand and gravel (Map 3.4). They are currently being tapped for 5 active wells for the City of Orange Township.

3.3 Watershed / Drainage Areas

The majority of South Mountain Reservation is located within Arthur Kill watershed. About a third of Mayapple Hill (the western portion) is located in the Upper Passaic, Whippany, and Rockaway watershed. (Map 3.5)

The majority of the drainage in the Reservation is overland flow that makes its way down the mountain in ravines of varying steepness and width to the West Branch of the Rahway River (River). The drainage areas were determined on a macro site scale. There are sub drainage areas within the larger drainage areas. The drainage areas vary greatly and range from 1.13 acres to 111.08 acres (Map 3.5). The ravines with large drainage areas are not surprisingly showing a high degree of erosion.

The drainage that does flow underground through pipes is primarily culvert crossings under the wood road network in the reservation.

3.4 Springs

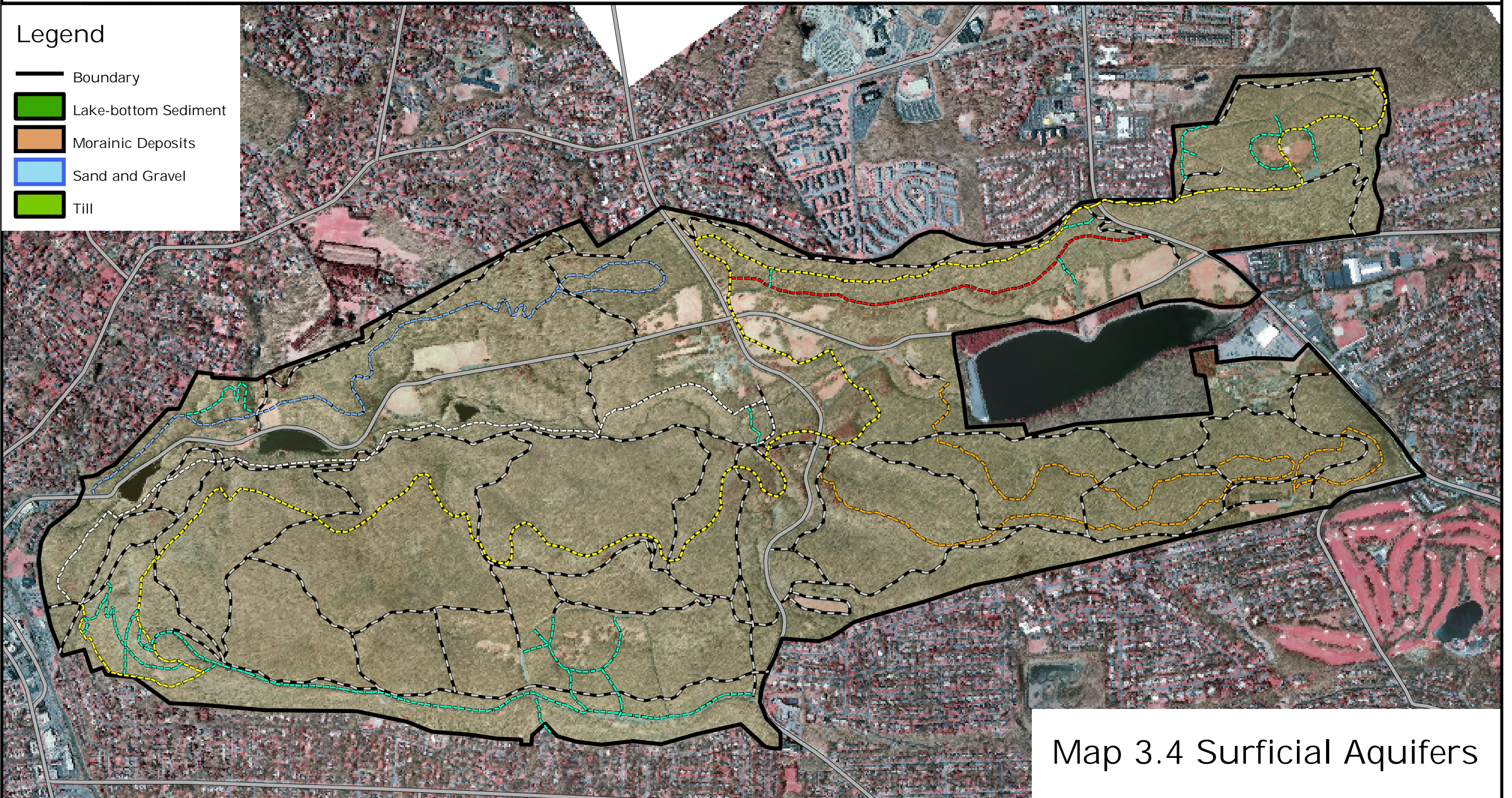
There are numerous springs located within the Reservation. The majority of them are located south of South Orange Avenue and east of Brookside Drive. The springs appear to be providing a significant amount of water to the surface drainage system. There are numerous forested wetlands located along steep slopes as well as those at the top of the First Mountain. The water source for some of these wetlands appears to be springs that were noted on the Olmsted plan of 1909 (See Map 3.6).

This additional and more constant flow of water places an extra burden on the soils, vegetation and trails within the Reservation. Water from Hot Winter Spring located at Overlook and Balls Bluff Trails intersection was observed during December 2005 traveling adjacent to Balls Bluff Trail and crossing the trail causing erosion.

There are numerous areas where water seeps through the soil to form erosion channels or gullies. Some are small and some have been growing over the years. Others yet are located within trail bed making it difficult to maintain a passable trail. Active management of the water from the springs and seepage areas in and near the trails as well as from storm events will be required to sustain the Reservation.

SOUTH MOUNTAIN RESERVATION

LANDSCAPE AND INFRASTRUCTURE ASSESSMENT AND RESTORATION MANAGEMENT PLAN



Legend

- Boundary
- Lake-bottom Sediment
- Morainic Deposits
- Sand and Gravel
- Till

Map 3.4 Surficial Aquifers

INFORMATION SOURCES: NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, BUREAU OF GEOGRAPHIC INFORMATION SYSTEMS










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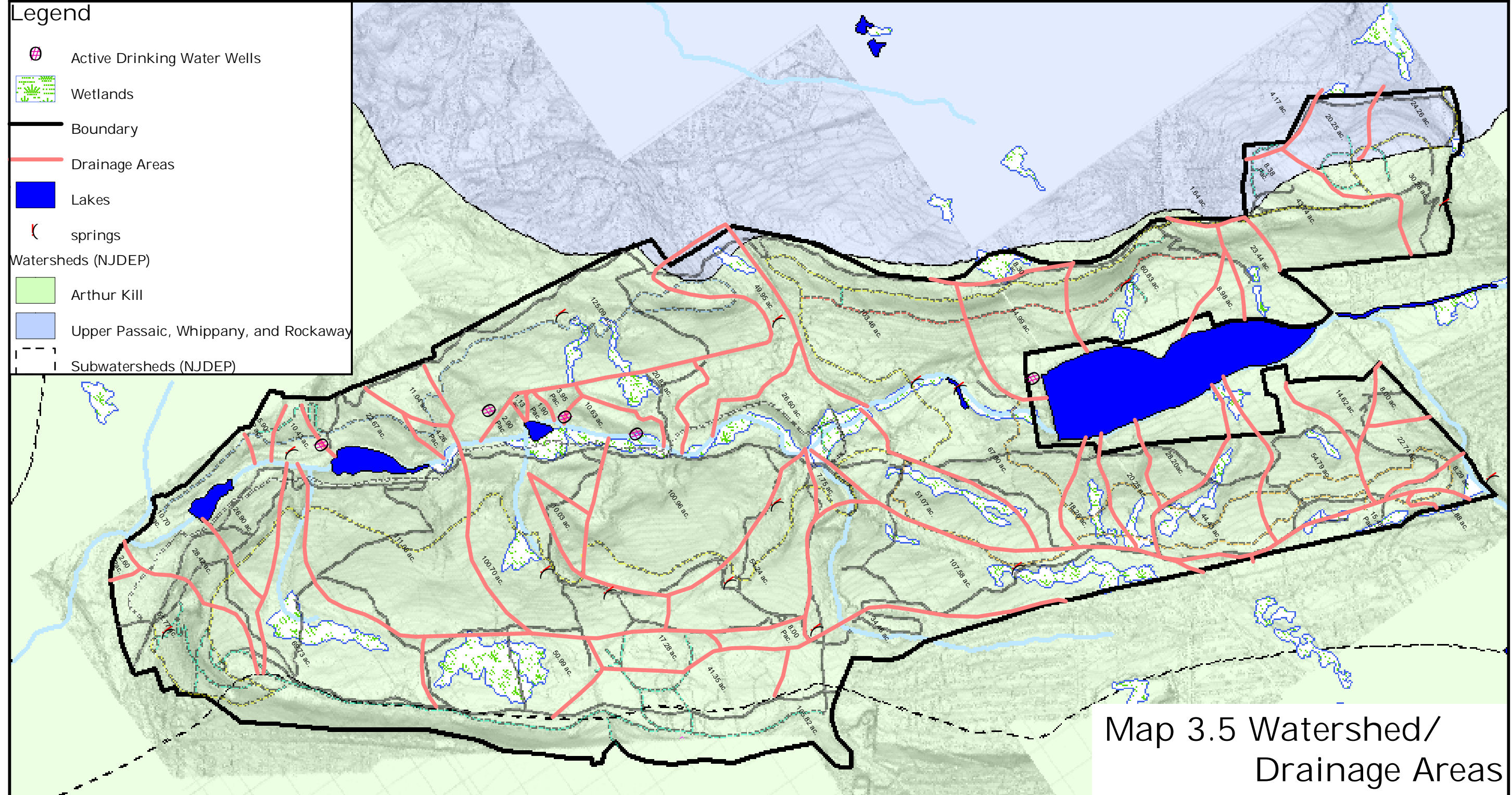


SOUTH MOUNTAIN RESERVATION

LANDSCAPE AND INFRASTRUCTURE ASSESSMENT AND RESTORATION MANAGEMENT PLAN

Legend

-  Active Drinking Water Wells
-  Wetlands
-  Boundary
-  Drainage Areas
-  Lakes
-  springs
- Watersheds (NJDEP)
 -  Arthur Kill
 -  Upper Passaic, Whippany, and Rockaway
-  Subwatersheds (NJDEP)

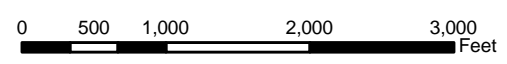


Map 3.5 Watershed/
Drainage Areas

INFORMATION SOURCES: NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, BUREAU OF GEOGRAPHIC INFORMATION SYSTEMS

<http://www.nj.gov/dep/gis/index.html>






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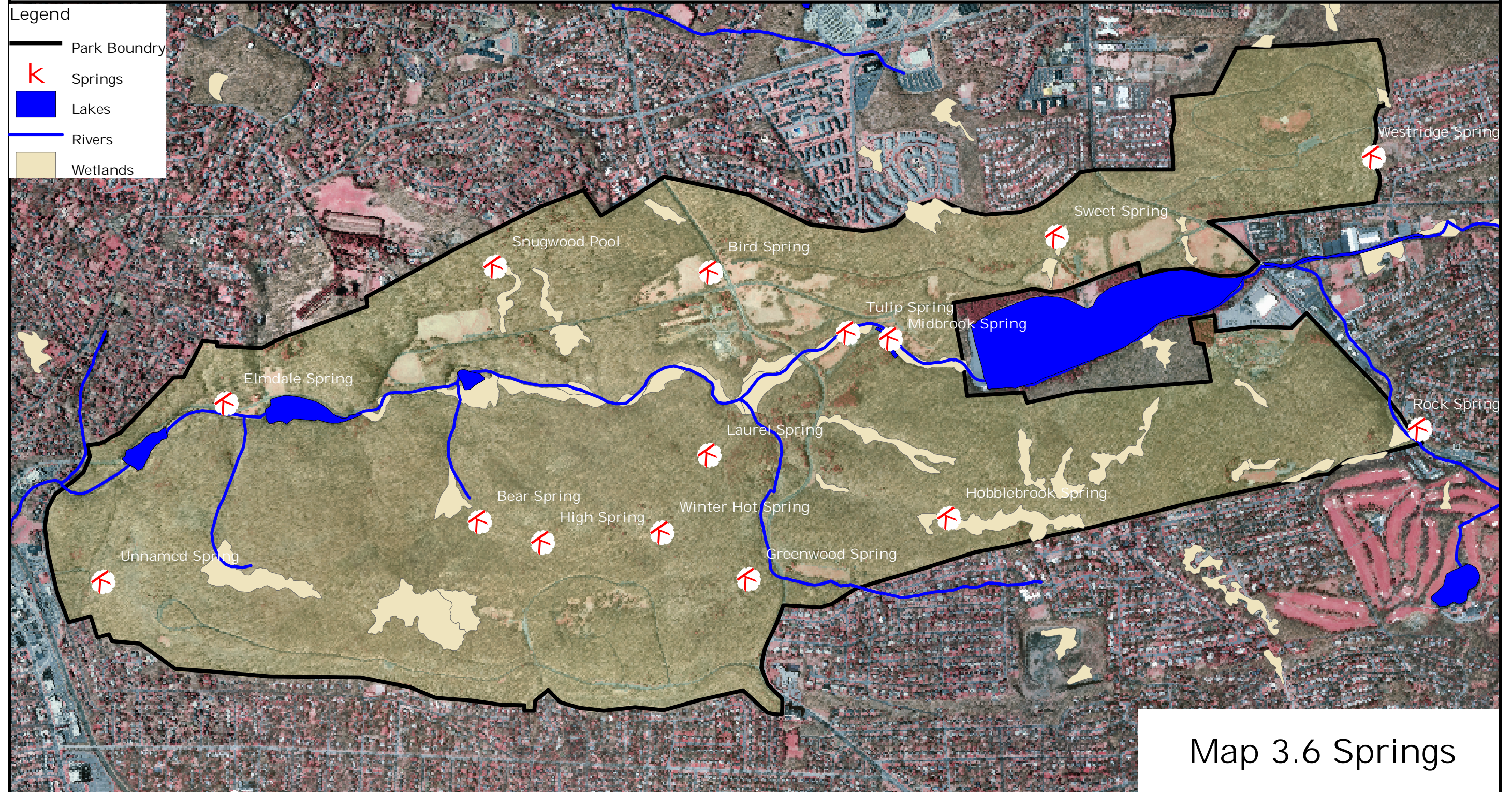


SOUTH MOUNTAIN RESERVATION

LANDSCAPE AND INFRASTRUCTURE ASSESSMENT AND RESTORATION MANAGEMENT PLAN

Legend

-  Park Boundary
-  Springs
-  Lakes
-  Rivers
-  Wetlands



Map 3.6 Springs

INFORMATION SOURCES: NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, BUREAU OF GEOGRAPHIC INFORMATION SYSTEMS

<http://www.nj.gov/dep/gis/index.html>

NEW JERSEY IMAGE WHAREHOUSE
http://njig.nj.gov/OIT_IW/index.jsp

0 500 1,000 2,000 3,000
Feet



4.0 SOILS

The United States Geologic Survey released a soil survey for Essex County in December 2004. Up until that time there was no soil survey for Essex County, New Jersey. Eleven soil family groups were identified, Boonton, Dunellen, Haledon, Hasbrouck, Peckmantown, Tunkhannock, Udifluents, Udorthents on both Boonton and Dunellen substratum, Yalesville-Boonton-Holyoke and Yalesville-Holyoke. A basic description of each classification within the families follows. See Map 3.7 for the soil distribution in the Reservation.

The **Boonton** series covers over 80% of the Reservation and occurs on the Watchung Mountains.

Boonton sandy loam, terminal moraine, extremely stony

The parent material consists of coarse-loamy till derived from basalt with slopes ranging from 0-25% (BoeBc, BoeCc, BoeDc).

Boonton loam

The parent material consists of coarse-loamy basal till derived from basalt with slopes ranging from 3-15% (BogB, BogC).

Boonton loam, extremely stony

The parent material consists of coarse-loamy basal till derived from basalt with slopes ranging from 0-35% (BogBc, BogCc, BogDc,).

Boonton – Urban land complex

The parent material consists of coarse-loamy till derived from basalt with 0-15% slopes (BouB, BouC).

Boonton – Urban land complex, red sandstone lowland

The parent material consists of coarse-loamy till derived from sandstone and shale with 0-8% slopes (BowrB).

The **Dunellen** series occurs at Pleasant Valley Way and Northfield Avenue and in some small pockets along the southwest border.

Dunellen sandy loam

The parent material consists of coarse-loamy outwash derived from sandstone with slopes 3-8% (DunB).

Dunellen – Urban land complex

The parent material consists of coarse-loamy outwash derived from sandstone with slopes from 0-8% (DuuB).

Haledon series occurs in pockets on the ridge, mountainside and the valley.

Haledon silt loam, extremely stony

The parent material consists of coarse-loamy basal till derived from basalt with 0-8% slopes (HanBc).

The **Hasbrouck** series occur near the ridge in the southern part of the Reservation.

Hasbrouck silt loam, extremely stony

The parent material consists of fine-loamy eroded and redeposited glacial material over glacial till with 0-8% slopes (HctBc).

The **Peckmantown** is located in the valley on the west side of the river. It does not run contiguous from the north to the south but is interrupted with pockets of Tunkhannock and Boonton soils.

Peckmantown silt loam

The parent material consists of coarse-silty glaciolacustrine deposits derived from basalt with 3-15% slopes (PecmB, PecmC).

Peckmantown silt loam, extremely stony

The parent material consists of coarse-silty glaciolacustrine deposits derived from basalt with 0-15% slopes (PecmBc, PecmCc).

Peckmantown – Urban land complex

The parent material consists of coarse-silty glaciolacustrine deposits derived from basalt with 0-8% slopes (PecuuB).

Tunkhannock soils are located only in the valley and run adjacent to the river on the west side.

Tunkhannock fine sandy loam

The parent material consists of loamy-skeletal outwash from red sandstone with slopes from 15-25% (TunkD, TunkE).

Udifluents soils extend the length of the river and are interrupted with small pockets of Haledon, and Peckmantown soils.

Udifluvents, frequently flooded

The parent material consists of recent alluvium with 0-3% slopes (UcdAt).

Udorthents soils occur at the southernmost tip of the reservation by Glen Avenue.

Udorthents, Boonton substratum

The parent material consists of loamy material transported by human activity with 0-8% slopes (UdbonB).

Udorthents, Dunellen substratum

The parent material consists of loamy material transported by human activity with 0-8% slopes (UddunB).

Yalesville complex soils occur along the eastern side of the Second Watchung Mountain in the northern part of the reservation and on the eastern side of the First Watchung Mountain in the southern part of the reservation.

Yalesville-Boonton-Holyoke complex, extremely stony

Yalesville soils make up 40% of the map unit. The parent material consists of coarse-loamy till derived from basalt. Holyoke soils make up 30% of the map unit. The parent material consists of loamy till derived from basalt. Boonton soils make up 30% of the map unit. The parent material consists of coarse-loamy basal till derived from basalt. This component is typically found on the summit position of ground moraines. The slopes range from 0-8%.

Yalesville – Holyoke complex, very rocky

Yalesville soils make up 50% of map unit. The parent material consists of coarse-loamy till derived from basalt. Holyoke soils make up 30% of the map unit. The parent material consists of loamy till derived from basalt. Slopes range from 35-60%.

Table 1 notes the soils suitability for use as paths, trails and off-road motorcycles. The Boonton series covers over 80% of the Reservation and occurs on the Watchung Mountains. This series (except for the lowland classification of BowrB) is very limited for uses as paths, trails and off-road motorcycles. This is due to the steep slopes and highly erodable soils. Map 3.8 identifies the soils that are suitable for use as path, trail or off-road motorcycle. These soils are generally in the valley. In this location, however, there are other environmental issues with the floodplain and wetlands that affect these uses.

Soil Family	Uses: Soil suitability for use as paths, trails and off-road motorcycle trails.
Boonton	Very limited use due to stony soil, slope and susceptibility to water erosion. The lowland classification (BowrB) is not limited in the above uses.
Dunellen	Not limited in use.
Haledon	Very limited use due to stony soil and depth to saturated zone.
Hasbrouck	Very limited use due stony soil, to depth to saturated zone and ponding.
Peckmantown	Information not available.
Tunkhannock	Information not available.
Udifluvents	Somewhat limited use due to sandy soil and flooding with the sandy soil being the greater of the two limiting factors.
Udorthents (Boonton)	Not limited in use.
Udorthents (Dunellen)	Not limited in use.
Yalesville – B-H	Information not available.
Yalesville-H	Information not available.

Table 1 ~ Soil suitability for designated uses

4.1 SOIL EROSION

Soil erosion is mainly occurring adjacent to the pedestrian trails and wood road network and in gullies and ravines. Trails are the hiking trails that are approximately three feet in width and have a natural bed of bedrock, rubble or soil. Wood roads are approximately ten feet wide and primarily have a gravel bed, with the exception of the lower trails close to the West Branch of the Rahway River. These lower wood roads are a mix of soil and DGA that was placed to address the wet conditions. The wood roads are generally in good condition with the exception to the stretches affected by erosion as described below. These roads were cut initially to harvest the wood in the reservation for opening views, manage experiences and fight forest fires. The original intent of the Olmsted Firm was to develop them as paved roads, but due to budgetary constraints that never occurred. No vehicles are allowed on the wood roads; however, there is evidence of off road vehicle use such as ATV's.

The majority of erosion is occurring due to the forces of the stormwater traveling down the mountain to the West Branch of the Rahway River in the valley at the base of the mountain. There is also evidence of vehicular use such as ATV's.

Erosion along the wood roads is occurring where the swales and culverts adjacent to the wood roads have filled with leaf litter. The water, in finding the straightest course down the mountain, crosses onto the trail and continues downslope on the trail. This is exacerbated by the fact that there is not an adequate cross slope or crown on the wood roads to direct the water across the wood road or back into the swale to continue further downslope. There are significant erosion gullies that have formed with a v-shaped section three feet wide and one foot deep within the wood roads that extend for upwards of 200 feet in several areas of the reservation.

There are some sections along the trail network that have also been affected by erosion due to stormwater. There are also sections of trails that cross steep sections of the reservation where the trail width is narrowing due to inadequate downslope stabilization and thus erosion occurring on the downslope side of the trail.

Erosion is also occurring in the natural ravines. This is primarily occurring on the downslope side of a pipe or culvert crossing. There are large drainage areas that are being concentrated through a pipe or culvert instead of being able to traverse the natural v-section of the ravine. The concentration is creating a large force that is eroding the soil on the downslope side. In some cases the headwalls or trail stabilization walls that also act as headwalls have collapsed on the downstream side constricting or blocking the flow of water. This causes water to back-up on the high side and travel across the wood road causing erosion.

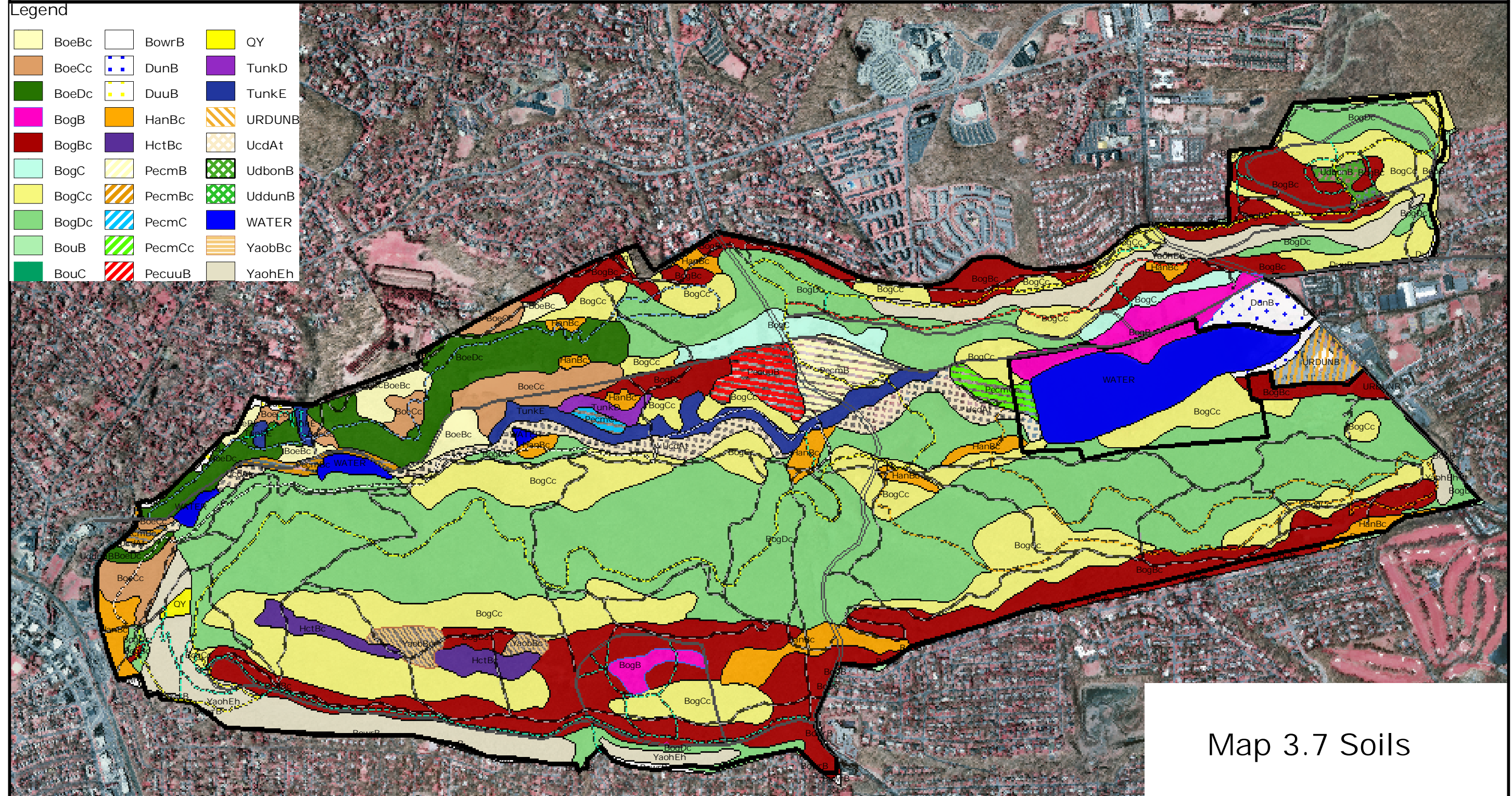
Topography, with the steep mountainsides and ravines along with large land area, is a significant contributing factor to erosion.

SOUTH MOUNTAIN RESERVATION

LANDSCAPE AND INFRASTRUCTURE ASSESSMENT AND RESTORATION MANAGEMENT PLAN

Legend

	BoeBc		BowrB		QY
	BoeCc		DunB		TunkD
	BoeDc		DuuB		TunkE
	BogB		HanBc		URDUNB
	BogBc		HctBc		UcdAt
	BogC		PecmB		UdbonB
	BogCc		PecmBc		UddunB
	BogDc		PecmC		WATER
	BouB		PecmCc		YaobBc
	BouC		PecuuB		YaohEh



Map 3.7 Soils

INFORMATION SOURCES: NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, BUREAU OF GEOGRAPHIC INFORMATION SYSTEMS

<http://www.nj.gov/dep.gis/index.html>

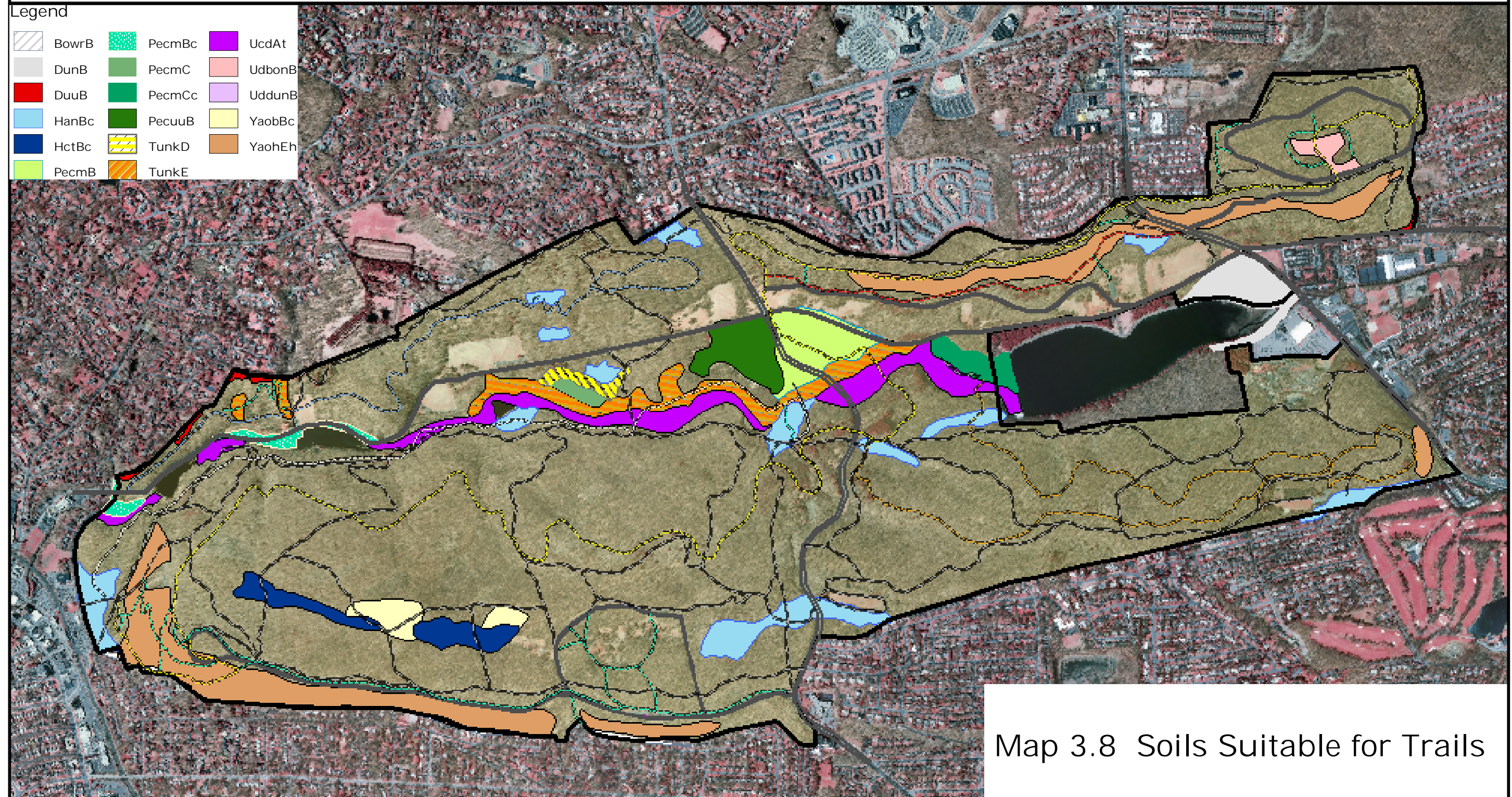
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SOUTH MOUNTAIN RESERVATION

LANDSCAPE AND INFRASTRUCTURE ASSESSMENT AND RESTORATION MANAGEMENT PLAN

Legend



Map 3.8 Soils Suitable for Trails

INFORMATION SOURCES: NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, BUREAU OF GEOGRAPHIC INFORMATION SYSTEMS

<http://www.nj.gov/dep/gis/index.html>

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http://njig.nj.gov/OIT_IW/index.jsp



5.0 FOREST AND MEADOW ECOLOGY

The first step in developing the forest management plan was to review the history of the ecosystem and the original plans for the park, as well as its current conditions. Next, to further understand the natural resources within the South Mountain Reservation, a vegetative cover map was developed and field checked based on available topographic maps, aerial maps, and other available maps and reports. The vegetative cover map includes descriptions of cover types and conditions, as described below.

5.1 The Forest Ecosystem

The majority of the South Mountain Reservation is forested, with a mixture of deciduous and coniferous stands. The understory within the forested areas varies, ranging from diverse and abundant to predominantly sparse and monotypic. Streams and creeks run through the Reservation, draining into the West Branch of the Rahway River. Open (non-forested) areas are associated with parking, picnic and miscellaneous management areas. A road and trail system traverses through and around the Reservation.

The ecology of the Reservation is variable, and its complexity is interwoven with the surrounding influences located adjacent to and outside of the Reservation. The surrounding tree and ground cover, buildings, infrastructure, wildlife and human populations all contribute to the diversity of the Reservation's forest system as well as to its limitations.

Two important factors affecting the South Mountain Reservation are the land use distribution and the amount of direct human manipulation of the ecological system. By understanding how human and natural forces interact to affect the forest system, this can lead to better management decisions that minimize negative forest changes and facilitate positive changes. The land use distribution is described below. The manipulation is discussed in Section 1.1.4.

5.1.1 Ecological Cover Types

Qualitative site surveys were completed in the spring and summer of 2005 to document the different vegetation and dominant covers observed within the South Mountain Reservation. The list of the vegetative types is not inclusive, but provides an indication of the dominant vegetation types commonly observed within the Reservation. Based on these site surveys, a vegetation cover map was developed, presented as Map 3.9.

The vegetation cover types represented on the cover map include: Mixed Forest - dominated by deciduous and coniferous trees; Deciduous Forest; Coniferous Forest; Wet Deciduous Forest – canopy of deciduous trees within a freshwater wetland area; Artificial Lake; Old Field; Urban Land; Modified Wetland; and Disturbed Forest.

5.1.2 Observed Vegetation Species

The vegetation species observed during the site surveys are listed in the following Table 2. It is worth noting again that the following list is not all-inclusive, but provides an indication of the dominant vegetation commonly observed within the Reservation.

Vegetative types observed include 32 tree species (both deciduous and coniferous) native to North America and 3 invasive tree species, 20 shrub species native to North America and 4 invasive shrub species (and 2 not classified), and 35 native herbaceous species and 4 invasive herbaceous species.

Scientific Name	Common Name	Native**	NWI Status***
TREES			
<i>Acer negundo</i>	Boxelder maple	US	FAC+
<i>Acer platanoides*</i>	Norway maple	Alien	NI
<i>Acer rubrum</i>	Red maple	NJ	FAC
<i>Acer saccharum</i>	Sugar maple	NJ	FACU-
<i>Ailanthus altissima*</i>	Tree-of-heaven	Alien	NI
<i>Betula alleghaniensis</i>	Yellow birch	NJ	FAC
<i>Betula lenta</i>	Black birch	NJ	FACU
<i>Betula nigra</i>	River birch	NJ	FACW
<i>Betula populifoli</i>	Gray birch	NJ	FAC
<i>Carpinus caroliniana</i>	Ironwood	NJ	FAC
<i>Castanea dentata</i>	American chestnut	US	NI
<i>Catalpa speciosa</i>	Catalpa	US	FAC
<i>Carya cordiformis</i>	Bitternut hickory	NJ	NI
<i>Carya glabra</i>	Pignut hickory	NJ	FACU-
<i>Carya ovata</i>	Shagbark hickory	NJ	FACU-
<i>Carya tomentosa</i>	Mockernut hickory	NJ	NI
<i>Crataegus sp.</i>	Hawthorn	US	NI
<i>Fagus grandifolia</i>	American beech	NJ	FAC+
<i>Fraxinus americana</i>	White ash	NJ	FACU
<i>Fraxinus pennsylvanica</i>	Green ash	NJ	FACW
<i>Ilex opaca</i>	American holly	NJ	FACU+
<i>Liquidambar styraciflua</i>	Sweet gum	US	FAC
<i>Liriodendron tulipifera</i>	Tulip poplar	NJ	FACU
<i>Nyssa sylvatica</i>	Black gum	NJ	FAC
<i>Pinus strobus</i>	White pine	NJ	FACU
<i>Platanus occidentalis</i>	American sycamore	NJ	FACW-
<i>Prunus serotina</i>	Black cherry	US	FACU
<i>Quercus alba</i>	White oak	NJ	FACU-
<i>Quercus palustris</i>	Pin oak	NJ	FACW
<i>Quercus prinus</i>	Chestnut oak	NJ	UPL
<i>Quercus rubra</i>	Red oak	NJ	FACU-
<i>Quercus velutina</i>	Black oak	NJ	NI
<i>Robinia pseudoacacia</i>	*Black locust	US	FACU-
<i>Sassafras albidium</i>	Sassafras	US	FACU-
<i>Tilia americana</i>	American basswood	NJ	FACU
<i>Tsuga canadensis</i>	Hemlock	NJ	FACU
<i>Ulmus americana</i>	American elm	US	FACW-
<i>Ulmus rubra</i>	Slippery elm	NJ	FAC-

SHRUBS

<i>Alnus serrulata</i>	Smooth alder		US		OBL
<i>Aronia arbutifolia</i>	Red chokeberry		NJ		FACW
<i>Berberis thunbergii</i> *	Japanese barberry	Alien		FACU	
<i>Cephalanthus occidentalis</i>	Buttonbush		NJ		OBL
<i>Clethra alnifolia</i>	Sweet pepperbush		NJ		FAC+
<i>Cornus amomum</i>	Silky dogwood		NJ		FACW
<i>Cornus florida</i>	Flowering dogwood		US		FACU-
<i>Euonymus alata</i> *	Winged euonymus	Alien		NI	
<i>Hamamelis virginiana</i>	Witch hazel		US		FAC-
<i>Ilex glabra</i>	Inkberry holly	NJ		FACW-	
<i>Ilex verticillata</i>	Winterberry holly		NJ		FACW+
<i>Kalmia latifolia</i>	Mountain laurel		NJ		FACU
<i>Lindera benzoin</i>	Spice bush		NJ		FACW-
<i>Lonicera</i> sp.	Honeysuckle		?		----
<i>Rhododendron maximum</i>	Rose-bay rhododendron		NJ		FAC
<i>Rhus coccinea</i>	Winged sumac		US		NI
<i>Rhus glabra</i>	Smooth sumac		US		NI
<i>Rosa multiflora</i> *	Multiflora rose	Alien		FACU	
<i>Rubus occidentalis</i>	Black raspberry		US		NI
<i>Rubus phoenicolasius</i> *	Wineberry	Alien		NI	
<i>Rubus</i> sp.	Berry species		?		----
<i>Vaccinium angustifolium</i>	Lowbush blueberry		NJ		FACU-
<i>Vaccinium corymbosum</i>	Highbush blueberry		NJ		NI
<i>Viburnum dentatum</i>	Arrow-wood	NJ		FAC	
<i>Viburnum lentago</i>	Nannyberry		US		FAC
<i>Viburnum acerifolium</i>	Mapleleaf viburnum		NJ		UPL
<i>Viburnum prunifolium</i>	Black-haw viburnum		US		FACU

HERBACEOUS/FERNS/GRASSES

<i>Alliaria petiolata</i> *	Garlic mustard				FACU-
<i>Allium canadense</i>	Wild onion				FACU-
<i>Ambrosia artemisiifolia</i>	Common ragweed				FACU
<i>Arisaema triphyllum</i>	Jack-in-the-pulpit			FACW-	
<i>Artemisia vulgaris</i>	Common mugwort				UPL
<i>Asclepias</i> sp.	Milkweed				----
<i>Aster divaricatus</i>	White wood aster				NL
<i>Athyrium Filix-femina</i>	Lady fern			FAC	
<i>Calystegia sepium</i>	Hedge bindweed				NI
<i>Boehmeria cylindrical</i>	False nettle				FACW+
<i>Daucus carota</i>	Queen Anne's lace				NI
<i>Duchesnea indica</i>	Indian strawberry				FACU-
<i>Fragaria virginiana</i>	Wild strawberry				FACU
<i>Galium</i> sp.	Bedstraw				----
<i>Impatiens capensis</i>	Jewelweed				FACW
<i>Juncus effusus</i>	Soft rush				FACW+
<i>Juncus tenuis</i>	Path rush				FAC-
<i>Maianthemum canadense</i>	Canada mayflower				FAC-
<i>Medicago lupulina</i>	Black medic				UPL
<i>Melilotus</i> sp.	Sweet clover				----
<i>Microstegium vimineum</i> *	Japanese stiltgrass				FAC
<i>Onoclea sensibilis</i>	Sensitive fern				FACW
<i>Osmunda cinnamomea</i>	Cinnamon fern				FACW
<i>Oxalis stricta</i>	Yellow wood-sorrel				NI
<i>Panicum clandestinum</i>	Deer tongue grass				NI
<i>Phragmites australis</i> *	Common reed				FACW
<i>Phytolacca americana</i>	Pokeweed				FACU+
<i>Poa</i> sp.	Grasses				----
<i>Podophyllum peltatum</i>	May apple				FACU
<i>Polygonum cuspidatum</i> *	Japanese knotweed				FACU-

<i>Polygonum sagittatum</i>	Arrow-leaved tearthumb				OBL
<i>Polystichum acrostichoides</i>	Christmas fern				FACU-
<i>Potentilla simplex</i>	Common cinquefoil				FACU-
<i>Ranunculus abortivus</i>	Small-flowered crowfoot				FACW-
<i>Solidago</i> sp.	Goldenrod				----
<i>Sphagnum</i> sp.	Moss				----
<i>Streptopus amplexifolius</i>	Twisted-stalk				FAC+
<i>Symplocarpus foetidus</i>	Skunk cabbage				OBL
<i>Taraxacum officinale</i>	Dandelion			FACU-	
<i>Thelypteris noveboracensis</i>	New York Fern				FAC
<i>Trillium sessile</i>	Toad trillium				NI
<i>Trillium</i> sp.	Trillium				----
<i>Verbascum thapsus</i>	Common mullein				NI
<i>Veronica officinalis</i>	Common speedwell				FACU-
<i>Viola</i> sp.	Violets				----
<i>Vitis</i> sp.	Grape				----

- VINES**
- | | | | | | |
|------------------------------------|---------------------|--|--|--|------|
| <i>Ampelopsis brevipedunculata</i> | Porcelainberry | | | | NL |
| <i>Celastrus orbiculatus</i> * | Asiatic bittersweet | | | | FACU |
| <i>Parthenocissus quinquefolia</i> | Virginia creeper | | | | FACU |
| <i>Smilax rotundifolia</i> | Green briar | | | | FAC |
| <i>Toxicodendron radicans</i> | Poison Ivy | | | | FAC |
| <i>Vitis aestivalis</i> | Summer grape | | | | FACU |
| <i>Vitis riparia</i> | Riverbank grape | | | | FACW |
- * Considered to be invasive in New Jersey
 ** References: www.wildflower2.org/NPIN/Plants/plant.html
www.npsnj.org/invasivespecies-0203.htm
<http://www.rce.rutgers.edu/njriparianforestbuffers/nativeALL.htm>
 *** Based on <http://www.fws.gov/nwi/bha/download/1996/national.pdf>

NJ – Native to New Jersey
 US – Native to the United States
 Alien – Not Native to the United States
 OBL – Obligate Wetland Vegetation, occurs almost always under natural conditions in wetlands
 FACW – Facultative Wetland Vegetation, usually occurs in wetlands, but occasionally found in non-wetlands
 FAC – Facultative Wetland Vegetation, equally likely to occur in wetlands or non-wetlands.
 FACU – Facultative Upland Vegetation, Usually occurs in non-wetlands but occasionally found in wetlands
 UPL – Obligate Upland Vegetation, occurs in wetlands in another region, but occurs almost always under natural conditions in non-wetlands in this region.
 NI – Not Indicated

For each plant species on the list, the estimated probability that the species will occur within a wetland habitat (versus non-wetlands) is represented by assignment of a wetland indicator category. These categories were developed to reflect the frequency, from almost always to rarely, that a plant species would occur in a wetland. In addition to the five main categories, three of the categories (FACU, FAC, and FACW) are further subdivided by modifiers (+, -) which represent the likelihood of occurrence within wetter (+) and drier conditions (-). Listed species having an indicator status of Obligate (OBL), Facultative Wetland plus (FACW+), Facultative Wetland (FACW), Facultative Wetland minus (FACW-), Facultative plus (FAC+), or Facultative (FAC) are considered to be species **typically adapted** for life in wetland conditions. Species having a Facultative minus (FAC-), Facultative Upland (FACU+, FACU, and FACU-), or Upland (UPL) indicator status are not considered hydrophytic species but are still occasionally found in wetland areas. A NI (No Indicator) is recorded

on the list for those species for which insufficient information was available to determine the indicator status.”

5.1.3 Observed Fauna and Avian Species

A formal study of the fauna and avian species that reside and use the South Mountain Reservation was not conducted for this investigation. However, species observed during the qualitative ecological cover survey were noted and are documented below. The New Jersey Audubon Society was contacted regarding the bird species within the Reservation. They were able to state that they identified 26 species in their 1999 Breeding Bird Survey but they were unable to provide a specific list of species.

<u>Scientific Name</u>	<u>Common Name</u>
BIRDS	
<i>Agelaius phoeniceus</i>	Red-winged Blackbird
<i>Branta canadensis</i>	Canada Goose
<i>Cardinalis cardinalis</i>	Northern Cardinal
<i>Corvus brachyrhynchos</i>	American Crow
<i>Cyanocitta cristata</i>	Blue Jay
<i>Meleagris gallopavo</i>	Wild Turkey
<i>Phalacrocorax</i> sp.	Cormorant species
<i>Poecile atricapillus</i>	Black-capped Chickadee
<i>Turdus migratorius</i>	American Robin
<i>Zenaidura macroura</i>	Mourning Dove
MAMMALS	
<i>Didelphis marsupialis</i>	Opossum
<i>Tamias striatus</i>	Eastern Chipmunk
<i>Sciurus carolinensis</i>	Gray Squirrel
<i>Erethizon dorsatum</i>	Porcupine
<i>Procyon lotor</i>	Raccoon
<i>Mephitis mephitis</i>	Striped Skunk
<i>Odocoileus virginianus</i>	White-tailed Deer
REPTILES	
<i>Terrapene c. Carolina</i>	Eastern Box Turtle
<i>Thamnophis s. sirtalis</i>	Eastern Garter Snake
AMPHIBIANS	
<i>Rana spenocephala</i>	Southern Leopard Frog

5.1.4 Discussion of the Forest Ecosystem

By comparing the current observed species with historical reports and maps, it is evident that some of the vegetation observed is a remnant of what the original planners mapped out for the Reservation. From the turn of the century thru the early 1930s in the early 1900s Hemlock and various Pine species were planted along with Rhododendrons and Mountain Laurel. Unfortunately, blights have destroyed most of the Hemlocks in the area. Hemlocks are still evident within the Reservation, but in much smaller numbers than originally intended and many of the older trees are defoliated. The area around Hemlock Falls contains the largest density of Hemlocks, while the Mixed Forests in the central eastern section of the Reservation contain small pockets of Hemlocks and Pine spotted throughout the forest, and along the trail and picnic areas.



Figure 26 – Rhododendron

Rhododendrons and Mountain Laurels planted under the direction of the Olmsted firm are evident throughout the Reservation (Figures 26 and 27). Rhododendrons are dominant along the Lenape Trail in the central section of the Reservation. In some of the areas such as Tulip Springs and Maple Falls, these species appeared to have been planted based on their spacing and placement; however the Rhododendron and Mountain Laurels appear to have expanded into adjacent areas and are thriving naturally in some of these areas. In addition Chestnuts were lost throughout the forest further reducing the forest diversity.

Most areas that are indicated on the vegetation cover map as Coniferous Forest mimic the historical maps where such areas were planned, but are much smaller in acreage than originally intended. Areas indicated as Mixed Forest are generally located in areas originally intended to be dominated by coniferous species, but into which deciduous trees have migrated. Due to this mix, these areas are generally diverse (Figure 28). For example, in the area near the top of Maple Falls, tree, shrub and herbaceous stratum are evident and densely populated. Mountain Laurel and Pines are located in the area and appear to have been planted.



Figure 27 – Mountain Laurel



Figure 28 – Mixed forest.

Despite some likeness to the original plan for the forest, overall the forest structure is not what was originally set out in the late 19th century. The Deciduous Forest dominates the Reservation in areas beyond what was initially planned, as reflected on the vegetation cover map. Also, areas that were not originally meant to be forested are observed to be covered with an early successional forest growth. Early successional forests commonly develop following a disturbance, so it may be that these areas were originally managed as open areas and once management of these areas was discontinued they developed into early successional forested areas. These areas are characterized by a large number of saplings and shrubs, and are evident in the northeastern and central sections of the forest, most typically in the areas noted as Mixed Forest.

Dominant vegetation within the majority of the mature Deciduous Forest includes Beech, Maple and Oak. However, a number of different ecological areas occur within the Deciduous Forest. One such area is the Wet Deciduous Forest, classified as a palustrine forested wetland. These forested wetland areas are located at the higher elevated areas of the eastern portion of the Reservation off of Crest



Figure 29 – Meandering stream from the wetlands located near Crest Drive.

Drive and are indicative of a healthy hardwood freshwater swamp. A stream meanders through the wetland, eventually draining through the reservation into the Western Branch of the Rahway River (Figure 29). Despite the observed presence of many deer within the wetland, ground cover was observed to be about 100 percent. The deer within this area appeared to be foraging on Jewelweed – a large number of grazed Jewelweed stalks were observed. The understory appeared to be dominated in the summer by Japanese Stiltgrass, an invasive species.

The northeastern and eastern portions of the Deciduous Forest were observed to be the healthiest parts of the Deciduous Forest due to the vegetative diversity and dense understory. Pockets of Mixed Forest are located within these areas, creating a greater diversity. Also, pockets of this section border landscaped residential areas. Plants may have migrated from these residences that may further contribute to the diversity of the area. This section of the forest contained dense tree, sapling and understory stratum.

Within the other areas of the forest (northwest, western central, sections of the eastern central, and southern), disturbances contributing to a lack of diversity and stability include dying trees,

invasive plant species migration, erosion, and a lack of forest regeneration. These changes are likely to cause a continued change in the forest structure if not actively managed.



Figure 30 – Forest dyback is occurring in several places in the Reservation.

An area of dying trees was observed in the southern portion of the Reservation near Maple Falls, indicated on the Vegetation Cover Map as Disturbed Forest (Figure 30). Tree stumps of varying height, from two feet to ten feet in height, were evident throughout the area. This area of dying trees may have been due to an infestation– in July of 2005 the leaves of some of the remaining trees appeared to be coated with insects. As a result of the dying trees, a large open space had been created in the tree canopy allowing increased light penetration, and Japanese Barberry appeared to be invading the open area and was beginning to dominate the area.

As with most urban areas, the invasion of non-native plant species continues to be a growing problem. Invasive plant species appear to be most problematic in areas that were previously disturbed and/or have open canopies and edges. For example, abundant Common Reed and Japanese Knotweed can be observed in areas where fences were placed for the deer paddock area near Crest Drive. Within the Mayapple Picnic Area, Tree-of-Heaven and Norway Maple and other herbaceous invasive vegetation can be observed along the roadways and within other areas where light easily penetrates due to recent construction work. Within the southern section of the site, at the base of the abandoned quarry, open light penetrates the area and Japanese stiltgrass is dominant (Figure 31).

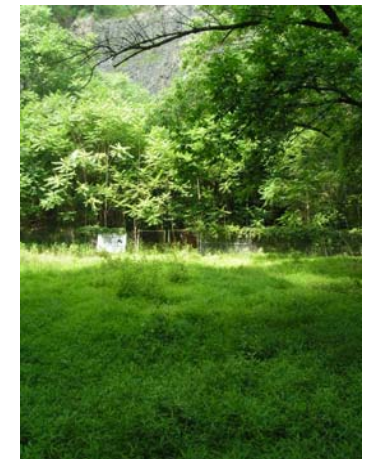


Figure 31 – Invasive Japanese stiltgrass in the clearing at the base of the old quarry.

Erosion is evident in a number of areas throughout the site, but appears to be most severe and affecting the stability of the forest within the southern portion of the site between the abandoned quarry and Maple Falls areas, within the western central areas along Cherry Lane, and within the central eastern section of the site near the river trail located behind the zoo and Orange Reservoir. Within the southern and western central sections, portions of the hill and the trails are actively eroding and the herbaceous canopy is minimal if it exists at all, further contributing to the erosion. Within the central eastern section of the site, areas near the Reservoir, Ravine and Hillspur Trails are actively being undercut during storm events and large trees have fallen as a result. Areas near the trail have scoured, resulting in a lack of vegetation within the scour areas.

As mentioned above, within some of the more steeply sloped areas in the southern section and within the western central section there are no or minimal species within the herbivory stratum of the Deciduous Forest. The lack of understory may be related to deer grazing and in other areas to soil compaction and erosion. This lack of an understory can result in an increase in erosion in these steeply sloped areas and can ultimately result in a lack of forest regeneration (Figure 32).



Figure 32 – Steep slopes with lack of understory vegetation and no forest regeneration.

The natural forest within the South Mountain Reservation should serve as a protective layer between the atmosphere and the land in the water cycle. The forest canopy intercepts both the falling rain and its kinetic energy. Some of the intercepted rainfall is evaporated to the atmosphere while the rest drips to the ground as throughfall or runs down the trunk as stemflow. Healthy forest soils are generally very porous so little rainfall washes over the soil surface as runoff to water bodies. Instead, most rainfall seeps or infiltrates into the soil where pollutants and nutrients are filtered, transformed, or assimilated.

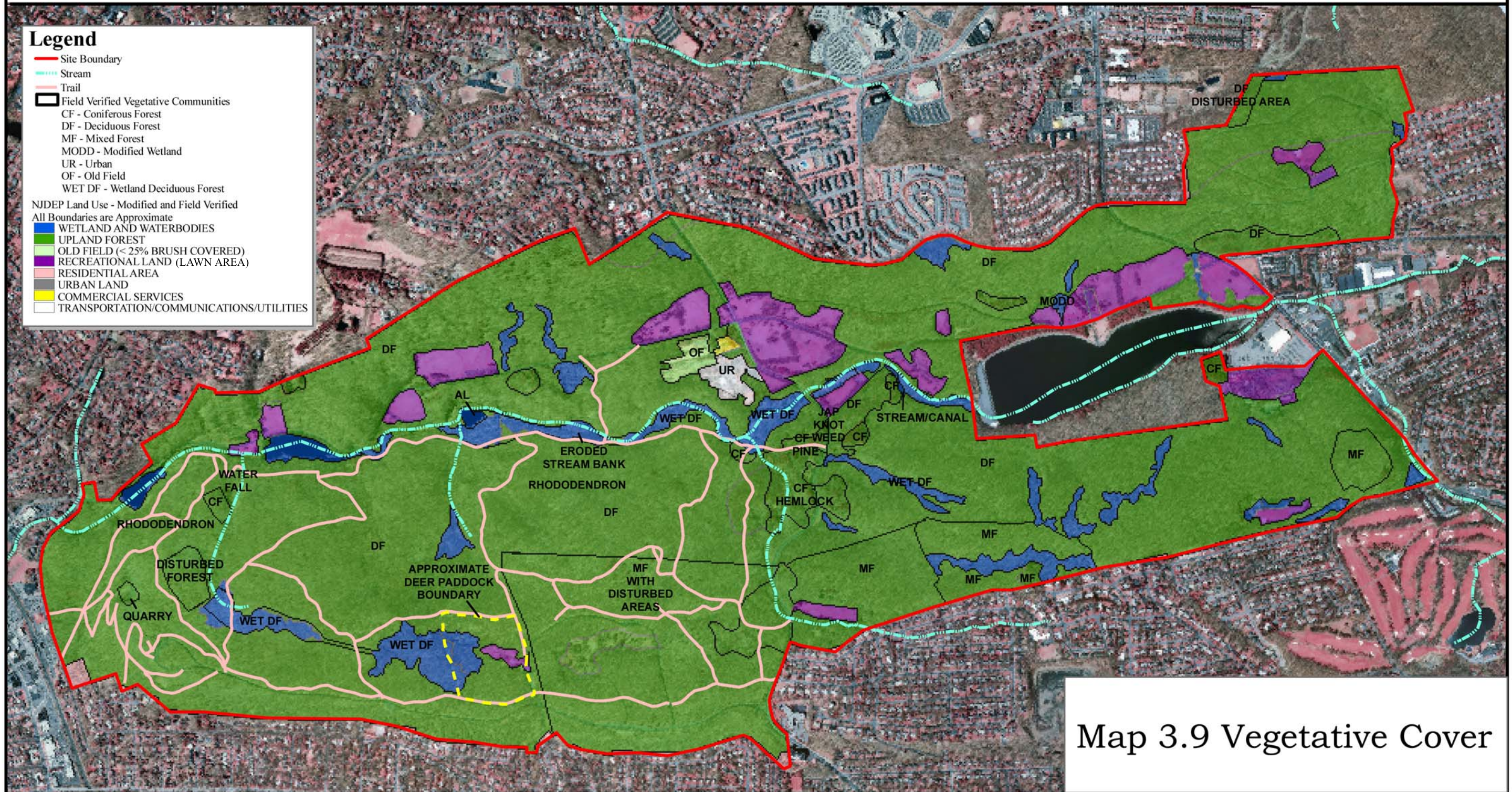
However, over time at South Mountain, soils on the steep slopes in the southern section and in some areas along the western central sections have become eroded due to the nature of the soils and the human disturbances within the area. As a result, water moves through the landscape within the steep portions of South Mountain largely as overwash, further contributing to erosion and causing a decrease in water quality within the site's stream systems.

Lastly, most predominantly within the southern tip of the Reservation, the forest sections that have steeper slopes and evidence of erosion and soil compaction consist of an evenly aged stand of trees with low species diversity and minimal understory. As a result of these factors and potentially deer predation, there is concern about future forest regeneration. The early successional habitat found in seedlings and saplings stands is no longer present in some of these areas.

The fragile forest resources of the South Mountain Reservation lie within the highly developed and populated Essex County region. As a result of its proximity to these surrounding areas, the undeveloped remnants of the Reservation are highly degraded, edge habitats are becoming more abundant, sensitive native species are decreasing in number, active erosion is evident along the river and its tributaries, and disturbances to the ecological systems continue. Due to these various degradations, ecosystem recovery will not occur naturally or due to any one management action, but rather must be handled as an ongoing maintenance effort with adaptive management policies.

SOUTH MOUNTAIN RESERVATION

LANDSCAPE AND INFRASTRUCTURE ASSESSMENT AND RESTORATION MANAGEMENT PLAN



INFORMATION SOURCES: NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION BUREAU OF GEOGRAPHIC INFORMATION SYSTEMS

<http://www.nj.gov/dep/gis/index.html>

NEW JERSEY IMAGE WHAREHOUSE
http://njig.nj.gov/OIT_IW/index.jsp

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Feet



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6.0 AQUATIC ECOLOGY

Field observations were made and an assessment of the West Branch of the Rahway River and its tributaries located within the Reservation were conducted in the spring and summer of 2005. The following is a summary of the observations and assessment.

To understand the natural resources within the South Mountain Reservation, a vegetative cover map was developed and field checked based on available topographic maps, aerial maps, and other available maps and reports. The vegetative cover map includes descriptions of cover types and conditions, as described below.

6.1 Field Observations

Observations of the aquatic systems located within the Reservation are described briefly below. These aquatic features of the site are grouped into three categories: wetlands; the tributaries that flow through the Reservation into the West Branch; the West Branch of the Rahway River and its associated ponds.

6.1.1 Wetlands

A number of wetlands are located throughout the site. The majority of the observed wetlands are categorized as palustrine forested wetlands. Three of the largest forested wetlands are located at the summit, as indicated on the vegetative cover map. These areas appear to be healthy forested wetland ecosystems, although Japanese Stiltgrass was observed within the two areas located in the southwest. Deer were observed within these areas grazing on such herbaceous plants as Jewelweed, but a full understory was evident.

Along the steep slopes, there are a number of forested wetlands acting as flood plain zones for the stream tributaries that flow down to the West Branch. The understory within these areas is less abundant than the wetlands located at the summit, but is still evident.

Small wetland areas are also located adjacent to the West Branch and the small ponds located in the southern portion of the Reservation. The majority of these areas are also forested. One small triangular area located adjacent to the southern portions of the river appears to have been created as a floodwater retention area and is dominated by herbaceous and shrub species, and is surrounded by a berm. The area is no longer open to the river and is now dominated by upland species.

6.1.2 The Tributaries

The tributaries that act as the headwaters for the West Branch of the Rahway River, located within the Reservation, generally flow either westerly (from the east portions of the site) or

easterly (from the west portions of the site) to the south-flowing West Branch. The tributaries generally are located along steep slopes, often next to trails, and have maintained a sinuous shape.

As previously stated, small wetland areas are located along the edges of some of the tributaries. Trees and shrubs tend to line the sides of the tributaries, while some wetland species (Jewelweed, Skunk cabbage,...) are located in various areas.

In general, the tributaries appear to be eroding and unstable. The heads of the tributaries appear to be undercutting and a lot of loose sediment is evident throughout the streams. In areas where the tributaries intersect the trail system, evidence of scouring and erosion, and undercutting of large trees is evident. The tributaries appear to follow their natural stream course, although in general they are located alongside trails.

6.2 Assessment of the West Branch of the Rahway River

The West Branch of the Rahway River runs through the Reservation from the north to the south, and includes Orange Lake. The West Branch has been listed by the NJDEP in 1999 (Appendix B) and USEPA in 2002 as moderately impaired primarily due to the paucity of clean water organisms found there and contaminant exceedances including copper, lead, zinc and fecal coliform (Appendix C).

Based on current observations of the lake, other stressors include stream bank erosion, invasive vegetation along the banks, erosion from the headwater tributaries, and straightening of the riverbank over time due to the development of trails and roadways. However, despite all these urban stresses on the river, the river exhibits many signs of a healthy system. Even in mid-summer, moderately sized fish were observed to be using deeper pools located within the river. Other aquatic species observed in mid-summer included Eastern Box Turtle and Southern Leopard Frog. The water was clear and moved at a moderate rate even in mid-summer without recent rain.

The ponds located along the West branch within the Reservation are a public attraction based on their aesthetic characteristics, accessibility and fishing opportunities (the ponds are regularly stocked). The edges of the pond on the forest side are dominated by trees and provide shade along the banks. The roadside of the ponds has less vegetation and in some areas appears to be mowed and/or maintained to be free of vegetation. In mid-summer, the ponds are covered by algae. Waterfowl use the pond regularly throughout the year.

A qualitative assessment of the West Branch was completed, based on observations made at the site in the summer of 2005 and the guidelines provided by the New Jersey Department of

Environmental Protection Bureau of Freshwater and Biological Monitoring's "*Habitat Assessment for Low Gradient Streams*." The assessment ranks the following categories from high to low as "Optimal/Suboptimal/Marginal/Poor. Each ranking for each category has a descriptor that identifies the qualities that would be observed (See Appendix D). Using these guidelines, the following observations made were characterized as described below.

Epifaunal Substrate/Available Cover

The stable habitat availability observed throughout the majority of the stream that lies within the Reservation was less than desirable. The substrate was observed to possess marginal conditions.

Pool Substrate Characterization

Soft sand dominant at surface, some root mats and submerged vegetation present. Suboptimal conditions.

Pool Variability

Some deep pools, but more shallow pools than deep. Not very numerous. Marginal conditions.

Sediment Deposition

Moderate deposition of new sediment on bars, as well as sediment deposits at obstructions, constrictions, and bends. Marginal conditions.

Channel Flow Status

Water fills only about 25 to 75 percent of the available channel, and riffle substrates are mostly exposed. Marginal conditions.

Channel Alteration

Evidence of past channelization present. Suboptimal conditions.

Channel Sinuosity

Channel has been straightened over time for a distance. Poor conditions.

Bank Stability

The majority of the streambank surfaces are covered by native vegetation, but diversity is low and invasive species are prevalent. Suboptimal conditions.

Bank Vegetation Protection

The majority of the streambank surfaces are covered by vegetation; disruption is evident. Marginal conditions.

Width of Riparian Vegetation

The width of the riparian vegetation along the West Branch of the Rahway River has been impacted by human activities to a large extent – trails are located along the edges of the river, vegetation in some areas has been mowed or disturbed in other ways. However, in some areas the banks are still natural. Marginal conditions.

Conclusion

Streams are also classified as non-impaired, moderately impaired and severely impaired based on biological indicators which respond to changes in stream degradation. Degradation can result from a variety of factors that modify habitat or other environmental features such as land use, water chemistry, and streamflow. These biological indicators are used because of their ability to discriminate, in a predictable way, human influences on the environment, sensitivity to environmental stressors, and a low dependency on natural variability such as elevation, stream size, and ecoregion.

Based on the above analysis, and in comparison with the results of an analysis performed by the NJDEP and the USEPA (provide in Appendices B and C respectively), the overall condition of the stream is marginal, while the water quality has been determined to be moderately impaired.

7.0 UTILITIES

South Mountain Reservation is traversed by municipal water and sanitary sewer systems (Map 3.10). These utilities have impacts on the reservation due to issues related to providing vehicular access to the utilities, portions of which are restricted from public access. They also impact future work in the reservation and the aesthetics of the Reservation with the architecture of utility buildings. Electrical lines also follow along major roads for street lighting and for lighting in a couple parking areas.

7.1 Water

South Mountain Reservation serves as a major source of drinking water for the City of Orange Twp. and the Short Hills division of Jersey American Water Company. The City of Orange owns land within the reservation including the area around Orange Reservoir and land to the south in the river valley including Campbell's Pond as well as structures both inactive and active that are operated by the United Water Company. The City of Orange currently owns five active wells located along the Rahway River including four south of South Orange Avenue (well numbers 2, 3, 4, and 5) and one north of South Orange Avenue south of the Reservoir (well number 6). See Map 3.10 for well locations. Being these structures are not affiliated with the county, these buildings were not built in keeping with the historic character of the park. There are currently plans to perform interior renovations to the equipment within several of the wells, but no change to the exterior is anticipated. Most of the wells and the reservoir are fenced off with chain link fence, again not in character with the Reservation.

Water is piped through two water mains that traverses the Reservation. A 16-inch main starts at well number 6 and runs south under South Orange Avenue. It then continues south in close proximity to the River Trail with connections to well numbers 2, 3, and 4. The line bends southeast paralleling the Maple Falls trail and exits the Reservation towards Glen Avenue. A 20 inch main begins at well number 4 and runs on the west side of the Rahway River, through Painters Point and out to Brookside Drive. The line then follows Brookside Drive with a connection to well number 5 and then follows Glen Avenue on the southern border of the Reservation. United Water Company currently utilizes trails (primarily the River trail) and access drives to gain daily access to the facilities and the water mains. (See Map 3.10 for location of these facilities and current access routes.)

In addition to the active wells and water mains, there are several inactive facilities and abandoned structures still owned by the City of Orange. Orange Reservoir is no longer used as a source of drinking water, however public access to the reservoir is still prohibited. The potential exists for the Essex County to acquire the land and make the reservation a major asset to the reservation. Adjacent to Campbell's Pond is an abandoned water treatment plant. The building has become a source of vandalism over the years. Repeated attempts have been made to secure the building, but vandals continue to gain access. Fires have been set in the building, prompting responses by the Millburn Fire Department. Despite the continued

vandalism, the structure appears to be in fair condition. An abandoned well (number 1) is located near Campbell's Pond dam along Brookside Drive. There are currently no plans by the City of Orange regarding the future use of these structures. There are no plans to re-activate well #1.

Jersey American Water Company owns two active underground reservoirs within the Reservation. The largest is located east of Washington Rock at the end of Crest Drive and is comprised of two concrete tanks partially below ground that were constructed in 1957. The second smaller reservoir is located east of the Deer Paddock and was constructed in 1955. This reservoir is completely underground. These tanks serve the areas of Maplewood and Millburn directly below the Reservation. Water is supplied to these reservoirs from treatment plants off-site and piped to the reservoirs. The water is then piped to their service areas. Jersey American Water Company does not collect any water from the Reservation itself. The facilities are accessed about once a week for inspections.

7.2 Sanitary

The Township of West Orange maintains several major sanitary lines that traverse the Reservation as well as a pump station. The major lines are the Luddington Road Tunnel that runs east to west at the northern end of the reservation and the Pleasant Valley Trunk Sewer that runs north to south from Northfield Avenue along Cherry Lane and Brookside Drive and continues into Millburn. The pump station is located along this line adjacent to the Oakdale Picnic Area. A series of sanitary laterals run in the Turtle Back Picnic Area where the CCC camp was located as well as in Mayapple Hill.

The Luddington Road tunnel is a tunnel containing a sanitary line. The tunnel runs between Luddington Road in West Orange and South Mountain Arena which locates it under the Turtle Back Picnic Area. The tunnel has access points at Luddington Road as well as the parking garage at South Mountain Arena. The tunnel provides a means of servicing the line where it runs under the Watchung Mountains.

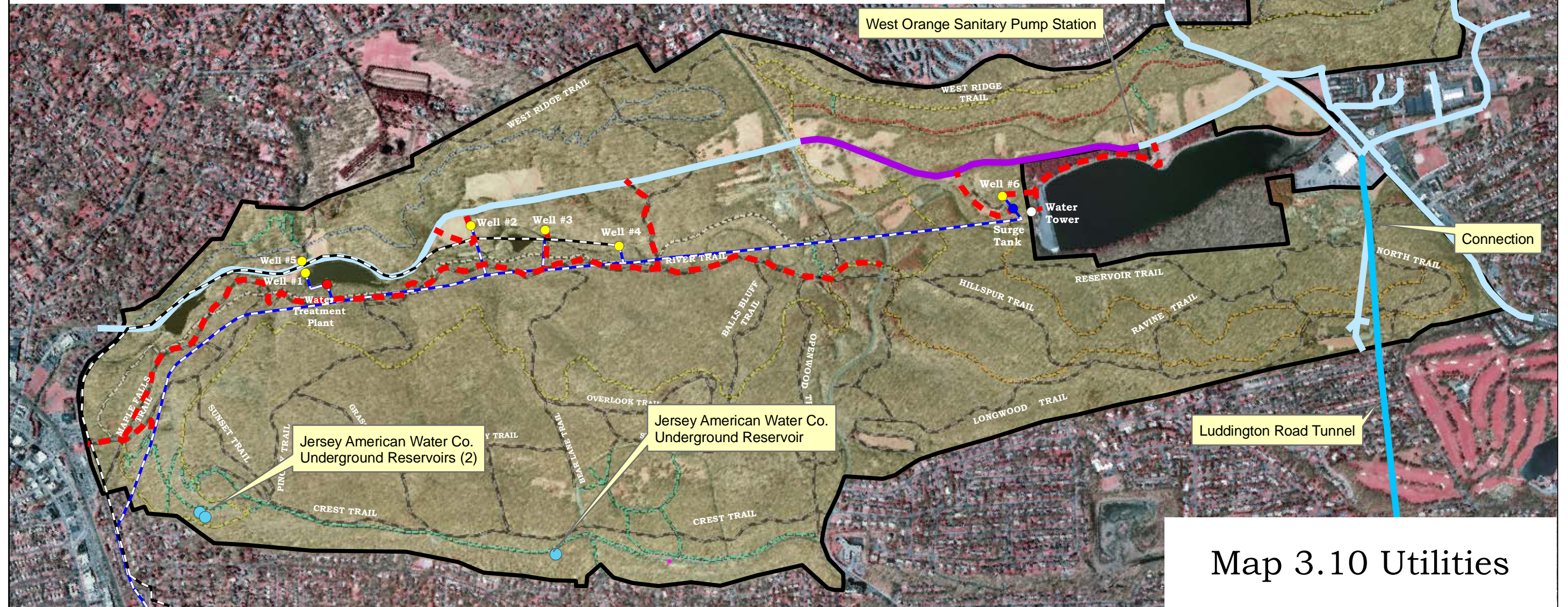
The Pleasant Valley Trunk Sewer is a combination gravity and force main. It begins at Northfield Avenue and gravity flows along Cherry Lane to the pump station. The line is then a force main from there to a manhole just north of South Orange Avenue. The line is then gravity flow along Brookside Drive and continues beyond the Reservation and into Millburn. The line and pump station were constructed in the late 1980's and went on-line in 1989.

SOUTH MOUNTAIN RESERVATION

LANDSCAPE AND INFRASTRUCTURE ASSESSMENT AND RESTORATION MANAGEMENT PLAN

Legend

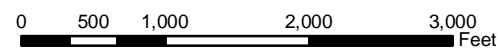
Bridle Trails	Turtle Back	Ex. Sanitary - Forced Main	Surge Tank	Existing Water Line - 16"
Oakdale	Lenape Trail	Ex. Sanitary - Gravity Line	Well	Existing Water Line - 20"
Rahway	Footpaths	Ex. Sanitary - Luddington	Water Treatment	Water Company Maintenance Route
Elmdale			Underground Reservoir	
			Water Tower	



Map 3.10 Utilities

INFORMATION SOURCES:
 NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
 BUREAU OF GEOGRAPHIC INFORMATION SYSTEMS
<http://www.nj.gov/dep/gis/index.html>

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http://njig.nj.gov/OIT_IW/index.jsp



8.0 VEHICULAR CIRCULATION AND PEDESTRIAN ACCESS

There are many opportunities to access South Mountain Reservation by car as well as on foot or bicycle.

8.1 Vehicular Circulation

The Reservation has three east/west roads that travel through and adjacent to the Reservation. Northfield Avenue borders portions of the northern Reservation boundary as well as travels through the northeastern portion of the Reservation. South Orange Avenue bisects the Reservation. Glen Avenue runs along the southern border of the reservation. There is one north/south route through the park along Pleasant Valley Way, which turns into Cherry Lane at Northfield Avenue and Brookdale Drive at South Orange Avenue.

There are five points along these main roadways where the traveler becomes aware of entering the Reservation. These locations serve as gateways to the Reservation: Northfield Ave. and Wheaton, Northfield Avenue west of Pleasant Valley Way, South Orange Avenue east of Winthrop Road and west of Harding Drive and Brookside Drive at Glen Avenue. These are shown as green dots on Map 3.11.

Within the reservation there are numerous places for vehicles to further enter the Reservation. These are shown as red dots on Map 3.11. These entrances are primarily for trailhead parking and picnic area parking. There are only two areas where there is a circuit drive, Summit Picnic Area and Mayapple Hill. These circuit drives encircle larger picnic areas.

Parking areas vary from unpaved dirt and gravel to macadam pavements. None of the parking lots delineate parking stalls. In addition, Reservation users pull off to the side of the roads and even onto the interior lawn areas to park. This occurs for users who are fishing, picnicking and utilizing the hiking trails.

There is no stabilized access to internal scenic areas and places of interest within the Reservation, making these experiences unavailable to individuals who might be physically challenged. There is access to scenic points along Crest Drive.

8.2 Pedestrian Access

Pedestrian access is provided at all parking areas. There is also several pedestrian access points located at the end of residential streets primarily along the eastern border. These are shown as blue dots on Map 3.11. Some of these entrance points have been established without the consent of the County. It was also observed that numerous residences that abut the Reservation access the trail network by a direct path to their backyard. In addition

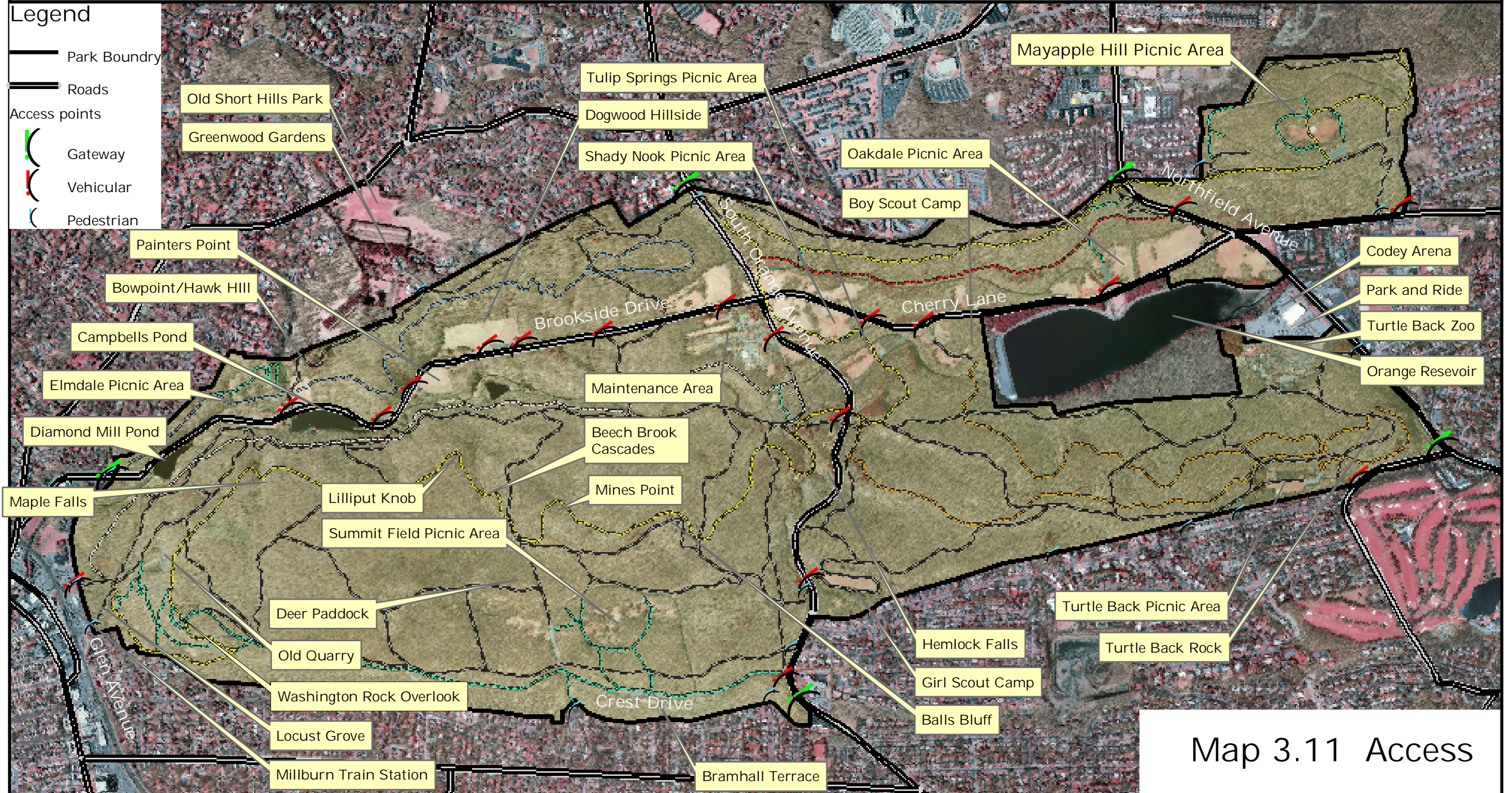
numerous debris piles were observed close to the Reservation boundary which appeared to be from a residential use.

An unmarked trail leads to the west off of the West Ridge Trail about halfway between South Orange Avenue and Glen Avenue. This trail follows along a portion of the eastern edge of Greenwood Gardens and Old Short Hills Park. There is no open access from Greenwood Gardens. There is also no path connecting Old Short Hills Park to the Reservation.

A bus stop NJ Transit bus route 73 is located at the newly constructed park-and-ride parking garage at Richard J. Cody Arena in the Reservation. Access to the trail network can be found by walking east on Northfield Avenue. Bus Route 73 connects to Livingston, East Hanover, Whippany, Florham Park, West Orange, Orange, East Orange and Newark. The Millburn train station is located across from the Locust Grove area and provides easy access on the Morris and Essex line from New York City in the east and Somerset, Morris and Warren Counties to the west.

SOUTH MOUNTAIN RESERVATION

LANDSCAPE AND INFRASTRUCTURE ASSESSMENT AND RESTORATION MANAGEMENT PLAN



Map 3.11 Access

INFORMATION SOURCES: NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, BUREAU OF GEOGRAPHIC INFORMATION SYSTEMS

<http://www.nj.gov/dep/gis/index.html>

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9.0 TRAIL NETWORK

9.1 Trail History

Historically there was to be a series of pleasure drives and pedestrian trails throughout the Reservation. Due to inadequate funding this was never fully realized. A couple pleasure drives were paved, *East Ridge Drive* (Crest Drive), *Valley View Drive* and *Mayapple Hill* entrance drive and circuit drive. The Mayapple Hill circuit drive however was not constructed in the location historically planned.

Several of the pleasure drives were constructed but not paved and are currently used as part of the pedestrian (hiking) trail network in the Reservation. These current hiking trails have been given the historic place names of the pleasure drives. These include, *West Ridge Drive* (West Ridge Trail), *Turtle Back Drive* (portion of which is now North Trail), and *Overlook Drive* (Swampy Trail). These are interchangeably called bridal trails and wood roads within this report. Map 3.12 shows the historic drive and trail network overlaid with the existing trail network. See also Map 2.4, which shows the remaining historic drive and trail fabric.

Historic pedestrian trails have been developed to the level of the unpaved pleasure drives. These include the River Trail, Crest Trail, Grassy Trail, Summit Trail, Balls Bluff Trail, Hillspur Trail and the Ravine Trail. These did not have place names noted on Olmsted Plan 68 and were named from nearby features or were not named at all.

A new network of blazed hiking trails was introduced. These are named after nearby historic place names or as the continuation of a county-wide trail, the Lenape Trail. These include the Rahway (white blaze), Elmdale (blue blaze), Oakdale (Red blaze), Turtle Back (orange blaze) and interpretive trail which was indicated by a series of interpretive posts. Map 3.13 presents the existing trail network of bridal trails and blazed trails.

9.2 Classifications

The bridal trails/wood roads and blazed trails have been given a classification relating to the existing conditions and the amount of improvements anticipated for the trail. The intent of the classification is for overall planning and budgeting purposes giving an order of magnitude for work on the trails in the reservation.

The footpaths that users have blazed that are not sanctioned by the County or South Mountain Conservancy have not been evaluated. While these “desire paths” have not been evaluated in this project they need to be reviewed as part of the wayfinding system tasks. Their purpose needs to be understood so they can be eliminated, further developed as part of the Reservation trail system, or relocated and developed as part of the Reservation trail system.

Improvements should follow design guidelines that are to be developed as an immediate task for the Reservation. The trails need to take into consideration the views from their locale (the Olmsted plan No. 45 identified 29 viewpoints throughout the Reservation) as trail construction themselves (See Maps 2.2 and 2.3). The improvement classification is presented below and in Map 3.14 illustrating the classifications and Table 3 for classification length per trail.

9.2.1 Limited improvements

Trails in the limited improvement category are in overall good condition. No significant erosion is occurring and the trails are holding up well. These trails generally only require typical maintenance such as cleaning leaves and debris from swales and removing fallen trees from the trails themselves. These activities should be included as routine maintenance performed by park staff or volunteers. This type of maintenance is not specific to any particular trail and should be applied to trails in all categories, especially after repairs are made.

9.2.2 Minor Improvements

The second level of improvement is considered minor improvements. Trails in this category are in generally good condition. Improvements include minor trail bed replacement, cleaning or minor swale re-establishment, and minor side slope stabilization. Areas in minor improvement may include cleaning of pipe crossings and installing cobble crossings and riprap.

9.2.3 Medium Improvements

The third level of improvement is medium or moderate improvements. These trails are exhibiting some erosion. Improvements include reconstruction of trail crown and side slope stabilization. Other improvements include constructing cobble crossings, replacing pipes, repairing headwalls and installing riprap.

9.2.4 Major Improvements

The highest level of trail improvements is the major category. These trails exhibit extreme erosion or total breakdown of the trail making the trail difficult to utilize. Improvements include total reconstruction of the trail bed, construction or reconstruction of swales, and major side-slope stabilization. Improvements may also include replacement or construction of water crossings with such items as pipes, culverts, cobbles and berms. Consideration should be given to converting roads to hiking trails (narrowing), abandoning or re-routing trails.

Trail Name	Classification				TOTAL (Feet)
	Limited (Feet)	Minor (Feet)	Medium (Feet)	Major (Feet)	
Bridal Trail/Wood Road					
Balls Bluff Trail	0	900	1,200	1,100	3,200
Bear Lane	500	0	700	0	1,200
Crest Drive Footpath (1)	9,600	0	0	0	9,600
Crest Trail	0	7,900	400	0	8,300
Grassy Trail	0	2,700	0	0	2,700
Hillspur Trail	3,600	500	400	2,000	6,500
Lenape Trail bypass (2)	500	0	500	0	1,000
Locust Grove/Washington Rock Connection (3)	1,000	500	0	800	2,300
Longwood / Hillspur Connection (4)	1,200	700	0	800	2,700
Longwood Trail	2,200	0	0	600	2,800
Longwood Trail / North Trail Connection (5)	1,500	0	0	0	1,500
Longwood Trail / Reservoir Trail Connection (6)	0	0	0	800	800
Longwood Trail Loop (7)	1,900	0	0	0	1,900
Maple Falls / Lenape Trail Connection (8)	500	0	500	0	1,000
Maple Falls Trail	0	4,500	0	600	5,100
May Apple Hill Loop (9)	800	1,500	500	600	3,400
May Apple Hill Picnic Area Trail (10)	3,110	370	0	0	3,480
North Trail	1,200	0	0	0	1,200
Oakdale Picnic Area Connection to Trail (11)	0	420	0	0	420
Oakdale Trail / Lenape Trail Connection (12)	500	0	0	0	500
Openwood Trail	0	1,000	2,500	0	3,500
Openwood Trail / Summit Trial Loop Connection (13)	500	500	400	0	1,400
Overlook Trail	1,200	3,300	900	1,000	6,400
Pingry Trail	0	1,250	0	1,500	2,750
Quarry/Quarry Trail Connection (14)	200	230	0	0	430
Ravine Trail	0	100	1,200	200	1,500
Reservoir Trail	1,400	300	2,100	3,900	7,700
River Trail	0	4,900	800	1,700	7,400
Summit Field Picnic Area Trails (15)	4,400	0	0	0	4,400
Summit Trail	0	2,900	0	0	2,900
Sunset Trail	0	900	500	2,400	3,800
Sunset Trail / Maple Falls Trail Connection (16)	0	0	1,200	200	1,400
Swampy Trail	0	2,300	0	0	2,300
Swampy Trail / Crest Trail Connection (17)	0	1,200	0	0	1,200
West Ridge Trail	13,200	1,700	1,800	0	16,700
West Ridge Trail / River Trail Connection (18)	1,200	3,000	0	0	4,200
SubTotal	50,210	43,570	15,600	18,200	127,580

Trail Name	Classification				TOTAL (Feet)
	Limited (Feet)	Minor (Feet)	Medium (Feet)	Major (Feet)	
Blazed Trails					
Elmdale Trail	1,900	9,200	1,300	0	12,400
Interpretive Trail	3,400	0	0	0	3,400
Lenape Trail	4,000	3,200	900	1,800	9,900
Oakdale Trail	6,000	0	0	0	6,000
Rahway Trail	11,500	400	400	0	12,300
Turtleback Trail	12,300	1,600	900	0	14,800
SubTotal	39,100	14,400	3,500	1,800	58,800
Total Improvements Per Classification (feet)	89,310	57,970	19,100	20,000	186,380
Total Improvements Per Classification (miles)	16.9	11.0	3.6	3.8	35.3

(#) Wood roads that are currently unnamed. These should be considered descriptive names and not place names to be added to the trail map. See Map 3.13 Existing Trail Network for locations of these trails.












Note: The above numbers do not include 4.2 miles of unblazed foot paths.

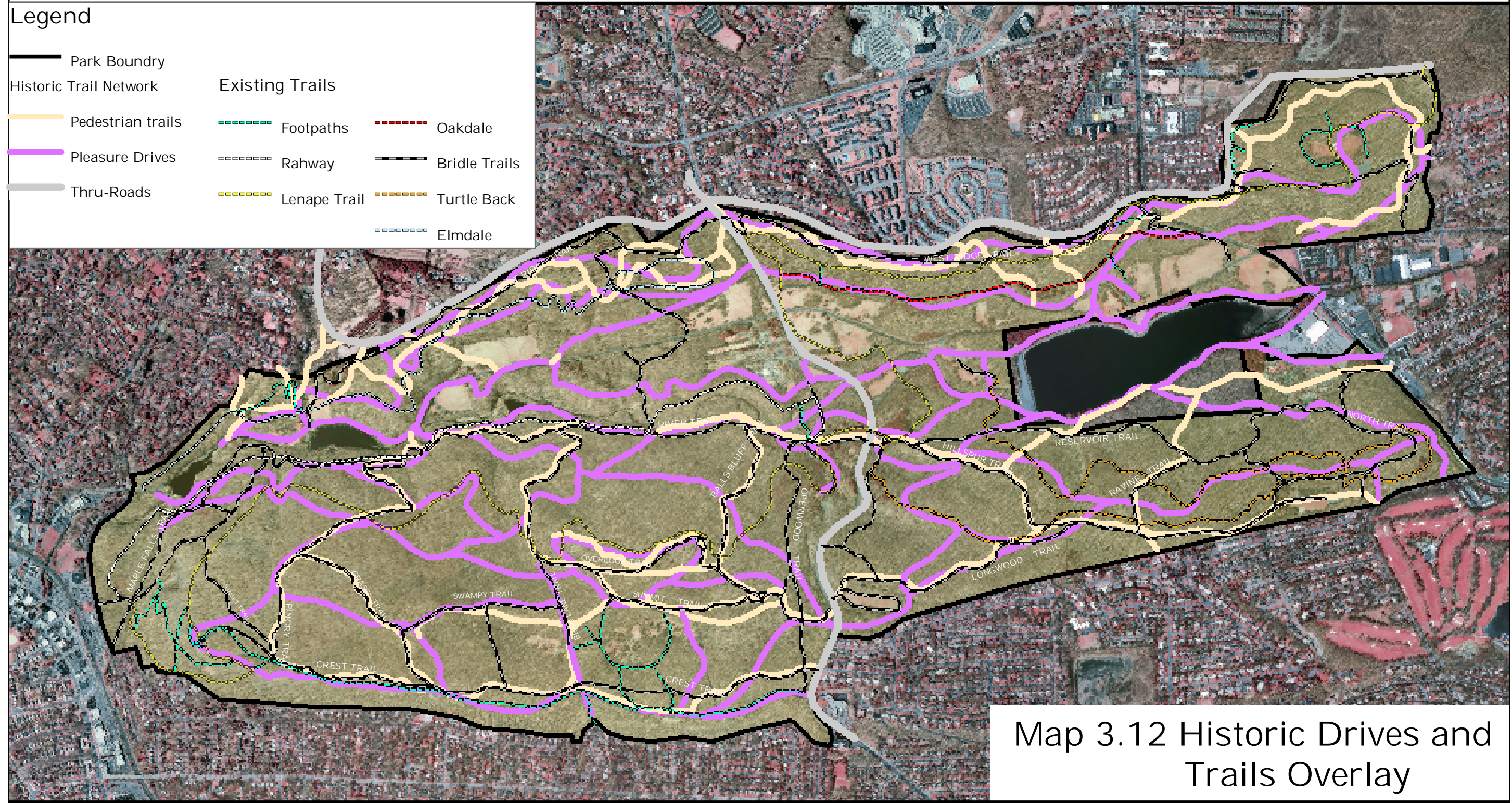
Table 3 ~ Trail Classifications

SOUTH MOUNTAIN RESERVATION

LANDSCAPE AND INFRASTRUCTURE ASSESSMENT AND RESTORATION MANAGEMENT PLAN

Legend

 Park Boundry	Existing Trails	
Historic Trail Network	 Footpaths	 Oakdale
 Pedestrian trails	 Rahway	 Bridle Trails
 Pleasure Drives	 Lenape Trail	 Turtle Back
 Thru-Roads	 Elmdale	



Map 3.12 Historic Drives and Trails Overlay

INFORMATION SOURCES: NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, BUREAU OF GEOGRAPHIC INFORMATION SYSTEMS

<http://www.nj.gov/dep/gis/index.html>










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SOUTH MOUNTAIN RESERVATION

LANDSCAPE AND INFRASTRUCTURE ASSESSMENT AND RESTORATION MANAGEMENT PLAN

Legend

-  Park Boundary
-  Elmdale
-  Turtle Back
-  Bridal Trails
-  Oakdale
-  Lenape Trail
-  Rahway
-  Footpaths
-  Unnamed Trails
See Table 3.1
for description



Map 3.13 Existing Trail Network

INFORMATION SOURCES: NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION, BUREAU OF GEOGRAPHIC INFORMATION SYSTEMS

<http://www.nj.gov/dep/gis/index.html>

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http://njig.nj.gov/OIT_IW/index.jsp

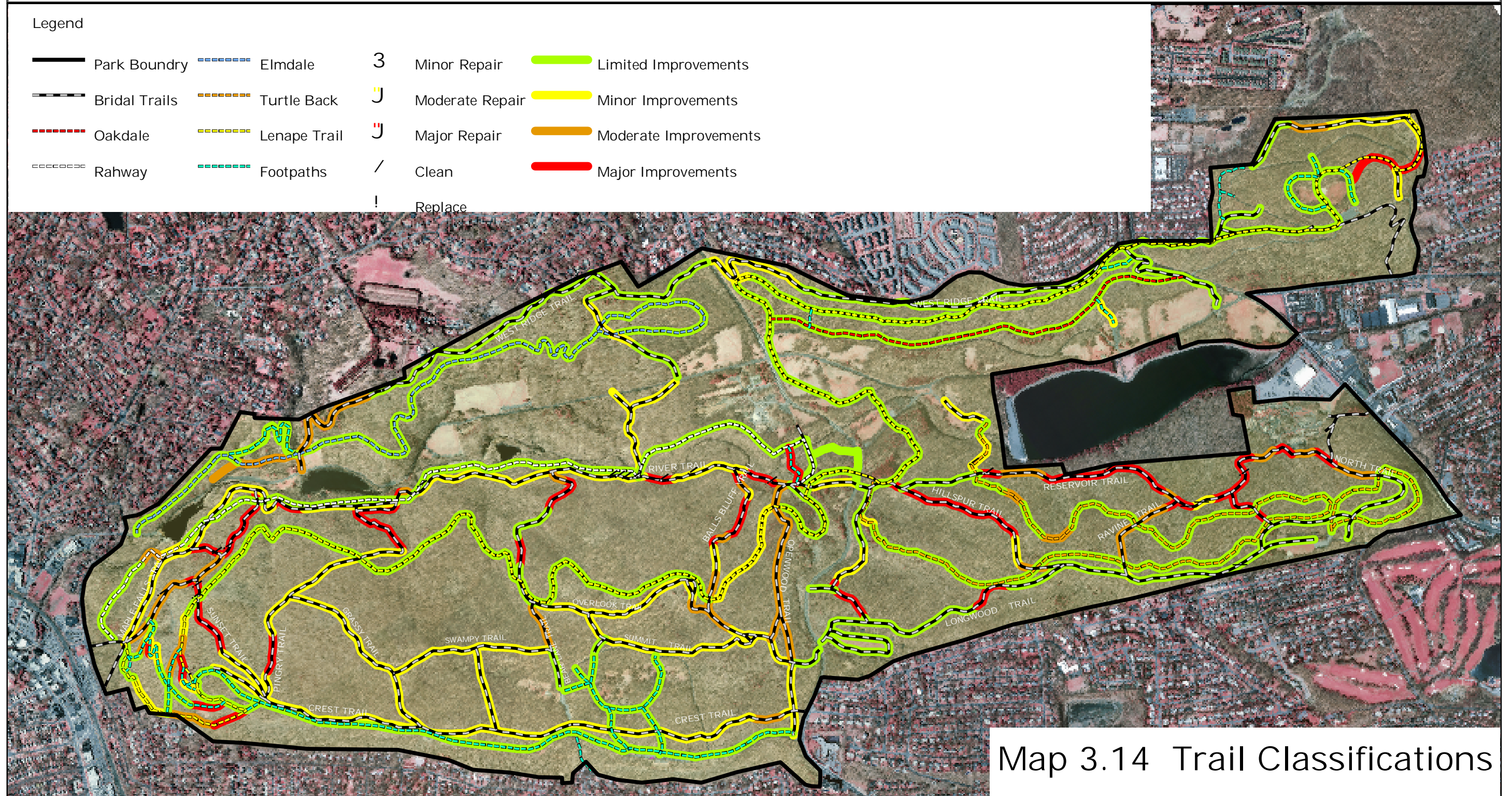


SOUTH MOUNTAIN RESERVATION

LANDSCAPE AND INFRASTRUCTURE ASSESSMENT AND RESTORATION MANAGEMENT PLAN

Legend

— Park Boundry	--- Elmdale	3 Minor Repair	— Limited Improvements
- - - Bridal Trails	--- Turtle Back	J Moderate Repair	— Minor Improvements
- - - Oakdale	--- Lenape Trail	J Major Repair	— Moderate Improvements
----- Rahway	--- Footpaths	/ Clean	— Major Improvements
		! Replace	



Map 3.14 Trail Classifications

Note:

INFORMATION SOURCES: NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION BUREAU OF GEOGRAPHIC INFORMATION SYSTEMS
Bridges and Pipes shown are not all inclusive. Additional bridges and pipes existing within the Reservation

<http://www.nj.gov/dep/gis/index.html>

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http://njig.nj.gov/OIT_IW/index.jsp



10.0 WAYFINDING SYSTEM

The signage for the Reservation is not consistent throughout the Reservation. There are different entrance signs for the various access points to the Reservation. Some of the picnic shelters have signs on the roof fascia, but not all. There is no directional signage to points of interest within larger areas such as at Crest Drive.

10.1 Trails

The trail signage for the Reservation is poor and inconsistent with the trail map available to the public. Blazes are not clearly marked on all trails. Reservation users are blazing trails on their own without consent by the County or the South Mountain Conservancy. Trail markers utilized are not consistent with the trail hierarchy, i.e. not providing the same type of trail head marker at each location.

There is an unclear distinction of trail hierarchy in some sections of the Reservation. There is an apparent trail hierarchy of bridle trail, blazed trail, foot path. There are also desired paths that people have created with the repetitive walking along the same path. Each trail has its own characteristic trail bed size and material. Summit Field picnic area is an example of the confusing trail hierarchy between the Reservation map and actual site conditions. The trails inside the Bear Lane loop are noted on the Reservation map as foot paths, but they are bridle trails with the larger trail bed with and aggregate trail bed. This discrepancy could confuse the user when attempting to traverse the trails. There are also areas where vegetation has covered the bridle trail with a one foot wide clear path. This is primarily due to poor maintenance of the trails allowing vegetation to encroach within the trail bed.

A Turtle Back Rock Interpretive Trail identification sign does not exist and point of interest signs are missing or in poor repair. Description of the points of interest along the trail is not available to the public.

11.0 GENERAL USE AREAS

11.1 User Survey

A user survey was developed in cooperation with the South Mountain Conservancy and Essex County. The purpose of the survey was to get an understanding of the demographics of the Reservation users as well as the activities they participate in the Reservation. The survey was also to be used to confirm the high use areas and gain an understanding of the areas they see as important. Management of the Reservation has been a challenge since the inception of the Reservation. The results of the survey was to augment the management recommendations with other areas for priority management by either confirming what was found in the field and speaking with Reservation users or to add areas for management. The survey was to be accomplished by two methods, direct mail and field reconnaissance. Due to funding constraints the survey could not be implemented as a part of this report. The South Mountain Conservancy and Essex County will implement the survey in the spring of 2006.

The survey should not be implemented utilizing only a field survey or public meetings. This will exclude a large portion of attitudes and opinions of people who were not at the Reservation that day or who are unable to attend public meetings. Implementation should consist of two parts. One part would be a random sample mailing (direct mail) to residents within a five-mile radius. The second part would consist of a field survey conducted by the South Mountain Conservancy volunteers within the Reservation and at newly installed map/survey boxes located at prime access points.

11.1.1 Direct Mail

Direct mail was chosen as the primary method for implementing the survey. The purpose to conducting a random sample mailing is to get a statistically accurate (within 3-5% error) response rate. This will give the County realistic data to base further recommendations in the Reservation. The number of surveys to mail is set by the user response rate and the acceptable error. The normal response rate for a mailed survey is 10%. The most accepted error range for a survey is 3%-5%. Therefore, 5000 surveys are required for mailing for the target response and error range. (See below for more information on the survey target population.)

Survey Population

The survey population is the collective group of people who will receive the survey. The survey population is defined by the goals of the survey. In this case information is being sought regarding the areas of use and areas of most importance within the Reservation. We are also interested to receive responses from residents that do not use the Reservation and why. Sloth Mountain Reservation is a regional resource. From general discussions with users at public meetings and during site visits the Reservation does draw users from the metropolitan area, not just Essex County. However, due to the abundance of similar resources in the areas

outside Essex County the survey population has been limited to an area within five miles of the reservation (Figure 33).

The population was identified through the use of zip codes that fall within five miles of the Reservation. Thirty-four municipalities with thirty-six zip codes lie within the population area. (See Appendix F for the complete list.) The random sample should be selected from the target population zip codes and should include owners and residents.

If a random sample is not used then the survey response will be weighted toward one population group. For example, if the Conservancy mailing list is used as the survey sample then the responses will be weighted towards existing users or those with a known interest in the Reservation. The population that might not know about the Reservation or the Conservancy would be left out of the survey sample and results. It is just as important to receive responses from people who don't use the reservation as that can guide efforts such as further community outreach or security enhancements. Mailing the survey to an existing membership is beneficial, but these mailings should not go towards the 5000 sent out and the results should be kept separate from the random sample mailing.

11.1.2 Field Reconnaissance

South Mountain Conservancy will station members and other interested volunteers at high use areas in the Reservation. These areas include Crest Drive, Summit Field, Tulip Springs, Locust Grove, Turtle Back Picnic Area and Mayapple Hill. Survey/map boxes will be utilized at these locations as well as five other locations noted in Figure 34 on the next page. The surveys from

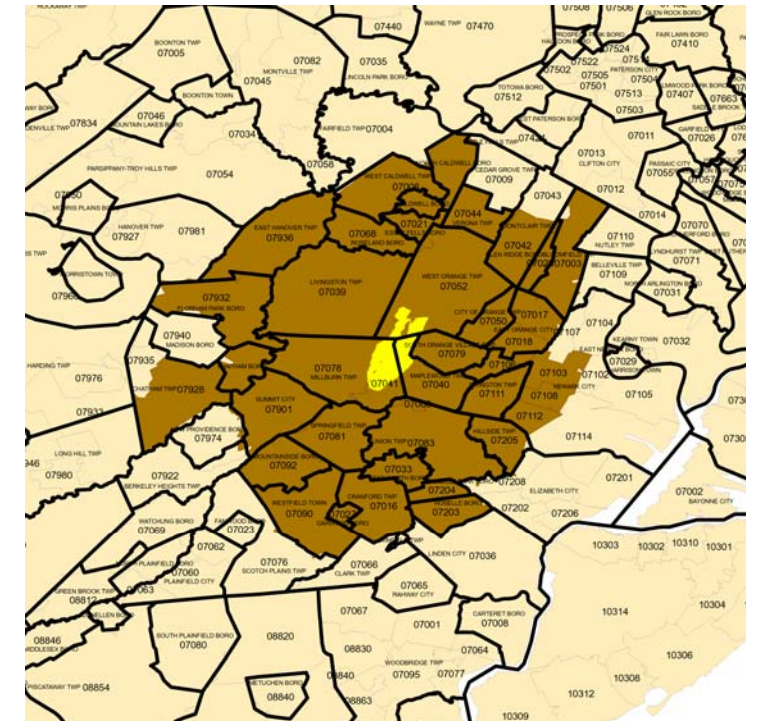
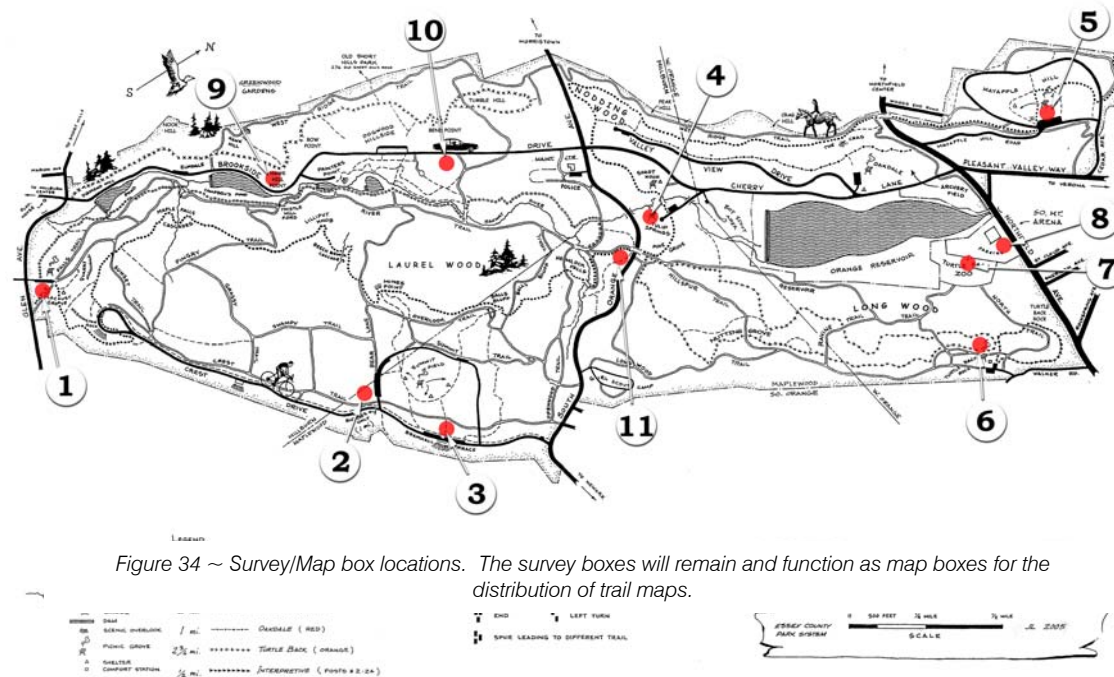


Figure 33 ~ Direct Mail Survey Population highlighted in brown.

the field reconnaissance and the survey boxes should be collected on a daily basis during the survey period.



11.1.3 Analysis

Once the questionnaires are received the data should be entered and coded into a database by the County of the South Mountain Conservancy to be analyzed to determine preference and augment the recommendations set forth in the report. If the number of respondents is within 3-5% of the census criteria the data can be used as received, otherwise it will need to be weighted up or down to create “equal” numbers. From this analysis the recommendation in the report should be updated.

11.2 Reservation Area Usage

South Mountain Reservation provides usability year round in all areas. Hiking and picnicking are the primary uses during the warmer months. Hikers can be spotting using the trails even on the coldest days. In addition, evidence of cross-country skiers can be found when the ground is snow covered. Mountain bikers were also observed at various times of day and year on both the wood roads and hiking trails even though they are only allowed on Crest Drive.

Overall, the times of highest usage were late morning to early afternoon that coincides with people coming to the park for lunch. Other times include early morning for joggers and later evening.

While all areas are utilized, the most popular areas are ones that provide paved parking areas, in close proximity to picnic areas and major hiking trails and have a stabilized walking surface. The highest usage was generally observed in the southeast area bounded by Brookside Drive and South Orange Avenue. This area provides the most varied topography, scenery, access points and hiking trails for various abilities. The least utilized areas were in the Southwest area (west of Brookside Drive). This is due to limited hiking ability variety, limited trail access, and limited trail loops. Map 3.16 presents the use areas within the reservation.

The through roads that travel through the reservation have cut the Reservation into four unequal quadrants. Northeast lies between Cherry Lane and South Orange Avenue. Southeast lies between South Orange Avenue and Brookside Drive, Southwest between Brookside Drive and South Orange Avenue and Northwest between South Orange Avenue and Cherry Lane. The order of use from highest to lowest is Southeast, Northeast, Northwest, Southwest.

The areas to the west of Cherry Lane/Brookside Drive are two to three times smaller than the areas east of these roads. This brings these areas closer to traffic and generally less secluded. It is not as easy for the user to get totally removed from every day tasks when in this area of the Reservation with the constant reminder of vehicular traffic. These areas also provide fewer access opportunities as well as limited variety in the landscape character. The trails provide limited variety for hiking abilities and only one larger bridal trail, the West Ridge Trail, with no ability to loop on similar trails. A Reservation user must traverse down to the valley floor to access additional bridle trails. All of these factors combine to make the Second Mountain the lesser-used area of the Reservation. The Second Mountain, however, could provide striking views of the First Mountain if the vegetation was opened up. The area north of South Orange Avenue has a higher use than that to the south.

The Reservation to the east of Cherry Lane/Brookside Drive, with the varied trails and hiking abilities, the varied landscape character with specific points of interest and the ease of access combine to make the First Mountain the highest used. The close proximity to Millburn, the relatively level paved roadway dedicated for pedestrian use, several points of interest, easy access from South Orange Avenue and numerous parking opportunities has made the southeast quadrant the highest used area in the Reservation.