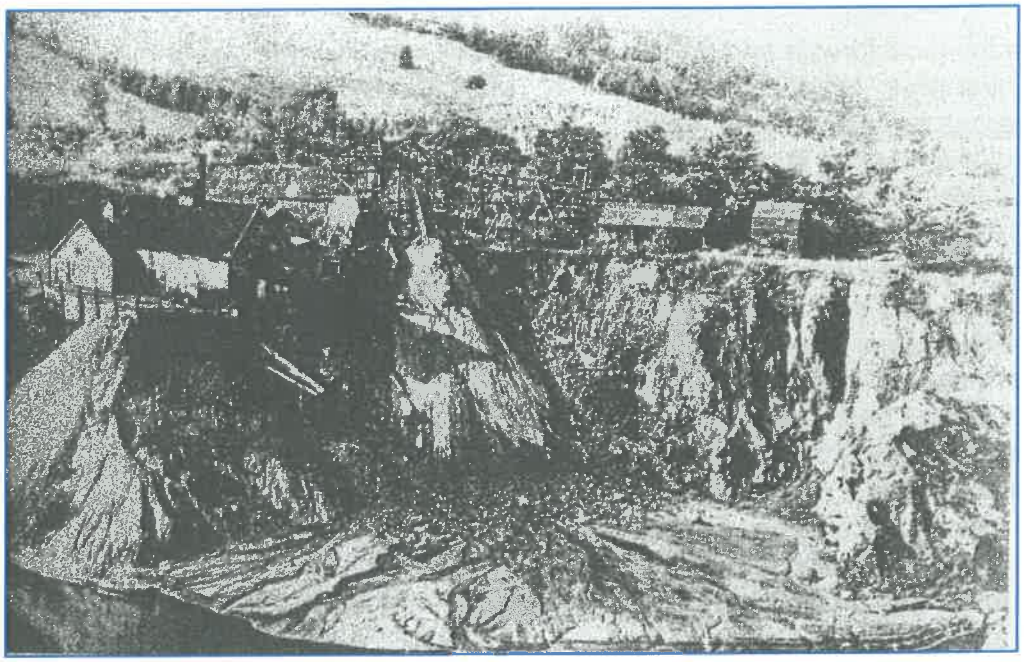
Natural Resource Inventory

- Mining in Amenia: A brief history and prospectus
- Groundwater in Amenia
- Mineral Resources in Amenia
- Natural Habitats in Amenia
- Wetlands of Amenia
- Soils in Amenia
- Streams (map)
- Topography of Amenia
- Water Resources: Streams and Floodplains of Amenia

Mining in Amenia

A brief history and prospectus



AMENIA MINE CIRCA 1880. Now the site of Arrowhead lake.(after Bryden)

INTRODUCTION

Iron

Iron was discovered in the Salisbury, Connecticut area as early as 1731. The first iron production began in 1734 and rapidly spread throughout the region. Connecticut's Northwest Corner became known as the "Arsenal of Democracy" during the American revolution for its important iron mines, smelters, and forges. The Amenia area was also impacted heavily by the iron industry starting in 1780 near Sharon Station. For a definitive account of the history of the local iron industry consult Echoes of Iron by Ed Kirby.

The most important iron deposits were located (and still are) near the boundary between the ridge-forming Walloomsac schists and the carbonates of the Stockbridge Formation. A series of complex chemical reactions over millions of years altered the iron minerals in both rock formations and formed the Salisbury ore belt, an elongated zone rich in iron along the borders of New York, Connecticut, Massachusetts, and Vermont.

Making iron from ore required waterpower, charcoal, limestone, and labor. As the industry expanded, so did the need for these resources.

All the iron works were set up near streams, such as the Gridley works which were located along Wassaic Creek about where present Rt. 22 crosses that creek. Charcoal was obtained from the local forests and used in very large quantities. Kirby estimated that the average furnace needed about 600 acres of woodland to supply the charcoal for one year. Obviously, the impact on local forests was large, shortly resulting in the complete destruction of the original forest. In 1825, the Gridley Iron Works, in Wassaic, constructed permanent charcoal kilns which still stand, restored by their present owner. Charcoal production caused local air pollution and the deforestation resulted in severe soil erosion. By the time forge owners understood that wholesale forest destruction was going to hurt the industry by depriving it of fuel, local iron production was becoming unprofitable.

The numerous forges and mines also needed labor and the population grew quickly. It was not until the late 20th century that populations in local towns reached the levels they were in the 1850's at the height of the iron industry.

The arrival of the railroad in the 1850's made it easier for forge operators to move their products to market and to also bring in anthracite coal for fuel. The Gridley Iron Works in Wassaic and the Manhattan Mine in Sharon Station both benefited by their proximity to the Harlem Valley Line and became major hubs of production.

Although the forests have grown back, there is still evidence of the "iron age" in Amenia. Most of the mines were open pit operations that had to be continuously pumped out and are now water filled. Arrowhead Lake, near the center of Amenia, was the site of the Amenia Mine, the Squabble Hole located on Island Green golf course was the source of ore for the Gridley works in Wassaic, and the large pond near Sharon Station was known as the Manhattan Mine. Most of the Gridley works are gone, buried under Rt. 22, but the charcoal kilns are still at the site along with abundant deposits of slag.

The iron industry survived in a much-diminished state until the early 20th century when it finally closed down because it was unable to compete with much larger and more efficient operations located, ironically, in today's "Rust Belt" region of the United States.

Aggregate

At present, each American consumes about 10 tons of aggregate a year. This consists of sand and gravel and crushed stone. A six-room house consumes about 90 tons of aggregate, one mile of four-lane highway requires 85,000 tons, and Grand Coulee Dam used 17 million tons! Production (and consumption) of aggregate is a multi-billion dollar industry in the United States accounting for about half the nonfuel mining volume.

Aggregate production in New York State is a major business accounting for more that 60% of the state's nonfuel mineral value. The statewide total tonnage mined in 2003 was over 80 million tons with a production value over 500 million dollars. In 2002 State Mining Region 2, which includes the Mid and Lower Hudson Valley counties, sold or used over 4 million tons valued at nearly 25 million dollars.

MINING IN AMENIA

The major uses for New York's aggregate consist of concrete aggregate and products, asphaltic concrete and road base materials, and fill.

Natural aggregate comes from two main sources of supply: sand and gravel deposits which are rounded particles that vary widely in size, and crushed stone which is artificially produced and has sharp edges.

Nearly all aggregate, whatever its origin, has to undergo a lot of processing after it is mined including sorting, grading, washing, and further crushing. The nature of the final product depends on its use. Most mines have on-site processing equipment to accomplish the various tasks needed to make a final product. A lot of water is needed for this phase of production.

Like all mineral resources, aggregate is where you find it and, more and more often, this is not where it is needed. As resources become depleted and societal pressures against mining increase, transportation distances become greater and costs increase. Trucks transport most aggregate, which is costly and results in many problems such as dust, noise, windshield breakage, and increasing traffic congestion. The ideal situation would be to have dedicated rail service adjacent to a mine and conveyer belt transport to the rail cars. There is at least one location in Amenia that meets these criteria.

GEOLOGY

The sand and gravel deposits in the Amenia area are the result of geological and astronomical events that initiated the era in time known as the Pleistocene Ice Age. The position of the continents two million years ago blocked the northern circulation of the oceans causing low temperatures in the far northern latitudes year round. At the same time, the cyclic combination of slight changes in the Earth's orbit, its axial tilt, and the time of the year when the sun's direct ray is over the equator combined to reduce energy from the sun, further cooling the Earth. The northern hemisphere along with high mountain areas began cooling down below freezing. When more snow falls in winter than melts the following summer, it eventually changes to ice and, when the ice is thick enough, gravity causes it to flow outward from the areas of thickest accumulation. An ice age begins. Over the last 2 million years there have been four major advances of glacial ice. Since the position of the continents still block ocean circulation and since the astronomical cycles still exist, geologists are certain that the earth is still in an ice age and is presently in an interglacial, or warm period, between ice advances. Global warming may be just be a blip on the cooling that has already begun. In human terms, the blip may be quite serious.

Geologists divide glaciers into two main categories: mountain glaciers that exist in high mountains even at low latitudes and continental glaciers that cover large sections of continents such as those still found in Greenland and Antarctica. Up until about 17,000 years ago, a continental glacier thousands of feet thick covered nearly all of New York during the last glacial advance known as the Wisconsin.

As ice slowly advances it picks up enormous quantities of rock that it wrenches from the bedrock. The embedded rock becomes the tools that the ice uses to sculpt the landscape leaving evidence of its passing. When the ice melts, this rock is left behind as a thick blanket of till and outwash. Till is unsorted material containing particles from clay size to very large boulders. Outwash is material that was transported and sorted by glacial meltwater.

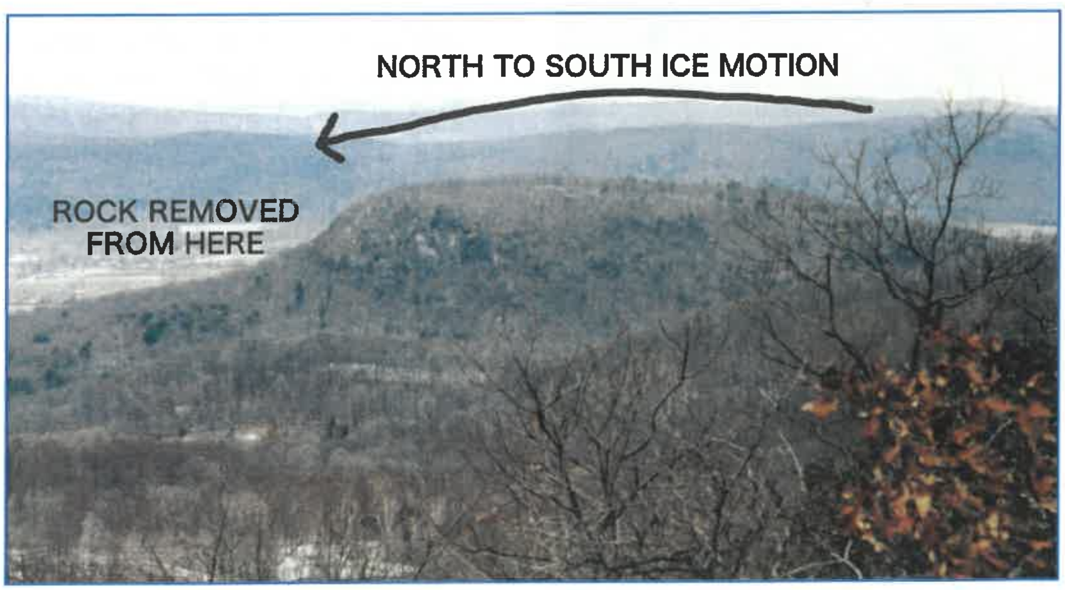
Till being deposited by melting glacier

Glacial lake forming behind a moraine.

Large ridges of till that mark the stable endpoint of a glacier, where melting and glacial advance were in balance for a long period of time are known as terminal moraines. Recessional moraines mark places where retreating ice regained a state of equilibrium for a period of time. Recessional moraines can dam up stream flow from melting ice and form glacial lakes. Till deposits cover a large part of Amenia.

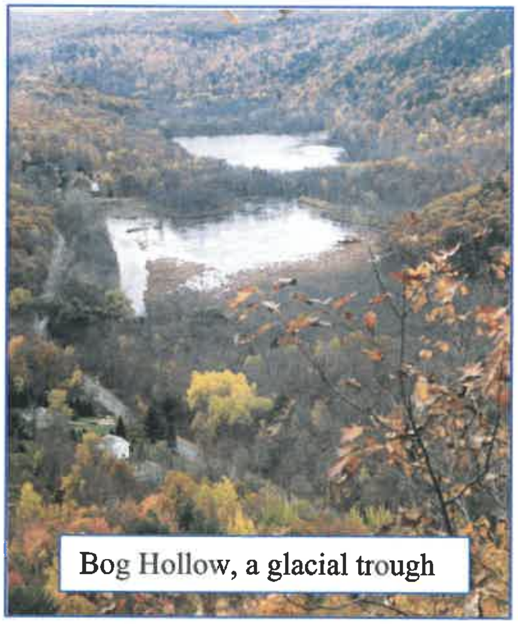
Other evidence that glaciers leave are striations carved into the bedrock, glacial polish, and rock drumlins. The bedrock in the Amenia area is too easily weathered to have preserved striations and polish except in areas where the rock has recently been unearthed after being buried beneath till and outwash for thousands of years. Peaked Mountain in South Amenia shows the characteristic streamlining of a rock drumlin.

Glacial grooves cut into newly uncovered bedrock



Peaked Mountain in South Amenia

MINING IN AMENIA



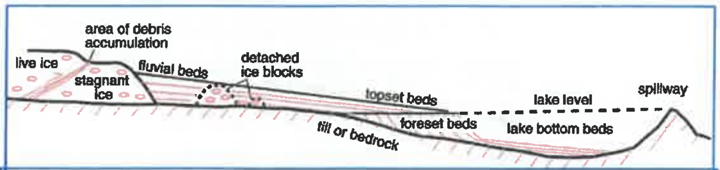
Bog Hollow, a glacial trough

Glacial deposits in South Amenia

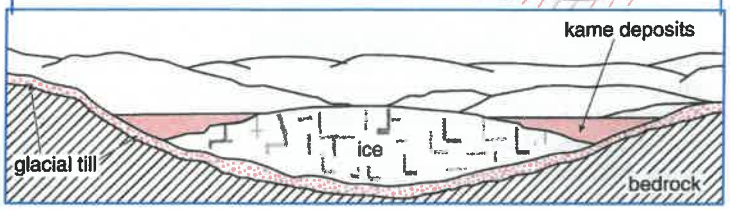
About 17,000 years ago the mile-thick ice sheet over Amenia began to melt, producing rivers of meltwater that transported, sorted by size, rounded off, and eventually deposited much of the rock that the glacier had carried. The ice did not melt all at the same time or rate. Blocks of ice cut off from the main body were sometimes buried under the gravel outwash which insulated the ice and slowed its melting. Some ice blocks formed dams behind which lakes rapidly filled with rock debris. Torrents of water rushed down small valleys excavating them to great depth. Deep Hollow and Turkey Hollow are examples of these post-glacial valleys. Glaciologists have coined numerous terms to describe depositional features left by melting continental glaciers. These include outwash plains, kames, kettle lakes, and proglacial lakes. Examples of all these are found locally and many are sources of sand and gravel.

The Oblong Valley, a wide valley filled with glacial outwash.

MINING IN AMENIA

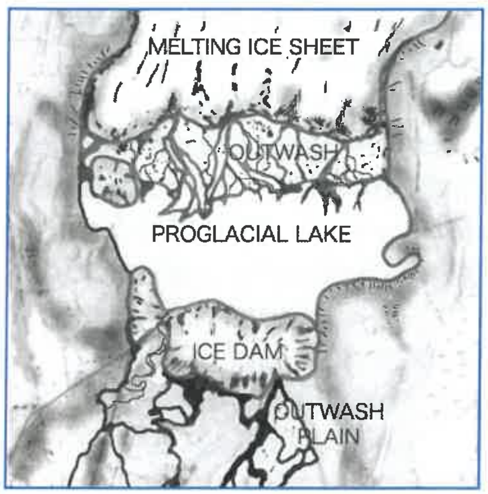


Formation of glacial lake deposits along with an outwash plain. (after Skehan)

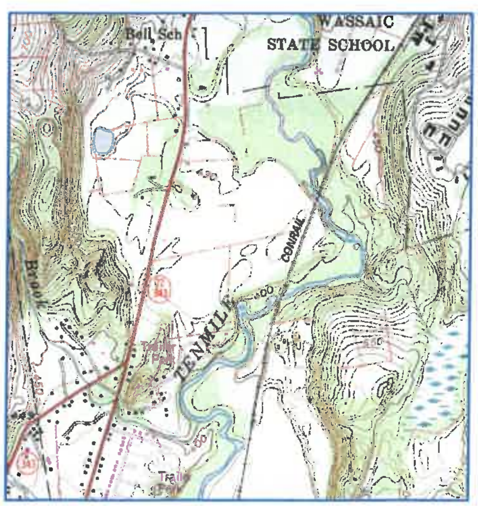


Formation of kame deposits, which form between melting ice and bedrock. (after Skehan)

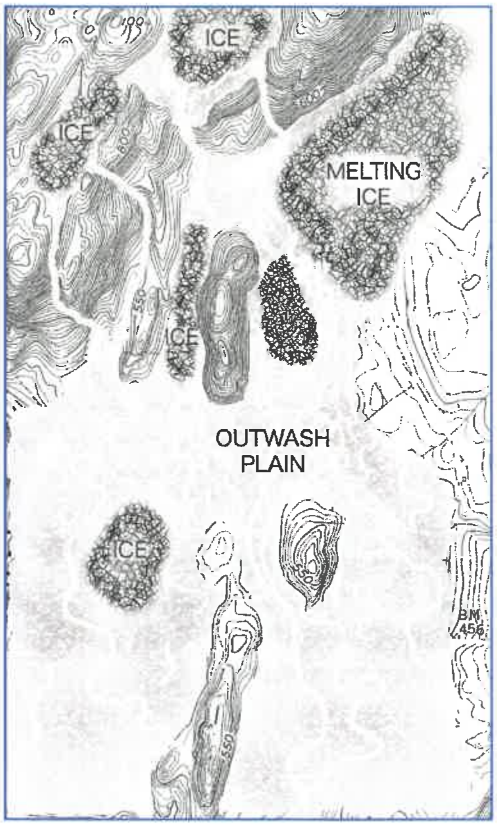
The following maps show hypothetical "before and after" situations that demonstrate how gravel deposits in Amenia could have formed.



17,000 years ago. Ice dam blocks meltwater from ice sheet forming a pro-glacial lake and outwash plain. South of the lake, meltwaters form another outwash plain.



Same area as shown above. A confirmed large gravel deposit showing evidence of having been deposited in a lake exists in the flat region near the center of the map. Further south, an extensive outwash plain is found in the area of Dover Plains.



Upper map shows a possible situation about 17,000 years ago near South Amenia.

Kame deposits are forming between bedrock ridges while outwash deposits accumulate to the south, burying the bedrock with sand and gravel.

Lower map shows South Amenia today. Most of the gravel mining in Amenia has taken place here in the past and continues at present. Over several thousand years, Webatuck Creek has formed a wide flood plain in the Oblong Valley and has rearranged and altered many of the glacial deposits. Stream terraces occur at the edges of the valley due to the stream's downcutting into its flood plain. Many gravel deposits are still present and unmined in this area.

LOCAL EFFECTS

MINING IN AMENIA

Gravel mining in Amenia, as elsewhere, has had positive and negative effects. The positive effects, mainly economic, have been to provide employment and a local supply of important raw material for new buildings, road construction and repair, and a wintertime supply of traction sand for roads. In theory, with such an abundant local supply of product, Amenia consumers of aggregate and its products should benefit from lower prices since transportation costs are directly related to the cost of the materials. It would be interesting to compare regional prices of aggregate based products to see if there is a local benefit. It should be easy to determine if the Town of Amenia, which uses a lot of sand, fill, and asphalt, buys locally. Mines also pay property and sales tax, which may be a source of income for the Town. The amount of taxes paid locally by the mining companies could be easily determined in assessing the local economic benefit of mining.

Amenia, particularly South Amenia, supplies a lot of the region with aggregate. Much of what is mined appears to head south towards Westchester and Putnam counties as well as into Connecticut. No mines pay a royalty to the Town for gravel removed, although a few years ago, a mining company did propose this as part of a gravel mining project that did not get past the planning stage. Since aggregate is a non-renewable resource, with much of the product leaving the Town, this may be a way for the Town to benefit directly from the mining industry.

Negative effects fall into two categories: social and environmental.

Social effects are quality of life issues primarily for the community members who live near operating mines or along the transportation corridors the mine trucks use. Some of these issues are noise, dust, diesel exhaust, debris on roadway, visual impact, vibration, and large trucks sharing narrow roadways with cars, pedestrians, bicyclists, and farm vehicles.

It should be noted that some of these problems are subjective in nature and many are not. For example: truck noise is related to how fast the truck is moving, engine r.p.m., downshifting, compression braking, exhaust noise, tire whine, gear noises, the state of the roadway, how close a person is to the roadway, weather, how many trucks are passing in a time period, and local acoustic effects, among others. Because people respond differently to noise it is difficult to guage the effects and the impacts may be considered subjective. What one person finds intolerable an-

other person may not even notice. There are, however, objective noise standards that mandate maximum noise levels that can be measured. Mining permits set noise standards and so do local ordinances. Measurement and lack of enforcement can be a problem. Noise can easily rise from nuisance levels to levels that have demonstrable harmful effects on the mental and physical health of those exposed to it.

Every issue listed above has a number of sub-issues and it is beyond the scope of this paper to go into all of them in the detail needed to convey the total impact of mining on the community surrounding the mines. To cover visual impact would take pages.

Environmental issues overlap with social issues, especially noise and visual impact. Mining impacts that need further study include loss of soil and excavation below the water table.

When a mining operation begins, depending on the mining plan, soil is

scraped off and stored in piles on site or as berms surrounding the mine to function as visual impact mitigation. Depending on the final reclamation plan some, or all, of the soil may be sold. If the reclamation plan creates a pond or lake in the mine area as mining below the water table does, then the soil can be sold and disappears. When soil is cut off from its parent material and placed in thick, dense piles it loses many of the characteristics that make it soil. This probably damages the organisms that create soil and play a large part in its fertility. Qualified soil scientists should be asked to study this problem when a mine operator does an environmental impact statement.

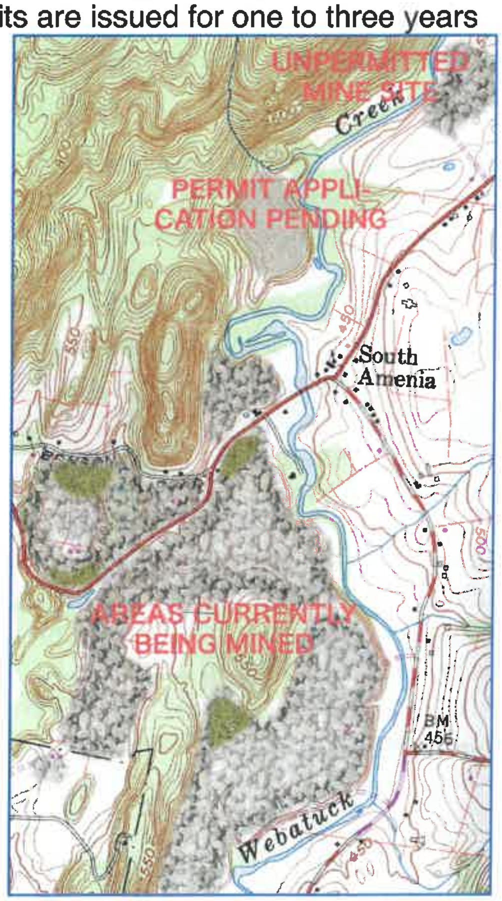
Mining below the water table is not a new issue. Lately mine operators have been using this mining method to increase the yield of their mines when they have mined out the entire product within the permitted "footprint" of their mines. The mining permit is renewed allowing this type of mining with typically minimal environmental review required. All three major permitted mines in South Amenia are currently using this technique. Mining below the water table has environmental effects that have been cited by experts, including the removal of the filtering effect of the overburden and possibly allowing pollutants to enter directly into the groundwater system. The exposure of groundwater allows its direct loss through evaporation. Another problem that should be studied locally is that when the unconsolidated overburden is removed over a limestone aquifer, unfiltered pollutants may move quickly into the secondary fissures present in the limestone.

A positive aspect of mining below the water table is the creation of ponds and lakes that have the potential for recreation, wildlife habitat, and visual enhancement.

In 1975, New York State put into effect the Mined Land Reclamation Law that regulates mining within the state. It empowers the Department of Environmental Conservation (DEC) to carry out "...the policies of the State to foster and encourage the development of an economically sound and stable mining industry, and the orderly development of domestic mineral resources and reserves necessary to assure satisfaction of economic needs compatible with sound environmental management practices." In 1986, the law was amended to allow local governmental agencies more control by allowing them to enact stricter mined land reclamation standards than the State.

A mine may be opened without a permit if extraction is limited to 1000 tons over a 12-month period. There are two mines in Amenia today that operate under this loophole. There are presently four operating permitted mines in Amenia and another that has not operated for years but has not been reclaimed.

Mined land permits are routinely issued by DEC after the applicant goes through an environmental review process. Permits are issued for one to three years and are easily renewed. DEC is charged with enforcing the provisions of the permit and with eventual reclamation of the land. On paper, this is an effective system of checks and balances that allows mining within set environmental standards. Region 3 of the DEC located in New Paltz regulates mines within Amenia. It oversees more than 350 mines covering several counties and it can be frustratingly difficult for citizens not familiar with the system to work with, sometimes giving the impression that they are more "pro-mining" than "pro environment."



Town planners interested in the impact of mining should look at South Amenia, as it is a microcosm of the problems that mining can generate.

Mining began in South Amenia probably in the late 1930's. Some gravel was mined for the construction of the Wassaic Developmental Center. In the 1960's gravel mining was begun in earnest and has continually expanded to the present day and now covers hundreds of acres. Zoning was implemented in 1975 that regulated where mining could take place, but existing mines were "grandfathered" allowing them to operate within their original mining areas or "footprints". All of the mines have expanded to near their permitted limits and have been mining below the water table for years. The only way new mines may be opened is for the zoning to change or by special use permit.

Currently, there are three permitted mines and one unpermitted mine that has 1,000 ton per 12-month limit. On site processing takes place at one mine while the others transport their material for off site processing.

In the rest of the Town, there are two mine sites, both in Wassaic. One mine quit operating years ago and should have been reclaimed by now. Some reclamation was recently done, but much remains, including the removal of a lot of machinery and temporary buildings. An unpermitted mine also operates in the same area. A large processing plant which produces asphalt and concrete is located in Leedsville.

Reclamation, which is part of every mining permit and for which the operator puts up a significant bond, has been done for some closed mines notably in Leedsville and near Old Route 22 just south of the village of Amenia. Partial reclamation, shown in green on the map on the previous page, has taken place in South Amenia. New operators are mining some of the reclaimed land, however. Current reclamation plans call for the construction of ponds in the three operating South Amenia area mines.

THE FUTURE

Mining has been a fixture in Amenia since the early 1800's. At its apex, iron mining was more important than agriculture in the area. The environmental damage done during that period of time has, superficially at least, mostly been naturally healed. The second and third growth forests that replaced the original forest are only a poor substitute for what existed before clear cutting for charcoal fuel took place and since no biodiversity study was done prior to the cutting, no one knows how the present flora and fauna compare. The iron industry dwindled away, the people who did the work moved on, and only scattered ruins of that culture still exist. It was an important era because it furnished a material, like aggregate today, that was needed for the growing economy of the time.

Gravel mining will remain part of present-day Amenia for quite some time. For example, a mine in South Amenia was recently issued a permit that will allow it to mine about a million tons more product, extending the life of the mine 10 to 15 more years. This was done by allowing mining below the water table. Significant amounts of gravel exist in the valley between Wassaic and Amenia, in the Oblong Valley, in South Amenia, and along the flood plains of the Wassaic Creek, Webatuck Creek, and the Tenmile River and probably other places in Amenia as well. As with all mineral deposits, the actual value of these deposits depends on many variables.

The 1989 Master Plan specified that siting and operation of mining activities should be regulated so as not to have negative impacts on adjacent land uses. The Plan also discussed how to limit the visual impact of mining activities and stated that mining below the water table should be carefully reviewed for the potential, irreversible impacts on the Town's aquifers and water resources.

Because residential areas are not compatible with mining, the Plan recommended that areas zoned for residential use be avoided. Mining activities that already exist as a nonconforming use in an area should not be allowed to expand and reclamation should take place as soon as possible. Factors that must be considered in opening a new mine should include (besides previously discussed items) the size of the mining operation, the type of resource, the equipment used, the cumulative effect of the new mine on the surrounding area, proximity to residential land, buffers proposed, and the mitigation of noise and visual impacts. Prior performance of the applicant on other mines operated should also be a factor.

The Master Plan emphasizes reclamation as a method of minimizing impacts, especially concurrent reclamation. Concurrent reclamation, also known as phased reclamation, is a process of mining small areas and reclaiming those areas before opening up new mine areas.

The future of gravel mining in Amenia would seem to depend on the Town's determination to adopt an updated version of the 1989 Master Plan and continue the process of conforming the zoning codes to the new plan. Virtually every potential new mine site under the present zoning cannot be mined without a change in zoning or a special use permit.

There are some deposits that should not be mined at all because of their location near a residential neighborhood or because they have special significance to the community, such as being in the center of a treasured view or a prehistoric archaeological site. In some sites, the gravel could be mined but the transportation of the product through residential areas becomes the problem. Other potential sites are environmentally sensitive such as sites near wetlands, streams, or over groundwater recharge areas.

The new 2007 Comprehensive Plan has language creating a Soil Mining Overlay District, which will have the potential for more local control on all types of mining in Town.

After eliminating potential mine locations based on the preceding objections, are there any places left in Amenia where new mines may be opened? The answer to that, of course, is, it depends. Among other things it would depend on how willing the operator of a new mine is to sit down with the people most directly affected by a mine as well as Town officials and discuss in a non-political atmosphere the negative effects and the benefits of a new mine. Many concessions and changes would probably have to take place in the way the mine was operated compared with today's operations. But, with imagination and honesty from all sides, it could be possible.

Another method of producing aggregate is by quarrying and crushing suitable rock. This process is far more disrupting to the environment and to a community than surficial mining. In the main body of this report is geologic map that shows the different rock types present in Amenia. Virtually any of these rock formations could, when quarried and crushed, provide aggregate suitable for many uses. No single place in Amenia has rock that is unique in itself for use as aggregate; rock in the middle of Amenia is as good as rock in South Amenia for that purpose.

MINING IN AMENIA

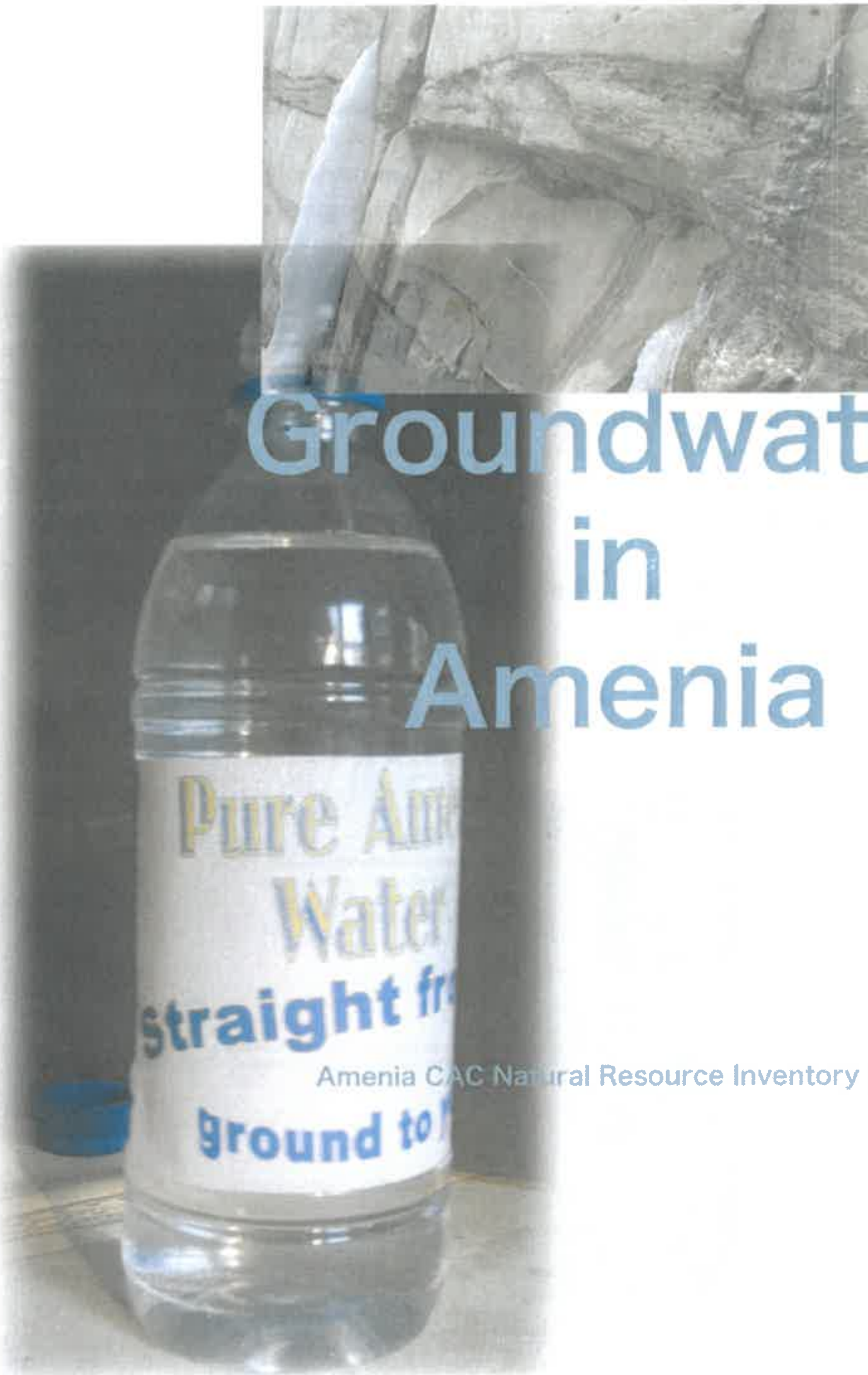
There are many locales in the area that have operating rock quarries including Dover Plains, Pawling, and Cannan, Connecticut. Planners wishing to assess the impact of these operations should visit them. Visual, dust, noise, and traffic impacts are all part of the picture.

Over the past 20 years, two quarries have been proposed in Amenia. One was on Rt. 22 near the closed Harlem Valley Landfill and the other was in South Amenia. The South Amenia site has been bitterly fought since 1989 by residents of the area. Many issues were contested. The proposal called for the mining of 20 millions tons of rock from two sites over a period of 150 years. This is more rock than in most of the largest structures ever built anywhere.

The land that the quarry was to have been built on has been sold, so the quarry proposal may be off the table.

The new 2007 Amenia Comprehensive Plan and zoning will make it very difficult to open a quarry, will regulate soil mining locations through a Soil Mining Overlay District, will regulate surface rock removal, and install new noise regulations.

What a rock quarry in South Amenia may have looked like.



Groundwater in Amenia

Amenia CAC Natural Resource Inventory 2005

Amenia CAC Open Space Inventory May, 2007 by D. Reagon

Groundwater in Amenia

The most important and abundant natural resource in Amenia is groundwater. All of the water used by local residents comes from the plentiful supply of water stored in subsurface formations of rock and unconsolidated sand and gravel deposits. Taken together these water resources comprise the Harlem Valley aquifer, the second largest groundwater deposit in Dutchess County.

Groundwater Basics

In the water cycle about 2/3 of all precipitation is returned to the atmosphere through evaporation from the ground surface and transpiration via plants. About ¼ runs off into streams and the remaining amount enters the ground and becomes groundwater.

The entry of water into the ground, called infiltration is controlled mainly by the porosity and permeability of the ground surface. Porosity is the amount of empty space between soil and rock particles that can be filled with groundwater. Permeability is a measure of how easily water can pass through soil or rock and is governed mainly by the size of the pore spaces and how interconnected they are. See Figure 1 for details.

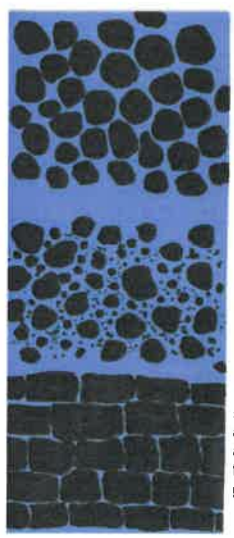


Figure 1. Porosity and permeability relationships.

Once water enters the ground, gravity carries it downward at a rate determined by the permeability of the rock and soil. Some of the water is held back by its attraction to soil particles and becomes soil water which is directly available to plants. In most cases, groundwater only moves a few inches a day although in some rock types, such as limestone, water may move much faster. When groundwater reaches a layer of rock or soil that has relatively low permeability it stops moving downward and continues to move laterally still under the pull of gravity. Pore spaces become saturated with water and a saturated zone is formed. Directly above the saturated zone the soil/rock particles contain air and water forming the unsaturated zone. The boundary between these zones is known as the water table. Generally, wherever the water table cuts the surface of the land it manifests itself as a spring, wetland, swamp, lake, or even a stream. When significant quantities of water can be extracted from the saturated zone it becomes known as an aquifer. Figure 2 shows some the details of the groundwater system.

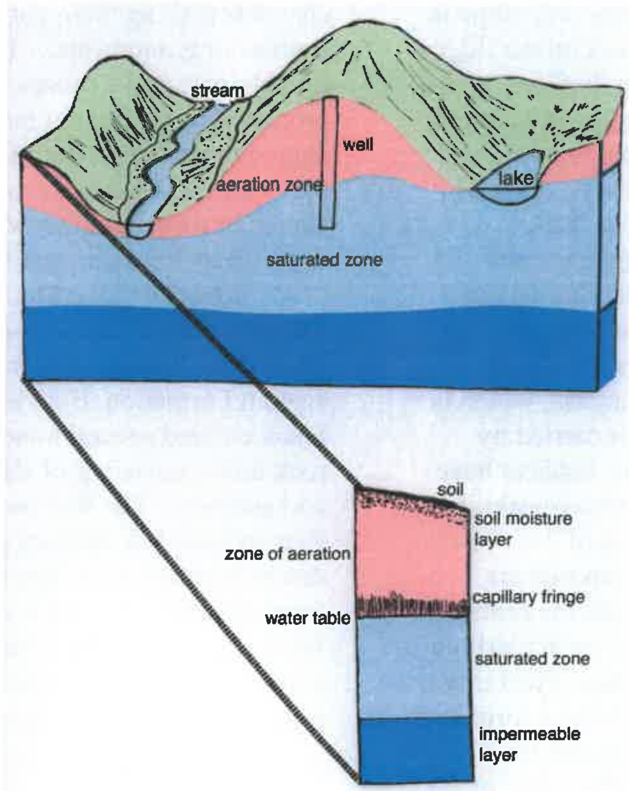


Figure 2. The groundwater system at a glance.

Aquifers in Amenia

As previously stated, groundwater in Amenia comes from an aquifer system known as the Harlem Valley aquifer which generally underlies closely the Ten Mile River watershed. Few formal studies of this aquifer exist but the Chazen Company did an important one in 1999 for the town of Dover and another was done in 1985 for Dutchess County which is known as the Gerber report. Both provide valuable information about this important water source. The Chazen report, coordinated by hydrologist Russell Urban Meade, provides the most up-to-date and complete source of information.

In Amenia, as well as Dover and Northeast, the Harlem Valley aquifer is divided into two principal components; a surficial part which is largely a complex mixture of glacial and post-glacial unconsolidated material consisting of sand, gravel, and clay, and a bedrock component consisting of consolidated rock formations.

The surficial deposits were deposited on top of the valley bedrock formations by moving and melting ice about 15,000 years ago. They vary greatly in their permeability and range in thickness from a few inches on the ridge tops to more than one hundred feet in the valley bottoms. Glacial till and outwash are the two most important type of glacial deposits found locally. Glacial till consists of material that was deposited directly by glacial ice and generally has low permeability due to high clay content and mixed grain sizes. Till does not make a good source of groundwater. Glacial outwash, which is rounded and sorted debris carried by glacial meltwater streams, tends to have high primary porosity and permeability and is an important source of groundwater. Outwash deposits are common in Amenia and are the primary source of sand and gravel particularly in South Amenia and Wassaic. Most of the important soils in Amenia have formed on these outwash deposits and are considered to be an important part of the aquifer due to their capacity to filter out contaminants that may enter the groundwater system.

At least two water systems draw water from the gravel aquifer including the Taconic DDSO.

Except for Bog Hollow, most of Amenia has two principal bedrock formations having distinct geological and hydrological properties. The Stockbridge Formation, a several hundred foot thick layer of carbonate rocks (limestone, marble, and dolostone) is mostly found in the valley bottoms often covered by glacial deposits. Carbonate rocks have low primary porosity but often are fractured and jointed and may contain solution channels making them good potential sources of groundwater. The solubility of carbonate rocks causes the groundwater in them to have a high degree of hardness. The Stockbridge rocks are an important groundwater source in Amenia. Most wells in Town draw water from this aquifer.

Overlying the Stockbridge and forming most of the ridges in Amenia are the Walloomsac Formation and Everett Formation. Both are dark gray to black colored several hundred feet thick rock units consisting of slates, phyllites, and gneisses. The Walloomsac and Everett have low primary permeability due to its small grain size and compactness. They have extensive fracturing and can be a water source although not as important as the previously mentioned formations.

Generally speaking, the carbonate rocks along with their glacial outwash overburden form the valley bottom aquifer system of the Harlem Valley while the ridge-forming schists and gneisses form an upland aquifer. The two systems are closely related but the valley bottom aquifer is by far the most productive and important aquifer in Amenia. See Figure 3 for details.

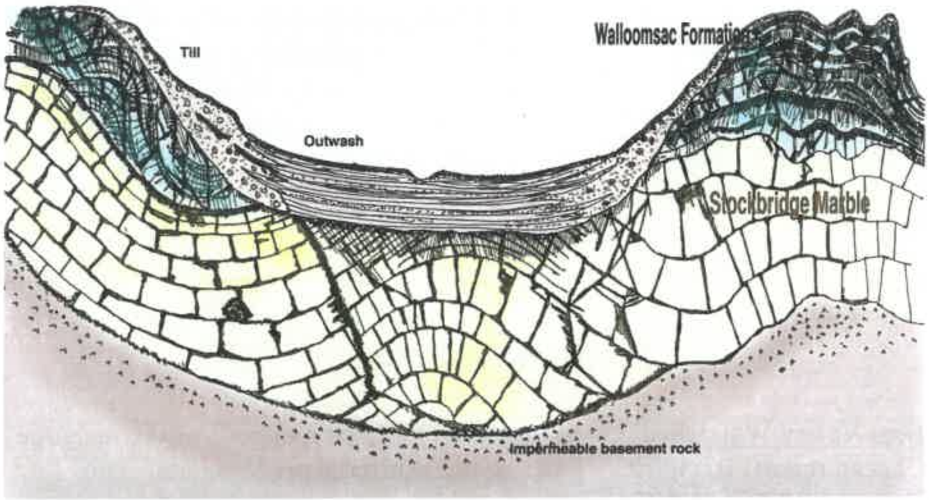


Figure 3. An idealized east-west geologic cross-section near Wassaic.

The amount of usable water in the Harlem Valley aquifer can be estimated since there is a connection between groundwater and streamwater. Streams continue to flow during dry periods because groundwater enters the streambed. Precipitation amounts in a watershed can be measured and the amount of water entering an aquifer can be approximately determined. By measuring the stream flow through an area the amount of water flowing through the related aquifer can be determined. The Chazen report estimates the amount of available water for each town in the Harlem Valley.

Threats to Groundwater

Groundwater quality can be affected in two main ways: point source pollution and non-point pollution.

Point source pollution is a contaminant that emanates from an isolated source such a leaking underground storage tank, landfill, septic tank, or material that is spilled onto the surface of the ground. Pollutants can be soluble solids or, most often, liquids that enter the ground just like water and spread out underground to form plume shaped masses. Wells can pick up the contamination and introduce it into the water supply. The severity of the problem depends on the type of contaminant, how far a well is from the point of contamination, and the permeability of the rock or soil the water moves through. Gasoline, volatile organic compounds, road salt, and numerous common household products are common examples of point source pollutants.

Non-point pollution typically is a substance that is spread over a wide area and infiltrates into the groundwater. Farms and golf courses are important sources of non-point pollution because of the practice of spreading manure, pesticides, herbicides, and chemical fertilizers. Road de-icing is another important source of non-point pollution.

Taking more water out of the ground than is replaced by precipitation obviously affects the amount of groundwater available and often results in the lowering of the water table causing wells to go dry. Evaporation from surface sources of water can also result in lowering the amount of water available to the groundwater system. Long periods of drought will significantly lower the water table.

Gravel mining reduces the thickness of the protective soil layer over an aquifer making it easier for pollutants to reach groundwater while mining below the water table causes evaporation losses and exposes the water table to the possibility of direct contamination and results in warming .

Recommendations

The Harlem Valley Watershed Inventory (the Chazen report) is a must read for anyone who is concerned with setting water usage and protection policies in Amenia. The report's writer, hydrologist Russell Urban Meade, makes the following specific recommendations concerning the future of the aquifer in the Harlem Valley:

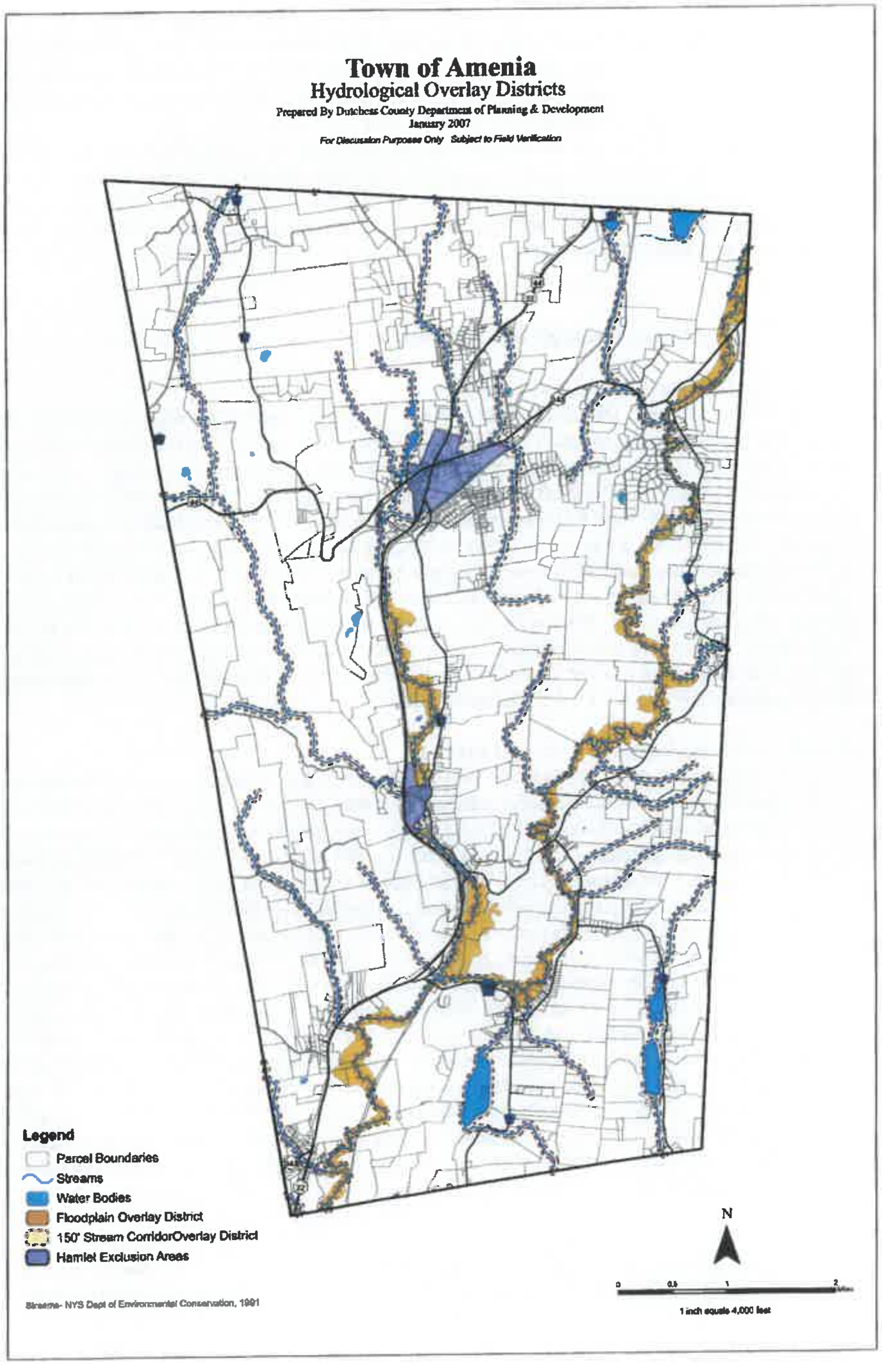
Component One recommends defining water quality protection areas within the valley towns and adopting them as an aquifer overlay districts under municipal zoning. Water quality protection areas should be established in areas (yet to be mapped) where recharge of the aquifer is predominant. This would be in areas where the ground surface has high permeability.

Component Two involves making sure that the aquifer is not overused. The recommendation limits water usage in each community to a level that equals one-half the drought flow of valley bottom streams in each community.

Amenia has large supplies of quality groundwater for foreseeable future. Keeping the quality at its current high level will be the challenge.

Amenia Comprehensive Plan Update and new Zoning

The Draft Amenia Comprehensive Plan (2007) has extensive language dealing with the groundwater in the Town. The new proposed zoning proposes detailed language for protecting Amenia's water supply. An aquifer overlay district has been proposed that separates the various aquifers in Town and describes different levels of protection for each. The new zoning, along with the overlay map, is so important and detailed that is included in its entirety at the end of this report.


Town of Amenia
Hydrological Overlay Districts
Prepared By Dutchess County Department of Planning & Development
January 2007
For Discussion Purposes Only   Subject to Field Verification
Legend
Parcel Boundaries
Streams
Water Bodies
Floodplain Overlay District
150' Stream CorridorOverlay District
Hamlet Exclusion Areas
N
0
0.5
1
2
1 inch equals 4,000 feet
Streams- NYS Dept of Environmental Conservation, 1991

(2) No structure greater than 65 years old shall be demolished without a public hearing held pursuant to §121-62E through G. This hearing requirement may be waived by the Planning Board if it finds that the structure has minimal historic value and/or that it is in a condition that is so seriously deteriorated that it cannot be economically restored and/or must be demolished for safety reasons.

(3) If the Planning Board determines that the structure has historic value and should be preserved, the applicant shall advertise it for 60 days as available to be moved off the site to another location. The applicant shall be obligated to pay the moving costs up to the amount deemed by the Planning Board to be equivalent to the cost of demolishing the structure. If no person agrees to remove the structure at the end of 60 days, the applicant shall be permitted to demolish the structure.

§121-15 AQUIFER OVERLAY DISTRICT (AQO)

A. Legislative Findings, Intent, and Purpose

The Aquifer Overlay AQO District has been created to protect the health and welfare of residents of the Town of Amenia by minimizing the potential for contamination and depletion of the Harlem Valley's aquifer system. The entire Town of Amenia contains an aquifer system that has been divided into four categories described in Subsection B. This aquifer system provides drinking water to public water systems and private wells and also provides groundwater and surface water that is essential to the maintenance of healthy aquatic and terrestrial ecosystems. The Town has determined that a limiting factor on the carrying capacity of the land is its capability to provide water in sufficient quality and quantity so that water use by some users does not adversely affect other users. Another limiting factor on the carrying capacity of the land is its ability to absorb wastewater without adversely affecting the quality or quantity of groundwater and surface water necessary for water supplies and other needs of the natural and human environment. The purpose of these regulations is to protect the Town's groundwater aquifer system, to provide the most protective standards to those areas of the aquifer at greatest risk of contamination, and to manage development so that groundwater supplies are not depleted or degraded.

B. Delineation and Regulatory Effect of District

1. The Aquifer Overlay (AQO) District encompasses the entire Town of Amenia and includes two basic types of aquifers: the Valley Bottom Aquifer, containing significant amounts of groundwater located in areas that are generally more developed, and the Upland Aquifer, containing lesser quantities of groundwater and less development (see definitions in subsection C below). The AQO district consists of three aquifer zones, two in the Valley Bottom Aquifer and one in the Upland Aquifer. These zones are designated as the Priority Valley Bottom Aquifer (PVBA), which is the aquifer area most susceptible to contamination that would affect public water supplies, the Buffered Valley Bottom Aquifer (BVBA), which is less susceptible than the PVBA because it is in an area serviced by public water systems, and the Upland Aquifer (UA) which consists of areas not covered by the Valley Bottom Aquifer zones. These zones are delineated on the Aquifer Overlay District Map. There is also provision in this §121-15 for an Upland Wellhead Protection Area (UWP), which has not been mapped at this time because the Upland Aquifer area does not presently contain any settlements with an intensity of development that would require additional groundwater protection. The UWP category has been established in this Chapter for possible future mapping in the event that more intensive development occurs within the UA zone , resulting in the need to protect public water supply wellheads within this area. The official Aquifer Overlay District Map can be found at the Town offices. A photo-reduction of this map is attached to this chapter for reference purposes. The Aquifer Overlay AQO District map and any amendments to it must be prepared or approved by a hydrogeologist working for the Town.

2. The official Aquifer Overlay District Map shall be used to determine the boundaries of zones within the AQO District. In case of a question or dispute as to the exact location of a boundary on a specific parcel of land, the

Town may retain a qualified hydrogeologist at an applicant's expense to make such a determination in the field based upon the criteria in this § 121-15. An applicant may challenge the Town's determination by retaining a qualified hydrogeologist to make such determination independently based upon the criteria in this § 121-15. In the event of such a challenge, the Town's hydrogeologist shall review the report of the applicant's hydrogeologist at the applicant's expense and shall make the final determination as to the location of the specific boundary. Any such boundary delineation shall not, by itself, effect a change in the AQO District Map. The AQO District Map may only be changed by action of the Town Board as provided in Subsection 121-15H.

3. Within the Aquifer Overlay District, all of the underlying land use district rules shall remain in effect except as specifically modified by this § 121-15. In case of a conflict between this §121-15 and the underlying use regulations, the more restrictive shall control. Nothing in this § 121-15 shall be construed to allow uses that are not permitted by the underlying land use district.

C. Definitions

For purposes of this § 121-15, the following definitions shall apply:

Action: A project or physical activity as defined in the SEQR Regulations of the NYS Department of Environmental Conservation, 6NYCRR Part 617 , including all actions subject to SEQR that are covered by this Chapter, as well as subdivision applications and other actions requiring local government approval under SEQR.

Aquifer: A consolidated or unconsolidated geologic formation, group of formations or part of a formation capable of yielding a significant or economically useful amount of groundwater to wells, springs or infiltration galleries.

Aquifer Overlay AQO District Map: The Town's overlay map showing Aquifer Overlay District zones.

Buffered Valley Bottom Aquifer BVBA: Areas delineated as Buffered Valley Bottom Aquifer BVBA on the Aquifer Overlay AQO District Map. As defined or approved by a hydrogeologist working for the Town, BVBA areas consist of regions within the Valley Bottom Aquifer VBA served by community water systems, where the sources of water supply for the community water system and for any other wells would not be substantially threatened by a contaminant release occurring within the BVBA. No portion of the BVBA may lie hydrogeologically upgradient of any wells, including wells used by the community water system.

Community Water System: A public Water System regulated by the New York State Department of Health that serves at least five service connections used by year-round residents or regularly serves at least 25 year-round residents.

Conditionally Exempt Small Quantity Generators: As defined by the Resource Conservation and Recovery Act and amendments thereto, sites generating or storing less than 100 kilograms per month and 1000 kilograms of listed and /or characteristic wastes, respectively, <u>and</u> generating and storing less than 1 kilogram per month and 1 kilogram of acutely hazardous waste, respectively.

Consumption of Water: The net loss of water from a watershed through evaporation and transpiration processes caused by any human activities and associated land uses, other than open space uses, including evaporative losses from septic system leaching lines. The definition of Consumption of Water includes the use of water in diluting wastewater discharges so that groundwater quality at the property line downgradient from the discharge will be 50% or less of the New York State Department of Environmental Conservation's Title 10 Part 703 Groundwater (GA) Water Standards, i.e. the DEC's groundwater contamination standards.

Discharge: Any intentional or unintentional action or omission resulting in the releasing, spilling, leaking, pumping, pouring, emitting, emptying, or dumping of substances or materials into the waters of the State or onto lands from which the discharged substances or materials might flow or drain into said waters, or into waters outside the jurisdiction of the State, when damage may result to the lands, waters, or natural resources within the jurisdiction of the State.

Generator of Hazardous Waste: Any person or site whose act or process produces hazardous waste.

Groundwater: Water contained in interconnected pores and fractures in the saturated zone in an unconfined aquifer or confined aquifer.

Hazardous Substance: Any substance, including any petroleum by-product, which may cause harm to humans or the environment when improperly managed. A complete list of all hazardous substances except for petroleum by-products can be found in 6 NYCRR Part 597.2(b) Tables 1 and 2 and amendments thereto.

Hazardous Waste: See 6 NYCRR Part 371 and amendments thereto for the identification and listing of hazardous wastes.

Herbicide: Any substance or mixture of substances intended to prevent, destroy, repel, or mitigate any weed, and being those substances defined as herbicides pursuant to Environmental Conservation Law § 33-0101, and amendments thereto.

Large Quantity Generator: As defined by the Resource Conservation and Recovery Act and amendments thereto, sites generating more than 1000 kilograms per month of listed and/or characteristic hazardous wastes, or generating or storing more than 1 kilogram per month and 1 kilogram of acutely hazardous waste, respectively.

Major Oil Storage Facilities; Facilities with a storage capacity of 400,000 gallons or more of petroleum.

Natural Recharge: The normal rate at which precipitation enters the subsurface to replenish groundwater in aquifers, without interruption or augmentation by human actions or landscape modifications.

Non-point discharge: Discharges of pollutants not subject to SPDES (State Pollutant Discharge Elimination System) permit requirements.

Pesticide: Any substance or mixture of substances intended to prevent, destroy, repel, or mitigate any pest, and any substances intended to for use as a plant regulator, defoliant or desiccant, and being those substances defined as pesticides pursuant to Environmental Conservation Law § 33-0101 et seq. and amendments thereto.

Petroleum: Oil or petroleum of any kind and in any form including but not limited to oil, petroleum fuel oil, oil sludge, oil refuse, oil mixed with other waste, crude oil, gasoline and kerosene, as defined in 6 NYCRR Part 597.1(7) and amendments thereto.

Point Source Discharge: Pollutants discharged from a point source as defined in Environmental Conservation Law § 17-0105 and amendments thereto.

Priority Valley Bottom Aquifer PVBA: The area delineated as the Priority Valley Bottom Aquifer PVBA on the Aquifer Overlay AQO District Map. As defined or approved by a hydrogeologist working for the Town, the PVBA consists of all areas within the Valley Bottom Aquifer VBA which are not included in Buffered Valley Bottom Aquifer BVBA areas.

Pollutant: Any material or byproduct determined or suspected to be hazardous to human health or the environment.

Radioactive Material: Any material that emits radiation.

Small Quantity Generator: As defined by the Resource Conservation and Recovery Act and amendments thereto, sites not meeting Conditionally Exempt Small Quantity Generator status but which generate and store less than 1000 kilograms per month and 6000 kilograms of listed and /or characteristic wastes, respectively, and generating and storing less than 1 kilograms per month and 1 kilogram of acutely hazardous waste, respectively.

Solid Waste: Generally refers to all putrescible and non-putrescible materials or substances, except domestic sewage, sewage treated through a publicly owned treatment works, or irrigation return flows, that is discarded or rejected as being spent or otherwise worthless, including but not limited to garbage, refuse, industrial and commercial waste, sludges from air or water treatment facilities, rubbish, tires, ashes, contained gaseous material, incinerator residue, construction and demolition debris and discarded automobiles, as defined in 6 NYCRR Part 360-1.2(a) and amendments thereto.

State Pollutant Discharge Elimination System ("SPDES"): The system established pursuant to Article 17 Title 8 of Environmental Conservation Law for issuance of permits authorizing discharges to the waters of the state of New York.

Upland Aquifer UA: The area delineated as Upland Aquifer UA on the Aquifer Overlay AQO District Map. As defined or approved by a hydrogeologist working for the Town, the UA consists of all areas on the Aquifer Overlay AQO District Map not included in the Valley Bottom Aquifer VBA or in Upland Wellhead Protection UWP areas.

Upland Wellhead Protection UWP areas: Areas delineated or to be delineated in the future as Upland Wellhead Protection UWP areas on the Aquifer Overlay AQO District Map. As defined or approved by a hydrogeologist working for the Town, UWP areas consist of wellhead protection areas for community water system wells not located

environment when improperly managed. A complete list of all hazardous substances except for petroleum by-products can be found in 6 NYCRR Part 597.2(b) Tables 1 and 2 and amendments thereto.
Hazardous Waste: See 6 NYCRR Part 371 and amendments thereto for the identification and listing of hazardous wastes.
Herbicide: Any substance or mixture of substances intended to prevent, destroy, repel, or mitigate any weed, and being those substances defined as herbicides pursuant to Environmental Conservation Law § 33-0101, and amendments thereto.
Large Quantity Generator: As defined by the Resource Conservation and Recovery Act and amendments thereto, sites generating more than 1000 kilograms per month of listed and/or characteristic hazardous wastes, or generating or storing more than 1 kilogram per month and 1 kilogram of acutely hazardous waste, respectively.
Major Oil Storage Facilities; Facilities with a storage capacity of 400,000 gallons or more of petroleum.
Natural Recharge: The normal rate at which precipitation enters the subsurface to replenish groundwater in aquifers, without interruption or augmentation by human actions or landscape modifications.
Non-point discharge: Discharges of pollutants not subject to SPDES (State Pollutant Discharge Elimination System) permit requirements.
Pesticide: Any substance or mixture of substances intended to prevent, destroy, repel, or mitigate any pest, and any substances intended to for use as a plant regulator, defoliant or desiccant, and being those substances defined as pesticides pursuant to Environmental Conservation Law § 33-0101 et seq. and amendments thereto.
Petroleum: Oil or petroleum of any kind and in any form including but not limited to oil, petroleum fuel oil, oil sludge, oil refuse, oil mixed with other waste, crude oil, gasoline and kerosene, as defined in 6 NYCRR Part 597.1(7) and amendments thereto.
Point Source Discharge: Pollutants discharged from a point source as defined in Environmental Conservation Law § 17-0105 and amendments thereto.
Priority Valley Bottom Aquifer PVBA: The area delineated as the Priority Valley Bottom Aquifer PVBA on the Aquifer Overlay AQO District Map. As defined or approved by a hydrogeologist working for the Town, the PVBA consists of all areas within the Valley Bottom Aquifer VBA which are not included in Buffered Valley Bottom Aquifer BVBA areas.
Pollutant: Any material or byproduct determined or suspected to be hazardous to human health or the environment.
Radioactive Material: Any material that emits radiation.
Small Quantity Generator: As defined by the Resource Conservation and Recovery Act and amendments thereto, sites not meeting Conditionally Exempt Small Quantity Generator status but which generate and store less than 1000 kilograms per month and 6000 kilograms of listed and /or characteristic wastes, respectively, and generating and storing less than 1 kilograms per month and 1 kilogram of acutely hazardous waste, respectively.
Solid Waste: Generally refers to all putrescible and non-putrescible materials or substances, except domestic sewage, sewage treated through a publicly owned treatment works, or irrigation return flows, that is discarded or rejected as being spent or otherwise worthless, including but not limited to garbage, refuse, industrial and commercial waste, sludges from air or water treatment facilities, rubbish, tires, ashes, contained gaseous material, incinerator residue, construction and demolition debris and discarded automobiles, as defined in 6 NYCRR Part 360-1.2(a) and amendments thereto.
State Pollutant Discharge Elimination System ("SPDES"): The system established pursuant to Article 17 Title 8 of Environmental Conservation Law for issuance of permits authorizing discharges to the waters of the state of New York.
Upland Aquifer UA: The area delineated as Upland Aquifer UA on the Aquifer Overlay AQO District Map. As defined or approved by a hydrogeologist working for the Town, the UA consists of all areas on the Aquifer Overlay AQO District Map not included in the Valley Bottom Aquifer VBA or in Upland Wellhead Protection UWP areas.
Upland Wellhead Protection UWP areas: Areas delineated or to be delineated in the future as Upland Wellhead Protection UWP areas on the Aquifer Overlay AQO District Map. As defined or approved by a hydrogeologist working for the Town, UWP areas consist of wellhead protection areas for community water system wells not located

within the Valley Bottom Aquifer VBA. At a minimum, wellhead protection areas enclose all lands situated within 60-days travel time (seepage velocity) from the community water system's wells, and enclose sufficient land that average annual Natural Recharge in the UWP area matches the average water demand of the community water system.
Valley Bottom Aquifer VBA: The area delineated as the Valley Bottom Aquifer VBA on the Aquifer Overlay AQO District Map. As defined by a hydrogeologist working for the Town, the VBA consists of the following areas:

1. All locations where outcrops of the Stockbridge Formation, as generally defined by New York State Museum Geologic Maps, are present at grade;
2. All locations where the Stockbridge Formation is the first bedrock formation found under unconsolidated soil materials;
3. All overburden soils (sand, gravel, clay, till, etc.) overlying the Stockbridge Formation;
4. All locations which do not overlie the Stockbridge Formation but where moderately to highly permeably overburden soils (K >10^{-5} cm/sec), including stratified silt, sand, and/or gravel are hydraulically connected to, and are substantially contiguous to, the Stockbridge Formation.

The VBA includes the Priority Valley Bottom Aquifer PVBA and Buffered Valley Bottom Aquifer BVBA areas.
Wastewater: Aqueous-carried solid or hazardous waste.
Watershed: That land area that includes the entire drainage area contributing water to the Town water supply and which includes the Aquifer Protection Overlay District.
Water Supply: The groundwater resources of the Town of Amenia, or the groundwater resources used for a particular well or community water system.
Well: Any present or future artificial excavation used as a source of public or private water supply which derives water from the interstices of the rocks or soils which it penetrates including bored wells, drilled wells, driven wells, infiltration galleries, and trenches with perforated piping, but excluding ditches or tunnels, used to convey groundwater to the surface.

D. General Provisions of the Aquifer Overlay District

1. The manufacture, use, storage, or discharge of any products, materials or by-products subject to these regulations, such as wastewater, solid waste, hazardous substances, or any pollutant, must conform to the requirements of these regulations.
2. Usage of Water for proposed actions within the Aquifer Overlay AQO District shall be examined pursuant to SEQRA in accordance with the methodology set forth in Subsections F and G of this § 121-15.
3. In addition to the list of Statewide Type I Actions contained in § 617.4(b) of 6 NYCRR, all proposed actions resulting in discharges exceeding standards provided in 6 NYCRR Part 703.6(e) and amendments thereto (groundwater contamination standards), and all proposed actions where Water Consumption exceeds Natural Recharge, as defined in Subsections F and G herein, shall be designated as Type I Actions under the Implementing Regulations of the State Environmental Quality Review Act (6 NYCRR Part 617), unless the action is listed as a Type II action under such regulations.
4. Installation of any underground fuel tank or tanks, whose combined capacity is less than 1,100 gallons, is prohibited in the Aquifer Overlay AQO District.
5. This Section 121-15 shall not apply to customary agricultural practices conducted in conformity with applicable rules of the New York State Department of Environmental Conservation and the New York State Department of Agriculture and Markets which are in conformance with a whole farm management plan approved by the Dutchess County Soil and Water Conservation District.
6. This Section 121-15 shall not apply to any single-family, two-family, or multi-family residential use of land containing five or fewer dwelling units, or to any home occupation unless such residential use or home occupation includes one of the activities listed in subsection E below.

E. Use and Permit Requirements in the Aquifer Overlay District

In accordance with Article IX of this chapter, the Planning Board shall review and act upon Special Permit applications within the Aquifer Overlay AQO District. If the uses listed below are regulated by any state federal agency, the definitions of such uses and all applicable regulations under state and federal law shall apply.

1. Special Permits within the Priority Valley Bottom Aquifer PVBA and Upland Wellhead Protection UWP areas. The following uses, if permitted in the underlying land use district, shall require the issuance of a Special Permit within the Priority Valley Bottom Aquifer PVBA and the Upland Wellhead Protection UWP areas:
   a. Photo labs;
   b. Auto repair facilities and truck terminals, including engine repair and machine shops;
   c. Furniture stripper/painter, metal works, wood preservers;
   d. Printers and the use of printing presses;
   e. Conditionally Exempt or Small Quantity Generators of Hazardous Waste.
   f. Solid waste management facilities not involving burial, including incinerators, composting facilities, liquid storage, regulated medical waste, transfer stations, recyclables handling & recovery facilities, waste tire storage facilities, used oil, C&D processing facilities, each as defined in 6 NYCRR Part 360, and junk or salvage yards in general.
   g. Salt storage facilities.
   h. Uses where Water Consumption exceeds Natural Recharge.
   i. Cemeteries, including pet cemeteries
   j. Veterinary hospitals and offices
   k Funeral parlors.
   l. Storage or disposal of manure, fertilizers, pesticides/herbicides. No special permit shall be required for storage of less than 500 pounds or where such storage or disposal is conducted in connection with a farm operation that is covered by the exemptions in Section 121-37E.
2. Special Permits within the Buffered Valley Bottom Aquifer BVBA areas and the Upland Aquifer UA. The following uses, if permitted in the underlying land use district, shall require the issuance of a Special Permit within the Buffered Valley Bottom Aquifer BVBA and Upland Aquifer UA:
   a. Gasoline service stations;
   b. Major Oil Storage Facilities;
   c. Junkyards and automobile cemeteries.
   d. Salt storage facilities.
   e. Conditionally Exempt, Small Quantity, or Large Quantity Generators of Hazardous Waste.
   f. Disposal of any hazardous waste, as defined in 6 NYCRR Part 371, by burial.
   g. Land application of septage, sludge, or human excreta, including land application facilities defined in 6 NYCRR Part 360-4.
   h. Cemeteries, including pet cemeteries
   i. Veterinary hospitals and offices
   j. Funeral parlors.
   k. Storage or disposal of manure, fertilizers, pesticides/herbicides. No special permit shall be required for storage of less than 500 pounds or where such storage or disposal is conducted in connection with a farm operation that is covered by the exemptions in Section 121-37E.
3. Application Requirements: In addition to the Special Permit application requirements set forth in Article IX, applicants proposing actions listed in subsections (1) and (2) above that are located within the Aquifer Overlay AQO District shall identify the following as part of their applications:
   a. The source of water to be used;
   b. The quantity of water required;
   c. Water use minimization measures to be implemented;
   d. Water recycling measures to be implemented;
   e. Wastewater discharge measures;
   f. Grading and/or storm water control measures to enhance on-site recharge of surface water;

g. Point Source or Non-Point Discharges;

h. A complete list of any Hazardous Substances to be used on site along with quantity to be used and stored on site; and

i. A description of Hazardous Substance storage or handling facilities and procedures.

4. Special Conditions for proposed uses within the Priority Valley Bottom Aquifer PVBA and Upland Wellhead Protection UWP areas requiring a Special Permit:

   a. Storage of chloride salts is prohibited except in structures designed to minimize contact with precipitation and constructed on low permeability pads designed to control seepage and runoff.

   b. Generators of Hazardous Waste shall provide the Town with copies of all applicable permits provided by State and/or Federal regulators and copies of all annual, incident, and remediation-related reports.

   c. Any projects where Water Consumption exceeds the Natural Recharge, as defined in Subsections F and G herein, shall demonstrate through SEQRA how such impact will be mitigated through, for example, compensatory recharge equal to the identified recharge deficit through a combination of artificial on-site or off-site recharge, or provision of compensatory natural recharge areas elsewhere in the Town.

5. Special Conditions for proposed uses within the Buffered Valley Bottom Aquifer BVBA areas and the Upland Aquifer UA areas requiring a Special Permit:

   a. Gasoline service station operators shall provide the Town with copies of all applicable permits provided by State and/or Federal regulators and copies of all annual, incident, and remediation-related reports.

   b. Junkyard operators shall drain fuels, lubricants, and coolants from all cars stored on site to properly permitted above-ground holding tanks, provide to the Town copies of all applicable permits provided by State and/or Federal regulators and copies of all annual and incident reports, provide the Town with an annual summary of numbers of vehicles on site and total gallons of various classes of fluids drained from vehicles and disposal manifests or other documentation of disposition of such fluids.

   c. Storage of chloride salts is prohibited except in structures designed to minimize contact with precipitation and constructed on low permeability pads designed to control seepage and runoff.

   d. Storage of coal and/or cinders is prohibited except in structures designed to minimize contact with precipitation and constructed on low permeability pads designed to control seepage and runoff.

   e. Generators of Hazardous Waste shall provide the Town with copies of all applicable permits provided by State and Federal regulators and copies of all annual, incident, and remediation-related reports.

   f. Any projects where Water Consumption exceeds the Natural Recharge, as defined in subsections F and G herein, shall demonstrate through SEQRA how such impact will be mitigated through, for example, compensatory recharge equal to the identified recharge deficit through a combination of artificial on-site or off-site recharge, or provision of compensatory natural recharge areas elsewhere in the Town .

6. Prohibited uses within the Priority Valley Bottom Aquifer District PVBA and Upland Wellhead Protection UWP areas:

   a. Municipal, private and C&D landfills as defined in 6 NYCRR Part 360-2 and 6 NYCRR Part 360-7.

   b. Land application of septage, sludge, or human excreta, including land application facilities as defined in 6 NYCRR Part 360-4.

   c. Disposal, by burial, of any hazardous waste, as defined in 6 NYCRR Part 371

   d. Large Quantity Generators of Hazardous Waste.

   e. Gas stations and Major Oil Storage Facilities.

   f. On-site dry cleaning.

   g. Junkyards and Junked car lots.

7. Prohibited uses within the Buffered Valley Bottom Aquifer BVBA and Upland Aquifer UA: Land application of septage, sludge, or human excreta, including land application facilities defined in 6 NYCRR Part 360-4.3.

8. General Non-Degradation Standard: No special permit shall be granted unless the applicant can show that the proposed action will not degrade the quality of the groundwater in a manner that poses a potential danger to public health or safety. Compliance with applicable standards, requirements, and permit conditions imposed by federal, state, or county agencies shall be deemed to constitute compliance with this standard.

F. Determination of a Parcel's Natural Recharge
The natural recharge rate for a parcel shall be determined by identifying the soil types on the property, classifying them by hydrologic soil groups (A through D, A/D and C/D), and applying a recharge rate of 20.2 inches/year for A and A/D soils, 14.7 inches/year for B soils, 7.6 inches/year for C and C/D soils, and 4.2 inches/year for D soils, and multiplying the recharge rate(s) by the number of acres in the parcel for each soil group.

G. Consumption of Water
Water consumption is the net loss of liquid phase water through site activities, plus the water needed to dilute wastewater and other discharges to a concentration equal to 50% of the NYS Title 6 Part 703 Groundwater Standard.

The following table establishes the method to calculate water consumption:

Use	Gallons per day	Multiplied by Dilution factor	Consumption/day
Irrigated Lands (non-agricultural)	Irrigated Acres x 4,000[1]	x 1	= ________
Uses with Surface Water Discharge	Site activity use x 0.2	x 1	= ________
Residential Uses with Subsurface Water Discharge[2]	70 gpd/capita	x 6	= ________
Nonresidential Uses with Subsurface Water Discharge[2]	Daily Use	x 6	= ________

(1) Applicable for vegetation requiring 1 inch/week irrigation. May be adjusted for vegetation with other water requirements.
(2) Calculate use per NYSDEC intermediate wastewater disposal guide. Discharge must not exceed NYSDEC Title 10, Part 703 effluent limits.

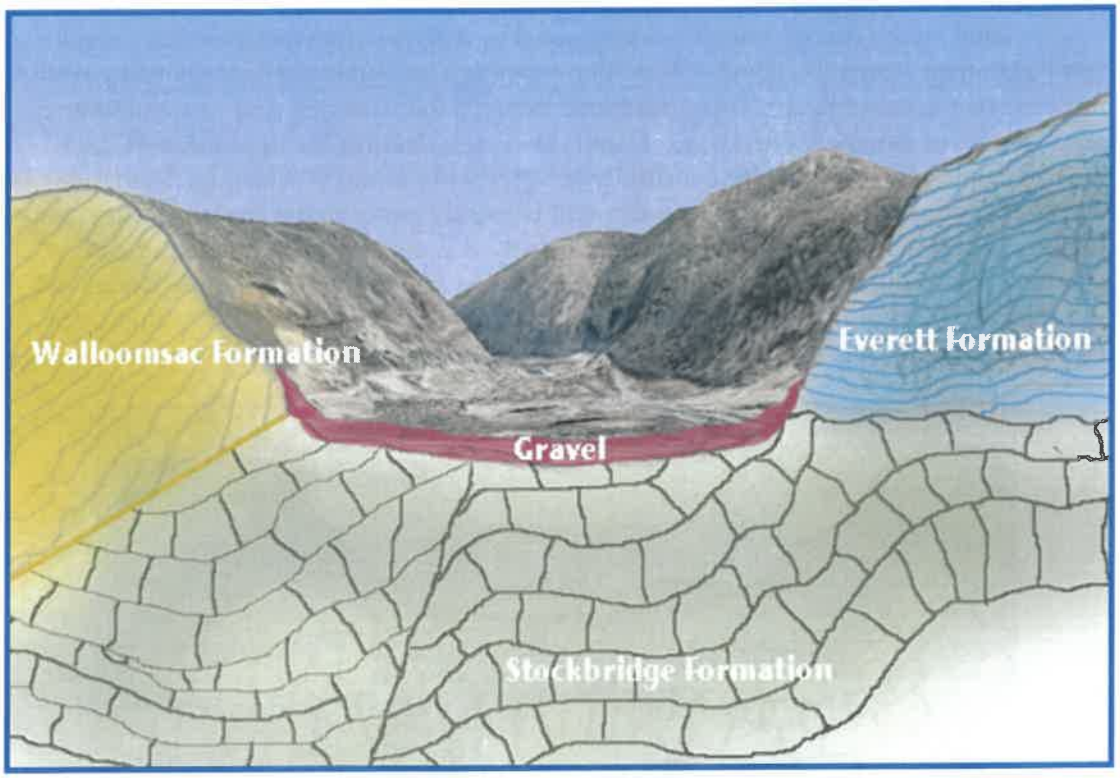
H. Map Changes
1. New Buffered Valley Bottom Aquifer BVBA and expanded Buffered Valley Bottom Aquifer BVBA areas may be established by the Town's Hydrogeologist at the request of the Town, or proposed to the Town by groups of site owners where a new Community Water System source regulated by the NYS Department of Health is proposed, and where the Town's Hydrogeologist concludes or agrees that the water source for the Community Water System and any private wells within or hydraulically downgradient from the new or expanded Buffered Valley Bottom Aquifer BVBA would not be threatened by a Pollutant Discharge originating anywhere within the Buffered Valley Bottom Aquifer BVBA.
2. New Buffered Valley Bottom Aquifer BVBA shall be regional in nature and no single project, or single parcel Buffered Valley Bottom Aquifer BVBA may be proposed.
3. New Upland Wellhead Protection UWP areas, or expanded Upland Wellhead Protection UWP areas, must be defined for the water sources for any existing and future proposed Community Water Systems within the Upland Aquifer UA by their owners, and must be reviewed and approved by the Town's hydrogeologist.
4. The Aquifer Overlay District Map may be modified to reflect new or more accurate geological or hydrological information, provided that the Town's hydrogeologist reviews and approves any such modification.
5. Any new areas or revisions of boundaries made pursuant to this Subsection H shall be placed on the Aquifer Overlay District Map pursuant to the zoning map amendment process in Article X.

I. Reporting of Discharges
Any person or organization responsible for any discharge of a Hazardous Substance, Solid Waste, Hazardous Waste, petroleum product, or radioactive material shall notify the Town Clerk of such discharge within 24 hours of

the time of discovery of the discharge. This notification does not alter other applicable reporting requirements under existing law and applies to all uses, whether conforming or non-conforming in any respect.

J. Non-conforming Uses, Structures, and Lots
See Article VI of this Chapter. For any non-conformity which requires a special permit to expand or change, all requirements of this § 121-15 shall apply to such expansion or change.

Mineral Resources In Amenia



Generalized geologic cross-section looking south between Amenia and Wassaic. Vertical exaggeration is three times.

Amenia CAC Open Space Inventory, May 2007, by D. Reagon

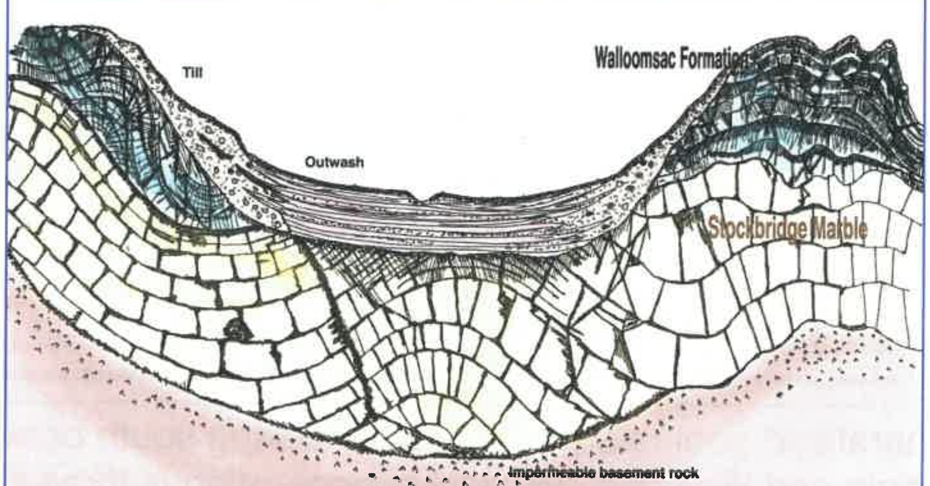
Mineral Resources in Amenia

The Rocks

Mineral resources in Amenia are, of course, intimately related to the long geologic history of the region.

The oldest rock, over a billion years old, is found in the area of Bog Hollow, and East Mountain. It is composed of hard granitic gneiss, which is resistant to erosion and tends to form steep ridges.

Most of the rest of Amenia is dominated by a series of metasedimentary rocks that began their formation about 450 million years ago in a wide shallow sea that covered most of what is now eastern North America. Imagine the Bahamas and you will have a good picture of Amenia at that time. Conditions were ideal for the deposition of thick layers of limestone, which now constitute the locally important Stockbridge formation. The Stockbridge is fairly soft and soluble and is found mainly in the Harlem Valley, the Oblong Valley, and the Smithfield Valley. Mostly it is covered with thick sand and gravel deposits although outcrops occur in South Amenia, along the Tenmile River, and the Harlem Valley Rail Trail. Because it contains many fractures it is a very important source of groundwater for Amenia forming the "Valley Bottom Aquifer".



A very generalized cross-section of the Harlem Valley.

As time passed, colliding continents pushed up a mountain range along the eastern edge of this shallow sea and sediment eroding from this ancient range covered the limestone with sediment and formed the Walloomsac formation. The Walloomsac is composed of metamorphosed sedimentary rocks known as slate, schist, and gneiss, is resistant to erosion and forms the ridges to the east of Amenia including Rattlesnake Mountain. Ridges on the western side of Amenia are composed of the Everett formation, another series of metamorphic rocks very similar to the Walloomsac. These rocks form the scenic "backbone" of Amenia and produce smaller amounts of groundwater than the Stockbridge rocks do. They are still important, forming what is known as the "Upland Aquifer".

Eventually, as continents split and collided over the immensity of geologic time, the aforementioned rock formations were buried deeply, their components were altered by great heat and pressure, they were folded, fractured, and faulted, and eventually exposed at the surface after hundreds of millions of years of erosion.

The Ice Age

About two million years ago a period of time known to geologists as the Pleistocene Ice Age began. The climate cooled and four great ice sheets advanced and retreated across northern North America. Glacial ice, over a mile thick, covered the entire landscape and altered the bedrock by carving away the relatively soft Stockbridge marbles and creating ridges from the harder rocks. The Harlem Valley was formed during these ice advances. When the ice melted, it left enormous deposits of ground up rock known as till and stream sorted material known as outwash. The last glacial advance, known as the Wisconsin, ended locally about 15,000 years ago with a great melting that carved out steep ravines and left the area covered with thick deposits of sand and gravel. These deposits, which are mainly in the valley bottoms, are very important sources of groundwater as well as commercially important sources sand and gravel.

The soils in Amenia, some of which are very fertile, have formed from these glacial deposits. Soils of this type are known as transported soils because they are largely unrelated to the deeply buried bedrock on which soils in unglaciated areas generally form.

Mineral Resources

As in most towns in this part of New York and adjacent New England, mining has historically been important. Iron mining and smelting was a dominant industry locally from the late 1700's into the late 1800's before more economical sources of iron ore and the fuel to process it with the latest technologies were developed in other parts of the United States. The ruins of several iron works and flooded open-pit mines still dot the countryside if a person knows where to look. Important sites were located in Wassaic, Sharon Station, Amenia Union, and Amenia.

As romantic as it may appear today, the iron industry, while creating large numbers of jobs and providing important products, had major detrimental environmental effects. Entire forests were cut to produce charcoal for furnaces resulting in enormous unchecked erosion on the steep denuded hillsides. Air pollution was a serious problem and quarrying was unregulated. No reclamation was ever undertaken; mines were simply abandoned and allowed to fill with groundwater.

Recent mineral extraction has been in the form of surface mining of sand and gravel. Currently (May, 2007), there are four operating mines in Amenia. Three are concentrated in South Amenia with another in Wassaic. The South Amenia mines are in the process of mining beneath the water table, a controversial method of extending the life of a mine without expanding its aerial extent.

Large amounts of unmined gravel remain in Amenia. These deposits are in areas where zoning, social, and economic pressures may limit their utilization. The new Comprehensive Plan and its zoning will somewhat limit mining to a Soil Mining Overlay District.

Mining and its effects have never been very popular with the neighbors. Among the detrimental environmental effects of mining include dust, noise, truck traffic, groundwater impact, soil destruction, loss of agricultural land, loss of wildlife habitat, and enormous visual impact.

Gravel mining in South Amenia, May 2007.

Besides surficial sand and gravel deposits, there is obviously a lot of rock in Amenia that could be mined. There have been two serious quarrying proposals in Amenia over the past twenty years. One, a proposal to mine 20 million tons of rock in South Amenia, was the focus of a bitter, protracted, and expensive struggle between the proposed mine operator and neighboring residents. At this writing, that particular quarry proposal may have been made moot by the sale of the land it was proposed for.

Another type of rock removal, taking surface rocks for landscape use, has become a recent development in Amenia. As of May 2007, only two such mines are operating and the new zoning rules will regulate this activity.

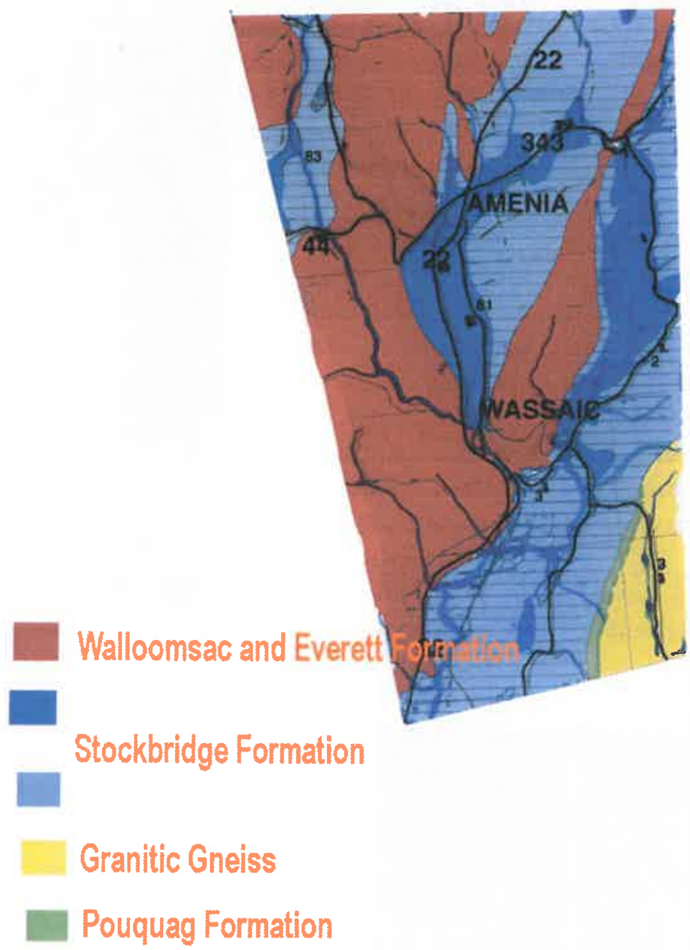
Amenia has a long and continuing history of using its mineral resources. Some areas of Town have been burdened with this more than others, particularly South Amenia. Reclamation, while part of the mining process is still largely incomplete and many problems remain.

The most important mineral resource in Town, although strictly speaking it is not a mineral, is groundwater, which is covered in another section of this report.

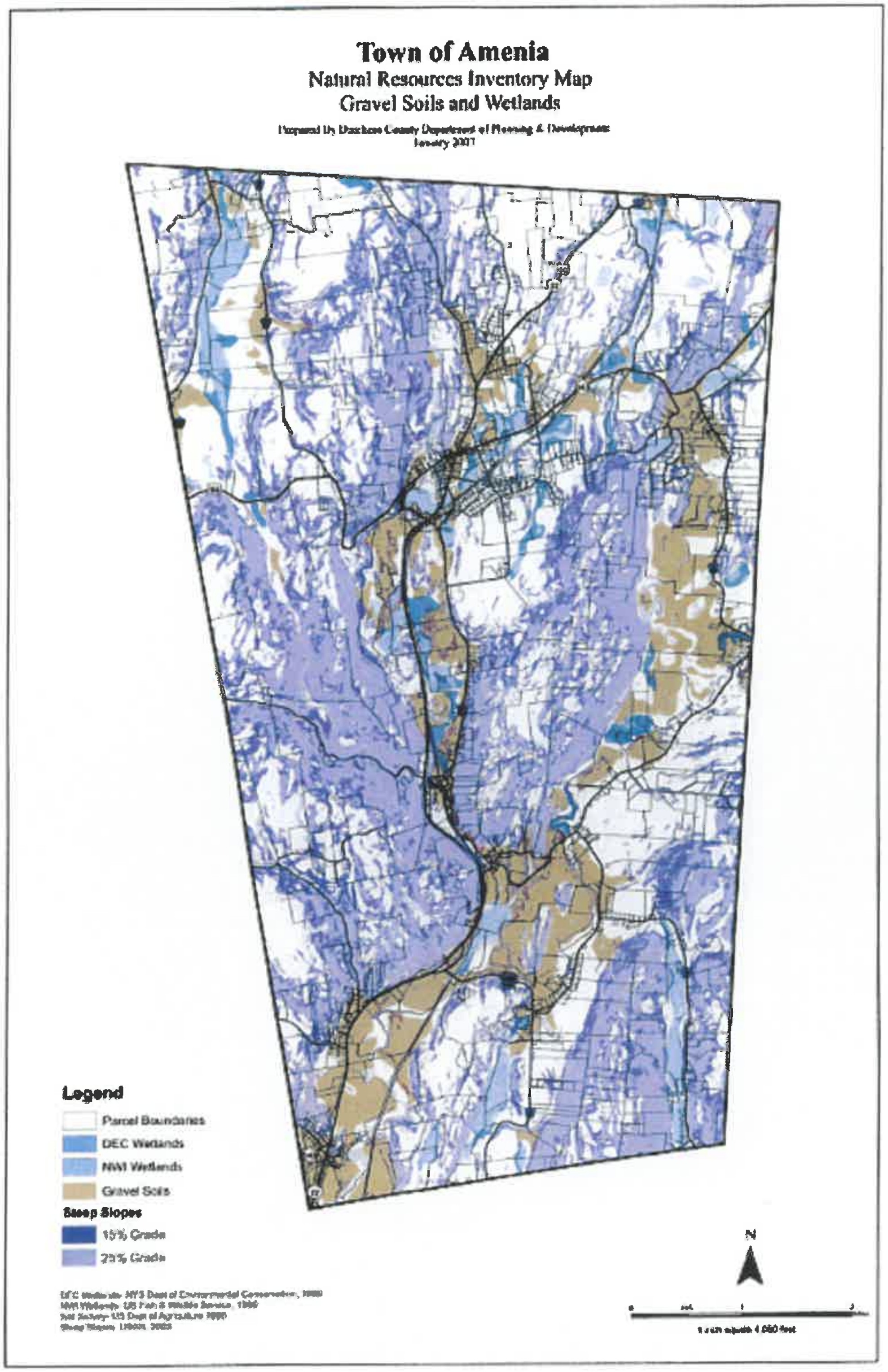
Walloomsac Formation, Wassaic

Stockbridge Formation, South Amenia

GENERALIZED GEOLOGIC MAP OF AMENIA, NEW YORK



After Fisher 1961


Town of Amenia
Natural Resources Inventory Map
Gravel Soils and Wetlands
Legend
Parcel Boundaries
DEC Wetlands
NWI Wetlands
Gravel Soils
Steep Slopes
15% Grade
25% Grade
N

Natural Habitats in Amenia

This is a very simplified introduction to habitats in Amenia and is based on work done in 1988 by Hudsonia in Dover Plains, which is very similar to Amenia in terms of topography and natural settings. A complete biodiversity survey of Amenia should be undertaken in the near future so that the Town has a baseline of its unique and important natural areas and the life within those areas.

Natural habitats in the context of an area that has been settled by Europeans since at least 1703 are determined largely by topography, stream drainage, bedrock type, bedrock structure, soils, micro-climates, and, of significant importance, land use history and human population centers.

There is very little land, if any, in Amenia that has escaped human influence. The landscape and natural features that define the Town today have been, and continue to be, in a constant state of change. The forests that cover much of Amenia were denuded during the iron mining period and early periods of agriculture replaced forest with fields. Fields have been replaced by forest as agriculture has diminished in recent years. Streams change their courses altering and enlarging flood plains and valleys carrying away soil in the process. Plant communities that appear stable and unchanging prove to be just temporary associations subject to fire, disease, and alien species. The only constant in the natural community is change.

Erik Kiviat of Hudsonia defined several significant habitats in the Harlem Valley in his 1988 study of the Town of Dover. The following discussion mostly derives from that study.

The two main natural areas in Amenia, defined by the topography, are mountain habitats and valley habitats.

Mountain Habitats consist of the following areas:

Acidic bogs and swamps
Intermittent woodland pools
Ponds and lakes
High-gradient streams and ravines
Cliff, ledge, talus, slab, and crest
Old growth forest
Extensive forest

Valley Habitats consist of the following areas:

Marble hills
Fens
Cattail marsh
Potential Bog and Blanding's turtle habitat
Intermittent pools
Ponds and lakes
Low-gradient streams and extensive floodplains
Sand plains
Forest
Farmland

A discussion of all these areas is beyond the scope of this presentation. However, because of their importance, the following habitats will be discussed.

Forested Lands

According to the Town's Master Plan, about 9,000 acres of Amenia is covered with forest consisting of a mix of hardwood and coniferous species. Most of this forest is second or third growth and covers the highland and steep slope sections of Town including East Mountain, Bog Hollow, Rattlesnake Mountain, and the entire system of ridges that border the western edge of Town including Tower Hill, Deep Hollow, Butts Hollow, Turkey Holllow, and Cascade road. Because of the steep slopes that exist in all of these areas, development is sparse and scattered.

This extensive tract of forest although fragmented by roads, a railroad, farmland, and towns is a vital part of the watershed area within the Town and should be protected against both over development and over logging. It also is an irreplaceable scenic resource, prime recreation land, as well as valuable wildlife habitat.

Adopting a series of local laws that would regulate logging, protect watersheds, protect ridgelines, and preserve wildlife areas should protect forested lands. The Master Plan has specific recommendations for the protection of Amenia's forested lands.

The Master Plan has a very complete discussion and description of significant areas within Amenia and very detailed recommendations for protecting this resource. Policy makers and planners should consult it.

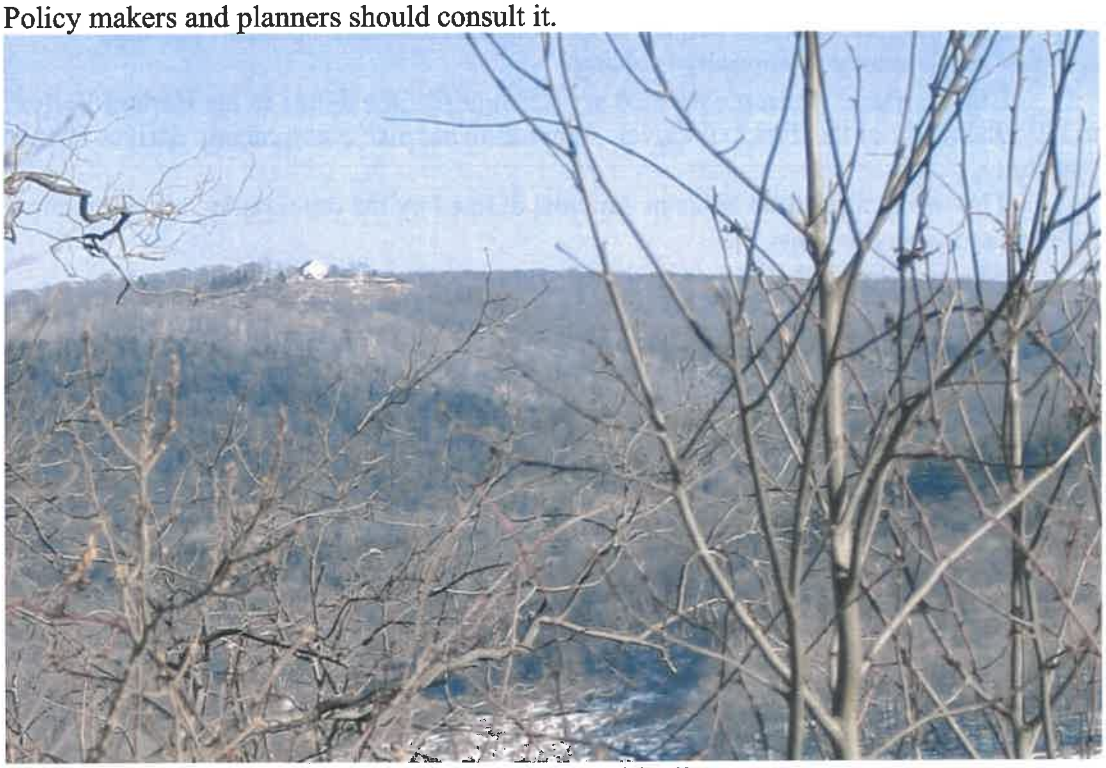
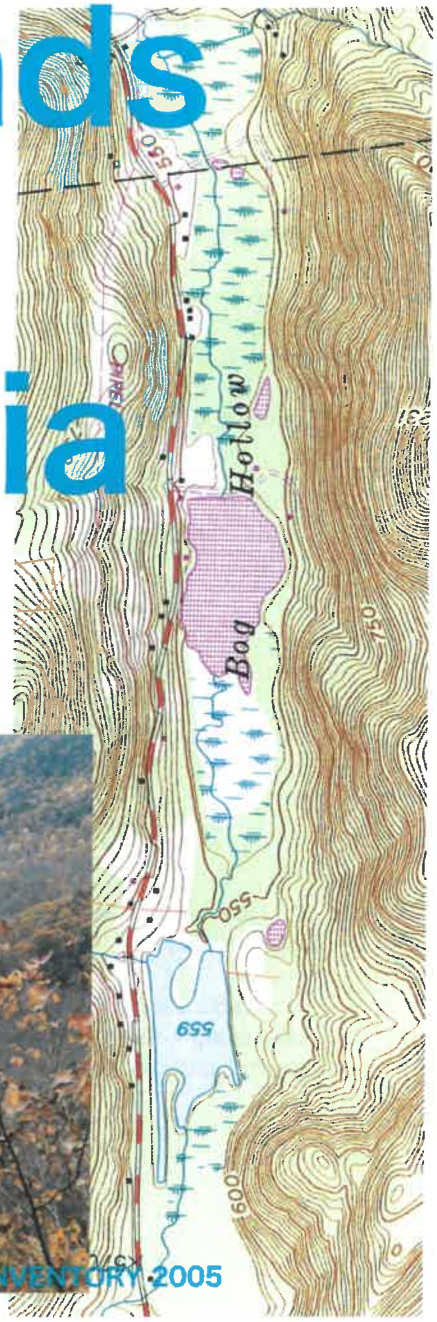


Fig. 1. Showing the effect of building on ridgeline.

Wetlands of Amenia



AMENIA CAC NATURAL RESOURCE INVENTORY 2005

Wetlands in Amenia

What is a Wetland?

Swamps, bogs, marshes, and meadows are commonly referred to as "wetlands". Most wetlands share a single characteristic of having soil or substrate that is at least periodically saturated or covered by water.

The Freshwater Wetland Act of 1975 uses "indicator plants" to identify freshwater wetlands. The law defines wetlands as:

a. Lands and submerged lands commonly called marshes, swamps, sloughs, bogs, and flats supporting aquatic or semi-aquatic vegetation.

b. Lands and submerged lands containing remnants of any vegetation that is not aquatic or semi-aquatic that has died because of wet conditions over a long period, provided that such wet conditions do not exceed a maximum seasonal water depth of six feet and provided further such can be expected to persist indefinitely, barring human intervention.

c. Lands and waters substantially enclosed by aquatic vegetation or dead vegetation as described in b.

In Dutchess County, there exists a list of "official wetland" indicator plants as shown in Table 1.

Table 2 is a classification scheme used in Dutchess County in an attempt to neatly group wetlands into separate types. In reality, many wetlands have characteristics that overlap and are not easily classified.

Wetland Boundaries

Since wetlands are defined by soils and vegetation, locating the boundary of a wetland is a lot more difficult than just finding that point or line where your feet stop getting wet. The actual boundary includes the place where the vegetation in Table 1 stops plus a 100 foot "buffer zone". Wetlands are not permanent features and they change over time. So, even though maps exist of wetlands, the real boundaries have to be determined in the field by qualified experts. DEC will, upon request, "flag" or mark the limits of a wetland.

Wetland Regulation

The Freshwater Wetlands Act (FWA) passed by the New York State Legislature in 1975 requires that a permit be obtained before altering a wetland of 12.4 acres (5 hectares). Local governments were given the option of being the regulating body and were also given the option of regulating wetlands smaller than 12.4 acres. The FWA is a lengthy document and covers many aspects of wetlands including recognition, definition, and regulation. The law clearly spells out the benefits of wetlands to the public and the need to protect and preserve those benefits.

Why are Wetlands Important?

Wetlands have several valuable functions including the following:

1. Flood, erosion, and storm control
2. Sediment and pollution control
3. Water discharge and recharge
4. Nutrient source and food production
5. Wildlife habitat
6. Recreation
7. Education and scientific study
8. Open space and aesthetics

For a much more detailed explanation and description of wetlands, refer to the document "Freshwater Wetlands of Dutchess County, Part 1, Inventory and Guide for Local Governmental Officials". This is an excellent and definitive guide to managing wetlands.

The Wetlands of Amenia

Amenia has 28 regulated wetlands of 12.4 acres or above totaling 1350 acres and amounting to 5.1% of the Town's area. In addition, there are 7 wetlands between 5 and 12.4 acres totaling 51 acres, and 102 of 5 acres or less totaling 146 acres. Altogether, this amounts to 137 wetlands, 1547 acres, and **5.9%** of the Town's area. Only the wetlands above 12.4 acres are presently protected and regulated by the State. Smaller wetlands come under the aegis of the U.S. Army Corps of Engineers. The totals stated above are only approximate because wetlands are constantly changing.

The Amenia CAC has the following wetland maps and information:

1. "Streams, Water Bodies, and Wetlands" of Amenia, 2004, scale :2 inches = 1 mile. This map is part of a larger set that includes a tax map overlay.
2. "Wetlands of Amenia" Based on USGS quads. Scale 1 inch equals 2,000 feet. Map is very battered and needs to be replaced.
3. Overlay of wetlands in Amenia. Based on USGS map. Old and outdated but still useful.
4. A detailed field study of most of the regulated wetlands in Amenia. This is a very detailed study done by wetland experts for the DEC in the late 70's. It needs to be updated.
5. "Freshwater Wetlands of Dutchess County, Part 1, Inventory and Guide for Local Government Officials". Very useful guide and information source. All you need to know about wetlands, their value, and their regulation.

Recommendations

Because of development pressures that are already threatening the health and existence of wetlands of all sizes in Amenia the CAC srongly recommends that the Town adapt a local ordinance for wetland, waterbody, and water course protection. The CAC has models for such an ordinance.

TABLE 1

Plants which are used as indicators in determining freshwater wetlands in New York State

(Adapted from Article 24 Freshwater Wetlands Act.)

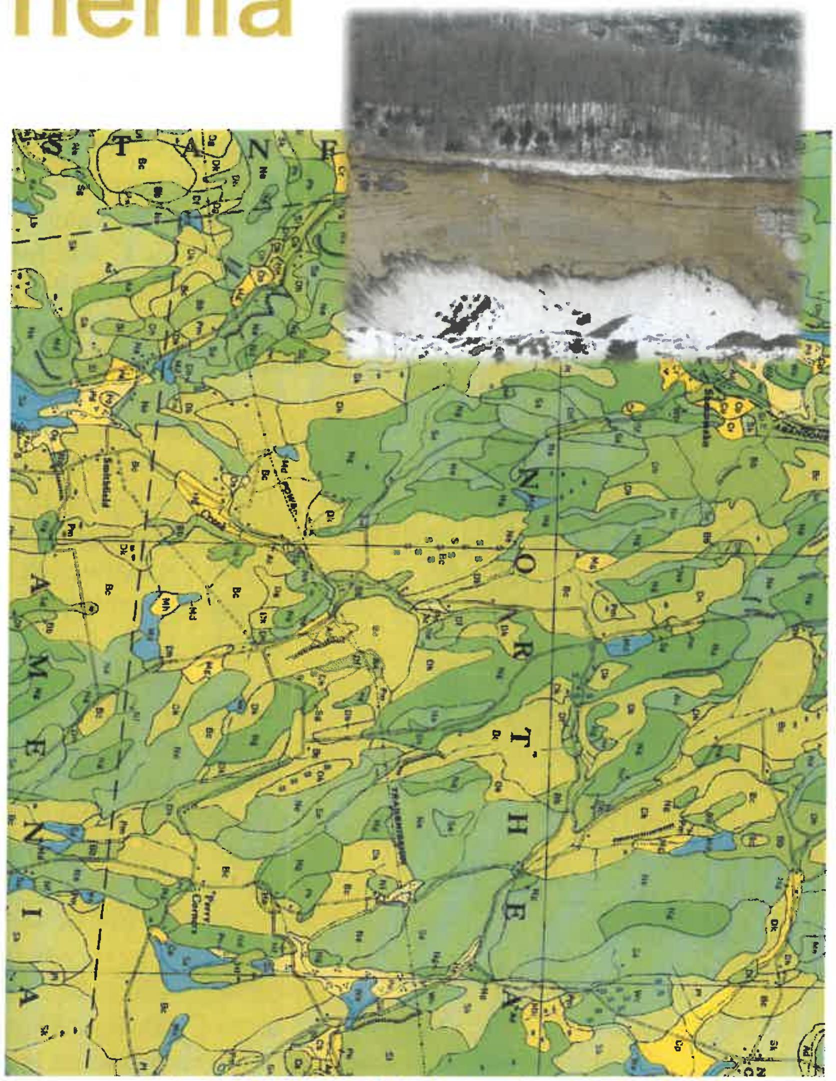
Vegetative Covertype	Description	Common Name	Botanical Name
1. Wetland Trees	Depends upon seasonal or permanent flooding or sufficiently water-logged soils to give them a competitive advantage over other trees	Red Maple Willows Black Spruce Swamp White Oak Red Ash American Elm Larch Black Ash Silver Maple	*Acer rubum* *Salix* spp. *Picea mariana* *Quercus bicolor* *Fraxinus pennsylvania* *Ulmus americana* *Larix laricina* *Fraxinus nigra* *acer saccharinum*
2. Wetland Shrubs	Depends upon seasonal or permanent flooding or sufficiently water-logged soils to give them a competitive advantage over other shrubs	Alder Buttonbush Bog Rosemary Leatherleaf Dogwoods	*Alnum* spp. *Cephalanthus occidentalis* *Andromeda glaucophylla* *Chamaedaphne calyculata* *Cornus* spp.
3. Emergent Vegetation	Areas of herbaceous plants growing in standing water or water-logged soils	Cattails Pickerelweed Bulrushes Arrow Arum Arrowheads Reed Wildrice Bur-reeds Purple Loosestrife Swamp Loosestrife Water Plantain	*Typha* spp. *Pondtedria cordata* *Scirpus* spp. *Peltandra virginica* *Sagittaria* spp. *Pharagmites communis* *Zizania aquatica* *Sparganium* spp. *Lythrum salicaria* *Decodon verticillatus* *Alisma plantago-aquatica*
4. Rooted, Floating-Leaved Vegetation	Vegetation in open water which is rooted, having vegetative portions floating	Water-lily Water-shield Spatterdock	*Nymphaea odorata* *Brasenia schreberi* *Nuphar* spp.
5. Free Floating Vegetation	Vegetation in open water which is free floating	Duckweek Big Duckweed Watermeal	*Lemna* spp. *Spirodela polyrhiza* *Wolffia* spp.
6. Wet Meadow Vegetation	Depends upon seasonal or permanent flooding or sufficiently water-logged soils to give it a competitive advantage over other open land vegetation	Sedges Rushes Cattails Rice Cut-grass Reed Canary Grass Swamp Loosestrife Spikerush	*Carex* spp. *Juncus* spp. *Typha* spp. *Leersia oryziodes* *Phalaris arundinacea* *Decodon verticillatus* *Eleocharis* spp.
7. Bog Mat Vegetation	Refers to floating mats of vegetation found in bogs	Sphagnum Mosses Bog Rosemary Leatherleaf Pitcher Plant Cranberries	*Sphagnum* spp. *Andromeda glaucophylla* *Chamaedaphne calyculata* *Sarracenia purpurea* *Vaccinium macrocarpon* and *V. oxycoccos*
8. Submergent Vegetation	Those plants that normally grow beneath the surface of the water	Pondweeds Naiads Bladderworts Wild Celery Coontail Water Milfoils	*Potamogeton* spp. *Najas* spp. *Ultricularia* spp. *Vallisneria americana* *Ceratophyllum demersum* *Myriophyllum* spp.

TABLE 2

A Classification of Dutchess County Wetlands

Wooded Swamp	saturated soil which may be covered with up to one foot of water. Dominant vegetation over fifteen feet high - most common wetland plants - red maple, elm, ash, and swamp white oak.
Shrub Swamp	saturated soil which may be covered with up to one foot of water - vegetation under fifteen feet - willow, dogwoods, alders, are the most common shrubs.
Marsh	saturated soil most often covered with water up to three feet. Dominant vegetation - herbaceous - cattails, arrow arum, arrowheads, bulrush, reed, pickerelweed, wild rice, purple loosestrife. Most significant waterfowl production areas.
Meadow	soil is saturated to within a few inches and without standing water during the growing season (depending on rainfall may be dry enough to be used for agriculture during the growing season) grasses, sedges and rushes.
Bogs	spongy saturated soil usually deep (spongy nature of soil is due to decomposed and living moss) sphagnum mosses, pitcher plant, leather leaf, cranberries, bog rosemary.
Open Water	water less than ten feet deep which is bordered by emergent vegetation (marsh type) - floating vegetation includes duckweed, water lily, water shield and water meal. Submerged vegetation - pondweeds, naiads, wild celery, muskgrass, coontails. Open water is important area for waterfowl production.
Wet Areas of Dead Vegetation	dead trees and shrubs are predominant - vegetation that has died because of permanent increase in water level.

Soils in Amenia



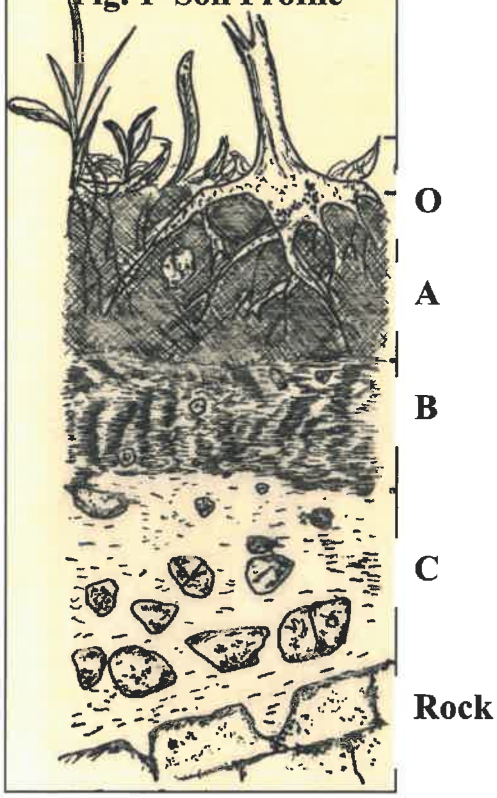
Amenia CAC Natural Resource Inventory 2005

Revised as part of an Open Space Inv.
May 2007 by David Reagon

Soils in Amenia

Philosophers argue over the definition of philosophy, biologists can't agree on the definition of life, and soil scientists have many definitions of soil. Most people, however, recognize soil when they see it (and dirt when they hear it). Generally, soil is defined as the weathered outer layer of the Earth's crust formed by the interaction of climate and living organisms thus acting as a link between the inorganic and organic worlds. Soils serve dual roles as the foundation of life on the surface of the Earth and, for engineers, the solid basis for constructing roads, buildings, and other structures.

Fig. 1 Soil Profile



The interaction between inorganic rock and the biosphere can be easily illustrated by digging a hole from the surface until unweathered rock is encountered and examining the **soil profile** that is exposed.

In a simple soil profile, the topmost layer or **horizon** consists mainly of decomposing plant material and is known as the **O horizon**. Beneath the O horizon is the **A horizon** which is dark colored because it contains **humus,** the decomposed remains of organic material and weathered rock. In a mature soil, there will follow a **B horizon** made of weathered minerals and material dissolved from the overlying horizons and transported downward by water. The lowest horizon, the **C horizon,** is generally made of weathered bedrock that grades downward into unweathered **parent material,** which may be bedrock or transported material such as glacial till or outwash. Each horizon has distinct physical, chemical, and organic characteristics and they are distinguished by abrupt changes in color and texture. Figure 1 illustrates an idealized soil profile. In nature, they can differ greatly.

Factors involved in soil formation include type of parent material, climate, vegetation, organisms living in the soil, topography, and time. All six of these factors combine to form the 11 major soil orders recognized in the United States.

The rate of soil formation varies from slow to very slow. Estimates vary between 160 to 800 years to form one inch of soil depending on the interaction of the six variables involved. Soil is a renewable resource but not on a human time scale. Erosional soil losses due to agriculture alone are staggering. The world's most productive soils are being lost at the rate of 7 percent each decade, far faster than soil is formed.

In most of New York the parent material is not bedrock but is composed of glacially transported material, mainly till and outwash. At the end of the last glacial melting, about 15,000 years ago, thick deposits of weathered rock that were imbedded in the ice were deposited in a thick blanket over most of the bedrock in New York. Material deposited directly by melting ice consists of a large range of particle sizes from clay to large boulders is known as till. Material that was transported by meltwater from the ice is sorted by size and is known as outwash. Soils that have developed on this material are known as transported soils and may bear little or no resemblance to the bedrock, which they cover.

All of the soil in Amenia is transported soil except on the steep ridges where erosion has stripped the glacial deposits and quickly removes most new soil as it forms. The thickest and most productive soils are in the principal valleys of the Webatuck, Wassaic, and Tenmile River. These are formed primarily on thick outwash deposits. Steep slopes tend to have rocky, thin, and unproductive soils.

In Dutchess County soil is one of the most studied and documented natural resource. The Dutchess County Soil and Water Conservation District, located in Millbrook, New York, has published the Dutchess County Soil Survey, which is an exhaustive study of the county's soils including very detailed maps for each town and a complete description of each of the soils found. It is based on field studies and presented in map and narrative form. The maps, based on USGS quadrangles, show soil units as small as six acres. This report includes the maps for Amenia and the Soil Survey Users Guide. Virtually any question pertaining to soils in Amenia can be answered with these resources and a field survey.

Not surprisingly, considering its agricultural heritage, Amenia has some very highly rated soils. One soil group, the Stockbridge silt loam, is rated as prime farmland on the USDA scale, considered the best soils for important crops and a "2" on a scale of 1-10 for New York State Soil Groups. No soils in the County are rated higher. Several hundred acres of this soil are found in the Oblong Valley-South Amenia area of the Town. Two other prime rated soil groups, the Georgia silt and the Copake groups, occur in several hundred acre plots in the broad valleys east and west of Rattlesnake Ridge. These soils are a resource that cannot be replaced.

The valuable soils in Amenia are closely associated with underlying deposits of glacial outwash invariably found in the valley bottoms. On the ridges and steep slopes, the soils are thin, rocky, or nonexistent.

Besides rating the agricultural importance of soils in the County, the Soil Survey rates soils for their engineering qualities, that is their ability to support structures and roadways as well as their very important role in septic systems. If soils had been an important consideration when the center of Amenia was located, it surely would not be where it is today where the soils are incapable of supporting a functional septic system.

With the resources available from Dutchess County and the USDA, a farmer or builder can determine the qualities and limitations of soils on which they plan to farm or build.

Development on soils for agricultural and construction reasons may be limited because of several factors among them: depth to bedrock, permeability, hydric soils, and erosion and sedimentation.

Depth to bedrock is a determining factor when placing a septic system and digging a foundation for a house. The upland areas of Amenia have shallow soils that require substantial investments of time and money to build a house.

Permeability is the rate at which water can pass through soil. Septic systems need the correct degree of permeability to function, as do farmlands. Soils that are too permeable can allow pollutants to travel rapidly through the ground. Low permeable soils do not allow water to flow fast enough for septic systems to work. Generally, most of Amenia's permeable soils are in the lowland areas over sand and gravel deposits.

Hydric soils are water-saturated soils having low permeability and are not suited for building or septic systems. Hydric soils are present in wetlands.

Soils on steep slopes and soils that have had plant material stripped off are subject to erosion. Construction sites and road building activity without regard to erosion control are a potential major problem.

Figure 2
Soil Groups by Developmental Limitations
Town of Amenia

Limitation		Acres	Percent of Total
Slight	(0-15%)	6,305	25
Moderate	(16-25%)	1,137	4
Severe	(25%)	3,486	12
Excessive	(over 25%)	15,867	59
Total		26,795	100

Source: 1969 Master Plan, 1991 Master Plan

Figure 2 shows how little land in Amenia is available free of significant developmental restriction.

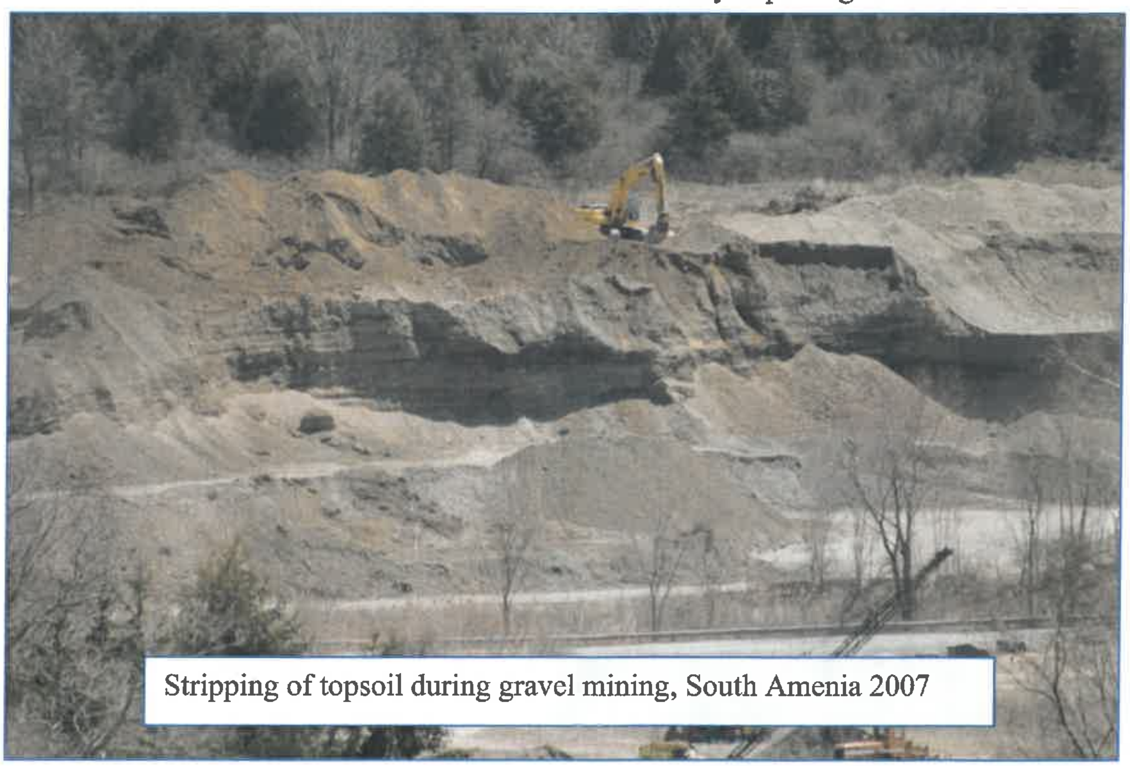
Threats and Problems

The most obvious roadblock in Amenia and other local area towns to preserving valuable, irreplaceable soils is simple economics. The land is becoming so valuable for development, particularly for subdivisions, that farming is in danger of becoming an economically unviable activity. This is a problem across the United States and will get worse in the future. People need a place to live and land to build on. One solution is to set aside the most valuable soils in land trusts. Another solution would have building codes take into consideration the value of the soils in a building proposal and regulate the land use on these parcels.

One of the first steps in opening a gravel mine is to strip the soil off the land. Some of this soil is sold and the rest is stored in berms or piles for use in later reclamation. Once soil is stripped it loses many of the qualities that made it valuable. Besides being compacted and losing its oxygen supply, the living organisms in the soil are diminished severely. When and if a mine is reclaimed, the amount of soil spread back over the mined land may not approach the original depth and quality of the original soil cover. The value of the land for agriculture will not be the same as it was before the land was mined. The unnaturally steep slopes of stored soil piles and berms also leads to increased erosion and loss of the stored soil.

Soil erosion is an inevitable process that human activities can speed up significantly. Besides loss of soil, this process results in siltation of water bodies and great damage to aquatic organisms. Steep slopes are most subject to soil loss due to erosion and agricultural practices for controlling erosion on steep slopes have been practiced for thousand of years, yet the losses continue. Crops that do not fully cover the ground surface, such as corn, allow more erosion than a grain crop that covers the ground surface more completely. Planting a crop such as winter rye instead of plowing a field after harvest can sharply cut down on off-season soil erosion. Local farmers have practiced these techniques and more for years.

Loss of soil fertility results from planting certain crops year after year eventually depriving the soil of nutrients and resulting in the application of expensive and potentially harmful chemical fertilizers. Crop rotation is a time-honored method of avoiding this problem and has been used locally for years. Increasingly, local land is rented



Stripping of topsoil during gravel mining, South Amenia 2007 and farmed intensively with one crop, such as sweet corn, for many years and crop rotation is not being practiced.

Application of pesticides and herbicides can damage the biota of a soil for years to come. Many of these substances are long-lived and may enter into stream water and ground water. Farmers wishing to raise certified organic crops may not be able to use otherwise valuable soils because of their residual chemical content. Golf courses also use large amounts of agricultural chemicals including potent fungicides on greens in an effort to establish a monoculture of grass.

During the "Iron Age" in Amenia and surrounding towns charcoal was the primary fuel for the many smelters in the area. Local forests were clear cut and converted to charcoal. As most of this forest was located, then as now, on steep land the resulting soil erosion was great. Since the demise of the local iron industry, forests have grown back on the steep ridges and also onto abandoned pastureland. Some estimates put the amount of land in forest now as greater than 200 years ago. Logging, especially clear cutting, can damage fragile upland soils by exposing them to erosion. Improperly constructed logging roads can also lead to major erosion and increase the possibility of flooding of lowland areas.

All terrain vehicles (ATVs) and other off-road vehicles are increasingly leaving their impact by compacting and eroding soil. This is especially obvious along the stream corridors and on logging roads in the woods.

Severe erosion occurring on an old logging road during heavy rainfall in April 2007.

2007 Comprehensive Plan Update and Revised Zoning Law

The proposed 2007 Comprehensive Plan and Zoning has new language that describes the importance of soils in Amenia and includes provisions for protecting this vital resource.

The Plan and Zoning must be consulted by anyone considering an action that may affect soils in Town.

One section of the new plan, the **Soil Mining Overlay District**, establishes important local controls over soil mining. Two other sections**, the Stream Corridor Overlay District**, and the **Floodplain Overlay District**, by prescribing what activities can take place in these areas will also enhance protection of soils.

New Supplementary Regulations that will protect and conserve soils include:

Article 121-32 Erosion and Sediment Control

Article 121-34 Excavation, Grading, Rock Removal, and Clearcutting

Article 121 -35 Wetland and Watercourse Protection

Article 121-36 Steep Slope Regulations

Article 121-37 Protection of Agriculture

Article 121-47 Timber Harvesting

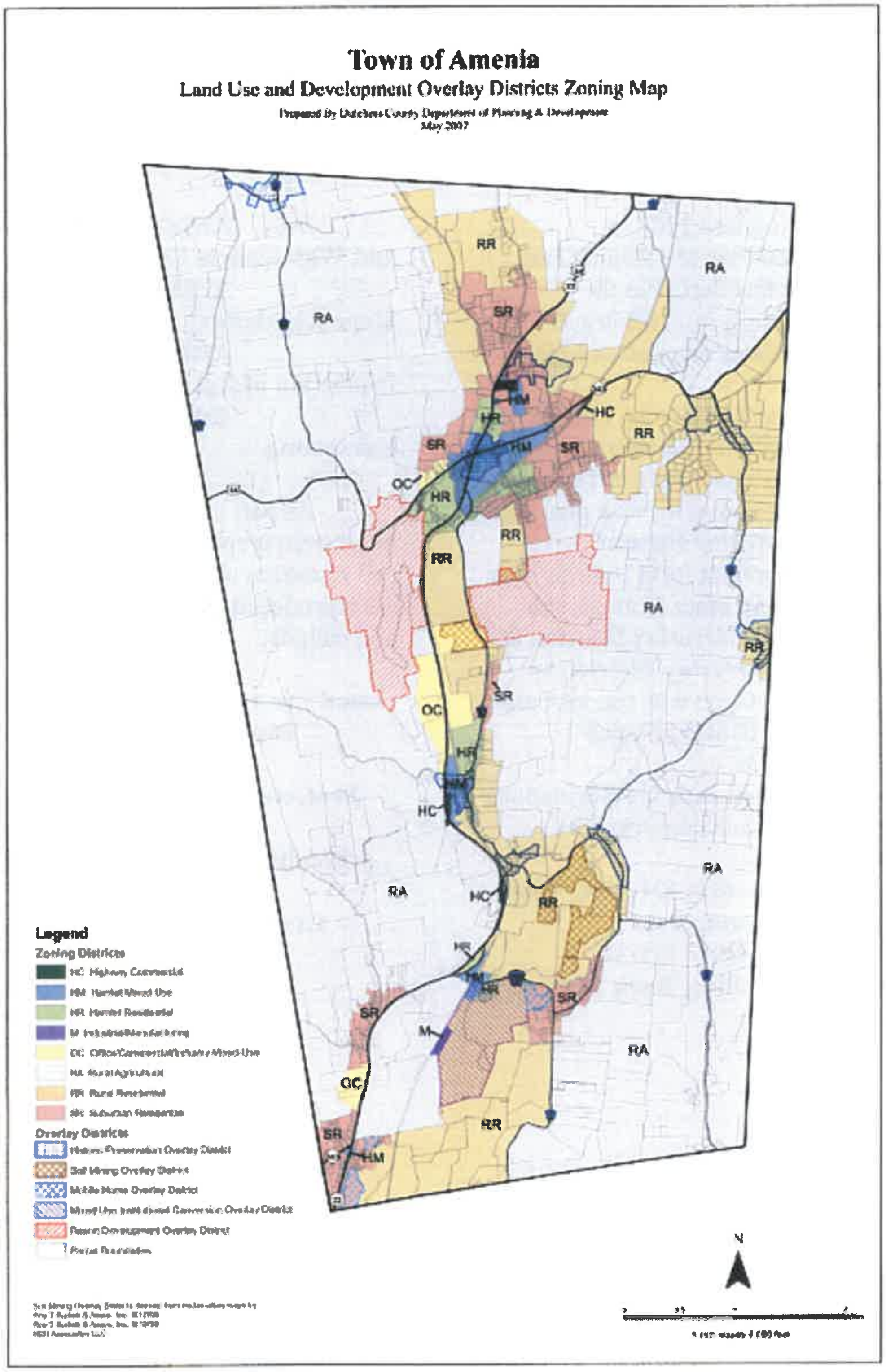
As part of the new plan, several maps were prepared that illustrate the soil resources of the Town. These maps are reproduced on the following pages and include:

Land Use and Development Overlay Districts Zoning Map

Protected Lands and Farm Soils

Agricultural Development Districts

Gravel Soils and Wetlands


Town of Amenia
Land Use and Development Overlay Districts Zoning Map
Legend
Zoning Districts
Overlay Districts
RR
RA
SR
HM
HR
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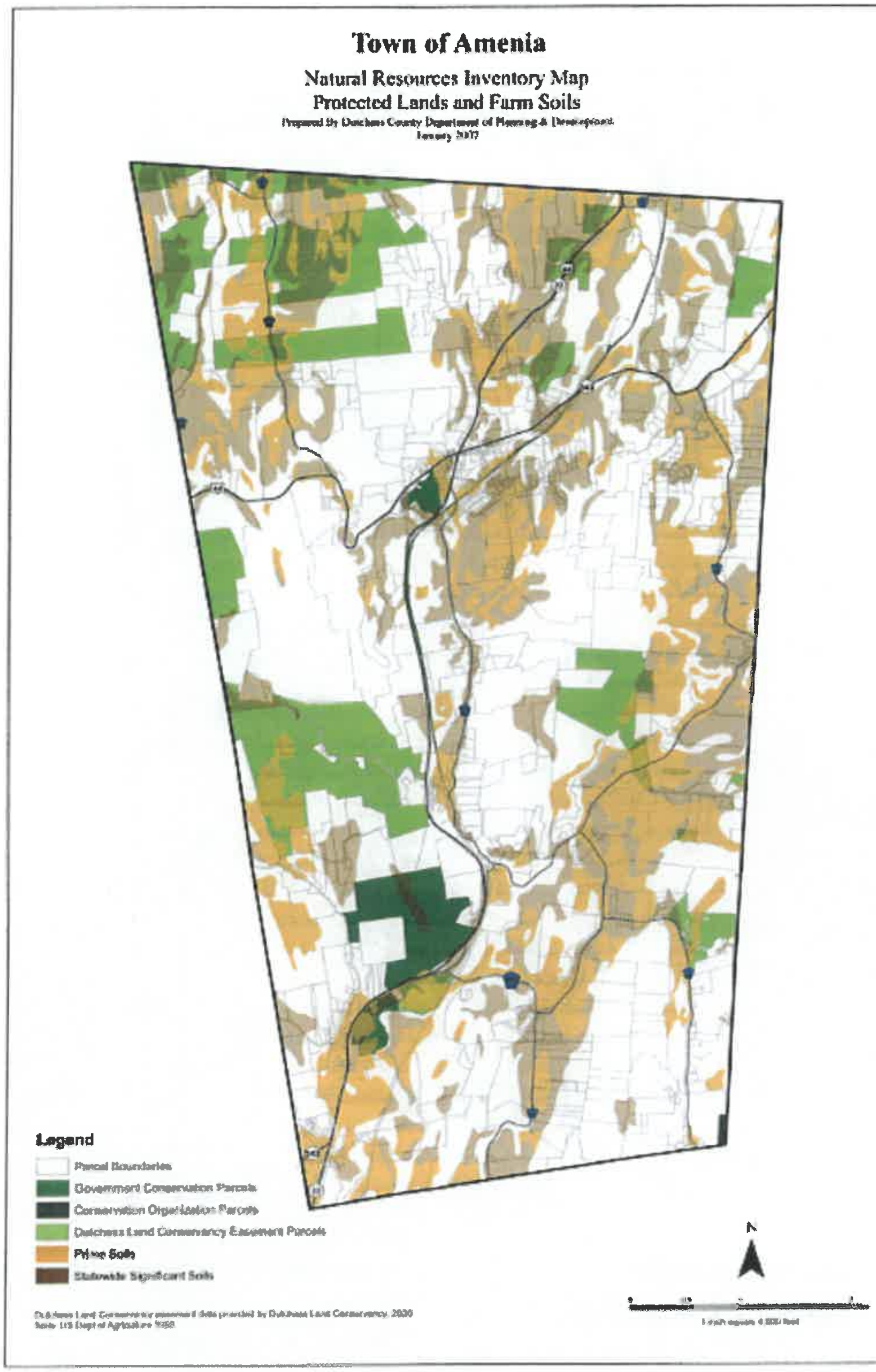
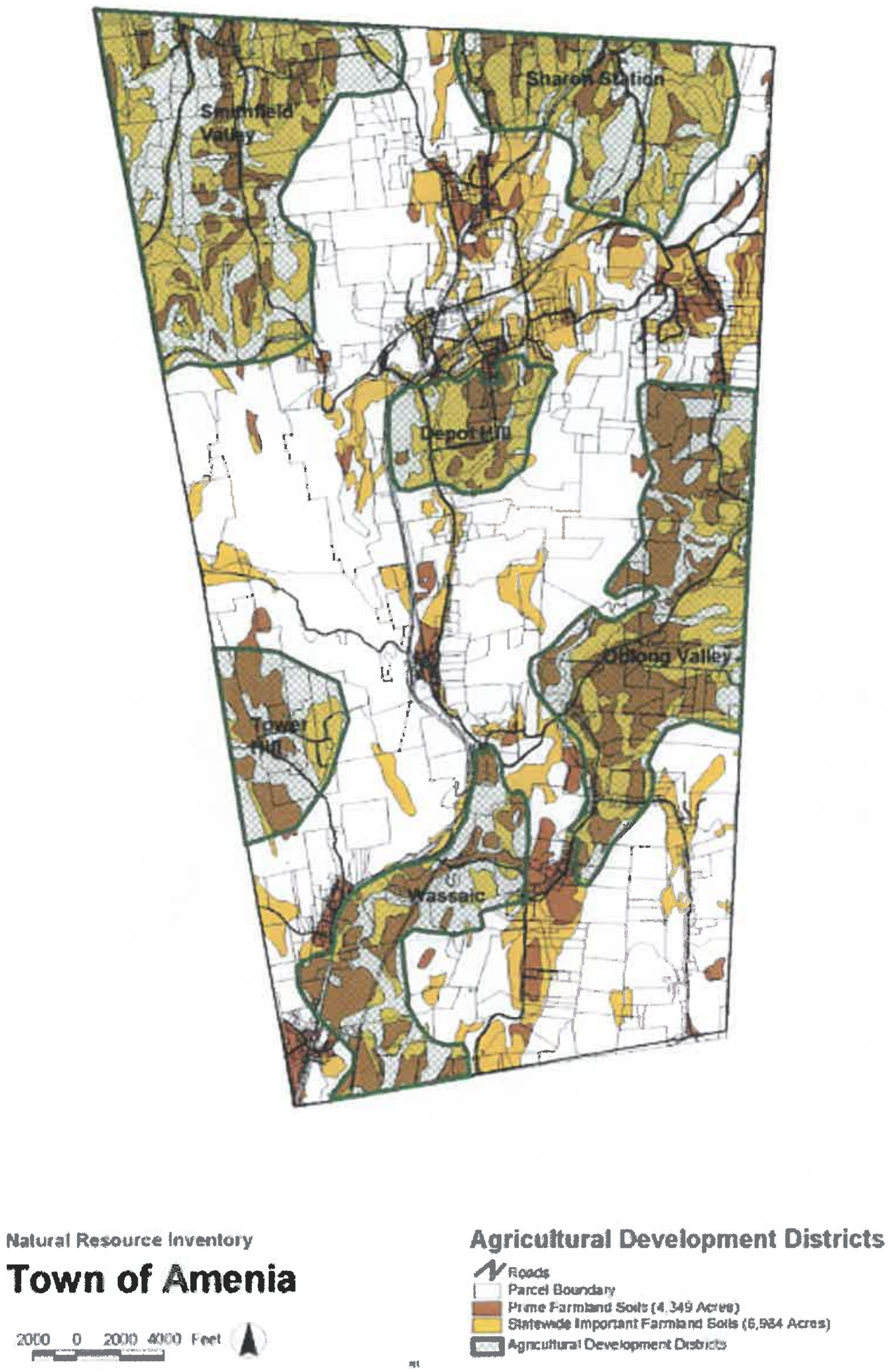
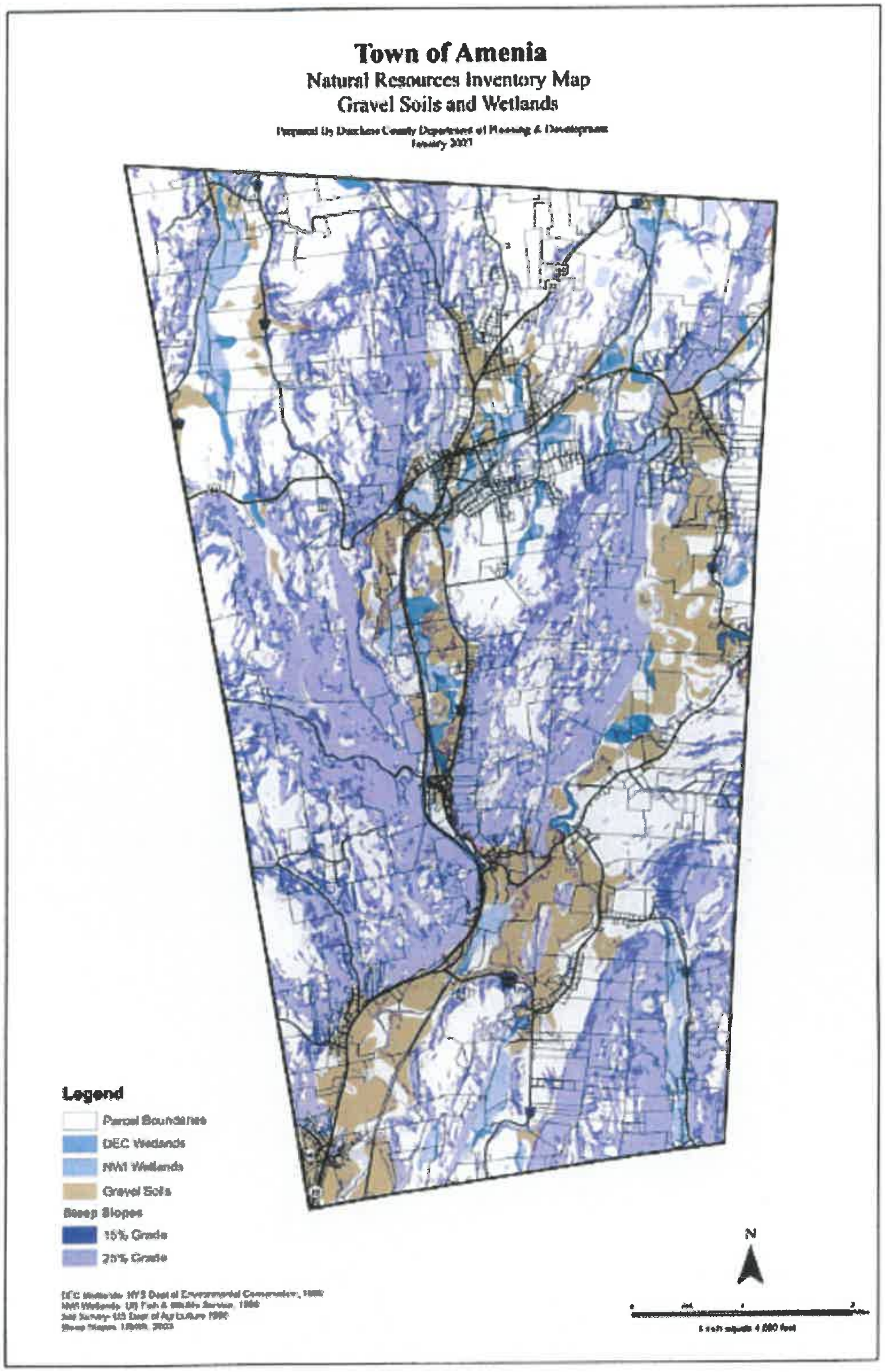
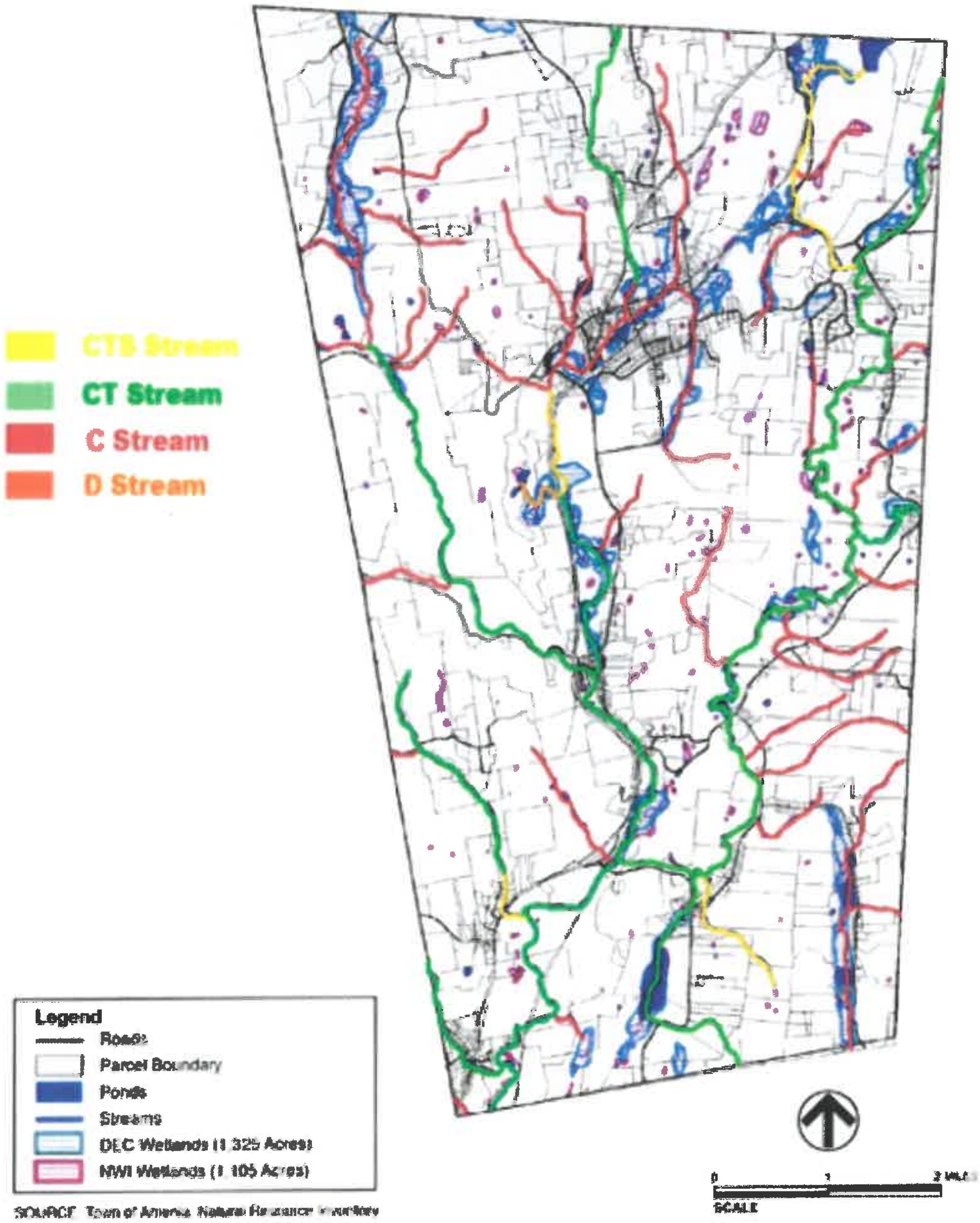
M


Town of Amenia
Natural Resources Inventory Map
Protected Lands and Farm Soils
Legend
Parcel Boundaries
Government Conservation Parcels
Conservation Organization Parcels
Dutchess Land Conservancy Easement Parcels
Statewide Significant Soils
N

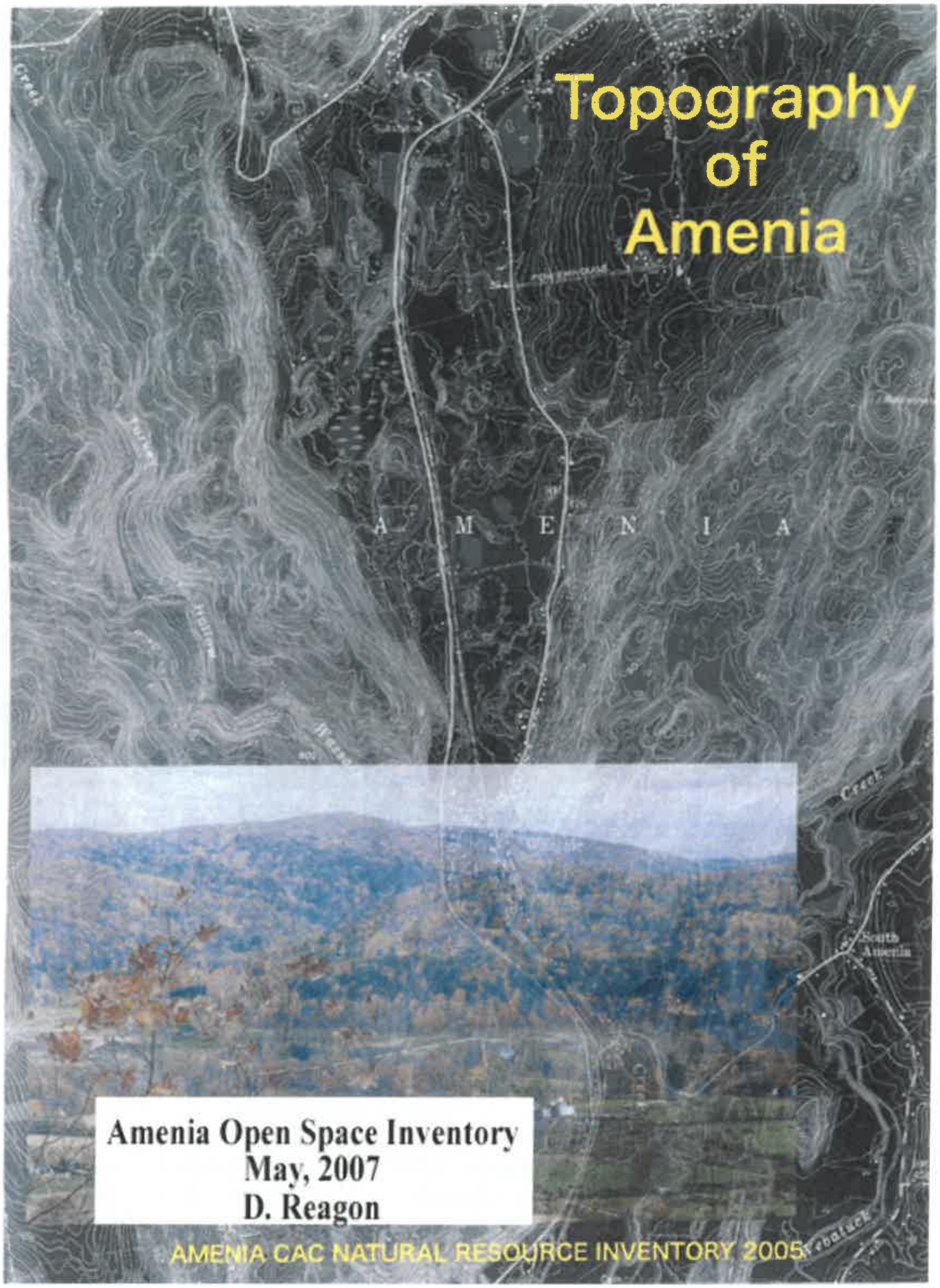

Smithfield Valley
Sharon Station
Depot Hill
Oblong Valley
Tower Hill
Wassaic
Natural Resource Inventory
Town of Amenia
2000 0 2000 4000 Feet
Agricultural Development Districts
Roads
Parcel Boundary
Prime Farmland Soils (4,349 Acres)
Statewide Important Farmland Soils (6,984 Acres)
Agricultural Development Districts


Town of Amenia
Natural Resources Inventory Map
Gravel Soils and Wetlands
Legend
Parcel Boundaries
DEC Wetlands
NWI Wetlands
Gravel Soils
Steep Slopes
15% Grade
25% Grade
N

Town of Amenia
Natural Resources Inventory Map
Water Resources



SOURCE: Town of Amenia Natural Resource Inventory
NYDEC Regs. Part 825 Housatonic River Drainage Basin Map 825.8



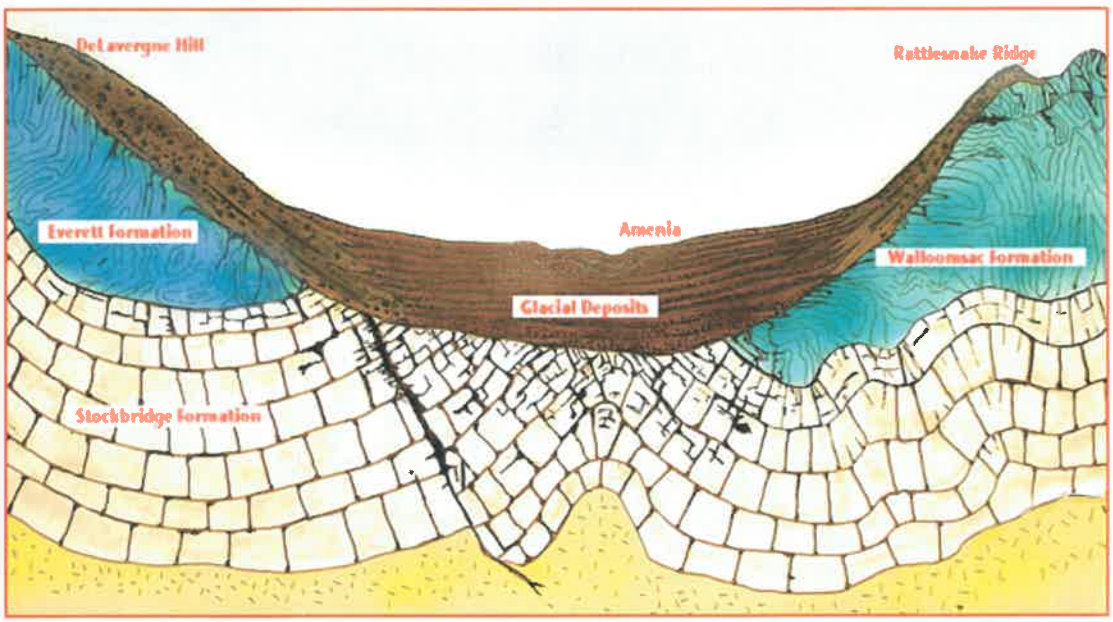
Topography of Amenia

Amenia Open Space Inventory
May, 2007
D. Reagon

AMENIA CAC NATURAL RESOURCE INVENTORY 2005

The Topography of Amenia

The spectacular scenery of Amenia, from DeLavergne Hill to the cool recesses of Turkey and Bog Hollow, is largely the result of the bedrock "bones" of the area. In general, the valleys are composed of relatively soft limestones and marbles known as the Stockbridge formation, deposited in a primordial sea along the continental shelf of a long gone continent, and harder schists and gneisses of the Walloomsac and Everett formations which were formed as an ancient mountain range eroded away about 500 million years ago, forming the ridges. Subsequent colliding and rending of continents have folded, faulted, buried, and moved these rock formations to their present positions, while erosion has exposed them at the surface. Two million years ago the Earth entered a period of time known as the "Ice Age" and four glacial advances through the area carved away softer rocks, created rivers of meltwater, and deposited billions of tons of glacial till and outwash in the valleys. Geologists are still struggling to figure out all the details of this ongoing process.



This is a very generalized geological cross-section looking north up the Harlem Valley in the vicinity of Amenia. The diagram is not to scale. Modified from Fisher et al, 1961.

Topographic relief in Amenia is about 1,000 feet with the highest elevations being around 1,400 feet above sea level on the ridgeline east of the Smithfield valley and the lowest being just under 400 feet where the Tenmile River runs into the southern neighbor of Amenia, Dover Plains.

The geology has also shaped the transportation corridors through Amenia. NYS Route 22 follows the softer rocks of the Stockbridge formation in the northerly trending Harlem Valley. The Harlem Valley line of the Metro North Railroad follows the same valley, which narrows down from over a mile wide to about one-fourth of a mile wide on the valley bottom at the south entrance to the hamlet of Wassaic where a large fault has moved the harder more resistant ridges close together, constricting the valley for about one half mile. A river, two roads, a railroad, and a village are compacted into this narrow water gap!

Aerial view looking north about one mile south of Wassaic. Rattlesnake Ridge trends diagonally across the photo. DeLavergne Hill is on the far ridgeline to the extreme left. D. Reagon photo

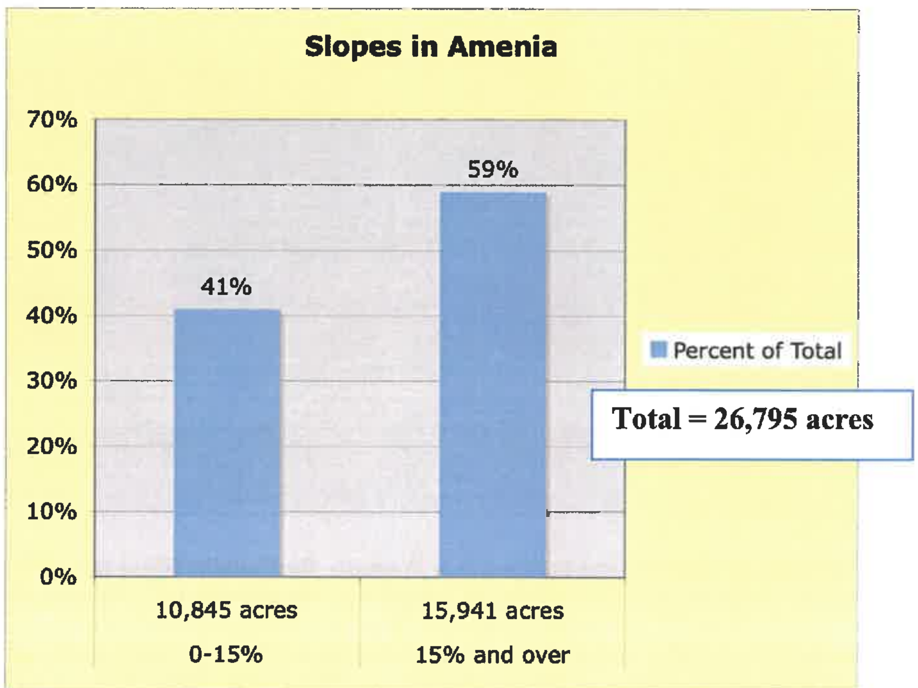
Roads that exit the valley to the west must travel up steep inclines such as DeLavergne Hill, Deep Hollow, Butts Hollow, and Plymouth Hill. It can be difficult to get out of town in the winter unless the traveler is going east into Connecticut where the roads follow less steep routes.

Steep Slopes

Because of the difficulty, environmental constraints, and expense of building on steep slopes most of the development in the Town has been in the valleys and on the more gentle slopes. According to the 1991 Master Plan for the Town of Amenia, slopes greater than 25% are considered not buildable and slopes between 15% and 25% require special site consideration. The new Comprehensive Plan and the new zoning that accompanies stresses the importance of regulating development on steep slopes. Article 121-36 in the zoning regulations gives specific language on steep slopes. The 25% limit of the 1991 plan has been raised to 30% in the 2007 plan.

Slopes in Amenia

Percent Slopes	Acreage	Percent of Total
0-15	10,854	41
15 and over	15,941	59
Total	26,795	100
Source: 1969 Master Plan		

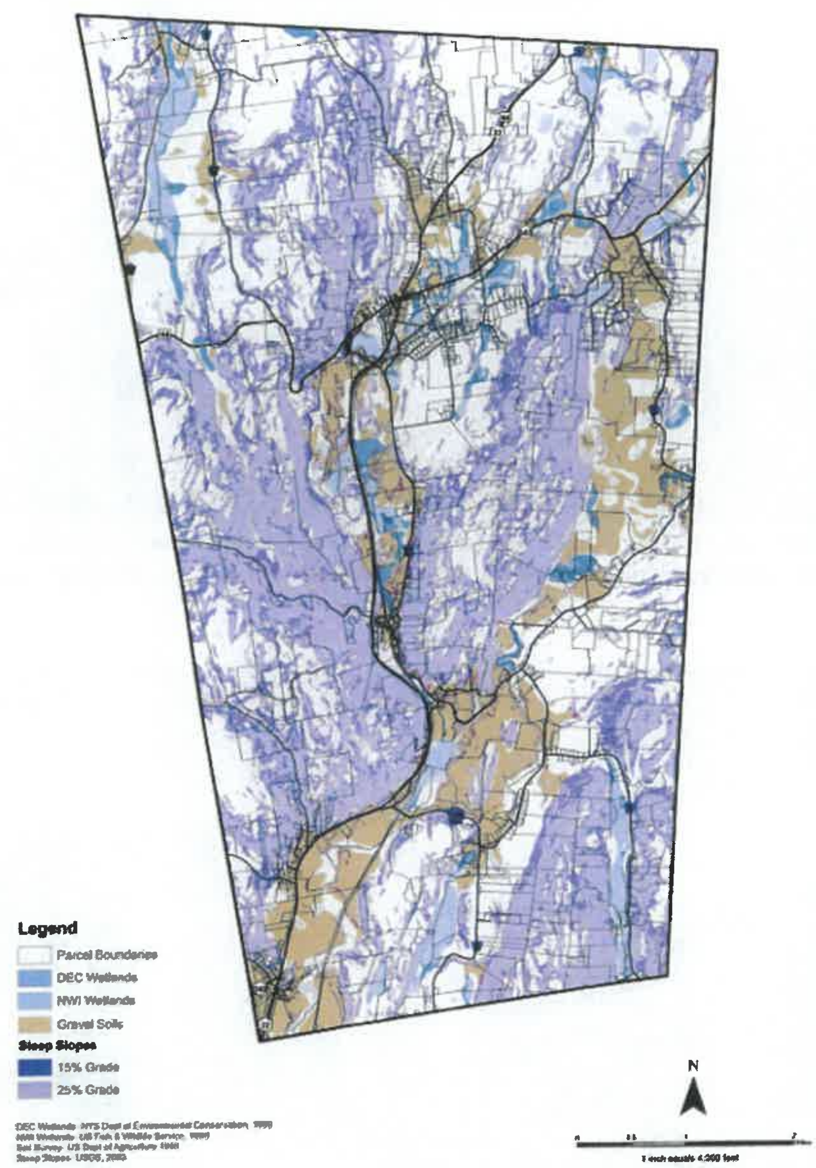


As level building lots in the Town become scarcer, steep slopes will be turned to as an alternative. With enough money, expertise, and imagination building on steep slopes will become more common.

Another feature of the new zoning will be to protect ridgelines from development. The Scenic Protection Overlay District language does not permit construction, within 40 feet of the "crest line" of a ridge except for antennae and the like. This will preserve the tree line continuity of ridges, which is so important in preserving scenic vistas.

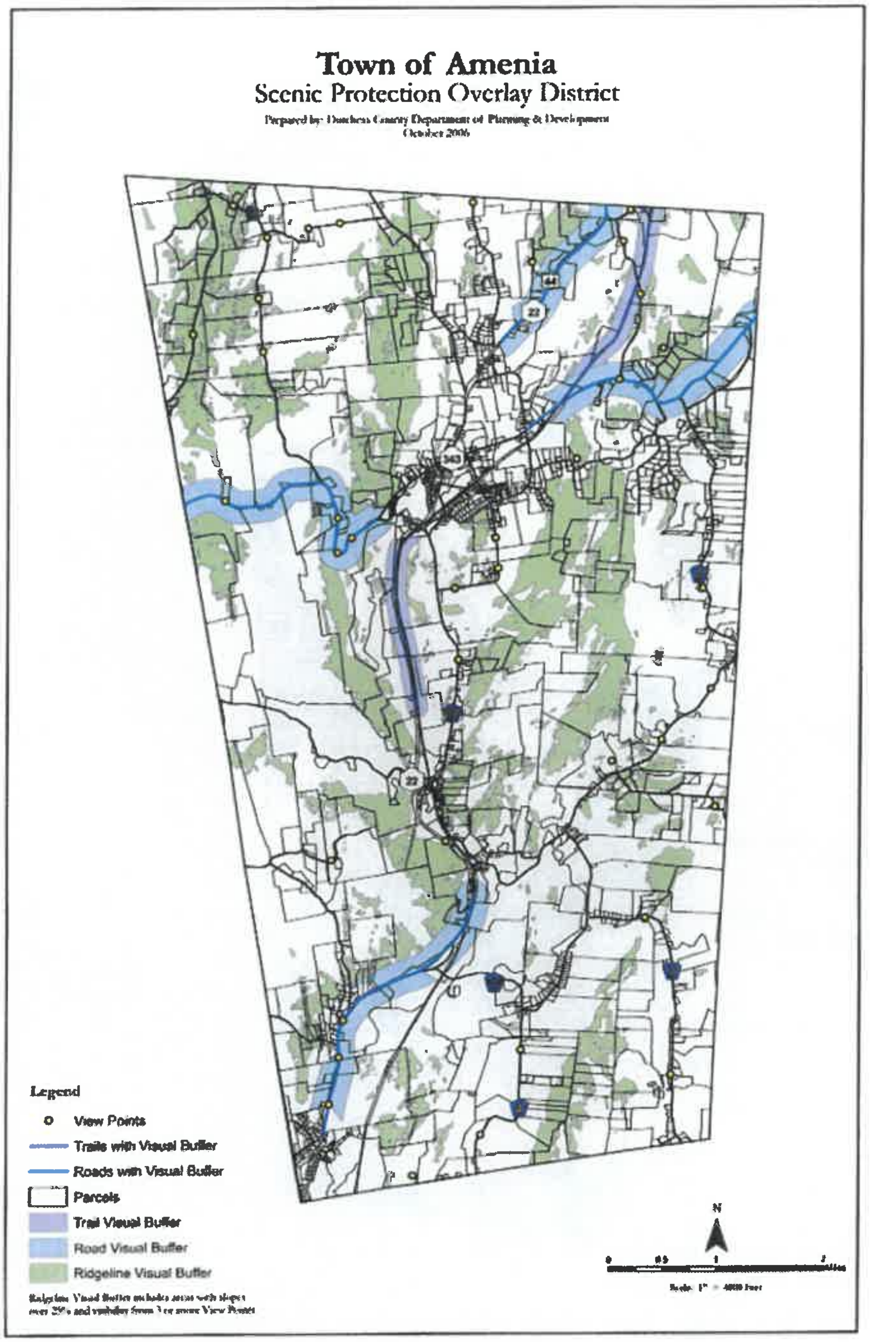
Town of Amenia

Steep Slopes



House on ridgeline just over the Connecticut border. New Comprehensive Plan language would not allow this in Amenia. D. Reagon photo

Aerial view of the Oblong Valley looking south. The valley bedrock is Stockbridge limestone covered with a thick layer of glacial sand and gravel. D. Reagon photo


Town of Amenia
Scenic Protection Overlay District
Prepared by: Dutchess County Department of Planning & Development
October 2006
22
343
Legend
View Points
Trails with Visual Buffer
Roads with Visual Buffer
Parcels
Trail Visual Buffer
Road Visual Buffer
Ridgeline Visual Buffer
N

Hudsonia Report

In 2006 Hudsonia Ltd. of Annandale, NY completed a report titled Significant Habitats in the Town of Amenia, Dutchess County, New York. This report studies the biodiversity of Amenia which is tied, significantly, to the topography. Soon to be made easily available to the general public, this document is a must read for everyone in Town who is interested in the environment. Several of the maps in the study are included in the following pages of this report. By studying the maps it will be readily apparent the relationship between the topography and the environment in Amenia.

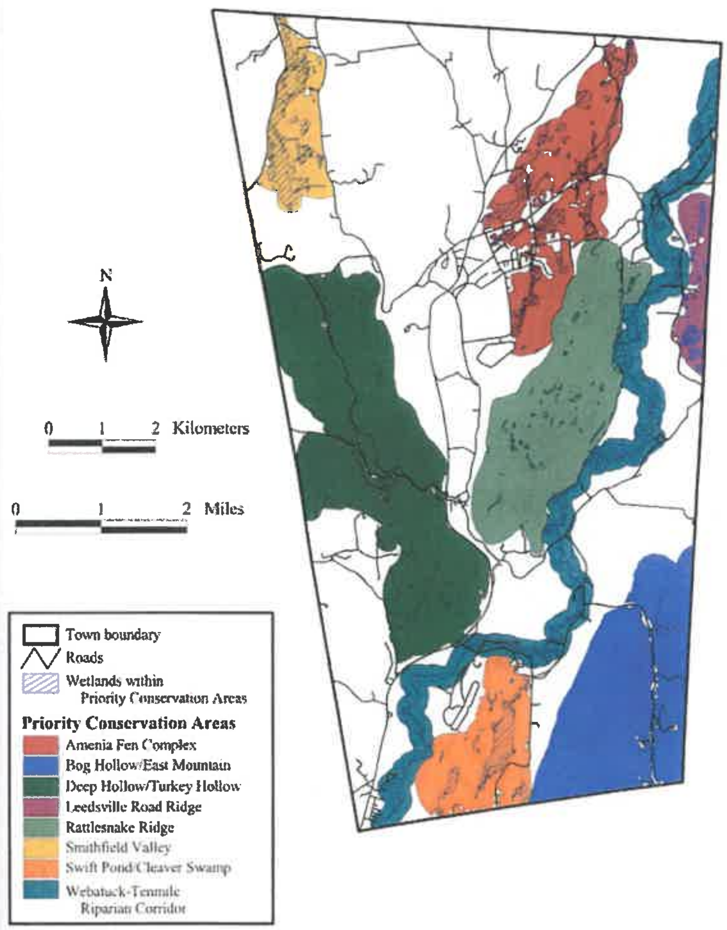


Figure 11. Priority Conservation Areas in the Town of Amenia, Dutchess County, New York. The map shows areas with especially high biodiversity value, but does not depict all areas of conservation concern. Hudsonia Ltd., 2006.

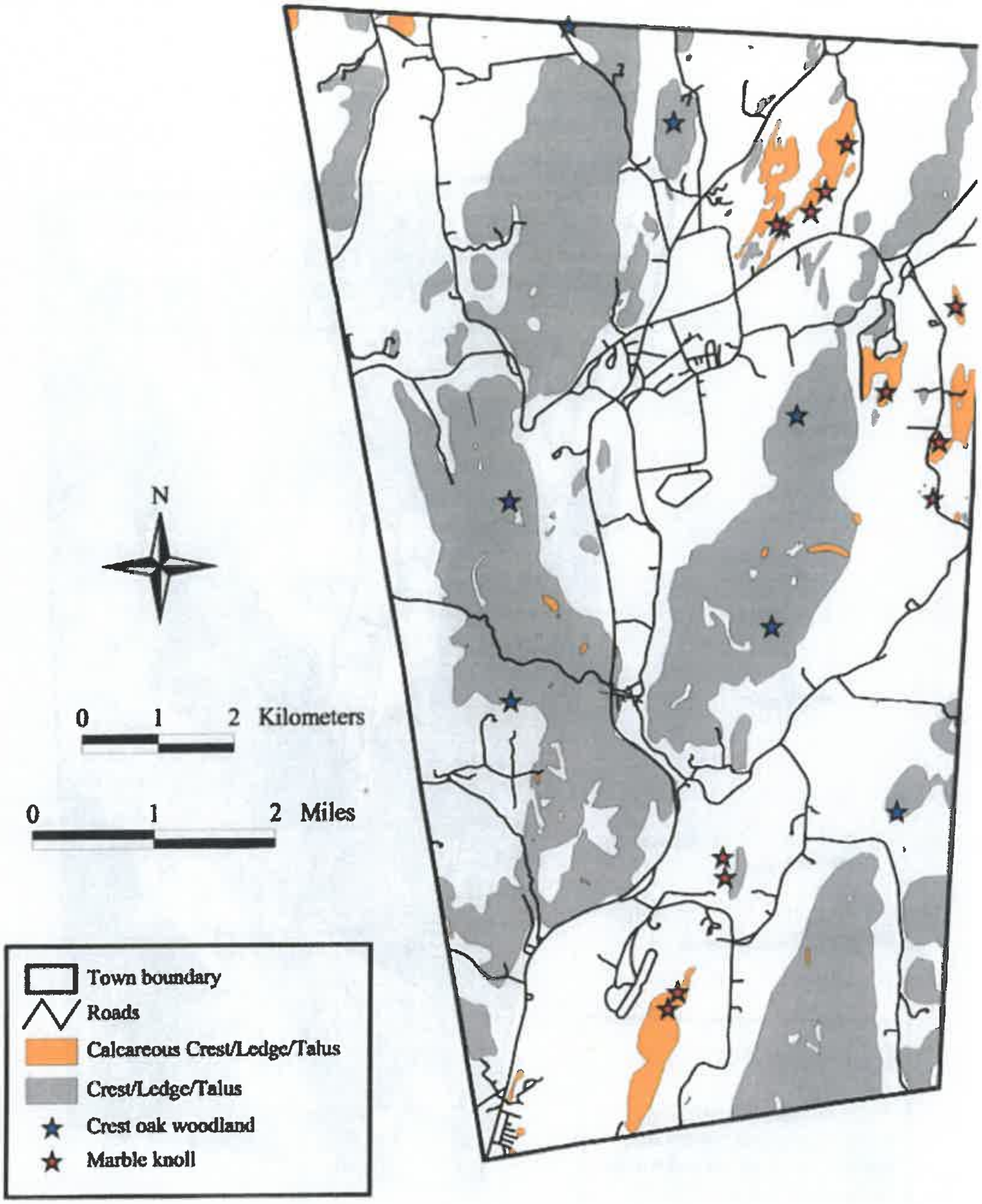


Figure 5. Generalized distribution of calcareous and non-calcareous crest, ledge, and talus habita and observed crest oak woodlands and marble knolls in the Town of Amenia, Dutchess County, New York. Locations identified from field observations and inferred from areas of shallow soils on steep slopes. Hudsonia Ltd., 2006.

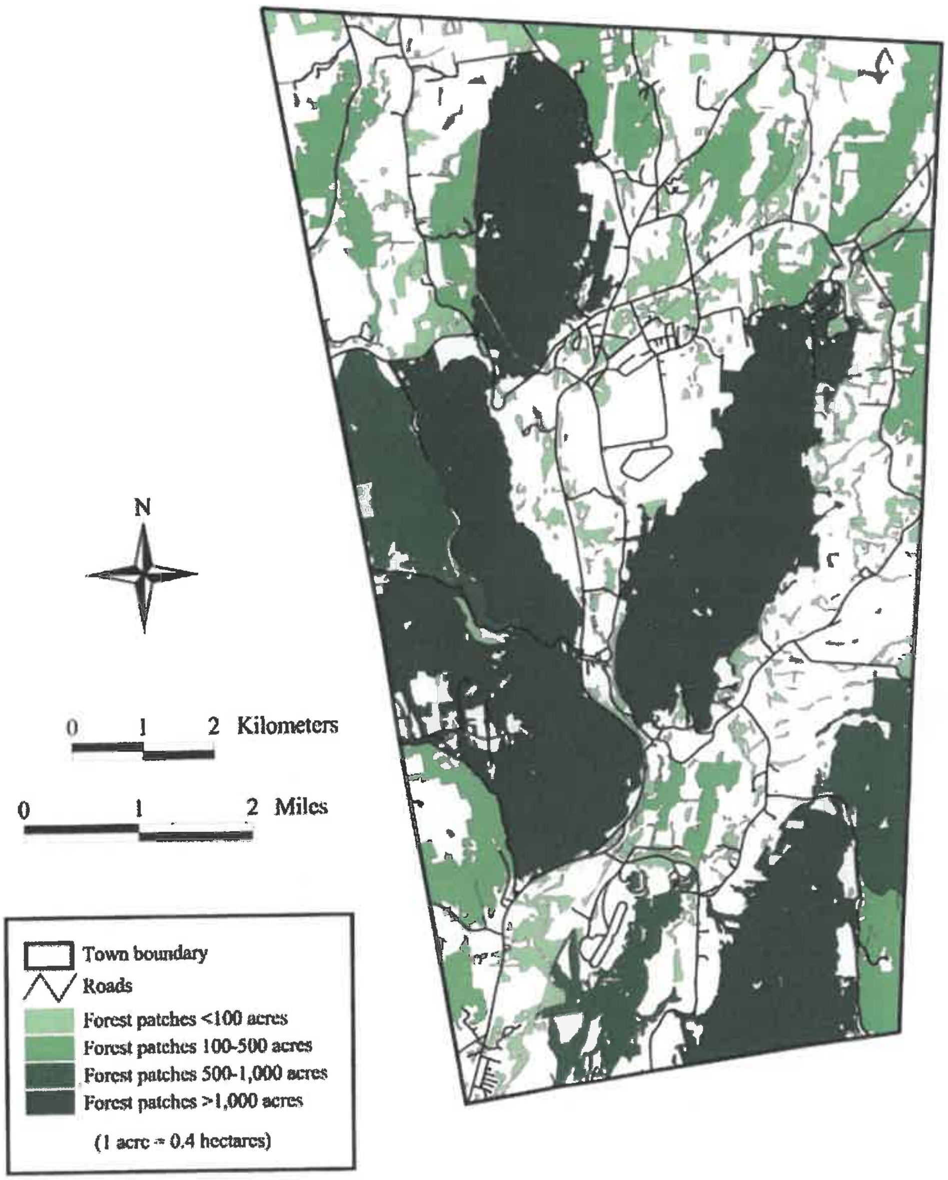
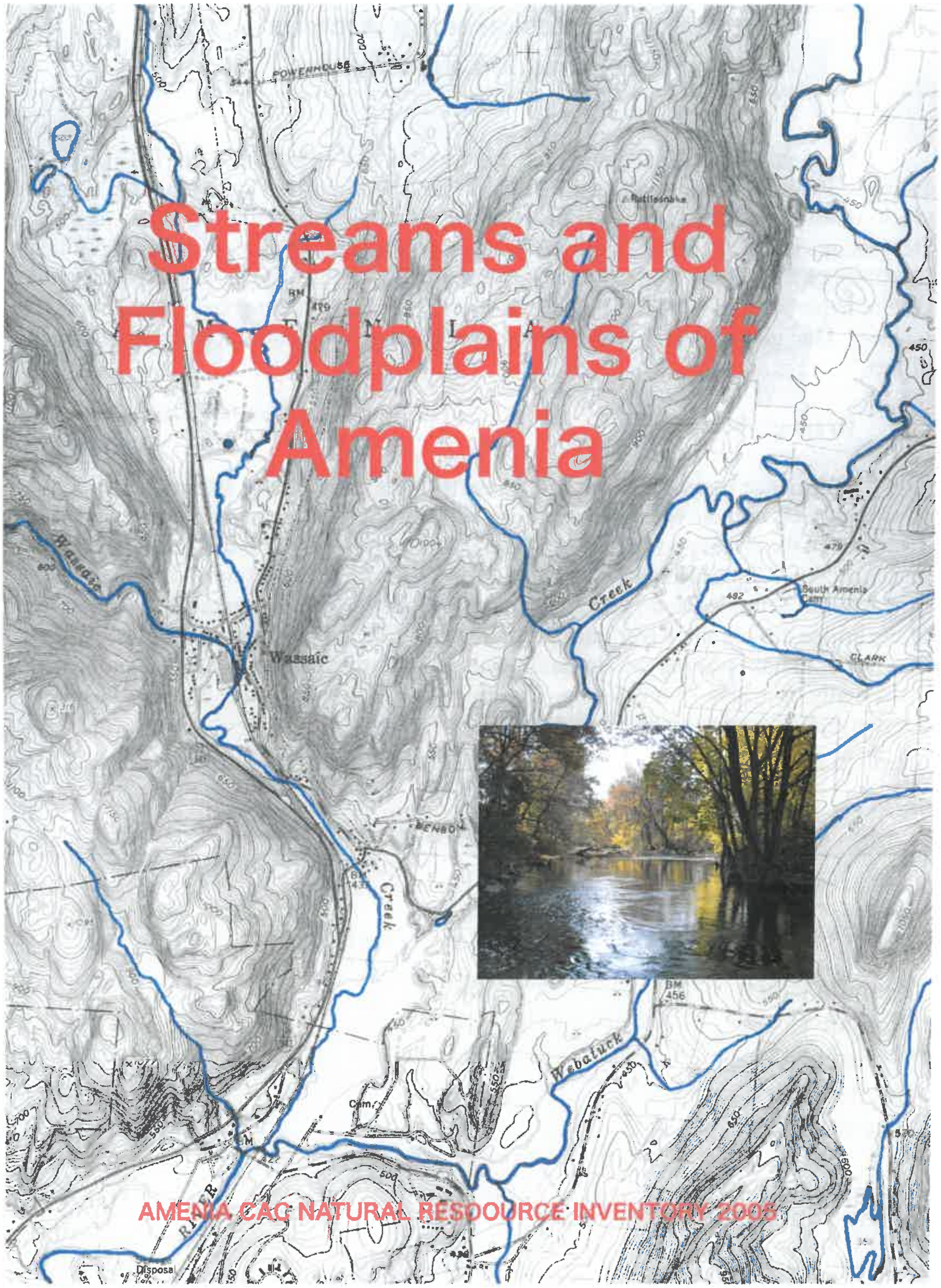


Figure 4. Contiguous forest patches (including hardwood, conifer, and mixed forests in uplands and swamps) in the Town of Amenia, Dutchess County, New York. Hudsonia Ltd., 2006.

Streams and Floodplains of Amenia



AMENIA CAC NATURAL RESOOURCE INVENTORY 2005

Water Resources in Amenia
Streams and Floodplains

Residents of Amenia would probably be surprised to learn that the Town has, during some times of the year, nearly 300 miles of shoreline. Before comparing Amenia to a town on Long Island, it should be understood that the "shoreline" really consists of the riparian zone that exists along each of the approximately 60 streams of all types that flow through the Town. Perhaps Mark Twain, in Life on the Mississippi, expresses this kind of hyperbole best in the following quote. "There is something fascinating about science. One gets such wholesale returns of conjecture out of such a trifling investment of fact."

Drainage Basins

A drainage basin, or watershed, consists of the entire area a stream and its tributaries receive their water. Except for a tiny portion in extreme northwestern part of Town. all of the rivers and streams in Amenia flow eventually into the Housatonic River in Connecticut. Two principal streams in Town, Webatuck Creek and Wassaic Creek, flow into the Tenmile River, which begins at the junction of the two creeks just northeast of the bridge at Tenmile River railroad station. The Tenmile flows south out of Amenia into Dover Plains entering the Housatonic near Gaylordsville, Connecticut. The Tenmile, incidentally, is nearly 15 miles long. Figure 1 shows the areas of the drainage basins of the five major streams in the Town.

Figure 1
Drainage Basins, Town of Amenia

Basin	Acres	Percent
Tenmile River	3,506	13.0
Wassaic Creek	12,514	47.0
Webatuck Creek	9,334	35.0
Bog Hollow	1,332	4.8
Jansen Kill	109	0.2
Total	26,795	100

Source: 1969 Master Plan

Surface Water

The streams listed above receive their water in three ways, directly from precipitation, from groundwater input, and from runoff. Runoff and groundwater are by far the most important sources of water to a stream.

Three things can happen to precipitation after it falls. About two-thirds of precipitation returns to the atmosphere as evaporation from the ground and transpiration through plants. A fourth runs off the land surface and the remainder may infiltrate into the ground and become groundwater. Runoff can be defined as precipitation minus (infiltration plus evapotranspiration).

Runoff reaches streams through a process known as sheet flow, water courses over the land surface, until it gathers into very small streams known as rills. Rills join to form larger streams and a drainage network forms. Drainage networks consist of land area between the streams, known as divides, and the streams themselves. Streams are ordered, or classified, by the number of tributaries they contain. The simplest stream, one with no tributaries, is classified as "1". When two "1"s join, they form a "two" and so on. Geologists classify the Mississippi as a "12". See figure 2 for an explanation of this process. See figure three for a summary of orders of streams in Amenia. Check the "Stream Order Map of Amenia" for details.

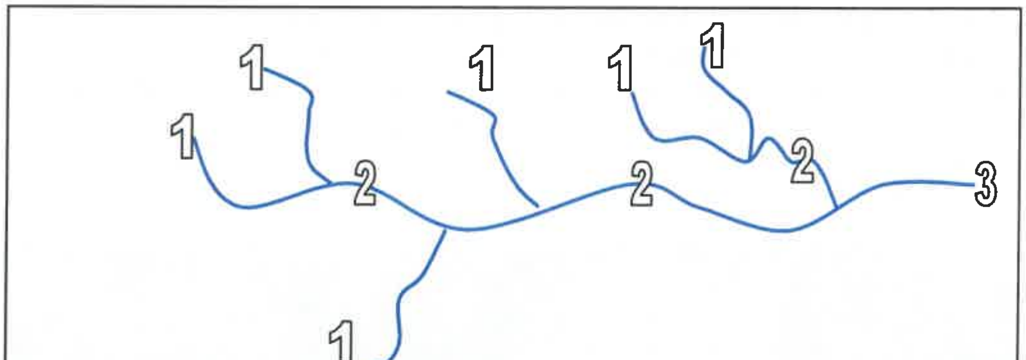


Figure 2 Stream Order

Fig. 3 Stream Summary

Order	Number of Streams	Combined Length
1	44	115 miles
2	11	15 miles
3	2	9 miles
4	2	22 miles
5	1	4 miles

All numbers are approximate.

The quantity of water flowing in a stream is known as its discharge and is equal to the measured cross-section of the stream multiplied by its velocity in feet per second. Discharge is measured in cubic feet per second. The width and depth of a stream is proportional to the discharge. The velocity of a stream is determined by its gradient, discharge, and the roughness of the stream channel. The Tenmile River has a gauging station located near Wingdale, New York, that has been recording the discharge for 70 years. This record of data is very valuable for assessing the quantity of groundwater in the river basin and for predicting floods downstream. The United States Geological Survey maintains the site and its database plus real-time data are available online at USGS.gov.

Stream channel patterns are the result of the interaction of many variables including discharge, velocity, sediment load, and obstacles in the streambed. The main patterns are straight, meandering, and braided, all of which occur in Amenia. Meanders form when a stream encounters an obstacle in its way and is forced to detour around it. Because water flows faster on the outside of a stream curve, the stream tends to erode away the stream bank at that point. Opposite the fast moving part of the curve, the stream slows down and begins depositing sediment. In this way, a floodplain in constructed. Often, in the course of meandering, an upstream meander will catch up to the next meander downstream and cut it off, shortening the length of the stream and forming a lake on the floodplain. Meanders usually form in wide valleys in material that is easily eroded such as sand and gravel. The length of a meander is proportional to the width of the river. In Amenia good examples of meanders are found between Amenia and Wassaic along the Amenia Stream and along Webatuck Creek in the Oblong Valley. See Figure 4 for details.

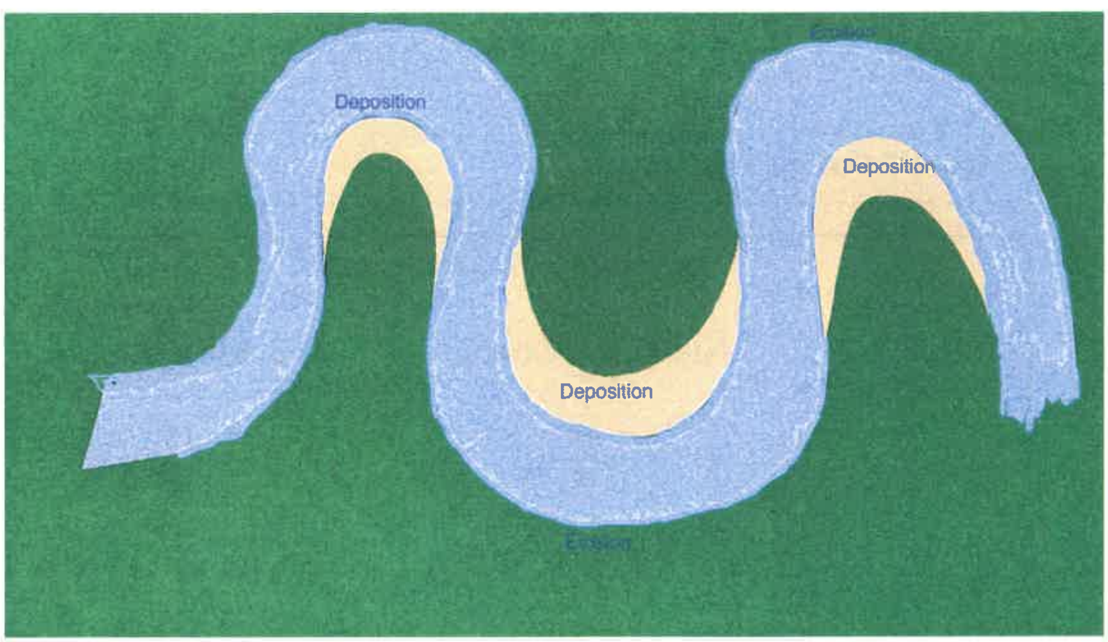


Diagram of a meandering stream

The floodplain of a river is the area bordering the stream and is really a part of the streambed. Flooding occurs when the discharge exceeds the capacity of the streambed and it overflows onto its adjacent floodplain. Floodplains are often wetlands in Amenia and are easy to recognize. However, some floodplains appear to be dry land much of the year and take a trained eye to recognize.

The Federal Emergency Management Agency (FEMA) has mapped the 100-year floodplains in Amenia. This data is available on several maps including the one in this report. The 100-year floodplain is the area adjacent to a stream that has, on average, a one percent chance of having a flood in any given year. Development is strictly regulated on the 100-year floodplain although there are areas in Amenia that were built on prior to the establishment of the standard. There are permitted uses for floodplains that do not result in destruction of property during flooding nor do they interfere with an important function of floodplains which is to absorb and hold runoff protecting downstream areas from flooding. The 100-year floodplain areas in Amenia mostly follow the Tenmile River and the Wassaic and Webatuck Creeks as well as the Amenia Stream, which flows, from Amenia into Wassaic.

Groundwater and Streams

Water that soaks into the ground (infiltrates) becomes groundwater, the most important source of usable, relatively pure water for the Town. Groundwater can be an important source of water for streams and stream water can recharge the groundwater. It is impossible to separate the two and difficult to measure the interactions as the number of variables are large. Streams that lose water to groundwater are known as losing streams and those that gain water from groundwater are known as gaining streams. During periods of time, such as summer droughts, streams like the Tenmile do not run dry because they are supplied by groundwater flowing into their streambeds. Streams that flow year-round are classified as perennial streams and during dry periods of no runoff they gain water from groundwater supplies. Intermittent streams flow during periods of high runoff and gradually dry up during drought periods usually going dry near their headwaters first. The creek that comes down Tower Hill Road is a good example of this. When precipitation is abundant, runoff swells streams and the streams can recharge the groundwater. Most streams, however, have reaches along their courses where water flows into the stream from the ground and reaches where the stream supplies the groundwater regardless of the time of year. The interaction between the stream regime and the groundwater regime is constant and inseparable.

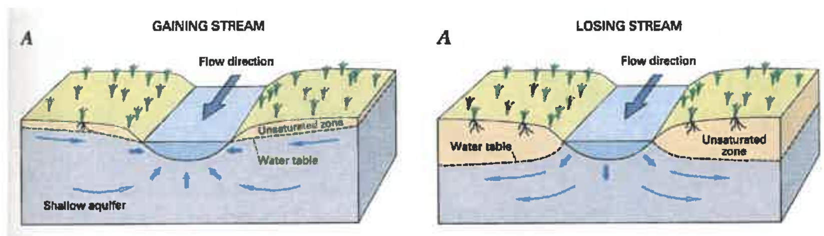


Fig. 5 Gaining and losing streams. (USGS Circular 1139 1998)

Water Quality Issues

In 2003, because the Tenmile River is an important tributary of the Housatonic, the Housatonic Valley Association (HVA) an organization that, among other activities, serves as an important "watchdog" for water quality in the Housatonic watershed, undertook a survey of both the Webatuck Creek and the Wassaic Creek from source to the start of the Tenmile River where the two creeks join. The result of this survey showed that the water quality of both creeks was overall pretty good. A number of issues were cited in these studies that will serve as benchmarks for future reference.

In 2004, the HVA appointed a "river keeper" for the Tenmile and has funded a study of the entire river from its beginning at the confluence of Wassaic and Webatuck Creek to its mouth on the Housatonic about 15 miles south near Gaylordsville, Connecticut. This study was conducted by several volunteers and has been being completed. Both of these studies will further knowledge of the entire Tenmile watershed and will serve as a benchmarks.

Tenmile River

Streams form an ecosystem known as the "lotic" system. This is a dynamic system that transports, besides water, a number of substances. Because water is an excellent solvent, all streams contain dissolved materials derived from the river bed, from the groundwater entering the stream, from disintegrating organic debris, and from materials that humans living along the stream introduce. In addition, streams transport food and energy for the inhabitants of the stream as well as sediment and debris including trash.

Streams are conveyers of all sorts of materials and communities can be the recipients of unwanted and undesirable additions to their water supply courteous of their upstream neighbors. For this reason, drainage basin wide water quality management plans are a good idea. Since potable water in all the communities in the northern Harlem Valley is dependent on groundwater and since groundwater and stream waters constantly mix, it is obvious that if Amenia is ignoring the health of its streams, residents of Dover Plains will be affected. Similarly, events in Northeast will affect Amenia. Water quality problems do not stay at home.

At present, no local ordinances protect the water resources of the Town. The CAC has proposed that Amenia adopt a comprehensive plan for freshwater wetlands and watercourse protection. Dutchess County has a model ordinance for local towns and the Town of Pawling has adopted such an ordinance. It is very important that Amenia follows suit promptly.

Potential problems along Amenia's streams include the following:

- Development
- Lack of a buffer zone between streams and adjacent properties
- Lack of an adequate salt storage facility
- Uncontrolled runoff from roadways and parking areas
- Nutrient, pesticide, and herbicide runoff from agriculture and, possibly, golf courses
- Small dams that were built years ago and have no modern function except to create a lake interrupting the flow of stream water and stopping the upstream migration of organisms
- Trash and debris that is directly dumped into streams including leaves and yard waste
- Leachate and runoff from closed landfills both permitted and non
- Direct discharge of sewage, treated or not into streams from failing septic systems and large systems such as the one at TDDSO
- Entry of contaminated groundwater into the stream water system
- Sediment from construction, agriculture, road sanding, and mining operations
- Filling, diverting, constructing a roadway across a streambed, driving any vehicle through a streambed, allowing livestock into a waterbody

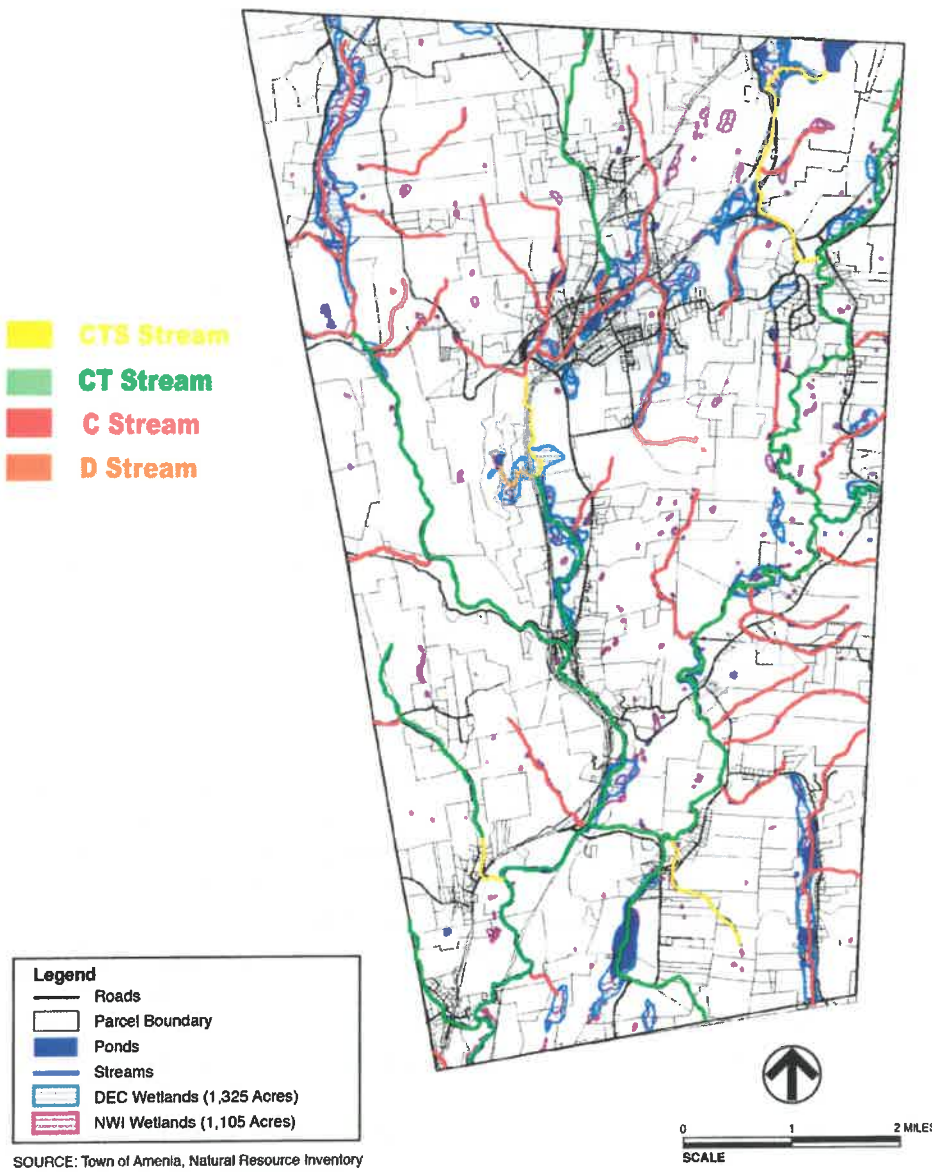
Stream Classification

Streams in New York are classified as to their best usage. For detailed information on this subject, consult NYSDEC Regs. Part 701, Classification of Surface Waters and Groundwaters. No impact on a stream is allowed to degrade it below its best usage classification.

The map on the next page shows the classification of streams in Amenia. The streams were classified many years ago and much has changed along some of these streams that would affect their quality. An example would be the impact of Silo Ridge golf course on Amenia Brook.

Most streams in Amenia are classified as C streams meaning that their best usage is fishing. The waters shall be suitable for fish propagation and survival. A CT classification means the waters will support trout and CTS means that the water quality is high enough for trout to spawn in. Trout require fast moving, highly oxygenated waters free from pollution. It is obvious from the map that most streams in Amenia are in good health.

Town of Amenia
Natural Resources Inventory Map
Water Resources



SOURCE: Town of Amenia, Natural Resource Inventory
NYDEC Regs. Part 825 Housatonic River Drainage Basin Map 825.8

Recent studies of the principal streams in Amenia have found them to be in good health. The Housatonic Valley Association has done three studies in the last five years to determine the quality of the Webatuck Creek, the Wassaic Creek, and the Tenmile River. All three of the studies emphasize the near-pristine water quality in these streams. NYSDEC has also studied parts of the Tenmile and has found from macroinvertebrate collecting that the stream is doing well. This is not to say that everything is perfect nor should it be thought that this high level of stream quality is not threatened.

Hudsonia Report

In 2006 Hudsonia Ltd., published "Significant Habitats in the Town of Amenia, Dutchess County, New York" a landmark study of the biodiversity of Amenia. **This report should be required reading for every elected and appointed official**. Part of the study contemplates perennial streams and their riparian corridors and the importance of these areas. One of the key recommendations of this study is to establish conservation corridors along streams ranging from 160 feet along small streams, including intermittent streams, and 650 feet along larger streams. The report contains specific guidelines for these conservation zones.

Hudsonia identifies eight priority conservation areas within the Town and it states that "any conservation action within these is likely to have disproportionately large returns for biodiversity as compared with other areas." One of these is the Webatuck-Tenmile Riparian Corridor which, besides being an important area of its own right, links together other significant areas and forms a continuum with downstream areas.

The Hudsonia report is an extremely valuable report that must be consulted when environmental issues are to be decided in the Town of Amenia.

Town of Amenia Comprehensive Plan Update to the 1991 Amenia Master Plan

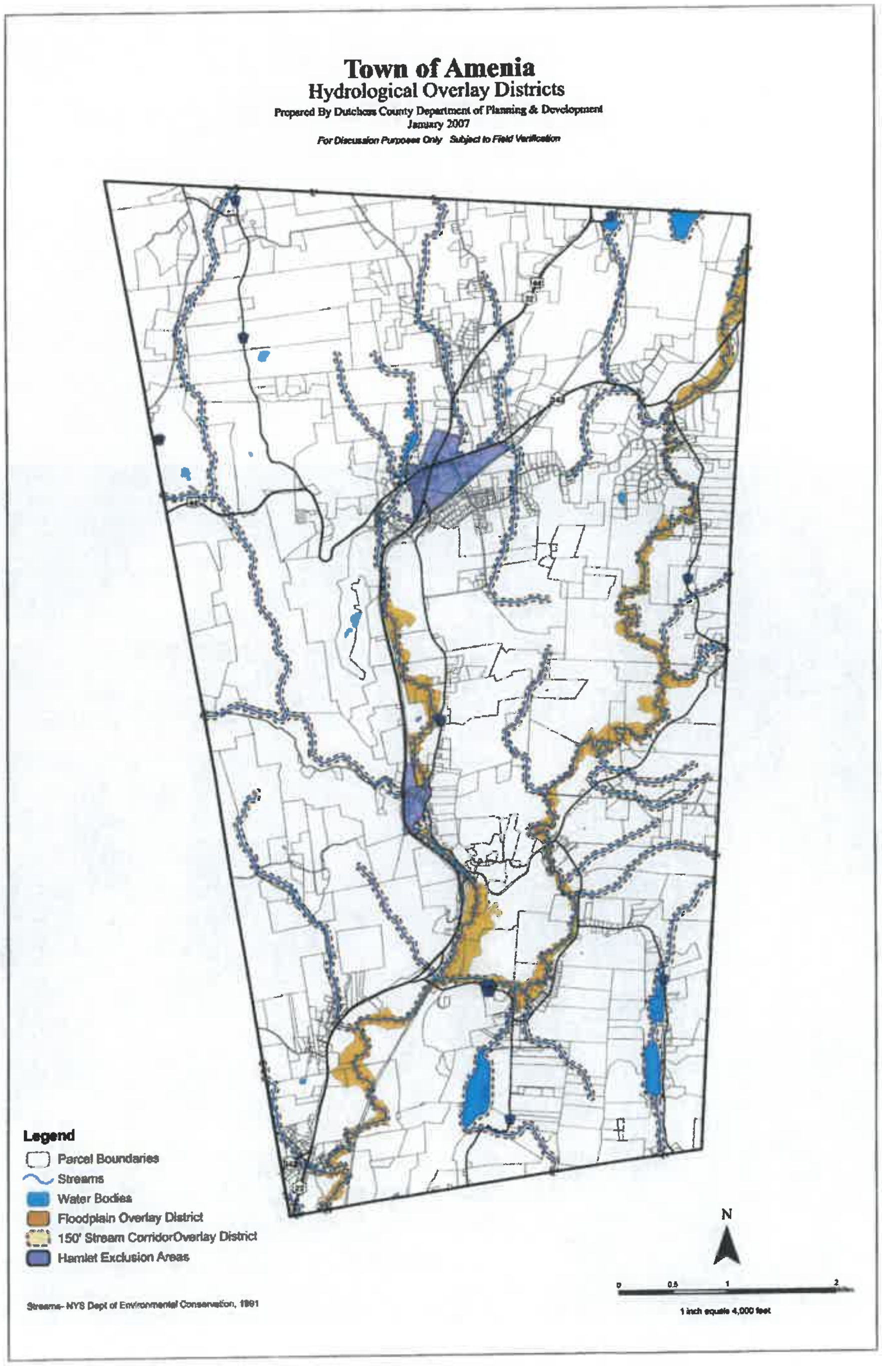
In 1991, the Town revised its Master Plan, updating it from the 1965 Plan. However, new zoning was never written to reflect the Plan and it was largely forgotten. The new Comprehensive Plan updates the 1991 Plan and includes new zoning that compliments the new plan. One very important part of the zoning includes the establishment of "overlay districts" that have the effect of requiring a more careful review process of the underlying land use.

Two overlay districts that are relevant to watercourses are the Floodplain Overlay District and the Stream Corridor Overlay District.

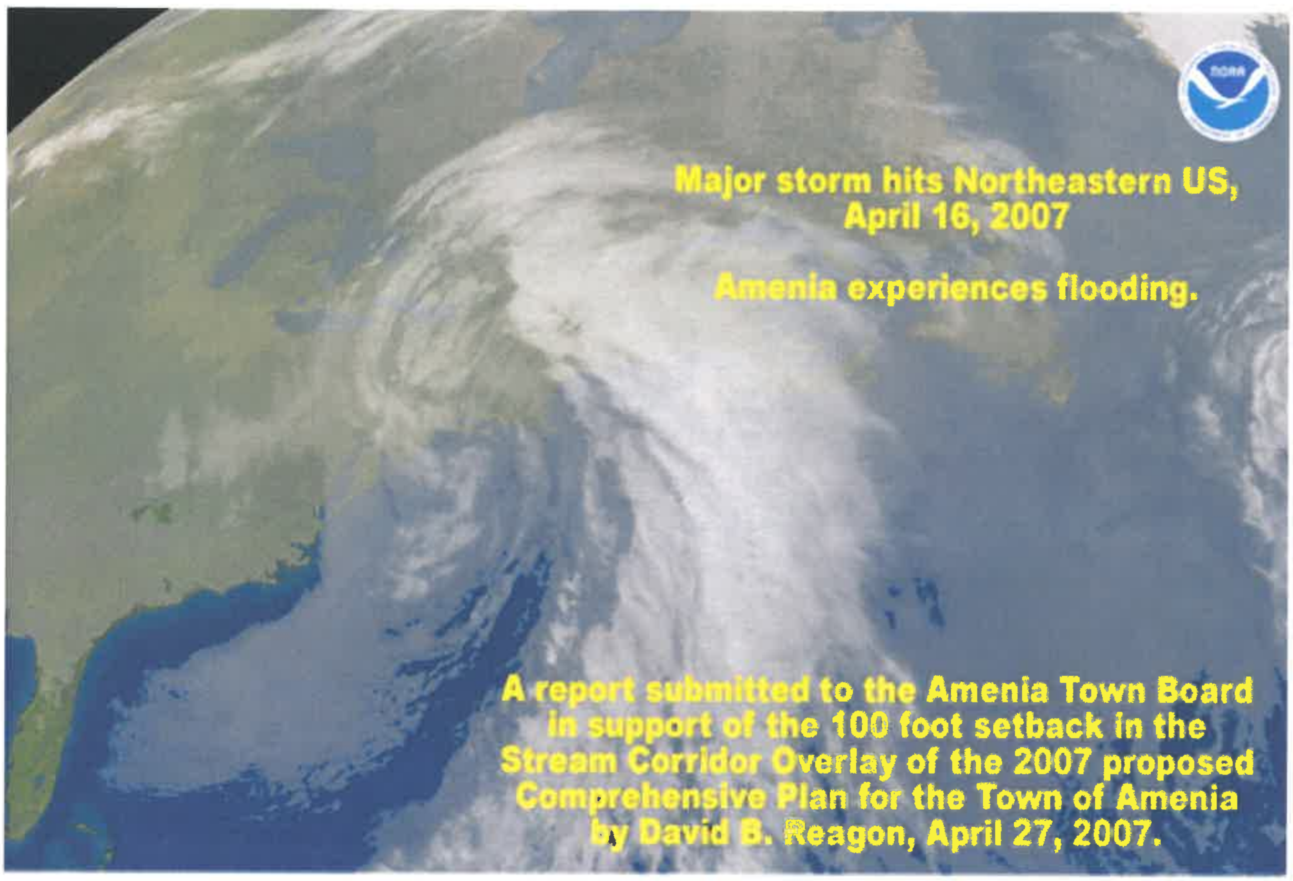
The Floodplain Overlay District establishes the 100-year floodplain as the District boundary and imposes restrictions on what can be built in this area.

The Stream Corridor Overlay District recognizes the value of the border areas (riparian zones) of all streams in the Town that are classified by NYDEC and it establishes a 150 foot corridor on both sides of a stream, regulating what kind of development can occur within those bounds. The regulations have been very carefully written into the new zoning and the specifics can be found in the document.

The new Comprehensive Plan and the new zoning will have a very positive effect on streams and stream corridors within Amenia.


Town of Amenia
Hydrological Overlay Districts
Prepared By Dutchess County Department of Planning & Development
January 2007
For Discussion Purposes Only Subject to Field Verification
Legend
Parcel Boundaries
Streams
Water Bodies
Floodplain Overlay District
150' Stream CorridorOverlay District
Hamlet Exclusion Areas
N
0 0.5 1 2
1 inch equals 4,000 feet
Streams- NYS Dept of Environmental Conservation, 1991

How maps and other resources can be used to support an environmental argument.



In support of the 100 foot setback in the Stream Corridor Overlay using Cascade Brook as an example.

Cascade Brook is classified by New York State Department of Conservation as either a "Ct" stream, which means it can support trout, or as a "Cts" stream, which means it is a trout-spawning stream. The designation varies with location along the stream.

92	Conn. 15-11-2	Cascade Brook	From trib. 1b to 0.2 mile above trib. 2.	N-25se	C	C(TS)
93	Conn. 15-11-2	Cascade Brook	From 0.2 mile above trib. 2 to trib. 3.	N-25se	C	C(T)
94	Conn. 15-11-2	Cascade Brook	From trib. 3 to source.	N-25se N-25ne	C	C(T)
95	Conn. 15-11-2-a, 1, 1a, 5, P 1125a and tribs. 1-P 1121, 1-P 1122, 1b-1, 1b-1-P 1123a, 1b-1-P 1124, 2-1, 2-P 1125	Tributaries of Cascade Brook and subtributaries		N-25se N-25ne	C	C
95.1	Conn. 15-11-2-1b	Tributary of Cascade Brook		N-25se	C	C(TS)
95.2	Conn. 15-11-2-2	Tributary of Cascade Brook		N-25se	C	C(T)

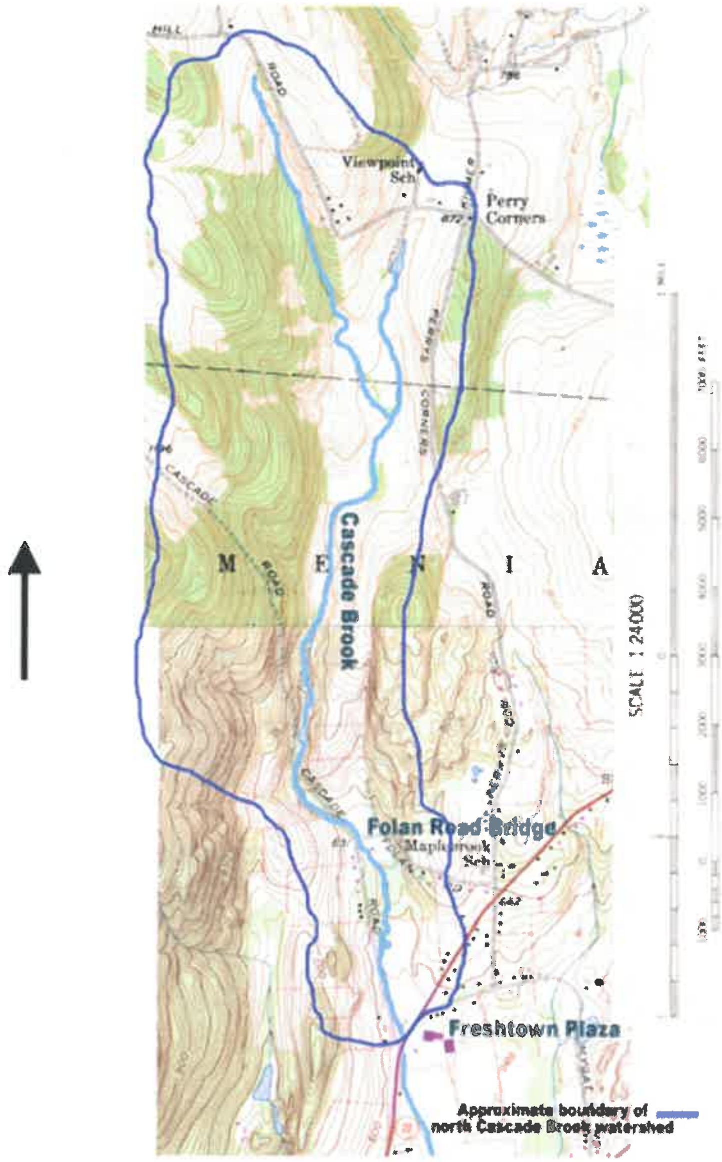
NYSDEC Reg. 6 NYCRR Housatonic River Basin, Cascade Brook

Trout are an important game fish in New York and trout waters are highly valued by NYDEC. The presence of trout in a stream, particularly one that can support spawning, is a sign that the stream is healthy, free of pollution, and cold enough to have a high dissolved oxygen content. Regulating development near such as stream, as the Comprehensive Plan does in implementing the Stream Corridor Overlay, will afford protection to this valuable resource. Landowners can take advantage of planting programs that NYSDEC offers to restore and shade the riparian zone along streams that lie within the Stream Corridor Overlay. Low bushes along the stream banks shade the water, keep it cool, and provide habitat for birds and reptiles.

Tenmile River showing well-developed riparian zone.

Northern Cascade Brook Watershed

Watershed Area = approx. 1200 acres



Source: USGS, Millerton and Amenia Quadrangles


Cascade Brook overflowing Folan Road Bridge, April 16th, 2007.

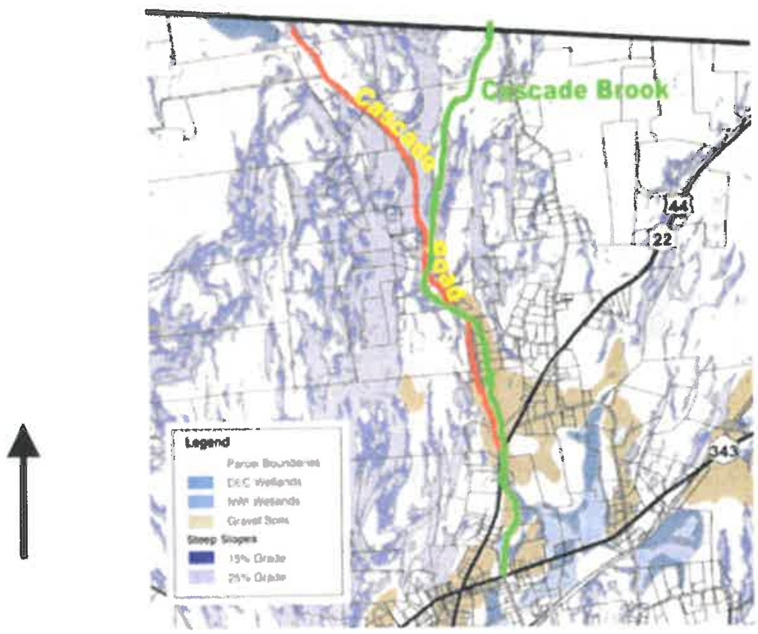
Even though some landowners claim that Cascade Brook dries up during the summer, it is not classified as an "intermittent stream" and is regulated by NYSDEC. In fact, as the recent floods of April 2007 demonstrate, Cascade Brook can flood and cause significant flooding.

The watershed, or drainage basin, of a stream is the area that collects all of the rainfall that ends up in the stream. Northern Cascade Brook's watershed, illustrated on the previous page, comprises about 1200 acres, approximately two-thirds of which is in Amenia. Rainfall reaches a stream principally by runoff and is dependent on several variables such as rainfall rate, slope, vegetation, soil type, soil thickness, amount of impervious surface, bedrock type, previous rainfalls, and time of year.

Cascade Brook begins at elevations exceeding 1,000 feet in several locations, as can be seen on the topographic map of the watershed, dropping over a short distance to about 500 feet where it crosses under Folan Road. The steep slope map, on the next page, shows that slopes that range between 15 and 25% dominate the valley making up the watershed. High stream gradients and steep slopes covered with thin soils and relatively impervious bedrock means that water can very quickly run off into Cascade Brook. If the soils are already saturated by previous rainfall and there are no leaves on the trees or actively growing plants to deflect the rainfall and the rainfall is heavy, runoff quickly reaches the main stream and may exceed the ability of the stream to contain the water. On April 16, 2007, all of the above variables came together and the stream flooded.

The amount of water in a stream is known as its discharge, which is proportional to the cross-sectional area of a stream and its velocity. High gradient streams have high

Steep slopes and gravel soils in the Cascade Brook drainage



Scale: One Inch = 2500 feet

Adapted from Amenia Comprehensive Plan and USGS Amenia Quadragle

velocities. When the cross-sectional area is not adequate to contain the water, the stream overflows its banks onto the flood plain, an area that is part of the stream channel.

Because of its high gradient north of Folan Road Cascade Brook, on April 16th, left its banks and damaged Cascade Road severely. The bridge over the stream on Folan Road was also badly damaged. South of Folan Road, the stream gradient becomes less steep, the valley widens, and the stream has a flood plain onto which it flows during high water. For reasons unknown, there is not a designated flood plain along Cascade Brook and several houses have been built close to the stream in this area. These houses came very close to being in the stream instead of along the edge. A larger rainfall under the same circumstances could inundate them.

Cascade Brook running down Cascade Road, April 16th, 2007.

Just north of Route 22, the stream stops meandering on its floodplain and runs straight south in a channel between Cascade Road and farm fields to the east. It is joined by an intermittent stream just before passing under Route 22 where it flows into a large wetland. The Freshtown Plaza parking lot has also received the overflow from the stream at this point.

Cascade Brook flooding Freshtown Plaza parking lot, April 16th, 2007.

It should be evident that Cascade Brook, like most streams, is prone to flooding. Structures built too close to this stream, and any other watercourse, will be subject to damage. When the floodplain of a stream is built on, the water will still go there. If levees and other flood control devices confine the stream, the water will still cause damage to neighbors downstream.

Wassaic Creek flooding onto the floodplain south of Wassaic, April 16th, 2007.

Wassaic Creek flooding the Wassaic playground April 16th, 2007. Playgrounds, properly constructed, can be located on floodplains. Floodwater came over a 3' high berm.

The flood of April, 2007 should be ample evidence that the 100 foot buffer and other buffer zones in the Stream Corridor Overlay in the Comprehensive Plan is needed and should not be changed. Cascade Brook is just one example in the Town Amenia. Nearly all the damage done in flooding was to structures and roads that were built too close to a stream.

The Town Board should not consider changing the 100-foot setback in the Stream Corridor Overlay of the 2007 Comprehensive Plan.

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