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# The homestead: Revisited

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The Homestead: Revisited

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A thesis submitted to the Graduate Faculty of

JAMES MADISON UNIVERSITY

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## ABSTRACT

This paper discusses ideas for harmony on 100 acres in mid-eastern New York. Problems leading to this research include the depletion of resources from irresponsible energy use and profit-driven industrial agriculture; dependency on fossil fuels and centralized energy; and lack of connection between people within communities, with their environment, and with sources of food and water. It is feared that sustainable, resilience building practices that nourished generations throughout history are being neglected. This specific application provides depth and concreteness to the discussion and planning process. Resources including books, maps, reports, and periodicals were integrated to select the site and plan the layout of the homestead. The outcome is a place where an extended family could meet as many of their needs as possible while improving resources. Instead of depleting resources the intention is to strengthen them with responsible management. Recommendations include reduced dependency on high-technology and fossil fuels. Soils may be nurtured with amendments, reestablished nutrients, and growth of healthy microbes instead of continuously being plowed, planted, and treated with chemicals. Multi-tiered gardens of perennial trees and shrubs provide varieties of food and materials throughout the year. Home or community scale energy projects can be developed. Through adequate design and practice, energy needs can be reduced to a level that is possible to maintain from the site or local community. Renewable construction, extensive insulation, passive solar heating, traditional food preparations, as well as polyculture plant and animal husbandry can be combined to create a living system that cycles nutrients with itself and neighbors, instead of producing waste. The conclusions of the author are that corporate agribusinesses, energy companies, and the debt-economy should be broken-up to establish local trade. Families should be kept together, not spending what they do not have, and learning how to love the environment that provides them with sustenance. Hope should not be placed on salvation through ever higher technology or through political or economic gimmicks. Sustainable husbandry produces benefits by attention and anticipation toward natural systems that already work together with the power to move mountains yet the gentleness to heal wounds.

## ***1 INTRODUCTION***

This paper outlines the search for a place to live and a way of life that can truly be perpetuated indefinitely. It proposes a plan for a hypothetical homestead at a specific location that can comfortably and healthfully support an extended family of 8-20 inhabitants. A homestead is a dwelling with land and buildings where a family makes its home. This homestead could also be a place to test, model, and educate about sustainability with the goals of impacting the health of our environment and resources.

If future crises will be severely disruptive to society, the goal is to establish a homestead that is safe, sustainable, and healthy now. This may not be the only way but it might be the most enduring, depending on how fast and severe a crisis occurs and how people react to it. It is important that a homestead should consist of safe, comfortable, indefinitely sustainable shelter and provision for some number of people living a natural existence. This includes heat, water, food, clothing, and income that can be used to provide for any needs beyond what is possible to produce onsite. External inputs should be minimized and the homestead should be very loosely coupled and non-dependent in its interactions with the outside. Every part of the system should be open to inspection and adjustment to the most appropriate technology in view of its interdependencies within the rest of the system.

At stake is life as we know it, including how we live, where we live, how we interact with the world, the products and processes we make and use, and how we feel about our surroundings, as well as the effects we have on them and they on us. This study draws on history and traditional ways of doing things as well as new technologies and innovations. It aims to look at the whole life-cycle of all of its parts, seeking elegance and harmony.

Designs can be more proactive so products are nurturing throughout their entire existence instead of serving a single purpose, produced then disposed of regardless of the expense.

The objective of this project is to plan for a home. Not just a house but a thriving homestead, of which people are a central part. It is intended to describe and reason out the details of such a dwelling. It is hoped that through research, planning, and description, the idea can be developed concretely. The guiding principles of this study are very important to the problems that plague the world in resources, environment, health care, and housing. While this paper does not set out to solve these symptoms it aims to treat the system that produces them, starting with the family unit and the home.

This project attempts to walk through the thought and planning process of creating a homestead including everything from site selection and basic habitation, to building and land layout design and construction. Additionally, cultivation, food and maintenance processes, special technologies, and the ways in which the homestead system depends on the outside world are covered.

It may seem simple but there are some things that represent the character of a homestead. They include cultured dairy products, whole grains, and homemade beer. They conjure visions of a warm, timeless atmosphere in the home with a fire, timber frame construction, and a heavy wooden table. There is comfort and a desire to enjoy and perpetuate life. This may be a quaint picture but there must be some reason for it.

This paper idealizes and envisions a sustainable, self-sufficient, homestead; a place for a family to live and grow that could continue to support successive generations indefinitely, allowing them to thrive comfortably and happily to their greatest potential. Given adequate water and soil, a homestead would need to support 8 – 20 people, which

would responsibly replace each generation (including those who do not or cannot have offspring), having up to four generations alive at once. It would need to provide shelter, heat, water, food, and clothing. Our current ways of providing these things for ourselves are not sustainable, so they will have to be done differently.

While some agricultural operations are modeled in terms of financial flow or energy flow, here a holistic model is proposed that depicts the variable inputs and outputs of all the subcomponents of the system necessary for the system to function. The goal is natural health and sustainability not optimizing solely for the greatest profit. The reasoning behind this paper is multifaceted and includes some philosophical beliefs about the ways we approach the world and our place in it. It comes from a concern about our environment, abusive energy habits, our personal and national security, and our ability to live proactively healthy lives. To assess the things we take for granted it asks the question: what is the least it takes to live comfortably? And how can we live more simply with less?

Some goals include trying to provide the greatest amount of leisurely, contemplative, family and education time as possible. Part of this dream is to live as remotely as possible in a place that has low population and low levels of light, noise, and chemical pollution. Another aim is to be as independent from society as possible in energy, goods, and services; not disconnected just independent. In essence what is sought is a natural existence in harmony with the environment and uncontaminated by modern processes. Cost is a factor and it is a goal to make money less of an issue by resourcefulness and design that considers the full lifecycle of materials. It is also a goal of this project to encourage a community and systems where local food is the norm.



## SELF-SUFFICIENCE, ENERGY, SUSTAINABLE

The crux of the energy matter is that modern society has developed in a way that is so dependent on large quantities of inexpensive oil that without it life, as it is known today, will cease to exist. The population of the world at 6.8 billion has quadrupled in size in the last 100 years since the widespread use of oil began. As is commensurate with a population using up the resource it most depends on, there could be a human population crash in the next 50 years. Part of the motivation for this project is to seek out a livelihood that is most resilient to these conditions.

Based on published land and population estimates there are currently only 1.56 arable acres per person in the United States. That would allow each family of 20 people 31.2 acres of arable land. If it turns out that 31.2 acres is not enough for a family to live off of, it would not be possible for everyone to implement a plan such as this. What this points to is the fact that we have overpopulated to the point of being dependent on our technology, which undermines our ability to perpetuate our lifestyle indefinitely. The goal is to determine the optimum balance and implement responsible living.

Some ideals for planning and living a more self-sufficient life have become apparent. It is desirable to use petroleum fuel wisely and not be dependent on it, not waste time or money, reduce unnecessary material items, try to keep from getting tied to metropolitan areas, be very careful about entering into a mortgage that is unaffordable, keep a simple systems view in mind, and keep projects and their requisite materials simple. While these ideals seem easy they may prove to be very challenging and exactly the catalyst to the change in life that is necessary.

Living “off the grid” is a popular catch-phrase for not being connected to the power utility company. Often it seems to be the first step people consider in becoming self-sufficient; motivations vary, but it may be for the simple reason of not being subject to the price and availability of electricity. Thinking about life “off the grid” is productive because it causes one to reexamine how life is lived in terms of modern dependencies that are taken for granted. For all expenditures of energy one should reevaluate their needs instead of attempting to produce all the energy they currently use from alternative means.

### ECONOMY, DEBT

This paper examines the home as a place of value. What does it really take to make a home that is comfortable and productive for its inhabitants? What does it take to make a home supportive of life and an integral extension of its inhabitants? How can we design homes that are healthy to live in, inexpensive, and efficient; houses that encourage creativity and activity? Is it possible to own a comfortable home without paying for a mortgage for the rest of one’s life? It may be a good model for everyone to wait until they can afford a piece of property in full before they buy it.

A goal of the homestead plan is to alleviate the debt trap. Society is slow to change and could be characterized as a prisoner of its own technology and economic system. The average citizen would probably say that they are so deep in debt that they have no choice but to hold on and keep plodding. For most people buying a house is the most expensive decision they will ever make. The house is part of the “American identity”; the American dream is the house and lifestyle that goes with it. This country is the perfect place for a housing market. There are a lot of people and a land to develop while the open market ensures that the things people value most can command a premium. But that premium is

not necessarily true value. Over the last seventy years suburbs have risen and are now arguably dying because of their distance from jobs and resources (Leinberger 2010).

Another side of homesteads and debt is their relation to agriculture. In his book *Crisis & Opportunity*, John Ikerd (2008) discusses this to great effect. The debt trap reaches deep into American agriculture and is destroying it. The problem is aggravated by the industrialization and corporatization of farms. Farmers find themselves on a technology treadmill where they must continually run faster and faster every time they make a gain in their market. Every battle won requires greater debt to expand and compete; always seeking the promise of greater profits. While greater profits are supposed to increase standard of living, the greater debt and higher risk actually lower the standard of living at every step. This system is based on competition; when one farm fails another grows. It ignores the social and environmental aspects of farming.

The current industrial agriculture system was formed by classic economic theory that tries to maximize profit, assuming it to yield higher standards of living for the farmers and consumers. Things with no economic value are not counted. In order for farmers to compete in the corporate scheme they must specialize, using monocropping systems to gain efficiency. To further gain efficiency, they must continually invest in new technology and expand to compete in the market. They do not set their own prices. They must depend on agribusiness to handle transportation, processing, and marketing, while they specialize on producing one product. This makes them more and more vulnerable to fluctuations in market prices and the health of the crops because of weather. (Ikerd 2008)

Ikerd goes on to say that a farmer without a corporate contract does not have a market. The industrial system is not sustainable because it uses resources to make money.

Agriculture is addicted to fossil fuel and government subsidies. It does not invest in its own soil and community because those factors are not accounted for in traditional economics and large corporations do not care about localities. Consolidation of decision-making under corporate control harms the individual farmer and the community. The corporation only wants to control the market and their profits, take advantage of an area and leave it barren. (Ikerd 2008)

Being competitive requires specialization, which increases financial risk by reducing the ability of the farm to repay its debts. High-input, high-investment farms require a lot of cash intensive inputs and relies on government programs to protect them from risks. When farm commodity prices plummeted during the 1980s, farms with large cash commitments for loans and high-variable cost inputs failed. Their labor and management had little to do with their value and so they were at the mercy of the market and corporations. Large corporations dominate the economy, consumer, and producer through supply, demand, and advertising. Producers no longer compete, and consumers do not make free informed decisions. (Ikerd 2008)

Sustainable agriculture is about meeting the needs and wants of consumers, building relationships with them, and producing in environmentally responsible ways. Value is created by building relationships with people and providing products to them in unique locations. Ikerd lays out three principles of sustainable farm economics (2008, 122-139).

The first is the pursuit of enlightened self-interest, which recognizes the individual, interpersonal, and spiritual responsibilities of the producer. It goes beyond historical profit driven economic theory and seeks to benefit the community and future generations that do not even exist yet.

Secondly, he recommends taking a holistic approach to farm management. This involves integrating crops and livestock to manage pests, maintain soil health, efficiently use labor, and diversify production and markets to reduce risk. Interactions of economic, social, and ecological aspects of the farm should be assessed to improve quality of life instead of just seeking profit. In line with the proposed homestead ideals, Ikerd recommends relying on diversity instead of off-farm inputs to reduce out-of-pocket variable costs and increase resilience.

Finally, the principle of individuality provides consumers with full economic value. Here, profits are gained from providing unique products that are what people want, not the standardized marginal quality products often found in supermarkets. Instead of selecting products for mass production they are selected for flavor and nutrition. It is essential to make relationships with consumers and sell specific goods directly to them.

In trying to overcome and subdue our environment we have initiated ways and means with which we and our successive generations have to live. The short-cuts and technologies of today crystallize and stick to us for better or worse and become a part of us. People are afraid of climate change as well as water and energy scarcity. Our infrastructures are falling apart around us, and we grow ever more dependent on increasingly complex and fragile technologies with the potential for catastrophic losses when they fail. Self-sufficiency may require independence from industrial products so refined that they cannot be recreated by hand. As post-industrialization is considered here, it may be found that humans do not need these things to live well; in fact living without them may have environmental, social, and spiritual affects that actually increase

standard of living. Perhaps our children will never know what it feels like to be unable to breathe deep enough, or find water clean enough.

## OUTLINE

This paper is broken into eight chapters. This first chapter introduces the subject of the paper its aim and objectives. The scope of the project is discussed here as well as some of the philosophy and reasoning behind it. Background information on the subject area is given consideration and main resources are mentioned. This section also contains the plan or layout of the paper and its contents.

The second chapter discusses the real location that is being used as a concrete example for this study. The selection process, albeit in reverse from normal real estate research where the location is chosen first, is laid out including information sources and tools. The location is variously described in great detail including topography, and resources. The reasons for choosing this site, from the universal to those of personal choice, are explained as well.

Chapter 3 describes the approach to the site assuming the inhabitants to be starting from scratch. It includes the process of getting settled on the property and dealing with shelter and immediate needs such as heat and water. More developed water and heat systems are briefly discussed, including alternative technologies that minimize our impact on the environment and reduce our use of energy while making better use of the resources that are available.

Chapter 4 looks at the land on the property and how it is laid out. The geology of the site is described in detail. Land use areas including fields and a pond are considered from the view point of the physical environment, resources, purposes, and topography.

Building placement is also discussed here along with other land uses on a modified aerial photograph of the location. The environment is approached with respect, recognizing the ease with which it could be disrupted to its detriment.

Chapter 5 describes how the land will be used. Housing is discussed as an extension of the inhabitants, how it meets their needs and provides a safe, nurturing place. This chapter also looks at the needs and operation in cultivating livestock, aquaculture, crops, permaculture, and plants in the greenhouse. Livestock too, needs shelter and a habitat that produces health and good food for human consumption. An underlying goal is to reduce energy and work input by utilizing natural forces and interactions that perpetuate beneficial life.

Chapter 6 is about processes for food, preservation, and nutrition. The fundamental energy chain of the homestead is directed to supply continued sustenance. Staples of the human diet are discussed, along with ways of producing them that were developed and used by humans, long before refrigeration and processed foods, to match their nutritional needs. The assertion is that ways of making and preparing food that were effective for long periods of human history are more likely to be sustainable and healthy than newer “improved” or “convenience” goods. Methods for culturing dairy are detailed along with fermented foods and beverages.

Chapter 7 takes a look at some unique technologies and their role in the homestead. Man is a maker of tools that allow him to interact with his environment for his benefit. Many inventions that are wonderful in the short-term have long-term consequences that are not beneficial. Technologies are viewed as appropriate when they are sufficiently low-tech, long lived, useful, pleasing, and especially relieve a stress or disharmony with

the environment. As we find ourselves with waning petroleum resources, back-up systems must be developed; ideally these will be indefinitely sustainable and have no ill effects on the environment.

The final chapter, Chapter 8, evaluates the homestead as a system of dependencies. It looks at the disharmony created by the needs of the inhabitants and the flows into and out of the homestead. With a goal of self-sufficiency, the reality that some useful items are readily available is not to be overlooked just because they come from off the site. Resourcefulness is a characteristic of survival, which is the ultimate concern. The long-term sustainability may be catalyzed with contemporary resources while they are available. Processes should be constructed to have outputs that are useful, not wastes.



## **2 LOCATION**

Now is a time of unparalleled mobility. For someone who wants to move across the state or country it has never been easier. Computers and the internet make available a vast amount of location and mapped data for determining a location. While this is a hypothetical study, it is shaped by many real-world parameters. Those which are most restrictive to location include: adequate amounts of rain, affordable arable land, low population, low levels of nighttime lights, and (of individual preference) two United States Department of Agriculture Climate Zones north of the mid-Atlantic. While this site selection process is in reverse from the normal order of finding a location and then researching it, the tools used here are equally useful for conventional real estate research.

This chapter discusses the location, topography, and resources of the property. Some reasons for choosing it include: fertile soil, abundant ground water, areas of open water, a good growing season, and adequate precipitation to grow food and animals. It also has clean air, low noise pollution, and is a reasonable distance from neighbors. There is a town within 10 miles and there are no nighttime lights. It is not so flat that it is boring yet not so mountainous that it is stifling. This location has low property taxes, low property cost, a snowy winter, low population density, diverse ecology, and forested land.

### **COARSE SELECTION**

The selection process began with a very wide area; the entire United States was under consideration. One of the greatest factors for life is fresh water. While much of the world faces water shortages, roughly half of the United States contains moist, Udic soils that receive adequate rain for robust agriculture. This is shown in the green areas of the map in *Figure 1* (United States Department of Agriculture 2003).

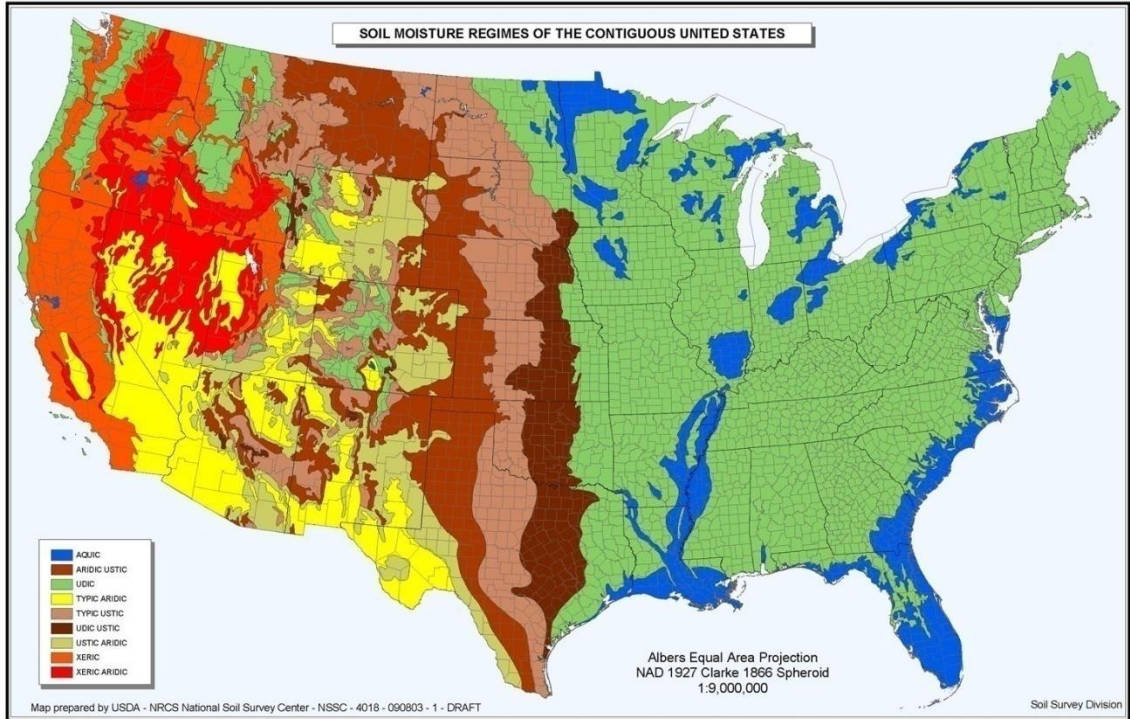


Figure 1. USDA Soil Moisture Regimes of the Contiguous United States

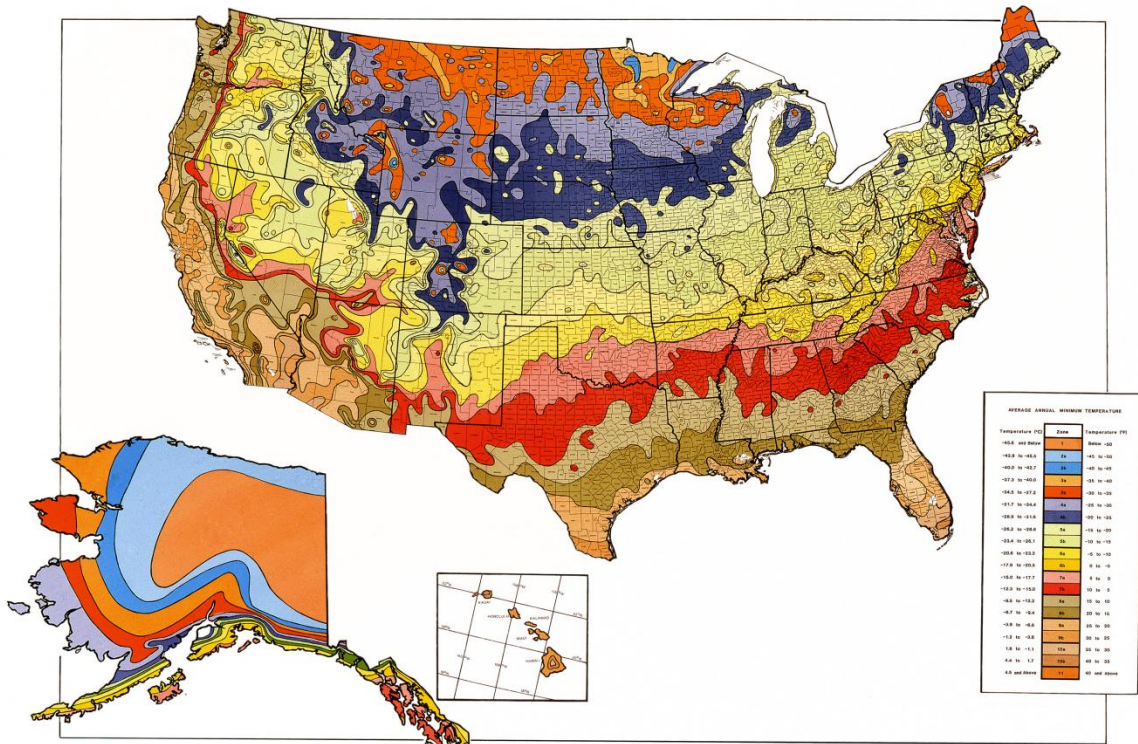


Figure 2. USDA Plant Hardiness Zone Map Zone 5a is the lightest yellow

The hypothetical search is then narrowed to the eastern half of the country or some moist strips in the Pacific Northwest, Idaho, and Colorado. Looking at the United States

Department of Agriculture (1990) Plant Hardiness Zone Map (*Figure 2*) shows the goal region (Zone 5a) of two Climate Zones north of the Mid-Atlantic (Zone 7a) to cover a small band of the Northeast from southwestern and mid-eastern New York to southern Vermont and New Hampshire, and up the coast of Maine. The more moist areas of the Pacific Northwest are too warm to fall into Zone 5a and the cooler areas of Idaho and Colorado were determined to be too rocky.

Looking at the Northeast region in finer detail, in *Figures 3 and 4*, shows poor soils covering most of the area (United States Department of Agriculture 1985). The purple band specified from southwestern and mid-eastern New York to southern Vermont and New Hampshire, and up the coast of Maine, can be further excluded by the population density as shown by maps of population and nighttime lights shown in *Figures 5 and 6*, respectively (National Atlas 2010). These figures show the population of southern New Hampshire and the Maine coast being relatively high. This leaves only the areas of southwestern and mid-eastern New York as well as southern Vermont. Southern Vermont is ruled out by being too rocky.

A soil report conducted in 1967 by the United States Geological Survey shows these areas to contain warm, moist inceptisols, or soils with weakly differentiated horizons showing alteration of parent materials. From east to west they are I9 – Eutrochrepts, I8 – Dystrochrepts, and I10 – Fragiocchrepts. Eutrochrepts means good, fertile soil that is pale with little organic matter. Dystrochrepts means infertile soil that is pale with little organic matter. Fragiocchrepts means brittle soil that is pale with little organic matter. In this classification scheme this plot falls into the I9-2 area of Eutrochrepts just west of the Vermont border (See *Figures 3 and 4*).

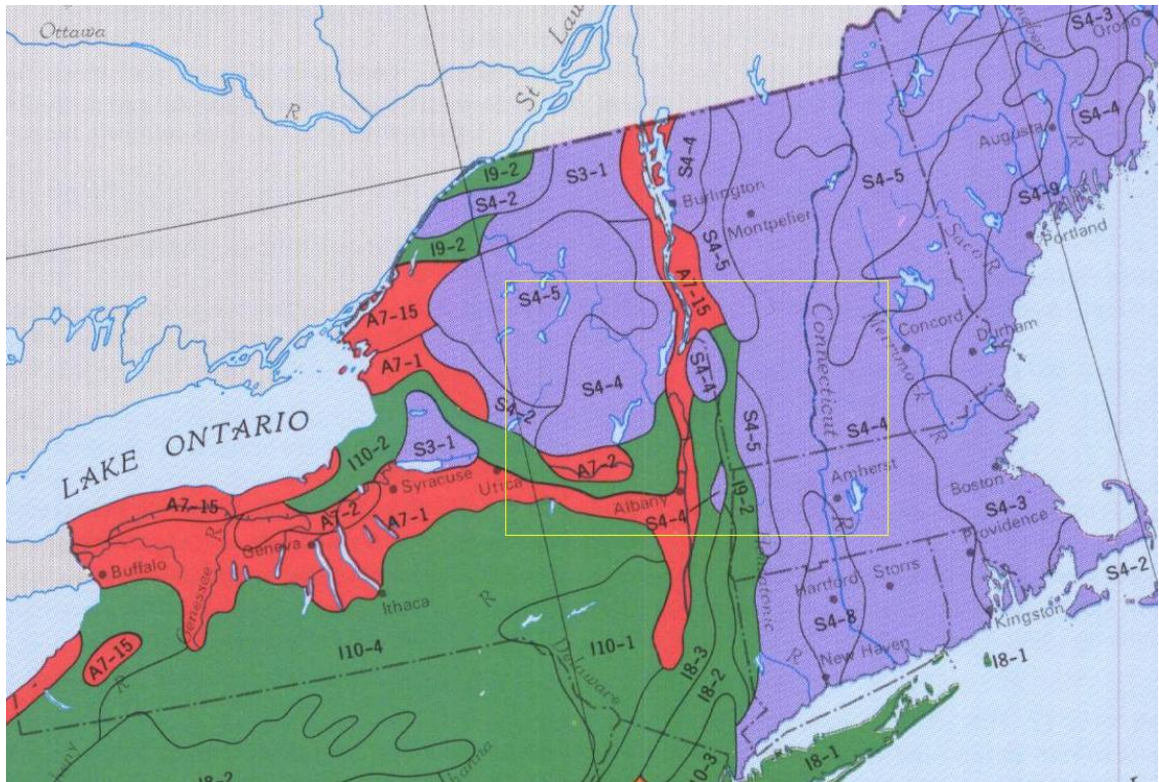


Figure 3. USDA Principal Kinds of Soils; cool, moist, rocky Orthod soil in purple

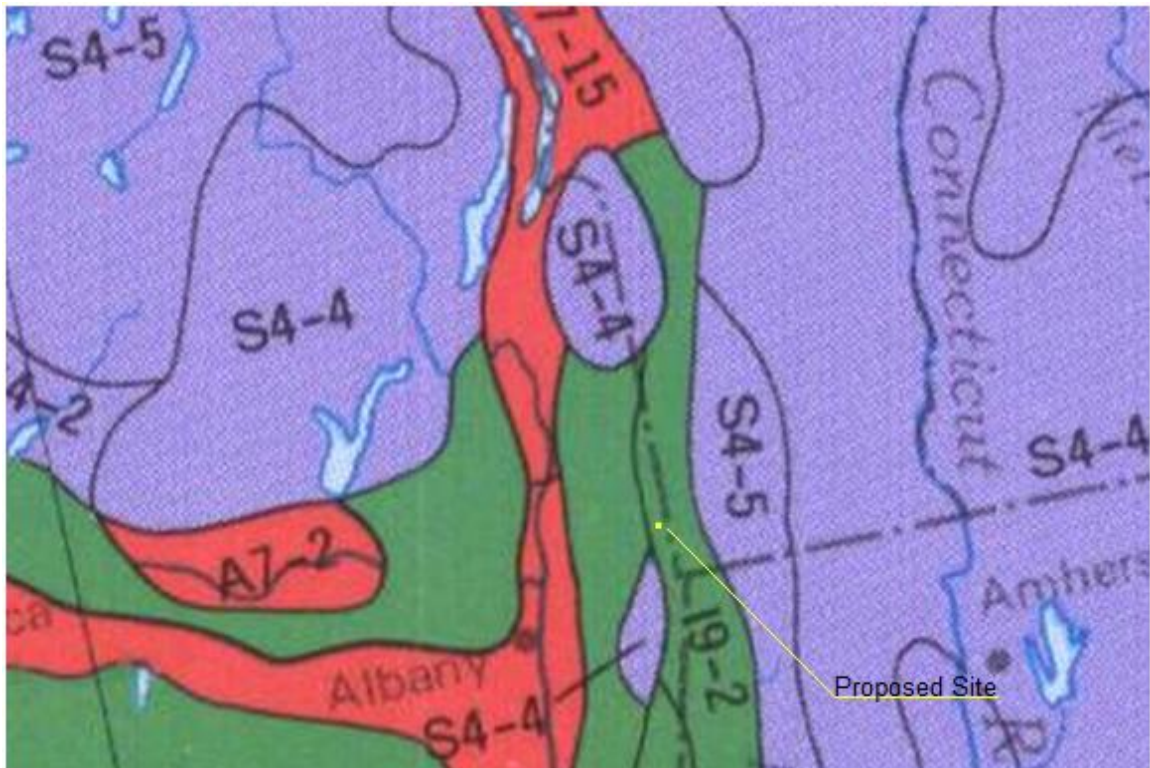


Figure 4. I9-2 Inset from Figure 3, Eutrochrepts is fertile soil that is pale with little organic matter

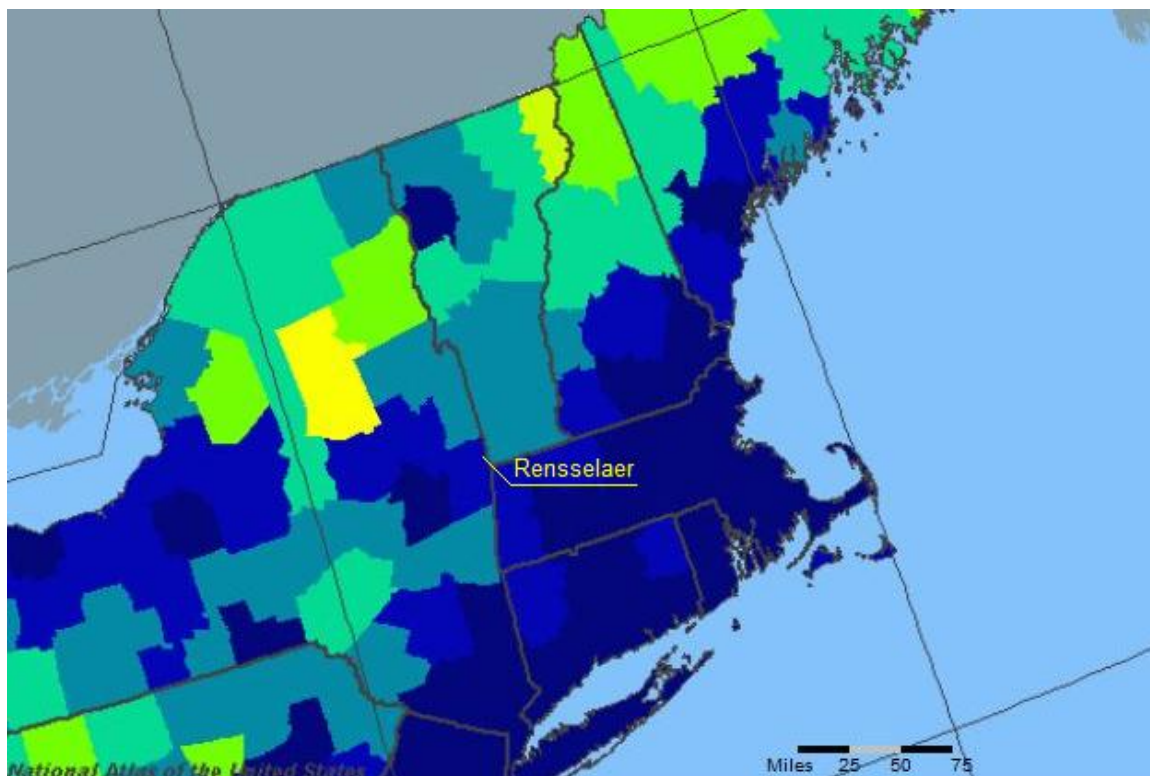


Figure 5. Population density from the 2000 U.S. Census; Rensselaer Co. has 100-249 people square mile

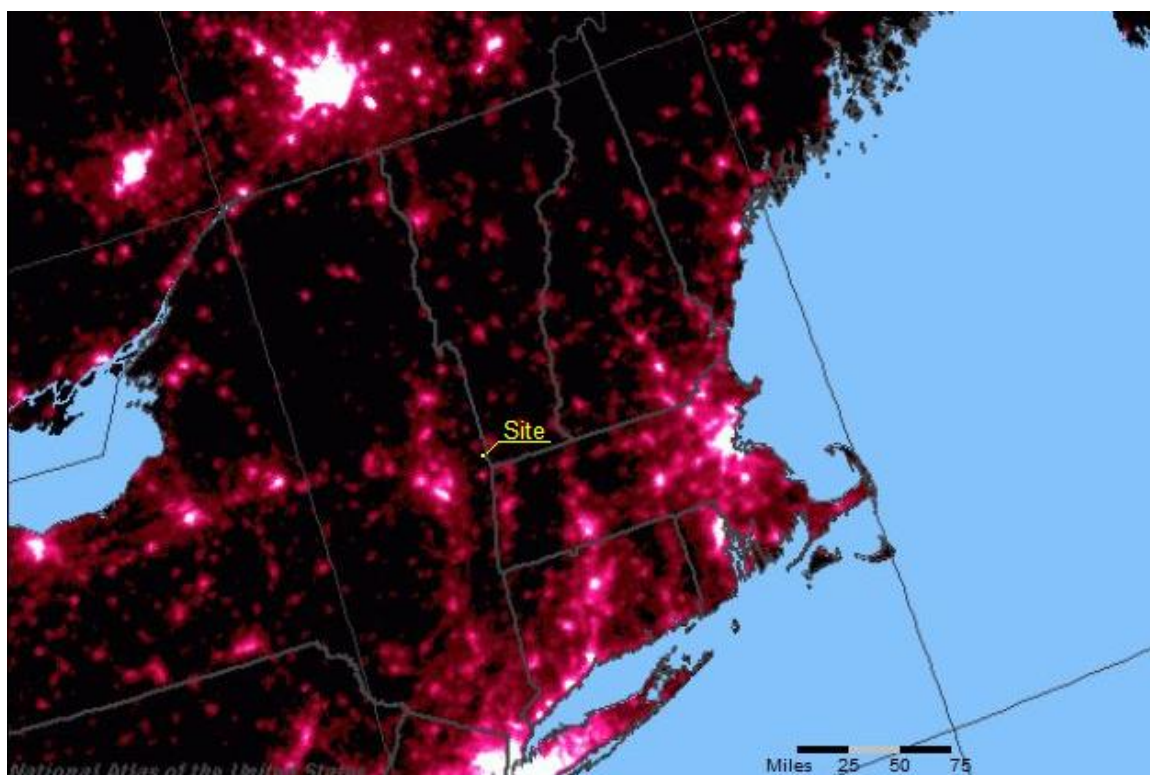


Figure 6. Nighttime lights are low within 10 – 12 miles of the site; Albany is 30 mi to the southeast

## FINE SELECTION

Additional detail has been afforded by modern digital mapping techniques. A survey by the National Resource Conservation Service (2009) confirms the site to be of adequate soil quality as is the moderate quality of the central western plains surrounding Seneca and Cayuga lakes (*Figures 7 and 8*). The more western areas are of higher quality on average, but they do not have any mountains for the preferable south facing slopes.

The Natural Resources Conservation Service survey provides the Nonirrigated Land Capability Class. The classifications show the general suitability of soils for most kinds of crops. The soils are grouped according to the limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. Class 1 soils, shown in green, have few limitations that restrict their use. Class 2 soils, shown in yellow, have moderate limitations that reduce the choice of plants or that require moderate conservation practices. Class 3 soils, shown in red and Class 4 in blue, have severe limitations that reduce the choice of plants or that require special conservation practices or both. Classes 5 – 8 (teal, orange, brown, and magenta) are not suited to crops.

Comparing the two locations in New York, Cayuga (*Figure 7*) and Rensselaer (*Figure 8*) counties shows Cayuga to be of better overall average quality, being mostly Class 2 soil. However, Rensselaer County has a small amount of Class 1 soil in its northeastern corner along a river bed (shown in *Figure 9*). Looking more closely at the topography (in *Figure 10*) of this area shows some topographical features that are also desirable. The heart of this fertile land is Hoosick River, especially at the intersection of routes 22 and 346, south of Hoosick Falls, NY along the Hoosick River. There is a vein of fertile land that follows, then extends down along routes 22 and 346.

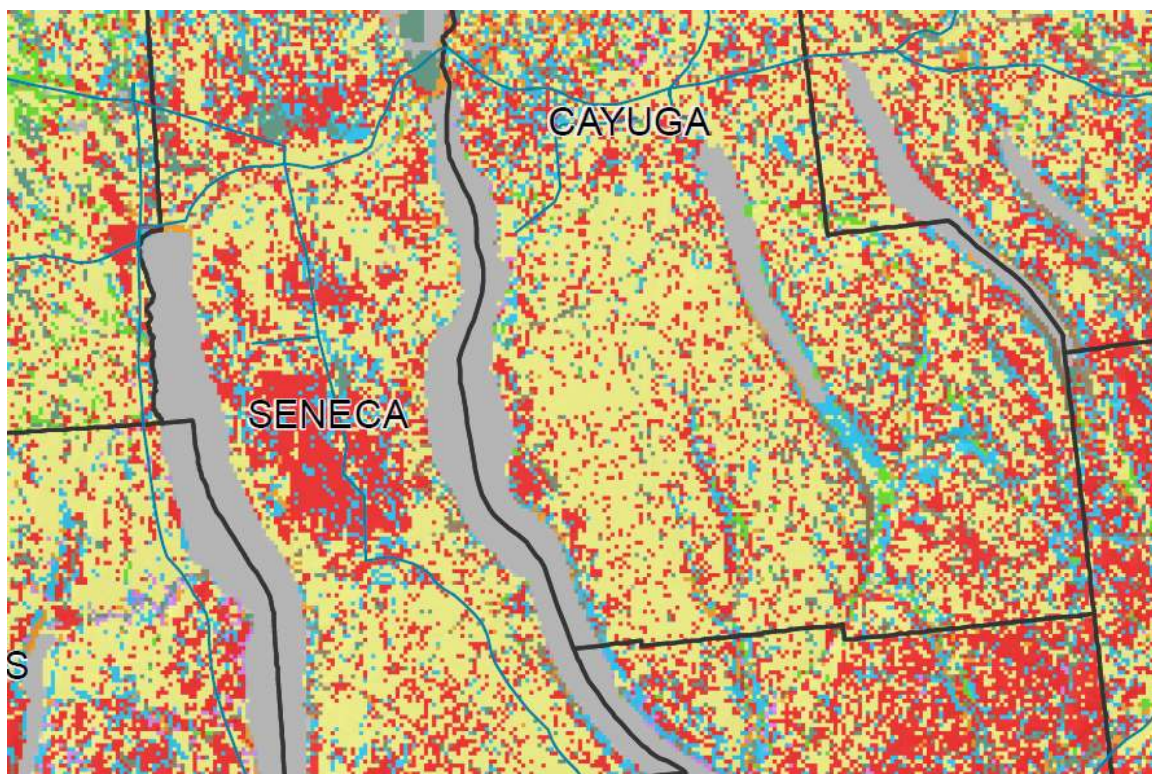


Figure 7. Cayuga Co. is mostly Land Capability Class 2 in yellow; green represents Class 1, and red is 3

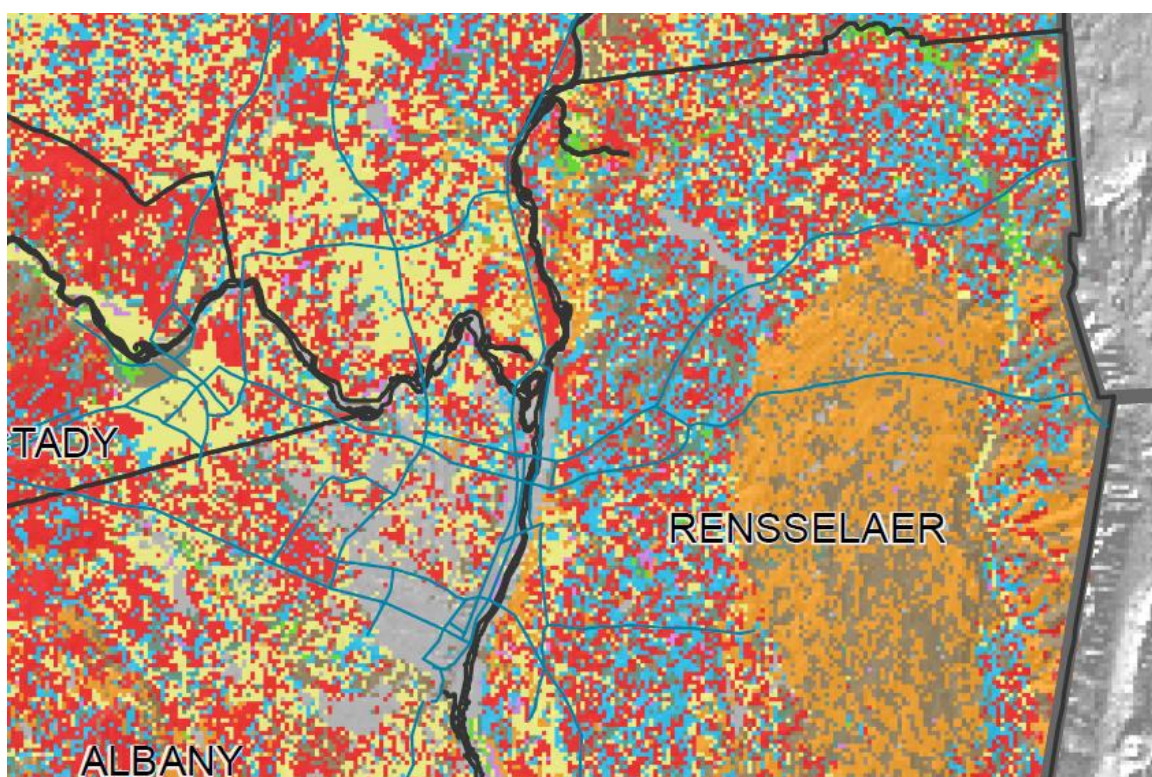


Figure 8. The Hoosick River Valley in northeastern Rensselaer Co. forms some Capability Class 1 land

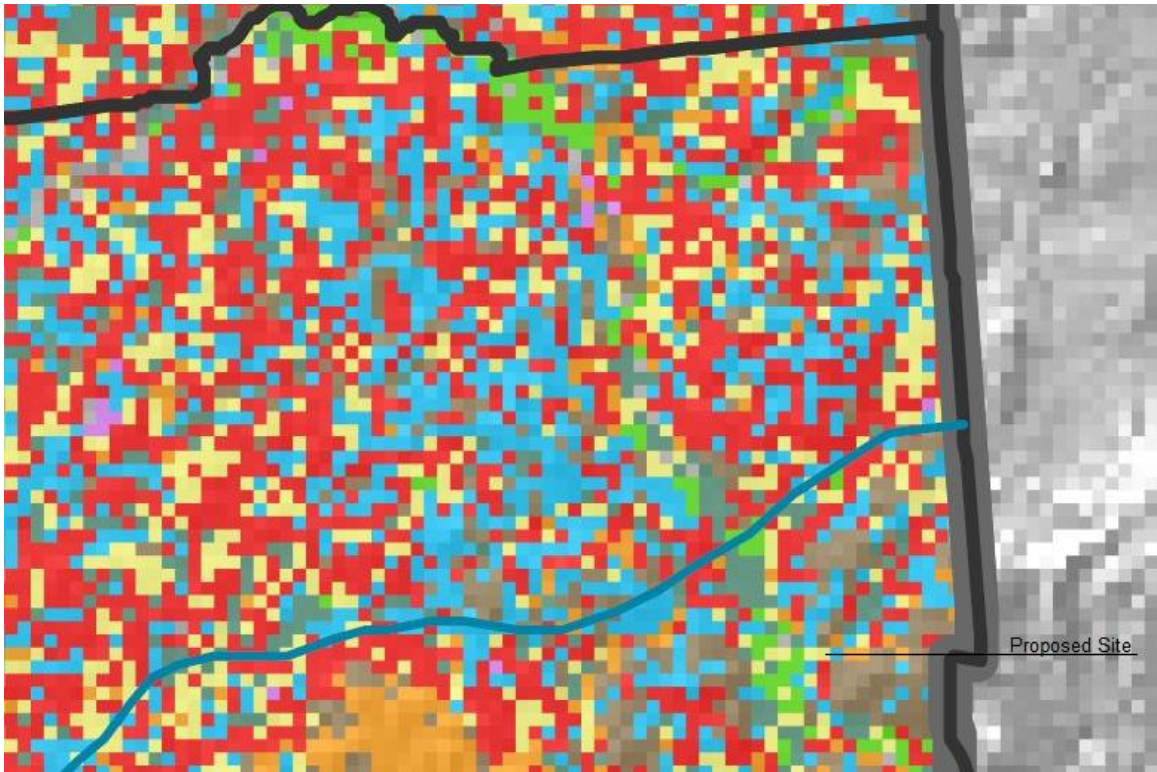


Figure 9. A close-up of the proposed site situated to the northeast of the Hoosick River Valley



Figure 10. The yellow square marks the site chosen; it is shown in greater detail in *Figure 11* below



The Hoosick valley is formed by low Berkshire Mountains ranging up to 1500 feet in height. It ranges from 2 to 5 miles from the Vermont border and is about 8 miles west of Bennington, VT and 30 miles northeast of Albany, NY. The Hoosick river originates in the Berkshire Hills of Massachusetts, the Green Mountains of Vermont, and the Taconic Mountains. It runs northwest through Hoosick Falls, providing hydroelectric power there and terminates in the Hudson River.

After finding land of a suitable Capability Class, a specific location was chosen. In reality this will depend on actual availability of a piece of land and would be constricted by its real dimensions. However for this study, liberty is being taken to choose these dimensions freely. To hone in on a specific location, consideration was given to open, flat, low-lying land with a south facing slope behind it to shelter it from cold north winds.

Perhaps the most ideal location in this area is along the north side of County Road 96 (not shown on map), which runs southeast toward VT, parallel to Route 346 and the Hoosick river shown in the lower right of *Figure 10*. Here there is a fine, flat plain of fertile soil in the valley. However, this site was discarded for two reasons. First, County Road 96 runs so close to the mountain that it would invade the privacy of the house. The second reason, while being less practical but more salient, is that County Road 96 is named Indian Massacre and that, whether a memorial or not, makes it less desirable.

The next closest south facing slope that stands out is in Breese Hollow (*Figure 11*). There is a steep south facing slope at what would be 270 Breese Hollow Road. The more gentle and amicable sounding Breese Hollow Road extends from the Hoosick Valley northeast toward Vermont's Green Mountain National Forest where it joins VT Route 9 to Bennington, VT, which is about 7.5 miles. On the way it passes by Southern Vermont

College and the route is without any major changes in elevation. Likewise it is about 6 miles to the town of Hoosick Falls and 2 miles to the Hoosick River. The exact latitude and longitude of the location is: 42.850322, -73.306748.



Figure 11. This contour map shows the site superimposed as a grey square on the topography of the area

The plot size chosen for this site is somewhat arbitrary; it contains 42 acres of arable land, 10 more than the theoretical allotment of 1.56 per 20 person family. A homestead in the United States, per the convention of the Homestead Act before 1909, was up to 160 acres of undeveloped land outside of the original thirteen colonies (National Archives and Records Administration 2010). This is the size of one-quarter of a land survey section (a

section equals 1 square mile). 100 acres at this location reaches up to the top of the mountain behind it and encompasses a stream along its eastern edge.

#### SITE DESCRIPTION

*Figure 11* depicts the site on Breese Hollow Road. It is centered at street address 270 and encompasses 100 acres. The red marks along the axis are at 500 foot intervals with the outside border being 1,043.75 feet from the center. The highest point on this map is the top of the mountain at 1080 feet above sea level. The lowest point is approximately 660 feet within the area circumscribed by the 680 foot contour line to the south. The eastern side of the plot contains over 1000 feet of stream. The 720 foot contour line circumscribes approximately 16 acres of flat land. County Route 100 (Breese Hollow Road) runs through the plot from the southwest to the northeast.

The northwestern quarter of the plot contains the steepest, nearly south-facing, slope. The land grade on it was determined by drawing a line that runs from the center of the top of the mountain perpendicular to the contour lines. From the 960 foot contour line to 920 feet the grade is 25%, down to 880 feet is 21%, to 840 is 22%, to 800 is 27%, to 760 is 23%, to 720 is 11%, and finally to 680 is 2%. The steepest segment, from 800 to 840 feet in elevation is a good location for the house so that it can be protected and insulated by the mountain while enjoying its southern exposure for warmth and sunlight. It is also far enough back from the road to provide privacy without being too far from the center to make it inconvenient as a hub of the property.

#### LOCALE INFORMATION

According to an ecological survey done by the United States, Mexico, and Canada (Commission for Environmental Cooperation 2006) this area resides in an ecological

region known as the Eastern Great Lakes and Hudson Lowlands. It is an area of mixed wood plains in the Eastern Temperate Forests. It is a region of irregular plains formed by glacial activity and bordered by hills. It contains less surface irregularity and more agricultural activity and population density than the Northeastern Highlands to the northeast and Northern Appalachian Plateau and Uplands to the southwest. Orchards, vineyards, and vegetable farming are important locally, but a large percentage of the agriculture is associated with dairy operations. The area adjacent to the Great Lakes experiences an increased growing season, more winter cloudiness, and greater snowfall.

The climate in Hoosick, NY is generally mild and temperate. Temperatures range from an average low of 20 °F in mid January to 70 °F in late July; about 20 °F cooler than the United States average. During the winter, precipitation at 2.5 inches per month is a little lower than the national average. In the spring, summer, and fall precipitation ranges from 3.5 – 4 inches, about 20 – 30% higher than the United States average. This is reflected in the relative humidity as well, in early spring it is at the bottom of the average United States range around 50 – 70%, at the end of summer it is nearer the top at 60 – 90%. (City-Data 2010)

Hoosick falls into the United States Department of Agriculture growing Zone 5a. Here the average minimum annual temperature is -15 to -20 °F. The growing season is 144 days long with the first frost date being 29 September and the last frost not until 7 May (United States Department of Agriculture 1985). In 2008 and 2009, New York averaged 6,042 heating degree days from a base temperature of 65 °F. There was also an average of 698 cooling degree days (National Oceanic and Atmospheric Administration 2010). The climate of the area affects its character and suitability for agriculture.

Hoosick receives fair amounts of wind, snow, and sunshine. Wind speed ranges from a high of 10.5 miles per hour in early spring to a low of 7 miles per hour in mid-August, closely matching the national pattern. The northern latitude of Hoosick provides more snow and less sunshine than average. Snowfall often occurs from October through April at 3.4 times the national average. The peak in January and February often sees over 16 and 13 inches respectively. Sunshine is moderate as cloudy days prevail 50% of the year and partly cloudy days 30%. Sunshine is about 10% less than the United States average hitting a low of 35% radiance in November and a high of 65% in July. (City-Data 2010)

In 90% of New York State, bedrock is buried by surficial deposits that are more than 3 feet thick. Most of the deposits were left by a continental glacier ice sheet that was probably 1.5 miles deep. The most common glacial deposit is called till. It is a mixture of mud, sand, gravel, cobbles, and boulders carried by the glacier over the land. Till can be up to 150 feet thick and is generally thickest in valleys and thinnest over highlands.

In the map shown in *Figure 12*, the location lies in a strip of purple bounded by light green with a neighboring triangle of dark blue (Natural Resources Conservation Service 2010). The purple represents the Hudson-Mohawk Sheet of the Walloomsac Formation. It was formed in the middle Ordovician period and consists of slate, phyllite, schist, and metagraywacke. The green is the Adirondack Sheet of the Poultney Formation ("B" and "C" Members). It was also formed in the Ordovician period and is made of shale, slate, and siltstone. Finally the dark blue, which does not occur on this site but is the next closest geological formation, represents the Province Hudson-Mohawk Sheet of the Stockbridge Formation. It was formed in the Cambrian and Lower Ordovician periods and consists of calcitic and dolomitic marble.

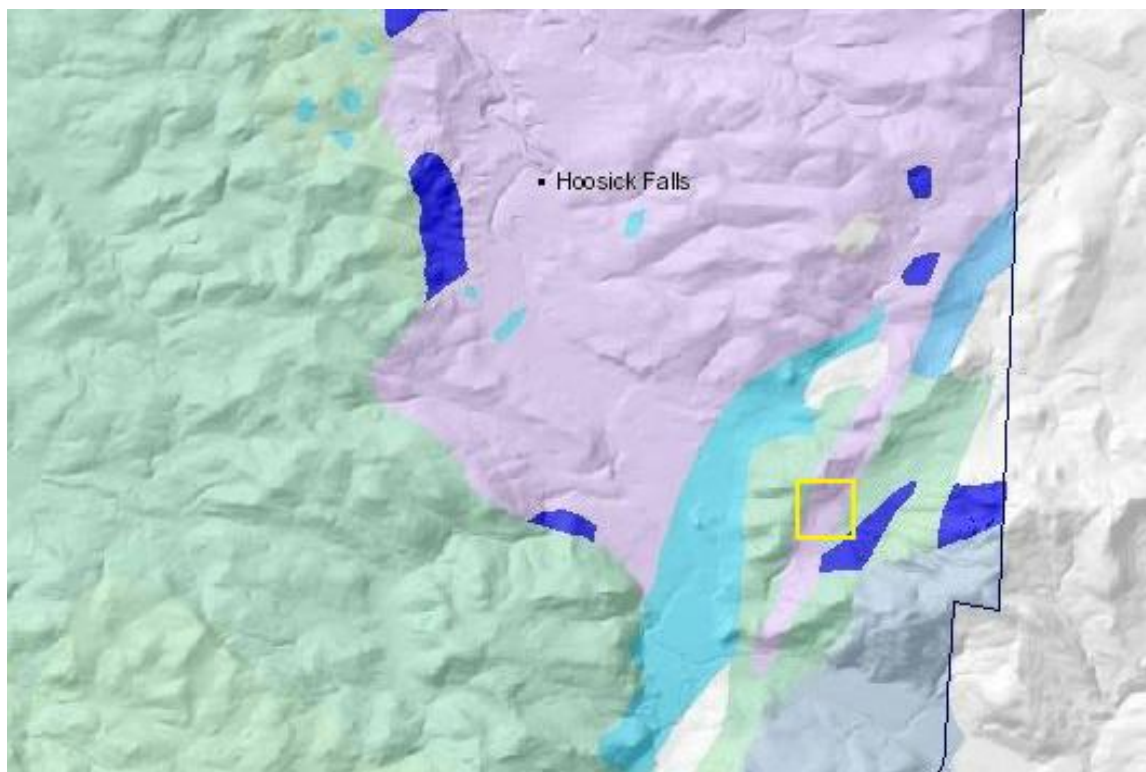


Figure 12. Geological formations in the area from the NRCS; the yellow square marks the site chosen

There are six air and two water release permits downstream in Hoosick Falls; there are eight hazardous waste handlers there as well. There are a couple of dams upstream on the Hoosick River to the southeast in Adams, Massachusetts. Arsenic contamination is not a problem in the ground water; it is less than 3 micrograms per liter. Under the site and nearby are New York carbonate-rock aquifers, aquifers of alluvial and glacial origin, and a New York sandstone aquifer. (National Atlas 2010)

*Figure 13* shows the soil survey of greatest detail; thanks to the Natural Resources Conservation Service's (2010) interactive Web Soil Survey. It is layered over a satellite picture of the site. The site is marked by the light blue boundary and the soil areas are marked by the orange lines. The soil components, their total area, and percent of the area of the plot are shown in the table in *Figure 14* (Natural Resources Conservation Service 2010). The soils labeled PtC, SrB, and PtB are all suitable for farming. The PtC and SrB



Figure 13. NRCS soil assessment of the entire 100 acres layered over a satellite picture of the site

Rensselaer County, New York (NY083) <span style="float: right;">(A)</span>			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
NrC	Nassau-Rock outcrop, complex, rolling	0.5	0.5%
NrD	Nassau-Rock outcrop complex, hilly	32.2	32.5%
PtB	Pittstown gravelly silt loam, 3 to 8 percent slopes	8.1	8.1%
PtC	Pittstown gravelly silt loam, 8 to 15 percent slopes	28.0	28.2%
SrB	Scriba silt loam, 3 to 8 percent slopes	5.4	5.5%
<b>Totals for Area of Interest</b>		<b>99.2</b>	<b>100.0%</b>
AnA	Alden silt loam, 0 to 3 percent slopes	3.7	3.8%
BnD	Bernardston-Nassau complex, hilly	12.0	12.1%
CaA	Carlisle muck, 0 to 1 percent slopes	1.5	1.5%
FIA	Fluvaquents-Udifulvents complex, 0 to 3 percent slopes	7.8	7.8%

Figure 14. Soil components, their total area, and percent of the area from Figure 13

areas are rated as Land Use Capability Class 3 because of their predisposition to erosion. The SrB soil area is also prone to holding excess water. The PtB area is Class 2 soil because of its propensity to erosion. The PtC areas make up 28 acres or 28% of this plot, the SrB soils 5.5, and the PtB 8.1 (United States Department of Agriculture 1988).

The PtC and PtB soil areas are a gravely silt-loam, mixed, mesic Aquic Dystrochrepts. The SrB are silty-loam, mixed, mesic Aeric Fragiaquepts. They are all relatively flat at 5 – 15% grade with a depth to the water table of 25 – 100 feet. Water availability to the Pt soils is 10 – 17 cubic centimeters in the top 100 centimeters; it is 4 – 10 cubic centimeters in the SrB. None of these soils are prone to ponding, flooding, or considered hydric (excessively wet); the Pt soils are moderately well drained. They are all well suited to hand or mechanical planting and have low rates of seedling mortality except in the SrB which has a high seedling mortality risk from its poorer drainage. These soils are strongly acidic with a pH of 5.1 – 5.5. Their sand content is about thirty to 32%, silt is 55%, clay is 10 – 12%, and organic matter is 3 – 5%. Their soil plasticity rating is nine to 9.5. (United States Department of Agriculture 1988)

Further this area can be described by its abundant wild life. The predominant forest cover in this area is maple-beech-birch. The next most common is oak-hickory as well as white-red-jack pine stands. There are also small numbers of spruce-fir stands in the region but they are more common in the Green Mountains of Vermont along with some rare aspen-birch cover. An oak-pine mix is more common to the southeast near Albany. Other likely softwood species include: balsam fir, tamarack, red spruce, pitch pine, Eastern hemlock. Hardwoods include: red maple, yellow and paper birch, black ash,



blackgum, Eastern hop hornbeam, and white oak. (New York State Department of Environmental Conservation 2010)

New York is home to a wide variety of wildlife. There are over 130 native bird species including the wood duck, bald eagle, snipe, wild turkey, and many others as well as several species of hawk, heron, woodpecker, sparrow, and warbler (Peterson 1980, 304-370). Mammalian life includes the river otter, black bear, Eastern cougar, gray wolf, moose, white-tailed deer, and other furbearers. Fish include various bullhead, catfish, shad, shiner, minnow, pickerel, salmon, bass, and trout. There are several species of salamander, toad, frog, turtle, and land and water snakes (New York State Department of Environmental Conservation 2010). See Appendix A for plant and animal species lists.

## DEMOGRAPHICS

Some statistics to describe Rensselaer County cover energy use, employment, and agriculture. Energy use per capita in 2001 was 42 – 73 million BTUs per year; total energy expenditure per capita was 21 – 266 million BTUs. The population density is 237 people per square mile, likely because of the southwestern corner's proximity to Albany. The type of workers in Rensselaer include: 71% private wage or salary, 24% government, and 5% self-employed or not incorporated. The median age is 36.7 years and the average wage is \$35,000. (City-Data 2010)

The average farm size is 168 acres, and the average value of agricultural products sold per farm is \$51,224. The average value of crops sold per acre for harvested cropland is \$274.25. The estimated value of land and buildings per acre is \$2,400. The average value of cropland is \$2,200 per acre and \$1,050 for pastureland. The percentage of farms operated by a family or individual is 90.53%. The average age of principal farm operators

is 55 years. Average number of cattle and calves per 100 acres of all land in farms is 15.53, milk cows as a percentage of all cattle and calves is 41.07%. The corn harvested for grain is 6,220 acres, vegetables are 1,107 acres, and land in orchards is 114 acres (City-Data 2010). Please see Appendix B for more detailed statistics.

In addition to routes 346 and 22 there is also a CSX railroad track running along the Hoosick River approximately 2 miles from the site. The closest bus station is in Hoosick Falls, the closest airport is west of Bennington, and the closest train stations are in Troy just northeast of Albany (Google Maps 2010).

The aim of this chapter has been to describe in the greatest detail possible the location under consideration for this study. It began with goals and preconceptions of what an ideal location would be and used historical and modern map data to determine a location that meets them. While most real estate purchases are ordered in the opposite direction with the consumer researching a specific piece of property, there was no such constraint here. Like buying a car or adopting a child, one would like to know as much concrete descriptive information as possible about taking on such a weighty responsibility. Even information that seems spurious to any assumed pertinent variables is important to give depth, color, and texture to one's understanding of their surroundings. Information about topography, geology, soils, demographics, resources, and local services all lead to an information rich environment from which to plan and make decisions. The next chapter will look at the initial experience people would have as they come to this place.

### **3 SETTling**

This chapter describes the approach to the site as a thought process and living experience. It includes getting settled on the property and dealing with shelter and immediate needs such as heat and water. Some mention of food and more developed water and heat systems are discussed including some practices that help people minimize their impact and use of energy while taking advantage of available resources. This chapter looks at locally and immediately available food and energy sources. The impact and relation to the environment is considered as well as other resources for living.

#### **APPROACH TO THE SITE**

The site which is the subject of this study is a mixture of fields and trees with a mountain behind it to the northwest. It is tucked away in the northern end of the southern outcropping of the Taconic Mountains. The south face of the mountain to the north of the site rolls gently up to 1080 feet (*Figure 15*). The fields to the south of Breese Hollow Road set the foreground to the southwest down Breese Hollow toward the Hoosick River Valley 1.6 miles away (see *Figure 16* for a view from the ground). One mile directly south stands a wide hill close to 1500 feet tall. Through the hollow one can see across the valley to the mountains on the other side 2.4 miles away, creating a deep field of view

By early April it has stopped freezing at night in the hollow and days are getting up to 60 °F. The air is still dry and crisp and the ground is moist from the winter melt. The grasses are starting to get a little greener. The sky is clear and the sun shines brightly, but clouds come easily as the darker months pass away. May will bring more sunshine, but the lack of cold and increase in sun since January is notable. The mountains in the

distance show an evergreen here and there, and one can almost imagine a slight green haze where countless leaves are beginning to sprout.



Figure 15. View to the north of Breese Hollow Rd, the green line is the approximate location of the house



Figure 16. View of the property looking southwest at the northeastern boarder on Breese Hollow Rd

In this hypothetical situation the first step is to secure shelter, heat, water, and food. Perhaps they have a tent, some food, water, and tools to help get started but not an infinite supply. There is a stream to the east that is swollen from the winter melt and a moist area to the southwest. The wind often comes from the west and northwest and the property is sheltered in the lee of its hill. The new inhabitants set up a camp tucked into the side of the hill at about 800 feet above sea level, 1200 feet from the stream (120 vertical feet). While a hypothetical situation could be any size or a system without property lines and boundaries, for this study 100 square acres was chosen.

Obtaining and preparing materials on site will take a lot of labor because the aim is to have a low impact on the surroundings, use little fossil or electric energy, and spend the least amount of money possible. Help will be needed for planning and building and there are supplies and materials that will not be immediately available on site. It will be important to make good connections with the other people living within 10 miles. Besides neighbors, locations within that distance include: Bennington, Bennington College, William Morse Airport, Southern Vermont College, Vermont Medical Center, Hoosick Falls, East Hoosick, Babcock Lake, Boyntonville, and Potter Hill.

#### SETTLING ON THE PROPERTY

It is necessary to have the utmost respect for a site. The approach used is to start from nothing and slowly build the necessities instead of starting out with a complete list and plan of must haves. The respect must extend to the site, its current inhabitants, neighbors and future life that will be affected by it. It would be a mistake to change the plot in any way that is not necessary for immediate survival without first spending some time with the space and getting to know it. To illustrate: while the trees will not say a word if they

are cut down, they take a long time to grow back. The full impact and consequences of actions must be carefully considered before carrying them out.

On this site there are many resources to work with from the very beginning. There is a clearing north of the road at about 800 feet above sea level. It is secluded by a row of mature conifers that cannot be seen through from the road (see *Figure 15*). There is another row 200 feet further north and 80 feet higher in elevation. Between the two rows, the clearing is about a 50% dense with regrowing forest (see *Figure 13*). This is the exact spot proposed for a dwelling place and it seems like a good location to begin. The needs of the season are protection from winds and a surface open to as much sun as possible.

Once a tent or temporary shelter is set up, longer consideration can be given to the land. As an intermediate dwelling one would construct a semi-permanent structure. A yurt is a round portable, wood lattice structure that is covered in furs or felt. It originated among nomads in the steppes of Central Asia and has become popular form of alternative dwelling in the United States (Nir 2009). Perhaps a more culturally appropriate structure would be an Adirondack shelter (Fears 2004, 31-36). Developed in this area when the frontier was Vermont and New York, they are traditionally three-sided cabins that can later be closed in. They provide permanent shelter and can be built quickly of local materials. A reflective fire-pit is built where the fourth side would be for heat.

Water is available from the stream some 1200 feet away. However there is another small stream in the inset corner of the mountain to the southwest about 750 feet away at nearly the same elevation (*Figure 17*). It will allow tapping off some of the water to store it in a dependable way. Rain collection could be incorporated into the storage as well. The water table is fifty to 100 feet deep here, which could work for a well in the future.



Figure 17. A picture of the site; water is marked with blue, clearings are bordered in green buildings in red

Food for this living situation comes in the form of staples like flour, oats, rice, and sugar. They can be bought inexpensively in bulk and kept for a long time. While it is not a model of self-sufficiency the inhabitants would initially depend on the local grocery stores for all food. There are stores as close as Hoosick Falls and Bennington where items can be bought in bulk and stored to minimize trips to the store. Eventually the intent is to grow grains, fruits, vegetables, nuts, animals, as well as produce dairy. In the meantime it would be ideal to buy or trade for as many of these items from neighbors as possible. It is

a goal to produce, process, and store food as naturally as possible without plastics and manufactured chemicals. Traditional methods of food production like cultured dairy and smoked meats will be preferred over preservatives and refrigeration.

Waste will be introduced on this space as soon as it is inhabited. Before the advent of settled homes people migrated leaving their organic wastes behind to be reclaimed by nature. That is no longer legal or desirable. Conventionally in a long-term camp, a pit latrine is dug and burned out occasionally. A dry or composting toilet seems to be a good solution and will be discussed later in more detail. The most important considerations to begin with are privacy and sanitation. The initial latrine could be placed nearby, at about the same elevation as the site to the northeast where it would not contaminate the water source at the same elevation to the southwest because of the slope of the underlying rock.

Sleeping accommodations can be based on sleeping bags at first. They will serve in both a tent and later more permanent shelters. The ability to sleep in the fresh air and natural sounds, waking to the sun bright and early will be missed as more permanent shelter walls off the environment. However the closed shelter will be welcome by November and probably sooner. While it would be ideal to stay away from synthetic materials, the best sleeping bag to have in this situation is a warm synthetic one. They are durable and retain their heat when wet, which is when they are needed most. Transition to other bedding can be made once it is practical to suit comfort and aesthetics.

## SHELTER

In early April, snow is unusual but overnight frosts are possible until early May. That is a sufferable condition and it will continue to get warmer as the year progresses however a more permanent shelter will give more room and stability. The lack of space



makes tent living difficult and an enclosed cooking area is desirable. On 31 December 2009 Sarah Maslin Nir of the *New York Times* (“Broadband Yes. Toilet, No.”) reported on a young couple living in the frigid land of Soldova, Alaska in a yurt covered in roofing vinyl and Tyvek. This is of interest because of the unique and innovative approach they have taken to a home. While it is often 0 °F when they wake up, that is a factor of their design and climate; a lot can be learned from their pioneering effort.

As was said, a tent will suffice at first to keep out the elements. Since biblical times tents have been made of goat’s hair by nomadic people who follow their flocks to pasture and water and move around according to the seasons. Their tents are larger than camping tents and have multiple sections. Often there is a front section, where the men of the family live and visitors are entertained and a private section at the rear, for women and children. In this area tents like that are available made from canvas, they could be made very inexpensively if a cheap source of canvas could be found. There is no way to be nomadic so a lot of energy invested into this form might not be wise.

The Adirondack shelter (Fears 2004, 31-36) already mentioned would be a good structure to begin building. They were likely first built by Native Americans in this area then adopted by settlers. They can be expanded as needed by starting with one then building a second with the two openings facing the fire. Finally the two can be joined and closed in to form a cabin. There are currently Adirondack shelters all over the Appalachian Trail that have proved their longevity with lots of hard public use. To build a 100 square foot shelter could take up to 60 logs 8 inches in diameter. Logs should be cut, trimmed, and peeled in July and August and dried for six weeks. While this is a lot of lumber for a temporary structure it could be reused, repurposed, or added onto. If

consideration is given to what trees are used, there may be some that are desirable to cut down anyway.

Another possibility would be living in a recreational vehicle, van, bus, or truck. While there are many reasons not to do this, not the least being their unsightly unnatural presence, they are still a viable option. This option depends more on the resources at hand and necessity. An old bus or flatbed truck may be obtained for much less than building materials and driven to the site and parked. Neighbors would have to be a primary consideration here. A beautiful and sizable home can be built on the back of a commercial truck frame, there are many examples of these from the 1960's and 70's but the likely future of petroleum makes their mobility questionable. In the worst case it might get parked and stuck and then just become rotting industrial waste that outlives the plot's inhabitants. Large steel shipping containers have even been repurposed as homes though they would need to be partially buried and well-shaded to prevent overheating.

Related to the converted vehicles are mobile homes and related to these are prefabricated homes. While they are probably a somewhat inexpensive and quick solution, the greatest concern would be for the materials they are constructed of. Mobile homes are unsightly, not easily repaired, and tend to rot and fall apart. Prefab or modular homes are intriguing and becoming more popular. Traditionally prefab buildings look like robust mobile homes; they are generally of stronger construction. They have a lot of potential for energy and construction efficiency. Newer designs are more aesthetically pleasing and are taking on the image of being ecologically responsible (Eco-infill).

An interesting alternative to traditional housing are dome homes. Some companies make kits for constructing them out of component pieces. Domes from American

Ingenuity have been left untouched by hurricanes in Florida and are very energy efficient. They are constructed from triangular sections made of a sandwich of insulation, wire mesh, and a concrete shell. They can be constructed by homeowners with little additional labor or machinery. First a temporary frame is erected then each piece is cemented into place like an igloo. Their main drawbacks are the difficult to use internal perimeter areas with sloping walls and their non-traditional appearance which makes them unacceptable in some places. (American Ingenuity 2010)

Straw bale construction is a darling of the green movement but has roots in antiquity. Straw has been a building material for millennia but it was the advent of the mechanical bailer in the early 1900's that provided the form used in this technique. It is the top choice for this site as well because straw bales are locally available, natural, energy efficient, and inexpensive. Because of the foundation and frame necessary for the construction of this type, it is better suited as a more permanent solution. However there may be ways of taking advantage of the insulation and cost properties of the material even in a temporary shelter. (StrawBale.com 2010)

## HEAT

With enough insulation, it is possible to stay warm without an auxiliary source of heat but the lack of air flow is stifling. Oddly enough there are people today who purposefully live without heat as *The New York Times* reported 20 January 2010 (Green, "Chilled by Choice"). It is hard to imagine that there was life before furnaces or central heat. The primitive solution is fire and this works well with the Adirondack shelter when the fire is built with a back that reflects the heat forward and into the overhang of the shelter. Still

this is very inefficient, dirty, difficult to cook with, and time consuming. The transition to a cast-iron or brick stove should be made as soon as possible.

For the first temporary shelter, heat retention will be limited by the thin walls of a tent or vehicle or the open side of the Adirondack shelter. Insulation will have to come from the clothing worn. Keeping heat is as important as making it and will be vital to improvements in dwelling space. Insulation cannot be overdone, especially if it can be made of natural materials and acquired inexpensively. Natural cork (if plentiful) can be a good alternative to fiberglass or foam insulation. Straw bales really excel in this category; typical wood and fiberglass mat walls have an insulation factor of R-19, roofs are generally insulated to R-30, an unfinished straw bale has an R factor of 48 (Stone, 2003). Thick walls, small windows, and round construction set into the south face of the hill will help retain heat.

Wood stoves, while derided at the turn of the 20<sup>th</sup> century as being ugly and ineffective (Hooper 1905, 185), can be surprisingly effective and how they look does not matter as long as they work. The complaint was that the heat all went straight up to the ceiling leaving the room cold. Perhaps the ceilings were too high and the rooms too big in these country mansions. While insulation 100 years ago also was not what it is today, their point was that a furnace located in the basement and draft-fed heated fresh air was the best option. Newer designs for wood stoves are more efficient and may be augmented by heat piping and storage to extend their effectiveness.

Fireplaces are nearly as wasteful as open fires. They use wood inefficiently and they draw the warmed air in the room and the heat they produce right up the chimney. The last improvement made on the fireplace was Benjamin Franklin's stove (really a fireplace)

that drew combustion air in from outside and ran the exhaust over baffles to radiate the heat before it left the house. This stove does not conform to current building codes and so many houses have the even more ancient type of hearth fireplace. An interesting design for a homemade all-in-one brick stove, furnace, oven, smoker, and boiler is given by John Seymour in “The Self-Sufficient Life and How to Live it” (2003, 287). Made out of brick, this useful design incorporates chambers for baking, smoking, and heat extraction.

Devices colloquially called boilers, though actually water heaters, are the rudiments of modern heat applications. A simple design for a boiler consists of a long tubular fire chamber encased in a water jacket (Reader's Digest Association 2003, 86-91). The heated water can be pumped through the house to radiators or heat exchangers that are fed by fresh air. True boilers, which are used to make steam, are more efficient but more dangerous; steam systems are also more difficult to make. Water heaters are an attractive option for conventional heating because they can be heated with wood and other natural materials. They provide thermal mass to store heat overnight while the hot fluid can be easily piped where it is needed.

Heat used in cooking takes a few unique forms. A controllable hot surface is needed for cooking in pans and heating water, and an oven is necessary for bread and other baked items. A hot surface for cooking meats, grains, and flat breads can be accomplished as simply as on coals from a fire or a camping stove. Earth ovens or pit ovens have been made since antiquity by burying food in a fire pit to cook it. The ancient Greeks are credited with developing oven baked bread into an art (Dalby 1996, 90-91). They made portable clay baking chambers on legs that were placed over coals; similar to Dutch ovens. Beehive ovens were a form of brick oven used in Colonial America that

were heated by coals then cleared out to bake the food. Solar cookers (Reader's Digest Association 2003, 117) can be used where there is no other fuel source and are gentle on the environment as small fire ovens are one of the largest producers of CO<sub>2</sub> and soot.

## WATER

The water sources immediately available on this site are the stream at the bottom of the valley and the stream in the corner of the mountain to the southwest. The lower stream is plentiful but it collects the runoff from the neighboring fields. It could be contaminated by neighbor's fertilizer, pesticides, herbicides, animal waste, or septic waste. While it could be used and treated, the stream on the mountain is cleaner. The stream on the mountain would be considered 8<sup>th</sup> magnitude because it flows at less than 1 pint per minute however in 24 hours it produces over 100 gallons. Using this water would minimally dry the habitat in Carlisle muck basin where it used to collect. However, a pond is going to be created there, which will build a new habitat.

While the stream's purity is not known, it can be assumed to be contaminated. It draws from the top of the mountain's south side and is channeled by a depression in the northwestern corner of the plot. From there it runs down through a track of trees. It heads in the general direction of the low area at the center of the south side of the southwestern quarter of the plot. Because of the slow rate of flow it will need to be collected in a holding vessel which will allow some particles to settle out, from there it can be boiled, filtered, and/or treated to remove any pathogens before human consumption.

Storage of fresh water can be accomplished with a cistern. Water consumption for two is generously estimated at 100 gallons a day. A relatively large cistern of 1,000 gallons (a 5.1131 foot cube) would cover all necessities in a dry season and could be

augmented by a rain water collection system. Keeping it above the elevation of the house would provide pressure to reduce the need for pumping.

The excess stream and rain water could be diverted just a little way to the Carlisle muck (soil CaA, *Figure 13*, pg. 25) that is prone to ponding. This would allow other water storage and perhaps a pond for wildlife and aquaculture. By constructing a dam, a pond area 400 feet by 150 feet by 1 foot (448,000 gallons) could be created providing a large water reserve. It would not impact a stream, freshwater wetland, impound more than one million gallons, or require the excavation of over 100 tons of soil. The pond would be low and flat, less than six feet at the breach, so a dam safety permit would not be required (Cornell Cooperative Extension 2010).

A greywater system would help reduce the fresh water needs of the property. Because water is such an important resource and it may be scarcer in the late summer it would be best to try to use it as efficiently as possible. Greywater is collected from bathing, dishwashing, and laundry which can be downcycled to water used for irrigation or washing of less clean things like cars and outdoor equipment. Care should always be given for the use of natural and biodegradable soaps, but this is especially so with greywater systems. Blackwater is water that is contaminated with human waste but at this site will not be a part of the plumbing system as human waste will be composted.

In the envisioned water system some simple interconnections add to the robustness and efficiency. Water comes from rain and the stream to the cistern, and excess continues to the pond or follows its natural course. The cistern gravity feeds to the top of the house. Here hot and cold supply can be split and the potential hot water can go to another system created by using solar energy on the roof to heat the water (see Ch. 7, pg. 81 for more

details). The solar heater can be connected to the heat reservoir and boiler system to supply hot water and radiant heat in the house. Eventually a well will need to be drilled to provide water in the winter in case the mountain stream freezes and to supply water for the anticipated maximum of twenty inhabitants.

This chapter has taken the viewpoint of two people going to inhabit this property in early spring. The site was described verbally in ways that the new inhabitants would experience it. Pictures of actual ground level views of the location displayed the fields and forested hill. This was done to give the reader a non-technical impression of the area and an appreciation for the nuances that are beyond description. Further, an aerial photograph of the exact plot was given. It was improved with highlighted forest boundaries, buildings, and water. This conveys the mental map one would build as they become more familiar with the plot. Finally, a brief discussion was made of the bare necessities for life (shelter, heat, and water) and how they might be set up initially.



#### ***4 LAND LAYOUT***

The following chapter looks at the land on the property and how it is laid out. Land use areas and building placement are considered from the view point of the physical environment, resources, purposes, and topography. It is important to remember how long the environment has existed and how relatively short of a time humans have been impacting it. Understanding, appreciation, and thankfulness for the things in nature that cannot be re-created are necessary to deal with them responsibly.

#### **SOILS AND GEOLOGY**

As has been stated this property is located in the Taconic Range of central eastern New York. It includes 100 acres, 45 of which are on the southern slope of a 380 foot tall hill with an average of 21.5% slope. Based on the soil survey, of the remaining 55 acres, 13 are too wet for cultivation of crops, which leaves about 42 acres of prime farmland.

The Taconic Range is part of the Appalachian Mountains in the Northeast. It runs along the border between New England and New York from the northwestern corner of Connecticut near the town of Lakeville. It continues through Berkshire County in Massachusetts and the adjacent counties in New York and further north into Vermont. To the west of the ridge in New York are 12 miles of foothills then the Hudson River Valley. To the east, the Taconic Mountains fall off abruptly, ending in the valleys of the Housatonic River, the upper Hoosick River, and the greater Valley of Vermont, from there rise the Berkshires and Green Mountains. The northern end of the Taconics in New York lead to the eastern foothills of the Adirondack Mountains.

The soil types on this property according to the United States Department of Agriculture (1988) include Alden silt loam, Bernardston-Nassau complex, Carlisle muck,

Fluvaquents-Udifluvents, Nassau-Rock outcrop, and Pittstown gravelly silt loam (please refer to *Figures 13 and 14*, pg. 26). This information is detailed in Appendix C.

The Alden silt loam (AnA) on this site forms 0 – 3% slopes and occur at an elevation of 300 – 1500 feet. They receive a mean annual precipitation of 36 – 44 inches and a mean annual air temperature of 45 – 48 °F. On this property the Alden silt loam is in the furthest northeast corner along the stream bed. Its landform includes the stream depressions and forms the concave toe and base slope of the hill. It is composed of a silty mantle of local deposition overlying loamy till. Its depth is greater than 80 inches and its drainage Class is very poor. It resides at the water table and experiences frequent ponding with about 9.3 inches of water capacity. Its nonirrigated Land Capability Class is 5w. It contains up to 15% calcium carbonate and is typically silt loam from 0 – 7 inches, silty clay loam from 7 – 40 inches, and gravelly silt loam from 4 – 40 inches. Because it is so flat but relatively poor for agriculture this area is best used as a recreational field.

The hilly Bernardston-Nassau complex (BnD) on this site forms 15 – 25% slopes and occurs at an elevation of 0 – 1800 feet. On this property, the hilly Bernardston-Nassau complex is a narrow projection of 12 acres that follows the 800 foot elevation line north of the road from the southwest. The Bernardston landform includes drumlinoid ridges, hills, till plains on the side slope of the hill. It is composed of Loamy, acid, dense till derived mainly from phyllite, shale, slate, and schist. Its depth is greater than 80 inches and it is well drained. It resides 18 – 24 inches above the water with no risk of ponding or flooding. Its Land Capability Class is 4e with about 8.5 inches of available water capacity. It is typically gravelly silt loam from 0 – 8 inches and gravelly loam from 8 – 40 forty inches. The Nassau formation forms benches, ridges, and till plains in convex

side slopes. It is composed of channery loamy till derived mainly from local slate or shale. It has a depth of 10 – 20 inches to lithic bedrock and somewhat excessively drained. The depth to the water table is 50 – 100 feet and the available water capacity is very low at about 1.5 inches. Its land capability is 6e and typically contains very channery silt loam from 0 – 7 inches, very channery loam from 7 – 15 inches, and unweathered bedrock from 15 – 19 inches. The proximity to the house and higher slope makes erosion control and perennial cultivation important here.

The Carlisle muck (CaA) constitutes 1.5 acres of 0 – 1% slopes in the center of the southern border of the southwestern quadrant of the plot. It is found at elevations between 600 – 1200 feet. This soil forms swamps and marshes in concave toeslopes. It is composed of deep organic material. The depth to restrictive material is more than 80 inches and it is very poorly drained. The available water capacity is very high at about 23.9 inches. Its Land Capability Class is 5w. Carlisle mucks typical constituent profile is muck from inch 0 to 62. It lies right at the water table and its most limiting factor is its inability to drain and so it is frequently a pond. This will be taken advantage of to create a pond and support aquaculture.

The Fluvaquents-Udifluvents (FlA) complex is a 7.8 acre tract found along the southeastern border of the property along the stream bed. Its slope ranges from 0 – 3% and elevation from 100 – 3000 feet. The Fluvaquents form flood plains as toeslope, and dips in a concave pattern. It is composed of alluvium with highly variable texture but is generally silt loam from 0 – 6 inches in depth and gravelly silt loam from 6 – 40 inches. It is more than 80 inches deep to a restrictive layer but is poorly drained. The depth to the water table is 0 inches and it is subject to frequent flooding and ponding. Its maximum

calcium carbonate content is 5% and has a moderate water availability of about 6.6 inches; its Land Capability Class is 5w. The Udifluvents form summit flood plains concave in down-slope shape but convex across-slope. It is composed from Alluvium material with a wide range of texture. It is moderately well drained but limited by its ability to transmit water. The depth to the water table can be 36 – 72 inches and there is no risk of flooding or ponding. It is Capability Class 5w land of gravelly fine sandy loam from 0 – 9 inches deep. This riparian area and its stream must remain protected.

Rolling Nassau-Rock complex (NrC) outcrops are approximately 50% Nassau and related soils and 25% rock outcropping between 600 – 1800 feet in elevation. It forms benches, ridges, and till plains as shoulders and crests. On this property it forms a relatively flat, compared to the hill it is on, 0.5 acre tract at about 900 feet from the center of the western edge of the northwestern quadrant. It is composed of channery loamy till derived mainly from local slate or shale. There is 10 – 20 inches to lithic bedrock and the soil is somewhat excessively drained. The depth to water table is greater than 200 feet and there is no chance of flooding or ponding. The available water capacity is very low at about 1.5 inches and the Land Capability Class is 4e. The soil's typical profile is very channery silt loam from 0 – 7 inches, very channery loam from 7 – 15 inches, and unweathered bedrock from 15 – 19 inches deep. Because it is flatter, this area may offer more water and straighter growth, providing a place to nurture a stand of more valuable trees, perhaps hardwoods grown to produce veneer.

The related hilly Nassau-Rock complex (NrD) outcrop comprises the majority of the forestland. It is also found at elevations between 600 and 1800 feet and makes up 32.5 acres on this plot. In it the Nassau and similar soils constitute 40% and rock outcrops

35%. It forms benches, ridges, and till plains on back and side slopes in a convex shape. Its parent material is channery loamy till derived mainly from local slate or shale. It is found at 25 – 35% slope and has a depth of 10 – 20 inches to lithic bedrock. It is somewhat excessively drained and is more than 200 feet above the water table. The Land Capability Class is 7e and it is typically made up of very channery silt loam from 0 – 7 inches, very channery loam from 7 – 15, and unweathered bedrock from 15 – 19 inches.

Pittstown gravelly silt loam (PtB) makes up 8.1 acres on this plot and is the highest quality cropland on it. It has between 3 – 8% slopes forming Drumlinoid ridges, hills, and till plains in crests and summits that are concave down-slope and convex across-slope. It is formed from loamy till with a depth of over 80 inches. This soil is moderately well drained and about 18 – 36 inches from the water table. It has no likelihood of flooding and about 9 inches of available water. Its Land Capability Class is 2e and is composed of gravelly silt loam in the top 60 inches. The greatest limit factor of this soil is its pH of 5.5.

The Pittstown gravelly silt loam (PtC) is the next best soil for crops on the land making up 28 acres of Capability Class 3e land. It surrounds the strip of (PtB) soil to the east and west in the southeastern quadrant. While similar to the PtB soil its quality is further limited by its 8 – 15% slopes in Drumlinoid ridges, hills, and till plains in crests and summits that are concave down-slope and convex across-slope. It is composed from loamy till and is more than 80 inches to a restrictive layer. It is moderately well drained and limited most by its ability to transmit water. The depth to the water table is about 18 – 36 inches with about 9 inches of water available. It is usually composed of all gravelly silt loam in the top 60 inches.

Finally the Scriba silt loam (SrB) covers about 5.5 acres of Capability Class 3w at the center of the southern border of the plot. Its 3 – 8% slopes form into drumlins and till plains of base slopes, concave down-slope and linear across-slope. Its parent material is loamy till dominated by sandstone, with lesser amounts of limestone and shale. The depth to a restrictive feature is more than 80 inches and it is about 6 – 18 inches to the water table though its available water capacity is low only about 4.1 inches. The soils most limiting capacity is that it is somewhat poorly drained, however it is not prone to flooding or ponding. It is composed of up to 15% calcium carbonate; the top 21 inches are silt loam and gravelly silt loam is present from 21 – 60 inches depth. This section's greatest limitation is its slope, which increases erosion and makes cropping more labor intensive.

#### LAND USE AREAS

For this section compare *Figure 17* (pg. 34), an accentuated picture of the property, to *Figure 18* (pg. 50), an improved picture with proposed plans drawn on it. The houses and buildings on this site will need to perform a multitude of functions. The most essential is to house the occupants and protect them from the elements. The house design will be an evolving structure changing with size demands but as small, simple, and efficient as possible. The house will incorporate the ability to passively collect sun energy and facilitate growing plants in a solarium/greenhouse. Additional structures will eventually be needed for animals, tools, processes and projects, as well as food storage. The planned site for the house is on a shelf right above the 800 foot elevation line in the southeastern corner of the northwestern quadrant, about 500 feet northwest of the road in the hilly Bernardston-Nassau complex. It is shown in (*Figure 18*) as green square with a red line around it to the north of Breese Hollow Road.



Figure 18. Improved picture shows areas for the home and barn in red as well as the pond and new trees

A pond can be a great asset. It acts as a water reservoir and a habitat for amphibians, birds, insects, and reptiles. It would be a good use of the pond prone 1.5 acres of Carlisle muck (CaA) at the southern border of the southwestern quadrant. A dam at the property line (*Figure 18*) could create up to a 65,000 cubic foot pond per foot of water depth. It could be fed by the overflow from the spring and rain collection system after the cistern is full. The Cornell Cooperative Extension (2010) recommends stocking 500 sunfish fingerlings and 100 largemouth bass fingerlings per acre of pond surface area.

There are 42 acres of prime farmland on this property. They could be divided up for different uses such as fields for grain, vegetables, fodder, pasture, paddocks, vegetable and fruit gardens, perennials and orchards. It may be possible to grow a kitchen garden with herbs, spices, and flowers near the house in an attached green house. The poorer Bernardston-Nassau soil around the house could also be improved with deeply dug beds brought up to a level grade with added limestone and organic matter to reduce the pH and help the soil retain nutrients and water.

Mixed deciduous stands of maple, beech, and birch trees are the most common here. Following that in prevalence are mixed stands of oak and hickory as well as white, red, and jack pines. There are small numbers of spruce and fir in the region as well. Currently there are trees covering the Carlisle muck, about half of the Bernardston-Nassau area, and almost all of the 33 acres of Nassau-Rock outcrop. When fully stocked and mature, this forest should contain 300 – 100 trees of 8 – 15 inches (respectively) in diameter per acre (West 2009, 73 – 76), (Forbes 1961, 3.58). The wooded area backs up to over 800 undisturbed wooded acres that cover the hill to the southwest, west, northwest, and north.

The 3 acres of Bernardston-Nassau complex region along the 800 foot elevation is ideal for orchards. It has already been cleared of most trees. It was probably used for crops or pasture in the past. It gets full sun light, is well drained, and the high slope allows the cold air to drain off to reduce freezing. It will be important to plant trees on the ridges formed at the 800 and 840 foot elevations and clear the brush and trees from below the orchard trees to allow the frost to drain. In addition to this area, the clearings in the Nassau-Rock outcrop soil further up the hill make 13.5 acres that have been cleared in the past and are in early stages of succession.



Some land will need to be used as pasture. The intention is not to raise a lot of animals but to produce some meat, eggs, and dairy to consume. Large high-production farms raise their animals in feedlots and stalls. While that may be efficient it does not respect the needs of the animals. Grazing animals on pasture will keep them healthy and moving. It also provides low-cost feed and nutrient retention in the soil. One acre can support a cow and a sheep or goat and their different eating habits will help maintain the growth of the pasture. Swine and poultry can also be can also be pastured together if the swine have nose rings to keep them from digging up roots and the poultry have movable cages. Part of the rotational crop plan to retains some plots as pasture. (Florence 2002)

Play and socialization are important to a healthy lifestyle. While there is an abundance of green space and no end to the outdoor work to be done on a homestead, it would be beneficial to have some yard space specifically maintained for people to play and run in. Area around the house or even in flatter parts of the grounds could be set aside for some open grass space that is not being used for anything in particular. The area could be moved around if need be, but it would be best to be relatively smooth and flat for running in and sports and games. In the northwest quadrant there are a few acres in the northwest corner between the road and the creek that are flat but poor quality soil in the Alden silt loam region that would be ideal for recreational fields. It is also the only area that is not in the line of sight from the house.

## BUILDING PLACEMENT

It would seem only natural to consider the layout of a site in building placement to take advantage of its available materials to harmonize with surroundings. One look at the suburban enclaves developed in the last half-a-century would show anything but. The

main goals are utility and energy efficiency. Part of what caused the selection of this site was the south-facing slope with a steep section that would allow a house to be set into the hill to protect its northern side from cold wind. This spot is in the southeast corner of the northwest quadrant on the shelf formed at the 800 foot elevation line. This location is fairly central to the property but set back off the road by 300 feet. It helps that the house site is below the spring, the water can be routed to the roof for passive solar heating and gravity aided distribution.

In the northeastern United States the winter climate is one of the greatest challenges. Building in a protected location reduces the amount of heat the wind convects from the house. The temperature usually stays below freezing in January, and 60 – 90 inches of snow per year is normal with continuous snow cover from December through March. With a typical wind speed of 9 miles an hour and average temperature of 20 °F it can feel like 5 °F out. Burying the north side of the house reduces the heating and cooling load because the ground stays near 55 °F all year. There are many adjustments that can be made to the house design to improve light and air quality that will be discussed later in Chapter 7. For instance setting the house into the rocky hillside, even leaving it exposed in the house, creates a situation of passive convection that stabilizes the temperature.

Another problem with the cold winter in the northeast is its impact on the growing season. The season is shorter and frosts are later in the spring making it dangerous to start some plants too early. Several options to extend the season include cold frames, hot beds, growing mounds, and greenhouses. The design for this house incorporates a greenhouse on the southward face that can be used in the winter as a kitchen garden and in early spring to get an early start on sprouts to be transplanted outside later. Having the

greenhouse attached to the house makes it easily accessible while shielding it from the cold and buffering its temperature.

The expanse of south facing glass is also a great opportunity to collect heat for the indoor environment. Passive solar heating systems take advantage of nature's working in low tech ways. Painting the wall and floor of the greenhouse in dark colors, and paving the floor with native stone can help collect heat. Large tanks of water or rocks in the green house provide thermal mass to store heat while insulation along the lower outside wall helps keep the heat in. The greenhouse can then help heat the house. It also provides fresh air and the soothing, mood enhancing effects of green growing things; this is especially important to counteract the bleak, black and white scene of the long northeastern winter.

Farm buildings come in many different flavors and sizes. From the catch-all barn to a separate hayshed, cowshed, sheep stalls, dairy house, tool and machine shop, threshing floor, shed, coops, corn barn, etc. The E.C. Bliss Farm in N.Y. at the turn of the twentieth century had many of these out buildings, some in duplicate and triplicate as well as horse and oxen stables, a carriage house, and assorted barnyards. These were laid out in a ring covering 212 by 192 feet (1 acre) including a barnyard but not the associated fields, pasture land, and orchards (McMurry 1988, 65). Because the aim here is simplicity it would again be best to start small and build as needed. The site set aside for housing of animals, storing feed, and equipment is acre number 25 (*Figure 18*, pg. 50) of the fields in the upper northwestern corner of the southeastern quadrant. It is close to 400 feet from the house on the other side of the road. While it is a little far from the house it is central

to the whole property and is on the field side of the road giving easy access to animals and equipment.

The span of the property from the northeastern corner to the southwestern is well serviced by County Road 100, or Breese Hollow Road. An old dirt road runs up the hill to the northwestern corner, some sections of it approach a 25% incline which is unsafe. The segment that runs over the stream to the northwest will be closed. Where the road turns north at 840 feet it may be turned with a 40 foot or greater radius to the northeast to bring the grade back down to 10% and give access to the woodlot. Further, a driveway will be built to the house from the northeast off of Breese Hollow Road at the 800 foot elevation line as well as a side-loop access road that connects to Breese Hollow in both directions from the barn. These drives will both be flat thereby reducing erosion as well as danger in snow and ice. (*Figure 18*)

This chapter has taken a more detailed look at the land that the owners will be dealing with and what ways they may utilize different areas. Land use areas are based on analysis of a soil survey that breaks the property into nine regions. The aerial photograph was further updated with new tree, pond, and building locations. Then the reasoning for these additions was discussed. The next chapter talks about how those features can be used.

## 5 LAND USE

This chapter describes how the land will be used. It looks at the needs and operation in cultivating crops, livestock, permaculture, aquaculture, and plants in the greenhouse. Please refer to *Figure 18* (pg. 50) for building, field, and road placement.

### HOUSE SITE

The primary purpose of the home is shelter. Up through the housing-boom there was a trend in many places to overbuild. In areas such as Davidsonville, MD near Washington D.C., houses grew in size to five and ten thousand square feet to house only two residents whose children have left. In *The Self-Sufficient Life and How to Live It*, author John Seymour (2004, 241) remarks that on a working farmstead, the inhabitants get more than their fair share of sunlight and the outdoors. Therefore they want a small solid house, lots of huge windows are not necessary, and thick walls of rammed earth are best. Perhaps this would make a cozy and restful home, unfortunately earth walls are not very efficient insulators. Building with straw bales is easier, less expensive, and more efficient. Ultimately the best building materials are those locally available. For this reason, old homesteads built when only local materials were available blend-in harmoniously with their surroundings.

The house must provide room for rest and sleep. There is nothing as important for a weary body and healing from illness and injury as a sound restful place. One of the great advantages sought in a low population area is peace and quiet for the sake of health, relaxation, and security. It would be ideal to house four generations of two to three persons so an entire family, at population maintenance levels, could live on the same site. That is likely up to 20 people, but this design will start with 2, assuming a young couple

following the modern convention of leaving home to start a family, and will build up as needed with the intention of bringing an extended family together to live.

The greatest amenity is either a hot shower or a hot meal. One cannot live very long without a meal but there is almost no point without a hot shower. It seems like a wasteful practice to use 25 gallons of water a day mostly just for the hot sensation and to apply a regimen of artificially synthesized smelly goos (and people were thought crazy for buying tonics a 100 years ago). However an average ten minute shower uses only  $3\frac{1}{3}$  cubic feet, which is also half as much water as is required for a bath. Surely, some benefit could be had from as little as 2% of this quantity (2 liters). After the fall of ancient Greece and the Roman Empire, regular bathing was thought unhealthy until the Victorian era. In the early 1800's showers were invented that captured and recycled their own water; baths remained more popular until the mid 1900's (McNeil 1990, 919).

Eating is arguably one of humanities great pastimes. It is necessary for life and essential to socialization. Many waking hours in the house are spent in the kitchen. It should be a well lit space, ideally with as much natural light as possible, and be pleasant to gather and work in. A 4 February 2009 *New York Times* article entitled "Trashing the Fridge" (Kurutz) reported that some people are unplugging their refrigerators for good. It would be an interesting experiment; after all, there was life before refrigeration. Culturing dairy reduces its pH so it keeps longer and it is more nutritious because the culture pre-digests it. Many things like condiments that take up room in the fridge can be stored out of it. A small propane fridge or a cooler with a chest freezer for longer-term storage may be a good alternative. Gas powered refrigeration is quieter and mechanically longer lived. A small fridge uses less energy and may be converted to run on homemade methane.

Of all the alternative designs for dealing with human waste a composting toilet seems the best; it does not waste water and recycles all the nutrients. Human waste also contains harmful pathogens which make it unfit for use as fertilizer, but after the waste is digested it can be used as a fertilizer on plants not used for consumption. According to some sources this is overcautious; however it reflects the current state of our health codes. A composting toilet collects solid waste and allows it to be digested by bacteria, worms, and bugs while methane and moisture are vented out; the addition of vegetable scraps, straw, and composted manure help keep the digester running. Flush toilets are an expensive way to pollute fresh water and waste nutrients by sending them “away”.

While the abundance of outdoor space is ideal for recreation, there must be some play space indoors as well. A large sturdy table, besides serving as a dinner table, could serve as work space. Children and adults both need a little room indoors to do things outside of the box of books, lined paper, and computer; art and craft supplies give creative and tactile pleasure. As powerful as computers are, they still do not match a large piece of paper or a whiteboard for brainstorming. Today’s toys are expensive, poorly made, and costly to the environment. There is no end to the “must have” pink and blue plastic items that end up broken in piles leaching into the environment. Children then turn around and play with a stick or beat on a pan; happiness would still exist without misuse of plastic.

Study is a wonderful thing and should be encouraged and facilitated in every way without being forced. As more and more information becomes instantly available, learning how to use information will continue to become as important as the ability to memorize. A comfortable space for thinking, reading, designing, planning, and so on is essential. Because of the concentration and maturity involved in these tasks, this area

may be better set apart from a play area if possible. While books are hard to move from one place to another they are rich with content and the ways they interact with the mind. Comfortable chairs for reading and a large table for drafting, laying out papers, and computing would be of great benefit to development and maintenance of home and self.

Besides providing food, greenhouses are invigorating places. This house plan also incorporates a greenhouse for the natural beauty they provide as well as sunshine and the fresh, fragrant air of growing plants. It will be a place to contemplate and marvel over living things up close. It should provide room for sprouted seeds, grains, and beans; tomatoes; herbs; flowers; and perhaps even fruits. It will provide an extension to the outdoor kitchen garden for delicate or needy plants and a nursery hotbed for starting new plants even when it is too cold outside. The warm, moist air full of sun and life help connect one to nature while remaining protected from the elements in the comfort of their own home. When it is covered and vented in the summer it will also provide shade for the south face of the house.

As has been discussed, straw bale is the preferred home construction type for this site. To aid in indoor temperature regulation and offer food storage, the house's foundation will be dug into the hill behind it. The rear wall of the house will contain a storage cellar that is effectively underground while the house will not have a basement. It may be possible to drill into the hill and run a duct into it for an air cooling system for the warmer months. The excavated soil and rock can be used to fill the slope on the front half of the site and bring it up to a level grade. Evergreen trees and shrubs uphill to the north will provide protection from the cold while deciduous trees to the south will provide shade in the summer and allow sun in the winter.



## BARN SITE

It would not be long before a barn is needed. They are essential to agrarian self-sufficiency and are often the oldest building on a farm. This may be because they were built better, were given precedence to a finished house, or more likely that people desire newer housing more than animals and so they do not get the same level of maintenance. The ultimate goal is to farm a mixture of a cow or two and a few sheep and/or goats, pigs, geese and chickens. One day it may also be possible to transition to horse-powered tilling. Stalls would be satisfactory for cows and sheep, goats are not as well adapted to cold climates and need insulation in their pens. Pigs and chickens would have their own movable sheds while geese and ducks roam freely.

The amount and types of feed necessary to store depend on the number, type, and purpose of the animals housed. A small cow giving a gallon of milk a day needs 3700 pounds of hay for the winter, assuming they eat fresh grass when it is available, it is suggested to store two years worth at a time (Seymour 2003, 96). Square bales are between 3 to 4 feet long and 24 by 18 inches square. They weigh from 60 to 130 pounds depending on how densely they are baled. Given 100 pound bales, this would require 75 per cow, taking up an area 7.5 by 9 by 10 feet. Sheep can feed on mostly grass not eaten by the cows but as with all animals extra hay, grains, and fodder vegetables supplement their diet (Florence 2002). Room for dry storage of grains and roots are necessary for both animals and people. Large round bales are not appropriate for a sustainable farm because they require heavy machinery and are difficult to breakup for distribution.

An area for processing grains and other crops is necessary whether done by hand or machine. After harvesting, threshing is the process of removing the grain from the straw.

It is followed by winnowing, or separating the seed from chaff, bits of cut straw, and other foreign matter. This was traditionally done on a threshing floor where the grain was beaten with a flail; the threshold at the door to the room kept the mess contained. The flailed grain was then gathered and tossed in a breeze to allow the lighter chaff and straw to blow away (Mabel 2006). Other methods of threshing require a sled pulled by an animal with metal or stone blades on the bottom that dislodge the grains. Grains can then be stored indefinitely if kept dry and free of pests though the nutrient content will diminish over time.

This multi-purpose building is also the location for most equipment needed for farming. Room is needed for various tools for cutting, digging, tilling, carrying, and smoothing and loosening. Tools are needed for clearing and draining land, building, and dealing with woodlands. The tractor has been the iconic farm implement since it became more popular and affordable in the early twentieth century replacing the animal powered plow. Harrows, cultivators, and plows are common tilling attachments along with others for planting, fertilizing, irrigation, harvesting, and loading. While they are not all equally essential to running a farm, they all take up space, as do the equipment and work room to maintain them and other machines. Walk behind tillers are effective and efficient alternatives for smaller plots. Goats can be used to clear aboveground vegetation and pigs will dig up roots and turnover the soil; both will manure while they work.

There would be no way to operate a homestead without being able to make and maintain most things. Because this homestead is a work in progress it will always be changing, evolving, and unfortunately falling apart. The barn should provide a workshop space with a sturdy bench and vice. Hand and power tools are necessary for building and

maintenance. A decent workshop space is required for performing dwelling construction, appliance repair, making labor saving devices, improving current items, and making tools. Tools are needed for cutting, shaping, and fastening. With the proper tools lumber could be processed by hand. Portable chainsaw based lumber mills are effective but lumber processing of larger volumes would be best done at the community level.

A new twist on the old farm barn will be an experimental energy processing area. This is the place to make ethanol and biodiesel. Both processes require processing large batches of feed stock, whether grains and sugars or oil, methanol, and lye. The sugars are fermented by yeast into alcohol then need to be distilled into a high percentage alcohol fuel. The oil is filtered, heated, and mixed with chemicals to change its consistency. Both processes require heat sources and the room and ability to move large quantities of hot liquids. They can be dangerous, even explosive, and special consideration will need to be made for safety. This would provide a hotbed for developing community-scale energy projects that would be more efficient to operate while keeping energy production local.

It would be ideal to obtain all building materials on site. The smaller the building the fewer materials needed. The unique juxtaposition of this project is that the result is the ability to perpetuate the homestead indefinitely, especially without modern energy, goods, and technology. However, there is no reason not to take advantage of inexpensive mass produced goods for the initial set-up as long as they are not produced in grossly inhumane or environmentally irresponsible ways. While these products will work for now long-term plans must be made for their eventual replacement with sustainable ones. For instance, a pole barn with metal siding and roof can be erected for less than \$15 a square foot. The cost may be further reduced by using on-site timber. If pine poles are

replanted at the time of building they would grow large enough in 30 to 40 years to replace the old ones when they wear out.

## FIELDS

After the sun, the fields are the next link in the food chain. The fields are the landscape that host the growing things that use energy from the sun to sustain themselves and others. So many plants can be grown and used in so many different ways. They fall along a continuum of nutritional value and fiber content. People tend to eat the softer more nutritious type while animals can eat the coarser; at the furthest end of the spectrum, ruminants can eat grass while people cannot. This parcel has ample room and good soil for fields, the question becomes how to divide and manage them for the greatest benefit to humans, animals, the land and all of their interconnections.

Vegetative food grown for human consumption should include a wide variety. In the greenhouse and garden: celery, kale, leeks, broccoli, Brussels sprouts and cabbage are good winter crops. Green beans, asparagus, spring cabbage, and radishes are ready in early summer. Late summer and early fall are plentiful in variety including corn, beans, squash, potatoes, tomatoes, cucumbers, beans, carrots, spinach, etc. For fruits, strawberries, raspberries and other brambles, black currants, and blueberries can be established quickly while fruit trees take longer to produce a yield. (Seymour 2004, 70)

Using fields to grow grains for food and animal feed can produce enormous amounts of food. An average yield for an acre of hay with a high alfalfa mix is 3.35 tons per year. That is enough for four cows or more than enough for two cows and a mixture of other, smaller animals. The U.S. average barley yield per acre is about 50 bushels at 48 pounds per bushel, oat is 100 bushels at 34 – 42 pounds per bushel, corn averages 100 bushels an

acre at 56 pounds per shelled bushel, and wheat is likely to produce 30 or more bushels per acre at 60 pounds a bushel. Additional roots and vegetables can be grown for fodder and fields of grasses for pasture. (United States Department of Agriculture 2010)

The use of pasture has been reduced in modern farming techniques. Livestock is commonly fattened in place with high-nutrition feeds for high-yield production. Often growth hormones and antibiotics are also given to maximize productivity. These practices have questionable effects on humans consuming them. Conversely, pasture land has gained a rebirth in “free-range” and “organic” farming. The most productive and lowest maintenance improved pastures for ruminants are mixed legumes and grass. Mixing legumes and grass on a pasture works well because the clover and grass grow at different times of the year providing good feed and a varied diet. Clover and other legumes also generate nitrogen that fertilizes the soil as a form of green manure.

Animals and their grazing habits actually improve pasture productivity if managed properly. Pasture needs to rest and regrow after it is grazed; two weeks of rest is good but four weeks is better. Dividing the pasture area up into enough sections for the animals to be moved every day or two will ensure the best fresh feed by what is known as rotation grazing. Animals always need access to fresh water, salt and mineral supplements, and shade. It is possible to make a central watering area that is accessed by its surrounding paddocks to keep the movement of resources limited and allow the animals to pass through gates to different areas. This grazing management is part of the crop rotation cycle when a given plot is in its three year grass cycle. (Florence 2002)

Soil improvements may be necessary to maintain the health of the pasture. The first step is to identify the existing forage and do a pH test. All of the soils in potential grazing

areas of this site are acidic, being between 5.1 – 5.5 pH. This is too low for the best forage grasses and legumes. Lime is used to bring the soil pH up to 6.0 – 6.5; additional phosphorus may be necessary for the liming to be effective, and it is best to incorporate it into the soil with a disc harrow. Depending on the current mix of forage the grass and legume mix can be changed by feeding seeds to the animals and letting them broadcast them as they graze or seeds can be disked or drilled in unless one is reseeding from clean tillage. (Florence 2002)

New growth needs to be well established before animals can graze on them or else they will rip out the roots. Fertilizer applications should be based on soil or plant tissue mineral tests. Fields will likely need 30 – 60 pounds of phosphate and 90 to 120 pounds of potash once a year. Because this soil is good quality and there will be manure to spread the lower end of the ranges will be adequate. Ideal quantities are: 10 tons per acre of cow manure, 6 tons from sheep, or 3 from chickens. One cow producing 150 pounds of manure a day can manure one acre in 20 weeks. Extra nitrogen will not be needed because of the legumes that will be sown. Rotational grazing tends to limit weeds; additionally, pasture can be clipped or augmented with a goat to control weeds and plants that other animals will not eat. Goats are of even greater benefit in maintaining land around the house and garden where intensive management is needed. (Florence 2002)

There are many types of fences that have been developed, some recently and some in antiquity. An interesting traditional option is a living hedge made of thorn bushes. To get the hedge established one can plant two rows of thorn seedlings spaced 18 inches between plants and 9 inches between staggered rows. The hedge must grow for four years before it can be used or it will get eaten and infiltrated by animals. Every five years the

stem is cut half way through and bent over and woven into the next one. This type of fence is natural and will last indefinitely. The best modern option is electric fencing because it gives great control and is easily moved. They are often powered by solar charged batteries, but this solution is too dependent on high technology for nature-sourced sustainability, more labor intensive animal husbandry would be preferred. Also electric fencing will not keep sheep in, sheep need light mesh or hurdle fencing, which can also be moved easily. (Seymour 2003, 138-141)

## POND

The 1.5 acres of Carlisle muck at the southern border of the southwestern quadrant is ideal for building a pond. It is naturally prone to ponding and so just needs some encouragement. The soil readily holds water and is a fertile place for water plants to grow. The horseshoe shape of greater elevation to the north, east, and west will help contain water. A dam with a core of impervious clay will be necessary for the boundary on the southern edge to keep water in. An overflow tube through the dam will allow the depth to be maintained as the pond is fed by the stream from the hill to the northwest; an emergency spillway is also necessary to backup the drain tube and control flooding. (Reader's Digest Association 2003, 100)

Ponds of warmwater fish are easier and less expensive to manage. This means stocking a population of largemouth bass instead of trout. Bass are predators and need forage fish to feed on. There are hybrid sunfish that are a cross between a bluegill and green sunfish that produce more males and so will not overcrowd the pond when stocked as feeder fish. Channel catfish are sometimes stocked in addition to largemouth bass as

livestock. The Cornell Cooperative Extension recommends 750 sunfish fingerlings per acre, 70 catfish fingerlings, and 100 bass fingerlings per acre. (2010)

The proper balance of fish populations can be maintained by adjusting the stocking rates. Fish populations do not reach equilibrium in a pond. They are optimized toward the goals of harvestable size, annual reproduction, and the balance between the species.

Many fish dying at once in a 'fish kill' is a bad sign and is most commonly the result of oxygen depletion. Low oxygen levels can be indicated by fish gasping at the surface right before sunrise when the oxygen level is the lowest. Oxygen depletion may be caused by decomposition of organic matter or reduction in photosynthesis. Water grasses produce oxygen and reduce turbidity allowing more light in the water. (Cornell Cooperative Extension 2010)

## PERMACULTURE

Permaculture seeks to model an intentional environment on observations about how ecosystems interact. It intends to mimic or imitate nature while acknowledging the inability to replicate it. The goal is to take advantage of interrelationships that naturally balance each other. The driving motivations behind permaculture are: taking care of the Earth's health and viewing it as valuable, helping people to change ways of living that do not harm people or the planet, and limiting consumption to ensuring that Earth's resources are used responsibly. The word permaculture is a linguistic blend of permanent agriculture as well as permanent culture.

As an approach to designing human settlements and agricultural systems that emulate the natural relationships found in nature this entire homestead design seeks to be a permaculture. There are some areas though, that can be used especially as test beds for



more a more dense demonstration of intentional ecology techniques such as polyculture or forest gardens. The homestead aims to produce the greatest amount of life's necessities in the most environmentally responsible ways. The ideal for food production is to make a variety of nutritious food to support the inhabitants of the homestead.

The location, climate, and soils limit the species that are appropriate for this plot. The range of some can be extended by growing them in greenhouses or with other special treatments. Perennial polyculture plots such as those proposed here are made up of plants occupying different levels of space and even times. There are large trees, smaller trees, brush and shrubs, and ground cover. In the first volume of Dave Jake's book *Edible Forest Gardens* (2005, 1:305) he gives his assessment of the top 100 species that are most likely to succeed and are the best producers in the eastern deciduous forests.

Large trees such as sugar maple, walnut, hickory, and pecan can be spaced to produce nuts and syrup while letting in light for understories. Smaller apple, plum, pear, and chestnut trees can be interspersed for their fruit yields as well as alders, which are nitrogen fixers. Some vines include grapes, kiwi, and hops; the essential beer ingredient. There are numerous types of food producing bushes and shrubs including hazelnuts, bush cherries, currants, brambles, and blueberries. There are ground vines, vegetables, and herbs like onions, garlic, asparagus, groundnut, mint, strawberry, nettle, rhubarb, sorrel, etc. Many ground plants are nitrogen fixers and there are also edible fungi such as shiitake, stropharia, and oyster mushrooms.

## FOREST

Close to half of the acreage of this plot is covered in forest. Most of it is probably a mixture of maple, beech, and birch trees. There are also likely to be oak and hickory as

well as white, red, and jack pines. It has been determined that when fully stocked and mature, this forest should contain 100 – 300 trees of 15 to 8 inches (respectively) in diameter per acre. There is about 1,400 cubic feet of tree volume per acre, or nearly 4,000 board feet of saw timber per acre. This is a good resource for habitat, construction materials, and fuel (West 2009, 23).

The contiguous area of forest uphill of the house covers about 33 acres. A 200 year growing cycle (more or less depending on the lifespan of the species) would allow a yield of 0.15 of an acre per year or about 210 cubic feet harvested per year. The average energy value for this mix of trees is approximately 310,000 BTU's per cubic foot of tree volume (Oyen 2010), which would result in over 65.5 million BTU's available per year by burning. This would be a very conservative management routine and would allow the forest to mature thoroughly. It would be possible to gather much if not all of this volume from fallen timber and culling poorly shaped or unhealthy trees over the entire forest. This process, called low grading, allows the straighter, higher-quality, and more mature trees to have more space and nutrients.

This chapter discussed all the fundamental purposes of the main features of the homestead. The house site was described as a creative healthy place for a family to live. The barn is a multipurpose building that promotes healthy animal, energy, and material longevity. The stewardship of field, pond, permaculture, and forest was portrayed as living systems that have benefits if responsibly managed. In the next chapter, ways of preserving food are drawn from times when the world was closer to being sustainable.

## ***6 PROCESSING, CULTURING, PRESERVING***

This chapter is about processes for food preservation including historical culinary traditions for cultured dairy, fermented foods, and beverages. One of the most important skills of food production is the preservation of quality and utility of the product. Food production is highly seasonal and abundance in one season must be carried over to other seasons. Processing food is considered producing “value added” products. The concept of value added is important for making money on a homestead because it usually involves turning a bulk item like grain into a craft item like bread. The item might have more value because it is easier to utilize, transport, or keep for a longer period of time. While “value added” products can be worth a multiple of what it cost to produce them they are also essential in themselves to life on the homestead. (Macher 1999, 125)

### **FRUITS AND VEGETABLES**

Time, heat, light, oxidation, freeze-thaw, contamination, and adulteration are common factors that devalue food. Protection from pests and pathogens are also of prime importance. Food may be preserved by canning, souring, culturing, fermenting, dehydrating, freezing, smoking, and/or salting. For efficient storage, food can be buried or kept in cold cellars. Produce keeps best in cold moist air so water can be added in pans to cellars. Fruits, meat, and vegetables are often canned, which is a very effective method of preservation. Low acid foods such as meat and vegetables must be canned in a pressure cooker to ensure effective sterilization of the contents. The drawback of canning at high temperatures is the degradation of the nutrition available from the food (although less nutrition is lost than if the food rotted). Sauerkraut and pickles are examples of fermented vegetables. Sauerkraut sours naturally at room temperature in brine for three

weeks, pickles are often made with salt and vinegar. Soybeans can be made into a fermented block called tempeh, a malt paste used to make soup called miso, or the bean curd formed into a soft smooth block of tofu. One of the most interesting of these areas of processing are those pertaining to dairy products.

## CULTURED DAIRY

To the best of man's understanding, dairy products have been consumed by cultures around the world since 9 – 10,000 B.C. while the ability to digest lactose into adulthood did not develop in humans until thousands of years later. (Fallon 2001, 34-35) A University College of London study reported by Science Daily on 1 September 2009 suggests that the genetic change that enabled early Europeans to drink milk without getting sick appeared in dairying farmers who lived around 5,500 B.C. in a region between the central Balkans and central Europe. Their analysis shows the mutation spreading out from there especially to northern Europe and the Middle East. Their conclusions are consistent with archeological evidence from dairying in (present-day) Romania and Hungary some 7,400 – 7,900 years ago. Traces of fats from the onset of farming in England around 5000 B.C. have been found however it was likely fermented to make yoghurt, butter and cheese, thus reducing its lactose content.

A well researched cookbook, called *Nourishing Traditions*, by nutritionist Sandy Fallon (2001, 34) discusses the health benefits of traditional food preparation. The following information was drawn from her treatment of dairy. The process of fermenting or souring milk is found in almost all people that use milk from their animals. This helps break down lactose and predigest casein, a difficult protein to digest that accounts for 80% of the proteins in cow's milk. Even for the 30 – 40% of the world who can digest

milk in all its forms, fermented and soured dairy are more digestible. Cheeses made from raw milk contain enzymes that help digest them and all cheeses that are unheated prior to eating are easier to digest. Processed cheeses contain emulsifiers, extenders, phosphates, and hydrogenated oils and should be avoided.

Fallon (2001, 34-35) claims that with modern milking methods, pasteurization is not necessary and it reduces the nutrition available in the milk. Pasteurization of milk involves heating it to 161 °F for 15–20 seconds. All the outbreaks of salmonella from contaminated milk in recent decades have occurred in pasteurized milk. An outbreak in Illinois in 1985 affected 14,000 people and the salmonella strain was found to be penicillin and tetracycline resistant. Raw milk contains lactic-acid producing bacteria that inhibit harmful pathogens making it naturally protected. When it sours naturally it takes a pleasant form but pasteurized milk that sours turns rancid. The heat used in pasteurization also denatures the lysine and tyrosine and reduces the availability of vitamin C and other water soluble vitamins. Heat destroys the vitamin B<sub>12</sub> content and reduces the absorptive availability of many minerals contained in the milk including, calcium, chloride, magnesium, phosphorus, potassium, sodium, sulfur, and other trace minerals.

Pasteurization is tested by the absence of enzymes present in the milk. Those enzymes help retrieve the nutrition contained in the milk and assimilate it, which would really “do a body good” as the advertisement suggests. Healthy indigenous cultures have been found to consume dairy products of raw milk and cultured raw milk and cheese from non-super breeds of animals fed on fresh grass. Contemporary dairying practices of hormone-induced super-high protein fed animals arouse all kinds of links to human diseases from cancer to diabetes to hormonal abnormalities. These animals produce three

to four times the natural amount. The animals themselves often have liver problems, high occurrence of mastitis and reduced life spans. (Fallon 2001, 34-35)

Milk is the source of many dairy products. It can be consumed in its raw state or processed into many other forms (see *Figure 19*). These include cream products, butter products, sour milk products, whey products, and cheeses. Raw milk contains 3 to 5% fat content and can be separated into various fat content creams and low fat milk; the cream can then be churned into butter of differing fat contents. Milk can also be coagulated with rennet into fresh cheeses (i.e. cottage cheese, feta) with the byproduct of sweet whey, which can then be processed into whey cheese like ricotta and hard and soft cheeses from brie to parmesan. The addition of various lactobacillus cultures to different stages of these products returns items such as yoghurt, soured milk which is made into cream cheese, soured cream, cultured butter, etc. (Reader's Digest Association 2003, 57)

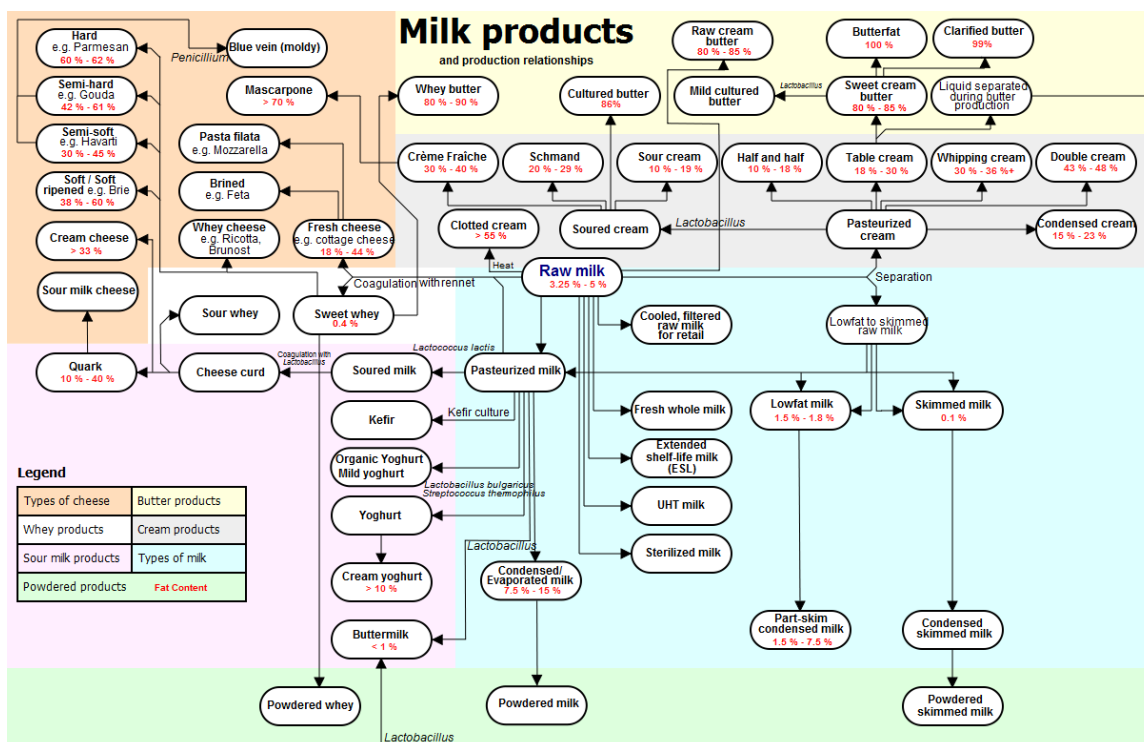


Figure 19. Dairy products begin with raw milk; source: [http://en.wikipedia.org/wiki/Dairy\\_products](http://en.wikipedia.org/wiki/Dairy_products)

These many different dairy products are important for the longevity that they add to milk. Some increase the availability of the nutrients present in the original milk, and they showcase the milk in different culinary forms that please the palate. In the 1800's before the advent of refrigeration milk was kept cool in springhouses. The springhouse could be a separate building in a shady spot or a cool northeastern corner of the house (Reader's Digest Association 2003, 57). A cool spring would be channeled through the room in a trough that containers of milk would sit in keeping them at near refrigeration temperatures even in the summer. Vegetables, cheese, beverages, meat, and other foods could also be kept here in dry storage in the room or containers in the stream.

A couple of small Jersey cows will each produce a few gallons of milk a day which would add up fast. This will ensure plenty of material to preserve into more convenient forms. After excess cream is removed, milk should be stored while fresh until there is enough to make a batch of butter or yoghurt. The bacteria that yogurt contains maintain digestive health; it is most active when freshly made and should be eaten often.

Sanitation is extremely important when working with animal products as well as cultured and preserved foods. Containers and implements must be cleaned of any foreign matter, washed with hot soap and water, rinsed very well to remove any residual soap that could interfere with processing, scalded, and then left to air dry upside-down until they are used so they do not get contaminated.

Cream will rise to the surface of fresh milk and is then skimmed off or the milk is drained out from under it. Cream separates faster when the milk is cooler and it is best to cool the milk as soon as possible when it is fresh anyway. Clotted cream is made from milk that is heated to 187 °F and separated. Sour cream and yogurt are from cream or

milk respectively incubated with lactobacillus for a few days at body temperature. The culture will need to be insulated to keep its warmth or incubated. (Seymour 2003, 188)

Fresh raw milk that is left out warm will sour and turn into curds and whey. The whey can be used in cooking or fed to animals while the curds can be eaten fresh or processed into cheeses. Unlike rancid pasteurized milk, raw milk that curdles does not taste foul because the acidic conditions produced by the natural lactobacillus help prevent harmful pathogens from growing. Alternatively curds can be formed using rennet, an enzyme produced in calves' stomachs that coagulates the milk proteins. If curds are hung in cheese cloth the whey will drain off and the curds form into soft cheese that is nearly flavorless but is often flavored with salt and herbs. This process will not preserve the cheese for long periods of time. (Reader's Digest Association 2003, 236)

Soft and hard cheeses contain nearly twice the energy per pound as meat and can be kept for a long time. For a small homestead operation they should be made in small batches from two consecutive milkings; an evening and the next morning. This will ensure the milk is fresh going in to the cheese and keep off-flavors out. To make hard cheese, a first milking is set in a pan overnight and the next morning the cream is strained off then heated and mixed back in. The second milking is added with a starter culture of lactobacillus to help keep out unwanted pathogens. The milk is then gently heated to 90 °F and rennet is added. The milk is stirred until it begins to coagulate, and the surface is brushed to keep the cream mixed in. After the curds have solidified they are cut into small cubes. Then the curds are warmed very slowly to 100 °F. The curds then sit in their whey and increase in acidity. After this the curds have to be broken up and then pressed in a container with holes in it under increasing weight (up to 1000 pounds) for 2 days.



The drained and pressed cheese is then wrapped and aged at 55 – 60 °F being turned regularly. (Seymour 2003, 191)

Another dairy staple is butter. While butter keeps longer than milk it is not an effective method of preservation. Butter is formed from cream that has been allowed to sour for at least 12 hours at room temperature. With the correct temperature and acidity level the cream will form into butter globs after beating for a few minutes. Next the buttermilk is drained off and can be drunk. The butter must then be washed of any cream and buttermilk that remain. The next step is to work every last drop of water out of the butter; any remaining water will allow the butter to go bad more quickly. For a longer storage life the butter can be made extra salty, the salt can then be washed and worked out before use. (Seymour 2003, 188)

Eggs have been consumed since prehistory but they will only stay fresh for three to five weeks when refrigerated. There are some interesting ways of preserving eggs so they can be stored at room temperature. Aside from hard boiling, eggs can be flash-boiled for five seconds and will keep at room temperature for several weeks (Garvey 2003, 202). This process sanitizes the outside and forms a barrier membrane on the inside of the shell but the inside remains liquid; the egg can then be broken and used like a normal raw egg. Other treatments rely on pickling in salt, acid, or alkaline solutions. All three methods fix the proteins of the yoke by cross-linking them; the latter two fix the whole egg and render it preserved for a year or more.

## GRAIN

Whole grains should be the staple of the human diet, but they are foreign to most modern Americans. Wheat berries, rolled oats, sprouted grains, and real rice are nearly

unheard of. If people ate only fresh fruits, vegetables, and whole grains there would probably be no obesity problem in this country. Grains keep for a long time if they are kept dry and free from pests. There are many varieties of grains useful in making hearty delicious breads that are so far removed from Wonder Bread it is a wonder that such an unsubstantial product with almost no nutritional value is so popular.

Bread making has been central to humanity for many years. It is thought to have developed along with the rise of agriculture in the Middle East around the beginning of the Neolithic period in 10,000 B.C. (Tannahill 1973, 37). Flour for making bread can be ground from dry or sprouted and/or roasted grains. This and water are the basic ingredients. Bread can also contain salt, spices, leavening agents, milk, egg, sugar, spices, fruits, cheese, meat, vegetables, nuts, and/or seeds. Fresh bread is a handy form in which to prepare grains because it is convenient to eat and can be made in infinite ways.

The first breads were likely hard lumps of unleavened dough that were cooked. To make them easier to eat people rolled them out flat to bake; this is a common form of bread in the Middle East to this day. People discovered that when wild yeasts got into the bread dough that sat warm for a while it got fluffier. When baked, the puffed up dough was more palatable than the unleavened flat bread. This is the culturing or fermenting common to most bread. Until the 1800's all yeast breads were sourdoughs, made by retaining a piece of dough from the previous day to use as a form of sourdough starter. The souring comes from lactobacilli that are also alive in the starter that produce lactic acid thereby creating a sour taste and acting as a preservative. Once yeasts were understood and strains isolated, non-sour yeast breads became possible.

Victoras Kulvinskis describes sprouts and their production as essential to life in his book *Survival into the 21<sup>st</sup> Century*, (1975, 72-78). Sprouts are one of the mainstays of the Hunza people of the Himalayan Mountains who are known for their longevity. Sprouting a seed turns the nutrients stored within it into fresh readily available enzymes and nutrients that are great for health. Once sprouted, basic proteins are converted into amino-acids, starches into sugars, and the gas and mucous producing properties of legumes are reduced. Two to three days after germination seeds are at their optimum vitamin availability, especially vitamin C and B as well as A and E. Sprouts are thought to increase fertility and prevent cancer.

Wheat, oats, buckwheat, and soybeans make good sprouts. They are best sprouted 4 – 8 days and eaten without the seed. Mung beans, alfalfa, adzuki, buckwheat lettuce, sunflower greens, wheatgrass, broccoli, and fenugreek are especially nutritious and easy to digest. Grass sprouts such as wild legumes, millet, vetch, lupines, and beans are edible as well and their vitamin content can exceed 20 times that of the mature plant. The water used to soak the seeds can be consumed and the soaked seeds used in breads, the sprouts eaten, sprouts of vegetables that have matured into greens can be eaten, and finally all can be used in blended drinks or juiced and strained. Nuts too can be gently removed from their shells and sprouted.

Sprouts are easily grown in wide-mouthed mason jars. The disk in the lid is replaced with cheesecloth or stainless steel screen. The seeds are washed thoroughly and soaked overnight in two parts lukewarm water to one of seed. The smaller the seed the shorter the soak, from 3 hours for alfalfa to 24 for mung beans. After the first soaking the water is drained off, the seeds are washed and placed in a dark place between 60 – 70 °F. The

seeds should be rinsed twice a day with tepid water and allowed to drain; any seed hulls should be removed. Clover, radish, alfalfa, fenugreek, and others can be put in the sun after 3 days so they can grow chlorophyll. Beans may need two soakings, require more frequent washings, total darkness, and are ready in 3 – 5 days.

## WINE

A discussion of fresh grains and then subsequently sprouted grains must ultimately lead to the noblest of all food processes: alcohol fermentation. The product of grain fermentation is beer but wine from fermented juice can be spectacular as well. Benjamin Franklin is often quoted as saying that “beer is proof that God loves us.” The reverence of this statement aside, while under its influence, one may see some truth in it. It is suspected that 12,000 years ago malted barley was discovered accidentally when some grains were left out in the rain and later found to be sweeter. This sprouted grain is good for food and cooking but taken a few steps further makes a delicious, refreshing, intoxicating beverage whose making has become a fine art.

The crude beer that resulted from drinking a soup of malted grains that had sat long enough to ferment had a profound impact on cultures wherever it was discovered. Enjoyed by ancient Egyptians, Aztecs, Eskimos, and Incas fermented beverages were often given religious status within their societies. Today, depending on who is asked, beer consists of water, fermentable sugars, hops, and yeast. The Germans, third only to the Czechs and Irish in their per capita consumption of beer, adhere to their *Reinheitsgebot* (or "purity order") dating from 1516 that allows only water, hops and barley-malt; they did not know what yeast were back then. (Papazian 2003, 5-7)

In essence, even contemporary beer making is a simple process. Barley (for instance) is sprouted then dried to make malt. The malted grains are then steeped at around 150 – 158 °F for 20 – 90 minutes allowing the enzymes to convert starches in the grains to sugars and for the sugars to dissolve in the water. The temperature is then brought up to boiling to deactivate the enzymes, sterilize the mixture, and bring flavor out of the hops that are now being added. After boiling for 15 – 60 minutes more hops are added, and the wort (as the fluid mixture is called) is strained on its way to being cooled as quickly as possible to 70 °F. At this point brewing yeast is added and turns the sugars into alcohol and CO<sub>2</sub>. (Papazian 2003, 242-314)

A condensation of John Seymour's description of wine and vinegar making follows (Seymour 2003, 226-231). At a basic level, wine making is an even simpler process than beer making but it has enjoyed a much greater cultural and culinary appreciation. Grapes are crushed and fermented, with the skins for red wine and without for white. While wild yeasts are present in the bloom of the wine skin, special wine yeast is added to the juice (or 'must' as it is called) to assure complete fermentation and optimal flavor. After a process of transferring the wine off its sediment into a clean container several times it is bottled and aged; at least three months for a white and a year for a red. A similar process is used for making mead with honey and water or hard cider from pressed apples.

Vinegar can be made from wine, cider, or beer. Vinegar is formed by *Acetobacter* in aerobic environments. This will happen naturally to these liquids if they are left open to the air for a few weeks. The process can be better controlled and sped up a little bit if the liquid is slowly dripped over beech wood chips that have been soaked in a previous batch of vinegar. The dripping ensures plenty of exposure to air and the old vinegar helps

introduce the bacterial strain desired. Like many other cultured products discussed here the organism needed to help the process can be cultivated from one batch to another.

## MEAT

Eight of the twenty-two amino acids that make up all proteins can only be ingested; humans cannot make them. Before the agricultural revolution of the Neolithic era humans subsisted on meat and fat augmented with wild vegetables, fruits, nuts, and seeds. Meat is a source for these essential amino acids as well as Vitamins A and D, iron, zinc, calcium and other minerals as well as the fats that are needed for the absorption of the nutrients. Meats provide the most nutrients when they are cooked the least. Raw and rare red meats are full of healthy enzymes and vitamins and are best consumed this way or braised on the outside in water or stock. (Fallon 2001, 26-32)

The easiest way to store meat is to freeze it but without refrigeration it can be salted and/or smoked. Meat should always be kept below 40 °F before curing. Small animals like lambs, ducks, chicken, rabbits, etc. can be butchered and eaten by a family before they go bad. Traditionally beef and pork are salted either dry or in brine with 8 pounds of salt and 2 pounds of sugar for every 100 pounds of meat, and then possibly smoked. Cured meats should be wrapped in waxed paper and cloth and hung in a cool dark dry place where no flies or other pests can get to it. Smoking should be done at less than 120 °F. Meats can also be dried and made into jerky by cutting thinly, brining, rinsing, and then cold smoking for twelve to 36 hours. (Reader's Digest Association 2003, 222-229)

A final cured food product of note are salami. Salami are cured, fermented, and air dried meat products that originated in southern Europe that can be stored at room temperature for up to 10 years. They are made from chopped and salted meats that are

left to ferment at room temperature for 1 day. Originally bacteria were introduced into the meat mixture by adding wine but cultures are now used for this step. Meats may include pork, chopped beef or veal, venison, and poultry (especially turkey). Additional ingredients may include minced fat, wine, wheat, cornstarch, salt, herbs, spices, and vinegar. (Reader's Digest Association 2003, 222-229)

After the initial fermentation the meat is then stuffed into casings and allowed to continue to cure reaching a pH of 4.5 – 5. The high salt, low water, and low pH inhibit the growth of harmful bacteria. The process is carried out in a warm moist environment to encourage the growth of the desired bacteria in the meat. The salami requires about 36 weeks to cure. Afterwards the salami are dried which turns the casing from being a semi-permeable membrane to a nearly air tight one. The outside of the casing is often inoculated with *Penicillium* which adds flavor and forms a white crust on the outside that protects it from harmful mold. The crust or a coating of flour also keeps out light which would speed up oxidation of the meat. (Reader's Digest Association 2003, 222-229)

This chapter discussed methods of preserving and preparing food with the greatest attention given to those that are beneficial to our health (unlike most grocery store “processed foods”) but least common in our culture today. Food is best in its freshest most natural form to obtain its vitamin, mineral, and enzyme content. Grains should be preferred in their most whole form and/or sprouted, dairy is best cultured to make it most digestible but without excessive heating, and homebrew can make a happy neighbor. Chapter 7 looks at the technological adaptations people can make to facilitate a standard of living similar to which we have become accustomed in modern times.

## ***7 TECHNOLOGY AND ENERGY***

The following chapter looks at technologies and their role in the homestead. Energy production, material sources, and repair are considered. Technologies are viewed as appropriate when they are sufficiently low-tech, long lived, useful, pleasing, and especially relieve a stress or disharmony with the environment.

### **ENERGY**

Energy is a great concern in the world today. There were oil shocks in the seventies that began a rebirth of the homesteading or “back to the land” movement but now there is much greater cause for concern. According to some estimates humans are currently or nearly at the peak of the global ability to produce oil (Biol, 10 December 2009; Mason, 22 March 2010; Macalister, 29 November 2009). This would be bad enough if it only meant that oil is going to get more expensive in the future; the cost of oil is already stretching the economy. Even more so, it is bad because the world’s oil use and demand is continuing to grow. Needless to say if the demand keeps rising and the supply keeps falling there will be worse problems than just economic ones.

Energy is a physical quantity that describes how much work can be performed by a force. Without the ability to utilize force in addition to themselves, men are severely limited. Of course the most readily available, low-tech forms of energy originate from the sun (i.e. not nuclear or geothermal). Sunlight reaches the Earth and warms it, moves the atmosphere, moves the oceans, allows things to grow, etc. Man needs some forms of energy for all survival including heat and food. Energy is used to make inedible foods edible, to help clean things, to regulate indoor climate, to change the form of materials,



and to move things. Humanity's use of energy has gotten exponentially more complex throughout history.

The first and second laws of thermodynamics say that energy is not created or destroyed, but it tends toward less useful forms as it is used. The zeroth (yes, there is a zeroth law of thermodynamics) and third laws have to do with temperature; specifically thermally coupled systems tend toward equilibrium and it is impossible to reach absolute zero temperature in a system (Vuille 2009, 355). In the economy of things, these statements are not so cheery because they mean that the world of energy is a losing battle. It always takes energy to get energy, which is a source of loss. If this energy came from a tank, it would run out. Worrying about the energy of the sun being depleted is not necessary; there will be bigger things to worry about before then.

The energy dilemma remains: it is unlikely that energy will move into smaller spaces or more concentrated forms on its own. Additionally the known concentrated stores of energy can be depleted in a conceivable amount of time, say for instance in 100 – 200 years. Alternative energy is about collecting energy into a useful form from sources that can be renewed at a rate that exceeds their use. Even alternative energy requires the input of energy. It should also include alternative approaches to energy including ways to leverage and catalyze process to use less energy as well as to simply not waste so much.

Humanity has grown so far to be facing the loss of so much. Human potential lies in learning, reasoning, communication, and processes. Before there were cars, trains, and planes people got where they needed to. Before there was central heating people adapted and wore more clothes. Before there was electricity life was just as livable. Now that there are technologies that allow people to traverse the globe almost instantly mentally, it

may be time to reduce and refine the infrastructure of the last century to maximize the use of cognitive potential reducing energy used for transportation. There are probably enough internet-ready computers in existence for every family in the world to have one. If they were all connected to share information and meet people's needs what would be left to fight over? Maybe water.

Despite this utopian vision, there is no faith to be put into the machines and machinations of men. There are several energy sources available on this property. To simply live responsibly taking account of one's own self and family leads to a simplified model; a defined space with inputs and needs. The resources are what are available on the site and the technologies to develop them are those that are easily obtained, scavenged, and/or constructed by hand. A potentially available energy source is burnable organics including wood, biomass, manure, etc. Another is alcohol made from biomass; vegetables for oil can also be grown. Passive solar relies on collecting energy from the sun. Wind power is another source of work that has been used for at least the last 2,000 years (Drachmann 196, 145-151).

The last thing anyone wants to read (or write) is more statistics about petroleum. It's a finite resource, it will not last forever, production has probably peaked, and demand has not. If high technology is not going to save the world then transitional technologies are needed that allow life to be perpetuated by making good use of the leftovers from yesteryear. Another aspect of transition will be the use of renewable energy sources that will be available in the future, moderated by a heavy dose of governing. Heating, cooking, cleaning, transportation, and material processing are all necessities that will not go away (until we gain our sustenance directly by being in the presence of the sun).

Heating has traditionally been accomplished with fire. As has been mentioned in the house design section, it can be augmented by environmental design to help capture heat in the winter and shade it in the summer. It can also be increased in effectiveness with passive solar heating systems as simple as a black water box on the roof, or a glass wall with black water drums or stones behind it. The claim has been made that woodstoves (or coal, biomass, etc.) are inefficient because they send the heat to the ceiling and out the flue (Hooper, 1905, 185). Heat system design could be improved with a hot water tank and piping that extracts excess heat from the stove and stores it coupled to a radiator system that can move it around the house where it is needed. This would make it more like a contemporary oil furnace except that it runs on renewable fuel.

The space heat system and solar heater could interconnect with the hot water heater through a heat exchanger. The whole plumbing system could be gravity fed from the cistern and hot tank on the roof. The furnace and solar hot water box would balance each other in summer and winter for the hot water demand. When the furnace is not running in the summer the heat available from the solar box will be greatest. A box that is 9 feet square and 0.5 inches deep would contain 25 gallons. This location in New York receives between 100 and 300 BTU's per hour per square foot throughout the day in the summer (Solar-estimate 2010). This box could collect between 8,000 and 24,000 BTU's per hour, per day. That would allow 25 gallons of shower water to be heated from 60 to 100 °F in 20 – 240 minutes.

Biomass can also be turned into ethanol at a percentage that is high enough to burn as fuel. In a process similar to making beer, sugars are fermented with yeast to make a mash or beer-like liquid that can have an alcohol content as high as 20% naturally before it

starts killing the yeast. Beer yeast will tolerate 5 – 10% alcohol so the higher alcohol content requires specially bred yeast such as a Champaign yeast. Extra enzymes and nutrients may be added to help the fermentation process that would not be fit for human consumption. A byproduct of the process is spent grain that makes great animal feed; often called DDGS, or distillers dried grain and solubles. (Howard 1999, 101)

The mash must be distilled to a higher alcohol percentage to make it a worthwhile fuel. A 50% ethanol water blend will burn but to get the most energy per weight per distillation heat input, 90 – 95% is a realistic level. The last 5% of purity above 95% is very difficult to get and requires extra processing steps. A continuous run distillation column would be the most efficient for a fuel production system. A continuous run has an input that allows mash to be added during the distillation process. Otherwise the system has to be stopped, cleaned, loaded, and worst of all reheated after every batch.

Theoretically, a bushel of corn will yield up to 5.5 gallons of ethanol though that is not likely. Ethanol distillation is illegal in America for consumption purposes (Howard 1999, 122). As per Title 27, CFR 19.912 of the U.S. Bureau of Alcohol Tobacco and Firearms code it is possible to obtain a permit to produce fuel. To produce fuel for personal use to be used on one's own property, there are no bonds, taxes, or denaturing required. This permit allows the production of up to 10,000 gallons (or 19,000 gallons of 95% pure ethanol) per year (National Archives and Records Administration, 2010). This is much more than would be needed for this homestead or even its community. Making that much ethanol would consume 3,800 bushels of corn for the feed stock, this would require 20 – 25 acres of high production cropland, and would propel a 30 mile per gallon car 570,000 miles. This is not an appropriate use of farmland to maintain current use.

Vegetable oil is both a cooking staple as well as a potential energy source. Vegetable oil can be readily extracted from sunflower, rapeseed, soybean, flax safflower, corn and many other plants. Once the oil is pressed out seed residues are an excellent source of nutrient supplement for livestock. The oils can be used for cosmetics in soaps and lotions, lighting, and wood preservatives. Oil to be used as fuel can actually be collected as waste from some restaurants for free, providing an almost free source of energy for the entrepreneurial spirit who will truck down to McDonalds and siphon out a few gallons. Besides motor fuel, vegetable oils can be used as home heating oil.

The commercial process for extracting oils has been well refined and complicated using hexane as a solvent, then sparging to remove impurities and hydrogenation to make the oil solid at room temperature. Hydrogenation also keeps oil from going rancid quickly; nevertheless the fundamental process of oil extraction is simple. The seeds from the plants must first be cracked in a mortar and pestle or in a mill. They are then wrapped in cloth and pressed under pressure as are apples for cider or cheese. A simple press for all of these purposes can be made from a heavy vertical frame of metal or wood. The container holding the pressed items sits inside the frame with a pressing plate on top of it. Between the top plate and the top cross member of the frame goes a hydraulic car jack, the car jack can then exert its tons of pressure on the substance being squeezed. (Seymour, 2003, 158)

The oil can then go into a diesel motor. A diesel motor will run on pure vegetable oil however, there are some unfortunate limitations to this. The most apparent is that when the temperature drops the oils solidify. The solution to this is to have two fuel tanks, one with traditional fuel in it, and the other with vegetable oil and a heat coil. The motor

starts on the conventional diesel and heats up the other fuel then fuel sources are switched. Another problem less noticed is that the oils, as triglycerides, have waxy properties that cause varnish buildup on very precise fuel injection parts; so plain vegetable oil works but not for very long.

To work around these problems the vegetable oil can also be processed into biodiesel. In this process the triglycerides are reacted with an alcohol such as ethanol or methanol. The alcohol is deprotonated with lye to make it a stronger nucleophile (Fernando, 2007). Heat is added to speed the reaction and the products are ethyl esters of fatty acids and glycerol. The glycerin precipitates out and forms sludge at the bottom of the biodiesel. The fuel is then drained off leaving behind the glycerin. The glycerin can then be used to make soap and other cosmetics, in compost, or as antifreeze.

After this transesterification process the biodiesel has viscosity properties more similar to conventional diesel at cooler temperatures. It is claimed by those trying to sell it that it contains more energy and has better cleaning properties than diesel. Consequently, it also deteriorates plastics and rubber that diesel will not and can destroy the fuel system if the seals and hoses are not changed to higher grade materials. On older diesel motors that have varnish buildup covering up engine wear, the varnish may be dissolved causing the motor to have much looser fit between bearing surfaces; the motor will then promptly self-destruct; as the author experienced in 2008.

Now that bright-white LED's produce sufficient light for reading, it would be a small step to experiment with homemade batteries. There are various methods for making non-rechargeable batteries using copper, aluminum, carbon, salt water, chlorine bleach, or rechargeable ones of lead and acid (Creative Science and Research 2003). With

homemade batteries, a lighting system may be arrived at that runs on scrap metal and is charged with a windmill coupled to a car alternator. While not the ultimate in efficiency, the parts are almost free and if energy use is kept to a minimum it would make a useful supplement. It could be argued that this is a waste of resources because the metal is downgraded in the process. Commercially made rechargeable batteries such as NiMH's, while available, are an efficient alternative. Natural lighting can be enhanced with sunroofs, mirrors, window sills that are large and reflective, and light tubes that collect natural light and tunnel it into understories. These can also be augmented with lights powered by homemade alcohol, oil, or methane.

## TRANSPORTATION

The best solution to transportation is to order one's life so less is needed. The figures for petroleum fuel used in America for transportation are disturbing. The fact that lettuce may travel 3,000 miles before it is even brought home from the grocery store or that Shenandoah's Pride milk comes from Pennsylvania is unsettling. This phenomenon is driven by consumer demand, mega-corporation food distribution companies, and real estate value, but it is not necessary and cannot be sustained. Petroleum use may not go away anytime soon but it may not be long before people must use as little as possible because of limited availability and high cost. (Meadows 2004)

Every family could have the mechanical ability to cobble together a simple cart powered by small gas, diesel, or electric motor that could get them around town for pennies on the dollar of what is currently spent on automobiles and fuel. Vehicles for local use need to be lighter, slower, and less powerful (i.e. wood, bike parts, and a few horse power), which would allow them to far exceed industry fuel mileage achievement

and life cycle cost. With homemade ethanol, methanol, or biodiesel there would be no lack of mobility. The Amish and Old Order Mennonites get around on scooters, bikes, and horse and buggies; it can be done but their society is organized locally. This plot is situated in close proximity to two small towns one of which is fed by a commercial rail road line. While the ultimate goal is to be self-sufficient, if need be, it is also good to be able to easily get groceries and building supplies while they are easily available.

## WASTE

In nature there is no such thing as waste; every material is in some stage of an endless cycle. To humans waste is generally an output and it deserves a lot of attention. Waste is something that is not useful or being used. In a self-sufficient, homestead economy that is a bad thing. For people living hand-to-mouth, the reality that waste equals food is much easier to grasp. One should seek to eliminate waste not only by trimming down inputs but also by repurposing outputs. A good example of this is using manure for fertilizer or spent grains from alcohol mash for animal feed. It helps to think of the constituents of biological materials the fats, proteins, carbohydrates, water, and nutrients. Sawdust may make good insulation or wood filler; wood scraps make good shims and can be burned as fuel or pyrolyzed into charcoal or soil amendments.

An alcohol closely related to ethanol is methanol. It is liquid at room temperature and boils at a lower temperature than ethanol, 148 versus 173 °F (Centers for Disease Control and Prevention 2010). Methanol is called wood alcohol because it is formed when cellulose is fermented rather than simple carbohydrates for ethanol. Because of the cellulose content of grains it is a minor byproduct of ethanol production. It can also be made from grass, wood or any other cellulosic material; ruminant dung for instance has a



high content of undigested cellulose. Cellulose is harder to digest than simple sugars so it takes enzymes or heat to help the process. (Howard 1999, 115)

Methanol, the simplest alcohol, is a light, volatile, colorless, flammable, liquid with a distinctive odor that is very similar to ethanol but slightly sweeter with a more slippery feel. It is used as an antifreeze, solvent, fuel, and in producing biodiesel. The easiest way to make methanol is by heating wood without letting it burn. Wood or other cellulosic material is heated in an air tight container with a pipe that allows gasses to escape. The gasses are then cooled so they condense just like in ethanol production. The result is methanol, a deadly poison and fuel with nearly as much energy as ethanol, made from waste. (Howard 1999, 143)

The leftover residue in the airtight container will be nearly pure carbon. The waiflike charcoal is very light in weight and black. It is the skeletal remains of the biomass that went into the process. The empty spaces left behind by the water and cellulose that vaporized are called pores. When made from wood or other materials that leave behind large (for being microscopic) pores, the charred remains can be used as a product called Biochar. The Bio prefix indicates the biological purpose of the product, in this case as a soil amendment. In soil with a low organic content, Biochar sequesters carbon as a nearly permanent matrix for microbes to live in as they enrich and enliven the soil. (Sohi, 2009)

A compound related to methanol, methane is also an easily producible fuel. Methane is the simplest hydrocarbon and is a methanol molecule without an oxygen atom. Methane comprises about 87% of natural gas. It is a colorless and odorless gas with a boiling point of -259 °F. It is flammable only over a narrow range of concentrations (5 – 15%) in air which makes it a little safer to handle than say hydrogen, which is flammable

at 4 – 74% (BOC Gases 2010). Almost any raw organic material can be used in a methane digester from food and paper scraps to wood and biological effluent.

A methane digester is fundamentally a container for refuse. Methane is produced by bacteria present in rotting materials. They can break down cellulose efficiently, which most other living things cannot do. In an anaerobic process, raw material is added through a closable pipe or door and allowed to be decomposed by the bacteria. In the presence of oxygen, these bacteria would only produce CO<sub>2</sub> or nothing at all. A pipe at the roof of the container allows the methane to exit the vessel. A convenient storage container can be made by inverting a container in water and piping the methane exhaust into the airspace created between the inverted container and the water surface. As the inverted container fills it will raise acting like an expandable bladder. A relief pipe can then feed into a stove, light, refrigerator, or other appliance. (Howard 1999, 145)

## MATERIALS

While there should be no waste on a homestead there will inevitably be some even as one transitions to making less and less of it. The closest waste collection and recycling center is the Eastern Rensselaer County Solid Waste Management Authority 10 miles away north of Hoosick Falls and there are private trash collectors that will take things to it. Without them, trash collection and removal could be done as a community effort aided by a shared truck or large cart. The closest junkyard is about 9 miles away in North Bennington. These stockpiles of everything society casts off contain exactly the items that people in the local area have been using for generations so they are ideal places for scavenging resources. Much of what society throws away is still in usable condition. Partially worn tools and still usable tires go into the heap, along with demolition debris

from homes and business that are full of useful stuff. It only takes looking beyond the form to the content and a little creativity to make good use of them.

An article from *The New York Times* on 2 September 2009 entitled “One Man’s Trash...” (Murphy) is a story about a government retiree who builds artistic cottages out of junk for low income individuals in Huntsville Texas. His wild imagination allows him to make windows out of crystal platters and roofs out of license plates. He said he was disturbed by the irony of landfills choked with building materials and a lack of affordable housing. Many residents default or abandon the homes in disrepair to which the builder, Mr. Phillips, surmises “You can put someone in a new home but you can’t give them a new mindset”. This is echoed in what solar-design architect Malcolm Wells says after giving many practical construction tips that the secret to the success of a ‘green’ house is not technology but “your own attitude about things like nuclear power, pollution, and even the future of the human race”.

While some animals are reported to use objects as tools, humans are certainly set far and away from the rest of the animal kingdom in their purposeful making and keeping of tools. A sustainable homestead, in order to be robust, must rely only on low-technology that can be produced on-site or locally without relying on industrial energy (that rules out microchips and photo-voltaic arrays). This chapter discussed simple methods for home-scale conversion and concentration of renewable energy sources. Alternative views on energy use are mentioned as are the relationship between wastes and materials. The following chapter will critique this homestead plan looking for oversights or disunity that detract from its success as a sustainable habitat.

## **8 DEPENDENCIES**

The homestead is an intentional living system that requires management and external inputs. There is no way to get the diversity and variability needed for continual life on such a small plot. Though an effort is made to mimic nature and reduce the level of energy and resources put into it, without human direction the site would cease to be productive in a useable way; it would return to weeds and the surroundings would grow over it. This leadership and management is a necessary mental quality whether it is formally trained and planned out rigorously or learned from a life in contact with the environment and intuited. Sustainable husbandry relies on a conscientious steward.

This chapter reevaluates the homestead looking at dependencies caused by the needs of the inhabitants. Consideration is given to flows into and out of the homestead and how they can be protected or eliminated. There will be ranges and conditions within which it operates. In some cases it will operate better than others. If the ideal is self-sufficiency for a family to live there in perpetuity, the demands on the system will be high with the wellbeing of its inhabitants at stake. A goal of this chapter is to identify what the main inputs and outputs are and the keys to successful functioning without which the operation would be most severely impacted.

### **BIOLOGICAL INPUTS**

Self-sufficiency would seem to be the polar opposite of dependency but there is no organism on this Earth that is not helplessly dependent on its environment. While there are organisms that do capture their own energy, even without photosynthesizing, nutrients must still pass through their body; inputs and outputs. This homestead is a compound organism (to use the word loosely). The creatures on it metabolize energy to

maintain their internal homeostasis and grow. The inhabitants, to be living, must also be able to adapt, respond to stimuli, and reproduce. From a human standpoint reproduction is a limiting factor; without variability in mating, health could deteriorate very quickly.

There are many examples of constituent flows in ecosystems; the major players being nitrogen, phosphorus, potassium, water, and carbon. Nitrogen in the soil from nitrogen fixing plants and fertilizer are taken up by plants, which are consumed then returned to the soil as manure. The carbon cycle flows from deposits in the ground and living things, to their release into the atmosphere when they are consumed by microbes or animals; then they are collected again, mostly by plants in photosynthesis. The hydrologic cycle involves water from the ground surface evaporating or transpiring through living things into the atmosphere, where it comes down again as precipitation.

Nutrients are valuable links in the life of a homestead. Concern over the sustainability of modern agribusiness deals mostly with the fact that when a huge crop yield is taken away for sale, with it go the nutrients from the land. They are currently replaced with mined, processed, and synthesized chemical fertilizers in an unsustainable manner. The homestead, as an alternative to industrial agriculture, has to excel at responsible nutrient cycling. This means that production cannot be pushed to 110% or even 90% all of the time. Fields have to lay fallow to rebuild their biotic and nutritional integrity. Utilizing organic matter that cannot be consumed by animals (the outputs of other processes) as soil inputs, as well as trading only in the local economy of homesteads, will insure that nutrients that are used on site and those that are shared with neighbors will be responsibly replaced.

For the homesteader an initial source of animal stock, seed, feed, and fertilizer are essential. Animals are best obtained locally but a knowledgeable trusted source should be consulted to help obtain healthy animals, not just the discards from someone's flock. There are many mail order sources of interesting heirloom seeds available. These are non-hybrid, non-engineered (in a contemporary sense) varieties that were grown historically. They are an alternative to mass-produced modern monoculture bred for grocery store appeal. Manure for fertilizer may also be available from neighbors. Starting with non-synthetic fertilizers would help move toward organic certification, if desired.

#### TECHNICAL INPUTS

In *Cradle to Cradle* (2002, 109), William McDonough and Michael Braungart have developed an interesting view of materials as technical nutrients. They regard the whole lifecycle of materials during the design phase, and into the future, so that when the product's use is exhausted the leftover parts are designed to be fed back into the manufacturing cycle as raw materials. This is an alternative to throwing used goods 'away' or trying to effectively recycle them as an afterthought. They argue that recycling is actually "down-cycling" because goods are designed in a way that they become adulterated when they are recycled and cannot be returned to the level of purity or integrity from which they began as an industrial material. As the title suggests, a material should go from birth-to-life-to-birth endlessly instead of the old planning mode of 'cradle-to-grave'. In a way this mimics nature because in nature everything created is decomposed and cycled again. Human designed processes could never be as effective or efficient as natural ones but this viewpoint is instructive in that it teaches one to look at any waste as potentially valuable and to design systems whose output is nutritive.

One man, in a short period of time relative to his lifespan, could develop an example of every tool he would need to build a house and run a homestead. However, there are some fundamental items that would be so useful that having them initially would be very valuable. Others are so sophisticated, but readily available because they are currently mass produced with high precision, that it would take a lifetime to develop one by hand. This gives rise to a notion of items that have intrinsic value that increases with the breakdown of society and infrastructure. For instance without electricity or satellites a coffee pot, fancy computer, or cell phone is useless. On the contrary, everyday items such as plastic sheeting, hammers, bread, bleach, and alcohol are of absolute necessity.

There are materials that would be useful that do not exist on this property or would be too difficult to develop. As has been discussed, wood is plentiful, although a stock of seasoned wood needs to be developed. Plastic, metal, and glass are obviously not going to be made here, by hand, on site. Troy, a city in western Rensselaer County, was developed on the back of America's first Bessemer furnace (Bliven 1987). It used iron ore and coal from the Adirondacks to the northwest. However, there is so much scrap metal available there could almost never be a need to make it in a low-tech society. Because of the chemicals used in plastics that can act like hormones in living things, it would be ideal to avoid them. Glass will have to be bought or scavenged; the most being required for the green house. A collection of canning jars are a good example of a worthwhile investment because of their utility and longevity.

Tools do not appear out of thin air (thankfully, that could be painful). Blacksmithing is exalted in the saying "By hammer and hand all arts do stand." (It has also been called the second oldest profession in the world...). Blacksmithing can be done elegantly with

great skill but, as the author has experienced, it can also be done effectively with hardly any; just add metal to fire then pound. While a hammer and set of tongs are possible to make from scratch, having a set would act as a catalyst to being able to make more tools. Out of the great providence of materialism there are reams of high quality bar-scrap lying around that were unavailable to historical developers of tools and technology, just waiting to be re-forged. It is amazing to think of all the successes and failures over the slow and painful road to the myriad of tools that are taken for granted, yet the need for more can never be quenched.

In an essay written by Dmitry Orlov (2010) called *Post-Soviet Lessons for a Post-American Century* he makes some recommendations from his experience in the fall of the U.S.S.R. He is now a U.S. citizen and sees the U.S. heading for a similar fate. Overall, he stresses cooperation and communal living. He goes on to compliment Americans for their altruism in helping strangers, even taking pride in being helpful, and says this is critical to survival in the face of disaster. In the case of having money to invest this side of a disaster, for items that require high-technology to produce and have a long shelf-life he recommends: over-the-counter and prescription medication, razor blades, condoms, rechargeable batteries and solar chargers, toiletries (good soap being a luxury item), alcohol, illegal drugs, and tobacco. These items, he says from his experience, have the greatest value in an urban area.

This is not an exhaustive list, but it is an interesting window into what was most needed in an urban area during the collapse of a semi-modern society. Orlov does make the case that Americans in many ways, because of current lifestyle, culture, and technological sophistication, are more helpless than the Soviets were and have farther to



fall in terms of comfort and standard of living. The application of his recommendations to this project come as a warning to inspire greater independence and resilience. They also are a comfort because society has not collapsed, and it helps inform the decisions made in planning and selecting technology for survival.

## FAMILY AND COMMUNITY

Similar to life in any situation, running a homestead relies on the physical ability to work because it is more labor intensive than many modern lifestyles. The fewer the number of laborers, the greater is the necessity for individuals to endure work without injury. This is especially true as modern conveniences are replaced with greater amounts of labor. These are reasons people used to have large families and close relationships with their neighbors. There are many jobs, from harvesting to construction and food preparation, where greater numbers of workers allow a more than linear increase in the amount of work that can be done. Good planning is an important element of work as a lot of grueling labor, and possibly injury, can be prevented by carefully considering the appropriate tools and methods for a task.

Humans are by nature social creatures. There is a spectrum to how close people like to be to other people but people generally do not exist in isolation. Ironically, in suburbs, there is a growing culture of isolation. People go to their jobs and sit in their office all day then commute home alone in traffic, maybe have a few hours with the family, more likely a few hours with the TV, then go to bed and do it again in the morning. This was not possible in the past and looking at self-reliant communities like the Amish and Old Order Mennonites, one sees a community that does similar things at the same time together to help one another.

When one person has a product or resource that others desire, a market exists and trade or commerce can take place. Even on a small local scale where everyone is trying to be as self-sufficient as possible there will be natural differences in resources, goods, and services. A surplus that one person has can be stored until there is an opportunity to trade. Barter can replace money as a method of exchange when currency is worthless, local currencies and trade groups like freecycle.com and craigslist.com have been experiencing growth since the recession began in the fall of 2008. This leaves quality accountability up to individuals but in a small close community that would be easier to maintain than in the increasingly anonymous marketplace that operates today. There may also be a surplus of labor that could be traded for goods with the benefit of building community relationships.

Before being a fully functioning homestead, supplemental income will be needed. A huge shift occurred during the industrial revolution from home-based work to factory-based. David Wells in *No Place for Truth* (1993, 25) argues that this is the point when society really started to degrade. It pulled men away from their homes, removing them from their families for much of the day, while dumping greater stress and housework responsibility on their wives. The family is the natural extension of reproduction, the source of human life. Homesteads provide an unmatched opportunity for families to live and work together, the benefits of which are immeasurable.

The need for strong interdependent social structures is greatly apparent. For millennia this has been provided by the Church. Wells (1993, 23) traces the transition of a small rural New England town as a community center is erected across the street from the church to innocuously aid in supporting society; it has the unintended effect of splitting the pastoral governance and shepherding of the town. He lists this as a critical turning

point in the town's devolution. Incidentally, there are 9 churches within 5 miles of this site, they may be vibrant and faithful or they may be dying or dead, merely buildings. There would certainly be no church available, at any distance, without a space for it residing in the heart of the inhabitant.

The internet has opened a wide door for working from home in ways not seen since the pre-industrial revolution. It would be ideal to have some high-paying part-time employment that could be done from home to bolster the transition to self-sufficiency. With the proximity of Hoosick Falls and Bennington, Vermont there are likely to be opportunities for external income even if only in local retail. Without such opportunities, trade for labor would allow a new homestead to stay alive and grow to independence. It is central to this theory of homesteading to question the career-mortgage-debt trap that seems to be tearing society apart.

#### LOCAL ECONOMY

There is a growing movement of people who do not trust banks. Many distrust the fiat monetary system and say that all money should be backed with gold or something of intrinsic value. After the recent economic crash, mortgage debacle, and trading escapades this is understandable but if the economy really disintegrates completely there will be much more to worry about than a mortgage or 401k and no one is going to be eating gold. This paper could be construed as an argument to invest in property and tools but "moth and rust destroy" and there is no such thing as future-proof.

There will always be a need for banks; from seed and grain stores to labor sharing with neighbors to a safe place to keep extra money for emergencies and things that cannot be produced on site. The necessity of a bank is both the proof of non self-

sufficiency and protection against dependency. The storage and bank really act as an extension or buffer to the conventional processes that underlie independence. The danger comes from complicated usury and falling for the debt trap. This project assumes that the land is given to the inhabitants, or that they saved up to pay for it.

It is a goal of this project to encourage a community where local food is the norm. It should be inexcusable for anyone to buy something from further away when an acceptable, affordable product is available locally. An emphasis on trade and community building is important for the interdependence and strength that can be developed between neighbors. Methods for getting traded goods to a central location, for instance a communal cart or truck that goes from the Breese Hollow Valley to a market in Hoosick Falls once a week, could make local trade efficient, enabling neighbors to work together.

#### LIVING WITH RESPECT

Environmentalism has probably been around for as long as people have had to live in an area for an extended period of time. Surely it did not take long to figure out that rotting food and waste are not very pleasant to have around and so would need to be managed in some way. Middle Eastern writers in the first millennium were concerned with air, water, and soil contamination, as well as solid waste mishandling related to agricultural practices (Gari 2002, 475-488). In 1272, King Edward I of England banned the burning of coal because of the pollution the smoke created (Urbinato 1994). The industrial revolution was the true beginning of the modern pollution machine with the increased use of fossil fuels and production of chemical discharges on a grand scale.

The natural environment tends to be self-regulating, but humans being at the top of the food chain have a profound ability to be invasive and domineering. It would take very

little time for humans to level this entire 100 acres, which likely would not happen in their absence. One person could easily contaminate the entire place with pathogens, heavy metals, toxic chemicals, or radioactivity. It would not take long to kill every medium to large bird and mammal on the site, but to do nothing and let things be healthy and grow, is truly difficult. To not wear heavily on the natural environment is a challenge for something as powerful, sophisticated, and unfortunately short-sighted as a human. While it is impossible to conceive of and plan for the consequences of every action needed to live, there are always decisions to make between better and worse options.

Construction of the home dwelling and barn will disrupt a large portion of the land. Cutting the house into the hillside to reduce its energy profile will displace creatures and root systems. Heavy equipment used for construction might compact the soil around the site. Trees cut down for timber will disrupt the habitats of the very same creatures that could have the most benefit to the ecosystem. Many species probably do not like the noise and vibrations from construction or people moving around intruding everywhere. There would be new shade in places there was not before and new trees planted which will provide good habitats, but they may take a while to be repopulated and some species that are shy may never come back. Nevertheless, people do belong on the Earth at this time and there is a purpose for us being here (even if no one agrees on what that is). It is a gift to be alive and it is certainly our responsibility to have the most positive impact possible while maintaining a good standard of living.

Even the small scale use of energy is not to be overlooked. When fuels are burned they have the potential to give off noxious byproducts. These are harmful to all the inhabitants of the homestead and could affect neighbors as well. The chemicals used for

processing of fuels such as petroleum, lye, and methanol are hazardous and must be handled responsibly during their entire lifecycle. For biological materials to be responsibly turned into fuels, they cannot be grown as a monoculture with a single focus. A biofuel factory as a “sustainable” business model is not an environmentally sustainable system because it tries to replace one bad habit with another. Lifestyles need reorganization so only a small fraction of today’s fuel consumption is needed.

According to the United States Environmental Protection Agency’s Clean Air Act, smoke output is regulated (United States Environmental Protection Agency 2007, 7). The maximum residential smoke output is limited to 7.5 grams per hour. Old wood burning stoves used to produce between 10 – 40 grams of smoke per hour. Newer designs that operate hot enough to burn off the particulates in the exhaust reduce the emission to as little as 1 – 4 grams per hour. This also makes the stove more efficient, up to 70%, as opposed to 30% for a fireplace. The clean exhaust also keeps creosote from building up in the stove pipe, and a heat exchanger can be used to better disperse the heat.

Every effort should be made to reduce energy use. There is a lot of joy to be had in walking or biking to the store instead of driving. Local libraries and schools can be used for computing, internet use, and research. Central heating systems have existed in Greece and the Middle East for at least the last 2,000 years. They used pipes to channel heat from a stove through floors and walls; though it is unlikely that they maintained their houses at seventy (plus or minus one degree), as is common today. It is worth considering whether it makes sense to heat a building if the goal is keeping people warm, when people can wear warmer clothing and adapt to the cooler temperatures in the winter. A household that does not use electricity and uses renewable fuels responsibly could be said to be

energy independent; the lower-tech their energy system, the more independent they are. Energy conservation is lifestyle and mindset change.

It could easily take a decade to establish a functioning agricultural system that provides most dietary needs. Productive fruit trees would take longer than ten years to cultivate. A robust and complicated system of crops, harvesting, and preservation could not be expected to work all at once for a novice. Total production is never optimal: some years some crops will die, some years others will be infested; the idea on a homestead is to have variety and some excess so the loss of a few species would not be debilitating. The excess allows for trade with others who have extra of what was lost. Time would also be required to ensure sustainable use of home grown fuels and to develop the methods for processing them.

Critical attention must be given to any changes or stress to the environment for our own and our neighbor's sake. Pollution is a waste of resources that puts them in a form that is unusable by the ecosystem. There is no sustainability in a human designed system, one cannot now and never will be able to fathom the extent of the complexities and interactions in a natural ecosystem. There is no choice except to be considerate, gentle, observant, and willing to change when a deleterious impact is realized. Given the best efforts to understand and take care of the natural surroundings one can only hope that the negative impacts are not greater than the resilience of the environment and one's ability to promote a positive environmental response.

This is important to the health of everyone, from the person drinking his own water and breathing his own air to the family 10 miles down the stream, or the neighboring state whose native flora may be disrupted by strange seeds carried by birds. The health of

unseen things like fungus, insects, and microbes are probably more important than that of macro species. Respect for unknowns, reaching out with the mind's eye, allows one to extend respect beyond one's own designs. Having the health and harmony of the environment as the goal instead of profit will enable others to live happily and healthfully with everything they need.

This chapter attempted to point out shortcomings in the designs laid out in the preceding chapters. There are comments made about the general ideals and limitations of homesteads as well as human design. Biological and technical inputs were considered as assets to be maintained and built-up as well as used to create value. A discussion of the family and community harks back to simpler times of hard work and local economies. Finally as an endnote we are adjured to live with love and respect for our neighbor and the Creator of all these good things that sustain us.

#### PAPER SUMMARY

This paper has been a journey through a philosophy of stewardship and responsible interaction with the environment, even to the point of self-denial, for the survival of a people. The focus was a 100 acre plot of land in Rensselaer County, New York but the principles contained within it can be practiced anywhere by anyone. The first chapter discussed some of the motivation and reasoning behind this project; searching for a harmonious living that can persist to its own benefit rather than its detriment. For the second chapter, research was performed to find a location suitable for this study. Chapter 3 was an experiential description of some of the things the inhabitants might go through as they secure shelter, heat, and water. The next two chapters discussed the resources available on the property and how to use them. Geology as well as building design and



use were considered as were management of plants and animals. Chapters 6 and 7 focused mostly on how to take advantage of resources efficiently and responsibly; from traditional food preparations that accentuate nutrition to alternative ways of producing and using fuels.

Though more important information has been omitted from this paper than included, it is the author's sincere hope that it serves as an illustration of some useful research tools and a source of inspiration about the things of life and the ways that they can be arranged. As resources are used to make connections between the things of life and between people and the environment, a continual effort must be made to strengthen the ones that lead to health, harmony, and simplicity.

## **APPENDIX A – LOCAL ANIMAL SPECIES**

Bird species include: American black duck, mallard, wood duck, bald eagle, common gallinule, black-crowned night heron, green heron, least bittern, American bittern, Virginia rail, king rail, sora, killdeer, American woodcock, upland sandpiper, spotted sandpiper, ruffed grouse, ring-necked pheasant, sharp-shinned hawk, Cooper's hawk, Northern goshawk, Northern harrier, red-tailed hawk, rough-legged hawk, red-shouldered hawk, broad-winged hawk, turkey vulture, American kestrel, common screech owl, long-eared owl, great horned owl, barred owl, saw-whet owl, mourning dove, yellow-billed cuckoo, black-billed cuckoo, common nighthawk, whip-poor-will, ruby-throated hummingbird, belted kingfisher, red-headed woodpecker, pileated woodpecker, common flicker, yellow-bellied sapsucker, downy woodpecker, hairy woodpecker, Eastern kingbird, great crested flycatcher, Eastern pewee, Eastern phoebe, least flycatcher, willow flycatcher, alder flycatcher, horned lark, purple martin, cliff swallow, barn swallow, tree swallow, rough-winged swallow, bank swallow, chimney swift, American crow, blue jay, black-capped chickadee, tufted tit mouse, white-breasted nuthatch, red-breasted nuthatch, brown creeper, house wren, winter wren, marsh wren, golden-crowned kinglet, blue-gray gnatcatcher, brown thrasher, grey catbird, Northern mockingbird, Eastern bluebird, American robin, wild turkey, Bicknell's thrush, Swainson's thrush, hermit thrush, veery, wood thrush, cedar waxwing, red-eyed vireo, warbling vireo, yellow-throated vireo, solitary vireo, Northern parula warbler, black-throated green warbler, black-and-white warbler, black-throated blue warbler, magnolia warbler, yellow-rumped warbler, Canada warbler, chestnut-sided warbler, blackburnian warbler, American redstart, pine warbler, prairie warbler, blue-winged warbler, yellow warbler, Nashville warbler, mourning warbler, common yellowthroat, Northern waterthrush, Louisiana waterthrush, ovenbird, red-winged blackbird, brown-headed cowbird, common grackle, bobolink, Eastern meadowlark, European starling, Northern oriole, scarlet tanager, house sparrow, Northern junco, snow bunting, Northern cardinal, purple finch, evening grosbeak, American goldfinch, pine siskin, indigo bunting, rose-breasted grosbeak, rufous-sided towhee, white-throated sparrow, chipping sparrow, swamp sparrow, American tree sparrow, grasshopper sparrow, song sparrow, vesper sparrow, and Savannah sparrow. (Peterson 1980, 304-370)

Animal life taken from New York State Department of Environmental Conservation 2010. Mammalian life includes the river otter, Allegheny wood rat, beaver, black bear, bobcat, coyote, Eastern cougar or mountain lion, Eastern coyote, gray wolf, Indiana bat, little brown bat, moose, white-tailed deer, squirrel, chipmunk, fisher, marten, mink, muskrat, otter, raccoon, red fox, striped skunk, and weasel.

Freshwater fish include: brown bullhead, yellow, bullhead, black bullhead, channel catfish, white catfish, American shad, alewife, blueback herring, hickory shad, fallfish, creek chub, golden shiner, blacknose dace, longnose dace, central stoneroller, cutlips minnow, redbelly dace, spottail shiner, emerald shiner, Northern redbelly dace, common shiner, fathead minnow, river chub, yellow perch, walleye, sauger, Eastern sand darter, greenside darter, rainbow darter, Iowa darter, fantail darter, spotted darter, Johnny darter, variegated darter, logperch, channel darter, chain pickerel, redbfin pickerel, grass pickerel, Northern pike, muskellunge, tiger muskellunge, Atlantic salmon, chinook salmon, coho salmon, kokanee (sockeye) salmon, pink salmon, Atlantic sturgeon, lake sturgeon, shortnose sturgeon, smallmouth bass, largemouth bass, bluegill, pumpkinseed, redbreast, rock bass, black crappie, lake trout, brook trout, brown trout, rainbow trout.

Amphibians and reptiles include: salamanders and lizards include: Jefferson salamander, blue-spotted salamander, spotted salamander, red-spotted newt, Allegheny dusky salamander, Northern redback salamander, Northern slimy salamander, four-toed salamander, and Northern two-lined salamander. Frogs and toads include: Eastern American toad, Northern cricket frog, gray tree frog, bullfrog, wood frog, green frog, Northern leopard frog, and pickerel frog. Turtles include: common snapping turtle, wood turtle, and painted turtle. Snakes include Northern water snake, Northern brown snake, Northern redbelly snake, common garter snake, Northern ringneck snake, smooth green snake, and Eastern milk snake.

Some insects of note are: monarch butterfly, Karner blue butterfly, Karner blue butterfly, praying and Chinese mantises, chittanooga ovate amber snail fact sheet, dwarf wedge, mussel, Northeastern beach tiger beetle, American burying beetle, pine shoot beetle, viburnum leaf beetle, white pine weevil, sugar maple borer, ants and termites, common tent caterpillars, white pine weevil, pear thrips, hemlock woolly adelgid, pine shoot beetle, pine feeding sawflies, fall webworm, spanworm, cherry scallop shell moth, pine bark adelgid, sawyer beetles, fall cankerworm, oak twig pruner, ambrosia beetles, larch casebearer, elm spanworm, cicadas, Asian longhorned beetle, twolined chestnut borer, gypsy moth, maple leaf cutter, pine false webworm, locust borer, mourningcloak butterfly, peach bark beetle, and powder post beetles.

## ***APPENDIX B – RENSSELAER COUNTY STATISTICS***

In 2002 less than 0.7% of the population was affected by burglary. Residential energy use per capita in 2001 was 42 – 73 million BTUs per year; total energy expenditure per capita was 21 – 266 million BTUs. Cancer deaths in males occur at a frequency of 231 to 891 per 100,000; females are 143 – 209. The population density is 237 people per square mile, likely because of the southwestern corner's proximity to Albany. The current population is 155,261 (68% urban, 32% rural). The cost of living index is 88.4, lower than the national average of 100. (City-Data 2010)

The type of workers in Rensselaer include: 71% private wage or salary, 24% government, and 5% self-employed or not incorporated. Races in Rensselaer County, New York are: white non-Hispanic (90.2%), black (4.7%), other race (2.2%), Hispanic (2.1%), Chinese (0.6%), and American Indian (0.6%). The median age is 36.7 years and the average wage is \$35,000. The average house price is 220,000. Politically the county split 49.4/47.6 democrat/republican in the 2004 presidential election; in 2008 it was 63/36. As of October 2009, unemployment was 7.4%, this compares to the NY average of 8.7%. 66% of homes have a mortgage, which is just under the NY average. 71% of the residents in the county are Catholic, 9% Methodist, and are 2.2% Presbyterian. (City-Data 2010)

The average farms size is 168 acres, and the average value of agricultural products sold per farm is \$51,224. The average value of crops sold per acre for harvested cropland is \$274.25. The value of nursery, greenhouse, floriculture, and sod as a percentage of the total market value of agricultural products sold is 20.67%. The value of livestock, poultry, and their products as a percentage of the total market value of agricultural products sold is 57.28%. The average total farm production expenses per farm are \$39,438. The estimated value of land and buildings per acre is \$2,400. The average value of cropland is \$2,200 per acre and \$1,050 for pastureland. (City-Data 2010)

The harvested cropland as a percentage of land in farms is 47.44%; irrigated harvested cropland as a percentage of land in farms is 1.80%. The average market value of all machinery and equipment per farm is \$55,105. The percentage of farms operated by a family or individual is 90.53%. The average age of principal farm operators is 55 years. Average number of cattle and calves per 100 acres of all land in farms is 15.53, milk cows as a percentage of all cattle and calves is 41.07%. The corn harvested for grain is 6220 acres, vegetables are 1107 acres, and land in orchards is 114 acres. (City-Data 2010)

Between 40 – 60% of the farm land is harvested cropland. They average 15 – 20 heads of cattle or calves per 100 acres of farm land. The average age of farm operators is 55. Between 90 – 94% of farms are operated by families or individuals. Rensselaer County covers 425,600 acres, less than 250 of which are in orchards. Between 1000 – 3000 acres are vegetables harvested for sale. (National Atlas 2010)

## **APPENDIX C – SOIL TYPE DESCRIPTIONS FROM USDA WEB SOIL SURVEY**

### **AnA—Alden silt loam, 0 to 3 percent slopes**

#### **Map Unit Setting**

Elevation: 300 to 1,500 feet  
 Mean annual precipitation: 36 to 44 inches  
 Mean annual air temperature: 45 to 48 degrees F  
 Frost-free period: 115 to 195 days

#### **Map Unit Composition**

Alden and similar soils: 75 percent

#### **Description of Alden**

##### **Setting**

Landform: Depressions  
 Landform position (two-dimensional): Toeslope  
 Landform position (three-dimensional): Base slope

Down-slope shape: Concave  
 Across-slope shape: Concave  
 Parent material: A silty mantle of local deposition overlying loamy till

##### **Properties and qualities**

Slope: 0 to 3 percent  
 Depth to restrictive feature: More than 80 inches  
 Drainage class: Very poorly drained  
 Capacity of the most limiting layer to transmit water  
 (Ksat): Moderately low to moderately high (0.06 to 0.57 in/hr)

Depth to water table: About 0 inches  
 Frequency of flooding: None  
 Frequency of ponding: Frequent  
 Calcium carbonate, maximum content: 15 percent  
 Available water capacity: High (about 9.3 inches)

##### **Interpretive groups**

Land capability (nonirrigated): 5w

##### **Typical profile**

0 to 7 inches: Silt loam  
 7 to 40 inches: Silty clay loam  
 40 to 60 inches: Gravelly silt loam

### **BnD—Bernardston-Nassau complex, hilly**

#### **Map Unit Setting**

Elevation: 0 to 1,800 feet  
 Mean annual precipitation: 36 to 44 inches  
 Mean annual air temperature: 45 to 48 degrees F  
 Frost-free period: 115 to 195 days

#### **Map Unit Composition**

Bernardston and similar soils: 40 percent  
 Nassau and similar soils: 30 percent

#### **Description of Bernardston**

##### **Setting**

Landform: Drumlinoid ridges, hills, till plains

Landform position (two-dimensional):

Backslope

Landform position (three-dimensional): Side slope

Down-slope shape: Convex

Across-slope shape: Convex

Parent material: Loamy, acid, dense till derived mainly from phyllite, shale, slate, and schist

##### **Properties and qualities**

Slope: 15 to 25 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Well drained

Capacity of the most limiting layer to transmit water

(Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)

Depth to water table: About 18 to 24 inches

Frequency of flooding: None

Frequency of ponding: None

Available water capacity: Moderate (about 8.5 inches)

##### **Interpretive groups**

Land capability (nonirrigated): 4e

##### **Typical profile**

0 to 8 inches: Gravelly silt loam

8 to 30 inches: Gravelly loam

30 to 60 inches: Gravelly loam

#### **Description of Nassau**

##### **Setting**

Landform: Benches, ridges, till plains

Landform position (two-dimensional):

Backslope

Landform position (three-dimensional): Side slope

Down-slope shape: Convex

Across-slope shape: Convex

Parent material: Channery loamy till derived mainly from local slate or shale

##### **Properties and qualities**

Slope: 15 to 25 percent

Depth to restrictive feature: 10 to 20 inches to lithic bedrock

Drainage class: Somewhat excessively drained

Capacity of the most limiting layer to transmit water (Ksat): Very low

to moderately low (0.00 to 0.06 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Available water capacity: Very low (about 1.5 inches)

**Interpretive groups**

Land capability (nonirrigated): 6e

**Typical profile**

0 to 7 inches: Very channery silt loam

7 to 15 inches: Very channery loam

15 to 19 inches: Unweathered bedrock

**CaA—Carlisle muck, 0 to 1 percent slopes**

**Map Unit Setting**

Elevation: 600 to 1,200 feet

Mean annual precipitation: 36 to 44 inches

Mean annual air temperature: 45 to 48 degrees F

Frost-free period: 115 to 195 days

**Map Unit Composition**

Carlisle and similar soils: 75 percent

**Description of Carlisle**

**Setting**

Landform: Swamps, marshes

Landform position (two-dimensional): Toeslope

Landform position (three-dimensional): Talf

Down-slope shape: Concave

Across-slope shape: Concave

Parent material: Deep organic material

**Properties and qualities**

Slope: 0 to 1 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Very poorly drained

Capacity of the most limiting layer to transmit water

(Ksat): Moderately high to high (0.20 to 5.95 in/hr)

Depth to water table: About 0 inches

Frequency of flooding: None

Frequency of ponding: Frequent

Available water capacity: Very high (about 23.9 inches)

**Interpretive groups**

Land capability (nonirrigated): 5w

**Typical profile**

0 to 62 inches: Muck

**FIA—Fluvaquents-Udifuvents complex, 0 to 3 percent slopes**

**Map Unit Setting**

Elevation: 100 to 3,000 feet

Mean annual precipitation: 36 to 44 inches

Mean annual air temperature: 45 to 48 degrees F

Frost-free period: 115 to 195 days

**Map Unit Composition**

Fluvaquents and similar soils: 40 percent

Udifuvents and similar soils: 35 percent

**Description of Fluvaquents**

**Setting**

Landform: Flood plains

Landform position (two-dimensional): Toeslope

Landform position (three-dimensional): Dip

Down-slope shape: Concave

Across-slope shape: Concave

Parent material: Alluvium with highly variable texture

**Properties and qualities**

Slope: 0 to 3 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Poorly drained

Capacity of the most limiting layer to transmit water

(Ksat): Moderately low to high (0.06 to 5.95 in/hr)

Depth to water table: About 0 inches

Frequency of flooding: Frequent

Frequency of ponding: Frequent

Calcium carbonate, maximum content: 5 percent

Available water capacity: Moderate (about 6.6 inches)

**Interpretive groups**

Land capability (nonirrigated): 5w

**Typical profile**

0 to 6 inches: Silt loam

6 to 60 inches: Gravelly silt loam

**Description of Udifuvents**

**Setting**

Landform: Flood plains

Landform position (two-dimensional): Summit

Landform position (three-dimensional): Talf

Down-slope shape: Concave

Across-slope shape: Convex

Parent material: Alluvium with a wide range of texture

**Properties and qualities**

Slope: 0 to 3 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Moderately well drained

Capacity of the most limiting layer to transmit water

(Ksat): Moderately low to very high (0.06 to 19.98 in/hr)

Depth to water table: About 36 to 72 inches

Frequency of flooding: None

Frequency of ponding: None

Available water capacity: Low (about 5.9 inches)

**Interpretive groups**

Land capability (nonirrigated): 5w

**Typical profile**

0 to 9 inches: Gravelly fine sandy loam

**NrC—Nassau-Rock outcrop, complex, rolling**

**Map Unit Setting**

Elevation: 600 to 1,800 feet

Mean annual precipitation: 36 to 44 inches

Mean annual air temperature: 45 to 48 degrees F

Frost-free period: 115 to 195 days

**Map Unit Composition**

Nassau and similar soils: 50 percent

Rock outcrop: 25 percent

**Description of Nassau**

**Setting**

Landform: Benches, ridges, till plains

Landform position (two-dimensional): Shoulder

Landform position (three-dimensional): Crest

Down-slope shape: Convex

Across-slope shape: Convex

Parent material: Channery loamy till derived mainly from local slate or shale

**Properties and qualities**

Slope: 8 to 15 percent

Depth to restrictive feature: 10 to 20 inches to lithic bedrock

Drainage class: Somewhat excessively drained

Capacity of the most limiting layer to transmit water (Ksat): Very low

to moderately low (0.00 to 0.06 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Available water capacity: Very low (about 1.5 inches)

**Interpretive groups**

Land capability (nonirrigated): 4e

**Typical profile**

0 to 7 inches: Very channery silt loam

7 to 15 inches: Very channery loam

15 to 19 inches: Unweathered bedrock

**NrD—Nassau-Rock outcrop complex, hilly**

**Map Unit Setting**

Elevation: 600 to 1,800 feet

Mean annual precipitation: 36 to 44 inches

Mean annual air temperature: 45 to 48 degrees F

Frost-free period: 115 to 195 days

**Map Unit Composition**

Nassau and similar soils: 40 percent

Rock outcrop: 35 percent

**Description of Nassau**

**Setting**

Landform: Benches, ridges, till plains

Landform position (two-dimensional): Backslope

Backslope

Landform position (three-dimensional): Side slope

Down-slope shape: Convex

Across-slope shape: Convex

Parent material: Channery loamy till derived mainly from local slate or shale

**Properties and qualities**

Slope: 25 to 35 percent

Depth to restrictive feature: 10 to 20 inches to lithic bedrock

Drainage class: Somewhat excessively drained

Capacity of the most limiting layer to transmit water (Ksat): Very low

to moderately low (0.00 to 0.06 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Available water capacity: Very low (about 1.5 inches)

**Interpretive groups**

Land capability (nonirrigated): 7e

**Typical profile**

0 to 7 inches: Very channery silt loam

7 to 15 inches: Very channery loam

15 to 19 inches: Unweathered bedrock

**PtB—Pittstown gravelly silt loam, 3 to 8 percent slopes**

**Map Unit Setting**

Mean annual precipitation: 36 to 44 inches

Mean annual air temperature: 45 to 48 degrees F

Frost-free period: 115 to 195 days

**Map Unit Composition**

Pittstown and similar soils: 75 percent

**Description of Pittstown**

**Setting**

Landform: Drumlinoid ridges, hills, till plains

Landform position (two-dimensional): Summit

Landform position (three-dimensional): Crest

Down-slope shape: Concave

Across-slope shape: Convex

Parent material: Loamy till

**Properties and qualities**

Slope: 3 to 8 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Moderately well drained

Capacity of the most limiting layer to transmit water

(Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)

Depth to water table: About 18 to 36 inches

Frequency of flooding: None

Frequency of ponding: None

Available water capacity: Moderate (about 9.0 inches)

**Interpretive groups**

Land capability (nonirrigated): 2e

**Typical profile**

0 to 9 inches: Gravelly silt loam

9 to 24 inches: Gravelly silt loam

24 to 60 inches: Gravelly silt loam

**PtC—Pittstown gravelly silt loam, 8 to 15 percent slopes****Map Unit Setting**

Mean annual precipitation: 36 to 44 inches

Mean annual air temperature: 45 to 48 degrees F

Frost-free period: 115 to 195 days

**Map Unit Composition**

Pittstown and similar soils: 75 percent

**Description of Pittstown****Setting**

Landform: Drumlinoid ridges, hills, till plains

Landform position (two-dimensional): Summit

Landform position (three-dimensional): Crest

Down-slope shape: Concave

Across-slope shape: Convex

Parent material: Loamy till

**Properties and qualities**

Slope: 8 to 15 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Moderately well drained

Capacity of the most limiting layer to transmit water

(Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)

Depth to water table: About 18 to 36 inches

Frequency of flooding: None

Frequency of ponding: None

Available water capacity: Moderate (about 9.0 inches)

**Interpretive groups**

Land capability (nonirrigated): 3e

**Typical profile**

0 to 9 inches: Gravelly silt loam

9 to 24 inches: Gravelly silt loam

24 to 60 inches: Gravelly silt loam

**SrB—Scriba silt loam, 3 to 8 percent slopes****Map Unit Setting**

Mean annual precipitation: 36 to 44 inches

Mean annual air temperature: 45 to 48 degrees F

Frost-free period: 115 to 195 days

**Map Unit Composition**

Scriba and similar soils: 75 percent

**Description of Scriba****Setting**

Landform: Drumlins, till plains

Landform position (two-dimensional): Footslope

Landform position (three-dimensional): Base slope

Down-slope shape: Concave

Across-slope shape: Linear

Parent material: Loamy till dominated by sandstone, with lesser amounts of limestone and shale

**Properties and qualities**

Slope: 3 to 8 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Somewhat poorly drained

Capacity of the most limiting layer to transmit water

(Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)

Depth to water table: About 6 to 18 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum content: 15 percent

Available water capacity: Low (about 4.1 inches)

**Interpretive groups**

Land capability (nonirrigated): 3w

**Typical profile**

0 to 10 inches: Silt loam

10 to 21 inches: Silt loam

21 to 50 inches: Gravelly silt loam

50 to 60 inches: Gravelly silt loam

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