Environmental Assessment For the Village of Underhill Flats/Riverside

Towns Of Underhill And Jericho, Vermont

Stone Project # 051570-W

Prepared For:

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EXECUTIVE SUMMARY

The Towns of Underhill and Jericho share a common village area called the Underhill Flats/Riverside area. Compact residential development as well as small commercial businesses, schools, churches are located along Vermont Route 15 and surrounding a triangle area formed by Route 15, River Road and Park Street. This area, located at the outskirts of Chittenden County, is steadily growing. Several large properties in the heart of the village, including the Green Crow Lumber Company property, can potentially be redeveloped for residential, multi-family and commercial growth. The Jericho-Underhill Water District provides the water supply for much of the area, and individual onsite wastewater treatment and disposal systems are used throughout the area for wastewater disposal.

A Joint Task Force made up of members of both communities was formed and is conducting this study with municipal planning grant funds from the Vermont Department of Housing and Community Affairs. The study's objective is to collect information from a variety of sources and evaluate environmental conditions that currently constrain properties and which might constrain future growth. Stone Environmental, Inc. of Montpelier, Vermont was hired to conduct the study. This report contains a review of environmental conditions as they related to onsite wastewater treatment and disposal, water supply, stormwater, transportation, and hazardous sites.

Wastewater Treatment and Disposal

The Village study area contains many developed properties, some of which were constructed prior to the development state or local regulations. Much of the area consists of well-drained sands and gravels, which are generally conducive to wastewater treatment and disposal. Some properties, particularly those with small lot sizes, are constrained such that if a system fails it must be upgraded with a "best fix" type of system, where reductions in setbacks and minimum soil conditions may be employed. The latest Vermont Environmental Protection Rules allow additional options for pre-treatment components and disposal field types that should aid in successful onsite upgrades for existing failed systems. The Towns may wish to further investigate some developed areas where soils limitations are known, as well as reviewing the existing elementary school system and site.

New construction and development should maximize use of areas of suitable soils and pretreatment technologies to achieve building densities typical of village centers, or to allow the higher wastewater flows necessary for some commercial uses, such as restaurants and laundromats. The Towns' subdivision and zoning regulations can include incentives for providing excess wastewater capacity such as increasing densities or reducing setbacks.

Existing publicly owned properties, such as the schools and Riverside Park, may contain suitable capacity for future cluster systems. These areas may ensure expansion needs of the schools, provide for offsite upgrades in areas where soils are not suitable, and provide for growth capacity and density in the Village area.

Water Supply

The Jericho-Underhill Water District (J-UWD) has the capacity to serve further residential and commercial development and redevelopment in the Underhill Flats/Riverside area. The water source appears to be of good quality and reasonably protected from contamination. High levels of manganese and iron occurring naturally in the source water are managed. No problems were identified in the function of the wells, treatment system, or distribution system. J-UWD has contingency plans in place to continue serving customers in case of failure or contamination of its water supply wells.

Stormwater

There are no major stormwater problems in the Underhill Flats/Riverside area. The relatively minor problems noted in reconnaissance of the area may be easily remedied. The stormwater drainage system is regularly, though not frequently, maintained. A greater attention to erosion prevention is warranted, both in current management practices and to mitigate potential impacts of future development. New development and redevelopment of properties such as the Green Crow Lumber Company property present opportunities to implement innovative stormwater practices that infiltrate runoff onsite rather than conveying untreated runoff to surface waters.

Transportation

Underhill Flats is experiencing transportation related pressures from both internal and external sources. A great deal of through traffic travels Route 15, while internal destinations such as Browns River Middle School attract traffic at key times of the day. Morning peak traffic is the central challenge facing the village today, though speed and future development pressures are also important. Key issues include:

- Improving the intersection of Route 15 and River Road
- Slowing speeds to acceptable levels
- Preparing the transportation network and policies for future development

Possible solutions include:

- Traffic signals or roundabouts
- Gateways
- Traffic calming
- Sidewalks
- Realigning the intersection of Dickinson Road and Route 15
- Modifying policies and guidelines

Logical and thoughtful steps can be taken today to resolve the transportation issues facing the village. Some solutions may take time, but short term measures exist to enhance safety and to move traffic along.

Hazardous Sites

Stone conducted a modified Phase I Environmental Assessment on the Underhill Flats-Riverside Road triangle and surroundings as part of this project. A review of federal, state, and local environmental site databases located several properties within the study area that have various degrees of degraded environmental condition. For the most part, sites discovered during the database review either are in the process of being removed from their respective hazardous sites list or are outside the immediate village area. Three active hazardous sites are within the study area: Big John's Riverside Store, Clark's Truck Center, and Village Service and Auto Repair. The degree and extent of contamination at two sites has not been addressed nor has the condition of nearby sensitive receptors (such as groundwater, basements of buildings adjacent the contamination, nearby surface waters, and public or private water supply wells).

A review of the Green Crow Lumber Company property included a previously conducted Phase I Environmental Site Assessment and a review of the appropriate up-to-date environmental databases. Underground storage tanks (USTs) were removed from the site in 1990. Contaminated soils were detected during the 1990 tank removal.

Brownfield Program funds may be used for assessment of contaminated or suspected contaminated properties through either the State of Vermont or US EPA. These programs form a bridge between the private property owner and Towns for using grant funds to assist with cleanup and redevelopment purposes.

In summary, there are limited environmental constraints related to sustainability and growth in the village. These include:

- Some areas contain poor soil conditions affecting stormwater and wastewater disposal
- Some hazardous sites with potential contamination
- Rush hour traffic problems at the River Road/Route 15 intersection.

While respecting these limitations, careful development planning, saving funds for future upgrades such as the school wastewater treatment system upgrades, and setting aside areas for future use as cluster disposal systems may allow the higher development densities necessary for a sustainable village center in the future.

1. INTRODUCTION

This study is a planning level environmental assessment of the Underhill Flats/Riverside shared Village area within the Towns of Underhill and Jericho. The towns received a municipal planning grant from the Department of Housing and Community Affairs to conduct this study. A Joint Task Force made up of residents from both towns was formed and is managing this study for the towns. Stone Environmental, Inc. (Stone) of Montpelier, Vermont is conducting the study.

The study includes meetings with the Task Force, the environmental assessment included in this report, and a public presentation of the assessment results. The assessment includes a review of existing conditions and potential future actions related to wastewater treatment and disposal, water supply, stormwater, transportation issues, and hazardous sites.

1.1. Study Area Description

The focus of the environmental assessment is the triangle made by Route 15, River Road, and Park Street in the Towns of Jericho and Underhill. The town boundary splits the village. The Jericho side of the village is called Riverside, while the Underhill portion is called Underhill Flats. To assess the environmental conditions within the Underhill Flats/Riverside area (the Village), properties within an approximate 1-mile radius of the Center Triangle were subjected to review (Figure 1). Vermont Route 15, running southwest to northeast through the village, bisects the village nearly in half. Other major roads in the area include River Road, Raceway Road, and Park Street.

The Village consists of single-family residences, small businesses, churches, schools, open fields, and some wetlands. The village is in the foothills of Mount Mansfield and is bisected by several large streams leading to the Browns River. Most properties are served by municipal water supply and by individual onsite wastewater treatment and disposal systems.

A review was made of environmental sensitive receptors such as wetlands, rivers and streams, and wellhead protection areas. The endangered species list was also reviewed. One property along The Creek in the southwest portion of the study area has a listing for a vascular plant.

1.2. Current Uses of Parcels within the Study Area

The study area consists of private, one-family and multi-family residences, small businesses (including a print shop, convenience stores, and gas stations), the Browns River Middle School, an elementary school, library, and a fire station. The former lumberyard owned by the Green Crow Lumber Company is located in the Center Triangle.

The Green Crow Lumber Company property consists of two parcels that total nearly 20 acres. Buildings on the property include a sawmill, two pole barns, a tool storage building, dust buildings, and grading and sorting sheds. A pre-engineered steel garage building lies on the southwest corner of the site. In addition, the site has two water supply wells that were used to shower logs during hot summer months to prevent splitting. Excess log water drained into a large drywell at the center of the log yard and was recycled. During times of low water, the lumberyard has supplied the Jericho-Underhill Water District with water to supplement their wells. The Green Crow property has been inactive as a lumberyard for over three years. The Green Crow property has been a lumberyard since 1960 when it had a small garage, office and band saw mill. The old mill was removed in 1981 to make way for the current circular saw mill, sawdust building, grading and sorting sheds, and pre-engineered steel garage building.

According to Mr. Brunet, Green Crow Corporation purchased the property on March 29, 2000 and ran the sawmill for a year and a half. The property was used as a log storage yard for an additional year and a half.

1.3. Topography

The study area is located within the western foothills of Mt. Mansfield, Vermont's tallest peak. The village area near Route 15 is relatively flat, sloping to the west and south. The elevation in the area is around 700 feet above sea level.

1.4. Geology

The Geological Map of Vermont (Doll et al., 1961) indicates that the study area is underlain primarily by the Underhill Formation. The Underhill Formation is a silvery, grey-green, quartz sericite-albite-chlorite-biotite schist containing abundant lenticular segregations of granular white quartz. Locally, quartz-sericite-albite-chlorite phyllite with porphyroblasts of albite, garnet, and magnetite are common and can be very abundant in gneissic facies in axial anticlines of the Green Mountain anticlinorium.

The Surficial Geologic Map of Vermont (Doll et al., 1970) indicates that the triangle area is underlain by coarse fluvial sediments, primarily composed of horizontally bedded gravel deposits with silt. An understanding of surficial geology is important for the setting of appropriate protection measures for community water supply wells (see Section 3).

1.5. Soils

The soils in the study area consist of a variety of soils types, with the predominant soil being well-drained sands and gravels. Stetson sands are found along Route 15, in the Underhill Flats, the triangle area, and where the elementary school is located. Surrounding soils on hills and along the streams consist of silt loams with shallow seasonal high groundwater tables and slower permabilities. Figure 2 shows the soil types in relation to the anticipated wastewater treatment system suitability in the study area. Additional information on soils found in septic permit files is provided in the Wastewater Treatment and Disposal section.

Soils and site conditions are important for onsite wastewater treatment and for stormwater drainage.

1.6. Hydrology

Hydrology refers to the surface and groundwater characteristics in the area.

1.6.1 Surface Water

Surface runoff within the Study Area eventually enters the Browns River, a tributary of the Lamoille River, which leads to Lake Champlain. The National Wetland Inventory and Vermont Significant Wetlands Inventory maps indicate several wetlands associated with The Creek, a large stream tributary to the Browns River (Figure 1). The majority of these wetlands lie adjacent the Underhill Flats triangle to the northwest.

1.6.2 Hydrogeology

Stone infers that local groundwater flow generally mimics regional topography and that groundwater flows towards the west. The Surficial Geologic Map of Vermont (Doll et al., 1970) indicates that the Green Crow property is in a mapped sand and gravel aquifer deposit.

The onsite septic system constraints shown on Figure 1 include community water supply wellhead protection zones.

2. WASTEWATER TREATMENT AND DISPOSAL ASSESSMENT

Onsite wastewater treatment and disposal systems (septic systems), when properly sited, installed, and maintained, can be a long-term effective means of treatment and disposal. However, septic systems can negatively impact surface waters and groundwater when malfunctioning, or placed too close to the groundwater table, impervious soils, or bedrock. Older systems, which were installed prior to more recent regulations, can also have a negative impact on the environment and public health, since they are often undersized, may not meet the current minimum soil conditions, and may not have the minimum separation distances to important features such as wells, building foundation drains, and surface water. Appendix A contains additional information about septic systems, their treatment performance, failed systems, and potential environmental impacts.

2.1. Wastewater Treatment and Disposal System Basics

The traditional onsite septic system in the Underhill Flats/Riverside Village (and throughout Vermont) includes a 1,000 gallon concrete septic tank, a concrete distribution box, and leach bed or trenches (Figure 3). The septic tank settles out the solids and provides some treatment; the distribution box splits the flows evenly between pipes or trenches, and the leach bed or trenches (made out of stone or alternative materials) with perforated pipe covered with filter fabric or hay, along with the unsaturated soils below the system provide the final distribution and treatment. Pump stations can be added after the septic tank where the disposal field is higher in elevation than the building outlet, or for at-grade, mounds, and advanced treatment systems. Pressurizing the disposal field also allows for greatly improved distribution of the effluent, making more efficient use of the entire field.

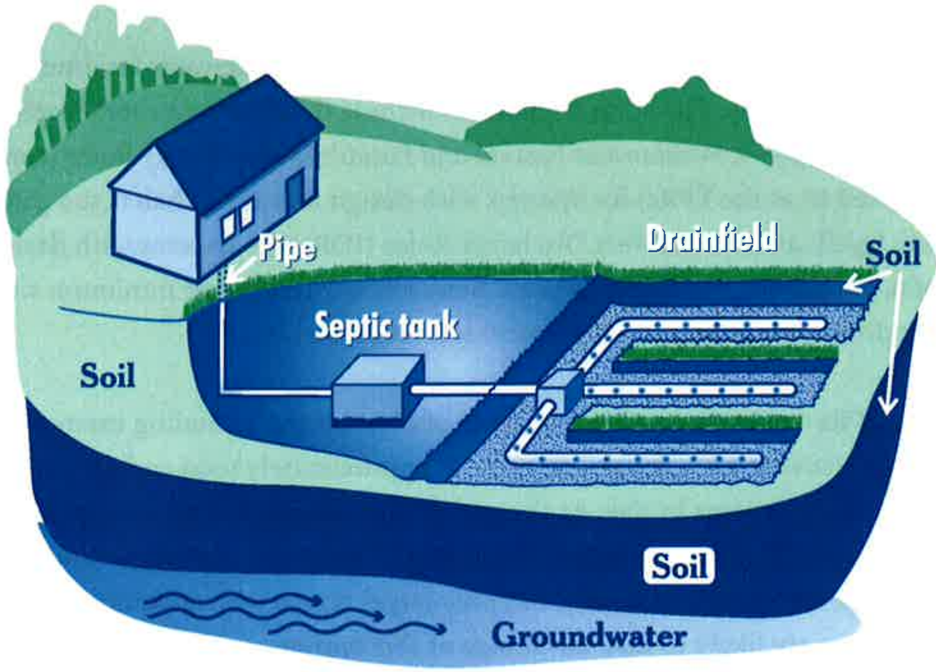


Figure 3: A typical individual onsite septic system. Source: US EPA.

Effluent filters and risers are now included in the septic tank. The effluent filter is located at the tank outlet, and screens any solids from the effluent when it leaves the tank. If the tank is not pumped regularly and becomes full of solids, the filter will plug and the system will slow or back up before the solids leave the tank and enter the disposal field, where the entire field may need replacing. The filters need to be hosed off usually once a year, which is also when the septic tank should be inspected. Risers over the accesses to the tank allow for easy access for maintenance.

Advanced pre-treatment components can be added after the septic tank to improve wastewater treatment prior to disposal This can allow for smaller sized leach fields (up to ½ the size), which can be important on small lots and to cluster new subdivisions. It may also eliminate the need for a mound system, since there are reductions in the vertical separations to limiting soils when using pre-treatment units. Pre-treatment components may also allow for increased capacity of existing onsite systems, which maximizes the soil resources, or may allow for use of sites not previously approved under the Environmental Protection Rules (EPRs). Several technologies are currently approved for general use, including peat filters, geotextile filters, and trickling filters using other media.

2.2. State and Local Regulations

There are currently state and town regulations for wastewater treatment and disposal systems. The state regulations include the *Environmental Protection Rules, Chapter 1, Wastewater System and Potable Water Supply Rules* (commonly referred to as the EPRs) for systems with design flows less than 6,500 gallons per day (gpd); and the Indirect Discharge Rules (IDRs) for systems with design flows of 6,500 gallons per day or greater. Both sets of rules define minimum site and soil conditions for various wastewater treatment systems.

The EPRs currently contain a number of exemptions, including exemptions for properties that were developed prior to approximately 1969 and for properties larger than 10 acres in size. At the end of June 2007, all current exemptions will expire, as will all local Sewage Ordinances. Towns can choose to administer the entire permit program locally, but only larger towns with adequate staff and resources are likely to take advantage of this option.

The Indirect Discharge Rules regulate all soil-based systems that are 6,500 gpd or larger. These rules include more stringent testing and research than required under the EPRs for soil characteristics, groundwater table depth, mounding beneath the system, and identifying and evaluating the point where groundwater from the septic system is discharged into the surface receiving waters. The surface water study includes an assessment of the stream biota and assimilative capacity in order to show that negative impacts will not result from the operation of the new septic system. Permitting requirements also include effluent and groundwater sampling before and after system installation. Primary and secondary treatment may be required prior to dispersal via a leach field. In order for a permit to be issued, the project must demonstrate that the new indirect discharge:

- Will not significantly alter the aquatic biota of the receiving waters;
- Will not pose more than a negligible risk to public health;
- Will be consistent with existing and potential beneficial uses of the waters; and
- Will not violate Water Quality Standards.

Act 250 permits may also be required for larger developments (i.e. 10 or more units). This permit process typically relies on the EPRs and IDRs for project approval of the proposed water supply and wastewater treatment systems. The Act 250 review covers 10 criteria including reviewing traffic, air pollution, and stormwater impacts, where much of the evidence is tied to various permit programs.

Wastewater treatment and direct discharges into surface waters, such as standard municipal wastewater treatment facilities (WWTF), are an alternative to onsite and cluster wastewater treatment systems. These discharges are closely regulated through the Vermont NPDES program. New WWTFs are extremely difficult to locate, particularly on smaller rivers and waterbodies, and are generally not an option for many Vermont communities unless major public health issues are discovered (such as straight pipes from septic tanks or houses discharging directly into surface waters). The high costs of constructing and maintaining new facilities are major constraints on this option.

2.3. Minimum Site Conditions and Wastewater Design Flows

The minimum soil conditions related to depths to seasonal high groundwater table and bedrock are shown in Table 1. This table also lists the potential wastewater treatment system types and the estimated area needed for the leach field. The areas are calculated based on a single family residence with soils with a range of percolation rates. A replacement area of equal size would also be required for new construction or expansions. Systems greater than 6,500 gpd include 2-100% constructed leach fields. If pretreatment is added to the system, the size may be reduced by up to ½ and a reduction in the separation to seasonal high groundwater and bedrock is granted. This reduction can allow for a different system type. For example, if a mound system could be sited according to the minimum site conditions and pretreatment is added, the leach field may change to an at-grade system, plus be ½ the normal size.

Residential wastewater flows are based on the number of bedrooms (minimum 3 bedrooms for a single family residence) up to four units. Multiple units are based on a sliding scale ranging from 315 gpd for 5 units to 245 gpd per unit for 20 units. Table 2 includes various building use types, the basis for calculating flows, and estimated flow calculations.

2.4. Wastewater Treatment System Assessment

A review of soils and site conditions related to onsite systems was conducted, and a review of existing septic system permits was conducted in both town offices. Following is a summary of available permit information and subarea summaries, particularly as related to the soils rankings shown on Figure 2, and cluster system potential.

Browns River Middle School

There is an Indirect Discharge Permit (#9-0079) for the septic system serving the Browns River Middle School. This system was designed and permitted for a capacity of 700 students and 17,500 gallons per day (gpd). The leach fields consist of four seepage beds that were constructed in 1970 (over 35 years ago). There are two large septic tanks and a pump tank, each of which have received some maintenance over the life of the system.

The last inspection of the system was conducted on June 21, 2004 by Lamoureux and Dickinson Consulting Engineers Inc. The system was basically functioning properly and "no immediate maintenance items [were] recommended." Some monitoring of water use was conducted, although actual results were not obtained. Actual metered flows may be significantly lower than the design flows for the system, and thus there may be adequate capacity in this system to support future growth at the school. Due to the age of the system, it is recommended that the leach fields be inspected and plans for replacement be considered if needed.

The soils on the school site generally consist of deep well-drained sands, although there may be a seasonal high groundwater table on part of the site. Backhoe test pits and hydrogeologic evaluations can be conducted to evaluate the potential for a new cluster disposal field serving existing and future growth within the village. This property and the adjoining recreational fields may contain more wastewater capacities than the school needs. For example, the Town of Warren, Vermont has a pretreatment system and half-sized disposal field for the Warren Elementary School and a 30,000 gpd system serving many properties in Warren Village that is located under their recreational ball fields. Consideration must be made of the floodway and streambank stability along the Browns River. No components of a cluster system should be located within a floodway. Additional setbacks to the river may be needed for long-term use of a cluster system in this area.

Underhill-Jericho Permit Review

A review of approximately 25 permits was conducted in the Underhill and Jericho Town Offices.

The Green Crow property recently received a 3-lot subdivision permit with total wastewater flows of 1,125 gpd. The systems on site appear to be conventional leach fields and have also received Act 250 approval.

Along Route 15, particularly on the western side of the road, there are several properties that were originally constructed with drywells or cesspools. In order to upgrade or replace their systems, these properties either were barely able to fit a replacement system or required pre-treatment and reductions in setbacks and soil requirements. In the future, if residences in this area were converted to offices, wastewater flows would usually be reduced and replacement systems could fit without pre-treatment or reductions in setbacks. However, if the properties were redeveloped with increased flows, the small lot sizes, large building coverages, and steep slopes in the rear of the lots could constrain development. There are also indications on at least one property of a shallow seasonal high groundwater table 30 inches below the ground surface, posing greater potential constraints in this area than are indicated on the soils map.

The subdivisions at the Post Office and surrounding the Jacobs property have utilized much of the suitable soils in this area. With the changes in the EPRs, there may be more capacity in the open area than what could have been allowed in the past. The soils and system types may allow for pretreatment and mound systems for individual houses, or small cluster systems in the higher elevation areas. Another alternative might be to consider compact development onsite served by an offsite cluster system, perhaps south of Park Street or at the school.

Some of the lots in the Harvest Run subdivision had failed systems where soil conditions were not as favorable as originally indicated due to shallow seasonal high groundwater tables. Some repairs included pump tanks and relocated leach fields to the rear of the lots on higher elevations where soil conditions were more suitable. One lot's repair plans reported the initially approved mound area was often saturated.

The Meadow Lane subdivision had failures due to undersized, deeply placed disposal fields. Some of the replacement systems were considered "best fixes". One replacement system last year had failed drywells, with seasonal high groundwater table reported at 18 inches and a percolation rate of 93 minutes per inch (unsuitable for in-ground systems). The best fix included a biofilter pretreatment unit and a mound disposal system.

Many of the existing properties may have been developed prior to current soils and siting regulations and may have difficulties meeting today's rules. Best fixes can be used as needed to bring systems into closer compliance if the system fails or the owners wish to upgrade the system. The use of pretreatment technologies allow reductions in minimum soil requirements and system size, which can allow already developed properties to meet current standards. The use of a municipal water supply eliminates the setbacks required to drilled wells (100 feet if the well is uphill, and 200 feet if the well is downhill of the disposal field). For the most part, existing properties should be able to upgrade onsite without the use of reduced minimum site conditions.

2.5. Community Cluster Systems

Community cluster systems can be designed to serve a handful of properties, an entire village, or anywhere in between. Either all of the wastewater, or the effluent discharging from the septic tanks from each property can be collected, treated if necessary, and disposed of in a large leach field. The Roaring Brook subdivision is an example of a cluster wastewater treatment and disposal system.

Cluster systems can be regulated under either of the two sets of State wastewater disposal rules (the EPRs or the IDRs), depending on the system design flows. Systems under the IDRs (with design flows of 6,500 gpd or greater) are required to construct replacement disposal fields as well as the primary fields, whereas the EPRs (design flows less than 6,500 gpd) only require that the replacement field areas be set aside for future use. One 5,000 gpd leach field would take approximately 13,000 square feet, with an equal area to be set aside. A 5,000 gpd system could serve up to 20 residential units, or a 110 seat restaurant serving three meals per day. An example of the area needed for a cluster system that is larger than 6,500 gallons per day (gpd) follows. A 30,000 gpd system in coarse sands may need approximately 3.6 acres of land. If the soils contain finer sands, the area may be closer to 4.5 acres. If pretreatment systems are added prior to disposal, the area needed may be only 2.6 acres. Thirty thousand gpd could serve approximately 122 residences or a combination of residences and commercial properties.

Some of the criteria used in considering sites for cluster systems include:

1. Well suited soils, typically sandy soils with relatively fast percolation rates, with five feet or greater depths to seasonal high groundwater table, impervious soils or bedrock;
2. Relatively flat or moderate slopes;
3. Proximity to properties needing offsite connections;
4. Environmental issues such as nearby water supply wells, surface water crossings, floodways;
5. Physical issues such as access, bedrock depths for collection systems, bridge or river crossings; and
6. Local knowledge of properties.

Examples of systems sizes and areas needed for two cluster system sizes are shown in Table 1. Potential cluster system sites in the Underhill Flats/Riverside Village area include the following areas.

Green Crow Property

The Green Crow property is mostly undeveloped and appears to contain suitable soils for a large cluster treatment and disposal system. Due to the fast infiltration rate of the sands, onsite stormwater treatment and disposal should also be possible on this site. Existing water supply and other wells in the area must be addressed.

Jacobs Property

The Jacobs property is located behind the Fire Station and contains a mixture of suitable and unsuitable soils. This property contains sands and gravels over silts with high seasonal groundwater tables and slower percolation rates than allowed for conventional systems. This site could be evaluated according to today's regulations to identify and maximize the suitable soils for cluster development. Stormwater impacts may be more difficult to handle on this site due to the soils and shallow seasonal groundwater table.

Other Properties

Other properties with potential for cluster system use include the elementary school property, the Riverside Park area, and some areas along Raceway Road. Additionally, some of the parcels along the western side of Park Street are relatively large and may include wastewater disposal capacity that is not currently utilized.

2.6. Conclusions and Recommendations

The Village study area contains many developed properties, some of which were constructed prior to the development state or local regulations. Much of the area consists of well-drained sands and gravels, which are generally conducive to wastewater treatment and disposal. Some properties, particularly those with small lot sizes, are constrained such that if a system fails it must be upgraded with a "best fix" type of system, where reductions in setbacks and minimum soil conditions may be employed. The latest Vermont Environmental Protection Rules allow additional options for pre-treatment components and disposal field types that should aid in successful onsite upgrades for existing failed systems.

Further investigation of the properties along Route 15, and in the Harvest Run and Meadowbrook subdivisions where failed systems were observed in the past, could indicate a need for offsite disposal. A more detailed feasibility study could be conducted using a planning grant (or loan) from DEC's Facilities Engineering Division. This assessment could include a more detailed needs assessment of these areas and the schools, plus provide funding for preliminary investigations for cluster systems and preliminary cost estimates. If the Towns wish to pursue this study, a citizens advisory committee should be formed to help develop a scope of services and project budget. (Contact Donald Robisky (802) 241-3734, donald.robisky@state.vt.us). Note on funding programs; most are focused on pollution prevention or abatement. While municipal projects typically include some growth, funding is very competitive and is based on environmental and public health needs.

Existing publicly owned properties, such as the schools and Riverside Park, may contain suitable capacity for future cluster systems. These areas may ensure expansion needs of the schools, provide for offsite upgrades in areas where soils are not suitable, and provide for growth capacity in the Village area.

New construction and development should maximize use of areas of suitable soils and pretreatment technologies to achieve building densities typical of village centers, or to allow the higher wastewater flows necessary for some commercial uses, such as restaurants and laundromats.

3. WATER SUPPLY ASSESSMENT

The Jericho-Underhill Water District (J-UWD) serves customers in the villages of Underhill Flats and Riverside (Jericho) with potable water. J-UWD is classified as a Community Water System under the Safe Drinking Water Act. J-UWD was chartered in 1961 (State of Vermont, 1961) and is directed by a 3-member board of trustees, presently composed of Peter Mitchell (President), Dick Eldred, and Joe O'Brien. J-UWD currently employs four part-time staff: Marc Maheux (Chief Operator), Jane Maheux (Clerk/Treasurer), Paul Selsky (Assistant Operator), and Dwight DeCoster (meter reader/collector). Mr. Maheux has operated the system for approximately the last 30 years.

The Jericho-Underhill Water District's service area is represented on Figure 1 (Environmental Sensitivities). The original district boundary was determined based on land ownership at the time J-UWD was chartered and has changed slightly since that time. The Poker Hill water line extension and storage tank, along with the current supply wells, were added to the district boundary. Subdivision of some parcels in the intervening years has meant that the district boundary now includes developed parcels not connected to the system. For example, Alpine Drive is within the district boundary although there are not any water lines to serve the residents.

There are an unknown number of private wells in service within the Jericho-Underhill Water District. A map of private wells in Jericho and Underhill obtained from the Vermont Agency of Natural Resources, Water Supply Division (February 4, 2003 update) shows approximately 50 wells within the Jericho-Underhill Water District. These wells include three supply wells on the Green Crow Logging Company's lumber yard property, one of which is a high capacity well yielding 180 gallons per minute. It is likely that some of the private wells indicated have been abandoned as owners have connected to J-UWD or changed use. Additionally, there are likely to be some non-permitted well points remaining in the area, although the number of these wells is believed to be declining as owners connect to J-UWD. Non-permitted wells are not included in the 50 well estimate, as the locations of non-permitted wells are unknown.

3.1. Water Supply Sources

There is no surface water source used for water supply in the Underhill Flats/Riverside study area. Two wells, identified as Well 1 and Well 2, supply all the Jericho-Underhill Water District's source water. The wells were constructed in 1991. The wells are located 54 feet apart (Jericho Underhill Water District, 2005) near the Browns River near the Underhill/Jericho town line. Their exact location is not specified here for security reasons. Well 1 is a six-inch diameter, naturally packed well drilled to 185 feet. Solid casing extends to 145 feet followed by a 21.1-foot well screen. Well 2 is a 10-inch diameter, gravel packed well drilled to 179 feet, cased with solid pipe to 165 feet, and screened 9 feet.

Both wells tap a confined sand and gravel aquifer in the Browns River valley. An aquifer is a rock or sediment formation that is saturated and sufficiently permeable to transmit economic quantities of water to wells and springs. Sand and gravel aquifers are generally highly permeable, which enables high pumping rates. A confined aquifer is an aquifer overlain by a confining bed of significantly lower permeability. The source water aquifer lies below two confining units of clay and till. It is the third water yielding layer in the vertical sequence; beneath the aquifer lies bedrock. Due to the isolation of the source water aquifer from the surficial aquifer and the Browns River by two slowly permeable layers, the source water is believed to be relatively protected from contamination from surface runoff and the Browns River in the area of Underhill Flats. Of greater concern is protection from pollutant sources originating in Underhill Center, where the confining units are thinner and the depth to the source water aquifer is shallower.

Wells 1 and 2 were placed into service soon after construction in 1991. Prior to construction of the supply wells, J-UWD used water drawn from a network of 10 well points located in the sand and gravel aquifer along "The Creek" west of Route 15. The well points were used as an emergency water source for a brief time after construction of the supply wells near the Browns River before they were abandoned entirely. The well points are still in place; however connection between them and the J-UWD's system has been eliminated.

3.2. System Capacity

J-UWD provides an average of approximately 50,000 gallons per day (gpd) for residential, commercial, municipal (including fire department and school) uses. A 2002 sanitary survey of J-UWD—as referenced in a letter dated March 25, 2004 from Greg Bostock, Senior Environmental Engineer, Agency of Natural Resources, Water Supply Division to Marc Maheux— indicated an Average Day Demand of 47,000 gpd and a Maximum Day Demand of 59,500 gpd. Based on these figures, the peaking factor (ratio of Maximum Day Demand to Average Day Demand) is 1.27. According to J-UWD's monthly use reports (available at http://water.jerichounderhill.com/monthly-reports/2004-water-use-report/odyframe.htm) current demand is slightly higher—Average Daily Demand ranged from approximately 40,000 to 64,000 gpd for the twelve months of 2004, averaging 52,039 gpd for the year. There are approximately 300 service connections. The largest customer is the Browns River Middle School in Jericho, which has an estimated daily use of 800 gpd when school is in session.

Wells 1 and 2 each have an approved yield of 150 gallons per minute. The wells are pumped alternately, switching on and off according to water levels in J-UWD's two storage tanks. Using the daily demand figures from the 2002 Sanitary Survey, the supply wells have the capacity to meet an Average Day Demand of 170,079 gpd. This rated capacity accounts for the peaking factor mentioned previously. The difference between the rated capacity and the Average Day Demand (52,039 gpd—assuming 2004 average) is the reserve capacity, 118,040 gpd. The supply wells are capable of sustainably supplying more than three times their current output; therefore source water supply should not be a limitation on reasonable growth and redevelopment of the Underhill Flats/Riverside study area in the foreseeable future, apart from the potential connection of large industrial users.

There are two water tanks used to store water and pressurize the J-UWD's water system. The larger tank, 250,000 gallons, is located north of River Road. The smaller tank, 150,000 gallons, is on Poker Hill at the northern end of the water district. Based on average daily water demand, the tanks hold a combined eight-day supply of water.

Water mains in J-UWD are either six- or eight-inch diameter ductile iron or asbestos cement (AC) pipes, with the exception of the 12-inch ductile iron main leading from the control building to the distribution system at Pleasant Valley Road, a section of 8-inch diameter Blue Brute (PVC) pipe serving residential developments on Harvest Run Road and Maple Ridge Road, and a section of 8-inch HDPE pipe serving Poker Hill. The distribution system is believed to be more than adequate to meet current demands.

Service connections to J-UWD's water mains are made subject to written approval by J-UWD. The fee for a service connection is $2000; fees for other types of connections are listed in the District Regulations. Any person, corporation, or governing body intending to construct water mains and connect to J-UWD's distribution system is required to apply to the municipality by submitting a letter and engineering plans and specifications developed by a Professional Engineer.

Under the Vermont Water Supply Rules (2005), a permit must also be obtained from DEC's Water Supply Division. Fees for extending water mains are based on the size of the connection, ranging from $6,000 for a three-inch diameter main extension to $9,400 for an eight-inch diameter extension.

Mr. Maheux believes the existing distribution system is adequate to support extension of water mains to serve significant residential and commercial development and redevelopment in J-UWD's service area. Specifically, Mr. Maheux does not foresee any problems related to source or distribution system capacity in serving potential redevelopment of the Green Crow Logging Company property, or possible subdivision development of open parcels within the District. Water mains may be bought onto the Green Crow property from existing mains along Route 15, River Road, and Park Street. The design favored by J-UWD would likely involve creating a loop between the existing mains. Looping mains have the advantage of minimizing slack water because pipe ends are avoided, equalizing water pressure in the system, and allowing greater flexibility in management of the distributions system because individual mains may be closed at many junctures in the system. A single water main extension fee is charged for creation of a looped main despite connection at two points.

3.3. Water Quality

The J-UWD has not been cited for any monitoring or water quality violations in the past five years. Bacteriological, chemical, and radiological testing indicates good water quality, with the exception of high manganese and iron. Vermont's Water Supply Rule, as revised April 25, 2005, specifies secondary contaminant standards for iron and manganese of 0.3 milligrams per liter (mg/l) and 0.05 mg/l, respectively. EPA's Secondary Maximum Contamination Levels (SMCLs) for iron and manganese are identical to Vermont's secondary contaminant standards. Of the two analyses for iron reported by J-UWD in annual consumer confidence reports (see: http://water.jerichounderhill.com/consumer-confidence-report/odyframe.htm), one exceeded the secondary standard. All three analyses for manganese reported between 1999 and 2003 (0.139 mg/l, 0.145 mg/l, and 0.263 mg/l) have substantially exceeded the secondary standard. Exceedance of the secondary standards for iron and manganese does not constitute a water quality violation; the secondary standards are based not on health effects but on aesthetic considerations. The District water is treated with a sequestering agent to keep iron and manganese in suspension, however, manganese and iron still may stain water fixtures. Elevated levels of manganese and iron occur because the aquifer source water is high in these minerals.

3.4. System Management

Source water is treated in J-UWD's control building with a polyphosphate to sequester manganese and iron, 12 percent sodium hypochlorite for disinfection and to maintain a chlorine residual of less than 1 ppm through-out the distribution, and fluoride to help prevent tooth decay. No sedimentation or filtration of source water is performed.

J-UWD performs routine leak detection, meter reading, and necessary system maintenance. J-UWD flushes the distribution system through hydrants twice annually (typically in May and October). Flushing minimizes sediment accumulation within the system. Elevated water demand from fire department use can dramatically increase water velocities through the system of mains, causing accumulated sediments to be resuspended, which can result in poor water quality for customers for short periods of time. Routine flushing of the mains minimizes water quality disruption resulting from fire fighting.

J-UWD is currently drafting a revision to its Operations and Maintenance Manual, with assistance from Phelps Engineering. This manual update was needed to incorporate the operation of the new water tank into the existing manual. It will describe operations and maintenance of the system, and serve to document much of the accumulated knowledge possessed by the chief operator.

3.5. Source Water Protection

The Vermont Agency of Natural Resources, Water Supply Division approved a source protection plan for J-UWD on July 23, 1996, and has accepted and recorded subsequent updates. The most recent update to the plan was completed in March of 2005. The source protection plan is designed to assess and manage existing and future risks to source water quality.

There are four source protection zones delineated for the water supply wells.

Zone 1 is a circle of land 200 foot in radius around the wellheads. Zone 1 is owned and controlled by J-UWD.

The boundary of the Zone 2 protection area represents the extent of the two-year travel distance to the wellheads, as estimated in a hydrogeologic analysis by Wagner, Heindel, and Noyes. Zone 2 is shown of Figure 1. Within the Zone 2 boundary, travel time to the wellheads is estimated to be less than two years. There are only eight landowners in the Zone 2 wellhead protection area, representing a mixture of residential and agricultural land uses. All property owners in Zone 2 have been given information on wellhead protection strategies. Farm operators have additionally been supplied with information about agricultural best management practices. Based on information supplied by farm operators in 1996, 2001, and 2005, pesticide use on the agricultural land is believed to be conservative. J-UWD plans to visit the farms every three years to review current pesticide use. Other potential sources of contamination include onsite septic systems and fuel storage tanks. None of the properties in Zone 2 are believed to have an underground fuel storage tank. It is believed that all owners of developed parcels have an onsite wastewater system. Some owners reported pumping septic tanks at regular intervals while other owners made no note of this. In summary, potential sources of contamination within Zone 2 are minor and J-UWD is collecting useful information with which to manage risks in this zone.

The boundary of the Zone 3 protection area represents the extent of the twenty five-year travel distance to the wellheads as estimated by Wagner, Heindel, and Noyes. Zone 3 encompasses Zone 2 and is much larger, extending east along the Browns River valley to Underhill Center. Land use in Zone 3 is predominantly low density residential. All landowners in Zone 3 (and those in Zone 2) were mailed information in 2005 regarding source water protection. Two sites that have been of concern to J-UWD include the Town of Underhill's salt shed and town garage and a store in Underhill Center, Wells Corner Market, which has gasoline service. The salt shed and garage were relocated sometime between 1996 and 2001; while it is possible that contamination may slowly migrate from this site towards J-UWD's wellheads, the risk posed by this site is not considered high. This site and the Wells Corner Market site are approximately 2.5 miles from J-UWD's wellheads. The Wells Corner Market site is listed as a hazardous materials site 941710 by the State of Vermont, DEC due to a gasoline release from leaking underground storage tanks. The tanks were replaced in 1995 and remediation was begun using soil vapor extraction and sparging. The remediation system was shut down in 1997 and removed in 2000. According to Haslam, the site cleaned up well and more quickly than most. Low level residual contamination of groundwater remains at the release site, but down gradient wells have cleaned up. The site remains on DEC's list of active sites because monitoring is ongoing and low level contamination remains.

The Zone 4 protection area is the entire watershed of the Browns River above the supply wells. Zone 4 extends up Mount Mansfield. Zone 4 includes closed landfills, one former open dump, and two underground fuel storage tanks listed with the State of Vermont, DEC, Hazardous Materials Division. Given the large area of Zone 4, the small number of potential high hazard sites, and the very long travel time/distance to the wellheads, J-UWD is not concerned about potential impacts of the documented sites. The travel time/distance, which is estimated as 100 years from the Zone 4 boundary, is believed to be sufficient to attenuate contaminants moving through the soil profile and groundwater toward the source water aquifer.

3.6. Contingency Plans

Jericho-Underhill Water District's source protection plan (2005) identifies safety precautions, corrective actions, and several contingencies in case of failure or contamination of the existing supply wells. Short-term contingency plans include:

- Trucking treated water from Champlain Water District (CWD) or another source to a hydrant on J-UWD's system.
- Restoring non-potable water service by pumping water from the Browns River or a different potable well to a hydrant on J-UWD's system.

In the event of a prolonged interruption in water supply from the existing wells, longer-range contingency plans include:

- Using the two test wells drilled near The Creek west of Route 15 as a replacement water source. These wells were not selected as J-UWD's water source because of high iron and manganese, but could be economically used with treatment.
- Construction of a water main to connect to the Champlain Water District's system. CWD's distribution system currently ends in the vicinity of the Jericho East development. A temporary measure could be to lay a pipe to CWD's system over the ground. The Source Protection Plan indicates it may take a year or more to obtain the approvals and do the work necessary to implement this contingency plan.

Based on our understanding of J-UWD's system, each of these options appears feasible. With careful operation and maintenance of the existing supply wells and vigilant attention to source protection, Stone expects the likelihood of failure or contamination of the existing wells to be low.

3.7. Conclusions and Action Items

The J-UWD has the capacity to serve further residential and commercial development and redevelopment in the Underhill Flats/Riverside area. The water source appears to be of good quality and reasonably protected from contamination. High levels of manganese and iron occurring naturally in the source water are managed. No problems were identified in the function of the wells, treatment system, or distribution system. J-UWD has several good contingency plans to continue serving customers in case of failure or contamination of its supply wells.

J-UWD is always working to find ways to improve the system. The following actions are ongoing:

- Continue practice of disseminating information to the public on water quality, source protection, water demand, and system operations on J-UWD's website (http://water.jerichounderhill.com/)
- Continue careful administration of the source protection plan. In particular, maintain outreach and education efforts with agricultural producers within the Zone 2 and Zone 3 Source Protection Areas.
- In construction of new mains or storm sewer lines, continue ensuring appropriate separation distances between lines are maintained, per the Regulations of the Jericho-Underhill Water District (2002) and the Vermont Water Supply Rules.

Based on our review of J-UWD's Source Protection plan and annual consumer confidence reports, the following items may warrant further consideration:

- Consider more frequent sampling to better characterize iron and manganese concentrations in tapwater. Based on data reported on J-UWD's web site, the last iron analysis was in 2000 and the last manganese analysis was in 2003. Additional test data may enable more precise treatment for iron and manganese and assist the District in responding to customer concerns.
- Consider formalizing a contingency plan with Champlain Water District for extension of service to the Underhill Flats/Riverside area in case of extended

shutdown of the J-UWD system. If connection to CWD is a realistic possibility, it could be beneficial to obtain necessary approvals in advance.

4. STORMWATER ASSESSMENT

Stormwater is made up of water runoff from impervious surfaces, such as buildings, paved roads, sidewalks, and water that washes off of land during storm events into ditches and rivers. Stormwater can contain pathogens, trash, sediment, and various chemical compounds into our waterways. Nationally, it is a large contributor to declining water quality in lakes and rivers. We reviewed stormwater regulatory requirements as well as existing conditions of drainage pathways and infrastructure, and have made some recommendations on existing conditions and future growth. The review included site reconnaissance, stormwater permit files, meetings with the town road foremen from Jericho and Underhill, and developed a schematic of the existing drainage systems (Figure 3).

The towns of Jericho and Underhill received a waiver from the Vermont Agency of Natural Resources, Water Quality Division from the requirements of the Municipal Separate Storm Sewer System (MS4) program. The towns are therefore not required to adopt Stormwater Pollution Prevention Plans or report annually to the Water Quality Division on the stormwater management controls required of MS4 permittees. While neither community is obligated to manage stormwater specifically, stormwater is nonetheless an issue in the Underhill Flats/Riverside triangle, as it is in all developed areas.

Stone Environmental Inc. performed a reconnaissance of stormwater infrastructure around the Underhill Flats/Riverside triangle on April 29, 2005. The same morning we met with Jeff Sprout, Town of Underhill Road Foreman, and Kenny Barkyoumb, Town of Jericho Road Foreman, to discuss stormwater management in the Underhill Flats/Riverside area.

Flooding of roadways is not a problem in the Underhill Flats/Riverside triangle, according to Mr. Sprout and Mr. Barkyoumb, nor is sedimentation of catch basins and culverts considered a major problem.

Maintenance activities conducted by Jericho and Underhill include annual cleaning of catch basins. Underhill manually cleans out catch basins along Park Street once annually. Jericho typically hires a vacuum truck to clean out catch basins once annually. Clean out of Jericho's catch basins along Route 15 and River Road was scheduled for May 31. Underhill cleans out any problematic culverts in Underhill Flats in spring and fall. Street sweeping is not regularly done in the Underhill Flats/Riverside triangle. There are no ponds or other structures in the area designed specifically to control stormwater.

The Town of Jericho's subdivision regulations include provisions for minimizing stormwater impacts from new development. The regulations include erosion prevention and sediment control provisions during construction. The regulations specify that culverts and other drainage facilities be appropriately sized to accommodate the 25-year storm.

The following subsections include a discussion of the existing stormwater infrastructure, existing stormwater permits, notes from the site meetings, and conclusions and recommendations.

4.1. Existing Infrastructure

Stone identified the location of catch basins around the Underhill Flats/Riverside triangle and observed probable flow directions. We also consulted site plans of the Green Crow property to determine the location of catch basins and drain lines on the property.

Stormwater conveyances include: 1) a small storm sewer system in the area around the Park Street/Route 15 intersection that discharges west of Route 15 towards The Creek; 2) a ditch, culvert, and catch basin system along Park Street that discharges south of River Road towards the Browns River; 3) a series of catch basins and culverts, including two catch basins on the Green Crow property, draining south by the Browns River Middle School toward the Browns River; 4) a ditch, culvert, and catch basin system in the area of the Route 15/River Road intersection that drains west through a culvert under Route 15; and 5) two catch basins on the property of Big Joe's store that discharge to a grassed swale that drains west of Route 15. Figure 3 shows the location of catch basins and general runoff flow direction based on Stone's April 29 inventory and review of orthophotographs. In all there are 26 catch basins located along the triangle formed by Route 15, River Road, and Park Street.

The condition of catch basins and culverts was typical of many towns in Vermont. Most of the catch basins appeared to be functioning and the culverts were mostly free of heavy sediment accumulation. Some corrugated metal culverts were badly corroded, particularly the culvert under River Road leading from the hobby farm.

4.2. Existing Stormwater Permits

Based on a review of existing stormwater permits held by the Vermont Agency of Natural Resources, only one permit has been issued in the Underhill Flats/Riverside study area. A temporary pollution permit, number 2-1153, was issued in 1986 to Edward and Francis von Turkovich for stormwater discharges from the Roaring Brook residential subdivision off Route 15 on the northeasterly portion of the study area. The permit expired in 1988. Permit conditions for the development included:

- "Discharge of stormwater runoff to The Creek is permitted after treatment in grass lined drainage swales."
- "Catch basins, settling ponds, recharge basins or other treatment devices shall be maintained in good working order at all times and shall be cleaned quarterly and at such other times as necessary to maintain design treatment levels".
- "Paved parking lots and roads should be swept on a regular basis when seasonally practicable."

In 2003, the Stormwater Management Section of the Agency of Natural Resources granted a waiver to the development from coverage under General Permit 3-9010—"Previously Permitted Stormwater Discharges to Waters That Are Not Principally Impaired by Collected Stormwater Runoff" (Pease, 2005). The waiver was reportedly granted because the total area of impervious surfaces in the development was below 2 acres (approximately 1.3 acres) (Pease, 2005).

A brief reconnaissance by Stone Environmental in May 2005 in the Roaring Brook development revealed no major erosion problems. Stormwater is conveyed from the development in drainage swales that support wetland vegetation.

4.3. Study Area Reconnaissance

A study area review was conducted on April 29, 2005. Determining which conditions constitute a problem needing remedy and which do not is a matter of opinion, but Stone noted several conditions on April 29, 2005 we believe warrant repair. Between the April 29 reconnaissance and submission of this report, some of these conditions may have been addressed. Problems identified are:

1. The catch basin next to gasoline pumps at Big John's Riverside Store on Route 15 receives contaminated runoff from small fuel and oil spills. In the event of a larger spill, gasoline could flow directly to this catch basin. Contaminated runoff is conveyed directly to the environment via a culvert and ditch.

Possible solutions could be to install an awning over the fueling area and relocate the problem catch basin. A treatment unit such as an oil/grit separator may also be considered for this location.

2. The outfall of the 24-inch diameter corrugated plastic pipe under River Road discharging to the Browns River Middle School property was not properly constructed and is being undermined. A concrete headwall should be considered for this location. The bank adjacent to the outfall is eroding badly. Silt fence was improperly placed in a downslope orientation here, which is channeling runoff and forming a gully on the upslope side; silt fence is designed to be used parallel to ground surface contours. Seed and mulch should be applied. Drainage from the adjacent sidewalk should be directed away from the exposed bank until the bank is stabilized to minimize further erosion.
3. Next to the redesigned intersection of Dickinson Road and River Road is a depression approximately five feet deep that is drained by a culvert under Dickinson Road. This depression is a safety hazard to vehicles traveling around the curve on River Road. Consideration should be given to bringing this depression up to grade and installing a catch basin instead.
4. The culvert under River Road draining the hobby farm property is badly corroded, as discussed above. A more pressing problem, however is that the culvert drains runoff from a large pile of horse manure located within feet of its entrance, clearly a potential source of water quality impairment. A possible solution would be to work with the property owner to relocate the manure pile to the back of the property and to cover it.
5. The corrugated steel arch under Harvest Run Road at the Park Street intersection may be undersized. It receives stream flow from the slope to the northeast and stormwater runoff from Park Street. Tire tracks into the open ditch at the downstream end of the pipe arch suggest that a vehicle recently drove into the ditch. Consider reconfiguring this intersection as a safety precaution.
6. A catch basin grate on the west side of Route 15 across from the pocket park with the fountain is plugged with sediment and debris. Consider cleaning the grate and seeding and mulching any exposed soils in the vicinity.
7. The erosion control matting placed along the sidewalk on Park Street near the intersection of River Road and at the reconstructed intersection of River Road and Route 15 was not properly installed. It has largely blown off, leaving bare soil exposed. Areas of bare soil in these locations should be seeded and mulched as soon as practicable.

4.4. New Development and Redevelopment of the Study Area Properties

New development and redevelopment of properties in the Village area presents an opportunity to implement stormwater control practices that infiltrate stormwater into the soil. Traditional practices of capturing runoff from impervious areas and conveying it untreated to water bodies has resulted in water quality impairment in many Vermont streams and countless streams and lakes nationwide.

The areas where well-drained sandy soils exist, which is most of the village triangle area, present an excellent opportunity to minimize or eliminate runoff of stormwater leaving the sites because of the level slopes and the soils are relatively coarse textured. The triangle area is mapped as Stetson gravelly fine sandy loam—0-5 percent slopes, which is described as a deep soil that is moderately rapidly permeable in the upper part and very rapidly permeable in the lower part of the soil (USDA-SCS, 1989). Permeability is between 2.0 and 6.3 inches per hour in the upper approximately 8 inches and greater than 6.3 inches per hour in the lower part. These characteristics indicate the soil has a high capacity to infiltrate water: open, vegetated areas should produce little runoff. Stone believes that a carefully planned residential development of the area could actually reduce stormwater runoff over the existing condition.

Design considerations, many of which can be incorporated into the towns' zoning and subdivision and roadway regulations, include:

- Minimize creation of impervious surfaces by limiting roadway width and clustering buildings while maintaining open, vegetated space in remaining areas. Consider using permeable pavement, unit pavers, and other semi-permeable materials in parking areas.
- Direct concentrated runoff from interior roads and parking areas to infiltration trenches or infiltration basins. Some pretreatment of runoff in a sedimentation basin, sump pit, grass channel, or manufactured treatment unit is necessary.
- Direct roof runoff to dry wells or infiltration basins.
- Collect a portion of roof runoff in cisterns for use in landscape irrigation.
- Create concave landscaped areas along streets, parking lots, and cul-de-sacs such that road runoff drains into grass swales or other depressions, where it may infiltrate the soil. If permissible, do not install curbing. If curbing is necessary, create appropriately spaced curb cuts with rock aprons (swale inlets) to direct runoff to landscaped areas.

4.5. Conclusions and Recommendations

There are no major stormwater problems in the Underhill Flats/Riverside area. The relatively minor problems noted in reconnaissance of the area may be easily remedied. The stormwater drainage system is regularly, though not frequently, maintained. Overall, a greater attention to erosion prevention is warranted. New developments and redevelopment of properties such as the Green Crow property present an opportunity to implement innovative stormwater practices that have the goal of infiltrating water onsite rather than conveying untreated runoff to surface waters.

5. TRANSPORTATION ASSESSMENT

Transportation issues include existing and future road networks, traffic patterns, speed and volume issues, and pedestrian and bicycle issues. Issues in the Underhill Flats/Riverside area have been well documented and studied along the Route 15 corridor. Corridor studies for both the broader Route 15 area and the Jericho specific section have been evaluated. Analyses have been performed for both River Road and Park Street, with intersection realignments and pedestrian infrastructure added as a result of these efforts. Many public discussions have occurred to gain important insight from residents as to their views on what the problems are and what solutions may be acceptable locally. In short, the Underhill Flats/Riverside Village area does not lack for transportation information.

To build on past efforts, this section of the report provides updated information and offers a fresh perspective on the options evaluated and additional ideas to consider. We also provide recommendations for next steps for these options.

The transportation network of Underhill Flats/Riverside is most easily characterized by the triangle road grid that Vermont Route 15, River Road, and Park Street create. Dickinson Road Runs southerly one way from Route 15 to Park Street, creating a small triangle out of the larger. Outside of the triangle area, the village seems to be naturally bounded along Route 15 by the Browns River to the southwest and The Creek and Roaring Brook to the north. On River Road, the natural transition to the village occurs on the curve in the road immediately to the east of the intersection of River Road and Park Street.

Route 15 is a State Highway and, as such, is maintained under the jurisdiction of the State of Vermont. River Road, Park Street and Dickinson Road are Class 2 highways and are maintained by the towns they are located in. Route 15 is considered to be a minor arterial; River Road a major collector; and all others are of lesser classification. The status of Route 15 as both a State Highway and a minor arterial means that the local towns have less control over decisions regarding how to potentially reconfigure this road and require that various State level policies be followed. For example, traffic calming on Route 15 would require compliance with the State's Traffic Calming Approval Process, where on River Road or Park Street, the Towns could set the decision making process. Similarly, choices to consider limiting or not allowing truck traffic on Route 15 are not available for discussion, though they may be on River Road or Park Street. This is offered simply to be clear about jurisdiction and not to suggest that nothing may occur on Route 15. Lastly, none of the intersections in the study area are designated as a "High Accident Location" by the State of Vermont. This does not mean no accidents occur. Rather, it means there are many intersections in Vermont with a worse record of performance for accidents than those in the study area.

In a small study area, the transportation issues are simple to find. For this project, we reviewed available previous studies, spoke with residents and the local highway foremen from Jericho and Underhill, and spent time observing the system in the field. No traffic data was generated for this effort beyond visual observation.

Clearly the largest and potentially most dangerous situation in the study area is the intersection of Route 15 and River Road. Though recently realigned to form a T-Intersection, the sight distance for a left hand turn out of River Road can be challenging at times when coupled with high speeds moving southwest on Route 15. Further, significant local traffic patterns, related to both the commute to work and the location of the Browns River Middle School, place a heavy burden on this intersection, particularly during the morning rush hour.

Dickinson Road was recently realigned to run one way from Route 15 to River Road, with a newly configured intersection at River Road. This apparently was done to provide an alternative route to the School to direct some traffic away from the aforementioned intersection. However, the turn on Route 15 is not marked. Further, the location of the intersection of Dickinson Road and Route 15 is fairly close to the crest of the hill to the southwest on Route 15. This situation provides sight distance challenges for a left turn onto Dickinson if oncoming traffic from Route 15 is speeding, which seems commonplace along all of Route 15.

Speeds throughout the study area appear to be quite high as compared to the posted speed limits. While the village enjoys a higher density of buildings that should act as a visual sign to drivers to slow down, it is not enough. Other infrastructure, such as sidewalks, gateways, and storefronts are missing to add to the information a driver uses to decide whether to slow down in the absence of police patrols.

Sidewalk infrastructure exists on one side of both Park Street and River Road, all appearing to be very recent. On River Road, future connection locations have been left for connection to the school and to the Green Crow Lumber Yard. A sidewalk on one side of Route 15 is currently under construction. In the past, the pedestrians visually observed along Route 15 were walking on the edge or very near the edge of the road surface.

It is not clear if the two towns have identified their preferred method of serving bicyclists. Two basic options exist that are considered by most communities – share the road (either with or without painted lanes), or separate paths (either exclusive or shared with pedestrians).

The Green Crow Lumber Yard and other properties will likely be developed at some future date. The type of development and the standards it is developed under has the potential to improve, keep static, or impair traffic flow through Underhill Flats/Riverside.

5.1. Potential Options for Intersection Improvement

The intersection of River Road and Route 15 will continue to be the single largest danger and constriction in the Village until additional actions are taken. Four options appear to exist for this intersection as follows:

- Do nothing
- Institute morning peak uniformed traffic control (short to medium term)
- Install a Roundabout
- Install a traffic signal

Of these options, one does not seem to provide needed relief (do nothing), a second may be a viable means to buy the community more time to fairly consider options and line up funding (uniformed traffic control), and two are competing infrastructure methods for improving intersections performance.

Do Nothing Option

Doing nothing should always be considered in a fair evaluation of options. In this case, it is known that volumes exceed this intersection's ability to allow for good traffic flow and some accidents are occurring.

Traffic Officer Option

The single largest problem with the intersection occurs in the morning peak traffic rush as drivers hurry to work and drop off children at school. The afternoon peak is also somewhat troublesome, but by most measures and accounts, not as serious. In many communities, uniformed traffic control officers are stationed as a temporary measure to remove the bottleneck and assure safe passage of vehicles and pedestrians. Putting real people in the intersection for an hour or so a day, five days a week, can amount to the expenditure of real money. Thus, local discussion of how serious the concern is, is necessary before implanting such a measure. In some cases, communities have instituted such a measure for years, bridging a problem until funding or support builds to the point of building an infrastructure based solution.

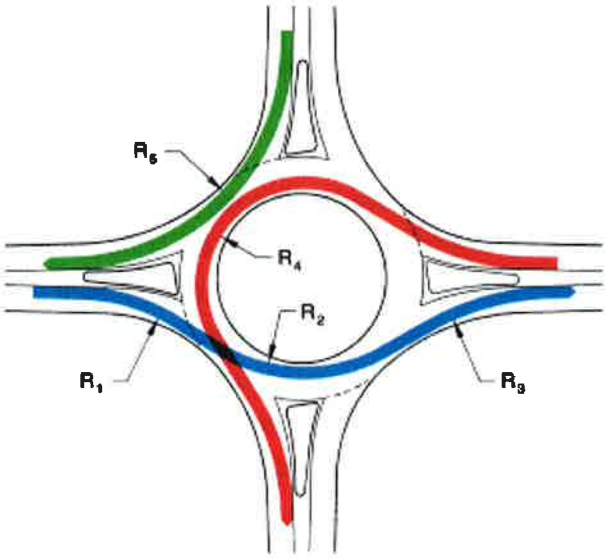
Traffic Signal Option

The choice between a traffic signal and a roundabout will build from among a few issues. Cost of each solution, land acquisition requirements for each solution, local acceptability of each, and the ability to serve the transportation needs with each option. In this case, each could likely meet the needs and function adequately.

Signals are more comfortable for drivers in Vermont since we are simply used to them. They can be less efficient in non-peak times, generally have a higher incidence of "fender bender" type accidents, and, represent a poorer energy policy choice, since red lights require loss of momentum and idling. During times of real need they move cars efficiently and can be programmed to meet most needs. It is likely that some small amounts of land acquisition and/or easements would be required to install a signal.

Roundabout Option

Roundabouts can be very efficient in moving vehicles and represent an emerging intersection across Vermont and the United States. For a highway like Route 15 they require some significant space and thus, would likely require important land acquisition as part of any project. This is particularly true in light of the layout of this intersection.



For roundabouts to function properly, all drivers must be required by infrastructure that makes them slow down significantly. Thus, the roundabout cannot be offset allowing any one lane of traffic to "slip" through at high speeds. To avoid this for the Route 15 driver moving to the southwest seems to be quite a challenge.

It appears that Underhill Flats/Riverside residents have expressed a preference to using a roundabout at this location. Pre-scoping work to determine the extent of land acquisition necessary to accommodate a fully functional roundabout would seem the next obvious step in this process. If there is less of a local preference than we understand, then both the signal and roundabout should be evaluated for fit and cost to provide the best information possible to leaders and residents. In each case, the necessity of addressing the large curb cut for the Big John's Riverside Store is a vital component of the evaluation. Neither a signal nor a roundabout will function well under the current condition.

Dickinson Road could also be used to move part of the incoming traffic to the School off of Route 15 prior to the intersection of Route 15 and River Road. If that were desirable locally, a sign indicating that Dickinson Road is a route to the school would provide the information necessary for some drivers to take that route.

In the future, the intersection location of Dickinson Road and Route 15 should be reevaluated. Lining it up approximately with Raceway Road would provide a couple of advantages. First, it would improve sight distances on Route 15 coming up the hill from the southwest. Second, should redevelopment of Green Crow Lumber generate significant traffic, a realigned intersection would better serve the development and accommodate either a traffic signal or a roundabout, should traffic volumes ever require such infrastructure.

5.2. Other Options for Improvements

Speed Reduction

Speeds appear quite high, particularly along Route 15 and River Road. The most common solution is to send out police cruisers and issue tickets. Unless very frequently performed, this activity tends to have only short-term impacts. However, if done sustainably, drivers do come to know they must slow down.

Village Gateways

Some communities are now using gateways and traffic calming techniques to slow traffic through design, rather than through enforcement. Gateways are constructed at natural entrance points to the village.

Whether signs, banners, lighting, textured pavement, or some combination of all of these, gateways tell the driver "You are now in a different place – it's time to slow down". A gateway won't work if it is too far out of the village. It needs to be at the edge of or very near to the edge of density and other infrastructure. The gateway, then, becomes the means of getting the drivers attentions for the first time, with the density, sidewalks, traffic calming, and other activity keeping their attention.

In Underhill Flats/Riverside, the bridges crossing the Creek and Browns River on Route 15 are appropriate locations for gateways, while the curve on River Road before the intersection with Park Street would also provide a suitable location.

Traffic Calming

Traffic calming devices can be rather innocuous or rather severe. Simple techniques such as changing the pavement texture occasionally, perhaps for a cross walk, or creating a speed hump that rises and falls 4 - 6 inches over 20 – 30 feet can easily keep drivers' attention and force speeds to slow. More severe approaches such as chicanes where the road begins to weave within the right of way seem out of place in Underhill Villages existing road network, though such strategies may fit in nicely with future development plans at Green Crow Lumber or other sites.

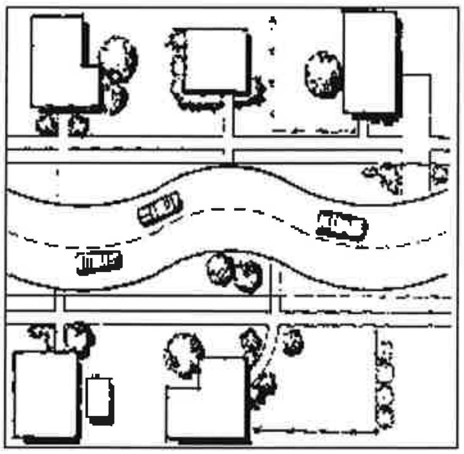
Sidewalks and Crosswalks

Sidewalks on Route 15 are necessary on each side of the street. This is an important design consideration for a minor arterial through a village area. The sidewalks should be connected with appropriately located crosswalks. This combination of sidewalks and crosswalks provides safety for pedestrians on what is an important road moving goods and services and again provides important stimulus to drivers to slow down. Finally, they simply make a village look more like a village aesthetically.

Construction Standards and Policies

The final area for options is standards and policy. As noted previously, the communities should decide, if they have not already, how they would best accommodate bicyclists. While not many exist today, it is important to think such decisions through as all of the other changes contemplated here are evaluated. Each choice has an impact on the typical cross section of the road. If you want painted lanes for bikes, you need wider overall pavement than if you share the road with out painted lanes. This impacts the location of the sidewalks and other infrastructure.

The towns could also reconsider their standards for new development roads within the Village. Most communities require minimum width streets and encourage curbs. Relatively flat, straight, and wide streets are primary causes of higher speeds. Traffic calming principles suggest that for new development, setting maximum widths and not allowing them to be so straight would be beneficial. In today's stormwater permitting environment in Vermont, this new model of road construction is less expensive, creates less stormwater to handle, leaves more land to develop, and is more aesthetically pleasing for buyers, ultimately creating additional grand list value. Eliminating curbs as an option allows for recessed islands instead of raised islands, providing important stormwater treatment, either through simple detention, partial infiltration, or biological uptake.



5.3. Recommendations and Next Steps

Decision making about the future of the intersection of Route 15 and River Road is the most important priority for the transportation system in Underhill Flats. The communities should consider either moving a roundabout ahead for pre-scoping or request an evaluation of both a signal and a roundabout be performed.

Speed appears to be the next most important issue. Beginning the process of determining local acceptability of gateways, traffic calming, and/or police enforcement is the essential next step. In communities where gateways and calming have been simply installed, resident resentment and occasional backlash is common. Successful implementation of these techniques requires a commitment to work with and accept the will of the residents who will live in the new setting.

Following basic decisions on the viability of such techniques, scoping which techniques can be installed on Route 15 under the states rules will become important.

Progress on sidewalk installation is a continuing priority. This action appears on track, so vigilance appears to be the only action required.

Modifications to Dickinson Road and issues related to street standards are linked more to future development than existing challenges. Should these issues resonate with the community, then planning activities should begin soon, for as every community has experienced at least once, you can't change the standards after the application comes in the door.

To implement transportation initiatives requires significant funding. Underhill and Jericho have been somewhat successful in attracting funding, the new sidewalks and intersection modification for instance. Continuing to stay abreast of various funding opportunities with VTrans, the Agency of Commerce and Community Development, and other funding agencies should be permanently on the to do list. Considering filing an application for designation as a village under the downtown program may create certain benefits for the Village as well and should be explored.

6. HAZARDOUS SITES ASSESSMENT

A modified Phase I Environmental Site Assessment (ESA) was completed to assess the environmental condition of the Underhill Flats/Riverside village area, specifically the area confined by Vermont Route 15, Park Street, and Riverside Road (the Village Triangle) and the area within an approximate 2-mile radius. The procedure consists of identifying, to the extent feasible pursuant to the American Society for Testing Materials (ASTM) Standard E 1527-00, visual and documented recognized evidence of an existing release, past release, or material threat of future releases of hazardous substances and/or petroleum products at or in the immediate vicinity of the study area.

6.1. Description of Approach

Stone Environmental, Inc. (Stone) performed the following activities in accordance with the guidelines set forth in the American Society for Testing and Materials Standard E 1527-00 (Standard practices for Environmental Site Assessments: Phase 1 Environmental Site Assessment Process) and in the spirit of the "All Appropriate Inquiry" standard recently proposed by US EPA:

- Interview with Mr. Nick Brunet (owner representative) and Mr. David Villeneuve, on May 23, 2005 conducted by Daniel Voisin of Stone.
- Interview with Mr. Gerald Adams (former employee of the lumber yard prior to Green Crow and town planning commissioner) on June 3, 2005 by Daniel Voisin of Stone.
- Windshield survey of study area conducted by Glenn Schellinger of Stone on May 18, 2005
- Review of topographic maps of the subject site (See Appendix 2—Maps, Figures, and Photograph Documentation)
- Review of EDR database of government records, which cover state and federal listed sites present within a given radii (See Appendix 3—EDR Environmental Records Database Search Results).

Limitations and Exceptions

This report was prepared for the exclusive use of the Village Task Force of Underhill and Jericho (the Client) and cannot be reproduced or disseminated without the written approval of Stone or the Client. Stone retained a copy of this report. No additions or deletions are authorized without the written consent of Stone. Use of this report in whole or in part by parties other than the Client is prohibited.

Limiting Conditions and Methodology Used

Stone summarized the available information but takes no responsibility for the accuracy of the information gathered from written records or interviews. Asbestos, radon, and lead inspections were not within the scope of this assessment. Stone renders no opinion as to the presence of oil and/or hazardous materials located at inaccessible and/or non-inspected portions of the study area.

6.2. Records Review

A review was conducted of federal and state databases. Following are two tables summarizing the results of the database searches.

Table 1: Summary of State and Federal database review results that have E911 addresses

Site	Database/Description	Direction	Distance (feet)	Relative Elevation to Green Crow	Status
Greenia residence	Fuel Spill	NNE	769	Lower	Spill cleaned and site closed
First Step Print Shop	RCRA-SQG	N	1003	Higher	Permitted facility, no violations
United Church of Underhill	Pulled UST, contamination found	N	1224	Higher	Sites Management Activity Closed (SMAC)
Anestopoulos Residence	FINDS, complaint filed for burning pressure treated wood	NW	1345	Lower	Occurred in 2002, no further action
Nadeau residence	Pulled UST, contamination found	NW	1542	Lower	SMAC
Gile residence	Pulled UST	WSW	2199	Lower	Tank pulled without incident
Allen residence	Pulled UST	WSW	5250	Lower	Tank pulled without incident
Jericho Service Center	RCRA-SQG	SSE	5803	Higher	Permitted facility, no violations
Dr. Paul Dunkling, DDS	RCRA-SQG	WSW	7477	Lower	Permitted facility, no violations
Mt. Mansfield Animal Hospital	RCRA-SQG	SW	7685	Lower	Permitted facility, no violations
Gustaven residence	Pulled UST (2)	NNE	7728	Higher	Tanks pulled without incident

206 River Road	FINDS, Downed transformer	ESE	9074	Higher	Spill cleaned and site closed
26 Pinehurst	VT SPILLS, Fuel spill	WSW	9343	Lower	Spill cleaned and site closed

6.2.1 Federal Environmental Record Sources

The review of federal, state and local databases is based on an accurate, geographical location of site and each listing. If a listing within the database does have a mapable address, they are considered an "orphan site". Field staff are then required to locate the site and confirm its location relative the site (Table 2).

Table 2: Summary of Orphaned Sites whose locations were verified via field "windshield survey"

Site Name	List	Town
Wheeler Residence	UST	Underhill
United Church of Underhill	UST	Underhill
Browns River School	FTTS INSP	Jericho
Greenmont Lumberyard	RCRA-SQG, FINDS	Jericho
Ferrell Chiropractic	RCRA-SQG	Underhill
Nadeau Residence	UST	Underhill
Big John's Riverside Store	UST, RCRA-SQG, FINDS, LUST	Jericho
Clark's Truck Center	UST, LUST, RCRA-SQG, FINDS	Jericho
Jeri-Hill Hardware	UST	Jericho
Village Service and Auto Repair	UST	Underhill
Merchants Bank	LUST	Jericho
Breault Residence	UST	Jericho
Bergendahl Residence	UST	Jericho

6.2.2 National Priorities List Sites

A review of the National Priorities List (NPL) database determined that there are no listings within the study area.

6.2.2.1 CERCLA (Active and NFRAP Archive) Sites

A review of the Active and NFRAP Archive Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) database determined that there are no listings within the study area.

6.2.2.2 RCRA (TSD and Generator) Facilities

A review of the Resource Conservation and Recovery Information System (RCRIS) database determined that there two RCRA Small Quantity Generators within the Study Area. These sites are Dr. Paul Dunkling (7477 feet to the WSW) and Mt. Mansfield Animal Hospital (7685 feet to the SW). Both of these sites are permitted facilities without violations.

6.2.2.3 Emergency Response Notification System Sites

A review of the database determined that the site is not listed as an Emergency Response Notification System (ERNS) site.

6.3 State Environmental Record Sources

6.3.1 State Listed Hazardous Waste Sites

A review of the Vermont Hazardous Sites List (HSL) database determined that there are three state-listed hazardous waste sites within the Study Area. Summaries for each of these sites (Big John's Riverside Store, Clark's Truck Center, and Village Service and Auto Repair) can be found below.

Big John's Riverside Store: In September of 1995, five USTs were removed from the site. At the time of the excavation, extensive contamination was detected within the UST graves and free product within 2 onsite monitoring wells. 230 yards of soil were polyencapsulated and stockpiled onsite behind the convenience store. Follow-up investigations resulted in finding dissolved phase contamination downgradient of the site (south). The site is currently undergoing periodic groundwater monitoring with the next round due in the Fall of 2005.

Clark's Truck Center: In November of 1999, three USTs were removed from the site (1, 3000-gallon diesel; 1, 1000-gallon gasoline; 1, 1000-gallon waste oil). Upon excavation, contamination was found in soils surrounding the former USTs. Follow up investigation has not been conducted since removal of the USTs. The State of Vermont Sites

Management Section (SMS) has required that an investigation be performed that does the following:

1) Define degree and extent of contamination in soil
2) Determine if airspace within adjacent buildings has been impacted via field screening with PID and confirm by sampling and analysis by EPA TO-2
3) Determine degree and extent of contamination, if any, in groundwater
4) Assess potential impact to sensitive receptors
5) Establish need for long-term remediation and/or monitoring
6) Summarize findings in a report to the SMS.

Village Service and Auto Repair: In 1997, a 4,000-gallon gasoline UST was pulled from the site. Contamination was found in soils below piping for the tank. Extent of this contamination was not defined at the time of the excavation. Follow up work was never performed. The SMS has required that an investigation be performed with the same objectives listed above.

Three sites that are no longer active (have been given a SMAC designation) can be found within the Study Area. These sites are the United Church of Underhill, the Nadeau residence, and the former Greenmont Lumber site. Due to the proximity of the Greenmont Lumberyard to the center of the Study Area, a summary of its environmental site activity is found below.

Greenmont Lumber: In September of 1990, 6 tanks were removed from the site. Low levels of soils contamination were observed during the tank pull. Results from follow-up groundwater sampling indicated no evidence of petroleum contamination. Following the follow-up investigation results, SMS assigned a SMAC designation to the site. It is important to note that a SMAC designation does not release the owner (now Green Crow) from any past or future liability which may arise from the petroleum contamination which originated from the leaking UST. The closure does, however, mean that the DEC isn't requiring any additional work be performed at this site in response to the September tank removal.

6.3.2 Registered Underground Storage Tanks (USTs) and Pulled USTs

Ten registered UST sites were found within the Study Area as summarized in Tables 1 and 2. Registered UST sites also include some sites where the tanks have been pulled but the database has not been updated.

6.3.3 *Solid Waste Facilities/Landfills*

A review of the Vermont Solid Waste Facilities database determined that there are no active solid waste and/or landfills within the Study Area.

6.4 Information from Site Reconnaissance and Interviews on Green Crow Property

Stone personnel conducted interviews with the owner representative Nick Brunet, property manager David Villeneaux, and former employee of the lumberyard and current planning commissioner Gerald Adams. Test pits conducted during an onsite feasibility study by T&M Associates in 2001 indicate that the Green Crow property is underlain by silty, gravelly sand.

6.4.1 *Evidence of Hazardous Substances/Potential for Release*

A site walkover was not performed on the Green Crow property, therefore Stone can not offer observations based on site reconnaissance. Conversation with Mr. Gerald Adams suggested that work practices at Green Crow have not directly led to release of contamination. Mr. Adams reports that logging trucks would unload and load logs on the gravel parking area on the site. Leaks from vehicles would generally migrate uninhibited to the subsurface.

The lumberyard utilized a drywell located in a central low area of the site to receive surface runoff to be recycled for watering logs during the summer months. Theoretically, this drywell could receive contaminated runoff from the load/unload lots and redistribute the contaminant mass across the site.

6.4.2 *Underground Storage Tanks*

There are known, in use USTs on the Green Crow property. Review of the Phase I ESA previously conducted on the Green Crow site and interview with Mr. Adams has revealed that there have been past releases from previously onsite USTs. Condition of t he current tanks is unknown. The extent of contamination at the site (either in soil or in groundwater) was not divulged to Stone by Mr. Brunet.

The lumberyard has two, high-volume (>100 gpm) water supply wells to use for watering its logs during the summer months. Due to the coarse nature of soils at the site and the high hydraulic conductivity (as evidenced by the well pump rate) and the sheer volume that was pumped from the overburden aquifer, it is possible for migration of contamination from discovered releases to migrate to the water supply wells onsite and then further transported by the sprinkler system onsite.

6.4.3 Indications of Polychlorinated Biphenyls (PCBs)

During the course of interviews and review of available data, there is no indication of the use or presence of PCBs within the study area.

6.4.4 Indications of Solid Waste Disposal

The interview with the owner representative indicates that instances of past and present disposal of solid waste have not occurred at the site.

6.4.5 Physical Setting Analysis of Migrating Hazardous Substances

For a description of migration pathways at the Green Crow property, please refer to Sections 6.1 and 6.2. There are three sites within the Study Area that either have known offsite migration of contaminants or are un-characterized. The first site, Big John's Riverside Store, is well defined with contamination migrating offsite to the south of the site. The second two sites (Village Service and Auto Repair and Clarks Truck Center) are un-characterized. Village Service and Auto Repair lies relatively distant (three quarters of a mile north) away from the center of the Study Area, but at a higher elevation. The degree and extent of contamination must be established at this site prior to evaluating the likelihood for migration to the Village Center area. Clarks Truck Center, lies approximately 0.8 miles southeast of the site and at a lower elevation. Migration of contaminants to the Village Center is unlikely, despite the site's lack of characterization.

6.5 Findings and Conclusions

Based on an interview with the Town of Underhill planning commissioner and a review of all appropriate databases and reports, Stone has identified three State-listed hazardous waste sites within the Study Area. Offsite migration of contaminants is known to occur at one of these sites, but has not adversely affected sensitive receptors. As the other two sites have not had follow-up site investigations, it cannot be ascertained whether contaminants from these sites has adversely affected sensitive receptors.

From interviews with the land owner representative and a former employee, and review of a previously conducted Phase I ESA, Stone has gleaned that there is known onsite contamination from now-removed USTs at the Green Crow site. The degree and extent of contamination is uncertain. In addition, there is a possible pathway for these contaminants to migrate to a broader area via the onsite log sprinkling system.

Stone recommends investigation to define the degree and extent of contamination resulting from leaking USTs at the Green Crow site prior to utilizing the existing onsite water supply wells. This investigation should include borings in the UST grave area to assess impacted soil with subsequent installation of monitoring wells to assess impact to groundwater. If contamination were found to exist in this source area, further investigation of the log yard would be warranted.

Several avenues for securing funds for assessment of contaminated or suspected contaminated properties (Brownfield properties) exist through either the State of Vermont of US EPA. To help facilitate the redevelopment of Brownfields, the Vermont DEC, Brownfield Program is seeking applicants for grant monies to be used for site assessment purposes. Information regarding the protocol for applying for the Targeted Brownfield Assessment grant can be found in Attachment 2. The actual application for the grant can be found in Attachment 3. For additional clarification on the Vermont Brownfield Program, Hugo Martinez Cazon of the Vermont DEC, Brownfield Program can be contacted at (802) 241-3892, hugo.martinezcazon@anr.state.vt.us.

Another possibility available to the Village Task Force for securing Brownfield Assessment funds is to apply directly with the US EPA Brownfield for Targeted Brownfield funding. The following link has information on the US EPA Region 1 Targeted Brownfield Assessment Grant program.
http://www.epa.gov/region01/brownfields/programs/targeted.htm.

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APPENDIX A: THE BASICS OF ONSITE WASTEWATER TREATMENT AND DISPOSAL

Decentralized water supply and wastewater treatment and disposal technology choices can have a significant impact on protecting water supplies and surface waters, meeting development density goals, and preserving traditional New England village land use patterns. These onsite and clustered systems can be protective of public health, drinking water supplies, and the quality of water resources if they are properly planned, installed, operated, and maintained. When they are managed properly, these systems can also protect property values, preserve tax bases, result in life-cycle cost savings, and further goals of intelligent development and land use. Current state regulations, recent technology improvements (including management system technologies for smaller systems), and new management models give communities more options for meeting public health, environmental, and land use planning goals. The following sections explain how septic systems function, what land characteristics and soil conditions are needed for proper treatment performance, and what types of impacts systems can have on the environment.

Typical Components in an Individual Septic System

A typical system contains two major components: a septic tank and a disposal field. The septic tank is a watertight structure that allows solids to settle to the bottom. Scum and oils rise to the top of the tank, and are kept from leaving the tank by baffles. Relatively clear effluent leaves the septic tank. Newer tanks include access risers to the ground surface for easy access and maintenance and an effluent filter at the tank outlet that keeps solids from leaving the tank and clogging the disposal field. The septic tank provides primary treatment of the sewage and is a vitally important part of the entire system. Older tanks may leak and may eventually collapse. The baffles in older tanks may also deteriorate, allowing scum, oils, or solids to escape into the disposal field.

The disposal field is designed to maintain unsaturated soil conditions below the disposal field provides both physical and biochemical treatment of wastewater effluent. As the effluent moves through the soil, solids and microbes are physically filtered out of the wastewater. Treatment processes that occur in the unsaturated soils between the disposal field and groundwater, impervious soils, and bedrock significantly reduce pathogen levels, but can have a varying impact on nitrogen and phosphorus concentrations.

Septic System Treatment Performance

Much of the treatment in the disposal field occurs at the interface between the media (i.e., stone) and the undisturbed soil, where a chemical and biological layer known as a biomat forms. This biomat is often less permeable than the surrounding soils, and system design standards take into effect the long-term acceptance rate of this mat. Highly permeable soils with deeply placed disposal systems may not develop biomats, and thus may contribute more nitrogen and phosphorus to nearby groundwater or surface waters than shallow-placed systems on finer textured soils.

Soil can provide treatment of effluent through a series of physical, chemical and biological processes. However, some of the nutrients (such as nitrate) are capable of moving through the soil into the groundwater (and surface waters). Nitrogen can undergo several transformations in and below the disposal field. Nitrification, the conversion of ammonium nitrogen to nitrite and then nitrate by bacteria is the predominant transformation. However, if there is inadequate separation to seasonal groundwater, this conversion may not occur.

Although traditional onsite septic systems can treat many of the constituents present in residential wastewater, septic systems can still have public health impacts and ecological impacts. Domestic sewage contains high concentrations of Total Suspended Solids (TSS), 5-Day Biochemical Oxygen Demand (BOD_5), pathogens, ammonium nitrogen, total nitrogen, and total phosphorus, as well as varying amounts of heavy metals, organic compounds, pharmaceuticals, and other potentially hazardous materials. A properly installed and operated onsite system can treat many of the constituents present in residential wastewater. Standard and properly installed onsite systems that protect public health may not, however, protect drinking water supplies, recreational waters, or aquatic habitats from the nutrient loading that onsite systems can add to local waters.

In addition to the effects of septic systems on local drinking water supplies, an overabundance of nutrients from human sources in surface waters can lead to the excessive growth of algae and other nuisance aquatic plants—a process known as cultural eutrophication. Freshwater lakes, rivers, and ponds can be particularly impacted by phosphorus from onsite system effluent.

Other wastewater constituents that can cause problems in drinking water and surface waters include the following:

- Toxic organic compounds in household chemicals can be persistent in groundwater and cause damage to surface water ecosystems and human health;
- Heavy metals like lead and mercury in drinking water can cause human health problems, and when in aquatic environments they can accumulate in fish and shellfish;
- Dissolved inorganic compounds like chloride and sulfide can cause taste and odor problems in drinking water; and
- Pharmaceuticals can be persistent in groundwater and recent studies are evaluating their potential impact on drinking water and surface waters.

Failing and Substandard Systems

Septic systems are called "non-point" sources of pollution, and they are considered nationally to be the third most common source of groundwater contamination. Many older systems were installed before people understood how onsite systems functioned and what soil and site requirements were needed for best system performance. These older systems may still "function" in the sense that they are not backing up into the plumbing or surfacing in the yard, but they do not always function properly in terms of treating the wastewater before it reaches groundwater or surface water. Many existing rural villages may not have adequate soils and site conditions to upgrade older systems so that they treat wastewater properly. When New England's villages were planned in the 18th and 19th centuries, sewage disposal, as we understand it today was not considered.

Improperly designed or constructed systems, where the disposal field is too close to groundwater, can impact groundwater through the release of pathogens, nitrate, and other contaminants. Cesspools are no longer allowed in Vermont because they do not provide adequate treatment, but they may still exist, particularly on older lots. Cesspools are also typically undersized and can be deep in the soil profile, requiring additional separation to seasonal groundwater tables, impervious soils, and bedrock.

Modern septic systems, even those that are sited and installed properly, can still fail if they are not maintained. Conditions that can cause the soil to provide poor treatment primarily involve hydraulic or organic overloading of the disposal field. This overloading is most commonly caused by failure to maintain the septic tank. If the disposal field receives wastewater effluent faster than the soil can assimilate it, contaminants can travel through the soil to groundwater without receiving adequate treatment.

Impacts on Land Use, Environmental Sensitivities

Preserving compact village development patterns while also protecting public health and water quality by improving septic systems is a delicate balance. Both in small villages and in more rural areas, the use of septic systems for wastewater disposal creates important concerns regarding nutrient and bacterial loadings, particularly near or over important water resources, aquifers, and recreational waters. The most common environmental and public health impacts attributed to septic systems are impacts from the pathogens and nutrients that can be present in wastewater effluent.

Potential impacts on surface waters that are used for bathing and recreation are typically monitored and swimming areas can be closed if indicator pathogens, such as *Enterococcus* or *E. coli*, are reported in high numbers. However, it is widely recognized that these bacteria indicate only the presence of fecal material; thus, the presence of indicator bacteria does not always mean that nearby septic systems are not performing properly. In recent years, new methods for monitoring pathogens near recreation areas have been developed. Microbial source typing, for instance, attempts to identify the type of animal that was the source for a certain bacteria.

An overabundance of nutrients from human sources in surface waters can lead to the excessive growth of algae and other nuisance aquatic plans—a process known as cultural eutrophication. Freshwater lakes and ponds can be impacted by phosphorus from septic system effluent. Since the Village's surface waters all eventually discharge to Lake Champlain, they may contribute to the cumulative impact of high nutrient and pathogen amounts.