STONE ENVIRONMENTAL
535 Stone Cutters Way / Montpelier / VT / 05602 / USA
802.229.4541 / info@stone-env.com / www.stone-env.com

October 5, 2015

Westford Planning Commission
Attn: Melissa Manka, Planning Coordinator
Westford Town Office
1713 VT Route 128
Westford, Vermont 05494

Stone Project No. 13-224
Subject: Site Investigation, Capacity, and Preliminary Cost Estimates for a Shared Wastewater System at the Jackson Farm Property, Westford, Vermont

Dear Melissa,

Stone and Green Mountain Engineering are pleased to provide the results of field and desktop analysis of the potential onsite wastewater treatment capacity of two land areas on the Jackson Farm at 123 Brookside Road, near Westford's Town Common, as well as preliminary system layouts and project cost estimates to construct a community system on one of the identified land areas. This work was completed to support the Westford Planning Commission's continued exploration of ways to build capacity to accommodate focused and appropriate development in the Town Center. The soils underlying the up-slope area identified as an area of interest on the soil survey and by the Planning Commission were generally not suitable for the construction of community scale wastewater treatment systems. A second area of suitable soils was further evaluated and confirmed in the northern portion of the hay field (previously identified as "Zone 3" in the Hamlin Engineers report cited below). This area may support a new soil-based community wastewater system with a capacity of 16-17,000 gallons per day. Limited additional testing will be needed to confirm the extent of suitable soils if the preliminary leachfield layout proposed is advanced to final design.

Sources of information consulted to complete the analyses included:

- *Soil Investigation, Jackson Farm, Brookside Road, Westford, Vermont*: Letter report, maps, and test pit logs from Donald L. Hamlin Consulting Engineers, Inc. to David Gauthier, dated February 10, 2015.
- LiDAR data for the 1,200-foot buffer surrounding the Browns River, dated August 2007; acquired by Stone in April 2014. Metadata available at http://maps.vcgi.org/gisdata/metadata/ElevationOther_LiDAR_Chittenden_Floodplain_2007.htm.
- ANR Natural Resources Atlas and Well Locator mapping database, http://anrmaps.vermont.gov/websites/anra/, as accessed on September 22, 2015.
- Backhoe test pit logs and hydraulic conductivity testing completed by Amy Macrellis of Stone Environmental, Inc. on August 4, 2015.

- Limited topographic survey, including locations of backhoe test pits, completed by Kevin Camara, P.E. of Green Mountain Engineering on August 4, 2015.
- *Drawing No. 1: Proposed Wastewater Collection System Map*, preliminary collection system layout for existing connections completed by Green Mountain Engineering, dated October 1, 2015.
- *Drawing No. 2: Wastewater Disposal System Site Plan*, preliminary leachfield layout completed by Green Mountain Engineering, dated October 1, 2015.

Site Description and Field Soil Characterization Results

The property, located at 123 Brookside Road, is approximately 201 acres in size with an existing single family home and associated barns and outbuildings. A soils investigation completed by Hamlin Engineering in December 2014-January 2015 identified three areas on the property that were potentially suitable for wastewater disposal. Two areas described in Zone 2 were estimated to have capacity to support approximately 10 homes each (for a total of 20). An area identified in Zone 3 was estimated to have capacity to support approximately 20 homes (which, if permitted under the Wastewater System and Potable Water Supply Rules, would equate to a design flow of 4,900 gallons per day). The Town has chosen to focus attention and resources on understanding the capacity of the soils underlying the "northern lobe" of the hay field, identified as Zone 3 in the Hamlin Engineering report, as well as a wooded area located up-slope and northwest of Zone 3.

Sixteen locations on this site were pre-marked during a meeting at the site on July 22, 2015. The soils investigation conducted by Amy Macrellis of Stone on August 4, 2015 using a backhoe supplied by John Roberts of Roberts Excavation Inc. (operator Glenn). Others present during some or all of the investigation included David and Lynn Gauthier (property owners), Melissa Manka (Town of Westford Planning Coordinator), Kevin Camara, P.E. (Green Mountain Engineering), Bryan Harrington (Vermont DEC, Indirect Discharge Permitting Program), Jessanne Wyman(Vermont DEC, Regional Engineer), and Mary Clark (Vermont DEC, Hydrogeologist). Appendix A contains test pit logs, results of hydraulic conductivity testing, and hydraulic capacity calculations.

Eight test pits, TP-101 through TP-108, were excavated in the area northwest of Zone 3, where the soil survey indicated additional suitable soils were potentially located. The test pits were 28-84 inches (2.36- 7.0 feet) deep. The test pit logs are attached, and test locations are shown on the site plan (Drawing No. 2). The soil test pits revealed a great deal of variability in the soils in this area. Only two locations (TP-101 and TP-107) were underlain by well-drained sandy loam to loamy sand, with redoximorphic features at depths of 72-76 inches (6.0 – 6.3 feet). These locations were generally consistent with the mapped Stetson series soils, and are suitable for construction of in-ground leachfields (attached soil logs and Drawing No. 2). Test pit TP-103 also consisted of sandy loam to loamy sand to 46 inches below the ground surface, but these soils were underlain by firm very fine sandy loam soils with indications of seasonal high groundwater at 48 inches below the ground surface. The soils in this location would be suitable for an at-grade leachfield. The remaining test locations in this area consisted of gravelly very fine sandy loam to silty clay loam, with firm to very firm consistence and indications of seasonal high groundwater relatively high in the soil profile (14-28 inches below ground surface). The soils in these locations may be suitable for mound leachfields for individual residences, but cannot be expected to sustain significant community-scale wastewater treatment capacity. Bedrock outcrops were observed to be nearly continuous on the eastern and western sides of the area where test pits were excavated. The capacity of this area for wastewater treatment is limited, and so purchase of this portion of the property by the Town for the purpose of siting community wastewater systems is not recommended.

Eight additional test pits, TP-109 through TP-116, were excavated in and adjacent to Zone 3, to confirm and potentially expand the area of suitable soils identified in the Hamlin Engineering investigation. The new test pits were 24-128 inches (2.0- 10.7 feet) deep. The test pit logs are attached, and test locations are shown on the site plan (Drawing No. 2).

Test pit TP-109 was excavated in the woods to the northwest of TP-017 in Zone 3, to understand whether the proposed leachfield area could be extended past the tree-line and closer to the bedrock west of the open field. While the soils at this location are consistent with the well-drained sands observed in TP-017, bedrock was observed at 22 inches below ground surface in a portion of this test pit. Extending the area where community leachfields can be sited in this direction is not likely to be feasible.

Test pit TP-110 was excavated in the field north of TP-018, to confirm and attempt to extend the area of suitable soils north from the previously characterized area. This test pit consisted of gravelly loamy fine to coarse sands throughout the soil profile, with no indications of limiting features to a depth of 128 inches (10.7 feet). An in-hole hydraulic conductivity test was conducted at this location (see Appendix A), resulting in a hydraulic conductivity value of 69 feet/day in the soil horizon that would likely receive renovated effluent (24-39 inches below ground surface). These deep, well-drained soils appear to extend past the northern tree-line, although there are also areas of steeply sloping terrain approximately 100 feet north of the tree-line that are likely to limit the siting of community leachfields in this direction.

Test pit TP-111 was excavated along the tree-line east of TP-018 and TP-020, to confirm and attempt to extend the area of suitable soils east from the previously characterized area. This test pit consisted of gravelly loamy medium to coarse sands throughout the soil profile, until a groundwater seep was encountered at 41 inches below ground surface in the down-slope end of the pit.

Test pits TP-114 and TP-116 were both more complex. In each of these cases, relatively shallow soil horizons that are finely textured and have firm to very firm consistency are associated with indications of seasonal high groundwater—and then these shallow restrictive horizons are underlain by three feet or more of sand to gravelly coarse sand. While the shallow seasonal high groundwater limitations preclude using these areas for in-ground leachfields, the deeper unsaturated sands do have some capacity to transmit renovated effluent dosed into up-slope, in-ground leachfields.

Test pits TP-112, TP-113, and TP-115 generally consisted of gravelly silt loam to silty clay loam, with firm to very firm horizons at 16-32 inches below ground surface that corresponded with indications of seasonal high groundwater. These locations could be used for mound wastewater treatment systems, but are generally not suitable for larger-scale community wastewater treatment.

The best possible option for wastewater disposal on this property remains in northern portion of the Zone 3 area identified in the Hamlin Engineering report in the vicinity of test pits TP-017, TP-018, TP-019, TP-020, TP-021, and TP-024, and expanded to include TP-110 and a portion of the area near TP-111. After accounting for separations from areas of unsuitable soils, a roughly oblong area of approximately 2.8 acres is potentially available for wastewater disposal. This area is additionally limited by the presence of slopes in excess of 20% in portions of the best-suited soils and associated setbacks (roughly 0.4 acres), leaving roughly 2.4 acres. The area identified here represents the likely maximum area available for wastewater treatment. It may be somewhat further constrained by as-yet unidentified areas of finely textured soils with firm subsoils and shallow seasonal high groundwater, especially in the southern portion of Zone 3.

Capacity Analysis for Zone 3 at the Jackson Farm Site

The best possible option for wastewater disposal on this property remains in northern portion of the Zone 3 area identified in the Hamlin Engineering report in the vicinity of test pits TP-017, TP-018, TP-019, TP-020, TP-021, TP-024, TP-110, and a portion of the area near TP-111, parallel to the tree line running from north to south. After accounting for areas of unsuitable soils and steep slopes, an irregular, oblong area approximately 85-200 feet wide (east-west) by 775 feet long (north-south) (104,500 ft^2 or 2.4 acres) is potentially available for wastewater disposal.

In order to estimate the hydraulic capacity of this potential wastewater dispersal site, we used a conservative method called Darcy's Law. This formula is represented as Q = KiA where

- Q = design flow (gallons/day) (gpd)
- K = hydraulic conductivity (ft. /day)
- i = hydraulic gradient (slope of water table)
- A = transmitting soil cross-sectional area (square feet) = D x L where
  - D = transmitting soil thickness (depth to impeding layer or water table, minus the required separation depth, minus the system depth) (feet)

L = length of the disposal system in the estimated direction of groundwater flow (feet)

We used this formula to develop a hydraulic capacity estimate, given the assumptions described below. The full calculations are included in Appendix A.

1. Hydraulic conductivity (K) = 69 feet per day, as measured in the soil horizon that would receive renovated effluent at TP-110. Vermont DEC guidance regarding K values for the loamy sand to coarse sand soil textures encountered gives a range of 50-100 feet/day, consistent with our field measurement.
2. Hydraulic gradient (i) = 11.0%, estimated as similar to ground surface slope from the topographic survey (10-13% in the area of suitable soils, excluding areas that are too steep for leachfield siting). Groundwater mounding beneath the disposal field will also slightly increase the hydraulic gradient, but we did not include an allowance for this increased slope in the capacity analysis.
3. The average limiting depth to an impeding layer or seasonal high water table across all test pits with sufficient depth of suitable soils for in-ground leachfields (7.9 feet below ground surface) was assumed to be continuous across the potential disposal area.
4. Given these conditions, the most feasible design that maximizes capacity will be for in-ground absorption trenches with the bottom of the trench a maximum of 18 inches (1.5 feet) below the ground surface. In this design, the treatment capacity of the upper soil horizons will be maximized. The top of the gravel in the trenches will be at the pre-existing ground surface, and 6 inches of topsoil will be used to cover the trenches.
5. For in-ground trenches, the required separation distance to seasonal high groundwater is 3.0 feet, leaving a transmitting soil thickness of 3.4 feet between the induced groundwater mound and the bottom of the disposal trenches.
6. System length in the estimated direction of groundwater flow (across slope, perpendicular to contours from west to east) is 97 feet (the average distance across the areas where leachfields can be sited).

Based on our calculations, the hydraulic capacity available for wastewater disposal in this area is on the order of 18,700 gallons per day.

Jackson Farm Property Treatment and Disposal System

The irregular, oblong area approximately 85-200 feet wide (east-west) by 775 feet long (north-south) (104,500 ft^2 or 2.4 acres) determined to be available for wastewater disposal, and to have a potential capacity of roughly 18,700 gallons per day, is shown on Drawing No. 2. To further refine the estimate of hydraulic capacity for this area, a preliminary layout was designed assuming the disposal area will be designed to treat septic tank effluent using in-ground absorption trenches. Once setbacks from steep slopes and un-suitable soils are accounted for, the equivalent of 94 trenches, each 4 feet wide by 100 feet long, can be located parallel to the ground contours. Since only half of the trenches can be loaded with renovated effluent at any given time, the leachfield's capacity is calculated based on 47 trenches, as follows:

System capacity (gallons/day) = trench length * trench width * total trenches * loading rate, where

Trench length = 100 feet

Trench width = 4 feet

Total trenches = 47

Loading rate = 0.9 gallons/square foot of trench area/day (for loamy sand to coarse sand, see Indirect Discharge Rules Table 19)

System capacity (gallons/day) = 4 feet * 100 feet * 47 trenches * 0.9 gal/square foot

System capacity = 16,920 gallons/day

An in-ground system utilizing four-foot-wide trenches, maximizing the available length along contour (~775 ft.) with this capacity would have a linear loading rate of 16,920 gal/day / 775 ft. = 22 gallons/day/linear foot. This linear loading rate is higher than 4.5 gallons per day per linear foot, and so if pre-treatment is desired in order to further increase the system's capacity, the state's Indirect Discharge Rules (Section 14-1010(d)(2)) require that a hydrogeologic analysis be completed to demonstrate:

- An unsaturated soil zone of at least 36 inches is maintained beneath the filtrate disposal system; and
- The mounded water table is at least one foot below grade at the downhill toe of the filtrate disposal system.

Wastewater Flow Projections

Wastewater flow projections were developed using the State of Vermont, Environmental Protection Rules (EPR), Chapter 1, dated September 29, 2007. Wastewater flow projections for residential and apartment units were developed based on the number of living units. A living unit is defined as a single family home, apartment or mobile home. For alternatives connected to a system with a system capacity of 16,920 gpd, a design flow of 245 gpd per living unit is used without regard to the number of bedrooms.

Table 1 on the following page provides a summary of the current and design year flow projections for a 16,920 gpd system at the Jackson Farm.

Table 1. Wastewater Flow Projection Summary

Street	Use & Flow Rate	Initial Year Flow (gpd)	Equivalent Users
Brookside Road	White Church= 150 gpd 9 SFR x 245 gpd/SFR=2,205 gpd	2,355	10
Cambridge Road	1 SFR x 245 gpd/SFR=245 gpd	245	1
Common Road	4 SFR x 245 gpd/SFR=980 gpd	980	4
VT Rte. 128	11 SFR x 245 gpd/SFR=2,695 gpd 8 Apt. X 245 gpd/Apt.=1,960 gpd 1 Store=140 gpd Town Office & Library=90 gpd Brick Meeting House= 480 gpd	5,365	22
White Church Lane	2 SFR x 245gpd/SFR=490 gpd	490	2
Initial Year Total		9,435	39

The number of equivalent users is used later in the report for the user cost analysis. For residential users, one equivalent user is defined as one house, one apartment, or one mobile home, etc. For non-residential users, the equivalent unit is defined as 245 gpd. The non-residential equivalent user amount is calculated by dividing that establishment's flow basis and dividing it by 245 gpd. The minimum equivalent unit for all accounts is 1 equivalent unit.

For a system designed for the maximum capacity of 16,920 gpd, there would be approximately 7,485 gpd in reserve capacity, which equates to approximately 30 additional single family homes.

Wastewater Collection and Disposal System

For this preliminary evaluation, the lowest cost wastewater collection, treatment and disposal system was anticipated to be a Septic Tank Effluent Pump (STEP) system (Drawing No. 1), followed by a conventional trench disposal system (Drawings No. 1 and No. 2). The Indirect Discharge Rules require dual alternating disposal systems, and that the systems are pressurized. A STEP system is a system in which both the septic tank and effluent pumping processes occur in a single tank. Portions of the tank are dedicated to septic tank capacity, effluent pumping, and emergency storage. The STEP tank for a typical single family home is a 1,500 gallon tank.

Located inside the STEP tank is a pump vault that houses a filter and pumping system. Effluent from the clear zone of the septic tank enters the pump vault and is filtered by the effluent filter. Because only effluent is pumped, a small ½ horsepower submersible turbine high head effluent type pump is used to pump the effluent. The ½ horsepower effluent pump saves energy over larger horsepower solids handling pumps. The electrical service is typically connected to the property's electrical system and the electrical costs are typically borne by the property owner.

The STEP system utilizes small diameter pressure sewer and low pumping rates. The STEP tank operates on a "pump on/pump off" scenario based on float positions. The low pressure sewer service is typically minimum of 1" diameter and the main line low pressure sewer is typically 2" diameter. Pumping heads for operation of the system are developed using the combined energy of multiple STEP system pumps working together to convey flow through the collection system.

The STEP system will convey the effluent to a dosing tank at the Jackson Farm site. The dosing tanks will dose the disposal fields at the proper pressure and flow volume. There will also be a valve pit for the dosing tank.

Opinion of Probable Construction Cost

Prior to the development of the opinion of probable construction cost, quantity take-offs were completed to establish quantities of equipment, materials, and labor necessary to construct a fully operational system. Construction costs were generated using *RS Means Building Construction Data*, cost quotations from vendors and contractors, and bid results from recent construction jobs in Vermont. An ENR cost index was used to project the construction cost to February 2018 to account for inflation. Opinions of probable construction costs were developed for both the wastewater collection system (Contract No. 1) at $1,150,000 and the wastewater disposal system (Contract No. 2) $460,000, for a total opinion of probable construction cost of $1,610,000 in 2018 dollars. A 10% contingency is included in the construction cost estimate. Detailed summaries of costs are provided in Appendix B.

Opinion of Total Project Cost

An Opinion of Total Project Cost was developed to include all project costs including construction cost, preliminary engineering, permitting, hydrological, archeological, final design engineering, construction services engineering, land acquisition, legal, fiscal and administrative costs. The Opinion of Total Project Cost is $2,250,000. The Opinion of Total Project Cost is detailed in the table in Appendix B.

Opinion of "First Year" Operation and Maintenance Cost

An Opinion of Operation and Maintenance (O&M) Cost was developed to include all operation and maintenance costs for the proposed system including contract operations, electrical expenses, sludge pumping, groundwater testing, capital replacement, insurance, miscellaneous repairs, and administration/billing. The Opinion of First Year O&M Cost is $24,000. The Opinion of First Year O&M Cost is detailed in the table in Appendix B.

Opinion of User Fee Analysis

An opinion of user fess is the method used in this report to determine if an alternative is affordable or not. Annual user rates from wastewater collection and treatment systems in Vermont vary from community to community and range from a low of $250/year to as high as $1,200/year. The typical average wastewater user rate fee across the State is between $400 - $600/year. Newer systems are typically higher, in the $1,000+/year range. User costs over $1,000 are generally considered unaffordable.

Typically, the users of the system pay for 100% of the O&M costs of a system. Therefore, the user cost for the annual O&M cost of this system would be the $24,000 annual O&M cost divided by the 39 users or $615. If and as additional users or connections are added to the system, it is likely that the per-user O&M costs will decrease.

Different communities handle the debt retirement in different ways. The three most common approaches are the following:

1. The users pay all of the debt retirement.
2. The debt retirement is distributed throughout the Town on a parcel tax basis.
3. The debt retirement is distributed throughout the Town tax based on the grand list.
4. Combinations of the above.

Because the funding package is not known at this time, the debt retirement user fees are also not known. User costs were estimated for the total project cost using method #1 (only the users pay the debt retirement) and using grant scenarios of 0%, 35%, 50%, and 75%. See Appendix B for detailed calculations of the user costs per approach. Table 2 on the following page provides a summary of the user cost using the first three approaches described above.

Table 2. Estimated User Fee Summary

Approach	User Fee			
	No Grants	35% Grants	50% Grants	75% Grants
Users Pay both Debt & O&M Costs				
Non-Connected Property	$0	$0	$0	$0
Connected Property	$4,143	$2,909	$2,379	$1,497
Users Pay O&M and Debt on a Town Wide Parcel Tax Basis				
Non-Connected Property	$147	$96	$73	$37
Connected Property	$762	$711	$689	$652
Users Pay O&M and Debt of a Town Wide Parcel Tax Basis [1.]				
Non-Connected Property	$152	$99	$76	$38
Connected Property	$768	$714	$692	$653

1. Note: The Town wide parcel tax user fee portion is based on a property value of $275,000.

Potential Funding Sources

A summary of the available State and Federal funding programs investigated for this project are described in the following narratives.

- State of Vermont, Department of Environmental Conservation (VTDEC)
  - Clean Water State Revolving Fund (CWSRF)
  - Pollution Abatement Grant
- USDA Rural Development (RD)
- U.S. Environmental Protection Agency (EPA)
- Vermont Community Development Program (VCDP)

The State of Vermont offers low interest loans for planning, design, and construction of municipal infrastructure improvements. This loan is offered with an annual administrative fee equivalent to 2% of the remaining balance for a 20 year period. The funding schedule depends on the individual project's priority ranking in comparison to other projects.

The State of Vermont offers a Dry Weather Pollution Abatement Grant to municipalities for the planning and construction of facilities which have project sections that abate pollution to waters of the State. The grant is for 35% of eligible items from the point of pollution to the point of discharge. Available funding is currently limited and dependent upon legislative set-asides.

The USDA Rural Development (RD) Program includes both grants and loans, depending on the project and the community's ability to pay, which is based on the Town's user rates and median household income (MHI). The MHI for the Town of Westford is high at $61,000, which makes the Town not eligible for grants under the RD program.

The U.S. Environmental Protection Agency (EPA) offers a State and Tribal Assistance Grant (STAG) program. These grants are based on financial need and environmental protection. The municipality must work closely with Vermont's U.S. congressional delegates in an effort to get their wastewater projects into the U.S. Capital Budget for STAG grants. These grants have become very limited in the current economic and political climate.

The Vermont Community Development Program (VCDP) administers funding from the U.S. Department of Housing and Urban Development (HUD) under the Community Development Block Grant (CDBG) program. The CDBG program celebrated its 40th anniversary this year. Activities that support economic development and affordable housing continue to be VCDP's top priorities for funding. The VCDP assists communities on a competitive basis by providing financial and technical assistance to identify and address local needs in the areas of housing, economic development, public facilities, public services and handicapped accessibility modifications. The program is designed to predominantly benefit persons of low and moderate income.

Conclusions and Next Steps

In summary, our field and desktop analyses indicate that a new in-ground wastewater disposal system to accommodate existing or new development with design flows of up to 16,920 gpd may be feasible in the Zone 3 area on the Jackson Farm property. This design flow would be adequate to serve the current needs of the areas identified as "high priority" for community wastewater service by the Planning Commission (if connected to a community system, the current uses in this area have a combined design flow of approximately 9,435 gallons per day). Thus, up to 7,485 gallons/day of capacity could be available to serve other current or future needs.

For this preliminary evaluation, the lowest cost wastewater collection, treatment and disposal system was anticipated to be a Septic Tank Effluent Pump (STEP) system, followed by a conventional trench disposal system (Drawings No. 1 and No. 2). Construction costs were estimated $1,610,000 in 2018 dollars, total project costs were estimated to be $2,250,000, and the first-year operation and maintenance costs were estimated to be $24,000. These preliminary opinions of probable cost were used to evaluate a series of possible user fee breakdown and financing options, understanding that there are still many unknowns in how any community wastewater project in the Town Center and at the Jackson Farm property would ultimately be developed and financed.

There are several steps to be taken in finalizing the capacity of the Zone 3 area on the Jackson Farm property and moving forward with developing a community wastewater project for the Town Center, keeping in mind that additional testing may increase or decrease the capacity investigated during this study. The items below are by no means an exhaustive or complete list, and we look forward to collaborating with the Town, the Planning Commission, and other stakeholders on this exciting project.

1. Complete limited additional soil characterization to confirm system capacity, primarily in the southern portion of Zone 3.
2. Update capacity estimate and preliminary leachfield layout incorporating new field data, and update preliminary opinions of probable construction and total project cost as necessary.
3. Work with project stakeholders to refine financing options, including funding for preliminary and final design, system construction, and operation/maintenance—especially to understand how public-private partnerships and/or companion proposals to develop affordable housing could impact per-user costs and potential reserve fund capacity available for other future uses.

Sincerely yours,

Amy Macrellis
Project Water Quality Specialist
Direct Phone / 802.229.1884
Mobile / 802.272.8772
E-Mail / amacrellis@stone-env.com

Encl.

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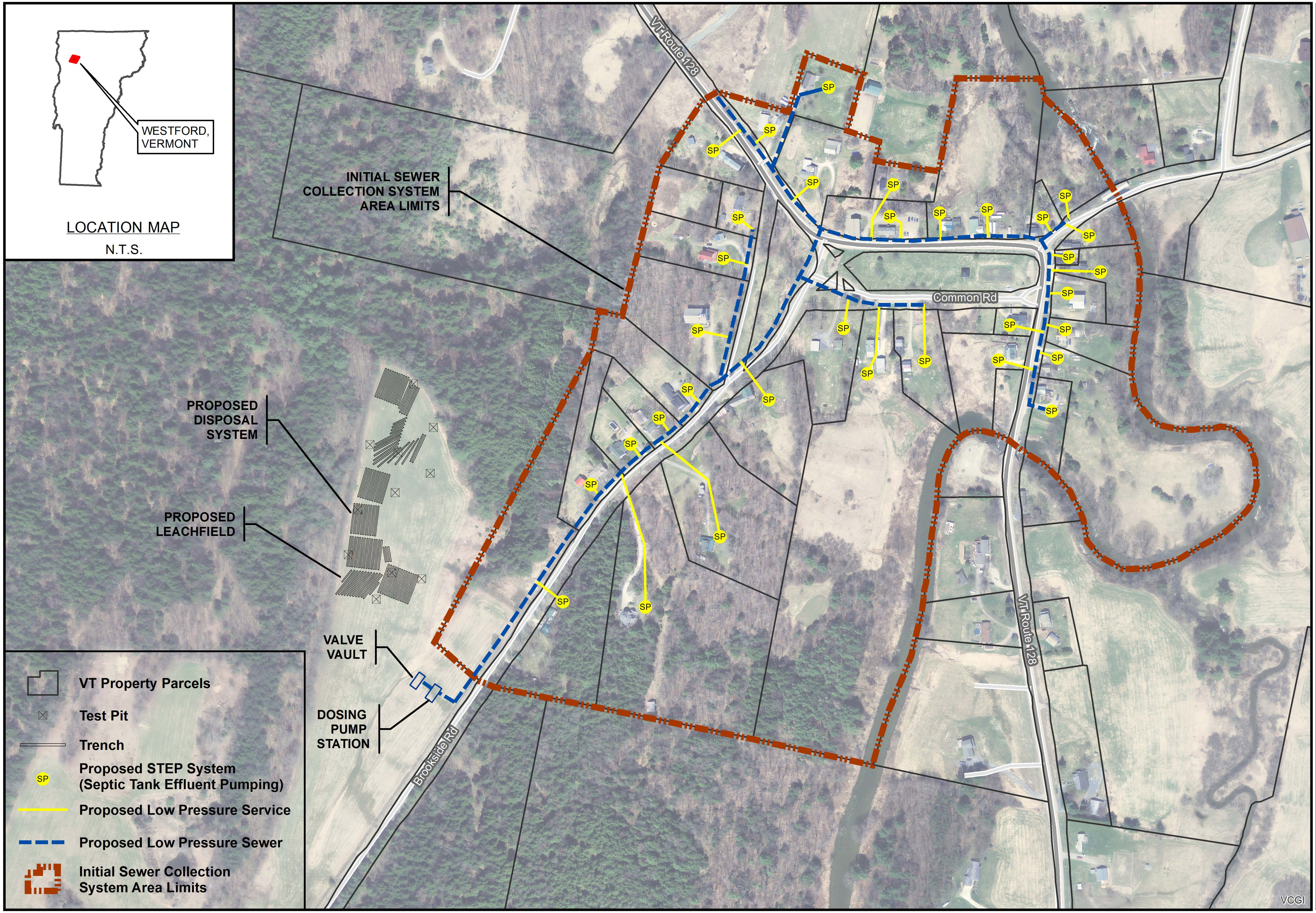


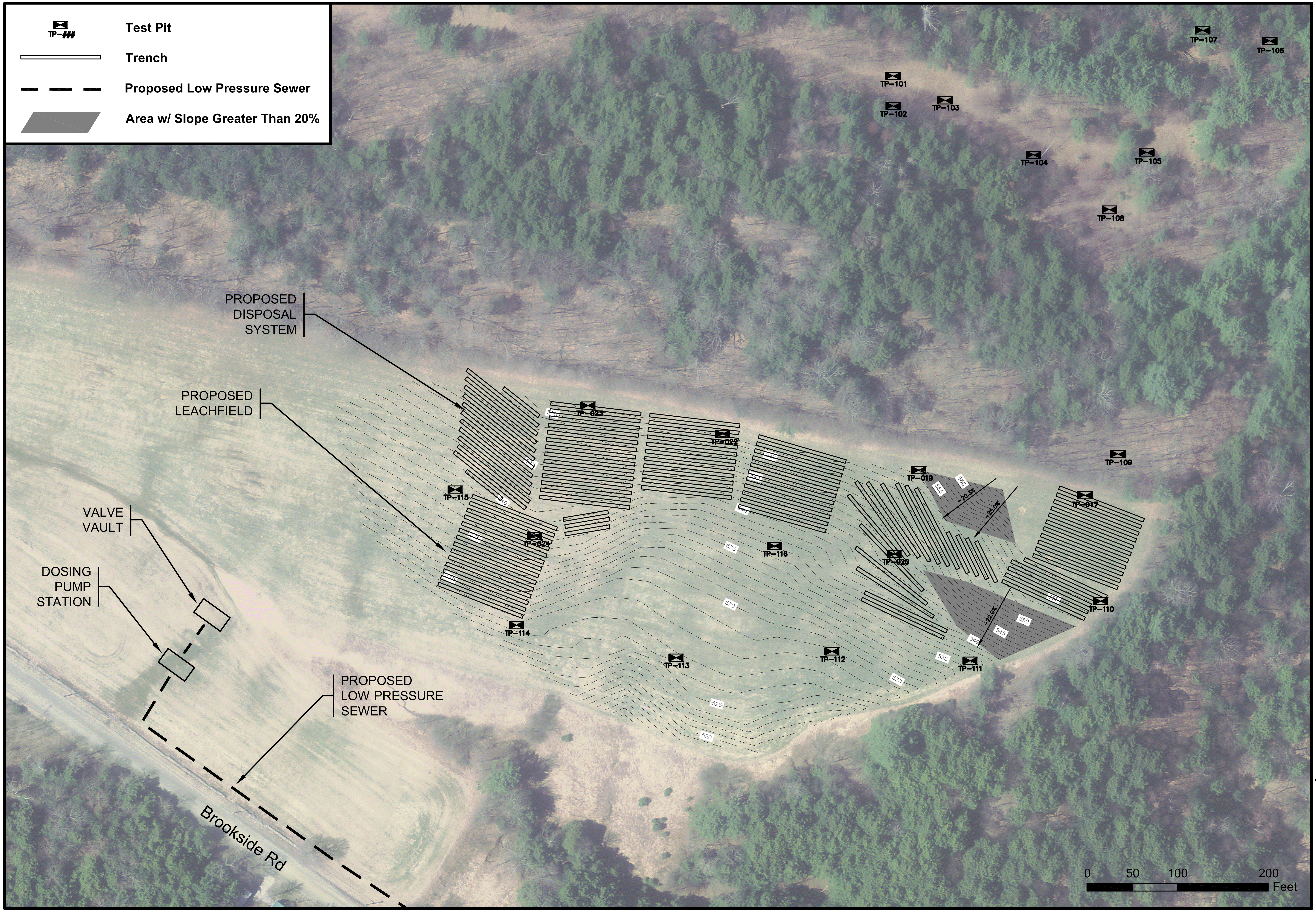
PROPOSED WASTEWATER COLLECTION SYSTEM MAP

WESTFORD WASTEWATER STUDY

WESTFORD, VERMONT

GREEN MOUNTAIN ENGINEERING
CIVIL WATER WASTEWATER
1438 SOUTH BROWNELL ROAD
WILLISTON, VERMONT 05495
PHONE: (802)862-5590
FAX: (802)862-7598

DESIGNED KJC	PROJECT NO. 25-007
DRAWN RSO	
CHECKED BY KJC	
PLOT DATE 09/30/15	DRAWING NO. 1
SCALE 1"=300'	
DATE 3/12/10	



WASTEWATER DISPOSAL SYSTEM SITE PLAN

WESTFORD WASTEWATER STUDY

WESTFORD, VERMONT

1438 SOUTH BROWNELL ROAD
WILLISTON, VERMONT 05495
PHONE: (802)862-5590
FAX: (802)862-7598

GREEN MOUNTAIN ENGINEERING
CIVIL WATER WASTEWATER

DESIGNED KJC	PROJECT NO. 25-007
DRAWN RSO	
CHECKED BY KJC	
PLOT DATE 10/01/15	DRAWING NO. 2
SCALE 1" = 100'	
DATE OCT 2015	

Appendix A: Test Pit Logs, Hydraulic Conductivity Test Results, and Capacity Calculations

Site Capacity and Opinion of Probable Cost of a Shared Wastewater System at the Jackson Farm Property, Westford, Vermont – Backhoe Test Pit Logs

Soils investigation conducted by Amy Macrellis of Stone Environmental, Inc. on August 4, 2015. Backhoe supplied by John Roberts of Roberts Excavation Inc. (operator Glenn). Others present during some or all of the investigation included David and Lynn Gauthier (property owners), Melissa Manka (Town of Westford Planning Coordinator), Kevin Camara (Green Mountain Engineering), Bryan Harrington (Vermont DEC, Indirect Discharge Permitting Program), Jessanne Wyman(Vermont DEC, Regional Engineer), and Mary Clark (Vermont DEC, Hydrogeologist).

Woodland Area West of "Zone 3" Hay Field

Test Pit TP-101

0" – 6"	Brown (7.5YR 5/2) fine sandy loam, weak subangular blocky structure, friable consistence, moist. Topsoil.
6" – 15"	Strong brown (7.5YR 4/6) fine sandy loam, weak subangular blocky structure, friable consistence, moist. Common tree roots.
15" – 24"	Brown (7.5YR 5/4) loamy fine sand, weak subangular blocky structure, loose consistence, moist.
24" – 72"	Light olive brown (2.5Y 5/3) sand, weak subangular blocky structure, loose consistence, moist.
72" – 80"	Brown (10YR 5/3) gravelly silt loam, moderate subangular blocky structure, very firm consistence, moist. Few fine faint mottles at 76". Very hard digging with hardpan and many cobbles.

No bedrock to depth. Seasonal high groundwater indicators at 76".

Test Pit TP-102

0" – 6"	Brown (7.5YR 4/2) fine sandy loam, granular structure, loose consistence, moist. Topsoil and duff.
6" – 19"	Strong brown (7.5YR 5/6) gravelly fine sandy loam, weak subangular blocky structure, friable consistence, moist. 10% gravel.
19" – 36"	Brown (10YR 5/3) gravelly silt loam, moderate subangular blocky structure, very firm consistence, dry. Till / hardpan. Mineralogy makes identification of redoximorphic features very difficult. Few fine faint mottles possible at 24".

No bedrock to depth. Possible seasonal high groundwater indicators at 24".

Test Pit TP-103

0" – 7"	Dark brown (7.5YR 3/3) fine sandy loam, weak subangular blocky structure, loose consistence, moist. Topsoil.
7" – 13"	Brown (7.5YR 4/4) very fine sandy loam, moderate angular blocky structure, friable consistence, moist.
13" – 22"	Dark reddish brown (5YR 3/4) loamy sand to loamy fine sand, weak angular blocky structure, friable consistence, moist.
22" – 46"	Olive brown (2.5Y 4/3) fine sand, weak subangular blocky structure, friable consistence, moist.
46" – 72"	Light olive brown (2.5Y 5/3) gravelly very fine sandy loam, moderate platy structure, firm consistence, moist. Few fine faint mottles at 48". Boulder in center of test pit at 54".

No bedrock to depth. Seasonal high groundwater indicators at 48".

Test Pit TP-104

0” – 7”	Black (7.5YR 2.5/1) silty clay loam, weak granular structure, loose consistence, moist. Topsoil.
7” – 16”	Brown (7.5YR 4/4) silty clay loam, moderate platy structure, loose consistence, moist.
16” – 28”	Olive brown (2.5Y 4/3) gravelly silty clay, moderate platy structure, firm consistence, moist. Many medium distinct mottles at 16”.

No bedrock to depth. Seasonal high groundwater indicators at 16”.

Test Pit TP-105

0” – 5”	Black (7.5YR 2.5/1) silty clay loam, weak granular structure, loose consistence, moist. Topsoil.
5” – 14”	Brown (7.5YR 4/4) very fine sandy loam, weak subangular blocky structure, loose consistence, moist.
14” – 23”	Brown (7.5YR 4/3) very fine sandy loam, weak subangular blocky structure, friable consistence, moist. VT DEC observed indications of seasonal high groundwater at 14”.
23” – 47”	Olive brown (2.5Y 4/3) very gravelly silt loam, moderate subangular blocky structure, firm consistence, moist to wet. Common medium prominent mottles beginning at 26”.

No bedrock to depth. Conservative estimate of seasonal high groundwater indicators at 14”; clear evidence at 26”.

Test Pit TP-106

0” – 5”	Black (7.5YR 2.5/1) gravelly very fine sandy loam, weak granular structure, loose consistence, moist. Duff/topsoil.
5” – 16”	Brown (7.5YR 4/4) very fine sandy loam, weak subangular blocky structure, loose consistence, moist.
16” – 27”	Brown (7.5YR 4/3) gravelly silt loam, weak subangular blocky structure, friable consistence, moist.
27” – 42”	Dark grayish brown (2.5Y 4/2) very gravelly very fine sandy loam, moderate subangular blocky structure, firm consistence, moist. Few small faint mottles beginning at 27”.

No bedrock to depth. Seasonal high groundwater indicators at 27”.

Test Pit TP-107

0” – 3”	Black (7.5YR 2.5/1) veryfine sandy loam, weak granular structure, loose consistence, moist. Duff, very rich organic material.
3” – 12”	Strong brown (7.5YR 4/6) gravelly fine sandy loam, weak granular structure, loose consistence, moist. 10% gravel.
12” – 18”	Strong brown (7.5YR 5/6) gravelly fine sandy loam, weak subangular blocky structure, friable consistence, moist. 15% gravel.
18” – 30”	Yellowish brown (10YR 5/4) gravelly very fine sandy loam, moderate subangular blocky structure, friable consistence, moist. 15% gravel.
30” – 40”	Light olive brown (2.5Y 5/3) Very gravelly fine sandy loam, weak subangular blocky structure, firm consistence, moist. 30% gravel.
40” – 84”	Light olive brown (2.5Y 5/3) Very gravelly loamy sand, weak granular structure, very firm consistence, moist to wet. Horizon coarsens downward, to very gravelly sand and coarse sand at 60”, but also becomes wetter. Few fine distinct mottles at 72”.

No bedrock to depth. Seasonal high groundwater indicators at 72”.

Test Pit TP-108

0" – 6"	Dark brown (7.5YR 3/2) sandy loam, weak granular structure, loose consistence, moist. Duff/topsoil.
6" – 13"	Strong brown (7.5YR 4/6) loamy sand to loamy coarse sand, weak granular structure, loose consistence, moist.
13" – 21"	Brown (7.5YR 4/4) sand, no structure (single grain), loose consistence, moist.
21" – 28"	Dark grayish brown (10YR 3/4) coarse sand, no structure (single grain), loose consistence, moist.
28" – 55"	Dark grayish brown (2.5Y 4/2) silty clay loam, moderate subangular blocky structure, firm consistence, moist. Common medium prominent mottles at 28". Upper boundary of this horizon is wavy – VT DEC measured depth to mottles at 24" in a different area of the pit, but at the same relative position in the soil profile.

No bedrock to depth. Seasonal high groundwater indicators at 28".

"Zone 3" Hay Field

Test Pit TP-109

0" – 7"	Very dark brown (7.5YR 2.5/2) fine sandy loam, weak granular structure, loose consistence, moist. Duff/topsoil.
7" – 16"	Strong brown (7.5YR 4/6) gravelly loamy fine sand, no structure (single grain), loose consistence, moist. 10-15% gravel.
16" – 28"	Brown (7.5YR 4/3) gravelly loamy sand, no structure (single grain), friable consistence, moist. 15% gravel.
28" – 45"	Brown (10YR 4/3) gravelly sand, no structure (single grain), friable consistence, moist. 15% gravel. Wavy bedrock boundary – 22" only in the northwestern portion of the pit, trending northeast and downward in the soil profile.

Bedrock at 22" in a portion of the pit. No seasonal high groundwater indicators to depth.

Test Pit TP-110

0" – 8"	Dark brown (7.5YR 3/4) very fine sandy loam, weak granular structure, loose consistence, dry. Topsoil.
8" – 16"	Strong brown (7.5YR 5/6) fine sandy loam, weak granular structure, loose consistence, dry.
16" – 32"	Strong brown (7.5YR 5/8) very gravelly loamy fine sand, no structure (single grain), loose consistence, dry. 40% gravel.
32" – 45"	Dark yellowish brown (10YR 4/6) gravelly fine sand, no structure (single grain), loose consistence, dry. 10% gravel, but less gravel deeper in this horizon.
45" – 128"	Dark grayish brown (2.5Y 4/2) gravelly coarse sand, no structure (single grain), loose consistence, dry. 10% gravel, but less gravel deeper in this horizon. Overdug pit from 64-128 inches, but did not enter. Sand to coarse sand present to depth.

No bedrock or seasonal high groundwater indicators to depth.
Hydraulic conductivity test completed at this location, 24-39" below ground surface.

Test Pit TP-111

0” – 6”	Dark brown (7.5YR 3/3) gravelly loamy sand, weak granular structure, loose consistence, moist. Topsoil/plow layer.
6” – 14”	Strong brown (7.5YR 4/6) very gravelly sand to coarse sand, no structure (single grain), loose consistence, moist. 40% gravel.
14” – 29”	Brown (7.5YR 4/4) very gravelly sand, no structure (single grain), loose consistence, moist. 30% gravel.
29” – 57”	Dark yellowish brown (2.5Y 4/4) gravelly coarse sand, no structure (single grain), loose consistence, moist. Wet at 54”, seep that became standing water. At the down-slope end of the pit, measured distance to standing water was 41”.

No bedrock or seasonal high groundwater indicators to depth.
Standing water at 54” (middle of pit) to 41” (down-slope end of pit).

Test Pit TP-112

0” – 10”	Dark brown (7.5YR 3/2) very fine sandy loam, weak granular structure, loose consistence, moist. Topsoil/plow layer.
10” – 32”	Strong brown (7.5YR 4/6) very gravelly silt loam, weak subangular blocky structure, friable consistence, moist. 50% gravel.
32” – 44”	Dark grayish brown (2.5Y 4/2) gravelly silty clay loam, moderate angular blocky structure, firm consistence, moist. Common medium prominent mottles at 32”.

No bedrock to depth. Seasonal high groundwater indicators at 32”.

Test Pit TP-113

0” – 9”	Dark brown (7.5YR 3/3) silt loam, weak granular structure, loose consistence, moist. Topsoil/plow layer.
9” – 19”	Brown (7.5YR 4/4) gravelly silty clay loam, weak subangular blocky structure, friable consistence, moist. 10% gravel.
19” – 24”	Light olive brown (2.5Y 5/3) silty clay loam, moderate angular blocky structure, firm consistence, moist. Few medium faint mottles at 19”.

No bedrock to depth. Seasonal high groundwater indicators at 19”.

Test Pit TP-114

0” – 10”	Dark brown (7.5YR 3/2) very fine sandy loam, weak granular structure, loose consistence, moist. Topsoil/plow layer.
10” – 18”	Brown (7.5YR 4/4) silt loam, weak granular structure, loose consistence, moist.
18” – 30”	Olive brown (2.5Y 4/3) very gravelly silty clay loam, moderate subangular blocky structure, very firm consistence, moist. 40% gravel. Many medium distinct mottles at 18-30”.
30” – 68”	Dark olive brown (2.5Y 3/3) Gravelly coarse sand, no structure (single grain), friable consistence, moist. 20% gravel. No mottles in this horizon.

No bedrock to depth. Seasonal high groundwater indicators at 18”.

Test Pit TP-115

0" – 8"	Dark brown (7.5YR 3/3) silt loam, weak granular structure, loose consistence, moist. Topsoil/plow layer.
8" – 16"	Brown (7.5YR 4/4) gravelly silt loam, weak granular structure, friable consistence, moist.
16" – 25"	Olive brown (2.5Y 4/4) gravelly silty clay loam, moderate subangular blocky structure, firm consistence, moist. 40% gravel. Many medium distinct mottles at 16".

No bedrock to depth. Seasonal high groundwater indicators at 16".

Test Pit TP-116

0" – 9"	Dark brown (7.5YR 3/2) fine sandy loam, weak granular structure, loose consistence, moist. Topsoil/plow layer.
9" – 18"	Brown (7.5YR 4/4) loamy fine sand, no structure (single grain), loose consistence, moist.
18" – 28"	Dark yellowish brown (10YR 4/6) loamy sand, no structure (single grain), friable consistence, moist.
28" – 36"	Dark olive brown (2.5Y 3/3) very fine sand, moderate subangular blocky structure, firm consistence, moist. Many medium prominent mottles at 28-36".
36" – 70"	Olive brown (2.5Y 4/3) sand, no structure (single grain), friable consistence, moist. No mottles in this horizon.
70" – 84"	Olive brown (2.5Y 4/3) gravelly clay loam, structure not recorded, firm consistence, moist. Many medium distinct mottles in this horizon.

No bedrock to depth. Seasonal high groundwater indicators at 28-36" and 70".

O:\Proj-13\WRM\13-224 Westford WW Capacity Eval\Project Reports\Draft\Jackson Farm\Soil test pit logs 2014 08 04.docx

Auger Hole Hydraulic Conductivity Measurement

Project Title: Westford Town Center Wastewater - Jackson Farm Evaluation
Stone Project #: 13-224
Date: 8/4/2015
Sampling Personnel: Amy Macrellis, David Gauthier, Melissa Manka
Backhoe test pit #: 110
Auger hole radius: 1.5" (3.8 cm)
Auger hole depth: 15" (38 cm) (test run at 24-39" below ground surface)

Field Measurements:

Run	Time (t) seconds	Δ t	Volume (v) Liters	Δ v	Flow Rate (Q_e) cm^3/sec
1	0		11		
	10	10	10	1	100
	23	13	9	1	77
	35	12	8	1	83
	50	15	7	1	67
	61	11	6	1	91
	72	11	5	1	91
	86	14	4	1	71
	100	14	3	1	71
2	159		14		
	165	6	13	1	167
	178	13	12	1	77
	190	12	11	1	83
	201	11	10	1	91
	214	13	9	1	77
	228	14	8	1	71
	241	13	7	1	77
	255	14	6	1	71
	268	13	5	1	77
	281	13	4	1	77
	293	12	3	1	83
3	346		15		
	360	14	14	1	71
	372	12	13	1	83
	386	14	12	1	71
	400	14	11	1	71
	413	13	10	1	77
	424	11	9	1	91
	438	14	8	1	71
	452	14	7	1	71
	466	14	6	1	71
	478	12	5	1	83
	492	14	4	1	71
	506	14	3	1	71

Calculations:

K = hydraulic conductivity (cm/sec)
L_w = wetted length of auger hole (cm)
r_w = radius of auger hole (cm)
S_i = vertical distance from bottom of auger hole to impeding layer (cm)
Q_e = equilibrium rate of water added (cm^3/sec) = average Δv/Δt for last run

$$K = \frac{Q_e}{2\Pi L_w^2}\left[\ln\left(\frac{L_w}{r_w} + \sqrt{\left(\frac{L_w^2}{r_w^2} - 1\right)}\right) - 1\right]$$

Assumption: Impermeable layer was not encountered; distance from bottom of auger hole to top of impermeable layer is more than 2x the wetted length (impermeable assumed at bottom of test pit, 128 inches bgs).

Results:

L_w =	38	cm
r_w =	3.8	cm
S_i =	226	cm
Q_e =	75	cm^3/sec
K =	**0.0243**	**cm/sec**
	69	**ft/day**

Project Title: Community Wastewater Capacity in the Westford Town Common Area, Jackson Farm site
Stone Project No.: 13-224
Date: September 21, 2015
Prepared by: Amy Macrellis

Darcy's Law Calculations: Q = KiA

Q = design flow (gallons / day)
K = Hydraulic conductivity (feet / day)
i = Hydraulic gradient (slope of water table, unitless)
A = transmitting soil cross-sectional area (D) times length of disposal system (L) in square feet, where
D = depth to impeding layer or water table, minus required vertical separation, minus system depth

Assumptions:

1. Hydraulic conductivity (K) = 69 feet/day (measured at TP-110)
2. Water table slope (i) is similar to ground surface slope, estimated from site survey, average of the slopes of the 6 leachfield areas laid out nearest the western tree line (11%)
3. Depth to limiting feature or bottom of pit (average 7.9 feet below ground surface across all test pits with sufficient depth of suitable soils for in-ground leachfields) is continuous across proposed leachfields
4. Design is for in-ground trenches with the bottom of the trenches located 1.5 feet below ground surface
5. Required separation distance to seasonal high groundwater = 3.0 feet for septic tank effluent
6. System length (L) across slope (perpendicular to contours) = 97 feet (average across all leachfield areas)

Calculations:

K = 69 ft./day
i = 11%
L = 97 ft.
D = (7.9 ft. - 1.5 ft. - 3.0 ft.) = 3.4 ft.

Q = 69 ft./day x 0.11 x (97 ft x 3.4 ft) x 7.48 gal/ft^3
Q = 18,724 gallons / day

Appendix B: Detailed Calculations for Opinions of Probable Cost and User Fee Estimates

Town of Westford
Jackson Farm Wastewater Capacity Study
Contract No. 1- Septic Tank Effluent Pumping (STEP) Collection System
Opinion of Probable Construction Cost

DESCRIPTION	Unit	Quantity	Unit Price	Total Amount ENR 10,037	Total Amount ENR 11,000
A- Sewers					
A-1 2" HDPE LPS	LF	4,600	$40	$184,000	$201,654
B- Sewerline Appurtenances					
B-1 5' Diameter Air Release/CO Manholes	EA	4	$8,000	$32,000	$35,070
B-2 5' Dia, C.O. Manholes	EA	4	$7,500	$30,000	$32,878
B-3 1 1/4" Low PressureSewer Services	LF	3,300	$34	$112,200	$122,965
B-3 4" Gravity Sewer Services	LF	500	$38	$19,000	$20,823
C- Earthwork					
C-1 Rock Excavation	CY	400	$120	$48,000	$52,605
C-2 Boulder Excavation	CY	50	$100	$5,000	$5,480
C-3 Misc. Extra and Below Grade Excavation	CY	20	$40	$800	$877
C-4 Excavation & Replace Unsuitable	CY	20	$40	$800	$877
D- Roadwork					
D-1 Permanent Bit. Pavement Repair	SY	80	$60	$4,800	$5,261
D-2 Permanent Gravel Road & Drive Repair	SY	800	$50	$40,000	$43,838
E-Incedental Work					
E-1 Class B Concrete	CY	10	$175	$1,750	$1,918
E-2 Calcium Chloride	TON	2	$600	$1,200	$1,315
E-3 Rigid Insulation	LF	300	$8	$2,400	$2,630
E-4 Uniform Traffic Officers	HRS	50	$60	$3,000	$3,288
E-5 Silt Fence	LF	1,000	$4	$4,000	$4,384
E-6 Degradable Erosion Control Blankets	SY	300	$4	$1,200	$1,315
E-7 Temporary Stone Check Dams	EA	12	$120	$1,440	$1,578
E-8 1,500 Gallon STEP Tanks (Includes Electrical and Panels)	EA	31	$10,000	$310,000	$339,743
E-9 2,000 Gallon STEP Tanks (Includes Electrical and Panels)	EA	2	$12,000	$24,000	$26,303
E-10 House Replumbs	EA	10	$1,000	$10,000	$10,959
E-11 Septic Tank Deactivation	EA	33	$1,000	$33,000	$36,166
F- Lump Sum Items					
Preparation of Site and Miscellaneous Work (8%)	LS	1	$69,487	$69,487	$76,154
Bonds (1.5%)	LS	1	$14,071	$14,071	$15,421
Contingency (10%)	LS	1	$95,215	$95,215	$104,350
SUBTOTAL				**$1,047,363**	**$1,147,852**
USE				**$1,050,000**	**$1,150,000**

Notes: The estimate is based on PLANNING phase estimates for construction and engineering. The quantities noted in the estimate are based on GIS scaled unit quantities from scenario's developed by Green Mountain Engineering (GME). GME bears no responsibility for prices and quantities noted in the estimate, beyond the planning phase. The quantities and unit prices will likely vary based on the actual design, site conditions. ENR = Engineering News Record- Construction Cost Index. ENR 10,037= July 2015. ENR 11,000= Predicted February 2018 (Bid Date)

Town of Westford
Jackson Farm Wastewater Capacity Study
Contract No. 2- Wastewater Disposal System
Opinion of Probable Construction Cost

DESCRIPTION	Unit	Quantity	Unit Price	Total Amount ENR 10,037	Total Amount ENR 11,000
Mobilization/Demobilization	LS	1	$3,000	$3,000	$3,288
Silt Fence	LF	600	$3	$1,800	$1,973
Excavate Leachfield Trenches	CY	3,333	$8	$26,667	$29,225
Leachfield Stone	CY	1,975	$25	$49,383	$54,121
1 1/2" Laterals	LF	10,000	$6	$60,000	$65,757
Filter Fabric	SY	4,444	$2	$8,889	$9,742
Topsoil	CY	123	$25	$3,086	$3,383
3" Forcemains	LF	1,500	$30	$45,000	$49,318
3" Gate Valves	Ea	6	$800	$4,800	$5,261
6' x 12' Precast Valve Structure					
Excavation	CY	80	$8	$640	$701
Precast Structure	LS	1	$8,000	$8,000	$8,768
Hatch	LS	1	$3,000	$3,000	$3,288
Steps	LS	1	$600	$600	$658
Sump Pump	LS	1	$500	$500	$548
3" Gate Valves	EA	6	$400	$2,400	$2,630
3" Check Valves	Ea	3	$400	$1,200	$1,315
3" SCh 80 PVC Pipe	LF	24	$40	$960	$1,052
Vent Pipe	LS	1	$300	$300	$329
Misc. Items	LS	1	$1,500	$1,500	$1,644
Structural Backfill	CY	50	$25	$1,250	$1,370
6' x 12' Precast Dosing Tank					
Excavation	CY	80	$8	$640	$701
Precast Structure	LS	1	$8,000	$8,000	$8,768
Hatches	LS	1	$9,000	$9,000	$9,864
Pumps and Slide Rails	EA	6	$5,000	$30,000	$32,878
3" SCh 80 PVC Pipe	LF	24	$40	$960	$1,052
Vent Pipe	LS	1	$300	$300	$329
Misc. Items	LS	1	$1,500	$1,500	$1,644
Structural Backfill	CY	50	$25	$1,250	$1,370
Electrical (New Service, Panel., Wiring)	LS	1	$30,000	$30,000	$32,878
Fine Grade, Seed and Mulch	SY	17,778	$2	$35,556	$38,967
Start-Up/Testing	LS	1	$3,000	$3,000	$3,288
Preparation of Site and Miscellaneous Work (8%)	LS	1	$27,454	$27,454	$30,089
Bonds (1.5%)	LS	1	$5,560	$5,560	$6,093
Contingency (10%)	LS	1	$37,619	$37,619	$41,229
SUBTOTAL				**$413,814**	**$453,517**
USE				**$415,000**	**$460,000**

Notes: The estimate is based on PLANNING phase estimates for construction and engineering. The quantities noted in the estimate are based on GIS scaled unit quantities from scenario's developed by Green Mountain Engineering (GME). GME bears no responsibility for prices and quantities noted in the estimate, beyond the planning phase. The quantities and unit prices will likely vary based on the actual design, site conditions. ENR = Engineering News Record- Construction Cost Index. ENR 10,037= July 2015. ENR 11,000= Predicted February 2018 (Bid Date)

Town of Westford
Jackson Farm Wastewater Capacity Study
Opinion of Probable Total Project Cost

DESCRIPTION	Total Cost
Construction	
Contract No. 1- Wastewater Collection System [1.]	$1,150,000
Contract No. 2- Wastewater Disposal System [1.]	$460,000
Construction Subtotal	**$1,610,000**
STEP I- Preliminary Engineering	
Feasibility Study	$10,000
Preliminary Engineering Study [2.]	$55,545
Act 250 Permitting	$5,000
Indirect Discharge Permitting	$25,000
Water Supply/Wastewater Disposal Permits	$2,000
Archeological Phase 1 B	$5,000
Wetlands Review	$2,500
Environmental Assessment Report	$5,000
Bond Vote Technical Assistance	$5,000
Sewer Use Ordinance	$5,000
STEP I- Preliminary Engineering Subtotal	**$120,045**
STEP II- Final Design Engineering	
Final Design Allowance [2.]	$111,090
STEP II- Final Design Subtotal	**$111,090**
STEP III- Construction Engineering Services	
Construction Enginering [2.]	$203,665
STEP III- Construction Engineering Subtotal	**$203,665**
Other Costs	
Administrative	$5,000
Land Acquisition	$150,000
Easement Assistance	$5,000
Legal & Fiscal	$5,000
Short Term Interest	$40,000
Other Costs Subtotal	**$205,000**
SUBTOTAL	**$2,249,800**
USE	**$2,250,000**

Notes: The estimate is based on PLANNING phase estimates for construction and engineering. The quantities noted in the estimate are based on GIS scaled unit quantities from scenario's developed by Green Mountain Engineering (GME). GME bears no responsibility for prices and quantities noted in the estimate, beyond the planning phase. The quantities and unit prices will likely vary based on the actual design, site conditions. ENR = Engineering News Record- Construction Cost Index. ENR 11,000= Predicted February 2018 (Bid Date)

Town of Westford
Jackson Farm Wastewater Capacity Study
Opinion of Probable First Year O&M Cost

Cost Category	O&M Cost
Contract Operations	$13,000
Electrical	$2,500
Septage Pumping	$2,500
Groundwater Monitoring	$3,000
Capital Replacement	$1,000
Insurance	$500
Misc. Repairs	$1,000
Billing	$500
O&M Cost Total	**$24,000**

Notes: The estimate is based on PLANNING phase estimates for O&M Costs. The estimateis based on scenario's developed by Green Mountain Engineering (GME). GME bears no responsibility for prices and quantities noted in the estimate, beyond the planning phase. The costs will likely vary based on the actual design, site conditions. Contract Operations is based on $45/hour x 288 hr/yr. Electrical is based on $0.14/kw-hr. Each homeowner pays for their own STEP system electrical cost. Septage pumping is based on 1/4 systems pumped each year at a cost of $300/pump out.

Town of Westford
Jackson Farm Wastewater Capacity Study
User Fee Estimates- Users Pay 100%

Category	No Grants	35% Grants	50% Grants	75% Grants
Bond Repayment Amount	$2,250,000	$1,462,500	$1,125,000	$562,500
Annual Bond Payment	$137,588	$89,432	$68,794	$34,397
Annual O&M costs	$24,000	$24,000	$24,000	$24,000
Total Annual Cost	$161,588	$113,432	$92,794	$58,397
No. of EU's	39	39	39	39
Annual User Fee	**$4,143**	**$2,909**	**$2,379**	**$1,497**

Notes: Annual Payment 20yr., SFRF 2% loan ($61.16/$1,000 borrowed)

Town of Westford
Jackson Farm Wastewater Capacity Study
User Fee Estimates- Parcel Assessment

Category	No Grants	35% Grants	50% Grants	75% Grants
Bond Repayment Amount	$2,250,000	$1,462,500	$1,125,000	$562,500
Annual Bond Payment	$137,588	$89,432	$68,794	$34,397
No. of Parcels	936	936	936	936
Annual Parcel Fee	**$147**	**$96**	**$73**	**$37**
Annual O&M costs	$24,000	$24,000	$24,000	$24,000
No. of EU's	39	39	39	39
User O&M Fee	$615	$615	$615	$615
Total User Fee	**$762**	**$711**	**$689**	**$652**

Notes: Annual Payment 20yr., SFRF 2% loan ($61.16/$1,000 borrowed)

Town of Westford Jackson Farm Wastewater Capacity Study User Fee Estimates- Property Assessment Fee				
Category	**No Grants**	**35% Grants**	**50% Grants**	**75% Grants**
Bond Repayment Amount	$2,250,000	$1,462,500	$1,125,000	$562,500
Annual Bond Payment	$137,588	$89,432	$68,794	$34,397
Increase in Tax Rate Needed	$0.055	$0.036	$0.028	$0.014
Property Value Assessed Fee	**$152**	**$99**	**$76**	**$38**
Annual O&M costs	$24,000	$24,000	$24,000	$24,000
No. of EU's	39	39	39	39
User O&M Fee	$615	$615	$615	$615
Total User Fee	**$768**	**$714**	**$692**	**$653**

Notes: Annual Payment 20yr., SFRF 2% loan ($61.16/$1,000 borrowed); Property value assessed fee is that typical for a property value of $275,000.