Agenda Item III.4

GREEN MOUNTAIN ENGINEERING, INC.

1438 South Brownell Road
P.O. Box 159
Williston, VT 05495
(802) 862-5590

January 24, 2018

Town of Bristol Selectboard
c/o Ms. Valerie Capels, Town Administrator
Town of Bristol
P.O. Box 249
Bristol, VT 05443

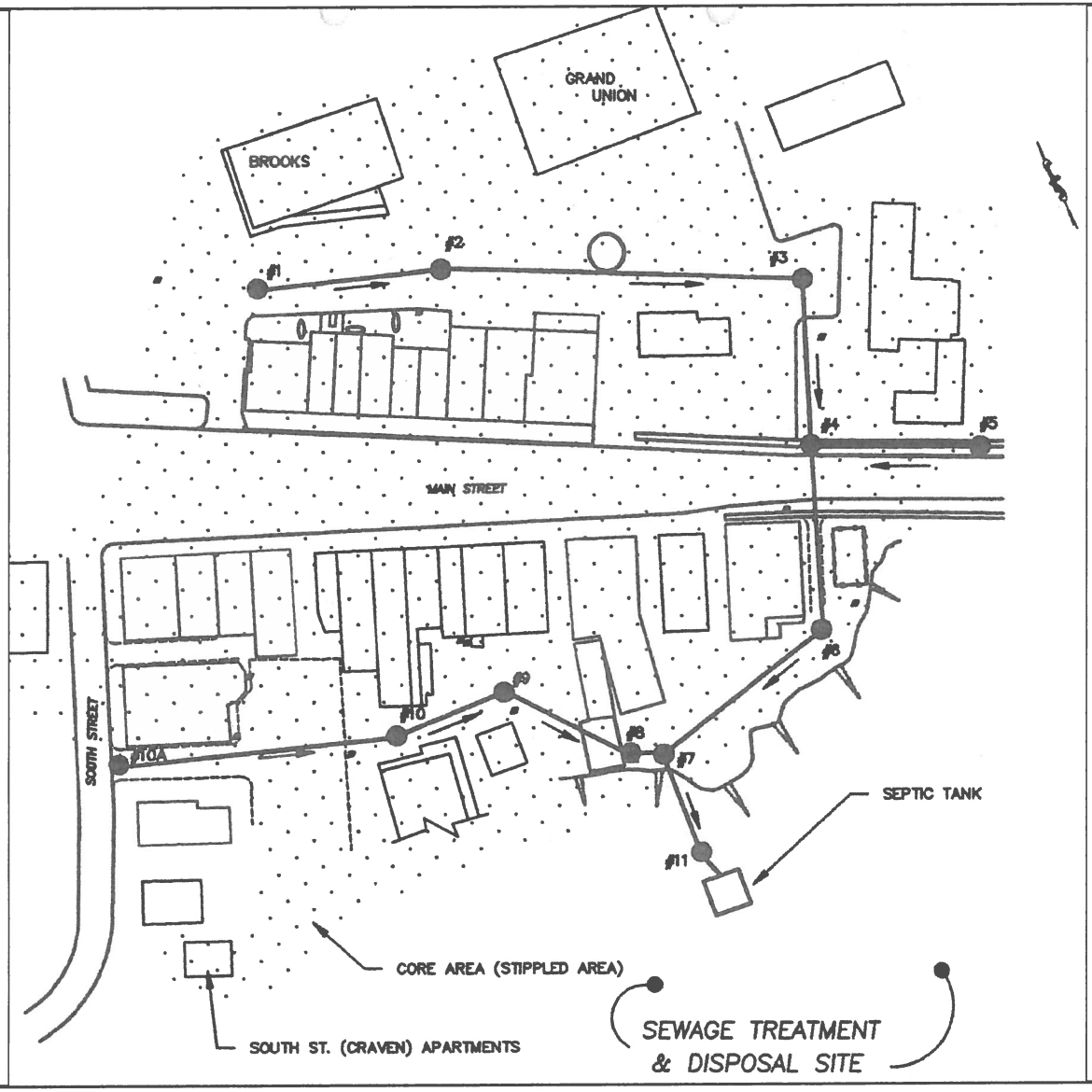
Re: Preliminary Engineering Letter Report - DRAFT
Wastewater System Upgrade
GME Project No. 16-025

Dear Valerie and Selectboard Members;

Green Mountain Engineering, Inc. (GME) has updated this preliminary engineering report in anticipation of an upgrade to the existing wastewater treatment system with a project primarily financed by the State of Vermont Revolving Loan Fund and local funds combination.

PROJECT PLANNING AREA

Figure No. 1 shows the approximate original service area, more commonly referred to as the Bristol Core Area, and a schematic layout of the existing collection system. The Core Area was originally comprised of 23 business and apartment buildings along Main Street and one (1) business and one (1) apartment building along South Street. Slight expansion of the service area has occurred to the northeast to serve residential, office and light commercial uses.



BRISTOL WASTEWATER STUDY

SEWER SYSTEM FLOW SCHEMATIC

GREEN MOUNTAIN ENGINEERING
CIVIL WATER WASTEWATER
1438 SOUTH BROWNELL ROAD
WILLISTON, VERMONT 05495
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SCALE:	DATE:	PROJECT NO.:	FIGURE #
NONE	JANUARY 22, 2018	16-025	1

EXISTING FACILITIES

The Bristol Wastewater Treatment Facility consists of collection sewers, a septic tank, and disposal fields located on the west side of Basin Street. The system is permitted to discharge treated domestic sewage from a subsurface disposal system serving numerous establishments located in Bristol, to the groundwater and indirectly into the New Haven River. The facility has a design capacity of 20,000 gallons per day (gpd). The average daily flow during the period from April 2016 to March 2017 was 8,696 gpd. The collection system consists of primarily 8-inch diameter PVC and some ductile iron piping shown schematically in Figure No. 1.

Originally, the commercial spaces located on both sides of Main Street all had individual wastewater disposal systems typically consisting of a buried septic tank and leach field or dry wells. The Bristol Wastewater Treatment Facility was constructed in 1993 as a replacement system for the individual systems, many of which experienced recurring failures that were serving the business and apartment buildings in the Core Area. The system was constructed and provided no capacity for growth within the service area. After several years of operation, actual flows were documented well below design flows and an Indirect Discharge Permit (No. ID-9-0208) was applied for and issued in 1998 with an approved discharge flow of 20,000 gpd.

In accordance with the discharge permit, issued by the State of Vermont, Wastewater Management Division, the Town of Bristol is required to have a Vermont registered Professional Engineer complete an annual inspection of the sewage collections, treatment and disposal system. Currently, Green Mountain Engineering is contracted to complete the system evaluation during the spring of each year to ensure that a copy of the annual inspection report is submitted to the State by June 1st. The annual inspection report displays a list of items inspected; the conditions encountered, and any recommended repairs or changes in operation that are required.

According to the Bristol Core Area Sewer System Budget & Annual Report, the annual operating budget for the sewer system is approximately $40,920, which includes approximately $11,874 in debt retirement. Users of the wastewater system presently pay a minimum charge of $125.00 per quarter for up to 100 gallons of Average Daily Flow (ADF) and a usage charge of $50.00 per quarter for every 100 gallons of ADF above the minimum 100 gallons.

NEED FOR PROJECT

By May 15th of every year, the Town of Bristol is required to submit a letter to the Secretary listing any facilities which were approved for connection to the sewage collection, treatment and disposal system during the previous twelve (12) months and the approximate date of connection. The Secretary reviews the long term data for concentrations of BOD5 and TSS in the septic tank effluent and the long term average daily flow. The reserve capacity is calculated based on the pounds of BOD5 and TSS discharged to the leach fields and the actual leach field loading capacity (based on a ADF = 20,000 gpd). The uncommitted reserve capacity, equal to 80% of the reserve capacity for any given year (after subtracting those approved connections to the system or those which have been connected for less than six (6) months), is then reported to the Town of Bristol. In May of 2017, the Wastewater Management Division reported that the uncommitted reserve capacity available for new connections was 1,417 gpd.

The available uncommitted reserve capacity varies based on average daily wastewater flow for the previous two years and the long-term wastewater strength for the system since its inception, represented by Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS).

This reserve capacity is low enough to limit growth or possible changes of use within the core area (i.e. inadequate to allow for a 50-seat restaurant or six two-bedroom apartments). It is for this reason, that an upgrade to the existing sewage treatment system is needed. Also, during the annual system evaluations performed by GME, several deficiencies were noted which pose safety concerns for the system Operator. The hatches for each structure are in poor condition and in need of refurbishment or replacement. Lift gates inside the septic tank are seized and difficult to operate. Also, the dosing siphon counters have been problematic throughout the life of the system primarily due to vandalism and humidity. The counters are no longer used or maintained.

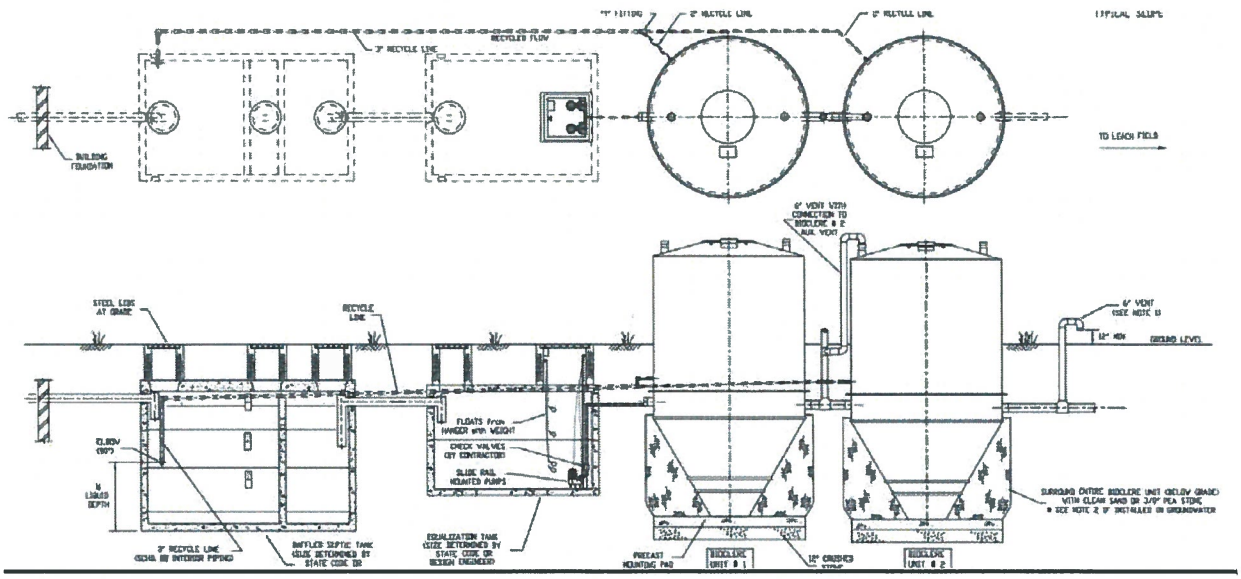
EVALUATION OF ALTERNATIVES

Based on limited research of available technologies, four wastewater treatment system alternatives were investigated to upgrade the existing facility to allow for additional reserve capacity. Each of the technologies chosen is appropriate for the flow range of the Bristol system and were chosen based on their relative cost and space limitations of the existing disposal system site.

1. Bioclere®, by Aquapoint

   The Bioclere® treatment system is manufactured by Aquapoint, headquartered in New Bedford, Massachusetts. The system is designed to provide enhanced treatment in a smaller footprint compared to conventional residential and commercial septic systems and leach field. The pre-engineered packaged systems have a modular design allowing for the installation of several systems in parallel to meet flow requirements.

   The typical Bioclere® system consists of the following components: 1) septic tank, 2) Bioclere, and 3) effluent disposal. Tertiary treatment such as filtration and UV disinfection also can be added between the Bioclere and effluent disposal. The Bioclere® unit is located mostly below grade with only a couple feet of the top of the tank exposed at grade. The unit is a circular fiberglass tank with a cone-shaped bottom consisting of two main sections, a biofilter and clarifier. The biofilter consists of PVC plastic media that provides a surface for microorganism to attach and grow. The clarifier is located below the biofilter and contains submersible pumps for media dosing, recirculation to the septic tanks, and effluent disposal.



Bioclere provided three different treatment options including:

- Option 1: Dual stage Bioclere units in series.
- Option 2: AquaCELL aerobic moving bed biofilm reactor and single stage Bioclere unit.
- Option 3: AquaCELL aerobic moving bed biofilm reactor and single stage Bioclere unit.

For all alternatives, they recommend an 8,000 gallon flow equalization tank ahead of the treatment components.

We chose to evaluate Option 1 as all of the options are very similar in price. Option 1 is more simplistic and provides for redundancy. There is also less maintenance.

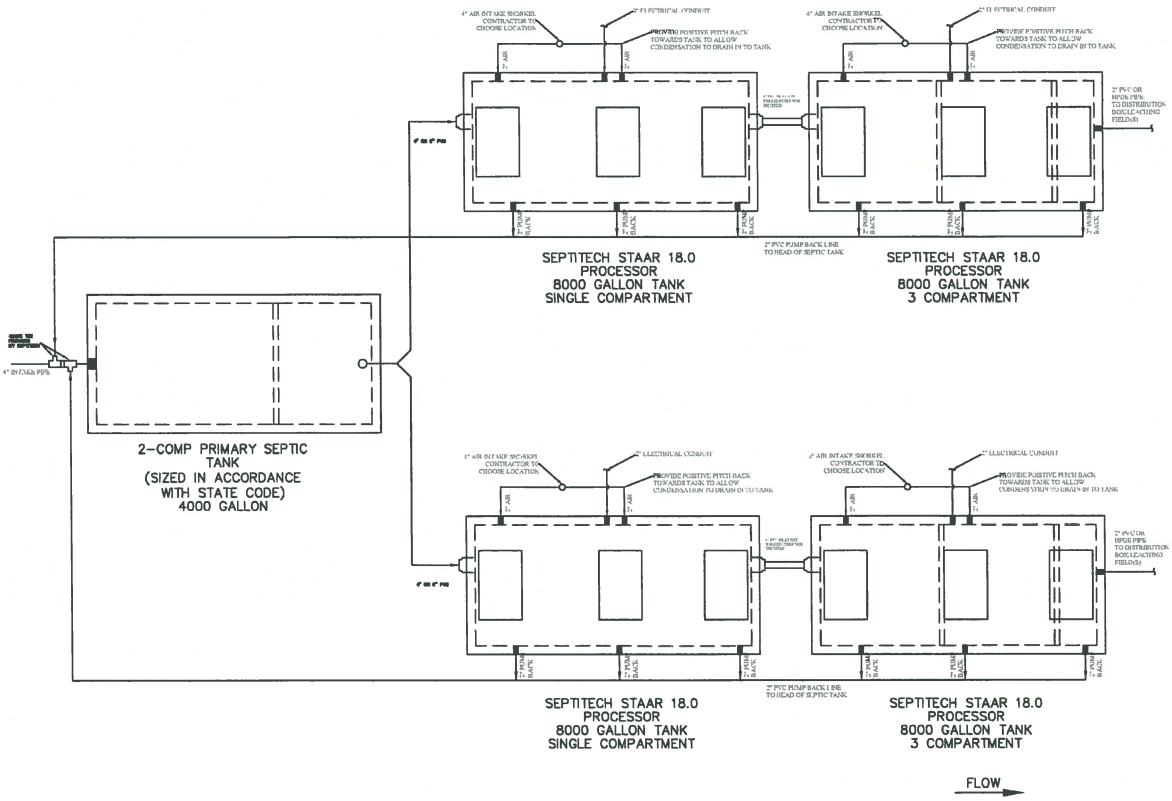
2. SeptiTech®

SeptiTech®, Inc. is headquartered in Gray, Maine and manufactures a packaged trickling filter system. This product is represented and supported locally by S.D. Ireland. The treatment system is designed to provide enhanced treatment in a smaller footprint compared to conventional residential and commercial septic systems and leach fields.

The pre-engineered packaged systems for commercial and residential uses are available in standard sizes up to 3,000 gpd. Custom systems in larger sizes up to 100,000 gpd are also available.

The SeptiTech® system consists of the following components: 1) 2-chambered baffled septic tank, 2) SeptiTech® Processor, and 3) effluent disposal fields/disinfection system (if used). The SeptiTech® Processor is a below-ground concrete tank containing the trickling filter. The media consists of hydrophobic polystyrene beads.

The SeptiTech® system model is a STAAR 18. This system is comprised of (2) STAAR 4.5 systems that basically work as two separate systems. There would be a total of (4) 8000 gallon treatment tanks. The outside dimensions of each tank would be 9'wide x 17'long x 11'-4" tall, and will have approximately 1' of riser above the top of the tanks for cover material. Each tank will also have (3) 30"x48" Aluminum hatches that will be mounted to the top each of the risers. The tanks will be two piece tanks and each half will weigh approximately 35,000lbs and will need to be set by an outside crane service provided by the contractor. The first tank in each system with be a single compartment and have three pump back pumps, recirculation pump and will basically be full of roughing media. The two second tanks will be three compartment tanks and will have three pump back pumps, recirculation pump, discharge pump and will have roughing and polishing media. The flows from the septic tank with need to be equally split to go to the two systems this means the existing septic tank may need to have an additional outlet hole drilled in it or some other way to split the outlet flow.

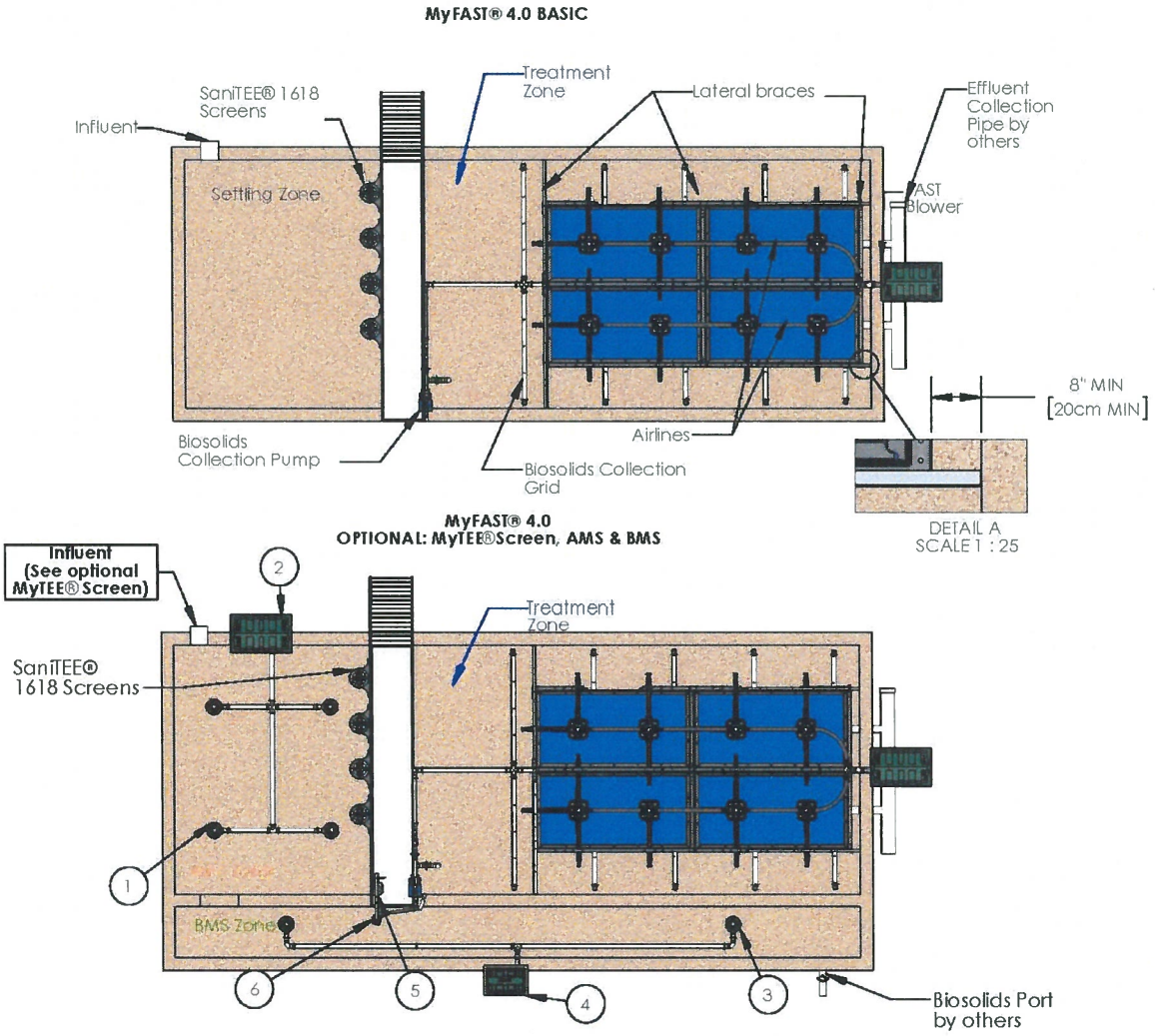


3. High-Strength FAST®, by Bio-Microbics

The FAST®, or Fixed Activated Sludge Treatment, wastewater treatment system is a pre-engineered modular wastewater treatment system/device designed to treat wastewater from residential, commercial, high strength, and small community applications. The system is a fixed film, aerated system utilizing a combination of attached and suspended growth. High-Strength FAST® is utilized in commercial applications or anywhere the strength of the waste introduces special challenges. The system is currently available with hydraulic capacities up to 9,000 gpd, but may be used in parallel and/or in series to meet larger flow or waste strength needs.

The FAST® system consists of the following components: 1) 2-chambered septic tank for primary settling and duplex pump vault, 2) tank with FAST® treatment insert, and 3) effluent disposal fields. The system is located below ground level and the only moving part, the quiet-running aerating blower, is placed above ground in an unobtrusive blower housing. The housing can be located up to 100 feet away.

No other filters or pumps are needed for the FAST® system. Below is a figure displaying the High-Strength FAST® treatment system.



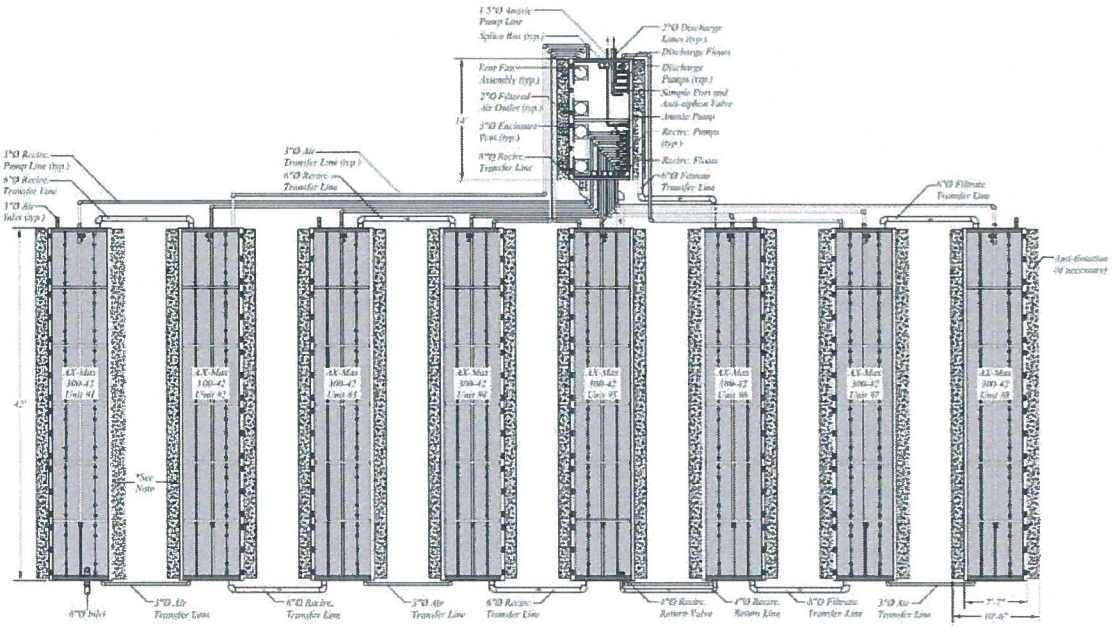
4. Orenco® Systems, Inc.

Orenco® Systems, Inc. is headquartered in Southerin, Oregon and manufactures a packaged trickling filter system. This product is represented and supported by Water Industries of Alton, New Hampshire. The treatment system is designed to provide enhanced treatment in a smaller footprint compared to conventional residential and commercial septic systems and leach fields.

Orenco's AdvanTex® AX-Max Treatment Systems are a dependable, proven technology for treating domestic-strength, primary-treated effluent to better-than-secondary standards, including nitrogen-reduction. They consist of sturdy, watertight fiberglass tanks that incorporate recirculation-blend and discharge tankage in a single module. Each complete, pre-manufactured unit also includes pumping systems, ventilation, and a lightweight, highly absorbent, engineered textile media that treats wastewater in a small space.

AX-Max Treatment Systems are intended for large residential applications or for commercial and municipal applications that require advanced secondary treatment. They eliminate the need for separate recirculation and discharge tanks by performing both functions within a single module. AX-Max units are marketed for subdivisions, "fringe" development, hotels, resorts, schools, churches, businesses, manufactured home parks, RV parks, campgrounds, rest areas, and truck stops.

Depending on model, a single AdvanTex® AX-Max unit can treat peak flows of 5,000-15,000 gpd (18.9-56.8 m3/day). AdvanTex® Treatment Systems are modular, however, and can be installed in multi-unit arrays to handle higher flows. Eight (8) treatment units are anticipated for the Bristol system.



5. Cromaglass®

Cromaglass® was the system recommended in the previous report, dated August 13, 2007. Cromaglass® has since gone out of business. Therefore, Cromaglass® is not an alternative anymore.

The following influent conditions and effluent requirements were used during the comparison of the technologies described above.

Table 1
Design Criteria

1.	Influent Conditions	
	a. Average Design Flow	20,000 gpd
	b. BOD	400 mg/l
	c. Total Suspended Solids	85 mg/l
2.	Effluent Criteria	
	a. BOD (5 days – 10 C)	30 mg/l
	b. Total Suspended Solids	30 mg/l

One of the most important considerations for this project is the constraints presented by the existing site. Access is limited to Basin Street and due to its steep grade and sharp change in grade from Main Street, delivery of large heavy tanks is challenging.

Electric power for each alternative is readily available at the site. However, a new electric service is needed for each of the alternatives. The new electric service costs are included in the cost of the alternatives.

Septic tank modifications, which are included in each alternative will include replacement of slide gates and hatches.

The dosing siphons are in poor condition. The existing counters do not work. The dosing syphons should be replaced and new dosing counters should be added. The FLOUT® Dosing System offers a simple, self-contained and trouble-free method of delivering intermittent dosing to gravity fed and pressure fed septic fields.

A chamber of sufficient dimensions to contain the required dose has an upper inlet and a lower outlet, usually at floor level. No plumbing extends below the floor. The outlet diameter is usually 3 inches but may be 4 inches, 2 inches, or as small as 1 inch.

A box shaped vessel floats on the surface of the liquid in the chamber. There is an opening in the upper side of the vessel and a ballast weight is attached. A length of pipe extends far into the vessel, through the side, and attaches to a special flexible connector the same diameter as the pipe. The other end of the connector is connected to the outlet, usually via a tee fitting with a vent extending above the maximum liquid level.

The flexible connector acts as a hinge, allowing the vessel to float ever higher as the chamber fills. When the vessel can float no higher, liquid spills into the vessel, forcing it to sink to the floor, allowing the liquid to flow through the outlet. When the liquid level drops to the top of the vessel, flow stops when the vessel drains and re-floats in the remaining liquid.

Failed siphons are readily replaced with Flouts.

With the exception of the Orenco® System, each of the wastewater treatment technologies that were described above would fit within the confines of the existing treatment and disposal area on Basin Street. For this reason, the Orenco® System has been eliminated as a viable option.

Each of the remaining alternatives would require excavation and relocation/removal of existing components, but additional lands are not required. For each alternative, the existing splitter box would be removed. Each alternative will result in effluent pumps being used to deliver wastewater to the existing dosing tank. Dosing out of the fields would then be achieved by the flout units.

The Bioclere unit can be fed by gravity from the existing septic tank. Septitech®, and Fast® units require influent pump stations to distribute the wastewater uniformly. Only one of the four options (Fast) employs actual blowers for wastewater treatment. Bioclere® units have small horsepower fans. Adequate provisions would be required to reduce the noise levels of this alternative due to the residential nature of the surrounding area.

The Bioclere® units are represented by AquaPoint of New Bedford, Massachusetts. See Appendix C for the Bioclere® proposal and technical information. Septitech® units are presently represented locally by S.D. Ireland of South Burlington, Vermont. See Appendix D for the Septitech® Proposal and technical information. The Fast® units are represented by Camp Precast from Milton, Vermont. See Appendix E for the Fast® proposal. Technical information Orenco® are represented by Camp Precast of Milton, Vermont. See Appendix F for the Orenco® technical information.

Table 2
Mechanical Requirements

Technology	Influent Pumps (#)	Blowers(#)	Process Pumps (#)	Discharge Pumps (#)
Bioclere	No	Fan	Yes (6)	Yes (4)
Septitech	Yes (2)	No	Yes (12)	Yes (4)
Orenco	Yes	Fan	Yes (4)	Yes (2)
Fast	Yes (2)	Yes (2)	No	Yes (4)

PROJECT COSTS

This section presents Opinions of Probable Costs for construction, total project costs and operation and maintenance costs.

Opinions of Probable Construction costs for each* alternative described above are presented in Tables A-1 through A-4 in Appendix A.

A Total Project Cost Summary for each alternative* is presented in Table 3. Total project costs include construction costs, plus other project related costs such as technical services, legal and fiscal, administrative, construction and engineering contingency, land acquisition, and interest on short-term loans.

Representative first year operation and maintenance costs are presented in Table 4.

RECOMMENDED PROJECT

Green Mountain Engineering, Inc. recommends the Septitech® alternative for the Bristol Core Area Wastewater Treatment Upgrade, based on its relative construction cost, local representation and overall basic operation.

Table 5 presents a recommended schedule for implementation of the project.

TABLE 3

BRISTOL WASTEWATER STUDY

TOTAL PROJECT COST SUMMARY

DESIGN AND CONSTRUCTION COSTS

System Alternative No.	Bioclere® No. 1	SeptiTech® No. 2	Fast® No. 3	Orenco® No. 4
CONSTRUCTION	$430,000	$450,000	$500,000	$1,655,000
ENGINEERING	105,000	110,000	120,000	150,000
LEGAL AND FISCAL	5,000	5,000	5,000	5,000
ADMINISTRATIVE	2,000	2,000	2,000	2,000
LAND ACQUISITION	0	0	0	0
INTEREST	5,000	5,000	6,000	10,000
CONTINGENCY	54,000	56,000	62,000	180,000
TOTAL	$601,000	$628,000	$695,000	**$2,002,000**

TABLE 4

BRISTOL WASTEWATER STUDY

ANNUAL OPERATION AND MAINTENANCE COST

ANNUAL OPERATION & MAINTENANCE COSTS	CURRENT OPERATIONAL EXPENSES	FIRST YEAR
OPERATING CONTRACT	$ 9,592	$ 12,000
ADMINISTRATIVE	$ 2,724	$ 2,724
FICA/MEDICAL	$ 208	$ 208
RETIREMENT	$ 204	$ 204
HEALTH INSURANCE	$ 997	$ 997
DISABILITY INSURANCE	$ 30	$ 30
SUPPLIES	$ 800	$ 800
INSURANCES	$ 202	$ 1,250
MAINTENANCE/PUMPING	$ 11,100	$ 15,000
ELECTRICITY	$ 0	$ 15,000
TELEPHONE/CELLULAR SERVICE	$ 0	$ 600
TESTING	$ 1,200	$ 2,000
ENGINEERING	$ 1,800	$ 2,000
DEBT RETIREMENT	$ 11,874	$ 48,631*
CAPITAL RESERVE	$ 169	$ 1,000
MISCELLANEOUS	$ 20	$ 1,000
TOTAL	**$ 40,920**	**$103,444**

***Includes existing debt retirement ($11,874 – expires November 2023), plus an estimated debt retirement ($36,757) for the recommended project based on financing at 2% for 20 years.**

TABLE 6

BRISTOL WASTEWATER STUDY

PROJECT SCHEDULE

The following schedule is a proposed chronological listing of the activities that should follow the review of this report by the Town of Bristol.

The Town may wish to consider the November 2023 maturity of the existing debt when considering the timing of moving the project forward through the process.

Please note that the first bond payment for a project of this type is typically due 2 years following substantial completion or 1 year following the end of the warranty period.

1.	Submit Final Study Report to ANR with Planning Loan Application	September 2018
2.	Complete Reviews (ANR, Other)	November 2018
3.	Begin Final Design	December 2018
4.	Public Meeting/ Vote	March 2019
5.	Complete Final Design and Submit with Construction Application for Review	March 2019
6.	Complete Reviews & Make Final Changes	May 2019
7.	Advertise for Bids	June 2019
8.	Begin Construction	August 2019
9.	Substantial Completion	June 2020

As you can see this schedule is fairly aggressive and is presented for discussion purposes only at this phase of the project.

Thank you for the opportunity to provide this wastewater study for the Core Area Sewer System. I look forward to discussing this report at your February 5, 2018 Selectboard meeting.

Sincerely.

GREEN MOUNTAIN ENGINEERING, INC.

Kevin J. Camara, P.E.
Project Engineer

APPENDIX A – OPINION OF PROBABLE CONSTRUCTION COST TABLES

TABLE A-1

OPINION OF PROBABLE CONSTRUCTION COST

ALTERNATIVE NO. 1 - Bioclere, by Aquapoint

Dual Stage Bioclere units in series.

Bristol, Vermont

Description	Quantity	Units	Unit Price	Total Cost
WASTEWATER TREATMENT UPGRADE				
Treatment System	1	L.S.	$162,000	$162,000
Treatment Sitework	1	L.S.	$50,000	$50,000
Equalization Tank	1	L.S.	$30,000	$30,000
Effluent Pump Station	1	L.S.	$30,000	$30,000
Controls	1	L.S.	$35,000	$35,000
Septic Tank Modifications	1	L.S.	$20,000	$20,000
Electrical	1	L.S.	$25,000	$25,000
Piping, Valves, Misc.	1	L.S.	$15,000	$15,000
Dosing Siphon Modifications	1	L.S.	$25,000	$25,000
			SUBTOTAL	$392,000
MISCELLANEOUS				
Site Prep./Misc. Work	1	L.S.	$31,360	$31,360
Contractor's Bond	1	L.S.	$6,350	$6,350
			SUBTOTAL	$37,710
			TOTAL	$429,710
			USE	**$430,000**

TABLE A-2

OPINION OF PROBABLE CONSTRUCTION COST

ALTERNATIVE NO. 2 - SeptiTech

Bristol, Vermont

Description	Quantity	Units	Unit Price	Total Cost
WASTEWATER TREATMENT UPGRADE				
Treatment System	1	L.S.	$204,000	$204,000
Treatment Sitework	1	L.S.	$40,000	$40,000
Effluent Pump Station	1	L.S.	$30,000	$30,000
Controls	1	L.S.	$35,000	$35,000
Septic Tank Modifications	1	L.S.	$20,000	$20,000
Electrical	1	L.S.	$25,000	$25,000
Piping, Valves, Misc.	1	L.S.	$15,000	$15,000
Dosing Siphon Modifications	1	L.S.	$25,000	$25,000
			SUBTOTAL	$394,000
MISCELLANEOUS				
Site Prep./Misc. Work	1	L.S.	$39,400	$39,400
Contractor's Bond	1	L.S.	$13,002	$13,002
			SUBTOTAL	$52,402
			TOTAL	$446,402
			USE	**$450,000**

TABLE A-3

OPINION OF PROBABLE CONSTRUCTION COST

OPTION NO. 3 - High-Strength FAST, by Bio-Microbics

Bristol, Vermont

Description	Quantity	Units	Unit Price	Total Cost
WASTEWATER TREATMENT UPGRADE				
Treatment System	1	L.S.	$135,000	$135,000
Concrete Tank	1	L.S.	$120,000	$120,000
Treatment Sitework	1	L.S.	$40,000	$40,000
Effluent Pump Station	1	L.S.	$30,000	$30,000
Controls	1	L.S.	$35,000	$35,000
Septic Tank Modifications	1	L.S.	$20,000	$20,000
Electrical	1	L.S.	$25,000	$25,000
Piping, Valves, Misc.	1	L.S.	$15,000	$15,000
Dosing Siphon Modifications	1	L.S.	$25,000	$25,000
			SUBTOTAL	$445,000
MISCELLANEOUS				
Site Prep./Misc. Work	1	L.S.	$44,500	$44,500
Contractor's Bond	1	L.S.	$7,343	$7,343
			SUBTOTAL	$51,843
			TOTAL	$496,843
			USE	**$500,000**

TABLE A-4

OPINION OF PROBABLE CONSTRUCTION COST

ALTERNATIVE NO. 4- Orenco

Bristol, Vermont

Description	Quantity	Units	Unit Price	Total Cost
WASTEWATER TREATMENT UPGRADE				
Treatment System	1	L.S.	$1,270,836	$1,270,836
Treatment Sitework	1	L.S.	$40,000	$40,000
Effluent Pump Station	1	L.S.	$30,000	$30,000
Controls	1	L.S.	$35,000	$35,000
Septic Tank Modifications	1	L.S.	$20,000	$20,000
Electrical	1	L.S.	$25,000	$25,000
Piping, Valves, Misc.	1	L.S.	$15,000	$15,000
Dosing Siphon Modifications	1	L.S.	$25,000	$25,000
			SUBTOTAL	$1,460,836
MISCELLANEOUS				
Site Prep./Misc. Work	1	L.S.	$146,084	$146,084
Contractor's Bond	1	L.S.	$48,208	$48,208
			SUBTOTAL	$194,291
			TOTAL	$1,655,127
			USE	**$1,655,000**

APPENDIX B – FIGURES

APPENDIX C – BIOCLERE PROPOSAL

APPENDIX D – SEPTI-TECH PROPOSAL

APPENDIX E – FAST PROPOSAL

APPENDIX F – ORENCO PROPOSAL