SYSTEM PERFORMANCE DATA

Submitted to Montana Department of Environmental Quality for Approval of SepticNET™ System

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EXECUTIVE SUMMARY

Recently, housing development in many areas of Montana have been restricted due to elevated nitrate levels in water supply wells. These nitrate sources are believed to be from nearby on-site septic systems. The Montana Department of Environmental Quality (MDEQ) has stated in a memo that in order for development to occur in areas of Montana with near surface bedrock or areas with documented nutrient impacts, the total nitrogen concentration entering a drainfield must be less than 7.5 mg/L. ***All existing on-site, individual treatment systems fail to meet this requirement.***

In July 2008, Water & Environmental Technologies (WET) was awarded funding from the Montana Board of Research and Commercialization Technologies (MBoRCT) for the design optimization and commercialization of a Septic Nutrient Elimination Technology (**SepticNET™**) for individual on-site septic treatment systems. This new and revolutionary technology was invented and developed by Dr. Steve Anderson, P.E., a Senior Engineer with WET. Using a combination of private funding and MBoRCT grant funds, five (5) full-scale SepticNET™ systems were designed, assembled, and installed at households in the Butte, Montana area from September 2008 to January 2009. System operation and testing occurred from January 2001 thru July 2009. Depending on the system, performance data was collected from July 2009 thru September 2010.

Performance of the existing **SepticNET™** systems justifies approval and certification of **SepticNET™** to remove **92.2% of total nitrogen; 98.7% of bio-chemical oxygen demand (BOD); and over 99% of total suspended solids (TSS)** (see Table E1). Approval of **SepticNET™** will provide the most environmentally complete alternative to on-site wastewater treatment available in Montana and the entire United States. Average performance highlights for each system are listed below.

- **System 1** [redacted]
  - Total Nitrogen – 91.9% Removal (influent – 82.2 mg/L; effluent – 6.7 mg/L);
  - BOD – 98.7% Removal (influent – 154.0 mg/L; – effluent 1.9 mg/L); and
  - TSS – 99% Removal (influent – 218.0 mg/L; effluent – <4 mg/L).
- **System 2** [redacted]
  - Total Nitrogen – 90.7% Removal (influent – 67.1 mg/L; effluent – 6.3 mg/L);
  - BOD – 98.2% Removal (influent – 116.6 mg/L; effluent – 2.1 mg/L); and
  - TSS – 99% Removal (influent – 121.1 mg/L; effluent – <4 mg/L).
- **System 3** [redacted]
  - Total Nitrogen – 89.3% Removal (influent – 58.0 mg/L; effluent – 6.2 mg/L);
  - BOD – 97.6% Removal (influent – 85.0 mg/L; effluent – 2.0 mg/L); and
  - TSS – 99% Removal (influent – 77.5 mg/L; effluent – <4 mg/L).
- **System 4** [redacted]
  - Total Nitrogen – 92.6% Removal (influent – 61.4 mg/L; effluent – 4.5 mg/L);
  - BOD – 98.8% Removal (influent – 171.5 mg/L; effluent – 2.0 mg/L); and
  - TSS – 99% Removal (influent – 119.7 mg/L; effluent – <4 mg/L).
- **System 5** [redacted]
  - Total Nitrogen – 94.6% Removal (influent – 105.5 mg/L; effluent – 5.7 mg/L);
  - BOD – 99% Removal (influent – 215.7 mg/L; effluent – 2.1 mg/L); and
  - TSS – 99% Removal (influent – 103.5 mg/L; effluent – <4 mg/L).

Table E1, below, summarizes performance data collected for the existing **SepticNET™** systems.

Table E1. SepticNET™ System Performance Data

System	Sample Description	Date	Total Nitrogen (TN)			BOD			Total Suspended Solids (TSS)		
			Influent	Effluent	% Reduction	Influent	Effluent	% Reduction	Influent	Effluent	% Reduction
SYSTEM 1 [redacted]	Summer Quarterly (Aug-Oct)	9/30/2010	75.66	14.14	81.3%	110	ND	100.0%	172	<4	100.0%
	Winter Monthly (Nov-Apr)	11/19/2009	94.80	6.83	92.8%	178	3.18	98.2%	584	<4	100.0%
	Winter Monthly (Nov-Apr)	12/17/2009	88.90	4.71	94.7%	136	2.1	98.5%	464	<4	100.0%
	Winter Monthly (Nov-Apr)	1/28/2010	70.50	8.89	87.4%	99.5	2.35	97.6%	44	<4	100.0%
	Winter Monthly (Nov-Apr)	2/24/2010	73.76	4.78	93.5%	145	2.14	98.5%	252	<4	100.0%
	Winter Monthly (Nov-Apr)	3/31/2010	82.03	5.23	93.6%	137	<2	100.0%	224	<4	100.0%
	Winter Monthly (Nov-Apr)	4/29/2010	71.72	8.51	88.1%	96.3	2.25	97.7%	38	<4	100.0%
	Summer Quarterly (May -July)	5/26/2010	57.58	4.48	92.2%	86.4	3.94	95.4%	30	<4	100.0%
	Summer Quarterly (May -July)	6/30/2010	70.27	4.76	93.2%	62.4	2.92	95.3%	83	<4	100.0%
	Summer Quarterly (May -July)	7/29/2010	156.02	3.90	97.5%	590	2.44	99.6%	370	<4	100.0%
	Summer Quarterly (Aug-Oct)	8/18/2010	62.83	6.94	89.0%	53	<2	100.0%	137	<4	100.0%
SYSTEM 2 [redacted]	Summer Quarterly (Aug-Oct)	10/29/2009	62.56	11.96	80.9%	150	<2	100.0%	244	<4	100.0%
	Winter Monthly (Nov-Apr)	11/19/2009	77.20	11.18	85.5%	214	<2	100.0%	352	<4	100.0%
	Winter Monthly (Nov-Apr)	12/17/2009	65.10	6.21	90.5%	101	<2	100.0%	100	<4	100.0%
	Winter Monthly (Nov-Apr)	1/28/2010	55.30	6.17	88.8%	77.6	<2	100.0%	19	<4	100.0%
	Winter Monthly (Nov-Apr)	2/24/2010	53.96	4.43	91.8%	82.9	<2	100.0%	45	<4	100.0%
	Winter Monthly (Nov-Apr)	3/31/2010	70.92	5.38	92.4%	107	<2	100.0%	156	<4	100.0%
	Winter Monthly (Nov-Apr)	4/29/2010	51.58	1.86	96.4%	80.5	4.75	94.1%	38	<4	100.0%
	Summer Quarterly (May -July)	5/26/2010	62.32	3.73	94.0%	139	3.57	97.4%	47	<4	100.0%
	Summer Quarterly (May -July)	6/30/2010	86.63	7.76	91.0%	106	2.29	97.8%	101	<4	100.0%
	Summer Quarterly (May -July)	7/29/2010	87.21	4.02	95.4%	113	4.09	96.4%	56	<4	100.0%
	Summer Quarterly (Aug-Oct)	8/18/2010	67.30	6.27	90.7%	112	6.08	94.6%	174	<4	100.0%
SYSTEM 3 [redacted]	Summer Quarterly (May-Jul)	7/30/2009	66.00	13.90	78.9%	47	<2	100.0%	21	<4	100.0%
	Summer Quarterly (Aug-Oct)	9/30/2009	45.51	4.10	91.0%	18	5.56	69.1%	28	<4	100.0%
	Winter Monthly (Nov-Apr)	11/19/2009	55.70	10.08	81.9%	108	<2	100.0%	52	<4	100.0%
	Winter Monthly (Nov-Apr)	12/17/2009	52.60	5.48	89.6%	67.9	2.73	96.0%	71	<4	100.0%
	Winter Monthly (Nov-Apr)	1/28/2010	48.10	6.79	85.9%	25.8	<2	100.0%	18	<4	100.0%
	Winter Monthly (Nov-Apr)	2/24/2010	82.07	5.16	93.7%	274	<2	100.0%	280	<4	100.0%
	Winter Monthly (Nov-Apr)	3/31/2010	58.50	7.80	86.7%	59.7	<2	100.0%	35	<4	100.0%
	Winter Monthly (Nov-Apr)	4/29/2010	62.40	5.90	90.5%	105	3.64	96.5%	65	<4	100.0%
	Summer Quarterly (May -July)	5/26/2010	55.70	2.64	95.3%	68.3	4.07	94.0%	26	<4	100.0%
	Summer Quarterly (May -July)	7/29/2010	55.80	3.19	94.3%	77.4	2.74	96.5%	114	<4	100.0%
	Summer Quarterly (Aug-Oct)	8/18/2010	55.40	3.50	93.7%	84.2	3.42	95.9%	143	<4	100.0%
SYSTEM 4 [redacted]	Summer Quarterly (May-Jul)	7/30/2009	37.40	6.80	81.8%	96	<2	100.0%	21	2.4	88.6%
	Summer Quarterly (Aug-Oct)	9/30/2009	33.46	4.10	87.7%	85	2.08	97.6%	28	<4	100.0%
	Winter Monthly (Nov-Apr)	11/19/2009	82.40	7.11	91.4%	179	<2	100.0%	216	<4	100.0%
	Winter Monthly (Nov-Apr)	12/17/2009	92.20	8.32	91.0%	414	<2	100.0%	480	<4	100.0%
	Winter Monthly (Nov-Apr)	1/28/2010	55.60	3.53	93.7%	119	<2	100.0%	34	<4	100.0%
	Winter Monthly (Nov-Apr)	2/24/2010	65.73	2.92	95.6%	176	<2	100.0%	72	<4	100.0%
	Winter Monthly (Nov-Apr)	3/31/2010	84.32	3.52	95.8%	208	2.78	98.7%	168	<4	100.0%
	Winter Monthly (Nov-Apr)	4/29/2010	32.26	3.14	90.3%	85.5	11.28	86.8%	14	<4	100.0%
	Summer Quarterly (May -July)	5/26/2010	49.94	3.60	92.8%	160	4.26	97.3%	31	<4	100.0%
	Summer Quarterly (May -July)	6/30/2010	75.80	3.04	96.0%	164	2.18	98.7%	109	<4	100.0%
	Summer Quarterly (May -July)	7/29/2010	48.81	5.88	88.0%	189	<2	100.0%	31	<4	100.0%
	Summer Quarterly (Aug-Oct)	8/18/2010	79.02	2.08	97.4%	182	2	98.9%	232	<4	100.0%
SYSTEM 5 [redacted]	Summer Quarterly (Aug-Oct)	8/27/2009	67.01	10.01	85.1%	180	5	97.2%	36	<4	100.0%
	Winter Monthly (Nov-Apr)	11/19/2009	111.00	6.62	94.0%	404	2	99.5%	295	<4	100.0%
	Winter Monthly (Nov-Apr)	12/17/2009	107.00	8.09	92.4%	324	2.94	99.1%	313	<4	100.0%
	Winter Monthly (Nov-Apr)	1/28/2010	68.00	6.49	90.5%	184	<2	100.0%	14	<4	100.0%
	Winter Monthly (Nov-Apr)	2/24/2010	85.38	6.34	92.6%	159	<2	100.0%	33	<4	100.0%
	Winter Monthly (Nov-Apr)	3/31/2010	86.10	5.51	93.6%	244	<2	100.0%	124	<4	100.0%
	Winter Monthly (Nov-Apr)	4/29/2010	295.00	5.51	98.1%	217	3.65	98.3%	40	<4	100.0%
	Summer Quarterly (May -July)	5/26/2010	70.00	2.96	95.8%	237	2.64	98.9%	78	8	89.7%
	Summer Quarterly (May -July)	6/30/2010	91.80	2.79	97.0%	151	<2	100.0%	120	<4	100.0%
	Summer Quarterly (May -July)	7/29/2010	77.52	2.95	96.2%	181	<2	100.0%	44	<4	100.0%
	Summer Quarterly (Aug-Oct)	8/18/2010	102.00	5.09	95.0%	91.5	4.43	95.2%	42	<4	100.0%
		AVERAGE	**74.6**	**5.84**	**92.2%**	**149.0**	**2.0**	**98.7%**	**127.8**	**0.2**	**99.9%**

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INTRODUCTION/BACKGROUND

Increased levels of nitrate and other nutrients in ground water have been documented in hundreds of locations throughout the United States. According to published reports, individual on-site septic systems are a primary non-point source responsible for increased nitrate levels. Recent groundwater sample results from Helena, Missoula, Billings Bozeman, and Butte have shown elevated nitrate levels in areas with a high density of conventional, on-site septic tank and drainfield systems. Septic systems in fractured bedrock aquifers are especially susceptible to elevated nitrate levels, since bedrock soils have limited ability to filter drainfield effluent. As the population of Montana expands away from urban centers and toward the outer reaches of valley floors, the issue of elevated nutrient concentrations will become more important.

Data published by the Montana Bureau of Mines and Geology's (MBMG) Groundwater Information Center (GWIC) show an increasing trend of development in fractured bedrock aquifers in the western half of Montana. Statewide estimates suggest that approximately 56% of all new subdivision lots permitted in Montana contain domestic wells and individual on-site septic systems, with many of these installed in fractured bedrock conditions. Because of the hydraulic properties of these aquifers and the general lack of suitable soils above the bedrock, nutrients produced in septic systems enter the groundwater without receiving adequate treatment from the drainfields. Future population and economic growth without significant environmental consequences will depend on developing technologies to eliminate the issues associated with elevated nutrients and other chemicals produced by septic systems.

Economic development across Montana and in neighboring rural states depends on the availability of suitable housing. Recently, housing development in Silver Bow County has been restricted due to elevated nitrate levels in area wells. Similar restrictions have occurred in other Montana counties as well, including

Yellowstone, Gallatin, Missoula, and Lewis and Clark, and it is anticipated that nearly all of Montana's most developed counties will be impacted by elevated nitrate levels in the very near future.

These nitrate sources are believed to be primarily from conventional on-site septic systems. Montana needs to address the growing nitrate and phosphorus problem before these nutrients further impact surface waters and drinking water, thus, creating widespread human health impacts. In addition, the economic impact associated with increased nutrient loading to Montana's lakes and rivers would be extreme.

In response to increased nutrient contamination, the Montana Department of Environmental Quality (MDEQ) has stated in a memo to Butte-Silver Bow that in order for development to occur in areas of Silver Bow County (and many other counties with near surface bedrock); the total nitrogen concentration entering a drainfield must be less than 7.5 mg/L. ***All existing State-approved on-site individual wastewater treatment systems fail to meet this requirement, thus, creating a major need and opportunity for a more advanced on-site wastewater treatment system***.

In July 2008, Water & Environmental Technologies (WET) was awarded funding from the Montana Board of Research and Commercialization Technologies (MBoRCT) for design optimization and commercialization of the Septic Nutrient Elimination Technology (**SepticNET™**) for individual on-site septic treatment systems. This new and revolutionary technology was invented and developed by Dr. Steve Anderson, P.E., a Senior Engineer with WET. Currently, two patents are pending on the **SepticNET™** system. The technology has been proven effective in bench-scale, pilot-scale, and full-scale testing. Results show the **SepticNET™** system removes total nitrogen, BOD, and TSS in septic tank effluent to levels below current regulatory requirements.

EXISTING SepticNET™ SYSTEMS

Using MBoRCT grant funds, five (5) full-scale SepticNET™ systems were designed, assembled, and installed at households in the Butte, Montana area from September 2008 to January 2009. All locations consisted of an existing, conventional gravity flow septic system. Details of each system and specific system data are included in the following sections.

System 1 [redacted]

SepticNET™ System 1 was installed at the residence of [redacted] Butte, MT 59701. The residence was constructed within the last 5 years and consists of two adult parents, two adult, college bound children, and two grade school-aged children. System inflow rates ranged from approximately 300 gallons per day (gpd) to approximately 50 gpd, depending on sampling day and time. Experiments with reactor design and operational modes took place from January 2009 through August 2009. Beginning in September 2009 official system influent and effluent samples were collected quarterly for the summer months (May – October) and monthly for the winter months (November – April). Influent and effluent samples were analyzed for the following constituents: Total Kjeldahl Nitrogen (TKN); Nitrate-N; Nitrite-N; Ammonia-N; Total Phosphorus; Total Suspended Solids (TSS); Biochemical Oxygen Demand (BOD); and Alkalinity.

System 1 was able to achieve approximately 91.9% total nitrogen reduction; 98.7% BOD reduction and over 99% TSS reduction. The average inflow total nitrogen concentration of 82.2

mg/L is 64.4% higher than the assumed value of 50 mg/L used for design purposes by the MDEQ. Table 1 below represents the data obtained during sampling events for System 1. All influent samples for System 1 have the following sample identification notation (TSINmmyy). All effluent samples for System 1 have the following sample identification notation (TSEFmmyy). For example, the sample set for September 2009 would be identified by the samples TSIN0909 and TSEF0909. Official laboratory analytical reports are located in Appendix A of this document.

Table 1. SepticNET™ System 1 – [redacted] Analytical Results.

SepticNET - System 1 [redacted]

Influent Analysis

		Laboratory Measurements								
		TKN	Nitrate	Nitrite	Ammonia	Tot. Nitrogen	Tot. Phos.	BOD_5	Alkalinity	TSS
Sample ID	Date	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
TSIN0909	9/30/2009	75.6	0.06	<0.01	63.7	75.66	6.81	110	540	172
TSIN1109	11/19/2009	94.8	<0.002	<0.001	57.5	94.80	25.8	178	444	584
TSIN1209	12/17/2009	88.9	<0.0150	<0.0150	53.2	88.90	21.9	136	430	464
TSIN0110	1/28/2010	70.5	<0.002	<0.001	57.8	70.50	7.85	99.5	422	44
TSIN0210	2/24/2010	73.7	0.051	0.008	49.7	73.76	14.4	145	412	252
TSIN0310	3/31/2010	82	0.027	0.004	66.7	82.03	12.4	137	468	224
TSIN0410	4/29/2010	71.7	0.017	0.002	52.6	71.72	7.36	96.3	444	38
TSIN0510	5/26/2010	57.5	0.071	0.008	43.2	57.58	7.71	86.4	384	30
TSIN0610	6/30/2010	70.2	<0.006	0.065	67.4	70.27	7.67	62.4	414	83
TSIN0710	7/29/2010	156	<0.006	0.023	61.8	156.02	26.8	590	464	370
TSIN0810	8/18/2010	62.5	0.319	0.013	47.3	62.83	8.58	53	396	137
				AVERAGE (mg/L)		**82.2**	**13.4**	**154.0**	**438.0**	**218.0**

Effluent Analysis

		Laboratory Measurements								
		TKN	Nitrate	Nitrite	Ammonia	Tot. Nitrogen	Tot. Phos.	$CBOD_5$	Alkalinity	TSS
Sample ID	Date	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
TSEF0909	9/30/2009	5.1	5.75	3.29	2.9	14.14	3.29	<4	300	<10
TSEF1109	11/19/2009	6.72	<0.002	0.107	5.03	6.83	8.86	3.18	207	<3
TSEF1209	12/17/2009	4.05	0.58	0.082	2.96	4.71	5.3	2.1	238	<3
TSEF0110	1/28/2010	4.55	4.05	0.285	3.33	8.89	6.56	2.35	210	<4
TSEF0210	2/24/2010	3.5	0.855	0.425	2.36	4.78	5.59	2.14	230	<4
TSEF0310	3/31/2010	4.5	0.223	0.504	2.56	5.23	5.55	<2	235	<4
TSEF0410	4/29/2010	3.36	3.6	1.55	2.47	8.51	4.81	2.25	224	<4
TSEF0510	5/26/2010	2.91	0.0925	1.48	1.47	4.48	5.65	3.94	208	<4
TSEF0510	6/30/2010	2.09	1.95	0.722	0.9	4.76	4.57	2.92	196	<4
TSEF0710	7/29/2010	3.6	0.226	0.077	2.31	3.90	2.81	2.44	448	<4
TSEF0810	8/18/2010	2.73	3.37	0.843	1.96	6.94	5.03	<2	203	<4
				AVERAGE (mg/L)		**6.7**	**5.3**	**1.9**	**245.4**	**0.0**
				% Removal		**91.9%**	**60.6%**	**98.7%**	**44.0%**	**100.0%**

System 2 [redacted]

SepticNET™ System 2 was installed at the residence of [redacted] Butte, MT 59701. The residence was constructed within the last 15 years and consists of two adults (age 55-70) and numerous visits each year from children and other relatives. System inflow rates ranged from approximately 300 gallons per day (gpd) to approximately 50 gpd, depending on sampling day and time. Experiments with reactor design and operational modes took place from January 2009 through August 2009. Beginning in September 2009 official system influent and effluent samples were collected quarterly for the summer months (May – October) and monthly for the winter months (November – April). Each influent and effluent sample were analyzed for the following constituents: Total Kjeldahl Nitrogen (TKN); Nitrate-N; Nitrite-N; Ammonia-N; Total Phosphorus; Total Suspended Solids (TSS); Biochemical Oxygen Demand (BOD); and Alkalinity.

System 2 was able to achieve approximately 90.7% total nitrogen reduction; 98.2% BOD reduction and over 99% TSS reduction. The average inflow total nitrogen concentration of 67.1 mg/L is 34.2% higher than the assumed value of 50 mg/L used for design purposes by the MDEQ. Table 2 below represents the data obtained during sampling events for System 2. All influent samples for System 2 have the following sample identification notation (CSINmmyy). All effluent samples for System 2 have the following sample identification notation (CSEFmmyy). For example, the sample set for September 2009 would be identified by the samples CSIN0909 and CSEF0909. Official laboratory analytical reports are located in Appendix B of this document.

Table 2. SepticNET™ System 2 – [redacted] Analytical Results.

SepticNET - System 2 [redacted]

Influent Analysis

		Laboratory Measurements								
		TKN	Nitrate	Nitrite	Ammonia	Tot. Nitrogen	Tot. Phos.	BOD_5	Alkalinity	TSS
Sample #	Date	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
CSIN1009	10/29/2009	62.4	0.06	0.1	41.5	62.56	9.02	150	430	244
CSIN1109	11/19/2009	77.2	<0.015	<0.015	43.7	77.20	13.5	214	458	352
CSIN1209	12/17/2009	65.1	<0.015	<0.015	61.1	65.10	9.82	101	420	100
CSIN0110	1/28/2010	53.3	<0.002	<0.001	45.9	53.30	9.68	77.6	336	19
CSIN0210	2/24/2010	53.9	0.05	0.013	44.3	53.96	8.21	82.9	336	45
CSIN0310	3/31/2010	70.9	<.006	0.022	40.2	70.92	9.49	107	400	156
CSIN0410	4/29/2010	51.4	0.179	0.003	34.6	51.58	7.12	80.5	343	38
CSIN0510	5/26/2010	62.2	0.115	0.009	42.7	62.32	7.71	139	459	47
CSIN0610	6/30/2010	86.6	<0.006	0.034	68.4	86.63	9.08	106	468	101
CSIN0710	7/29/2010	87.2	<0.006	0.005	69.8	87.21	5.15	113	256	56
CSIN0810	8/18/2010	67.3	<0.006	0.001	49.5	67.30	8.51	112	450	174
				AVERAGE (mg/L)		**67.1**	**8.8**	**116.6**	**396.0**	**121.1**

Effluent Analysis

		Laboratory Measurements								
		TKN	Nitrate	Nitrite	Ammonia	Tot. Nitrogen	Tot. Phos.	$CBOD_5$	Alkalinity	TSS
Sample #	Date	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
CSEF1009	10/29/2009	6.1	3	2.84	3.96	11.96	10.3	1.89	200	<3
CSEF1109	11/19/2009	4.1	5.17	1.87	2.61	11.18	10.1	<2	190	<3
CSEF1209	12/17/2009	4.5	0.872	0.84	2.58	6.21	7.79	<2	213	<3
CSEF0110	1/28/2010	2.0	3.93	0.235	1.06	6.17	9.6	<2	187	<4
CSEF0210	2/24/2010	1.9	1.56	0.981	0.73	4.43	7.11	<2	180	<4
CSEF0310	3/31/2010	2.5	1.97	0.905	0.713	5.38	7.39	<2	200	<4
CSEF0410	4/29/2010	1.8	0.018	0.023	0.554	1.86	5.02	4.75	164	<4
CSEF0510	5/26/2010	2.8	0.486	0.458	1.12	3.73	5.18	3.57	2.14	<4
CSEF0610	6/30/2010	4.4	1.91	1.43	2.41	7.76	7.16	2.29	203	<4
CSEF0710	7/29/2010	4.0	0.045	0.016	2.03	4.02	4.86	4.09	252	<4
CSEF0810	8/18/2010	4.9	1.16	0.251	2.79	6.27	10.7	6.08	234	<4
				AVERAGE (mg/L)		**6.3**	**7.7**	**2.1**	**184.1**	**0.0**
				% Removal		**90.7%**	**12.4%**	**98.2%**	**53.5%**	**100.0%**

System 3 [redacted]

SepticNET™ System 3 was installed at the residence of [redacted] Butte, MT 59701. The residence was constructed within the last 15 years and consists of two adult parents and three children ranging in age from 20 to 15. System inflow rates ranged from approximately 300 gallons per day (gpd) to approximately 50 gpd, depending on sampling day and time. Experiments with reactor design and operational modes took place from January 2009 through June 2009. Beginning in July 2009 official system influent and effluent samples were collected quarterly for the summer months (May – October) and monthly for the winter months (November – April). Each influent and effluent sample were analyzed for the following constituents: Total Kjeldahl Nitrogen (TKN); Nitrate-N; Nitrite-N;

Ammonia-N; Total Phosphorus; Total Suspended Solids (TSS); Biochemical Oxygen Demand (BOD); and Alkalinity.

System 3 was able to achieve approximately 89.3% total nitrogen reduction; 97.6% BOD reduction and over 99% TSS reduction. The average inflow total nitrogen concentration of 58.0 mg/L is 16% higher than the assumed value of 50 mg/L used for design purposes by the MDEQ. Table 3 below represents the data obtained during sampling events for System 3. All influent samples for System 3 have the following sample identification notation (ESINmmyy). All effluent samples for System 3 have the following sample identification notation (ESEFmmyy). For example, the sample set for September 2009 would be identified by the samples ESIN0909 and ESEF0909. Official laboratory analytical reports are located in Appendix C of this document.

Table3. SepticNET™ System 3 –[redacted] Analytical Results.

SepticNET - System 3 [redacted]

Influent Analysis

		Laboratory Measurements								
		TKN	Nitrate	Nitrite	Ammonia	Tot. Nitrogen	Tot. Phos.	BOD_5	Alkalinity	TSS
Sample #	Date	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
ESIN0709	7/30/2009	63.8	<0.50	2.2	50	66.0	5.2	47	320	21
ESIN0909	9/30/2009	44.9	<0.05	0.61	38.6	45.5	4.89	18	280	28
ESIN1109	11/19/2009	55.2	0.156	0.375	41.9	55.7	5.14	108	242	52
ESIN1209	12/17/2009	52	<0.015	0.577	34.5	52.6	5.73	67.9	274	71
ESIN0110	1/28/2010	46.3	1.24	0.526	38.4	48.1	6.39	25.8	268	18
ESIN0210	2/24/2010	79.6	1.96	0.505	38.1	82.1	7.44	274	244	280
ESIN0310	3/31/2010	57.7	0.1	0.748	38	58.5	5.71	59.7	274	35
ESIN0410	4/29/2010	62.3	0.125	0.017	43.6	62.4	6.99	105	333	65
ESIN0510	5/26/2010	55.5	0.129	0.032	33.1	55.7	5.52	68.3	278	26
ESIN0710	7/29/2010	55.8	0.019	<0.001	43.4	55.8	2.7	77.4	285	114
ESIN0810	8/18/2010	54.9	0.328	0.195	39.4	55.4	5.14	84.2	303	143
				AVERAGE (mg/L)		**58.0**	**5.5**	**85.0**	**281.9**	**77.5**

Effluent Analysis

		Laboratory Measurements								
		TKN	Nitrate	Nitrite	Ammonia	Tot. Nitrogen	Tot. Phos.	$CBOD_5$	Alkalinity	TSS
Sample #	Date	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
ESEF0709	7/30/2009	8.4	3.8	1.7	5.8	13.90	4.3	<2	130	<2.4
ESEF0909	9/30/2009	4.03	0.035	0.034	2.58	4.10	6.4	5.56	165	<3
ESEF1109	11/19/2009	2.81	5.44	1.83	1.37	10.08	4	<2	106	<3
ESEF1209	12/17/2009	3.9	0.742	0.842	2.39	5.48	4.84	2.73	146	<3
ESEF0110	1/28/2010	3.21	3.24	0.335	1.98	6.79	5.9	<2	90	<4
ESEF0210	2/24/2010	4.08	0.73	0.348	2.74	5.16	5.55	<2	152	<4
ESEF0310	3/31/2010	6.43	0.583	0.782	4.07	7.80	4.89	<2	149	<4
ESEF0410	4/29/2010	4.73	1.09	0.079	3.2	5.90	4.87	3.64	156	<4
ESEF0510	5/26/2010	2.63	<.006	0.006	0.714	2.64	4	4.07	154	<4
ESEF0710	7/29/2010	2.93	0.152	0.104	1.72	3.19	2.1	2.74	170	<4
ESEF0810	8/18/2010	3.1	0.16	0.237	2.27	3.50	6.3	3.42	230	<4
				AVERAGE (mg/L)		**6.2**	**4.8**	**2.0**	**149.8**	**0.0**
				% Removal		**89.3%**	**12.7%**	**97.6%**	**46.9%**	**100.0%**

System 4 [redacted]

SepticNET™ System 4 was installed at the residence of [redacted] Butte, MT 59701. The residence was constructed within the last 3 years and consists of two adult parents and one infant child. System inflow rates ranged from approximately 300 gallons per day (gpd) to approximately 50 gpd, depending on sampling day and time. Experiments with reactor design and operational modes took place from January 2009 through June 2009. Beginning in July 2009 official system influent and effluent samples were collected quarterly for the summer months (May – October) and monthly for the winter months

(November – April). Each influent and effluent sample were analyzed for the following constituents: Total Kjeldahl Nitrogen (TKN); Nitrate-N; Nitrite-N; Ammonia-N; Total Phosphorus; Total Suspended Solids (TSS); Biochemical Oxygen Demand (BOD); and Alkalinity.

System 4 was able to achieve approximately 92.6% total nitrogen reduction; 98.8% BOD reduction and over 99% TSS reduction. The average inflow total nitrogen concentration of 61.4 mg/L is 22.8% higher than the assumed value of 50 mg/L used for design purposes by the MDEQ. Table 4 below represents the data obtained during sampling events for System 4. All influent samples for System 4 have the following sample identification notation (GSINmmyy). All effluent samples for System 4 have the following sample identification notation (GSEFmmyy). For example, the sample set for September 2009 would be identified by the samples GSIN0909 and GSEF0909. Official laboratory analytical reports are located in Appendix D of this document.

Table4. SepticNET™ System 4 –[redacted] Analytical Results.

SepticNET - System 4 [redacted]

Influent Analysis

		Laboratory Measurements								
		TKN	Nitrate	Nitrite	Ammonia	Tot. Nitrogen	Tot. Phos.	BOD_5	Alkalinity	TSS
Sample #	Date	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
GSIN0709	7/30/2009	35.3	<0.5	2.1	34	37.40	4.7	96	310	21
GSIN0909	9/30/2009	33.4	0.06	<0.01	30.8	33.46	5.15	85	350	28
GSIN1109	11/19/2009	82.4	<0.015	<0.015	30.8	82.40	8.31	179	418	216
GSIN1209	12/17/2009	92.2	<0.015	<0.015	38.3	92.20	10.5	414	425	480
GSIN0110	1/28/2010	55.6	<0.002	<0.001	40.2	55.60	6.37	119	360	34
GSIN0210	2/24/2010	65.7	0.016	0.013	45.5	65.73	6.61	176	360	72
GSIN0310	3/31/2010	84.3	<.006	0.023	41.1	84.32	9.32	208	408	168
GSIN0410	4/29/2010	32.2	0.059	0.005	22.6	32.26	3.6	85.5	280	14
GSIN0510	5/26/2010	49.9	0.035	0.008	28.7	49.94	5.87	160	382	31
GSIN0610	6/30/2010	75.8	<0.006	0.004	41.2	75.80	8.13	164	417	109
GSIN0710	7/29/2010	48.8	<0.006	0.006	46.6	48.81	3.53	189	390	31
GSIN0810	8/18/2010	79	0.014	0.001	34.2	79.02	8.03	182	474	232
				AVERAGE (mg/L)		**61.4**	**6.7**	**171.5**	**381.2**	**119.7**

Effluent Analysis

		Laboratory Measurements								
		TKN	Nitrate	Nitrite	Ammonia	Tot. Nitrogen	Tot. Phos.	$CBOD_5$	Alkalinity	TSS
Sample #	Date	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
GSEF0709	7/30/2009	4.9	<0.5	1.9	4.6	6.80	5.9	<4	210	2.4
GSEF0909 M	9/30/2009	3.83	0.052	0.473	2.32	4.36	5.88	2.08	230	<3
GSEF1109	11/19/2009	2.4	3.19	1.52	1.82	7.11	5.3	<2	167	<3
GSEF1209	12/17/2009	2.72	4.66	0.943	1.55	8.32	5.08	<2	200	<3
GSEF0110	1/28/2010	2.48	0.476	0.576	1.65	3.53	6.44	<2	191	<4
GSEF0210	2/24/2010	2.73	0.111	0.08	1.44	2.92	6.02	<2	213	<4
GSEF0310	3/31/2010	3.5	0.008	0.008	0.95	3.52	5.52	2.78	196	<4
GSEF0410	4/29/2010	3.12	0.019	0.003	2.48	3.14	5.5	11.28	200	<4
GSEF0510	5/26/2010	2.33	0.748	0.519	0.967	3.60	4.73	4.26	180	<4
GSEF0610	6/30/2010	1.52	0.352	1.17	0.44	3.04	11.3	2.18	218	<4
GSEF0710	7/29/2010	2.29	2.25	1.34	0.904	5.88	3.48	<2	198	<4
GSEF0810	8/18/2010	1.78	0.15	0.15	0.788	2.08	6.49	2	240	<4
				AVERAGE (mg/L)		**4.5**	**6.0**	**2.0**	**203.6**	**0.2**
				% Removal		**92.6%**	**10.6%**	**98.8%**	**46.6%**	**99.8%**

System 5 [redacted]

SepticNET™ System 5 was installed at the residence of [redacted] Butte, MT 59701. The residence was constructed within the last 20 years and consists of two adults and an attached shop for the owner's construction company. System inflow rates ranged from approximately 200 gallons per day (gpd) to approximately 50 gpd, depending on sampling

day and time. Experiments with reactor design and operational modes took place from January 2009 through July 2009. Beginning in August 2009 official system influent and effluent samples were collected quarterly for the summer months (May – October) and monthly for the winter months (November – April). Each influent and effluent sample were analyzed for the following constituents: Total Kjeldahl Nitrogen (TKN); Nitrate-N; Nitrite-N; Ammonia-N; Total Phosphorus; Total Suspended Solids (TSS); Biochemical Oxygen Demand (BOD); and Alkalinity.

System 5 was able to achieve approximately 94.6% total nitrogen reduction; 99% BOD reduction and over 99% TSS reduction. The average inflow total nitrogen concentration of 105.5 mg/L is 111% higher than the assumed value of 50 mg/L used for design purposes by the MDEQ. Table 5 below represents the data obtained during sampling events for System 5. All influent samples for System 5 have the following sample identification notation (LSINmmyy). All effluent samples for System 5 have the following sample identification notation (LSEFmmyy). For example, the sample set for September 2009 would be identified by the samples LSIN0909 and LSEF0909. Official laboratory analytical reports are located in Appendix E of this document.

Table5. SepticNET™ System 5 –[redacted] Analytical Results.

SepticNET - System 5 [redacted]

Influent Analysis

		Laboratory Measurements								
		TKN	Nitrate	Nitrite	Ammonia	Tot. Nitrogen	Tot. Phos.	BOD_5	Alkalinity	TSS
Sample #	Date	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
LSIN0809	8/27/2009	67	<0.05	0.01	62.2	67.0	14.6	180	440	36
LSIN1109	11/19/2009	111	<0.015	<0.015	64.8	111.0	18	404	452	295
LSIN1209	12/17/2009	107	<0.015	<0.015	74.5	107.0	20.4	324	545	313
LSIN0110	1/28/2010	68	<0.002	<0.001	53.4	68.0	10.8	184	432	14
LSIN0210	2/24/2010	85.3	0.069	0.011	58.5	85.4	11.4	159	454	33
LSIN0310	3/31/2010	86.1	<.006	0.019	55.2	86.1	12	244	440	124
LSIN0410	4/29/2010	295	0.025	0.004	346	295.0	13.8	217	440	40
LSIN0510	5/26/2010	69.9	0.02	0.051	49.4	70.0	12.9	237	412	78
LSIN0610	6/30/2010	91.7	<0.006	0.05	79	91.8	12.9	151	490	120
LSIN0710	7/29/2010	77.5	0.011	0.008	71.8	77.5	9.48	181	556	44
LSIN0810	8/18/2010	102	<0.006	<0.001	70.5	102.0	15.5	91.5	540	42
				AVERAGE (mg/L)		**105.5**	**13.8**	**215.7**	**472.8**	**103.5**

Effluent Analysis

		Laboratory Measurements								
		TKN	Nitrate	Nitrite	Ammonia	Tot. Nitrogen	Tot. Phos.	$CBOD_5$	Alkalinity	TSS
Sample #	Date	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
LSEF0809	8/27/2009	8	1.42	0.59	5.8	10.01	13.6	5	230	<10
LSEF1109	11/19/2009	5.22	0.909	0.494	3.42	6.62	13	2	190	<3
LSEF1209	12/17/2009	4.62	2.42	1.05	2.68	8.09	10.4	2.94	233	<3
LSEF0110	1/28/2010	2.65	3.55	0.286	1.47	6.49	11.9	<2	193	<4
LSEF0210	2/24/2010	2.42	2.59	1.33	1.05	6.34	10.9	<2	185	<4
LSEF0310	3/31/2010	3.06	1.67	0.776	1.45	5.51	9.86	<2	204	<4
LSEF0410	4/29/2010	5.43	0.056	0.026	3.93	5.51	13	3.65	242	<4
LSEF0510	5/26/2010	2.54	0.242	0.175	1.03	2.96	11.4	2.64	245	8
LSEF0610	6/30/2010	2.55	0.128	0.116	1.01	2.79	6.81	<2	236	<4
LSEF0710	7/29/2010	1.4	1.31	0.243	0.541	2.95	8.23	<2	254	<4
LSEF0810	8/18/2010	4.16	0.674	0.254	2.81	5.09	11	4.43	232	<4
				AVERAGE (mg/L)		**5.7**	**10.9**	**2.1**	**222.2**	**0.8**
				% Removal		**94.6%**	**20.9%**	**99.0%**	**53.0%**	**99.2%**

SUMMARY AND CONCLUSIONS

The **SepticNET™** on-site, individual wastewater treatment system has been proven to significantly reduce contaminants associated with traditional septic systems. Average total nitrogen (TN) concentrations are reduced by 92.2% according to data collected on the existing **SepticNET™** systems. SepticNET™ removes TN to levels below the MDEQ trigger level of 7.5 mg/L, even with the average influent TN concentration 148% of the MDEQ design concentration. Average inflow TN concentrations are 74.6 mg/L; average effluent concentrations are 5.84 mg/L. Average BOD concentrations are reduced by 98.7%: average inflow concentrations are 149 mg/L; average effluent concentrations are 2 mg/L. Average TSS concentrations are reduced by over 99%: average inflow concentrations are 127.8 mg/L; average effluent concentrations are <1 mg/L.

Montana DEQ approval of the SepticNET™ system would provide a much needed, environmentally sound solution to an increasing problem in Montana and numerous other states. Contaminated groundwater resulting from inadequate treatment of residential wastewater in conventional septic systems is well documented in many areas with high densities of traditional septic systems. High nitrate levels in residential wells are becoming more widespread as subdivisions are being constructed in areas where little treatment is provided by native soils. As urban sprawl continues, environmental impacts associated with on-site septic systems will increase. **SepticNET™** provides a solution to both the urban sprawl and contamination issues.

SepticNET, Inc. is a Montana-based business that is dedicated to providing state of the art on-site wastewater treatment systems to Montana and eventually the entire country. The principals are Montana natives with professional experience in subdivision permitting and wastewater treatment, and thus understand the both the developers and the regulators' concerns regarding the issues associated with development.