

WATER CHEMISTRY STUDY
FOR VA DEPARTMENT OF MINES, MINERALS, AND
ENERGY (VA-DMME);
FEBRUARY 21, 2013.

Conducted For:

VA-DMME
P. O. DRAWER 900
3405 MOUNTAIN EMPIRE ROAD
BIG STONE GAP, VA 24219

By:

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March 05, 2013.

REI Consultants, Inc. was hired by the Virginia Department of Mines, Minerals, and Energy (VA-DMME), to sample several outfalls on a bi-monthly basis. The outfalls are located in the vicinity of Harman, in the county of Buchanan, in Virginia. Each of the outfalls are associated with pre-law mining activities, and the outfalls are well documented on maps. The outfalls sampled are all located on various named tributaries of Bull Creek (FIGURE 1). GPS locations of the individual sampling sites are located in the table below.

Physical water quality measurements are collected in-the-field, and consist of stream flow, water temperature, pH, Dissolved Oxygen (DO), and conductivity. A few of the outfall's flows are difficult to measure, and thus, flow measurements of the actual mine effluent may be calculated by subtracting upstream flow from the downstream flow on the receiving stream. Samples are collected after field readings by utilizing a clean, "general chemistry" plastic container which contains no preservative. This is because currently only Total Dissolved Solids (TDS) and conductivity are measured in-lab, and no current parameters require preservatives, such as metals analyses.

Photos of each of the sites sampled follow, and results of the analytical work are shown in TABLES A – I.

Sampling Station	Approximate GPS Location	
	Latitude	Longitude
HMBC	37° 17' 27.8"	82° 12' 22.9"
Deel Up	37° 16' 29.2"	82° 12' 54.3"
Deel Down	37° 17' 9.3"	82° 12' 46.5"
Burnt Hollow	37° 18' 28.8"	82° 11' 0.6"
Charlie Up	37° 18' 16.4"	82° 11' 56.1"
Charlie Down	37° 18' 13.4"	82° 11' 54.1"
Up Belcher	37° 16' 27.0"	82° 11' 29.4"
Down Belcher	37° 17' 20.5"	82° 11' 48.1"
Cove Hollow	37° 18' 24.4"	82° 11' 24.0"

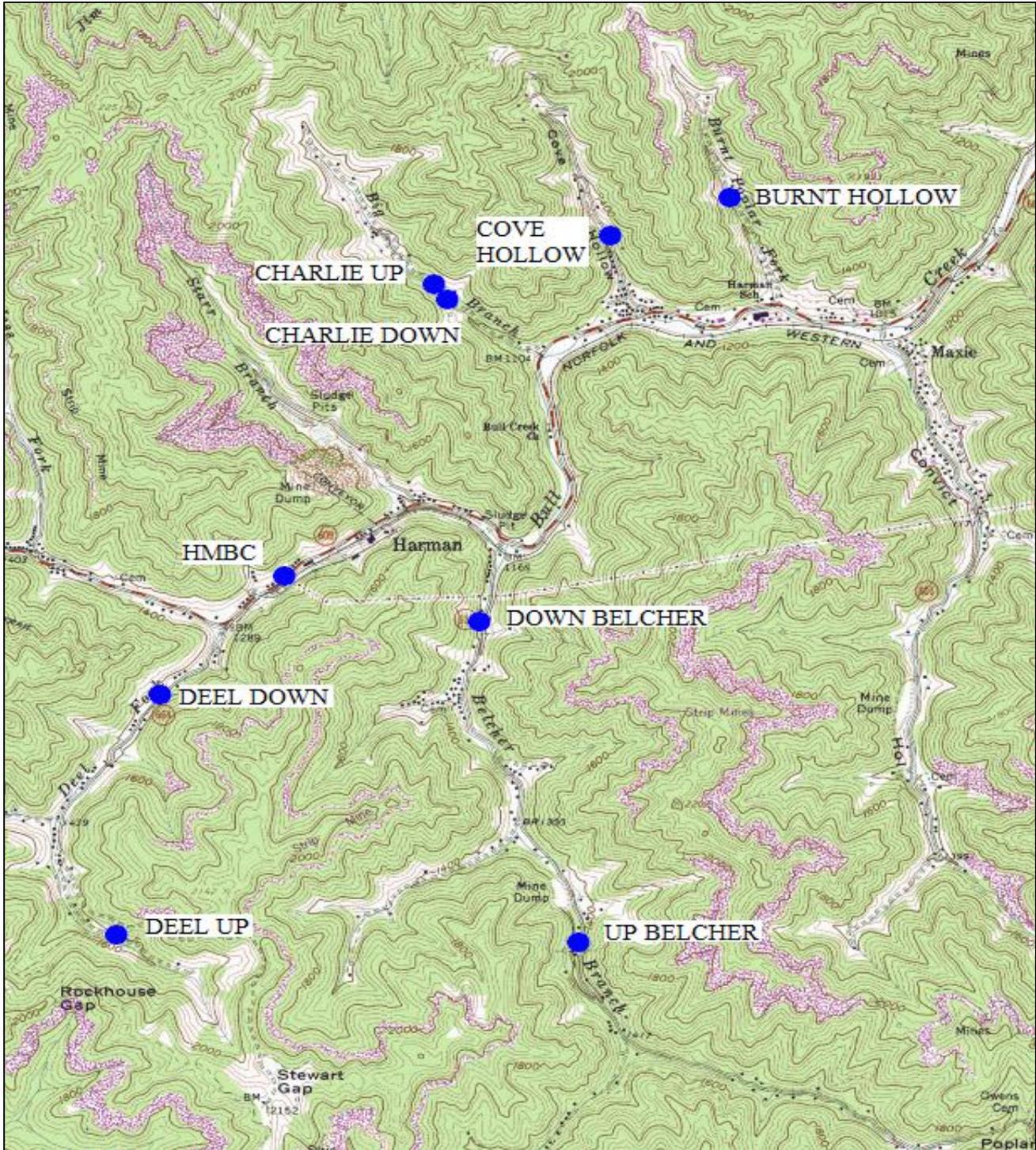


FIGURE 1. Terrain Navigator map showing the approximate location of the sampling stations associated with Grundy Outfalls Project for VA-DMME. REI Consultants, Inc., October 1, 2012.



PHOTO 1. Looking upstream from station HMBC, located on Bull Fork for the VA-DMME “Grundy Outfalls” Project. REI Consultants, Inc., October 1, 2012.



PHOTO 2. Looking downstream from station HMBC, located on Bull Fork for the VA-DMME “Grundy Outfalls” Project. REI Consultants, Inc., October 1, 2012.



PHOTO 3. Looking at the substrate at station HMBC, located on Bull Fork for the VA-DMME “Grundy Outfalls” Project. REI Consultants, Inc., October 1, 2012.

TABLE A. Summary of water quality results for the VA-DMME “Grundy Outfalls” Project.
REI Consultants, Inc., February 21, 2013.

	Site “HMBC”				
	09/11/12	09/25/12	10/08/12	10/23/12	11/15/12
Temperature (°C)	14.3	14.7	13.9	14.6	13.8
pH (Field; Standard Units)	7.86	7.78	7.68	7.92	7.80
Stream Flow (CFS)	1.356	0.659	0.627	0.701	0.703
Dissolved Oxygen (mg/L)	9.85	9.81	10.19	9.85	10.25
Conductivity (µmhos/cm)	1,119	1,122	1,134	1,161	1,073
TDS (mg/L)	754	703	715	595	621

TABLE A. Continued.

	Site “HMBC”				
	11/28/12	12/13/12	12/28/12	01/10/13	01/24/13
Temperature (°C)	13.8	13.3	13.7	14.1	10.7
pH (Field; Standard Units)	7.55	7.95	8.28	8.12	7.65
Stream Flow (CFS)	1.081	1.004	0.975	1.119	1.784
Dissolved Oxygen (mg/L)	10.07	10.26	10.06	10.02	10.35
Conductivity (µmhos/cm)	1,112	1,101	1,055	1,005	902
TDS (mg/L)	671	687	628	597	527

TABLE A. Continued.

	Site “HMBC”	
	02/07/13	02/21/13
Temperature (°C)	13.7	13.7
pH (Field; Standard Units)	7.70	7.60
Stream Flow (CFS)	2.655	1.536
Dissolved Oxygen (mg/L)	10.08	10.12
Conductivity (µmhos/cm)	766	874
TDS (mg/L)	484	546



PHOTO 4. Looking upstream from station DEEL UP, located on Deel Fork for the VA-DMME “Grundy Outfalls” Project. REI Consultants, Inc., October 1, 2012.



PHOTO 5. Looking downstream from station DEEL UP, located on Deel Fork for the VA-DMME “Grundy Outfalls” Project. REI Consultants, Inc., October 1, 2012.



PHOTO 6. Looking at the substrate at station DEEL UP, located on Deel Fork for the VA-DMME “Grundy Outfalls” Project. REI Consultants, Inc., October 1, 2012.

TABLE B. Summary of water quality results for the VA-DMME “Grundy Outfalls” Project.
REI Consultants, Inc., February 21, 2013.

	Site “Deel Up”				
	09/11/12	09/25/12	10/08/12	10/23/12	11/15/12
Temperature (°C)	15.6	13.2	10.7	13.0	7.7
pH (Field; Standard Units)	7.80	7.55	7.18	7.70	7.48
Stream Flow (CFS)	0.028	0.006	0.04	0.004	0.016
Dissolved Oxygen (mg/L)	8.77	9.33	10.33	9.63	11.09
Conductivity (µmhos/cm)	916	920	803	948	855
TDS (mg/L)	603	634	560	627	372

TABLE B. Continued.

	Site “Deel Up”				
	11/28/12	12/13/12	12/28/12	01/10/13	01/24/13
Temperature (°C)	7.5	6.6	6.7	10.6	9.6
pH (Field; Standard Units)	7.54	7.36	7.75	7.87	7.48
Stream Flow (CFS)	0.011	0.006	0.011	0.015	0.050
Dissolved Oxygen (mg/L)	11.16	11.57	11.27	10.00	10.66
Conductivity (µmhos/cm)	9.12	879	781	820	751
TDS (mg/L)	603	650	476	558	498

TABLE B. Continued.

	Site “Deel Up”	
	02/07/13	02/21/13
Temperature (°C)	12.1	9.5
pH (Field; Standard Units)	7.73	7.56
Stream Flow (CFS)	0.033	0.043
Dissolved Oxygen (mg/L)	10.04	10.67
Conductivity (µmhos/cm)	715	860
TDS (mg/L)	520	601



PHOTO 7. Looking upstream from station DEEL DOWN, located on Deel Fork for the VA-DMME “Grundy Outfalls” Project. REI Consultants, Inc., October 1, 2012.



PHOTO 8. Looking downstream from station DEEL DOWN, located on Deel Fork for the VA-DMME “Grundy Outfalls” Project. REI Consultants, Inc., October 1, 2012.



PHOTO 9. Looking at the substrate at station DEEL DOWN, located on Deel Fork for the VA-DMME “Grundy Outfalls” Project. REI Consultants, Inc., October 1, 2012.

TABLE C. Summary of water quality results for the VA-DMME “Grundy Outfalls” Project.
REI Consultants, Inc., February 21, 2013.

	Site “Deel Down”				
	09/11/12	09/25/12	10/08/12	10/23/12	11/15/12
Temperature (°C)	14.1	13.9	12.7	13.3	11.7
pH (Field; Standard Units)	7.82	7.77	7.29	7.66	7.24
Stream Flow (CFS)	0.0045	0.0117	0.012	0.009	0.011
Dissolved Oxygen (mg/L)	9.55	9.82	10.57	9.82	10.75
Conductivity (µmhos/cm)	838	804	770	869	673
TDS (mg/L)	537	519	544	536	396

TABLE C. Continued.

	Site “Deel Down”				
	11/28/12	12/13/12	12/28/12	01/10/13	01/24/13
Temperature (°C)	11.0	11.6	11.8	12.6	10.8
pH (Field; Standard Units)	7.52	7.75	7.70	7.79	7.13
Stream Flow (CFS)	0.011	0.034	0.074	0.030	0.107
Dissolved Oxygen (mg/L)	10.64	10.50	10.33	10.24	10.78
Conductivity (µmhos/cm)	809	749	548	617	513
TDS (mg/L)	503	516	300	382	309

TABLE C. Continued.

	Site “Deel Down”	
	02/07/13	02/21/13
Temperature (°C)	12.5	12.0
pH (Field; Standard Units)	7.03	7.62
Stream Flow (CFS)	0.134	0.134
Dissolved Oxygen (mg/L)	10.22	10.26
Conductivity (µmhos/cm)	539	664
TDS (mg/L)	371	446



PHOTO 10. Looking upstream from station BURNT HOLLOW, located on Burnt Poplar Fork for the VA-DMME “Grundy Outfalls” Project. REI Consultants, Inc., October 1, 2012.



PHOTO 11. Looking downstream from station BURNT HOLLOW, located on Burnt Poplar Fork for the VA-DMME “Grundy Outfalls” Project. REI Consultants, Inc., October 1, 2012.



PHOTO 12. Looking at the substrate at station BURNT HOLLOW, located on Burnt Poplar Fork for the VA-DMME “Grundy Outfalls” Project. REI Consultants, Inc., October 1, 2012.

TABLE D. Summary of water quality results for the VA-DMME “Grundy Outfalls” Project.
REI Consultants, Inc., February 21, 2013.

	Site “Burnt Hollow”				
	09/11/12	9/25/12	10/08/12	10/23/12	11/15/12
Temperature (°C)	14.4	14.8	14.6	14.8	14.7
pH (Field; Standard Units)	6.89	6.72	6.68	6.82	6.58
Stream Flow (CFS)	0.539	0.596	0.472	0.371	0.914
Dissolved Oxygen (mg/L)	6.85	7.44	7.54	7.47	7.17
Conductivity (µmhos/cm)	1,602	1,625	1,627	1,669	1,555
TDS (mg/L)	1,070	1,100	1,130	1,120	1,060

TABLE D. Continued.

	Site “Burnt Hollow”				
	11/28/12	12/13/12	12/28/12	01/10/13	01/24/13
Temperature (°C)	14.7	14.7	14.6	14.5	14.3
pH (Field; Standard Units)	6.69	6.97	6.77	6.67	6.47
Stream Flow (CFS)	0.562	0.414	0.619	0.886	0.887
Dissolved Oxygen (mg/L)	7.29	7.44	7.22	6.77	7.36
Conductivity (µmhos/cm)	1,642	1,612	1,534	1,508	1,261
TDS (mg/L)	1,100	1,120	998	1,050	888

TABLE D. Continued.

	Site “Burnt Hollow”	
	02/07/13	02/21/13
Temperature (°C)	14.3	14.6
pH (Field; Standard Units)	6.58	6.46
Stream Flow (CFS)	1.283	1.385
Dissolved Oxygen (mg/L)	7.04	7.74
Conductivity (µmhos/cm)	1,289	1,383
TDS (mg/L)	954	1,010



PHOTO 13. Looking upstream from station CHARLIE HOLLOW UP, located on Big Branch for the VA-DMME “Grundy Outfalls” Project. REI Consultants, Inc., October 1, 2012.



PHOTO 14. Looking downstream from station CHARLIE HOLLOW UP, located on Big Branch for the VA-DMME “Grundy Outfalls” Project. REI Consultants, Inc., October 1, 2012.



PHOTO 15. Looking at the substrate at station CHARLIE HOLLOW UP, located on Big Branch for the VA-DMME “Grundy Outfalls” Project. REI Consultants, Inc., October 1, 2012.

TABLE E. Summary of water quality results for the VA-DMME “Grundy Outfalls” Project.
REI Consultants, Inc., February 21, 2013.

	Site “Charlie Up”				
	09/11/12	9/25/12	10/08/12	10/23/12	11/15/12
Temperature (°C)	14.6	15.3	14.2	14.9	14.3
pH (Field; Standard Units)	6.87	6.82	6.62	7.05	6.74
Stream Flow (CFS)	0.128	0.068	0.023	0.027	0.011
Dissolved Oxygen (mg/L)	6.93	7.38	7.57	7.40	7.86
Conductivity (µmhos/cm)	1,670	1,668	1,673	1,733	1,500
TDS (mg/L)	1,060	1,080	1,130	1,070	958

TABLE E. Continued.

	Site “Charlie Up”				
	11/28/12	12/13/12	12/28/12	01/10/13	01/24/13
Temperature (°C)	14.3	14.5	14.6	14.6	14.1
pH (Field; Standard Units)	6.78	7.21	7.23	7.19	6.65
Stream Flow (CFS)	0.012	0.155	0.268	0.062	0.450
Dissolved Oxygen (mg/L)	7.85	7.61	7.66	7.67	7.70
Conductivity (µmhos/cm)	1,637	1,622	1,397	1,429	1,178
TDS (mg/L)	1,060	1,050	934	953	772

TABLE E. Continued.

	Site “Charlie Up”	
	02/07/13	02/21/13
Temperature (°C)	14.7	14.8
pH (Field; Standard Units)	6.85	6.88
Stream Flow (CFS)	0.672	0.563
Dissolved Oxygen (mg/L)	7.52	7.56
Conductivity (µmhos/cm)	1,244	1,405
TDS (mg/L)	866	946



PHOTO 16. Looking upstream from station CHARLIE HOLLOW DOWN, located on Big Branch for the VA-DMME “Grundy Outfalls” Project. REI Consultants, Inc., October 1, 2012.



PHOTO 17. Looking downstream from station CHARLIE HOLLOW DOWN, located on Big Branch for the VA-DMME “Grundy Outfalls” Project. REI Consultants, Inc., October 1, 2012.



PHOTO 18. Looking at the substrate at station CHARLIE HOLLOW DOWN, located on Big Branch for the VA-DMME “Grundy Outfalls” Project. REI Consultants, Inc., October 1, 2012.

TABLE F. Summary of water quality results for the VA-DMME “Grundy Outfalls” Project.
REI Consultants, Inc., February 21, 2013.

	Site “Charlie Down”				
	09/11/12	09/25/12	10/08/12	10/23/12	11/15/12
Temperature (°C)	15.6	14.8	13.1	14.9	12.8
pH (Field; Standard Units)	7.97	7.80	7.64	7.99	7.50
Stream Flow (CFS)	0.094	0.072	0.123	0.057	0.015
Dissolved Oxygen (mg/L)	9.40	9.70	10.35	9.85	10.55
Conductivity (µmhos/cm)	2,110	2,110	2,130	2,120	1,669
TDS (mg/L)	1,320	1,420	1,430	1,450	1,170

TABLE F. Continued.

	Site “Charlie Down”				
	11/28/12	12/13/12	12/28/12	01/10/13	01/24/13
Temperature (°C)	12.3	12.0	10.8	13.5	8.3
pH (Field; Standard Units)	7.86	7.88	8.00	8.00	7.30
Stream Flow (CFS)	0.057	0.253	0.148	0.084	0.081
Dissolved Oxygen (mg/L)	10.39	10.49	10.35	10.13	10.78
Conductivity (µmhos/cm)	1,850	1,905	1,637	1,590	1,351
TDS (mg/L)	1,250	1,330	1,100	1,100	876

TABLE F. Continued.

	Site “Charlie Down”	
	02/07/13	02/21/13
Temperature (°C)	11.7	12.4
pH (Field; Standard Units)	7.79	7.97
Stream Flow (CFS)	0.428	0.033
Dissolved Oxygen (mg/L)	10.38	10.52
Conductivity (µmhos/cm)	1,345	1,500
TDS (mg/L)	1,060	1,100



PHOTO 19. Looking upstream from station BELCHER UP, located on Belcher Branch for the VA-DMME “Grundy Outfalls” Project. REI Consultants, Inc., October 1, 2012.



PHOTO 20. Looking downstream from station BELCHER UP, located on Belcher Branch for the VA-DMME “Grundy Outfalls” Project. REI Consultants, Inc., October 1, 2012.



PHOTO 21. Looking at the substrate at station BELCHER UP, located on Belcher Branch for the VA-DMME “Grundy Outfalls” Project. REI Consultants, Inc., October 1, 2012.

TABLE G. Summary of water quality results for the VA-DMME “Grundy Outfalls” Project.
REI Consultants, Inc., February 21, 2013.

	Site “Up Belcher”				
	09/11/12	09/25/12	10/08/12	10/23/12	11/15/12
Temperature (°C)	14.5	15.0	14.7	14.8	14.6
pH (Field; Standard Units)	7.15	7.07	6.93	7.30	7.03
Stream Flow (CFS)	0.888	0.64	0.299	0.621	0.781
Dissolved Oxygen (mg/L)	9.40	9.54	9.81	9.48	9.84
Conductivity (µmhos/cm)	1,542	1,544	1,546	1,588	1,545
TDS (mg/L)	970	1,050	1,090	1,030	1,020

TABLE G. Continued.

	Site “Up Belcher”				
	11/28/12	12/13/12	12/28/12	01/10/13	01/24/13
Temperature (°C)	14.5	14.6	15.0	14.8	14.6
pH (Field; Standard Units)	6.78	7.46	7.64	7.44	6.99
Stream Flow (CFS)	0.712	0.925	2.129	0.659	2.156
Dissolved Oxygen (mg/L)	9.68	9.76	9.77	9.68	9.73
Conductivity (µmhos/cm)	1,584	1,545	1,513	1,495	1,343
TDS (mg/L)	1,040	1,060	976	1,000	921

TABLE G. Continued.

	Site “Up Belcher”	
	02/07/13	02/21/13
Temperature (°C)	14.7	14.8
pH (Field; Standard Units)	7.29	6.95
Stream Flow (CFS)	2.571	2.093
Dissolved Oxygen (mg/L)	9.74	9.61
Conductivity (µmhos/cm)	1,259	1,338
TDS (mg/L)	887	924



PHOTO 22. Looking upstream from station BELCHER DOWN, located on Belcher Branch for the VA-DMME “Grundy Outfalls” Project. REI Consultants, Inc., October 1, 2012.



PHOTO 23. Looking downstream from station BELCHER DOWN, located on Belcher Branch for the VA-DMME “Grundy Outfalls” Project. REI Consultants, Inc., October 1, 2012.



PHOTO 24. Looking at the substrate at station BELCHER DOWN, located on Belcher Branch for the VA-DMME “Grundy Outfalls” Project. REI Consultants, Inc., October 1, 2012.

TABLE H. Summary of water quality results for the VA-DMME “Grundy Outfalls” Project.
REI Consultants, Inc., February 21, 2013.

Site “Down Belcher”					
	09/11/12	09/25/12	10/08/12	10/23/12	11/15/12
Temperature (°C)	15.6	14.7	11.9	13.3	10.5
pH (Field; Standard Units)	8.20	7.91	7.74	8.11	7.42
Stream Flow (CFS)	0.576	0.87	0.378	0.45	0.776
Dissolved Oxygen (mg/L)	9.47	9.78	10.82	10.13	10.85
Conductivity (µmhos/cm)	1,532	1,563	1,499	1,649	1,586
TDS (mg/L)	960	1,070	1,080	1,090	1,050

TABLE H. Continued.

Site “Down Belcher”					
	11/28/12	12/13/12	12/28/12	01/10/13	01/24/13
Temperature (°C)	9.2	10.0	10.5	13.0	8.3
pH (Field; Standard Units)	7.84	8.21	8.35	8.22	7.99
Stream Flow (CFS)	0.230	1.254	1.776	0.821	1.237
Dissolved Oxygen (mg/L)	10.91	10.98	10.76	10.23	10.90
Conductivity (µmhos/cm)	1,656	1,549	1,437	1,480	1,321
TDS (mg/L)	1,080	1,070	884	1,020	896

TABLE H. Continued.

Site “Down Belcher”		
	02/07/13	02/21/13
Temperature (°C)	12.1	11.9
pH (Field; Standard Units)	8.15	7.73
Stream Flow (CFS)	6.808	2.708
Dissolved Oxygen (mg/L)	10.37	10.49
Conductivity (µmhos/cm)	1,225	1,344
TDS (mg/L)	855	928



PHOTO 25. Looking upstream from station COVE HOLLOW, located on Cove Hollow for the VA-DMME “Grundy Outfalls” Project. REI Consultants, Inc., October 1, 2012.



PHOTO 26. Looking downstream from station COVE HOLLOW, located on Cove Hollow for the VA-DMME “Grundy Outfalls” Project. REI Consultants, Inc., October 1, 2012.



PHOTO 27. Looking at the substrate at station COVE HOLLOW, located on Cove Hollow for the VA-DMME “Grundy Outfalls” Project. REI Consultants, Inc., October 1, 2012.

TABLE I. Summary of water quality results for the VA-DMME “Grundy Outfalls” Project.
REI Consultants, Inc., February 21, 2013.

	Site “Cove Hollow”				
	09/11/12	09/25/12	10/08/12	10/23/12	11/15/12
Temperature (°C)	15.0	14.9	14.2	14.9	14.0
pH (Field; Standard Units)	8.03	7.88	7.82	8.13	7.98
Stream Flow (CFS)	0.098	0.128	0.103	0.205	0.113
Dissolved Oxygen (mg/L)	9.51	9.74	9.98	9.90	10.15
Conductivity (µmhos/cm)	1,741	1,732	1,694	1,764	1,661
TDS (mg/L)	1,080	1,080	1,180	1,190	1,010

TABLE I. Continued.

	Site “Cove Hollow”				
	11/28/12	12/13/12	12/28/12	01/10/13	01/24/13
Temperature (°C)	14.0	13.5	13.7	14.2	13.2
pH (Field; Standard Units)	7.92	8.13	7.97	8.04	7.76
Stream Flow (CFS)	0.134	0.099	0.080	0.025	0.105
Dissolved Oxygen (mg/L)	10.0	10.13	10.03	10.01	10.27
Conductivity (µmhos/cm)	1,674	1,716	1,640	1,620	1,334
TDS (mg/L)	1,130	1,140	1,010	1,050	879

TABLE I. Continued.

	Site “Cove Hollow”	
	02/07/13	02/21/13
Temperature (°C)	13.9	14.0
pH (Field; Standard Units)	7.99	7.90
Stream Flow (CFS)	0.255	0.090
Dissolved Oxygen (mg/L)	10.17	10.02
Conductivity (µmhos/cm)	1,230	1,460
TDS (mg/L)	907	986