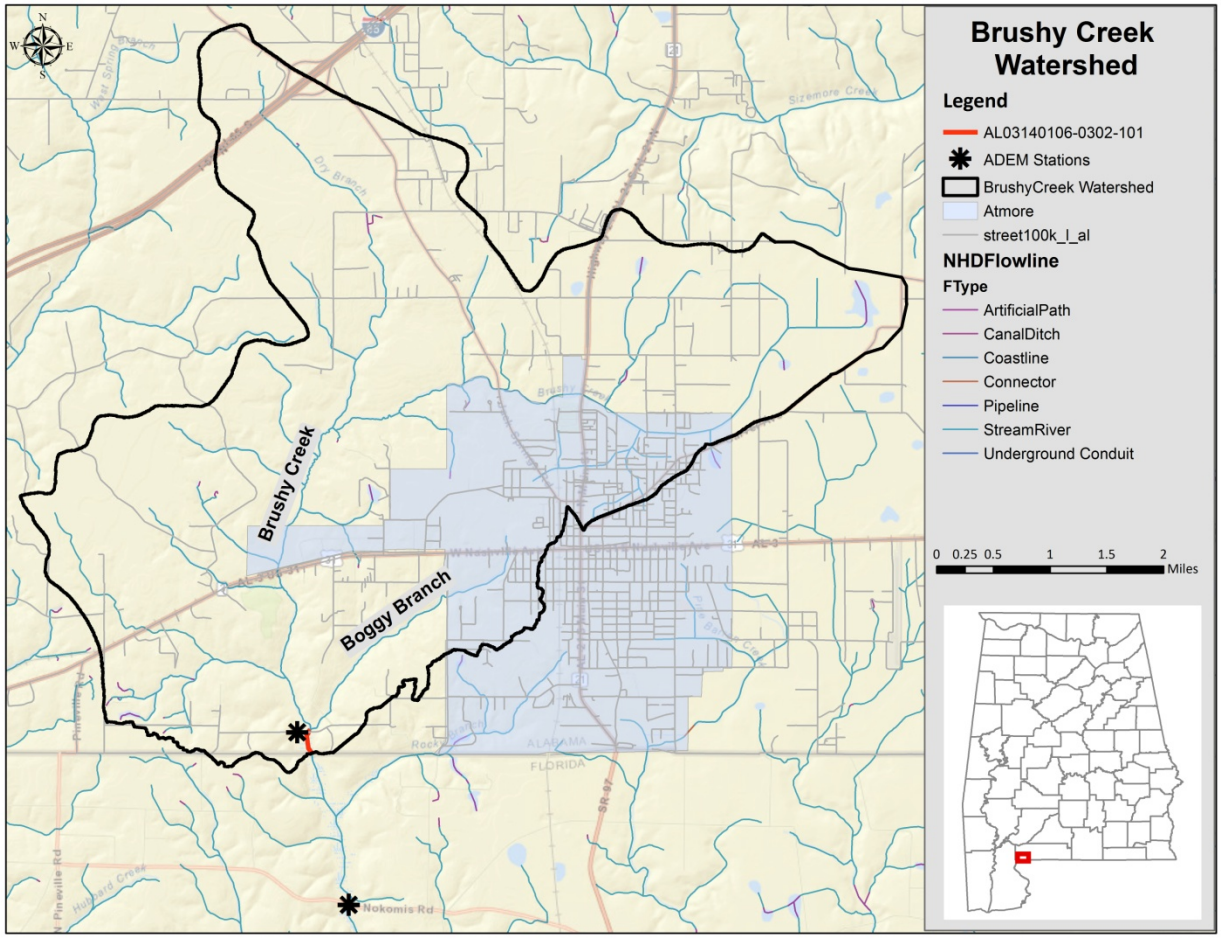
Draft
Delisting Decision
for
Brushy Creek

Waterbody ID AL03140106-0302-101

Organic Enrichment (CBOD,NBOD)

Alabama Department of Environmental Management
Water Division
Water Quality Branch
February 2016

Brushy Creek Watershed Map in the Perdido - Escambia River Basin



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1.0 Executive Summary

Brushy Creek is a free-flowing waterbody located in the Perdido-Escambia river basin. The headwaters of the watershed are located in Escambia County, Alabama. Brushy Creek originates just north of the town of Atmore, AL and flows south for a total stream length of 14.97 miles before reaching the Alabama – Florida state line. The total drainage area of the watershed extent located in the State of Alabama is 23 mi^2.

The purpose of this Delisting Decision document is to provide evidence supporting the decision to remove the organic enrichment pollutant on Brushy Creek from the Department's §303(d) List of Impaired Waterbodies.

In 1999, the Department sampled Brushy Creek as part of the CY1999 §303(d) Monitoring Project. The goal of the §303(d) Monitoring Project was to target potentially impaired waterbodies in order to document water quality conditions. The results of the sampling effort indicated low dissolved oxygen concentrations in Brushy Creek. Therefore, Brushy Creek was added to the Department's 2000 §303(d) List of Impaired Waterbodies with the impairment being Organic Enrichment / Low Dissolved Oxygen. The segment of Brushy Creek listed on the §303(d) list begins at the mouth of Boggy Branch and extends downstream a very short distance (0.22 miles) to the Alabama-Florida state line.

In 2014, the Department collected additional water quality data on Brushy Creek for TMDL development. Based on an examination of the water quality data collected on Brushy Creek in 2014, the Department has determined that a water quality impairment due to organic enrichment does not currently exist. The Department believes this segment of Brushy Creek is currently fully supporting its use classification with respect to organic enrichment. Therefore, ADEM will not develop a TMDL due to "more recent data," which is a just cause for delisting waterbodies according to Title 40 of the Code of Federal Regulations (CFR), Part 130.7(b)(6)(iv).

2.0 Basis for §303(d) Listing

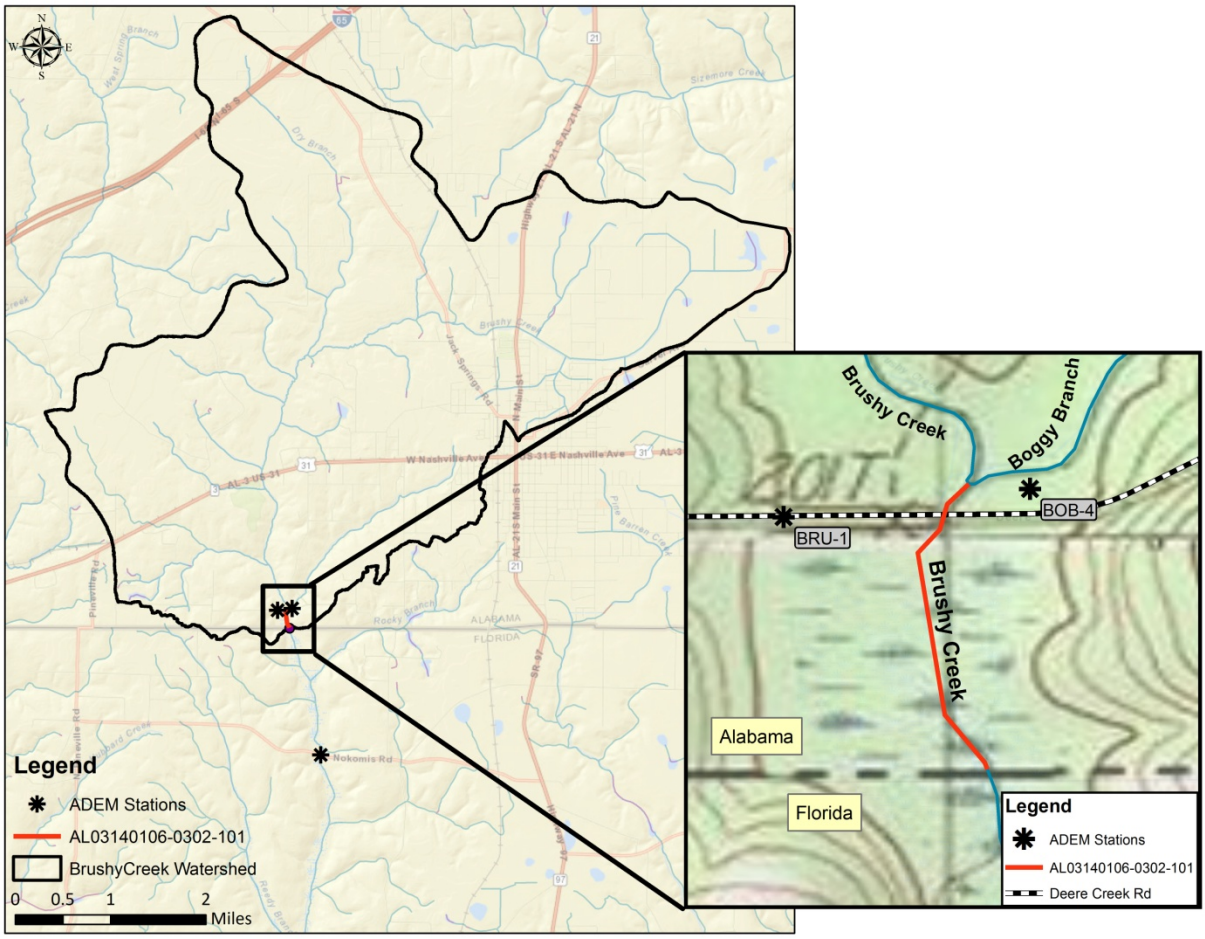
Section 303(d) of the Clean Water Act (CWA), as amended by the Water Quality Act of 1987 and EPA's Water Quality Planning and Management Regulations [Title 40 of the Code of Federal Regulations (CFR), Part 130], requires states to identify waterbodies which are not meeting water quality standards applicable to their designated use classifications. The identified waters are prioritized based on severity of pollution with respect to designated use classifications. TMDLs for all pollutants causing violation of applicable water quality standards are established for each identified waterbody. Such loads are established at levels necessary to attain the applicable water quality standards when also considering seasonal variations and margins of safety. The TMDL process establishes the allowable loading of pollutants, or other quantifiable parameters for a waterbody, based on the relationship between pollution sources and in-stream water quality conditions, so that states can establish water-quality based controls to reduce pollution from both point and non-point sources and restore and maintain the quality of their water resources (USEPA, 1991).

In 1999, the Department sampled Brushy Creek as part of the CY1999 §303(d) Monitoring Project. The goal of the §303(d) Monitoring Project was to target potentially impaired waterbodies in order to document present water quality conditions. The results of the sampling effort indicated low dissolved oxygen concentrations in Brushy Creek. Therefore, Brushy Creek was added to the Department's 2000 §303(d) List of Impaired waterbodies with the impairment being Organic Enrichment/ Low Dissolved Oxygen.

Table 2.1 Excerpt from Final 2000 §303(d) List for Alabama

Waterbody ID	Waterbody Name	River Basin	Uses	Cause	Sources	Date of Data	Size (mi)	Downstream / Upstream Locations
AL/03140106-070_02	Brushy Creek	Perdido-Escambia	Fish & Wildlife	OE/ DO	Industrial, Municipal, Urban runnoff/ storm sewers	1999	0.2	Al/Fla. State Line / Boggy Branch

Figure 2.1 Brushy Creek Segment Listed to Final 2000 §303(d) List



3.0 Technical Basis for Delisting Decision

3.1 Water Quality Target Identification

The use classification for Brushy Creek is Fish and Wildlife. According to ADEM's Water Quality Criteria (Administrative Code 335-6-10), the Dissolved Oxygen criteria for the Fish and Wildlife use classification is as follows:

For a diversified warm water biota, including game fish, daily dissolved oxygen concentrations shall not be less than 5 mg/l at all times; except under extreme conditions due to natural causes, it may range between 5 mg/l and 4 mg/, provided that the water quality is favorable in all other parameters. The normal seasonal and daily fluctuations shall be maintained above these levels.

In order to determine if an organic enrichment impairment exists in Brushy Creek, the Department will evaluate measured dissolved oxygen concentrations against the criteria mentioned above. Furthermore, the Department will also focus on some of the primary drivers affecting instream dissolved oxygen concentrations, including carbonaceous biochemical oxygen demand (CBOD) and nitrogenous biochemical oxygen demand (NBOD). Specifically, laboratory $CBOD_5$ results will be assessed in order to determine if excessive carbonaceous biochemical oxygen demand (CBOD) is negatively impacting dissolved oxygen concentrations. Also, total Kjeldahl nitrogen (TKN) laboratory results will be assessed to determine if an excessive nitrogenous biochemical oxygen demand (NBOD) is negatively impacting dissolved oxygen concentrations as well.

For the purposes of evaluating the $CBOD_5$ and TKN laboratory results, the Department has chosen to utilize the 90^{th} percentile of the data distributions from the previously published 2010 eco-region reference guidelines concentrations. The guideline values will be used in establishing CBOD and NBOD evaluation concentrations that will serve as a reference points for comparison to the collected ambient water quality data from Brushy Creek.

In 2010, ADEM published ecoregional reference guidelines for a number of parameters and pollutants. Reference streams, also referred to as “reference reaches” or “ecoregional reference sites,” are defined as relatively homogeneous areas of similar climate, land form, soil, natural vegetation, hydrology, and other ecologically relevant variables (USEPA, 2000b) which have remained comparatively undisturbed or minimally impacted by human activity over an extended period of time in relation to other waters of the State. While not necessarily pristine or completely undisturbed by humans, reference streams do represent desirable chemical, physical and biological conditions for a given ecoregion that can be used for evaluation purposes.

The reference streams selected for a particular analysis depends primarily on the number of available reference stations and associated data within a particular ecoregion. Therefore, the total number of reference sites selected and the aerial scale (i.e. Ecoregion Level III, Level IV) used to represent a reference condition will often vary on a case-by-case basis.

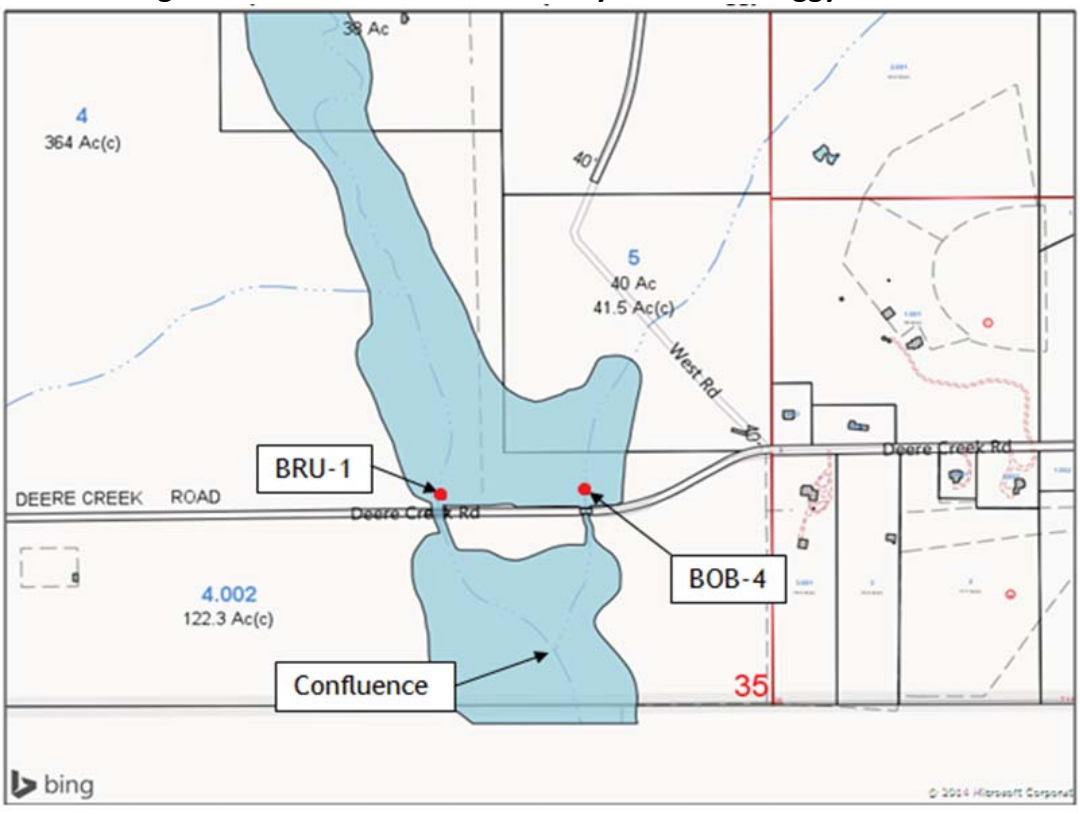
The entire Brushy Creek watershed is located within the Level IV Ecoregion 65f – Southern Pine Plains and Hills. The 90^{th} percentile of the CBOD5 (mg/l) and TKN (mg/l) data distributions collected from this eco-region are 1.96 mg/l and 0.418 mg/l, respectively. Ambient water quality data will be evaluated against these eco-reference concentrations to determine if an organic enrichment related impairment exists in Brushy Creek.

3.2 Data Availability and Analysis

In 1999, the Department sampled Brushy Creek as part of the CY1999 §303(d) Monitoring Project. The goal of the project was to target potentially impaired waterbodies in order to document present water quality conditions. During the monitoring project, a total of four in-situ and water quality samples were collected during the months of May through September. The results of all four of the in-situ dissolved oxygen measurements yielded concentrations below the Fish and Wildlife use classification criteria of 5.0 mg/L.

In 2014, the Department collected additional water quality data on Brushy Creek for TMDL development. The segment of Brushy Creek listed on the §303(d) list begins at the mouth of Boggy Branch and extends downstream a very short distance (0.22 miles) to the Alabama-Florida state line. The only road crossing on the listed segment of Brushy Creek is at station BRU-1. During a visit to this station prior to the sampling season, the Department discovered that Brushy Creek and Boggy Branch flow through a large swamp prior to the confluence of the main creek channels. Further investigation of the area revealed that Brushy Creek and Boggy Branch are in fact hydraulically connected by a series of small braided streams prior to the main confluence downstream of the road crossing.

Figure 3.2.1 Confluence of Brushy Creek and Boggy Branch

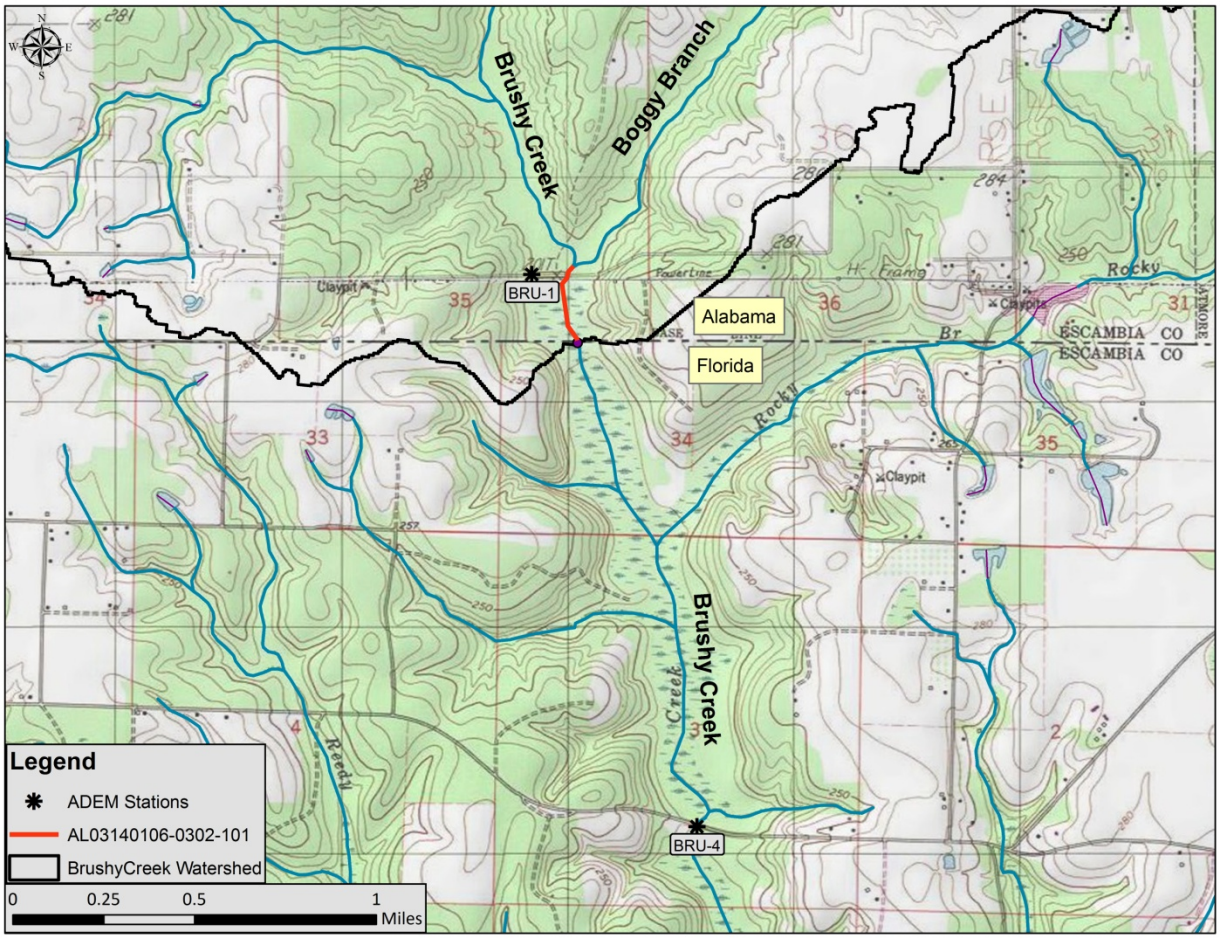


Considering the original §303(d) listed segment of Brushy Creek was downstream of Boggy Branch, the Department decided to move the 2014 sampling station further downstream in order to verify the sampling location is truly capturing the influence of Boggy Branch. Therefore, Brushy Creek was sampled at the next immediate road crossing downstream (station BRU-4). At station BRU-4, in-situ measurements and water samples were collected monthly, from April through November. During the month of July 2014, a 72-hour diurnal study was also conducted at station BRU-4 by deploying a datasonde to continuously monitor for the following parameters on a 15 minute time interval: dissolved oxygen (mg/l), temperature (C), pH (su), and specific conductivity (umhos).

Table 3.2.1 Brushy Creek Station Descriptions

Station	Latitude	Longitude	Station Description
BRU-1	31.00037	-87.5358	Brushy Creek at Deere Creek Rd
BRU-4	30.97837	-87.528	Brushy Creek in Escambia County Florida at Nokomis Road.

Figure 3.2.2 Brushy Creek Sampling Stations



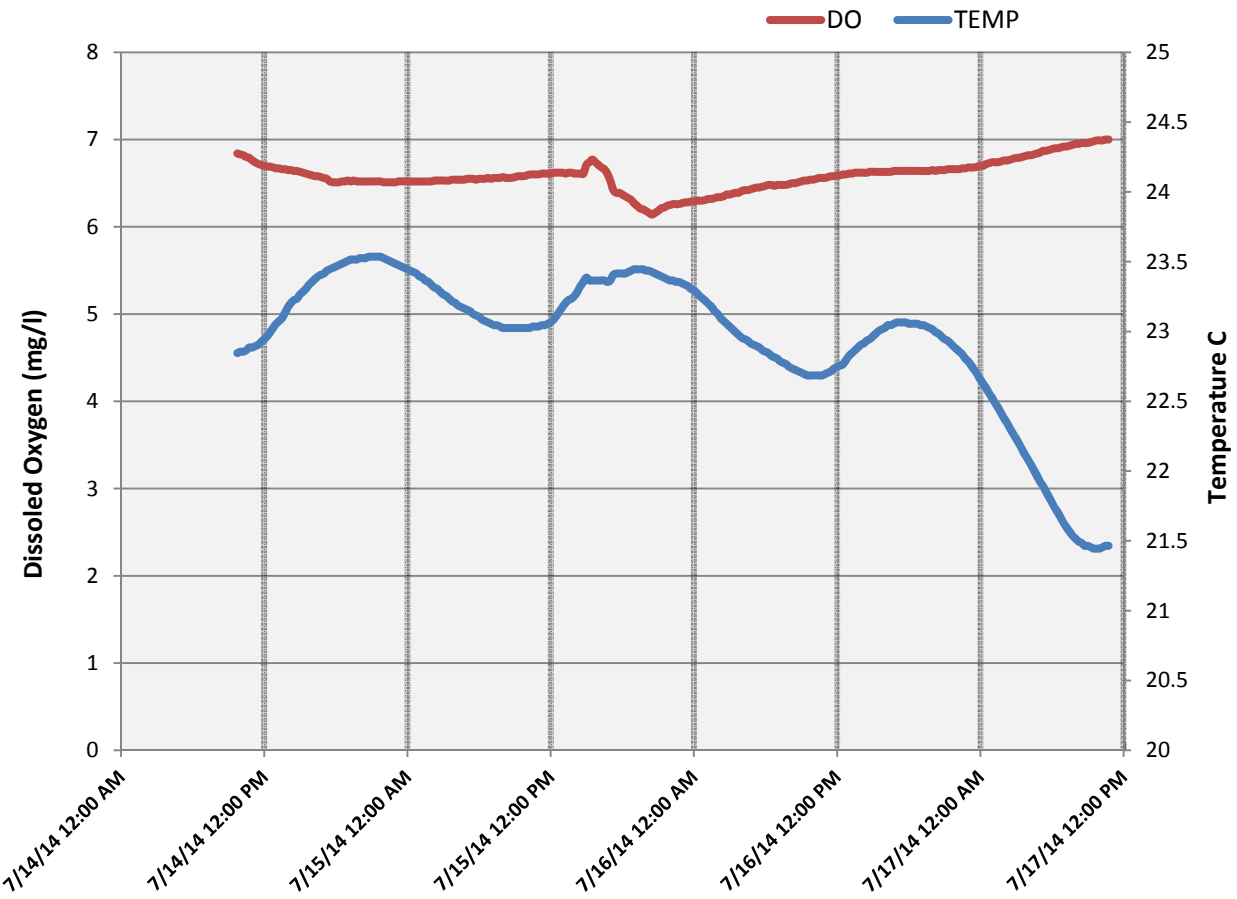
In the table below, the results of the dissolved oxygen samples collected at station BRU-4 on Brushy Creek during 2014 indicate all of the measured dissolved oxygen concentrations were above the Fish and Wildlife use classification criteria of 5.0 mg/L.

Table 3.2.2 Brushy Creek 2014 Dissolved Oxygen Results

Station	Type of Measurement	# of DO Samples	# of DO Samples < 5 (mg/l)	Minimum D.O. (mg/l)
BRU-4	In-Situ Grab Sample	6	0	6.2
	Long-term Continuous Monitoring	293	0	6.14

The dissolved oxygen results of the long term 72-hour deployment study conducted at station BRU-4 from 7/14/2014 to 7/17/2014 are shown in the graph below. The datasonde was deployed at approximately mid-depth and collected continuous samples on a 15 minute time interval over the course of three days.

Figure 3.2.3 Station BRU-4 72hr Diurnal Study Results



Organic Enrichment (CBOD & NBOD) Data Analysis

In the table below, the CBOD and NBOD data collected from Brushy Creek during the 2014 sampling efforts are compared to the eco-reference CBOD and NBOD concentrations. Based on the lab results, all of the collected CBOD5 concentrations were below the Department's method detection limit of 2 mg/L. Therefore, based on Departmental protocol, one-half of the method detection limit concentration will be used in the data analysis. The median CBOD5 and Ammonia Nitrogen concentrations collected from Brushy Creek are less than the eco-reference values. Furthermore, the median total Kjeldahl nitrogen (TKN) concentration collected from Brushy Creek is only very slightly greater than the eco-reference value.

Table 3.2.4 Brushy Creek Organic Enrichment Data Analysis

Parameter	N	Min	Max	Med	Avg	SD	10th % ile	90th % ile	Eco-Reference (65f)
Dissolved Oxygen (mg/L)	6	6.2	9	**6.7**	7.2	1.1	6.2	9	6.94 [a]
Ammonia Nitrogen (mg/L)	8	0.006	0.095	**0.005**	0.026	0.04	0.003	0.095	0.046 [b]
Total Kjeldahl Nitrogen (mg/L)	8	0.331	0.655	**0.419**	0.469	0.140	0.331	0.655	0.418 [b]
CBOD-5 (mg/L)	8	2	2	**1**	1	0	1	1	1.96 [b]

a. 10^{th} Percentile b. 90^{th} Percentile

4.0 Conclusion

Based on an examination of the collected water quality data on Brushy Creek in 2014, ADEM has determined that a water quality impairment due to organic enrichment does not currently exist. The Department believes this segment of Brushy Creek is currently fully supporting its use classification with respect to organic enrichment. Therefore, ADEM will not develop a TMDL due to "more recent data," which is a just cause for delisting waterbodies according to Title 40 of the Code of Federal Regulations (CFR), Part 130.7(b)(6)(iv).

5.0 Public Participation

As part of the public participation process, this Delisting Decision (DD) will be placed on public notice and made available for review and comment. A public notice will be prepared and published in the major daily newspapers in Montgomery, Huntsville, Birmingham, and Mobile, as well as submitted to persons who have requested to be on ADEM's postal and electronic mailing distributions. In addition, the public notice and subject DD will be made available on ADEM's Website: www.adem.state.al.us. The public can also request hard or electronic copies of the DD by contacting Ms. Kimberly Minton at 334-271-7826 or kminton@adem.state.al.us. The public will be given an opportunity to review the DD and submit comments to the Department in writing. At the end of the comment period, all written comments received during the public notice period will become part of the administrative record. ADEM will consider all comments received by the public prior to final completion of this DD and subsequent submission to EPA Region 4 for final approval.

Appendix A
References

ADEM Administrative Code, 2013. Water Quality Program, Chapter 335-6-10, Water Quality Criteria, and Chapter 335-6-11 Use Classifications for Interstate and Intrastate Waters.

USEPA. 1991. Guidance for Water Quality-Based Decisions: The TMDL Process, Office of Water, EPA 440/4-91-001.

USEPA. 2000b. Nutrient Criteria Technical Guidance Manual: River and Streams. United States Environmental Protection Agency, Office of Water. EPA 822-B-00-002.

Appendix B
Water Quality Data

Station ID	Visit Date	Rel Depth	Flow cfs	T H2O C	DO mgL	Cond µmhos	pH su	Turb NTU	TDS mgL	TSS mgL	CBOD-5 mgL	CBOD-5 dc
BRU-4	4/23/14 12:09 PM	Mid-Depth	23	18.41		57.1	7.45	7.66	31	1	2	< MDL 2
BRU-4	5/21/14 12:12 PM	Mid-Depth	48					7.13	51	1	2	< MDL 2
BRU-4	6/11/14 11:50 AM	Mid-Depth	63	22.18	6.19	51.8	5.76	16	77	23	2	< MDL 2
BRU-4	7/9/14 11:48 AM	Mid-Depth	32	22.81	6.66	70.6	6.05	4.92	53	6	2	< MDL 2
BRU-4	8/20/14 12:02 PM	Mid-Depth	27	23.38	6.61	59.4	5.95	7.77	1	21	2	< MDL 2
BRU-4	9/17/14 12:38 PM	Mid-Depth	20	22.87	6.75	71.9	6.1	5.27	63	5	2	< MDL 2
BRU-4	10/28/14 12:12 PM	Mid-Depth	18	17.71	7.98	64.1	5.82	3.47	50	3	2	< MDL 2
BRU-4	11/18/14 12:28 PM	Mid-Depth	23	11.24	9.03	58.8	5.9	3.13	36	1	2	< MDL 2

Station ID	Visit Date	Alk Tot mgL	Alk Tot dc	Hard mgL	Hard dc	NH3 mgL	NH3 dc	NO3 NO2 N mgL	NO3 NO2 N dc	TKN mgL	TKN dc	DRP mgL	DRP dc	Total P mgL	Total P dc
BRU-4	4/23/14 12:09 PM	9.92	JQ	14.8		0.006	< MDL .006	0.647		0.655		0.031		0.081	
BRU-4	5/21/14 12:12 PM	9	JI	16.4		0.006	< MDL .006	0.853		0.362		0.028		0.08	
BRU-4	6/11/14 11:50 AM	7.8		14.3		0.087		0.452		0.647		0.033		0.099	
BRU-4	7/9/14 11:48 AM	10.8		17.4		0.006	< MDL .006	1.174		0.476		0.037		0.083	
BRU-4	8/20/14 12:02 PM	7.84		14		0.01	< MDL .01	0.755		0.581		0.032		0.104	
BRU-4	9/17/14 12:38 PM	10.5		18.3		0.095		1.276		0.345		0.056		0.11	
BRU-4	10/28/14 12:12 PM	8.1		15.2		0.01	< MDL .01	1.334		0.331		0.054		0.09	
BRU-4	11/18/14 12:28 PM	7.57		15.4		0.01	< MDL .01	0.805		0.358		0.029		0.062	

Station ID	Date & Time	Depth (m)	TEMP C	DO (mg/l)	pH (su)	SPCOND (umhos)
BRU-4	7/14/14 9:45 AM	0.538582	22.845	6.84	5.75	69
BRU-4	7/14/14 10:00 AM	0.536448	22.855	6.83	5.86	69
BRU-4	7/14/14 10:15 AM	0.534924	22.855	6.82	5.86	69
BRU-4	7/14/14 10:30 AM	0.538582	22.865	6.8	5.87	68
BRU-4	7/14/14 10:45 AM	0.535229	22.885	6.79	5.87	68
BRU-4	7/14/14 11:00 AM	0.532486	22.885	6.76	5.87	67
BRU-4	7/14/14 11:15 AM	0.535229	22.895	6.74	5.87	67
BRU-4	7/14/14 11:30 AM	0.533095	22.905	6.72	5.87	66
BRU-4	7/14/14 11:45 AM	0.534924	22.925	6.71	5.87	66
BRU-4	7/14/14 12:00 PM	0.531571	22.945	6.7	5.87	66
BRU-4	7/14/14 12:15 PM	0.5334	22.965	6.69	5.87	66
BRU-4	7/14/14 12:30 PM	0.522427	22.995	6.69	5.87	66
BRU-4	7/14/14 12:45 PM	0.522122	23.025	6.68	5.87	66
BRU-4	7/14/14 1:00 PM	0.521818	23.055	6.67	5.87	66
BRU-4	7/14/14 1:15 PM	0.523951	23.075	6.67	5.87	66
BRU-4	7/14/14 1:30 PM	0.519379	23.095	6.66	5.88	66
BRU-4	7/14/14 1:45 PM	0.519379	23.135	6.66	5.88	66
BRU-4	7/14/14 2:00 PM	0.51877	23.175	6.65	5.88	66
BRU-4	7/14/14 2:15 PM	0.523037	23.205	6.65	5.88	66
BRU-4	7/14/14 2:30 PM	0.51816	23.225	6.64	5.88	66
BRU-4	7/14/14 2:45 PM	0.518465	23.235	6.64	5.88	66
BRU-4	7/14/14 3:00 PM	0.519379	23.265	6.63	5.88	66
BRU-4	7/14/14 3:15 PM	0.516636	23.285	6.62	5.88	66
BRU-4	7/14/14 3:30 PM	0.514198	23.305	6.61	5.88	66
BRU-4	7/14/14 3:45 PM	0.507492	23.335	6.6	5.88	66
BRU-4	7/14/14 4:00 PM	0.504444	23.355	6.59	5.88	66
BRU-4	7/14/14 4:15 PM	0.51115	23.375	6.58	5.88	66
BRU-4	7/14/14 4:30 PM	0.509626	23.395	6.58	5.88	66
BRU-4	7/14/14 4:45 PM	0.508102	23.405	6.57	5.88	66
BRU-4	7/14/14 5:00 PM	0.50292	23.415	6.56	5.88	65
BRU-4	7/14/14 5:15 PM	0.498958	23.435	6.55	5.88	65
BRU-4	7/14/14 5:30 PM	0.50231	23.445	6.52	5.88	65
BRU-4	7/14/14 5:45 PM	0.498348	23.455	6.51	5.88	65
BRU-4	7/14/14 6:00 PM	0.497738	23.465	6.51	5.88	65
BRU-4	7/14/14 6:15 PM	0.49469	23.475	6.51	5.88	65
BRU-4	7/14/14 6:30 PM	0.496519	23.485	6.52	5.88	65
BRU-4	7/14/14 6:45 PM	0.492252	23.495	6.52	5.88	65
BRU-4	7/14/14 7:00 PM	0.497434	23.505	6.53	5.88	65
BRU-4	7/14/14 7:15 PM	0.496519	23.515	6.52	5.88	65
BRU-4	7/14/14 7:30 PM	0.499567	23.515	6.53	5.88	65
BRU-4	7/14/14 7:45 PM	0.496519	23.515	6.52	5.88	64
BRU-4	7/14/14 8:00 PM	0.494081	23.525	6.52	5.88	64
BRU-4	7/14/14 8:15 PM	0.4953	23.525	6.52	5.88	64
BRU-4	7/14/14 8:30 PM	0.501091	23.525	6.52	5.87	64
BRU-4	7/14/14 8:45 PM	0.502615	23.535	6.52	5.87	63
BRU-4	7/14/14 9:00 PM	0.506882	23.535	6.52	5.87	63
BRU-4	7/14/14 9:15 PM	0.503834	23.535	6.52	5.87	63

Station ID	Date & Time	Depth (m)	TEMP C	DO (mg/l)	pH (su)	SPCOND (umhos)
BRU-4	7/14/14 9:30 PM	0.507492	23.535	6.52	5.87	63
BRU-4	7/14/14 9:45 PM	0.509626	23.535	6.52	5.87	63
BRU-4	7/14/14 10:00 PM	0.516636	23.525	6.51	5.87	63
BRU-4	7/14/14 10:15 PM	0.513893	23.515	6.51	5.87	62
BRU-4	7/14/14 10:30 PM	0.51755	23.505	6.51	5.87	62
BRU-4	7/14/14 10:45 PM	0.521208	23.495	6.51	5.88	62
BRU-4	7/14/14 11:00 PM	0.517246	23.485	6.51	5.87	62
BRU-4	7/14/14 11:15 PM	0.519989	23.475	6.52	5.88	62
BRU-4	7/14/14 11:30 PM	0.517246	23.465	6.52	5.88	62
BRU-4	7/14/14 11:45 PM	0.519074	23.455	6.52	5.88	62
BRU-4	7/15/14 12:00 AM	0.512369	23.445	6.52	5.88	63
BRU-4	7/15/14 12:15 AM	0.514502	23.435	6.52	5.88	63
BRU-4	7/15/14 12:30 AM	0.512674	23.425	6.52	5.88	63
BRU-4	7/15/14 12:45 AM	0.505663	23.415	6.52	5.88	64
BRU-4	7/15/14 1:00 AM	0.501396	23.395	6.52	5.88	64
BRU-4	7/15/14 1:15 AM	0.498958	23.385	6.52	5.88	64
BRU-4	7/15/14 1:30 AM	0.501396	23.365	6.52	5.88	65
BRU-4	7/15/14 1:45 AM	0.497738	23.355	6.52	5.88	65
BRU-4	7/15/14 2:00 AM	0.498043	23.335	6.52	5.88	65
BRU-4	7/15/14 2:15 AM	0.499567	23.315	6.53	5.88	66
BRU-4	7/15/14 2:30 AM	0.497738	23.305	6.53	5.88	66
BRU-4	7/15/14 2:45 AM	0.496519	23.285	6.53	5.88	66
BRU-4	7/15/14 3:00 AM	0.504444	23.265	6.53	5.88	66
BRU-4	7/15/14 3:15 AM	0.500786	23.255	6.53	5.88	67
BRU-4	7/15/14 3:30 AM	0.502615	23.235	6.53	5.88	67
BRU-4	7/15/14 3:45 AM	0.500482	23.215	6.54	5.88	67
BRU-4	7/15/14 4:00 AM	0.50231	23.205	6.54	5.88	68
BRU-4	7/15/14 4:15 AM	0.50353	23.185	6.54	5.88	68
BRU-4	7/15/14 4:30 AM	0.504139	23.175	6.54	5.89	68
BRU-4	7/15/14 4:45 AM	0.503834	23.165	6.54	5.89	69
BRU-4	7/15/14 5:00 AM	0.500177	23.155	6.55	5.89	69
BRU-4	7/15/14 5:15 AM	0.503834	23.145	6.55	5.89	69
BRU-4	7/15/14 5:30 AM	0.497129	23.125	6.55	5.89	69
BRU-4	7/15/14 5:45 AM	0.498043	23.115	6.54	5.89	69
BRU-4	7/15/14 6:00 AM	0.50353	23.105	6.55	5.89	69
BRU-4	7/15/14 6:15 AM	0.501396	23.085	6.55	5.88	69
BRU-4	7/15/14 6:30 AM	0.502006	23.075	6.55	5.89	69
BRU-4	7/15/14 6:45 AM	0.503225	23.065	6.56	5.88	69
BRU-4	7/15/14 7:00 AM	0.505054	23.055	6.55	5.88	69
BRU-4	7/15/14 7:15 AM	0.504749	23.045	6.56	5.88	69
BRU-4	7/15/14 7:30 AM	0.506273	23.045	6.56	5.88	69
BRU-4	7/15/14 7:45 AM	0.509626	23.035	6.56	5.88	69
BRU-4	7/15/14 8:00 AM	0.506578	23.025	6.57	5.88	69
BRU-4	7/15/14 8:15 AM	0.506578	23.025	6.56	5.88	69
BRU-4	7/15/14 8:30 AM	0.505968	23.025	6.56	5.88	69
BRU-4	7/15/14 8:45 AM	0.508711	23.025	6.56	5.88	69
BRU-4	7/15/14 9:00 AM	0.506882	23.025	6.57	5.88	69

Station ID	Date & Time	Depth (m)	TEMP C	DO (mg/l)	pH (su)	SPCOND (umhos)
BRU-4	7/15/14 9:15 AM	0.50353	23.025	6.58	5.88	69
BRU-4	7/15/14 9:30 AM	0.502615	23.025	6.58	5.88	68
BRU-4	7/15/14 9:45 AM	0.50231	23.025	6.58	5.88	68
BRU-4	7/15/14 10:00 AM	0.449275	23.025	6.59	5.89	68
BRU-4	7/15/14 10:15 AM	0.452628	23.025	6.6	5.89	68
BRU-4	7/15/14 10:30 AM	0.449275	23.035	6.6	5.89	68
BRU-4	7/15/14 10:45 AM	0.451409	23.035	6.6	5.89	68
BRU-4	7/15/14 11:00 AM	0.450799	23.035	6.6	5.89	68
BRU-4	7/15/14 11:15 AM	0.447751	23.045	6.61	5.89	67
BRU-4	7/15/14 11:30 AM	0.447446	23.045	6.61	5.88	67
BRU-4	7/15/14 11:45 AM	0.44958	23.055	6.61	5.88	67
BRU-4	7/15/14 12:00 PM	0.447446	23.065	6.61	5.88	66
BRU-4	7/15/14 12:15 PM	0.445618	23.085	6.62	5.88	66
BRU-4	7/15/14 12:30 PM	0.444398	23.115	6.62	5.88	66
BRU-4	7/15/14 12:45 PM	0.446227	23.145	6.62	5.88	66
BRU-4	7/15/14 1:00 PM	0.446532	23.175	6.62	5.88	66
BRU-4	7/15/14 1:15 PM	0.447446	23.205	6.61	5.88	66
BRU-4	7/15/14 1:30 PM	0.445922	23.225	6.62	5.88	66
BRU-4	7/15/14 1:45 PM	0.443789	23.235	6.62	5.88	66
BRU-4	7/15/14 2:00 PM	0.438607	23.255	6.61	5.89	66
BRU-4	7/15/14 2:15 PM	0.436474	23.285	6.61	5.88	66
BRU-4	7/15/14 2:30 PM	0.436169	23.325	6.61	5.89	66
BRU-4	7/15/14 2:45 PM	0.437083	23.355	6.61	5.89	66
BRU-4	7/15/14 3:00 PM	0.472135	23.385	6.71	5.9	64
BRU-4	7/15/14 3:15 PM	0.470306	23.365	6.74	5.89	64
BRU-4	7/15/14 3:30 PM	0.477622	23.365	6.77	5.89	63
BRU-4	7/15/14 3:45 PM	0.479146	23.365	6.74	5.88	63
BRU-4	7/15/14 4:00 PM	0.48768	23.365	6.71	5.88	63
BRU-4	7/15/14 4:15 PM	0.486461	23.365	6.68	5.87	63
BRU-4	7/15/14 4:30 PM	0.491338	23.365	6.66	5.85	62
BRU-4	7/15/14 4:45 PM	0.499262	23.355	6.61	5.82	61
BRU-4	7/15/14 5:00 PM	0.507492	23.365	6.53	5.79	60
BRU-4	7/15/14 5:15 PM	0.513588	23.405	6.42	5.76	59
BRU-4	7/15/14 5:30 PM	0.51755	23.415	6.39	5.75	59
BRU-4	7/15/14 5:45 PM	0.519989	23.415	6.39	5.75	58
BRU-4	7/15/14 6:00 PM	0.524866	23.415	6.37	5.74	58
BRU-4	7/15/14 6:15 PM	0.530352	23.415	6.35	5.74	57
BRU-4	7/15/14 6:30 PM	0.529438	23.425	6.33	5.73	56
BRU-4	7/15/14 6:45 PM	0.532486	23.435	6.31	5.71	55
BRU-4	7/15/14 7:00 PM	0.532486	23.445	6.27	5.69	54
BRU-4	7/15/14 7:15 PM	0.53279	23.445	6.24	5.67	53
BRU-4	7/15/14 7:30 PM	0.54041	23.445	6.21	5.66	52
BRU-4	7/15/14 7:45 PM	0.538277	23.445	6.2	5.66	53
BRU-4	7/15/14 8:00 PM	0.541934	23.435	6.18	5.66	53
BRU-4	7/15/14 8:15 PM	0.537058	23.435	6.16	5.66	53
BRU-4	7/15/14 8:30 PM	0.531266	23.425	6.14	5.65	54
BRU-4	7/15/14 8:45 PM	0.53401	23.415	6.16	5.66	54

Station ID	Date & Time	Depth (m)	TEMP C	DO (mg/l)	pH (su)	SPCOND (umhos)
BRU-4	7/15/14 9:00 PM	0.53401	23.405	6.18	5.67	55
BRU-4	7/15/14 9:15 PM	0.534619	23.395	6.21	5.68	56
BRU-4	7/15/14 9:30 PM	0.529742	23.385	6.22	5.69	56
BRU-4	7/15/14 9:45 PM	0.521513	23.375	6.24	5.69	57
BRU-4	7/15/14 10:00 PM	0.516636	23.365	6.25	5.71	58
BRU-4	7/15/14 10:15 PM	0.520903	23.365	6.26	5.72	59
BRU-4	7/15/14 10:30 PM	0.513283	23.355	6.26	5.73	60
BRU-4	7/15/14 10:45 PM	0.515417	23.355	6.26	5.74	60
BRU-4	7/15/14 11:00 PM	0.517246	23.345	6.27	5.75	61
BRU-4	7/15/14 11:15 PM	0.510235	23.335	6.28	5.75	62
BRU-4	7/15/14 11:30 PM	0.505358	23.325	6.28	5.75	62
BRU-4	7/15/14 11:45 PM	0.502615	23.305	6.29	5.75	62
BRU-4	7/16/14 12:00 AM	0.501701	23.295	6.29	5.75	63
BRU-4	7/16/14 12:15 AM	0.49469	23.275	6.3	5.75	63
BRU-4	7/16/14 12:30 AM	0.49469	23.255	6.3	5.75	63
BRU-4	7/16/14 12:45 AM	0.493776	23.235	6.3	5.75	63
BRU-4	7/16/14 1:00 AM	0.488594	23.215	6.31	5.75	63
BRU-4	7/16/14 1:15 AM	0.491033	23.195	6.32	5.75	63
BRU-4	7/16/14 1:30 AM	0.4953	23.175	6.32	5.75	63
BRU-4	7/16/14 1:45 AM	0.491033	23.145	6.33	5.76	63
BRU-4	7/16/14 2:00 AM	0.487985	23.125	6.34	5.75	63
BRU-4	7/16/14 2:15 AM	0.48707	23.095	6.34	5.75	63
BRU-4	7/16/14 2:30 AM	0.484937	23.075	6.35	5.75	63
BRU-4	7/16/14 2:45 AM	0.484327	23.055	6.37	5.76	63
BRU-4	7/16/14 3:00 AM	0.487985	23.035	6.37	5.76	63
BRU-4	7/16/14 3:15 AM	0.48768	23.015	6.38	5.76	63
BRU-4	7/16/14 3:30 AM	0.485546	22.995	6.39	5.76	63
BRU-4	7/16/14 3:45 AM	0.484632	22.975	6.39	5.76	63
BRU-4	7/16/14 4:00 AM	0.487985	22.955	6.41	5.76	63
BRU-4	7/16/14 4:15 AM	0.483413	22.945	6.42	5.76	63
BRU-4	7/16/14 4:30 AM	0.485242	22.935	6.42	5.76	63
BRU-4	7/16/14 4:45 AM	0.483413	22.915	6.43	5.76	63
BRU-4	7/16/14 5:00 AM	0.483413	22.905	6.44	5.76	63
BRU-4	7/16/14 5:15 AM	0.483108	22.895	6.45	5.76	63
BRU-4	7/16/14 5:30 AM	0.485851	22.885	6.45	5.76	63
BRU-4	7/16/14 5:45 AM	0.491033	22.865	6.46	5.76	63
BRU-4	7/16/14 6:00 AM	0.497434	22.855	6.47	5.76	63
BRU-4	7/16/14 6:15 AM	0.490423	22.845	6.48	5.77	62
BRU-4	7/16/14 6:30 AM	0.493776	22.825	6.48	5.76	62
BRU-4	7/16/14 6:45 AM	0.493471	22.815	6.47	5.76	62
BRU-4	7/16/14 7:00 AM	0.496824	22.805	6.48	5.76	62
BRU-4	7/16/14 7:15 AM	0.495605	22.785	6.48	5.76	62
BRU-4	7/16/14 7:30 AM	0.493776	22.775	6.48	5.76	62
BRU-4	7/16/14 7:45 AM	0.49591	22.765	6.48	5.76	62
BRU-4	7/16/14 8:00 AM	0.497434	22.745	6.49	5.76	62
BRU-4	7/16/14 8:15 AM	0.497434	22.735	6.5	5.76	62
BRU-4	7/16/14 8:30 AM	0.498958	22.725	6.5	5.75	62

Station ID	Date & Time	Depth (m)	TEMP C	DO (mg/l)	pH (su)	SPCOND (umhos)
BRU-4	7/16/14 8:45 AM	0.499872	22.715	6.51	5.75	62
BRU-4	7/16/14 9:00 AM	0.497738	22.705	6.52	5.75	62
BRU-4	7/16/14 9:15 AM	0.501091	22.695	6.53	5.75	61
BRU-4	7/16/14 9:30 AM	0.498958	22.685	6.53	5.75	61
BRU-4	7/16/14 9:45 AM	0.504444	22.685	6.54	5.75	61
BRU-4	7/16/14 10:00 AM	0.50231	22.685	6.54	5.75	61
BRU-4	7/16/14 10:15 AM	0.501396	22.685	6.55	5.75	61
BRU-4	7/16/14 10:30 AM	0.502615	22.685	6.56	5.75	61
BRU-4	7/16/14 10:45 AM	0.50231	22.685	6.56	5.75	61
BRU-4	7/16/14 11:00 AM	0.50231	22.695	6.56	5.75	61
BRU-4	7/16/14 11:15 AM	0.501396	22.705	6.57	5.75	60
BRU-4	7/16/14 11:30 AM	0.499567	22.715	6.58	5.75	60
BRU-4	7/16/14 11:45 AM	0.499567	22.735	6.58	5.75	60
BRU-4	7/16/14 12:00 PM	0.498653	22.745	6.59	5.75	60
BRU-4	7/16/14 12:15 PM	0.497434	22.755	6.59	5.75	60
BRU-4	7/16/14 12:30 PM	0.494386	22.765	6.6	5.75	60
BRU-4	7/16/14 12:45 PM	0.493776	22.795	6.6	5.75	60
BRU-4	7/16/14 1:00 PM	0.492557	22.825	6.61	5.75	60
BRU-4	7/16/14 1:15 PM	0.489814	22.845	6.61	5.76	60
BRU-4	7/16/14 1:30 PM	0.48768	22.865	6.62	5.76	60
BRU-4	7/16/14 1:45 PM	0.484937	22.885	6.62	5.76	60
BRU-4	7/16/14 2:00 PM	0.483413	22.905	6.62	5.76	60
BRU-4	7/16/14 2:15 PM	0.480974	22.915	6.62	5.76	60
BRU-4	7/16/14 2:30 PM	0.478841	22.935	6.62	5.77	60
BRU-4	7/16/14 2:45 PM	0.477926	22.945	6.63	5.77	60
BRU-4	7/16/14 3:00 PM	0.477317	22.965	6.63	5.77	60
BRU-4	7/16/14 3:15 PM	0.475488	22.985	6.63	5.77	60
BRU-4	7/16/14 3:30 PM	0.473659	23.005	6.63	5.77	59
BRU-4	7/16/14 3:45 PM	0.47244	23.015	6.63	5.77	59
BRU-4	7/16/14 4:00 PM	0.470611	23.025	6.63	5.77	59
BRU-4	7/16/14 4:15 PM	0.467563	23.045	6.63	5.77	59
BRU-4	7/16/14 4:30 PM	0.466039	23.045	6.63	5.77	59
BRU-4	7/16/14 4:45 PM	0.46543	23.055	6.64	5.78	59
BRU-4	7/16/14 5:00 PM	0.464515	23.065	6.64	5.78	59
BRU-4	7/16/14 5:15 PM	0.463601	23.065	6.64	5.78	59
BRU-4	7/16/14 5:30 PM	0.463601	23.065	6.64	5.78	59
BRU-4	7/16/14 5:45 PM	0.461467	23.065	6.64	5.78	59
BRU-4	7/16/14 6:00 PM	0.459943	23.055	6.64	5.78	59
BRU-4	7/16/14 6:15 PM	0.459943	23.055	6.64	5.79	59
BRU-4	7/16/14 6:30 PM	0.459638	23.055	6.64	5.79	59
BRU-4	7/16/14 6:45 PM	0.458724	23.055	6.64	5.79	58
BRU-4	7/16/14 7:00 PM	0.459029	23.045	6.64	5.79	60
BRU-4	7/16/14 7:15 PM	0.458724	23.045	6.64	5.79	59
BRU-4	7/16/14 7:30 PM	0.461467	23.035	6.64	5.79	59
BRU-4	7/16/14 7:45 PM	0.460858	23.025	6.64	5.79	59
BRU-4	7/16/14 8:00 PM	0.462382	23.015	6.65	5.79	59
BRU-4	7/16/14 8:15 PM	0.462077	22.995	6.64	5.8	59

Station ID	Date & Time	Depth (m)	TEMP C	DO (mg/l)	pH (su)	SPCOND (umhos)
BRU-4	7/16/14 8:30 PM	0.462382	22.985	6.65	5.79	59
BRU-4	7/16/14 8:45 PM	0.46482	22.965	6.65	5.79	59
BRU-4	7/16/14 9:00 PM	0.466039	22.945	6.65	5.8	59
BRU-4	7/16/14 9:15 PM	0.466344	22.935	6.66	5.8	59
BRU-4	7/16/14 9:30 PM	0.466649	22.915	6.66	5.8	59
BRU-4	7/16/14 9:45 PM	0.468478	22.895	6.66	5.8	59
BRU-4	7/16/14 10:00 PM	0.471526	22.875	6.66	5.8	59
BRU-4	7/16/14 10:15 PM	0.47244	22.855	6.66	5.8	59
BRU-4	7/16/14 10:30 PM	0.469392	22.835	6.67	5.8	59
BRU-4	7/16/14 10:45 PM	0.468478	22.805	6.67	5.8	59
BRU-4	7/16/14 11:00 PM	0.467563	22.785	6.68	5.8	59
BRU-4	7/16/14 11:15 PM	0.468173	22.755	6.68	5.8	60
BRU-4	7/16/14 11:30 PM	0.467563	22.725	6.68	5.8	60
BRU-4	7/16/14 11:45 PM	0.468173	22.695	6.69	5.8	60
BRU-4	7/17/14 12:00 AM	0.470306	22.655	6.7	5.8	61
BRU-4	7/17/14 12:15 AM	0.470916	22.625	6.7	5.8	61
BRU-4	7/17/14 12:30 AM	0.470916	22.595	6.72	5.8	61
BRU-4	7/17/14 12:45 AM	0.470916	22.555	6.73	5.8	61
BRU-4	7/17/14 1:00 AM	0.470611	22.525	6.74	5.8	61
BRU-4	7/17/14 1:15 AM	0.47183	22.485	6.74	5.8	61
BRU-4	7/17/14 1:30 AM	0.47244	22.455	6.74	5.8	61
BRU-4	7/17/14 1:45 AM	0.471221	22.415	6.75	5.81	62
BRU-4	7/17/14 2:00 AM	0.472135	22.375	6.76	5.81	62
BRU-4	7/17/14 2:15 AM	0.471526	22.345	6.76	5.81	62
BRU-4	7/17/14 2:30 AM	0.470611	22.305	6.77	5.81	62
BRU-4	7/17/14 2:45 AM	0.470611	22.265	6.78	5.81	62
BRU-4	7/17/14 3:00 AM	0.470916	22.235	6.79	5.81	63
BRU-4	7/17/14 3:15 AM	0.47183	22.195	6.79	5.81	63
BRU-4	7/17/14 3:30 AM	0.47244	22.155	6.8	5.82	63
BRU-4	7/17/14 3:45 AM	0.472135	22.115	6.81	5.82	64
BRU-4	7/17/14 4:00 AM	0.47305	22.085	6.82	5.82	64
BRU-4	7/17/14 4:15 AM	0.474574	22.045	6.82	5.82	64
BRU-4	7/17/14 4:30 AM	0.477317	22.005	6.83	5.82	65
BRU-4	7/17/14 4:45 AM	0.474878	21.965	6.84	5.83	65
BRU-4	7/17/14 5:00 AM	0.476402	21.925	6.85	5.83	65
BRU-4	7/17/14 5:15 AM	0.478841	21.895	6.87	5.83	66
BRU-4	7/17/14 5:30 AM	0.47945	21.855	6.87	5.84	66
BRU-4	7/17/14 5:45 AM	0.480365	21.815	6.88	5.84	66
BRU-4	7/17/14 6:00 AM	0.480974	21.775	6.89	5.84	66
BRU-4	7/17/14 6:15 AM	0.48067	21.735	6.9	5.84	66
BRU-4	7/17/14 6:30 AM	0.483108	21.705	6.9	5.84	66
BRU-4	7/17/14 6:45 AM	0.484022	21.665	6.91	5.84	66
BRU-4	7/17/14 7:00 AM	0.485242	21.625	6.92	5.85	66
BRU-4	7/17/14 7:15 AM	0.486461	21.595	6.92	5.85	66
BRU-4	7/17/14 7:30 AM	0.488594	21.565	6.93	5.85	66
BRU-4	7/17/14 7:45 AM	0.489204	21.535	6.94	5.85	66
BRU-4	7/17/14 8:00 AM	0.489509	21.515	6.95	5.85	66

Station ID	Date & Time	Depth (m)	TEMP C	DO (mg/l)	pH (su)	SPCOND (umhos)
BRU-4	7/17/14 8:15 AM	0.491642	21.495	6.95	5.85	66
BRU-4	7/17/14 8:30 AM	0.491947	21.485	6.96	5.85	66
BRU-4	7/17/14 8:45 AM	0.491338	21.465	6.96	5.85	66
BRU-4	7/17/14 9:00 AM	0.493166	21.465	6.96	5.85	66
BRU-4	7/17/14 9:15 AM	0.492557	21.455	6.97	5.85	66
BRU-4	7/17/14 9:30 AM	0.491033	21.445	6.98	5.85	66
BRU-4	7/17/14 9:45 AM	0.489814	21.445	6.99	5.85	66
BRU-4	7/17/14 10:00 AM	0.488899	21.445	6.99	5.85	66
BRU-4	7/17/14 10:15 AM	0.489204	21.455	6.99	5.85	66
BRU-4	7/17/14 10:30 AM	0.48707	21.465	7	5.85	66
BRU-4	7/17/14 10:45 AM	0.486461	21.465	7	5.85	66

Appendix C. Station Pictures

Figure C.1 4/23/14 Station BRU-4 Upstream

Figure C.2 4/23/14 Station BRU-4 Downstream

Figure C.3 5/21/14 Station BRU-4 Upstream

Figure C.4 5/21/14 Station BRU-4 Downstream

Figure C.5 8/20/14 Station BRU-4 Upstream

Figure C.6 8/20/14 Station BRU-4 Downstream