Mactaquac Aquatic Ecosystem Study
Report Series 2015-014

METHODS PAPER:
River Transect Sampling of Physical Attributes Downstream of the Mactaquac Generating Station

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DISCLAIMER

Intended use and technical limitations of the report, "River Transect Sampling of Physical Attributes Downstream of the Mactaquac Generating Station". This interim report describes the first summer of the Saint John River's physical environment downstream of the Mactaquac Generating Station. This programme is continuously evolving as sites are tested, added, and excluded, and the following report is summary of the 2014 results. The CRI doesn't assume liability for any use of the included data and analyses outside the stated scope.

Introduction

The spatial and temporal variations in river flow (from stage and velocities), temperature, and chemistry are important for informing many of the models (validation data sets), sampling designs (habitat maps), and baselines for future analyses (e.g., addressing nutrients post-dam removal - Riggsbee et al. 2007, Cavaliere and Homann 2012). Beginning with existing bathymetry (Canadian Hydrographic Service) and expanding as detailed bathymetry comes online, we will annually and seasonally measure vertical profiles of velocities, temperatures, dissolved oxygen, pH, and conductivity at 500m intervals along the reach, including main and left channels and lateral channel sites. These maps form one element of the baseline data for ***NB Power Deliverables*** of Section 4, Healthy River Ecosystem, 4.1 Metrics and Monitoring, and ***NSERC CRD Projects*** 1A.1.3 Spatio-temporal flow, temperature, and water quality baselines, 1.A.2 River Biomonitoring-Baselines and Metric Development, and 1A.2.8 Modeling existing and future fish habitats-A quantitative approach.

Methods

In 2014, a total of 88 transect sites were selected from the main channel (R-DS-#), Keswick River channel (R-DS-KES-#), and the cross channels (R-DS-CH-#). Sites were spaced 0.5 km apart and covered the Saint John River from the Westmorland Bridge in Fredericton to the Mactaquac Generating Station (Figure 1). The sites were divided into two sets (Table 1): Sample Period A (17-24 June; 'even numbered sites') and Sample Period B (14-21 July; 'odd numbered sites').

The best sampling regime would assess all points for a given Sample Period in a single day; this proved logistically impossible. Instead, for each Sample Period, a core of transect points that covered the entire length of the study site were assessed on the first day (Table 2), and then as many as possible were sampled for the next week. While daily and even hourly variability is inevitable in this section of the flow-managed river, our approach provided the best possible spatial coverage for the first year. As this programme continues, we will develop a focused sampling regime to address the specific needs of the project components.

At each transect site, three samples were taken; center, river right, and river left (determined looking downstream). The center sample was taken at the mid-channel. The right and left samples were taken approximately midway between the center and the corresponding shore.

The sampling crew boated to each transect location using the coordinates stored in the GPS and set the anchor. Once anchored a new coordinate taken, saving it under the site name (i.e., R-DS-1_Middle) and recording it on the data sheets (Appendix 1).

The following parameters were observed or measured and recorded at each site:

- Crew members present, weather conditions, and time of day.
- Water depth was initially, measured by two methods. First, a long pole that had a tape measure affixed, and second, Hondex, Hand-Held Portable Depth Sounder with digital display. After the accuracy of the portable depth sounder was determined, it was used exclusively. The water depths were recorded to 0.1 meter.

- Water velocity was measured using a Marsh-McBirney Flomate 2000 water velocity meter. The velocity was taken once, at the 60% depth, for a water depth of 1.5 m or less. For a water depth greater than 1.5 meters, velocity was taken twice, at 20% and 80% the total water depth. Water velocities were averaged over 30 seconds and recorded in meters per second.
- Substrate size was estimated using a modified Wentworth scale (Appendix 1) and one of three different methods depending on site conditions. Substrate was estimated visually when water clarity and or depth would permit. When the substrate was not visible, the depth pole was used to "feel" the bottom, and lastly, an Ekman grab sampler was used to pull up a sample for observation.
- Water chemistry was measured using an YSI 556 MPS (Multiprobe System) equipped with dissolved oxygen (mg/L and % saturation), temperature, conductivity, and pH probes. The meter was calibrated in the lab daily prior to departure to the field. The calibration was tested and/or redone before each transect. For sites less 3m deep, the sample was taken at the mid water column depth. Sites deeper than 3m had two samples taken, one meter from the bottom and one meter under the surface.
- The secchi depth was measured by lowering until it to the point it was not visible and then recorded the depth in centimeters.
- Aquatic vegetation was recorded at each site as present or absent, and by type (submergent or surface).
- Wetted width was measured using a Bushnell Sport 850 laser rangefinder. This was done by leaving one person on shore with a white bucket or the secchi disc, while another goes to the opposite shore. The rangefinder is pointed at the bucket or disc until a distance, in meters, appears on the screen.

Figure 1. Locations of the river transects sampled downstream of the Mactaquac Generating Station in summer 2014.

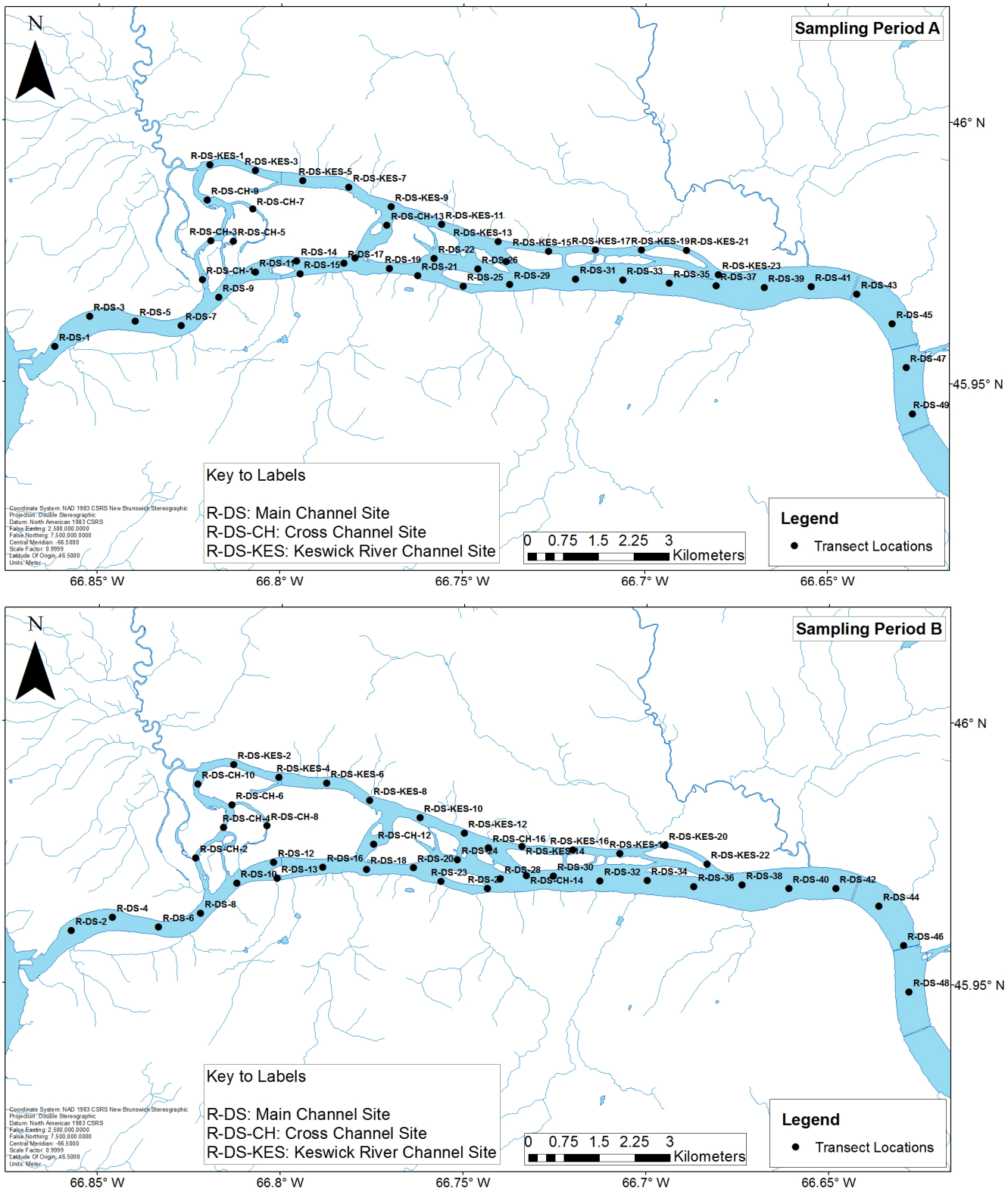

Table 1: Transect ID and GPS locations.

SAMPLE PERIOD A

Site	Latitude	Longitude
R-DS-1	45.9567	-66.8617
R-DS-3	45.9625	-66.8522
R-DS-5	45.96157	-66.8397
R-DS-7	45.96079	-66.8271
R-DS-9	45.96623	-66.8169
R-DS-11	45.97108	-66.8068
R-DS-14	45.97324	-66.7955
R-DS-15	45.97078	-66.7946
R-DS-17	45.97284	-66.7826
R-DS-19	45.97185	-66.7701
R-DS-21	45.9705	-66.7624
R-DS-22	45.97379	-66.7578
R-DS-25	45.96851	-66.7499
R-DS-26	45.97177	-66.7459
R-DS-29	45.96884	-66.7371
R-DS-31	45.96991	-66.7191
R-DS-33	45.96979	-66.7062
R-DS-35	45.9692	-66.6933
R-DS-37	45.96873	-66.6805
R-DS-39	45.96839	-66.6674
R-DS-41	45.96858	-66.6545
R-DS-43	45.96717	-66.6419
R-DS-45	45.96152	-66.6322
R-DS-47	45.95315	-66.6284
R-DS-49	45.94427	-66.6266
R-DS-KES-1	45.99158	-66.8194
R-DS-KES-3	45.99046	-66.8069
R-DS-KES-5	45.98856	-66.794
R-DS-KES-7	45.98735	-66.7813
R-DS-KES-9	45.98365	-66.7696
R-DS-KES-11	45.9803	-66.7558
R-DS-KES-13	45.97705	-66.7403
R-DS-KES-15	45.97521	-66.7265
R-DS-KES-17	45.97554	-66.7136
R-DS-KES-19	45.97554	-66.701
R-DS-KES-21	45.97547	-66.6887
R-DS-KES-23	45.97081	-66.6799
R-DS-CH-1	45.96957	-66.8214
R-DS-CH-3	45.977	-66.8191
R-DS-CH-5	45.97693	-66.8129
R-DS-CH-7	45.98315	-66.8077
R-DS-CH-9	45.98477	-66.8201
R-DS-CH-11	45.97384	-66.7796
R-DS-CH-13	45.98015	-66.7709
R-DS-CH-15	45.9733	-66.7381

SAMPLE PERIOD B

Site	Latitude	Longitude
R-DS-2	45.95997	-66.8573
R-DS-4	45.9625	-66.846
R-DS-6	45.96066	-66.8334
R-DS-8	45.96336	-66.8219
R-DS-10	45.96913	-66.812
R-DS-12	45.97312	-66.802
R-DS-13	45.9701	-66.801
R-DS-16	45.97217	-66.7885
R-DS-18	45.97186	-66.7765
R-DS-20	45.9722	-66.7637
R-DS-23	45.96957	-66.7561
R-DS-24	45.97377	-66.7517
R-DS-27	45.96823	-66.7435
R-DS-28	45.97015	-66.7399
R-DS-30	45.9707	-66.7254
R-DS-32	45.96976	-66.7126
R-DS-34	45.96984	-66.6997
R-DS-36	45.96868	-66.6869
R-DS-38	45.96909	-66.6737
R-DS-40	45.9684	-66.6609
R-DS-42	45.96843	-66.6481
R-DS-44	45.96502	-66.6363
R-DS-46	45.95757	-66.6295
R-DS-48	45.94866	-66.628
R-DS-KES-2	45.99177	-66.813
R-DS-KES-4	45.98931	-66.8007
R-DS-KES-6	45.98824	-66.7876
R-DS-KES-8	45.98501	-66.7758
R-DS-KES-10	45.98174	-66.762
R-DS-KES-12	45.9788	-66.7498
R-DS-KES-14	45.97629	-66.734
R-DS-KES-16	45.97569	-66.7201
R-DS-KES-18	45.97501	-66.7072
R-DS-KES-20	45.97658	-66.6949
R-DS-KES-22	45.97304	-66.6833

RESULTS

There were a total of 79 transects completed in June and then July, 2014 (Table 2). The data can be found in the MAES Data Management System. Examples of the average velocity (all samples), average June temperatures, and average Secchi depths (all samples) are presented to display the data sets at this preliminary stage (Figure 2).

Figure 2. Examples of the physical data that will grow to inform the habitat modelling of the river downstream of the Mactaquac Generating Station.

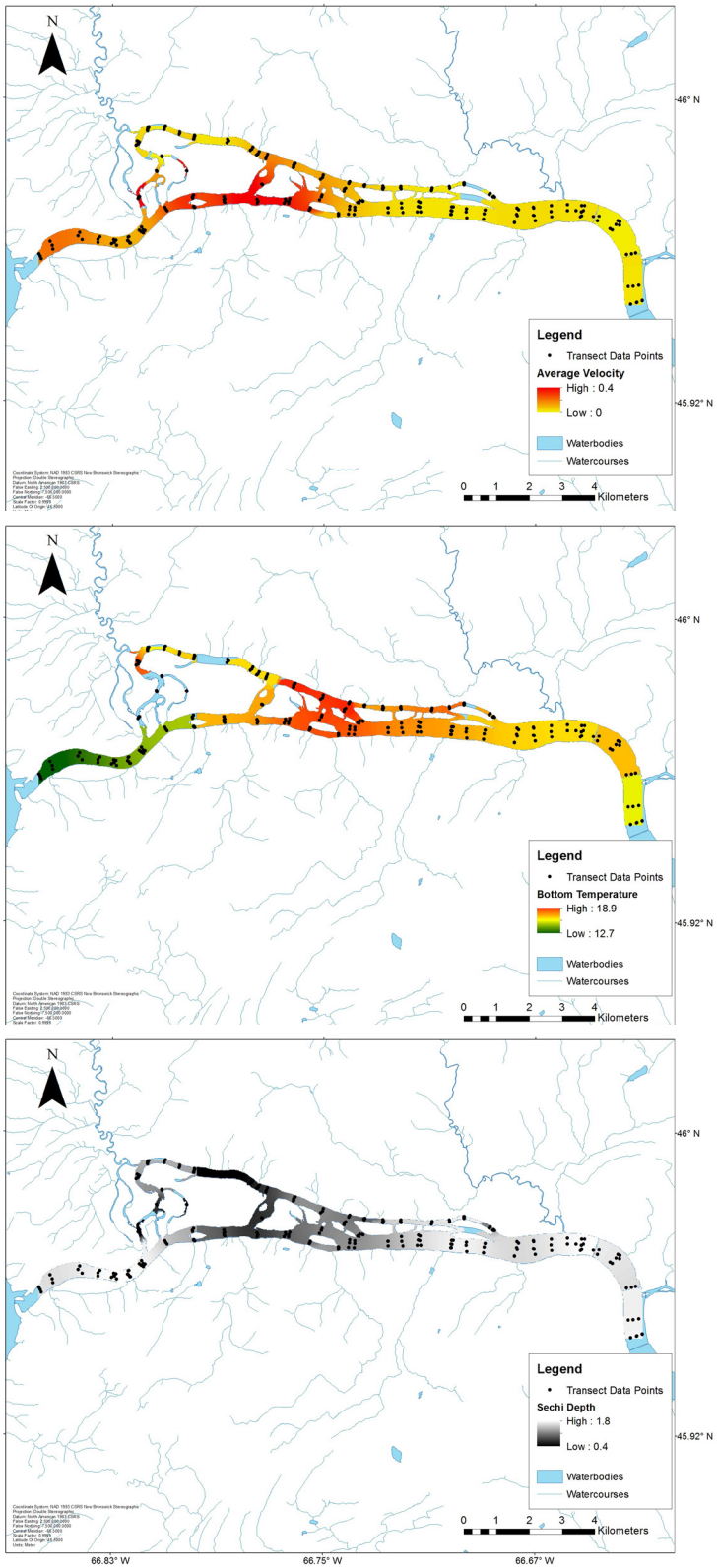

Table 2. Sampling location by date for the river downstream of the Mactaquac Generating Station, 2014.

Sample Period A

Transect Number	17-Jun-14	19-Jun-14	20-Jun-14	23-Jun-14	24-Jun-14
R-DS-1	**X**				
R-DS-2					
R-DS-3					
R-DS-4					
R-DS-5				**X**	
R-DS-6					**X**
R-DS-7	**X**		**X**		
R-DS-8		**X**			
R-DS-9					
R-DS-10					
R-DS-11					
R-DS-12					
R-DS-13					
R-DS-14					
R-DS-15					
R-DS-16		**X**			
R-DS-17					
R-DS-18					
R-DS-19					
R-DS-20					**X**
R-DS-21					
R-DS-22					
R-DS-23					
R-DS-24					
R-DS-25					
R-DS-26					
R-DS-27					
R-DS-28					
R-DS-29				**X**	
R-DS-30					
R-DS-31	**X**				
R-DS-32		**X**			
R-DS-33					
R-DS-34					**X**
R-DS-35				**X**	
R-DS-36					
R-DS-37					
R-DS-38		**X**			
R-DS-39	**X**		**X**		
R-DS-40					

Transect Number	17-Jun-14	19-Jun-14	20-Jun-14	23-Jun-14	24-Jun-14
R-DS-41				**X**	
R-DS-42		**X**			
R-DS-43	**X**				
R-DS-44					**X**
R-DS-45					
R-DS-46					
R-DS-47					
R-DS-48					
R-DS-49	**X**		**X**		
R-DS-KES_1	**X**		**X**		
R-DS-KES_2					
R-DS-KES_3				**X**	
R-DS-KES_4					**X**
R-DS-KES_5					
R-DS-KES_6					
R-DS-KES_7					
R-DS-KES_8		**X**			
R-DS-KES_9	**X**				
R-DS-KES_10					**X**
R-DS-KES_11					
R-DS-KES_12					
R-DS-KES_13				**X**	
R-DS-KES_14					
R-DS-KES_15	**X**		**X**		
R-DS-KES_16					
R-DS-KES_17					
R-DS-KES_18					
R-DS-KES_19				**X**	
R-DS-KES_20					**X**
R-DS-KES_21					
R-DS-KES_22					
R-DS-KES_23					
R-DS-CH-1					
R-DS-CH-2					
R-DS-CH-3					
R-DS-CH-4					
R-DS-CH-5					
R-DS-CH-6					
R-DS-CH-7					
R-DS-CH-8					
R-DS-CH-9					
R-DS-CH-10					**X**
R-DS-CH-11					
R-DS-CH-12					

Transect Number	17-Jun-14	19-Jun-14	20-Jun-14	23-Jun-14	24-Jun-14
R-DS-CH-13					
R-DS-CH-14					
R-DS-CH-15					
R-DS-CH-16					**X**

Sample Period B

Transect Number	14-Jul-14	15-Jul-14	17-Jul-14	18-Jul-14	21-Jul-14
R-DS-1					
R-DS-2	**X**				
R-DS-3					
R-DS-4					**X**
R-DS-5					
R-DS-6					**X**
R-DS-7					
R-DS-8					**X**
R-DS-9					
R-DS-10					**X**
R-DS-11					
R-DS-12					**X**
R-DS-13					**X**
R-DS-14					
R-DS-15					
R-DS-16	**X**				
R-DS-17					
R-DS-18					**X**
R-DS-19					
R-DS-20			**X**		
R-DS-21					
R-DS-22					
R-DS-23			**X**		
R-DS-24			**X**		
R-DS-25					
R-DS-26					
R-DS-27			**X**		
R-DS-28			**X**		
R-DS-29					
R-DS-30			**X**		
R-DS-31					
R-DS-32	**X**				
R-DS-33					
R-DS-34		**X**			
R-DS-35					
R-DS-36		**X**			
R-DS-37					

Transect Number	14-Jul-14	15-Jul-14	17-Jul-14	18-Jul-14	21-Jul-14
R-DS-38	**X**				
R-DS-39					
R-DS-40		**X**			
R-DS-41					
R-DS-42		**X**			
R-DS-43					
R-DS-44		**X**			
R-DS-45					
R-DS-46		**X**			
R-DS-47					
R-DS-48	**X**				
R-DS-49					
R-DS-KES_1					
R-DS-KES_2	**X**				
R-DS-KES_3					
R-DS-KES_4				**X**	
R-DS-KES_5					
R-DS-KES_6				**X**	
R-DS-KES_7					
R-DS-KES_8	**X**				
R-DS-KES_9					
R-DS-KES_10				**X**	
R-DS-KES_11					
R-DS-KES_12			**X**		
R-DS-KES_13					
R-DS-KES_14			**X**		
R-DS-KES_15					
R-DS-KES_16		**X**			
R-DS-KES_17					
R-DS-KES_18		**X**			
R-DS-KES_19					
R-DS-KES_20		**X**			
R-DS-KES_21					
R-DS-KES_22	**X**				
R-DS-KES_23					
R-DS-CH-1					
R-DS-CH-2				**X**	
R-DS-CH-3					
R-DS-CH-4				**X**	
R-DS-CH-5					
R-DS-CH-6				**X**	
R-DS-CH-7					
R-DS-CH-8				**X**	
R-DS-CH-9					

Transect Number	14-Jul-14	15-Jul-14	17-Jul-14	18-Jul-14	21-Jul-14
R-DS-CH-10				**X**	
R-DS-CH-11					
R-DS-CH-12					**X**
R-DS-CH-13					
R-DS-CH-14					**X**
R-DS-CH-15					
R-DS-CH-16			**X**		

APPENDIX 1. Data Sheet - Physical Parameters of the River.

Transect Number: _____ Weather:_____

Date: _____ Personnel:_____

River Center

Time _____ Latitude _____

Waypoint # _____ Longitude _____

	Lower	Upper
Temperature (°C)		
DO (%)		
DO (mg/L)		
pH		
Conductivity (µS/cm)		
Velocity (m/s)		

Depth (m)	
Secchi Depth (m)	
Substrate Size	
Macrophytes (Y/N)	

Notes:

Wetted Width _____

River Left

Time _____ Latitude _____

Waypoint # _____ Longitude _____

	Lower	Upper
Temperature (°C)		
DO (%)		
DO (mg/L)		
pH		
Conductivity (µS/cm)		
Velocity (m/s)		

Depth (m)	
Secchi Depth (m)	
Substrate Size	
Macrophytes (Y/N)	

Notes:

Wetted Width _____

River Right

Time _____ Latitude _____

Waypoint # _____ Longitude _____

	Lower	Upper
Temperature (°C)		
DO (%)		
DO (mg/L)		
pH		
Conductivity (µS/cm)		
Velocity (m/s)		

Depth (m)	
Secchi Depth (m)	
Substrate Size	
Macrophytes (Y/N)	

Notes:

Wetted Width _____

Comments

Class	Size	Name	Lay term
1	n/a	fine organic	
2	n/a	coarse organic	
3	n/a	clay	clay
4	1-2mm	sand	sand
5	2mm-2cm	gravel	fine gravel
6	2-3cm	small pebble	"raisins"
7	3-6cm	pebble	grape -- egg
8	6-12cm	small cobble	fist size
9	12-25cm	cobble	grapefruit-
10	25-38cm	large cobble	head size
11	38-52cm	boulder	beach ball caliber
12	>52	l. boulder	
13	n/a	bedrock	

Modified Wentworth Scale