



Tennessee Department of Environment and Conservation
 Division of Water Resources
 William R. Snodgrass Tennessee Tower,
 312 Rosa L. Parks Avenue, 11th Floor, Nashville, Tennessee 37243
 1-888-891-8332 (TDEC)

DRAFT

Phase II Small Municipal Separate Storm Sewer System (MS4) Annual Report

1. MS4 Information

Name of MS4: Brentwood		MS4 Permit Number: TNS075175
Contact Person: Darek Baskin, P.E.		Email Address: darek.baskin@brentwoodtn.gov
Telephone: (615) 371-0080	MS4 Program Web Address: http://www.brentwoodtn.gov/departments/engineering/stormwater-quality-management-program	
Mailing Address: P.O. Box 788		
City: Brentwood	State: TN	ZIP code: 37024

DRAFT

What is the current population of your MS4? 43,889

What is the reporting period for this annual report? July 1 2018 to June 30 2019

DRAFT

2. Discharges to Waterbodies with Unavailable Parameters or Exceptional Tennessee Waters (Section 3.1)

- A. Does your MS4 discharge into waters with unavailable parameters (previously referred to as impaired) for pathogens, nutrients, siltation or other parameters related to stormwater runoff from urbanized areas as listed on TN's most current 303(d) list and/or according to the on-line state GIS mapping tool (tdeconline.tn.gov/dwr/)? If yes, attach a list. Yes No
- B. Are there established and approved TMDLs (<http://www.tn.gov/environment/article/wrws-tennessees-total-maximum-daily-load-tmdl-program>) with waste load allocations for MS4 discharges in your jurisdiction? If yes, attach a list. Yes No
- C. Does your MS4 discharge to any Exceptional Tennessee Waters (ETWs - http://environment-online.tn.gov:8080/pls/enf_reports/f?p=9034:34304:4880790061142)? If yes, attach a list. Yes No
- D. Are you implementing specific Best Management Practices (BMPs) to control pollutant discharges to waterbodies with unavailable parameters or ETWs? If yes, describe the specific practices: The City of Brentwood is providing training and education at the annual Environmental Education Day for over 300 students this year; we are increasing public awareness through the City Newsletter, website, PSA's and paid participation in TNSA Social Media Campaign; we have partnered with the Harpeth River Watershed Association to fund bank stabilization projects; we also partner with Brentwood Rotary Club and Keep Williamson Beautiful to organize an annual stream clean-up. Yes No

3. Public Education/Outreach and Involvement/Participation (Sections 4.2.1 and 4.2.2)

- A. Have you developed a Public Information and Education plan (PIE)? Yes No
- B. Is your public education program targeting specific pollutants and sources, such as Hot Spots? If yes, describe the specific pollutants and/or sources targeted by your public education program: Residential impacts, including car washing and maintenance, yard fertilizers, animal and yard waste, salt water pool draining, and erosion prevention and sediment control. Yes No

Phase II Small Municipal Separate Storm Sewer System (MS4) Annual Report

- C. Do you have a webpage dedicated to your stormwater program? If yes, provide a link/URL: <http://www.brentwoodtn.gov/departments/engineering/stormwater-quality-management-program> Yes No
- D. Summarize how you advertise and publicize your public education, outreach, involvement and participation opportunities: The City of Brentwood advertises through a newsletter, the TAB program, paid participation in TNSA's Social Media Campaign, and a press release for Environmental Education Day.
- E. Summarize the public education, outreach, involvement and participation activities you completed during this reporting period: The City of Brentwood hosted Hazardous Waste Day, Environmental Education Day (October 2018), and has participated in Tennessee Stormwater Association (TNSA) meetings and their annual conferences.
- F. Summarize any specific successful outcome(s) (e.g., citizen involvement, pollutant reduction, water quality improvement, etc.) fully or partially attributable to your public education and participation program during this reporting period: Neighborhood Associations participate in stream clean ups and neighborhood clean ups that are not administered by the City of Brentwood. Brentwood and Ravenwood Highschool have environmental science programs, in which part of the curriculum covers storm water quality topics and includes the Environmental Education Day held at Deerwood Arboritum through which the Little Harpeth flows.

4. Illicit Discharge Detection and Elimination (Section 4.2.3)

- A. Have you developed and do you continue to update a storm sewer system map that shows the location of system outfalls where the municipal storm sewer system discharges into waters of the state or conveyances owned or operated by another MS4? Yes No
- B. If yes, does the map include inputs into the storm sewer collection system, such as the inlets, catch basins, drop structures or other defined contributing points to the sewershed of that outfall, and general direction of stormwater flow? Yes No
- C. How many outfalls have you identified in your storm sewer system? 327
- D. Do you have an ordinance, or other regulatory mechanism, that prohibits non-stormwater discharges into your storm sewer system? Yes No
- E. Have you implemented a plan to detect, identify and eliminate non-stormwater discharges, including illegal disposal, throughout the storm sewer system? If yes, provide a summary: Once each per permit cycle the outfalls are screened for illicit discharges in combination with visual stream assessments of impaired streams. (See attached.) Yes No
- F. How many illicit discharge related complaints were received this reporting period? 1
- G. How many illicit discharge investigations were performed this reporting period? 1
- H. Of those investigations performed, how many resulted in valid illicit discharges that were addressed and/or eliminated? 1

5. Construction Site Stormwater Runoff Pollutant Control (Section 4.2.4)

- A. Do you have an ordinance or other regulatory mechanism requiring: Construction site operators to implement appropriate erosion prevention and sediment control BMPs consistent with those described in the TDEC EPSC Handbook? Yes No

Phase II Small Municipal Separate Storm Sewer System (MS4) Annual Report

- Construction site operators to control wastes such as discarded building materials, concrete truck washout, chemicals, litter, and sanitary waste? Yes No
- Design storm and special conditions for unavailable parameters waters or Exceptional Tennessee Waters consistent with those of the current Tennessee Construction General Permit (TNR100000)? Yes No
- B. Do you have specific procedures for construction site plan (including erosion prevention and sediment BMPs) review and approval? Yes No
- C. Do you have sanctions to enforce compliance? Yes No
- D. Do you hold pre-construction meetings with operators of priority construction activities and inspect priority construction sites at least monthly? Yes No
- E. How many construction sites disturbing at least one acre or greater were active in your jurisdiction this reporting period? 33
- F. How many active priority and non-priority construction sites were inspected this reporting period? 33
- G. How many construction related complaints were received this reporting period? 14
6. Permanent Stormwater Management at New Development and Redevelopment Projects (Section 4.2.5)
- A. Do you have a regulatory mechanism (e.g. ordinance) requiring permanent stormwater pollutant removal for development and redevelopment projects? If no, have you submitted an Implementation Plan to the Division? Yes No
 Yes No
- B. Do you have an ordinance or other regulatory mechanism requiring:
Site plan review and approval of new and re-development projects? Yes No
A process to ensure stormwater control measures (SCMs) are properly installed and maintained? Yes No
Permanent water quality riparian buffers? If yes, specify requirements: Waterway natural area (WNA) on each side of waterway is to be 60 feet when the upstream watershed area is at least one square mile, and 30 feet when the upstream watershed area is less than one square mile, unless federal or state regulations require a wider WNA. Yes No
- C. What is the threshold for development and redevelopment project plans plan review (e.g., all projects, projects disturbing greater than one acre, etc.)? All new or redevelopment projects, regardless of disturbance.
- D. How many development and redevelopment project plans were reviewed for this reporting period? 12
- E. How many development and redevelopment project plans were approved? 12
- F. How many permanent stormwater related complaints were received this reporting period? 0
- G. How many enforcement actions were taken to address improper installation or maintenance? 0
- H. Do you have a system to inventory and track the status of all public and private SCMs installed on development and redevelopment projects? Yes No
- I. Does your program include an off-site stormwater mitigation or payment into public stormwater fund? If yes, specify. _____ Yes No

7. Stormwater Management for Municipal Operations (Section 4.2.6)

A. As applicable, have stormwater related operation and maintenance plans that include information related to maintenance activities, schedules and the proper disposal of waste from structural and non-structural stormwater controls been developed and implemented at the following municipal operations:

- | | | |
|--|---|--|
| Streets, roads, highways? | <input type="checkbox"/> Yes | <input checked="" type="checkbox"/> No |
| Municipal parking lots? | <input type="checkbox"/> Yes | <input checked="" type="checkbox"/> No |
| Maintenance and storage yards? | <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No |
| Fleet or maintenance shops with outdoor storage areas? | <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No |
| Salt and storage locations? | <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No |
| Snow disposal areas? | <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No |
| Waste disposal, storage, and transfer stations? | <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No |

B. Do you have a training program for employees responsible for municipal operations at facilities within the jurisdiction that handle, generate and/or store materials which constitute a potential pollutant of concern for MS4s? Yes No

If yes, are new applicable employees trained within six months, and existing applicable employees trained and/or retrained within the permit term? Yes No

8. Reviewing and Updating Stormwater Management Programs (Section 4.4)

A. Describe any revisions to your program implemented during this reporting period including but not limited to:

Modifications or replacement of an ineffective activity/control measure. None
 Changes to the program as required by the division to satisfy permit requirements. The City of Brentwood plans to implement the pollutant removal requirements for new and re-development as required by final TN CGP to improve the quality of water. These changes will be implemented after further clarification or direction is provided by TDEC.
 Information (e.g. additional acreage, outfalls, BMPs) on newly annexed areas and any resulting updates to your program. None

B. In preparation for this annual report, have you performed an overall assessment of your stormwater management program effectiveness? If yes, summarize the assessment results, and any modifications and improvements scheduled to be implemented in the next reporting period. The current stormwater ordinance and monitoring efforts are very effective. Minor stormwater management program modifications to be implemented in compliance with new CGP and when direction from TDEC is provided. Yes No

Phase II Small Municipal Separate Storm Sewer System (MS4) Annual Report

9. Enforcement Response Plan (Section 4.5)

- A. Have you implemented an enforcement response plan that includes progressive enforcement actions to address non-compliance, and allows the maximum penalties specified in TCA 68-221-1106? If no, explain. _____ Yes No
- B. As applicable, identify which of the following types of enforcement actions (or their equivalent) were used during this reporting period; indicate the number of actions, the minimum measure (e.g., construction, illicit discharge, permanent stormwater management), and note those for which you do not have authority:

<u>Action</u>	<u>Construction</u>	<u>Permanent Stormwater</u>	<u>Illicit Discharge</u>	<u>In Your ERP?</u>	
Verbal warnings	# <u>12</u>	#_____	# <u>1</u>	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
Written notices	# <u>8</u>	#_____	#_____	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
Citations with administrative penalties	# <u>0</u>	# <u>0</u>	# <u>0</u>	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
Stop work orders	# <u>6</u>	#_____	#_____	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
Withholding of plan approvals or other authorizations	# <u>2</u>	#_____	#_____	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
Additional Measures	#_____	#_____	#_____	Describe: _____	

- C. Do you track instances of non-compliance and related enforcement documentation? Yes No
- D. What were the most common types of non-compliance instances documented during this reporting period? Lack of ESPC measures, improper construction entrance, failure to maintain ESPC measures during construction.

10. Monitoring, Recordkeeping and reporting (Section 5)

- A. Summarize any analytical monitoring activities (e.g., planning, collection, evaluation of results) performed during this reporting period. Benthic Macroinvertebrate samples were taken in tributaries to Little Harpeth, Holt, Owl, Beech, and Spencer Creeks as part of our in-stream assessments during the current reporting period.
- B. Summarize any non-analytical monitoring activities (e.g., planning, collection, evaluation of results) performed during this reporting period. In-stream visual assessments were conducted along tributaries to Little Harpeth during the current reporting period.
- C. If applicable, are monitoring records for activities performed during this reporting period submitted with this report. Yes No

11. Certification

City of Brentwood, TN
Municipal Separate Storm Sewer System (MS4) Annual Report
Report Attachments

Section 2.A. - List of Waters with Unavailable Parameters in Jurisdiction Based on TDEC Viewer as of September 2019

Waterbody Name	Waterbody I.D. #	Cause(s)	Source Name(s)
Little Harpeth River	TN05130204021_2000	Sedimentation/Siltation	Grazing in Riparian or Shoreline Zones
		Sedimentation/Siltation	Discharges from Municipal Separate Storm Sewer Systems (MS4)
		Phosphorus (Total)	Discharges from Municipal Separate Storm Sewer Systems (MS4)
		Nitrate/Nitrite (Nitrite + Nitrate as N)	Discharges from Municipal Separate Storm Sewer Systems (MS4)
Unnamed Trib to the Little Harpeth River	TN05130204021_0200	Sedimentation/Siltation	Discharges from Municipal Separate Storm Sewer Systems (MS4)
		Alteration in stream-side or littoral vegetative covers	Discharges from Municipal Separate Storm Sewer Systems (MS4)
Unnamed Trib to the Little Harpeth River	TN05130204021_0300	Sedimentation/Siltation	Discharges from Municipal Separate Storm Sewer Systems (MS4)
		Alteration in stream-side or littoral vegetative covers	Discharges from Municipal Separate Storm Sewer Systems (MS4)
Holt Creek	TN05130202007_1100	<i>Escherichia coli</i>	Discharges from Municipal Separate Storm Sewer Systems (MS4)
		Phosphorus (Total)	Discharges from Municipal Separate Storm Sewer Systems (MS4)
		Nitrate/Nitrite (Nitrite + Nitrate as N)	Discharges from Municipal Separate Storm Sewer Systems (MS4)
Owl Creek	TN05130202007_0900	Phosphorus (Total)	Discharges from Municipal Separate Storm Sewer Systems (MS4)
		Sedimentation/Siltation	Discharges from Municipal Separate Storm Sewer Systems (MS4)
		Alteration in stream-side or littoral vegetative covers	Discharges from Municipal Separate Storm Sewer Systems (MS4)
Beech Creek	TN05130204021_0400	Sedimentation/Siltation	Site Clearance (Land Development or Redevelopment)
		Alteration in stream-side or littoral vegetative covers	Site Clearance (Land Development or Redevelopment)
Spencer Creek	TN05130204016_0200	<i>Escherichia coli</i>	Discharges from Municipal Separate Storm Sewer Systems (MS4)
		Sedimentation/Siltation	Discharges from Municipal Separate Storm Sewer Systems (MS4)
		Alteration in stream-side or littoral vegetative covers	Discharges from Municipal Separate Storm Sewer Systems (MS4)

Section 2.B. TMDLs with Waste Load Allocations for MS4 Discharges

CHEATHAM LAKE WATERSHED (05130202)

TMDL for E. coli (April 2008)

None of the impaired waterbodies listed are within the Brentwood City Limits.

HARPETH RIVER WATERSHED (05130204)

TMDL for siltation (May 2002)

The implementation plan notes that the wasteload allocation for MS4s will be implemented through MS4 permits and the MS4's stormwater management plan. No additional TMDL monitoring is required.

TMDL for metals (July 2003)

No waste load allocations for MS4 discharges

TMDL for E. coli (March 2006)

None of the impaired waterbodies listed are within the Brentwood City Limits.

TMDL for organic enrichment/low dissolved oxygen (September 2004)

See below

Water Quality Limited Segments and Pollutant Causes Addressed by the TMDLs

Waterbody (waterbody ID#)	Impacted Waterbody	CAUSE (Pollutant)
Harpeth River – West Harpeth River to Spencer Creek	TN05130204 016 – 1000	Organic enrichment/low dissolved oxygen
Harpeth River – Spencer Creek to Watson Creek	TN05130204 016 – 2000	Organic enrichment/low dissolved oxygen
Harpeth River – Watson Creek to Mayes Creek	TN05130204 016 – 3000	Low DO
Harpeth River – Mayes Creek to Wilson Branch	TN05130204 016 – 4000	Low DO
HARPETH RIVER TRIBUTARIES Arrington Cr, Spencer Cr, Watson Br, 5-mile Cr, Lynnwood Cr, and Starnes Cr	TN05130204 016	Organic enrichment/low dissolved oxygen
Concord Creek	TN051300204 018 – 0200	Organic enrichment/low dissolved oxygen
Kelley Creek	TN051300204 018 – 0300	Organic enrichment/low dissolved oxygen
Harpeth River – unnamed trib. To headwaters	TN051300204 018 – 3000	Low DO
HARPETH RIVER TRIBUTARIES Newsome Cr, Trace Cr, and Murray Branch are partially supporting	TN05130204 009	Organic enrichment/low dissolved oxygen
Beech Creek	TN05130204 009 – 1100	Organic enrichment/low dissolved oxygen
WEST FORK HARPETH RIVER A portion of West Harpeth, plus Cayce Branch, Polk, and Kennedy Creek are partially supporting	TN05130204 013	Organic enrichment/low dissolved oxygen
Rattlesnake Branch	TN05130204 013 – 0610	Organic enrichment/low dissolved oxygen
HARPETH RIVER From South Harpeth River to the Little Harpeth River	TN05130204009-2000	Organic enrichment/low dissolved oxygen
HARPETH RIVER From Little Harpeth River to the West Harpeth River	TN05130204009-3000	Organic enrichment/low dissolved oxygen
LITTLE HARPETH RIVER From Harpeth River to Otter Cr	TN05130204021-1000	Low DO

City of Brentwood, TN
Municipal Separate Storm Sewer System (MS4) Annual Report
Report Attachments

Table 18 Nutrient Waste Load Allocations for MS4s

Subwatershed (05130204)	WLAs for MS4s			
	Total Nitrogen		Total Phosphorus	
	Summer *	Winter *	Summer *	Winter *
	[lbs/ac/month]	[lbs/ac/month]	[lbs/ac/month]	[lbs/ac/month]
0101	0.186	0.521	0.037	0.105
0104	0.173	0.520	0.021	0.063
0105	0.164	0.516	0.012	0.041
0201	0.167	0.521	0.014	0.043
0202	0.152	0.459	0.012	0.037
0301	0.148	0.438	0.012	0.035
0302	0.167	0.521	0.014	0.043

* Summer: 5/1 – 10/31; Winter: 11/1 – 4/30.

Table 26 Wasteload and Load Allocations to Watershed Runoff protect DO levels in the lower Harpeth River

HUC-12 Subwatershed (05130204)	Total Nitrogen * Summer lbs/month	Total Nitrogen * Winter lbs/month	WLA Percent Reduction in MS4 Area	LA Percent Reduction in rural area
0104	7335	21966	20.0	20.0
0105	5864	18260	49.4	49.4
0201	4062	12649	53.1	53.1
0202	3026	9119	53.1	53.1
0301	6253	18537	44.8	44.8
0302	5275	16425	34.3	34.3

* Summer: May 1 – October 31; Winter: November 1 – April 30

The majority of Spencer Creek (TN05130204016-0200) in the 0105 watershed is not located within the City Limits. Only small portions of the headwaters are within the City Limits.

The portion of the Little Harpeth (TN05130204021-1000) listed for the 0302 watershed (0601 on the TDEC GIS viewer) is not located within the City Limits.

Section 2.C. - List of Exceptional Tennessee Waters (ETWs) to which the MS4 discharges

Waterbody Name	Waterbody Description	HUC 8	Reason for Inclusion
Edmonson Branch	From Owl Creek to Sunset Road crossing.	05130202	Federal endangered Nashville Crayfish.
Mill Creek Unnamed Tributary	From Mill Creek near Old Hickory Blvd to Hwy 11/41a/31a crossing.	05130202	Federal endangered Nashville Crayfish.
Owl Creek Unnamed Tributary	From Owl Creek near Sunset Rd to origin.	05130202	Federal endangered Nashville Crayfish has been documented from Owl Creek to first road crossing.
Owl Creek Unnamed Tributary	From Owl Creek to origin.	05130202	Federal endangered Nashville Crayfish has been documented from Owl Creek to Carpenter Rd crossing.

**BENTHIC MACROINVERTEBRATE SURVEY
MS4 PERMIT COMPLIANCE
CITY OF BRENTWOOD, TENNESSEE**

**PREPARED FOR:
CITY OF BRENTWOOD
MR. MIKE HARRIS, P.E., DIRECTOR OF ENGINEERING
P.O. BOX 788
BRENTWOOD, TN 37024**

**PREPARED BY:
CIVIL & ENVIRONMENTAL CONSULTANTS, INC.
NASHVILLE, TENNESSEE**

CEC PROJECT 174-840

APRIL 2019



Civil & Environmental Consultants, Inc.

TABLE OF CONTENTS

1.0	INTRODUCTION	1
2.0	METHODS	2
2.1	Field	2
2.2	Laboratory	2
2.3	Data Analysis	3
3.0	RESULTS	4
4.0	LITERATURE CITED	8

FIGURES

Figure 1 Site Location Topographic Map

TABLES

Table 1 Water Quality Measurements and Habitat Assessment Scores
Table 2 Values for Biological Measures
Table 3 Biological Measure Scores (TMI)

APPENDICES

Appendix A Photographs of Sampling Sites
Appendix B Field Data Sheets and Habitat Assessment
Appendix C Taxa List

1.0 INTRODUCTION

As part of the Municipal Separate Storm Sewer System (MS4) Phase II NPDES permit – TNS000000 (Permit) for the City of Brentwood, issued by the Tennessee Department of Environment and Conservation (TDEC), the City is required to perform benthic macroinvertebrate surveys in all streams identified by TDEC as waters with unavailable parameters for siltation, habitat alteration, nutrients, and/or pathogens within a five year permit cycle. The City is currently in year three of their five year permit cycle. There are seven streams within the City's MS4 jurisdiction that require benthic invertebrate sampling: Holt Creek, Beech Creek, Little Harpeth River, Owl Creek, Spencer Creek, and two unnamed tributaries to the Little Harpeth River (UT to Little Harpeth 0300 and UT to Little Harpeth 0200). Sampling locations are identified on Figure 1. Beech Creek and Spencer Creek sampling locations are located just outside the Brentwood City limits in proximity to TDEC designated sampling locations. CEC determined that the majority of the watershed at the TDEC sampling locations for Beech Creek and Spencer Creek is primarily located in the City of Brentwood and that outside sources would not significantly alter the results of the benthic survey. Owl Creek and Holt Creek are located in the Mill Creek Upper watershed (HUC-12 – 051302020101) within the Cheatham Lake watershed (HUC-8 – 05130202). Beech Creek, Little Harpeth River, the two unnamed tributaries, and Spencer Creek are located in the Little Harpeth River watershed (HUC-12 – 051302040601) within the Harpeth River watershed (HUC-8 – 05130204).

2.0 METHODS

2.1 FIELD

Seven benthic invertebrate samples were collected on March 29 and April 01, 2019 in accordance with the TDEC Standard Operating Procedure (SOP 2017) for macroinvertebrates. In each sampling reach (site), a square meter net (500- μ m mesh) was used to collect approximately one square meter of material from two different locations in riffle habitat (SQKICK). The two samples were then composited. For smaller streams, four kick samples were collected using a modified one-person kick net, having a 500 μ m mesh net. The four samples were then composited. The material collected at each site was combined, washed in a 500- μ m mesh sieve to remove excess sediment, emptied into a labeled heavy-duty plastic bag, and fixed with 80 percent ethanol. Appendix A contains photos of upstream and downstream views of each site.

In conjunction with the benthic macroinvertebrate sampling, habitat assessments were performed at each site, following the procedures of TDEC (2017). Parameters such as substratum, embeddedness, velocity, depth, bank characteristics, and land use were assessed and rated to determine if, and to what extent the habitat is capable of supporting a diverse benthic community. Other site characteristics such as sketches of the site, important features, weather, sampling personnel, methods, and other aquatic life were recorded on TDEC's field data sheets. *In-situ* water quality measurements were taken for dissolved oxygen, pH, conductivity, and temperature using a YSI Professional Plus portable meter. Water velocity and depth at each specific sampling site were measured using a Marsh-McBirney flow meter. All meters were calibrated prior to field use. All data, including habitat assessments and sketches of each site, can be found in Appendix B.

2.2 LABORATORY

Each sample was washed using a US Series No. 35 (500 μ m mesh) sieve to remove ethanol and excess detritus. The samples contained a large amount of material (detritus and organisms) and were subsampled using the Caton (1991) method recommended by TDEC (2017). This procedure consists of dividing a given sample into 30 equal portions (termed grids) using a specified subsampling device, then sorting at least four of these grids (which have been randomly selected) to obtain 200 \pm 20 percent (160-240) organisms. If sorting a grid had been started, it was finished in its entirety. The benthic organisms removed from the sample were placed by major groupings (e.g., mayflies, worms, snails) into glass vials containing 70 percent ethanol. Each vial was labeled with information such as date of collection, location, specific sample identification, name of taxonomic group and number of organisms. The residue from the sorted portion of a sample was preserved separately from the portion that was not sorted. Organisms were identified using either a dissecting or compound microscope. The microscope was used for identifying chironomids (midgefly larvae) and oligochaetes (aquatic segmented worms) after these organisms were mounted on microscope slides using CMCP mounting medium. Most organisms were identified to the generic level, unless the specimens were too small or damaged to allow identification to this level. Identifications were recorded on laboratory bench sheets. The benthic laboratory data can be found in Appendix C.

2.3 DATA ANALYSIS

When identifications were complete, the raw benthic data were used to calculate values for seven individual metrics. The following metrics are required by the TDEC (2017) SOP and are all based on generic level identifications:

1. **TR** (Taxa Richness) – total number of distinct taxa identified.
2. **EPT** (Ephemeroptera Plecoptera Trichoptera) **Richness** – total number of genera of mayflies (Ephemeroptera), stoneflies (Plecoptera), and caddisflies (Trichoptera).
3. **%EPT-Cheum** (EPT abundance excluding *Cheumatopsyche* spp.) – total number of individuals of EPT taxa minus number of *Cheumatopsyche*, divided by the total number of individuals in the sample.
4. **%OC** (Percent Oligochaeta and Chironomidae) – total number of individuals in these two groups, divided by total number of individuals in the sample.
5. **NCBI** (North Carolina Biotic Index) – calculated as $NCBI = \sum \frac{x_i t_i}{N}$ where:

 x_i = number of individuals in a taxon
 t_i = tolerance value of a taxon
 N = total number of individuals in sample that have an assigned tolerance value
6. **%Clingers** (Percent Clingers) – total number of individuals that build fixed retreats (or have adaptations to attach to surfaces in flowing water), divided by the total number of individuals in the sample.
7. **%TNUTOL** (Percent TN Nutrient Tolerant Organisms) – total number of Tennessee nutrient tolerant organisms divided by the total number of organisms in the sample. The Tennessee nutrient tolerant organisms include *Cheumatopsyche*, *Stenelmis*, *Polypedilum*, *Cricotopus*, *Cricotopus/Orthocladius*, *Lirceus*, *Caenis*, *Elimia*, *Nais*, *Dero*, and undetermined (immature) tubificids.

Upon completion of the individual metric calculations, each metric is assigned a score of 0, 2, 4, or 6 based on comparison to the ecoregion reference database and stream size. The resulting total of all metrics is the Tennessee Macroinvertebrate Index (TMI) score (TDEC 2017). The drainage area for Owl Creek, Little Harpeth River, the two unnamed tributaries, and Beech Creek sampling sites is >2.5 square miles while the drainage area for Holt Creek and Spencer Creek sampling sites is <2.5 square miles.

3.0 RESULTS

Measurements of *in-situ* water quality parameters, water velocity, and habitat assessment are presented in Table 1 below.

Table 1. <i>In-situ</i> Water Quality Monitoring City of Brentwood, Williamson County, TN							
Site	Owl Creek	Little Harpeth River	UT to Little Harpeth River (0300)	UT to Little Harpeth River (0200)	Beech Creek	Holt Creek	Spencer Creek
pH (su)	8.02	8.01	8.07	7.26	8.31	8.81	7.77
Conductivity (uS/cm)	387.4	383.5	409.8	432.1	312.4	360.7	302.7
Temperature (C°)	13.0	13.6	13.4	15.4	7.1	13.7	15.0
Dissolved Oxygen (mg/L)	10.05	11.96	13.61	8.97	15.44	16.98	11.41
Dissolved Oxygen (%)	NA	114.6	129.5	89.1	125.5	160.6	112.4
Flow (cfs)	16.1	11.2	1.55	0.37	2.40	1.40	0.18
Habitat Assessment	120	109	124	75	119	101	88

In-Situ water quality parameters give a general sense of water quality at each of the benthic sampling locations. The pH ranged from 7.26 to 8.81 with Holt Creek having the highest pH. The higher pH in Holt Creek is most likely related to the amount of limestone rock in the channel which can cause alkaline waters and is common in middle Tennessee streams. The normal range for pH in freshwater streams is 6.5 to 8.5. Conductivity is the ability of water to carry an electric current and indicates the physical presence of dissolved chemicals in the water. The conductivity readings ranged from 302.7 to 432.1 which is considered normal. Dissolved oxygen refers to the level of free oxygen in the stream. Aquatic life depends on dissolved oxygen to survive. The dissolved oxygen (mg/L) levels in the sampled streams ranged from 8.97 to 16.98 with Beech Creek and Holt Creek having the highest readings of 15.44 and 16.98, respectively. Dissolved oxygen is produced primarily by agitation (riffles) and plant photosynthesis. There are three main factors that can be attributed to the higher dissolved oxygen numbers; lower water temperature, excessive algae, and the time of day in which the samples were taken. Dissolved oxygen fluctuates daily and seasonally based on water temperature and photosynthetic activity of aquatic plants. Samples taken later in the day in streams with excessive algae can have higher dissolved oxygen than samples taken early in the day. Colder water temperatures also increase the water's capacity for oxygen.

Results from the calculations of the biological measures are presented in Table 2, with the corresponding TMI scores shown in Table 3.

Table 2. Values for Biological Measures City of Brentwood, Williamson County, TN							
Site	Owl Creek	Little Harpeth River	UT to Little Harpeth River (0300)	UT to Little Harpeth River (0200)	Beech Creek	Holt Creek	Spencer Creek
Total # of individuals	187	160	231	168	204	204	221
Taxa Richness	32	24	23	19	24	29	19
EPT Richness	12	5	6	3	11	9	4
Percent EPT-Cheumatopsyche	28.34	8.13	30.74	11.9	18.63	7.84	9.95
Percent Oligochaeta/Chironomidae	35.83	85.63	41.56	83.93	68.14	70.59	77.83
NC Biotic Index	4.93	5.93	4.54	5.26	5.93	5.35	6.57
Percent Clingers-Cheumatopsyche	51.34	46.88	21.65	27.98	67.16	24.02	77.83
Percent Nutrient Tolerant	41.71	59.38	35.5	44.64	67.16	59.31	66.52

The total number of individuals identified ranged from 160 to 231 organisms. A total of 64 taxa was identified from the samples with a range of 19 to 32 taxa per sample. Thirty four taxa were categorized as intolerant (tolerance values < 4.51) and eight taxa were categorized as tolerant (tolerance values \geq 7.50); those between these two values are considered facultative. Tolerance values ranged from 1.2 (*Dipheter sp.*) to 8.6 (*Physella sp.*), and there were twenty eight (28) taxa classified as clingers. A phylogenetic list of taxa identified from the benthic samples is provided in Appendix C.

Table 3. Biological Measure Scores (TMI scores) City of Brentwood, Williamson County, Tennessee							
Site	Owl Creek	Little Harpeth River	UT to Little Harpeth River (0300)	UT to Little Harpeth River (0200)	Beech Creek	Holt Creek	Spencer Creek
Drainage Area at Sampling Site (square miles)	12	9.9	2.8	2.83	5	1.67	0.73
Bioregion	71i	71h	71h	71h	71h	71i	71h
Taxa Richness	6	4	4	4	4	6	2
EPT Richness	6	2	2	0	4	6	2
Percent EPT- <i>Cheumatopsyche</i>	4	0	2	0	2	0	0
Percent Oligochaeta/Chironomidae	6	0	4	0	2	2	0
NC Biotic Index	6	4	6	4	4	6	2
Percent Clingers- <i>Cheumatopsyche</i>	6	4	2	2	6	2	6
Percent Nutrient Tolerant	6	2	4	4	2	4	2
Total (TMI)	40	16	24	14	24	22	14

The values for Taxa Richness ranged from 19 to 32, resulting in TMI scores ranging from 2 to 6, with Spencer Creek having the lowest number of taxa and the only site to score a 2 for this metric. EPT Richness values ranged from 3 to 12, resulting in TMI scores ranging from 0 to 6, with the Unnamed tributary (0200) having the lowest score for this metric and the only site that scored a 0. Percent EPT-*Cheumatopsyche* values were highest at Owl Creek resulting in a metric value of 4, while the other six sites each had metric values of 0 and 2. Owl Creek and the Unnamed tributary (0300) had the lowest percentage of Oligochaeta + Chironomidae resulting in scores of 6 and 4, respectively. The NC Biotic Index scores ranged from 4 to 6 for all sites except Spencer Creek which scored a 2 for this metric. Percent of Clingers ranged from 21.65 to 77.83, resulting in metric values from 2 to 6, and percent nutrient tolerant ranged from 35.5 to 67.16, resulting in metric values from 2 to 6.

A determination of biological condition is determined from the TMI bio-criteria scores as follows:

- >32 – Non-impaired (Supporting)
- 21-31 – Slightly impaired (Partially Supporting)
- 10-20 – Moderately impaired (Partially Supporting)

- <10 – Severely impaired (Non-supporting)

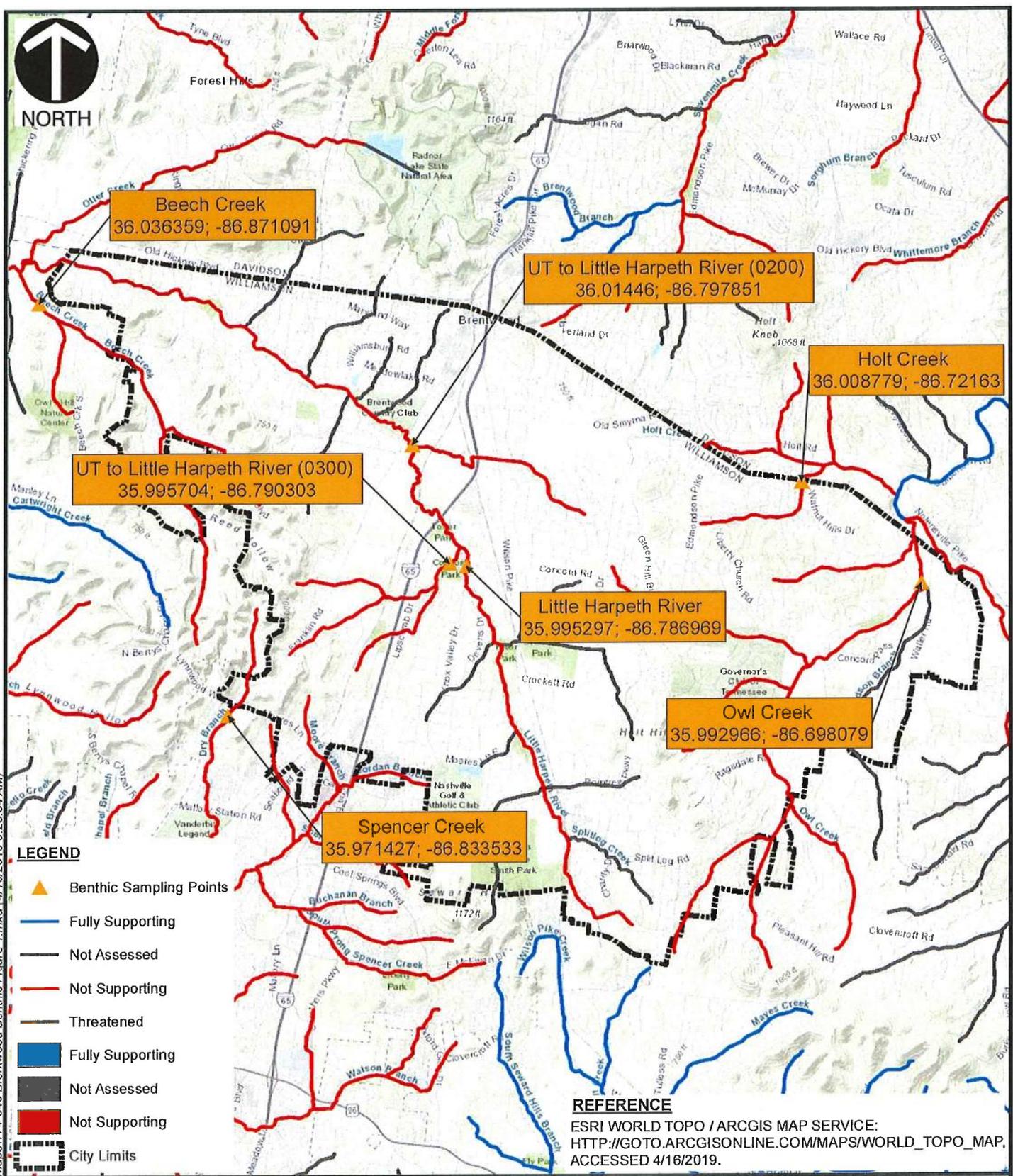
The target TMI score for each bioregion is 32, which indicates no impairment. Owl Creek, at the sampling location, had the highest TMI score of 40 (no impairment/supporting) and the second highest habitat assessment score of 120. Owl Creek scored a metric value of 6 for every category except Percent EPT-*Cheum* where it scored a metric value of 4. Owl Creek is a healthy stream with a diverse benthic community. The Unnamed tributary (0300), Beech Creek, and Holt Creek had TMI scores ranging from 22 to 24 indicating slight impairment (partially supporting) and habitat assessment scores of 124, 119, and 101 respectively, indicating suboptimal habitat. The Little Harpeth River, Unnamed tributary (0200), and Spencer Creek had TMI scores ranging from 14 to 16 indicating moderate impairment (partially supporting) and habitat assessment scores of 109, 75, and 88 respectively, indicating marginal to suboptimal habitat.

4.0 LITERATURE CITED

Tennessee Department of Environment and Conservation. 2017. Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys, Nashville. 3 sections + appendices.

Caton, L.W. 1991. Improved subsampling methods for the EPA "Rapid Bioassessment" benthic protocols. Bull. N. Am. Benthol. Soc. 8:317-319.

FIGURES



I:\SVR-NASHI.P\2017\174-840-GIS\Maps\174-840-Brentwood Benthic Figure 1.mxd (4/16/2019 9:25:54 AM)



Civil & Environmental Consultants, Inc.
 325 Seaboard Lane, Ste. 170 Franklin, Tennessee
 615-333-7797 · 800-763-2326
 www.cecinc.com

CITY OF BRENTWOOD
MS4 PERMIT COMPLIANCE
WILLIAMSON COUNTY, TN

BENTHIC SAMPLING MAP
COMPLETED IN PERMIT YEAR 3

DRAWN BY:	CDH	CHECKED BY:	BCL	APPROVED BY:	TJN * Hand signature on file	FIGURE NO:	1
DATE:	4/16/2019	SCALE:	1" = 7,500'	PROJECT NO:	174-840		

APPENDIX A
PHOTOGRAPHS OF SAMPLING SITES

Photo Summary: Photos taken March 29 and April 01, 2019

Project Description: Benthic Macroinvertebrate Survey; City of Brentwood, Williamson County, Tennessee



Photo 1. View of Owl Creek looking upstream at the sampling location (35.992966; -86.698079).



Photo 2. View of Owl Creek looking downstream toward Concord Rd. at the sampling location (35.992966; -86.698079).

Photo Summary: Photos taken March 29 and April 01, 2019

Project Description: Benthic Macroinvertebrate Survey; City of Brentwood, Williamson County, Tennessee



Photo 3. View of Little Harpeth River looking upstream (35.995297; -86.786969).



Photo 4. View of Little Harpeth River looking downstream (35.995297; -86.786969).

Photo Summary: Photos taken March 29 and April 01, 2019

Project Description: Benthic Macroinvertebrate Survey; City of Brentwood, Williamson County, Tennessee



Photo 5. View of an Unnamed Tributary to Little Harpeth River (0300) looking upstream (35.995704; -86.790303).



Photo 6. View of an Unnamed Tributary to Little Harpeth River (0300) looking downstream (35.995704; -86.790303).

Photo Summary: Photos taken March 29 and April 01, 2019

Project Description: Benthic Macroinvertebrate Survey; City of Brentwood, Williamson County, Tennessee



Photo 7. View of an Unnamed Tributary to Little Harpeth River (0200) looking upstream (36.01446; -86.797851).



Photo 8. View of an Unnamed Tributary to Little Harpeth River (0200) looking downstream (36.01446; -86.797851).

Photo Summary: Photos taken March 29 and April 01, 2019

Project Description: Benthic Macroinvertebrate Survey; City of Brentwood, Williamson County, Tennessee

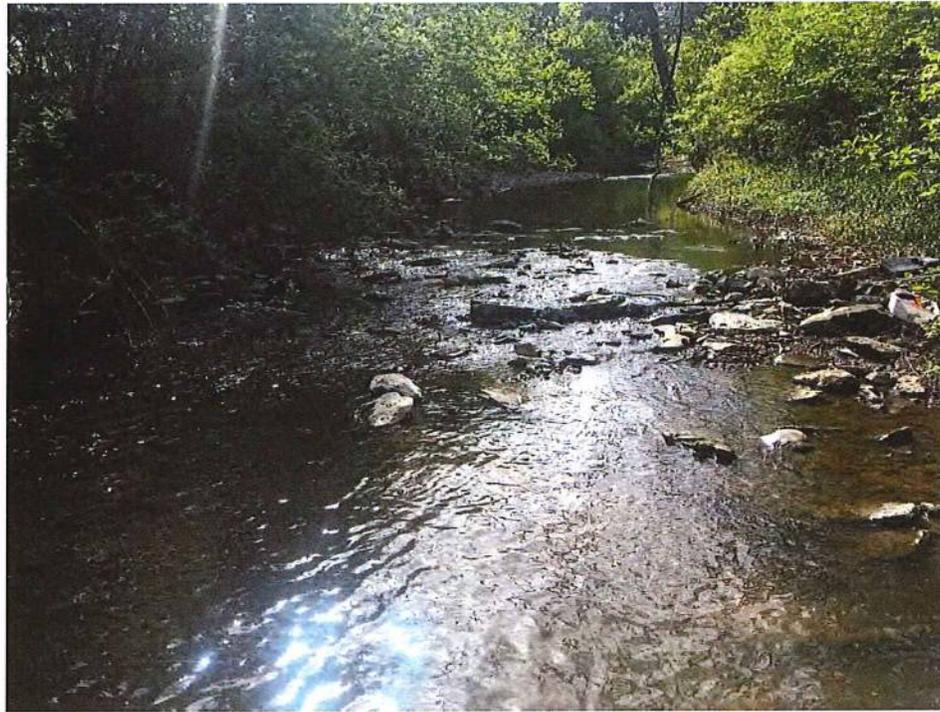


Photo 9. View of Beech Creek looking upstream at the sampling location (36.036359; -86.871091).



Photo 10. View of Beech Creek looking downstream at the sampling location (36.036359; -86.871091).

Photo Summary: Photos taken March 29 and April 01, 2019

Project Description: Benthic Macroinvertebrate Survey; City of Brentwood, Williamson County, Tennessee



Photo 11. View of Holt Creek looking upstream at the sampling location (36.008779; -86.72163).



Photo 12. View of Holt Creek looking downstream at the sampling location (36.008779; -86.72163).

Photo Summary: Photos taken March 29 and April 01, 2019

Project Description: Benthic Macroinvertebrate Survey; City of Brentwood, Williamson County, Tennessee



Photo 13. View of Spencer Creek looking upstream at the sampling location (35.971427; -86.833533).

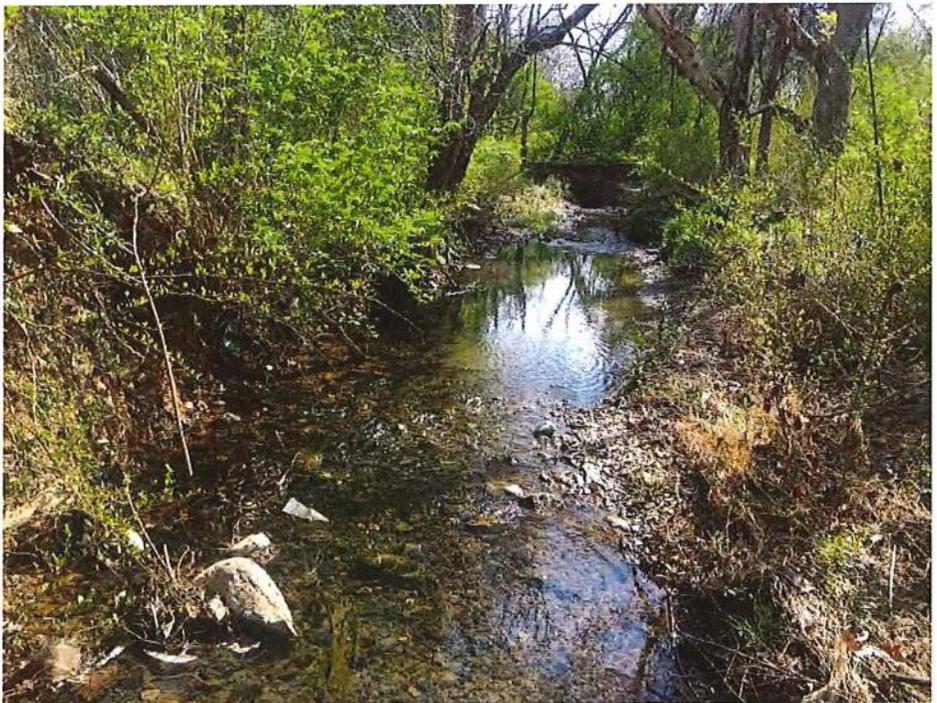


Photo 14. View of Spencer Creek looking downstream at the sampling location (35.971427; -86.833533).

APPENDIX B
FIELD DATA SHEETS AND HABITAT ASSESSMENTS

STREAM SURVEY INFORMATION

DWR Station ID: <u>OW1000.8LJE</u>	Samplers: <u>C. Duke, C. Liggett</u>	
Monitoring Location Name: <u>OW1 Creek</u>	Date: <u>3/19/19</u>	Time: <u>8:54</u>
Monitoring Location: <u>OW1 Creek @ Concord Rd</u>	Organization: <u>CEO Inc.</u>	Drainage Area: <u>11,99 sq ft</u>
County: <u>Williamson</u>	Ecoregion: <u>71i</u>	u/s ECO:
Latitude: <u>35.992966</u>	HUC: <u>051302020101</u>	WS Grp:
Longitude: <u>-86.198079</u>	WBID:	Field Log #:

Project Name: Watershed 303(d) Antideg ECO FECO Other: MS4

Project ID: TNPR

Activity Type: Sample QC Sample Habitat QC habitat QC ID

Sample Status: Collected Seasonally Dry Frequently Dry No Channel
 Too Deep (Not Wadeable) Too Deep (Temporary) Permanent Barrier Fenced
 Landowner Denial: Temporary Barrier Posted Plan to revisit? Yes No

Flow Conditions: Dry Isolated Pools Stagnant Low Moderate High Bankful Flooding

Sample	Collected?	Comment	Sample	Collected?	Comment
Biorecon			Periphyton		
SQKICK	<u>yes</u>	<u>SQKICK</u>	Other		
SQBANK			Describe Other Sample:		

Chemicals/Bacteria: None Routine Nutrient Metals E. coli Organics Other _____

Field Parameters: Meter(s) Used: YSI Pro Plus

pH (su)	<u>8.02</u>	Dissolved Oxygen %	
Conductivity (umhos)	<u>367.4</u>	Turbidity (NTU)	
Temperature (C°)	<u>13.25</u>	TDS (mg/L)	
Dissolved Oxygen (ppm = mg/L)	<u>10.05</u>	Flow (cfs)	<u>16.1</u>

Meter Problems? No

Photos Taken? No Yes: Description: 1-2 LPS resins / down stream

Previous 48 hours precipitation: Unknown None Slight Moderate Heavy Flooding

Air Temperature (°F) 55°

Physical Characteristics & Light Penetration:

Gradient (sample reach): Flat Low Moderate High Cascades
 Average Stream Width: Very Small (<1.5yd) Small (1.5-3yd) Med. (3-10yd) Large (10-25yd) Very Large (>25yd)
 Maximum Stream Depth: Shallow (<0.3yd) Medium (0.3-0.6yd) Deep (0.6 - 1yd) Very Deep (>1yd)
 % Canopy Cover Estimated for Reach: 40 %
 % Canopy Cover Measured (mid-reach): 75 u/s + 40 d/s + 20 LDB + 20 RDB = Total/384*100

Channel Characteristics:

Bank Height: 1-3 (yd.) High Water Mark: 1-2 (yd.)
 Bank Slope LDB: Deeply incised Bluff/Wall Undercut Sloughing Steep terrain Gentle Slope
 Bank Slope RDB: Deeply incised Bluff/Wall Undercut Sloughing Steep terrain Gentle Slope
 Manmade Modification: None Rip-Rap Cement Gabions Channelized Dam Dredging Bridge ATV

Stream Characteristics:

Sediment Deposits: None Slight Moderate Excessive Blanket
 Sediment Type: None Sand Silt Mud Clay Sludge Mn Precipitant Orange Flocculent
 Turbidity: Clear Slightly Turbid Muddy Milky Tannic Planktonic Algae Dyed
 Foam/Surface Sheen: None Nutrient Surfactant Bacteria
 Algae: None Slight Moderate High Choking Type: Diatoms Green Filamentous Blue-green

TDEC-DWR Stream Survey Field Sheet (Back)

DWR Station ID: OWL000.8WI Date: 3/15/14 Assessors: (D. Diller, C. G. G. G. G.)

Dominate Substrate: (More than 25%) Check all that apply

- | Riffle | Run | Pool |
|---|--|--|
| <input type="checkbox"/> Boulders (>10") | <input checked="" type="checkbox"/> Boulders (>10") | <input checked="" type="checkbox"/> Boulders (>10") |
| <input checked="" type="checkbox"/> Cobble (2.5-10") | <input checked="" type="checkbox"/> Cobble (2.5-10") | <input checked="" type="checkbox"/> Cobble (2.5-10") |
| <input checked="" type="checkbox"/> Gravel (0.1-2.5") | <input type="checkbox"/> Gravel (0.1-2.5") | <input type="checkbox"/> Gravel (0.1-2.5") |
| <input type="checkbox"/> Bedrock | <input type="checkbox"/> Bedrock | <input type="checkbox"/> Bedrock |
| <input type="checkbox"/> Sand | <input type="checkbox"/> Sand | <input type="checkbox"/> Sand |
| <input type="checkbox"/> Silt (not gritty) | <input type="checkbox"/> Silt (not gritty) | <input type="checkbox"/> Silt (not gritty) |
| <input type="checkbox"/> Clay (Slick) | <input type="checkbox"/> Clay (Slick) | <input type="checkbox"/> Clay (Slick) |

Surrounding Land Uses (list additional land uses under comments)

- | | | | | |
|--|-------------------------------------|---|---|---------------------------------------|
| <input checked="" type="checkbox"/> Forest | <input type="checkbox"/> Grazing | <input type="checkbox"/> Stormwater | <input type="checkbox"/> STP/WWTP | <input type="checkbox"/> Construction |
| <input type="checkbox"/> Wetland | <input type="checkbox"/> Row Crops | <input type="checkbox"/> Urban | <input type="checkbox"/> Industry | <input type="checkbox"/> Impoundment |
| <input type="checkbox"/> Park | <input type="checkbox"/> CAFO/Dairy | <input checked="" type="checkbox"/> Commercial | <input type="checkbox"/> Mining/Dredging | <input type="checkbox"/> ATV/OHV |
| <input checked="" type="checkbox"/> Hay/Fields | <input type="checkbox"/> Logging | <input checked="" type="checkbox"/> Residential | <input checked="" type="checkbox"/> Road/Hwy/RR | <input type="checkbox"/> Golf Course |

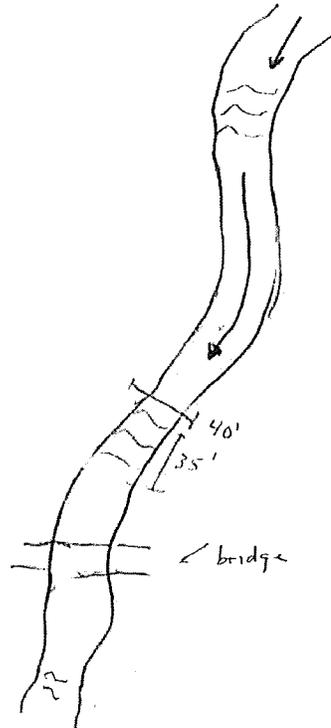
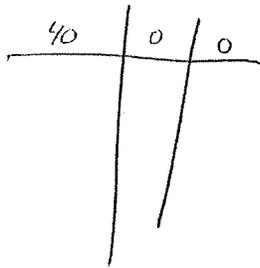
Observed Human Disturbance to Stream: Blank (not observed) S (Slight) M (Moderate) H (High)

Disturbance	S	M	H
Riparian Loss	S		
Channelization			
Active Grazing			
Row Crops		S	
CAFO/Dairy			
Logging			
Urban			
Commercial			
Residential			
Stormwater			
Industry			
Mining/Dredging			
Road/Hwy/RR			
STP/WWTP			
Construction			
Impoundment			
ATV/OHV			
Golf Course			
Garbage/Trash			
Landfill			
Water Withdrawal			

Other Stream Information and Stressors:

Stream Sketch: (include road name or landmark, flow direction, reach distance, distance from bridge or road, sampling points, tributaries, outfalls, livestock access, riparian, potential impacts, north arrow, immediate land use, buildings, etc.) Use additional sheet if necessary.

Dist.	Flow	Depth
6	0	0
8	0	.5
10	0	.4
12	1.64	.5
14	1.62	.4
16	2.35	.5
18	0.91	.6
20	1.40	.4
22	.66	.5
24	.87	.95
26	1.02	1'
28	1.11	.8
30	.39	.8
32	.96	.9
34	.51	.65
36	.04	.2
38	0	.05



HABITAT ASSESSMENT FIELD DATA SHEET – MODERATE TO HIGH GRADIENT STREAM (FRONT)

(Refer to Protocol E for detailed descriptions and rank information)

PROJECT: <i>Madison Bridge Sampling</i>		HABITAT ASSESSED BY: <i>C. Lygell, C. D. Ure</i>	
STA:		DATE: <i>3/27/19</i>	TIME: <i>9:00</i>
STREAM NAME: <i>W1 Creek</i>		ECOREGION:	
MAP LABEL:		QC: Consensus / Duplicate	
HUC:			

	OPTIMAL					SUBOPTIMAL					MARGINAL					POOR				
1. Epifaunal Substrate / Available Cover	Over 70% of stream reach has natural stable habitat suitable for colonization by fish and/or macroinvertebrates. Four or more productive habitats are present.					Natural stable habitat covers 40-70% of stream reach. Three or more productive habitats present. (If near 70% and more than 3 go to optimal.)					Natural stable habitat covers 20 -40% of stream reach or only 1-2 productive habitats present. (If near 40% and more than 2 go to suboptimal.)					Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.				
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				
	OPTIMAL					SUBOPTIMAL					MARGINAL					POOR				
2. Embeddedness of Riffles	Gravel, cobble, and boulders 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. If near 25% drop to suboptimal if riffle not layered cobble.					Gravel, cobble and boulders 25-50% surrounded by fine sediment. Niches in bottom layers of cobble compromised. If near 50% & riffles not layered cobble drop to marginal.					Gravel, cobble, and boulders are 50-75% surrounded by fine sediment. Niche space in middle layers of cobble is starting to fill with fine sediment.					Gravel, cobble, and boulders are more than 75% surrounded by fine sediment. Niche space is reduced to a single layer or is absent.				
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				
	OPTIMAL					SUBOPTIMAL					MARGINAL					POOR				
3. Velocity/ Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow).					Only 3 of the 4 regimes present (if fast-shallow is missing score lower). If slow-deep missing score 15.					Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).					Dominated by 1 velocity/depth regime. Others regimes too small or infrequent to support aquatic populations.				
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				
	OPTIMAL					SUBOPTIMAL					MARGINAL					POOR				
4. Sediment Deposition	Sediment deposition affects less than 5% of stream bottom in quiet areas. New deposition on islands and point bars is absent or minimal.					Sediment deposition affects 5-30% of stream bottom. Slight deposition in pool or slow areas. Some new deposition on islands and point bars. Move to marginal if build-up approaches 30%.					Sediment deposition affects 30-50% of stream bottom. Sediment deposits at obstruction, constrictions and bends. Moderate pool deposition.					Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.				
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				
	OPTIMAL					SUBOPTIMAL					MARGINAL					POOR				
5. Channel Flow Status	Water reaches base of both lower banks and streambed is covered by water throughout reach. Minimal productive habitat is exposed.					Water covers > 75% of streambed or 25% of productive habitat is exposed.					Water covers 25-75% of streambed and/or productive habitat is mostly exposed.					Very little water in channel and mostly present as standing pools. Little or no productive habitat due to lack of water.				
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				

HABITAT ASSESSMENT FIELD DATA SHEET – MODERATE TO HIGH GRADIENT STREAM (BACK)

MAP LABEL:				DATE:				ASSESSOR INITIALS:												
6. Channel Alteration	OPTIMAL Channelization, dredging rock removal or 4-wheel activity (past or present) absent or minimal; natural meander pattern. NO artificial structures in reach. Upstream or downstream structures do not affect reach.					SUBOPTIMAL Channelization, dredging or 4-wheel activity up to 40%. Channel has stabilized. If larger reach, channelization is historic and stable. Artificial structures in or out of reach do not affect natural flow patterns.					MARGINAL Channelization, dredging or 4-wheel activity 40-80% (or less that has not stabilized.) Artificial structures in or out of reach may have slight affect.					POOR Over 80% of reach channelized, dredged or affected by 4-wheelers. In-stream habitat greatly altered or removed. Artificial structures have greatly affected flow pattern.				
	SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2
Comments:																				
7. Frequency of re-oxygenation zones. Use frequency of riffles or bends for category. Rank by quality.	OPTIMAL Occurrence of re-oxygenation zones relatively frequent; ratio of distance between areas divided by average stream width <7:1.					SUBOPTIMAL Occurrence of re-oxygenation zones infrequent; distance between areas divided by average stream width is 7 - 15.					MARGINAL Occasional re-oxygenation area. The distance between areas divided by average stream width is over 15 and up to 25.					POOR Generally all flat water or flat bedrock; little opportunity for re-oxygenation. Distance between areas divided by average stream width >25.				
	SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2
Comments:																				
8. Bank Stability (score each bank) Determine left or right side by facing downstream.	OPTIMAL Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems <5% of bank affected.					SUBOPTIMAL Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. If approaching 30% score marginal if banks steep.					MARGINAL Moderately unstable; 30-60 % of bank in reach has areas of erosion; high erosion potential during floods, If approaching 60% score poor if banks steep.					POOR Unstable; many eroded area; raw areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
	SCORE (LDB)	LEFT	10	9			8	7	6			5	4	3			2	1	0	
SCORE (RDB)	RIGHT	10	9			8	7	6			5	4	3			2	1	0		
Comments:																				
9. Bank Vegetative Protection (score each bank) include vegetation from top of bank to base of bank. Determine left or right side by facing downstream.	OPTIMAL More than 90% of the bank covered by undisturbed vegetation. All 4 classes (mature trees, understory trees, shrubs, groundcover) are represented and allowed to grow naturally. All plants are native.					SUBOPTIMAL 70-90% of the bank covered by undisturbed vegetation. One class may not be well represented. Disruption evident but not effecting full plant growth. Non-natives are rare (< 30%).					MARGINAL 50-70% of the bank covered by undisturbed vegetation. Two classes of vegetation may not be well represented. Non-native vegetation may be common (30-50%).					POOR Less than 50% of the banks covered by undisturbed vegetation or more than 2 classes are not well represented or most vegetation has been cropped. Non-native vegetation may dominate (> 50%).				
	SCORE (LDB)	LEFT	10	9			8	7	6			5	4	3			2	1	0	
SCORE (RDB)	RIGHT	10	9			8	7	6			5	4	3			2	1	0		
Comments:																				
10. Riparian Vegetative Zone Width (score each bank.) Zone begins at top of bank.	OPTIMAL Average width of riparian zone > 18 meters. Unpaved footpaths may score 9 if run-off potential is negligible.					SUBOPTIMAL Average width of riparian zone 12-18 meters. Score high if areas < 18 meters are small or are minimally disturbed.					MARGINAL Average width of riparian zone 6-11 meters. Score high if areas less than 12 meters are small or are minimally disturbed.					POOR Average width of riparian zone <6 meters. Score high if areas less than 6 meters are small or are minimally disturbed.				
	SCORE (LDB)	LEFT	10	9			8	7	6			5	4	3			2	1	0	
SCORE (RDB)	RIGHT	10	9			8	7	6			5	4	3			2	1	0		
Comments:																				
TOTAL SCORE 170											Comparison to Ecoregion Guidelines (circle): ABOVE or BELOW									
If score is below guidelines, result of (circle)											Natural Conditions					Human Disturbance				
Comments:																				

STREAM SURVEY INFORMATION

DWR Station ID: <u>LHAR.P011.2WE</u>	Samplers: <u>C. L. / C. D.</u>	
Monitoring Location Name: <u>Little Harpeth Creek</u>	Date: <u>3-29-2019</u>	Time: <u>10:45 am</u>
Monitoring Location: <u>Little Harpeth @ Concord Rd.</u>	Organization: <u>C.E.C. Inc.</u>	Drainage Area: <u>9.9</u>
County: <u>Madison</u>	Ecoregion: <u>71b</u>	u/s ECO:
Latitude: <u>35.915297</u>	HUC: <u>051302040601</u>	WS Grp:
Longitude: <u>-86.786964</u>	WBID:	Field Log #:

Project Name: Watershed 303(d) Antideg ECO FECO Other: MS4

Project ID: TNPR
 Activity Type: Sample QC Sample Habitat QC habitat QC ID

Sample Status: Collected Seasonally Dry Frequently Dry No Channel
 Too Deep (Not Wadeable) Too Deep (Temporary) Permanent Barrier Fenced
 Landowner Denial: Temporary Barrier Posted Plan to revisit? Yes No
 Flow Conditions: Dry Isolated Pools Stagnant Low Moderate High Bankful Flooding

Sample	Collected?	Comment	Sample	Collected?	Comment
Biorecon			Periphyton		
SQKICK	<input checked="" type="checkbox"/>		Other		
SQBANK			Describe Other Sample:		

Chemicals/Bacteria: None Routine Nutrient Metals E. coli Organics Other _____

Field Parameters: Meter(s) Used: VSE Pro Plus

pH (su)	<u>8.01</u>	Dissolved Oxygen %	<u>114.0</u>
Conductivity (umhos)	<u>383.5</u>	Turbidity (NTU)	
Temperature (C°)	<u>15.00</u>	TDS (mg/L)	
Dissolved Oxygen (ppm = mg/L)	<u>11.36</u>	Flow (cfs)	<u>11.2</u>

Meter Problems? NO

Photos Taken? No Yes: Description: 3 u/s 4 d/s

Previous 48 hours precipitation: Unknown None Slight Moderate Heavy Flooding
 Air Temperature (°F) 57

Physical Characteristics & Light Penetration:

Gradient (sample reach): Flat Low Moderate High Cascades
 Average Stream Width: Very Small (<1.5yd) Small (1.5-3yd) Med. (3-10yd) Large (10-25yd) Very Large (>25yd)
 Maximum Stream Depth: Shallow (<0.3yd) Medium (0.3-0.6yd) Deep (0.6 - 1yd) Very Deep (>1yd)
 % Canopy Cover Estimated for Reach: 75 %
 % Canopy Cover Measured (mid-reach): 75 u/s + 75 d/s + 60 LDB + 75 RDB = Total/384*100 _____

Channel Characteristics:

Bank Height: 2-3 (yd.) High Water Mark: 3 (yd.)
 Bank Slope LDB: Deeply incised Bluff/Wall Undercut Sloughing Steep terrain Gentle Slope
 Bank Slope RDB: Deeply incised Bluff/Wall Undercut Sloughing Steep terrain Gentle Slope
 Manmade Modification: None Rip-Rap Cement Gabions Channelized Dam Dredging Bridge ATV

Stream Characteristics:

Sediment Deposits: None Slight Moderate Excessive Blanket
 Sediment Type: None Sand Silt Mud Clay Sludge Mn Precipitant Orange Flocculent
 Turbidity: Clear Slightly Turbid Muddy Milky Tannic Planktonic Algae Dyed
 Foam/Surface Sheen: None Nutrient Surfactant Bacteria
 Algae: None Slight Moderate High Choking Type: Diatoms Green Filamentous Blue-green

TDEC-DWR Stream Survey Field Sheet (Back)

DWR Station ID: LHARPO11.2WI Date: 3/29/19 Assessors: Liggett/Duke

Dominate Substrate: (More than 25%) Check all that apply

- | Riffle | Run | Pool |
|---|---|--|
| <input type="checkbox"/> Boulders (>10") | <input checked="" type="checkbox"/> Boulders (>10") | <input checked="" type="checkbox"/> Boulders (>10") |
| <input checked="" type="checkbox"/> Cobble (2.5-10") | <input checked="" type="checkbox"/> Cobble (2.5-10") | <input checked="" type="checkbox"/> Cobble (2.5-10") |
| <input checked="" type="checkbox"/> Gravel (0.1-2.5") | <input checked="" type="checkbox"/> Gravel (0.1-2.5") | <input type="checkbox"/> Gravel (0.1-2.5") |
| <input type="checkbox"/> Bedrock | <input type="checkbox"/> Bedrock | <input type="checkbox"/> Bedrock |
| <input type="checkbox"/> Sand | <input type="checkbox"/> Sand | <input type="checkbox"/> Sand |
| <input type="checkbox"/> Silt (not gritty) | <input type="checkbox"/> Silt (not gritty) | <input type="checkbox"/> Silt (not gritty) |
| <input type="checkbox"/> Clay (Slick) | <input type="checkbox"/> Clay (Slick) | <input type="checkbox"/> Clay (Slick) |

Surrounding Land Uses (list additional land uses under comments)

- | | | | | |
|--|-------------------------------------|--------------------------------------|---|---------------------------------------|
| <input type="checkbox"/> Forest | <input type="checkbox"/> Grazing | <input type="checkbox"/> Stormwater | <input type="checkbox"/> STP/WWTP | <input type="checkbox"/> Construction |
| <input type="checkbox"/> Wetland | <input type="checkbox"/> Row Crops | <input type="checkbox"/> Urban | <input type="checkbox"/> Industry | <input type="checkbox"/> Impoundment |
| <input checked="" type="checkbox"/> Park | <input type="checkbox"/> CAFO/Dairy | <input type="checkbox"/> Commercial | <input type="checkbox"/> Mining/Dredging | <input type="checkbox"/> ATV/OHV |
| <input type="checkbox"/> Hay/Fields | <input type="checkbox"/> Logging | <input type="checkbox"/> Residential | <input checked="" type="checkbox"/> Road/Hwy/RR | <input type="checkbox"/> Golf Course |

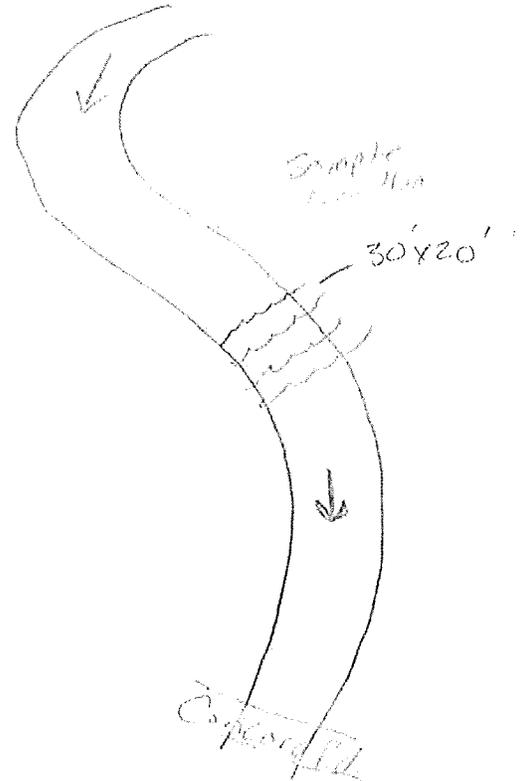
Observed Human Disturbance to Stream: Blank (not observed) S (Slight) M (Moderate) H (High)

Riparian Loss		Logging		Industry		ATV/OHV	
Channelization		Urban	/M	Mining/ Dredging		Golf Course	
Active Grazing		Commercial		Road/Hwy/RR	/M	Garbage/Trash	
Row Crops		Residential		Construction		Landfill	
CAFO/Dairy		STP/WWTP		Impoundment		Water Withdrawal	

Other Stream Information and Stressors:

Stream Sketch: (include road name or landmark, flow direction, reach distance, distance from bridge or road, sampling points, tributaries, outfalls, livestock access, riparian, potential impacts, north arrow, immediate land use, buildings, etc.) Use additional sheet if necessary.

Distance	Depth	Flow
2	0	0 EW
4	.16	.46
6	.11	.395
8	2.79	.75
10	2.68	.40
12	2.74	.30
14	2.41	.35
16	1.00	.20
18	0	.05
20	.39	.05
22	.84	.20
24	.61	.10
26		
28	.47	.20
30	.55	.20
32	0	0



HABITAT ASSESSMENT FIELD DATA SHEET – MODERATE TO HIGH GRADIENT STREAM (FRONT)

(Refer to Protocol E for detailed descriptions and rank information)

PROJECT: <i>Restoration of the ...</i>		HABITAT ASSESSED BY: <i>...</i>		
STA: <i>6833(0)1, 201</i>		DATE: <i>2-29-2019</i>		
STREAM NAME: <i>Little Wash Creek</i>		TIME: <i>10:15</i>		
MAP LABEL:		ECOREGION:		
HUC:		QC: Consensus / Duplicate		
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
1. Epifaunal Substrate / Available Cover	Over 70% of stream reach has natural stable habitat suitable for colonization by fish and/or macroinvertebrates. Four or more productive habitats are present.	Natural stable habitat covers 40-70% of stream reach. Three or more productive habitats present. (If near 70% and more than 3 go to optimal.)	Natural stable habitat covers 20 -40% of stream reach or only 1-2 productive habitats present. (If near 40% and more than 2 go to suboptimal.)	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1
Comments:				
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
2. Embeddedness of Riffles	Gravel, cobble, and boulders 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. If near 25% drop to suboptimal if riffle not layered cobble.	Gravel, cobble and boulders 25-50% surrounded by fine sediment. Niches in bottom layers of cobble compromised. If near 50% & riffles not layered cobble drop to marginal.	Gravel, cobble, and boulders are 50-75% surrounded by fine sediment. Niche space in middle layers of cobble is starting to fill with fine sediment.	Gravel, cobble, and boulders are more than 75% surrounded by fine sediment. Niche space is reduced to a single layer or is absent.
SCORE	20 19 18 17 16	15 14 13 12 11	(10) 9 8 7 6	5 4 3 2 1
Comments:				
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
3. Velocity/ Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow).	Only 3 of the 4 regimes present (if fast-shallow is missing score lower). If slow-deep missing score 15.	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime. Others regimes too small or infrequent to support aquatic populations.
SCORE	20 19 18 17 16	15 (14) 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments:				
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
4. Sediment Deposition	Sediment deposition affects less than 5% of stream bottom in quiet areas. New deposition on islands and point bars is absent or minimal.	Sediment deposition affects 5-30% of stream bottom. Slight deposition in pool or slow areas. Some new deposition on islands and point bars. Move to marginal if build-up approaches 30%.	Sediment deposition affects 30-50% of stream bottom. Sediment deposits at obstruction, constrictions and bends. Moderate pool deposition.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 (8) 7 6	5 4 3 2 1
Comments:				
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
5. Channel Flow Status	Water reaches base of both lower banks and streambed is covered by water throughout reach. Minimal productive habitat is exposed.	Water covers > 75% of streambed or 25% of productive habitat is exposed.	Water covers 25-75% of streambed and/or productive habitat is mostly exposed.	Very little water in channel and mostly present as standing pools. Little or no productive habitat due to lack of water.
SCORE	20 19 18 (17) 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments:				

HABITAT ASSESSMENT FIELD DATA SHEET – MODERATE TO HIGH GRADIENT STREAM (BACK)

MAP LABEL:		DATE:										ASSESSOR INITIALS:									
6. Channel Alteration	OPTIMAL	Channelization, dredging rock removal or 4-wheel activity (past or present) absent or minimal; natural meander pattern. NO artificial structures in reach. Upstream or downstream structures do not affect reach.					SUBOPTIMAL					MARGINAL					POOR				
		Channelization, dredging or 4-wheel activity up to 40%. Channel has stabilized. If larger reach, channelization is historic and stable. Artificial structures in or out of reach do not affect natural flow patterns.					Channelization, dredging or 4-wheel activity 40-80% (or less that has not stabilized.) Artificial structures in or out of reach may have slight affect.					Over 80% of reach channelized, dredged or affected by 4-wheelers. In-stream habitat greatly altered or removed. Artificial structures have greatly affected flow pattern.									
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
Comments:																					
7. Frequency of re-oxygenation zones. Use frequency of riffles or bends for category. Rank by quality.	OPTIMAL	Occurrence of re-oxygenation zones relatively frequent; ratio of distance between areas divided by average stream width <7:1.					SUBOPTIMAL					MARGINAL					POOR				
		Occurrence of re-oxygenation zones infrequent; distance between areas divided by average stream width is 7 - 15.					Occasional re-oxygenation area. The distance between areas divided by average stream width is over 15 and up to 25.					Generally all flat water or flat bedrock; little opportunity for re-oxygenation. Distance between areas divided by average stream width >25.									
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
Comments:																					
8. Bank Stability (score each bank) Determine left or right side by facing downstream.	OPTIMAL	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems <5% of bank affected.					SUBOPTIMAL					MARGINAL					POOR				
		Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. If approaching 30% score marginal if banks steep.					Moderately unstable; 30-60 % of bank in reach has areas of erosion; high erosion potential during floods, if approaching 60% score poor if banks steep.					Unstable; many croded area; raw areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.									
SCORE (LDB)	LEFT	10	9	8	7	6	5	4	3	2	1	0	2	1	0	2	1	0			
SCORE (RDB)	RIGHT	10	9	8	7	6	5	4	3	2	1	0	2	1	0						
Comments:																					
9. Bank Vegetative Protection (score each bank) include vegetation from top of bank to base of bank. Determine left or right side by facing downstream.	OPTIMAL	More than 90% of the bank covered by undisturbed vegetation. All 4 classes (mature trees, understory trees, shrubs, groundcover) are represented and allowed to grow naturally. All plants are native.					SUBOPTIMAL					MARGINAL					POOR				
		70-90% of the bank covered by undisturbed vegetation. One class may not be well represented. Disruption evident but not effecting full plant growth. Non-natives are rare (< 30%).					50-70% of the bank covered by undisturbed vegetation. Two classes of vegetation may not be well represented. Non-native vegetation may be common (30-50%).					Less than 50% of the banks covered by undisturbed vegetation or more than 2 classes are not well represented or most vegetation has been cropped. Non-native vegetation may dominate (> 50%).									
SCORE (LDB)	LEFT	10	9	8	7	6	5	4	3	2	1	0	2	1	0						
SCORE (RDB)	RIGHT	10	9	8	7	6	5	4	3	2	1	0									
Comments:																					
10. Riparian Vegetative Zone Width (score each bank.) Zone begins at top of bank.	OPTIMAL	Average width of riparian zone > 18 meters. Unpaved footpaths may score 9 if run-off potential is negligible.					SUBOPTIMAL					MARGINAL					POOR				
		Average width of riparian zone 12-18 meters. Score high if areas < 18 meters are small or are minimally disturbed.					Average width of riparian zone 6-11 meters. Score high if areas less than 12 meters are small or are minimally disturbed.					Average width of riparian zone <6 meters. Score high if areas less than 6 meters are small or are minimally disturbed.									
SCORE (LDB)	LEFT	10	9	8	7	6	5	4	3	2	1	0	2	1	0						
SCORE (RDB)	RIGHT	10	9	8	7	6	5	4	3	2	1	0									
Comments:																					
TOTAL SCORE		109										Comparison to Ecoregion Guidelines (circle): ABOVE or BELOW									
If score is below guidelines, result of (circle) Natural Conditions Human Disturbance																					
Comments: Score is slightly lower than ecoregion guidelines primarily due to buffer disturbance.																					

STREAM SURVEY INFORMATION

DWR Station ID: <u>LHARD113TD, 2WE</u>	Samplers: <u>C.L. / C.D.</u>	
Monitoring Location Name: <u>UT to Little Harpeth</u>	Date: <u>8-29-2019</u>	Time: <u>12:00</u>
Monitoring Location: <u>(UT to Little Harpeth (0300))</u>	Organization: <u>CEC, Inc.</u>	Drainage Area: <u>2.78</u>
County: <u>Williamson</u>	Ecoregion: <u>71h</u>	u/s ECO:
Latitude: <u>35.995704</u>	HUC: <u>051302040601</u>	WS Grp:
Longitude: <u>-86.790303</u>	WBID:	Field Log #:

Project Name: Watershed 303(d) Antideg ECO FECO Other: MS4

Project ID: TNPR

Activity Type: Sample QC Sample Habitat QC habitat QC ID

Sample Status: Collected Seasonally Dry Frequently Dry No Channel
 Too Deep (Not Wadeable) Too Deep (Temporary) Permanent Barrier Fenced
 Landowner Denial: Temporary Barrier Posted Plan to revisit? Yes No

Flow Conditions: Dry Isolated Pools Stagnant Low Moderate High Bankful Flooding

Sample	Collected?	Comment	Sample	Collected?	Comment
Biorecon			Periphyton		
SQKICK	<input checked="" type="checkbox"/>		Other		
SQBANK			Describe Other Sample:		

Chemicals/Bacteria: None Routine Nutrient Metals E. coli Organics Other _____

Field Parameters: Meter(s) Used: VSI Pro Plus

pH (su)	<u>8.07</u>	Dissolved Oxygen %	<u>129.5</u>
Conductivity (umhos)	<u>409.8</u>	Turbidity (NTU)	
Temperature (C°)	<u>13.4</u>	TDS (mg/L)	
Dissolved Oxygen (ppm = mg/L)	<u>13.61</u>	Flow (cfs)	<u>1.55</u>

Meter Problems? N/A

Photos Taken? No Yes: Description: 5 u/s 6 d/s

Previous 48 hours precipitation: Unknown None Slight Moderate Heavy Flooding
 Air Temperature (°F) 60

Physical Characteristics & Light Penetration:

Gradient (sample reach): Flat Low Moderate High Cascades

Average Stream Width: Very Small (<1.5yd) Small (1.5-3yd) Med. (3-10yd) Large (10-25yd) Very Large (>25yd)

Maximum Stream Depth: Shallow (<0.3yd) Medium (0.3-0.6yd) Deep (0.6 - 1yd) Very Deep (>1yd)

% Canopy Cover Estimated for Reach: 85 %

% Canopy Cover Measured (mid-reach): 90 u/s + 90 d/s + 80 LDB + 80 RDB = Total/384*100

Channel Characteristics:

Bank Height: 1-2 (yd.) High Water Mark: 2 (yd.)

Bank Slope LDB: Deeply incised Bluff/Wall Undercut Sloughing Steep terrain Gentle Slope

Bank Slope RDB: Deeply incised Bluff/Wall Undercut Sloughing Steep terrain Gentle Slope

Manmade Modification: None Rip-Rap Cement Gabions Channelized Dam Dredging Bridge ATV

Stream Characteristics:

Sediment Deposits: None Slight Moderate Excessive Blanket

Sediment Type: None Sand Silt Mud Clay Sludge Mn Precipitant Orange Flocculent

Turbidity: Clear Slightly Turbid Muddy Milky Tannic Planktonic Algae Dyed

Foam/Surface Sheen: None Nutrient Surfactant Bacteria

Algae: None Slight Moderate High Choking Type: Diatoms Green Filamentous Blue-green

TDEC-DWR Stream Survey Field Sheet (Back)

DWR Station ID: LHARP 11.3T o.2 WE Date: 3/29/19 Assessors: Loggett/Duke

Dominate Substrate: (More than 25%) Check all that apply

- | Riffle | Run | Pool |
|---|---|---|
| <input type="checkbox"/> Boulders (>10") | <input type="checkbox"/> Boulders (>10") | <input checked="" type="checkbox"/> Boulders (>10") |
| <input checked="" type="checkbox"/> Cobble (2.5-10") | <input checked="" type="checkbox"/> Cobble (2.5-10") | <input type="checkbox"/> Cobble (2.5-10") |
| <input checked="" type="checkbox"/> Gravel (0.1-2.5") | <input checked="" type="checkbox"/> Gravel (0.1-2.5") | <input type="checkbox"/> Gravel (0.1-2.5") |
| <input type="checkbox"/> Bedrock | <input checked="" type="checkbox"/> Bedrock | <input checked="" type="checkbox"/> Bedrock |
| <input type="checkbox"/> Sand | <input type="checkbox"/> Sand | <input type="checkbox"/> Sand |
| <input type="checkbox"/> Silt (not gritty) | <input type="checkbox"/> Silt (not gritty) | <input type="checkbox"/> Silt (not gritty) |
| <input type="checkbox"/> Clay (Slick) | <input type="checkbox"/> Clay (Slick) | <input type="checkbox"/> Clay (Slick) |

Surrounding Land Uses (list additional land uses under comments)

- | | | | | |
|--|-------------------------------------|--|---|---------------------------------------|
| <input type="checkbox"/> Forest | <input type="checkbox"/> Grazing | <input type="checkbox"/> Stormwater | <input type="checkbox"/> STP/WWTP | <input type="checkbox"/> Construction |
| <input type="checkbox"/> Wetland | <input type="checkbox"/> Row Crops | <input type="checkbox"/> Urban | <input type="checkbox"/> Industry | <input type="checkbox"/> Impoundment |
| <input checked="" type="checkbox"/> Park | <input type="checkbox"/> CAFO/Dairy | <input checked="" type="checkbox"/> Commercial | <input type="checkbox"/> Mining/Dredging | <input type="checkbox"/> ATV/OHV |
| <input type="checkbox"/> Hay/Fields | <input type="checkbox"/> Logging | <input type="checkbox"/> Residential | <input checked="" type="checkbox"/> Road/Hwy/RR | <input type="checkbox"/> Golf Course |

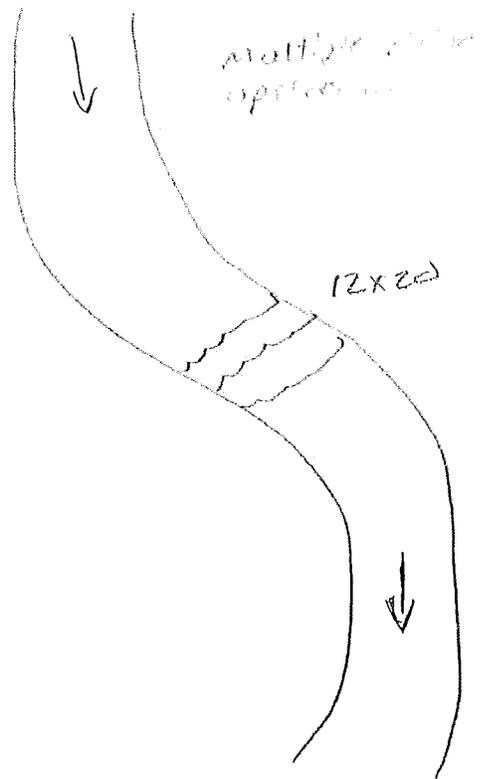
Observed Human Disturbance to Stream: Blank (not observed) S (Slight) M (Moderate) H (High)

Riparian Loss	H	Logging		Industry		ATV/OHV	
Channelization		Urban	M	Mining/ Dredging		Golf Course	
Active Grazing		Commercial		Road/Hwy/RR	S	Garbage/Trash	
Row Crops		Residential		Construction	-1	Landfill	
CAFO/Dairy		STP/WWTP		Impoundment		Water Withdrawal	

Other Stream Information and Stressors:

Stream Sketch: (include road name or landmark, flow direction, reach distance, distance from bridge or road, sampling points, tributaries, outfalls, livestock access, riparian, potential impacts, north arrow, immediate land use, buildings, etc.) Use additional sheet if necessary.

Distance	Depth	Flow
1	.20	.19
2	.20	.18
3	.20	.12
4	.20	.51
5	.35	1.42
6	.35	.11
7	.40	1.01
8	.35	.88
9	.25	.49
10	0.05	0
11	0	0



HABITAT ASSESSMENT FIELD DATA SHEET – MODERATE TO HIGH GRADIENT STREAM (FRONT)

(Refer to Protocol E for detailed descriptions and rank information)

PROJECT: Brentwood Beehive Sampling - M84																				
STA: UT to Little Harpeth River (8300)										HABITAT ASSESSED BY: C. L. / C. D.										
STREAM NAME: Little Harpeth UT										DATE: 3-29-2019					TIME: 12:00					
MAP LABEL:										ECOREGION:										
HUC:										QC: Consensus / Duplicate										
	OPTIMAL					SUBOPTIMAL					MARGINAL					POOR				
1. Epifaunal Substrate / Available Cover	Over 70% of stream reach has natural stable habitat suitable for colonization by fish and/or macroinvertebrates. Four or more productive habitats are present.					Natural stable habitat covers 40-70% of stream reach. Three or more productive habitats present. (If near 70% and more than 3 go to optimal.)					Natural stable habitat covers 20 -40% of stream reach or only 1-2 productive habitats present. (If near 40% and more than 2 go to suboptimal.)					Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.				
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				
	OPTIMAL					SUBOPTIMAL					MARGINAL					POOR				
2. Embeddedness of Riffles	Gravel, cobble, and boulders 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. If near 25% drop to suboptimal if riffle not layered cobble.					Gravel, cobble and boulders 25-50% surrounded by fine sediment. Niches in bottom layers of cobble compromised. If near 50% & riffles not layered cobble drop to marginal.					Gravel, cobble, and boulders are 50-75% surrounded by fine sediment. Niche space in middle layers of cobble is starting to fill with fine sediment.					Gravel, cobble, and boulders are more than 75% surrounded by fine sediment. Niche space is reduced to a single layer or is absent.				
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				
	OPTIMAL					SUBOPTIMAL					MARGINAL					POOR				
3. Velocity/ Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow).					Only 3 of the 4 regimes present (if fast-shallow is missing score lower). If slow-deep missing score 15.					Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).					Dominated by 1 velocity/depth regime. Others regimes too small or infrequent to support aquatic populations.				
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				
	OPTIMAL					SUBOPTIMAL					MARGINAL					POOR				
4. Sediment Deposition	Sediment deposition affects less than 5% of stream bottom in quiet areas. New deposition on islands and point bars is absent or minimal.					Sediment deposition affects 5-30% of stream bottom. Slight deposition in pool or slow areas. Some new deposition on islands and point bars. Move to marginal if build-up approaches 30%.					Sediment deposition affects 30-50% of stream bottom. Sediment deposits at obstruction, constrictions and bends. Moderate pool deposition.					Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.				
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				
	OPTIMAL					SUBOPTIMAL					MARGINAL					POOR				
5. Channel Flow Status	Water reaches base of both lower banks and streambed is covered by water throughout reach. Minimal productive habitat is exposed.					Water covers > 75% of streambed or 25% of productive habitat is exposed.					Water covers 25-75% of streambed and/or productive habitat is mostly exposed.					Very little water in channel and mostly present as standing pools. Little or no productive habitat due to lack of water.				
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				

HABITAT ASSESSMENT FIELD DATA SHEET – MODERATE TO HIGH GRADIENT STREAM (BACK)

MAP LABEL:		DATE:										ASSESSOR INITIALS:									
6. Channel Alteration	OPTIMAL	Channelization, dredging rock removal or 4-wheel activity (past or present) absent or minimal; natural meander pattern. NO artificial structures in reach. Upstream or downstream structures do not affect reach.					SUBOPTIMAL					MARGINAL					POOR				
		Channelization, dredging or 4-wheel activity up to 40%. Channel has stabilized. If larger reach, channelization is historic and stable. Artificial structures in or out of reach do not affect natural flow patterns.					Channelization, dredging or 4-wheel activity 40-80% (or less that has not stabilized.) Artificial structures in or out of reach may have slight affect.					Over 80% of reach channelized, dredged or affected by 4-wheelers. In-stream habitat greatly altered or removed. Artificial structures have greatly affected flow pattern.									
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
Comments:																					
7. Frequency of re-oxygenation zones. Use frequency of riffles or bends for category. Rank by quality.	OPTIMAL	Occurrence of re-oxygenation zones relatively frequent; ratio of distance between areas divided by average stream width <7:1.					SUBOPTIMAL					MARGINAL					POOR				
		Occurrence of re-oxygenation zones infrequent; distance between areas divided by average stream width is 7 - 15.					Occasional re-oxygenation area. The distance between areas divided by average stream width is over 15 and up to 25.					Generally all flat water or flat bedrock; little opportunity for re-oxygenation. Distance between areas divided by average stream width >25.									
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
Comments:																					
8. Bank Stability (score each bank) Determine left or right side by facing downstream.	OPTIMAL	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems <5% of bank affected.					SUBOPTIMAL					MARGINAL					POOR				
		Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. If approaching 30% score marginal if banks steep.					Moderately unstable; 30-60 % of bank in reach has areas of erosion; high erosion potential during floods, If approaching 60% score poor if banks steep.					Unstable; many eroded area; raw areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.									
SCORE (LDB)	LEFT	10	9	8	7	6	5	4	3	2	1	0									
SCORE (RDB)	RIGHT	10	9	8	7	6	5	4	3	2	1	0									
Comments:																					
9. Bank Vegetative Protection (score each bank) include vegetation from top of bank to base of bank. Determine left or right side by facing downstream.	OPTIMAL	More than 90% of the bank covered by undisturbed vegetation. All 4 classes (mature trees, understory trees, shrubs, groundcover) are represented and allowed to grow naturally. All plants are native.					SUBOPTIMAL					MARGINAL					POOR				
		70-90% of the bank covered by undisturbed vegetation. One class may not be well represented. Disruption evident but not effecting full plant growth. Non-natives are rare (< 30%).					50-70% of the bank covered by undisturbed vegetation. Two classes of vegetation may not be well represented. Non-native vegetation may be common (30-50%).					Less than 50% of the banks covered by undisturbed vegetation or more than 2 classes are not well represented or most vegetation has been cropped. Non-native vegetation may dominate (> 50%).									
SCORE (LDB)	LEFT	10	9	8	7	6	5	4	3	2	1	0									
SCORE (RDB)	RIGHT	10	9	8	7	6	5	4	3	2	1	0									
Comments:																					
10. Riparian Vegetative Zone Width (score each bank.) Zone begins at top of bank.	OPTIMAL	Average width of riparian zone > 18 meters. Unpaved footpaths may score 9 if run-off potential is negligible.					SUBOPTIMAL					MARGINAL					POOR				
		Average width of riparian zone 12-18 meters. Score high if areas < 18 meters are small or are minimally disturbed.					Average width of riparian zone 6-11 meters. Score high if areas less than 12 meters are small or are minimally disturbed.					Average width of riparian zone <6 meters. Score high if areas less than 6 meters are small or are minimally disturbed.									
SCORE (LDB)	LEFT	10	9	8	7	6	5	4	3	2	1	0									
SCORE (RDB)	RIGHT	10	9	8	7	6	5	4	3	2	1	0									
Comments:																					
TOTAL SCORE	174										Comparison to Ecoregion Guidelines (circle): ABOVE or BELOW										
If score is below guidelines, result of (circle)											Natural Conditions					Human Disturbance					
Comments:																					

STREAM SURVEY INFORMATION

DWR Station ID: <u>LHARP9, TTD, WI</u>	Samplers: <u>C.L. / C.D.</u>	
Monitoring Location Name: <u>UT to Little Memphis (2000)</u>	Date: <u>3-29-2019</u>	Time: <u>1:45</u>
Monitoring Location: <u>UT to Little Memphis (2000)</u>	Organization: <u>CEC, Inc.</u>	Drainage Area: <u>2.83</u>
County: <u>Williamson</u>	Ecoregion: <u>71h</u>	u/s ECO:
Latitude: <u>36.01446</u>	HUC: <u>051302040601</u>	WS Grp:
Longitude: <u>-86.797851</u>	WBID:	Field Log #:

Project Name: Watershed 303(d) Antideg ECO FECO Other: msci

Project ID: TNPR
 Activity Type: Sample QC Sample Habitat QC habitat QC ID

Sample Status: Collected Seasonally Dry Frequently Dry No Channel
 Too Deep (Not Wadeable) Too Deep (Temporary) Permanent Barrier Fenced
 Landowner Denial: Temporary Barrier Posted Plan to revisit? Yes No

Flow Conditions: Dry Isolated Pools Stagnant Low Moderate High Bankful Flooding

Sample	Collected?	Comment	Sample	Collected?	Comment
Biorecon			Periphyton		
SQKICK	<u>yes</u>	<u>SQ KICK</u>	Other		
SQBANK			Describe Other Sample:		

Chemicals/Bacteria: None Routine Nutrient Metals E. coli Organics Other _____

Field Parameters: Meter(s) Used: YSI Pro Plus

pH (su)	<u>7.26</u>	Dissolved Oxygen %	<u>89.1</u>
Conductivity (umhos)	<u>432.1</u>	Turbidity (NTU)	
Temperature (C°)	<u>15.4°</u>	TDS (mg/L)	
Dissolved Oxygen (ppm = mg/L)	<u>8.97</u>	Flow (cfs)	<u>0.37</u>

Meter Problems? N/D

Photos Taken? No Yes: Description: 7+8 upstream/downstream

Previous 48 hours precipitation: Unknown None Slight Moderate Heavy Flooding

Air Temperature (°F) 66

Physical Characteristics & Light Penetration:

Gradient (sample reach): Flat Low Moderate High Cascades
 Average Stream Width: Very Small (<1.5yd) Small (1.5-3yd) Med. (3-10yd) Large (10-25yd) Very Large (>25yd)
 Maximum Stream Depth: Shallow (<0.3yd) Medium (0.3-0.6yd) Deep (0.6-1yd) Very Deep (>1yd)
 % Canopy Cover Estimated for Reach: 50 %
 % Canopy Cover Measured (mid-reach): 50 u/s + 50 d/s + 50 LDB + 50 RDB = Total/384*100

Channel Characteristics:

Bank Height: 2 (yd.) High Water Mark: 2 (yd.)
 Bank Slope LDB: Deeply incised Bluff/Wall Undercut Sloughing Steep terrain Gentle Slope
 Bank Slope RDB: Deeply incised Bluff/Wall Undercut Sloughing Steep terrain Gentle Slope
 Manmade Modification: None Rip-Rap Cement Gabions Channelized Dam Dredging Bridge ATV

Stream Characteristics:

Sediment Deposits: None Slight Moderate Excessive Blanket
 Sediment Type: None Sand Silt Mud Clay Sludge Mn Precipitant Orange Flocculent
 Turbidity: Clear Slightly Turbid Muddy Milky Tannic Planktonic Algae Dyed
 Foam/Surface Sheen: None Nutrient Surfactant Bacteria
 Algae: None Slight Moderate High Choking Type: Diatoms Green Filamentous Blue-green

TDEC-DWR Stream Survey Field Sheet (Back)

DWR Station ID: LHARP9.770.1W2 Date: 3/29/19 Assessors: Liggett/Duke

Dominate Substrate: (More than 25%) Check all that apply

- | Riffle | Run | Pool |
|---|---|---|
| <input type="checkbox"/> Boulders (>10") | <input type="checkbox"/> Boulders (>10") | <input type="checkbox"/> Boulders (>10") |
| <input type="checkbox"/> Cobble (2.5-10") | <input type="checkbox"/> Cobble (2.5-10") | <input type="checkbox"/> Cobble (2.5-10") |
| <input checked="" type="checkbox"/> Gravel (0.1-2.5") | <input checked="" type="checkbox"/> Gravel (0.1-2.5") | <input type="checkbox"/> Gravel (0.1-2.5") |
| <input type="checkbox"/> Bedrock | <input type="checkbox"/> Bedrock | <input type="checkbox"/> Bedrock |
| <input type="checkbox"/> Sand | <input type="checkbox"/> Sand | <input type="checkbox"/> Sand |
| <input type="checkbox"/> Silt (not gritty) | <input checked="" type="checkbox"/> Silt (not gritty) | <input checked="" type="checkbox"/> Silt (not gritty) |
| <input type="checkbox"/> Clay (Slick) | <input type="checkbox"/> Clay (Slick) | <input type="checkbox"/> Clay (Slick) |

Surrounding Land Uses (list additional land uses under comments)

- | | | | | |
|--|-------------------------------------|--------------------------------------|---|---|
| <input type="checkbox"/> Forest | <input type="checkbox"/> Grazing | <input type="checkbox"/> Stormwater | <input type="checkbox"/> STP/WWTP | <input type="checkbox"/> Construction |
| <input type="checkbox"/> Wetland | <input type="checkbox"/> Row Crops | <input type="checkbox"/> Urban | <input type="checkbox"/> Industry | <input type="checkbox"/> Impoundment |
| <input type="checkbox"/> Park | <input type="checkbox"/> CAFO/Dairy | <input type="checkbox"/> Commercial | <input type="checkbox"/> Mining/Dredging | <input type="checkbox"/> ATV/OHV |
| <input checked="" type="checkbox"/> Hay/Fields | <input type="checkbox"/> Logging | <input type="checkbox"/> Residential | <input checked="" type="checkbox"/> Road/Hwy/RR | <input checked="" type="checkbox"/> Golf Course |

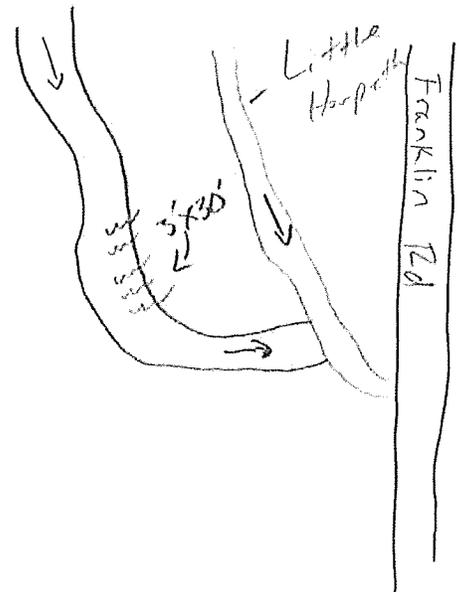
Observed Human Disturbance to Stream: Blank (not observed) S (Slight) M (Moderate) H (High)

Riparian Loss	H	Logging		Industry		ATV/OHV	
Channelization		Urban		Mining/ Dredging		Golf Course	
Active Grazing		Commercial		Road/Hwy/RR	S	Garbage/Trash	
Row Crops		Residential		Construction		Landfill	
CAFO/Dairy		STP/WWTP		Impoundment		Water Withdrawal	

Other Stream Information and Stressors:

Stream Sketch: (include road name or landmark, flow direction, reach distance, distance from bridge or road, sampling points, tributaries, outfalls, livestock access, riparian, potential impacts, north arrow, immediate land use, buildings, etc.) Use additional sheet if necessary.

Distance	Depth	Flow
1'	0	0
1.5	.05	0
2.0	.10	0
2.5	.25	.64
3.0	.20	1.06
3.5	.20	.99
4.0	.15	.97
4.5	.10	.26
5.0	.05	0
5.5	0	0



HABITAT ASSESSMENT FIELD DATA SHEET – MODERATE TO HIGH GRADIENT STREAM (FRONT)

(Refer to Protocol E for detailed descriptions and rank information)

PROJECT: Beechwood Benthic Sampling - M54																				
STA: UT to Little Hopketh River (20a)										HABITAT ASSESSED BY: P.L./C.D.										
STREAM NAME: UT to Little Hopketh River										DATE: 03-29-2019				TIME: 1:45						
MAP LABEL:										ECOREGION:										
HUC:										QC: Consensus / Duplicate										
	OPTIMAL					SUBOPTIMAL					MARGINAL					POOR				
1. Epifaunal Substrate / Available Cover	Over 70% of stream reach has natural stable habitat suitable for colonization by fish and/or macroinvertebrates. Four or more productive habitats are present.					Natural stable habitat covers 40-70% of stream reach. Three or more productive habitats present. (If near 70% and more than 3 go to optimal.)					Natural stable habitat covers 20 -40% of stream reach or only 1-2 productive habitats present. (If near 40% and more than 2 go to suboptimal.)					Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.				
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				
	OPTIMAL					SUBOPTIMAL					MARGINAL					POOR				
2. Embeddedness of Riffles	Gravel, cobble, and boulders 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. If near 25% drop to suboptimal if riffle not layered cobble.					Gravel, cobble and boulders 25-50% surrounded by fine sediment. Niches in bottom layers of cobble compromised. If near 50% & riffles not layered cobble drop to marginal.					Gravel, cobble, and boulders are 50-75% surrounded by fine sediment. Niche space in middle layers of cobble is starting to fill with fine sediment.					Gravel, cobble, and boulders are more than 75% surrounded by fine sediment. Niche space is reduced to a single layer or is absent.				
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				
	OPTIMAL					SUBOPTIMAL					MARGINAL					POOR				
3. Velocity/ Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow).					Only 3 of the 4 regimes present (if fast-shallow is missing score lower). If slow-deep missing score 15.					Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).					Dominated by 1 velocity/depth regime. Others regimes too small or infrequent to support aquatic populations.				
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				
	OPTIMAL					SUBOPTIMAL					MARGINAL					POOR				
4. Sediment Deposition	Sediment deposition affects less than 5% of stream bottom in quiet areas. New deposition on islands and point bars is absent or minimal.					Sediment deposition affects 5-30% of stream bottom. Slight deposition in pool or slow areas. Some new deposition on islands and point bars. Move to marginal if build-up approaches 30%.					Sediment deposition affects 30-50% of stream bottom. Sediment deposits at obstruction, constrictions and bends. Moderate pool deposition.					Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.				
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				
	OPTIMAL					SUBOPTIMAL					MARGINAL					POOR				
5. Channel Flow Status	Water reaches base of both lower banks and streambed is covered by water throughout reach. Minimal productive habitat is exposed.					Water covers > 75% of streambed or 25% of productive habitat is exposed.					Water covers 25-75% of streambed and/or productive habitat is mostly exposed.					Very little water in channel and mostly present as standing pools. Little or no productive habitat due to lack of water.				
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				

HABITAT ASSESSMENT FIELD DATA SHEET – MODERATE TO HIGH GRADIENT STREAM (BACK)

MAP LABEL:			DATE:					ASSESSOR INITIALS:												
	OPTIMAL					SUBOPTIMAL					MARGINAL			POOR						
6. Channel Alteration	Channelization, dredging rock removal or 4-wheel activity (past or present) absent or minimal; natural meander pattern. NO artificial structures in reach. Upstream or downstream structures do not affect reach.					Channelization, dredging or 4-wheel activity up to 40%. Channel has stabilized. If larger reach, channelization is historic and stable. Artificial structures in or out of reach do not affect natural flow patterns.					Channelization, dredging or 4-wheel activity 40-80% (or less that has not stabilized.) Artificial structures in or out of reach may have slight affect.			Over 80% of reach channelized, dredged or affected by 4-wheelers. In-stream habitat greatly altered or removed. Artificial structures have greatly affected flow pattern.						
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				
	OPTIMAL					SUBOPTIMAL					MARGINAL			POOR						
7. Frequency of re-oxygenation zones. Use frequency of riffles or bends for category. Rank by quality.	Occurrence of re-oxygenation zones relatively frequent; ratio of distance between areas divided by average stream width <7:1.					Occurrence of re-oxygenation zones infrequent; distance between areas divided by average stream width is 7 - 15.					Occasional re-oxygenation area. The distance between areas divided by average stream width is over 15 and up to 25.			Generally all flat water or flat bedrock; little opportunity for re-oxygenation. Distance between areas divided by average stream width >25.						
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				
	OPTIMAL					SUBOPTIMAL					MARGINAL			POOR						
8. Bank Stability (score each bank) Determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems <5% of bank affected.					Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. If approaching 30% score marginal if banks steep.					Moderately unstable; 30-60 % of bank in reach has areas of erosion; high erosion potential during floods, If approaching 60% score poor if banks steep.			Unstable; many eroded area; raw areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.						
SCORE (LDB)	LEFT	10	9			8	7	6			5	4	3			2	1	0		
SCORE (RDB)	RIGHT	10	9			8	7	6			5	4	3			2	1	0		
Comments:																				
	OPTIMAL					SUBOPTIMAL					MARGINAL			POOR						
9. Bank Vegetative Protection (score each bank) include vegetation from top of bank to base of bank. Determine left or right side by facing downstream.	More than 90% of the bank covered by undisturbed vegetation. All 4 classes (mature trees, understory trees, shrubs, groundcover) are represented and allowed to grow naturally. All plants are native.					70-90% of the bank covered by undisturbed vegetation. One class may not be well represented. Disruption evident but not effecting full plant growth. Non-natives are rare (< 30%).					50-70% of the bank covered by undisturbed vegetation. Two classes of vegetation may not be well represented. Non-native vegetation may be common (30-50%).			Less than 50% of the banks covered by undisturbed vegetation or more than 2 classes are not well represented or most vegetation has been cropped. Non-native vegetation may dominate (> 50%).						
SCORE (LDB)	LEFT	10	9			8	7	6			5	4	3			2	1	0		
SCORE (RDB)	RIGHT	10	9			8	7	6			5	4	3			2	1	0		
Comments:																				
	OPTIMAL					SUBOPTIMAL					MARGINAL			POOR						
10. Riparian Vegetative Zone Width (score each bank.) Zone begins at top of bank.	Average width of riparian zone > 18 meters. Unpaved footpaths may score 9 if run-off potential is negligible.					Average width of riparian zone 12-18 meters. Score high if areas < 18 meters are small or are minimally disturbed.					Average width of riparian zone 6-11 meters. Score high if areas less than 12 meters are small or are minimally disturbed.			Average width of riparian zone <6 meters. Score high if areas less than 6 meters are small or are minimally disturbed.						
SCORE (LDB)	LEFT	10	9			8	7	6			5	4	3			2	1	0		
SCORE (RDB)	RIGHT	10	9			8	7	6			5	4	3			2	1	0		
Comments:																				
TOTAL SCORE	75					Comparison to Ecoregion Guidelines (circle) <u>ABOVE</u> or <u>BELOW</u>														
If score is below guidelines, result of (circle)										<u>Natural Conditions</u>					<u>Human Disturbance</u>					
Comments: stream has only marginal habitat.																				

STREAM SURVEY INFORMATION

DWR Station ID: <u>BE ECH 000.4 U3I</u>	Samplers: <u>C.L. / C.D.</u>	
Monitoring Location Name: <u>Beech Creek</u>	Date: <u>4-1-2019</u>	Time: <u>10:00 am</u>
Monitoring Location: <u>Beech Creek @ HWY. 431</u>	Organization: <u>CEC, Inc.</u>	Drainage Area: <u>3.161</u>
County: <u>Williamson</u>	Ecoregion: <u>71h</u>	u/s ECO:
Latitude: <u>36.036359</u>	HUC: <u>051302040601</u>	WS Grp:
Longitude: <u>-86.871091</u>	WBID:	Field Log #:

Project Name: Watershed 303(d) Antideg ECO FECO Other: MSJ

Project ID: TNPR

Activity Type: Sample QC Sample Habitat QC habitat QC ID

Sample Status: Collected Seasonally Dry Frequently Dry No Channel
 Too Deep (Not Wadeable) Too Deep (Temporary) Permanent Barrier Fenced
 Landowner Denial: Temporary Barrier Posted Plan to revisit? Yes No

Flow Conditions: Dry Isolated Pools Stagnant Low Moderate High Bankful Flooding

Sample	Collected?	Comment	Sample	Collected?	Comment
Biorecon			Periphyton		
SQKICK	<input checked="" type="checkbox"/>		Other		
SQBANK			Describe Other Sample:		

Chemicals/Bacteria: None Routine Nutrient Metals E. coli Organics Other _____

Field Parameters: Meter(s) Used: YSI Pro Plus

pH (su)	<u>8.31</u>	Dissolved Oxygen %	<u>125.5</u>
Conductivity (umhos)	<u>312.4</u>	Turbidity (NTU)	
Temperature (C°)	<u>7.1</u>	TDS (mg/L)	
Dissolved Oxygen (ppm = mg/L)	<u>15.44</u>	Flow (cfs)	<u>2.40</u>

Meter Problems? No

Photos Taken? No Yes: Description: 9 u/s 10 d/s

Previous 48 hours precipitation: Unknown None Slight Moderate Heavy Flooding

Air Temperature (°F) 39

Physical Characteristics & Light Penetration:

Gradient (sample reach): <input type="checkbox"/> Flat <input type="checkbox"/> Low <input checked="" type="checkbox"/> Moderate <input type="checkbox"/> High <input type="checkbox"/> Cascades
Average Stream Width: <input type="checkbox"/> Very Small (<1.5yd) <input type="checkbox"/> Small (1.5-3yd) <input checked="" type="checkbox"/> Med. (3-10yd) <input type="checkbox"/> Large (10-25yd) <input type="checkbox"/> Very Large (>25yd)
Maximum Stream Depth: <input type="checkbox"/> Shallow (<0.3yd) <input type="checkbox"/> Medium (0.3-0.6yd) <input checked="" type="checkbox"/> Deep (0.6 - 1yd) <input type="checkbox"/> Very Deep (>1yd)
% Canopy Cover Estimated for Reach: <u>65%</u>
% Canopy Cover Measured (mid-reach): <u>80 u/s + 40 d/s + 35 LDB + 45 RDB = Total/384*100</u>

Channel Characteristics:

Bank Height: <u>1-2</u> (yd.) High Water Mark: <u>1-1.5</u> (yd.)
Bank Slope LDB: <input type="checkbox"/> Deeply incised <input type="checkbox"/> Bluff/Wall <input checked="" type="checkbox"/> Undercut <input type="checkbox"/> Sloughing <input type="checkbox"/> Steep terrain <input checked="" type="checkbox"/> Gentle Slope
Bank Slope RDB: <input type="checkbox"/> Deeply incised <input type="checkbox"/> Bluff/Wall <input checked="" type="checkbox"/> Undercut <input type="checkbox"/> Sloughing <input type="checkbox"/> Steep terrain <input type="checkbox"/> Gentle Slope
Manmade Modification: <input type="checkbox"/> None <input type="checkbox"/> Rip-Rap <input type="checkbox"/> Cement <input type="checkbox"/> Gabions <input type="checkbox"/> Channelized <input type="checkbox"/> Dam <input type="checkbox"/> Dredging <input checked="" type="checkbox"/> Bridge <input type="checkbox"/> ATV

Stream Characteristics:

Sediment Deposits: <input type="checkbox"/> None <input type="checkbox"/> Slight <input checked="" type="checkbox"/> Moderate <input type="checkbox"/> Excessive <input type="checkbox"/> Blanket
Sediment Type: <input type="checkbox"/> None <input type="checkbox"/> Sand <input checked="" type="checkbox"/> Silt <input type="checkbox"/> Mud <input type="checkbox"/> Clay <input type="checkbox"/> Sludge <input type="checkbox"/> Mn Precipitant <input type="checkbox"/> Orange Flocculent
Turbidity: <input type="checkbox"/> Clear <input checked="" type="checkbox"/> Slightly Turbid <input type="checkbox"/> Muddy <input type="checkbox"/> Milky <input type="checkbox"/> Tannic <input type="checkbox"/> Planktonic Algae <input type="checkbox"/> Dyed
Foam/Surface Sheen: <input checked="" type="checkbox"/> None <input type="checkbox"/> Nutrient <input type="checkbox"/> Surfactant <input type="checkbox"/> Bacteria
Algae: <input type="checkbox"/> None <input type="checkbox"/> Slight <input checked="" type="checkbox"/> Moderate <input type="checkbox"/> High <input type="checkbox"/> Choking Type: <input type="checkbox"/> Diatoms <input type="checkbox"/> Green <input checked="" type="checkbox"/> Filamentous <input type="checkbox"/> Blue-green

TDEC-DWR Stream Survey Field Sheet (Back)

DWR Station ID: DEECHA000.4 WF Date: 4/1/19 Assessors: Loggett/Duke

Dominate Substrate: (More than 25%) Check all that apply

- | Riffle | Run | Pool |
|---|---|---|
| <input checked="" type="checkbox"/> Boulders (>10") | <input type="checkbox"/> Boulders (>10") | <input type="checkbox"/> Boulders (>10") |
| <input checked="" type="checkbox"/> Cobble (2.5-10") | <input checked="" type="checkbox"/> Cobble (2.5-10") | <input type="checkbox"/> Cobble (2.5-10") |
| <input checked="" type="checkbox"/> Gravel (0.1-2.5") | <input checked="" type="checkbox"/> Gravel (0.1-2.5") | <input checked="" type="checkbox"/> Gravel (0.1-2.5") |
| <input type="checkbox"/> Bedrock | <input type="checkbox"/> Bedrock | <input type="checkbox"/> Bedrock |
| <input type="checkbox"/> Sand | <input type="checkbox"/> Sand | <input type="checkbox"/> Sand |
| <input type="checkbox"/> Silt (not gritty) | <input checked="" type="checkbox"/> Silt (not gritty) | <input checked="" type="checkbox"/> Silt (not gritty) |
| <input type="checkbox"/> Clay (Slick) | <input type="checkbox"/> Clay (Slick) | <input type="checkbox"/> Clay (Slick) |

Surrounding Land Uses (list additional land uses under comments)

- | | | | | |
|--|---|---|---|---------------------------------------|
| <input checked="" type="checkbox"/> Forest | <input checked="" type="checkbox"/> Grazing | <input type="checkbox"/> Stormwater | <input type="checkbox"/> STP/WWTP | <input type="checkbox"/> Construction |
| <input type="checkbox"/> Wetland | <input type="checkbox"/> Row Crops | <input type="checkbox"/> Urban | <input type="checkbox"/> Industry | <input type="checkbox"/> Impoundment |
| <input type="checkbox"/> Park | <input type="checkbox"/> CAFO/Dairy | <input type="checkbox"/> Commercial | <input type="checkbox"/> Mining/Dredging | <input type="checkbox"/> ATV/OHV |
| <input checked="" type="checkbox"/> Hay/Fields | <input type="checkbox"/> Logging | <input checked="" type="checkbox"/> Residential | <input checked="" type="checkbox"/> Road/Hwy/RR | <input type="checkbox"/> Golf Course |

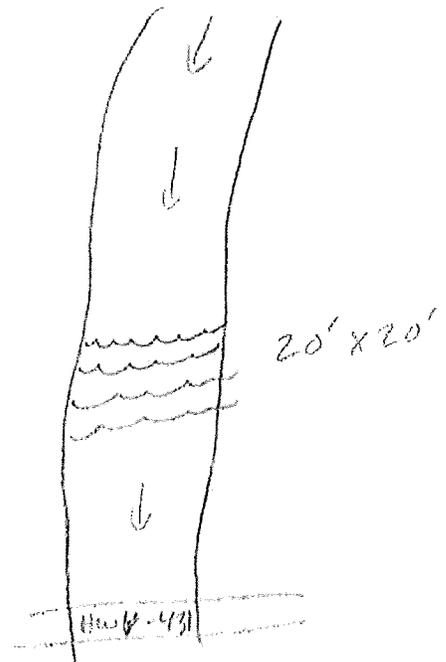
Observed Human Disturbance to Stream: Blank (not observed) S (Slight) M (Moderate) H (High)

Disturbance	M	S	H
Riparian Loss	M		
Channelization		Urban	Mining/ Dredging
Active Grazing		Commercial	Road/Hwy/RR
Row Crops		Residential	Construction
CAFO/Dairy		STP/WWTP	Impoundment
			ATV/OHV
			Golf Course
			Garbage/Trash
			Landfill
			Water Withdrawal

Other Stream Information and Stressors:

Stream Sketch: (include road name or landmark, flow direction, reach distance, distance from bridge or road, sampling points, tributaries, outfalls, livestock access, riparian, potential impacts, north arrow, immediate land use, buildings, etc.) Use additional sheet if necessary.

Distance	Depth	Flow
1.5	0	0 EW
2.0	0.10	0.26
4.0	0.20	0.62
6.0	0.30	0.92
8.0	0.20	1.88
10.0	0.20	1.02
12	0.10	0.23
14	0.10	0.44
16	0.20	1.81
18	0	0
20	0.05	0.01
21	0	0 EW



HABITAT ASSESSMENT FIELD DATA SHEET – MODERATE TO HIGH GRADIENT STREAM (FRONT)

(Refer to Protocol E for detailed descriptions and rank information)

PROJECT: Brentwood MS4 Benthic Sampling		HABITAT ASSESSED BY: C.L. / C.D.																		
STA: BEECH#000.4WT		DATE: 4-1-2019										TIME: 10:00								
STREAM NAME: Beech Creek @ HWY-431		ECOREGION:																		
MAP LABEL:		QC: Consensus / Duplicate																		
HUC:																				
	OPTIMAL	SUBOPTIMAL					MARGINAL					POOR								
1. Epifaunal Substrate / Available Cover	Over 70% of stream reach has natural stable habitat suitable for colonization by fish and/or macroinvertebrates. Four or more productive habitats are present.	Natural stable habitat covers 40-70% of stream reach. Three or more productive habitats present. (If near 70% and more than 3 go to optimal.)					Natural stable habitat covers 20 -40% of stream reach or only 1-2 productive habitats present. (If near 40% and more than 2 go to suboptimal.)					Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.								
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				
	OPTIMAL	SUBOPTIMAL					MARGINAL					POOR								
2. Embeddedness of Riffles	Gravel, cobble, and boulders 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. If near 25% drop to suboptimal if riffle not layered cobble.	Gravel, cobble and boulders 25-50% surrounded by fine sediment. Niches in bottom layers of cobble compromised. If near 50% & riffles not layered cobble drop to marginal.					Gravel, cobble, and boulders are 50-75% surrounded by fine sediment. Niche space in middle layers of cobble is starting to fill with fine sediment.					Gravel, cobble, and boulders are more than 75% surrounded by fine sediment. Niche space is reduced to a single layer or is absent.								
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				
	OPTIMAL	SUBOPTIMAL					MARGINAL					POOR								
3. Velocity/ Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow).	Only 3 of the 4 regimes present (if fast-shallow is missing score lower). If slow-deep missing score 15.					Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).					Dominated by 1 velocity/depth regime. Others regimes too small or infrequent to support aquatic populations.								
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				
	OPTIMAL	SUBOPTIMAL					MARGINAL					POOR								
4. Sediment Deposition	Sediment deposition affects less than 5% of stream bottom in quiet areas. New deposition on islands and point bars is absent or minimal.	Sediment deposition affects 5-30% of stream bottom. Slight deposition in pool or slow areas. Some new deposition on islands and point bars. Move to marginal if build-up approaches 30%.					Sediment deposition affects 30-50% of stream bottom. Sediment deposits at obstruction, constrictions and bends. Moderate pool deposition.					Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.								
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				
	OPTIMAL	SUBOPTIMAL					MARGINAL					POOR								
5. Channel Flow Status	Water reaches base of both lower banks and streambed is covered by water throughout reach. Minimal productive habitat is exposed.	Water covers > 75% of streambed or 25% of productive habitat is exposed.					Water covers 25-75% of streambed and/or productive habitat is mostly exposed.					Very little water in channel and mostly present as standing pools. Little or no productive habitat due to lack of water.								
SCORE	20	19	18	7	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				

HABITAT ASSESSMENT FIELD DATA SHEET – MODERATE TO HIGH GRADIENT STREAM (BACK)

MAP LABEL:	DATE:										ASSESSOR INITIALS:									
6. Channel Alteration	OPTIMAL					SUBOPTIMAL					MARGINAL					POOR				
	Channelization, dredging rock removal or 4-wheel activity (past or present) absent or minimal; natural meander pattern. NO artificial structures in reach. Upstream or downstream structures do not affect reach.					Channelization, dredging or 4-wheel activity up to 40%. Channel has stabilized. If larger reach, channelization is historic and stable. Artificial structures in or out of reach do not affect natural flow patterns.					Channelization, dredging or 4-wheel activity 40-80% (or less that has not stabilized.) Artificial structures in or out of reach may have slight affect.					Over 80% of reach channelized, dredged or affected by 4-wheelers. In-stream habitat greatly altered or removed. Artificial structures have greatly affected flow pattern.				
	SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2
Comments:																				
7. Frequency of re-oxygenation zones. Use frequency of riffles or bends for category. Rank by quality.	OPTIMAL					SUBOPTIMAL					MARGINAL					POOR				
	Occurrence of re-oxygenation zones relatively frequent; ratio of distance between areas divided by average stream width <7:1.					Occurrence of re-oxygenation zones infrequent; distance between areas divided by average stream width is 7 - 15.					Occasional re-oxygenation area. The distance between areas divided by average stream width is over 15 and up to 25.					Generally all flat water or flat bedrock; little opportunity for re-oxygenation. Distance between areas divided by average stream width >25.				
	SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2
Comments:																				
8. Bank Stability (score each bank) Determine left or right side by facing downstream.	OPTIMAL					SUBOPTIMAL					MARGINAL					POOR				
	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems <5% of bank affected.					Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. If approaching 30% score marginal if banks steep.					Moderately unstable; 30-60 % of bank in reach has areas of erosion; high erosion potential during floods, If approaching 60% score poor if banks steep.					Unstable; many eroded area; raw areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
	SCORE (LDB)	LEFT	10	9			8	7	6			5	4	3			2	1	0	
SCORE (RDB)	RIGHT	10	9			8	7	6			5	4	3			2	1	0		
Comments:																				
9. Bank Vegetative Protection (score each bank) include vegetation from top of bank to base of bank. Determine left or right side by facing downstream.	OPTIMAL					SUBOPTIMAL					MARGINAL					POOR				
	More than 90% of the bank covered by undisturbed vegetation. All 4 classes (mature trees, understory trees, shrubs, groundcover) are represented and allowed to grow naturally. All plants are native.					70-90% of the bank covered by undisturbed vegetation. One class may not be well represented. Disruption evident but not effecting full plant growth. Non-natives are rare (< 30%).					50-70% of the bank covered by undisturbed vegetation. Two classes of vegetation may not be well represented. Non-native vegetation may be common (30-50%).					Less than 50% of the banks covered by undisturbed vegetation or more than 2 classes are not well represented or most vegetation has been cropped. Non-native vegetation may dominate (> 50%).				
	SCORE (LDB)	LEFT	10	9			8	7	6			5	4	3			2	1	0	
SCORE (RDB)	RIGHT	10	9			8	7	6			5	4	3			2	1	0		
Comments:																				
10. Riparian Vegetative Zone Width (score each bank.) Zone begins at top of bank.	OPTIMAL					SUBOPTIMAL					MARGINAL					POOR				
	Average width of riparian zone > 18 meters. Unpaved footpaths may score 9 if run-off potential is negligible.					Average width of riparian zone 12-18 meters. Score high if areas < 18 meters are small or are minimally disturbed.					Average width of riparian zone 6-11 meters. Score high if areas less than 12 meters are small or are minimally disturbed.					Average width of riparian zone <6 meters. Score high if areas less than 6 meters are small or are minimally disturbed.				
	SCORE (LDB)	LEFT	10	9			8	7	6			5	4	3			2	1	0	
SCORE (RDB)	RIGHT	10	9			8	7	6			5	4	3			2	1	0		
Comments:																				
TOTAL SCORE <u>21/19</u>										Comparison to Ecoregion Guidelines (circle): <u>ABOVE</u> or BELOW										
If score is below guidelines, result of (circle)										Natural Conditions					Human Disturbance					
Comments:																				

STREAM SURVEY INFORMATION

DWR Station ID: <u>N/A</u>	Samplers: <u>CL / C.D.</u>	
Monitoring Location Name: <u>Holt Creek</u>	Date: <u>4-1-2019</u>	Time: <u>1:00 pm</u>
Monitoring Location: <u>Holt Creek @ Northwoods ct.</u>	Organization: <u>CEC, Inc.</u>	Drainage Area: <u>1.67 mi²</u>
County: <u>Davidson</u>	Ecoregion: <u>71c</u>	u/s ECO:
Latitude: <u>36.008779</u>	HUC: <u>051302020101</u>	WS Grp:
Longitude: <u>-86.72163</u>	WBID:	Field Log #:
Project Name: <input type="checkbox"/> Watershed <input type="checkbox"/> 303(d) <input type="checkbox"/> Antideg <input type="checkbox"/> ECO <input type="checkbox"/> FECO Other: <u>M34</u>		

Project ID: TNPR

Activity Type: Sample QC Sample Habitat QC habitat QC ID

Sample Status: Collected Seasonally Dry Frequently Dry No Channel
 Too Deep (Not Wadeable) Too Deep (Temporary) Permanent Barrier Fenced
 Landowner Denial: Temporary Barrier Posted Plan to revisit? Yes No

Flow Conditions: Dry Isolated Pools Stagnant Low Moderate High Bankful Flooding

Sample	Collected?	Comment	Sample	Collected?	Comment
Biorecon			Periphyton		
SQKICK	<input checked="" type="checkbox"/>		Other		
SQBANK			Describe Other Sample:		

Chemicals/Bacteria: None Routine Nutrient Metals E. coli Organics Other _____

Field Parameters: Meter(s) Used: YSI Pro Plus

pH (su)	<u>8.81</u>	Dissolved Oxygen %	<u>160.6</u>
Conductivity (umhos)	<u>360.7</u>	Turbidity (NTU)	
Temperature (C°)	<u>13.7</u>	TDS (mg/L)	
Dissolved Oxygen (ppm = mg/L)	<u>16.98</u>	Flow (cfs)	<u>1.40</u>

Meter Problems? No

Photos Taken? No Yes: Description: 11 u/s 12 d/s

Previous 48 hours precipitation: Unknown None Slight Moderate Heavy Flooding

Air Temperature (°F) 48

Physical Characteristics & Light Penetration:

Gradient (sample reach): Flat Low Moderate High Cascades

Average Stream Width: Very Small (<1.5yd) Small (1.5-3yd) Med. (3-10yd) Large (10-25yd) Very Large (>25yd)

Maximum Stream Depth: Shallow (<0.3yd) Medium (0.3-0.6yd) Deep (0.6 - 1yd) Very Deep (>1yd)

% Canopy Cover Estimated for Reach: 40 %

% Canopy Cover Measured (mid-reach): 25 u/s + 70 d/s + 50 LDB + 58 RDB = Total/384*100

Channel Characteristics:

Bank Height: 0.5-1.5 (yd.) High Water Mark: 1.5 (yd.)

Bank Slope LDB: Deeply incised Bluff/Wall Undercut Sloughing Steep terrain Gentle Slope

Bank Slope RDB: Deeply incised Bluff/Wall Undercut Sloughing Steep terrain Gentle Slope

Manmade Modification: None Rip-Rap Cement Gabions Channelized Dam Dredging Bridge ATV

Stream Characteristics:

Sediment Deposits: None Slight Moderate Excessive Blanket

Sediment Type: None Sand Silt Mud Clay Sludge Mn Precipitant Orange Flocculent

Turbidity: Clear Slightly Turbid Muddy Milky Tannic Planktonic Algae Dyed

Foam/Surface Sheen: None Nutrient Surfactant Bacteria

Algae: None Slight Moderate High Choking Type: Diatoms Green Filamentous Blue-green

TDEC-DWR Stream Survey Field Sheet (Back)

DWR Station ID: Holt Creek Date: 4/1/19 Assessors: Liggett/Duke

Dominate Substrate: (More than 25%) Check all that apply

- | Riffle | Run | Pool |
|---|---|---|
| <input type="checkbox"/> Boulders (>10") | <input type="checkbox"/> Boulders (>10") | <input type="checkbox"/> Boulders (>10") |
| <input checked="" type="checkbox"/> Cobble (2.5-10") | <input checked="" type="checkbox"/> Cobble (2.5-10") | <input checked="" type="checkbox"/> Cobble (2.5-10") |
| <input checked="" type="checkbox"/> Gravel (0.1-2.5") | <input checked="" type="checkbox"/> Gravel (0.1-2.5") | <input checked="" type="checkbox"/> Gravel (0.1-2.5") |
| <input checked="" type="checkbox"/> Bedrock | <input checked="" type="checkbox"/> Bedrock | <input checked="" type="checkbox"/> Bedrock |
| <input type="checkbox"/> Sand | <input type="checkbox"/> Sand | <input type="checkbox"/> Sand |
| <input type="checkbox"/> Silt (not gritty) | <input type="checkbox"/> Silt (not gritty) | <input checked="" type="checkbox"/> Silt (not gritty) |
| <input type="checkbox"/> Clay (Slick) | <input type="checkbox"/> Clay (Slick) | <input type="checkbox"/> Clay (Slick) |

Surrounding Land Uses (list additional land uses under comments)

- | | | | | |
|-------------------------------------|-------------------------------------|---|---|---------------------------------------|
| <input type="checkbox"/> Forest | <input type="checkbox"/> Grazing | <input type="checkbox"/> Stormwater | <input type="checkbox"/> STP/WWTP | <input type="checkbox"/> Construction |
| <input type="checkbox"/> Wetland | <input type="checkbox"/> Row Crops | <input type="checkbox"/> Urban | <input type="checkbox"/> Industry | <input type="checkbox"/> Impoundment |
| <input type="checkbox"/> Park | <input type="checkbox"/> CAFO/Dairy | <input type="checkbox"/> Commercial | <input type="checkbox"/> Mining/Dredging | <input type="checkbox"/> ATV/OHV |
| <input type="checkbox"/> Hay/Fields | <input type="checkbox"/> Logging | <input checked="" type="checkbox"/> Residential | <input checked="" type="checkbox"/> Road/Hwy/RR | <input type="checkbox"/> Golf Course |

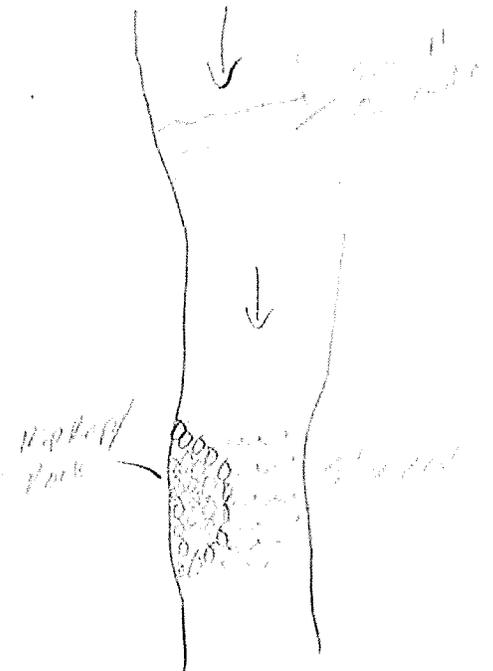
Observed Human Disturbance to Stream: Blank (not observed) S (Slight) M (Moderate) H (High)

Disturbance Type	#	Logging	Industry	ATV/OHV
Riparian Loss				
Channelization		Urban	Mining/ Dredging	Golf Course
Active Grazing		Commercial	Road/Hwy/RR	S Garbage/Trash
Row Crops		Residential	H Construction	Landfill
CAFO/Dairy		STP/WWTP	Impoundment	Water Withdrawal

Other Stream Information and Stressors:

Stream Sketch: (include road name or landmark, flow direction, reach distance, distance from bridge or road, sampling points, tributaries, outfalls, livestock access, riparian, potential impacts, north arrow, immediate land use, buildings, etc.) Use additional sheet if necessary.

Distance	Depth	Flow
1	.2	0 SW
3	.9	.02
5	.9	.01
7	.85	.01
9	.90	.12
11	.90	.26
13	.90	.32
15	.80	.04
17	0	0 SW



HABITAT ASSESSMENT FIELD DATA SHEET – MODERATE TO HIGH GRADIENT STREAM (FRONT)

(Refer to Protocol E for detailed descriptions and rank information)

PROJECT: City of Brentwood MS4 Benthic Sampling		HABITAT ASSESSED BY: C.L. / C.D.	
STA: Holt Creek @ Northwoods Ct.		DATE: 4-1-2014	TIME: 1:00
STREAM NAME: Holt Creek		ECOREGION:	
MAP LABEL:		QC: Consensus / Duplicate	
HUC:			

	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
1. Epifaunal Substrate / Available Cover	Over 70% of stream reach has natural stable habitat suitable for colonization by fish and/or macroinvertebrates. Four or more productive habitats are present.	Natural stable habitat covers 40-70% of stream reach. Three or more productive habitats present. (If near 70% and more than 3 go to optimal.)	Natural stable habitat covers 20 -40% of stream reach or only 1-2 productive habitats present. (If near 40% and more than 2 go to suboptimal.)	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments:				
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
2. Embeddedness of Riffles	Gravel, cobble, and boulders 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. If near 25% drop to suboptimal if riffle not layered cobble.	Gravel, cobble and boulders 25-50% surrounded by fine sediment. Niches in bottom layers of cobble compromised. If near 50% & riffles not layered cobble drop to marginal.	Gravel, cobble, and boulders are 50-75% surrounded by fine sediment. Niche space in middle layers of cobble is starting to fill with fine sediment.	Gravel, cobble, and boulders are more than 75% surrounded by fine sediment. Niche space is reduced to a single layer or is absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments:				
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
3. Velocity/ Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow).	Only 3 of the 4 regimes present (if fast-shallow is missing score lower). If slow-deep missing score 15.	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime. Others regimes too small or infrequent to support aquatic populations.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments:				
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
4. Sediment Deposition	Sediment deposition affects less than 5% of stream bottom in quiet areas. New deposition on islands and point bars is absent or minimal.	Sediment deposition affects 5-30% of stream bottom. Slight deposition in pool or slow areas. Some new deposition on islands and point bars. Move to marginal if build-up approaches 30%.	Sediment deposition affects 30-50% of stream bottom. Sediment deposits at obstruction, constrictions and bends. Moderate pool deposition.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments:				
	OPTIMAL	SUBOPTIMAL	MARGINAL	POOR
5. Channel Flow Status	Water reaches base of both lower banks and streambed is covered by water throughout reach. Minimal productive habitat is exposed.	Water covers > 75% of streambed or 25% of productive habitat is exposed.	Water covers 25-75% of streambed and/or productive habitat is mostly exposed.	Very little water in channel and mostly present as standing pools. Little or no productive habitat due to lack of water.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Comments:				

HABITAT ASSESSMENT FIELD DATA SHEET – MODERATE TO HIGH GRADIENT STREAM (BACK)

MAP LABEL:			DATE:					ASSESSOR INITIALS:												
	OPTIMAL					SUBOPTIMAL					MARGINAL					POOR				
6. Channel Alteration	Channelization, dredging rock removal or 4-wheel activity (past or present) absent or minimal; natural meander pattern. NO artificial structures in reach. Upstream or downstream structures do not affect reach.					Channelization, dredging or 4-wheel activity up to 40%. Channel has stabilized. If larger reach, channelization is historic and stable. Artificial structures in or out of reach do not affect natural flow patterns.					Channelization, dredging or 4-wheel activity 40-80% (or less that has not stabilized.) Artificial structures in or out of reach may have slight affect.					Over 80% of reach channelized, dredged or affected by 4-wheelers. In-stream habitat greatly altered or removed. Artificial structures have greatly affected flow pattern.				
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				
	OPTIMAL					SUBOPTIMAL					MARGINAL					POOR				
7. Frequency of re-oxygenation zones. Use frequency of riffles or bends for category. Rank by quality.	Occurrence of re-oxygenation zones relatively frequent; ratio of distance between areas divided by average stream width <7:1.					Occurrence of re-oxygenation zones infrequent; distance between areas divided by average stream width is 7 - 15.					Occasional re-oxygenation area. The distance between areas divided by average stream width is over 15 and up to 25.					Generally all flat water or flat bedrock; little opportunity for re-oxygenation. Distance between areas divided by average stream width >25.				
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				
	OPTIMAL					SUBOPTIMAL					MARGINAL					POOR				
8. Bank Stability (score each bank) Determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems <5% of bank affected.					Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. If approaching 30% score marginal if banks steep.					Moderately unstable; 30-60 % of bank in reach has areas of erosion; high erosion potential during floods, if approaching 60% score poor if banks steep.					Unstable; many eroded area; raw areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.				
SCORE (LDB)	LEFT	10	9			8	7	6			5	4	3			2	1	0		
SCORE (RDB)	RIGHT	10	9			8	7	6			5	4	3			2	1	0		
Comments:																				
	OPTIMAL					SUBOPTIMAL					MARGINAL					POOR				
9. Bank Vegetative Protection (score each bank) include vegetation from top of bank to base of bank. Determine left or right side by facing downstream.	More than 90% of the bank covered by undisturbed vegetation. All 4 classes (mature trees, understory trees, shrubs, groundcover) are represented and allowed to grow naturally. All plants are native.					70-90% of the bank covered by undisturbed vegetation. One class may not be well represented. Disruption evident but not effecting full plant growth. Non-natives are rare (< 30%).					50-70% of the bank covered by undisturbed vegetation. Two classes of vegetation may not be well represented. Non-native vegetation may be common (30-50%).					Less than 50% of the banks covered by undisturbed vegetation or more than 2 classes are not well represented or most vegetation has been cropped. Non-native vegetation may dominate (> 50%).				
SCORE (LDB)	LEFT	10	9			8	7	6			5	4	3			2	1	0		
SCORE (RDB)	RIGHT	10	9			8	7	6			5	4	3			2	1	0		
Comments:																				
	OPTIMAL					SUBOPTIMAL					MARGINAL					POOR				
10. Riparian Vegetative Zone Width (score each bank.) Zone begins at top of bank.	Average width of riparian zone > 18 meters. Unpaved footpaths may score 9 if run-off potential is negligible.					Average width of riparian zone 12-18 meters. Score high if areas < 18 meters are small or are minimally disturbed.					Average width of riparian zone 6-11 meters. Score high if areas less than 12 meters are small or are minimally disturbed.					Average width of riparian zone <6 meters. Score high if areas less than 6 meters are small or are minimally disturbed.				
SCORE (LDB)	LEFT	10	9			8	7	6			5	4	3			2	1	0		
SCORE (RDB)	RIGHT	10	9			8	7	6			5	4	3			2	1	0		
Comments:																				
TOTAL SCORE X 101					Comparison to Ecoregion Guidelines (circle): ABOVE or BELOW															
If score is below guidelines, result of (circle)										Natural Conditions					Human Disturbance					
Comments:																				

STREAM SURVEY INFORMATION

DWR Station ID: <u>N/A</u>	Samplers: <u>C. Dike, C. Liggett</u>	
Monitoring Location Name: <u>Spencer creek</u>	Date: <u>4/1/19</u>	Time: <u>3:30 PM</u>
Monitoring Location: <u>Spencer creek (day branch)</u>	Organization: <u>C.E.C.</u>	Drainage Area: <u>0.73 mi²</u>
County: <u>Williamson</u>	Ecoregion: <u>71h</u>	u/s ECO:
Latitude: <u>35.971427</u>	HUC: <u>051302040601</u>	WS Grp:
Longitude: <u>-86.833533</u>	WBID:	Field Log #:

Project Name: Watershed 303(d) Antideg ECO FECO Other: MS4

Project ID: TNPR

Activity Type: Sample QC Sample Habitat QC habitat QC ID

Sample Status: <input type="checkbox"/> Collected <input type="checkbox"/> Seasonally Dry <input type="checkbox"/> Frequently Dry <input type="checkbox"/> No Channel <input type="checkbox"/> Too Deep (Not Wadeable) <input type="checkbox"/> Too Deep (Temporary) <input type="checkbox"/> Permanent Barrier <input type="checkbox"/> Fenced <input type="checkbox"/> Landowner Denial: <input type="checkbox"/> Temporary Barrier <input type="checkbox"/> Posted Plan to revisit? <input type="checkbox"/> Yes <input type="checkbox"/> No
Flow Conditions: <input type="checkbox"/> Dry <input type="checkbox"/> Isolated Pools <input type="checkbox"/> Stagnant <input checked="" type="checkbox"/> Low <input type="checkbox"/> Moderate <input type="checkbox"/> High <input type="checkbox"/> Bankful <input type="checkbox"/> Flooding

Sample	Collected?	Comment	Sample	Collected?	Comment
Biorecon			Periphyton		
SQKICK	<u>Yes</u>	<u>SQ Kick</u>	Other		
SQBANK			Describe Other Sample:		

Chemicals/Bacteria: None Routine Nutrient Metals E. coli Organics Other _____

Field Parameters: Meter(s) Used: VSI Pro Plus

pH (su)	<u>7.77</u>	Dissolved Oxygen %	<u>112.4</u>
Conductivity (umhos)	<u>302.7</u>	Turbidity (NTU)	
Temperature (C°)	<u>15.05</u>	TDS (mg/L)	
Dissolved Oxygen (ppm = mg/L)	<u>11.41</u>	Flow (cfs)	<u>0.18</u>

Meter Problems? No

Photos Taken? No Yes: Description: 13 + 14

Previous 48 hours precipitation: Unknown None Slight Moderate Heavy Flooding

Air Temperature (°F) 52

Physical Characteristics & Light Penetration:

Gradient (sample reach): <input type="checkbox"/> Flat <input type="checkbox"/> Low <input checked="" type="checkbox"/> Moderate <input type="checkbox"/> High <input type="checkbox"/> Cascades
Average Stream Width: <input type="checkbox"/> Very Small (<1.5yd) <input checked="" type="checkbox"/> Small (1.5-3yd) <input type="checkbox"/> Med. (3-10yd) <input type="checkbox"/> Large (10-25yd) <input type="checkbox"/> Very Large (>25yd)
Maximum Stream Depth: <input type="checkbox"/> Shallow (<0.3yd) <input checked="" type="checkbox"/> Medium (0.3-0.6yd) <input type="checkbox"/> Deep (0.6 - 1yd) <input type="checkbox"/> Very Deep(>1yd)
% Canopy Cover Estimated for Reach: <u>70</u> %
% Canopy Cover Measured (mid-reach): <u>50</u> u/s + <u>80</u> d/s + <u>60</u> LDB + <u>60</u> RDB = Total/384*100

Channel Characteristics:

Bank Height: <u>1-3</u> (yd.) High Water Mark: <u>15-1</u> (yd.)
Bank Slope LDB: <input type="checkbox"/> Deeply incised <input type="checkbox"/> Bluff/Wall <input checked="" type="checkbox"/> Undercut <input type="checkbox"/> Sloughing <input type="checkbox"/> Steep terrain <input type="checkbox"/> Gentle Slope
Bank Slope RDB: <input type="checkbox"/> Deeply incised <input type="checkbox"/> Bluff/Wall <input type="checkbox"/> Undercut <input type="checkbox"/> Sloughing <input type="checkbox"/> Steep terrain <input checked="" type="checkbox"/> Gentle Slope
Manmade Modification: <input type="checkbox"/> None <input type="checkbox"/> Rip-Rap <input type="checkbox"/> Cement <input type="checkbox"/> Gabions <input type="checkbox"/> Channelized <input type="checkbox"/> Dam <input type="checkbox"/> Dredging <input checked="" type="checkbox"/> Bridge <input type="checkbox"/> ATV

Stream Characteristics:

Sediment Deposits: <input type="checkbox"/> None <input type="checkbox"/> Slight <input checked="" type="checkbox"/> Moderate <input type="checkbox"/> Excessive <input type="checkbox"/> Blanket
Sediment Type: <input type="checkbox"/> None <input type="checkbox"/> Sand <input checked="" type="checkbox"/> Silt <input type="checkbox"/> Mud <input type="checkbox"/> Clay <input type="checkbox"/> Sludge <input type="checkbox"/> Mn Precipitant <input type="checkbox"/> Orange Flocculent
Turbidity: <input type="checkbox"/> Clear <input checked="" type="checkbox"/> Slightly Turbid <input type="checkbox"/> Muddy <input type="checkbox"/> Milky <input type="checkbox"/> Tannic <input type="checkbox"/> Planktonic Algae <input type="checkbox"/> Dyed
Foam/Surface Sheen: <input checked="" type="checkbox"/> None <input type="checkbox"/> Nutrient <input type="checkbox"/> Surfactant <input type="checkbox"/> Bacteria
Algae: <input type="checkbox"/> None <input type="checkbox"/> Slight <input checked="" type="checkbox"/> Moderate <input type="checkbox"/> High <input type="checkbox"/> Choking Type: <input type="checkbox"/> Diatoms <input checked="" type="checkbox"/> Green <input checked="" type="checkbox"/> Filamentous <input type="checkbox"/> Blue-green

TDEC-DWR Stream Survey Field Sheet (Back)

DWR Station ID: Spencer Creek Date: 4/1/19 Assessors: Leggett/Duke

Dominate Substrate: (More than 25%) Check all that apply

- | Riffle | Run | Pool |
|---|---|---|
| <input type="checkbox"/> Boulders (>10") | <input type="checkbox"/> Boulders (>10") | <input type="checkbox"/> Boulders (>10") |
| <input type="checkbox"/> Cobble (2.5-10") | <input checked="" type="checkbox"/> Cobble (2.5-10") | <input checked="" type="checkbox"/> Cobble (2.5-10") |
| <input checked="" type="checkbox"/> Gravel (0.1-2.5") | <input checked="" type="checkbox"/> Gravel (0.1-2.5") | <input checked="" type="checkbox"/> Gravel (0.1-2.5") |
| <input type="checkbox"/> Bedrock | <input type="checkbox"/> Bedrock | <input type="checkbox"/> Bedrock |
| <input type="checkbox"/> Sand | <input type="checkbox"/> Sand | <input type="checkbox"/> Sand |
| <input type="checkbox"/> Silt (not gritty) | <input type="checkbox"/> Silt (not gritty) | <input type="checkbox"/> Silt (not gritty) |
| <input type="checkbox"/> Clay (Slick) | <input type="checkbox"/> Clay (Slick) | <input type="checkbox"/> Clay (Slick) |

Surrounding Land Uses (list additional land uses under comments)

- | | | | | |
|-------------------------------------|-------------------------------------|---|---|--|
| <input type="checkbox"/> Forest | <input type="checkbox"/> Grazing | <input type="checkbox"/> Stormwater | <input type="checkbox"/> STP/WWTP | <input checked="" type="checkbox"/> Construction |
| <input type="checkbox"/> Wetland | <input type="checkbox"/> Row Crops | <input type="checkbox"/> Urban | <input type="checkbox"/> Industry | <input type="checkbox"/> Impoundment |
| <input type="checkbox"/> Park | <input type="checkbox"/> CAFO/Dairy | <input checked="" type="checkbox"/> Commercial | <input type="checkbox"/> Mining/Dredging | <input type="checkbox"/> ATV/OHV |
| <input type="checkbox"/> Hay/Fields | <input type="checkbox"/> Logging | <input checked="" type="checkbox"/> Residential | <input checked="" type="checkbox"/> Road/Hwy/RR | <input type="checkbox"/> Golf Course |

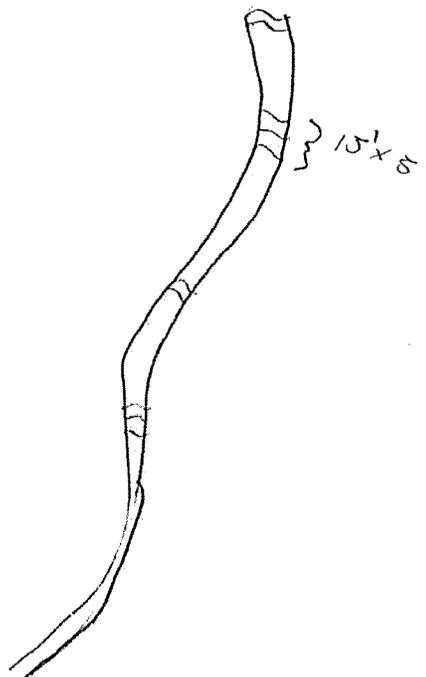
Observed Human Disturbance to Stream: Blank (not observed) S (Slight) M (Moderate) H (High)

Riparian Loss	Logging	Industry	ATV/OHV
	Urban	Mining/ Dredging	Golf Course
Active Grazing	Commercial	M Road/Hwy/RR	M Garbage/Trash
Row Crops	Residential	S Construction	S Landfill
CAFO/Dairy	STP/WWTP	Impoundment	Water Withdrawal

Other Stream Information and Stressors:

Stream Sketch: (include road name or landmark, flow direction, reach distance, distance from bridge or road, sampling points, tributaries, outfalls, livestock access, riparian, potential impacts, north arrow, immediate land use, buildings, etc.) Use additional sheet if necessary.

Dist.	Depth	Flow
6	0	0
6.5	0	0
7	.05	0
7.5	.20	.14
8	.20	.23
8.5	.20	.31
9	.25	.36
9.5	.20	.37
10	.22	.27
10.5	.15	.05
11	.10	.02
11.5	.10	.01
12	.05	0
12.5	0	0



HABITAT ASSESSMENT FIELD DATA SHEET – MODERATE TO HIGH GRADIENT STREAM (FRONT)

(Refer to Protocol E for detailed descriptions and rank information)

PROJECT: City of Brentwood MS4 Benbow Sampling		HABITAT ASSESSED BY: C.D. ; C.L.																		
STA: Spencer Creek @ Old Branch		DATE: 4/1/19							TIME: 3:30											
STREAM NAME: Spencer Creek @ Old Branch		ECOREGION:																		
MAP LABEL:		QC: Consensus / Duplicate																		
HUC:																				
	OPTIMAL	SUBOPTIMAL					MARGINAL					POOR								
1. Epifaunal Substrate / Available Cover	Over 70% of stream reach has natural stable habitat suitable for colonization by fish and/or macroinvertebrates. Four or more productive habitats are present.	Natural stable habitat covers 40-70% of stream reach. Three or more productive habitats present. (If near 70% and more than 3 go to optimal.)					Natural stable habitat covers 20 -40% of stream reach or only 1-2 productive habitats present. (If near 40% and more than 2 go to suboptimal.)					Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.								
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				
	OPTIMAL	SUBOPTIMAL					MARGINAL					POOR								
2. Embeddedness of Riffles	Gravel, cobble, and boulders 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. If near 25% drop to suboptimal if riffle not layered cobble.	Gravel, cobble and boulders 25-50% surrounded by fine sediment. Niches in bottom layers of cobble compromised. If near 50% & riffles not layered cobble drop to marginal.					Gravel, cobble, and boulders are 50-75% surrounded by fine sediment. Niche space in middle layers of cobble is starting to fill with fine sediment.					Gravel, cobble, and boulders are more than 75% surrounded by fine sediment. Niche space is reduced to a single layer or is absent.								
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				
	OPTIMAL	SUBOPTIMAL					MARGINAL					POOR								
3. Velocity/ Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow).	Only 3 of the 4 regimes present (if fast-shallow is missing score lower). If slow-deep missing score 15.					Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).					Dominated by 1 velocity/depth regime. Others regimes too small or infrequent to support aquatic populations.								
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				
	OPTIMAL	SUBOPTIMAL					MARGINAL					POOR								
4. Sediment Deposition	Sediment deposition affects less than 5% of stream bottom in quiet areas. New deposition on islands and point bars is absent or minimal.	Sediment deposition affects 5-30% of stream bottom. Slight deposition in pool or slow areas. Some new deposition on islands and point bars. Move to marginal if build-up approaches 30%.					Sediment deposition affects 30-50% of stream bottom. Sediment deposits at obstruction, constrictions and bends. Moderate pool deposition.					Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.								
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				
	OPTIMAL	SUBOPTIMAL					MARGINAL					POOR								
5. Channel Flow Status	Water reaches base of both lower banks and streambed is covered by water throughout reach. Minimal productive habitat is exposed.	Water covers > 75% of streambed or 25% of productive habitat is exposed.					Water covers 25-75% of streambed and/or productive habitat is mostly exposed.					Very little water in channel and mostly present as standing pools. Little or no productive habitat due to lack of water.								
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Comments:																				

HABITAT ASSESSMENT FIELD DATA SHEET – MODERATE TO HIGH GRADIENT STREAM (BACK)

MAP LABEL:		DATE:										ASSESSOR INITIALS:									
6. Channel Alteration	OPTIMAL	Channelization, dredging rock removal or 4-wheel activity (past or present) absent or minimal; natural meander pattern. NO artificial structures in reach. Upstream or downstream structures do not affect reach.					SUBOPTIMAL					MARGINAL					POOR				
		Channelization, dredging or 4-wheel activity up to 40%. Channel has stabilized. If larger reach, channelization is historic and stable. Artificial structures in or out of reach do not affect natural flow patterns.					Channelization, dredging or 4-wheel activity 40-80% (or less that has not stabilized.) Artificial structures in or out of reach may have slight affect.					Over 80% of reach channelized, dredged or affected by 4-wheelers. In-stream habitat greatly altered or removed. Artificial structures have greatly affected flow pattern.									
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
Comments:																					
7. Frequency of re-oxygenation zones. Use frequency of riffles or bends for category Rank by quality.	OPTIMAL	Occurrence of re-oxygenation zones relatively frequent; ratio of distance between areas divided by average stream width <7:1.					SUBOPTIMAL					MARGINAL					POOR				
		Occurrence of re-oxygenation zones infrequent; distance between areas divided by average stream width is 7 - 15.					Occasional re-oxygenation area. The distance between areas divided by average stream width is over 15 and up to 25.					Generally all flat water or flat bedrock; little opportunity for re-oxygenation. Distance between areas divided by average stream width >25.									
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
Comments:																					
8. Bank Stability (score each bank) Determine left or right side by facing downstream.	OPTIMAL	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems <5% of bank affected.					SUBOPTIMAL					MARGINAL					POOR				
		Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. If approaching 30% score marginal if banks steep.					Moderately unstable; 30-60 % of bank in reach has areas of erosion; high erosion potential during floods, If approaching 60% score poor if banks steep.					Unstable; many eroded area; raw areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.									
SCORE (LDB)	LEFT	10	9			8	7	6			5	4	3			2	1	0			
SCORE (RDB)	RIGHT	10	9			8	7	6			5	4	3			2	1	0			
Comments:																					
9. Bank Vegetative Protection (score each bank) include vegetation from top of bank to base of bank. Determine left or right side by facing downstream.	OPTIMAL	More than 90% of the bank covered by undisturbed vegetation. All 4 classes (mature trees, understory trees, shrubs, groundcover) are represented and allowed to grow naturally. All plants are native.					SUBOPTIMAL					MARGINAL					POOR				
		70-90% of the bank covered by undisturbed vegetation. One class may not be well represented. Disruption evident but not effecting full plant growth. Non-natives are rare (< 30%).					50-70% of the bank covered by undisturbed vegetation. Two classes of vegetation may not be well represented. Non-native vegetation may be common (30-50%).					Less than 50% of the banks covered by undisturbed vegetation or more than 2 classes are not well represented or most vegetation has been cropped. Non-native vegetation may dominate (> 50%).									
SCORE (LDB)	LEFT	10	9			8	7	6			5	4	3			2	1	0			
SCORE (RDB)	RIGHT	10	9			8	7	6			5	4	3			2	1	0			
Comments:																					
10. Riparian Vegetative Zone Width (score each bank.) Zone begins at top of bank.	OPTIMAL	Average width of riparian zone > 18 meters. Unpaved footpaths may score 9 if run-off potential is negligible.					SUBOPTIMAL					MARGINAL					POOR				
		Average width of riparian zone 12-18 meters. Score high if areas < 18 meters are small or are minimally disturbed.					Average width of riparian zone 6-11 meters. Score high if areas less than 12 meters are small or are minimally disturbed.					Average width of riparian zone <6 meters. Score high if areas less than 6 meters are small or are minimally disturbed.									
SCORE (LDB)	LEFT	10	9			8	7	6			5	4	3			2	1	0			
SCORE (RDB)	RIGHT	10	9			8	7	6			5	4	3			2	1	0			
Comments:																					
TOTAL SCORE		86																			
Comparison to Ecoregion Guidelines (circle) -- ABOVE or BELOW																					
If score is below guidelines, result of (circle)																					
(Natural Conditions)										(Human Disturbance)											
Comments:																					

APPENDIX C
TAXA LIST

CEC, CITY OF BRENTWOOD, WILLIAMSON CO., TN, BENTHIC MACROINVERTEBRATES COLLECTED 3/29-4/1/2019.

PAI ID NO				52194	52195	52196	52197	52198	52199	52200
STATION			UT 0300	UT 0200	Little Harpeth	Owl Creek	Beech Creek	Holt Creek	Spencer Creek	
DATE			3/29/2019	3/29/2019	3/29/2019	3/29/2019	4/1/2019	4/1/2019	4/1/2019	4/1/2019
FRACTION			1/32	1/30	1/32	1/64	3/128	1/15	1/30	
SPECIES	T.V.	F.F.G.	CL							
Insecta										
Ephemeroptera										
Baetidae	6	CG								
<i>Acentrella</i> sp.	2.5	CG	49	9	7	19	11			5
<i>Acerpenna</i> sp.	3.7	CG						2		
<i>Baetis</i> sp.	6	CG	4	4			2	1		
<i>Diphetor</i> sp.	1.2	CG	7	7	2	5	1	5		1
Caenidae	6	CG								
<i>Caenis</i> sp.	6.8	CG			3	2	1	1		
Heptageniidae	3	SC	CL							
<i>Maccaffertium</i> sp.	3.1	SC	CL			5	7	1		
<i>Stenacron</i> sp.	3.5	SC	CL	1						
Isonychiidae	3.6	FC								
<i>Isonychia</i> sp.	3.6	FC				2	2			
Odonata										
Coenagrionidae	8	P								
<i>Argia</i> sp.	8.3	P						2		
Plecoptera										
Capniidae	3	SH				1				
<i>Allocapnia</i> sp.	3.3	SH			1					
Perlidae	2	P	CL							
<i>Perlesta</i> sp.	2.9	P	CL			4				
Perlodidae	2.2	P	CL							
<i>Isoptera</i> sp.	3.2	P	CL	4		1	2			9
Trichoptera										
Hydropsychidae	4.1	FC	CL							

CEC, CITY OF BRENTWOOD, WILLIAMSON CO., TN, BENTHIC MACROINVERTEBRATES COLLECTED 3/29-4/1/2019.

PAI ID NO			52194	52195	52196	52197	52198	52199	52200
STATION			UT 0300	UT 0200	Little Harpeth	Owl Creek	Beech Creek	Holt Creek	Spencer Creek
DATE			3/29/2019	3/29/2019	3/29/2019	3/29/2019	4/1/2019	4/1/2019	4/1/2019
FRACTION			1/32	1/30	1/32	1/64	3/128	1/15	1/30
SPECIES	T.V.	F.F.G.	CL						
<i>Cheumatopsyche sp.</i>		FC	CL		1	4	1	4	
<i>Hydropsyche</i>	4.3	FC	CL					1	
<i>Hydroptilidae</i>	5.55	PI							
<i>Hydroptilia sp.</i>	6.5	PI	CL	6		3	1	3	
<i>Ochrotrichia sp.</i>	4	PI	CL			10	4		
<i>Philopotamidae</i>	2.2	FC	CL						
<i>Chimarra sp.</i>	3.3	FC	CL			1	7	2	7
Coleoptera									
<i>Elmidae</i>	4.41	CG	CL						
<i>Dubiraphia sp.</i>	5.5	SC	CL						1
<i>Microcyloopus sp.</i>	3.3	SC	CL					1	
<i>Opioservus sp.</i>	2.1	SC	CL						1
<i>Stenelmis sp.</i>	5.60	SC	CL	24	2	28	22	8	15
<i>Psephenidae</i>	3.3	SC	CL						
<i>Psephenus sp.</i>	2.3	SC	CL	8		5	2	1	5
Diptera									
<i>Ceratopogonidae</i>	6.8	P				1	1	2	
<i>Bezzia/Palpomylia gp.</i>	6	P				1			
<i>Chironomidae</i>									
<i>Ablabesmyia sp.</i>	7.1	P			1				
<i>Britlia flavifrons</i>	5.7	SH					1		
<i>Cardiocladius sp.</i>	6.2	P						1	
<i>Conchapelopia sp.</i>	8.4	P		4	1	4	4	2	27
<i>Corynoneura sp.</i>	5.7	CG		2	1		1	1	1
<i>Cricotopus sp.</i>	7.44	CG	CL	7	71	16	92	18	129
<i>Cryptochironomus sp.</i>	6.4	P						1	

CEC, CITY OF BRENTWOOD, WILLIAMSON CO., TN, BENTHIC MACROINVERTEBRATES COLLECTED 3/29-4/1/2019.

PAI ID NO				52194	52195	52196	52197	52198	52199	52200
STATION			UT 0300	UT 0200	Little Harpeth	Owl Creek	Beech Creek	Holt Creek	Spencer Creek	
DATE			3/29/2019	3/29/2019	3/29/2019	3/29/2019	4/1/2019	4/1/2019	4/1/2019	4/1/2019
FRACTION			1/32	1/30	1/32	1/64	3/128	1/15	1/30	
SPECIES	T.V.	F.F.G.	CL							
<i>Diamesa sp.</i>	6.6	CG	CL							1
<i>Dicrotendipes sp.</i>	7.2	CG								1
<i>Eukiefferiella sp.</i>	3.45	CG	31	34	6	11	9	27	8	
<i>Micropsectra sp.</i>	2.4	CG		1						
<i>Microtendipes sp.</i>	4.6	CG	CL		1					
<i>Nilotanytus sp.</i>	4.1	P		1			4			2
<i>Orthocladus sp.</i>	4.4	CG		9	14	27	6	5		1
<i>Parakiefferiella sp.</i>	4.8	CG		4						
<i>Paramerina sp.</i>	4.1	P				1				
<i>Parametrioconemus sp.</i>	3.9	CG	6	2	2				9	
<i>Paratanytarsus sp.</i>	8	CG	1	4	1				1	
<i>Paratendipes sp.</i>	5.6				3					
<i>Polypedilum sp.</i>	6.1	SH	24	32	14	23	21	81	2	
<i>Pothastia sp.</i>	5.4	CG				1				
<i>Rheocricotopus sp.</i>	4.7	CG								1
<i>Rheotanytarsus sp.</i>	6.5	FC	CL	3		3				
<i>Stempellinella sp.</i>	5.6	CG				1				
<i>Tanytarsus sp.</i>	6.6	FC		3	2					
<i>Thienemanniella sp.</i>	6.4	CG	1	1	2					
<i>Tribelos sp.</i>	6.4	CG				1				
<i>Tvetenia sp.</i>	3.55	CG	10	2	6		2	2		
Empididae	7.6	P								
<i>Hemerodromia sp.</i>	6	P								
Simuliidae	4.7	FC	CL							
<i>Prosimulium sp.</i>	4.5	FC	CL						3	
<i>Simulium sp.</i>	4.9	FC	CL	4		1	17		14	4

CEC, CITY OF BRENTWOOD, WILLIAMSON CO., TN, BENTHIC MACROINVERTEBRATES COLLECTED 3/29-4/1/2019.

PAID NO	52194	52195	52196	52197	52198	52199	52200
STATION	UT 0300	UT 0200	Little Harpeth	Owl Creek	Beech Creek	Holt Creek	Spencer Creek
DATE	3/29/2019	3/29/2019	3/29/2019	3/29/2019	4/1/2019	4/1/2019	4/1/2019
FRACTION	1/32	1/30	1/32	1/64	3/128	1/15	1/30
SPECIES	T.V.	F.F.G.	CL				
TOTAL NO. OF ORGANISMS	231	168	160	187	204	204	221
TOTAL NO. OF TAXA	23	19	24	32	24	29	19
EPT	6	3	5	12	11	9	4
%OC	41.56%	83.93%	85.63%	35.83%	68.14%	70.59%	77.83%
%EPT-CHEUM	30.74%	11.90%	8.13%	28.34%	18.63%	7.84%	9.95%
NCBI	4.54	5.26	5.93	4.93	5.93	5.35	6.57
%TNUTOL	35.50%	44.64%	59.38%	41.71%	67.16%	59.31%	66.52%
% CLINGERS-CHEUM	21.65%	27.98%	46.88%	51.34%	67.16%	24.02%	77.83%



April 24, 2019

Mr. Mike Harris, P.E.
Director of Engineering
City of Brentwood
P.O. Box 788
Brentwood, TN 37024

Dear Mr. Harris:

Subject: 2019 Visual Stream Assessment (VSA)
MS4 Permit – Non-Analytical Stream Monitoring
City of Brentwood, Williamson County, Tennessee
CEC Project 174-840.0002

Civil & Environmental Consultants, Inc. (CEC) performed a Visual Stream Assessment (VSA) on two Unnamed Tributaries to the Little Harpeth River (TN05130204021_0200 & TN05130204021_0300) for the City of Brentwood (City) according to Task 3 from our October 2, 2018 proposal.

All visual survey locations have been logged into a geodatabase. Each location includes completed data fields, GPS location, and a photo. The geodatabase is included on the USB flash drive.

The total mileage assessed for each stream is included in the following table.

Permit Year 3 Streams for Assessment	Mileage
Unnamed Tributary to the Little Harpeth River (TN05130204021_0200)	2.5
Unnamed Tributary to the Little Harpeth River (TN05130204021_0300)	4.9
Total	7.4

There were a few locations of concern that CEC wanted to bring to the City's attention. These locations are described below:

1) Channel Alteration near Wilson Pike

Sections of the Concrete Masonry Unit (CMU) retaining wall appear to be falling. CEC wanted to bring this to the attention of the City and recommends that the City inspect the channel section near the retaining wall. This point is a "Channel Alteration" point (Object ID 18) in the geodatabase provided. The retaining wall extends approximately 1,400 feet upstream from the culvert under Wilson Pike. The culvert on Wilson Pike is approximately 375 feet south of Hood Place, and approximately 0.1 miles north of Summerfield Drive.



*Figure 1 - Aerial View of Channel Alteration
(Red Dot Indicates Wall Location)*



Figure 2 - View of CMU Retaining Wall (Notice bulge in wall)

2) Standing Black Water near I-65

CEC personnel noted an area where flow stopped, and there was black standing water. The standing water had an odor of sewer and gasoline. CEC recommends that the City inspect the area. This point is an “Unusual Condition” point (Object ID 20) in the geodatabase provided. The location of the standing black water is southeast of the Green Pasture Equestrian Arena, approximately 370 feet west of I-65 South, and approximately 135 feet east of what appeared to be a shed.



*Figure 3 - Aerial View of Standing Water
(Red Dot Indicates Standing Water Location)*



Figure 4 - View of Standing Water

3) Falling Foot Bridge

CEC personnel noted a falling foot bridge along the stream, and recommends that the City inspect the bridge. The structural integrity of the foot bridge appears to be deteriorated. The foot bridge is not currently having adverse effects on the stream, but CEC wanted to bring this to the City’s attention as a potential safety issue. This point is an “Unusual Condition” point (Object ID 29) in the geodatabase provided. The foot bridge is located in the backyard area between 1304 and 1300 Lavada Place.



*Figure 5 - Aerial View of Falling Bridge
(Red Dot Indicates Bridge Location)*

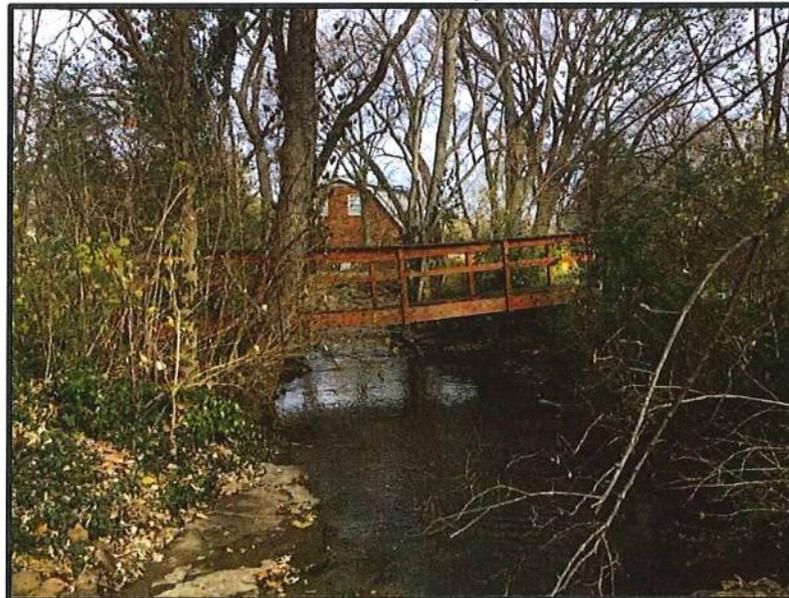
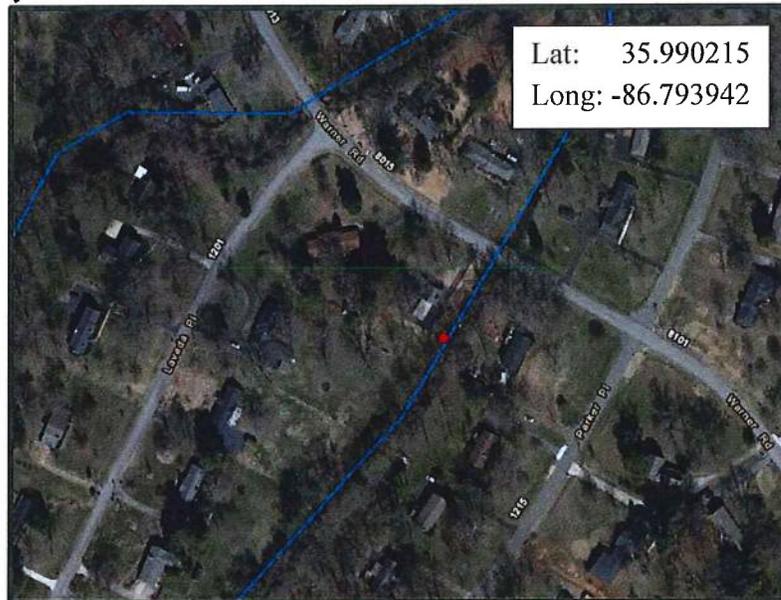


Figure 6 - View of Falling Bridge

4) Debris Dam near Warner Road

CEC personnel noted a debris dam where the water drops approximately one foot. CEC wanted to bring this to the attention of the City and recommends that the City inspect this location. This point is a “Fish Barrier” point (Object ID 22) in the geodatabase provided. The debris dam is located between 1215 Parker Place and 8017 Warner Road, and approximately 160 feet southwest of Warner Road.



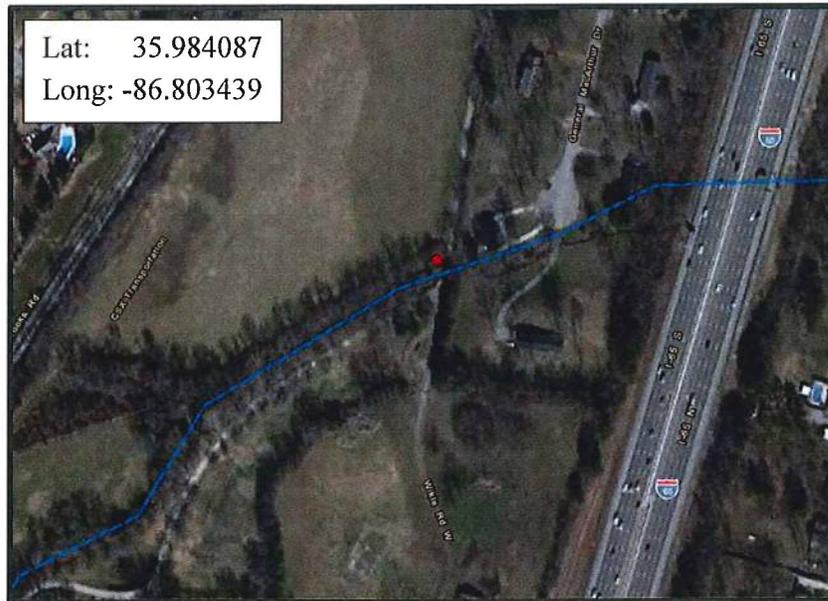
*Figure 7 - Aerial View of Debris Dam
(Red Dot Indicates Dam Location)*



Figure 8 - View of Debris Dam

5) Debris Dam near General MacArthur Drive

CEC personnel noted a debris dam obstructing the upstream end of a culvert conveying the stream. CEC understands the City is aware of this condition. This point is a “Fish Barrier” point (Object ID 23) in the geodatabase provided. The debris dam is located on the upstream side of the culvert under Wikle Road West southwest of 1329 General MacArthur Drive.



*Figure 9 - Aerial View of Debris Dam
(Red Dot Indicates Dam Location)*



Figure 10 - View of Upstream End of Blocked Culvert

6) Exposed Pipe near Jasmin Park Drive

There is a 6" exposed pipe near Jasmin Park Drive. The pipe location is approximately 85 feet north of the fence on 1389 Moonlight Trail, and 250 feet east of the culvert under Jasmin Park Drive. CEC believes it to be a sewage line, but recommends that the City inspect the exposed pipe. This point is an "Exposed Pipe" point (Object ID 14) in the geodatabase provided.



*Figure 11 - Aerial View of Exposed Pipe
(Red Dot Indicates Pipe Location)*



Figure 12 - View of Exposed Pipe

Mr. Harris – City of Brentwood
CEC Project 174-840.0002
Page 8
April 24, 2019

Please call us at 615-333-7797 or email Justin Bryan at jbryan@cecinc.com if you should have any questions or need any additional information regarding this deliverable.

Sincerely,

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.



Justin M. Bryan, P.E., CPESC
Project Manager



Steven E. Casey, P.E., CPESC
Senior Principal

Enclosures: Attachment 1 – Visual Stream Assessment Completed In Permit Year 3 (Map)
USB flash drive



GIS Aerial of Concrete



