Total Maximum Daily Load Synopsis

State: Kentucky
Major River Basin: Kentucky
USGS HUC8 #: 05100204
Counties: Powell; Estill
Pollutant of Concern: *E. coli*

The Hardwick Creek watershed is primarily located in Powell County, with minor extensions into Estill County. The total watershed area is 27.3 square miles, with 23.4 square miles in Powell County and 3.9 square miles in Estill County. The Hardwick Creek watershed is close to Bert T Combs-Mountain PKWY, which traverses north of the watershed (Figure S.1).

During the primary contact recreation (PCR) season in 2006, Escherichia coli (*E. coli*) samples were collected at 6 sampling sites within the watershed. This document contains the monitoring results and describes Total Maximum Daily Load (TMDL) development for *E. coli* in the Hardwick Creek watershed as required under Section 303(d) of the Clean Water Act. Table S.1 indicates the *E. coli* impaired segments for which TMDLs are developed in this document.
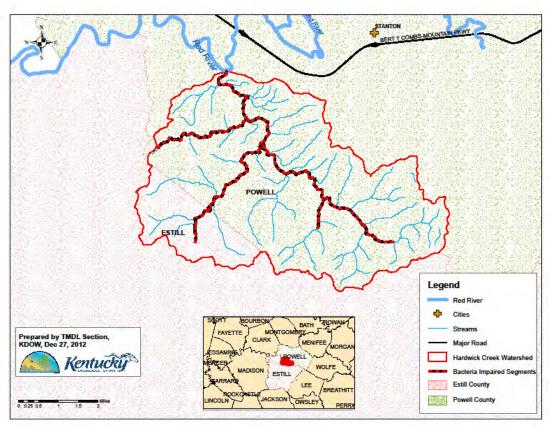

Figure S.1 Location of the Hardwick Creek Watershed

Table S.1 Impaired Waterbodies Addressed in this TMDL Document

Waterbody Name	Pollutant	County	Waterbody Identification Number (WBID)*	Suspected Sources	Impaired Use (Support Status)
Branham Branch 0.0 to 0.8	*E. coli*	Powell	KY510896_01	On-site Treatment Systems (septic Systems and Similar Decentralized Systems) &Livestock (Grazing or Feeding Operations)	PCR (partial support)
Little Hardwick Creek 0.0 to 4.2	*E. coli*	Powell Estill	KY513488_01	On-site Treatment Systems (septic Systems and Similar Decentralized Systems) &Livestock (Grazing or Feeding Operations)	PCR (nonsupport)
Frames Branch 0.0 to 2.95	*E. coli*	Powell	KY512238_01	On-site Treatment Systems (septic Systems and Similar Decentralized Systems) &Livestock (Grazing or Feeding Operations)	PCR (nonsupport)
Hardwick Creek 3.25 to 8.6	*E. coli*	Powell	KY512561_02	On-site Treatment Systems (septic Systems and Similar Decentralized Systems) &Livestock (Grazing or Feeding Operations)	PCR (nonsupport)
Hardwick Creek 0.0 to 3.25	*E. coli*	Powell	KY512561_01	On-site Treatment Systems (Septic Systems and Similar Decentralized Systems) &Livestock (Grazing or Feeding Operations)	PCR (nonsupport)

* The Waterbody Identification Number (WBID) is a unique identifier assigned to all assessed waters in KY. It is based upon the USGS Geographic Names Information System (GNIS) (USGS, 1999) with a KY in front of the GNIS number and a _## where ## is a segment identification number.

Kentucky Water Quality Criteria (WQC) and the TMDL Endpoint (i.e. Water Quality Standard / TMDL Target):

E. coli is a bacteria indicator used to identify if the waterbody is polluted. Kentucky regulations have numbers for the safe amounts of *E. coli* in the water (401 KAR 10:031) for the Primary Contact Recreation (PCR) season (May – October only) and year round Secondary Contact Recreation (SCR) (Table S.2).

Table S.2 Kentucky's Bacteria Limits

Bacteria Indicator	Summer PCR Limit (May 1 - Oct. 31)		SCR Limit (year round)	
	Geometric Mean (colonies/100 ml)	Maximum (colonies/100 ml)	Geometric Mean (colonies/100 ml)	Maximum (colonies/100 ml)
E. coli	**130** (from 5 samples collected within 30 days)	**240** (number not to be exceeded in more than 20% of the samples)	No criterion (this does not mean that any number is safe; rather that KY regulations do not tell the safe limit)	No criterion (this does not mean that any number is safe; rather that KY regulations do not tell the safe limit)

TMDL Equation and Calculations:

A TMDL calculation is performed as follows:

$$TMDL = WLA + LA + MOS$$
(Equation 1)

The WLA usually has three components:

$$WLA = SWS\text{-}WLA + MS4\text{-}WLA + Future\ Growth\text{-}WLA$$
(Equation 2)

but there were no SWS or MS4 sources in this watershed so the WLA was only divided to the Future Growth-WLA.

Where:
TMDL: the WQC, expressed as a load. The WQC is defined in Section 6.0 as an instantaneous concentration of 240 colonies/100 ml for *E. coli*.
MOS: the Margin of Safety, which can be an implicit or explicit additional reduction applied to sources of pollutants that accounts for uncertainties in the relationship between effluent limits and water quality.
TMDL Target: the TMDL minus the MOS.
WLA: the Wasteload Allocation, which is the allowable loading of pollutants into the stream from KPDES-permitted sources, such as SWSs and MS4s.

SWS-WLA: the WLA for KPDES-permitted sources, which have discharge limits for pathogen indicators (including wastewater treatment plants, package plants and home units).

Future Growth-WLA: the allowable loading for future KPDES-permitted sources, including new SWSs, expansion of existing SWSs, new storm water sources, and growth of existing storm water sources (such as MS4s). Also includes the allocation for the KPDES-permitted sources that existed but were not known at the time the TMDL was written.

Remainder: the TMDL minus the MOS and minus the SWS-WLA (also equal to Future Growth-WLA plus the MS4-WLA and the LA).

MS4-WLA: the WLA for KPDES-permitted municipal separate storm water sewer systems (including cities, counties, roads and right-of-ways owned by the Kentucky Transportation Cabinet, universities and military bases).

LA: the Load Allocation, which is the allowable loading of pollutants into the stream from sources not permitted by KPDES and from natural background.

Seasonality: yearly factors that affect the relationship between pollutant inputs and the ability of the stream to meet its designated uses.

Critical Condition: the time period when the pollutant conditions are expected to be at their worst.

MAF: the Mean Annual Flow as defined by USGS.

Adjusted MAF: the MAF plus SWS-WLA design flows.

Critical Flow: the flow used to calculate the TMDL as a load (is equivalent to the Adjusted MAF for MAF TMDLs)

Existing Conditions: the load that exists in the watershed at the time of TMDL development (i.e., sampling) and is causing the impairment.

Percent Reduction: the loading reduction needed to bring the existing condition in line with the TMDL target.

Load: concentration * flow * conversion factor

Concentration: colonies per 100 milliliters (colonies/100ml)

Flow (i.e. stream discharge): cubic feet per second (cfs)

Conversion Factor: the value that converts the product of concentration and flow to load (in units of colonies per day); it is derived from the calculation of the following components: ($28.31685 L/f^3$ * 86400seconds/day * 1000ml/L)/ (100ml) and is equal to 24,465,758.4.

       Calculation Procedure:

       1) The MOS, if an explicit value, is calculated and subtracted from the TMDL first, giving the TMDL Target;
       2) Percent reductions are calculated to show the difference between Existing Conditions and the TMDL Target;
       3) The Future Growth-WLA is calculated and subtracted from the Remainder;
       4) Leaving the LA.

The TMDL for each *E. coli* impaired segment is shown in Tables S.3.

Table S.3 TMDLs for *E. coli* PCR Impaired Segments

Waterbody Name	TMDL (colonies/ day)	MOS (colonies/ day)	SWS-WLA (colonies/ day)	Future Growth-WLA (colonies/ day)	MS4-WLA (colonies / day)	LA (colonies/ day)	Percent Reduction (%)
Branham Branch 0.0 to 0.8	1.53E+10	1.53E+09	0	6.87E+07	0	1.37E+10	58.5
Little Hardwick Creek 0.0 to 4.2	5.05E+10	5.05E+09	0	2.27E+08	0	4.52E+10	98.8
Frames Branch 0.0 to 2.95	1.47E+10	1.47E+09	0	1.32E+08	0	1.31E+10	97.9
Hardwick Creek 3.25 to 8.6	1.06E+11	1.06E+10	0	4.78E+08	0	9.52E+10	98.1
Hardwick Creek 0.0 to 3.25	2.03E+11	2.03E+10	0	9.12E+08	0	1.81E+11	99.1