

Assessment of Ecoregional Dissolved Oxygen Regimes
Data Report for 2006 Study Season

SECTION 2

STUDY AREA

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Three biocriteria reference streams were identified by MDNR staff to be monitored during the summer 2006 study season (Figure 1):

- Little Drywood Creek (Vernon County, Missouri)
- Cedar Creek (Cedar County, Missouri), and
- Heaths Creek (Pettis County, Missouri).

Study streams were selected to further characterize DO regimes in the Osage Plains and assess potential low DO conditions within adjacent and transitional ecoregions. Anthropogenic influences to DO regimes were minimized by sampling reference streams. As defined by MDNR, reference streams are “stream reaches determined by the department to be the best available representatives of ecoregion waters in a natural condition, with respect to habitat, *water quality*, biological integrity and diversity, watershed land use and riparian conditions.” (Carnahan 2005).

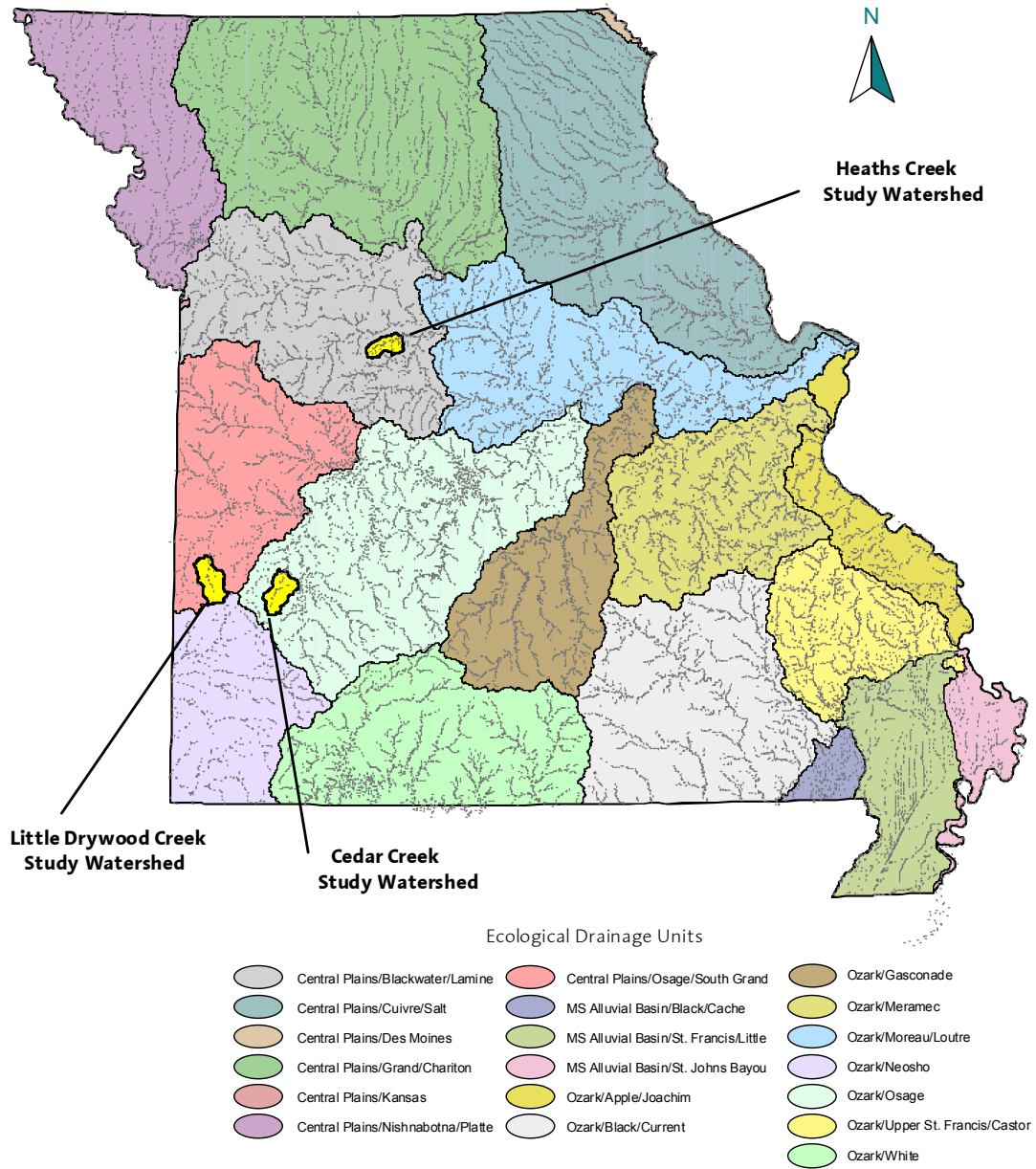


FIGURE 1. Location of Study Watersheds and Ecological Drainage Unit Boundaries

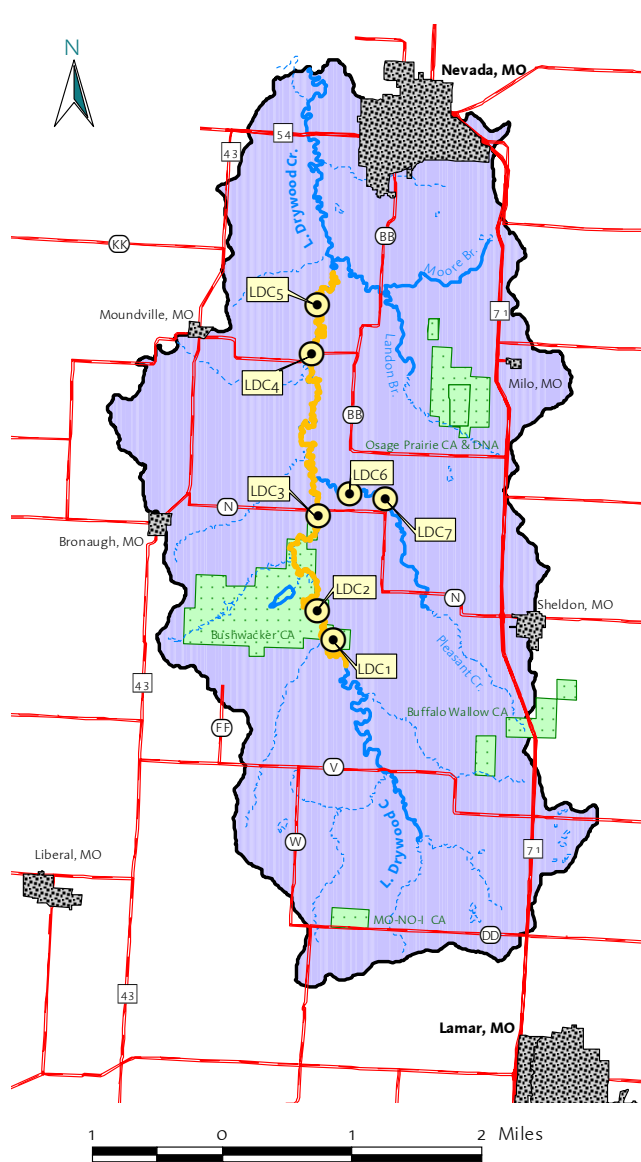
2.1 Little Drywood Creek

Little Drywood Creek originates in central Barton County, Missouri and flows north to its confluence with the Marmaton River, located northwest of Nevada, Missouri (Figure 2). Monitored reaches of Little Drywood Creek lie between 37.7818° N and 37.5260° N latitude and 94.4123° W and 94.2867° W longitude.

A 19 mile segment of Little Drywood Creek is identified by MDNR as a biocriteria reference stream having a predominately glide-pool structure. Reaches upstream of the Pleasant Creek confluence are classified as 'Class C' (intermittent) waters of the state while segments downstream to the Marmaton River confluence are classified as perennial 'Class P' waters (Carnahan 2005). Classified tributaries to Little Drywood Creek include Pleasant Creek (C), Moore Branch (C), and Landon Branch (C).

Little Drywood Creek is located in Ecological Drainage Unit #15 (Central Plains/Osage/South Grand, Sowa *et al.* 2004). Catchment areas upstream of mainstem monitoring sites range from 48 to 123 mi.² and are dominated by grassland and row-crop land uses (Figure 2, Appendix C). Parts of four public land areas are contained within or intersect the boundaries of study watersheds resulting in refugia percentages ranging from 2.4% to 11.6%.

Thirty-year mean annual precipitation at the Nevada, Missouri Water Plant is 44.2 in. (MRCC 2007a). Annual precipitation for 2006 (35.6 in.) at the Nevada station is the sixth lowest record within the past 30 years (~19th percentile). Estimated average July through September baseflow at site LDC2 is 1.23 cubic feet per second (cfs). Baseflow separation and regional regression are described in Appendix E.



- Cities
- Monitoring Sites
- Highways
- Biocriteria Reach
- Classified Waters
- Unclassified Waters
- Public Lands
- L. Drywood Watershed

2005 Thematic Mapper

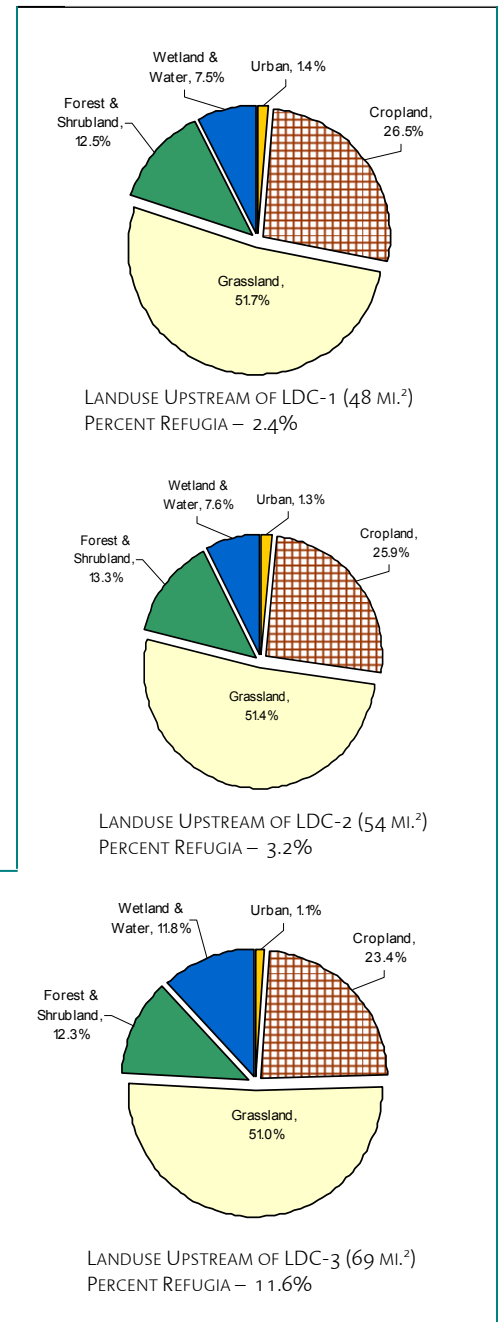


FIGURE 2. Little Drywood Creek Study Area and 2005 Landuse Distribution

2.1.1 Little Drywood Creek Biotic Community

Benthic macroinvertebrates have been sampled in Little Drywood Creek as part of biocriteria programs administered by the Missouri Department of Natural Resources. Summarized results from a data request (Appendix D) issued in January 2007 are provided in Table 1a.

TABLE 1a. Primary Macroinvertebrate Metrics for Little Drywood Creek. Based on sixteen MDNR Collections between Spring 1995 to Fall 2003

*Metric	Range (min to max)	Median
EPT Index	4 to 16	8
Taxa Richness	45 to 73	61.5
Biotic Index	6.4 to 8.0	7.1
Shannon Index	2.1 to 3.5	3.0

*See MDNR Standard Operating Procedure for Semi-Quantitative Macroinvertebrate Stream Bioassessment

The Missouri Department of Conservation (MDC) performed three macroinvertebrate collections in Little Drywood Creek during the Fall of 2002, 2003, and 2004. Metrics compare reasonably (Table 1b) to those derived from field investigations led by MDNR.

TABLE 1b. Primary Macroinvertebrate Metrics for Little Drywood Creek. Based on three MDC Collections during the Fall of 2002, 2003, and 2004.

Metric	2002	2003	2004
EPT Index	10	12	13
Taxa Richness	62	60	70
Biotic Index	5.2	6.8	6.4
Shannon Index	3.4	3.1	3.1

Fish assessments targeting evaluation of aquatic community health have not been performed in Little Drywood Creek. Fish species in the Drywood basin have been characterized by MDC as tolerant, insectivorous, and wide ranging based on periodic sampling since 1940 (Fantz *et al.* 2007).

2.2 Cedar Creek

Cedar Creek flows north from Cedar County, Missouri into Dade County, Missouri (Figure 3). Cedar Creek joins the Sac River approximately 8 miles south of Roscoe, Missouri. Monitored reaches of Cedar Creek lie between 37.4760° N and 37.7163° N latitude and 94.0429° W and 93.8036° W longitude.

A 6 mile segment of Cedar Creek is identified by MDNR as a biocriteria reference stream. Cedar Creek transitions from an intermittent 'Class C' riffle-pool system to a perennial 'Class P' flow regime downstream of Teague Branch (Carnahan 2005). Classified tributaries to monitored reaches of Cedar Creek include Teague Branch (C) and Snag Creek (C).

Cedar Creek is located in Ecological Drainage Unit #27 (Ozark/Osage, Sowa *et al.* 2004). Watershed areas along the Cedar Creek mainstem range from 88 mi.² upstream of monitoring site CC-1 to 113 mi.² upstream of site CC-5. Landuse is approximately 66% grassland, 19% Deciduous Forest and Shrubland, and 13% Cropland (Figure 3, Appendix C). Public lands contained within or intersecting monitored reaches of the Cedar Creek drainage include Niawathe Prairie and Sky Prairie Conservation Areas.

Thirty-year mean annual precipitation at Stockton Dam is 42.5 in. (MRCC 2007b). Annual precipitation for 2006 (33 in.) at the Stockton station is the fifth lowest record within the past 30 years (~16th percentile). Regional baseflow separation analysis and regression yield an estimated average July through September baseflow of 2.86 cfs at site CC1 (see Appendix E).

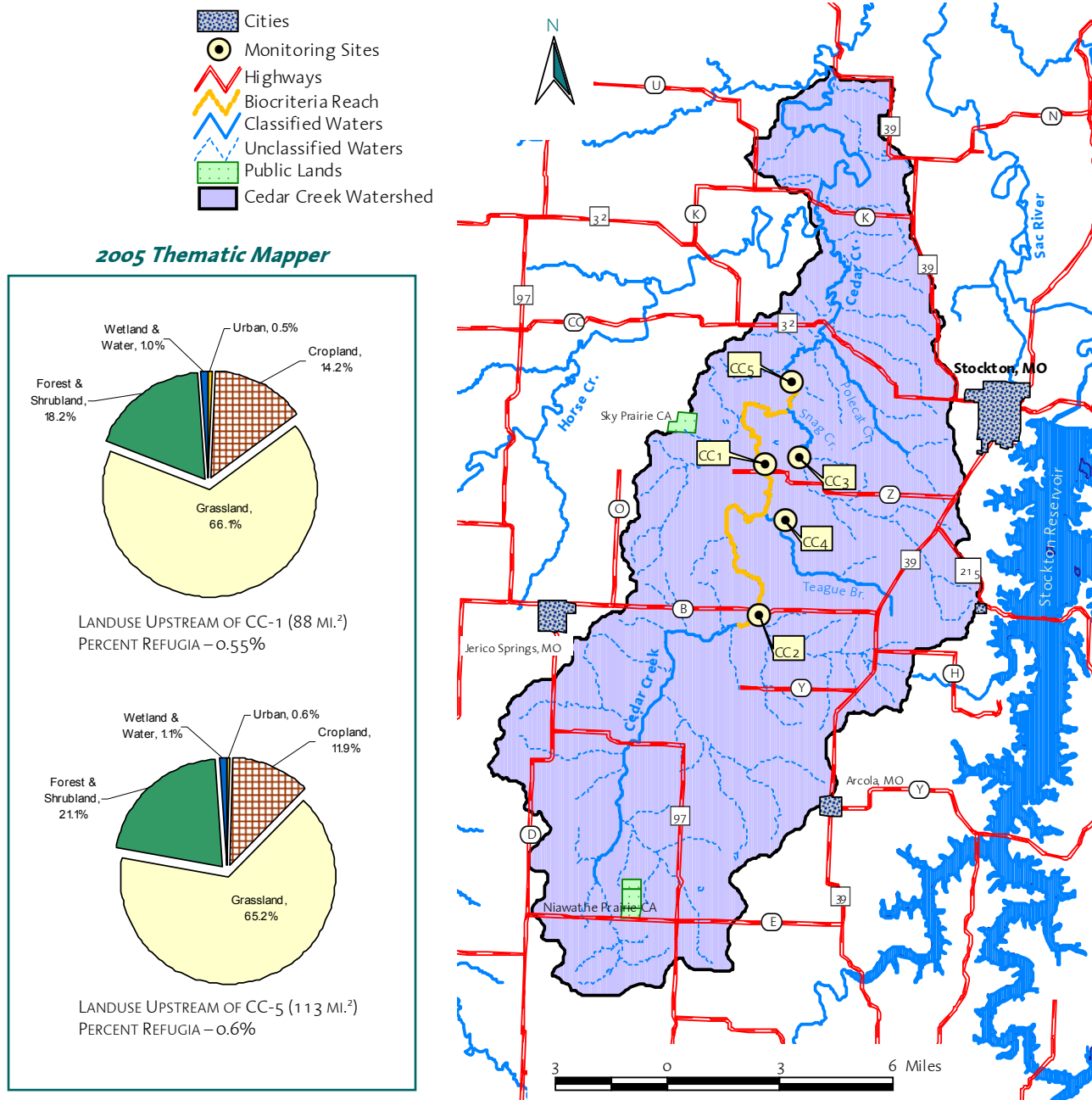


FIGURE 3. Cedar Creek Study Area and 2005 Landuse Distribution

2.2.1 Cedar Creek Biotic Community

Benthic macroinvertebrates have been sampled in Cedar Creek as part of Missouri's biocriteria program. Summarized results from a data request (Appendix D) issued in January 2007 are provided in Table 2a.

TABLE 2a. Primary Macroinvertebrate Metrics for Cedar Creek. Based on four MDNR Collections between Spring 2001 to Spring 2004

*Metric	Spring 2001	Fall 2001	Fall 2003	Spring 2004
EPT Index	20	16	14	18
Taxa Richness	77	85	84	83
Biotic Index	7.1	6.9	6.9	6.4
Shannon Index	3.1	3.2	3.3	3.3

*See MDNR Standard Operating Procedure for Semi-Quantitative Macroinvertebrate Stream Bioassessment

The MDC performed three macroinvertebrate collections in Cedar Creek during the Fall of 2002 (two reaches) and 2004. Metrics derived from MDC efforts (Table 2b) depict Cedar Creek as having lower biologic integrity compared to metrics derived from MDNR field studies.

TABLE 2b. Primary Macroinvertebrate Metrics for Cedar Creek. Based on three MDC Collections during the Fall of 2002 and 2004.

Metric	Fall 2002 – Reach A	Fall 2002 – Reach B	Fall 2004
EPT Index	7	15	15
Taxa Richness	56	54	71
Biotic Index	6.6	6.0	5.7
Shannon Index	3.1	3.1	2.9

Fish assessments targeting evaluation of aquatic community health have not been performed in Cedar Creek. The MDC identified 48 fish species occurring in the Cedar Creek Basin during collections performed since 1964 (Horton and Hutson 2007). In addition, 4 crayfish taxa and 36 mussel or clam species have been documented in the Sac River basin (Horton and Hutson 2007). Cedar Creek is a major tributary to the Sac River.

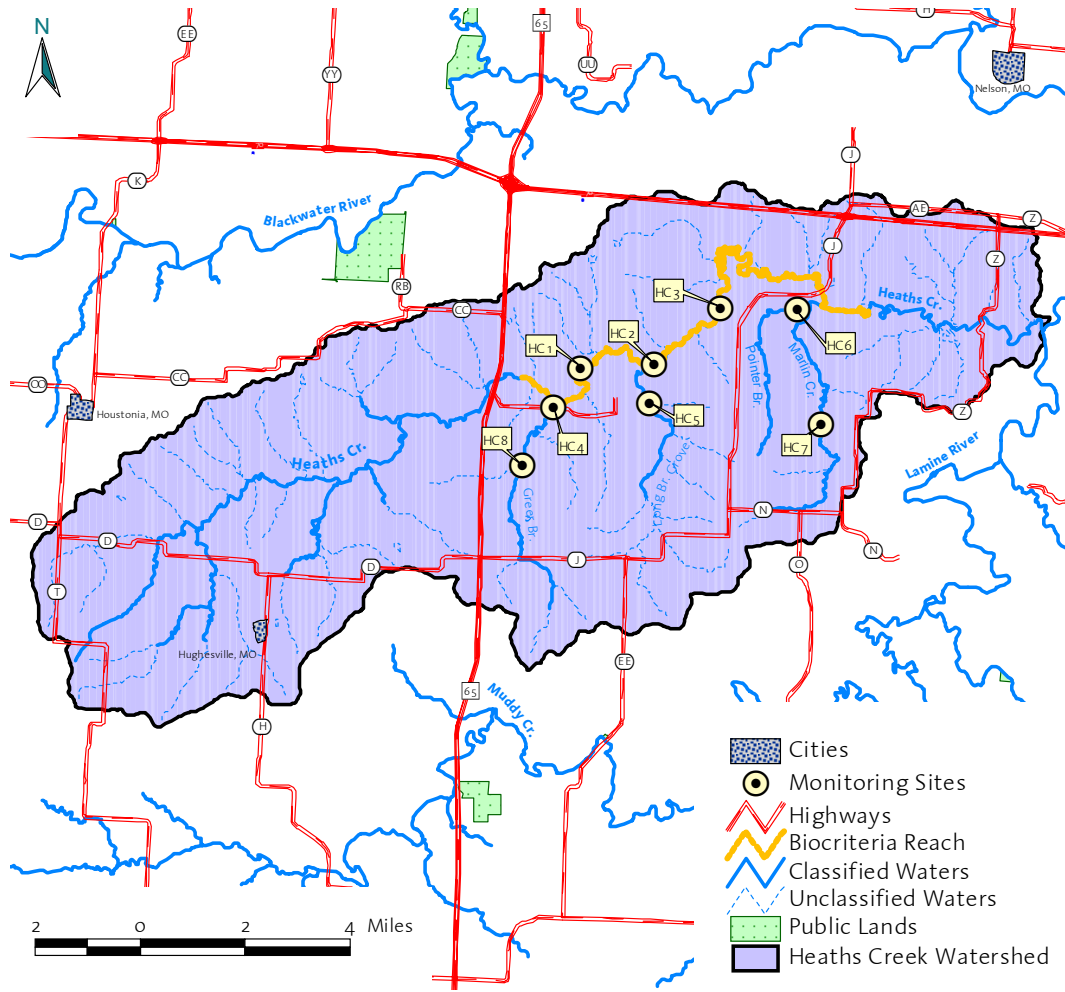
2.3 Heaths Creek

Heaths Creek headwaters are located in north-central Pettis County, Missouri (Figure 4). Flowing northeast into Saline and Cooper Counties, Heaths Creek joins the Lamine River 5 miles south of Nelson, Missouri. Monitored reaches of Heaths Creek lie between 38.81500 N and 38.94560 N latitude and 93.37830 W and 93.12160W longitude.

A thirteen mile segment of Heaths Creek is identified by MDNR as a biocriteria reference stream. Reaches monitored as part of the AERDOR study are classified as 'Class P' waters of the state (Carnahan 2005) and exhibit a riffle-pool structure. Classified tributaries near monitored reaches include: Greer Branch (C), Long Grove Branch (C & P), Pointer Br. (C), and Marlin Cr. (C & P).

Heaths Creek is located in Ecological Drainage Unit #11 (Central Plains /Blackwater/Lamine, Sowa *et al.* 2004). Watershed areas upstream of mainstem monitoring sites range from 57 to 75 mi.² (Figure 4). Agricultural croplands (~54%), grasslands (~30%), and deciduous forest & shrublands (~13%) compose the majority of landuses upstream of Cedar Creek monitoring sites (Figure 4, Appendix C). There are no public lands contained within or intersecting monitored reaches of the Heaths Creek.

Thirty-year mean annual precipitation at the Sedalia Water Plant is 41.7 in. (MRCC 2007c). Annual precipitation for 2006 (27.2 in.) at the Sedalia station is the lowest record within the past 30 years (~3rd percentile). Estimate average July through September baseflow is 2.42 cfs at site HC2 (see Appendix E).



2005 Thematic Mapper

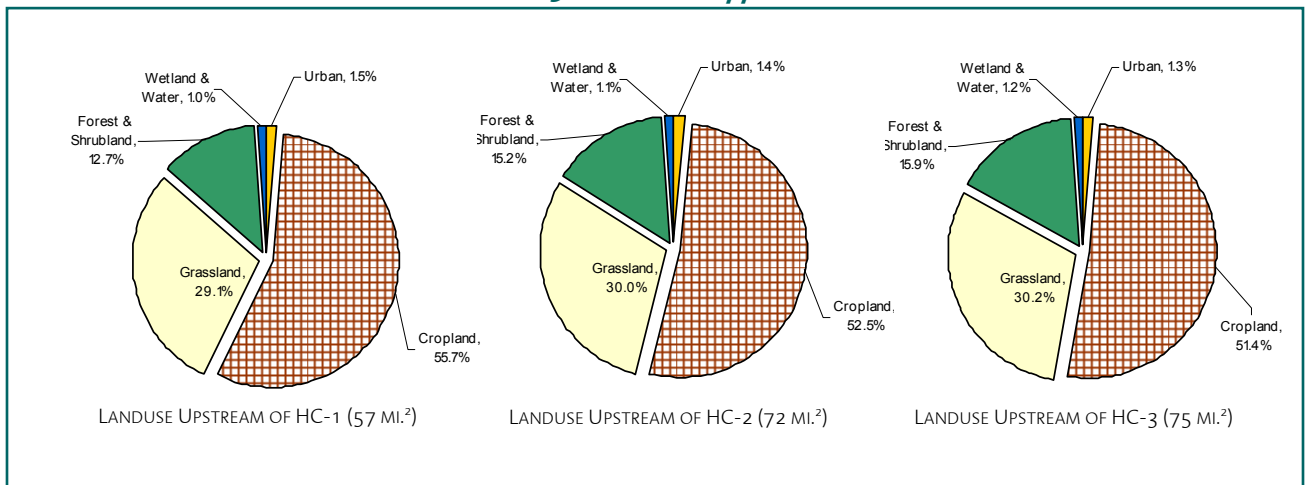


FIGURE 4. Heaths Creek Study Area and 2005 Landuse Distribution

2.3.1 Heaths Creek Biotic Community

Benthic macroinvertebrates have been sampled in Heaths Creek as part of Missouri's biocriteria program. Summarized results from a data request (Appendix D) issued in January 2007 are provided in Table 3.

TABLE 3. Primary Macroinvertebrate Metrics for Heaths Creek. Based on six MDNR Collections between Spring 1998 to Fall 2001.

*Metric	Range (min to max)	Median
EPT Index	8 to 15	13
Taxa Richness	62 to 80	70
Biotic Index	6.3 to 7.3	6.4
Shannon Index	2.6 to 3.2	2.9

*See MDNR Standard Operating Procedure for Semi-Quantitative Macroinvertebrate Stream Bioassessment

Fish communities in Heaths Creek were assessed by MDC during the summers of 2002, 2003, and 2005 through the Resource Assessment and Monitoring Program (RAM). An modified index of biologic integrity (Karr *et al.* 1986, EPA-EMAP Modification, see Appendix D) calculated by MDC ranks Heaths Creek as follows:

- 06/10/2002, M-IBI = 78
- 07/24/2002, M-IBI = 79
- 06/18/2003, M-IBI = 88
- 08/04/2005, M-IBI = 72

Heaths Creek joins the Lamine River south of Nelson, Missouri. Within the Lamine River watershed MDC (Brown *et al.* 2007) has identified:

- 69 species of fish;
- 27 mussel or clam species; and
- 4 expected crayfish taxa.