The revised regulations (5/31/12) at 10 CSR 20-7.031 (4) (L). indicates that water contaminants shall not cause sulfate or chloride criteria to exceed the levels of that described in Table A.

The chloride criteria are calculated as provided below. Chloride criteria are hardness and sulfate dependent; thus to determine the criteria value, we must first search for existing site-specific water quality data for sulfate and hardness as CaCO3; and second, as a default value in the absence of site-specific value, we use the median concentration of sulfate of similar stream or the 8-digit USGS Hydrologic Unit Code (HUC8) and 25th percentile of the hardness as CaCO3 to calculate acute or chronic criteria. For HUC8s with little or no data, data from adjacent HUC8s may be acceptable. For site-specific data, the median value of the chloride data and the 25th percentile of the hardness data should be used.

Acute: 287.8 *(Hardness)^0.205797 * (sulfate)^-0.07452 = XX mg/L
Chronic: 177.87 *(Hardness)^ 0.205797 * (sulfate)^-0.07452 = XX mg/L

The sulfate criteria determination requires some knowledge of the water's hardness and chloride concentration to decide among the matrix of choices in Table A of the 10 CSR 20-7.031; thus, to determine the criteria value, we must first search for existing site-specific water quality data for chloride and hardness as CaCO3. While site-specific data is preferred, if site-specific or HUC8 or similar stream chloride concentration is known and hardness is not known, we can assume that hardness is 162 mg/L hardness as CaCO3 (statewide hardness); thus, as first tier default, we may use these values in the S1 or S2 equation to determine sulfate criteria. As a second tier default, we use the median concentration of chloride within the HUC8 and 25th percentile of the hardness as CaCO3. In the absence of water quality data for a HUC8, data from adjacent or similar HUC8s may be acceptable.

For sulfate with a hardness ≥ 100 and ≤ 500 and chloride > 5 but ≤ 25, sulfate criteria are calculated by the following equation:

S1: -57.478 + 5.79*(Hardness) + 54.163 (chloride) * 0.65 = XX mg/L

The use of S1 equation is slightly more conservative than S2 equation. Equation S2 should be used with site-specific data or with the second tier default values, if HUC8 data are within the range chloride ≥ 25 and ≤ 500. For sulfate with a hardness ≥ 100 and ≤ 500 and chloride ≥ 25 and ≤ 500, sulfate criteria are calculated by the following equation:

S2: 177.87 + 5.508 (Hardness) - 1.457 * (chloride)* 0.65 = XX mg/L

Application to Permitting and Water Quality Based Effluent Limitations:

1) The consensus of the Watershed Protection Section is that permitting staff first use existing site-specific water quality data for sulfate, chloride, and hardness; and second, as a default value in the absence of site-specific value, staff use the median concentrations of chloride or sulfate within the HUC8 to calculate criteria for both chloride and sulfate.

2) In addition, water quality-based effluent limitations (WQBELs) for chlorides may be developed in the manner described in the EPA *Technical Support Document for Water Quality –based Toxics Control* [EPA-505/2-90-001] and in the *Guidance for Water Quality and Antidegradation Review Assistance*.
3) For WQBELs, while chloride will have a two-value waste load allocation (acute and chronic) and selection of the more limiting of the long-term averages, the sulfate WQBEL will have a one-value waste load allocation (chronic) and only one long-term average.

The tables below have chloride, sulfate, and hardness summary statistics for the 66 Hydrologic Unit Codes (HUC) in Missouri. This summary data were assembled to represent normal background for a watershed, not within particular stream or river.

From the original department Water Quality Assessment Database download (approx., 43,000 records) we removed 1) the data with the type identifiers “field blanks”, “trip blanks” and any other quality assurance samples other than “field duplicates”, 2) sample media identified as effluent samples, 3) some data records where the sampled site was greatly affected by a point source discharge or mine site; however, because the descriptors in the database did not give much information, we may have retained records that were drainage from a mine site or the fact that the HUC in question contains streams such as the Missouri River (which has relatively high levels of sulfate) and small tributaries to the Missouri River (many of which have low levels of sulfate).

Chloride Summary Table for Streams

8-digit HUC	USGS Basin Name	Missouri Basin Name	Count	N	N - Blank	Mean	SE Mean	StDev	Minimum	Maximum	Range	Median	Q1=25%	Q3=75%
7100009	Lower Des Moines	Des Moines Basin	244	227	17	26.8	0.7	11.1	3.7	64.0	60.3	26.0	18.0	34.0
7110001	Bear-Wyaconda	Wyaconda - Fox Rivers	303	278	25	16.2	0.4	5.9	5.0	47.2	42.2	15.0	12.0	20.0
7110002	North Fabius	North Fabius River Basin	59	59	0	12.8	0.5	3.7	4.7	18.7	14.0	14.0	9.6	15.3
7110003	South Fabius	South Fabius River Basin	177	175	2	10.9	0.4	5.7	2.0	61.0	59.0	10.0	7.6	13.8
7110004	The Sny	North River - Bobs Creek	194	194	0	33.6	2.9	40.4	3.0	369.4	366.4	21.8	13.8	34.9
7110005	North Fork Salt	North Salt River Basin	144	136	8	10.6	0.4	4.4	3.0	24.9	21.9	10.0	8.0	13.0
7110006	South Fork Salt	Middle-South Forks of the Salt River	181	173	8	16.1	1.3	16.8	0.0	124.0	124.0	11.0	8.0	18.0
7110007	Salt	Lower Salt River Basin	245	244	1	13.9	0.7	11.5	2.0	88.9	86.9	11.0	7.0	16.0
7110008	Cuivre	Cuivre River Basin	205	205	0	13.4	0.4	5.2	3.0	35.5	32.5	12.0	10.0	16.0
7110009	Peruque-Piasa	Peruque-Dardenne Creeks	2265	2179	86	29.8	0.7	31.7	1.6	560.0	558.4	22.0	17.0	30.7
7140101	Cahokia-Joachim	Mississippi River Tribs - St. L-Ste. Gen	1881	1417	464	180.4	10.9	411.4	4.0	8450.0	8446.0	78.0	28.8	168.0
7140102	Meramec	Meramec River Basin	4234	1756	2478	88.1	7.8	327.7	0.0	8050.0	8050.0	19.1	5.0	77.0
7140103	Bourbeuse	Bourbeuse River Basin	165	165	0	5.4	0.2	2.5	2.0	17.0	15.0	5.0	4.0	6.1
7140104	Big	Big River Basin	961	707	254	13.3	1.4	37.1	0.5	488.0	487.5	6.0	3.8	9.0
7140105	Upper Mississippi-Cape Girardeau	Mississippi River Tribs - Ste. Gen-Cape Gir.	1901	1843	58	20.8	0.2	9.8	0.2	133.0	132.8	20.3	15.7	26.0
7140107	Whitewater	Castor-Whitewater Rivers Basin	88	87	1	8.4	1.1	10.2	1.0	57.8	56.8	5.0	2.5	7.0
8010100	Lower Mississippi-Memphis	Mississippi River Mainstem Below Ohio River	15	13	2	14.3	1.0	3.4	10.0	21.0	11.0	14.0	11.0	16.5
8020201	New Madrid-St. Johns	St. Johns Bayou	69	67	2	9.6	0.3	2.6	2.7	17.5	14.8	9.4	8.4	10.9
8020202	Upper St. Francis	Upper St. Francis Basin	373	246	127	9.7	1.1	16.6	0.3	120.0	119.8	4.1	3.0	9.0
8020203	Lower St. Francis	Lower St. Francis Basin	165	160	5	7.9	0.4	5.4	2.0	36.2	34.2	6.2	4.6	8.9
8020204	Little River Ditches	Little River Ditches	189	186	3	16.9	0.8	10.7	2.0	71.0	69.0	14.0	10.5	18.8
8020302	Cache	Cache River Basin	No data - Use a watershed with similar characteristics											
10240001	Keg-Weeping Water	Missouri River Bottom	No data - Use a watershed with similar characteristics											
10240004	Nishnabotna	Nishnabotna River Basin	310	278	32	15.8	0.3	5.1	5.5	51.0	45.5	15.0	13.0	18.0
10240005	Tarkio-Wolf	Tarkio-Squaw Tributaries Basin	9	9	0	14.3	0.6	1.8	10.6	16.0	5.4	14.0	13.5	16.0
10240010	Nodaway	Nodaway River Basin	454	421	33	10.9	0.2	3.4	3.0	32.0	29.0	11.0	9.0	13.0
10240011	Independence-Sugar	Missouri River Mainstem	465	451	14	20.8	0.7	14.8	7.0	181.0	174.0	19.0	16.0	22.0
10240012	Platte	Platte River Basin	220	212	8	13.6	0.4	5.5	0.1	41.0	41.0	12.8	10.0	17.0
10240013	One Hundred and Two	102 River Basin	11	11	0	20.0	1.7	5.7	11.8	33.0	21.2	19.4	17.0	24.0
10280101	Lower Kansas	Kansas River Basin	366	350	16	11.3	0.3	5.2	3.0	50.0	47.0	10.0	8.2	12.7
10280102	Upper Grand	Upper Grand River Basin	248	246	2	10.6	0.8	12.4	2.2	195.0	192.8	9.5	7.0	12.0
10280103	Thompson	Thompson River Basin	967	962	5	103.5	30.7	952.0	0.2	20800.0	20799.8	9.8	7.5	13.0
10270104	Lower Grand	Middle Grand River Basin	No data - Use a watershed with similar characteristics											
10280201	Upper Chariton	Upper Chariton River Basin	547	531	16	10.0	0.4	9.7	1.0	138.0	137.0	8.0	6.0	10.0
10280202	Lower Chariton	Lower Chariton River Basin	100	100	0	15.9	1.3	13.2	2.5	77.0	74.5	10.9	7.0	20.9
10280203	Little Chariton	Little Chariton River Basin	550	447	103	11.7	0.6	11.7	1.0	210.0	209.0	10.0	6.6	14.0
10290102	Lower Marais Des Cygnes	Maries des Cygnes River Basin	345	296	49	16.5	0.8	13.3	1.0	79.0	78.0	13.0	9.0	18.9
10290103	Little Osage	Little Osage River Basin	160	149	11	7.1	0.3	3.3	1.0	21.0	20.0	6.0	5.0	8.0
10290104	Marmaton	Marmaton River Basin	431	383	48	23.0	2.2	43.7	0.3	484.0	483.7	11.0	7.0	19.0
10290105	Harry S. Truman Reservoir	Upper Osage River Basin	212	191	21	14.5	0.7	9.9	0.4	68.0	67.6	12.0	7.5	19.7
10290106	Sac	Sac River Basin	691	660	31	17.5	0.9	24.3	1.1	358.9	357.8	10.7	9.0	13.8
10290107	Pomme De Terre	Pomme de Terre River Basin	135	121	14	14.5	1.2	13.0	4.0	78.8	74.8	10.1	8.5	14.1
10290108	South Grand	South Grand River Basin	872	768	104	14.0	0.4	12.2	1.0	125.0	124.0	10.0	6.8	16.8
10290109	Lake of the Ozarks	Lake of Ozarks Basin	95	93	2	6.8	1.0	9.2	2.0	53.0	51.0	4.0	3.0	6.4
10290110	Niangua	Niangua River Basin	209	205	4	6.1	0.2	3.2	0.0	32.0	32.0	6.0	5.0	7.0
10290111	Lower Osage	Lower Osage River Basin	319	315	4	8.0	0.9	16.4	2.0	262.0	260.0	6.0	5.0	7.6
10290201	Upper Gasconade	Upper Gasconade River Basin	15	15	0	9.0	3.7	14.4	3.0	61.0	58.0	5.9	5.0	6.5
10290202	Big Piney	Big Piney River Basin	131	130	1	3.6	0.2	1.7	1.0	8.0	7.0	3.8	2.0	5.0
10290203	Lower Gasconade	Lower Gasconade River Basin	247	247	0	5.4	0.3	4.5	2.0	45.7	43.7	5.0	4.0	6.0
10300101	Lower Missouri-Crooked	Missouri River Mainstem- KC to Glasgow	1008	963	45	100.0	8.5	263.7	0.0	4968.0	4968.0	46.0	26.0	89.1
10300102	Lower Missouri-Moreau	Missouri River Mainstem- Glasqow to Hermann	1619	1051	568	67.4	22.1	716.3	0.2	22800.0	22799.8	19.0	11.3	35.0
10300103	Lamine	Lamine River Basin	481	481	0	46.1	2.9	62.7	0.5	343.0	342.5	18.0	10.7	50.9
10300104	Blackwater	Blackwater River Basin	25	25	0	16.9	3.0	14.9	6.0	62.0	56.0	11.3	7.1	19.0
10300200	Lower Missouri	Missouri River Mainstem- Hermann to St.L	3804	1867	1937	81.9	4.9	212.8	4.7	3400.0	3395.3	22.0	16.0	74.0
11010001	Beaver Reservoir	Table Rock Lake Basin	464	451	13	7.3	0.3	5.6	1.1	62.0	60.9	5.1	3.8	9.0
11010002	James	James River Basin	3049	2982	67	38.6	0.9	48.9	0.0	1116.5	1116.5	17.2	10.3	48.1
11010003	Bull Shoals Lake	Bull Shoals Lake Basin	201	201	0	5.4	0.2	2.5	1.2	22.0	20.8	5.0	4.0	6.4
11010006	North Fork White	North Fork White River Basin	213	213	0	3.6	0.2	2.3	0.5	20.0	19.5	3.1	2.2	4.0
11010007	Upper Black	Black River Basin	812	656	156	8.6	0.4	9.7	0.8	66.0	65.2	4.0	2.5	11.0
11010008	Current	Current River Basin	379	370	9	2.5	0.1	2.7	0.0	38.0	38.0	2.0	2.0	2.5
11010009	Lower Black	Fourche Creek Basin	5	5	0	2.4	0.2	0.5	2.0	3.0	1.0	2.0	2.0	3.0
11010010	Spring	Spring River Basin (Howell/Oreg counties)	107	107	0	5.8	0.4	3.9	2.0	27.1	25.1	4.5	3.9	6.6
11010011	Eleven Point	Eleven Point River Basin	67	66	1	2.4	0.1	0.7	0.0	5.0	5.0	2.2	2.0	2.8
11070206	Lake O' the Cherokees	Cherokees Lake Basin	39	39	0	8.6	0.5	3.3	0.3	14.0	13.8	8.0	6.0	11.0
11070207	Spring	Spring River Basin	1797	1579	218	24.0	1.5	59.6	1.7	962.0	960.3	12.0	8.2	20.4
11070208	Elk	Elk River Basin	2081	2071	10	8.1	0.1	5.7	0.0	61.0	61.0	7.0	5.0	9.0

Sulfate (SO4) Summary Table

8-digit HUC	USGS Basin Name	Missouri Basin Name	Count	N	N - Blank	Mean	SE Mean	StDev	Minimum	Maximum	Range	Median	Q1=25%	Q3=75%
7100009	Lower Des Moines	Des Moines Basin	244	227	17	74.1	2.0	29.9	9.2	180.0	170.8	69.0	52.0	92.0
7110001	Bear-Wyaconda	Wyaconda - Fox Rivers	303	162	141	51.0	2.2	27.6	1.0	150.0	149.0	44.5	33.0	67.5
7110002	North Fabius	North Fabius River Basin	59	25	34	54.1	5.0	25.1	11.0	94.0	83.0	59.0	29.9	73.4
7110003	South Fabius	South Fabius River Basin	177	155	22	42.8	1.7	21.7	4.9	110.0	105.1	41.0	26.2	53.0
7110004	The Sny	North River - Bobs Creek	194	172	22	41.1	2.4	31.7	7.2	181.7	174.5	30.9	19.5	51.8
7110005	North Fork Salt	North Salt River Basin	144	88	56	40.6	2.4	22.4	1.0	102.0	101.0	40.0	23.3	51.0
7110006	South Fork Salt	Middle-South Forks of the Salt River	181	148	33	59.0	2.6	31.9	10.0	176.0	166.0	53.5	35.0	79.5
7110007	Salt	Lower Salt River Basin	245	231	14	43.1	1.8	26.8	3.2	180.0	176.8	34.0	26.0	52.1
7110008	Cuivre	Cuivre River Basin	205	163	42	25.3	0.9	11.5	7.0	92.0	85.0	23.0	17.0	31.0
7110009	Peruque-Piasa	Peruque-Dardenne Creeks	2265	1424	841	35.3	0.7	24.8	0.0	423.8	423.8	30.8	24.8	39.8
7140101	Cahokia-Joachim	Mississippi River Tribs - St. L-Ste. Gen	1881	94	1787	71.8	4.0	38.7	5.0	167.4	162.4	70.5	37.5	97.3
7140102	Meramec	Meramec River Basin	4234	816	3418	165.2	30.3	865.7	0.0	10200.0	10200.0	16.0	9.0	25.0
7140103	Bourbeuse	Bourbeuse River Basin	165	164	1	20.9	0.7	9.2	4.2	79.4	75.2	19.5	15.0	24.0
7140104	Big	Big River Basin	961	686	275	66.4	3.9	103.1	2.5	698.0	695.5	25.1	14.2	52.0
7140105	Upper Mississippi-Cape Girardeau	Mississippi River Tribs - Ste. Gen-Cape Gir.	1901	1242	659	59.6	0.9	33.5	0.0	551.0	551.0	59.0	41.7	79.2
7140107	Whitewater	Castor-Whitewater Rivers Basin	88	84	4	9.5	0.9	8.3	1.8	51.0	49.3	6.5	5.0	9.8
8010100	Lower Mississippi-Memphis	Mississippi River Mainstem Below Ohio River	15	13	2	48.9	4.2	15.1	30.0	86.0	56.0	49.0	37.0	54.5
8020201	New Madrid-St. Johns	St. Johns Bayou	69	63	6	22.0	1.3	10.1	3.8	60.0	56.2	19.0	16.0	28.3
8020202	Upper St. Francis	Upper St. Francis Basin	373	283	90	151.3	17.8	298.8	4.0	1210.0	1206.0	17.0	9.0	76.0
8020203	Lower St. Francis	Lower St. Francis Basin	165	165	0	9.4	0.3	3.7	2.5	43.3	40.8	9.1	7.6	10.8
8020204	Little River Ditches	Little River Ditches	189	180	9	20.3	0.7	9.2	4.6	62.8	58.2	20.0	15.5	23.0
8020302	Cache	Cache River Basin	No data - Use a watershed with similar characteristics											
10240001	Keg-Weeping Water	Missouri River Bottom	No data - Use a watershed with similar characteristics											
10240004	Nishnabotna	Nishnabotna River Basin	310	270	40	31.2	0.5	8.3	9.7	52.0	42.3	30.5	26.0	37.3
10240005	Tarkio-Wolf	Tarkio-Squaw Tributaries Basin	9	1	8	19.4	*	*	19.4	19.4	0.0	19.4	*	*
10240010	Nodaway	Nodaway River Basin	454	381	73	30.8	0.6	10.7	7.0	67.0	60.0	29.0	23.0	38.0
10240011	Independence-Sugar	Missouri River Mainstem	465	358	107	170.2	1.9	34.9	28.0	240.0	212.0	177.3	150.0	191.3
10240012	Platte	Platte River Basin	220	169	51	31.0	0.9	11.3	2.5	76.0	73.5	30.0	24.0	39.0
10240013	One Hundred and Two	102 River Basin	11	6	5	29.4	2.5	6.1	20.0	36.3	16.3	30.0	24.5	34.6
10270104	Lower Kansas	Kansas River Basin	No data - Use a watershed with similar characteristics											
10280101	Upper Grand	Upper Grand River Basin	366	284	82	31.6	0.8	13.1	4.0	100.0	96.0	30.0	22.0	40.0
10280102	Thompson	Thompson River Basin	248	203	45	38.2	1.3	18.2	0.0	117.0	117.0	37.0	25.8	48.0
10280103	Lower Grand	Middle Grand River Basin	967	842	125	39.9	0.7	21.6	1.0	140.0	139.0	37.2	26.0	51.0
10280201	Upper Chariton	Upper Chariton River Basin	547	493	54	69.9	5.6	123.2	7.0	2220.0	2213.0	46.4	27.0	75.5
10280202	Lower Chariton	Lower Chariton River Basin	100	68	32	34.3	2.3	19.1	7.0	107.0	100.0	31.8	21.2	43.8
10280203	Little Chariton	Little Chariton River Basin	550	546	4	666.8	39.9	933.0	2.5	7310.0	7307.5	343.0	146.8	752.5
10290102	Lower Marais Des Cygnes	Maries des Cygnes River Basin	345	299	46	316.8	63.0	1089.6	8.0	7289.0	7281.0	39.0	24.0	64.0
10290103	Little Osage	Little Osage River Basin	160	140	20	28.1	1.7	20.1	4.0	119.0	115.0	25.0	15.0	33.8
10290104	Marmaton	Marmaton River Basin	431	398	33	149.5	12.2	242.5	1.8	1330.0	1328.2	50.5	29.9	118.0
10290105	Harry S. Truman Reservoir	Upper Osage River Basin	212	203	9	212.8	20.8	295.9	4.0	1480.0	1476.0	73.0	34.0	238.0
10290106	Sac	Sac River Basin	691	600	91	11.8	0.4	10.4	0.0	109.0	109.0	8.4	7.0	13.1
10290107	Pomme De Terre	Pomme de Terre River Basin	135	108	27	10.0	0.6	5.8	4.0	43.0	39.0	8.7	7.0	11.0
10290108	South Grand	South Grand River Basin	872	755	117	611.3	24.7	679.0	11.0	6940.0	6929.0	328.0	97.0	1000.0
10290109	Lake of the Ozarks	Lake of Ozarks Basin	95	86	9	9.0	0.9	8.2	5.0	78.0	73.0	7.1	6.0	9.2
10290110	Niangua	Niangua River Basin	209	203	6	6.2	0.2	2.4	0.0	17.0	17.0	6.0	5.0	7.0
10290111	Lower Osage	Lower Osage River Basin	319	298	21	21.8	0.5	8.3	5.0	47.0	42.0	22.0	15.2	28.0
10290201	Upper Gasconade	Upper Gasconade River Basin	15	14	1	5.0	0.2	0.8	4.0	7.0	3.0	5.0	4.4	5.2
10290202	Big Piney	Big Piney River Basin	131	125	6	5.9	0.3	3.5	2.0	22.0	20.0	5.0	4.0	7.0
10290203	Lower Gasconade	Lower Gasconade River Basin	247	237	10	7.4	0.2	3.7	2.0	42.0	40.0	7.0	5.0	9.0
10300101	Lower Missouri-Crooked	Missouri River Mainstem- KC to Glasgow	1008	283	725	98.8	4.5	76.3	10.1	516.0	505.9	80.3	41.8	134.0
10300102	Lower Missouri-Moreau	Missouri River Mainstem- Glasqow to Hermann	1619	981	638	225.7	8.8	275.5	3.0	3390.0	3387.0	129.4	66.6	281.0
10300103	Lamine	Lamine River Basin	481	257	224	47.3	2.5	40.3	2.5	270.0	267.5	38.8	18.9	60.9
10300104	Blackwater	Blackwater River Basin	25	15	10	36.2	4.1	15.9	13.4	62.3	48.9	37.6	20.6	49.3
10300200	Lower Missouri	Missouri River Mainstem- Hermann to St.L	3804	1094	2710	111.8	1.4	44.8	9.0	254.0	245.0	110.0	79.0	143.0
11010001	Beaver Reservoir	Table Rock Lake Basin	464	415	49	8.5	0.3	5.5	0.5	75.0	74.5	7.1	5.8	10.0
11010002	James	James River Basin	3049	2875	174	22.8	0.5	24.6	0.0	297.0	297.0	11.7	8.0	28.9
11010003	Bull Shoals Lake	Bull Shoals Lake Basin	201	157	44	5.8	0.2	2.4	1.4	20.4	19.0	5.8	4.0	7.0
11010006	North Fork White	North Fork White River Basin	213	196	17	5.2	0.5	6.9	0.1	98.0	98.0	4.4	4.0	5.2
11010007	Upper Black	Black River Basin	812	654	158	41.8	5.1	129.6	0.5	2870.0	2869.5	11.0	7.9	35.0
11010008	Current	Current River Basin	379	348	31	3.8	0.1	1.9	0.1	25.0	24.9	3.6	3.0	4.0
11010009	Lower Black	Fourche Creek Basin	5	5	0	4.8	0.4	0.8	4.0	6.0	2.0	5.0	4.0	5.5
11010010	Spring	Spring River Basin (Howell/Oreg counties)	107	107	0	4.5	0.5	4.9	2.0	53.5	51.5	3.9	3.4	4.4
11010011	Eleven Point	Eleven Point River Basin	67	67	0	2.8	0.2	1.3	0.4	11.0	10.6	2.5	2.0	3.0
11070206	Lake O' the Cherokees	Cherokees Lake Basin	39	39	0	7.1	0.7	4.4	0.1	24.5	24.4	6.0	5.0	8.0
11070207	Spring	Spring River Basin	1797	1420	377	120.1	7.4	278.9	0.1	4810.0	4809.9	49.0	22.0	95.4
11070208	Elk	Elk River Basin	2081	944	1137	9.1	0.3	7.7	0.0	78.3	78.3	7.0	5.9	10.0

Hardness Summary Table for Streams

8-digit HUC	USGS Basin Name	Missouri Basin Name	Count	N	N - Blank	Mean	SE Mean	StDev	Minimum	Maximum	Range	Median	Q1=25%	Q3=75%
7100009	Lower Des Moines	Des Moines Basin	244	232	12	279.3	4.6	70.6	28.0	510.0	482.0	270.0	230.0	320.0
7110001	Bear-Wyaconda	Wyaconda - Fox Rivers	303	168	135	208.3	3.5	45.3	74.0	370.0	296.0	210.0	180.0	240.0
7110002	North Fabius	North Fabius River Basin	59	25	34	197.4	12.1	60.6	85.9	291.0	205.1	213.0	145.0	241.0
7110003	South Fabius	South Fabius River Basin	177	142	35	167.8	4.7	56.1	33.0	310.0	277.0	170.0	130.0	210.0
7110004	The Sny	North River - Bobs Creek	194	17	177	208.8	18.9	77.8	61.0	296.0	235.0	220.0	170.0	268.0
7110005	North Fork Salt	North Salt River Basin	144	86	58	112.7	4.9	45.8	24.0	230.0	206.0	110.5	80.3	147.3
7110006	South Fork Salt	Middle-South Forks of the Salt River	181	135	46	150.2	5.6	64.8	10.5	368.0	357.5	148.0	106.0	193.0
7110007	Salt	Lower Salt River Basin	245	215	30	125.1	3.7	53.6	15.0	280.0	265.0	120.0	87.0	160.0
7110008	Cuivre	Cuivre River Basin	205	154	51	163.1	3.7	45.4	42.0	279.0	237.0	170.0	130.0	200.0
7110009	Peruque-Piasa	Peruque-Dardenne Creeks	2265	354	1911	209.7	2.4	45.0	27.0	322.0	295.0	210.0	190.0	240.0
7140101	Cahokia-Joachim	Mississippi River Tribs - St. L-Ste. Gen	1881	1156	725	245.7	3.0	103.1	35.0	779.0	744.0	230.0	180.0	297.0
7140102	Meramec	Meramec River Basin	4234	3869	365	191.0	1.3	81.6	0.0	820.0	820.0	180.0	146.0	208.0
7140103	Bourbeuse	Bourbeuse River Basin	165	164	1	120.2	3.0	38.8	40.0	227.0	187.0	120.0	92.2	140.0
7140104	Big	Big River Basin	961	648	313	280.3	5.8	148.4	1.7	1090.0	1088.4	240.0	199.3	300.0
7140105	Upper Mississippi-Cape Girardeau	Mississippi River Tribs - Ste. Gen-Cape Gir.	1901	467	1434	192.3	2.6	55.5	13.8	366.0	352.2	203.0	171.0	229.0
7140107	Whitewater	Castor-Whitewater Rivers Basin	88	64	24	133.5	6.4	51.0	23.0	227.0	204.0	130.5	95.2	177.0
8010100	Lower Mississippi-Memphis	Mississippi River Mainstem Below Ohio River	15	2	13	192.5	7.5	10.6	185.0	200.0	15.0	192.5 *		*
8020201	New Madrid-St. Johns	St. Johns Bayou	69	63	6	127.2	4.0	31.5	35.0	215.0	180.0	130.0	118.0	143.0
8020202	Upper St. Francis	Upper St. Francis Basin	373	243	130	160.0	11.3	175.8	12.3	1150.0	1137.7	123.0	88.0	158.0
8020203	Lower St. Francis	Lower St. Francis Basin	165	6	159	78.9	11.5	28.1	46.1	118.0	71.9	70.7	56.5	110.5
8020204	Little River Ditches	Little River Ditches	189	178	11	147.3	4.4	58.7	3.0	270.0	267.0	160.0	96.0	190.0
8020302	Cache	Cache River Basin	No data -	Use a watershed with similar characteristics										
10240001	Keg-Weeping Water	Missouri River Bottom	No data -	Use a watershed with similar characteristics										
10240004	Nishnabotna	Nishnabotna River Basin	310	295	15	256.2	4.3	74.3	5.0	740.0	735.0	260.0	230.0	300.0
10240005	Tarkio-Wolf	Tarkio-Squaw Tributaries Basin	9	1	8	190.0 *		*	190.0	190.0	0.0	190.0 *		*
10240010	Nodaway	Nodaway River Basin	454	353	101	195.9	2.2	40.6	8.0	320.0	312.0	200.0	180.0	220.0
10240011	Independence-Sugar	Missouri River Mainstem	465	373	92	279.3	2.8	53.7	63.0	540.0	477.0	271.0	240.5	312.0
10240012	Platte	Platte River Basin	220	162	58	184.1	3.9	49.2	54.0	360.0	306.0	180.0	149.8	220.0
10240013	One Hundred and Two	102 River Basin	11	6	5	194.2	11.3	27.8	147.0	223.0	76.0	194.5	176.3	220.8
10270104	Lower Kansas	Kansas River Basin	No data -	Use a watershed with similar characteristics										
10280101	Upper Grand	Upper Grand River Basin	366	310	56	214.7	3.1	55.0	53.0	360.0	307.0	220.0	180.0	247.3
10280102	Thompson	Thompson River Basin	248	198	50	186.4	4.1	58.1	39.0	320.0	281.0	190.0	150.0	225.0
10280103	Lower Grand	Middle Grand River Basin	967	743	224	187.8	2.1	58.1	13.0	400.0	387.0	196.0	150.0	222.0
10280201	Upper Chariton	Upper Chariton River Basin	547	439	108	167.5	3.2	67.4	32.0	470.0	438.0	150.0	120.0	200.0
10280202	Lower Chariton	Lower Chariton River Basin	100	74	26	163.5	6.2	53.2	60.0	327.0	267.0	160.0	130.0	188.5
10280203	Little Chariton	Little Chariton River Basin	550	220	330	379.0	23.1	343.0	32.0	3300.0	3268.0	270.0	162.3	510.0
10290102	Lower Marais Des Cygnes	Maries des Cygnes River Basin	345	215	130	309.9	31.0	455.1	53.0	3532.0	3479.0	183.0	153.7	225.0
10290103	Little Osage	Little Osage River Basin	160	75	85	208.6	6.6	57.2	1.7	354.0	352.4	212.0	173.3	237.0
10290104	Marmaton	Marmaton River Basin	431	261	170	204.0	5.0	80.7	28.0	514.0	486.0	208.0	164.8	249.5
10290105	Harry S. Truman Reservoir	Upper Osage River Basin	212	127	85	165.1	5.5	61.5	25.0	330.0	305.0	170.0	120.0	210.0
10290106	Sac	Sac River Basin	691	269	422	203.1	3.6	58.4	30.1	394.0	363.9	210.0	181.0	230.0
10290107	Pomme De Terre	Pomme de Terre River Basin	135	96	39	196.2	2.7	26.3	100.0	244.0	144.0	200.0	180.0	218.8
10290108	South Grand	South Grand River Basin	872	173	699	704.7	35.7	469.5	80.0	2100.0	2020.0	780.0	230.0	1100.0
10290109	Lake of the Ozarks	Lake of Ozarks Basin	95	67	28	207.8	6.3	51.7	79.0	300.0	221.0	209.0	170.0	240.0
10290110	Niangua	Niangua River Basin	209	187	22	168.4	2.7	37.4	44.0	240.0	196.0	170.0	145.0	198.0
10290111	Lower Osage	Lower Osage River Basin	319	287	32	154.9	1.9	32.9	70.0	243.0	173.0	150.0	130.0	178.0
10290201	Upper Gasconade	Upper Gasconade River Basin	15	14	1	162.1	10.1	37.8	98.0	210.0	112.0	175.0	120.0	191.8
10290202	Big Piney	Big Piney River Basin	131	127	4	148.9	3.6	41.0	26.0	243.0	217.0	150.0	130.0	170.0
10290203	Lower Gasconade	Lower Gasconade River Basin	247	150	97	167.0	2.2	27.2	61.0	220.0	159.0	170.0	150.0	183.8
10300101	Lower Missouri-Crooked	Missouri River Mainstem- KC to Glasgow	1008	277	731	228.4	4.9	80.7	6.0	910.0	904.0	230.0	187.0	270.8
10300102	Lower Missouri-Moreau	Missouri River Mainstem- Glasgow to Hermann	1619	397	1222	334.8	11.6	231.9	60.0	1660.0	1600.0	251.0	188.0	412.0
10300103	Lamine	Lamine River Basin	481	143	338	159.3	4.6	55.3	53.0	407.0	354.0	160.0	120.0	190.0
10300104	Blackwater	Blackwater River Basin	25	15	10	207.7	13.2	51.3	149.0	312.0	163.0	202.0	162.0	242.0
10300200	Lower Missouri	Missouri River Mainstem- Hermann to St.L	3804	3735	69	231.5	1.5	92.9	31.0	2904.0	2873.0	220.0	182.0	254.1
11010001	Beaver Reservoir	Table Rock Lake Basin	464	263	201	125.2	2.0	32.0	14.0	304.0	290.0	122.0	105.0	140.0
11010002	James	James River Basin	3049	683	2366	178.5	2.0	51.3	0.0	746.0	746.0	173.0	158.0	194.0
11010003	Bull Shoals Lake	Bull Shoals Lake Basin	201	157	44	204.3	3.0	37.7	67.0	294.0	227.0	210.0	180.0	230.0
11010006	North Fork White	North Fork White River Basin	213	198	15	193.5	2.3	32.2	45.5	250.0	204.5	200.0	180.0	217.3
11010007	Upper Black	Black River Basin	812	539	273	162.3	3.5	80.1	11.0	662.0	651.0	153.0	110.0	194.0
11010008	Current	Current River Basin	379	299	80	154.0	1.9	33.5	34.0	254.0	220.0	160.0	140.0	179.0
11010009	Lower Black	Fourche Creek Basin	5	5	0	206.8	23.8	53.3	130.0	250.0	120.0	237.0	151.0	247.5
11010010	Spring	Spring River Basin (Howell/Oreg counties)	107	54	53	250.2	5.2	38.3	72.0	376.0	304.0	254.0	231.8	271.3
11010011	Eleven Point	Eleven Point River Basin	67	58	9	170.0	3.6	27.6	63.0	210.0	147.0	175.0	150.0	190.0
11070206	Lake O' the Cherokees	Cherokees Lake Basin	39	39	0	126.5	4.8	30.0	2.5	196.0	193.5	127.0	118.0	138.0
11070207	Spring	Spring River Basin	1797	807	990	184.9	3.2	91.8	14.8	1380.0	1365.2	170.0	144.3	197.0
11070208	Elk	Elk River Basin	2081	397	1684	137.6	1.1	21.4	15.0	240.0	225.0	140.0	130.0	150.0

				Chloride Summary Table -8-digit HUCs with Reservoirs								
8-digit HUC	Count	N	N - Blank	Mean	SE Mean	StDev	Minimum	Maximum	Range	Median	Q1=25%	Q3=75%
7110001	8	8	0	2.1	0.1	0.4	1.5	2.7	1.2	2.2	1.8	2.5
7110002	31	31	0	3.3	0.4	2.3	0.0	7.6	7.6	2.6	2.0	5.3
7110003	12	12	0	5.8	0.8	2.8	3.1	10.5	7.4	4.3	3.9	9.0
7110004	16	16	0	4.5	0.4	1.8	2.9	7.7	4.8	3.9	3.0	6.4
7110005	24	24	0	7.7	0.7	3.4	2.5	14.6	12.1	7.4	5.8	10.9
7110007	34	23	11	7.6	0.5	2.4	3.2	14.0	10.8	8.0	5.9	9.0
7110008	8	8	0	3.0	0.2	0.5	2.4	3.8	1.3	3.1	2.5	3.4
7110009	23	11	12	11.0	0.7	2.4	7.3	14.6	7.4	11.0	9.0	12.9
7140101	10	10	0	49.2	12.6	39.8	4.4	103.6	99.2	69.2	4.5	77.4
7140103	18	18	0	2.6	0.1	0.5	2.0	3.2	1.2	2.6	2.0	3.0
7140104	36	36	0	5.3	0.5	3.0	1.0	10.1	9.1	5.2	4.1	6.0
7140105	8	8	0	1.7	0.3	0.8	0.8	2.5	1.6	1.7	1.0	2.5
8020202	20	20	0	2.4	0.2	0.8	1.0	3.8	2.8	2.5	2.0	2.8
8020203	1	0	1	*	*	*	*	*	*	*	*	*
8020204	4	4	0	1.4	0.1	0.1	1.2	1.6	0.3	1.4	1.3	1.5
10240010	7	7	0	4.2	0.2	0.5	3.7	4.8	1.1	4.0	3.8	4.7
10240011	5	5	0	15.2	5.5	12.2	9.3	37.0	27.8	9.7	9.3	23.7
10240012	48	24	24	7.4	0.5	2.2	2.7	10.4	7.8	8.2	6.3	8.8
10240013	27	16	11	6.7	0.5	2.1	4.4	10.4	5.9	6.2	5.0	9.0
10280101	52	52	0	4.8	0.5	3.3	1.6	19.3	17.8	3.6	2.4	6.6
10280102	4	4	0	1.2	0.2	0.3	1.0	1.6	0.7	1.0	1.0	1.5
10280103	89	88	1	437.5	90.0	844.1	1.3	6500.0	6498.7	130.0	2.9	580.5
10280201	4	4	0	2.2	0.2	0.5	1.6	2.6	1.1	2.4	1.7	2.6
10280202	24	24	0	4.8	0.3	1.4	2.0	7.0	5.0	5.0	3.7	6.1
10280203	15	15	0	5.9	0.3	1.2	3.4	7.5	4.1	6.3	5.3	6.8
10290103	4	4	0	4.4	0.1	0.1	4.3	4.6	0.4	4.4	4.3	4.6
10290104	4	4	0	2.0	0.1	0.2	1.7	2.2	0.5	2.0	1.8	2.2
10290105	135	44	91	5.3	0.3	2.1	0.4	8.0	7.6	5.3	3.8	7.0
10290106	630	521	109	9.4	0.1	2.8	0.0	34.0	34.0	9.3	8.0	10.4
10290107	24	22	2	5.6	0.2	0.8	4.0	7.5	3.5	5.4	5.2	6.0
10290108	54	54	0	6.5	0.7	5.5	1.2	30.5	29.3	4.4	3.3	7.8
10290109	274	233	41	5.5	0.1	1.2	1.0	8.0	7.0	6.0	5.0	6.0
10290203	4	4	0	4.8	0.1	0.1	4.7	5.0	0.3	4.8	4.7	5.0
10300101	7	7	0	6.2	0.2	0.5	5.5	6.8	1.3	6.5	5.7	6.6
10300102	47	47	0	5.7	0.6	4.3	0.7	15.1	14.4	4.6	1.6	7.1
10300103	8	8	0	2.7	0.1	0.4	1.8	3.2	1.5	2.7	2.6	2.9
10300104	32	32	0	5.4	0.2	0.9	3.9	7.3	3.4	5.4	4.9	6.0
11010001	98	98	0	25.6	1.8	17.8	0.8	68.5	67.7	19.5	12.5	37.5
11010003	130	120	10	6.5	0.2	2.4	2.5	17.0	14.5	5.9	5.0	7.0
11010007	38	16	22	1.7	0.2	0.7	1.0	3.5	2.5	1.5	1.1	2.3
11010011	11	11	0	1.3	0.2	0.8	0.0	2.0	2.0	1.0	1.0	2.0

				Sulfate (SO4) Summary Table -8-digit HUCs with Reservoirs								
8-digit HUC	Count	N	N - Blank	Mean	SE Mean	StDev	Minimum	Maximum	Range	Median	Q1=25%	Q3=75%
7110001	8	0	8	*	*	*	*	*	*	*	*	*
7110002	31	11	20	11.5	2.3	7.7	2.0	33.0	31.0	10.0	9.0	11.0
7110003	12	0	12	*	*	*	*	*	*	*	*	*
7110004	16	0	16	*	*	*	*	*	*	*	*	*
7110005	24	0	24	*	*	*	*	*	*	*	*	*
7110007	34	12	22	39.2	6.2	21.5	10.0	85.0	75.0	33.5	25.8	52.5
7110008	8	0	8	*	*	*	*	*	*	*	*	*
7110009	23	0	23	*	*	*	*	*	*	*	*	*
7140101	10	0	10	*	*	*	*	*	*	*	*	*
7140103	18	10	8	10.4	1.4	4.3	2.0	15.0	13.0	12.0	6.0	14.0
7140104	36	0	36	*	*	*	*	*	*	*	*	*
7140105	8	0	8	*	*	*	*	*	*	*	*	*
8020202	20	0	20	*	*	*	*	*	*	*	*	*
8020203	1	1	0	2.5	*	*	2.5	2.5	0.0	2.5	*	*
8020204	4	0	4	*	*	*	*	*	*	*	*	*
10240010	7	0	7	*	*	*	*	*	*	*	*	*
10240011	5	0	5	*	*	*	*	*	*	*	*	*
10240012	48	24	24	13.7	0.8	3.8	5.0	21.0	16.0	15.0	11.3	15.8
10240013	27	0	27	*	*	*	*	*	*	*	*	*
10280101	52	0	52	*	*	*	*	*	*	*	*	*
10280102	4	0	4	*	*	*	*	*	*	*	*	*
10280103	89	2	87	21.5	10.5	14.8	11.0	32.0	21.0	21.5	*	*
10280201	4	0	4	*	*	*	*	*	*	*	*	*
10280202	24	0	24	*	*	*	*	*	*	*	*	*
10280203	15	0	15	*	*	*	*	*	*	*	*	*
10290103	4	0	4	*	*	*	*	*	*	*	*	*
10290104	4	0	4	*	*	*	*	*	*	*	*	*
10290105	135	119	16	51.6	3.1	33.7	5.0	180.0	175.0	42.0	27.0	66.0
10290106	630	523	107	7.5	0.2	3.6	0.0	50.0	50.0	7.0	5.8	8.3
10290107	24	16	8	6.4	0.6	2.3	4.6	13.0	8.4	5.9	5.4	6.1
10290108	54	10	44	12.8	1.4	4.3	5.0	19.0	14.0	12.0	10.0	17.3
10290109	274	46	228	26.3	2.4	16.0	0.0	62.0	62.0	27.0	9.5	39.0
10290203	4	0	4	*	*	*	*	*	*	*	*	*
10300101	7	0	7	*	*	*	*	*	*	*	*	*
10300102	47	0	47	*	*	*	*	*	*	*	*	*
10300103	8	0	8	*	*	*	*	*	*	*	*	*
10300104	32	0	32	*	*	*	*	*	*	*	*	*
11010001	98	93	5	14.8	0.9	8.3	0.0	32.9	32.9	12.3	9.6	20.3
11010003	130	118	12	9.3	0.8	8.4	0.5	81.0	80.5	8.0	6.7	9.1
11010007	38	22	16	20.3	2.3	10.9	1.5	39.7	38.2	22.7	10.0	32.0
11010011	11	11	0	2.3	0.4	1.2	1.0	4.0	3.0	2.0	1.0	4.0

					Hardness Summary Table -8-digit HUCs with Reservoirs							
8-digit HUC	Count	N	N - Blank	Mean	SE Mean	StDev	Minimum	Maximum	Range	Median	Q1=25%	Q3=75%
7110001	8	0	8	*	*	*	*	*	*	*	*	*
7110002	31	11	20	56.3	5.0	16.5	38.0	94.0	56.0	54.0	43.0	67.0
7110003	12	0	12	*	*	*	*	*	*	*	*	*
7110004	16	0	16	*	*	*	*	*	*	*	*	*
7110005	24	0	24	*	*	*	*	*	*	*	*	*
7110007	34	23	11	132.4	8.5	40.8	60.0	196.0	136.0	130.0	102.0	160.0
7110008	8	0	8	*	*	*	*	*	*	*	*	*
7110009	23	12	11	124.1	9.1	31.5	64.0	158.0	94.0	135.0	96.5	150.3
7140101	10	0	10	*	*	*	*	*	*	*	*	*
7140103	18	10	8	37.9	2.6	8.4	27.0	55.0	28.0	36.0	31.8	44.0
7140104	36	0	36	*	*	*	*	*	*	*	*	*
7140105	8	0	8	*	*	*	*	*	*	*	*	*
8020202	20	0	20	*	*	*	*	*	*	*	*	*
8020203	1	1	0	58.0	*	*	58.0	58.0	0.0	58.0	*	*
8020204	4	0	4	*	*	*	*	*	*	*	*	*
10240010	7	0	7	*	*	*	*	*	*	*	*	*
10240011	5	0	5	*	*	*	*	*	*	*	*	*
10240012	48	0	48	*	*	*	*	*	*	*	*	*
10240013	27	11	16	106.0	8.9	29.5	70.0	151.0	81.0	106.0	75.0	136.0
10280101	52	0	52	*	*	*	*	*	*	*	*	*
10280102	4	0	4	*	*	*	*	*	*	*	*	*
10280103	89	0	89	*	*	*	*	*	*	*	*	*
10280201	4	0	4	*	*	*	*	*	*	*	*	*
10280202	24	0	24	*	*	*	*	*	*	*	*	*
10280203	15	0	15	*	*	*	*	*	*	*	*	*
10290103	4	0	4	*	*	*	*	*	*	*	*	*
10290104	4	0	4	*	*	*	*	*	*	*	*	*
10290105	135	35	100	133.4	11.2	66.2	33.0	266.0	233.0	130.0	73.0	198.0
10290106	630	137	493	130.0	2.0	23.3	68.0	204.0	136.0	126.0	118.0	142.0
10290107	24	13	11	119.0	1.3	4.7	113.0	130.0	17.0	119.0	116.0	119.5
10290108	54	10	44	122.5	7.8	24.8	90.0	162.0	72.0	114.0	104.8	146.3
10290109	274	45	229	148.8	3.7	24.5	103.0	198.0	95.0	144.0	130.0	168.5
10290203	4	0	4	*	*	*	*	*	*	*	*	*
10300101	7	0	7	*	*	*	*	*	*	*	*	*
10300102	47	0	47	*	*	*	*	*	*	*	*	*
10300103	8	0	8	*	*	*	*	*	*	*	*	*
10300104	32	0	32	*	*	*	*	*	*	*	*	*
11010001	98	0	98	*	*	*	*	*	*	*	*	*
11010003	130	130	0	115.5	1.9	21.2	70.0	240.0	170.0	110.0	110.0	120.0
11010007	38	0	38	*	*	*	*	*	*	*	*	*
11010011	11	11	0	17.6	2.3	7.8	10.0	36.0	26.0	14.0	12.0	23.0

Below is a list and brief description of revisions:

Version	Date Completed	Description
Version 1.0	September 7, 2012	Original version written by Todd Blanc.