METHODOLOGY FOR THE EVALUATION AND DEVELOPMENT OF THE 2018 SECTION 303(D) LIST OF IMPAIRED WATER BODIES FOR KANSAS

Bureau of Water
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1.0 BACKGROUND

1.1 REQUIREMENTS UNDER SECTION 303(D) OF THE FEDERAL CLEAN WATER ACT

Section 303(d) of the Clean Water Act requires that States develop a list of water bodies needing additional work beyond existing controls to achieve or maintain water quality standards. This Section 303(d) list is meant to identify waters that require Total Maximum Daily Loads (TMDLs) because technology-based effluent limitations, more stringent State or local effluent limitations, and other pollution control requirements such as best management practices, are not stringent enough to implement applicable water quality standards. 40 CFR 130.7(b)(1).

A TMDL refers to the "total maximum daily load" of a pollutant that achieves compliance with a water quality standard, therefore a TMDL is essentially a regulatory tool which caps the allowable pollutant load to a water body and a planning tool which directs and guides practices that will bring a water body into compliance with the applicable water quality standard.

Under the current federal rules, States are to submit their 2018 Clean Water Act Section 303(d) lists of impaired waters, as well as the methodologies used to prepare them, by April 1, 2018. On October 20th, 2017 the U.S. Environmental Protection Agency issued a draft guidance memorandum regarding the 2018 Integrated Reporting (IR) including 303(d), 305(b) and 314 reports. This guidance builds on previous guidance's issued regarding the 2008, 2010, 2012, 2014, and 2016 Integrated Reporting (IR) and Listing Decisions documents, pursuant to sections 303(d), 305(b) and 314 of the Clean Water Act. The 2016 Kansas 303(d) list was submitted by KDHE on March 27, 2016 and was approved on April 30, 2016. The 2016 Kansas 303(d) list builds upon the prior approved lists, and seeks to further clarify the status of Kansas waters in light of ongoing water quality monitoring data.

1.2 WATER QUALITY STANDARDS (STATE OF KANSAS)

Kansas surface water quality standards create the 'yardstick' by which water bodies are measured against. Kansas surface water quality standards are defined by:

1) designating beneficial uses of the water as contained in K.A.R. 28-16-28d;
2) setting criteria necessary to protect the beneficial uses, contained in K.S.A. 28-16-28e; and
3) establishing an antidegradation policy, contained in K.A.R. 28-16-28c(a).

Beneficial uses of waters in Kansas include aquatic life, domestic water supply, food procurement, groundwater recharge, industrial water supply, irrigation, livestock watering, and recreation. In general, most pollutants impair aquatic life, recreation, domestic water supply and food procurement.

1.3 DESCRIPTION OF 303(D) LIST PURPOSE AND LINKAGE TO 305(B) WATER QUALITY REPORT

The generation of this 303(d) List is an essential planning and guidance tool for the state. The Kansas 2018 303(d) list not only identifies those water bodies from the 2016 303(d) list which still require TMDLs, but also determines those new water bodies and pollutants for which TMDLs will

be needed. Water bodies are assigned a priority for TMDL development by assessing the frequency, magnitude and duration of impairment by a pollutant, as well as considering public comment.

2018 represents the sixth reporting cycle of integrating the 305(b) report and the 303(d) list in a single report. Nonetheless, fundamental differences remain for the two assessment procedures. The 305(b) report provides an assessment or measure of *all* waters in the state through probabilistic monitoring. The 305(b) report provides an overall picture of the water quality and recent status of support for the designated uses of waters within a state and is intended to represent a statistical analysis of overall water quality rather than provide information regarding individual water bodies.

In contrast, the assessment procedures used for 303(d) listing, by necessity, are more intensive. The 303(d) list is a subgroup of all surface waters in the state; i.e., those water bodies not meeting one or more water quality standards because of pollutants and needing a TMDL. Because of the associated cost to the state in developing and implementing TMDLs, the state must determine the extent a water body is impaired and its relative severity among other water bodies with some degree of confidence. Hence, the need for more vigorous assessment prior to listing a water body as impaired.

1.4 RELATIONSHIP OF KANSAS 303(D) LIST TO 2018 INTEGRATED REPORT GUIDANCE

In as much as practicable, the Kansas 303(d) list and supporting information will be developed and submitted to the EPA in accordance with the October 20th, 2017 draft memorandum. The list viewed for public review includes those waters identified by guidance as "Category 5"; those waters requiring development of a TMDL because of impairment by a pollutant. However, the public list will also include Category 2 waters that represent waters delisted from the 2008, 2010, 2012, 2014 and 2016 303(d) lists and Category 3 waters requiring additional information in order to make listing decisions for future 303(d) lists. Waters that now have a TMDL because of impairments identified from the 1998, 2002, 2004, 2008, 2010, 2012, 2014 and 2016 lists are included in the reporting database as Category 4a waters and are identified for the public by posting of approved TMDLs on the KDHE website. Waters that have addressed their impairment by other means than a TMDL are identified in the public report and database as 4b waters. Definitions of the five Categories for waters provided by the guidance from EPA and Kansas' interpretation on using those Categories is provided in **Table 1**.

2.0 ASSESSMENT UNIT DEVELOPMENT

2.1 DESCRIPTION OF KANSAS AMBIENT SURFACE QUALITY NETWORK

Kansas has an extensive surface water quality monitoring network consisting of 328 active ambient stream chemistry monitoring sites spanning all the major river basins. Of these, there are 160 core sites currently visited on a quarterly basis every year, whereas the remaining 168 sites are monitored using a four-year rotational approach; i.e., samples are collected quarterly from approximately 25 percent of these sites each year. The biological network of monitoring sites includes 222 monitoring sites. Of these, samples are generally obtained from 40-70 core stations annually. Fish tissue samples normally are obtained each year from 40 water bodies across the

state, which include eight long-term river and 17 long term lake monitoring sites. Water quality information currently is obtained from 120 lakes and wetlands, which includes all 24 federal reservoirs, most state-administered fishing lakes, various other state, county or locally owned lakes, several privately owned but publicly accessible lakes, and seven state or federally owned marshes. Probabilistic stream monitoring of random sites across the state began in 2006 with approximately 50 sites which were sampled four times for chemistry and once for biology that year. Approximately another 50 sites were sampled each year over 2007 - 2017. The results from the probabilistic monitoring comprise the findings of the 305(b) assessment report regarding stream water quality.

2.2 DELINEATION ASSESSMENT UNITS (CONTRIBUTING AREAS TO MONITORING SITES)

Of the Kansas Department of Health and Environment's (KDHE) 328 ambient stream chemistry monitoring sites, 160 are fixed (permanent) sites sampled quarterly every year, and 168 are rotational sites sampled quarterly every four years. Assessment units (AU) were defined within the state by delineating the unique contributing area to each monitoring site. Groupings at the HUC 12 level were used as the basis for unique contributing areas to these monitoring sites. Once grouped by HUC 12, additional alterations to the boundaries were made using a digital elevation map (DEM) to create unique boundaries for each monitored area. This process ensures that no area is associated with more than one monitoring station and each AU boundary typically includes only tributary segments upstream of the monitoring station. The stream segments of the 2013 Kansas Surface Water Register (KSWR) were placed into each AU and a unique watershed name was assigned to each based on the main stem of each AU. The KSWR was also merged to the National Hydrography Dataset (NHD) (1:100,000) and this merge can be used as a translator from the AU stream routing structure in KSWR to a routing structure in NHD.

316 stream AUs were created from the 328 ambient stream chemistry monitoring sites. The discrepancy between the number of monitoring sites and AUs is because one monitoring station is located in Missouri, and monitors a watershed completely contained within Missouri, and the other stations are too new to have AUs assigned. When they meet minimum data requirements the AUs and the segment to station assignments will be revisited.

The 25 largest lakes and the largest wetland by surface area (Cheyenne Bottoms) of the 118 monitored lakes and wetlands were also delineated by the same method, complementing the existing stream AUs previously created. The establishment of these lake AUs creates unique contributing areas to the larger reservoirs in Kansas. The remainder of the monitored lakes and wetlands are identified simply as water bodies without a defined contributing area and have been identified as to which AU they are located within.

Generally, biological and fish tissue collection sites are located near a stream or lake monitoring site, so a best match for these sites were found from the existing AUs.

Based upon the combined area of all defined AUs within the state, almost 97% of the contributing areas of Kansas are monitored by the KDHE water quality monitoring program.

2.3 MAP AND TABLE FORMATS USED IN DESCRIPTION OF ASSESSMENT UNITS

For TMDL planning purposes, visual clarity and to make the public participation process consistent with the current state water planning process, the state was divided into 12 river basins. Maps locating the AUs and monitoring sites were created for each of these 12 river basins. These maps are available at: http://www.kdheks.gov/tmdl/download/Maps_AssessmentUnit.pdf. Tables of the registered streams in each assessment unit or in the case of a lake AU, streams and the lake itself, are available for each of the 12 river basins from the Watershed Planning, Monitoring, and Assessment Section.

3.0 DATA CONSIDERATIONS FOR 2018 LIST

3.1 APPLICATION OF 2016 303(D) LIST

Certain impairments listed in the 2016 303(d) list will be evaluated for delisting during the generation of the 2018 303(d) list. Section 4.6, 5.6 and 6.5 describes the assessment method for delisting decisions. Error corrections to the 2016 list will be made as set forth in Section 3.2.

3.2 2016 303(D) LIST - ERROR CORRECTIONS

Errors in the 2016 303(d) list will be corrected in the 2018 list. Examples of these corrections to the 2016 list are typographical list errors and water bodies that were never impaired but certain flaws in the original analysis led to the waters being listed.

3.3 2018 305(B) WATER QUALITY REPORT USE

Because of the relatively small number of sample points from the individual biological, lakes/wetlands and fish tissue network monitoring sites through time, the information and best professional judgment used to generate the assessment of these three sections of the 2018 305(b) report will be the primary basis for any associated listings in the 2018 303(d) list. The stream chemistry monitoring network sites have a larger number of samples for each monitoring site. This will allow a more intensive statistical assessment of impairment for these sites for inclusion in the 2018 303(d) list.

3.4 SPATIAL APPLICABILITY OF DATA

AUs have been defined based on contributing areas to ambient stream monitoring and lake stations. If an impairment is determined at a monitoring point, the stream segment or lake/wetland associated with that monitoring point will be listed. In the case of a stream AU, this will always be the main stem of the system within the AU and in the case of a lake/wetland AU, it will always be the lake/wetland. If the lake/wetland AU is defined as just that water body, then reference to potential contributors in the surrounding watershed will not be made.

3.5 USE OF DATA (CHEMICAL, BIOLOGICAL, INTERNAL, EXTERNAL)

As required by Section 303(d) of the Clean Water Act and 40 CFR 130.7(b)(5), KDHE will compile and consider "all existing and readily available water quality related data and information" in identifying waters to be listed. Existing and readily available data and information includes, but is not limited to:

- 2016 303(d) List;
- 2018 305(b) Report's waters that are not meeting a designated beneficial use;
- Clean Water Act 319 nonpoint source and Watershed Restoration and Protection Strategy assessments,
- Drinking water source water assessment under Section 1453 of the Safe Drinking Water Act;
- KDHE fish consumption advisories,
- Data, information, and water quality problems reported from local, State, or Federal agencies, Tribal governments, the public, and academic institutions.

Much of these data tend to corroborate existing listings or TMDLs generated from KDHE water quality data. Nonetheless, a targeted request will be made to U.S. Geological Survey, U.S. Army Corps of Engineers, and Kansas Biological Survey for any water quality data collected since 2000 on Kansas lakes and streams.

As stated earlier, KDHE operates an extensive water quality monitoring network throughout Kansas and believes it is important that the decision to list a water body be based upon credible evidence. KDHE encourages the submittal of additional data and information from the general public during the list development and public comment period. Data and information can be in the form of analytical results, numeric data or information or narrative/qualitative submittals. When such information is submitted, the observation date, location(s), quality assurance methods and other pertinent information should also be provided. Other pertinent information includes the rationale supporting the observation being considered outside the normal range of conditions. If not page verifiable, narrative and qualitative submittals may not be used in the 303(d) process. However, such information will be considered in the planning of future monitoring activities by KDHE. In order to solicit available data from other entities, KDHE will publish public notice in the Kansas Register on October 5th, 2017 to request data from various agencies and the public to be submitted to KDHE by November 17th, 2017.

4.0 STREAM CHEMISTRY METHODOLOGY

4.1 SAMPLE SIZE REQUIREMENTS – STREAM CHEMISTRY

In most cases, a minimum of 12 samples will be required to make a determination of impairment for ambient stream chemistry monitoring sites and their associated AUs. An exception to the minimum sample size requirement would be the case where a sufficient number (3) of criterion excursions to list an AU as impaired has occurred prior to the collection of all 12 samples. In this case, regardless of the result of the remaining samples required to meet the minimum sample size, the assessment will always determine impairment once the sample size requirement is met. Similarly, data from the

probabilistic stream monitoring network will indicate impairment if three or more criteria excursions are recorded.

4.1.1 Temporal Bounds of Data – Stream Chemistry

In an effort to meet the sample size requirements in 4.1, data collected from January 2000, through September 30, 2017, will be used for fixed (permanent) stream chemistry sites or their associated AUs. Data collected from 1990 through September 30, 2017, will be used for rotational chemistry sites or their associated AUs in the assessment of stream chemistry impairment. For chronic toxicity analysis for selenium at rotational or permanent sites, samples taken from January 2000 through September 30, 2017 will be evaluated. For chronic toxicity analysis for metals at rotational or permanent sites, samples taken from July 1, 2002 through September 30, 2017 will be evaluated.

4.2 Designated Use Applications – Stream Chemistry

Where possible, the water quality for use support of all monitored waters will be evaluated for potential inclusion on the 2018 303(d) List. The designated uses of these waters will determine the level of assessment necessary to evaluate impairment. For a complete list of criteria in conjunction with designated uses see K.A.R. 28-16-28e(d) table 1a.

The assessment levels of the designated uses are generally tailored after those suggested in EPA's *Guidelines for the Preparation of the Comprehensive State Water Quality Assessments and 305(b) Reports and Updates: Supplement*, where impairment is defined as excursion rates greater than 10 percent.

4.2.1 Aquatic Life Considerations

Kansas has two categories of aquatic life support. All parameter standards (except metals or selenium) associated with the *chronic* category of aquatic life support will have an assessment level by percent excursion of:

Not impaired: < 10% as determined by the binomial test (see section 4.3)
Impaired >10%, failing the binomial test (see section 4.3)

The standards associated with the *acute* category or for chronic toxicity (metals or selenium) will have a dual assessment level depending on the type of sampling site.

Stream chemistry sites (three sampling year minimum):
Not impaired: $\leq$ 1 violation for every three years of data
Impaired > 1 violation for every three years of data

4.2.2 Interpretation of Narrative Criteria For Total Suspended Solids and Total Phosphorus

In the 2008 303(d) analysis, KDHE decided to implement an adaptive approach to identifying areas where significant total suspended solids or nutrient pollution exists using interpretive numbers that

are neither adopted numeric criteria nor likely the final value that will be adopted should Kansas choose to establish numeric criteria for these parameters. The interpretive benchmarks for excessive suspended solids or nutrients identify areas that are the most severely impacted waters, without establishing the absolute concentrations that streams must attain to fully support aquatic life.

4.2.2.1 Total Phosphorus

K.A.R. specifies that "*The introduction of plant nutrients into streams, lakes, or wetlands from artificial sources shall be controlled to prevent the accelerated succession or replacement of aquatic biota or the production of undesirable quantities or kinds of aquatic life*." In 2001 EPA issued ambient nutrient water quality criteria recommendations for rivers and streams in nutrient ecoregion V, the South Central Cultivated Great Plains, which covers over 65% of Kansas (EPA 822-B-01-014). The recommendations summarized a large dataset and established 67 µg/L total phosphorus as the overall guidance value for the area. While KDHE has not adopted any specific nutrient criteria for phosphorus, some value for interpreting the narrative criteria is needed. There are 3 other ecoregions covering Kansas, and the 67 µg/L value is larger than the TP values corresponding to two of the three ecoregions. Nonetheless, the 67 µg/L value is viewed as a reasonable indicator of acceptable total phosphorus levels in Kansas streams.

Therefore, our initial analysis of total phosphorus concentrations focuses on waters most likely to be impaired and looks for values substantially larger than the 2001 guidance value as an ongoing condition. Specifically, for the purpose of developing the 2018 303(d) list, we shall consider a water as impaired by total phosphorus when a dataset of at least 12 samples over 2000 – September 30, 2017 for a monitoring site has a median concentration of total phosphorus exceeding 201 µg/L, or three times the 2001 guidance value. This interpretive value should not be seen as a final determination of nutrient concentrations acceptable to the state of Kansas, but rather as a first step in addressing the most seriously impaired waters while the state continues to deliberate specific nutrient criteria to be adopted in the future.

4.2.2.2 Total Suspended Solids

Total suspended solids (TSS) can be highly variable in stream and river systems, with strong linkages to stream discharge. K.A.R. specifies that "*Suspended solids added to surface waters by artificial sources shall not interfere with the behavior, reproduction, physical habitat, or other factors related to the survival and propagation of aquatic or semiaquatic life or terrestrial wildlife*." Prior to the development of the 2008 303(d) list of impaired waters, KDHE analyzed 15 years of suspended solids data and associated biological monitoring data. A strong threshold relationship exists at 50 mg/L median TSS, above which streams are unlikely to support a rich diversity of aquatic life. Species richness is strongly correlated with other measures of aquatic life use support, including proportion of ephemeroptera, plecoptera, and trichoptera species, a long-used indicator of acceptable biological condition in Kansas waters.

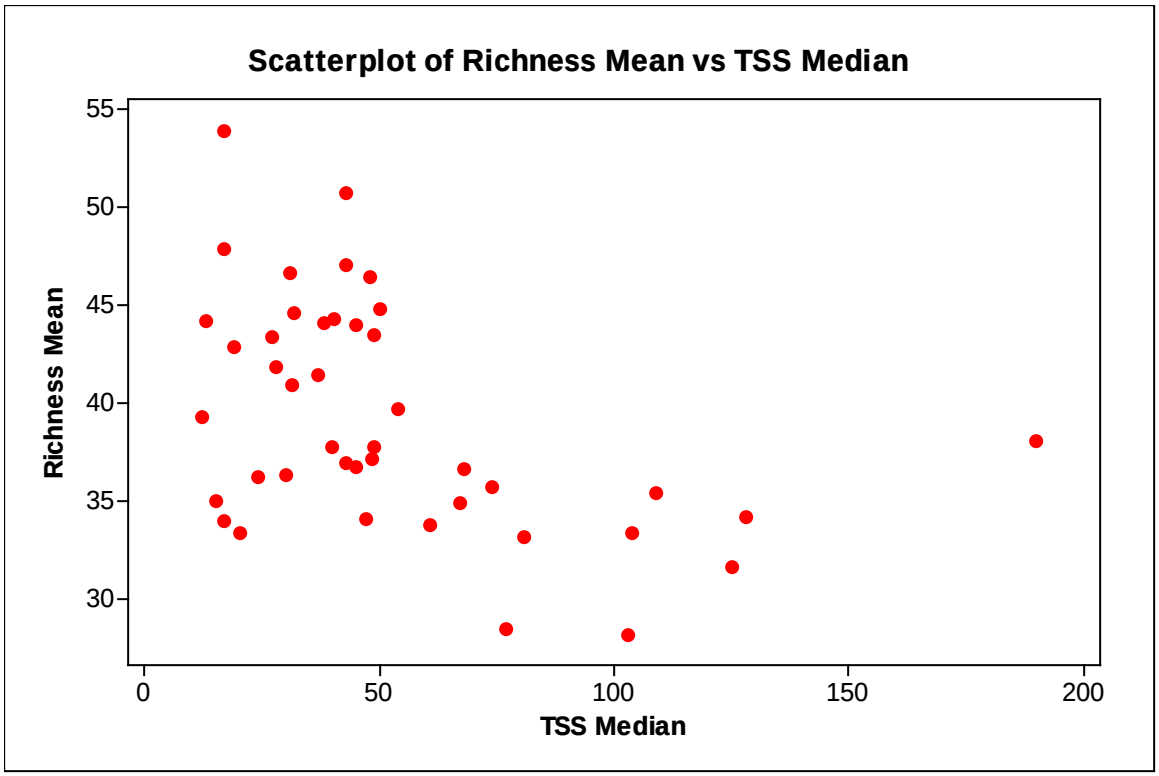

Figure 1-4. Scatterplot of species richness mean compared to median TSS values summarized from 15 years of KDHE data.

Therefore, for the purposes of 303(d) analysis, any stream or river with a dataset of at least 12 samples and a median concentration of greater than 50 mg/L TSS shall be listed as impaired, relative to aquatic life support.

4.2.2.3 Copper Biotic Ligand Model

KDHE adopted the Copper Biotic Ligand Model into the Water Quality Standards in 2015. For purposes of 303(d) analysis, stream or river data sets will be screened with the previous hardness based criteria in accordance with the methodology listed in 4.3, 4.4 and 4.6 of this document. The Biotic Ligand Model will be run for each sampling station that is currently listed for copper or for new stations that indicate potential impairment through the hardness based screening procedure. Sampling stations that indicate impairment based on the Biotic Ligand Model and the associated listing procedures for metals will be listed as Category 5. Stations that were previously listed in Category 5 and indicate no impairment through the Biotic Ligand Model and the associated impairment removal procedures will be placed in Category 2.

4.2.3 Contact Recreation

As applied to classified stream segments, Kansas has a Primary Contact Recreation (PCR) ‘not to exceed’ standard derived from a geometric mean calculated from at least five Escherichia coli bacteria (*E. coli)* samples collected from separate 24-hour periods within a 30-day period for PCR classes as follows (K.A.R. 28-16-28e (d)(7)(D) (table 1i)):

PCR class A; 160 cfu/100mL (in effect from April 1 through October 31 each year)
PCR class A; 2,358 cfu/100mL (in effect from November 1 through March 31 each year)

PCR class B; 262 cfu/100mL (in effect from April 1 through October 31 each year)
PCR class B; 2,358 cfu/100mL (in effect from November 1 through March 31 each year)

PCR class C; 427 cfu/100mL (in effect from April 1 through October 31 each year)
PCR class C; 3,843 cfu/100mL (in effect from November 1 through March 31 each year)

A Secondary Contact Recreation (SCR) 'not to exceed' standard derived from a geometric mean calculated from at least five *E. coli* samples collected from separate 24-hours periods within a 30-day period for SCR classes is as follows (K.A.R. 28-16-28e (d)(7)(E)(table 1i)):

SCR class A; 2,358 cfu/100mL (in effect January 1 through December 31)
SCR class B; 3,843 cfu/100mL (in effect January 1 through December 31)

KDHE routine stream monitoring protocols to date do not collect data to evaluate compliance with the minimum five-sample geometric mean criterion, therefore these designated uses cannot be assessed by any stream monitoring site within the state. However, there were 16 streams identified in 2006 as candidates for Category 3 for bacteria because they were previously listed before the water quality standard changed in 2003. These 16 streams were sampled intensively (5 times in a 30 day period) four times in 2006 to determine if they were impaired under the new standard. Those that violated the applicable geometric mean just once were listed as impaired by bacteria in the 2008 303(d) list. Those that did not exceed the geometric mean in any of the four seasonal samplings (Apr-May, Jun-Jul, Aug-Sept, & Oct-Nov) were identified as Category 2 waters.

Since then, a total of 110 stations have been sampled intensively over 2006 – 2013. Those recording a single violation went to Category 5 or remained in Category 4a if a fecal coliform bacteria TMDL was already in place. Those streams that did not indicate impairment from the intensive monitoring went to Category 2. New Category 3 streams for bacteria are identified based on binomial analysis of the routine monitoring data, if they showed at least 10% of individual samples with counts higher than the criteria value for *E. coli* bacteria. These streams await intensive monitoring to determine if impairment has occurred. An inventory of the 110 stations is provided in Table 4. Additionally, all stations on the Kansas and Arkansas Rivers have been intensively monitored numerous times over 2004 – 2013, many times indicating continued impairment by bacteria. No intensive bacteria sampling has occurred in 2014 through 2017. Therefore, stations identified as Category 5 for *E. coli* in the 2016 list are carried over onto the 2018 list.

4.2.4 Drinking Water, Irrigation and Livestock Watering Uses

Kansas has a suite of parameters used to protect water supply uses (K.A.R. 28-16-28e(e) table 1a). The nitrate, organics, metals, arsenic, selenium, and radionuclides standard assessment levels excursion will be:

Not impaired: = 0 or 1 violation over the past 10 years
Impaired: >1 violation over the past 10 years

All other parameters will be reviewed at assessment levels by binomial analysis:

Not impaired $\leq$ 10%
Impaired > 10%

Drinking Water Supply assessment level for pesticides (e.g. atrazine, alachlor) and priority pollutants will be first assessed based on violations of the criterion associated with annual averages.

Compliant Sampling Year: average concentration of samples in one calendar year < criterion for domestic drinking water supply

Non-compliant Sampling Year: average concentration of samples in once calendar year > criterion for domestic drinking water supply
Impaired: >1 non-compliant sampling year over the past 10 years

4.2.5 FOOD PROCUREMENT

Kansas has a variety of parameters used to protect food procurement use. Assessment will be made by fish tissue levels and consumption advisories.

The standard assessment level for pesticides, priority pollutants, organics, metals, and total selenium excursions will be:
Not impaired: = 0 or 1violation over the past 10 years
Impaired: >1 over the past 10 years

4.2.6 GROUNDWATER RECHARGE AND INDUSTRIAL USES

Assessed in consultation with GMDs and given evidence of recharge impairment by poor water quality in streams.

4.3 STATISTICAL METHODS FOR LISTING ASSESSMENT – STREAM CHEMISTRY

In evaluating water body monitoring data associated with stream chemistry sites using EPA's historical 305(b) guidelines, no more than 10% of the samples obtained from the water body should exceed a regulatory standard for conventional pollutants. This method, called the raw score method, simply sets an upper bound on the percentage of measurements at a monitoring site that may violate a standard. Unfortunately, the raw score method does not provide sufficient information to properly deal with the uncertainty concerning impairment, especially when dealing with smaller sample sizes (National Research Council, 2001).

For the Kansas 2018 303(d) list, candidate water bodies will be screened for impairment based on a nonparametric analysis of a confidence limit on a percentile of interest. Where applicable that percentile of the distribution is given by the assessment level of the review above, again based on

EPA's 305(b) guidelines of not more that 10% of the samples allowed to exceed a regulatory standard.

Conceptually, an assessment level of 10% excursion is really the same as the upper 90th percentile of the sample distribution. The question to answer in this evaluation is whether the true concentration for a particular constituent in a candidate water body meets or exceeds the assessment level of a regulatory standard. With only a certain number of samples to analyze from a monitoring site, the population's true concentration can never be known with certainty. However, it is possible to create an interval that will contain a particular percentile of the true concentration distribution with a given level of confidence. The confidence interval approach allows the incorporation of uncertainty in the true parameters of the distribution into a comparison to the regulatory standard.

In evaluating a stream's monitoring site data for impairment this confidence interval for the upper 90th percentile of the distribution can be used to determine, with a certain level of confidence, if a particular pollutant has exceeded the regulatory standard. This determination is based on whether or not the entire confidence interval exceeds the regulatory criterion. More conservatively, a one-sided lower bound on the true 90th percentile of the concentration distribution can be computed as a 100(1 - α)% Lower Confidence Limit (LCL), where for 90% confidence, $\alpha = 0.1$. Doing so tests the null hypothesis that the true 90th percentile of the concentration distribution is less than or equal to the regulatory criterion. If we reject the null hypothesis, the pollutant level in the water body is deemed to be an impairment to that water body's designated use(s) (Gibbons, 2001).

4.3.1 Binomial Analysis in Determination of Impairments

(Based on Gibbons, 2001 and Lin, 2000)

To construct a nonparametric confidence limit for the 90th percentile of the concentration distribution from a monitoring site, the fact that the number of samples falling below the p(100)th percentile of the distribution (in this case, $p = 0.9$, where p is between 0 and 1) out of a set of m samples will follow a binomial distribution with parameters m and success probability p, where success is defined as the event that a sample measurement is below the p(100)th percentile. The cumulative binomial distribution (Bin (x; m, p)) represents the probability of getting x or fewer successes in m trials with success probability p, and can be evaluated as

$$Bin(x; m, p) = \sum_{i=0}^{x} \binom{m}{i} p^{i} (1 - p)^{m-i} \qquad \textbf{E4.1}$$

The notation $\binom{m}{i}$ denotes the number of combinations of m things taken i at a time, where

$$\binom{m}{i} = \frac{m!}{i!(m-i)!}$$

and the factorial $m!$ is given by

$$m! = m(m-1)(m-2)\cdots 1$$

Where applicable, KDHE will use a 90% LCL on the 90th percentile of a concentration distribution ($LCL_{0.9,0.9}$) from a stream chemistry monitoring site.

As an example, find the minimum number of successes needed to keep a water body off an impaired water body list (or, more importantly, determine the critical number of failures needed to list a water body as impaired), where the number of samples m from a monitoring site is 12. Based on the 90th percentile and with as close to a LCL of 90% as possible, then from E4.1 starting with *i* = 12 as the first candidate and repeating additional candidates by *i* - 1 until the cumulative probability is as close to 90% as possible.

$$\binom{12}{12} 0.9^{12}(0.1)^{0} = 0.282$$

$$\binom{12}{11} 0.9^{11}(0.1)^{1} = 0.377$$ (cumulative probability is 0.282 + 0.377 = 0.659)

$$\binom{12}{10} 0.9^{10}(0.1)^{2} = 0.230$$ (cumulative probability = 0.282 + 0.377 + 0.230 = **0.889**)

$$\binom{12}{9} 0.9^{9}(0.1)^{3} = 0.085$$ (cumulative probability = 0.282 + 0.377 + 0.230 + 0.085= 0.974)

Comparing cumulative probabilities with an objective of getting as close to 90% as possible we choose the 0.889 option from the above. From this choice, the minimum number of successes out of 12 trials to keep a water body off an impaired list is 10 (or, conversely, 2 failures out of 12 trials). This is the same as saying that 3 failures out of 12 trials will get a water body listed as impaired (or finding only 9 successes out of 12 trials).

In practice, it is a nuisance calculating binomial probabilities by hand. The Microsoft Excel functions BINOMDIST does most of the work for the analyst. Table 2 was created using this Excel BINOMDIST function. Table 2 shows, using the BINOMDIST function to get as close to 90% confidence as possible, for *m* = 3 to 150 the minimum number of excursions needed to list a water body as impaired and the confidence level associated with that number.

4.3.2 Special Considerations in Balancing of Type I and Type II Error

In the case of determining whether or not a water body is impaired, two different kinds of errors can be made. The first is when an unimpaired water body is mistakenly determined to be impaired, called a Type I error. The second is if an impaired water body is erroneously determined to be unimpaired and is called a Type II error. Of special concern to KDHE is Type I error, which could lead to the dedication of time and resources in developing and implementing a TMDL for a water body that was determined to be impaired when it actually is not impaired. In a policy decision, KDHE has chosen to set the acceptable Type I error rate in advance. The 90% confidence limit

used by KDHE in its nonparametric method of assessing water bodies for impairment simply means that about 10% of the time a Type I error will occur.

KDHE also has concerns about Type II errors because failure to detect an impairment in a water body when one actually exists also has negative consequences through potential unabated environmental damage stemming from delayed TMDL implementation, and this delay can lead to greater marginal fiscal costs to restore waterbodies. In an effort to reduce the Type II errors associated with the nonparametric method of assessing water bodies, KDHE has added additional considerations to minimize it; the choice of $\alpha = 0.1$ rather than 0.05, determine the necessary number of failures with at least 90% confidence, minimum sample size requirement, and recent trend weighting (explained in 4.3.3).

4.3.3 Emphasis of Recent Trends in streams

Table 2 shows with as close to 90% confidence as possible for $m = 3$ to 150, the minimum number of excursions needed to list a stream as impaired and the confidence level associated with that number. A final step in the listing methodology will be a check of recent excursions in the samples from a monitoring site. If the number of excursions is within one of the critical number of excursions needed to list a stream as impaired from Table 2, and any one of those excursions occurred in the most recent year of sampling, then that water body will also be placed on the 303(d) list in category 5. Doing so emphasizes recent impairments in the sample data and creates the final step to minimize Type II errors. If the last excursion did not occur in the last year of sampling the water will be put in Category 3 for follow up assessment in the next 303(d) cycle.

4.3.4 Cases Where Alternate Background Concentrations Exist

In some cases streams have established and approved alternate background concentrations. These alternate background concentrations are identified in Table 1h of the Kansas Surface Water Quality Standards: Tables of Numeric Criteria. These alternate background concentrations were established in each case through the development of a TMDL and subsequent adoption into the water quality standards. In each case a TMDL exists for a site with an alternate background concentration. For the purposes of developing the 303(d) list Kansas shall assess streams with approved alternate background concentrations in Table 1h by use of the average and median values for data from the assessment period of record for the monitoring site, as specified in section 4.1.1 of this document, which typically followed the development of the TMDL. A stream shall be considered impaired if the median value exceeds the alternate background concentration in Table 1h. The stream shall be considered unimpaired if the average and median concentration for the site is less than the alternate background concentration in Table 1h.

4.4 Overview of 2018 Listing Methodology – Stream Chemistry

All categories as defined in the EPA Guidance (category definitions available in Table 1) will be submitted as the Kansas 2018 303(d) List. Category 5 waters will be submitted as the Kansas 2018 303(d) list. While all readily available data will be assessed, prior years' 303(d) lists have resulted in a suite of parameters for which listings are more likely. These pollutants and the specific

assessment methodology used to determine impairment are detailed in Table 5 in the Appendix of Tables at the end of this document.

4.4.1 STREAM CHEMISTRY ASSESSMENT UNITS - CATEGORIZATION

The following ordered steps will apply:

1) Screen for the domestic water supply nitrate criteria where a greater than one excursion provides support for listing in Category 5.

2) Screen for acute aquatic life violations for each monitoring site. If there is more than one acute violation for every three years of data from a monitoring site (in accordance with 4.1.1 and 4.2.1), then the monitoring site's AU will be listed on the 2018 303(d) List (Category 5). Table 3 provides information on the exact number of exceedances needed to list for a given number of monitoring years.

3) The 10% raw score will provide the next screen for the pollutant data from monitoring sites. Those sites that fail the raw score test (>10% excursion) will be subject to the binomial test described in Section 4.3.1.

4) If the binomial test indicates impairment then the AU will be placed on the 2018 303(d) List (Category 5).

5) If the binomial test indicates full support, those sites will be subject to the final screen, a check for evidence of recent excursions in the sample data. If the number of excursions is within one of the critical number of excursions (Table 2) needed to list an AU and any one of those excursions occurred within the most recent year of sampling at the monitoring site, then that AU will also be listed on the 2018 303(d) List in Category 5. If the last excursion occurred earlier, the AU will be placed in Category 3 for follow up assessment for the 2020 303(d) List.

4.4.2 CONTINUOUS DATA

USGS continuous data samplers are to be evaluated and considered. Daily averages are utilized to assess impairment utilizing methods described in section 4.4.1.

4.5 STREAM CHEMISTRY CATEGORY 5 PRIORITY FOR TMDL DEVELOPMENT

Consistent with Kansas' TMDL Vision Strategy, establishing priorities for TMDL development between 2014 and 2022, certain AUs containing streams impaired by total phosphorus in certain HUC 8s will be designated for TMDL development. The targeted HUC 8s and impaired streams intended for TMDLs in 2018 are:

HUC 8 Subbasin	Stream Chemistry Station	Stream Assessment Unit	Targeted TMDL Development Year
10260008 Smoky Hill - Saline	SC264	Smoky Hill River At Junction City	2018
	SC265	Smoky Hill River At Enterprise	2018
	SC268	Smoky Hill Near Salina	2018
	SC643	Mud Creek Near Abilene	2018
	SC749	Sharps Creek Near Freemount	2018
10260010 Smoky Hill - Saline	SC267	Saline River Near New Cambria	2018
	SC640	Mulberry Creek Near Salina	2018

Table 2-4. Targeted HUC8s for TMDL development in 2018.

The HUC8s and associated impaired streams impacted by phosphorus slated for TMDL development in 2019 are:

HUC 8 Subbasin	Stream Chemistry Station	Stream Assessment Unit	Targeted TMDL Development Year
10250017	SC503	Republican River Near Clay Center	2019
	SC504	Republican River Near Clay Center	2019
	SC509	Buffalo Creek Near Concordia	2019
	SC510	Republican River Near Rice	2019
	SC649	Peats Creek Near Clifton	2019
	SC650	Salt Creek Near Hollis	2019
	SC707	Wolf Creek Near Concordia	2019
	SC709	Elm Creek Near Ames	2019
	SC710	Mulberry Creek Near Clifton	2019
10270103	SC554	Delaware River Near Half Mound	2019
	SC603	Grasshopper Creek Near Muscotah	2019
	SC604	Elm Creek Near Larkinburg	2019
10270205	SC233	Big Blue River Near Oketo	2019
	SC240	Big Blue River Near Blue Rapids	2019
	SC505	Black Vermillion River Near Frankfort	2019
	SC717	Horseshoe Creek Near Marysville	2019
	SC731	North Elm Creek Near Oketo	2019
	SC754	Robidoux Creek Near Frankfort	2019
10270207	SC232	Little Blue River Near Hollenberg	2019
	SC712	Rose Creek Near Narka	2019
	SC741	Little Blue River Near Waterville	2019

Table 3-4. Targeted HUC8s for TMDL development in 2019.

Subsequent years will be tied to TMDL development in certain HUC 8s for streams impaired by excessive total phosphorus. Adjustments to targeted AUs will be made with the submission of each biennial Integrated Report.

Targeted HUC 8s	Intended TMDL Development Year
11030012 Little Arkansas	2020
11030013 Middle Arkansas – Slate	2020
TMDL Slippage & Ad hoc Addressed Impairments	2021
Evaluation and Revision of Existing TMDLs & Re-Designation of Priorities for 2023 - 2032	2022

Table 4-4. Targeted HUC8s TMDL development schedule.

4.6 STREAM CHEMISTRY ASSESSMENT UNITS - CONSIDERATIONS FOR REMOVING IMPAIRMENTS (CATEGORY 2)

4.6.1 GENERAL DELISTING CONSIDERATIONS FOR REMOVING IMPAIRMENTS

The assessment of water quality monitoring data from January 1st, 2000 forward provided KDHE with reason to remove a number of existing stream/pollutant impairments through the 2010, 2012, 2014, and 2016 303(d) listing cycles. In general, these removals were concentrated in the permanent KDHE stream monitoring sites, which provide yearly data, increasing the sample size available for assessment. Rotational sites may show signs of improved water quality, but generally did not have adequate sample sizes at the time to propose removing impairments. The situation in 2018 is similar to that of 2010, 2012, 2014 and 2016. Additionally, existing TMDLs addressing impairments indicate the desired timeframe in which to subsequently collect and assess data to support removal of the impairment as predicated by the data collected during the timeframe indicated by the TMDL. Removing impairments as signified in the 303(d) list as a Category 2 stream, indicates a stream formerly listed as impaired with (Category 4a) or without a TMDL (Category 5), but now is no longer assessed as impaired. In general, if a stream was previously listed as a Category 5 water, and no longer meets the listing requirements as discussed in Section 4 of this document, the stream may no longer be impaired. Other specific cases shall be assessed as follows.

4.6.2 DISCONTINUED SUBSTANCES

The first group of potential impairment removals relate to substances that are no longer produced or used in the United States. Because these substances should have no new loading sources they are expected to decline in concentration over time until they no longer pose a human health risk. These substances are assessed through the use of fish tissue analysis, and may be impairments removed if ongoing monitoring no longer supports KDHE designated consumption advisories and the advisory is withdrawn.

4.6.3 SUBSTANCES WITH APPROVED BACKGROUND CONCENTRATIONS

Kansas Surface Water Quality Standards provide that “In stream segments where background concentrations of naturally occurring substances, including chlorides and sulfates, exceed the water quality criteria listed in Table 1a of the ‘Kansas surface water quality standards: tables of numeric criteria’, as adopted by reference in subsection (d) of this regulation, at ambient flow, the existing

water quality shall be maintained, and the newly established numeric criteria shall be the background concentration, as defined in K.A.R. 28-16-28b(e)."

These alternate background concentrations are found in Table 1h of the water quality standards, and shall be used to assess the presence of impairment on waters where such alternate background concentrations exist for the most recently approved Kansas Surface Water Quality Standards. In cases where monitoring data from the period of record assessed for 303(d) listing purpose has an average and median concentration less than the alternate background concentration, the stream/pollutant combination shall be moved to Category 2.

4.6.4 METALS

KDHE has listed a number of water bodies as impaired by cadmium, copper, lead, and zinc for both chronic and acute aquatic life impairments. While some specific locations in the state with historic mining impacts continue to show ongoing impairment, other locations statewide have shown a sporadic pattern with regard to metal impairments, particularly copper and lead. Without attributing the decline to specific actions, KDHE believes that many of these listings are likely tied to unstable flow conditions. An analysis using aluminum concentrations as a signal of unstable flow is used to discount samples of high metal concentrations. Removing those outlier data tends to show no ongoing impairment based on the monitoring data for the 2018 303(d) listing cycle. These metal impairments can be divided into two groups, those with approved TMDLs and those that have been 303(d) listed, but do not have a TMDL developed. In the case of the former, movement to Category 2 shall be based on the preponderance of evidence from all available sources of no impairment present in the stream since the TMDL was approved. In the case of the latter Category 2 shall be assigned if the monitoring data no longer fails the chronic assessment procedure outlined in section 4.3 of this document, after discounting certain data thought to occur during unstable flow.

4.6.5 BACTERIA

In 2003 Kansas altered the water quality standards for bacterial contamination in surface waters. Prior to the change, streams were assessed and listed based on fecal coliform bacteria concentrations, and data analysis was similar to other pollutants with binomial assessments. After the adoption of new water quality standards the indicator was changed to *E. coli* and the requirement for listing became the geometric mean for five samples collected over 30 days exceeding the applicable criterion. Because this standard cannot be assessed with the regularly collected water sampling programs implemented by KDHE an alternative method of assessment was adopted. In this method streams with either existing TMDLs for bacteria or previous 303(d) listings for bacteria were targeted on a rotating basin approach outlined in section 4.2.3 of this document. Where none of the intensive sampling events generated geometric mean violations in two separate years, the stream was moved to Category 2 from either the existing TMDL (Category 4a) or the 303(d) listing (Category 5). The stream stations that have undergone intensive bacteria monitoring are listed in Table 4. However, no intensive bacteria monitoring occurred between 2014 through 2017 and no new Category 2 streams are expected on the 2018 303(d) list.

4.6.6 Typographical Errors and Other Corrections

Typographical errors and listing errors from the 2016 303(d) List will be corrected in the 2018 303(d) List. In cases where an impairment was previously reported, but the impairment reporting was based on typographical errors the site will be delisted if the monitoring data indicates that no impairment exists. Other corrections to the list will be made as needed to most accurately reflect the status of Kansas waters.

5.0 Stream Biology Methodology

5.1 Sample Size Requirements and Temporal Bounds of Data - Biology

A minimum of 3 samples will be required to assess biological and fish tissue data. For data collected from biological and fish tissue surveys, the same assessment period that is used in the 2018 305(b) Report will be used for the 2018 303(d) List.

5.2 Stream Biology - Categorization for Listing

1) Determine if the stream biological impairment appears on 2016 303(d) list and has not had a TMDL developed. If so, list in Category 5.

2) For biological monitoring stations with three or more samples over the latest five years, if Aquatic Life Use Support Index (ALUS index) indicate partial or non-support, list in Category 5.

3) If fish tissue samples show excessive amounts of bio-accumulative pollutants (PCB, chlordane, mercury, etc.) for three or more years over the latest five years, or if a consumption advisory exists for that water, list in Category 5.

5.3 Stream Biology Assessment Methodology For Aquatic Life Use Support

Biological condition was assessed with the Aquatic Life Use Support Index (ALUS Index). The index was designed to assess the response of macroinvertebrate communities to a wide variety of stressors including various toxics, low dissolved oxygen and sedimentation. The index is composed of five metrics. Following EPA Rapid Bioassessment Protocol guidance (EPA, 1999), data from candidate reference sites and regular targeted network sites were used to standardize the metrics to a dimensionless scale. Metric scores were aggregated to generate the ALUS index score. The ALUS Index score consists of five categorizations of biotic condition or three levels of aquatic life support.

The Biological metrics utilized in the ALUS Index are as follows:

1) Macroinvertebrate Biotic Index (MBI) (Davenport and Kelly 1983) - A measure used to evaluate the effects of nutrients and oxygen demanding pollutants on macroinvertebrate communities. The index provides order and family level tolerance values for several benthic

macroinvertebrate classes. The value represents a weighted average tolerance value for the organisms in a sample. The value is weighted by the number of individuals in each taxa.

2) Kansas Biotic Index for Nutrients (KBI-N) (Huggins and Moffett 1988) – Mathematically equivalent to the MBI, however the tolerance values are species specific and restricted to aquatic insect orders.

3) Ephemeroptera, Plecoptera and Trichoptera Index (EPT) - The number of taxa belonging to the insect orders Ephemeroptera, Trichoptera, and Plecoptera. Most species in these insect orders are considered intolerant of water quality and habitat perturbations.

4) EPT Percent of Count (EPT % CNT) – The percentage of organisms in a sample consisting of individuals belonging to the EPT orders.

5) Shannon's Evenness – A measure of diversity that describes how evenly distributed the numbers of individuals are among the taxa in a sample.

ALUS Index metrics with scoring ranges and standardized scores:

MBI	KBI-N	EPT	EPT % CNT	SHN EVN	SCORE
<=4.18	<=2.52	>=16	>=65	>=0.849	4
4.19-4.38	2.53-2.64	14-15	56-64	0.826-0.848	3
4.39-4.57	2.65-2.75	12-13	48-55	0.802-0.825	2
4.58-4.88	2.76-2.87	10-11	38-47	0.767-0.801	1
>=4.89	>=2.88	<=9	<=37	<=0.766	0

Table 1-5. ALUS Index metrics with scoring ranges and standardized scores.

ALUS Index score range, interpretation of biotic condition, and supporting, partial and no supporting categories.

ALUS Index Score	Biotic Condition	Support Category	Reporting Category
>16 -20	Very Good	Supporting	1 – If Never Impaired 2- If previously impaired
>13 -16	Good		
>7 -13	Fair	Partially Supporting	5 – If no TMDL Exists
>4 – 6	Poor	Non-supporting	
0 - 3	Very Poor		4a – If TMDL exists

Table 2-5. ALUS Index scoring categories.

5.4 STREAM BIOLOGY CRITERIA FOR FISH CONSUMPTION ADVISORIES AND ASSESSMENT FOR FOOD PROCUREMENT USE SUPPORT

1) If a fish consumption advisory was in effect within a waterbody segment then food procurement use was assigned "Not Supported" for that segment.

2) If a fish consumption advisory was not in effect in a sampled segment, then the food procurement use was assigned "Fully Supporting" of Food Procurement Use.

Fish consumption advisories are issued, in general, based on data from a minimum of three duplicate (6 total) composite samples (3-5 fish) collected over a three year period. Fish consumption advisories were developed following EPA guidelines using risk assessment methodology (KDHE 2007a, EPA 1989, 1995 a-b, 2000 a-b).

5.5 STREAM BIOLOGY PRIORITY METHOD FOR TMDL DEVELOPMENT

Pursuant to Kansas' TMDL Vision Strategy, priority will be given to those streams in certain eastern and central Kansas HUC 8s that are impaired by total phosphorus. For those streams that also are listed as having their aquatic biological communities impaired, the associated TMDLs will address any nutrient impacts on stream biology. If other pollutants are implicated as creating the stress on the aquatic community, those impairments will be addressed in subsequent (after 2020) TMDLs. Otherwise, the following criteria on data over the latest five years will continue to determine the relative priority among biology impairments.

Apply the following criteria on data over the latest five years to determine the priority:

1) Medium priority goes to streams with an ALUS index metric score showing partial support.

2) Lower priority goes to streams with an ALUS index metric score showing non-support with a poor biotic condition or impairments appearing through fish tissue analysis. Best professional judgment may be used to move a station from lower priority to medium priority.

3) Lowest priority goes to streams with an ALUS index metric score showing non-support with a very poor biotic condition.

4) Streams that have only one to two biological samples from the latest five years and show any designation of less than full support that has not previously had a TMDL developed, will be deemed Category 3.

5) Streams that are identified as fully supporting in the 2016 305(b) report and listed as partially supporting in the 2018 305(b) report, where the impairment is potentially drought linked, shall be listed as Category 3.

5.6 STREAM BIOLOGY ASSESSMENTS- CONSIDERATIONS FOR REMOVING IMPAIRMENT (CATEGORY 2)

1) For biological monitoring stations listed in 2016, if the latest five years have three or more samples and indicate full-support for all of the biological metrics, move to Category 2.

2) For fish tissue samples listed in 2016, if the latest five years have three or more years of monitoring and indicate compliant amounts of bio-accumulative pollutants (PCB, chlordane, mercury, etc.), move to Category 2.

6.0 LAKE AND WETLAND METHODOLOGY

6.1 SAMPLE SIZE REQUIREMENTS AND TEMPORAL BOUNDS OF DATA – LAKE/WETLAND

There are not a minimum number of samples needed for assessing lake/wetland data. For data collected from lakes and wetlands, the assessment period from 2000-2017 was used for the development the 2018 303(d) List.

6.2 CONTACT RECREATION – LAKE/WETLAND

As applied to classified lakes and wetlands, Kansas has a Primary Contact Recreation (PCR) 'not to exceed' standard derived from a single sample maximum or a geometric mean calculated from at least five *E. coli* samples collected from separate 24-hour periods within a 30-day period for PCR classes as follows (K.A.R. 28-16-28e(d)(7)(B) (table 1j)):

PCR Swimming Beach; 160 cfu/100mL or single sample maximum of 732 cfu/100mL (in effect from April 1 through October 31 each year)

PCR: Swimming Beach; 800 cfu/100mL or single sample maximum of 3,655 cfu/100mL (in effect from November 1 through March 31 each year)

PCR: Public Access; 262 cfu/100mL or single sample maximum of 1,198 cfu/100mL (in effect from April 1 through October 31 each year)

PCR: Public Access; 1,310 cfu/100mL or single sample maximum of 6,580 cfu/100mL (in effect from November 1 through March 31 each year)

PCR: Restricted Access; 427 cfu/100mL or single sample maximum of 1,950 cfu/100mL (in effect from April 1 through October 31 each year)

PCR: Restricted Access; 2,135 cfu/100mL or single sample maximum of 9,760 cfu/100mL (in effect from November 1 through March 31 each year)

A Secondary Contact Recreation (SCR) 'not to exceed' standard derived from a single sample maximum or a geometric mean of at least five samples collected during separate 24-hour periods within a 30-day period for SCR classes are as follows (K.A.R 28-16-28e (cd)(7)(C) (table1j)):

> SCR: Public Access and Restricted Access; 2,135 cfu/100mL or single sample maximum of 9,760 cfu/100mL (in effect from January 1 through December 31 each year)

6.3 LAKE AND WETLAND ASSESSMENT UNITS - CATEGORIZATION FOR LISTING

1) Determine if the lake or wetland assessment unit appears on the 2016 Section 303(d) list and has not had a TMDL developed or qualify for delisting for its specified impairment(s). If a TMDL has not been developed and the impairment does not qualify for delisting, list in Category 5.

2) For lakes not listed in 2016 for eutrophication, if the lake has a designated use of primary contact recreation but is not an active public water supply and the overall chlorophyll *a* average concentration is greater than 12 ppb or if the chlorophyll *a* concentration is greater than 12 ppb for more than one sample since 2000 and one of the excursions has been obtained during the two most recent sampling dates, list in Category 5.

3) For lakes not listed in 2016 for eutrophication, if the lake has a designated use of secondary contact recreation and the overall chlorophyll *a* average concentration is greater than 20 ppb or if the chlorophyll *a* concentration is greater than 20 ppb for more than one sample since 2000 and one of the excursions has been obtained during the two most recent sampling dates, list in Category 5.

4) For lakes not listed in 2016 for eutrophication, if the lake has an existing use of domestic water supply and the overall chlorophyll *a* average concentration is greater than 10 ppb, list in Category 5.

5) For lakes not listed in 2016 for eutrophication, if the lake serves as an active or reserve domestic water supply as detailed in Table 1l of the Kansas Surface Water Quality Standards, and the overall chlorophyll *a* average is greater than the site specific chlorophyll *a* criterion calculated as the running average of a minimum of 4 samples over a 12-year period or 10 ppb, list in Category 5.

6) If the lake or wetland, for any other parameter, exceeded water quality standards or regional norms for more than one year since 2000 and one of the excursions has been obtained during the two most recent sampling dates, list in Category 5.

6.4 LAKE PRIORITY (CATEGORY 5) DETERMINATION METHOD FOR TMDL DEVELOPMENT

While priority for TMDL development over 2018 – 2022 will focus on stream impairment from phosphorus or nitrate in selected HUC 8s, under certain circumstances, lakes that are impaired by

eutrophication may be designated for TMDL development. Those lakes noted through the 305b assessment as impaired by eutrophication and serve as an active or standby public domestic water supply (as noted in Kansas' pending water quality standards) or have suffered an outbreak of cyanobacteria blooms since 2010 may be slated to have a TMDL established. The timing of preparing these lake TMDLs may be within the targeted year assigned to the respective HUC 8 or the catch-up period after 2020 used to address ad hoc or ongoing impairment issues.

6.5 LAKE AND WETLAND ASSESSMENT UNITS - CONSIDERATIONS FOR REMOVING IMPAIRMENTS (CATEGORY 2)

1) For lakes that serve as active or reserve domestic water supply and are listed for eutrophication based on a site specific chlorophyll *a* criterion, if the two latest sampling dates have chlorophyll *a* concentrations below the site specific criterion and no TMDL has yet been developed, move to Category 2.

2) For lakes that have an existing use for domestic water supply and are listed for eutrophication on the 2016 list, if the two latest sampling dates have chlorophyll *a* concentrations below 10 ppb and no TMDL has yet been developed, move to Category 2.

3) For lakes designated for primary contact recreation and listed for eutrophication on the 2016 list, if the two latest sampling dates have chlorophyll *a* concentrations less than 12 ppb and no TMDL has yet been developed, move to Category 2.

4) For lakes and wetlands designated for secondary contact recreation and listed on the 2016 list for eutrophication, if the two latest samples have chlorophyll *a* concentrations less than 20 ppb and no TMDL has yet been developed, move to Category 2.

5) For lakes and wetlands, if the two latest samples, for any other parameter, attain water quality standards or regional norms, move to Category 2.

7.0 ADDITIONAL CONSIDERATIONS

7.1 ADDITIONAL CONSIDERATIONS IN PRIORITY

Domestic water supply nitrate impairments for streams within the specific HUC 8s targeted for nutrient (total phosphorus) impairments in streams will be designated for TMDL development in 2018 and 2019. Re-evaluation and designation of other streams impacted by nitrate in other basins and subbasins for TMDL development will be done during the development of the 2018 Integrated Report.

7.2 CATEGORY 3 WATERS

In addition to streams that are identified as needing more intensive bacteria sampling over the next listing cycle, a number of stream biology and lake stations are identified as Category 3 because they have insufficient data. In the case of stream biology, one additional seasonal sample is necessary to

determine its listing status for 2018. For some lakes, no data have been collected since 1997, though the data from prior to 1998 indicated some degree of impairment. Contemporary sampling will determine the listing status for these lakes. Streams placed in Category 3 because the binomial analysis was one excursion short of listing and the last excursion occurred prior to the last year of sampling will be reassessed as part of the 2018 listing process.

7.3 REGIONAL ADVISORY COMMITTEE AND WRAPS INPUT

In some cases, Regional Advisory Committees associated with the *State Water Plan* and comprising individuals residing within those regions of the state will offer input to revise the priority listing of certain waters within their basins. Typically, this input serves to elevate a waterbody that was originally not scheduled to have a TMDL developed in the next cycle and directs that a TMDL be prepared while TMDL development occurs in that given basin. Similarly, input from watershed and lake-specific WRAPS groups may offer input on priorities of listed waters.

7.4 CONSIDERATION OF ANTIDEGRADATION IN 303(D) LISTINGS

40 C.F.R. 131.6 lists the minimum elements required of water quality standards that are submitted to EPA for review and approval, including *(d) An antidegradation policy consistent with §131.12.* Antidegradation is defined in Kansas surface water quality standards as *"…the regulatory actions and measures taken to prevent or minimize the lowering of water quality in surface waters of the state, including those streams, lakes, and wetlands in which existing water quality exceeds the level required for maintenance and protection of the existing uses."* (K.A.R. 28-16-28b (c)). This is accomplished through the Kansas antidegradation policy, described at K.A.R. 28-16-28b (kk), and adopted by reference by the water quality standards. Kansas' antidegradation policy is described in more detail at K.A.R. 28-16-28c (a). Four tiers of water quality are maintained and protected by the Kansas antidegradation policy, in accord with 40 C.F.R. 131.12:

1. Levels of water quality in surface waters of the state shall be maintained to protect the existing uses of those surface waters (Tier 1).
2. For waters with existing water quality better than applicable water quality criteria, that water quality shall be fully maintained and protected and may be lowered only if such lowering is needed to allow for important social or economic development in the geographic area of such waters. Existing uses shall be maintained and protected and the highest statutory and regulatory requirements for all new and existing point sources of pollution and all cost-effective and reasonable best management practices for nonpoint sources of pollution shall be achieved (Tier 2).
3. For exceptional state waters, discharges are allowed only if existing uses and existing water quality are maintained and protected (Tier 2.5).
4. For Outstanding National Resource Waters, existing uses and water quality are to be maintained and protected and new or expanded discharges shall not be allowed (Tier 3).

These four tiers of waters comprise the inventory of classified waters in Kansas. Such waters are classified as General Purpose, Exceptional State Waters or Outstanding National Resource Waters.

The purpose of the Kansas 303(d) program is to restore waters to Tier 1 status, maintaining existing uses. Tier 2 waters are protected from new or expanded discharges of pollutants on a case-by-case and pollutant specific basis. This analysis is conducted through the NPDES permitting process to determine alternatives to discharging or protective conditions attached to permitted discharges. Tier 2.5 and 3 waters are protected by discouraging or prohibiting new or expanded discharges into such waters.

There are seven Tier 3 Outstanding National Resource Waters in Kansas. Five of these waters have TMDLs or are listed for certain pollutants. The remaining two are associated with impaired waters within their watersheds or adjoining them. There are 68 stream segments and 8 lakes or wetlands designated as Tier 2.5; exceptional state waters. Many of these are long reaches of rivers such as the Neosho, the Marais des Cygnes, the Cimarron, the Chikaskia, the Walnut, the Fall or the Smoky Hill rivers. Many of these exceptional state waters are also in Category 4a or Category 5. Because of the Kansas antidegradation policy, and the location of high quality waters relative to population centers and industrial activity, the vast majority of any impairment on the higher quality waters is caused by non-point sources of pollutants.

Therefore, the antidegradation policy portion of the Kansas water quality standards offers independent protection to high quality waters but only from the narrow niche of future new or expanding sources of pollutants. The policy does not apply well to non-point sources of pollutants. While adherence to the antidegradation policy essentially shields certain Kansas waters from 303d listing, the policy does not address the act of degradation in water quality nor does the Kansas water quality standards. Degradation in water quality can be determined by analysis of trends in water quality and where such trends are seen or suspected, the associated water is placed in Category 3 for additional assessment and determination or Category 5 if the evidence is substantial that water quality standards will not be achieved in the future on that water. Because of the predominant non-point source loading into Kansas waters, trends are a function of changing land use and weather patterns and are often confounded by the wide variability inherent in most water quality data.

Kansas assessment protocols under the 303(d) methodology attempt to be fairly conservative in listing possible impairments by emphasizing deficient conditions seen in the most recent years as potential evidence of water quality standards not being achieved, even though the statistical analysis shows compliance. Along with the placement of uncertain waters in Category 3 for subsequent assessment in the next listing cycle, the conservative assumptions underlying Kansas listings analysis provides some modicum of protection to waters on the brink of failing to meet their water quality standards. In taking these steps, Kansas is upholding the spirit and letter of Section 303(d) of the CWA.

8.0 PUBLIC PARTICIPATION

The public was invited to comment on this methodology and the draft list generated through this methodology. A draft of this methodology was posted on the KDHE TMDL Web site http://www.kdheks.gov/tmdl/index.htm. The draft list will be released on February 1, 2018 for public review and comment. The priorities within the list may be modified based on feedback provided by the Regional Advisory Committees (RACs) and Watershed Restoration and Protection Strategy (WRAPS) groups. RACs set priorities within their basins and these priorities may

influence which TMDLs will be developed within the basin. WRAPS incorporate high priority TMDLs into their watershed plans and direct implementation of pollutant load reduction practices in their watersheds to achieve TMDLs.

8.1 PUBLIC HEARING DATES AND LOCATIONS

KDHE will hold a public hearing to receive comments on the proposed 2018 Section 303(d) List in Topeka at the end of February, 2018.

8.2 PUBLIC COMMENTS AND AGENCY RESPONSE

Public comments will be taken at the public hearing through March 12, 2018. Late interest in commenting on the list of impaired waters and the methodology may prompt KDHE to extend the open period. After the public record closes, KDHE will consider the received comments, formulate a response to those comments and will post the comments and responses on its TMDL Web site.

9.0 SUBMITTAL TO EPA REGION 7

The finalized Section 303(d) List for 2018, public comments received by KDHE regarding the 303(d) List, and KDHE response to public comments will be submitted to EPA Region 7 by March 30, 2018.

10.0 REFERENCES

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Appendix of Tables

Table 1

Five EPA Reporting Categories and Kansas Interpretation

Category 1: All designation uses are supported, no use is threatened; **Kansas**: Water has never been listed

Category 2: Available data and/or information indicate that some, but not all of the designated uses are supported; **Kansas**: Water use was previously listed but now has water quality sufficient to support designated uses

Category 3: There is insufficient available data and/or information to make a use support designation; **Kansas**: No recent data to indicate use support, water falls short of statistical impairment, bacteria data

Category 4: Available data and/or information indicate that at least one designated use is not being supported or is threatened, but a TMDL is not needed
Kansas:
4a: TMDL has been developed for water
4b: NPDES permits addressed impairment or watershed planning is addressing atrazine problem
4c: Pollution (typically insufficient hydrology) is causing impairment

Category 5: Available data and/or information indicate that at least one designated use is not being supported or is threatened, and a TMDL is needed; **Kansas: 303(d) list**

Table 2
Binomial Listing Criteria Critical Values

Samples	Exceedences	Confidence Level %
3	3	0.999
4	3	0.996
5	3	0.992
6	3	0.985
7	3	0.977
8	3	0.967
9	3	0.955
10	3	0.943
11	3	0.929
12	3	0.915
13	3	0.900
14	4	0.965
15	4	0.957
16	4	0.949
17	4	0.940
18	4	0.930
19	4	0.920
20	4	0.910
21	5	0.962
22	5	0.956
23	5	0.949
24	5	0.943
25	5	0.935
26	5	0.928
27	5	0.920
28	5	0.913
29	6	0.958
30	6	0.953
31	6	0.947
32	6	0.941
33	6	0.936
34	6	0.930
35	6	0.924
36	7	0.961
37	7	0.956
38	7	0.952
39	7	0.947

Samples	Exceedences	Confidence Level %
40	7	0.942
41	7	0.937
42	7	0.932
43	7	0.927
44	8	0.960
45	8	0.956
46	8	0.952
47	8	0.948
48	8	0.944
49	8	0.940
50	8	0.936
51	9	0.964
52	9	0.960
53	9	0.957
54	9	0.954
55	9	0.950
56	9	0.946
57	9	0.943
58	9	0.939
59	9	0.935
60	10	0.961
61	10	0.958
62	10	0.955
63	10	0.952
64	10	0.949
65	10	0.946
66	10	0.942
67	10	0.939
68	11	0.962
69	11	0.960
70	11	0.957
71	11	0.954
72	11	0.951
73	11	0.948
74	11	0.945
75	11	0.942
76	12	0.963

Samples	Exceedences	Confidence Level %
77	12	0.961
78	12	0.959
79	12	0.956
80	12	0.953
81	12	0.951
82	12	0.948
83	12	0.945
84	13	0.965
85	13	0.963
86	13	0.960
87	13	0.958
88	13	0.956
89	13	0.953
90	13	0.951
91	13	0.948
92	14	0.966
93	14	0.964
94	14	0.962
95	14	0.960
96	14	0.958
97	14	0.955
98	14	0.953
99	14	0.951
100	15	0.967
101	15	0.965
102	15	0.964
103	15	0.962
104	15	0.960
105	15	0.958
106	15	0.956
107	15	0.953
108	15	0.951
109	16	0.967
110	16	0.965
111	16	0.963
112	16	0.961
113	16	0.960

Samples	Exceedences	Confidence Level %
114	16	0.958
115	16	0.956
116	16	0.954
117	16	0.952
118	17	0.967
119	17	0.965
120	17	0.963
121	17	0.961
122	17	0.960
123	17	0.958
124	17	0.956
125	17	0.954
126	18	0.968
127	18	0.966
128	18	0.965
129	18	0.963
130	18	0.962
131	18	0.960
132	18	0.958
133	18	0.957
134	18	0.955
135	19	0.968
136	19	0.966
137	19	0.965
138	19	0.963
139	19	0.962
140	19	0.960
141	19	0.959
142	19	0.957
143	20	0.969
144	20	0.968
145	20	0.966
146	20	0.965
147	20	0.964
148	20	0.962
149	20	0.961
150	20	0.959

Table 3
Acute Listing Criteria Critical Values

1 Year of Data- 1 exceedance shall be Category 3, 2 or more exceedances shall be Category 5 unless a TMDL already exists, in which case the station/pollutant combination shall be 4a

2-5 Years of Data- More than 1 exceedance shall be Category 5, unless a TMDL already exists, in which case the station/pollutant combination shall be 4a

6-8 Years of Data- More than 2 exceedances shall be Category 5, unless a TMDL already exists, in which case the station/pollutant combination shall be 4a

9-10 Years of Data- More than 3 exceedances shall be Category 5, unless a TMDL already exists, in which case the station/pollutant combination shall be 4a

Table 4. Stream Monitoring Stations that have Undergone Intensive Bacteria Sampling Since 2006

Station	Basin	Year(s)	Stream
SC203	KLR	2006, 2008	Kansas River At Kansas City, Kansas
SC254	KLR	2006, 2008	Kansas River At De Soto
SC255	KLR	2006, 2008	Kansas River At Eudora
SC257	KLR	2006, 2008	Kansas River At Lecompton
SC259	KLR	2006, 2008	Kansas River At Willard
SC260	KLR	2006, 2008	Kansas River At Wamego
SC518	KLR	2006, 2008	Kansas River Near Ogden
SC218	LARK	2006	Arkansas River Near Arkansas City
SC281	LARK	2006, 2009	Arkansas River At Derby
SC523	LARK	2006	Arkansas River Near Hutchinson
SC524	LARK	2006	Arkansas River Near Yoder
SC527	LARK	2006	Arkansas River At Oxford
SC528	LARK	2006, 2009	Slate Creek Near Wellington
SC536	LARK	2006	Arkansas River Near Maize
SC729	LARK	2006, 2009	Arkansas River At Wichita
SC274	NEO	2006, 2011	Cottonwood River Near Emporia
SC569	NEO	2006	Shawnee Creek Near Crestline
SC102	SMSA	2006	Smoky Hill River Near Arnold
SC224	SMSA	2006	Smoky Hill River At Elkader
SC265	SMSA	2006	Smoky Hill River At Enterprise
SC514	SMSA	2006, 2012	Smoky Hill River Near Mentor
SC515	SMSA	2006	Chapman Creek Near Sutphen
SC540	SMSA	2006, 2012	Big Creek Near Munjor
SC673	SMSA	2006	Spillman Creek Near Lincoln
SC014	SOLM	2006, 2012	North Fork Solomon River At Portis
SC543	SOLM	2006, 2012	South Fork Solomon River Near Osborne
SC545	SOLM	2006	Bow Creek Near Stockton
SC668	SOLM	2006	Twin Creek Near Corinth
SC669	SOLM	2006	Carr Creek Near Cawker City
SC670	SOLM	2006, 2012	Beaver Creek Near Gaylord
SC223	UARK	2006	Arkansas River At Coolidge
SC284	UARK	2006, 2009	Arkansas River Near Great Bend
SC286	UARK	2006	Arkansas River At Pierceville
SC584	UARK	2006, 2009	Arkansas River Near Dundee
SC587	UARK	2006, 2009	Arkansas River Near Kinsley
SC594	UARK	2006	Arkansas River Near Ford
SC598	UARK	2006	Arkansas River Near Deerfield
SC275	NEO	2007, 2011	Cottonwood River Near Plymouth
SC609	NEO	2007, 2011	Deer Creek Near Iola
SC610	NEO	2007, 2011	Owl Creek Near Humboldt
SC614	NEO	2007, 2011	Turkey Creek Near Le Roy
SC615	NEO	2007, 2011	Big Creek Near Le Roy
SC627	NEO	2007, 2011	Cottonwood River Near Elmdale
SC628	NEO	2007, 2011	Allen Creek Near Emporia
SC635	NEO	2007, 2011	South Cottonwood River Near Canada
SC637	NEO	2007, 2011	Neosho River Near Parkerville
SC691	NEO	2007, 2011	Mud Creek Near Marion
SC289	VERD	2007, 2011	Verdigris River Near Virgil
SC563	VERD	2007, 2011	Verdigris River Near Independence
SC575	VERD	2007, 2011	Fall River Near Climax
SC607	VERD	2007, 2011	Big Hill Creek Near Avian
SC693	VERD	2007	Elk River Near Howard
SC696	VERD	2007, 2011	Chetopa Creek Near Neodesha
SC654	WALN	2007, 2011	Rock Creek Near Rock
SC655	WALN	2007, 2011	Little Walnut River Near Douglas
SC239	KLR	2008, 2013	Soldier Creek Near Topeka
SC258	KLR	2008	Kansas River At Topeka
SC262	KLR	2008	Kansas River At Manhattan
SC506	KLR	2008	West Branch Mill Creek Near Alma
SC517	KLR	2008	Clarks Creek Near Grandview Plaza
SC519	KLR	2008	South Branch Mill Creek Near Alma
SC520	KLR	2008	Vermillion Creek Near Louisville
SC521	KLR	2008	Mill Creek Near Maple Hill
SC551	KLR	2008	Cross Creek Near Rossville
SC639	KLR	2008, 2013	Muddy Creek Near Grantville
SC645	KLR	2008	Rock Creek Near Louisville
SC648	KLR	2008, 2013	Mission Creek Near Valencia
SC652	KLR	2008	Wildcat Creek Near Manhattan
SC681	KLR	2008	Vermillion Creek Near Onaga
SC727	KLR	2008	Nehring Creek Near Hessdale
SC280	LARK	2009	Ninnescah River Near Belle Plaine
SC282	LARK	2009	Little Arkansas River At Valley Center
SC287	LARK	2009, 2013	Cow Creek Near Hutchinson
SC288	LARK	2009, 2013	Cowskin Creek In Wichita-Valley Center Floodway
SC522	LARK	2009, 2013	Cow Creek Near Willowbrook
SC529	LARK	2009	Chikaskia River Near Corbin
SC530	LARK	2009, 2013	Bluff Creek Near Caldwell
SC534	LARK	2009	Emma Creek Near Sedgwick
SC535	LARK	2009	Sand Creek Near Sedgwick
SC618	LARK	2009	Bluff Creek Near Bluff City
SC619	LARK	2009	Sandy Creek Near Ruella
SC620	LARK	2009	Little Sandy Creek Near Corwin
SC656	LARK	2009, 2013	Little Cow Creek Near Lyons
SC657	LARK	2009, 2013	Cow Creek Near Lyons
SC658	LARK	2009, 2013	Peace Creek Near Sterling
SC661	LARK	2009	Smoots Creek Near Murdock
SC702	LARK	2009, 2013	Cowskin Creek Near Belle Plaine
SC586	UARK	2009	Pawnee River Near Burdett
SC595	UARK	2009	Walnut Creek At Ness City
SC109	KLR	2010	Wakarusa River Near Topeka
SC238	KLR	2010	Shunganunga Creek Near Topeka
SC251	KLR	2010	Mill Creek Near Shawnee
SC252	KLR	2010	Cedar Creek Near Cedar Junction
SC253	KLR	2010	Kill Creek At Desoto
SC500	KLR	2010	Wakarusa River Near Eudora
SC501	KLR	2010	Stranger Creek Near Linwood
SC554	KLR	2010	Delaware River Near Half Mound
SC602	KLR	2010	Stranger Creek Near Easton
SC603	KLR	2010	Grasshopper Creek Near Muscotah
SC207	MDC	2010	Little Osage River Near Fulton
SC208	MDC	2010	Marmaton River Near Fort Scott
SC270	MDC	2010	Marais Des Cygnes River Near Ottawa
SC557	MDC	2010	Bull Creek Near Henson
SC578	MDC	2010	Salt Creek Near Lyndon
SC579	MDC	2010	One Hundred Forty Two Mile Creek Near Reading
SC742	MDC	2010	Marais Des Cygnes River Near Reading
SC201	MOU	2010	Wolf River Near Sparks
SC204	MOU	2010	Indian Creek At Kansas City, Missouri
SC205	MOU	2010	Blue River Near Stanley
SC234	MOU	2010	South Fork Nemaha River Near Bern
SC292	MOU	2010	Walnut Creek Near Reserve
SC601	MOU	2010	Turkey Creek Near Bern
SC682	MOU	2010	South Fork Nemaha River Near Seneca
SC215	VERD	2011	Verdigris River Near Coffeyville
SC038	WALN	2011	Whitewater River At Towanda
SC279	WALN	2011	Walnut River Near El Dorado
SC653	WALN	2011	Timber Creek Near Winfield
SC267	SMSA	2012	Saline River Near New Cambria
SC268	SMSA	2012	Smoky Hill River Near Salina
SC541	SMSA	2012	Big Creek Near Hays
SC550	SMSA	2012	Smoky Hill River Near Trego Center
SC641	SMSA	2012	Gypsum Creek Near Solomon
SC642	SMSA	2012	Holland Creek Near Sand Springs
SC644	SMSA	2012	Turkey Creek Near Abilene
SC748	SMSA	2012	Smoky Hill River Near Freemount
SC665	SOLM	2012	Kill Creek Near Bloomington
SC666	SOLM	2012	Covert Creek Near Osborne
SC721	SOLM	2012	Deer Creek Near Kirwin
SC737	SOLM	2012	South Fork Solomon River Near Woodston
SC659	LARK	2013	Salt Creek Near Hutchinson

Table 5

Impairment	Recreation	Acute AQL	Chronic AQL	Domestic, Irrigation, & Stockwater Use	Food Procurement	Notes	Data Source Note
Alachlor		Greater than 1 per 3 years on average	Binomial of samples March thru October	Annual average concentration for domestic drinking water supply			
Ammonia		Greater than 1 per 3 years on average	Greater than 1 per 3 years on average				
Aquatic Plants		Best Professional Judgement					Lake
Arsenic		Greater than 1 per 3 years on average	Greater than 1 per 3 years on average; chronic criteria applied to samples taken under stable flow	Greater than 1 over past 10 years	Greater than 1 over past 10 years		
Atrazine		Greater than 1 per 3 years on average	Binomial of samples March thru October	Annual average concentration for domestic drinking water supply			
Boron				Binomial; For natural background concentrations, median over past 10 years			
Beryllium				Greater than 1 over past 10 years			
Biology		Best Professional Judgement					Biology
Biology/Sediment		Best Professional Judgement					Biology
Cadmium		Greater than 1 per 3 years on average	Greater than 1 per 3 years on average; chronic criteria applied to samples taken under stable flow	Greater than 1 over past 10 years	Greater than 1 over past 10 years		
Chlordane		Greater than 1 per 3 years on average	Greater than 1 per 3 years on average	Greater than 1 over past 10 years	Greater than 1 over past 10 years	Typically Fish Tissue	Fish Tissue
Chloride		Greater than 1 per 3 years on average	Binomial; For natural background concentrations, median over past 10 years	Binomial; For natural background concentrations, median over past 10 years		Alternate background may exist	
Copper		Greater than 1 per 3 years on average	Greater than 1 per 3 years on average; chronic criteria applied to samples taken under stable flow	Greater than 1 over past 10 years		Biotic Ligand Model will confirm condition	
Diazinon		> 1 Detection					
Dissolved Oxygen		Greater than 1 per 3 years on average					
E. coli	Flag Binomial, Geometric mean of 5 samples collected within 30 days						

Table 5 Continued

Impairment	Recreation	Acute AQL	Chronic AQL	Domestic, Irrigation, & Stockwater Use	Food Procurement	Notes	Data Source Note
Eutrophication	By chlorophyll *a* concentration	By chlorophyll *a* concentration		Chlorophyll *a* average of 4 or more samples over past 12 years for domestic water supply		As outlined in 303(d) methods	Lake
Fluoride		Greater than 1 per 3 years on average	Binomial; For natural background concentrations, median over past 10 years	Binomial; For natural background concentrations, median over past 10 years		Alternate background may exist	
Gross Alpha				Greater than 1 over past 10 years			Separate Monitoring
Lead		Greater than 1 per 3 years on average	Greater than 1 per 3 years on average; chronic criteria applied to samples taken under stable flow	Greater than 1 over past 10 years			
Mercury		Greater than 1 per 3 years on average	Greater than 1 per 3 years on average; chronic criteria applied to samples taken under stable flow	Greater than 1 over past 10 years	Greater than 1 over past 10 years	Typically Fish Tissue	Fish Tissue
Nitrate				Greater than 1 over past 10 years			
PCB		Greater than 1 per 3 years on average	Greater than 1 per 3 years on average	Greater than 1 over past 10 years	Greater than 1 over past 10 years	Typically Fish Tissue	Fish Tissue
Perchlorate		>1 detection				Typically Fish Tissue	Fish Tissue
pH			Binomial				
Selenium		Greater than 1 per 3 years on average	Greater than 1 per 3 years on average; For natural background concentrations, median over past 10 years	Greater than 1 over past 10 years	Greater than 1 over past 10 years	Alternate background may exist	
Siltation		Best Professional Judgement					Lake
Sulfate				Binomial; For natural background concentrations, median over past		Alternate background may exist	
Temperature		Greater than 1 per 3 years on average					
Total Phosphorus		Median >201 µg/L				As outlined in 303(d) methods	
Total Suspended Solids		Median >50 µg/L				As outlined in 303(d) methods	
Uranium				Avg>30 µg/L			
Zinc		Greater than 1 per 3 years on average	Greater than 1 per 3 years on average; chronic criteria applied to samples taken under stable flow	Greater than 1 over past 10 years	Greater than 1 over past 10 years		