DIVISION OF ENVIRONMENT
QUALITY MANAGEMENT PLAN

PART III:

STREAM PROBABILISTIC MONITORING PROGRAM
QUALITY ASSURANCE MANAGEMENT PLAN

Revision 7
02/01/2019

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Section 1

INTRODUCTION

1.1 Purpose of Document

This document presents the quality assurance (QA) management plan for the Kansas Stream Probabilistic Monitoring Program (SPMP). Quality assurance goals, expectations, responsibilities, and program evaluation and reporting requirements are specifically addressed. Standard Operating Procedures (SOPs) for the collection, preservation, examination, and archiving of biological specimens and the procurement of supporting physical habitat and water chemistry data are provided in the appendices of the plan.

In general, revision dates in this document apply to each Section and each Appendix. The overall document revision date reflects the most recent date that any part of the document was updated.

1.2 Basic Principles

Probabilistic monitoring of a natural resource is a method of environmental sampling and assessment that provides unbiased, statistically robust information about its physical, chemical or biological quality. It differs from conventional monitoring approaches in that sampling stations are a randomly selected subset of the resource as a whole. In Kansas, for example, stream chemistry and stream biological monitoring programs have traditionally employed a targeted monitoring design, with stations positioned strategically at locations that capture runoff from a large portion of the state's land area, bracket potential contamination sources (*e.g.*, upstream and downstream of large wastewater treatment plants), monitor interstate waters, and describe and track long term trends. The main benefit of probabilistic monitoring over targeted monitoring is that the results are free from the bias of human choice and can thus be extrapolated with known confidence to the entire resource. In this instance, results provide a statistically sound and unbiased estimate of the overall compliance of the waters of the state with established environmental standards. The KDHE Stream Probabilistic Monitoring Program visits randomly selected sites and collects a variety of data to support a statewide assessment of rivers and streams. It also maintains and monitors a network of reference sites, which are used to establish thresholds for indices of aquatic life support.

1.3 Overview of Program

1.3.1 Historical Background

In 2004, the Kansas Department of Health and Environment (KDHE) participated in the U.S. Environmental Protection Agency's (USEPA) National Wadeable Streams Assessment and gained experience in the application of probabilistic sampling designs and associated field methodology (USEPA, 2004) (USEPA, 2006). In 2005, availability of supplemental monitoring funds under section 106(b) of the Clean Water Act (CWA) provided an opportunity for the department's Bureau of Environmental Field Services (BEFS) to: (1) develop a QA management

plan and accompanying set of SOPs for a similar statewide probabilistic program; (2) hire and train two environmental scientists to assist with the implementation of field and taxonomic duties; (3) develop design specifications to generate a list of randomly selected candidate stream monitoring sites; (4) obtain landowner permission to perform evaluations on these stream reaches; (5) initiate probabilistic monitoring operations; and (6) develop a methodology for applying probabilistic data to CWA section 305(b) water quality assessments. The probabilistic stream monitoring program was established by BEFS Technical Services Section in December 2005, with a three person staff (one program manager and two assistants). Sampling began in 2006. In late 2009, the staff allocation was reduced to two personnel (one program manager and one assistant). In July 2012, as part of a reorganization of the Division Of Environment (DOE), the entire BEFS Technical Services section, including the Stream Probabilistic Monitoring Program, was transferred to the Bureau of Water (BOW), under the purview of the newly formed Watershed Planning, Monitoring, and Assessment Section (WPMAS). In 2015, State of Kansas job classes were revised, and Environmental Scientist positions were converted to Environmental Specialist positions.

The Kansas Stream Probabilistic Monitoring Program (SPMP) is predicated on a spatially balanced random site selection process (Kauffman, 1991) (Messer, 1991) (Larsen, 1994) (Herlihy, 1998) (Urquhart, 1998) (Herlihy A. D., 2000). Data from this program are used to estimate the condition of the state's flowing waters and their overall level of compliance with the provisions of the Kansas Surface Water Quality Standards (K.A.R. 28-16-28b *et seq.*) for the 305(b) portion of the Kansas Integrated Water Quality Assessment (KDHE, 2016). This approach allows KDHE to produce unbiased estimates of designated use support for the state as a whole, accompanying measures of statistical confidence, and more meaningful water quality comparisons between Kansas and the rest of the nation.

Probabilistic operations complement, rather than supplant, the agency's targeted monitoring operations. Targeted monitoring continues to serve as the primary basis for CWA section 303(d) list development, total maximum daily load (TMDL) formulation, and National Pollutant Discharge Elimination System (NPDES) permit review and certification. Although site selection procedures for the probabilistic and targeted monitoring programs differ substantially, many field and laboratory methodologies developed for the targeted programs have been integrated into the probabilistic program. This decision has maintained methodological continuity across programs and facilitates inter-program data comparability for future assessments and studies.

1.3.2 Development of Monitoring Network and Sampling Protocols

The SPMP monitoring program differs substantially from other KDHE ambient water monitoring programs in two important ways: method of site selection, and data types collected.

First, SPMP site selection occurs as a random selection of points from the linear network of all classified streams listed in the Kansas Surface Water Register (KSWR). Thus there are theoretically an infinite number of potential sampling sites. In effect, the SPMP monitoring network can be defined as every point on all classified stream segments in Kansas, as represented by the most recently approved version of the KSWR (KDHE, 2013); only the Missouri River is excluded. The KSWR, and, therefore, the population of potential sampling locations, is subject to

change over time, owing to Use Assessment activities by the agency, *i.e.,* the deletion or addition of classified stream segments or revision of map linework (KDHE, 2012). In practice, a new set of approximately 30–40 randomly selected sites is sampled each year. Sites sampled from 2006 to 2016 are depicted in FIGURE 1. Potential sample sites for 2017 to 2021 are depicted in FIGURE 2.

Second, multiple data types are collected at each sample point. For each probabilistic monitoring site, samples are collected for water chemistry analysis, macroinvertebrate community composition, phytoplankton assemblage composition, and concentration of chlorophyll-a. Fish tissue samples are collected from a subset of these sites as well. As previously mentioned, the SPMP employs many field protocols developed originally for the agency's targeted stream monitoring programs, with minor modifications (see sections 4.2, 4.3, and 4.4 for a more detailed account). These established methods are robust, and their utility has been demonstrated over the course of several decades. Additionally, inter-program data comparability and consistency may prove important to future statewide as well as site-specific water quality assessments.

In addition to sampling randomly selected sites, the SPMP selects and monitors a network of reference sites. Data from these are used in the development of benchmarks for assessment of probabilistic sites; see FIGURE 1. This network evolves over time due to practical as well as scientific considerations, but sites are selected to represent a cross section of high quality, least-disturbed streams across all the major river basins, ecoregions, and stream size classes. Candidate sites are selected from a variety of sources; in some cases they may be sites originally sampled as probabilistic stations in previous assessment periods.

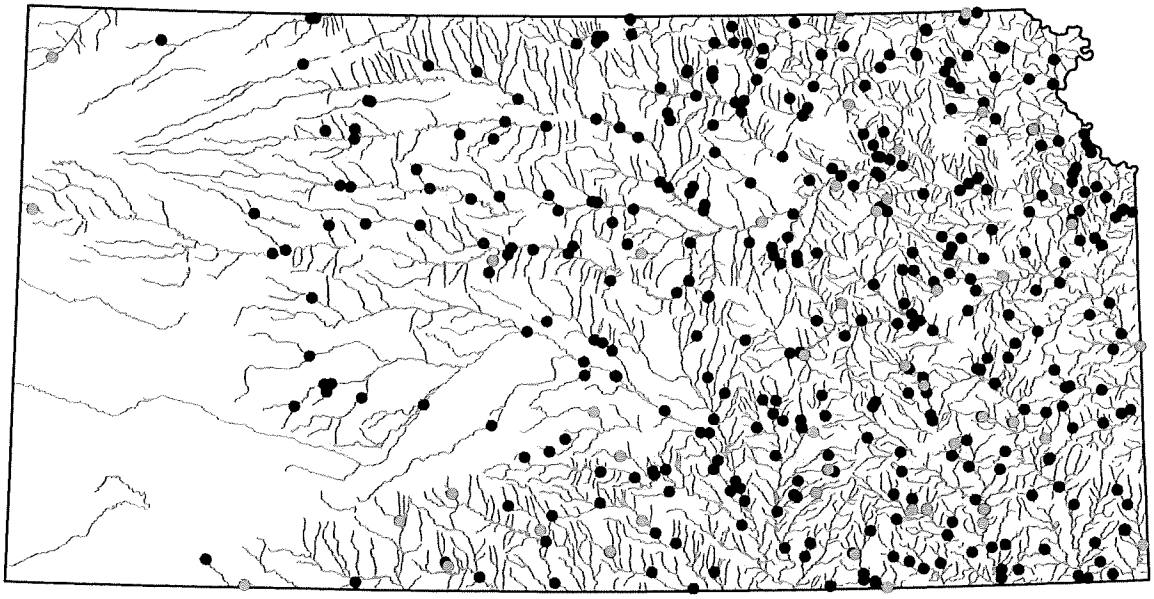

FIGURE 1: Sites sampled 2006–2016 (n = 394 probabilistic and 47 reference). Black dots and gray dots represent probabilistic and reference sites, respectively.

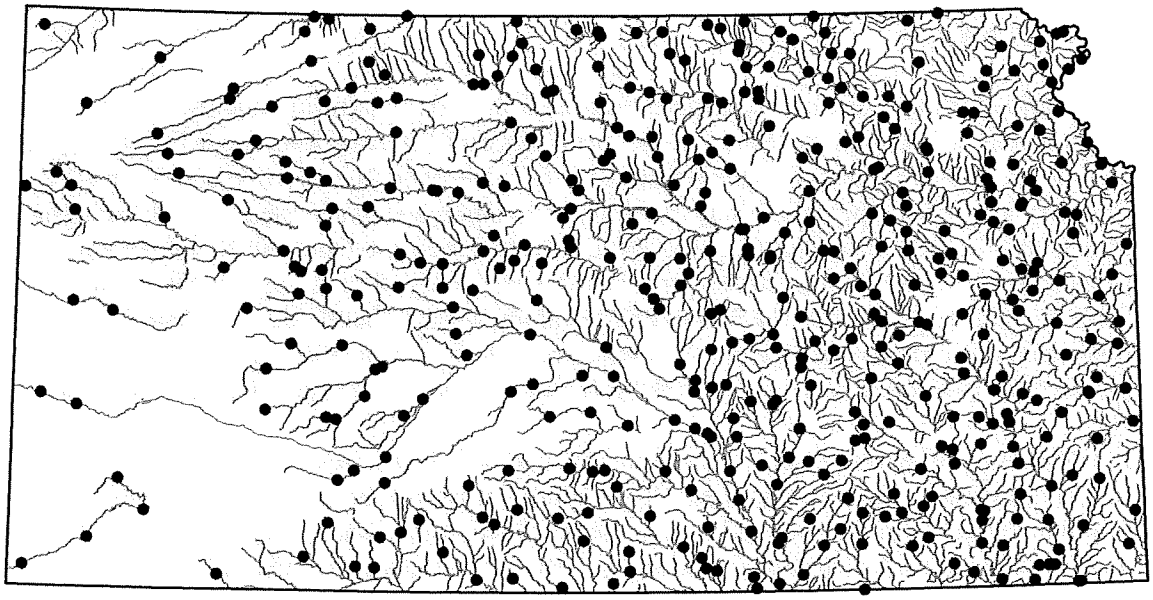

FIGURE 2: Potential probabilistic sites for 2017–2021 (n = 440).

1.4 Development of Taxonomic Capabilities and Water Quality Indicators

The staff of the SPMP use the same taxonomic literature, keys, and macroinvertebrate reference collections as those used by the Stream Biological Monitoring Program (SBMP) and in most cases identify specimens to the same taxonomic resolution. They also consult with SBMP colleagues for assistance in identifications of difficult specimens, verifications, QA functions, and training of new taxonomists. For a detailed history of the development of SBMP taxonomic capabilities and a list of pertinent taxonomic literature, refer to the SBMP QA Management Plan (KDHE, 2012). The Stream Probabilistic Monitoring Program maintains its own Taxonomic Effort document, to ensure consistency in taxonomic resolution of identifications; this document is updated annually.

Biological metrics routinely employed for diagnostic purposes include the Macroinvertebrate Biotic Index (MBI), Kansas Biotic Index (KBI), total number of Ephemeroptera-Plecoptera-Trichoptera taxa (EPT index), EPT individuals as a percentage of total abundance (Percent EPT), and total taxa. Habitat indices currently employed in the program include the Habitat Diversity Index (HDI) (Huggins & Moffett, 1998) and EPA's Rapid Habitat Assessment (RHA) protocol, taken from the Rapid Bioassessment methods (Plafkin, Barbour, Porter, Gross, & Hughes, 1989) (USEPA, 2004).

Together with water quality data, these metrics are used as indicators of the waterbody's capacity to meet its designated use for support of aquatic life, and identify the most likely limitations to that capacity. It is anticipated that future assessments also may employ newly developed aquatic biological metrics including regionally calibrated biological indices (Davis & Simon, 1995), sentinel aquatic species (Rosenberg & Resh, 1993), and/or multivariate statistical techniques

(Berkman & Rabeni, 1986) (Davies, Tsomides, DiFranco, & Courtemanch, 1999) (Hawkins & Carlisle, 2007).

Thresholds for macroinvertebrate metrics are established by distilling data from a statewide collection of reference sites. Some of these reference sites have a long record of biological and/or chemical data. The reference sites are selected to represent natural, stable conditions of a diversity of stream types in the state, ranging from small headwater streams to large mainstem rivers, and the collection includes waterbodies from across the Omernik Level III ecoregions (Omernik, 1995) (Omernik, 2004) (Omernik & Griffith, 2014) and major river basins in the state. Program staff typically sample reference sites along with probabilistic sites each year to ensure that variation in time-sensitive environmental factors (*e.g.,* weather, normal fluctuations in populations of taxa) is represented in the reference dataset as well as the assessment dataset.

In addition to collecting insects and associated macroinvertebrates, field staff collect valves of Unionid mussels, record notes on any live Unionid mussels, and take a water sample for analysis of phytoplankton community and measurement of chlorophyll-a. Unionid data may be compared to any available historical records for the waterbody and basin, and phytoplankton and chlorophyll data are compared to regionally relevant historical values from the Stream Chemistry Monitoring Program.

Fish tissue samples are taken from a subset of SPMP sites. Collections are attempted on all sites judged to be capable of supporting harvestable-size specimens of edible species. Most of these are located on segments already designated for food procurement (FP) use, but if edible fish are sampled from a non-FP-designated segment, this information is submitted to the Use Attainability Assessment program with a request that the FP use be added for the segment.

Field crews attempt to obtain a sample of top predators from each site, preferably 3–7 individuals of a preferred game species, or individuals of multiple species if necessary, of a harvestable size. Bottom feeders may be substituted if no suitable top predators are caught. Fish are collected in accordance with methods from the KDHE Fish Tissue Contaminant Monitoring Program (FTCMP), (KDHE, 2013). Muscle tissue biopsy plugs are prepared and submitted to the EPA Region 7 laboratory under FTCMP purview, tested for mercury, and compared against risk-based limits using a methodology established by the EPA (KDHE, 2013). Data are used to evaluate the waterbody's ability to support the food procurement use. Data may also be used by the FTCMP for support of consumption advisories and warnings.

Inorganic water chemistry samples are collected four times for each site (quarterly), and organic samples are collected twice: once in the second quarter (high flow) and once in third or fourth quarter (low flow). In any given year, the Stream Chemistry Monitoring Program (SCMP) typically collects samples for about half of the SP sites, and SPMP collects the remainder. Some sampling protocols for SPMP sites are different from those of the SCMP, though resulting data are comparable; see Section 4.2. With each sample, field staff record flow conditions and any other notes that may have bearing on interpretation of results. The data are used to evaluate the waterbody's ability to support a variety of designated uses; a large suite of parameters is compared against the state's numeric water quality criteria, with allowances made for natural background levels where necessary (KDHE, 2004).

Note that while the quality of data is high, the quantity of data collected for each site, which is adequate for the screening-level assessment used in the 305(b) portion of the Integrated Report, is in most cases not sufficient for a definitive site-level assessment that would lead to 303(d) listing.

1.5 Contemporary Program Objectives

The primary objective of this program is to provide scientifically rigorous information on the quality of flowing waters in Kansas. This information is intended for use in:

(1) complying with the water quality monitoring and reporting requirements of 40 CFR 130.4 and sections 106(e)(1) and 305(b) of the federal Clean Water Act, and
(2) evaluating waterbody compliance with the Kansas surface water quality standards (K.A.R. 28-16-28b *et seq.*).

In addition, data contribute to the following objectives:

(3) identifying and monitoring minimally disturbed (candidate reference quality) streams and watersheds;
(4) identifying point and nonpoint sources of pollution contributing most significantly to water use impairments in streams;
(5) documenting spatial and temporal trends in surface water quality that result from changes in land use patterns, resource management practices, wastewater treatment, climatological conditions, and corresponding pollutant loadings;
(6) developing scientifically defensible environmental standards, wastewater treatment plant permits, and waterbody/watershed pollution control plans; and
(7) evaluating the efficacy of pollution control efforts and waterbody remediation/restoration initiatives implemented by the department and other agencies and organizations.

Section 2

QUALITY ASSURANCE GOALS

The foremost goal of this QA management plan is to ensure that the SPMP produces data of known and acceptable quality. "Known quality" means that data precision, accuracy, completeness, comparability, and representativeness are documented to the fullest practicable extent. "Acceptable" means that the data support, in a scientifically defensible manner, the informational needs and regulatory functions of the BOW, the DOE, and the agency as a whole. The success of the program in meeting this general goal is judged on the basis of the following quality control performance criteria and requirements:

1. Where practicable, the reliability of program data shall be documented in a quantitative fashion. Precision of chemical data, biological data, and physical habitat measures shall be evaluated through duplicate sampling activities conducted by field staff. Sequential duplicate chemical samples will be collected from a minimum of one site during each sampling run, or at least once during any week of sampling. Duplicate biological samples will be obtained from at least ten percent of the sites sampled, and duplicate water column samples (for algal chlorophyll analysis) will be collected from every site. For all parameters being measured (*e.g.*, water chemistry analyses) or calculated (*e.g.* biological indices), average Relative Percent Difference (RPD) values between duplicate samples shall be less than twenty percent. If any parameter exceeds this RPD, possible causes will be investigated, documented, and corrected if possible.

   Accuracy of chemical data shall be evaluated through the use of field blanks and field spiked samples. A field blank shall be collected on each sampling run, or at least once during any week of sampling. Accuracy measures based on field spikes shall be based on data collected by the Stream Chemistry Monitoring Program (SCMP) (KDHE, 2014). Background contaminant levels (determined by field blank analysis) shall constitute, on average, less than ten percent of the reported sample concentrations, and spike recoveries shall average between 80 and 120 percent of the actual spike concentrations. Chlorophyll analysis is performed by staff from the Monitoring and Analysis Unit. Accuracy of chlorophyll-a measurements shall be determined through the standardization of the spectrophotometry equipment using solutions of known chlorophyll-a concentration and through the periodic analysis of certified chlorophyll-a reference samples.

   Accuracy, as the term pertains to biological sampling, refers to the correct identification of biological specimens to the lowest practicable taxonomic level. Accuracy is evaluated through the use of reference specimens and through internal and external audits of taxonomic performance (see section 4.8). As a general goal, program personnel shall misidentify less than one percent of the specimens collected in the course of sampling activities.

2. Loss of biological data due to specimen collection, transport, or storage problems, or to the subsequent mishandling of data, shall be limited to less than two percent of the data originally scheduled for generation. If problems occur and a substantial quantity of data is

lost, an effort shall be made to resample the stream(s) in question to maximize data completeness. Loss of chemical data due to sample collection, transport, or analytical problems, or to the subsequent mishandling of data, shall be limited to less than five percent of the data originally scheduled for generation. If this goal is not met and a substantial quantity of data is lost, an effort shall be made to resample the stream(s) in question.

These goals do not include circumstances in which streams scheduled for sampling are found to be dry at the time of attempted sampling. In these cases, the sites shall be designated as non-sampleable. The sites will not be revisited if a biological sample cannot be collected, and chemistry collection for that site will cease. However, if there is a biological sample, staff will attempt to collect remaining water chemistry samples. As a general goal, in a climatically normal year, the number of sites originally scheduled for sampling that are later found to be dry shall be less than ten percent of the total number of sites scheduled during any reporting period. In the event that successful sampling falls short of the target number of sites for a given year, replacement sites may be added to the sampling roster the following year in order to compensate.

3. Changes in the methods used to obtain and analyze environmental samples shall be carefully documented through formal revisions to the SOPs appended to this QA management plan. This requirement is intended to help maintain a reasonably consistent database over time, enhance knowledge of the effects of any procedural changes on reported metric values, and facilitate the identification and evaluation of long-term trends in surface water quality.

4. Data generated through this program shall be compared and contrasted with other available monitoring information to examine the representativeness of program findings relative to other reported results. Staff shall attempt to ascertain the probable causes of any discrepancies observed among the databases and describe, in end-of-year program reports, the magnitude and practical significance of such discrepancies.

Section 3

QUALITY ASSURANCE ORGANIZATION

3.1 Administrative Organization

The SPMP is one of several surface water monitoring programs administered by the KDHE. In 2012, these programs were transferred from the Bureau of Environmental Field Services (Technical Services Section) to the Bureau of Water (Watershed Planning, Monitoring, and Assessment Section). Program offices are located at the Curtis State Office Building, 1000 SW Jackson, Suite 420, in Topeka, Kansas.

3.2 Staff Responsibilities

In normal years, program staff includes two environmental specialists: a program manager and a program assistant. The program manager is accountable for most program planning, data interpretation, and report writing functions. This employee monitors program QC, apprises the unit leader and section chief of any equipment or staff training needs, schedules work, spearheads the annual review and revision of the program QA management plan (see section 5), approves data releases, and serves as the program's principal macroinvertebrate taxonomist. The program assistant assists in scheduling and planning, maintains the vehicle, equipment, and supplies, serves as the program's secondary taxonomist and primary GIS mapper, tracks samples and data, compiles and analyzes data for the annual quality assurance report, recommends edits for the QMP, and assists with data entry, data interpretation and report writing functions as well as training new staff. Both specialists routinely participate in field work, identify macroinvertebrates, and assist SBMP staff with maintenance of the biological reference collection and taxonomic library.

In addition to implementing the Kansas SPMP, program personnel are charged with formulating regionally calibrated biological indices and methods for routinely incorporating biological data into 305(b) assessments, as well as producing these assessments for the biennial Integrated Water Quality Assessment report. Further duties include deriving approaches for identifying and linking ecological stressors to aquatic life use impairments and performing the sampling and statistical analyses needed to finalize the Kansas list of reference streams and rivers (KDHE, 2010). Time permitting, both specialists may engage in work on special projects for the program or section.

Staff from other Watershed Planning programs regularly assist with water chemistry and fish tissue sampling and occasionally assist with other SPMP field activities in the event of staff absences or when additional personnel are needed to conduct the work in a timely, safe, and efficient fashion. Staff from the SPMP provide reciprocal assistance to other programs. When workloads demand and resources allow, auxiliary staff (summer interns, temporary staff) may also contribute to program efforts, provided they meet necessary qualifications to do the work and receive appropriate training and oversight.

3.3 Staff Qualifications and Training

Minimum technical qualifications for program staff vary by position. However, each environmental specialist must hold at least a four-year college degree in aquatic biology or a closely related scientific field and have substantial experience in the performance of surface water quality studies and associated data analysis and statistical procedures. Each staff member must also have a thorough understanding of the procedures used in the sampling, preservation, identification, enumeration, labeling, and archiving of invertebrate specimens and in the processing of associated paperwork and other documentation. They must also possess a strong taxonomic familiarity with the invertebrate organisms occurring in Kansas streams.

In addition to strong scientific skills, the program staff must understand the basic principles of project management, program administration, and quality control, and must possess advanced computer skills and written and oral communication skills. They serve as the primary contact for probabilistic monitoring, perform statistical analysis and assessments based on data, and may represent KDHE at public or scientific meetings.

All individuals routinely participating in this program must possess a valid Kansas driver's license and current certifications in first aid, cardiopulmonary resuscitation (CPR), and Automated External Defibrillator (AED) operation. New staff must review the program's QA management plan and SOPs prior to participating in any field/laboratory duties, as well as all other applicable Program, Section, and Division QA management plans, and existing staff must review them annually. All program staff receive in-house training in applicable work procedures and related safety requirements. As funding and other agency resources allow, personnel are encouraged to participate in technical workshops and seminars dealing with environmental monitoring operations and related field, analytical, data management, and statistical procedures.

Section 4

QUALITY ASSURANCE PROCEDURES

4.1 Survey Design and Monitoring Site Selection

4.1.1 Survey Design

General Principles. The goal of the SPMP survey design is to generate a spatially balanced random sample of sites from which data may be extrapolated with known confidence to the entire resource of interest. For the purposes of site selection, the target population comprises all streams and rivers on the most recently approved version of the Kansas Surface Water Register (KSWR) (KDHE, 2013). This sample frame includes intermittent streams as well as perennial streams and rivers.

Sampling sites are selected using a Generalized Random Tessellation Stratified (GRTS) design (Stevens & Olsen, 2004). This algorithm ensures that resources are sampled randomly, but in a spatially balanced fashion. Using GRTS, the resource sample frame, in this case the KSWR, is overlaid and partitioned with a rectangular grid. Nested subgrids further partition the frame until the expected probability of selecting a sampling site in any given cell is less than 1. The resulting cells are given hierarchical addresses that are used to order the resource sampling elements, which then are ordered linearly by address and sampled systematically. Sites selected for sampling are numbered from 1 to n (sample size), the numbers are converted to base-4, the addresses are reversed and the sites are then ordered according to the reversed address. This process of recursive partitioning and systematic sampling, followed by reverse hierarchical ordering, forms the basis for the ordered samples.

Survey Design A. Survey Design A was used as the basis for sampling in 2006–2010. The sample frame was the 15 December 2005 KSWR and its accompanying map coverages, which were based on the 1:100,000 NHD linework. Design specifications were provided by KDHE; the design itself was produced by the Design Team at the USEPA Office of Research and Development, National Health & Environmental Effects Laboratory's Western Ecology Division, in Corvallis, Oregon. The design team clipped the KSWR coverage at the Kansas border to yield a total sample frame stream length of 46,817 km.

Sites were selected at a uniform density relative to the sample frame without unequal weighting or stratification (that is, without respect to ecoregion, stream order, flow class, or any other classification parameter). The survey design was implemented using "R" statistical software, version 2.2.1, and the *psurvey.design* package, version 2.2.1 (EPA Office of Research and Development, Western Ecology Division).

The number of sampling sites requested for the first survey design was 100 (50 sites × 2 years), plus a generous oversample of 700 percent, for a total of 800 sites. The oversample was intended to compensate for landowner denials, estimated *a priori* at 50 percent, and non-sampleable (*e.g.*, dry) sites, estimated at 30–40 percent. The completed site list and supporting documentation

were provided by EPA on 07 February 2006. Survey Design A was retired after substantial updates were made to the sample frame in the form of a revision of the KSWR.

Survey Design B. The sample frame for Survey Design B was the 06 March 2009 version of the KSWR and its accompanying map coverage, based on the 1:24,000 NHD linework. The sample frame was trimmed at state borders, and sites were selected as for Survey Design A. Total length was 49,395 km. The design was provided on 07 March 2009 by EPA office of Research and Development, Western Ecology Division. KDHE requested a 200 site design (50 sites x 4 years) with 300% oversample, for a total of 800 sites. If site attrition rates (due to the permissions and reconnaissance process) and annual monitoring workload remain relatively constant, it is estimated that any given 800-point survey design can serve for five to eight years. Survey Design B was used for site selection for 2011-2017, then retired.

Survey Design C. The sample frame for Survey Design C was the 12 December 2013 version of the KSWR and its accompanying map coverage, based on the 1:24,000 NHD linework. The 2013 Register is not significantly different from the 2009 Register; the total length for Survey Design C was 49,246 km (30,600 mi). This site list includes 1683 new probabilistic sites. It will be used will be used for National Rivers and Streams Assessment sampling in 2018-2019 as well as normal program monitoring for state level assessments, and it will be used until sites are exhausted or significant changes to the KSWR require a redesign.

Design of Future Surveys. Future survey designs will most likely use the same target population and sample frame as the initial survey design; *i.e.*, designs will be based on all classified stream and river segments identified in the most up-to-date version of the KSWR, trimmed at the state boundary. Currently, the KSWR changes occur incrementally with updated Use Attainability Analyses (KDHE, 2012) performed by or submitted to the agency, or with simple geographic corrections to map linework. The timing and extent of new survey designs will be made relative to anticipated assessment periods and anticipated major changes to the KSWR.

Survey design specifications are unlikely to change, and it is anticipated that unweighted designs will be used for the foreseeable future. If discrete categories of the resource (*e.g.* intermittent streams, large rivers) emerge and present challenges in meeting monitoring or assessment objectives, consideration will be given to altering the design. Program staff will continue to consult with the USEPA Office of Research and Development Design Team (Corvallis, OR) to assist with survey design and generation of population-level estimates, but this task will increasingly be assumed by SPMP staff. The design team will use the newest published version of the appropriate software package that effects spatially balanced random sampling from a linear resource. Currently, this is "R"-based software package *spsurvey* version 3.3, available at www.r-project.org.

Additional Sampling Points. In some cases, additional probabilistic sites from compatible survey designs will augment the routine monitoring design. For example, sites from the National Rivers and Streams Assessment may be integrated with the SPMP routine monitoring points, provided that the target population and sample frame are compatible.

4.1.2 Evaluation and Selection of Biological Sampling Sites

Overview. Each survey design generates a numerically prioritized list of x-site coordinates. Every site on the list must be evaluated and either sampled or rejected, in order. The reasons for not sampling a site must be documented as described in the Wadeable Streams Assessment Site Evaluation Guidelines (USEPA, 2004). At KDHE, five steps are taken in evaluating whether a site can be sampled: preliminary modifications, desk reconnaissance, field reconnaissance, permissions, and final considerations.

Preliminary Modifications. Between survey designs, the sample frame may need to be adjusted from time to time to reflect revisions to the KSWR. For example, the Survey Design A sample frame was slightly altered after site selection to reflect the proposed deletion of 85 KSWR stream segments, which represented about 5% of total mileage. This led to the removal of 40 of the 800 sites. Aerial photos and maps of each of the affected sites were reviewed, along with use attainability analysis (UAA) data sheets and site photos, before site removal. This review confirmed that the sites were on dry segments. In addition, updates to segment designated uses (*e.g.*, Food Procurement) may affect mileage estimates for assessment. It is recognized that deletions from the sample frame, or any other changes to the frame between survey design and data analysis, can potentially influence data interpretation and reporting. Modifications are made only to improve the accuracy of the sample frame.

Desk Reconnaissance. A remote reconnaissance is conducted for all sites, using available informational resources. Reconnaissance procedures resemble those used for the National Wadeable Streams Assessment (USEPA, 2004). The remote reconnaissance of sites consists of a visual inspection of a variety of leaf-off and leaf-on imagery available to the agency as GIS compatible files. This imagery is combined with the site map and the KSWR using ESRI ArcMap. Other information used in evaluation may include additional photographic or satellite imagery, USGS flow estimate data (Perry, Wolock, & Artman, 2002), segment data from the UAA program, and verbal or written information from landowners or local aquatic resource experts. All data sources are documented.

Sites are reviewed using the resources described above and then separated into three categories:

1. "Wet:" water almost certain to be present. These sites are located on large streams with water clearly visible in the channel. These sites are designated suitable for sampling without field reconnaissance.

2. "Dry:" water almost certain to be absent. These sites are located on apparently ephemeral stream reaches and are confidently designated to be unsuitable for sampling, even without field reconnaissance. Aerial photographs typically reveal a dry, farmed-over "channel" with no distinction between the surrounding topography/vegetation and the nominal stream course. Such sites are not common but do occur in extreme headwaters or where anthropogenic channel modification or groundwater pumping have altered local flow. Note that wetted channel may occur upstream or downstream of such sites, but if the x-site is dry, the point must be rejected.

3. "Unknown:" presence or amount of water uncertain. These sites are located on small streams with limited or intermittent flow, or where channel features or quality of available imagery make it difficult to determine whether water is consistently present in a given reach. These sites are targeted for field reconnaissance.

Field reconnaissance. Field reconnaissance is typically performed during the low-flow period (July–October) of the year prior to sampling. A field reconnaissance file is prepared for each "Unknown" status site. The field reconnaissance file contains a schematic map (showing the x-site and nearest upstream and downstream bridges, as well as local road and waterbody names), an aerial map, landowner information (if available), and a site information sheet. The site information sheet includes site number, stream name, county name, geographical coordinates for points of interest, hydrologic unit plus Channel Unit Segment Number Alphabetical (CUSEGA), and any supplementary data available for the CUSEGA, *e.g.*, KDHE UAA data or USGS estimated flow data (Perry, Wolock, & Artman, 2002).

An x-site may fall at any point on the stream network and is thus not always near a road. The viability of a site is evaluated by observation of the stream channel at one or more of the following points: nearest upstream bridge, nearest downstream bridge, x-site, or alternate access point. At each evaluation point, GPS coordinates and digital photographs are taken, along with data on the presence, volume, and flow of water and notes regarding site accessibility, as necessary (see Field Reconnaissance Form, APP. C-2).

After field reconnaissance, one of three determinations is made concerning sampleability of the x-site. *Sampleable* means an adequate amount of water is present (either flowing or in pools). *Non-sampleable* indicates that an adequate amount of water is not present and is not likely to be present. *Undecided* indicates that an adequate amount of water may be present, but current weather conditions or other circumstances prevent a definitive determination; thus, a follow-up telephone call to the landowner or a re-visit is needed to obtain more information. A final determination is made for each site by the end of the calendar year prior to sampling.

Landowner permissions. Property ownership research and landowner permission is pursued independently of reconnaissance activities, although the two activities are often done concurrently. Normally, permissions are pursued for 200 x-sites at a time, a number deemed adequate for obtaining two years' worth of sampling locations (*i.e.*, 100 sites). Methods and considerations used for the permissions process are modified from an EPA technical report (Lesser, 2007). Property owners are identified using records from county appraisers and/or registers of deeds, and a systematic effort is made to contact each owner. A more detailed description of the landowner identification and contact process is presented in the appended SOP No. SPMP-005.

Additional Considerations.

There are two other factors that may affect a given year's final site list; these are the presence of pseudoreplicate sites and the loss of sites from the original sample list.

Dropping pseudoreplicate sites. If two sites meet all the following conditions, the higher-numbered site is dropped: (1) both sites pass the permissions and reconnaissance process; (2) sites are scheduled for sampling in same year; (3) both fall on the same CUSEGA, or on adjacent CUSEGAs that have the same designated uses (4) sites are within 10 linear miles of each other (5) there are no intervening KSWR confluences on the channel (6) there are no appreciable visible changes in land use, slope, riparian character, or channel width/shape and no apparent intervening point sources, water withdrawals, or other discernible influencing factors when sites are compared in an aerial map/photo view. In these cases, the second site is dropped because it is not likely to provide an independent data point.

Site replacements. When each year's site list is prepared, it is accompanied by a list of five or more replacement sites, which have all passed the same reconnaissance and permissions process. If a primary monitoring site is found to be dry or nearly dry during the first quarter of chemistry sampling, it may be replaced with the first available backup site on the list.

4.1.3 Selection of Companion Chemistry Sampling Sites

A "companion" chemistry sampling site is designated for each x-site at a nearby upstream or downstream bridge, low-water crossing, or other point of ready access. Water quality at the companion site should be equivalent to water quality at the x-site; thus, selection of the companion site is based not only on proximity to the x-site but on the absence of intervening stream confluences or permitted point sources as well as uniformity of land use in the reach. Furthermore, because an effort is made to collect water chemistry samples from each site on a quarterly basis, access to these sites must be reliable and direct. If no road crossing occurs within the named CUSEGA segment, an effort is made to collect water chemistry samples from the x-site itself or at an alternate access point. As a rule, the companion site is located on the same CUSEGA as the x-site but may occur on the next segment if designated uses are identical and the access point is the best available.

Candidate companion chemistry sampling locations are identified by viewing road and bridge coverages along with photographic/satellite images from the KDHE geographical information system (GIS) server and other available sources. In some cases, an alternate chemistry sampling site is designated if heavy rainfall or other factors clearly could prevent access to the primary companion site. In the unusual event that no acceptable bridge can be identified (for example, if both flanking bridges are in the regulatory mixing zone of discharging point sources), a non-bridge companion sampling point is chosen, subject to the same siting criteria. For illustrative purposes, 78 percent of the sites in the Survey Design A had a usable road crossing (bridge) within one stream mile, and 97 percent had a crossing within three stream miles.

Water chemistry sampled at the selected companion site is considered representative of chemistry at the x-site. The Indiana Department of Environmental Management used a similar

method for monitoring chemistry in the Lower Wabash River Basin and found only minor differences between x-sites and adjacent bridge sites (Christensen, 1999). In that study, the only consistently measurable difference was for the parameter "total solids," but this difference was not reflected in the two component parameters, total suspended solids or total dissolved solids. Differences were more pronounced in larger waterways where bridge crossings were, in many cases, several miles farther from x-sites. The Wisconsin Department of Natural Resources also found no measurable differences in water chemistry between x-sites and the nearest adjacent bridge sites (Miller, Colby, & Kanehl, 2006).

4.2 Chemistry Sampling

4.2.1 Overview

Typically, a significant fraction of the water chemistry sampling responsibilities for SPMP sites are fulfilled by SCMP staff, because they are able to accommodate many SP sites into their normal quarterly sampling trips. In order to allocate the workload between the two programs, SPMP staff provide the SCMP a complete list of all anticipated sites for a given calendar year in the fall of the year prior to sampling. This list contains SPMP site identifiers, stream names, counties, x-site coordinates, companion chemistry site coordinates, information about site access, and nearest towns. SPMP staff also typically provide area maps depicting the selected chemistry sampling locations relative to x-sites, with local roads labeled. Upon receipt of these resources, SCMP determines which sites can be incorporated into the existing schedule of the SCMP without overburdening field and district staff or the Kansas Health and Environmental Laboratories (KHEL). After the SCMP manager has made a determination, the SCMP manger advises SPMP staff which sites can and cannot be incorporated into that program's sampling schedule. The collection of samples from these remaining sites becomes the responsibility of the SPMP.

On the rare occasion that a SPMP site corresponds to a routine SCMP monitoring station, SCMP staff collect the samples under the SCMP station identifier as long as water is flowing, and under SP station identifier if it is pooled. SPMP staff then retrieve and copy the SCMP data from the shared water chemistry database, assigning the appropriate SPMP site number to those samples.

Because SPMP chemistry samples are collected by multiple programs and by various staff members, it is important that SPMP program staff track the progress of sampling activities by both programs, to ensure that all intended samples are collected. About two weeks before the end of each quarter, SPMP program staff review sampling records to determine whether any end-of-quarter makeup sampling is required.

Chemistry samples are collected and analyzed in much the same manner as those for the SCMP. Except as noted below, all equipment and supplies, field methods, laboratory methods, and data management procedures are nearly identical to those specified in the SCMP QA management plan (KDHE, 2014). It is anticipated that any significant future changes in SCMP methodology will be mirrored in the SPMP's corresponding methodology. Departures from the methodology of the SCMP are detailed below and fall under four general categories: sampling schedule, parameters, logistics, and sampling conditions.

When sampling trips are planned and carried out, consideration must be given to distributions of invasive species, in order to prevent transmission of propagules among sites. Approved protocols range from strategic trip planning to various methods for cleaning equipment; see SOP No. SPMP-012.

4.2.2 Sampling Schedule and Parameters

Samples are collected on a quarterly basis (January–March, April–June, July–September, October–December), for one year only, ideally corresponding to the same year in which biological samples are taken. A complete water chemistry sample series normally comprises four quarterly samples taken in a single calendar year (January 1–December 31).

Grab samples for routine composite and inorganic parameters (*e.g.*, pH, temperature, nutrients, metals) and for *Escherichia coli* are collected during each site visit. Samples for routine organic parameters (pesticides and related compounds) are collected from all sites only twice a year, once during the second quarter (high flow period) and once during the third or fourth quarter (low flow period). Samples for radiological parameters currently are not collected as part of the SPMP. In 2016, the program implemented regular *in situ* measurements of temperature, conductivity, pH, and dissolved oxygen, using a multimeter probe, according to SOP No. SPMP-013.

4.2.3 Sampling Conditions and Methods

Water chemistry samples may be collected from either flowing or pooled stream sites. This approach differs from that used by the SCMP, which focuses on flowing waters only. Because SPMP sites can fall on any segment of the KSWR, it is expected that sampling often will be conducted on smaller, intermittent streams that are prone to occasional pooling during summer low flow.

During each SPMP chemistry sampling event (regardless of which program collects the sample), staff use a systematic method to describe and record flow conditions at the site. This is especially important where pooling may affect water chemistry and/or dry reaches in an intermittent system may physically separate the x-site from the companion chemistry sampling site. Detailed instructions for the description and recording of flow conditions at probabilistic sites are presented in SOP No. SPMP-010.

Reduction of carryover (from one sample to another) is an ongoing concern for any sampling effort that re-uses equipment. A deionized-water wash would be ideal, but it is not feasible to carry deionized water in sufficient quantities to wash all equipment before or after each sample. Therefore, at sites collected by the SPMP program, staff perform an *in situ* pre-sample equipment rinse. The sampling containers are immersed in the waterbody and used to collect a pre-sample, the pre-sample is discarded, and the second collection from the waterbody provides the actual working sample. This method is sometimes used by the US Geological Survey to remove carryover from previous sites (Wilde, Radtke, Gibs, & Iwatsubo, 1999). If a stream is pooled or very slow-flowing such that pre-sampling might disturb the substrate prior to actual

sampling, the pre-sample rinse is performed away from the stream, using deionized water. This protocol was begun in the second quarter of 2011. Detailed instructions are presented in SOP No. SPMP-011.

4.3 Biological and Physical Habitat Sampling

Biological samples and physical habitat measurements are obtained from the x-site and the surrounding 150-m stream reach (75 meters above and below the x-site). Each site is visited one time between April 15 and October 15.

When sampling trips are planned, and before and after each individual site is visited, consideration must be given to distributions of invasive species, in order to prevent transmission of propagules among sites. Approved protocols range from strategic trip planning to different methods for cleaning equipment; see SOP No. SPMP-012.

4.3.1 Initial Site Activities

The first activity upon arrival at a stream is location and verification of the x-site. The designated x-site is often some distance from the nearest vehicle access point, requiring an overland hike. The geographical coordinates (latitude and longitude) of each x-site are independently programmed into two hand held global positioning system (GPS) devices (see SOP No. SPMP-008), and the field crew then navigates to the x-site on foot, following logical land features, leaving gates and fences as found, and avoiding trespass or crop damage.

If the nominal designated coordinates do not fall within the stream channel, a corrected x-site is established in the stream channel as close as possible to the nominal x-site. In either case, the field x-site coordinates are verified by a second crewmember (with the second GPS device) and recorded on the site data form. Additional information recorded on the site data form includes supplementary locality information, current and recent weather, and the names of participating field staff (see Site Data Form, APP. C-1). If flowing or persistent standing water (other than water from recent precipitation) is present in at least half of the reach, the site is deemed sampleable. Otherwise, the site is designated as dry and non-sampleable.

Normally, the sampling reach is established as 75 meters upstream and 75 meters downstream of the x-site. However, if there are significant stream confluences or relevant property lines within the 150-m reach surrounding the x-site, the site may be shifted upstream or downstream to avoid these features. Also, if the wetted channel is on average greater than 8 meters wide, the sampling crew has discretion to shift the x-site. In these larger systems, the x-site is bracketed by 20 wetted channel widths in each direction (total bracket length = 40 wetted widths), and the 150-m reach may be placed anywhere within this bracket in order to capture the best diversity of macrohabitats. It is desirable to site the sample reach to encompass at least some riffle habitat, and a general guideline of hydrogeomorphology is that twenty channel widths will usually capture at least one riffle-run-pool sequence.

Air temperature (in the shade) is recorded to the nearest degree Celsius using a NIST-calibrated analog thermometer. In the fastest-flowing accessible part of the channel, temperature,

conductivity, pH, and dissolved oxygen are measured using a multimeter probe (see SOP No. SPMP-013). A photograph is taken of written site identification information (from either a data sheet or a sample jar), then at least four photographs of the stream are taken at the x-site: one facing upstream, one downstream, one of the left bank, and one of the right. Other photos may be taken as well.

Unless noted otherwise, all collected samples and all completed forms are labeled with the appropriate site identifier, stream name, date of sampling, and initials of participating field staff. Macroinvertebrate sample jar labels (both inside and outside the jar) identify whether the sample is from the upper or lower half of the reach, as well as start time and sampling duration.

4.3.2 Phytoplankton and Chlorophyll-a Sampling

Before the substrate is disturbed by other activities, water samples are collected for identification and enumeration of phytoplankton and measurement of chlorophyll-a concentration. Care must be taken during water sampling to avoid disturbance of the streambed substrate and entrainment of sediment in the water samples, as well as to avoid inadvertent collection of surface scum. At each site, two 1-L polyethylene cubitainers are opened, filled, and sealed below the water surface, and then maintained in a cool, dark location (*e.g.*, in a shaded area in the stream margin) until transferred to the vehicle, where they are placed immediately on ice in a dark cooler.

4.3.3 Macroinvertebrate Sampling

A detailed description of macroinvertebrate sampling protocol is given in SOP No. SPMP-003. Field sampling for aquatic macroinvertebrates follows a slightly modified version of the SBMP's time-based "equal effort" method (KDHE, 2012), which is similar to EPA's Rapid Bioassessment Protocol III (Plafkin, Barbour, Porter, Gross, & Hughes, 1989). During each sampling event, two individuals using D-frame nets and forceps collect macroinvertebrate specimens for a one person-hour period, or 30 minutes of actual sampling for each of two collectors (as in the SBMP). Time spent traversing major obstacles (nonwadeable pools, massive logjams, *etc.*) is not counted as sampling time. The goal of each person is to collect at least 100 organisms. It is recognized that some sites may require more than 30 minutes of sampling to yield an adequate organism sample count; however, sampling must end after 60 minutes (two person-hours), regardless of the number of organisms collected. This time limit is imposed to ensure a degree of consistency in sampling effort from site to site.

Sampling is confined to a spatially defined reach of 150 meters. This is the minimum reach length sampled according to Wadeable Streams Assessment and National Rivers and Streams Assessment protocols (USEPA, 2004) (USEPA, 2009) and is also a typical reach length sampled by the SBMP. In most streams under 8 m wide, this should assure sampling of at least one complete riffle/pool/run or meander sequence; siting adjustments may be made in streams over 8 m wide. This work requires two scientists, one collecting upstream of the x-site for 75 m and the other collecting downstream of the x-site for 75 m. Before beginning the timed sampling effort, each crew member walks the full extent of his or her assigned half-reach in order to become familiar with the available macrohabitats and microhabitats. During a sampling event, an effort is made to sample all available macrohabitats (riffles, pools, runs) and evident microhabitats (*e.g.*,

tree roots, aquatic vegetation, woody debris) in proportion to their prevalence in the reach. Macroinvertebrates are collected into 70–80% ethanol. When macroinvertebrate duplicate samples are performed, each collector samples the portion of the reach that was previously sampled by the other. This provides a strict and impartial measure of repeatability.

On the Site Data Form, each scientist records details pertaining to macroinvertebrate sampling. Field staff also complete a Habitat Diversity Index (HDI) form describing habitats sampled (see section 4.3.5 and SOP No. SPMP-006), which is part of the integrated Site Data Form (see Appendix C-1).

4.3.4 Mussel Search

If live Unionid mussels, mussel valves, or identifiable valve remnants are encountered during macroinvertebrate sampling, or if mussels are expected to occur in the stream reach based on geographical area and stream type, the two-person crew conducts an additional 15-minute (0.5 person hour) intensive search for live mussels and remnant mussel valves in accordance with SOP No. SPMP-007. The search covers the same 150-m reach sampled previously for macroinvertebrates.

Procedures differ somewhat from those of the Stream Biological Monitoring Program. Specifically, collected material is sorted and culled on site only if there are more than 10 recent shells of a given species; only 11 individuals are needed to establish "abundant" status. Otherwise, all shells are brought back. This is for two reasons. First, sites visited by the SPMP, unlike those sampled by SBMP, are often visited only a single time. Therefore it is of value to make a good synoptic voucher collection from each site. Second, this program is often on a tight schedule with respect to field work; it is a better use of time to sort samples in the laboratory rather than in the field.

At least one valve or valve pair for each Unionid species found in the reach is retained for voucher purposes. If multiple age classes are present and/or the species is sexually dimorphic, a numerically representative collection is retained relative to the prevailing species, sex, and size classes, with priority given to the most recent specimens. Samples are secured in a plastic bag labeled with the site number, stream name, collection date, and collectors' initials. If live mussels are encountered, a Live Mussel Field Form (App. C-3) is completed on site, or notes are recorded on the Site Data form, and photos may be taken.

4.3.5 Physical Habitat Assessment

In addition to the HDI (see description above), physical habitat for the reach is assessed using a slightly modified version of the Rapid Habitat Assessment (RHA) from EPA's Rapid Bioassessment protocol (Barbour, Gerritsen, Snyder, & Stribling, 2010). This is an integrated part of the Site Data Form (see Appendix C-1). Additional information is recorded on the Site Data Form, describing the prevailing flow condition, channel structure, substrate type and condition, aquatic animals and vegetation observed, riparian condition, area land use, and obvious human influences on the quantity or quality of habitat. The RHA describes the entire reach, whereas the HDI includes only those habitats actually sampled for macroinvertebrates. For

example, if a very deep non-sampleable pool is present, its presence will be reflected on the RHA but not the HDI.

4.3.6 Final Site Activities

Before departure from the site, a sketch is made of the sampled stream reach, depicting the location and types of macroinvertebrate habitat, human influences, and any other salient features. Additional photos may be taken, field forms are checked for completeness and accuracy, and samples are secured for transport to the vehicle. The Site Data Form includes a checklist of forms completed and types of samples collected from each site (Appendix C-1). If the waterbody sampled is known or suspected to harbor invasive species, staff follow procedures in SOP No. SPMP-012 for guidance on decontaminating equipment.

4.4 Fish Tissue Samples

Fish tissue samples are collected from sites where harvestable size fish of edible species can be collected. Nearly all of these fall on KSWR segments already designated for food procurement. Agency scientists perform fishing reconnaissance during earlier site visits, *i.e.,* general field reconnaissance, chemistry sampling, and/or macroinvertebrate sampling visits. This is to establish where the best access point(s) are for electrofishing, whether harvestable top predators and bottom feeders are likely to be present, and what type of fishing equipment is most appropriate for the site. The general reconnaissance form includes areas to record information on fishing access and recommended equipment (Appendix C-2). If fishing access points require additional landowner permissions, these are pursued in spring and early summer.

The fishing site list and site dossiers (containing reconnaissance, access, and permission information) are then shared with the manager of the FTCMP, so that staff from the two programs can coordinate on sampling, sample preparation, and sample submission to the laboratory; see FTCMP Quality Assurance management plan for more information (KDHE, 2013). Electrofishing normally takes place from August through October.

From 2006 through 2012, fish tissue samples were submitted as fillets, and they were analyzed for mercury, cadmium, lead, selenium, and a suite of 19 organic compounds. During that time period, mercury was the only analyte observed more than once at levels exceeding established consumption risk guidelines. Thus, beginning in 2013, the fish tissue analysis method was modified to include only mercury, taken from a tissue plug. Although only a single analyte is measured, the tissue plug method has three advantages over the fillet method. First, a plug sample can be taken without sacrificing animals; the fish can be captured, biopsied, and released. Second, the preparation time for each sample (field biopsy as opposed to lab fillets) is much reduced. Third, because each plug is analyzed individually (rather than composited, as are fillets), the method offers much more informative data relative to fish species and size.

4.5 Sample Transport, Chain-Of-Custody, and Holding Times

4.5.1 Chemistry Samples

All water chemistry samples must be handled and stored in a fashion that prevents contamination, leakage, or damage during transport. Samples collected during one-day sampling runs are delivered to KHEL that same day, prior to the close of business, if possible. Samples gathered on two- or three-day sampling runs are delivered to the laboratory as soon as possible, preferably during laboratory normal business hours. In the event field staff are unavoidably detained, every effort is made to contact KHEL by telephone to arrange for a late afternoon or evening transfer of samples. As a rule, no sample arrives at KHEL later than 72 hours after collection.

Only those samples collected during three-day runs and submitted for Dissolved Oxygen (DO), bacteria, nitrate, nitrite and/or orthophosphate analysis routinely exceed the maximum holding times established by KHEL. Quality control studies conducted by KDHE have shown no short-term holding time effect for dissolved oxygen once the samples are acidified. However, reported concentrations of *E. coli* bacteria, nitrate, nitrite and orthophosphate may be somewhat less than actual ambient levels owing to bacteriological die-off, microbial assimilation of phosphorus and nitrogen, and other processes occurring within the samples. The magnitude of any change in concentration is ascertained through the use of field spikes as described in the SCMP QMP (KDHE, 2014) and through special QC (time-course) studies conducted by KDHE.

Standardized sample submission (chain-of-custody) forms accompany all water chemistry samples submitted to KHEL (App. C-8.1). These forms identify sampling location, date and time of sample collection, personnel involved in the collection of the sample, and analytical parameters of interest. They also assign each container a unique identification number (also printed on the container barcode) for future reference. Staff involved with the collection and transfer of samples and date the form and deliver it (with the samples) to KHEL.

Receiving personnel at KHEL provide a receipt showing the unique lab accession numbers assigned to each sample, generate and sign two copies of the form, record the date and time on the form to acknowledge receipt of the sample, and retain one copy. If an electronic version of the field form has been updated in a PalmPilot, the electronic data are downloaded into the KHEL system at the time samples are delivered. This basic transfer protocol also is performed if the sample changes hands prior to arrival at KHEL (*e.g.*, if district staff help transfer samples to KHEL). Upon return to the KDHE central office, electronic data from the PalmPilot are uploaded to a shared drive, and both the handwritten and printed/signed copies of the data collection sheets are filed. The Stream Chemistry Monitoring Program's methods in SOP No. SCMP-016 (Procedures for transfer of electronic data and uploading to laboratory data collection system) are adopted by reference (KDHE, 2014).

4.5.2 Macroinvertebrate and Mussel Samples

Macroinvertebrate and mussel valve samples are transported to the KDHE central office in Topeka. In the unlikely event that a sample is delivered by someone other than the staff involved

in its collection, the courier's signature and the date and time of sample transfer are recorded on the field collection form. Samples are retained in the possession of SPMP staff, stored in a secure location pending taxonomic determinations.

4.5.3 Phytoplankton and Chlorophyll Samples

Samples collected for analysis of phytoplankton and chlorophyll are transported on ice in a dark cooler and transferred to a refrigerator upon return to the KDHE central office. Before the maximum holding time (72 hours) is exceeded, 25 mL of each sample is preserved with Lugol's solution for phytoplankton assemblage identification. Each duplicate sample is filtered for chlorophyll-a determination according to the procedures outlined in SOP No. LWMP-005, Lab Analytical Procedures for Lake and Wetland Quality Samples (KDHE, 2014); sample filtration data are recorded on a Stream Probabilistic Monitoring Program form (App C-9), and sample status is communicated in a timely manner to the person/s who will be responsible for performing analysis.

4.5.4 Fish Tissue Samples

Fish tissue biopsies may be taken in the field, or they may be taken in the laboratory if whole fish are brought back. Samples are handled, labeled, transported, and processed according to guidelines described in the FTCMP Quality Assurance Management Plan (KDHE 2013a). Personnel from the FTCMP are responsible for submitting prepared samples to the analytical lab and returning data to the SPMP.

4.5.5 Field Forms, Photographs, and Electronic Data

All field forms are checked for accuracy and completeness before personnel leave the site. At least a few blank forms taken to the site are printed on "Rite-in-the-Rain"™ paper, for those sites where precipitation or immersion seem likely. Upon return to the field vehicle, forms are placed in the corresponding site folder for transport to the KDHE central office. Completed site folders are removed from the vehicle at the conclusion of each sampling trip and stored in a secure location pending data entry.

The waterproof digital camera used in the field is fitted with a floating strap. Digital photographs and data recorded on other electronic devices (*e.g.*, GPS units) are downloaded to the program's shared hard drive at the earliest possible opportunity and renamed with the station identifier, date, and label.

4.6 Taxonomic Determinations and Analytical Procedures

4.6.1 Macroinvertebrate Identification

A detailed description of the macroinvertebrate taxonomic procedures used in this program is given in SOP No. SPMP-004. Subsamples obtained by the field staff are combined in the laboratory to form a single pooled sample. Macroinvertebrate specimens are identified to the

lowest practicable taxonomic level utilizing literature specific to Kansas fauna or the most appropriate, up-to-date taxonomic literature available.

Following specimen identification, samples are retained through at least two 305(b) assessment cycles. Historical data may be adjusted to accommodate ongoing changes in the scientific nomenclature through revision of the Kansas Biological System (KBS) reference file. Voucher specimens of newly discovered or rarely encountered taxa are added to the reference collection on an ongoing basis. Opinions of outside taxonomic experts are solicited as needed.

In February 2012, the database and associated algorithms were updated to recognize and account for nondistinct parent taxa in samples where identified child taxa are also present. At that time, all macroinvertebrate identifications since the instigation of the SPMP were revisited and re-coded to take advantage of this advance. In cases where there is room for ambiguity, taxonomists now record on the bench identification sheet whether a given taxon is "Distinct" or "Nondistinct."

In January 2016, at the request of the SP program manager, Life Stages fields were added to the ENVI Oracle database to accommodate recording counts for individual life stages (larva, pupa, adult) for each taxon enumerated in a sample. Life stage data have been recorded on KDHE taxonomists' bench sheets for many years, but have not been recorded in the electronic database. Beginning with 2015 samples, the SP program will enter life stages data into the ENVI database.

If staffing resources are such that these procedures cannot be performed in a timely manner in-house, they may be outsourced to a qualified contractor, following identical quality assurance criteria and taxonomic effort guidelines.

4.6.2 Mussel Identification

A detailed description of the mussel taxonomic procedures used in this program is given in SOP No. SPMP-007. Mussel specimens are identified to species and, in some instances, subspecies utilizing literature specific to the Kansas fauna or other appropriate taxonomic literature. Specimens of newly discovered or rarely encountered taxa are added to the reference collection on an ongoing basis. Opinions of outside taxonomic experts are solicited as needed. A synoptic voucher sample from each site is retained and accessioned into the KDHE mussel archive collection. The accompanying electronic database is revised from time to time to accommodate ongoing changes in mussel nomenclature. Mussel data are stored in a Microsoft Excel database on a shared drive that is backed up daily.

4.6.3 Phytoplankton Identification and Chlorophyll-a Analysis

Phytoplankton identification and enumeration and chlorophyll-a analyses are performed by staff of the KDHE Lake and Wetland Monitoring Program (LWMP) according to procedures presented in the LWMP QA management plan (KDHE, 2014). Phytoplankton are grouped into six major categories: Chlorophytes, Cyanophytes, Diatoms/Chrysophytes, Dinoflagellates, Cryptophytes, and Euglenoids. Most are identified to genus, then measured and enumerated

using random subsampling procedures. Data are summarized as "percent total count" and "percent total biovolume."

Chlorophyll-a analyses are conducted pursuant to procedures detailed in SOP No. LWMP-005, Lab Analytical Procedures for Lake and Wetland Water Quality Samples. If staffing resources are such that these procedures cannot be performed in a timely manner in-house, they may be outsourced to a qualified contractor, following identical quality assurance criteria and taxonomic effort guidelines.

4.7 Assessment, Evaluation, and Reporting

Because the target population is defined relative to the sample frame (the Kansas Surface Water Register), sites on the KSWR may be designated non-sampleable but are typically not designated as "nontarget. " (The exception may be points on nominal stream segments that actually fall within impoundments.) No field reconnaissance can be perfect, because the presence of water in intermittent, headwater, and other smaller Kansas streams is inherently variable, both temporally and spatially. Additionally, a given site may not yield four viable water chemistry samples. However, if a site has at least one macroinvertebrate sample and at least one water chemistry sample that meet data quality requirements, it may be subject to a screening-level assessment. All of these factors may affect data interpretation and reporting.

All sites, whether sampled or not, are characterized according to permissions and sampleability. Combining permissions data with reconnaissance data can provide *a posteriori* estimation of whether there is a bias in permissions relative to flow status or site quality. The results of this estimate may affect interpretation and reporting (Lesser & Kalsbeck, 1999).

Data are analyzed and assessed in two- to six-year increments for the purpose of 305(b) reporting. Extrapolation of these results to the entire population of classified streams in Kansas relies, in part, on the use of "R" based statistical software package *spsurvey*, currently in version 3.1 (USEPA, 2015).

4.8 Internal Procedures for Assessing Data Precision, Accuracy, Representativeness, and Comparability

Because the SPMP implements data collection procedures that are very similar to both the SCMP and the SBMP, data quality assurance procedures are derived from methods already established in those programs.

4.8.1 In-house Audits

The section chief, unit leader, or an outside consultant identified by these personnel oversees annual audits of the implemented field, analytical, and taxonomic procedures. An audit may comprise (1) a system audit, consisting of a qualitative onsite review of QA systems and physical facilities and equipment used in monitoring, measurement, and specimen identification and (2) a performance audit, during which quantitative assessments are made of the efficiency, accuracy,

and variability of invertebrate sample collection and taxonomic procedures and/or chemistry field measurement procedures.

During system audits, staff conducting field operations are required to demonstrate a proper understanding of the requirements imposed by the QA management plan and accompanying SOPs. During performance audits, the two primary program staff members are required to conduct field and laboratory measurements and taxonomic determinations independently, and report measured values for *in situ* water chemistry measurements are no more than five percent apart (5% Relative Percent Difference), and report measured values for HDI, RHA, and selected community metrics that are no more than twenty percent apart (20% RPD). Should these values fall outside the stipulated control limits, the section chief, unit manager, and/or program personnel initiate corrective actions as described in Section 4.10.

4.8.2 Instrument Calibration and Standardization

On an annual basis, the performance of any thermometers used in the field is checked against a reference thermometer traceable to the National Institute of Standards and Technology (NIST). Before leaving for the field, monitoring staff also are expected to ensure that instruments are functioning properly. Should any instrument fail to calibrate correctly or provide stable and accurate readings, more frequent calibrations are performed or corrective action procedures are invoked (SCMP QMP section 4.8.1 describes equipment malfunction). The *in situ* water chemistry meter (YSI ProDSS) is two-point calibrated at least once per month, as well as every time cables or sensors are switched; see SOP No. SPMP-013.

4.8.3 Duplicate and Replicate Samples

Macroinvertebrate replicate samples comprise approximately five to ten percent of the total number of samples collected on an annual basis. These are collected immediately after the primary samples, by the same staff. Replicate samples are collected in the same sample reach, though the two samplers exchange half-reaches. Replicate macroinvertebrate samples are collected only at sites where macroinvertebrate habitat and community are sufficiently robust that there is minimal risk of depletion. During the collection of replicate samples, field staff take assiduous care not to resample substrate physically disturbed by prior sampling or impacted by drift (movement of dislodged organisms) from upstream sampling activities. Overall precision (*i.e.*, combined sample collection and taxonomic precision) is estimated for various metrics based on data obtained from these replicate samples. If precision levels indicated by the consecutive sampling method fail to meet the QC requirements of section (2), paragraph (1), the program manager and section chief invoke the corrective action measures described in section 4.10.

Duplicate water column samples (for chlorophyll analysis) are collected at five to ten percent of sites. Discrepancies between such samples should meet the limits set forth in section (2), paragraph (1). Should the precision of the data fall outside these control limits, corrective action procedures are invoked in accordance with section 4.10.

Quality control measures implemented in the field also include the collection of sequential duplicate chemistry samples. Sequential duplicate samples (collected approximately five minutes apart) are obtained from a minimum of one station during each sampling run to assess variability among samples resulting from collection, preservation, transport, and laboratory procedures. Should the precision of the data fall outside the control limits established in section (2), paragraph (1), corrective action procedures are invoked in accordance with section 4.10.

4.8.4 Field Blanks

Chemistry samples may be contaminated inadvertently during sample preservation, handling, transport, storage, and analysis. This potential for contamination is assessed through the use of field blanks prepared with glass-distilled water (inorganic analyses) or demineralized water (organic analyses) and subjected to the same treatment as surface water samples. Contamination is an especially important consideration when sampling for trace metals and metalloids, because of the extremely low ambient concentrations of these parameters. Concentrations of these parameters in water samples may be greatly augmented through exposure to airborne particulate matter and other sources.

On each sampling run, or on at least one run during any week of sampling, the weighted stainless steel bucket is filled under field conditions with glass-distilled water initially meeting ASTM Type-I specifications. The water (blank sample) is transferred to a complete set of randomly selected sample containers and subjected to the same preservation, handling, storage, and analysis procedures as the actual field samples. This occurs after the bucket is rinsed with demineralized water following the same rinse protocol established in this document. This procedure is repeated using the stainless steel pail and demineralized water to prepare field blanks for the organic parameters. If the limits for sample contamination presented in section (2), paragraph (1) are exceeded, corrective actions are implemented in accordance with section 4.10.

4.8.5 Field Spikes

The SPMP utilizes field spike data obtained by SCMP as part of its QA management plan. At least four times each year, a set of spiked samples is prepared in the field under the direct supervision of the SCMP program manager, through the addition of known concentrations of selected parameters to one of the sets of duplicate samples. Laboratory analysis is used to measure the levels of the selected parameters in spiked samples. The spiked samples are compared to those in the unamended duplicates to provide an overall indication of sample degradation and analytical recovery.

Field spikes are prepared using high accuracy and high precision fixed- and adjustable-volume pipettes, volumetric glassware, and certified reference standards obtained from EPA, USGS or appropriate commercial vendors as described in the SCMP QA management plan (KDHE, 2014). Should the precision and/or accuracy of the data fall outside the control limits established in section (2), paragraph (1), corrective action procedures are invoked in accordance with guidelines in the SCMP QA management plan.

4.8.6 Taxonomic Accuracy

Program staff work closely with other macroinvertebrate taxonomists in the Section to confirm any difficult macroinvertebrate identifications. This work also is verified by comparing the list of identified taxa against the KBS inventory of aquatic macroinvertebrates previously documented in Kansas. Rare or unusual specimens are compared to specimens in the agency reference collection and, if necessary, submitted to outside experts for further examination.

Each year, at a rate of approximately five percent of the annual taxonomic workload, the Program Taxonomists exchange several samples of moderate to high diversity for blind re-identification and re-enumeration of specimens. The results of this exercise are compared with information recorded on the original identification bench sheet, Appendix C-6. Exact reproducibility is not expected, as some specimens have already been subjected to dissection and removal of key anatomical features.

Annual program audits conducted by the section chief (or his/her designee) evaluate, among other things, the taxonomic proficiency of program staff. If the accuracy of specimen identification fails to meet the requirements of section (2), paragraph (1), corrective action measures are initiated in accordance with section 4.10.

4.8.7 Preventive Maintenance

Periodic inspection and routine maintenance of field and laboratory equipment are necessary to minimize malfunctions that could result in the loss of data, erroneous data, or disruption of project activities (see appended SOP No. SPMP-001). Field instruments must be inspected routinely prior to use and calibrated and serviced at intervals recommended by the manufacturer. Equipment maintenance logs must be maintained for all field thermometers and other field instruments. Sampling equipment, such as D-frame nets, hip and chest waders, forceps, and microscopes and illuminators used in specimen identification must be inspected periodically and repaired or replaced if necessary. Vehicles used during field activities also must be maintained in a reliable condition and equipped with emergency road gear. Entries must be made in the vehicle log upon completion of each day's use. All vehicle malfunctions must be reported to administration as soon as possible to expedite necessary repairs or the acquisition of a replacement vehicle.

4.8.8 Safety Considerations

Attention to job safety protects the health and well being of program staff and helps maintain a work atmosphere that ultimately enhances data quality and consistency. Program staff must be familiar with proper precautionary measures and the use of available safety equipment prior to assuming field duties. All field staff must be certified in adult cardiopulmonary resuscitation (CPR), basic first aid, and use of automated electronic defibrillator (AED) by the American Red Cross, American Heart Association, or an equivalent national organization.

All vehicles routinely used in the SPMP must be maintained in proper condition and equipped with first aid kits, emergency eye wash bottles, fire extinguishers, spare tire and tire changing

equipment, rain gear, road reflectors and/or flares, jumper cables, basic tools, and operable flashlights or headlamps.

Monitoring personnel are expected to carry a fully charged KDHE cellular phone and charger to use in the event of an emergency or significant change in plans, and they are encouraged to carry personal cellular phones as well. Access to a cellular phone is particularly important when traveling alone or in remote areas, conducting overnight sampling runs, or traveling during periods of potentially severe weather.

Field staff also must exercise care when handling glassware and chemical reagents in the field. Staff should not engage in the use of potentially dangerous reagents or breakable glassware if the weather, terrain, traffic, or any other concern impedes concentration, reduces visibility, jeopardizes footing, or otherwise precludes the safe handling of these materials. Rather, staff should move to a level, dry, protected, and well lit area before preserving or analyzing samples. In windy conditions, staff should avoid handling samples and reagents near coworkers or upwind of their own faces and eyes.

Additional safety considerations are presented in the SOPs accompanying this QA management plan.

4.9 External Procedures for Assessing Data Precision, Accuracy, Representativeness, and Comparability

At the discretion of the section chief, bureau QA representative, bureau director, or divisional QA officer, staff may participate in independent performance/system audits. Staff also may participate in interagency exchanges or comparisons of macroinvertebrate reference samples as well as in interlaboratory water chemistry sample comparisons. Participation in such activities promotes scientific peer review and enhances the technical integrity and overall credibility of the program.

4.10 Corrective Action Procedures for Out-of-Control Situations

4.10.1 Equipment Malfunction

Any equipment malfunction or irregularity discovered during routine field or laboratory activities or during performance audits must be documented in detail on the field form or notebook, and reported immediately to the program manager. Program staff are responsible for appraising the scope and seriousness of the problem and, if necessary, for determining whether the equipment item should be repaired or replaced. Program staff are also responsible for ensuring that backup equipment is available for all critical field and taxonomic activities. Arrangements for a backup vehicle must be made in advance of any mechanical problems or mishaps that might render the program's regular vehicle inoperable for an extended period.

4.10.2 Data Precision/Accuracy Problems

If environmental sampling activities, chemical analyses, or taxonomic determinations fail to meet the requirements of section (2), paragraph (1) of this QA management plan, the program manager must initiate an investigation to determine the cause of the problem. The program manager is expected to work closely with staff in this endeavor and in the selection and implementation of appropriate corrective measures. If the problem relates to water chemistry data, the program manager should consult with supervisors and with KHEL and/or SCMP staff to identify the cause(s) and implement appropriate corrective measures. Persistent problems may trigger a program audit by the section chief, result in the disqualification of a substantial amount of stream environmental data, or invoke other remedial responses (*e.g.*, an independent audit).

4.10.3 Staff Performance Problems

If an employee has difficulty with a given work procedure, as determined by an internal or independent performance audit, an effort must be made by the program manager to identify the scope and seriousness of the problem, to identify any data affected by the problem, and to recommend to the section chief an appropriate course of corrective action. All questionable data are either flagged within the computer database or, at the discretion of the section chief, deleted from the database. Possible corrective actions include further in-house or external training for the employee, a reassignment of work duties, or modification of the work procedure.

4.11 Data Management

4.11.1 General Data Management

All field- and laboratory-generated data are handled in an orderly and consistent manner. All forms and biological samples shall be correctly labeled with the appropriate station identifier, stream name, collection date, and sampler name(s). The original forms are carefully reviewed for errors or omissions and are subsequently filed in a secured location for future reference.

All general site data, landowner data, and physical habitat data are manually entered into a program-specific Microsoft Access database maintained on a shared network drive. All related GIS files and projects also are stored on a shared network hard drive. Additional GIS coverages are available on an agency server maintained by the KDHE Information Technology office. Phytoplankton taxonomic data and results from chlorophyll-a analyses are stored in native reporting formats.

Data management, processing, and checking procedures for SPMP water chemistry data are comparable to the procedures outlined in the SCMP QA management plan. In general, data are transferred electronically into the KHEL system, then compiled and processed on the ENVI ORACLE server. Additionally, a Microsoft Excel tracking file is maintained on the shared drive in order to maintain field notes and keep a record of the samples that have been collected and submitted to the laboratory. This file is a composite list of all submitted SPMP samples and their associated information (*e.g.*, collection date, lab accession numbers, collector names, flow conditions, and other comments). Staff from both the SCMP and SPMP are expected to transfer

data recorded on the completed Chemistry Sample Submission Form (APP. C-8) to this file upon return from a chemistry run. Close coordination between the SCMP and SPMP staff is necessary to assure the collection of all assigned samples. After water chemistry data for a given calendar year have passed quality checks and been finalized, records for any SP water chemistry samples collected under SC site names are duplicated and renamed.

Information from biological data forms (Appendices C-6 and C-7) are transferred manually to the Kansas Biological System Database (KBSD), currently maintained on the ENVI ORACLE system supported by the KDHE Information Technology (IT) office. The database houses raw sample data (site and sampling information, specimen counts), supporting data (KBSC taxon codes, which in turn are associated with pollution tolerance data and higher taxonomy) as well as calculated summary statistics and metrics. Data are input and can be edited through a browser-based Oracle Forms interface. The database can also be queried through common data management software via an ODBC (open database connectivity) interface.

Mussel archive datasheets are checked for accuracy and completeness, and data are manually entered into a Microsoft Excel spreadsheet maintained on the shared network drive. Hard copies of datasheets are maintained in a data repository in a secure location in the central office.

4.11.2 Data Entry Requirements

All environmental data (and metadata) manually entered into an electronic database are examined by visually comparing database retrievals with the original datasheets. Additionally, data entered into the program's Microsoft Access database are spot-checked at a rate of 5% of records. The resulting tables are then crosschecked for discrepancies, and the databases are subsequently corrected for any data entry errors. Staff transferring or receiving data electronically also perform random spot checks of the data and report any problems to IT or the KHEL, as appropriate, for further investigation and resolution. Persistent problems are reported to the section chief and bureau QA representative for consideration of necessary corrective actions.

4.11.3 Verification of Calculations

Computer-based mathematical, statistical, graphical, and geographical programs and models involving environmental data are tested before application by comparison to other computer programs, through hand calculations involving randomly selected data, or through other appropriate means. The reliability of these models and programs is reexamined on at least an annual basis or whenever a problem is reported within a computational system. Microsoft Access, Microsoft Excel, ESRI ArcMap, Minitab, and SigmaPlot, and R packages are among the software options used for generating spreadsheets, graphs and models or for performing statistical characterizations, comparisons, and trend analyses.

4.11.4 Data Transformation and Outliers

Many forms of environmental data do not conform to a normal distribution and may necessitate the use of nonparametric statistical methods. Alternatively, the data may be transformed

statistically to induce a normal, log normal, or other preferred data distribution. The data distribution often is depicted graphically to help identify the most appropriate transformation procedure. Commercially available computer programs also may be applied in more detailed assessments of data distribution. Minitab software maintained on select desktop computers offers several algorithms for characterizing departure from normality (*e.g.*, Shapiro-Wilk and Kolomogorov tests).

All environmental databases may contain a few anomalous values or statistical outliers. For field-recorded data, obvious outliers (those that are orders of magnitude beyond any reasonable value) often constitute data transcription errors or other simple errors. For water chemistry data for which analytical machines transmit data directly to the database, dilution errors are the most likely cause for human error. Staff automatically question data if a reported value or calculated metric is outside the historical range for the waterbody or watershed in question (if previous data exist). For biological data, such an occurrence may prompt another comparison of the information stored on the program database with the information recorded on the bench identification sheet. The program manager also may elect to reexamine the computer algorithms used to generate the metric. If necessary, the original macroinvertebrate sample may be retrieved from storage and reexamined by program staff. In other instances, biological or chemical outliers may reflect actual (though rarely occurring) environmental fluctuations. Nonparametric procedures based on rank-order or percentile tend to be less influenced by these kinds of data and are often favored by staff for statistical characterizations, comparisons and trend analyses.

4.11.5 Ancillary Data

Ancillary data used in this program may include physicochemical, hydrological, meteorological, or biological data derived from other KDHE programs or other governmental agencies. All routine environmental monitoring programs administered by BOW are subject to the provisions of Part I and Part II of the divisional QMP. An effort is made to ensure that data from outside agencies are generated in accordance with QA management plans similar to those developed by KDHE. In some instances, outside agencies collect data under a contractual agreement with the Division, or under the auspices of an EPA grant, both of which require development and approval of a Quality Assurance Project Plan prior to data collection (see QMP, Part I, Section 2.3).

Pollutant loading coefficients, biological metrics, species tolerance values, and some other values applied in modeling calculations are taken from documents produced by governmental agencies or from literature sources incorporating peer review of articles before publication. Staff carefully examine the underlying technical assumptions before applying these metrics and values.

4.12 Quality Assurance Reporting Procedures

End-of-year program evaluations shall be conducted and a written report submitted to the divisional QA officer by March 15 of the following year. The program manager shall cooperate fully in the evaluation of QA/QC performance and shall make available all records pertaining to the precision, accuracy, representativeness, and comparability of the monitoring data gathered during the evaluation period. Program evaluations must indicate when, how, and by whom the

evaluation was conducted, the specific aspects of the program subjected to review, a summary of significant findings, and technical recommendations for necessary corrective actions.

4.13 Purchasing of Equipment and Supplies

When newly ordered or repaired sampling, diagnostic, or computational equipment is delivered to the program office, program personnel shall compare the item to that requested on the original order, then inspect the item to ensure that no breakage has occurred in transit and that all components are included and function properly. The shipment is either accepted or rejected once this inspection is completed. Any included or manufacturer-included manuals are read by SPMP staff.

Office and laboratory supplies receive a comparable level of scrutiny. Reference standards and reference apparatus must be accompanied by a certificate from the vendor or manufacturer verifying the quality of these products. Certain costly durable items and electronics are tagged with KDHE property stickers.

4.14 Program Deliverables

Program deliverables include electronic databases, illustrative materials, statistical water quality summaries, and detailed written reports used in a variety of agency applications. Staff of the SPMP play a major role in the development of the Kansas biennial water quality assessment (305(b) report), and program data may also be used by TMDL staff in development of Kansas' list of water quality limited surface waters (303(d) list). As resources and circumstances allow, customized data retrievals are prepared by the program staff on behalf of administrative staff, legislative officials, other state and federal agencies, regulated entities, special interest groups, consultants, academicians, students, and members of the general public.

Section 5

REVIEW AND REVISION OF PLAN

To ensure that the SPMP continues to meet the evolving informational needs of the bureau and the agency, all portions of this QA management plan and its appended SOPs must be comprehensively reviewed by participating staff on at least an annual basis. Revisions to the plan and SOPs require the approval of the program manager, unit leader, section chief, bureau director, and bureau QA representative prior to implementation. Although review activities normally follow the annual program evaluation in February, revisions to the plan and SOPs may be implemented at any time based on urgency of need or staff workload considerations.

Original approved versions of the QA management plan and SOPs, as well as all historical versions of these documents, are maintained by the bureau QA representative or his/her designee. The bureau QA representative also maintains an updated electronic version of the plan and accompanying SOPs on the KDHE Internet server in a "read only" .pdf format.

APPENDIX A

INVENTORY OF FIELD AND LABORATORY EQUIPMENT

I. VEHICLE

A. Full sized van (or other vehicle, as available)
B. Vehicle registration and proof of insurance
C. Vehicle logbook (daily log sheets; fuel purchase card; copies of tire, battery, and emergency service contracts; accident and damage report forms; and other miscellaneous paperwork)
D. State highway map, 1/4" scale county maps, and Kansas gazetteer
E. Vehicle key and spare key(s)
F. Mobile cellular phone and charger
G. Spare tire (fully inflated), tire changing equipment, road reflectors and/or flares
H. Jumper cables, towrope, fire extinguisher (checked/refilled annually), windshield ice scrapers, emergency dynamo powered radio, emergency folding shovel
I. Fluorescent safety vests with reflective strips, work gloves
J. Whisk broom & dustpan, lawn and leaf sized trash bags
K. Power inverter (12V DC to 110V AC) to facilitate use of three-prong electrical devices in car
L. Tool box that includes:
   a. Socket driver set with ratchet handle, extension, and English sockets from 3/16" to 15/16" plus spark plug socket to fit vehicle
   b. Open/box combination wrench set with standard sizes from 3/16" to 1"
   c. Two crescent wrenches
   d. 2 pair of slip-joint pliers
   e. Channel locks
   f. Vise grips
   g. Pipe wrench
   h. Wire cutter
   i. Cold chisel and punches
   j. Wire brush
   k. Mallet
   l. Hammer
   m. Set of eight screwdrivers (flathead and Phillips, in large and small tip, short and long shank)
   n. Micro screwdriver set (flathead and Phillips in at least two sizes each)
   o. Allen wrench set
   p. Folding saw
   q. Hack saw with extra blade
   r. Utility knives
   s. Sandpaper
   t. Zip ties
   u. Duct tape
   v. Heavy rubber-coated gloves

M. General first aid kit, CPR mouthpieces, latex rubber gloves, safety glasses, emergency eyewash kit, paper towels, hand sanitizing solution in plastic squeeze bottle

N. The following items may not be stored in the vehicle continuously but should be present for every trip:
   a. Automated Electronic Defibrillator (AED)
   b. Flashlights or headlamps (fully operable with fresh batteries)
   c. One to two gallon jug of wash water, bar soap

II. FIELD EQUIPMENT AND SUPPLIES

A. For all field work, these items are required:
   a. Mobile phone, fully charged, with car charger and waterproof case
   b. Power inverter for each field vehicle, to convert 12-volt to standard AC power
   c. Garmin GPS unit with updated maps and software (or functional equivalent) with 12-volt plug, for use in vehicle
   d. Two Magellan/Thales MobileMapper or Forge 900 series hand-held GPS units or functional equivalent, for use in field
   e. YSI ProDSS multimeter with probes for temperature, pH, conductivity, and dissolved oxygen, as well as extra calibration solution sufficient for two field calibrations
   f. Digital camera, memory cards, carrying case, and instructions
   g. Extra batteries for GPS units and camera, if needed
   h. Chest and hip waders (one pair for each field worker plus at least one spare in each applicable size), wading boots (one pair for each field worker, if waders are stockingfoot), and a repair kit

B. For macroinvertebrate sampling trips, the following additional items are required:
   a. D-frame, 0.5-mm mesh nylon nets (two for use; one spare) with 1.5-meter wooden handles calibrated in decimeters for measuring stream depth
   b. Fine point grip tip forceps on lanyard or wrist keeper (two for use; one spare)
   c. Glass sample jars (120 ml) with watertight screw-on plastic lids
   d. Alcohol-proof label tape (white) for sample jar exteriors and plain white waterproof paper for making interior jar labels
   e. Ethanol solution (70–80%) for preserving invertebrate specimens
   f. Stop watches (or wristwatches with stopwatch function) for timing sampling events
   g. Site Data forms, Live Mussel recording forms, Reconnaissance forms, and any other necessary forms
   h. Metal or plastic storage clipboard
   i. Pens, pencils, and alcohol-proof indelible markers
   j. Fisher model #15-0778 stainless steel dial scale thermometer (-10 to +110°C) or functional equivalent, for measuring water temperature
   k. Personal gear for each staff person, including: Rain gear, brimmed or visored hat, polarized sunglasses, sun screen, insect repellent, hand disinfectant solution, drinking water, extra socks in case of wader leakage
   l. Supply of 1 L cubitainers for collection of algae samples

m. Cooler (with ice) for transporting samples
n. Zipper lock plastic bags in several sizes
o. Plastic bags and wired tags for securing and labeling mussel samples upon return to vehicle
p. Spare net bag, hog ring clips, and clip pliers
q. Sturdy backpack/s for carrying forms, gear, supplies, and samples between vehicle and monitoring site
r. Compact, waterproof field first aid kit
s. Plastic five-gallon bucket with padded steel handle for transporting Unionid samples between vehicle and monitoring site
t. Rustproof ruler with clear markings to at least 20 cm, for use in photo documenting live unionids
u. Optional: Calibrated flow meter w/extra batteries and User Manual, 50 m tagline, stakes, streamgauging logbook

C. For chemistry sampling trips, the following additional items are required:
a. Site map for each site to be visited
b. "Symbol, Palm-Powered" scanning and digital data recording device loaded with the sample submission spreadsheet
c. Hard copy of sample submission spreadsheet
d. USB flash drive loaded with a copy of the sample submission spreadsheet
e. Fisher model #15-0778 stainless steel dial scale thermometer (-10 to +110°C) or functional equivalent
f. Winkler dissolved oxygen kit (with reagents "1, 2, 3" in 250 ml Nalgene safety squeeze bottles, transported in sealed plastic container), and corresponding materials Safety Data Sheets
g. Safety glasses for use with dissolved oxygen kit
h. Weighted stainless steel sampling bucket (1 gal)
i. Stainless steel pail (1 gal)
j. Stainless steel funnel
k. Rope, ~30 m length with attached snap swivel
l. Extension rope, ~5 m length with attached snap swivel, to be used in waterbodies known or suspected to be infested with zebra mussels
m. Work gloves to protect hands from rope abrasion
n. Ice chests stocked with bags of ice
o. Sample containers (including at least two spare sets) appropriate for current sample run
p. Deionized wash water for sample containers

D. For fish tissue sampling trips, the following additional items are required
a. Access information and Site Dossier including pertinent landowner permissions.
b. Cooler with adequate ice or dry ice (depending on intended sample time and holding time)
c. Rubberized non-breathable waders (with at least one spare per person)
d. Electrical Line workers' protective rubber gloves, rated for high voltages
e. Winchester ear muffs or other adequate hearing protection
f. Coast Guard approved Personal Flotation Devices

g. Visor cap or brimmed hat and polarized sun glasses for each crew member
h. Salisbury Class 1 insulated rubber gloves or equivalent for each crew member
i. Smith-Root LR-24 Electrofisher (backpack), with charged 9.6Ah Lithium Iron Phosphate batteries and UBC-24 charger, and including two-piece 6' anode pole and rattail LR cathode
j. Smith-Root GPP Electrofishing System with tote barge:
    i. Koehler 5.5 hp generator
    ii. Control Box 2.5 GPP
    iii. Cable box output 2.5/5.0 GPP
    iv. Anode cable Extension 25-foot with belt and floats
    v. 6' Electroshock anode pole with 11" stainless steel ring
    vi. Smith-Root rat tail cathode and hull cathode
    vii. 8'-10' aluminum jon boat with rope or strap to tow in water
k. Two WildCo. Fiberglass nets with ¼" mesh, or other non-conducting nets
l. Five-gallon buckets or other appropriate live wells for fish
m. Clean mesh drawstring bags for fish
n. Sea-Eagle 126SR inflatable 12'6" raft with floor boards and rails, including paddles and seats
o. Nissan 6.0 hp 4-stroke outboard motor with marine gas tank and fuel line
p. WildCo fish measuring board or measuring tape
q. Digital fish scale (in grams or kilograms)
r. Fish tissue plugging equipment including: nitrile gloves, sterile scalpels, sterile 5 mm biopsy punches, sterile screw-cap glass vials, pipette bulb, plastic zipper lock bags, indelible marker, and notebook with pencil
s. Heavy Duty Aluminum foil, tags, markers, and tape
t. Fire Extinguisher
u. Van mounting pads, ratchet straps, and rope to attach jon boat to roof of van
v. Fishing rods/reels with 12 lbs. test line, with necessary tackle and bait, for occasions when safety and access issues necessitate bank fishing

III. FIELD FILES

A. Site dossiers that include site maps, aerial photos, geocoordinates, supporting data (*e.g.*, flow, ecoregion, CUSEGA), landowner permission form, and any reconnaissance forms
B. Valid Collection Permit from KDWPT
C. Travel information, office contact information, traveling personnel's emergency contact information

IV. TAXONOMIC EQUIPMENT AND SUPPLIES

A. Olympus SZX-10 variable zoom dissecting microscope with 10x eyepieces (one fitted with ocular micrometer), or functional equivalent
B. Variable intensity light source with focusable bifurcate fiber optic light guides

C. Zeiss variable magnification compound microscope with 10x oculars, objectives ranging from 5x–100x, phase contrast capability, and integrated light source, or functional equivalent
F. Glass Petri dishes and assorted laboratory glassware (dishes, vials, wellplates, *etc.*) for sorting and storing samples during processing
D. Stainless steel forceps and probes (coarse and fine point), disposable pipettes
G. Precleaned glass microscope slides and slide cover slips
H. 10% KOH and Euparal or CMC-9 or CMC-10 mounting medium (Master Chemical Company, Elk Grove, IL) for chironomid clearing and mounting
I. Laboratory hot plate or drying oven (optional)
J. Macroinvertebrate Identification Bench forms, Mussel Tally and Archive Forms, and Chlorophyll filtration forms (Appendix C)
K. Taxonomic keys and supporting scientific literature
L. Boxes for storage of invertebrate samples (in original glass sample jars) following identification and enumeration of specimens
    a. Slide storage boxes
    b. Undenatured ethanol (70–95%) for rinsing, sorting, and preserving invertebrate specimens
    c. Specimen vials and trays for reference collection
    d. Locking cabinet for non-Unionid reference specimen collection and map file cabinet for Unionid reference collection

APPENDIX B

STANDARD OPERATING PROCEDURES

MAINTENANCE PROCEDURES FOR MACROINVERTEBRATE SAMPLING EQUIPMENT (SPMP-001)

I. INTRODUCTION

A. Purpose

Sampling equipment must be maintained in a reliable working condition to maximize the efficiency of invertebrate collection activities and minimize the loss of data.

B. Minimum Staff Qualifications

These procedures normally are performed by program field personnel but may be performed by other qualified and trained Environmental Associate or Environmental Specialist.

C. Equipment/Accessories

1. Hip and chest waders
2. D-frame aquatic nets

II. PROCEDURES

A. Hip and chest waders

1. When boot foot rubber waders are not in use, they should be stored in an inverted position in a cool, dark location to reduce cracking. Stocking foot neoprene or Gore-tex breathable waders should be hung to dry and stored in a cool, dark location.
2. Rips and tears are repaired with silicone seal or adhesive patches, depending on the extent of damage and wader construction.
3. Mud is removed prior to storage.
4. Insides of waders must be kept dry to reduce deterioration of lining.

B. D-frame aquatic nets

1. Nets are checked for damage after each sampling event. Any rips or tears should be immediately repaired with silicone seal or sewn closed.
2. Depth gradations on the handles eventually fade and must be retraced from time to time with indelible marker.

PROCEDURES FOR FIELD ANALYTICAL MEASUREMENTS (SPMP-002)

This document is obsolete and has been archived. It has been replaced by SOP No. SPMP-013.

PROCEDURES FOR COLLECTION OF MACROINVERTEBRATE SAMPLES (SPMP-003)

I. INTRODUCTION

A. Purpose

Staff involved in the collection of macroinvertebrate samples must adhere to a standardized sampling procedure to maximize the comparability of the data generated by different workers over a potentially long period of time. Consistent procedures reduce the statistical "noise" that could otherwise detract from the utility of the data.

B. Minimum Staff Qualifications

Staff implementing this procedure must meet the minimum classification requirements for Environmental Specialist published by the Kansas Department of Administration. They also must possess a strong familiarity with the range of macroinvertebrate organisms occurring in Kansas streams and command a thorough understanding of the procedures used in obtaining representative macroinvertebrate samples.

C. Field Equipment and Supplies

For complete list of equipment and supplies, see Appendix A. Primary sampling gear is listed below:

1. Magellan/Thales MobileMapper handheld GPS device, or functional equivalent – used to locate/verify x-site coordinates and measure reach length
2. Hip or chest waders, depending on the depth and flow conditions of the stream being sampled. For navigating slippery or steep banks or tall riparian vegetation, breathable stockingfoot chest waders with ankle-support wading boots are recommended.
3. D-frame, 0.5-mm mesh aquatic net with decimeter gradations on handle for depth determination
4. Fine point grip-tip forceps (on lanyard or wrist keeper)
5. Glass sample jars (120 ml) with alcohol-proof screw-on lids, containing 70–80% ethanol (approximately 80 ml per jar)
6. White label tape and alcohol-proof markers for labeling jars; plain paper and pencil for making interior labels
7. Stopwatch (or wrist watch with stopwatch function)
8. Site Data Form (App. C-1)
9. Field clipboard, pencils

II. PROCEDURES

A. After the x-site is established, each scientist walks along the stream channel (one upstream, one downstream) to a distance of 75 m each, taking note of all available habitats.

B. During a macroinvertebrate sampling event, personnel sample macroinvertebrates in various habitats while walking back towards the x-site. The two workers collect macroinvertebrate specimens over a minimum period of 30 consecutive minutes each (a combined duration of one person-hour). The timer is paused for any significant (>1 min) time that is spent traveling in the stream channel or traversing obstacles without active sampling. If a worker does not collect 100 organisms in 30 minutes, sampling is initially for one 15-minute increment. If that worker does not collect 100 organisms in a total of 45 minutes, then one additional 15 minute sampling increment is added.

C. All available macrohabitats (riffles, pools, runs) and microhabitats (various depths, velocities, or substrates within a macrohabitat) are sampled, as permitted by size and depth of water body and time allotted.

D. Macroinvertebrate specimens are collected by:

1. Kicking riffles, substrate, and leaf packets and allowing current to carry dislodged organisms (and debris on which organisms may occur) into D-frame net;
2. Sweeping the D-frame net along undercut banks and through submerged or floating aquatic vegetation, submerged terrestrial vegetation and tree roots, accumulations of woody debris, and growths of filamentous algae; and
3. Sieving fine sediments (silt and fine sand) through the D-frame net.
4. Using forceps to pick directly from logs, rocks, or other surfaces from which organisms are not easily dislodged by kicking or sweeping.
5. Note that each D-frame net collection should capture only a single microhabitat type and should represent a relatively small area; the net is inverted and picked before the next microhabitat is sampled.

E. Note that each D-frame net collection should capture only a single microhabitat type and should represent a relatively small area; the net is inverted and picked before the next microhabitat is sampled.

F. Different macroinvertebrate taxa present at a site are collected in numbers roughly proportional to their relative abundance in the stream community. Neither worker should collect more than 50 organisms from any single microhabitat or individual D-frame net collection.

G. Each scientist endeavors to collect a minimum of 100 organisms, for a total of 200 or more organisms per pooled sample. Samples with total counts less than 100 may be excluded from analysis or assessment.

H. As specimens are separated from debris, they are placed directly into glass sample jars containing 70–80% ethanol. Each jar is labeled with indelible marker on a piece of white label tape that is wrapped completely around the jar. The outer label bears the station number, waterbody name, collector name, date, portion of reach, and sample type. A paper label bearing the same information (written in pencil), as well as the start time and sampling duration for the subreach, is also placed inside each jar.

I. Upon completion of the sampling effort, a Site Data Form is filled out by one of the workers (App. C-1).

III. SAFETY

A. SOP No. SCMP-002, addressing vehicle safety and maintenance, is adopted by reference. Section III of SOP SBMP-003a, addressing biological sampling safety, is also adopted by reference.

B. At least two coworkers in the office should have access to the crew's trip map and travel plans. If plans change significantly due to weather or other circumstances, a notification message is sent or voicemail left at the office.

C. One crew member carries a travel first aid kit in a waterproof case.

D. If the crew is hiking a significant distance from the van, working in a remote or dangerous area, or working near dusk or in extreme or inclement conditions, one person should carry the program mobile phone in a waterproof case, and the crew should use professional judgement to determine whether it is advisable to use text messaging or a phone call do a "check out/check in" with a coworker or other reliable contact.

PROCEDURES FOR PREPARATION, IDENTIFICATION, ENUMERATION, AND PRESERVATION OF BIOLOGICAL SPECIMENS (SPMP-004)

I. INTRODUCTION

A. Purpose

Procedures employed in the identification and enumeration of quantitative macroinvertebrate samples and preservation of voucher specimens are described in this SOP.

B. Minimum Staff Qualifications

Staff implementing this procedure must meet the minimum classification requirements for Environmental Specialist published by the Kansas Department of Administration. They also must be well versed in aquatic invertebrate taxonomy and possess a strong familiarity with the macroinvertebrate taxa known from the streams of Kansas. The required level of knowledge normally is gained through a combination of college course work and several years of active research in this field.

B. Equipment/Accessories

1. Olympus SZX-10 variable zoom dissecting microscope with 10x eyepieces (one fitted with ocular micrometer), or functional equivalent, and variable intensity light source with focusable bifurcate fiber optic light guides. or functional equivalent

2. Zeiss variable magnification compound microscope with 10x oculars, objectives ranging from 4x–40x for air and 100x for oil immersion, and integrated light source, or functional equivalent

3. Glass Petri dishes and assorted laboratory glassware (dishes, vials, wellplates, *etc.*) for sorting and storing samples during processing

4. Plastic Beem vials or glass genitalia vials or equivalent for storing dissected specimens

5. Stainless steel forceps (including ultra fine point) and probes (coarse and fine point), disposable pipettes

6. Undenatured ethanol (70–80%) for rinsing, sorting, and preserving invertebrate specimens, as well as undenatured 95% ethanol for processing

7. Precleaned glass microscope slides and slide cover slips

8. 10% KOH and Euparal or CMC-9 or CMC-10 mounting medium (Master Chemical Company, Elk Grove, IL), for chironomid clearing and mounting.

9. Laboratory hot plate to accelerate KOH clearing of unmounted specimens (optional)

10. Macroinvertebrate Identification Bench forms and Mussel Tally and Archive Forms (Appendix C)

11. Taxonomic keys and supporting scientific literature

12. Partitioned cardboard boxes for storage of invertebrate samples (in original glass sample jars) following identification and enumeration of specimens, and slide boxes for storage of slides

13. Specimen vials and trays for reference collection

14. Locking cabinet containing insect reference specimen collection, and map file cabinet containing Unionid reference collection

15. Drying oven for curing Euparal slide mounts (optional)

II. PROCEDURES

A. Identification and enumeration of macroinvertebrate samples in the laboratory begins with completion of the header information of the Macroinvertebrate Identification Bench Form (App. C-6.1). Station number and location, collection date, and collectors' names are transcribed from the sample jar and Site Data Form. The examination date and name of examiner are likewise recorded on the Macroinvertebrate Identification Bench Form.

B. Contents of the two jars that make up a sample are pooled into one or more glass dishes and examined carefully against both black and white backgrounds. Extraneous debris is removed, and the organisms are pre-sorted into various low resolution taxa (*e.g.*, order, family). This must be done under excellent lighting conditions. It may be done with the unaided eye or a 2x-3x magnifying visor. Care must be taken to make sure that all specimens are retained, including cryptic cases and shells. Remaining detritus is agitated and examined multiple times until no more organisms are recovered.

C. After preliminary sorting, the organisms are examined individually with a dissecting microscope, identified, and enumerated on the biological data form.

D. Certain taxonomic groups, small specimens, and certain anatomical features of some groups may need to be mounted on a microscope slide and examined under higher magnification (midges, oligochaetes, mayfly gills and legs, riffle beetle

genitalia, early instars of various taxa, *etc.*). Wet mounts may be used for temporary examination. Potassium hydroxide (10% solution, W/V) may be used to clear cuticle; CMC or Euparal are used to slide mount midges for identification. Euparal/CMC mounts may be cured with gentle heat from a drying oven set no higher than 50° C, for 24-48 hours.

E. An attempt is made to identify all specimens to the lowest practicable taxonomic level, generally genus or species. The program maintains a Standard Taxonomic Effort document that identifies lowest practicable levels; this is updated annually before taxonomic work for a particular calendar year's samples begins. Taxonomic works written specifically for the fauna of the state or region are preferentially utilized. Unusual or unprecedented determinations are compared to comprehensive lists of macroinvertebrate species previously documented in Kansas.

F. The Section maintains a reference collection of all aquatic macroinvertebrate taxa encountered historically in the SB and SC monitoring programs. This collection is helpful when working with difficult groups or less frequently encountered species, and it provides a valuable training and educational tool. Many specimens included in the collection have been identified or confirmed by outside experts.

G. After specimens have been identified, enumerated and recorded, pooled samples are transferred to storage and maintained for a minimum of two assessment cycles (generally eight years).

H. Microscopes must have dust covers in place when not in use. Cleaning of optics is performed with lens tissue and, if necessary, cleaning solvent.

I. Microscopes are serviced annually by a professional microscope dealer.

PROCEDURES FOR CONDUCTING LANDOWNER PERMISSIONS PROCESS (SPMP-005)

I. INTRODUCTION

A. Purpose

Details the systematic process used to identify landowners and contact them to solicit permission for site access.

B. Minimum Staff Qualifications

These procedures normally are performed by regular program staff but may be performed by virtually any other employee after initial training, provided they are familiar with ArcGIS and have good clerical skills.

C. Equipment/Accessories

Most of the necessary resources are in the form of electronic files or is informational type data.

II. PROCEDURES

A. A local map of each x-site is generated, identifying site number, stream name and county, and placing it in the context of streams and lakes, roads, towns, and the Public Land Survey (township-range-section) grid.

B. County information resources (Appraiser, Register of Deeds, Mapping Dept., Online Parcel Search, or internet mapping utilities if available) are consulted to determine names and addresses of landowner(s) for the x-site. Most Kansas counties have online parcel search (by township-range-section) or even web based mapping parcel search utilities online. CAMA sheets (from county appraiser systems) or web maps are printed and saved in the site dossier. If an online parcel map is not available, is helpful to hand draw parcel boundaries on a site map, based on legal descriptions from CAMA sheets.

C. If the x-site falls on or very near a property boundary, information regarding all property owners near the x-site is obtained. Streams sometimes form property boundaries: in these cases, owners of both sides are considered x-site owners. If a public road does not border the x-site property, information for any additional owners critical for site access is obtained. Internet telephone directory services are utilized to obtain phone numbers for as many of the owners as possible.

D. A permission request packet is mailed to each x-site owner, which includes the following items: a request letter (which includes complete contact information for the program), a simplified map of the site, an aerial photo of the site, a brochure

describing the SPMP program, a site-specific permission form, and a self-addressed postpaid (first class rate) envelope. On the permission form, there is space for landowners to impose limitations on access routes or sampling times, ask to accompany the crew, identify tenants or other parties that need to be notified, make notes of additional information or requests, and the like.

E. Permission letters are given a two to four week deadline.

F. Permission responses are scored as "YES," "LIMITED" (functionally equivalent to a "YES," with some constraints), or "NO." After multiple contact attempts, responses may also be scored as NO RESPONSE (functionally equivalent to a NO).

G. If no response is received within two weeks, additional contact attempts are made:

1. Preferably by phone – if a phone number can be found in a public directory, at least three call attempts are made at least before the permissions status is scored as NO RESPONSE. At least one of these three calls is made during an evening (6:00 to 8:00 pm) or on a weekend (10:00 am to 8:00 pm Saturday or 12:00-8:00 pm Sunday). For out of state owners, their local time zones are considered.

2. If no phone number is available, a reminder postcard or letter is sent.

3. A record is kept of each contact attempt, which details the time, date, number called, staff member calling, and outcome. Note: in cases where no feedback is received (*e.g.*, voicemail greeting does not state the owner's name, or there is no voicemail option available, or postcards are sent), there is no way to determine definitively whether the landowner was identified correctly or whether any contact was made.

H. If access to a site requires permission from two landowners (*e.g.*, the stream marks the property line, with separate landowners on each side) and one answer is an adamant NO, the site is coded NO regardless of the response of the other owner

I. If permission is acquired from the x-site landowner but there is no public access route to that individual's property, the x-site owner is asked to recommend a route in and assist with access permission from neighbors.

PROCEDURES FOR COMPLETION OF HABITAT DEVELOPMENT INDEX FORM (SPMP-006)

I. INTRODUCTION

A. Purpose

The Habitat Development Index (HDI) form is a part of the SPMP Integrated Site Data Form. Unlike the rest of the Integrated Site Data Form, the HDI applies only to those areas of the sample reach that were actually sampled for macroinvertebrates. An HDI form completed in this way provides comparability with collections made by the SBMP. The HDI score is a numerical expression of the capacity of a stream to support a diverse biological community in the absence of water pollution problems or other significant perturbations. A comparison of HDI scores among different sites is useful in accounting for the possible effects of habitat differences on biotic index values.

B. Minimum Staff Qualifications

Staff implementing this procedure must meet the minimum classification requirements for Environmental Specialist published by the Kansas Department of Administration. They must also possess a strong familiarity with the range of macrohabitat and microhabitat types across Kansas.

B. Equipment/Accessories

1. Measuring pole or D-frame aquatic net with handle graduated in decimeters
2. Laser rangefinder and/or measuring tape
3. Hip or chest waders, depending on water depth and prevailing flow conditions
4. HDI section of Integrated Site Data form and pencil

II. SCORING PROCEDURES

A. Minimum Macrohabitat Score

Each of the three types of macrohabitats (riffle, pool, run) is scored as a "3" if present in the stream and sampled; if a macrohabitat is not present or sampled, it is given a score of "0." If a given macrohabitat is present, it is then scored for the following variables:

B. Average Depth

Average depth of each of the macrohabitats sampled is rated as a "0," "1," or "2," according to the average depth categories on the HDI form.

C. Riffle Substrate Score

This score evaluates the habitat provided by a riffle in terms of the quality and quantity of cobble present. Quality is defined as degree of embeddedness. Quantity is defined as the percentage of cobble in the riffle. Embeddedness inhibits macroinvertebrate colonization and is the only HDI parameter that may actually lower the riffle quality score and overall HDI score.

D. Organic Detritus and Debris

The types and quantity of organic debris actually sampled within each macrohabitat are collectively rated as "0," "1," "2," or "3." Examples of organic debris are indicated on the HDI form. For the purposes of this form, a "log" is considered to be any woody debris greater than 2.5 inches (6.4 cm) in diameter.

E. Algal Masses

Algal growths which provide some macroinvertebrate habitat are rated "0" for absence and "1" for presence in each of the macrohabitats sampled. (Periphytic growths are rated "0," as they constitute food for grazers but provide little shelter.)

F. Macrophytes

Macrophytic vegetation provides habitat and is rated "0," "1," or "2," according to absence or presence and quantity within each macrohabitat sampled. Examples of macrophytes that provide macroinvertebrate habitat are provided on the HDI form.

G. Bank Vegetation

Bank vegetation provides habitat and is rated "0," "1," or "2," according to absence or presence and quantity within each of the macrohabitats sampled. Examples of bank vegetation that provide suitable habitat are provided on the HDI form.

III. CALCULATION PROCEDURE

Scores are subtotaled for each of the macrohabitats sampled, and subtotals are added together to derive the final HDI score.

PROCEDURES FOR QUALITATIVE OBSERVATION AND DOCUMENTATION OF UNIONID MUSSEL COMMUNITIES (SPMP-007)

I. INTRODUCTION

A. Purpose

Freshwater mussels occur in many Kansas streams but are seldom collected in quantitative macroinvertebrate samples owing to their comparatively large size as adults, burrowing habits, and sparse or scattered distribution in stream channels. Many species are also threatened or endangered, which contraindicates collection of live specimens. Most mussel taxa are long-lived but slow to mature and reproduce. The larvae of all but a few species are parasitic on the fins and gills of fish, whereas juvenile and adult mussels live as sedentary filter feeders. Mussel communities are unusually vulnerable to declines in environmental condition and serve a useful diagnostic function in biological assessments of water quality. The following paragraphs describe qualitative procedures employed by staff for determining the species of mussels inhabiting a particular stream reach and for ascertaining changes in the composition of mussel communities over time.

B. Minimum Staff Qualifications

Unless specifically exempted by the section chief, in writing, staff implementing this SOP must meet the minimum classification requirements for Environmental Specialist published by the Kansas Department of Administration. In all cases, these staff must demonstrate the ability to accurately and rapidly identify each of the state's more than forty species of mussels under field conditions. This ability is usually gained by careful study of archived specimens and by accumulation of field experience under the supervision of a biologist knowledgeable in mussel taxonomy.

C. Field Equipment and Supplies

1. Hip or chest waders, depending on depth and velocity of stream being sampled

2. Digital camera for documenting any rare (*e.g.*, threatened or endangered) mussel species represented by live individuals

3. Metric ruler for measuring length and height of any encountered rare species and for scale in photo documentation Backpacks to carry data clipboards and forms, first aid kit, and other supplies.

4. Five-gallon bucket with padded steel handle, for transporting collected shell material to field vehicle (optional)

5. Plastic bags, cardstock tags, and indelible markers, for segregating and labeling shell material from different sites and transporting to home office laboratory

6. Clipboard containing field forms (see APP. C-3), pens, and pencils

II. PROCEDURES

A. Procedures outlined in SOP No. SBMP-003b, for the collection of live mussels and mussel valve material, are adopted by reference with the following additions:

1. Shell material is not sorted at the stream site, unless there are greater than 10 live or recent specimens of a given species, in which case only 11 are brought back (if shell material). (In time sensitive cases or with difficult taxa, all shell material may be transported back to the lab for identification.)
2. A record of all shell material processed in the laboratory is entered on the Mussel Tally Form (App. C-4). Based on evidence of live individuals or recent shell material only (not weathered or relict shell material), a given species' abundance is scored as follows:
    a. Present: 1–4
    b. Common: 5–10
    c. Abundant: >10
3. From shell materials, a representative synoptic voucher is retained, according to the following guidelines:
    a. At least one representative of every species is retained
    b. Males and females are equally acceptable
    c. Preference is given to recent over weathered shell material, and weathered over relict
    d. Preference is given to extreme size classes (very small and/or very large individuals)
    e. Preference is given to paired valves over single, and whole shells over broken
    f. Unusual species or forms and specimens with developmental anomalies may be archived into the reference collection, if appropriate. A note to this effect is placed into the voucher collection for that site, in these cases.
    g. The voucher collection from each site is catalogued and accessioned into the archives. Information is recorded on the Mussel Shell Archive Form (App. C-5).
    h. Redundant valves of common species are discarded.

PROCEDURES FOR DETERMINING GEOGRAPHICAL COORDINATES OF SITES (SPMP-008)

I. INTRODUCTION

A. Purpose

Accurate documentation of geographical position (longitude and latitude) reduces the risk of obtaining environmental samples from the wrong monitoring site and facilitates the analysis of monitoring data through geographical information system (GIS) techniques. The location of all stream sites visited by staff for any type of environmental sampling purposes must be precisely documented using GPS procedures.

B. Minimum Staff Qualifications

Personnel implementing this SOP should meet the minimum classification requirements for Environmental Associate published by the Kansas Department of Administration. They also should be experienced in the use of GPS equipment and possess a basic understanding of the underlying technology.

C. Equipment/Accessories

1. Garmin Nuvi GPS unit, Magellan/Thales MobileMapper, or functional equivalent

II. PROCEDURES

A. Ensure that GPS unit is set to datum NAD83 and is set to record geographic coordinates in decimal degrees.

B. When locating a bridge crossing, it is acceptable to take the measurement in the vehicle from a safe location, *e.g.*, either end of the bridge.

C. When working in a stream channel, it is acceptable stand in the channel or on the bank at the water's edge.

D. Hold the GPS unit in an area with clear view of sky, if possible. Wait for the GPS unit to locate satellites and register the Positional Dilution of Precision (PDOP). Preferred PDOP is 1–4, but acceptable measurements may be taken when PDOP is <8. If PDOP is >7, record this in "notes" on field form. Allow coordinates to stabilize.

E. Record latitude and longitude on field form to five decimal places, saying digits aloud while recording. Repeat numbers from form aloud and double-check against GPS unit.

VEHICLE SAFETY AND MAINTENANCE PROCEDURES (SPMP-009)

I. INTRODUCTION

A. Purpose

This SOP outlines vehicle safety and maintenance procedures used during the collection and transport of SPMP samples. Safety procedures are established to prevent or minimize personal injuries and/or property damage. Maintenance procedures are established to prevent or minimize vehicle breakdowns and to extend the usable life of the vehicle.

B. Minimum Staff Qualifications

Personnel implementing this SOP should meet the minimum classification requirements for Environmental Associate published by the Kansas Department of Administration. They also must possess a valid Kansas driver's license and current certifications in both standard first aid and cardiopulmonary resuscitation (CPR). Although not required, these employees are strongly encouraged to participate in defensive driving courses offered by some law enforcement agencies and other qualified organizations.

C. Equipment/Accessories

Full size van or other sampling vehicle, as available

II. PROCEDURES

Procedures described in SOP No. SCMP-002 for vehicle safety are adopted by reference.

PROCEDURES FOR WATER CHEMISTRY SAMPLING ACTIVITIES AT SPMP SITES (SPMP-010)

I. INTRODUCTION

A. Purpose

Because probabilistic sites can be on any segment of the KSWR, it is expected that SPMP sites will regularly fall on smaller, intermittent streams that are prone to pooling. Whereas the SCMP does not allow for the sampling of pooled sites, the SPMP requires it. In addition, because each site is sampled only four times, sampling crews may not be familiar with the locality, and special care must be taken to identify the site correctly and record current flow conditions. In order to standardize chemistry sampling methods across SPMP sites and to acquire accompanying data on the status of flow at the time the sample was taken, the following guidelines have been developed.

B. Minimum Staff Qualifications

Personnel implementing this SOP should meet the minimum classification requirements for Environmental Associate published by the Kansas Department of Administration and possess general knowledge of stream ecology.

C. Equipment/Accessories

1. GPS unit with bridge site coordinates entered for navigation
2. Site maps showing position of bridge site relative to X-site
3. County maps and/or gazetteer for general navigation
4. Chemistry sampling equipment (pail, bucket, funnel, ropes), sample containers, reagents, and personal protective gear as described in the SCMP Quality Assurance Management Plan (KDHE, 2014)
5. YSI ProDSS with 1 or 10 m cable, bulkhead, and probes for temperature/pH, conductivity, and dissolved oxygen

D. Methods

Where not otherwise specified in this Quality Assurance Management Plan, water chemistry sampling methods follow those of SOP No. SCMP-005 (Procedures for collecting, preserving, and transporting stream water samples), SOP No. SCMP-006 (Chain-of-custody procedures), SOP No. SCMP-007 (Field blank procedures), and SOP No. SCMP-008 (Field duplicate procedures), from the SCMP Quality Assurance Management Plan (KDHE, 2014).

II. PROCEDURES

A. While driving to the site, consult maps/gazetteers to determine unequivocally which direction is upstream. It may not be obvious from flow conditions and site characteristics, especially where water is pooled. The area map for each site shows the relative locations of sampling bridges and x-sites, and roads are labeled.

B. If water is flowing at sufficient depth OR is there a sampleable pool at the bridge or very nearby and accessible, take a sample. A sampleable pool is one from which a sample can be drawn without entrainment of sediment and without noticeable depletion of the water volume of the pool.

1. Collect water samples, either from the bridge or from the bank. Collect from the bridge only if the sample bucket can be fully submerged in the water without disturbing the substrate.
2. Conduct in situ measurements with YSI ProDSS multiparameter probe in accordance with SOP No. SPMP-013.
3. Standing on bridge deck and looking upstream and downstream as far as the unaided eye can see, record in flow condition field, whether the sample is from water that is VISibly POOLed or from a Continuous Channel (codes are shown here in all capitals, but need not be recorded thus).
4. If the stream is VISibly POOLed, record approximate maximum dimensions of the pool from which you have sampled, L×W×D (meters). Also record UPstream conditions (WET CHANnel, DRY CHANnel, or POOLS) and DowNstream conditions (WET CHANnel, DRY CHANnel, or POOLS).
5. If Continuous Channel, record flow level (STILL, LOW, MODerate/baseflow, HIGH, RunOff, *etc.*). Note that if the water is not moving and looks backed up, but is not visibly confined to a pool with dry upstream and/or downstream margins, it would be scored as CC / STILL.

C. If sampleable water is not present at the site, *i.e.,* if the channel is dry OR if the quantity or depth water is such that a sample cannot be taken without depleting the pool or entraining sediment:

1. Do not attempt to sample
2. Standing on bridge deck, record UPstream conditions (DRY CHANnel or POOLS) and DowNstream conditions (DRY CHAN or POOLS).

D. If any other unusual conditions apply, make notes:

1. If water is frozen, use best professional judgment in sampling and record as much information as possible.

2. If any other conditions are present, especially in pools, that could reflect recent conditions or affect water quality, please make a brief note (*e.g.,* if pools appear turbid in the presence of bottom-feeding fish).

E. Take upstream & downstream photos, in that order, if a camera is available. Note this on data sheet or include photo notes in flow condition field if there is room.

Sampler comments must not exceed 60 characters. Some examples follow:

CC / STILL / BACKED UP, SURFACE SCUM / PAILED
CC / HIGH / LIVESTOCK ACCESS
VIS POOL / 10x3x1m / UP POOLS / DN DRYCHAN
CC / FROZEN ICE BROK / SAMPLED
NS DRY / UP DRYCHAN / DN DRYCHAN / MANY DEAD FISH

PROCEDURES FOR PRE-SAMPLE EQUIPMENT RINSE DURING WATER CHEMISTRY SAMPLING AT SPMP SITES (SPMP-011)

I. INTRODUCTION

A. Purpose

Even when field sampling containers are emptied completely, both particulates and dissolved substances can carry over from one site to another. This can result in an inaccurate representation of water chemistry at the second site, particularly when the sites differ significantly in concentration of solutes or particulates. A pre-sample rinse is implemented to minimize carryover.

B. Minimum Staff Qualifications

Personnel implementing this SOP should meet the minimum classification requirements for Environmental Associate published by the Kansas Department of Administration. They also should be trained and experienced in KDHE basic water chemistry sampling methods.

C. Equipment/Accessories

1. Chemistry sampling equipment (pail, weighted bucket, funnel, ropes) as described in the Stream Chemistry Monitoring Program Quality Assurance Management Plan
2. Deionized or distilled water for additional rinses where necessary

D. Methods

Where not otherwise specified in this Quality Assurance Management Plan, water chemistry sampling methods follow those of SOP No. SCMP-005 (Procedures for collecting, preserving, and transporting stream water samples), SOP No. SCMP-006 (Chain-of-custody procedures), SOP No. SCMP-007 (Field blank procedures), and SOP No. SCMP-008 (Field duplicate procedures).

II. PROCEDURES

A. With each sampling container that is used, collect an initial pre-sample. This should be a full bucket or full pail of stream water.

B. Swirl pre-sample and discard completely, away from stream channel.

C. Take a second sample, which will serve as the actual sample for the site.

D. There is one exception to this procedure: If water is pooled or backed up and exists in such limited quantities that the pre-sample is likely to mobilize sediment

or leave insufficient water for the primary sample, the pre-sample rinse may be replaced with a deionized water rinse.

E. Note: If a station is at a site known or suspected to be contaminated with zebra mussels, equipment should be subjected to a careful triple rinse with deionized or other clean bottled water after sampling. The next station will, however, receive a normal pre-sample rinse.

PROCEDURES FOR DECONTAMINATION OF EQUIPMENT USED AT SITES WITH SUSPECTED OR KNOWN INVASIVE SPECIES (SPMP-012)

I. INTRODUCTION

A. Purpose

Preventing new introductions and limiting the dispersal of zebra mussels and other aquatic nuisance species is paramount to the conservation of Kansas waters. There are a variety of methods to decontaminating field equipment that has been exposed to waters which have been invaded by zebra mussels (including tributaries and waters within a contaminated site's flood plain). This document's directive is to guide field staff on various methods. It is adopted in part from Michigan Department of Agriculture and Rural Development.

Decontamination of field equipment between sites varies depending upon which field activity is being conducted and the type of equipment used. The three most common types of sampling are for water chemistry, macroinvertebrates, and fish tissue.

Field crews must use best professional judgment when assessing risk of cross-contamination between sites. Properly following gear specific decontamination methods will prevent transfer of aquatic nuisance species between sampling sites. In an effort to eliminate risk of transfer, the best practice is to make all attempts to visit confirmed zebra mussel affected sites after non-contaminated sites.

B. Minimum Staff Qualifications

These procedures normally are performed by program field personnel but may be performed by virtually any other employee after limited initial training. Field staff should use best professional judgement in determining contaminant risk.

C. Equipment/Accessories

1. Virkon Aquatic disinfectant and virucide (Syndel Laboratories, Nanaimo, British Columbia, Canada)
2. Sodium hypochlorite as plain unscented household bleach
3. Scrub brush
4. 5 gal bucket
5. Large plastic trash bag
6. 2 m length of rope
7. Tap water
8. Deionized or distilled water
9. Hot (140°F) water
10. Pressure washer or access to car wash facility

II. PROCEDURES

A. Water Chemistry Sampling

1. As water chemistry field sampling trips are designed for expedience, it is often quite difficult to arrange for zebra mussel contaminated or suspected waterbodies to be sampled after all non-contaminated waters.
2. For collection of water in both the bucket and pail, attach 2 m section of dedicated "zebra" rope to end of sampling rope before attaching bucket or pail. When performing bucket rinse, ensure that rinse water is not being absorbed by rope.
3. Upon completion of sampling, disassemble the bucket. Rinse bucket and pail (interior, exterior, and handles) with deionized or distilled water, and store 2 m section of rope in plastic bag.
4. For in situ measurements conducted with the YSI ProDSS or similar equipment, rinse probes and cable with deionized or distilled water and store in calibration cup with a small amount of water.

B. Macroinvertebrate Sampling

1. Arrange weekly and daily schedule to sample zebra mussel contaminated waters last, if possible. When possible use clean waders, boots, and sampling equipment between sites.
2. For boots, waders, and sampling equipment that has been exposed to zebra mussel contaminated waters, either decontaminate equipment immediately, or quarantine it from clean equipment until it can be decontaminated. To quarantine, store waders, boots, nets, and other sampling equipment in black trash bags to prevent contaminating other equipment inside vehicle.
3. To decontaminate:
    a. Remove any remaining debris or mud, using dedicated or disposable tools.
    b. If contaminated equipment is not to be used again within five days, it may be rinsed and hung to dry in WPMAS shop at Curtis State Office Building.
    c. If equipment will need to be used sooner, or if in field decontamination is necessary: mix Virkon Aquatic with tap water to create at 0.5% solution (for veligers, 2% solution for adults). Completely submerge boots, waders, and equipment for 20 minutes to achieve 100% mortality. Hang to dry.
    d. Bleach may be used as a substitute for Virkon Aquatic powder, in 10% solution, with 10 minutes of contact time.
    e. Thorough washing with a hot wash or pressure wash is another acceptable method for equipment decontamination. Gear should be exposed for 10 seconds to water at 140°F. This method is potentially damaging to breathable waders and boots, but it is a good method for nets and buckets.

C. Fish Tissue Sampling

1. Waders, boots, and equipment may be decontaminated in identical manner to the process described above for macroinvertebrate sampling.

2. Boats must be inspected and any debris and mud shall be removed by hand or by scrubbing. Additionally, if boats are to be used within 5 days they must be washed at a high pressure, hot water car wash, and allowed to dry.

PROCEDURES FOR CONDUCTING IN SITU PHYSICAL-CHEMISTRY SAMPLING USING YSI ProDSS MULTIMETER (SPMP-013)

I. INTRODUCTION

A. Purpose

Conducting in situ stream chemistry measurements using the Xylem - YSI (Yellow Springs Instruments) Professional Digital Sampling System (ProDSS) multimeter provides immediate information to the sampler. Parameters measured include: Dissolved Oxygen, Specific Conductance, pH, Temperature, and Salinity. Use of the YSI ProDSS provides ancillary water quality data to support biological sampling events as well as additional quality assurance measurements during stream chemistry sampling.

B. Minimum Staff Qualifications

Personnel implementing this SOP should meet the minimum classification requirements for Environmental Associate published by the Kansas Department of Administration. They also should be trained and experienced in KDHE basic water chemistry sampling methods.

C. Equipment/Accessories

1. YSI ProDSS handheld multimeter with 1 m or 10 m cable, calibration cup, probe guard, 1 lb weight, 4.9 oz weight, and probes for temperature/conductivity, pH, and dissolved oxygen at minimum
2. YSI ProDSS maintenance equipment, including: probe brushes, probe storage bottles, port plugs, syringe, sensor installation tool, sponges, O-ring lubricant, spare O-rings
3. Tap water
4. Dry lint-free cloth or disposable tissues
5. Calibration Standards (Ricca Chemical conductivity standard: 1408.8, and pH buffers: 4, 7, and 10) in sufficient quantity for two complete calibrations per field run
6. Light detergent, sodium hypochlorite as household bleach, and acetic acid as cooking vinegar
7. YSI ProDSS User Guide (Xylem-YSI, 2014)
8. Protective case for multimeter and accessories

II. PROCEDURES

A. Attach either 1 m or 10 m cable with bulkhead to the charged handheld YSI ProDSS. Ensure correct alignment of 8 prong plug and correct installation of probes and port plugs according to "ProDSS User Manual Revision B."
   1. If switching between 1 m and 10 m cables, all probes must be switched to the appropriate bulkhead, and subsequently calibrated
   2. Any sensor can work in any port
   3. Bulkhead ports are NOT waterproof, so probes and plugs must be dried completely with a lint free cloth or tissue before transferring
   4. Lubricate O-ring with Krytox ™ or equivalent dielectric grease before installing probe
   5. Any port without a probe must have a probe plug installed

B. All probes (except temperature) require periodic calibration to maintain accurate measurements. Conductivity, pH, and DO should be calibrated at least monthly, when cable is changed, or when drift in values is observed.
   1. Follow calibration guidelines as outlined in "ProDSS User Manual RevB pp. 34-46" (Xylem-YSI, 2014).
   2. Ensure that optical DO calibration is performed with water that is NOT deionized or distilled. Either tap water or ambient stream water will suffice.
   3. Temperature/conductivity probe must be submerged for proper calibration of pH.

C. Typically, chemistry sampling necessitates use of the 10 m cable, while the 1m cable is more convenient for use during biological sampling. In either case, ensure that the sensor guard is installed prior to submerging bulkhead into water. Measurements can also be taken from the stainless steel sampling pail.
   a. When the sampler is standing in the stream channel, hold the sensor upstream and away from the body.
   b. In fast moving waters, either a 4.9 oz or 1 lb weight may be attached to limit movement of probes by current.
   c. In still water, it may be necessary to wave the sensor gently underwater to keep it bathed in fresh water or move slowly upstream during measurement to avoid an anthropogenic sediment plume.

D. Allow adequate time for value stabilization for all *in situ* measurements (3 minutes minimum), and observe stabilization of values to confirm. For instances in which pH stabilization takes a very long time (>5 min), operator should refer to the instrument manual section under "pH sensor maintenance" and follow stepwise probe cleaning

recommendations. Short term storage should be with all probes still attached to the bulkhead and stored within calibration cup with a wet sponge or a few cm of drinking water. Do not let probes sit in water. Do NOT use deionized or distilled water, as the DO sensor cap and pH probes are susceptible to damage when stored on deionized or distilled water. Do not use hard tap water, as this may leave mineral deposits that can foul sensors.

E. Maintenance and long term storage directions followed in accordance to "ProDSS User Manual RevB: Maintenance and Storage, pp. 52-65" (Xylem-YSI, 2014).

F. If in situ measurements are conducted in waters that are confirmed or suspected of zebra mussel infestation refer to "Invasive Species Decontamination for Field Operations," SOP No. SPMP-012.

III. SAFETY

A. Safety procedures for *in situ* sampling from bridges are as described in SOP No. SCMP-002 for vehicle safety.

APPENDIX C

STANDARDIZED FIELD AND TAXONOMIC FORMS

INTEGRATED SITE DATA FORM
App. C-1.1

SPMP Site data form v4.3 - 20160131 *1/6*

SITE DATA

Site # _____ Stream _____ Date _____ Time _____

Type [☐ Prob | ☐ Ref | ☐ Other _____] Basin _____ County _____

Location _____

Lat _____ Lon _____ Reach slid/relocated? [☐ Y | ☐ N]

Current weather _____ Recent weather _____

Air temp (°C)_____ H2O temp (°C) _____ pH_____ Cond (µS/cm) _____ DO (mg/L) _____

Nonsampling crew _____ Guests _____

Sampler (surname) Up _____ Down _____

Reach length (m) Up _____ Down _____

Duration (min) Up _____ Down _____

Banks sampled Up [☐ both | ☐ left only | ☐ right only] Down [☐ both | ☐ left only | ☐ right only]

Max channel depth (m.0) Up _____ . _____ || ☐ >1.2m? Down_____ . _____ _ || ☐ >1.2m?

Thalweg Depth: <0.5 m _____% 0.5-1.2 m_____% >1.2 m: _____%

General notes_____

FORMS COMPLETED & SAMPLES COLLECTED

Y N

☐ ☐ Macroinvertebrate sample || Replicate? [☐Y | ☐ N] || Notes_____

☐ ☐ Water column algae samples || Notes_____

☐ ☐ Mussel search || Samples collected [☐Y | ☐ N] || Live Mussel Form [☐Y | ☐ N]

Mussel Notes _____

☐ ☐ Photos || Notes_____

☐ ☐ Other samples/measurements (optional) || Describe _____

Notes _____

PRESENCE & FLOW OF WATER

☐ Sampleable water present in reach surrounding X-site (~75 m upstream + ~75 m downstream)

☐ Pooled || Approx proportion of reach with water present in channel _____ % *[illustrate on last page]*

Approx # pools_____ || Max pool size _____ m long x _____ m wide x _____ m deep

☐ Water present through entire reach

☐ No visible current (may be backed up)

☐ Visibly flowing || Flow appears [☐ low | ☐ moderate/baseflow | ☐ slightly elevated | ☐ very elevated]

☐ Sampleable water (>10 cm deep) NOT present in reach (~75 m upstream + ~75 m downstream)

☐ Completely dry | ☐ Old pools evaporating | ☐ Small puddles evidently from recent precipitation

☐ Channel wet in places, or some evidence of subsurface flow, but insufficient habitat for sampling

Notes _____

APPEARANCE OF WATER

Y N

☐ ☐ Excessively turbid || Describe_____

☐ ☐ Surface scum || Describe _____

☐ ☐ Unusual odor or color || Describe _____

Notes _____

CHANNEL DIMENSIONS IN VICINITY OF X-SITE (meters, last place to 0 or 5)

Wetted channel width (m.m) ____ . ____ Bankfull width (m.m) ____ . ____ Incised width* (m.m) _____ . ____

Thalweg depth (m.mm) ____ . ____ ____ Bankfull height* (m.mm) ___ . ____ ____ Incised height* (m.m) _____ . ____

Notes _____

**bankfull ht = water to bankfull terrace || incised ht = bankfull terrace to floodplain terrace || incised width = gully width at floodplain terrace level*

☐ *On-site QA* _____ ☐ *Data entry* _____

INTEGRATED SITE DATA FORM
App. C-1.2

SPMP Site data form v4.3 - 20160131 *2/6*

CHANNEL IN SAMPLE REACH

Channel is [☐ single | ☐ braided] and is: [☐ constrained in narrow valley by [☐ natural | ☐ artificial] features | ☐ in broad valley but constrained by incision | ☐ in broad valley – relatively unconstrained]
Check if present: ☐ islands | ☐ pointbars | ☐ backwtrs | ☐ tributaries | ☐ centerbars | ☐ undercuts | ☐ side chans ☐ springs, bank seeps, groundwater upwellings | ☐ recent torrent evidence | ☐ human chan. modif: _____
Notes _____

SUBSTRATE IN SAMPLE REACH

Dominant substrates – score each to nearest 5%

_____% Fines (silt, clay, muck)
_____% Sand (>0.06–2 mm)
_____% Small gravel (>2–16 mm)
_____% Large gravel (>16–64 mm)
_____% Cobble (>64–250 mm)
_____% Small Boulder (>25 cm –1 m)
_____% Large Boulder (>1–4 m)
_____% Bedrock (>4 m) [☐ Smooth | ☐ Rough]
_____% Hardpan (firm, consolidated fines)
_____% Other || Describe:_____

CHECK SUM: _____ (must equal 100%)

Overall embeddedness/siltation

	Riffs	Pools	Runs
Habitat not present	☐	☐	☐
Parent substrate sand/fines	☐	☐	☐
0-25%	☐	☐	☐
26-50%	☐	☐	☐
51-75%	☐	☐	☐
76-100%	☐	☐	☐

Substrate notes:

AQUATIC VEGETATION & AQUATIC/SEMIAQUATIC LIFE OBSERVED

Check if seen ☐ Fish / ☐ Amphibians / ☐ Crayfish / ☐ Beaver activity / ☐ Other aq anim _____
Fish taxa seen _____

Nearstream vegetation* includes ☐ grasses / ☐ forbs / ☐ shrubs / ☐ woody vines / ☐ sm trees* / ☐ lg trees*
Largest tree type _____ Height (m) _____ DBH (cm)_____ Notes_____
Channel shading [☐ absent | ☐ light | ☐ moderate | ☐ heavy] Cattails or rushes? [☐ Y | ☐ N]
Aquat. macrophytes [☐ absent | ☐ light | ☐ moderate | ☐ heavy] Duckweed? [☐ Y | ☐ N]
Periphyton [☐ absent | ☐ light | ☐ moderate | ☐ heavy] Filamentous algae? [☐ Y | ☐ N]
Notes _____

** nearstream vegetation is that <10 m from bankfull edge || sm tree = dbh <10 cm / lg tree = dbh ≥10 cm*

LAND USE, HUMAN IMPACT, AND OBSERVABLE DESIGNATED USES IN SAMPLE REACH

Dominant land uses	*0	B	N	V	*Human impacts*	*0	B	N	V	*Human impacts*	*0	B	N	V
Natural vegetation	☐	☐	☐	☐	Livestock access	☐	☐	☐	☐	Dam/weir	☐	☐	☐	☐
Woodland/forest	☐	☐	☐	☐	Overgrazing	☐	☐	☐	☐	Road/path	☐	☐	☐	☐
Row crop	☐	☐	☐	☐	Water withdrawal	☐	☐	☐	☐	Oil/gas well	☐	☐	☐	☐
Hayed/grazed	☐	☐	☐	☐	Irrigation	☐	☐	☐	☐	Industr/commerc	☐	☐	☐	☐
Suburban/urban	☐	☐	☐	☐	Drain/pipe	☐	☐	☐	☐	Dredging	☐	☐	☐	☐
Other	☐	☐	☐	☐	Bridge/culvert	☐	☐	☐	☐	Other (eg, ramp)	☐	☐	☐	☐

_____ _____ _____

**0=not present || B=on bank adjacent to channel || N = within 10 m bankfull edge || V = visible from bank but >10 m*
Other evidence of human activity ☐ Dumping / ☐ Littering / ☐ Fishing / ☐Swimming / ☐ Other_____
Notes _____

Photograph fishing, hunting/trapping, and existing human water supply uses

	Food proc	Industrial W	Domestic W	Livestock W	Irrigation	Groundw rchg
Existing	☐	☐	☐	☐	☐	☐
Attainable	☐	☐	☐	☐	☐	☐
Not attainable	☐	☐	☐	☐	☐	☐
Unknown	☐	☐	☐	☐	☐	☐

Use notes:

☐ *On-site QA* _____ ☐ *Data entry* _____

INTEGRATED SITE DATA FORM
App. C-1.3

SPMP Site data form v4.3 - 20160131 *3/6*

RAPID HABITAT ASSESSMENT

Site # _____ Stream _____ Date _____ Time _____

This [☐ riffle-run | ☐ glide-pool] stream has approx _____% riffle, _____% run/glide, and _____% pool.

Reach Length Evaluated (m) _____ Notes _____

Complete ALL STREAMS section, then complete either RIFFLE-RUN or GLIDE-POOL section, as appropriate.

ALL STREAMS

	OPTIMAL	SUB-OPTIMAL	MARGINAL	POOR
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed. 20 19 18 17 16	Water fills over 75% of the available channel; or less than 25% of channel substrate is exposed. 15 14 13 12 11	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed. 10 9 8 7 6	Very little water in channel and mostly present as standing pools. 5 4 3 2 1 0
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern. 20 19 18 17 16	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present. 15 14 13 12 11	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted. 10 9 8 7 6	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely. 5 4 3 2 1 0
8. Bank Stability Left: Right:	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. Less than 5% of bank affected. 10 9 10 9	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. 8 7 6 8 7 6	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods. 5 4 3 5 4 3	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars. 2 1 0 2 1 0
9. Vegetative protection Left: Right:	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. 10 9 10 9	70-90% if the streambank surfaces covered by native vegetation; but one class of plants is not well represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. 8 7 6 8 7 6	50-70% of the streambank surfaces covered by vegetation; disruptions obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining. 5 4 3 5 4 3	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height. 2 1 0 2 1 0
10. Riparian Vegetative Zone Width Left: Right:	Width of riparian zone greater than 18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted the zone. 10 9 10 9	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally. 8 7 6 8 7 6	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal. 5 4 3 5 4 3	Width of riparian zone less than 6 meters; little or no riparian vegetation due to human activities. 2 1 0 2 1 0

RIFFLE-RUN STREAMS

	OPTIMAL	SUB-OPTIMAL	MARGINAL	POOR
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential; (i.e., logs/snags that are NOT new fall and NOT transient.) 20 19 18 17 16	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale). 15 14 13 12 11	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed. 10 9 8 7 6	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking. 5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. 20 19 18 17 16	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment. 15 14 13 12 11	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment. 10 9 8 7 6	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment. 5 4 3 2 1 0

☐ *On-site QA* _____ ☐ *Data entry* _____

INTEGRATED SITE DATA FORM
App. C-1.4

3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is less than 0.3 m/s, deep is greater than 0.5 m.) 20 19 18 17 16	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes). 15 14 13 12 11	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low). 10 9 8 7 6	Dominated by 1 velocity/depth regime (usually slow-deep). 5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition. 20 19 18 17 16	Some new increases in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools. 15 14 13 12 11	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent. 10 9 8 7 6	Heavy deposits of fine material; increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition. 5 4 3 2 1 0
7. Frequency of Riffles (or Bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream greater than 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important. 20 19 18 17 16	Occurrence of riffles infrequent; distance between riffles divided by width of stream is between 7 to 15. 15 14 13 12 11	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by width of stream is between 15 to 25. 10 9 8 7 6	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by width of stream is a ratio of over 25. 5 4 3 2 1 0

GLIDE-POOL STREAMS

	OPTIMAL	SUB-OPTIMAL	MARGINAL	POOR
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e. logs/snags that are NOT new fall and NOT transient.) 20 19 18 17 16	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale). 15 14 13 12 11	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed. 10 9 8 7 6	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking. 5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common. 20 19 18 17 16	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present. 15 14 13 12 11	All mud or clay or sand bottom; little or no root mat; no submerged vegetation. 10 9 8 7 6	Hard-pan clay or bedrock; no root mat or vegetation. 5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small shallow, small-deep pools present. 20 19 18 17 16	Majority of pools large-deep; very few shallows. 15 14 13 12 11	Shallow pools much more prevalent than deep pools. 10 9 8 7 6	Majority of pools small-shallow or absent. 5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 20% of the bottom affected by sediment deposition. 20 19 18 17 16	Some new increases in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools. 15 14 13 12 11	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent. 10 9 8 7 6	Heavy deposits of fine material; increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition. 5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note-channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.) 20 19 18 17 16	The bends in the stream increase the stream length 2 to 3 times longer than if it was in a straight line. 15 14 13 12 11	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line. 10 9 8 7 6	Channel straight; waterway has been channelized for a long distance. 5 4 3 2 1 0

☐ *On-site QA* _____ ☐ *Data entry* _____

INTEGRATED SITE DATA FORM
App. C-1.5

SPMP Site data form v4.3 - 20160131 *5/6*

HABITAT DEVELOPMENT INDEX

Site # _____ Stream _____ Date _____ Time _____

Macroinvertebrate sample notes _____

Score only those macro- and microhabitat categories that were sampled.							Riffles	Pools	Runs
MINIMUM MACROHABITAT SCORE			Absent 0		Present 3				
AVERAGE DEPTHS	Riffles		< 5 cm 0	5-10 cm 1	> 10 cm 2				
	Pools		< 30 cm 0	30-60 cm 1	> 60 cm 2				
	Runs		< 15 cm 0	15-45 cm 1	> 45 cm 2				
RIFFLE SUBSTRATE SCORE (1) *(circle values)*	A	% Cobble	0-10% 0	11-25% 1	26-50% 2	51-100% 3			
	B	% Embeddedness	0-25% 0	26-75% -1	>75% -3				
			Record score in right hand column only if A+ B > 0						
ORGANIC DETRITUS & DEBRIS (2)	No organic detritus or debris sampled 0		Only sparsely scattered bits of detritus sampled 1	Large leaf packs or large amounts of scattered detritus sampled. 2	Both detritus and debris including logs sampled. 3				
ALGAL MASSES (3)	No algal masses sampled 0			Algal masses were sampled 1					
MACRO-PHYTES (4)	No macrophytes sampled 0		Very few macrophytes or small patches of plants sampled 1		Many macrophytes or large areas of dense growth sampled 2				
BANK VEGE-TATION (5)	No bank vegetation sampled 0		Only small amounts of thin bank vegetation sampled 1		Submerged tree roots or thick bank vegetation sampled 2				
(1) If percent cobble is ≤10% and boulders or bedrock are present, score box A as 1. Cobble is defined as particles between 6 and 26 cm in diameter. (2) Organic detritus includes seeds, pods, leaves, small bark, twigs, leaf fragments; may accumulate into piles or packs. Organic debris includes larger sticks, bark, and logs. (3) Algal masses should be sampled if they provide habitat and not just food. (4) Macrophytes include floating-leaved, emergent, or submerged aquatic plants. (5) Bank vegetation includes submerged terrestrial plants, tree limbs, and roots.					MACROHABITAT SCORES (SUMS)				
					SAMPLE SCORE				

☐ *On-site QA* _____ ☐ *Data entry* _____

INTEGRATED SITE DATA FORM
App. C-1.6

SPMP Site data form v4.3 - 20160131 *6/6*

SITE SKETCH *(indicate direction to each)*

NORTH VEHICLE

Is this stream suitable for fish tissue sampling? ☐ yes | ☐ uncertain | ☐ no

Fish notes: _____

Sample fish here at X-site? ☐ yes | ☐ uncertain | ☐ no

Access notes: _____

Recommended equipment: ☐ backpack | ☐ tote barge | ☐ other: _____

Equipment/wading notes: _____

☐ *On-site QA* _____ ☐ *Data entry* _____

FIELD RECONNAISSANCE FORM
App. C-2.1

SPMP Recon Form 20131009 *1/2*

Site ID _____ Stream name _____ County _____
Date _____ Time _____ Crew _____
Lat: _____ Lon: _____ Road name: _____
Type: ☐ Upstream bridge / ☐ Downstream bridge / ☐ X-site / ☐ Other: _____
Crew got in H20? ☐ Yes / ☐ No || Evaluated: ☐ Point / ☐ Reach of length: _____
Photos? ☐ Yes / ☐ No || Notes: _____
This year is ☐ Wet / ☐ Normal / ☐ Dry || Current/recent weather: _____
Notes: _____
Is there a USGS or other gauge nearby? ☐ Unk / ☐ No / ☐ Yes: _____
Current discharge or gauge height relative to baseflow _____

☐ Water is present in visible reach || Predominant substrate/s: [☐ Cannot tell / ☐ Fines / ☐ Sand / ☐ Gravel / ☐ Cobble / ☐ Bedrock / ☐ Hardpan / ☐ Other: _____]
☐ Continuous in channel (whether flowing or not)
Relative to channel features, water level looks: ☐ Low by _____cm / ☐ Normal-baseflow / ☐ Elevated by _____ cm / ☐ Unknown
Apparent current velocity: ☐ Still or backed-up / ☐ Slow / ☐ Moderate / ☐ Fast
Habitats visible from point (or in reach): ☐ Riffle / ☐ Run or glide / ☐ Pool
Est. channel width: Typical: _____m || Min: _____m || Max: _____m
Est. Thalweg depth: Typical: _____cm || Min: _____cm || Max: _____cm
☐ In pools || Est % Thalweg containing water: _____ || Number of pools visible: _____
Est. dimensions of largest pool: Length: _____m × Width:_____m × Depth:_____cm
Are the pools likely connected by subsurface flow? ☐ Yes / ☐ No / ☐ Unknown
Are the pools evidently just the result of recent precipitation? ☐ Yes / ☐ No / ☐ Unknown
☐ Water is not present in visible reach
Defined channel present? ☐ Yes | ☐ No || If yes, then channel substrate contains:
☐ Aquatic veg. / ☐ Terrestrial veg. / ☐ Bare sand, soil, mud / ☐ Other: _____
Notes: _____

Est typical channel dimensions under baseflow: _____
Est. bankfull height: _____ || Estimated percent of reach Thalweg wadeable …
Now: _____% || At normal baseflow: _____% || At bankfull: _____%
Water & channel notes, potential sampling issues: _____
_____
_____

In your judgment, is the visible reach capable of supporting aquatic animal life?
Current year: ☐ No / ☐ Invert only / ☐ Both invert & vert / ☐ I+V incl harvestable fish / ☐ Unk
Normal year: ☐ No / ☐ Invert only / ☐ Both invert & vert / ☐ I+V incl harvestable fish / ☐ Unk
Aquatic life seen: _____

FIELD RECONNAISSANCE FORM
App. C-2.2

SPMP Recon Form 20131009 *2/2*

In your judgment, is the evaluated reach

☐ Perennial / ☐ Perennial-intermittent / ☐ Intermittent / ☐ Intermittent-ephemeral / ☐ Ephemeral

Notes: _____

_____

Is the visible reach, without any additional info, likely representative of the X-site? ☐ Yes / ☐ No / ☐ Unk

Why: _____

Would this be a suitable water chemistry sampling point to represent X-site? ☐ Yes / ☐ No / ☐ Unk

Why: _____

Do current hydrological conditions permit valid recon of this site? ☐ Yes / ☐ No || Notes: _____

Final Decision: ☐ Reject / ☐ Sample wadeable / ☐ Sample boatable / ☐ Need more info (please detail...)

Notes: _____

_____

Most appropriate fishing equipment

☐ Seine ONLY / ☐ Backpack / ☐ Tote barge (wading) / ☐ Light/small passenger shockboat / ☐ 4-person shockboat || Fishing notes: _____

_____

Access from road to likely stream channel entry point

How to enter site: _____

_____

Road or path condition: _____ Distance from road to channel edge: _____ m

Distance bank edge to water: _____ Bank steepness: _____

Bank characteristics: _____

Vegetation: _____ Fences/other: _____

Access notes: _____

IF SITE IS BOATABLE – recommend boat type/s, note condition & location of entry banks and/or ramp

Additional notes: _____

_____

Sketch (if pooled or otherwise anomalous)

LIVE MUSSEL FIELD FORM
App. C-3.1

V 2.0 - 20121212

KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT
STREAM PROBABILISTIC MONITORING PROGRAM
LIVE UNIONID MUSSEL RECORDING FORM

Site #: _____ Waterbody: _____ Date: _____ Time: _____
Type [☐ Prob | ☐ Ref | ☐ Other _____] Basin _____ County _____
Samplers: _____
Lat: _____ Lon: _____
Site Notes: _____

Scientific name	Present (1-4)	Common (5-10)	Abundant (>10)	# of Age Classes	Notes
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					

Exotic bivalves present? [☐ No | ☐ Yes: _____

Remarks: _____

LIVE MUSSEL FIELD FORM
App. C-3.2

V 2.0 - 20121212

Kansas Naiad Reference List (Order Unionoida)

Scientific name	Common name	Kansas status
Family Margaritiferidae		
Subfamily Anodontinae		
Cumberlandia monodonta (Say, 1829)	Spectaclecase	extirpated
Family Unionidae		
Subfamily Anodontinae		
Alasmidonta marginata Say, 1818	Elktoe	endangered
Alasmidonta viridis (Rafinesque, 1820)	Slippershell	extirpated
Anodonta suborbiculata Say, 1831	Flat floater	endangered
Anodontoides ferussacianus (I. Lea, 1834)	Cylindrical papershell	SINC
Arcidens confragosus (Say, 1829)	Rock pocketbook	threatened
Lasmigona complanata complanata (Barnes, 1823)	White heelsplitter	
Lasmigona costata (Rafinesque, 1820)	Flutedshell	threatened
Pyganodon grandis (Say, 1829)	Giant floater	
Strophitus undulates (Say, 1817)	Creeper	SINC
Utterbackia imbecillis (Say, 1829)	Paper pondshell	
Subfamily Ambleminae		
Amblema plicata (Say, 1817)	Threeridge	
Cyclonaias tuberculata (Rafinesque, 1820)	Purple wartyback	candidate
Elliptio dilatata (Rafinesque, 1820)	Spike	SINC
Fusconaia flava (Rafinesque, 1820)	Wabash pigtoe	SINC
Fusconaia ozarkensis (Call, 1887)	Ozark pigtoe	SINC
Megalonaias nervosa (Rafinesque, 1820)	Washboard	SINC
Pleurobema sintoxia (Rafinesque, 1820)	Round pigtoe	SINC
Quadrula cylindrica cylindrica (Say, 1817)	Rabbitsfoot	endangered
Quadrula fragosa (Conrad, 1835)	Winged mapleleaf	extirpated
Quadrula metanevra (Rafinesque, 1820)	Monkeyface	
Quadrula nodulata (Rafinesque, 1820)	Wartyback	SINC
Quadrula pustulosa pustulosa (I. Lea, 1831)	Pimpleback	
Quadrula quadrula (Rafinesque, 1820)	Mapleleaf	
Quadrula quadrula form *nobilis* (Conrad, 1854)	Mapleleaf form	extirpated
Tritogonia verrucosa (Rafinesque, 1820)	Pistolgrip	
Uniomerus tetralasmus (Say, 1831)	Pondhorn	
Subfamily Lampsilinae		
Actinonaias ligamentina (Lamarck, 1819)	Mucket	endangered
Cyprogenia aberti (Conrad, 1850)	Western fanshell	endangered
Ellipsaria lineolata (Rafinesque, 1820)	Butterfly	threatened
Epioblasma triquetra (Rafinesque, 1820)	Snuffbox	extirpated
Lampsilis cardium Rafinesque, 1920	Plain pocketbook	
Lampsilis rafinesqueana Frierson, 1927	Neosho mucket	endangered
Lampsilis siliquiodea (Barnes, 1823)	Fatmucket	SINC
Lampsilis teres (Rafinesque, 1820)	Yellow sandshell	SINC
Leptodea fragilis (Rafinesque, 1820)	Fragile papershell	
Ligumia recta (Lamarck, 1819)	Black sandshell	extirpated
Ligumia subrostrata (Say, 1831)	Pondmussel	
Obliquaria reflexa (Rafinesque, 1820)	Threehorn wartyback	
Obovaria olivaria (Rafinesque, 1820)	Hickorynut	extirpated
Potamilus alatus (Say, 1817)	Pink heelsplitter	
Potamilus ohiensis (Rafinesque, 1820)	Pink papershell	
Potamilus purpuratus (Lamarck, 1819)	Bleufer	
Ptychobranchus occidentalis (Conrad, 1836)	Ouachita kidneyshell	threatened
Toxolasma lividus (Rafinesque, 1820)	Purple Lilliput	
Toxolasma parvus (Rafinesque, 1831)	Lilliput	
Truncilla donaciformis (I. Lea, 1828)	Fawnsfoot	SINC
Truncilla truncata Rafinesque, 1820	Deertoe	SINC
Vensustaconcha ellipsiformis (Conrad, 1836)	Ellipse	endangered

MUSSEL TALLY FORM
App. C-4

SPMP Mussel Tally form v4.1. 20121212 *1/1*

Basin: _____ Co: _____ Site num: _____
Num collected: _____ Num archived _____ Waterbody: _____
Archive numbers: _____ Sample type: _____
Det by: _____ QA! by: _____ Coordinates: _____
Arch by: _____ Arch date: _____ Date collected: _____
Other info: _____ Collected by: _____

Species	Number indivs represented:			From recent material:		Num arch
	Rel	Wea	Rec	Abund (P/C/A)	Num age classes	

MUSSEL SHELL ARCHIVE FORM
App. C-5

KDHE KANSAS MUSSEL DISTRIBUTION DATABASE

PAGE____ OF____ FOR SITE

STATION INFO:

BASIN _____ *ARCHIVE #* _____ *COUNTY* _____
PROGRAM _____ *STATION#* _____
WATERBODY _____
KSWR SEG _____ *LAT* _____ *LONG* _____
COLL DATE _____ *COLL BY* _____ *COLL NOTES* _____
SCIENTIFIC NAME _____
COMMON NAME _____
ID/ARCH BY _____ CONFIRMED BY _____
CONDITION: ☐ LIVE | ☐ RECENT | ☐ WEATHERED | ☐ RELICT / HEIGHT _____ mm LENGTH _____ mm
Optional: LIVE/RECENT # OF AGE CLASSES _____ LIVE/RECENT REL ABUND _____
REMARKS: _____

☐ *STATION INFO SAME AS PREVIOUS*

BASIN _____ *ARCHIVE #* _____ *COUNTY* _____
PROGRAM _____ *STATION#* _____
WATERBODY _____
KSWR SEG _____ *LAT* _____ *LONG* _____
COLL DATE _____ *COLL BY* _____ *COLL NOTES* _____
SCIENTIFIC NAME _____
COMMON NAME _____
ID/ARCH BY _____ CONFIRMED BY _____
CONDITION: ☐ LIVE | ☐ RECENT | ☐ WEATHERED | ☐ RELICT / HEIGHT _____ mm LENGTH _____ mm
Optional: LIVE/RECENT # OF AGE CLASSES _____ LIVE/RECENT REL ABUND _____
REMARKS: _____

☐ *STATION INFO SAME AS PREVIOUS*

BASIN _____ *ARCHIVE #* _____ *COUNTY* _____
PROGRAM _____ *STATION#* _____
WATERBODY _____
KSWR SEG _____ *LAT* _____ *LONG* _____
COLL DATE _____ *COLL BY* _____ *COLL NOTES* _____
SCIENTIFIC NAME _____
COMMON NAME _____
ID/ARCH BY _____ CONFIRMED BY _____
CONDITION: ☐ LIVE | ☐ RECENT | ☐ WEATHERED | ☐ RELICT / HEIGHT _____ mm LENGTH _____ mm
Optional: LIVE/RECENT # OF AGE CLASSES _____ LIVE/RECENT REL ABUND _____
REMARKS: _____

MACROINVERTEBRATE IDENTIFICATION BENCH FORM
App. C-6

KDHE-BOW-SPMP 20170123

MACROINVERTEBRATE IDENTIFICATION BENCH SHEET

STATION_____ STREAM/LOCATION_____
DATE COLLECTED_____ TIME COLLECTED _____ SAMPLING DURATION (min) _____
COLLECTOR(S)_____DATE (S) EXAMINED_____ DETERMINED BY_____

TAXON	D/N	CODE	Σ #	A #	I #	P #	TAXON	D/N	CODE	Σ #	A #	I #	P #
COLEOPTERA							ODONATA						
							PLECOPTERA						
							TRICHOPTERA						
CHIRONOMIDS removed for slide ID													
DIPTERA not including removed chironomids													
							CRUSTACEA						
EPHEMEROPTERA													
							BIVALVIA						
							GASTROPODA						
HEMIPTERA													
							ANNELIDA removed for slide ID						
							ANNELIDA						
							TURBELLARIA						
							OTHER / ADDITIONAL						
MEGALOPTERA-NEUROPTERA													

KBS CODE = KDHE Kansas biosystem taxon unique code / A# = Number of adults in sample / I# = Number of nymphs or larvae in sample / P# = Number of pupae in sample / D/N = mark if taxon needs to be identified specifically as Distinct or Nondistinct

PLEASE USE BACK OF SHEET FOR TAXONOMIST DRAWINGS AND NOTES AS WELL AS DATA ENTRY NOTES

ENTERED:_____ [ ] Number of associated slides [ ] See back?

SLIDE-MOUNTED SPECIMEN IDENTIFICATION BENCH FORM
App. C-7

V4 - 20121212

KDHE SLIDE MOUNTED SPECIMEN (MIDGE) IDENTIFICATION FORM

Site # & name: _____ Coll. date: _____ Coll. by: _____

Total # slides for site: _____ Medium: _____ ID date/s: _____ Det. by: _____

Notes: _____

Slide #	Spec	Taxon	?	NOTE	Slide #	Spec	Taxon	?	NOTE
	A					A			
	B					B			
	C					C			
	D					D			
	E					E			
	F					F			
	G					G			
	H					H			
	I					I			
	J					J			
	A					A			
	B					B			
	C					C			
	D					D			
	E					E			
	F					F			
	G					G			
	H					H			
	I					I			
	J					J			

Specimen A is the one closest to label. // ? = questionable ID / O = specimen orientation or mount not ideal / X = specimen damaged / If neither O nor X is marked, it is assumed that a questionable ID is because it is a difficult taxon or an early instar. // Use DIST or NONDIST to indicate if taxon needs to be identified specifically as distinct or nondistinct.

Page ____ of _____

See back for drawings or notes? ☐

WATER CHEMISTRY SAMPLE SUBMISSION FORM
App. C-8

KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT
DIVISION OF ENVIRONMENT
DATA FORM

PROJECT:

PROGRAM:
STREAM PROBABILISTIC

STA	LOCATION	NUM	FIELD DATE	DEPTH	CHEM	TOC	HM	DO	NH3	BACT	PEST	RAD	TRIT	TEMP	FIELD pH	SP COND	COMMENTS	COLLECTOR

STA	LOCATION	NUM	FIELD DATE	DEPTH	CHEM	TOC	HM	DO	NH3	BACT	PEST	RAD	TRIT	TEMP	FIELD pH	SP COND	COMMENTS	COLLECTOR

STA	LOCATION	NUM	FIELD DATE	DEPTH	CHEM	TOC	HM	DO	NH3	BACT	PEST	RAD	TRIT	TEMP	FIELD pH	SP COND	COMMENTS	COLLECTOR

CHAIN OF CUSTODY

Received by (Signature)	Date / Time	Received by		
Received by (Signature)	Date / Time	Received for lab by: (Signature)		Date / Time

WATER COLUMN CHLOROPHYLL FILTRATION BENCH FORM
APP. C-9

v. 1.0 - 20170111

Stream Probabilistic Monitoring Program - Filtration & preservation of water column algae samples

TAX? = check if algal taxonomy sample was removed from this cubitainer and preserved in Lugol's
PRECIP?/FILM? = score presence of visible precipitate or film as YES or NO only if sample has been sitting undisturbed for at least an hour, otherwise score these "n/a"
After scoring Precip/Film, introduce an air bubble into the cubitainer and agitate well
Clarity = transparency AFTER agitation, when held up to light: 1 = transparent, 2 = nearly transparent, 3 = translucent, 4 = nearly opaque, 5 = opaque
Color = color hue AFTER agitation: colorless ("none"), yellow, grey, green, tan, brown, etc.
Vol = volume filtered / Notes: notes about visible plant or algae particles, sample or filter condition, aliquots removed for HAB program, etc.

Date collected	Date filtered	Filtered by	Site num	Cubi num	Tax?	Precip?	Film?	Clarity (1-5)	Color	Vol (ml)	Notes

APPENDIX D

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APPENDIX E

GLOSSARY OF TERMS

accuracy: the extent to which a measured value actually represents the condition being measured. Accuracy is influenced by the degree of random error (precision) and systematic error (bias) inherent in the measurement operation (*e.g.*, environmental sampling and analytical operations).

activity: an all inclusive term describing a specific set of operations or related tasks to be performed, either serially or in parallel (*e.g.*, research and development, field sampling, analytical operations), that in total result in a product or service.

audit: a systematic and independent examination to determine whether quality activities and related results comply with planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve objectives.

bias: the systematic or persistent distortion of a measurement process which causes errors in one direction (*i.e.*, the degree to which the expected sample measurement is different from the true sample value).

chain of custody: an unbroken trail of accountability that ensures the physical security of samples, data and records.

comparability: a measure of the confidence with which one item (*e.g.*, data set) can be compared to another.

completeness: a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions.

computer program: a sequence of instructions suitable for processing by a computer. Processing may include the use of an assembler, compiler, interpreter, or translator to prepare the program for execution. A computer program may be stored on electrical, magnetic or optical media.

corrective action: any measure taken to rectify a condition adverse to quality and, where possible, to preclude its recurrence.

document: any written or pictorial information describing, defining, specifying, reporting, or certifying activities, requirements, procedures or results.

duplicate samples: paired samples collected at essentially the same time from the same site and carried through all assessment and analytical procedures in an identical manner. Duplicate samples are used to measure natural variability as well as the precision of a method, monitoring instrument, and/or analyst.

D-frame: a long handled net with an opening in the shape of the capital letter D and a bag mesh size of 0.5 mm.

ecoregion: an ecologically distinctive geographic area defined in the context of a combination of landscape characteristics such as climate, physiography, soils, vegetation (or potential vegetation), geology, and land use.

GRTS: stands for generalized random tessellation stratified - this algorithm imposes a survey design that is random but spatially balanced.

independent assessment: a quality assessment of an environmental monitoring program, project or system performed by a qualified individual, group, or organization that is not part of the program, project, or system.

internal assessment: any quality assessment of the work performed by an individual, group, or organization, conducted by those overseeing and/or performing the work.

method: a body of procedures for performing an activity in a systematic and repeatable manner.

organization: a company, corporation, firm, enterprise, or institution, or part thereof, whether incorporated or not, public or private, that has its own functions and administration.

performance evaluation: a type of audit in which quantitative data generated in a measurement system are obtained independently and compared with routinely obtained data to evaluate the proficiency of a technician, analyst, or laboratory.

precision: the level of agreement among individual measurements of the same property, conducted under identical or similar conditions.

qualified data: data that have been modified, adjusted or flagged in a database following data validation and verification procedures.

quality: those features of a product or service that bear on its ability to meet the stated or implied needs and expectations of the user.

quality assurance (QA): an integrated system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the user.

quality assurance project (program) plan (QAPP): a formal document that describes in detail the necessary QA, QC, and other technical activities that must be implemented to ensure that the results of the work performed for the program or project satisfy the stated performance criteria.

quality control (QC): the overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements of the user.

quality management plan (QMP): a formal document that describes a quality management system in terms of the organizational structure, functional responsibilities, and planning, implementation and assessment of work.

record: a document or portion thereof furnishing evidence of the quality of an item or activity, verified and authenticated as technically complete and correct. Records may include reports, photographs, drawings, and data stored on electronic, magnetic, optical or other recording media.

reference site: a stream location that is, from an ecological perspective, only minimally impacted by modern (post settlement) human activities based on comparisons to the historical baseline condition or in relation to other, more heavily impacted streams within the geographical region of interest.

relative percent difference: the difference between duplicates divided by the mean of the duplicates, expressed as an absolute percentage.

replicate sample: see duplicate sample.

representativeness: a measure of the degree to which data accurately and precisely represent a selected characteristic of a monitored system.

reproducibility: a measure of the degree to which sequential or repeated measurements of the same system vary from one another, independently of any actual change in the system.

sample frame: the best available representation of the target population – normally a map or list.

standard operating procedure (SOP): a written, formally approved document that comprehensively and sequentially describes the methods employed in a routine operation, analysis or action.

surveillance (quality): continual or frequent monitoring and verification of the status of an entity (*e.g.*, monitoring program) and the analysis of records to ensure that specified requirements are being fulfilled.

target population: an explicit description of the natural resource that is to be sampled.

taxon: (plural = taxa) the lowest practicable level of identification (*e.g.*, family, genus, species) that can be applied to a group of phylogenetically related organisms.

taxonomic richness: the number of taxa determined to be present in a sample.

taxonomy: the classification of organisms according to their established phylogenetic relationships and appropriate International Code of Nomenclature.

technical review: a critical review of an operation by independent reviewers collectively equivalent in technical expertise to those performing the operation.

validation: the establishment of a conclusion based on detailed evidence or by demonstration. This term often is used in conjunction with formal legal or official actions.

verification: the establishment of a conclusion based on detailed evidence or by demonstration. This term normally implies proof by comparison.